Territorial satellite technologies

The NEREUS Network's Italian partners' experiences

December 2011

Contents

1. Foreword

1.1. Reasons behind and object of this document

This document was prepared to support the NEREUS Network' Italian partners, coordinated by the Lombardy Regional Authority, in their survey of their experiences relating to the use of space technologies and the demand for them, with a view to preparing a position paper on the priorities and objectives, and the feasible strategic and operational actions for effectively developing Italy's role within the NEREUS network and for practically sustaining the application of satellite technologies in Europe, and in Italy in particular.

Consistently with the Strategic Document for Research and Innovation 2011-2015, recently approved by the Council governing the Lombardy Regional Authority (DGR n. IX/2195 DL 4 August 2011), and in accordance with the position paper presented by the Lombardy Regional Authority at the time of the European regions' consultation to formulate the new European framework programme for research and innovation, the purpose of the present document is **to implement one of the first, strategic experiments in *demand-oriented public policy-making***.

This approach aims to place the demand for innovation at the centre of public policies for scientific and technological research. This principle is based on the now established awareness that all the effort going into research activities and technological developments needs to become more effective in finding marketable solutions and products. All too often, highly-advanced technologies (and patents) are developed that subsequently find no market applications because they do not satisfy a clear, explicit demand. While maintaining a strong focus on basic research, it has consequently become crucial to dedicate resources and conduct analyses designed to bring out the demand for innovation expressed by the market and the public administration (PA).

The present document thus stems from the need to start organising and testing a working method, in cooperation with the Directorates General (DG) of the Lombardy Regional Authority and of the other parties involved, that highlights the demand for innovation coming from the principal areas of interest in order to orient scientific and technological research activities towards the generation of advanced products and prototypes that respond to the needs identified, involving the research and industrial systems in identifying the most appropriate possible solutions.

In this sense, the aerospace sector is of considerable interest because has the capability to develop a broad range of technologies and services transversally applicable to several sectors that refer to the various Directorates General of the Lombardy Regional Authority (for Agriculture, for Security, and for the Environment, to name just a few examples).

With this in mind, one of the main preliminary activities conducted by the Italian members of the NEREUS Network has involved monitoring the supply and demand in the sector of satellite applications. Specific goals of this monitoring procedure were:

1) to outline the NEREUS Network's heritage of Italian origin, in terms of projects already underway;

2) to ascertain whether well-established satellite data acquisition methods are in place;

3) to survey the working practices and expertise (both internal and external) involved in deriving products from these data that are currently useful in practice or potentially useful in future;

4) to ascertain likely future needs and curiosities, and existing critical issues/problems;

5) to share this information with the NEREUS Network with a view to consolidating and, wherever possible, developing existing or novel schemes in the context of the NEREUS Network's Working Groups;

6) to produce a position paper outlining Italy's position on NEREUS as regards the Network's possible role, with particular reference to its institutional political lobbying function, and as a pivot for new schemes for developing the potential of satellite technology for the Network's partners and for other *stakeholders*.

1.2. Activities conducted for the monitoring procedure

Consultations were held by the Italian members of the NEREUS Network. In particular:

- from February to May 2011, an exploratory survey was conducted at offices of the Lombardy Regional Authority to identify the products/services used and the demand for innovations potentially achievable using satellite technologies[1];
- from June to October 2011, there was a review of this first survey and a second survey focusing on the other Italian partners in the NEREUS Network (both Full Members and Associate Members).

The present document outlines the global results of the two surveys.

1.2.1 Organisations involved

The following table lists the Italian members of the NEREUS Network that took part in the surveys:

Member	Type	Mode of involvement	Contact person	Notes
Abruzzo Regional Authority	Full member	Participation at in-house meetings		
Puglia Regional Authority	Full member	Participation at in-house meetings	Gianna Pinto	
Basilicata Regional Authority	Full member	Reporting on satellite services on offer	Lucio Bernardini Papalia, Angelo Pietro Paolo Nardozza, Michele Vita, Enrica Marchese, Teresa Andriani, Giovanni De Costanzo, Guido Loperte, Francesca Antonucci; *ARPAB Basilicata: Ersilia Di Muro; Autorita' Di Bacino Della*	Description of experiences gained by various organisations in Basilicata

[1] The output from this survey was the document entitled "Territorial satellite technologies. Demand (potential and expressed) and projects undertaken by the Lombardy Regional Authority". The departments involved were: *Agriculture; Environment, Energy and Networks; Infrastructure and Mobility; Civil Protection, Local police and Security; Green systems and Landscape; Territory and Town Planning,*. The Directorate General for the Environment, Energy and Networks involved the ARPA in the survey activities as well.

			Basilicata: Marinella Gerardi; CNR IMAA: Vincenzo La Penna, Vincenzo Cuomo, Nicola Pergola, Stefano Pignatti; CONSORZIO TERN: Antonio Colangelo, Marina Doubell, Angelo Donvito; EGEOS SPA: Marcello Marenesi; Universita' Di Basilicata: Carmine Serio, Valerio Tramutoli	
Lombardy Regional Authority	Full member;	Survey coordinator; reporting on supply of and demand for satellite services	Alberto Cavalli, Francesco Baroni, Gianlorenzo Martini, Fabrizio Gentili, Armando De Crinito, Enza Cristofaro	Description of experiences gained by various DGs
Molise Regional Authority	Full member	Reporting on satellite services available	Nelida Ancora	
Piedmont Regional Authority	Full member	Participation at in-house meetings	Stefania Crotta, Edoardo Braccio	Description of experiences gained by various supplier organisations in the region
Veneto Regional Authority	Full member	Participation at in-house meetings	Aldo Marolla	Description of experiences gained by various units
Compagnia Generale per lo Spazio (Lombardy)	Associate member	Participation at in-house meetings; reporting on satellite services available	Paolo Cerabolini, Giovanna Ober,	Description of experience gained from projects in the preoperative stage
CISAS (Veneto)	Associate member			
CORILA (Veneto)	Associate member		Pierpaolo Compostrini	
Consorzio TERN (Basilicata)	Associate member			
EURAC (Bolzano)	Associate member			
IREA CNR (Lombardy)	Associate member	Participation at in-house meetings; reporting on satellite services available	Paola Carrara, Anna Basoni, Anna Rampini	
Milan Polytechnic, BEST Department	Associate member	Participation at in-house meetings; reporting on supply of and demand for satellite services	Raffaella Brumana, Amalia Ercoli Finzi, Massimiliano Lanz, Michelle Lavagna	
Turin Polytechnic	Associate member	Participation at in-house meetings		Description of experiences in the document submitted by the Piedmont Regional Authority
Selex Galileo (Lombardy)	Associate member	Participation at in-house meetings;	Luca Acquaviva, Francesco Rizzi	Description of expertise
Thales Alenia Space (Italy)	Associate member			
T.R.E. (Lombardy)	Associate member	Participation at in-house meetings; reporting on the satellite services available	Alessandro Ferretti	
Lombardy Aerospace District Committee	n.a.	Participation at in-house meetings	Paola Margnini	Description of principal activities undertaken

1.2.2. Layout of this document

Based on the objectives and on the action taken, this document is organised as follows:

(a) The satellite applications (supply and demand) chart briefly summarises the information collected by type of satellite application (Earth Observation, Navigation, Telecom, Space Exploration). For each entry, this chart contains the following details:

- ✓ existing applications and/or projects
- ✓ the proposer organisation or interested party
- ✓ the basic characteristics of the product/service and its level of maturity
- ✓ reports of any demands or specific needs

(b) Comments on the chart to provide a brief outline of the main elements emerging and to identify priorities and/or potential demands.

(c) Descriptions of the proposals for projects that may be worth bringing to the attention of the NEREUS Network, with a "brainstorming" of relevant factors emerging during the monitoring activities with a view to providing input for the preparation of a position paper on the Italian situation.

(d) Annexes containing detailed information on the applications surveyed and the outcome of interviews conducted and of the monitoring activities.

PART I – THE SATELLITE APPLICATIONS CHART

2. Supply and demand relating to satellite services in the context of the NEREUS Network's Italian partners

2.1. Criteria adopted for the *survey* on the supply of and demand for satellite services

The survey was inspired by the need to take two aspects into account, i.e.

a) to consider experiences potentially relating to the activities of the NEREUS Working Groups;

b) to classify the supply/demand relating to satellite services based on the international terminology/typology adopted within the context of the main European satellite programs for Earth observation, navigation and communications.

2.1.1. The NEREUS Working Groups

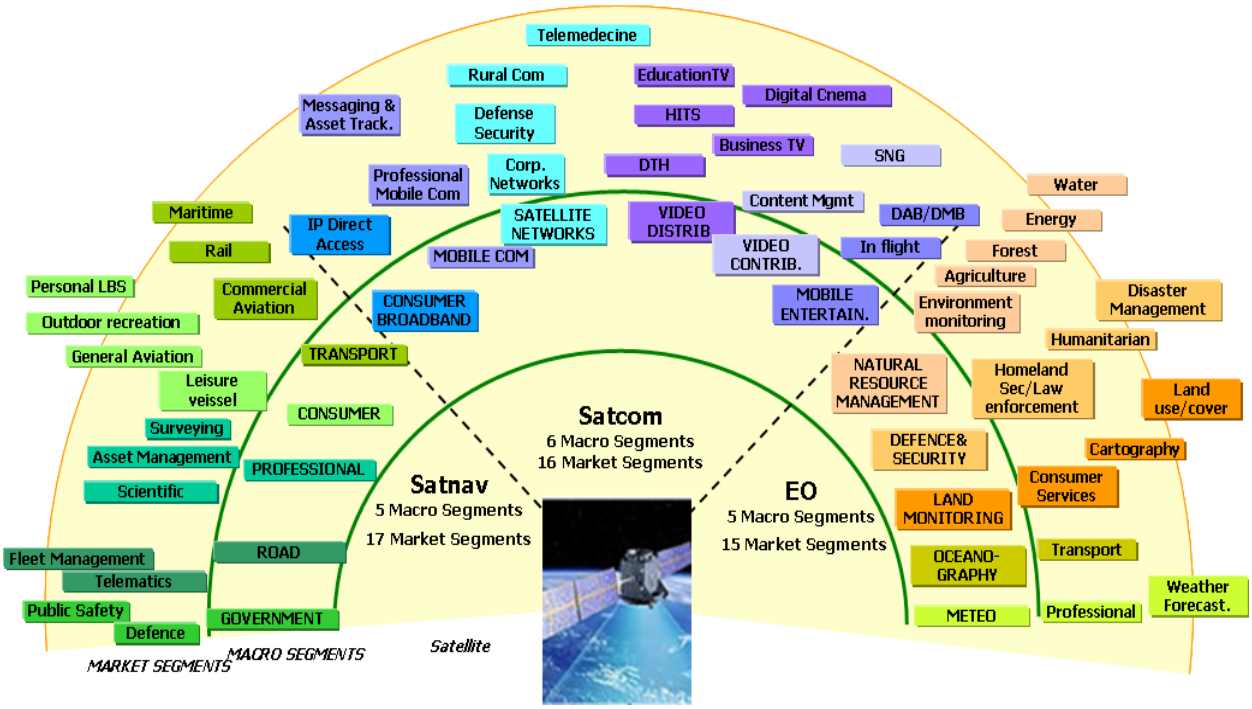
Here it is worth briefly recalling the names and purposes of the reference NEREUS Working Groups for any schemes mentioned in the survey described in this document:

- ✓ **Earth Observation/GMES**: the object of this working group is to identify and promote regional-level priorities within the European GMES Earth observation programme, which is based on the use of satellites and ground-level facilities; a specific focus of this working group concentrates on end user needs. Three subgroups have been created:
  1. Land Applications (for which the contact people are Paola Carrara of IREA-CNR and Silvano De Zorzi of the Veneto Regional Authority)
  2. Maritime Oceanography (for which the contact person is Alain Podaire, Midi-P)
  3. Security and Hazard Response
- ✓ **GNSS**: the goal of this working group is to promote the best possible exploitation of the services deriving from the GALILEO Global Navigation Satellite System for the benefit of the European regions, so as to provide input at European policy processing level.
- ✓ **Telecommunications**: this working group is preparing a body of information on end user needs in terms of satellite communications, their economic impact and their "transfer" to industry and society at large.
- ✓ **Technologies from Space Exploration**: this working group is responsible for identifying and promoting the use of space exploration technologies to support regional or end-user policies. The group is also concerned with monitoring the activities at European level (e.g. communications, consultations) and providing input on behalf of NEREUS members.
- ✓ **Education, Training, Communication**: this working group is involved in "horizontal" activities relating to the first three groups and serves as a platform for exchanging know-how and learning on the European training potential relating to space applications.
- ✓ **Task Force on Interreg IVc:** this is also a horizontal working group that aims to identify and develop projects to finance in the context of the European Union's regional policies.

2.1.2. General outline of the market for satellite services

The methodological reference criterion that was followed to "classify" experiences gained in the supply of and demand for satellite services being surveyed and contributing to the Italian part of the NEREUS Network refers to the macro distinctions adopted by various international sources (some of which are available to the public) for satellite applications in the fields of Navigation, Telecommunications and Earth Observation, and their various sub-classifications (e.g. the GMES[2] programme, Galileo and others). The figure below graphically represents this market.

The market for satellite applications



Source: Euroconsult 2009

[NdT- se possibile correggere Leisure vessel (not veissel)]

[2] As concerns Satellite Earth Observation (the application domain that is probably the most important in terms of its potential and the experience gained), this diagram is consistent with the applications and services identified by the GMES Programme: http://www.gmes.info/pages-principales/services/

2.2. The chart of the Italian NEREUS partners' satellite applications

2.2.1. How to interpret the chart

The chart that follows is the outcome of the monitoring activities conducted by the Italian partners in the NEREUS Network[3] by means of written requests, telephone interviews and "face-to-face" encounters, and its practical purpose is to provide a brief account of the information that was collected on experiences that are underway, have been completed, or have been requested, so as to:

1. outline the heritage of skills and experiences boasted by the network's Italian organisations;
2. identify possible areas for action on which to focus future projects based on the *end-user driven* logic.

The classification of the supply of and demand for satellite services is based on the distinction into the macro sectors: Earth Observation, Navigation, Telecommunications.

In alphabetical and/or numerical sequential order, the following are identified for each macro segment:

1. market sectors and subsectors (column 1 starting from the left)
2. projects already underway or in preparation (column 2 from the left, an expression of the existing offer of services relying on the use of satellite data)
3. parties involved as funding sources, implementers, or users (column 3)
4. technical considerations on the project (column 4)
5. the fifth and final column is dedicated exclusively to mentioning any expressed or potential demand and the corresponding schemes to be implemented to meet said demand.

2.2.2. The supply and demand chart

The "supply and demand" chart is overleaf.

[3] A specific activity for monitoring the supply and demand relating to remote sensing in Lombardy, and especially to the GMES programme, is foreseen in the context of the European Union's Doris_Net project.

Supply and demand chart

Setting	Macro segments	Segments	Segments in detail	Projects underway (Supply)	Reference organisations	Notes	Other needs identified requiring further analysis
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.1. Slow-moving landslides**	**1.1.1.1. Monitoring with PSInSAR technology**	Funding source: DG for Civil Protection, Lombardy Regional Authority); Implementer: TRE	ERS1 and ERS2, RADARSAT1, ENVISAT satellite data	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.1. Slow-moving landslides**	**1.1.1.2. Morpheus**	Funding source: ASI; User: Civil Protection Department; Implementer: Compagnia Generale per lo Spazio	EnviSat, COSMO-SkyMed satellite data; Monitoring with SPINUA technology	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.1. Slow-moving landslides**	**1.1.1.3. RFI - Italian Railways Network**	Funding source: Italian Railways Network; Implementer: CNR IMAA	Preparation of a new instrumental system based on electromagnetic technologies for controlling historical landslides on the Montenero-Petacciato stretch	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.2. Deep-seated gravitational slope deformation (DGSD)**	**1.1.2.1. Monitoring with PSInSAR technology**	Lombardy Regional Authority, DG for Civil Protection	Radar data	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.2. Deep-seated gravitational slope**	**1.1.2.2. Morpheus**	Funding source: ASI; User: Civil Protection Department; Implementer: Compagnia Generale	EnviSat, COSMO-SkyMed satellite data; Monitoring with SPINUA technology	

			deformation (DGSD)		per lo Spazio		
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.2. Deep-seated gravitational slope deformation (DGSD)**	**1.1.2.3. ENI-Val D'Agri**	Funding source: ENI; Implementer: CNR (IMAA, IREA and IRPI), in progress 2010-12	Integration of ground- and satellite-based electromagnetic technologies for monitoring landslides	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.3. Landslide risk map**	**1.1.3.1. SVA - Environmental monitoring system**	Owner: ASI; Implementer: IREA - CNR; Molise Dati SpA	Satellite and orthophotographic territorial analysis system with DDS (decision support system); Landsat, SPOT, QuickBird, Ikonos; Application in Lombardy, Trentino, Umbria, Basilicata	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.3. Landslide risk map**	**1.1.3.2. DORIS - Ground deformation risk scenarios**	Funding source; EC FP7, project underway, Implementer: CNR (IRPI, IREA, IMAA) in partnership with TeRN (Basilicata Regional Authority)	Design of a downstream GMES service for landslide prevention and risk mitigation with EO and non-EO integration to improve understanding of complex phenomena and support the Civil Protection service.	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.3. Landslide risk map**	**1.1.3.3. LAND (SAR land interferometric data exploitation)**	Geocart srl (Basilicata Regional Authority)	SAR software for processing ERS data, with sub-centimetre precision	

EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.3. Landslide risk map**	**1.1.3.4. MassMove**	DG for Land Defence, Veneto Regional Authority. Municipalities of Alleghe, Rocca Pietore, Colle Santa Lucia, Caprile, Perarolo, Valle di Cadore, Valstagna (Provinces of Belluno and Vicenza)	Helicopter laser-scanner imaging on land and nadir (density 4 dots/m²) and at 45° (density 10 dots/m²) using ground DTM resolution with 5X5 m and 2X2 m grids. Hydrogeological and geological investigations. Definition of minimum shared standards for assessing geological hazards of falling and surface sliding landslides. 3D and 2D rockfall modelling. Mapping of susceptibility to instability and geological hazards in GIS environment. Ref. DGR 1033/08; DGR 2983/08; DGR 624/09	The surveys are conducted using aerial laser scanning technology and are consequently applications that can be innovated using satellite technology.

EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.3. Landslide risk map**	**1.1.3.4. Investigation on the Torrente Rotolon landslide**	Veneto Region Land Defence Directorate; Municipality of Recoaro Terme (Vicenza)	Aerial laser scanning surveys (density 8 dots/m², using ground DTM resolution with 5X5 and 2X2 m grids) on the slopes in the area of the Torrente Rotolon basin (May 2009 and November 2010) in the Municipality of Recoaro Terme. Hydraulic and hydrogeological modelling for projects to make the area safe and restore the hydraulic function of the riverbed. Ref. L. 267/98, Dgr 2945/09	The surveys are conducted using aerial laser scanning technology and are consequently applications that can be innovated using satellite technology.
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.4. Identification of large-scale subsidence or local (regional, provincial) soil compacting phenomena**	**1.1.4.1. Monitoring with PSInSAR technology**	Lombardy Regional Authority, DG for Civil Protection	Millimetric variations	

EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.4. Identification of large-scale subsidence or local (regional, provincial) soil compacting phenomena**	**1.1.4.2. Special remote sensing – satellite interferometry plan**	Veneto Region Land Defence Directorate; Italian Ministry of the Environment (MATTM)	Satellite data of SAR type (ERS1/2 and ENVISAT), processed using interferometric technologies (PSInSAR and PSP-DIFSAR), enable data sets to be obtained that can provide meaningful support for activities to control and monitor instability phenomena and particularly ground deformations in response to slope displacements. Tested throughout the Veneto Region.	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.4. Identification of large-scale subsidence or local (regional, provincial) soil compacting phenomena**	**1.1.4.3. Special high-precision remote environment sensing plan for hydrogeologically high-risk areas.**	Veneto Region Land Defence Directorate; Italian Ministry of the Environment (MATTM)	Geodetic reference system used for the LIDAR ETRS89 data, also named WG584 or ETRF 89 (European Terrestrial Reference Frame 1989. DTM: digital model with grid 2,5 X 2,5 m. in line with marine-coastal areas; highly-critical areas: 1.5 dots/m². Riverbeds: width of bed from bank to bank with additional 350 m strip on either side 1.5 dots/m²; coastline: buffer 800 m. – 1 dot/m². Tested throughout the	

						Veneto Region.	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.5. Identification of local-scale subsidence or soil compacting phenomena (detailed monitoring of monuments, infrastructure, buildings or slopes. Extensive urban system)**	**1.1.5.1. Monitoring with classic (GNSS topographics) and experimental (interferometric radar, laser tracking) technologies**	Lombardy Regional Authority, DG for Civil Protection	Monitoring the safety of infrastructure and buildings revealing large-scale anomalies (PS-InSAR) with specific methods for better investigating the phenomenon (TRE, Milan Polytechnic, Lecco, ICT Lab & R.E.T.E.)	

EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.5. Identification of local-scale subsidence or soil compacting phenomena (detailed monitoring of monuments, infrastructure, buildings or slopes. Extensive urban system)**	**1.1.5.2. Monitoring of the stability of buildings in the historical city centre of Rome**	Funding source: private organisation; Implementer: Geocart srl (Basilicata Regional Authority)	Millimetric changes	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.5 Identification of local-scale subsidence or soil compacting phenomena (detailed monitoring of monuments, infrastructure, buildings or slopes. Extensive urban system)**	**1.1.5.3. GPS monitoring of the stability of slopes liable to landslides**	Funding source: private organisation; Implementer: e-Geos	Millimetric changes	

EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.5. Identification of local-scale subsidence or soil compacting phenomena (detailed monitoring of monuments, infrastructure, buildings or slopes. Extensive urban system)**	**1.1.5.3. ISTIMES (Integrated system for transport infrastructure surveillance and monitoring by electromagnetic sensing); detection and monitoring of surface and subsurface changes in infrastructure**	Funding source: EC FP7, project underway; Coordinator: TeRN with participation from CNR (IREA, IMAA), SMEs in Basilicata (Geocart, Digimat); various partners including Geocart Ltd (Basilicata Regional Authority). Tests on the Musmeci bridge (Potenza)	Electromagnetic monitoring (optical fibre sensors, synthetic aperture radar satellite platform-based, hyperspectral spectroscopy, infrared thermography, ground penetrating radar, low-frequency geophysical techniques, ground-based systems for monitoring displacements) for the safety of transport infrastructure (road and rail)	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.5. Identification of local-scale subsidence or soil compacting phenomena (detailed monitoring of monuments, infrastructure, buildings or slopes. Extensive urban system)**	**1.1.5.4. Ground deformation analysis Province of Rovigo**	Funding sources: Interreg, Province of Rovigo; Implementer: e-Geos	Subsidence analysis in urban area	

EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.5. Identification of local-scale subsidence or soil compacting phenomena (detailed monitoring of monuments, infrastructure, buildings or slopes. Extensive urban system)**	**1.1.5.5. LIMES – land and sea integrated monitoring for European security**	Funding source: EC FP6, various Italian partners	Among the various fields there is one for monitoring the safety of infrastructure	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.5. Identification of local-scale subsidence or soil compacting phenomena (detailed monitoring of monuments, infrastructure, buildings or slopes. Extensive urban system)**	**1.1.5.6. MISSAR - Monitoring of infrastructure services using SAR data**	Innova srl and other partners	The system is based on radar interferometric technology with the integrated use of satellite- and ground-based sensors. It enables the following to be monitored:- the evolution of instability in a given area (the area to analyse may be near road and/or railway bases); - the evolution of deformations in infrastructure such as bridges (road and/or rail) and dams;- the periodic evolution of areas with a high	

						environmental impact (quarries, landfills).	
EO	**1. Land monitoring**	**1.1. Identification and monitoring of deformation phenomena**	**1.1.6. Lowering of lake shores**	**1.1.6.1. Monitoring of Lake Varese**	ARPA Lombardy	Monitoring with SAR satellites: phenomena due to draining of water table (lowering of Lake Varese). Expressed in centimetres	
EO	**1. Land monitoring**	**1.2. Prevention of hydrogeological avalanche risks**	**1.2.1. Prevention of hydrogeological avalanche risks**	**1.2.1.1. Identification of avalanche sites**	Funding source: Lombardy Regional Authority, DG for Territory and Town Planning; Implementer ARPA Lombardy	Comparative photo interpretation methods	
EO	**1. Land monitoring**	**1.2. Prevention of hydrogeological avalanche risks**	**1.2.1. Prevention of hydrogeological avalanche**	**1.2.1.2. SVA (Environmental monitoring system)**	Molise Dati SpA	Satellite and orthophotographic territorial analysis system with DDS	

			risks			(decision supporting system)	
EO	**1. Land monitoring**	**1.3. Prevention of hydrogeological risks of flooding**	**1.3. 1. Prevention of hydrogeological risks of flooding**	**1.3.1.1. Laser scanning along lake shores and river and canal banks**	Lombardy Regional Authority, DG for Territory and Town Planning	LIDAR laser scanning methods	
EO	**1. Land monitoring**	**1.4. Monitoring flooding risks (e.g. overflowing rivers)**	**1.4.1. Monitoring flooding risks (e.g. overflowing rivers)**	**1.4.1.1. Mapping of flooded areas and comparison with maps of population, land use by enterprises, contaminated sites**	ARPA Lombardy	SAR satellite images	
EO	**1. Land monitoring**	**1.4. Monitoring flooding risks (e.g. overflowing rivers)**	**1.4.1. Monitoring flooding risks (e.g. overflowing rivers)**	**1.4.1.2. (Environmental monitoring system)**	Molise Dati SpA	Satellite and orthophotographic territorial analysis system with DDS (decision supporting system)	
EO	**1. Land monitoring**	**1.4. Monitoring flooding risks (e.g. overflowing rivers)**	**1.4.1. Monitoring flooding risks (e.g. overflowing rivers)**	**1.4.1.3. PROSA – Civil protection against flooding: Nowcasting**	Funding source: ASI as part of the Earth Observation Program; Implementer: Compagnia Generale per lo Spazio	Development, adoption and demonstration of a prototype system for the dynamic characterisation of meteo-hydrogeological quantities on the ground to help the public administration gain a better understanding of the weather systems generating flooding phenomena. Optical	

						and radar satellite data and LAM; microwave algorithms and Vis-Ir, etc.	
EO	**1. Land monitoring**	**1.4. Monitoring flooding risks (e.g. overflowing rivers)**	**1.4.1. Monitoring flooding risks (e.g. overflowing rivers)**	**1.4.1.4. SIGRA**	Funding source: ANIA; Principal organisation: e-GEOS	Flooding risk assessment system	
EO	**1. Land monitoring**	**1.5. Coastal land erosion**	**1.5. Coastal land erosion**	**1.5.1.1. Coastal subsidence**	Funding sources: World Bank and ESA; Implementer: T.R.E. srl		
EO	**1. Land monitoring**	**1.5. Coastal land erosion**	**1.5. Coastal land erosion**	**1.5.1.2. SVA (Environmental monitoring system)**	Molise Dati SpA	Satellite and orthophotographic territorial analysis system with DDS (decision supporting system)	
EO	**1. Land monitoring**	**1.5. Coastal land erosion**	**1.5. Coastal land erosion**	**1.5.1.3. COASTSAT - Coastal risk management**	Funding source: ASI; Implementer: Compagnia Generale per lo Spazio	This is a feasibility study financed by the ASI	

EO	**1. Land monitoring**	**1.5. Coastal land erosion**	**1.5. Coastal land erosion**	**1.5.1.4. Coastal erosion monitoring**	Funding sources: Lazio Regional Authority; Implementer: e-Geos	Coastline analysis and monitoring. Classification of coastal land use from high-resolution optical data.	
EO	**1. Land monitoring**	**1.5. Coastal land erosion**	**1.5. Coastal land erosion**	**1.5.1.5. Coastal erosion monitoring**	Funding source: Interreg - Consorzio del Polesine; Implementer: e-GEOS	Coastline analysis and monitoring. Classification of coastal land use from high-resolution optical data.	
EO	**1. Land monitoring**	**1.6. Monitoring of oil spill risks**	**1.6.1. Monitoring of oil spill risks**	**1.6.1.1. Oil spill maps**	Funding source: ASI; Implementer: IREA – CNR ; Application: sea/inland waters (lakes).	SAR, MODIS,/MERIS/MIVIS	
EO	**1. Land monitoring**	**1.6. Monitoring of oil spill risks**	**1.6.1. Monitoring of oil spill risks**	**1.6.1.2. Oil and gas storage monitoring**	TRE	SqueeSAR™ measures the value of the surface deformations in line with underground CO2 emission fields	
EO	**1. Land monitoring**	**1.6. Monitoring of oil spill risks**	**1.6.1. Monitoring of oil spill risks**	**1.6.1.3. PRIMI**	Funding source: ASI; Implementer: ISAC CNR, Innova srl	SAR, MODIS,/MERIS/MIVIS	
EO	**1. Land monitoring**	**1.6. Monitoring of oil spill risks**	**1.6.1. Monitoring of oil spill risks**	**1.6.1.4. SeaU - Multisensor satellite technologies for oil pollution monitoring and source identification**	Funding source: EC FP7 Implementer: various organisations including e-Geos		

EO	**1. Land monitoring**	**1.6. Monitoring of oil spill risks**	**1.6.1. Monitoring of oil spill risks**	**1.6.1.5. CleanSeaNet 2nd generation**	Funding source: EMSA (European Maritime Safety Agency); Implementers: various partners including e-Geos	System for real-time satellite monitoring of oil spills and for shipping vessels monitoring services. Operating since 2007 and currently being expanded; established in accordance with Directive 2005/35/EC on ship-source pollution and on the introduction of penalties for infringements.	
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7. 1. Types of vegetation**	**1.7.1.1. Application: Italy and Africa**	Funding sources: ASI, EC, Lombardy Regional Authority; Implementer: IREA – CNR	NOAA, SPOT, Landsat, QuickBird, Ikonos	
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7. 1. Types of vegetation**	**1.7.1.2. WARDSS - Water and rural decision support system**	Enea Trisaia (Basilicata Regional Authority) Interreg (2004 – 2008)		
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7. 1. Types of vegetation**		DG for Green Systems and Landscape, Lombardy Regional Authority		Favourably disposed to using satellite data (GMES) instead of orthophotography
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.2. Geolithology**	**1.7.2.1. Applications in Italy**	IREA – CNR	NOAA, SPOT, Landsat, QuickBird, Ikonos	
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.3. Combating desertification**	**1.7.3.1. RIADE**	Basilicata Regional Authority; ACS Spa; ENEA, Ministry (MIUR) funds		

EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.3. Combating desertification**	**1.7.3.2. DESERTNET (Monitoring and action to combat desertification in the European Mediterranean region)**	Funding source: INTERREG III B trans-European cooperation; Implementers: the partners include ENEA Trisaia, Basilicata Regional Authority) 2005 – 2008)	Shared service platform to support national policies for the study, monitoring and sustainable management of areas at risk of desertification facing onto the Mediterranean basin; Landsat TM images	
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.3. Combating desertification**	**1.7.3.3. DesertWATCH**	Funding source: European Space Agency; Implementer: the countries involved are Italy, Portugal and Turkey	Observations have been combined with in-situ information, processing tools, numerical models and geo-information systems to create standardised and comparable geo-information products that can be used to satisfy UNCCD (United Nations Convention to Combat Desertification) reporting requirements	
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.3. Combating desertification**	**1.7.3.4. DeSurvey – A surveillance system for assessing and monitoring desertification**	Funding source: EC FP6, Implementers: 39 partners include Enea Trisaia (Basilicata Regional Authority); the German Space Agency is also a partner		

EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.4. Cartographics**	**1.7.4.1. Database land coverage (see also Urban Atlases Project, Veneto Regional Authority)**	Veneto Regional Authority (Project Unit for the Information System and Cartography)	Use of territorial planning (preparation of the Regional Territorial Co-ordination Plan) and other objectives (parks and protected areas, special law for Venice, land use for farming, wildlife corridors, etc.). GSE Land methods (GMES), territorial classification according to the MOLAND legend. Scale 1:10.000. Margin of error <=5m. SPOT satellite images, multispectral (10 m) and panchromatic (2.5 m) bandwidths	The activities implemented have involved the use of more orthophotographs than satellite data but now more weight is to be given to the latter because the lower acquisition costs make more frequent updates economically sustainable. There is also a need to access data provided by synthetic aperture radar satellites that enable filming at night, in cloud and with a higher resolution.
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.5. Urbanised land**	**1.7.5.1. Applications in Italy**	Funding sources: ASI, EC, Lombardy Regional Authority; Implementer: IREA – CNR	NOAA, SPOT, Landsat, QuickBird, Ikonos	
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.5. Urbanised land**	**1.7.5.2. Ski lifts, identification of sites liable to avalanche**	Funding source: DG for Territory and Town Planning; Implementer: ARPA	Comparative photo interpretation methods	
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.5. Urbanised land**	**1.7.5.3. SIIT (integrated territorial information services for ISTAT surveys, the Land Registry, etc.)**	Molise Dati SpA	Satellite-based territorial analysis system	

EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.6. Assessment of the extent and trend of land cementification**		ARPA Veneto		Further need: the availability of support media that can be updated rapidly is fundamental but must be accompanied by technologies and analytical methods capable of promptly providing raw or processed data of interest
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.7. Identification of abandoned/ brownfield sites**		Local police and security		Indicated as a further need
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.8. Identification of abandoned / damaged buildings (e.g. ex industrial sites)**		Local police and security	Source: DG for Civil Protection	Indicated as a further need
EO	**1. Land monitoring**	**1.7.Land use and coverage**	**1.7.9. Identification of vehicle traffic flows on crucial stretches of road**		Local police and security	It is worth considering the creation of an information system based on regional cartographics, to be shared with the local police for viewing critical phenomena	Further need: identification of vehicle traffic flows on crucial stretches of road

EO	**1. Land monitoring**	**1.8. Monitoring and estimating environmental impact**	**1.8.1. Mapping of asbestos-cement roofing**	**1.8.1.11 Lombardy Regional Asbestos Plan (PRAL)**	ARPA Lombardy	Mapping required by the PRAL (approved with DGR of 22 December 2005 N. 8/1526. Areas mapped: Olona basin; A4 motorway corridor MI-BG-BS; Valcamonica; Val Trompia (total area 2000 km²)	
EO	**1. Land monitoring**	**1.8. Monitoring and estimating environmental impact**	**1.8.1. Mapping of asbestos-cement roofing**		Veneto Regional Authority (DG for Safeguarding the Environment); ARPA Veneto		Further need: The DG plans to develop the remote sensing activities, directly involving the ARPAV as specified in DM 18/03/2003, n. 101 and in view of a general clean-up of the region's territory
EO	**1. Land monitoring**	**1.8. Monitoring and estimating environmental impact**	**1.8.2. Monitoring major construction sites**	**1.8.2.1. Monitoring environmental impact of major construction sites (Alta Valtellina): estimation of damage to natural vegetation and morphological changes to the Adda river bed**	ARPA	False-colour IR aerial remote sensing; laser altimetry	

EO	**1. Land monitoring**	**1.8. Monitoring and estimating environmental impact**	**1.8.3. Monitoring of landfills for pollution control**	**1.8.3.1. Monitoring of landfills in the Padua area to identify potential sources of pollution**	Veneto Regional Authority (DG for Safeguarding the Environment, ARPA Veneto, Water Authority)	IR remote sensing with satellites and low-flying aircraft to identify pollution of the regional hydrogeological environmental system	Further need: the availability of support media that can be updated rapidly is fundamental but must be accompanied by technologies and analytical methods capable of promptly providing raw or processed data of interest
EO	**1. Land monitoring**	**1.8. Monitoring and estimating environmental impact**	**1.8.4. Monitoring of energy dispersion in the urban environment, districts (buildings and flooring surfaces)**	**1.8.4.2. Platform E2BA (Energy Efficiency Building Association)**	Milan Polytechnic	Interpretation of aerial and satellite images integrated with local sensor networks for local acquisition (on site data collection)	Further need to optimise the choice of building and flooring materials and road surfacing in order to contain city heat dispersion, and support analyses on trends and phenomena underway at urban level
EO	**1. Land monitoring**	**1.8. Monitoring and estimating environmental impact**	**1.8.4. Monitoring of energy dispersion in the urban environment, districts (buildings and flooring surfaces)**	**1.8.4.3. Monitoring electromagnetic fields**	ARPA Basilicata	Project proposal submitted to the Basilicata Regional Authority by the ARPA Basilicata for monitoring electromagnetic fields by mapping radio electric systems in the in the Province of Matera	

EO	**1. Land monitoring**	**1.8. Monitoring and estimating environmental impact**	**1.8.5. Monitoring ground contamination**	**1.8.5.1. MODELPROBE – Model-driven soil probing, site assessment and evaluation**	Funding source: EC FP7; Implementer: various partners including CNR IMAA	Use of satellite data for non-invasive monitoring of ground contamination levels (BTEX, PAH, CHC, THP explosives and heavy metals) to support the clean-up decisions	
EO	**1. Land monitoring**	**1.8. Monitoring and estimating environmental impact**	**1.8.6. Various environmental objectives**	**1.8.6.1. TeRN (Phase I and II) -Technologies for observing the Earth and natural risks**	Funding source: MIUR 2006 and 2009; Implementer: Consorzio TeRN		
EO	**1. Land monitoring**	**1.8. Monitoring and estimating environmental impact**	**1.8.6. Various environmental objectives**	**1.8.6.2. SESAMO - Integrated information system for acquiring, managing and sharing environmental data to support decision-making**	Funding source: POR FESR Sicilia 2007-13; Implementer TeRN		
EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**	**1.9.1.1. Project DUSAF**	Lombardy Regional Authority (DG for Territory and Town Planning)	Updating the Lombardy regional cartography on land use on a scale of 1:10.000 (entrusted to the ERSAF and ARPA); interpretation of digital aerial photographs and remote sensing results	
EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming,**	**1.9.1.2. Automatic method for periodic monitoring via satellite**	ARPA Lombardy	Interpretation of digital aerial photographs and remote sensing results (multispectral); scale 1:50.000 (ARPA)	

			forestry)				
EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**	**1.9.1.3. Territorial monitoring (forestry and farming measurements) for managing agricultural subsidies**	Lombardy Regional Authority (Regional Funding Body); AGEA	Interpretation of digital aerial photographs and remote sensing results (multispectral);	
EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**		Lombardy Regional Authority (DG for Green Systems and Landscape)		The DG for "Green Systems" uses orthophotographic data for territorial/environmental assessments because it is less expensive than satellite images for recognising the need for a reconstruction of a historical series of images
EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**	**1.9.1.4. Project for assessing deforestation, Molise Regional Authority**	Molise Regional Authority; Ministry of the Environment; Telespazio; University of Tuscia, University of Molise	Project included in the GEOSAT framework (SVA, SIIT), for assessing actual deforestation in relation to statistics. SPOT5 satellite images	

EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**	**1.9.1.5. Preparation of a 3-D digital topographical database**	Lombardy Regional Authority (DG for Territory and Town Planning); Local authorities; Milan Polytechnic	Activities for stereo rendering of images obtained using photogrammetric technologies.	Potential uses to develop: transformation of the territory; changes in riverbeds and design of mitigation measures; preservation and development of the territory; safeguarding the anthropic landscape. Various services to launch (the Milan Polytechnic proposals include: take-up of GMES sentinel data at regional level starting from DB of satellite data for various global and local, public and private uses)
EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**	**1.9.1.6. Digital update of new infrastructural measures (roads, railways, junctions, etc.)**	DG for Infrastructure and mobility		Identification of the need to access precise reference layers for reproducing, using or circulating topic-specific maps for analysing the infrastructure
EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**	**1.9.1.7. SIIT project (integrated information services for the territory for ISTAT surveys, land registry, roads, railways, road building site monitoring, etc.)**	Molise Dati SpA	Satellite-based territorial analysis system	

EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**	**1.9.1.8. TrIM Project**	Funding source: EC Interreg IV Italy – Austria, Veneto Regional Authority, Logistics Project Unit	Information on functional characterisations and traffic flows, for traffic analysis and planning.	
EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**	**1.9.1.9. Atlas Project (portal of the historical land registries and topographical maps in Lombardy, Navigate today in the territory of tomorrow)**	Milan Polytechnic, ASMI, Territorial Agency, CNR	Setup of an experimental sample for the take-up of regional and local GMES sentinel data for the comparative use of historical cartographic layers and aerospace images; potential and real demand for integration of the historical geo-referenced cartography with satellite data, interpretation using aerial photographs and satellite data integrated with the local sensor networks (UAV/micro-drones) to analyse anthropic territorial changes, analyse the landscape, interpret permanent and changing features, orient archaeological analyses, prevent flooding by	Need for services for extensive access at regional level and for use and local level. Need to develop algorithms for representing 3-D scenarios from panoramic views, use of waterfront from tilted images from UAV.

						safeguarding the historical secondary canal network	
EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**	**1.9.1.10. Land use classifications – monitoring of quarries and landfills**	Funding source: Interreg-Province of Isernia; Implementer: e-Geos	Classification of land use from optical high-resolution data	

EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**	**1.9.1.11. SVA project (environmental monitoring system)**	Molise Dati SpA	Satellite and orthophotographic territorial analysis system with DDS (decision supporting system)	
EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**	**1.9.1.12. Urban environmental quality**	ISPRA ARPA Basilicata	Study of a network of points displayed on orthophotographic maps of 2004-2007 to analyse the changing uses of farmland	
EO	**1. Land monitoring**	**1.9. Cartography**	**1.9.1. Monitoring changes in land use (urban, farming, forestry)**	**1.9.1.13. Regional Carta Tecnica project**	ARPA Basilicata	Topographical database on a scale of1:5.000 and maps derived on various scales using aerial photography (orthophotographs) - DGR. 2117 of 23.12.2010	The project could be associated in future with the use of satellite images and oriented towards monitoring the state of the environment on various levels of investigation. This will enable research for any sources of local/diffuse pollution in the different environmental settings, analyses on the dispersion of pollutants and monitoring of the instability of slopes.
EO	**1. Land monitoring**	**1.10. Tourism**	**1.10.1. Territorial monitoring for tourism**	**1.10.1.1. Geoportal for water quality on Lake Garda for the "blue flag"**	Funding source: Sirmione Environmental Monitoring Centre; entrusted to the IREA CNR	Landsat, MODIS; Included in the NEREUS Report “25 Uses of GMES”	

EO	**1. Land monitoring**	**1.10. Tourism**	**1.10.1. Territorial monitoring for tourism**	**1.10.1.2. Maps of archaeological areas**	Owner CNR; entrusted to the IREA CNR	Landsat, MIVIS; national project	
EO	**1. Land monitoring**	**1.10. Tourism**	**1.10.1. Territorial monitoring for tourism**	**1.10.1.3. Detection of buried structures**	Exploitation of multitemporal high-resolution spotlight acquisition for archaeological prospecting. Use of optical ATI as part of the Cosmo Skymed announcements by the Italian Space Agency	Funding source: ASI; Owner: IMAA	
EO	**1. Land monitoring**	**1.10. Tourism**	**1.10.1. Territorial monitoring for tourism**		Milan Polytechnic, B.E.S.T. Department	Development of SDI for sustainable tourism in the territories concerned. Use of geospatial data and geographical web services designed to support the development of territorial synergies and the promotion of sustainable economic development with the involvement of the SMEs operating in the sector in the "economic and cultural territorial districts" already activated in Lombardy.	Further need to produce geospatial maps for supporting services relating to the development of a sustainable use for the purposes of tourism (with a view to generating topic-related maps, historical itineraries, business services): integration with satellite data and historical series of maps, for the development of advanced web services connected to geoportals (smart devices, I-phone services, development of services for reconstructing 3-D scenarios, panoramic views)

EO	**1. Land monitoring**	**1.11. Various segments**	**1.11.1. Various segments**	**1.11.1.1. SMAT F1 - Advanced territorial monitoring system**	Aleina Aeronautica, Selex Galileo	System for monitoring the territory to support planning, areas affected by natural calamities, for border patrolling, damage caused by human activity, etc.	
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water balance in the basins (to predict water emergencies)**	**2.1.1.1. Identification of glacier levels for mitigating water emergencies**	Lombardy Regional Authority (DG for Territory and Town Planning); University of Milan	Interpretation of the digital aerial photos, remote sensing and field investigations	The application could be strongly reinforced with the aid of satellite technologies
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water balance in the basins (to predict water emergencies)**	**2.1.1.2. Estimation of the equivalent water in the glacier resources**	ARPA Lombardy	Very high-resolution IKONOS satellite images (pixels 1 m); Applications in Lombardy (Adamello and Forni glaciers)	
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water balance in the basins (to predict water emergencies)**	**2.1.1.3. Project 3PCLIM – Monitoring of water resources from glaciers**	Funding source: Interreg IV Italy – Austria; ARPA Veneto; IDPA CNR Venice	Project approved in 2011. Analysis of variations in the sources, mass balances and variations in the glaciers	Further need: the availability of support media that can be updated rapidly is fundamental but must be accompanied by technologies and analytical methods capable of promptly providing raw or processed data of interest
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water**	**2.1.1.4. Maps of snow coverage**	Owner: ESA and European Commission;	Application: Alps; Sensor: MODIS, TM, NOAA	

			balance in the basins (to predict water emergencies)		Implementer: IREA – CNR		
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water balance in the basins (to predict water emergencies)**	**2.1.1.5. Monitoring of the water equivalent of snowfall**	ARPA Lombardy	Application in Lombardy; TERRA satellite images (NASA), MODIS low-resolution sensor (pixel 500 m, weekly frequency); integration of data from level measuring networks	
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water balance in the basins (to predict water emergencies)**	**2.1.1.6. Monitoring water equivalent of snowfall**	Owner: European Commission; Implementer: IREA – CNR	Application: Lombard Alps. Sensor: MODIS, TM, NOAA	
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water balance in the basins (to predict water emergencies)**	**2.1.1.7. Monitoring of water equivalent of snowfall**	ARPA Veneto; CNR IFAC Firenze	Monitoring water resources; Activities conducted on Monte Cherz (Arabba, Belluno) to characterise snow cover (flake dimensions, water content, water equivalent) by monitoring with microwaves using instruments located on Envisat and Cosmo satellites	

EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water balance in the basins (to predict water emergencies)**	**2.1.1.8. Estimation of water capacity of Alpine basins**	Owner: ESA, European Commission; IREA – CNR	Applications in Lombardy, Val d'Aosta, Veneto. Sensor; MODIS, TM, NOAA	
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water balance in the basins (to predict water emergencies)**	**2.1.1.9. Estimation of water capacity of Alpine basins**	Owner: ESA and European Commission; Implementer: IREA – CNR	Applications in: lakes in Lombardy and Lazio; lakes in Sweden and Hungary; Italian coastal areas; Sensor: Landsat, MODIS, MERIS, MIVIS	The new generation of hyperspectral sensors (EnPam, PRISMA) will enable water quality monitoring (e.g. presence of toxic phytoplankton) even in small lakes
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water balance in the basins (to predict water emergencies)**	**2.1.1.10. SIIT Project (integrated territorial information services; monitoring seawater quality**	Molise Dati SpA	Satellite-based territorial analysis system	
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water balance in the basins (to predict water emergencies)**		ARPA Basilicata		A need has been identified to use satellite imaging to bring up-to-date and redefine the bathing beaches identified more than 20 years ago and no longer consistent with the morphological and anthropological conditions of the coastline in Basilicata.

EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water balance in the basins (to predict water emergencies)**		Reported by the Milan Polytechnic.	Implementation of the current EU and regional directives "Water Framework Directive" (WFD, GWD, …) of the EC Directive 2000/60/EC, …). Implementation of 3-D hydromorphological and ecological multiscale multitemporal models starting from satellite, aerospace data and integration of local data provided by GMES of various kinds (fisheries, biodiversity, ..), migratory corridors and humid corridors, riparian areas, anthropic environment, etc.). Development of 3-D model for simulating scenarios, predictions, mitigation. Development of near-RT multiscale integration models, topographical DB + LiDAR + satellite and UAV images of slopes and riparian areas	Further need to produce models for use in monitoring the dynamics underway over time, the exploitation and safeguarding of ecosystems, the orientation of mitigation and prevention measures (flooding ...)
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.1. Monitoring of the water balance in the basins (to predict water emergencies)**	**2.1.1.11. Identification of surface water bodies and the spatial occupation of riverbeds**	ARPA Veneto; Padua University Geography Department	Experience as part of the Plan for safeguarding the water resources as a tool for preventing and reducing pollution and improving the conditions of the water resources.	Further need: the availability of support media that can be updated rapidly is fundamental but must be accompanied by technologies and analytical methods capable of promptly providing raw or processed data of interest, in particular to identify outflows.

EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.2. Monitoring of inland water quality**	**2.1.2.1. Monitoring of weeds infesting inland waterways**	Owner: ASI; Implementer: CNR IMAA	Application: Lake Victoria (Kenya); Exploitation of multitemporal StripMap acquisitions for weed-infested equatorial inland waters (Kisumu bay of the Lake Victoria Kenya, Africa). Monitoring in synergy with optical data as part of the Italian Space Agency's COSMO-SkyMed Announcement Opportunity project	
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.2. Monitoring of inland water quality**	**2.1.2.1. Monitoring of the Pertusillo lake**	ARPA Basilicata	Use of Landsat images to search for unauthorised lake inlets/outlets using surface temperature mapping of the lake	
EO	**2. Natural resources management**	**2.1. Water resources**	**2.1.2. Monitoring of inland water quality**		ARPA Basilicata		A need has arisen for satellite images for monitoring the quality of surface water (lakes), and the coastal marine environments, and in the application of round-lake functionality index.

EO	**2. Natural resources management**	**2.2. Agriculture, forestry and pastures**	**2.2.1. Monitoring of crops**	**2.2.1.1. Monitoring of evapotranspiration from irrigated arable land**	ARPA Lombardy	Monitoring of vapour emissions from vegetation; satellite images of the Earth, sensor: MODIS (250 m pixels, monthly frequency) integrated with geomatic and meteorological methods	
EO	**2. Natural resources management**	**2.2. Agriculture, forestry and pastures**	**2.2.1. Monitoring of crops**	**2.2.1.2. Maps and estimates of rice production**	CNR-IREA, JRC, Faculty of Agricultural Studies in Milan and Lombardy Regional Authority	Application in Piedmont, Lombardy, Europe, Asia and Africa; Landsat, MODIS.	
EO	**2. Natural resources management**	**2.2. Agriculture, forestry and pastures**	**2.2.1. Monitoring of crops**	**2.2.1.3. Estimates of nitrogen concentration in crops**	CNR-IREA, JRC, Faculty of Agricultural Studies in Milan and Lombardy Regional Authority	Application in Italy, Europe, Asia and Africa; Field Spec, MERIS.	
EO	**2. Natural resources management**	**2.2. Agriculture, forestry and pastures**	**2.2.1. Monitoring of crops**	**2.2.1.4. Precision agriculture in viticulture**	Compagnia Generale per lo Spazio	Optical satellite and aerial remote sensing images (UAV)	
EO	**2. Natural resources management**	**2.2. Agriculture, forestry and pastures**	**2.2.1. Monitoring of crops**	**2.2.1.5. SAP4PRISMA -Development of algorithms and products for applications in cereal farming and land monitoring**	Funding source: ASI (PRISMA mission); PI CNR IMAA	Development of algorithms to support the PRISMA mission; hyperspectral satellite images for monitoring cereal crops	While awaiting the new generation of hyperspectral satellite sensors such as PRISMA and EnMAP
EO	**2. Natural resources management**	**2.2. Agriculture, forestry and pastures**	**2.2.1. Monitoring of crops**	**2.2.1.6. Monitoring N2O emissions and nitrate leaching in food production and bio-energy crop systems**	Funding source: MIUR (PRIN2008); Implementers: University of Basilicata, University of Tuscia, CNR IMAA. Application in Lazio	Analysis of the space-time relationship of N2O emissions and leaching of nitrates into food production and bio-energy crop systems	While awaiting the new generation of hyperspectral satellite sensors such as PRISMA and EnMAP

EO	**2. Natural resources management**	**2.2. Agriculture, forestry and pastures**	**2.2.2. Monitoring of vegetation**	**2.2.2.1. Monitoring of woodland plant diseases in the Parco del Ticino**	Lombardy Regional Authority (DG for Territory and Town Planning)	LandSat images	
EO	**2. Natural resources management**	**2.2. Agriculture, forestry and pastures**	**2.2.2. Monitoring of vegetation**	**2.2.2.2. Nature map**	ARPA Veneto	The Nature Map stems from the Framework Law n. 394/91. Cartography describing the current status of the habitats in the territory and that assesses environmental quality and vulnerability. The remote sensing images come from the Landsat TM5 sensor integrated in a GIS	
	2. Natural resources management	**2.2. Agriculture, forestry and pastures**	**2.2.2. Monitoring of vegetation**	**2.2.2.3. Nature map**	ARPA Basilicata	Identification, characterisation and safeguarding of the principal regional habitats. Use of hyperspectral MIVIS, GPS images and orthophotographic maps	
EO	**2. Natural resources management**	**2.2. Agriculture, forestry and pastures**	**2.2.2. Monitoring of vegetation**	**2.2.2.4. ESA CAT.1**	Funding source: ESA; Implementer: CNR IMAA	Management of resources from hyperspectral satellite images	
EO	**2. Natural resources management**	**2.2. Agriculture, forestry and pastures**	**2.2.2. Monitoring of vegetation**	**2.2.2.5. Humid zones**	ARPA Basilicata	Classification of humid zones using the MedWetPan method, with orthophotographic maps	

EO	**2. Natural resources management**	**2.2. Agriculture, forestry and pastures**	**2.2.3. Monitoring of pastures**	**2.2.3.1. Maps and estimates of pasture productivity**	CNR-IREA, JRC, Faculty of Agricultural Studies in Milan and Lombardy Regional Authority	Application in Piedmont and Lombardy; Field Spec, Landsat.	
EO	**2. Natural resources management**	**2.3. Energy resources**	**2.3.1. Monitoring and management of energy resources on offer**	**2.3.1.1. REACCESS - Risk of energy availability: common corridors for Europe supply security**	Funding source: EC FP7; Implementer: various partners including CNR IMAA	Use of web-based satellite data for identifying and characterising European energy infrastructure in order to manage the risks relating to energy procurement	
EO	**2. Natural resources management**	**2.3. Energy resources**	**2.3.1. Monitoring and management of energy resources on offer**	**2.3.1.2. NEEDS - New energy externalities developments for sustainability**	Funding source: EC FP7; Implementer: various partners including CNR IMAA	Use of GIS methods to support global assessments on the European energy sustainability policy	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.1. Mission ROSA**	Owner: ASI, various partners including Innova Srl (Basilicata Regional Authority)	Radio occultation	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.2. Variations in environmental conditions and changes**	Funding source: EC; Implementer: IREA – CNR;	NOAA, SPOT, Landsat, QuickBird, Ikonos. Applications in Italy and Africa	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.3. ACTRIS – Aerosols, clouds and trace gases research infrastructure network**	EC FP7, various partners, including CNR IMAA	Air quality monitoring integrating satellite data with ground level detectors	

EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.4. EARLINET – European aerosol research Lidar network "Advanced Sustainable Observation System"**	EC FP6, various partners including CNR IMAA	Statistical database for monitoring air quality for the prediction of climate change with the aid of remote sensing	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.5. GEOMON – Global Earth Observation and Monitoring of the Atmosphere**	EC FP6, various partners including CNR IMAA	Study of greenhouse gases, air pollution, aerosols, and stratospheric ozone	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.6. MTG - ESA-EUMETSAT _ consolidation of scientific baseline for MTG-IRS L2; role of EO for climatology**	ESA EUMETSAT, University of Basilicata	Air quality monitoring for climate change studies	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.7. MTG 3 - ESA-EUMETSAT _ Assessing the 3D correlation structure of atmospheric humidity fields**	ESA EUMETSAT, University of Basilicata	Air quality monitoring for climate change studies	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.8. MTG_T_q_ Assessment ESA-EUMETSAT - temperature and water vapour assessment**	ESA EUMETSAT, University of Basilicata	Air quality monitoring for climate change studies	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.9. COBRA ECOWAR**	MIUR, University of Basilicata	Observations spectrally resolved in the rotational bandwidth of water vapour, in the spectral range of 17-50 micron for validation and verification of models of radioactive transfer	

						in the Earth's atmosphere	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.10. QUITSAT**	Funding source: ASI; Compagnia Generale per lo Spazio	Observations coming from satellite sensors and ground level data collected by DOAS spectrometer, multispectral solar radiometer, Lidar technologies, etc.	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.11. PROMOTE – Protocol monitoring for the GMES service element atmosphere;**	Funding source: ESA; Implementer: Compagnia Generale per lo Spazio; ARPA Lombardy	To promotes services in the following areas: ozone monitoring and forecasting; UV monitoring and forecasting; air pollution monitoring and forecasting; climate change monitoring and emissions; special services (e.g. volcano warnings)	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.12. TEMIS – Tropospheric emission monitoring internet service**	Funding source: ESA; Implementer: Compagnia Generale per lo Spazio		

EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.13. GEMS**	Implementer: Compagnia Generale per lo Spazio		
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.14. MACC - Monitoring atmospheric composition and climate**	Funding source: EC FP7; Compagnia Generale per lo Spazio	Draws from the results of the GEMS project	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.14. PASODOBLE – Promote air quality services integrating observations - Development of basic localised information for Europe**	Funding source: EC FP7; Implementer: Compagnia Generale per lo Spazio		
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.15. Monitoring PM10 and PM2.5**	ARPA Emilia Romagna; Compagnia Generale per lo Spazio	Resolution 10x10 km2	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.15. Air quality measurement campaigns**	ARPA Basilicata	Use of satellite images to analyse data recorded in situ (PM10, SOX, O3, NOx, CH4)	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**	**3.1.1.16. IN AIRE - Integrated strategy for air quality evaluation and management**	CNR IMAA, University of Basilicata, project proposal as part of the Life +2011 awaiting assessment	Study on atmospheric particulate for discriminating anthropic from natural sources with satellite observations (SEVIRI and MODIS sensors)	

EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.1. Monitoring quality of air/atmosphere**		ARPA Veneto		Further need: there is evidence of the need for data that can be updated rapidly with the aid of satellites to perform air quality monitoring
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.2. Changes in glacier limits over time**	**3.1.2.1. Identification of glaciers**	Owner: University of Milan; Lombardy Regional Authority (DG for Territory and Town Planning)	Interpretation of digital aerial photographs and remote sensing data and investigations on IKONOS satellite imaging fields (1 m pixels) in northern Italy and Bolzano	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.2. Changes in glacier limits over time**	**3.1.2.2. Maps of glacier coverage and evolution**	Owner ESA, ASI. Application in Italian Alps; Implementer IREA – CNR.	Sensor: TM, ASTER	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.2. Changes in glacier limits over time**	**3.1.2.3. Database "Glaciers in Lombardy"(project of 2004)**	Lombardy Regional Authority (DG for Territory and Town Planning – Infrastructure for Territorial Data Unit)	Included in the NEREUS Report "25 Uses of GMES"	
EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.3. Other monitoring and estimates**	**3.1.3.1. ROSA - Radio occultation sounder for atmosphere**	Innova srl and other partners	Construction of the "ROSA for OCEANSAT-2 Data Processing Centre" and development of applications and/or products that will provide information and data of added value in the space geodesy field.	

EO	**3. Study of climate change and air quality**	**3.1. Changes in environmental conditions**	**3.1.3. Other monitoring and estimates**	**3.1.3.2. PRODIM**	Funding source: Interreg IIIB, Archimed 2000-06; ARPA Basilicata	Use of Landsat images for assessing the Normalized Difference Vegetation Index, which assesses plant stress and the impact on agriculture due to climate change	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.1. Seismic risk management**	**4.1.1.1. SVA Project (Environmental monitoring system)**	Molise Dati SpA	Satellite and orthophotographic territorial analysis system with DDS (decision supporting system)	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.1. Seismic risk management**	**4.1.1.2. Seismic risk management**	Civil Protection Department, ASI	National project	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.1. Seismic risk management**	**4.1.1.3. SAFER – Service and applications for emergency response**	Funding source: EC FP7, GMES; Implementer: various organisations including the CNR IMAA and e-GEOS	Various application settings: earthquakes and volcanic eruptions, fires, floods, avalanches	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.1. Seismic risk management**	**4.1.1.4. LINKER – Link Emergency Response**	Implementer: e-Geos (Basilicata Regional Authority)	Various settings: fires, floods, earthquakes and volcanic eruptions, landslides and other humanitarian crises	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.1. Seismic risk management**	**4.1.1.5. MOMET – Monitoring short-term fluctuations in mud volcano methane emissions**	NATO, University of Basilicata		
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.1. Seismic risk management**	**4.1.1.6. Stregeos – Stress-related geohazards in South-Caucasus**	EC FP6, University of Basilicata	Monitoring earthquakes in Caucasian regions	

EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.1. Seismic risk management**	**4.1.1.7. Pre-Earthquake – Processing Russian and European Earth observation for earthquake precursor studies**	EC FP7, University of Basilicata	Monitoring earthquakes in Russian regions	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.1. Project of the Civil Protection Department, ASI**	Funding source: ASI; Implementer: Civil Protection Department	National project	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.2. Maps of areas affected by forest fires**	Owner: CDE; Implementer: IREA - CNR	ASTER Landsat National project (National parks). Owner; Ministry of the Environment + Africa with NOAA data, Spot Vegetation,	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.3. Fire hazard maps**	Owner: CDE; Implementer: IREA - CNR	National project (Lombardy, Sardinia), Greece, Spain; Landsat data	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.4. Early recording and monitoring of forest fires**	Basilicata Regional Authority; (Dept. of Infrastructure and Civil Protection), CNR, University of Basilicata	Programme of experimental tests for early identification and continuous monitoring. Sensors: NOAA, AVHRR, EOS-MODIS, MSG-SEVIRI. Mentioned in NEREUS Report on "25 Uses of GMES"	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.5. Volcano monitoring**	Financer: EC FP7; Implementer: TRE	Monitoring of eruption phenomena	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.6. SAFER – Service and applications for**	EC FP7, GMES, including the CNR and e-GEOS	Various settings: earthquakes and volcanic eruptions,	

				emergency response		fires, floods, avalanches	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.7. PREVIEW / Eurorisk**	EC FP6, Various Italian partners including CNR IMAA	Various settings: fires, floods, avalanches, earthquakes and volcanic eruptions	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.8. LINKER – Link Emergency response**	Implementer: e-Geos (Basilicata Regional Authority)	Various settings: fires, floods, earthquakes and volcanic eruptions, landslides and other humanitarian crises	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.9. SIGRI – Integrated system**	Funding source: ASI, part of the Earth Observation Programme; Compagnia Generale per lo Spazio	Demonstration system capable of generating products based on 2nd-generation Meteosat data (MODIS), multispectral optical data, SAR data integrated with territorial data, cartography, etc. to support forest fire management before, during and after the event.	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.10. RISK-EOS**	Funding source: ESA; Partner: e-Geos	Fire risk management	

EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.11. AVVISA Basilicata – Satellite fire spotting in Basilicata**	Project forming part of a three-year plan for combating forest fires (2009-11) of the Basilicata Regional Authority, Department of Infrastructure and Public Works; Implementer: CNR IMAA, University of Basilicata (DIFA Landsat)	Fine tuning of a RST (Robust Satellite Technique) for identifying active fires and pre-operational tests with < 15 min refresh.	There is a need for further efforts to increase the level of reliability of these methods.
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.12. Monitoring plant fuels for fire risk prevention**	Basilicata Regional Authority, Department of Infrastructure and Public Works; CNR IMAA	Innovative satellite technologies for characterising and mapping plant fuels liable to fire; sensors: Landsat TM and Aster	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.2. Monitoring of forest fires**	**4.1.2.13. FORESTA - Forest environment awareness platform for forest fire protection and prevention"**	CNR, Civil Protection Basilicata Regional Authority, proposal submitted as part of Life+2011	Project to create an information system for preventing and managing forest fires using satellite data.	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.3. Early warning**	**4.1.3.1. G-MOSAIC (GMES); intelligence, early warning, crisis management**	Various European and Italian partners, including the CNR	Four main domains: Nuclear and Treaties Monitoring, Natural Resources and Conflicts, Migration and Border Monitoring, Critical Assets	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.3. Early warning**	**4.1.3.2. PREVIEW / Eurorisk**	EC FP6, Various Italian partners including CNR IMAA	Various settings: fires, floods, avalanches, earthquakes and volcanic eruptions	

EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.3. Early warning**	**4.1.3.3. LINKER – Link Emergency Response**	Implementer: e-Geos (Basilicata Regional Authority)	Various settings: fires, floods, earthquakes and volcanic eruptions, landslides and other humanitarian crises	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.3. Early warning**	**4.1.3.4. EVOSS – Volcanic risk**	Compagnia Generale per lo Spazio	Develop and demonstrate a pre-operational portfolio of GMES-Copernicus Downstream Services. It uses newly-developed space technology to optimise volcano monitoring capacity in Europe, Africa and the Lesser Antilles, and exploits the synergetic potential of radar and infrared observation from platforms in polar and geostationary orbits.	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.3. Early warning**	**4.1.3.5. CIRCE – Integrated coastal risk control**	Funding source: ASI; Implementers: CNR IMAA, IIA and ISMAR; Telespazio; Consorzio TeRN, ACS	Coastal area monitoring and risk control using satellite and aerial images	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.4. Monitoring of avalanches and floods**	**4.1.4.1. SAFER – Service and applications for emergency response**	EC FP7, GMES, including the CNR and e-GEOS	Various settings: earthquakes and volcanic eruptions, fires, floods, avalanches	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.4. Monitoring of avalanches and floods**	**4.1.4.2. PREVIEW / Eurorisk**	EC FP6, Various Italian partners including CNR IMAA	Various settings: fires, floods, earthquakes and volcanic eruptions	

EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.4. Monitoring of avalanches and floods**	**4.1.4.3. LINKER – Link Emergency Response**	Implementer: e-Geos (Basilicata Regional Authority)	Various settings: fires, floods, earthquakes and volcanic eruptions, landslides and other humanitarian crises	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.4. Monitoring of avalanches and floods**	**4.1.4.4. OPERA - Operational EO-based rainfall run-off forecast.**	Funding source: ESA, ASI; Partner: e-GEOS		
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.4. Monitoring of avalanches and floods**		ARPA Veneto		Further need: the availability of support media that can be updated rapidly is fundamental but must be accompanied by technologies and analytical methods capable of promptly providing raw or processed data of interest
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.4. Monitoring of avalanches and floods**		Basilicata Basin Authority		There is a need to use satellite data to integrate existing orthophotographic material to achieve a more in-depth understanding of the environmental and anthropic features of the territory and thus enable more detailed assessments of the various risks, e.g. flooding of coastal sites

EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.5. Monitoring of coastal and maritime areas**	**4.1.5.1. LIMES – Land and sea integrated monitoring for European security**	EC FP6, Various Italian partners including e-GEOS	Maritime surveillance, land and infrastructure surveillance, humanitarian relief and support for reconstruction	
EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.5. Monitoring of coastal and maritime areas**	**4.1.5.2. InterRisk Project- GMES services for environmental risk management in marine and coastal areas**	Funding source: EC FP6; Implementers: ACS, Innova (MT) and others	The main goal of InterRisk is to develop an open system architecture for supplying interoperable service delivery monitoring and prevention for European marine and coastal areas. The services are based on satellite data, in situ data and numerical models for the ocean and atmosphere. The project contributes to the implementation of GMES. INNOVA has worked on Italian service for monitoring hydrocarbons.	

EO	**4. Safety and emergency management**	**4.1. Emergency management**	**4.1.5. Monitoring of coastal and maritime areas**	**4.1.5.3. MARISS (Maritime security services)**	Funding source: ESA; Implementers: various organisations, including e-GEOS (Basilicata Regional Authority), TAS, Selex	Integration of coastal radar information, vessel detection systems, vessel traffic management systems (VTS) and automatic identification systems (AIS), with airborne and Earth Observation (EO) data	
EO	**4. Safety and emergency management**	**4.2. Security**	**4.2.1. Monitoring of coastal and maritime areas**	**4.2.1.1. DOLPHIN**	Funding source EC FP7; Primary implementer: e-GEOS	Development of pre-operational services for highly innovative maritime surveillance capabilities	
EO	**4. Safety and emergency management**	**4.2. Security**	**4.2.1. Monitoring of coastal and maritime areas**	**4.2.1.1. G-MOSAIC (GMES) - Intelligence, early warning, crisis management**	Funding source: EC FP7 Primary organisations : e-GEOS, various European partners including the CNR	Four main domains: nuclear and treaties monitoring, natural resources and conflicts, migration and border monitoring, critical assets	
EO	**4. Safety and emergency management**	**4.2. Security**	**4.2.2. Not specified**	**4.2.2.1. GMOSS Global monitoring for security and stability**	Funding source: EC FP6; Implementers various organisations including CNR IMAA	Generic methods, algorithms and software needed for the automatic interpretation and visualisation of imagery including feature recognition, change detection and visualisation; Investigations of present and future threats to security and the needs for exchange of	

						information between stakeholders during crises	
EO	**5. Horizontal projects**	**5.1. Geo-portals**	**5.1.1. European geo portal**		Various uses and organisations	GMES sentinel data	Upgrade of the regional geoportals and integration with INSPIRE
EO	**5. Horizontal projects**	**5.2. Urban Atlas**	**5.2.1. Urban Atlas for Lombardy**	**5.1.1.1. Project "GMES Urban Atlas" (Promoted by the European Environment Agency EEA)**	Lombardy Regional Authority; European Environment Agency; Milan Polytechnic		To be developed for various uses and users; project implementation proposed by the Milan Polytechnic; but with an "urban territory" dimension
EO	**5. Horizontal projects**	**5.2. Urban Atlas**	**5.2.2. Urban Atlas of the Veneto Regional Authority**	**5.1.1.2. Project "High-resolution GMES Urban Atlas" (Promoted by the European Environment Agency - EEA)**	Funding source: EC FP7; Veneto Regional Authority	Geoeye 1 satellite, Geoland 2 technological upgrade (resolution 1 m.). Basic uses: ground coverage, buildings, transport networks	

EO	**5. Horizontal projects**	**5.2. Urban Atlas**	**5.2.3. Urban Atlas of the Veneto Regional Authority**				Further need: the Veneto Regional Authority acknowledges that the primary goal is to increase the use of analytical tools deriving from the processing and treatment of satellite images to support European environmental and security policies, oriented towards territorial planning needs
EO	**5. Horizontal projects**	**5.3. Multichannel Integrated Portal**	**5.3.1. Multichannel Integrated Portal of the Molise Regional Authority**	**5.3.1.1. A) SVA (Environmental monitoring system; B) SIIT (Integrated Territorial Information Services)**	Molise Dati SpA (manager), e-GEOS Spa, Geosystems srl, Vitrociset SpA (implementers)	SVA: data on environmental and anthropic hazards; SIIT: topographical data	
EO	**5. Horizontal projects**	**5.4. Data interoperability**	**5.4.1. Data interoperability**	**5.4.1.1. EuroGEOSS (Global Earth Observation System or Systems)**	Funding source: EC FP7; Implementer: various organisations including the CNR IREA, CNR IMAA	Three main areas: drought, forests, biodiversity; Project for promoting interoperability between different organisations to facilitate access to and use of data	
EO	**5. Horizontal projects**	**5.4. Data interoperability**	**5.4.1. Infrastructure and Data interoperability**	**5.4.1.2. GIGAS GEOSS INSPIRE and GMES an Action in Support**	Funding source: EC FP7; Implementer: various organisations including CNR IMAA	Concerted adoption of standards, protocols, and open architectures	

EO	**5. Horizontal projects**	**5.4. Data interoperability**	**5.4.1. Infrastructure and Data interoperability**	**5.4.1.3. GEOVIQUA Quality aware VIsualisation for the global earth observation system or systems**	Funding source: EC FP7; Implementer: various organisations including CNR IREA, CNR IMAA	Project designed to improve the GEOSS Common Infrastructure (GCI) with innovative "quality-aware visualisation tools" and "geo-search capabilities", made available to the community of users through the geoportal and other tools (e.g. GeoLabel)	
EO	**5. Horizontal projects**	**5.4. Data interoperability**	**5.4.1. Infrastructure and Data interoperability**	**5.4.1.4. CYCLOPS Cyber Infrastructure for civil protection operative procedures**	Funding source: EC FP6; Implementer: various organisations including the CNR IREA, CNR IMAA, Civil Protection	GMES, GRID; develop e-infrastructures to serve GMES applications	
EO	**5. Horizontal projects**	**5.4. Data interoperability**	**5.4.1. Infrastructure and Data interoperability**	**5.4.1.5. UncertWeb**	Funding source: EC FP7 Implementer: various organisations including the CNR IREA, CNR IMAA	Infrastructure with a dynamic model (web model) to support the activities of researchers, politicians, GMES users	
EO	**5. Horizontal projects**	**5.4. Data interoperability**	**5.4.1. Infrastructure and Data interoperability**	**5.4.1.6. GRIDCC - Grid enabled remote instrumentation with distributed control and computation**	Funding source: EC FP7; Implementer: various organisations including the CNR IMAA		
EO	**5. Horizontal projects**	**5.5. Local observatories / regional user networks**	**5.5.1. Local observatories / regional user networks**	**5.5.1.1. DORIS-NET Downstream observatory organised by regions active in space network**	Funding source: EC FP7 Implementer: various organisations including the CNR IREA, CNR IMAA		

EO	**5. Horizontal projects**	**5.5. Local observatories / regional user networks**	**5.5.1. Local observatories / regional user networks**	**5.5.1.2. EGIDA Coordinating earth and environmental cross-disciplinary projects to promote GEOSS**	Funding source: EC FP7; Implementer: various organisations including CNR IMAA	Evaluation processes, tests and assessment indexes, expertise databases, a "GEO Label" concept, surveys, and other instruments that will link relevant European S&T communities to GEOSS and ensure it is built using state-of-the-art science and technology	
EO	**5. Horizontal projects**	**5.6. Major satellite networks**	**5.6.1. Various segments**	**5.6.1.1. Cosmo SkyMed**	Funding source: Ministry of Defence and Italian Space Agency Implementers: INNOVA srl and other partners	COSMO-SkyMed is a 100% Italian constellation of 4 LEO satellites with a SAR sensor in bandwidth X. Engineering, design and implementation with high-performance computational technologies for multiprocessor systems (C++/Linux) of software components for treating SAR COSMO-SkyMed data: - RAW data deformatter, telemetric data extractor and support data manager (L0) for all acquisition modes; - acquired data focusing in spotlight mode; - multilook, detection	

						and ground-projection for stripmap and spotlight modes.	
EO	**5. Horizontal projects**	**5.6. Major satellite networks**	**5.6.1. Various segments**	**5.6.1.1. MOSO**	Funding source: MIUR Implementers: INNOVA srl and other partners	Development of an innovative system for the remote sensing of sea weather conditions and seagoing traffic in the Mediterranean basin on full-resolution and quick-look SAR images.	

SATCOM	**6. Telemedicine**	**6.1. Telemedicine**	**6.1.1. Telemedicine**	**6.1.1.1. Near to Needs (telemedicine via satellite to bridge Italian and Rumanian healthcare and education services)**	Compagnia Generale per lo Spazio	Pre-operational satellite telemedicine service to support diagnostics, treatment and training. Experiments in Treviso and Timisoara (Rumania)	
SATCOM	**7. Satellite networks**	**7.1. Satellite networks**	**7.1.1. Satellite networks**	**7.1.1.1. Use of satellite communications for civil protection activities**	Lombardy Regional Authority (DG for Civil Protection)		
SATCOM	**7. Satellite networks**	**7.1. Satellite networks**	**7.1.1. Satellite networks**	**7.1.1.2. Emercom.Sat**	Civil Protection Department, Ministry of the Interior, Fire Fighting Department, Piedmont Regional Authority, DG for Public Works and Civil Protection	Protocol for the unified satellite system	
NAVI	**8. Infomobility**	**8.1. Road infomobility**	**8.1.1. Road infomobility**	**8.1.1.1. InfoSat (satellite navigation applications to support vehicle traffic control)**	Funding source: ASI, Compagnia Generale per lo Spazio	Prototype of service for monitoring traffic and transit through tolls at junctions, in areas with traffic restrictions, and to support first aid providers.	
NAVI	**8. Infomobility**	**8.1. Road infomobility**	**8.1.1. Road infomobility**	**8.1.1.2. Optimisation of goods transport (in exploratory stage)**	Veneto Regional Authority, Logistics Project Unit	GPS on vehicles and containers to reduce the percentage of "empty return journeys"	
NAVI	**8. Infomobility**	**8.1. Road infomobility**	**8.1.1. Road infomobility**		Milan Polytechnic, B.E.S.T. Department		Further need: fleet control (trains, public transport, fire brigades, police forces, etc.)

NAVI	**8. Infomobility**	**8.2. Maritime/pleasure sailing infomobility**	**8.2.1. Maritime/pleasure sailing infomobility**	**8.2.1.1. CAPRI**	Funding source: ESA; Compagnia Generale per lo Spazio	An AIS (Automatic Identification System) is being developed	
NAVI	**8. Infomobility**	**8.2. Maritime/pleasure sailing infomobility**	**8.2.1. Maritime/pleasure sailing infomobility**	**8.2.1.2. AIS System Study**	Funding source: ESA; Compagnia Generale per lo Spazio	An AIS (Automatic Identification System) is being developed	
NAVI	**8. Infomobility**	**8.2. Maritime/pleasure sailing infomobility**	**8.2.1. Maritime/pleasure sailing infomobility**	**8.2.1.3. Fenice**	Funding source: ESA; Compagnia Generale per lo Spazio	An AIS (Automatic Identification System) is being developed	
NAVI	**8. Infomobility**	**8.3. Logistics**	**8.3.1. Logistics**		Milan Polytechnic, Department B.E.S.T.		Further need: traffic control, crate/container storage, automation of precision agricultural procedures
NAVI	**8. Infomobility**	**8.3. Logistics**	**8.3.1. Logistics**	**8.3.1.1. TranSafeAlp (city logistics and hazardous goods management)**	Funding source: European Alpine Space Programme for territorial cooperation; Veneto Regional Authority, Logistics Project Unit	The importance of this scheme was reiterated in the recent National Logistics Plan	Further need: route tracking, provision of countermeasures to cope with critical events, assessment of the presence of adequate infrastructure and sensitive situations for emergency management, re-routing, integration with GMES; more effective interaction between territorial logistic platforms.

NAVI	**8. Infomobility**	**8.4. Safety in dry docks**	**8.4.1. Safety in dry docks**		Milan Polytechnic, B.E.S.T. Department		Further need: use of GNSS sensors for personal safety
NAVI	**8. Infomobility**	**8.5. Waste management**	**8.5.1. Waste management**	**8.5.1.1. Web solutions for waste**	Compagnia Generale per lo Spazio;	Automatic waste separators, devices to install on waste collection vehicles, web-based systems for managing information on waste collection and transport	
NAVI	**8. Infomobility**	**8.5. Waste management**	**8.5.1. Waste management**	**8.5.1.1. Web solutions for waste**	Innova srl	System for monitoring the location of 300 tanks used for transporting refining effluent as well as the management and intelligent planning of the tanks' journey schedules. Currently being integrated with calculation algorithms for optimised journey planning.	

NAVI	**8. Infomobility**	**8.6. Health**	**8.6.1. Support for the disabled**	**8.6.1.1. NADIA satellite navigation to support disabled citizens**	Innova srl and other partners	NADIA is a complex system that, starting with people's particular needs, arrives at the use of satellite navigation infrastructure. Terminals suited to the various types of disability have been designed for use with NADIA, with user-friendly interfaces that exploit visual, voice and tactile means optimised to suit the individual capabilities of people unable to use conventional terminals. These terminals receive and process satellite signals and also information coming from dedicated service centres that provide ad hoc information to suit different types of disability, e.g. on obstacles and places of interest. The service centres are connected to a single central navigation system that provides all the navigational aids obtainable from	

						the GNSS constellations. This functional structure is a novelty among the projects of this type. NADIA has several unique features, such as the use of innovative satellite technologies that offer the very high precision and reliability (integrity) achievable thanks to the EGNOS and Galileo.	

NAVI	**8. Infomobility**	**8.6. Training and advisory schemes**	**8.6.1. Various**	**8.6.1.1. NavSAS Group (Navigation Signal Analysis and Simulation Group**	Turin Polytechnic, Istituto Superiore Mario Boella	Research group in the field of navigation, consultant to the GNSSA	
NAVI	**8. Infomobility**	**8.6. Training and advisory schemes**	**8.6.1. Various**	**8.6.1.2. Master for specialising in "Navigation and Related Applications"**	Turin Polytechnic, Istituto Superiore Mario Boella, INRIM, UN Office for Outer Space Affairs		
Space exploration	**9. Space exploration systems and technologies**	**9.1. Space exploration systems and technologies**	**9.1.1. Space exploration systems and technologies**	**9.1.1.1. STEPS - Space exploration systems and technologies**	Funding source: Piedmont Regional Authority; Implementer: Thales Alenia Space, Turin Polytechnic, 24 SMEs	R&D into crucial technologies for enabling robotic and human exploration of the universe; development of demonstrators for soft landing procedures, fuel cells, aerothermodynamics, etc.	

PART III – ANALYSES AND PROPOSALS

3. Elements emerging from the supply and demand chart

3.1. Quantitative outline of the supply and demand chart

In strictly quantitative terms, the schemes identified can be classified as follows:

Segment	Supply (projects underway)	Demand (potential/expressed)	Supply/ demand matches	Schemes reportedly coming close to end user needs
A) Earth Observation	*169*	*21*	*7*	*13*
B) Navigation	*13*	*10*	*2*	*4*
C) Telecom	*3*	*0*	*0*	*2*
D) Space Exploration	1	0	0	0
Total	**186**	**31**	**9**	**19**

This brief outline shows that there is:

- a clear prevalence of schemes in the Earth Observation sector;
- a marked prevalence of descriptions of projects already underway (and therefore classifiable as services offered) over the descriptions of demands/needs to be satisfied.

These findings give the impression that there are several *matches* between projects already underway and needs expressed by end users, meaning that some parties are probably not entirely aware of the opportunities already made available by schemes exploiting satellite technologies that have been implemented by other players.

The most important details are highlighted below, in terms of:

- the demand for innovation of the services that use satellite data expressed by the people interviewed, pinpointing any correspondences between the services offered and expressed demands that have yet to be satisfied;
- schemes already underway and in the "pre-operational" stage, described by some service/technology providers as coming close to end-user needs and applicable to the public/institutional sector.

This is a list of projects on which it seems reasonable to suggest further action for technological and service upgrades, as in the field of new radar equipment deriving from the COSMO-SkyMed satellites for instance, or to extend services tested in pilot areas to wider areas or more numerous parties. It is from schemes of this kind that further ideas may emerge for implementing projects and partnerships.

3.2. Schemes identified as a demand needing to be met

The table below shows the main needs and/or requests for the innovation of satellite services expressed by participants in the survey.

A) **Earth Observation**

Demands identified	Origin of report	Correspondences with services offered / Criticality	Status / Funding
1. Monitoring abnormal displacements of buildings, urban settlements or whole sliding slopes, according to an established time schedule	Lombardy Regional Authority, DG for Civil Protection, Local police and Security Veneto Regional Authority, Land Defence Directorate	– T.R.E. – Compagnia Generale per lo Spazio (Morpheus) – IREA – CNR – Shortage of funds for applications dedicated to buildings and infrastructural works – Finmeccanica	To be further developed as part of the GMES. Very high-resolution observation data recorded fortnightly using Cosmo SkyMed; ***Public notice from MIUR – Lombardy Regional Authority*** (section 2.3 Annexe A) deadline 23/11/11 ***EC FP7****, Space Call 5. GMES 44 M€, deadline 23/11/11* **Interreg IV**, Priority "Environment and risk prevention" (themes: Natural and technological risks (including climate change); Water management; Waste prevention and management; Biodiversity and preservation of natural heritage (including air quality); Energy and sustainable transport; Cultural heritage and landscape). http://i4c.eu/ Beneficiaries: public bodies ***Public notice from ASI*** *"Earth Observation" (awaiting third call".* ***Beneficiaries:*** *SMEs*
2. Identification of abandoned/brownfield sites **3. Identification of abandoned/damaged buildings (e.g. ex industrial sites)**	Lombardy Regional Authority, DG for Civil Protection, Local police and Security; Finmeccanica		Awaiting assessment and start-up, e.g. in the GMES setting (monitoring with optical satellites, also combined/correlated with data coming from airborne optical sensors and other types of information (electricity and gas connections, etc.). ***EC FP7****, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),*** *call closed for 2011* http://ec.europa.eu/environment/life/funding/lifeplus.htm ***Public notice from ASI*** *"Earth Observation" (awaiting third call".* ***Beneficiaries:*** *SMEs*
4. Mapping of asbestos cement roofing	Veneto Regional Authority, DG for Safeguarding the Environment; ARPA Veneto	ARPA Lombardy Project	
5. Regional cartography for identifying vehicle traffic flows on crucial stretches	Lombardy Regional Authority, DG for Civil Protection, Local police and Security		Awaiting assessment and start-up N.B. This monitoring can only be done if the vehicles are fitted with satellite transmitters (in Italy approx. 900,000 vehicles carry this technology [Soc. Octotelematics]). To ensure that this type of service is accurate it is essential to expand the user base (offering additional services free of charge) and the areas to monitor (currently only motorways and by-passes). The application / service could be represented using Google Earth
6. Information layers on	Lombardy		Awaiting assessment and start-up using

infrastructure and transport networks and other 3D cartography	Regional Authority, DG for Infrastructure and Mobility: Lombardy Regional Authority, DG for Territory and Town Planning		optical satellites. Further developments could converge in the direction of 3D cartography.
7. Production of geospatial maps for tourist services	Milan Polytechnic, which proposes to involve the tourist districts	Offer a capacity to reconstruct 3D scenarios and manage web services	Awaiting assessment and start-up using optical satellites. Further developments could converge in the direction of 3D cartography.
8. Redefinition of bathing beaches in Basilicata and monitoring of inland water quality	ARPA Basilicata		
9. Monitoring of environmental risks (flooding)	ARPA Veneto, Basilicata Basin Authority	Various projects	
10. Various environmental and territorial monitoring activities and assessments. Use of satellite data as an alternative to the orthophotographic data available	Lombardy Regional Authority, DG for Green Systems and Landscape; Finmeccanica	Shortage of funds and training on the use of satellite data and/or data processing SW For vegetation, crops and parks, there is a product available, described in the chart, albeit for limited experimental areas (same as for the next item 8)	Awaiting assessment and start-up ***Public notice from MIUR – Lombardy RA*** (section 2.3 Annexe A) deadline 23/11/11 ***EC FP7****, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),*** *call closed for 2011* *http://ec.europa.eu/environment/life/funding/lifeplus.htm* ***Public notice from ASI*** *"Earth Observation" (awaiting third call)".* ***Beneficiaries:*** *SMEs* *To be connected to the EXPO topic, for example, with an advisory nature, involving regions with different climates both in Italy and in Europe.* *In GMES terms, use of satellite services for distributing fertilizers; monitoring vegetation; managing agricultural properties.* **Interreg IV**, Priority "Environment and risk prevention" (themes: Natural and technological risks (including climate change); Water management; Waste prevention and management; Biodiversity and preservation of natural heritage (including air quality); Energy and sustainable transport; Cultural heritage and landscape).http://i4c.eu/ Beneficiaries: public bodies
11. Monitoring level of glaciers to mitigate water shortages	Lombardy Regional Authority, DG for Territory and Town Planning	Various projects begun by IREA – CNR, ARPA	Consider extending the DG's projects already underway with the aid of GMES (data coming from optical satellites / radar / hyperspectral airborne sensors ***Public notice from MIUR – Lombardy RA*** (section 2.3 Annexe A) deadline 23/11/11 ***EC FP7****, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),*** *call closed for 2011*

			http://ec.europa.eu/environment/life/funding/lifeplus.htm ***Public notice from ASI*** *"Earth Observation" (awaiting third cal)l". **Beneficiaries:** SMEs*
12. Monitoring water quality	IREA – CNR	New hyperspectral sensors (e.g. PRISMA) will enable water quality monitoring even in small lakes	Awaiting assessment and start-up ***Public notice from MIUR – Lombardy RA*** (section 2.3 Annexe A) deadline 23/11/11 ***EC FP7****, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),*** *call closed for 2011* http://ec.europa.eu/environment/life/funding/lifeplus.htm ***Public notice from ASI*** *"Earth Observation" (awaiting third call)". **Beneficiaries:** SMEs*
13. Monitoring water quality (Water Framework Directive) for predicting and mitigating dynamics harmful to the ecosystem	Milan Polytechnic	Implementing 3D models	Awaiting assessment and start-up ***Public notice from MIUR – Lombardy RA*** (section 2.3 Annexe A) deadline 23/11/11 ***EC FP7****, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),*** *call closed for 2011* http://ec.europa.eu/environment/life/funding/lifeplus.htm ***Public notice from ASI*** *"Earth Observation" (awaiting the third cal)l". **Beneficiaries:** SMEs*
14. Monitoring of air quality	ARPA Veneto	Various projects	
15. Adaptation of the regional geoportals to INSPIRE	Lombardy Regional Authority, Milan Polytechnic, Veneto Regional Authority		
16. Training for *civil servants* on the use of SW and the management of GMES services	Lombardy Regional Authority, DG for Green Systems and Landscape Finmeccanica	Competences of service providers, remote sensing data processors (e.g. IREA – CNR) The Lombard Regional Contact Office for the DORIS_Net project is responsible for facilitating the development of competences in the EO sector, and GMES in particular	Awaiting assessment and start-up *a. Activate synergies between the education schemes in the Lombard aerospace district (and other districts in the region) and the Space Academy Foundation in Abruzzo (basic courses, knowledge networks, promotion of innovation to help develop the sector) by means of distance learning* *b. Training for civil servants on software use and on how to interpret satellite data* *c. Explanatory programs to improve public understanding in cooperation, for instance, with the Observa – Scienza e Società Observatory (Trento)* ***Interreg IV****, Priority "Innovation and the knowledge economy (themes: Innovation, research and technology development; Entrepreneurship and SMEs; Information society; Employment, human capital and education)* http://i4c.eu/

B) Navigation

Demands identified	Origin of report	Correspondences with services offered / Criticality	Status / Funding
17. Identification of vehicle	Lombardy	InfoSat Project	Consider creating an information system

traffic flows on crucial stretches of road	Regional Authority, DG for Civil Protection, Local police and Security; Finmeccanica	(Compagnia Generale per lo Spazio)	based on regional cartography to be shared with the local police headquarters for viewing crucial phenomena (roads and critical areas), to be developed specifically for said purpose.
18. Identification and monitoring of fleets (trains, public transport, fire brigades, police forces, etc.)	Milan Polytechnic; Finmeccanica	Competences of the Milan Polytechnic; InfoSat Project (Compagnia Generale per lo Spazio)	Awaiting assessment and start-up
19. Monitoring of storage and logistics (crates, containers, precision automation of operations)	Milan Polytechnic; Finmeccanica	Competences of the Milan Polytechnic	Awaiting assessment and start-up
20. Personal safety at construction sites (use of GNSS sensors for personal safety)	Milan Polytechnic	Competences of the Milan Polytechnic	Awaiting assessment and start-up

3.3. Projects in the "pre-operational" stage and close to "end-user needs"

It is worth mentioning the satellite-related projects and schemes undertaken by space technology players and indicated as being important and "close" to end-user needs.

A) Earth Observation

Needs identified	Origin of report	Correspondences with services offered / Criticality / Funding
1. **Precision agriculture.** Space applications in viticulture for scanning vineyards and mapping vegetation for plant health assessment purposes and as an aid in the distribution of pesticides.	Compagnia Generale per lo Spazio	Use of GMES (data coming from optical satellites, radar and/or airborne hyperspectral sensors to study crops and property boundaries ***EC FP7**, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),** call closed for 2011 http://ec.europa.eu/environment/life/funding/lifeplus.htm* ***Public notice from ASI** "Earth Observation" (awaiting third call)". **Beneficiaries:** SMEs.* *To be connected to the EXPO topic, for example, with an advisory nature, involving regions with different climates both in Italy and in Europe*
2. **Monitoring subsidence, oil & gas spills, buildings and infrastructure**	– T.R.E. – Remote sensing Europe; – Basilicata Regional Authority (ISTIMES project for infrastructure)	Lombardy Regional Authority, ARPA, other public bodies ***EC FP7**, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),** call closed for 2011 http://ec.europa.eu/environment/life/funding/lifeplus.htm* ***Public notice from ASI** "Earth Observation" (awaiting third call)" **Beneficiaries:** SMEs*
3. Prototype system for supporting **decision-making by the Civil Protection** department concerning **landslide risks,** based on the use of satellite technologies (**MORFEO**)	Compagnia Generale per lo Spazio	Lombardy Regional Authority (already involved as end user); Civil Protection Dept; Test areas: Cortenova, Garzeno, Madesimo, Ersino Lario, Lake Como; financed by the ASI ***Public notice from MIUR – Lombardy RA*** (section 2.3 Annexe A) deadline 23/11/11 ***EC FP7**, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),** call closed for 2011 http://ec.europa.eu/environment/life/funding/lifeplus.htm* ***Public notice from ASI** "Earth Observation" (awaiting third call)". **Beneficiaries:** SMEs*
4. **Monitoring air quality** (QUITSAT**)**	Compagnia Generale per lo Spazio	Project financed by the Italian Space Agency ***Public notice from MIUR – Lombardy RA*** (section 2.3 Annexe A) deadline 23/11/11 ***EC FP7**, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),** call closed for 2011 http://ec.europa.eu/environment/life/funding/lifeplus.htm* ***Public notice from ASI** "Earth Observation"*

		*(awaiting third call)". **Beneficiaries:** SMEs*
5. Prototype system designed for **monitoring flooding phenomena (PROSA)**	Compagnia Generale per lo Spazio	Project financed by the Italian Space Agency ***Public notice from MIUR – Lombardy RA*** (section 2.3 Annexe A) deadline 23/11/11 ***EC FP7**, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),** call closed for 2011 http://ec.europa.eu/environment/life/funding/lifeplus.htm* ***Public notice from ASI** "Earth Observation" (awaiting the third call)". **Beneficiaries:** SMEs*
6. Monitoring of woodland plant diseases	DG for Territory and Town Planning, CNR - IREA	Use of GMES (data coming from optical satellites, radar and/or airborne hyperspectral sensors to study crops and property boundaries ***EC FP7**, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),** call closed for 2011 http://ec.europa.eu/environment/life/funding/lifeplus.htm* ***Public notice from ASI** "Earth Observation" (awaiting the third call)". **Beneficiaries:** SMEs*
7. Support for forest fire management in the various stages - before, during and after the event. Project at the demonstration stage (SIGRI)	Compagnia Generale per lo Spazio; Finmeccanica	Project financed by the Italian Space Agency. Possible new BMES + GALILEO services using optical satellite data for localizing rescue equipment and resources. Involving the Basilicata Regional Authority (because it is the satellite's site on the ground), and the Lombardy, Veneto, Piedmont and Abruzzo Regional Authorities (because of the regions' high seismic risk), and Switzerland ***EC FP7**, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),** call closed for 2011 http://ec.europa.eu/environment/life/funding/lifeplus.htm* ***Public notice from ASI** "Earth Observation" (awaiting third call)". **Beneficiaries:** SMEs* **Interreg IV**, *Priority "Environment and risk prevention" (themes: Natural and technological risks (including climate change); Water management; Waste prevention and management; Biodiversity and preservation of natural heritage (including air quality); Energy and sustainable transport; Cultural heritage and landscape)* http://i4c.eu/ Beneficiaries: *public bodies*
8. Seismic risk management	Civil Protection Department; CNR; University of Basilicata; e-GEOS; Molise Dati; Finmeccanica	GMES: COSMO-SkyMed data relating to the damage caused by earthquakes ***EC FP7**, Space Call 5. GMES 44 M€, deadline 23/11/11* ***Public notice from ASI** "Earth Observation" (awaiting the third call". **Beneficiaries:** SMEs* **Interreg IV**, *Priority "Environment and risk prevention" (themes: Natural and technological risks (including climate change); Water management; Waste prevention and management; Biodiversity and preservation of natural heritage (including air quality); Energy and sustainable transport; Cultural heritage and*

		landscape). http://i4c.eu/ Beneficiaries: public bodies
9. Monitoring environmental impact – Environmental impact of major construction sites (e.g. the Turin – Lyon high-speed railway link) – Monitoring of flooded areas in contaminated locations	ARPA Lombardy; Finmeccanica	GMES: use of optical and radar data for monitoring building works ***EC FP7**, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),** call closed for 2011 http://ec.europa.eu/environment/life/funding/lifeplus.htm* ***Public notice from ASI** "Earth Observation" (awaiting third call)". **Beneficiaries:** SMEs*
10. Controlling energy dispersion from buildings, by optimizing the use of materials	Milan Polytechnic (E2BA platform)	Project underway, requiring further development
11. 3D cartography for numerous uses and monitoring of natural and anthropic changes in the territory; topographic knowledge base for: – monitoring changes in land use; – new digital cartography; – updating information layers.	Milan Polytechnic, DG for Territory and Town Planning	Project to be developed using optical satellite data. Further developments could converge in the direction of 3D cartography ***EC FP7**, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),** call closed for 2011 http://ec.europa.eu/environment/life/funding/lifeplus.htm* ***Public notice from ASI** "Earth Observation" (awaiting the third call)". **Beneficiaries:** SMEs*
12. Monitoring historical changes to the territory, with the aid of 3D scenarios	Milan Polytechnic, Territorial Agency, CNR (Atlas Project)	Project already underway, requiring further development
13. Studying climate change (identifying glaciers)	DG for Territory and Town Planning; CNR – IREA; Finmeccanica	GMES: optical data for monitoring changes in glacier profile **Interreg IV**, *Priority "Environment and risk prevention" (themes: Natural and technological risks (including climate change); Water management; Waste prevention and management; Biodiversity and preservation of natural heritage (including air quality); Energy and sustainable transport; Cultural heritage and landscape*). http://i4c.eu/ Beneficiaries: public bodies ***EC FP7**, Space Call 5. GMES 44 M€, deadline 23/11/11* ***LIFE+ (2007-13),** call closed for 2011 http://ec.europa.eu/environment/life/funding/lifeplus.htm* ***Public notice from ASI** "Earth Observation" (awaiting the third call)". **Beneficiaries:** SMEs*

B) Navigation

Needs identified	Origin of report	Correspondences with services offered / Criticality / Funding
14. Web solutions for waste management. System for managing (collecting, processing, displaying) information on the waste being collected and transported	Compagnia Generale per lo Spazio	
15. Mobility in urban and rural areas (INFOSAT). System for monitoring traffic and transit through tolls at junctions, in areas with traffic restrictions, and to support first aid providers. Project already financed by the ASI	Compagnia Generale per lo Spazio	Lombardy Regional Authority, DG for Civil Protection, Local police and Security
16. Mobility for maritime and pleasure sailing vessels (various projects). Automatic Identification System for monitoring the position and course of vessels	Compagnia Generale per lo Spazio	
17. Waste management (web solution for waste)	Compagnia Generale per lo Spazio	

C) Telecom

Needs identified	Origin of report	Correspondences with services offered / Criticality / Funding
18. Near To Needs. Pre-operational satellite telemedicine service to support diagnostics, treatment and training. Experiments in Treviso and Timisoara (Rumania)	Compagnia Generale per lo Spazio	
19. Interoperable platform for **emergency communications** between different regions in the event of natural or man-made disasters, to be integrated with ground communication systems. Pilot areas could include: Lombardy, Piedmont, Veneto, Switzerland. The Space Centre (Telespazio) in Lario, Lombardy can operatively manage the networked services	Finmeccanica	***Interreg IV**, Priority "Environment and risk prevention" (themes: Natural and technological risks (including climate change); Water management; Waste prevention and management; Biodiversity and preservation of natural heritage (including air quality); Energy and sustainable transport; Cultural heritage and landscape). http://i4c.eu/* ***Beneficiaries**: public bodies*

4. CONCLUSIONS

4.1. A few considerations emerging from the survey

Below are some conclusions drawn to comment on the satellite services supply and demand chart vis-à-vis the initially established goals.

1) To outline the NEREUS Network's heritage of Italian origin, in terms of projects already underway.

The survey provides a rich picture, even though it is incomplete, of what is on offer in terms of satellite schemes/applications for uses of public interest, which reveals an abundance of technical and scientific expertise available for processing/interpreting satellite data, and of interesting experiences of their application.

2) *To ascertain whether well-established satellite data acquisition methods are in place*

There are procedures for acquiring satellite data that refer to projects already underway, supported by European funding, ESA, ASI. In many cases there is evidence of schemes that are similar from the point of view of the usage of the information and its application (e.g. monitoring land sliding phenomena, forest fires, air quality, etc.). National civil protection activities often overlap with local risk management activities for the parties concerned (Lombardy).

All this certainly gives rise to a wealth of experience, but does not always facilitate the consolidation of the satellite data's acquisition and *exploitation*.

There are some well-established procedures, however, especially relating to the interpretation of orthophotographs, while there is an evident need - or an opportunity at least – for technological upgrades relying on the use of satellite data (e.g. DG for Green Systems and Landscape).

3) *To survey the working practices and expertise (both internal and external) involved in deriving products from these data that are currently useful in practice or potentially useful in future*

There appear to be plenty of well-established skills available to technology providers (e.g. T.R.E., IREA – CNR, Compagnia Generale per lo Spazio, etc.) for generating and processing satellite data, and for research and technology transfer to the enterprises (IREA – CNR) that already deliver services or are financed by public bodies (ESA, ASI, E) for projects that have reached the pre-operational stage and are consequently nearing the generation of products of and services.

There is evidence of shortcomings in the expertise of users, who have sometimes expressed the need for ad hoc training on how to use software and other tools for satellite data processing and, more in general, on how to manage the complicated heritage of information that satellites can provide, and integrate it with other knowledge sources already available to the public user. Specific training schemes are therefore needed for the organisations interested in innovating their functions and services by using GMES.

4) *To ascertain likely future needs and curiosities, and existing critical issues/problems*

Reference can be made to the above summary tables for this purpose.

5) *To share this information with the NEREUS Network with a view to consolidating and, wherever possible, developing existing or novel schemes in the context of the NEREUS Network's Working Groups*

The next goal of this mapping activity is to share the results with the widest possible network of parties. It should be noted that the schemes surveyed on the demand side have already been classified according to the types of activity of the NEREUS Working Group. The survey conducted shows that there is a clear gap between schemes implemented in the Earth Observation sector and those relating to the other sectors (e.g. Telecom and Navigation), for which ad hoc schemes need to be tested, e.g. with a view to reducing the *digital divide* or to implement strategic schemes in the satellite navigation services market.

6) *To produce a position paper outlining Italy's position on NEREUS as regards the Network's possible role, with particular reference to its institutional political lobbying function, and as a pivot for new schemes for developing the potential of satellite technology for the Network's partners and for other stakeholders.*

4.2. For a brainstorming on the Italian situation

The following is a brief outline of some of the issues to consider in detail at a brainstorming session with a view to producing a position paper for the Italian part of the NEREUS Network, based on the previously-described mapping activities.

1. Action for political representation

1.1. Reinforce NEREUS's role as a well-established political speaker for dealing with institutions responsible for policy and for financing the space sector (ESA, Galileo Supervisory Authority, EU, national Space Agencies, etc.) and particularly for satellite technologies and applications.

1.1.1. Create a specific function and job description for said purpose in the context of the European Union's Committee of the Regions

1.1.2. Exert this function at regular auditions

1.2. Introduce the regional level in the context of the European consultations relating to the next Multiannual Financial Framework (MFF)

1.2.1. Propose an increase in the amounts budgeted for financing space activities (e.g. GMES)

1.2.2. Within said budgets, identify funds to use as seed capital for the conception and setup of partnerships between different players with a view to developing competitive and precompetitive schemes

2. Aerospace as a driver of regional growth in a glo-local perspective

2.1. Promote action to coordinate and finance "inter-regional cooperation" schemes, as recommended in Action 3 of the Com533(2010) "*Regional policy contributing to smart growth in Europe 2020*", using structural and cohesion funds (ERFD, ESF);

2.2. Within the context of the NEREUS platform to use for *peer learning*, *review* and *monitoring*, contribute to the programming, implementation and monitoring of a shared and integrated regional strategy (adapted to the respective territorial priorities) for "s*mart specialisation*" in the space technology sector to develop "triple helix" systems (research bodies, PA, enterprises). The

Smart Specialisation Strategy[4] is a prerequisite established by the EC for financing R&D and ICT as part of the programme for 2014–2020. Various methods could be used to achieve this goal, including:

2.2.1. forums, seminars, studies;

2.2.2. short training modules;

2.2.3. databases of tools/models, guidelines, study visits, exchanges for executives, managers, researchers, students, etc.

2.3. With a view to implementing a *Smart Specialisation Strategy* in the aerospace sector, the Regional Authorities should identify, define, update and review a number of tools, i.e. policies, procurement, capital (risk and financial), infrastructure and services for supporting SMEs, the presence, use and accessibility of scientific and industrial facilities available within their regional territories, any networks and clusters, enterprise incubators, peer reviews, skills and mobility of human capital, technologies, market demand, and so on.

2.4. Make aerospace a lead market innovation driver

2.4.1. Identify lead markets (LM) that can be innovated with the aid of space technologies, starting for instance from the "LM Initiatives"[5] *identified by the EC, i.e. public health, bioproducts, renewable energy sources, food safety and control, and the reduction of the digital divide in crucial areas.*

2.4.2. Focus on lead markets with a high feedback potential by concentrating on satellite Telecommunications (e.g. telemedicine, reduction of the digital divide), counting on the tendency for the costs of the satellite bandwidth to drop, giving full support to activities achievable within the context of the NEREUS Telecom Working Group.

2.4.3. With reference to the previously-identified "LM Initiatives", facilitate the development of downstream GMES services, i.e. products/services that can be implemented by enterprises (and SMEs in particular) starting from EO products/services better suited to end-users in the market than to those in the PA.

2.5. Aerospace as a driver of innovation in the territorial government

2.5.1. Reinforce NEREUS's role as a negotiator for the contracting authorities with a view to supporting them in processes for defining the public procurement needs (by means of a prior identification of the application settings, "lead market initiatives", institutionalised PPP, living labs or other forms of cooperation in which the PA may participate as a co-innovator)

2.5.2. Pursue the technological innovation and competitive advantage of SMEs by involving them in the implementation of products and services relating to the downstreams of satellite applications, facilitating cooperation with major industries, centres of excellence,

[4] "Smart Specialisation" is the result of an "entrepreneurial process" that aims to identify the benefits achievable by a region by specialising in a particular scientific and technological area, business segment, niche market, or technological application. It is therefore a matter of "rethinking" about how to support innovation, growth and new occupation opportunities by exploiting a territory's endogenous resources.

[5] The concept of "lead market" was first introduced by the "Aho Report" (2006) revising the Lisbon Strategy. The term is used to mean markets in a given, clearly-delimited geographical area, relating to a given innovative product or service, that could lead to the diffusion of said product or service to other markets. The Space Council's Resolution No. 5 acknowledges that "Space" is a sector to include among the so-called "*Lead Market Initiatives*".

universities, start-ups and spin-offs, incubators, chambers of commerce and public administrations, and the consequent technological transfer activities, with a view to supporting action to identify and stimulate the end-user demand for satellite services. For this purpose, organise regular meetings either ad hoc or as part of the various European conferences on the topic of satellite applications. Also facilitate the development of "third-party" agencies capable of supporting the SMEs involved in the sector in fund raising and research on the most promising market schemes (on this aspect, see the role of the DORIS_Net Regional Contact Office, a NEREUS flagship project)

2.5.3. Reinforce the coordination between regional and district aerospace centres in Europe and/or other areas, that might naturally become parties interested in implementing satellite services

2.5.4. Continue to monitor the schemes for satellite applications, starting from the numerous experiences the Regions have gained (e.g. the NEREUS EO/GMES Working Group's report on the 25 uses of satellite technologies) on behalf of the Regions and with their contributions, by means of ad hoc studies and the adoption of venture contests and idea competitions. Conduct market surveys specifically for each sector and territory.

2.5.5. Continue with the schemes and projects already financed and at the "pre-operative" stage

2.5.6. Arrange ad hoc training activities for managers and executives in the public administration on the use of tools for interpreting and using satellite data with a view to reducing the cultural gap between the technology provider and the end user of satellite services

3. Financial innovation for aerospace applications

3.1. Establish a dialogue with the EIB and other financial organisations to propose/adopt new schemes for funding PPPs (or for the provision of special guarantees) to finance the development of satellite applications, to be integrated with European, national and regional funds allocated by local institutions or made available by European policies (e.g. FP, structural funds – ERFD, ESF, CIP, PON, POR, DOCUP, QCS).

3.2. Provide recommendations and systematically monitor financial sources suitable for use in the innovation of sectors and services involving the use of satellite technologies (e.g. Life+ for the environment, the European Fisheries Fund for fishing policy, Leonardo Da Vinci on lifelong learning, etc.).

3.3. Propose agreements with Regional Authorities and other authorities that manage investment and financing tools for R&I with a view to achieving a multiplication effect for private investments on a local scale in key sectors that can be innovated by means of satellite technologies.

3.4. Create a professional association of experts to support aerospace enterprises, research centres and public institutions, capable of supporting the conception of innovative schemes for satellite services and the building of related partnerships.

4. Set up public communication and public understanding programmes to reinforce the space sector's image and improve awareness of its potential uses

4.1. Increase the circulation of information on the existing technological offer.

4.2. Promote information and training activities for public officers in top positions.

4.1. Promote communication and the citizen involvement programmes to help needs to emerge and thus make better-informed and more effective decisions.

5. Recommendations for the Italian part

5.1. Developing the aerospace districts

5.1.1. Strengthen the role of the Committee for promoting Lombardy's aerospace district.

5.1.2. Take action to establish the aerospace district so that it includes not only the presence of major enterprises, but also that of the SMEs worth developing.

5.1.3. Take steps to ensure constant coordination with the other Italian aerospace districts

5.2. Formalise the programmatic agreement currently in preparation between the Lombardy Regional Authority and the Italian Space Agency.

5.3. Develop the research centres, major enterprises and SMEs with top-level expertise in the fields of HW and SW, avionics, the aerospace sector (e.g. remote sensing, SAR interferometry, microsatellites) and ICT.

5.4. Experiment with applications in sectors important to public demand in Italy (see chart) in the context of projects forming the object of European and national competitions, subject to coordination with the other partners in the NEREUS Network.

5.5. Move into the operational stage of the Doris Net project.

5.6. Establish a regular schedule for meetings between the Directorates-General of the Regional Authority and the worlds of research and industry with a view to orienting the processes of technological innovation according to the public demand logic.

4.3. A working method for the future

This work represents a novelty in terms of the method used by the public administration in its public policy-making for research and innovation. Inspired by the principle according to which it has to be the demand for innovation that drives the activities of (applied) research and experimental development, it aims to undertake an operational process by means of which to involve the public decision-makers belonging to the various Directorates-General (often far removed from the demand for innovation and from market demand) in order to guarantee the availability of the expertise needed to identify the public administration's demand for innovation.

As part of the exchange between the research system and the industrial system, this has enabled us to identify projects potentially worth developing in response to problems identified, safe in the knowledge that the solutions that are developed will have an appropriate specific setting for their application.

From the methodological standpoint, this process can be reiterated, involving the DGs in further sessions in years to come (with two sessions a year, or three at most). This method could also be developed in other application settings and technological domains - in the chemistry sector for instance, in relation to the European Chemistry Network (which is very similar to NEREUS).

ANNEXES – FEEDBACK FROM PARTICIPANTS IN THE SURVEY

A. Lombardy Region

The experience gained and the recommendations advanced by the Lombardy Regional Authority's Directorates General are outlined below.

1. Directorate General for Civil Protection, Local police and Security

The main function of the Directorate for Civil Protection, Local police and Security is to guarantee personal safety and to programme the Regional Authority's actions designed to remove the potential causes of natural disasters and situations of urban discomfort.

1.1. Monitoring deformation phenomena (landslides, subsidence)

The principal scheme relating to the remote sensing activities conducted by the DG for Civil Protection concerns the geological monitoring of deformation phenomena based on remote sensing data[6].

1.1.1. Status of the project for monitoring deformation phenomena (landslides, subsidence)

Ever since 2005 the Directorate General for Civil Protection has been using remote sensing images to identify deformation phenomena (landslides, subsidence of land and buildings, etc.) taking place between 1992 and 2009 (data obtained with the ERS1 and ERS2 satellites from 1992 to 2001, and with the Canadian RADARSAT1 satellite from 2003 to 2009)[7]. An experiment is also underway on the Idro landslide (BS) using artificial reflectors (corner reflectors).

In roughly 10 years, based on specific appointments assigned to the T.R.E. (one of the Milan Polytechnic's spin-off companies), or by means of research conducted by the IRER (Lombardy Research Institute), almost all of the mountains and hills in the territory of Lombardy have been investigated (approximately 13,500 km²), processing more than 3 million points and identifying 6,013 "anomalous" areas (i.e. where displacements exceed ± 2 mm/year), and the activity status of the landslides has been brought up to date.

As part of the PST (Extraordinary Remote Sensing Plan) coordinated by the Italian Ministry of the Environment by arrangement with all the Italian regions, a "photograph" of the whole national territory will soon be available, obtained using all the radar data obtained with the ERS 1 and 2 satellites from 1992 to 2001, and from the ENVISAT satellite from 2003 to 2010. But a great leap forward in quality terms will be achieved using the new radar data deriving from the COSMO-SkyMed constellation, which will enable a nearly real-time monitoring of all particularly critical situations, e.g. earth creep, deep-seated gravitational deformations and subsidence, yielding and consolidation phenomena in the lowland areas, and the Alpine and pre-Alpine valley floors.

The Italian Space Agency's COSMO-SkyMed satellite network (with 4 satellites already in orbit) should considerably improve the quality of territorial monitoring activities.

1.1.2. Demands met by the project

[6] On this topic, see "*Geological and hydro-geological monitoring through interpretation of radar Permanent Scatter data in the provinces of Varese, Como, Sondrio, and Brescia*" by A. Ceriani, A. Zaccone, M Ceriani, in "*25 Uses of GMES in the NEREUS Region*", June 2010, p. 47-48.

[7] The PSInSAR™ technology was used (developed by the Milan Polytechnic), which is a precision mapping method based on a grid of stable reflectors (called Permanent Scatterers, PS) that function like a "natural" geodetic network.

This technology satisfies various kinds of need, i.e. for:
a) monitoring low-speed deformation phenomena;
b) monitoring vertical displacements;
c) analysing "sensitive" sectors;
d) updating cartographically-documented instabilities.

In the geological field, the method is particularly effective for monitoring low-speed deformation phenomena, such as:

- slow-slipping landslides;
- deep-seated gravitational slope deformation (DGSD);
- and for pinpointing areas liable to subsidence phenomena or local soil compacting.

The monitoring of any vertical displacements, expressed in mean mm/year, can be conducted on a very large scale (e.g. on a regional or provincial scale), or on a local scale (single buildings or single landslides).

The object of such investigations is primarily to enable the preparation of a list of territorial sectors that are "sensitive" from the geological standpoint, for the dual purpose of identifying new areas to study and integrating current knowledge of those already surveyed and/or being monitored.

Radar data obtained using PS (Permanent Scatterer) technology can also be used to update the cartographic documentation of areas of instability in the Inventory of Landslide Phenomena (the IFFI Project), particularly as concerns their activity status and geometrical boundaries.

The technology has been applied to a considerable proportion of the Alpine, pre-Alpine and Apennine areas of the region, obtaining more than 3 million points for analysis, and this work will be completed by the end of 2011.

1.2. Civil protection goals for GMES applications

The stated goals of the Civil Protection department for satellite system applications refer to the Earth Observation opportunities offered by the GMES (*Global Monitoring for Environment and Security*) system, which include:

- producing a list of territorial sectors that are sensitive from the geological standpoint, for the dual purpose of identifying new areas to study and integrating current knowledge of those already surveyed and/or being monitored;
- fine-adjusting a novel type of monitoring system that, over the coming years, will enable the regional territory to be analysed according to a preset time schedule, so that any anomalous displacements of buildings, urban settlements or whole sliding slopes can be identified in good time;
- defining a method for storing and conducting a preliminary analysis on a massive amount of data;
- updating the Inventory of Landslides and Instability Phenomena (IFFI project).

1.3. Identifying further needs

Apart from the above considerations on the monitoring of subsidence phenomena, with reference to "civil protection" activities, the use of the satellite has hitherto been restricted to **communications via satellite**, while other schemes involving the use of space data have yet to be undertaken.

Regarding the use of information obtained from satellites for of **Local policing** functions and **Security** purposes, on the other hand, it is worth mentioning the following interesting possibilities:

1. the identification of abandoned/brownfield sites;
2. the identification of abandoned/damaged buildings (including ex-industrial sites);
3. the identification of vehicle traffic flows on crucial stretches of road (though the feasibility of this idea remains to be seen);

It would also be important to consider the creation of an information system on regional cartographic grounds, based on a scheme developed ad hoc, which could be shared with the local police headquarters, for keeping track critical phenomena (roads and other critical areas).

It has also been mentioned that, for the time being, no funding sources are available to enable any systematic ongoing radar satellite monitoring procedures that would enable the monitoring of deformation phenomena and major territorial changes (affecting communication routes, inner-city transport systems, Expo areas, etc).

The DG for Civil Protection also reports on two projects currently underway, organised by the Civil Protection Department in cooperation with the Italian Space Agency for Earth Observation, for the purposes of managing seismic risks and for monitoring forest fires.

2. Directorate General for the Territory and Town Planning

The Directorate General for the Territory and Town Planning is responsible for improving the Lombard territorial system as a whole, since it is considered important to underscore the beauty of its natural features and the quality of its urban settlements and industrial installations.

For some time now, the infrastructure for providing territorial information on the region has relied on data obtained using aerial sensing technologies to process territorial information of interest for the purposes of:

- expanding our topographical knowledge;
- studying the dynamics of changes taking place in urban developments and land use;
- preventing hydrogeological risks.

The topics of greatest interest, for which the data are kept up-to-date and made available via the Regional Geoportal, concern:

a) Variations in land use (the DUSAF project – Farmland and Woodland Use): the various types of usage of the territory (urban settlements, farmland, forests) are identified and delineated on the basis of digital aerial photographs, and deduced from the photo-interpretation of remote sensing images, and the findings are compared with those obtained from surveys conducted at previous times (usually at three-yearly intervals), applying standard (Corine Land Cover) classifications, and thereby deducing the changes taking place in the use of the land during the period examined. This enables a timely monitoring of variations underway and the extrapolation of quantitative data of considerable interest. This service is managed by the DG for the Territory and Town Planning and assigned to the ERSAF (Regional Body for Farming and Forestry Services).

b) Identification of avalanche sites: photo-interpretation methods are cross-referenced with field investigations and used to deduce the areas where avalanches might occur and delineate them cartographically. This service is useful for the purposes of land use planning

by the local authorities, e.g. for positioning ski lifts and, more in general, for the prevention of avalanche-related hydrogeological risks. The service is managed by the DG for the Territory and Town Planning and assigned to the ARPA (Regional Agency for Safeguarding the Environment).

c) Identification of glaciers: using photo-interpretation methods and field investigations, the Regional Authority succeeds in establishing the extent of the region's glaciers and the changes occurring over time. This enables them to obtain basic data for conducting studies on climate change and on the water balance in the region's basins. The activities are developed by the DG for the Territory and Town Planning and assigned to the University of Milan. A database has also been created, called the "Glaciers of Lombardy", which is the outcome of a project completed in 2004 by the DG for the Territory and Town Planning – Unit for Infrastructure for Territorial Information, in the Region of Lombardy[8]. This application could be amply developed with the aid of satellite technologies (GMES Programme)[9].

d) Recording areas with asbestos cement roofing: this service for identifying the areas where there is asbestos cement roofing is handled by the ARPA with the aid of MIVIS (hyperspectral scanner) data;

e) Preventing flooding-related hydrogeological risks: the recording of high-precision digital data on the ground along the banks of lakes and watercourses, using laser scanning (LiDAR) techniques, has proved useful for modelling areas liable to flooding for the purpose of preventing the related hydrogeological risks.

f) 3D topographical database: the three-dimensional topographical database is the principal project in which the Lombardy Regional Authority has invested in recent years; with a view to constructing a new digital topographical cartography in the form of a database, this is a project shared by local bodies and the Regional Authority. The 3-D recordings derive from the stereo rendering of images obtained using photogrammetric technologies.

g) Preventing hydrogeological and seismic risks: with a view to preventing hydrogeological and seismic risks, radar recording methods have been used to monitor millimetric vertical displacements of buildings or other works, or the ground (on this topic, see the previous description for the DG for Civil Protection).

3. Directorate General for Infrastructure and Mobility

The fundamental goals of the Directorate General for Infrastructure and Mobility are to develop and modernise the transport network, undertake works destined to create new routes for traffic flows, and improve the available services by means of guidelines, programming and direct regulation activities.

To satisfy the request to identify experiences relating to remote sensing, there is a unit called the Service for Mobility and for Managing Computerised Mobility Information Systems.

[8] http://www.cartography.regione.Lombardy.it/geoportale/DiscoveryServlet Directorate general for the Territory and Town Planning – Infrastructure for Territorial Information Unit, Lombardy Regional Authority.

[9] See the survey of the projects proposed as part of the"*25 Uses of GMES in the NEREUS Regions*" Report of June 2010 and particularly the reference to the "*Cadastre of Glaciers in Lombardy for the year 2000*" by Andrea Piccin and Anna Rampini (pages 7 and 8).

The Directorate for Infrastructure and Mobility uses vector and raster data formats made available by the competent organisation at the DG for the Territory and Town Planning, in cooperation with the DGs competent for the various types of data.

In particular, the DG for Infrastructure and Mobility cooperates with the DG for the Territory and the LI Spa (Lombardy Informatica) company to update the vectorial layers relating to the transport infrastructure (road networks and junctions, railways and guided-drive vehicles, ports and airports).

There is also a consolidated procedure underway for assessing and updating the information layers whenever new edges or nodes become operational in the graphs of road or railway networks, digitised starting from projects supplied by the parties responsible for completing the works.

To enable the proper inclusion in the territory of new projects it is essential to have territorial precise and up-to-date reference layers available. It is in this sense that the use of basic territorial layers, acquired by means of the best techniques available, becomes fundamental to the work done by the DG to update the vectorial layers for which it is responsible, for the reproduction, usage or circulation of topic-specific maps, and to provide a general picture of the infrastructure in the Lombard territory, as well as maps to support comparisons undertaken by the Directorate or for the exchange and processing of information layers relating to the infrastructure and other territorial data.

4. Directorate General for the Environment, Energy and Networks, and the ARPA

The Lombardy Regional Authority's Directorate General for the Environment, Energy and Networks is concerned with safeguarding the environment (and particularly with reclamation schemes, quarries and mines) and with environmental sustainability, water and energy services and telecommunications.

The ARPA is the Regional Agency for Safeguarding the Environment.

The DG for the Environment, Energy and Networks refers to activities conducted by the ARPA (the Regional Agency for Safeguarding the Environment) to identify the schemes conducted in the field of remote sensing.

Schemes of some importance have been identified, as of the year 2003, when a Remote Sensing Laboratory was established, enabling the development of numerous working methods for monitoring the environment (water resources, land use, vegetation, asbestos cement mapping) from satellites or aircraft.

The ARPA has produced a synthetic but exhaustive account of the experiences of remote sensing undertaken from 2003 to the present day, where readers can seek further details (see Section 7 "*Remote sensing in ARPA Lombardy*"). Suffice it to mention here the macro-topics identified by the ARPA as territorial needs that can be met with the aid of remote sensing:

1. Land use
2. Monitoring water resources
   - *2.1. Monitoring glaciers*
   - *2.2. Monitoring the water equivalent of snowfall*
   - *2.3. Monitoring evapotranspiration*
3. Monitoring asbestos cement roofing
4. Monitoring the environmental impact of major construction sites

5. Monitoring subsidence
6. Monitoring flooded areas

5. Directorate General for Green Systems and Landscape

The Directorate General for Green Systems and the Landscape was established in 2010, at the start of the 9th legislature. Its purpose is to develop the territorial and socio-environmental heritage and to emphasise the beauty of the Lombard landscape, its wealth and variety. It takes care of protected areas, biodiversity, landscape and forests.

5.1. Activities

The DG for Green Systems and the Landscape takes responsibility for the regional programme called "Monitoring Variations in Land Use and Consumption" (currently not running due to lack of funds).

This monitoring activity is conducted using photographic data and images from the air, i.e. colour and infrared orthophotographic material that is normally already at the Regional Authority's disposal, obtained from airborne platforms.

In the past, high-resolution (Ikonos and Quickbird) satellite images were tested on certain areas for the DUSAF project (Use of Farmland and Woodland); see the related project of the DG for the Territory and Town Planning.

The decision to use orthophotographic data instead of satellite images stemmed from the fact that the Regional Authority already has the orthophotographic data available (at the ERSAF – Regional Body for Agriculture and Forestry) with a resolution of 50 cm per pixel.

As for the possible use of satellite data, the Parks and Nature 2020 Network Unit lacks the computer equipment and software needed to exploit remote sensing data. On the other hand, the Unit is a supplier and user of computer-based cartographic data provided by the regional information system (SIT), including technical and land use maps, planning and Google Earth, that also has data coming from remote sensing among its sources.

It was also mentioned that the DG's activities could be favourably innovated by means of a full and free use of GMES satellite data, providing the DG is equipped with suitable computer systems and the necessary expertise, e.g. specific training not only on how to use the software for processing satellite data, but also on the global management of the complementary procedures, such as GIS, cartographic overlapping, etc.). This new set of actions could add an important contribution to the depth of the information useful for territorial management purposes.

5.2. Needs identified

Inasmuch as concerns the possible direct use of GIS images for territorial/environmental assessments, a primary need would be to obtain an alternative to the IT2000 orthophoto system, which is updated only very infrequently (the latest edition dates from 2007). This course of action was unfeasible up until a few years ago because the costs of the images were too high by comparison with the orthophotographic product.

Given that not particularly recent images are made available by producers at a low cost nowadays, or even free of charge, it would be useful to obtain a set of historical images, relating to successive time thresholds, for the uses described previously.

6. Directorate General for Agriculture and the Regional Paying Authority

Some of the goals of the Directorate General for Agriculture are to program and manage farming activities, to protect the environment, and to support the adoption of a healthy, proper diet.

The Regional Paying Authority (OPR) for the Lombardy Regional Authority is the organisation concerned with the payment of contributions and the various EU premiums relating to the funding of the Common Agricultural Policy (CAP).

The Lombardy Regional Authority's OPR and DG for Agriculture have signed a memorandum of understanding designed to outline their respective competences, responsibilities and sphere of operations.

The OPR uses information deriving from remote sensing and photo-interpretation activities in the context of their monitoring procedures for the purpose of distributing the EU contributions paid out on the basis of farmland usage, as governed by EU legislation.

As part of this activity, the OPR acquires two types of information:

1) aerial photographs of the whole regional territory;

2) multispectral and multi-temporal satellite images of portions of the territory.

The images of the territory are acquired at central level by the AGEA (Agricultural Payments Agency), which obtains the satellite images from the JRC in Ispra. The images are used to update the topic-specific layers of the GIS, which is part of the SIARL (Regional Agricultural Information System), an information system that enables the details in a company's file to be checked and brought up-to-date, and requests for help to be submitted.

7. ARPA Lombardy

Experiences of remote sensing via satellite and from the air for environmental monitoring purposes, developed by the ARPA Lombardy

Date *28/01/2011*

CONTENTS

1 Introduction

ARPA Lombardy began to take an interest in remote sensing in 2003, when it set up a Remote Sensing Laboratory, developing a set of working methods for monitoring the environment in general, via satellite and from aircraft, and particularly: water resources (glaciers, snow cover, evapotranspiration); land use (providing methodological support for the DG for the Territory, and to help the ERSAF update the DUSAF land use cartography) and vegetation; and for mapping asbestos cement roofing.

ARPA Lombardy cooperates with various institutions and is particularly involved in schemes organised by the ESA (European Space Agency), such as the PROMOTE project (a part of which has involved fine-adjusting a satellite-based mapping of NO2 concentrations in the atmosphere), or the HR-GEO (High-Resolution Geostationary) Workshop held in Frascati (in April 2010) dedicated by the ESA to the design of new-generation geostationary satellites for remote sensing. ARPA Lombardy was the only European environmental agency to be invited to bring a presentation to the HR-GEO Workshop, where it reported on the needs and the problems encountered in the application of remote sensing methods to environmental monitoring.

This document gives a brief account of the ARPA Lombardy's remote sensing experiences from 2003 to the present day. Based on its mission to serve as a technical body supporting the Regional Authority, the Agency has dealt with the topic of remote sensing by taking a pragmatic approach, setting itself the goal not of conducting scientific research, but of fine-tuning practical monitoring methods to use in its institutional activities. As always, the development of such methods required a period of experimentation during which various solutions were evaluated, and the one achieving the best cost-benefit ratio was chosen. A particular feature of the Agency's use of remote sensing is the close link between the remote sensing data and the environmental data acquired by the agency: in fact, remote sensing data can only be really useful when they are integrated with environmental data by means of numerical or conceptual models.

The development of practical remote sensing methods for monitoring the environment calls for expertise both in the field of remote sensing and in that of environmental monitoring. Both these competences are available at ARPA Lombardy, and almost all the methods were developed in-house by the Agency. Help from other institutions was only needed in cases demanding a highly-specialised remote sensing know-how, that it would have been impossible to develop rapidly within the Agency.

2 Diagram of ARPA Lombardy remote sensing experiences

Topic	*Experience*	*Operating level*	*Frequency of service*	*Sensor/platform*
Monitoring water resources: glaciers	Measurement of the glaciers' volume reduction and estimation of the annual mean capacities released	In operation	Approximately every three years	IKONOS stereo
Monitoring water resources: snowfall	Estimation of the water equivalent of snowfall	In operation	Once a week during winter and spring	MODIS
Monitoring of water resources: evapotranspiration	Estimation of water dispersion from arable crops due to evapotranspiration	In operation	Once a month during the period when the fields are irrigated (April to September)	MODIS
Monitoring of subsidence	Centimetric-precision measurement of ground level reductions caused by drawing water from the water table	In operation	According to specific needs	ERS1/2, RADARSAT
Monitoring of land use	Mapping of variations in the land use and coverage	In operation	Several years	Landsat, Spot
Monitoring of major construction sites	Monitoring of the impact of major construction sites on natural vegetation and morphological changes in the ground	In operation	Several years. The frequency depends on the nature of the work underway	False-colour infrared aerial or helicopter photographs and laser altimetry
Mapping of asbestos cement installations	Mapping of asbestos cement roofing	In operation	One-off measure	Aerial images using MIVIS hyperspectral scanner
Monitoring overflowing rivers	Monitoring of areas where rivers have overflowed and assessment of the impact on vulnerable aspects (population, contaminated by,…)	Experimental	When the event occurs	ASAR, RADARSAT
Risk of forest fires	Estimation of the humidity content of forests	Experimental	Weekly	MODIS
Air quality monitoring	Mapping of the concentration of NO2 in the atmosphere as part of the European	Experimental	Once a month during the period covered by the project	SCIAMACKY and OMI

	GMES project for research and development called PROMOTE			

3 Further considerations on some experiences

3.1 Land use

The use of the land is the result of an interaction between several driving forces: population, production activities and climate. Land use strongly influences the quality of the environment and in Lombardy it can change very quickly. The Agency has developed an automated method for the periodic satellite monitoring of changes in land use on a scale of 1:50.000. It also took part, together with the ERSAF, in the project for updating the DUSAF regional cartography on land use, on a scale of 1:10.000.

3.2 Monitoring water resources

In recent years, Lombardy has experienced water emergencies prompted partly by climate change, but partly also by users' unwise and conflicting use of the water resources. A rational management of the water resources in a given basin is comparable with the economic and financial management of a business. The management tool in this case is the hydrological balance. It is essential to carefully estimate the various components contributing to the hydrological balance, including the components that are more difficult to calculate, such as the water equivalent of snowfall, the water resources in glaciers, and evapotranspiration from irrigated crops. The use of remote sensing via satellite has proved particularly effective for the estimation of these components.

3.2.1 Monitoring glaciers

In Lombardy there are 276 glaciers amounting to a total surface area of 110 km², which corresponds to 20% of the glaciers in the Italian Alps and 4% of all the glaciers in the whole Alpine range. Lombardy also has Italy's two largest glaciers: the Adamello and the Forni. Glaciers are monitored by means of very high-resolution stereoscopic satellite images (using the IKONOS satellite with 1 m pixels), which enable us to construct an altimetric model of the glacier and to observe how it changes with time. As they shrink, glaciers not only represent the most obvious sign of the climate change underway in our region, they also - and more importantly in the short term - constitute an important water resource during the summer months, mitigating the effects of water shortages. The purpose of monitoring glaciers is to estimate the annual mean water outflow generated by the melting ice. This is done using panchromatic and multispectral stereoscopic IKONOS satellite images acquired during the period from June to September.
The four areas with the most important glacier systems in Lombardy are investigated, i.e. Adamello, Forni, Bernina and Disgrazia. Each area is monitored approximately once every three years. The method consists in constructing digital elevation models (DEM) of the glacier from paired stereo images. The latest DEM is then compared with the previous models to assess the changes in the glacier's volume.

3.2.2 Monitoring the water equivalent of snowfall

For Lombardy, snowfall coverage is the most important water reserve during the period from April to July. The water equivalent of the snow cover is estimated on the strength of satellite observations (the NASA's Terra satellite and its low-resolution MODIS sensor with 500 m pixels) obtained on a weekly basis, integrated with data obtained by the monitoring done with snowfall metering networks. The method enables an assessment of the quantity of water (expressed in millions of cubic metres) accumulated in the form of snow in the principal mountain basins of Lombardy. Estimating the water equivalent of the snow, combined with an understanding of the water resources accumulating in the reservoirs and in the major lakes being regulated, enables an assessment of the global water resources available and a consequent evaluation of the risk of water shortages with a view to enabling any consequent decision-making.

3.2.3 Monitoring evapotranspiration

Evapotranspiration is the emission of water, in the form of vapour, from vegetation and the soil. Evapotranspiration represents the main agriculture-related water loss: 70% of the water delivered to crops

by means of irrigation systems is lost due to evapotranspiration. The phenomenon depends largely on the weather and the type of crop and its stage of phenologic growth. ARPA Lombardy acquires information on the crops by means of remote sensing via satellite integrated, using geomatic methods, with data acquired from the meteorological network in order to estimate the potential evapotranspiration from crops. This method is based on MODIS images with 250 m pixels in the visible and near-infrared bandwidths. The frequency of acquisition is once a month during the period when crops need watering (April to September). The area monitored concerns the irrigated lowlands. Evapotranspiration is estimated according to the FAO's standard Penmann-Monteith method, pooling air temperature, wind speed and solar radiation data acquired from the ARPA Lombardy weather forecasting network. The purpose of remote sensing is to provide an estimate of the types of crop and their stage of growth (i.e. the Kc coefficient in the Penmann-Monteith equation).

3.3 Monitoring asbestos cement roofing

The geo-referenced survey of the asbestos cement roofing remaining in the territory of the Lombard region was decided by the Lombardy Regional Authority's Asbestos Plan (PRAL) approved with DGR of 22 December 2005 N. 8/1526. The survey was conducted with aerial images obtained by the MIVIS, a special hyperspectral scanner, on four sample areas: the Olona basin terminating to the north of Milan, the A4 motorway corridor along the stretch between Milan, Bergamo and Brescia, the Valcamonica and the Val Trompia, involving a total surface area of approximately 2,000 km². Judging from findings obtained on the ground, the method's estimated accuracy in identifying asbestos cement roofing amounted to 93%.

3.4 Monitoring the environmental impact of major construction sites

ARPA uses remote sensing from the air to monitor the environmental impact of major construction sites, such as the site set up in the Alta Valtellina for the environmental rehabilitation of the area affected by the Valpola landslide in 1987. The monitoring activity consists in obtaining false-colour infrared aerial images for assessing damage to natural vegetation, and aerial images with the laser altimeter to accurately measure morphological changes occurring in the Adda river bed during the works.

3.5 Monitoring subsidence

ARPA has used differential interferometry technologies with SAR (Synthetic Aperture Radar) satellite images to obtain centimetric-precision measurements of subsidence phenomena relating to the pumping of ground water (the area considered was Lake Varese, where for decades now there has been a gradual shrinkage in the water level indicated by a hydrometric rod installed on the edge of the lake).

3.6 Monitoring areas affected by overflowing rivers

ARPA has also tried using SAR satellite images for mapping areas flooded by overflowing rivers. The case study was the flooding occurring in November 2002 and involving the Adda basin downstream from the lake, and the Lodi area in particular. This led to the identification of the flooded areas and their automatic mapping on the SAR images, which were then cross-referenced with the maps concerning the population, land use, businesses at risk of major incidents (RIR), and contaminated sites, to assess the potential environmental impacts.

4 Conferences, seminars and publications by ARPA Lombardy on remote sensing

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25) E. Zini, "Il telerilevamento per il monitoraggio ambientale in ARPA Lombardia", lezione tenuta all'Università di Milano-Bicocca agli studenti del Corso di Telerilevamento, 1 Aprile 2010.

24) E. Zini, "Uso e copertura del suolo", lezione tenuta al corso "Pianeta suolo" organizzato da ARPA Lombardia e Fondazione Enrico Mattei, Pavia, 15 Ottobre 2009.

23) E. Zini, D. Bellingeri, "Asbestos-Concrete Mapping in Lombardy by Airborne Remote Sensing", intervento al World Asbestos Conference 2009, Taormina, 1-3 Ottobre 2009

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16) G. Lisini, P. Gamba, D. Bellingeri, E. Zini, “Unsupervised and supervised snow monitoring and mapping for hydrological applications using remotely sensed data” 27° EARSeL Symposium, 2007, Bolzano.
15) E. Zini, "Environmental Scenarios: a Regional Point of View", Management Board Seminar, European Environmental Agency, 23 November 2005, Copenhagen.
14) E. Zini, "Il telerilevamento per il monitoraggio ambientale in ARPA Lombardia: esperienze e prospettive", Forum Nazionale sul GMES (Global Monitoring of Environment and Security), Agenzia Spaziale Italiana, Capua, 24 Marzo 2006
13) D. Bellingeri, E. Zini, R. Serra, G. Peretti, “Stima della disponibilità idrica sotto forma di neve nei bacini idrografici alpini lombardi mediante integrazione di dati satellitari MODIS e misure nivometriche a terra”, Atti della 10° Conferenza Nazionale ASITA, Bolzano, 14-17 Novembre 2006 – Contributo premiato come Miglior Poster dal Consiglio scientifico ASITA.
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B. Piedmont Region

1 -THE AEROSPACE SECTOR IN PIEDMONT

The aerospace sector has become decidedly important in the Piedmont region, in terms of both the number of businesses involved and their contribution to stimulating research and technological innovation, with a positive fallout on major industrial sectors in the region. Piedmont is currently the Italian area with the highest technological density and the highest rate of investment in the aerospace sector, as well as the site of companies that have become world leaders in this field. It is not only for Piedmont and Italy that the aerospace sector has become a priority, but also for Europe as a whole - and to such a degree that in the 7th Framework Programme for research and technological development acknowledges the need to support this sector and coordinate its further development.
The enterprises in Piedmont can respond to the needs of the various subsystems into which the aerospace sector can be divided. The manufacturing activities and services offered by Piedmont businesses operating in this sector are varied and diversified, entailing the use of a broad array of technologies that range from conventional production systems to the use of advanced instrumentation and highly-specialized software. On the whole, approximately half of the enterprises possess technologies relating to the materials and expertise involved in mechanical design activities. Their products are represented mainly by aircraft engines and by services and tools for diagnostics, analyses and test approval activities.

The enterprises in Piedmont's aerospace sector occupy different positions along the whole sub-supply chain: 25.7% of these businesses are main contractors (principally providing technical services concerned with design, prototyping and software development); 36.4% are first-level sub-suppliers (i.e. enterprises that undertake precision mechanical processing and systems design and production); 27.1% are second-level subcontractors (enterprises operating either in mechanical manufacturing activities or supporting study and design activities); and the remaining 10.7% are third- and lower-level sub-supplier enterprises.

2 - THE AEROSPACE INDUSTRY IN PIEDMONT

Ever since the early years of Italian aviation, Piedmont has always been a hub for the development of integrated projects for aircraft fundamental to the progress of aeronautics. Many of the most important Italian aircraft and space systems developed in recent years have received an important contribution, especially in terms of system integrations, from industries in Piedmont. The most important international cooperation schemes in the aerospace sector have been followed up and coordinated (for Italy's part) by the design teams of the major Italian aerospace industries located in Piedmont. This region is an area with great potential, where leading enterprises work side-by-side with sub-suppliers and a close-knit network of research centres and universities - a winning combination that has enabled the growth of such an advanced and innovative sector as the aerospace industry.

The Piedmont aerospace district includes businesses of all sizes. Considering only the employees occupied at industrial installations and offices located in the region, there are 151 businesses (95% of the total) with less than 249 employees on their payroll. These medium-sized enterprises generate a total aerospace-related turnover of nearly €440 million, but in terms of the economic quantities involved it is the major industries that have the greatest weight in the aerospace sector as a whole. In fact, although there are only eight large industries (with more than 250 employees), i.e. they account for 5% of all the businesses involved), they are responsible for a turnover amounting to €2,050 million, which corresponds to 82.4% of the whole aerospace-related turnover in the region. Within this industrial sector, the above considerations apply particularly to the manufacturing activities.

The aerospace sector is rather complex in terms of the economic activities involved and the technical-productive specialisations comprising the enterprises' products. Within the limited terms of the present investigation, this sector includes:

- enterprises active mainly in manufacturing;
- enterprises whose activities consist essentially of technical services; and
- enterprises that provide services or conduct commercial activities.

The manufacturers are numerically the most sizeable component and the most significant one in terms of the economic quantities they generate.

3 -THE MAJOR AEROSPACE INDUSTRIES IN PIEDMONT

3.1 - THALES ALENIA SPACE

Thales Alenia Space is a world-level reference for developments in the space sector, a leader in satellite systems and ahead of the field in orbiting infrastructure; it is Europe's most important company in the space technology sector.
The company is active in the field of satellites for telecommunications, navigation, environmental monitoring, defence and security, scientific observation, and exploration of the universe, as well as for infrastructure in orbit and on the ground, and for space transport systems.

Its product range thus includes most of the range of space systems, plus the corresponding subsystems and avionic thermo-mechanical components and software, e.g.

- Manned Space Systems and Infrastructure
- Scientific Satellites and Observation Systems
- Systems for Exploring the Universe
- Space Transport Systems
- Satellites and Telecommunication Systems
- Satellites and Systems for Earth Observation and Environmental Monitoring

Its production capacity, technological foundations and avant-garde expertise have enabled Thales Alenia Space to attach its name to the main national and international programs, in cooperation with the ASI (the Italian Space Agency), the ESA (European Space Agency) and the NASA (North American Space Agency), and to earn itself an important role in the research programmes organised by the European Commission.
Thales Alenia Space is the European leader for civil and military *space telecommunication* systems. In the field of telecommunications for defence purposes, in particular, this Italian company has developed Sicral 1, the first satellite in an Italian system of secure military telecommunications. It is now engaged up until 2019 in the Sicral 1B project, which will extend the working capacity of the first Sicral. In France, Thales Alenia Space provides the Syracuse I, II and III military telecommunication systems to the French Ministry of Defence.
Thales Alenia Space can boast several remarkable achievements in the field of *environmental observation*: it is world leader in satellites for meteorological purposes and it has gained a great deal of experience of low-orbit climatology missions and the construction of terrestrial segments for Earth observation programmes.
The company is also a European leader in the field of high-precision *optical and radar instrumentation*, as well as a world leader in the field of space altimetry.
Thales Alenia Space is currently involved in the dual-purpose (military and civil) ORFEO (Optical and Radar Federated Earth Observation) project and in the COSMO-SkyMed scheme.
It is the main contractor for the European Space Agency's EGNOS (the European Geostationary Navigation Overlay System). In addition, it is involved in the space and terrestrial segment of the GNSS-1/EGNOS programme, taking responsibility for the Central Control Facility (CCF), the Reference Stations (RIMS) and the navigation transponder for the Artemis satellite.
Right from the start of the *Galileo* programme, it has been an important partner in this new European satellite navigation system, taking responsibility for the terrestrial segment and also participating with a significant contribution to the construction of the space segment.
Thales Alenia Space can boast an exceptional experience and a major presence in the field of satellites for scientific observation and of missions for exploring the universe.
In particular, Thales Alenia Space Italia has successfully implemented programs such as Integral and Sax, acting as systems engineer as well as taking responsibility for subsystems and final integration. It is currently completing some other major European programs, such as GOCE and Herschel/Planck, and will have an important role in the Bepi Colombo programme begun by the ESA.
The experience it has gained has enabled the company to develop an acknowledged capacity to coordinate and guide international teams, as well as assembling, integrating and testing complex scientific probes - as it did for the Cassini-Huygens, which reached Saturn's orbit after a journey lasting more than seven years in the solar system, or for Mars Express, Rosetta and Venus Express.
In addition, the company has a leading role in the European *Aurora* interplanetary exploration programme. In particular, it is responsible for the ExoMars programming system (for exploring Mars with a rover vehicle to seek

possible prebiotic life forms), which was recently approved by the ESA and is scheduled to be completed by 2013, and this will naturally lead to the Mars Sample Return programme (which involves bringing samples of Martian soil back to Earth).
The company designed and constructed more than 50% of the pressurised (i.e. habitable) spaces in the *International Space Station*, one of the technologically most advanced projects in the world, as well as having contributed to its launching, transportation and re-entry systems.
In particular, it built the three pressurised multi-purpose logistic modules (MPLM), Nodes 2 and 3 (the elements interconnecting the various pressurised modules in the ISS), the Cupola (an observation module), the Columbus scientific laboratory, and the automated transfer vehicle (ATV).
In the field of new-generation *transport systems*, Thales Alenia Space has been acquiring a leading role as concerns the EXPERT, USV and IXV re-entry demonstrators, and also for the crew transportation systems such as the CSTS and in the systems for exploring the Moon and Mars (e.g. the Lunar Lander).

In Piedmont
Through the Directorates of the “Space Infrastructure and Transport Systems" and "Optical Observation and Science", business units, the company site in Turin specialises in institutional programmes for manned infrastructure and scientific satellites, sectors where it expresses its top-level systems engineering expertise, which covers: studying the mission, design, development, integration, qualification, and state-of-the-art space system operations. These skills rely largely on subsystem-related activities, especially in the areas of structural solutions and of temperature and environmental control means, where they are also involved in designing and manufacturing component parts. But the Directorate in Turin also has to do with attitude control, robotics, optical payloads, avionics and software, with important design and development activities on various application levels.
The products characterising the Turin site at system level include:

- manned space systems and infrastructure
- scientific satellites and observation systems
- systems for exploring the universe
- space transport systems

together with:

- satellite platforms in general
- scientific payloads and optical equipment
- robotic systems
- satellite and pressurised structural solutions
- active and passive temperature control for satellites and manned infrastructure
- environmental control of manned infrastructure
- orbit and attitude control
- propulsion subsystems and related tanks
- avionic subsystems and wiring
- on-board software
- integration and testing

The prospects of the products made in Turin are essentially solid thanks to the undeniable excellence of the expertise available, especially in systems engineering, and also thanks to the decoupling of the scientific institutional market from the more "nervous" economic and technological cycles of the commercial markets.
To make sure that the company’s capacities are maintained and fully exploited, and that its presence on the market is consolidated, it is nonetheless essential to guarantee the following conditions:

- continuation of the International Space Station program, including the aspects relating to its usage and to test beds for validating the systems, subsystems and technologies for future international exploration programs;
- an effective Italian participation in the compulsory technological programmes of the European Space Agency - the TRP (Technology Research Program) and the CTP (Core Technology Program) - and in the optional GSTP (General Support Technology Program) and MREPP (Mars Robotic Exploration Preparation Program);
- an effective Italian participation in the European roadmap for the robotic and human exploration of the Moon and Mars;
- a substantial strengthening of the company’s presence in the sector of launchers and re-entry vehicles;
- a reinforcement of the company's presence in the sector of commercial satellite platforms.

3.2 - ALENIA AERONAUTICA

Alenia Aeronautica is one of the Finmeccanica companies, the largest Italian industrial concern in the aeronautical field, and a world leader for this sector in the civil and military markets. The company has a leading role in the design, construction, conversion and after-sales servicing of a vast range of civil and military aircraft and aeronautical systems. These activities are mainly undertaken in co-operation with the principal world industries in this sector.
Alenia Aeronautica is the historical heir (together with Avio) of the aeronautical industry that was first established in Turin in 1908, an undertaking that - after the First World War - was converted into the Fiat company. Alenia Aeronautica was created in 1990 from a merger between Aeritalia and Selenia, Finmeccanica's aerospace and defence industries, and its name soon became linked to the Eurofighter and other advanced programs.
The Alenia Aeronautica company of today was established in 2002, as a spin-off from the Finmeccanica divisions.
Alenia Aeronautica can boast the design and construction of more than 12,000 aircraft, often according to an original design, as in the case of the G222, which has since evolved into the C27J Spartan. Some of the most sophisticated aircraft in the world are now emerging from its factories, such as the Eurofighter, which is produced both in-house and through international cooperative schemes. Alenia Aeronautica currently employs more than 8300 people (12,100 considering the controlled companies as well).
Serving in the role of final "systems integrator", the company designs and develops complete aeronautical systems, taking full responsibility for all aspects (integration capacity) when answering to the end customer. In the role of "risk-sharing supplier", it also designs and manufactures components and assembles parts of whole aeronautical cells (with the capacity to develop and use innovative technologies efficiently).
Its main lines of activity include:
• defence aircraft
• military transport aircraft
• aircraft for special missions
• regional transport aircraft
• training aircraft
• airborne structures
• conversions and overhauls.
The aeromechanical design activities and systems engineering of complete aircraft, including final assembly and test flights, are completed in Piedmont, with a branch specialising in "trainer" aircraft in Lombardy, while design and production activities relating to structural components and overhauls take place in the Campania, Puglia and Veneto regions.
The products developed by Alenia Aeronautica cover the whole range of aeronautical products for military and civil purposes, i.e. high-performance military defence aircraft, sophisticated aircraft for special missions, aircraft for scheduled flights and transportation, UAV, major structures for jetliners and executive planes, and aircraft overhauls and conversions.
Among the *fighter aircraft* designed and manufactured in-house or as part of international cooperative schemes, there is also the Eurofighter Typhoon (one of the most advanced defence aircraft in the world today, and currently working for the major European Air Forces), the Amx and the Tornado.
In the military transport sector, it is worth mentioning the C-27J Spartan, a tactical transport aircraft designed and developed entirely in Italy and, having already been adopted by the Italian Air Force, it is currently being purchased by other European Air Forces too, while it is undergoing final assessment process by the North American Air Force ... which goes to show the validity of the project.

In Piedmont
The company has relaunched its presence in Turin by transferring all of its activities from its historical site in Corso Marche to the airport in Caselle, where major investments have already been made to potentiate its production and research facilities. From its installations in Piedmont, Alenia Aeronautica coordinates all its activities relating to design, development, integration, testing and customer support for its complete aeronautical systems.
In particular, its pool of technical offices has become specialised in the design and qualification of aircraft configurations in terms of their aeromechanical and systems engineering aspects.
The corresponding specialist expertise concerns:
- aeromechanical design of the aircraft
- design and integration of the avionic systems and software
- design and integration of general systems and flight controls
- calculation methods for design-related analyses
- design and construction of flight simulators
- aircraft test flights
- wind tunnel tests

In other words, the aircraft's conception and qualification to fly as a "complex system", starting from a product requirement and moving on to the definition of its architecture, specifications, hardware and software integration, testing on the ground and in the air, are all handled at the company's sites in Piedmont, for all the company's institutional programs. The development of technologies for unmanned aerial vehicles has recently prompted Alenia Aeronautica to invest resources in its own research projects with a view to developing the capability to offer the international market the best in this new sector. In particular, it is developing a family of technological flying demonstrators for unmanned aerial vehicles, for which the configurational design, systems engineering, and integration are undertaken entirely in Piedmont. *Sky-X* is the first vehicle in this family, which has already undertaken numerous local test flights. This prototype is being used to study mission- and remote-control-related systems engineering problems, and a control station on the ground has also been made ready for this purpose. *Sky-X* is being used to study and fine-adjust technologies for unmanned flight, including automatic take-offs and landings involving no human remote control. The technologies involved in these studies can also be extended to other types of unmanned vehicle. Work is underway on other demonstrators with a greater range (typically destined for civil uses), currently in the conception phase, and again of medium size, i.e. from 1000 to 3000 kg in weight, for use in a territorial surveillance and monitoring capacity. These demonstrators will also be developed with contributions from other Piedmont enterprises and the Turin Polytechnic.

*C*onceived as a technological demonstrator for a medium-altitude, long endurance (MALE) surveillance UAV, the *Sky-Y* will develop qualifying technologies to enable its independent flight range to be extended and to allow for data collection by the aircraft.

Characterised by an entirely composite structure, all-electrical systems and a 160 hp diesel thruster with a flight autonomy of 12 hours, the *Sky-Y* flew for the first time in June 2007.

Molynx is a research project that will develop a new high-altitude, twin-engine UAV for civil and military applications, with an autonomy of up to 30 hours. A secondary goal of the *Molynx* is to get research centres and SMEs in the Turin aerospace district involved. The project was presented in October 2006. The undisputedly excellent capacity for systems integration and indispensable know-how for a business aiming to go on designing and developing complete aircraft provide solid grounds for the development of the Piedmont territory. The future boost relating to the regional transport aircraft and the next-generation tactical transport aircraft - both sectors in which Alenia Aeronautica has an excellent standing - mean that the Piedmont territory will be playing a leading part, in synergy with the other industrial players and the Turin Polytechnic.

As for the UAV sector, the Piedmont region has the potential on the international stage to become a technological hub for the design of these extremely hi-tech flying machines.

3.3 - AVIO

Avio is the Italian reference civil and military aircraft engine manufacturer. The company was established in Turin in 1908 and for years it has been a world leader for accessory drive chains and a European leader for solid space propulsion. Today it is one of the engine manufacturers in Europe involved in projects relating to the green engines that will equip the next generation of aircraft, with a considerably more limited environmental impact.

The company employs 4800 people at 16 installations in Italy and abroad; 14% of its employees are involved in research and development on new products.

In partnership with the world's main engine manufacturers (General Electric, Pratt & Whitney and Rolls Royce), Avio takes part in important development and production programs that range from engines for wide-body aircraft to those for regional flights and executive jets. The most recent programs in the context of major commercial engines in which Avio has been involved include the GEnx (for the new Boeing aircraft), the Dreamliner (for which Avio cooperates with General Electric on the development of components for the low-pressure turbine and the accessory drive chain), and the new 115,000-pound thrust version of the GE 90, the most powerful aeronautical engine for civil uses, for which it makes the accessory drive chain and the low-pressure parts of the turbine.

Avio works in partnership with Rolls Royce on the Trent 900 project, a modern turbofan in the 80,000-pound thrust class, destined for the A380 "superjumbo" made by Airbus Industries.

In this program, Avio is responsible for the design, development, production and after-sales support of the accessory drive chain. In the segment of the smaller engines for business jet applications and regional transport services, Avio is a partner of Pratt & Whitney (Canada) and responsible for the low-pressure turbine for the PW 308 and the power transmission for the PW150. Together with Snecma, Avio is involved in the design, development, production and overhaul of the combustion chamber and accessory drive chain for the SaM146, the engine installed in the Russian Sukhoi company's regional aircraft (RRJ).

In the military engines sector, in addition to designing and manufacturing subsystems and components, Avio is also active in a systems engineering role, taking responsibility for assembly, testing, certification, delivery and after-sales support for the engines used by the Italian Armed Forces. This is the case of the EJ200, destined for the modern

European "Typhoon" fighter, the RB199 thruster for the "Tornado", and the new F124-GA-200 for the Aermacchi M346 trainer.
Avio was chosen by Pratt & Whitney to manufacture the accessory drive chain for the F119 engine fitted on the F-22 "Raptor", the U.S. Air Force's air superiority fighter. Avio takes part, together with the Dutch company DutchAero (80% Avio), in manufacturing the F136 engine for the JSF, the new-generation American fighter plane. Avio also produces the accessory drive chain for the F110 engine installed in the F16 planes.
Finally, Avio is involved in the design, development, manufacture and after-sales support of the power transmission for the thruster in the TP400 propulsion system, which will be installed on the European military transport vehicle, the Airbus A400M.
In the field of *helicopters*, Avio partners with General Electric to handle a 40% share of the production of the T700/CT7 engine , both in its basic version for the Blackhawk, Cobra and Apache helicopters, and in the T6A and T6E versions intended respectively for the European helicopters EH101 and NH90. Again with GE, Avio is developing the new version of the T700/CT7 that will be fitted in the Sikosky S92/H92.
In the *naval* sector, Avio provides aero-derived engines for fast ships and the military Navy in Italy and other countries. Among other uses, the LM2500 turbines it developed with General Electric will be installed in the Italian Navy's New Major Unit, the "Cavour", and in the "Orizzonte" frigates for the Italian and French navies, as well as in the future Italian-French FREMM frigates.
Avio is a also leader in the manufacture of *electronic automation systems* for propulsion control, automatic pilot control, and wheelhouse management for ships and submarines. The two new Italian submarines, Sciré and Todaro, the four new submarines for the German Navy, and four future submarines for the Spanish Navy are all fitted with one of the most advanced autopilot systems on the market, designed and manufactured by Avio, called the Gaudi.
The overhaul, technical support and servicing activities on aeronautical and aero-derived engines are services that the company provides both for the Armed Forces and for commercial airline companies. In this setting, Avio is the leading repair centre in Europe for the PW100 engine in the ATR aircraft, with 20% of the European market and 10% of the world market.
To ensure the best possible quality in these activities, Avio has developed two specific centres of excellence: one is in Brindisi, where all the activities relating to engine maintenance for military aircraft are concentrated, while the facility in Somigliano d'Arco, near Naples, is dedicated to the overhaul of engines for commercial applications.
In the *space sector*, Avio is a leader in the design and manufacture of thrusters with solid and liquid propellants, used by the Ariane family of launchers and also fitted in the Ariane 5 Evolution, the largest European launcher.
In particular, Avio produces the boosters (the two large, solid-propellant side engines that provide most of the thrust needed during launching) and the turbopump that makes the liquid oxygen flow into the combustion chamber. For the Vulcain cryogenic engine used in first stage (an extremely hi-tech component), Avio also develops and produces the liquid oxygen turbopump for the next generation of the engine, the Vulcain II, for the Ariane 5, coping with loads of up to 10 tons.
In 2001, Avio established the ELV company together with the Italian Space Agency and, at the request of the ESA (the European Space Agency) it took on the role of systems engineer in the design, development and production of Vega, a launcher dedicated to carrying satellites weighing up to 1500 kg into a 700 km circular polar orbit. This was the first time that Italy acted as prime contractor for launchers in Europe.
Avio is also involved in *tactical propulsion*, an aspect in which it has been engaged in several of the principal European programs, e.g. for the Aster, Aspide and Marte-MKII missiles.
To further improve its position and reinforce its role in the sector, Avio invests more than 10% of its turnover in research and development programs, also through a networked system of structured and organised cooperation schemes with various Italian universities and research centres possessing excellent capabilities in disciplines of interest to the company.
The main lines of Avio's activities include:

- design and production of aeronautical and naval military engines;
- design and production of modules and components for commercial and military aeronautical thrusters, and for aero-derived engines for industrial and naval applications;
- space propulsion systems and tactical thrusters;
- servicing and overhaul of commercial and military aeronautical engines;
- automation systems.

The products/services for which Avio is in a position of leadership or excellence include:

- accessory drive chains;
- mechanical power transmissions;
- low-pressure turbines;
- combustors and afterburners;
- naval automation and propulsion systems;

- assembly and testing of aeronautical and aero-derived engines;
- servicing, overhaul and after-sales support for aeronautical and aero-derived engines;
- solid space propulsion;
- VEGA launchers;
- turbopumps for cryogenic space engines.

In Piedmont

Avio has its head office in Piedmont, as well as two installations where it designs and develops components and systems for the main aeronautical engines, employing approximately 2000 people.

Here is where Avio develops its principal research and business lines, which include modules and components for aeronautical and helicopter engines, control and automation systems, and propulsion systems.

In particular, it is in Piedmont that the company conducts its activities to manage the national research network together with several universities. It is in Turin that it concentrates its excellent capabilities in the so-called cold mechanics field (drive systems with a high specific power), in cryogenic mechanics and turbine thermomechanics, in cooperation with the Turin Polytechnic (the Aerospace, Mechanics and Materials Departments), giving rise to the joint development of avant-garde technologies for the containment and analysis of turbine blade vibrations and vibration damping criteria and, in the engineering field, of probabilistic calculation methods.

Avio's cooperation with the university in Turin has also led to the Polytechnic setting up a top-quality laboratory focusing on thermomechanical issues relating to lightweight structures, in which it is essential to optimize their dynamic behaviour.

3.4 – SELEX GALILEO

SELEX Galileo is the most important Italian company in the avionics sector. It designs, develops and produces avionic and electro-optical systems, and space-related apparatus for platforms and satellites. It is one of the world's leaders in avionic radar and radio target systems. It develops and produces unmanned tactical aircraft and flight simulators. SELEX Galileo can boast capabilities and experience in integration systems, and it takes part in all the main aeronautical programs relying on European cooperation schemes (Eurofighter, NH-90, EH-101).

In addition to the design and integration of complete avionic systems with an open, integrated and modular architecture, SELEX Galileo has developed ATOS (Airborne Tactical Observation and Surveillance), an advanced and flexible mission system for aircraft used in maritime patrolling applications. It has been designed to be easy to install and dismantle on both rotary and fixed wing aircraft. SELEX Galileo is a centre of excellence for infrared technologies and manufactures temperature chambers for avionic, terrestrial and naval applications, and a family of electro-optical surveillance sensors called EOST for fixed and rotary wing aircraft and UAVs.

SELEX Galileo also produces sonar for installing on aircraft and serves in the role of prime contractor for supplies of these systems in the riot control version for the NH-90 helicopters used by the Italian and Dutch military navies. SELEX Galileo dominates all the technologies relating to the development of avionic radar and has sold more than 450 of its GRIFO radar fire control systems all over the world, while its PAR precision landing radar has been adopted in eight different countries.

A world leader in high subsonic aerial targets, SELEX Galileo figures among the most important producers of UAV surveillance and reconnaissance systems. Some of its latest generation of products include the FALCO UAV surveillance system, the NIBBIO UAV system for rapid in-depth reconnaissance missions, and the Miraci 100/5 radio target operating in Italy, France, the United Kingdom and Spain, and at the NATO Namfi installation in Crete.

The most advanced sectors in which the company is active relate to the electro-optical sensors and emitters, radar sensors, simulators and UAV apparatus, attitude sensors, multispectral sensors, and solar panels for space applications. The potential applications in the context of security and territorial surveillance are particularly interesting.

In Piedmont

SELEX Galileo has an installation in the Piedmont area, in Caselle Torinese. The activities conducted in the regional territory include the design, development, production and logistics of navigation and attack systems, surveillance and patrolling systems, radio measurement systems, systems and equipment for armaments control (SMS), flight control systems (FCS), radar altimeters, automatic test systems (ATS). Design and production of aerials and radomes. The installation in Caselle cover the following areas of activity:

- avionic systems
- mission systems
- critical safety systems
- production

- logistics

The mission systems of particular interest include: ATOS, an airborne surveillance system designed to support a great variety of patrolling missions. It is a highly modular system that processes and integrates data and images recorded by various sensors, correlating them with flight data and digital maps. Several types of multifunctional console enable the system to be installed even in lightweight aircraft and helicopters.

• Aerial patrolling with electronic and electro-optical sensors to identify, locate, classify and pursue maritime and terrestrial targets
• Search and rescue (SAR)
• Surveillance against pollution and for protecting fishing areas
• riot surveyors (with the addition of specific sensors)
• Surveillance against smuggling

The PLAR-VSS (Pipe Line Automatic Right-of-Way Videotape Survey System) is a system that enables the automated surveillance from the air of gas and methane pipelines. The system enables surveillance missions to be conducted from the air to monitor easement areas, check the orographic situation and identify gas leaks. It can be used as a system for acquiring real-time geographical data with a view to studying new installations.

The SESEL (Heliborne System for Power Lines Surveillance) is a system developed for the automated monitoring of electric power lines from the air. The system comprises an operator console that manages a gyro-stabilised platform equipped with a video camera and optionally also with an infrared sensor. Images are video recorded and can easily be edited by the operator, who can add technical details and comments.

The ATENA (Advanced Test Environment for Avionics) is an environment for modular, multipurpose simulations that can be reconfigured for basic and advanced training on complex systems and for ground systems operators.

4 - ENTERPRISES IN THE PIEDMONT AEROSPACE CHAIN

The aerospace sector in Piedmont can rely on a broad and varied array of products and services provided by small, medium and large enterprises, which serve as a reference for the buyers both locally and beyond the region's boundaries.

In Piedmont there are approximately 200 SMEs active in the aerospace segment, albeit with different levels of involvement. The size of the companies involved is generally in the range of 20 to 99 employees (such businesses account for 43.2% of the sector); then there are smaller businesses, with 1 to 19 employees, which make up 39.3% of the total, while the large enterprises with more than 100 employees comprise the remaining 17.5% of the sector. The mean number of employees in all these businesses is 71.3, a figure that does not vary greatly between the manufacturing enterprises (with a mean 73.6 employees) and the businesses providing technical services (72.1), although the size bracket (in terms of the number of employees) into which these companies fit does differ, since the manufacturing companies mainly tend to have 20 to 49 employees, while the service companies are distributed more frequently in the range of 1 to 9 employees.

The areas in which the Piedmont enterprises in the aerospace sector operate are diversified, ranging from the construction of special machinery and machine tools for aeronautical processing activities to precision mechanical machining in the defence sector, to the design and manufacture of cryogenic systems, the production of special wheel-mounted or track-mounted vehicles, amphibious vehicles, shelters and mobile laboratories for military and civil uses. There is also, a whole series of services for supporting design and prototyping, integrated engineering services and advanced computer services.

The picture is completed by enterprises offering services in the fields of servicing, overhaul and repairs, and training schemes, as well as businesses operating in commercial fields.

The Regional Authority's support for aerospace research has been fundamentally important in recent years, and has been subject to the condition that there be a close cooperation between universities, major industries and SMEs.

5 -THE RESEARCH SYSTEM

5.1 - TURIN POLYTECHNIC

The Turin Polytechnic represents one of the most prestigious schools of engineering and architecture at European level. The university's internationalisation has been constantly increasing and, in the latest world classification of technical universities drawn up by the Jao Tong University of Shanghai, the Turin Polytechnic came in 7th place in Europe, and in 1st place among the technological universities in Italy. The presence of foreign students has also been

increasing continuously and in 2011 the incidence of foreigners out of the total of all students enrolling for their first year reached 20%, as opposed to an Italian national average of 2-3%.
The Polytechnic is the cross-curricular scientific and technological reference on a large number of specific topics relating to the aerospace sector, as well as providing basic university training and running master's courses and research doctorates.

The Department of Aeronautical and Space Engineering (DIASP) promotes, coordinates and manages research, training, technological transfer and consulting activities in the most significant sectors of aerospace engineering: from systems design to structural analyses, and from fluid dynamics to flight mechanics, installations and propulsion.
Its research activities include studying methodological aspects and developing analytical models, numerical simulations and laboratory tests. The DIASP has seven laboratories (four experimental, i.e. Aerodynamics, Structures, Structural dynamics and controls, and Aeromechanics; one for calculations, i.e. Computational fluid dynamics; and two for teaching, i.e. Aeronautical systems and General calculus) and two centres (one for accelerometer calibration and one for airspeed indicator calibration), as well as a top-quality "AERMEC - Aeromechanical Structural Systems" laboratory, sponsored by the Thales Alenia Space, Alenia Aeronautica and Avio industries.
Teaching activities at the DIASP focus on providing students with training on bachelor's degree and master's courses in aerospace engineering; they are profoundly rooted in the European context, because the Turin Polytechnic is a founder member of the PEGASUS consortium (Partnership of a European Group of Aeronautics and Space Universities).
The Department of Mechanics (DIMEC) coordinates and manages research and teaching activities in the sectors of functional and structural design, and the testing of mechanical devices and systems, and the related basic problems.
Since January 2011, the DIASP and DIMEC have melted into a single administrative unit that goes by the name of the Department of Mechanical and Aerospace Engineering.

The Department of Electronics (DELEN) conducts research and provides teaching in the areas of electronics, telecommunications, opto-electronics, electrotechnology, electromagnetic fields, bioengineering, and electronic measurements. The Department is the main reference for degree courses in electronic engineering, telecommunications engineering, information engineering and telematic engineering for the Polytechnic's four Engineering Faculties. It also provides support on other degree courses, in the various sectors in which it has expertise.
The DELEN's research activities focus one aspects of ICT at all levels: telecommunication networks, systems, apparatus, circuits and devices, and characterisation techniques. It also covers related sectors such as bioengineering.
At the Department there is a beneficial juxtaposition of basic research activities (conducted as part of national and international projects) and applied research, often connected to the needs of the industry. Some professors, researchers and PhD students at the Department are members of the "Navigation Signal Analysis and Simulation Group" (NavSAS), a research team working jointly with the Istituto Superiore Mario Boella, which represents one of the scientific centres of excellence in Europe in the field of satellite navigation. For years now, members of the Department have been serving as consultants to the European Commission's GNSS Agency, providing technical support for the development of the Galileo system, as well as supporting the European Commission's Galileo office. In addition, lecturers from the Department coordinate the master's course in "Navigation and Related Applications", the purpose of which is to train top-level personnel in the field of satellite navigation, and this course is managed with the cooperation of the ISMB, the INRIM and the United Nations Office for Outer Space Affairs.

The Department of Automation and Computer Science promotes, coordinates and organises research, training and technological transfer and consulting activities relating to the areas of automation and information science. Topics of interest in the aerospace sector relate to hardware systems and their applications, software systems and their applications, automation and control, and operational research.
The Department is involved in studying and developing methods, algorithms and software architectures for the automation of complex appliances and systems. It is also dedicated to the development of methods and tools for analyzing and solving optimization problems and for decision-making in multivariable settings, such as space missions.

Among others, the Departments of the Science of Materials and Chemical Engineering (DISMIC), Energetics (DENER) are also strongly involved in aerospace-related research and other activities.

The following are of particular interest to the aerospace industry: systems and mechanical components design (reliability, fatigue, mechanics of materials, experimental methods, functional design, structural design, rotors, noise, tribology, vibrations, active vibration control); automated mechanical, robotic and mechatronic systems (fluid automation, mechanical system control, magnetic bearings, mechanical microsystems, servo systems, automated space systems, oil-hydraulic systems, pneumatic systems, and robotics).

5.2 – UNIVERSITY OF TURIN

The University of Turin is active in numerous scientific and technological sectors of considerable interest to the aerospace sector. In particular, the scientific departments working on the areas of materials science, computer science, physics and astrophysics, and the chemical sciences, have developed methods and technologies whose relevance to the aerospace sector has already been demonstrated. In this setting, the projects financed over the years by the Italian Space Agency are particularly significant.
Over the years there have been fruitful cooperation schemes with Piedmont industries operating in the aeronautical and space sectors, taking the form of industrial placements for university students and dissertations, particularly involving Alenia Aeronautica, Thales Alenia Space, SELEX Galileo, and the Società Italiana Avionica.
The research activities have taken shape in institutionalised cooperative schemes forming part of projects financed by the European Union. The recently completed G4RD-CT-2002-00754 project entitled "AUTAS: Automating FMECA for aircraft systems", co-ordinated by Alenia Aeronautica, is particularly significant: the partners in this scheme included the University of Turin (Computer Science Department) and other European industrial and academic organisations.
The University of Turin's research activity is also apparent in applied scientific research projects for the aeronautical and space sector.
In fact, the University has been able to offer its scientific expertise on topics such as:

- water monitoring and regeneration in space missions
- online monitoring and intelligent supervision techniques in independent space systems
- virtual reality applied to research, technology and the communication of astronomy and the space sciences.

The University of Turin is a founder member and host of the CIFS, an Inter-university Consortium for Space Physics (established by the Law 382/80 on the universities), which was created in 1989 to help to overcome the discrepancy between the creative potential and the productive functions of university teams developing instrumentation for space experiments. The eight universities currently involved (Catania, Florence, L'Aquila, Milan, Rome La Sapienza, Rome Tor Vergata, Turin and Trieste), joined in 2006 by the National Astrophysics Institute, have agreed to coordinate their efforts in order to deal more adequately with the space research commitments they accepted as part of the national intervention policy dictated by the MIUR through the ASI.

The partners are the universities making the greatest contribution to the principal space projects in which Italy is involved. Altogether, there are more than 70 researchers active in the space sector within the CIFS, with a total of more than 300 pertinent publications to their credit in the last three years. The technical personnel working at the laboratories and data processing centres add up to another 50 people. In addition to the university groups themselves, it is also worth mentioning the cooperation provided by organisations forming part of the National Astrophysics Institute, which are distributed all over the country.

The resources that the CIFS makes available for its members' aerospace-related activities are of the following types:

1. programmatic, contributing to the formulation and discussion of projects, the coordination of national and international programs, and the definition of priorities, always in close contact with the ASI and its related organisations;
2. structural, with the availability of laboratories for the design, construction and testing of flight instruments and centres for data processing and storage;
3. operational, to support the aerospace design and test phases, and the design of scientific instruments by interfacing with the manufacturing industries; the CIFS has contributed to the Eudosso, UVSTAR, Boomerang, BeppoSAX, AGILE and GLAST-Fermi space missions, and its own personnel help with the data processing and storage activities at the ASI's Science Data Centre (ASDC);
4. managerial, with the administration and accounting of agreements, consulting services and scientific cooperation schemes;
5. educational, with schools and centres for training specialised technical and scientific personnel, especially as part of university bachelor's, masters and PhD courses, and professional training schemes; the CIFS has established an International School of Space Science that has been holding annual courses on space physics and technologies since 1991 at the Universities of L'Aquila and Turin.

5.3 - UNIVERSITY OF WESTERN PIEDMONT

The "Amedeo Avogadro" University of Western Piedmont was established in 1998 and now has approximately 10,000 students, with a teaching and research staff of 354 lecturers/researchers and 350 technicians and administrative staff members.

Teaching activities are conducted in three different cities - Vercelli, Novara and Alessandria (which are the institutional faculty headquarters), and in another areas where lectures are held (Alba-Bra, Asti, Biella, Casale Monferrato, Stresa and Verbania). For the academic year 2011-2012, students were able to enrol on: thirty 3-year bachelor's degree courses, three 5-year and fifteen 4-year full master's degree courses. There are also 1- and 2-year post-graduate master's courses, schools of specialisation in the public-health sector, and various research doctorates run by a single PhD school.
As for research, there are numerous international agreements currently underway; the latest data from the CIVR put the University in 3rd place in Italy for its research output, and in 1st place for the physical sciences. There are 50 international projects being implemented with various major institutions.
The University takes part in several schemes intended to support the birth of spin-offs and innovative enterprises, and to promote the economic growth of the surrounding territory. It also takes part in the Start Cup (a competition between innovative businesses) and in the Lagrange Project and other schemes promoted by various organisations.

5.4 - INRIM

The Italian National Institute of Metrological Research (INRIM) was established in January 2006 from the fusion of the "Galileo Ferraris" National Electrotechnical Institute (IEN) and the Italian National Research Council's "Gustavo Colonnetti" Institute of Metrology (IMGC). It is a national-scale public body whose purpose is to conduct and promote scientific research activities in the field of metrology.
The INRIM serves as the primary metrological institution, taking up the work previously done by the IMGC and IEN, and thus becoming the hub for most of Italy's scientific metrology activities (apart from the field of ionising radiation). It has been amply acknowledged internationally for the research it conducts in fields relating to the science of measurements and materials, and innovative technologies.
In particular, the INRIM undertakes studies and research with a view to producing primary reference samples of the basic and derived units in the SI International System; it maintains the samples it develops, compares them with other samples internationally, and makes them available to other users. There are numerous basic and applied research areas in which it is involved, including the fundamental physical constants, materials, metrology for chemistry, nanotechnologies, the implementation of new measuring devices and innovative instrumentation, studies on quantistic information, and artificial vision.
The INRIM inherited the expertise and activities relating to the metrology of time and frequency that were previously handled by the IEN, whose expertise made them a world-class centre of in this sector. The most important applications concern the aerospace context and the Galileo satellite navigation system.
From 1998 to the present day, the INRIM has received 11 contracts from the ESA and 5 from the European Union on the topic of algorithms for modelling clocks, on timescales, and on comparisons between timepieces.
Since 2004, the IEN's time and frequency laboratory has been the site of an experimental station for generating the Galileo System Time and for its comparison with time signals obtained with GPS and other terrestrial references. The institution is part of the Torino Time consortium and has contributed largely to Turin being awarded the construction of the Precise Timing Facility.

5.5 - ISMB

Established in July 2000 by the Turin Polytechnic and the Compagnia di San Paolo (of which it has been a permanent structure since 2003), the Istituto Superiore Mario Boella (ISMB) was born as a "space for shared research" with the Polytechnic. It has Motorola, SKF, ST Microelectronics and Telecom Italy among its partners, and acting as ordinary members. Today it takes the form of an industrial applied research centre for the sector of information and communication technologies (ICT), focusing particularly on wireless applications.

The Institute's mission was initially oriented towards three fundamental goals: to promote research and technological development programs with a multidisciplinary nature; to support innovative teaching schemes based on the results of research, which contribute to the teaching content on ICT provided by the Polytechnic; and to develop our knowledge of the growing interconnections between social transformation, organisational changes and new technologies.

The gradually growing Institute has concentrated its efforts mainly on the first goal, making the institution evolve into an applied research centre of excellence at the service of industries in the territory for the technological wireless segment (it currently has about 30 industrial partners, with which various forms of cooperation have been established).

The ISMB's present-day organisation has been designed to enable the implementation the following programmatic items, developed in 2010, through interaction with the Compagnia di San Paolo and the Turin Polytechnic:

- definition of independent research programs to create knowledge and development prospects leading to process innovation;
- extension of relations with the industry through a boosting of the technological hub;
- closer co-operation with the Polytechnic to increase the Institute's prestige and its capacity to operate in the field of innovation;
- to take part in more bids for contracts and other, emerging, new mechanisms of promotion and assessment of research schemes at European level.

The new organisation achieves two strategic goals: to consolidate and rationalise the laboratories (now called Research Areas) by pooling and focusing their expertise; and to implement new strategic programs. The latter are programs of an interdisciplinary nature, dedicated to process innovation in the sectors most exposed to radical changes relating to economic and environmental sustainability issues (energy, mobility, health, sustainable production). Each program focuses all the necessary ICT expertise on the objectives in question and activates links with other sciences outside ICT that concur to providing a complete response to the innovative needs of the sector. The program has a markedly project-based nature and relies on a dynamic use of the resources and the enterprising capabilities of the project leader suited to the context and the goals of the program.

There are currently approximately 200 researchers actively involved (100 of them at the Polytechnic and in industry), who are focusing on the following research areas:
• Information systems architecture and SW development
• Multilayer wireless solutions
• Pervasive radio technologies
• Navigation technologies
• Optical communications and opto-electronics

The technological research area is particularly well developed with joint projects shared with industrial partners, with the Turin Polytechnic and other academic partners, and also with the business world, in both the national and the international setting, and this work has led to the filing of numerous patents and many scientific publications.
The Institute is also a member of the Torino Wireless foundation, which promotes a shared commitment of the main organisations responsible for social-economic development to improving the Piedmont system's competitiveness in the area of ICT.
The laboratory of satellite navigation technologies hosts the NavSAS (Navigation Signal Analysis and Simulation) research group set up in 1998 as part of the Turin Polytechnic's telecommunications group, and now including researchers at the ISMB as well. This laboratory consequently combines the high-quality research typical of the university environment with the capacity to propose and develop qualifying technologies and services thanks to the competitiveness that derives from a team effort in which all the laboratory's researchers are involved.
The laboratory's research activities can be divided into the following main settings:

- innovative architectures for the receivers used in satellite navigation, paying attention to innovative techniques for processing Galileo signals
- "fully software" implementation of GNSS receivers
- technologies for integrating navigation and communication terminals (mobile phones, PDAs, …)
- safety systems based on GPS and Galileo, and Safety-of-Life applications
- study of signals interfering with the Galileo system and of methods for dealing with them
- applications of the GNSS to environmental monitoring

It is also very important to emphasise that the laboratory is a point of cohesion for different research bodies, university (Polytechnic), private research (ISMB) and industry. In fact, the group activities are characterised by ongoing cooperation with businesses and universities both in Italy and abroad. The satellite navigation laboratory has concentrated most of its latest and most important research activities on the Galileo project, the future satellite navigation system chosen by the European Union.
The satellite navigation laboratory is also a reference for various activities relating to the EGNOS (European Global Navigation Overlay System). In particular, the laboratory is linked to the servers at the European Space Agency (ESA) for monitoring the EGNOS messages managed by the SISNeT system, and it will also soon be accredited as a centre for controlling the signals sent by the satellites in the context of the EGNOS Monitoring Network. Researchers from the laboratory also serve on numerous committees and in work groups on navigation-related topics.

5.6 -THE TURIN ASTRONOMICAL OBSERVATORY– INAF

The research activity conducted at the astronomical observatory of the National Astrophysics Institute (INAF) in Turin is multidisciplinary in nature. The main lines of research include: plasma and extragalactic astrophysics, theoretical and experimental astrometry, physics of the lesser bodies in the solar system, and solar physics. Plasma astrophysics is concerned with fine adjusting advanced codes for studying the formation and propagation of relativistic jets. Astrometry deals, from the experimental point of view, with the problem of how the galaxy was formed in the cosmological context, and planetology with the study of the physical properties of the lesser bodies. Research in solar physics hinges on studying the solar corona and solar wind based on data coming from space instrumentation, studies in which the group in Turin has also taken part.
The astrometric and planetological research groups are actively cooperating on the implementation of the GAIA mission organised by the European Space Agency, (ESA), on which they hope to develop long-term research schemes each in their respective fields. GAIA will also enable research on the exoplanets. The solar physics group is taking part in a technical study run by the ESA with a view to defining the Solar Orbiter, for which it is proposing new-generation instrumentation for observations of the solar corona in the ultraviolet range.
Alongside the activities of a more exquisitely astrophysical nature, there is also strong interest in technological research and the development of instrumentation in the field of interferometry in the visible and near infrared (which has already led to the construction of FINITO and PRIMA, which are parts of the Very Large Telescope Interferometer for the European Southern Observatory in Chile), and in the field of space coronography (which has prompted the construction of the UVCS coronograph that has been working very successfully for 10 years now on board the ESA's Solar observatory and Heliospheric Observatory (SOHO). The spectrometer for the UVCS was built in Italy with the involvement of the group in Turin, in cooperation with Alenia Spazio. Work is currently also continuing on the SCORE coronograph (approved as part of the NASA program of sub-orbital flights), which is a prototype of the coronograph being designed for the Solar Orbiter. As for the technological field, it is also worth mentioning the activities underway to develop highly innovative software for calibration purposes and data pipelines for space missions (e.g. GAIA, SCORE).
Financing from the Piedmont Regional Authority will enable the construction in Turin, over the next two years, of a large OPSYS facility, with features that will be unique at European level, for the testing and calibration of space optical instruments. The data on which the team's scientific work relies are collected in the archives and databases maintained at the observatory, i.e. the long-term SOLAR archive, where all the data from the SOHO space observatory are stored (these data can be used subject to authorisation by the ESA), and the GSCII. SOLAR is now already part of the SOLARNET virtual archive and it serves as a node in the European Grid for Solar Observations. The GSCII is becoming part of the virtual archive of astrophysical data at the INAF. The GSCII is currently being used to plan the pointing of the NASA Hubble Telescope and will be used in future to support GAIA data analysis activities. The observatory aims to continue to develop grid technologies, both computational and oriented towards the creation of virtual archives, with a view to the optimal use of observational data to support research underway.
The observatory's scientific and technological research is currently conducted by 27 astronomers, 17 scientific technicians and 12 researchers under contract. These research personnel at the observatory are also active in teaching on the master's degree course in astrophysics and cosmic physics at the University of Turin, and the observatory staff also follow up students preparing their research dissertations.
As for outreaching actions, alongside the traditional activities intended for the general public, there is an important scheme relating to the planetarium, which was opened in 2007, its construction financed by local organisations and foundations in and around Turin.

6 - INSTITUTIONAL INITIATIVES

6.1 -COMMITTEE FOR PROMOTING THE GALILEO PROGRAM

Within the context of GALILEO, the programme financed by the European Commission and the European Space Agency (ESA) to create a European satellite radio navigation system as an alternative and a complement to the American GPS and Russian GLONASS systems, this Committee for promoting the Galileo program was established in February 2003 by the Piedmont Regional Authority, the Turin Provincial Authority, the Turin Local Authority and the Chambers of Commerce, and FinPiedmont, with a view to furthering the involvement of the local territory in activities forming part of the program promoted by the European Union, selecting from among the proposed schemes and identifying the expertise and potential available in the territory of Piedmont.
The Committee includes members from the technical and scientific work groups, the University of Turin, the Turin Polytechnic, and the Italian National Research Council's Metrology Institute; the Committee of the Torino Wireless Foundation is also involved in the development of specific activities.

The first step consequently involved conducting a focused survey of the Piedmont territory to identify the specific know-how available at the existing institutional and industrial installations and relevant to particular contexts in which they might bid to take part.
The outcome of this action led to the acknowledgement of the Piedmont Region as a strategic candidate in the metrological sector, and in the more ample topics relating to the knowledge and measurement of time for the Galileo program. The Committee consequently took on the international challenge of proposing to take on the construction of the Precise Timing Facility (PTF) and, with this in mind, it promoted a series of coordinated actions designed to support the creation of an integrated system of individuals, professional capabilities, skills and enterprising abilities capable of interacting and cooperating to enable us to compete on the international scene. This led to the identification of a specific enterprising and scientific team in a position to present a detailed proposal to the European bodies responsible for the program.

6.2 - TORINO TIME CONSORTIUM

This team gave rise to an ad hoc operational organisation, the **Torino Time Consortium**, which involves FinPiedmont (on behalf of the Committee), the Torino Wireless Foundation, the Turin Polytechnic, the INRIM, Thales Alenia Space, Altec SpA, SEPA, Alenia SIA. The Torino Time Consortium was selected by the ESA (European Space Agency) as supplier for the construction of the Precise Timing Facility (PTF), the element for measuring and certifying Galileo's time.
Having achieved this first goal, the Committee has continued to promote other projects, supporting training schemes and organising scientific events with a view to rooting in the territory and exploiting the scientific and technological expertise relating to the space sector.
Acquiring the PTF contract has meant that Turin and the Piedmont region are now qualified as centres of excellence for the Galileo program, channelling and attracting resources into an area boasting a huge content of knowledge, innovation and technology, and offering new outlets for the region's enterprising and scientific fabric, not only in the sector concerning time, but also in the related applications and services.
It is in the light of these results that new, further ambitious goals could be set; this involved: keeping the time measuring station, made to the ESA's order, in Turin; proposing the region as the location for the "Galileo Infomobility Centre", a centre of excellence for certifying the signal coming from Galileo, and for developing applications and research in the infomobility sector; and recommending that Turin host the 2010 edition of the ICG-5 (International Committee on GNSS), an international conference held once a year and co-ordinated by the United Nations, which brings together the most authoritative organisations and operators engaged in the field of satellite navigation on the international scene.
In December 2010, the Torino Time Consortium reached the end of its term, as established in its bylaws. The assembly decided to shut the consortium down in the light of the different logical approaches and strategies of the member organisations and because the goal of Consortium's had been achieved with the development of the Galileo PTF in Turin and its installation and successful testing at the *Galileo Control Centre* in Fucino, as demanded by the architectural decisions made by the EFA, which divided the work between the two *Galileo Control Centres*, the one in Fucino and the other in Oberpfhaffenhofen in Bavaria.
The Consortium had fulfilled its purpose partly thanks to the research and development activities in the satellite navigation field conducted in projects shared with other public and private organisations, and research institutes and industries, and thanks to funding from the Regional Authority (DOCUP 2000/2006) and the European GNNS Agency (GSA).
The value of the Torino Time Consortium experience remains as a case study for future cooperation and partnership opportunities between local institutions, universities, research bodies and industries, and because it facilitated the growth of our region's "know-how" in the GNSS sector. The set of "strong" skills and the professional capabilities now available in the region provide fertile ground on which new schemes and opportunities will be able to germinate.

6.3 - TORINO PIEDMONT AEROSPACE

This Turin Chambers of Commerce project, managed by CeiPiedmont, has been designed to serve the Piedmont enterprises achieving excellence in the aeronautical, space and defence sectors, to help them grow together and expand beyond the regional borders.
Established in 2007, *Torino Piedmont Aerospace* places potential buyers in contact with more than **85 Piedmont enterprises,** selected on the strength of strict parameters, e.g. technical know-how, possession of innovative products and processes, business quality, involvement in aeronautical programs, level of internationalisation, and the potential of their human resources.
The aim of the project is to:

- increase the companies' turnover earned abroad
- increase their commercial capabilities
- identify new foreign buyers and partners
- help to make the companies more competitive by means of joint ventures and the development of innovative projects.

Principal services:

- meetings between **manufacturers and suppliers**: participation at international events, invitations for buyers, missions abroad, supplier days, seminars and technical meetings, the set-up of business groups, focus groups, foreign partner reliability services
- country **analyses**
- support for **technological innovation**
- support for **certification**
- support for **joint ventures** between enterprises
- free **advisory service** on: Customs regulations, tax issues and international agreements, transportation and currency regulations
- **international networking**
- **GAP** - Global Access Program: this involves the development of a business plan by a group of professionals at the UCLA (University of California Los Angeles) with a view to launching a product on the American market, building up a sales network or opening a branch abroad.

The **activities** are programmed in the light of opportunities identified in the various economic settings and after listening to the participants requirements. Among the **novelties for 2010**, there was the **Pia.Net. Lab**, a laboratory providing services designed to facilitate joint ventures between enterprises and a more convincing presentation of them to potential buyers and partners.

In 2008, Torino Piedmont Aerospace created the **Aerospace & Defence Meeting**, a unique business convention held in Italy and dedicated to the aerospace sector, which has already drawn to our area some of the most important names at world level. The third edition of this event was held in October 2011.

7 - AEROSPACE DISTRICT GOVERNANCE

7.1 - THE COMMITTEE FOR PROMOTING THE AEROSPACE DISTRICT

This committee was appointed in December 2005 and comprises:

- the Piedmont Regional Authority
- the Torino Provincial Authority
- the Turin Local Authority
- the Chambers of Commerce
- FinPiedmont SpA
- the Turin Industrialists' Association
- the Association of Turin SMEs

and it relies on a steering committee, which serves in an advisory capacity and consists of:

- the Turin Polytechnic
- the University of Turin
- the University of Western Piedmont
- the Professional Association of Engineers in the Province of Turin
- the COREP (Consortium for Permanent Research and Education)
- Alenia Aeronautica
- Avio
- SELEX Galileo
- Thales Alenia Space
- representatives of the Trade Unions

By means of this organisation, the Committee for Promoting the Aerospace District is able to voice the interests and needs of the industrial world, the institutions and the research system.

7.2 -THE COMMITTEE'S ACTIVITIES

The objects of the Committee are:
- to promote the exploitation of the capabilities and the scientific and enterprising excellence available in the region by providing active institutional support;
- to support the development of specific innovative projects to further boost the abilities and the competitive edge of the Piedmont aerospace industry;
- to stimulate the SMEs enterprising spirit and the development of the aerospace chain;
- to sustain the acknowledgement of the Piedmont aerospace technological district;
- to identify and develop synergies and strategic alliances with other Italian and European technological districts.

The Committee's aims are pursued by means of a strongly hands-on approach, involving all the parties interested in the growth of the aerospace sector and this has given rise to an organisational structure that is slender but, at the same time, also representative of the real situation in Piedmont.
In particular, the Committee's actions focus on identifying and sharing the technological problems characterising the sector's course of evolution, so as to generate local synergies to enable these problems to be overcome through technological innovation.
This has led to the creation of a shared technological action platform on which several projects are being organised that will involve the industrial chains in the aerospace sector on the various levels characterising their technological expertise, under the initiative of the interested enterprises.
The Committee has offices at the premises of FinPiedmont SpA, the Piedmont Regional Authority's development agency, and it has also undertaken to complete the following:
- the preparation of material for presentations and communication efforts;
- the mapping of the capabilities available in the territory of the region;
- activities to seek international partners for research and development activities with Alenia Aeronautica, as established in the INTERREG III public notice;
- the identification of shared project platforms.

The following schemes are also being developed:
- a project for qualifying and developing the Piedmont aerospace supply chain;
- a co-ordinated organisation of the Piedmont region's participation in the 7th EU Framework Programme for research (link to the "Europe" section);
- action to support and coordinate training activities.

8 – THE AEROSPACE TECHNOLOGICAL PLATFORM

Aerospace in Piedmont is now a mature knowledge sector, structurally juxtaposed with the application phase in which innovative processes and industrial fallouts are triggered at the interface where innovative technologies and services encounter already consolidated industrial chains and traditional service activities.
For some time now, and in various ways, the players in the aerospace sector in Piedmont have also demonstrated their determination to establish a formal structure for their production system and relations relating to the aerospace sector.
The creation of the Committee for Promoting the Aerospace District is evidence of the results of these efforts and serves as a reference for institutions, enterprises and research system, all of which are committed on a regional scale to developing the aerospace sector in Piedmont.
As part of the action to prompt innovation that is characterising the Piedmont Regional Authority's commitment, the technological platforms have thus been identified as the most appropriate tool for motivating the aerospace enterprises resident within the region to work on joint research and innovation schemes.
The Piedmont Regional Authority recognises the aerospace sector as a priority for the social and economic development of the territory.
The Piedmont Regional Authority explicitly identifies and undertakes to sustain aerospace as a technological platform for action in favour of innovation, through the programmatic documents associated with the regional law No. 4/2006, and also the content of the regional law No. 34/2004 (Measures for developing production activities).
The institutional support for the sector is also reflected in the involvement of the Piedmont Regional Authority in the "Network of European Regions using space technologies", which will contribute to the fine-tuning of the research proposals in the FP7 and to the promotion of the industrial excellence available in the region.
The attention of the parties active in the aerospace sector in this area has been concentrated so far on developing platforms for three projects:
- system for monitoring and controlling the territory for civilian purposes;
- environment-friendly engine solutions; and

- technologies for space exploration.

These are the topics on which the combined efforts of businesses and research centres in Piedmont will focus, coordinated by the Committee for Promoting the Aerospace District, and with the support of the Piedmont Regional Authority.

8.1 - REGIONAL CALLS FOR BIDS ON INNOVATIVE PLATFORMS

In 2004, the Piedmont Regional Authority began to play a fundamental part in financially supporting aerospace research conducted jointly by major industries, SMEs and the universities:
2004 - Call for bids relating to aerospace projects: 3.40 M€
2006 - Call for bids relating to aerospace projects: 2.38 M€

In 2007 the Regional Authority called for bids concerning "Strategic projects on topics of regional or supra-regional interest – Innovative platforms", first allocating €**20 million,** then **raising the figure to 30 M€,** for research projects in the aerospace sector.
In accordance with the platform logic, the research areas that could be financed were those brought to light by the work of the Committee for Promoting the Aerospace District, i.e.:

- systems for **surveillance and monitoring of the territory** for civilian purposes;
- **environmental compatibility** of air transportation and the **development of environment-friendly aeronautical engines;** and
- **space exploration** technologies.

The projects were undertaken by groups of enterprises and research centres and/or university departments. An essential requirement for these clusters was the inclusion of a significant number of small and medium enterprises and at least one research body or research centre.
The catalytic action of the cooperative schemes for innovation shared by large industries and small and medium enterprises, universities, research centres and institutional initiatives, represents a fundamental step in the strategy for fully exploiting what the Piedmont aerospace sector has to offer.

Three major projects were financed within the context of the call for bids for "Strategic projects on topics of regional or supra-regional interest – Innovative platforms":
- GREAT 2020 (aerospace propulsion; project leader: AVIO Group) including the Turin Polytechnic and 35 SMEs;
- STEPS (space technologies; project leader Thales Alenia Space) including the Turin Polytechnic and 37 SMEs;
- SMAT-F1 (environmental monitoring and surveillance from the sky; project leader Alenia Aeronautica) including the Turin Polytechnic and 11 SMEs.

8.2 - THE SMAT F1 PROJECT

ADVANCED TERRITORIAL MONITORING SYSTEM. The SMAT-F1 proposal was presented in response to the Regional Authority's call for bids relating to funds allocated by regional law 34/2004 (Axis 1 – Research and innovation) for the action plan Ri.7 "Strategic projects on the topic of regional or supra-regional interest" in the "Aerospace" area, on the topic "Systems for surveillance and monitoring of the territory for civilian purposes".

The goal of the SMAT project was to define, design and develop an advanced system for territorial monitoring and surveillance, integrating various existing territorial infrastructures and making them complementary. The system will be able to meet various potential needs, e.g.

- surveillance of the territory to support planning activities
  - monitoring of rural areas with data collection
  - surveillance of water courses
  - collection of information on urban areas before planning of urban developments
  - monitoring of urban and extra-urban traffic
- preventive monitoring of specific areas
  - surveillance of energy distribution lines (electric power lines, oil pipelines, gas pipelines)
  - control of the areas potentially liable to fire
- surveillance of areas affected by natural calamities (landslides, flooding, earthquakes, fire)
  - ongoing surveillance of areas where natural calamities have occurred
  - support for rescue services with a backup communications service

- surveillance of boundaries
  - monitoring of maritime boundaries to prevent illicit activities and unauthorised immigration
  - searching for missing persons
- surveillance of areas damaged or threatened by human intervention
  - surveillance of areas at risk of industrial and other forms of pollution
  - surveillance of areas where events of particular relevance are underway

The system is conceptually based on the following elements:
- airborne segment
  - innovative UAV platforms (Molynx, Falco, D-fly)
  - payloads
- terrestrial segment
  - monitoring stations
  - a supervision and coordination station (SS&C)
- communication infrastructure
  - wireless (data-link)
  - existing terrestrial network and control centres (in cooperation with ALTEC).

The first stage of the project (SMAT-F1) will include several activities functional to the scheme as a whole. In particular, it will be fundamentally important to establish: the requirements for the monitoring system and to analyse the scenarios in which the surveillance activities are expected to take place; the design and construction of the supervision and coordination station; the integration of the various control stations with the supervision and control station; the demonstration of the system as a whole in response to a given representative scenario or mission.
As the project develops, a set of technologies will also be studied, developed and integrated that will be of the utmost importance for the purpose of offering a competitive product, e.g.:
- unmanned flight technologies
- high altitude and the long duration flights
- diesel propulsion and electricity generation with a low environmental impact
- integrated structures made of composites and innovative materials
- advanced systems (software and hardware) for mission and flight control
- EGNOS/Galileo-based navigation
- territorial monitoring sensors
- advanced data links
- integration of complex and distributed systems
- processing and circulation of information (images, data, etc)
- flexible operational management.

The project is coordinated by Alenia Aeronautica and SELEX Galileo

Results

Institutions involved: the Piedmont Regional Authority's Civil Protection department, the Turin Provincial Authority, ARPA Piedmont, the Financial Police and the Coastguards.

Analysis of the infrastructure currently used for territorial surveillance

Definition of the supervision and coordination station, and adaptation of the existing UAV platforms (Sky-Y, Falco, D-Fly).

Involvement of the certification authorities to decide on the final demonstration (UAV test flights in Piedmont)

8.3 - THE GREAT 2020 PROJECT

GREAT 2020 – GREEN ENGINES FOR AIR TRANSPORT IN 2020 - this project was born as part of the schemes adopted by the Committee for Promoting the Aerospace District. It was proposed by Avio together with the Turin Polytechnic

and 24 SMEs operating in the region, with a view to supporting the Piedmont system's involvement in European projects for studying new, environment-friendly aeronautical engines to be ready for service by 2020.

Objectives:
Lower fuel consumption, fewer pollutant emissions and less noise.

R&D for environment-friendly solutions
- engines
- transmission systems
- integrated architecture

Coordinated by AVIO

Activities – Results

Agreement with the Polytechnic: locations and study grant holders

New materials: an alternative and more economical process for producing turbine blades using titanium aluminium alloy (TiAl), an avant-garde material that has revealed properties of light weight (50%) with no loss of specific mechanical strength by comparison with nickel blades.

New turbine architectures: a prototype contra-rotating turbine, a study conducted at the GREAT lab with the Turin Polytechnic.

Mechanical transmissions: together with the Polytechnic, Avio has completed the first assessment stage on a new configuration of a very powerful mechanical transmission (around 19,000 MW) for a completely new prototype engine

Research on low-emission combustors

The GREAT lab is the first Italian research centre specifically designed to develop strategic technologies for the production of environment-friendly aeronautical engines. Established by the Turin Polytechnic and Avio, the centre will be located at the Polytechnic's campus (used for research activities conducted by other organisations by agreement with the Polytechnic), which will host research groups guided by seven researchers, who will coordinate the work of new graduates and research doctorate students. In three years and there is expected to be the establishment of a basic core consisting of 21 people. The centre is financed by Avio and the Polytechnic with an investment of €6 million (€5M of which are provided by Avio). The laboratory is the first designed specifically for the aerospace sector to be set up at the campus and will support the Great 2020 project, conceived under the initiative of the Committee for Promoting the Aerospace District, and proposed by Avio and the Polytechnic together with around 20 Piedmont enterprises, with a view to supporting the region's involvement in European projects for studying new environment-friendly aeronautical engines that will come into service in 2020.

8.4 - THE STEPS PROJECT

SPACE EXPLORATION SYSTEMS AND TECHNOLOGIES - The STEPS project is about to begin, thanks to the efforts made by the Piedmont Aerospace District, in which Thales Alenia Space plays an active part on the Committee for the district's promotion. This project focuses on space exploration and was presented in response to the public bidding procedure dedicated to the aerospace sector set up by the Piedmont Regional Authority.
Thales Alenia Space acts as prime contractor for this project, which also actively involves the Turin Polytechnic and other universities and research centres, as well as 24 Piedmont SMEs interested in the specific technological issues concerned.
At its premises in Turin, Thales Alenia Space has acquired over the last few decades a fundamental, internationally-acknowledged role in the development of space infrastructure and in scientific missions. Drawing from the results it has achieved, Thales Alenia Space now aims to invest in various the essential qualifying technologies so that it can first apply for and then successfully develop various exploration programs. The company is already conducting research for this purpose, and other research programs are being planned by the ASI (Italian Space Agency), the ESA (European Space Agency) and the European Union. The Piedmont Regional Authority's schemes fit synergically into this scenario and respond to the need to fill certain technological gaps that would otherwise not be covered, but that are essential to achieving the goals of the space exploration programs.

The technological areas involved include: navigation and attitude control, viewing and recognizing the terrain, preventive diagnostics, aero-thermodynamics, energy and fuel cells, descent/ascent systems and impact absorbers, locomotion and mechanisms, innovative rigid and inflatable structures, environmental control and protection against dust, virtual reality and man-machine interfaces, multidisciplinary optimisation, concurrent and cooperative design schemes, commercial transportation systems, and systems of systems.
In the three years of the project's development, while activities proceed on the single technologies, work will also be done to fine-adjust the simulation infrastructure and virtual demonstrators, as well as physical demonstrators of a Mars lander and a pressurised Moon rover, to be used as a showcase of the technologies developed. In addition to the obvious space exploration objectives, the technologies developed will give the SMEs the opportunity (partly thanks to the academic support they can count on) to apply the related innovation to other sectors - e.g. aeronautics, energy, transportation, civil protection, and robotics - with an evident positive fallout on the whole industrial fabric of Piedmont.
With its participation in the STEPS program, Thales Alenia Space confirms its key role in the space sector and in the development of orbiting infrastructure and exploratory probe, particularly at its Turin site. Proof of this lies in the recent launches of manned modules that have been hooked up successfully to the International Space Station (the Node 2 Harmony with the Italian astronaut Nespoli, the European Columbus laboratory, and the automated transport vehicle, or ATV), or the Mars Express and Venus Express interplanetary probes in orbit around Mars and Venus, or Rosetta, which is travelling to reach a comet in the vicinity of Saturn. At the same site in Turin, through its controlled company ALTEC (whose partners also include the ASI and local institutions), the operations of the International Space Station modules are followed up in real time via a direct link with Houston and the other NASA centres.
It is common knowledge, in fact, that the NASA, the ESA and the space agencies in Russia, Japan and China (to mention just the most important) are aiming to take man back to the Moon by 2020 and to build a permanent base there, and also to have humans land on Mars for the first time by around 2030-2040. In preparation for these goals, they are developing a whole series of robotic and/or manned programs and missions. The USA, for example, has launched its Constellation program with the Orion capsule and the ARES super-launcher, while Europe is working on the ExoMars and Mars Sample Return projects, architectural studies for the Aurora program, CSTS, etc, in which Thales Alenia Space acts as prime contractor.

The STEPS project's horizon is the (robotic and human) exploration of the universe. It proposes to develop and produce a series of demonstrators (first virtual, then physical) of technologies designed to enable the development of a system for soft landings (landers) and surface mobility (rovers) applicable to both robotic and manned missions. It also includes the development and use of a system of laboratories equipped for remote-controlled operations, environments for concurrent design, simulation and virtual reality activities, and installations that reproduce the conditions and terrains typical of the surface of the Moon and Mars. Taken together, these activities and infrastructures will enable the Turin site to be accredited as a centre of excellence for prototyping activities for space exploration purposes.
Another outcome of this will be that the Piedmont aerospace district will have sufficient infrastructure, technologies and shared expertise in this and related fields to be able to sustain future projects.

Expected benefits for the district deriving from the STEPS project:
- a growth in employment in the high-tech sectors
- an increase in the competitive edge of the region's production system relating to aerospace activities, attracting new SMEs to the sector
- the consolidation of the cooperation schemes established by the Polytechnic and universities with research institutes and with large and small businesses
- the consolidation of the transversal features of technological excellence available in the district
- the activation of technological transfers from major industries and universities to SMEs
- the creation of opportunities for training young people at the premises of the various partners, both in industry and at research units
- the demonstration of Piedmont's enterprising and research capabilities on the national and international stage
- the attraction of students, researchers and investors from abroad

Results
- Research and development of crucial qualifying technologies for robotic and human exploration of the universe, comprising the preparation and use of a system of laboratories equipped for remote-controlled operations, environments for concurrent design, simulation and virtual reality activities, and installations that reproduce the conditions and terrains typical of the surface of the Moon and Mars;

- Development of demonstrators (first virtual, then physical) of technologies designed to enable the construction of a system for soft landings (landers) and surface mobility (rovers) applicable to both robotic and manned missions;
- Technological advances: fuel cells, aero-thermodynamics, multifunctional structures, pressurised drive wheels for rovers, viewing of landings and landing strategies.

9 - NEW TOOLS FOR THE REGIONAL CIVIL PROTECTION SERVICES

The new working tools enable the Civil Protection system to respond very rapidly to every emergency, guaranteeing immediate notification of all the parties concerned.

Prevention begins with ensuring that citizens are fully aware by promoting a an understanding of emergencies, providing the territorial system with all the tools it needs to ensure that the population is kept as safe as possible with the aid of highly-reliable novel technologies.

9.1 - CODE ONE

This name describes a series of daily meetings on topics relating to Civil Protection activities in their broadest sense. These encounters are broadcast by 18 radio stations (Radio Grp, Radio Juke Box, Radio Flash Torino, Radio Antenna Uno, Radio Alfa Canavese, Radio Dora, Radio Frejus, Tele Radio Savigliano, Radio Spazio 3 Omegna, Radio Amica Biella, Radio Piedmont Stereo Biella, Radio Pieve Tortona, Radio Gold Valenza, Radio BBSI Alessandria, Radio Canelli, Radio Monferrato, Radio Vallebelbo and Radio Monterosa), and by the satellite channel, on the Hot Bird frequency 11200 MHz 13° East, in co-operation with the Press Office of the Regional Authority's Governing Board; the service is implemented by the Mandragola national press agency and its aim is to open up a direct route for communicating with the population all over the territory and to develop an understanding of potential emergencies and of the value of civil protection schemes. From Monday to Friday, the crisis units (located in the control room in Corso Marche in Turin) broadcast daily programs that provide information, and there is a talk-show on Thursdays, from 11.30 to 12.00 in the morning that discusses a topic with guests and gives people a chance to air their views. The weekly broadcasting of information is thus completed with a more in-depth analysis. The "consumer information" scheme broadcast up until December 2010 has thus been retrieved and further implemented.

The Code One radio stations also serve another important purpose: thanks to specific agreements signed with the editors and to avant-garde technologies, in the event of an emergency, the Regional Authority can rely on the network to broadcast the related information and necessary instructions directly to the population, also diversifying the details broadcast to different areas (as Renato Truce, director of the Mandragola Press Agency, rightly pointed out, it is important to bear in mind that the only way to keep up with the news when the electricity supply fails is a portable battery-operated radio).

9. 2 - ALERTING SYSTEM

This is the portal that the Piedmont Regional Authority can use, as part of the "facility management" agreement concerning the telecommunication services provided by Telecom Italy, to carry information flows relating to early warning issues as established by regional law No. 7/2003. Having access to the necessary safety, confidentiality and fault tolerance mechanisms enable the Civil Protection operators to circulate bulletins to all the organisations involved in the alerting network, providing information on criticalities as stated in the procedure issued by the Regional Authority.

The interface published on the web is associated with an advanced system connected to the telephone network, which enables the simultaneous use of more than 100 lines to send voice messages (either pre-recorded or prepared using an advanced voice synthesiser capable of interpreting punctuation and the accents used in the Italian language) and fax messages. Alongside these services, messages can also be sent by e-mail.

The usage procedures rely on ARPA Piedmont, in its role as the regional operations centre, directly inputting the bulletins in the portal, so that the Civil Protection service can access them and start distributing them to the other organisations involved in the system. A specific portal has been prepared for each Province, so as to reach every municipality affected as quickly as possible, based on the areas defined in the procedure. In parallel with the paper document sent by fax, mayors or their deputies will also receive verbal notification.

As Gaetano Paolino of Telecom Italy explained, "The timeliness of the information provided and the reliability of the communication system are fundamental to the efficiency of the Civil Protection activities, especially in urgent situations and major emergencies. The Alerting System is a service that combines both these needs, enabling a speedy handling of communications over several channels simultaneously, including telephone, fax and e-mail, and assuring a high degree of reliability because they are delivered from the Italian Telecom's data centres".

9.3 - EMERCOM.SAT

This will be the Civil Protection service's first satellite network and a useful tool for ensuring speedy information flows in the event of emergencies or natural disasters. The scheme is the outcome of a synergy between the Italian Home Office and Fire fighting Departments and the Piedmont Regional Authority's Directorate for Public Works and Civil Protection, which have signed a protocol to develop a unified satellite system, focusing particularly on offering services of public utility with features of excellent reliability and availability. In particular, all the Civil Protection service's provincial control rooms and the centres for coordinating search and rescue workers organised by the local Prefectures can be connected together and with the regional control room; it will also be possible for them to arrange videoconferencing sessions and remote training activities. At the same time, they will be able to interact continuously all over the territory, even in mountainous areas, with operators and suitably-adapted vehicles on the ground, thereby enabling the coordination centres to remain in constant contact with the teams providing first aid or undertaking search and recovery actions, receiving high-definition audio-visual recordings from the latter.

The infrastructure relies on the SkyPlexNET technology provided by Telespazio and confirms the avant-garde position occupied by the Piedmont Civil Protection service when it comes to technological innovation at the service's disposal, as well as providing the territory with a further resource, in addition to those already developed by the Regional Authority, to reduce the so-called "digital divide" in accordance with the guidelines dictated by the European Union.

As the manager of Telespazio's added value services (a Finmeccanica company) Francesco Rispoli put it, "The satellite network for the Civil Protection service uses the most advanced satellite technology available in the world, which has been developed in Italy, and which enables the Piedmont Regional Authority and the other local organisations to operate via satellite directly, simply and reliably".

9.4 - EMERCOM.NET

This is the name of the Regional Authority's implementation of the isofrequency synchronous radio network for the Civil Protection service. In more detail, eight provincial networks and two semi-regional networks will be developed that will guarantee for all the units envisaged by the system the necessary coverage for the communications they manage. The network infrastructure is the object of a public funding scheme and will be developed to suit the needs of the activities to be supported. The maximum territorial coverage for use with portable terminals and the maximum availability of the service will consequently be guaranteed with remote-controlled systems sized to operate for up to 72 hours without electricity.
A primary node for the Emercom.Net will be the control room of the Regional Authority's Civil Protection service, in Corso Marche in Turin, where there will be terminals suitable for tuning in to all the system frequencies, which can be used to interconnect the various users operating on distinct networks.

10 – THE AEROSPACE META-DISTRICT

An agreement was signed in 2008 between the Regional Authorities of Piedmont, Puglia and Campania for the creation of the Italian aerospace meta-district. This agreement took shape in Venaria Reale, during the Alenia world convention, and its aim is to create a set of working platforms comprising a network of small and large enterprises in close cooperation with the universities and research centres.
The aerospace segments in the three regional territories already have strong industrial interrelations: this is the founding concept behind the agreement for coordinating measures to support the industrial development and technological innovation of the aerospace sector.

This protocol marks the start of a process of integration between the aerospace districts in Puglia, Campania and Piedmont, and will enable the three to go ahead together to prepare a project for their growth and innovation, starting from the presence in the three regions of Italy's largest industries in the sector along with a widely distributed system of SMEs that form the backbone of the whole industrial sector.

These are the three main districts where Italy's aerospace industry operates; with their solid aerospace traditions, in more recent years, these regions have become the sites of new industrial structures and witnessed the preparation of strategic technological development schemes.

The goal of the three Regional Authorities is "to coordinate the presence of their respective aerospace segments in the most suitable settings and international events"; they aim "to promote the creation of an industrial pole at the competent ministries, particularly focusing on the Ministry for Economic Development and the Ministry for the University and Research, with a view to triggering a process for relaunching the Italian aerospace industry and giving rise to a genuine industrial meta-district for the aerospace sector".

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C. Molise Region

Good practices of the Molise Regional Authority's geospatial services

Introduction

The Molise region can count on an industry consisting of 32,576 enterprises (source: Banca D'Italia 2010), the majority of which are farming activities. The local economy is growing as a result of developments in the business services and commercial sectors, however, generating potentially interesting scenarios for various applications of innovative spatial and satellite technologies.

The scenario

For several years now, the Molise Regional Authority has been taking determined action in the "space" sector because it is strongly felt that this sector can open up some very important opportunities for the Region's industrial and economic development. By acquiring a top-level technological know-how, the Molise will be able to occupy in a role of excellence in the sector, especially in the broader European context where "space" is considered a fundamental carrier for the world's economic growth. This explains the European Union's considerable investments in this field, aiming for the continent's strategic independence from the other major world powers.

In addition to the undeniable economic and occupational growth that the Molise Region stands to gain from the space sector, there is also the high quality level of the related expertise to consider. On this latter aspect, the Region stands at an advantage because it combines the specialist knowledge acquired by the University of Molise in its applied research activities with the practical experience gained from implementing information systems and services that rely on dedicated geospatial data and satellite monitoring for the environment and territorial planning as part of the Framework Programme Agreement (FPA) on the topic of E-Government and the Information Society.

The interest in pursuing this course of action is confirmed by the Region joining the NEREUS (Network of European REgions Using Space technologies; Réseau des Régions Européennes utilisatrices des Technologies Spatiales), a network of European regions that use space technologies. This Network meets the need to create a platform where the Regional Authorities and the other players involved in space policy in Europe, the European Commission (EC), the European Space Agency (ESA), the EU Member States and the industry, can exchange views and considerations.

A first practical demonstration of the Molise Region's role as a focus for aggregating capabilities already acquired by research and industry in the "space" sector, and those acquirable in the future, was the signing of the third document integrating the FPA for "Research and innovation" by the Italian Ministries for Economic Development, and for the University and Research, the Prime Minister's Office and the Molise Regional Authority on 26 March 2008. The agreement particularly concerns the adoption of two measures, one of which is executive in nature, the other programmatic. Both projects are functional to the implementation of a unified program designed to create a European-level centre of excellence for the development of geospatial services.

This has also meant an expansion of the role of the Sviluppo Italia Molise SpA agency (a Regional Authority spin-off company) as coordinator of the various activities in the sectors characterised by a strong technological and innovative content.

The Molise University's applied research activities

The University of Molise has expertise in the "space" sector in various Departments and Faculties, but particularly at the Forest Ecology and Geomatics Laboratory of the Department of Science and Technologies for the Environment and Territory (STAT), which has a natural vocation for research concerning all aspects of human-environment interactions. The reference Thematic Areas for the Department's activities range from remote sensing and territorial information systems to cartography and forest inventories, forest planning, forest usage and biodiversity. In the space technology applications sector, for instance, the University has acquired an excellent know-how in the field of thematic cartography of forest and pre-forest ecosystems, and priority community habitats, type-specific forest maps and experimental thematic forest maps developed from object-oriented, semiautomatic pixel classification. The University has also acquired an excellent know-how in the identification and mapping of cut woodland areas, based on the use of remote sensing images. The considerable experience gained in spatialising forest attributes with the aid of satellite images and ancillary data has been successfully applied in numerous international projects, using various modelling approaches (particularly k-NN, multivariate regression and neural networks). The University is also strongly involved in developing models for the real-time prediction and monitoring of environmental risk situations relating to forestry resources and to the territory as a whole, especially as regards the risk of forest fires. For several years now, it has been involved in fine-adjusting models for calculating mass and biomass per unit of surface area based on the processing of LiDAR data and radiometric indexes to generate maps of the variability in space and time of the territorial forestry resources and timber mass, both in Italy and abroad.

Information systems for environmental surveillance and town planning

Molise Dati SpA is the Molise Regional Authority spin-off company that was appointed to implement the Framework Programme Agreement on the topic of E-Government and Information Society (Molise Regional Plan for 2000-2006). In this role, it has followed up the completion of two projects that rely on geospatial technologies, i.e. the SVA (environmental surveillance system) and the SIIT (integrated territorial information services). These two systems share the same information base and software technologies, and they were developed by a consortium comprising e-GEOS SpA, Geosystems srl and Vitrociset SpA.

The two systems have already been completed and are currently being fine-tuned. They will soon be fully operational and will provide geographical services for various public bodies, businesses and citizens, by means of the Regional Authority's multichannel integrated portal (PIM).

The database contains topographical and thematic data recorded by satellites and aircraft (processed with specific GIS and remote sensing software), GPS data and monitoring details. All the topographical and thematic data concerning the Molise Region, plus some national data of local interest (Land Registry, legal constraints, Italian Statistics Institute, road graphs, satellite images from various sensors, orthophotographic material, DTM, etc.) have been collected, documented (as metadata using the ISO-CNIPA standard), systemised and normalised in the WGS84reference system. Some information has been computerised with a view to completing several information layers that are currently unavailable in digital format for the region as a whole (e.g. Local Authority town development plans).

Figure 1 – Portal for accessing the SIIT and SVA geographical services

These databases can be consulted by accessing a dedicated section of the PIM, called "Molise – Geographical Services", which offers a number of applications, some accessible to anyone, others for restricted access. The databases are also accessible from outside, both in their geo-database format and through classical OGC (Open Geospatial Consortium) standard interoperability services. The metadata can be accessed via an application that enables users to consult a description of the data according to the CNIPA standard, and to view the information in a geographical environment; the data can also be consulted directly in each of the application services.

Going into more detail on the services available, the environmental surveillance system (SVA) enables an analysis of the territory as a function of the potential environmental hazards (landslides, earthquakes, flooding, etc) and anthropic hazards (industries at risk of major incidents, dispersion of pollutants, etc), and of the territory's vulnerability, in both environmental terms (areas of particular value, landscaping constraints, woodland and forests, etc) and anthropic terms (urban settlements, isolated homes, roads, etc). Specific procedures can be used to generate risk scenarios that are useful for prevention and for environment and town planning activities. In fact, the SVA is equipped with a decision supporting system (DSS) that enables users with the necessary expertise to define certain analytical parameters and develop risk maps.

In addition to the decision supporting service, there are also other services concerning, for instance: Nature and Environmental Protection (visible on the sites of importance to the community [SIC], zones requiring special protection [ZPS], protected areas [EUAP], vegetation, fauna, caves and natural cavities, national forests); Fire (diachronic and statistical analyses of woodland areas obtained by processing satellite images); Land Use (CORINE land cover processed from satellite images); Land sliding phenomena; Industrial areas and related risks; Potential seismic hazards; Environmental impact assessments.

The system also monitors a site in the Municipality of Trivento where a landslide is underway. Five monitoring units have been installed in the area where the land is sliding, complete with piezometers, inclinometers and GPS stations, and all connected to a central station (with a weather station and a permanent GPS station) where the data is collected and undergoes preliminary processing before it is sent telematically to the Molise Regional Authority's Civil Protection Department and to the SVA system. The data from the test site are used to check the local situation and compared with similar sites in neighbouring areas that are highly vulnerable or

at risk. The website will also be used to develop systems for preventive analyses based on the processing of COSMO Sky-Med data and on low ... (a basso cosa?) extensive monitoring methods.

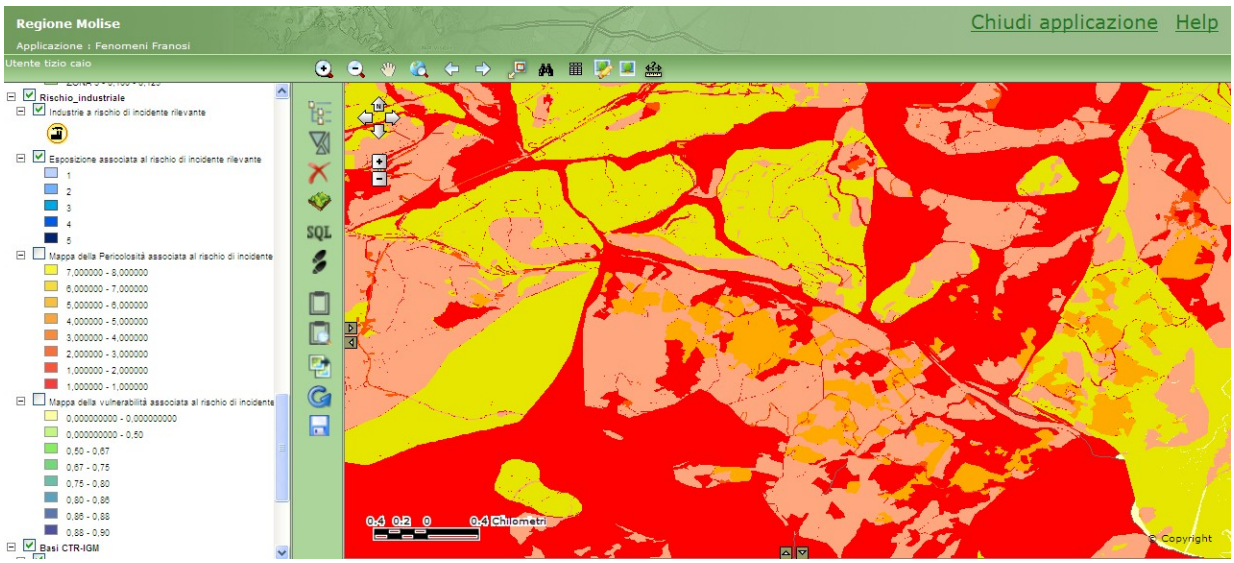


Figure 2 – Example of the SVA service: map of potential hazards

The integrated territorial information services (SIIT) are oriented towards town planning and topographical applications. The system provides an information service based on data coming from the network of permanent GPS stations implemented as part of the project, and useful for the differential correction of topographical data recorded in the field. The SIIT also offers a number of dedicated application services for various public bodies, enterprises, professionals and citizens. To give an example, these services include: Local Authority town development plans; catchment area plans; plans for safeguarding water reserves; landscaping plans; interfacing between different organisations in the management of road works; management of technological networks; land registry and urban land use plans; geology, geomorphology, and hydrogeology; inland and marine water conditions; demographic statistics.
Much of the content of the geo-database can be updated and processed using satellite data. In fact, the future and the updating of the two systems strongly depend on aerospace technologies.

The Framework Programme Agreement (FPA) for "Research and innovation"
As mentioned previously, this agreement includes two projects, one programmatic and one executive, that will be implemented by the “GEOSAT Molise” consortium, which relies mainly on public capital and comprises the Italian Space Agency (ASI), the Molise Regional Authority, the University of Molise, and Telespazio SpA (a private partner selected after an ad hoc public bidding procedure organised by the Molise Regional Authority in August 2008). The purpose of the consortium is to create a centre of excellence for generating geospatial services and producing advanced technologies for the aerial and satellite remote sensing sector, with a view to establishing in Molise a complex providing infrastructure and high-tech innovative services for managing the territory/environment and dealing with emergencies.
The scheme can be distinguished into five functional centres:

- a centre for managing geospatial data and products (geoDataBase - geoDB);
- a research and development centre for added-value applications and territorial services (laboratories for studying and testing products with added value and prototypes of services for end users - R&D Lab);

- a centre for the experimental development of innovative service chains (basic infrastructure relating to the chains of products and service prototypes mentioned in the previous item);
- a centre for circulating content and services via Internet (a web platform for delivering data and services);
- a highly specialised training centre (basic infrastructure for the direct and remote delivery of permanent training services as well as training on services and applications developed by the technological centre).

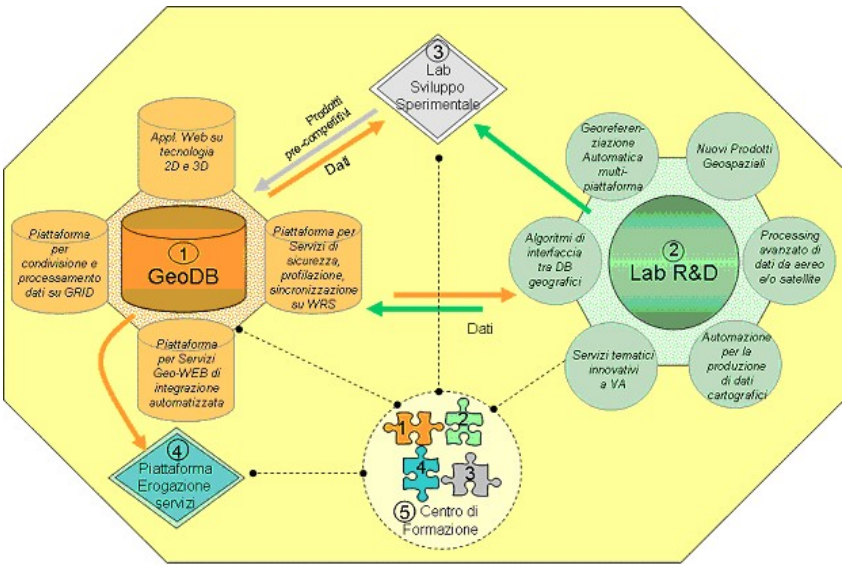


Figure 3 –General layout of the five GEOSAT Molise functional groups

3) Experimental development lab

	Pre-competitive data *Data*				
	Web applications on 2-D and 3-D technology		*Automatic multi-platform geo-referencing*		*New geospatial products*
Platform for sharing and processing data on GRID	*1) GeoDB*	*Platform for security services, profiling, synchronisation on WRS*	*Algorithms for interfacing between geographical DBs*	*2) R&D lab*	*Advanced processing of aerial and/or satellite data*
	Platform for geo-web automated integration services		*Innovative and value-added the topic-specific services*		*Automation for the production of cartographic data*
	4) Service delivery platform				

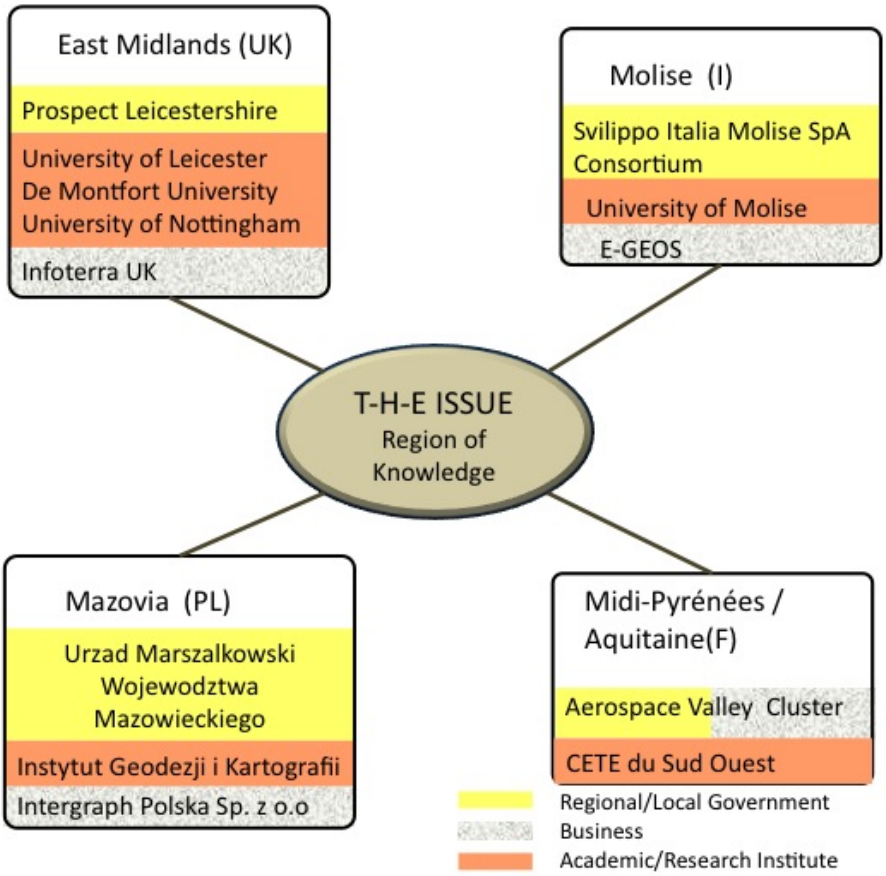
5) Training centre

The "T-H-E ISSUE" project: Traffic – Health - Environment. Intelligent Solutions towards Sustainable Urban Economies

The T-H-E ISSUE is a project that was presented as part of the schemes included in the Framework Programme VII on scientific research addressing the "**Regions of knowledge**", with a specific response to the call expiring on 10 December 2010[10]; it represents a novel model for intervention

[10] The proposed budget amounted to about €3 million and the formal starting date for the project, finally approved by the EC, was 1 December 2011.

in the sector of transportation, public health and the environment. The idea came from the Prospect Leicester (Leicestershire?) company (United Kingdom) and was developed in cooperation with numerous other English, Polish, Italian and French partners.



The T-H-E ISSUE project partners

Put very briefly, the project relies on cooperation between the business, political and academic worlds, enabling them to work together on innovative solutions and methods for traffic control and for managing links with local/regional authorities, the organisations legally responsible for transport policy planning and implementation, and the assessment of environmental impacts.
The consortium's research partners have strongly complementary features in terms of the application of the outcome of research in the sectors relating to traffic, health and the environment. Each regional cluster has expressed the wish and the commitment to working together to identify ways in which their RTD activities can be better aligned with local provisions and economic development priorities, also bearing the needs of enterprises in mind, to give a stronger contribution to the sustainable economic development in each of their regions.
The cluster focusing on research will cooperate to reinforce its capacity for attracting investments and developing applied research activities; in this sense, it will be possible to significantly improve the sustainable economic development processes, as well as the citizens' safety and quality of life.
Significant examples of the facets of the T-H-E ISSUE project include:

- ❑ intelligent solutions for the real-time interpretation of satellite navigation data, integrated in existing urban traffic management systems to improve the management and safety of transport infrastructure;
- ❑ localisation and assistance services for displacements based on information obtained using satellite technologies (e.g. in emergencies, to speed up the response times);
- ❑ measurements in situ and from space to help reduce the health risks for the population deriving from traffic and atmospheric pollution;
- ❑ the supply of mobile telephone services enabling users of urban public transport systems to plan their journeys in real time;
- ❑ economic and social consequences of congestion deriving from the burden of traffic;
- ❑ development of a database to support the regional authorities' transport planning activities;
- ❑ technological applications for demonstration purposes on vehicles powered by hydrogen batteries in an urban setting (2012).

The T-H-E ISSUE project aims to promote a greater integration, coordination and exploitation of existing experiences, and those currently being launched as part of the RTD programs, by means of the following processes:

- ➢ an active knowledge exchange between the principal partners;
- ➢ a program for specifically for circulating the results and preparing joint action plans (JAP);
- ➢ a structured approach to the transfer of tutoring and knowledge towards regions with less well developed research facilities.

These elements provide the basis for substantial economic and structural outputs.

D. Basilicata Region

1. Department of the Council's President and Department for Production activities, Enterprising policies and Technological innovation

Strategy

The Basilicata Regional Authority's strategic plan to stimulate innovation is illustrated in the document "Regional strategy for research, innovation and the information society - Basilicata Regional Authority 2007-2013" approved by the Basilicata Regional Council (DCR n. 571 04/08/2009).

The Regional Plan for innovation 2007-2013 focuses on the following objectives:

- to make enterprises more competitive by means of a more intensive use of technological innovation in the businesses in the region;
- to improve the expertise of human capital and know-how;
- to promote innovative projects conducted jointly by enterprises and public universities and research centres;
- to create a cluster of SMEs in the energy components sector.

The Plan concentrates on the following innovative sectors:

- earth observation, with a view to reinforcing cooperation between enterprises and research organisations for the development of new observation technologies and applications (particularly as concerns the environment, safeguarding the territory, monitoring and managing resources, preventing natural risks, security, discovering and monitoring our cultural heritage), and the necessary related ICT technologies;
- **energy**, with particular reference to the development of a district of enterprises specialising in the field of energy generation and energy components, as well as supporting the establishment or strengthening of enterprises specialising in the production and/or management of energy generation systems with a high conversion efficiency, e.g. small- and medium-scale cogeneration systems, innovative systems for summer air conditioning, and high-efficiency propulsion systems;
- **mobility**, supporting research and innovation processes already underway in the area to facilitate the establishment in this industrial sector of new initiatives for manufacturing innovative vehicles and/or components with a high energy efficiency;
- **agro-biotechnologies**, to facilitate the establishment of innovative enterprises around the region's research centres (ENEA, Agrobios, CNR, CRA) and the consequent creation of scientific and technological platforms;
- **innovative materials and new technologies**, with a view to supporting the setup of innovative enterprises, with proper support from the specialist research centres and institutes.

To implement this plan, the Basilicata Regional Authority will use the following financial resources: € 113,000,000 from the ERDF; € 129,000,000 from the ESF; € 112,000,000 from regionalised national resources. Total: € 354 million for the whole period from 2007 to 2013.

The regional strategy is coordinated jointly by the Department of the Council's President and the Department for Production activities, Enterprising policies and Technological innovation.

Supporting structures

The local organisations that provide support to contribute to the development of the space technologies sector include:

- the **Basilicata Innovation Centre**, which is a centre with the expertise needed to promote a culture of innovation;
- the **TeRN Consortium**, which is Basilicata's technological district for the field of earth observation and natural risks (a typical example of a triple-helix cluster in the space sector);

- the **Matera Space Geodesy Centre,** the part of the **Italian Space Agency** dedicated mainly to space geodesy and remote sensing, which is involved in processing the COSMO-SkyMed data;
- a **GMES regional contact office (RCO)** will be opened in 2012 as part of the FP7 DORIS_Net, promoted by the European NEREUS network.
- **enterprises, universities** and **research centres** active in the space sector.

The regional strategy is coordinated by the Department of the Council's President in co-operation with the Department for Production activities, Enterprising policies and Technological innovation. (già scritto prima, si puo' togliere)

Between Potenza and Matera, the region's two main cities, there is a group specialising in earth observation and space robotics. A network of enterprises, research centres and university departments focuses on satellite technologies, environmental monitoring, seismic research, and the prediction and attenuation of risks relating to natural disasters. More than a thousand people work in this cluster, which is supported by the Matera Space Geodesy Centre, Telespazio, E-GEOS, ENEA, the University of Basilicata, and the Italian National Research Council (CNR).
For further information: http://innovazione.basilicatanet.it/;

The main players in the space sector operating in Basilicata are:
ASI - Italian Space Agency - www.asi.it
CNR - Italian National Research Council- www.cnr.it - www.imaa.cnr.it
ENEA -Board for new technologies, energy and the environment - www.enea.it
This is a joint-stock company operating in the energy, environment and novel technology sectors
UNIVERSITY OF BASILICATA - www.unibas.it
RELUIS -Network of university seismic engineering laboratories - www.reluis.it
TELESPAZIO s.p.a. - Www.telespazio.it
E-GEOS www.e-geos.it
CREATEC Consortium - www.createc.basilicata.it
TeRN Consortium - www.tern.it
IMPRESAMBIENTE s.c.a.r.l. - Www.cct-impresambiente.com
ARPAB -Regional agency for safeguarding the environment in Basilicata - www.arpab.it

TOOLS AND MEANS FOR SUPPORTING INNOVATION IN THE SPACE TECHNOLOGY SECTOR IN BASILICATA:
As part of the ERDF OP for 2007-2013, Axis II "Knowledge society" and Axis III "Industrial competitiveness", the Basilicata Regional Authority has scheduled three public bidding procedures to provide specific support for groups of SMEs that use space technologies for earth observation.

1. "Public notice of financial aid for facilitating innovation in SMEs.
Global budget € 10,200,000.00 (DGR n. 2183 23.12.2010);
2. "Public notice of an assessment procedure in chronological order of presentation for supporting start-up and spin-off enterprises in innovative sectors.".
Global budget: € 5,050,000.00 (DGR n. 1044 2011/07/12);
3. "Public notice of financial aid to facilitate investments in research and development."
Global budget € 6,000,000.00 (in press).

The earth observation space technology sector has also been identified as an area of strategic interest for the Basilicata Region within the scope of the activities of the "Basilicata Centre for Innovation" (contract value € 9,800,000.00 - DGR n. 727/2009).
The Basilicata Regional Authority has signed a framework agreement (DGR n. 511/2010) with the ASI (Italian Space Agency) with a view to developing the Matera Space Geodesy Centre by creating: a) a centre of excellence for earth observation and satellite data interpretation; b) an innovative remote sensing network for territorial monitoring purposes; c) a permanent network for providing top-level training in this sector; d) a "space citadel" in Matera for providing information, formal education and training in the space

technologies sector. The global investment amounts to € 40,000,000, i.e. € 30,000,000 provided by the Italian Space Agency and € 10,000,000 by the Basilicata Regional Authority (€ 1,000,000 in 2010, from the ERDF OP, Axis III. L.1.2.A). As part of this agreement, the ASI and the Basilicata Regional Authority are committed to giving maximum priority to defining the activities pertinent to the development of applications for generating products and services using the data from the COSMO-SkyMed system.
Some of the principal players in the space sector are briefly described below.

2. Basilicata Regional Authority, Department for Infrastructure and Public Works, Civil Protection Office

The experiences of the Basilicata Regional Authority's Civil Protection Office relating to the use of satellite technologies as part of their activities for predicting, preventing and fighting forest fires are outlined below.

1. **Testing robust satellite technologies for the timely sighting of forest fires starting in Basilicata.**
   Acronym: **AVVISA-Basilicata (AVV**istamento **I**ncendi da **SA**tellite in **Basilicata)**

a. Description of the project

This experiment was based on a proposal made by the Italian National Research Council's Institute of Methodologies for Environmental Analysis (IMAA-CNR) in Tito Scalo, with the cooperation of the Department for Physical Engineering of the Environment's laboratory for satellite data analyses (DIFA-LADSAT) at the University of Basilicata; it was part of the Three-year forest fire fighting plan (PAR 2009-2011). The scientific cooperation involved fine-adjusting and pre-operational testing of innovative satellite technologies with a view to enabling near real time (NRT) products for satellite data analysis to be incorporated in the decision-supporting system of the Basilicata Regional Authority's operational structures with a view to ensuring the reliable (< 5% of false alarms) and timely (refresh rate down from 6 hours to 15 min) recognition of any forest fires starting to develop (active areas >100 m², target > 30 m²).
The project was organised to cover two years of activity and initially, for the first year, involved fine-adjusting the RST (Robust Satellite Technique) for identifying active fires and validating the method on the basis of available historical data, referring particularly to fires occurring in the summers of 2007 and 2008.
The second year focused instead on the pre-operational testing of the methods fine-adjusted during the first year, applied to the Basilicata Regional Authority's territory, in NRT mode.
By the end of the project, the following results had been achieved:

1. validation of the satellite system for NRT recognition (refreshed every 15 min) of fires beginning to develop (active area >30 m²) with a false alarm rate < 5% (< 1% at night);
2. regional exclusion map with MSG-SEVIRI resolution of the sites generating false alarms;
3. definition and pre-operational verification of protocols for integrating the satellite products for the NRT (every 15 min) identification of fires starting (> 30 m²) and mapping (each 6 hours) of forest fires (> 100 m²) as part of the working procedures of the Basilicata Regional Authority's fire fighting system.

In particular, this last result was achieved by incorporating a station for satellite findings in a permanent central control room (SOUP).
The fine-adjusted procedures enabled the CNR operators to identify sites in the territory where fires might be developing, where the real presence of a fire was subsequently checked by low-flying ultra light aircraft belonging to Civil Protection voluntary associations.
Being able to exploit their excellent viewing capabilities, these ultra light aircraft enabled the system to be validated with the aid of aerial photographs and summary charts of observations at the sites identified by the satellite data
.

b. Needs met by the project

AVVISA Basilicata enabled a genuinely operational use of the satellite systems to be tested as a means for the early identification of forest fires.

The satellite system was considerably improved from the first to the second year, specifically for the purposes of associating these techniques with the methods normally used at the permanent central control room to manage forest fires.
Continuing along these lines could further increment the reliability of these technologies and would be extremely useful, especially because of the mountainous nature of the Basilicata territory.

2. Satellite monitoring for predicting forest fire risks: pre-operational testing in Basilicata

a. Description of the project

This project was also undertaken as part of a scientific cooperation between the Basilicata Regional Authority and the IMAA CNR in Tito Scalo; it started in 2008 and was renewed up until 2012.
The project involves testing of innovative satellite technologies for characterising and mapping plant fuels, analysing factors predisposing them to the outbreak of fires, estimating their susceptibility and the propagation of fires, and the prompt, satellite-image-guided containment of the fires' boundaries, and estimating the resulting damage to the region's territory.
The project was organised over several years and has led to a characterisation of the types of fuel and to the adoption of dynamic risk and fire susceptibility maps.
The types of fuel were characterised by:

- processing medium- to high-resolution satellite images provided by the Landsat TM and ASTER space sensors (respectively with a spatial resolution of 30 and 15 m), integrated with ancillary data for fire risk assessment and graphical rendering;
- a map of the vegetation and characterisation of the fuel types/models using medium- to high-resolution satellite images provided by the Landsat TM and ASTER spatial sensors;
- maps of the fuel loads.

Estimating the dynamic risk with the aid of satellite images with a high temporal resolution led to the production of maps in geotiff format relating to the following variables obtainable from the satellite data:

1) relative greenness index,

2) humidity content of the vegetation (humidity indexes).

The maps relating to items 1 and 2 enabled the phytomass to be discriminated from the necromass on the strength of prototype algorithms developed at the IMAA-CNR laboratories, as well as identifying variations in the vegetation's humidity content and its consequently greater or lesser propensity to catch fire.
Since the map indicates the likelihood of a fire developing (ignition danger) and propagating (fire spread danger), it was used to support the identification of the most critical areas. As part of the activities for predicting, preventing and actively fighting forest fires, their use at the permanent central control room thus served as an early warning device for all components of the Civil Protection system involved in forest fire fighting, informing every Local Authority in Basilicata of its risk level (from nil to extreme).
Since the map predicts not only the capacity for propagation of a given fire once it has started, but also how difficult extinguishing it is likely to be, it was also issued on a daily basis to the operators responsible for fire fighting.

a. Needs met by the project

Using the hazard map in image format for all hazard levels (0-6), complete with the list of the Local Authorities and the related hazard classes, published on the Regional Authority's Civil Protection website, enabled the regional office to operate a detailed warning system because it also allowed for the identification of the areas at greatest risk, even within the same municipality.
In fact, the forest fire management activities conducted on a daily basis at the permanent central control room were based on these data, because it is well known that for fire fighting activities to be timely and effective they must be implemented promptly, as soon as the fire starts to develop.
Using these technologies is consequently extremely useful for forest fire fighting purposes, especially considering the mountainous nature of the region's territory, which makes it more difficult to transfer manpower and equipment.

3. ARPAB - Regional Agency for Safeguarding the Environment in Basilicata

The Regional Agency for Safeguarding the Environment in Basilicata (ARPAB), was established by Regional law n.27 of 19 May 1997 and modified by the subsequent Regional law n.13/99. It is a public-owned organisation for supporting the Basilicata Regional Authority, undertaking technical and scientific activities for safeguarding the Basilicata environment.

The ARPAB's main activities concern: the monitoring, control and safeguarding of the environment, in relation to the various matrices (air, water, soil, nature and biodiversity, etc); the development of methods for managing environmental data; the promotion of actions and practices based on principles of sustainable development. The ARPAB also provides technical and scientific support for the Basilicata Regional Authority's environmental plans and actions, as well as informing citizens on the state of the environment, offering cooperation, advice and services to other public bodies, organisations and/or citizens on environmental issues. The ARPAB is part of the network of regional agencies for the environment distributed all over Italy and coordinated by the ISPRA, and their work contributes to environmental quality control and the monitoring of the effects of anthropic actions on the country's territory.

Baseline heritage in terms of projects or activities already begun and/or completed:

- **"Carta della Natura", or Nature Map Project –** An ARPAB-ISPRA agreement stipulated in 2005 to identify, characterise and safeguard the main natural habitats existing in the region. Using hyperspectral satellite images (MIVIS) to construct "unsupervised" maps, supporting the identification of main micro-habitats. Serial surveys using GPS and orthophotographic maps to define natural habitats (project still underway).

- **"Zone Umide" Wetland Areas Project** coordinated by ISPRA with the cooperation of the Basilicata Regional Authority, for the purpose of classifying and characterising the wetland areas according to the MedWetPan Mediterranean Wetland Inventory method. Orthophotographic maps are used to identify and define the boundaries of the Basilicata Region's wetlands.

- **"Qualità dell'Ambiente urbano" permanent technical roundtable on the quality of the urban environment,** with the annual publication of a report on activities undertaken under the auspices of the ISPRA. Analysis of changes in the consumption of farmland in the Municipality of Potenza, based on a study of a network of points viewed on orthophotographic findings obtained over several years (2004- 2007).

- **Study on Lake Pertusillo, based on LANDSAT image interpretation,** with a view to seeking potential unauthorised water inputs and/or outputs. This experimental work concerned data for the year 2006 and generated a map of the surface temperature of the water in the lake, with a view to identifying temperature anomalies that, in principle, might stem from the dumping and mixing of water at a different temperature in the lake. The study would need further images, spanning several years, to enable a comparison with those analysed so far.

- **Projects relating to the effects of climate change (e.g. PRODIM Project -** INTERREG IIIB ARCHIMED 2000-2006), which involved using remote sensing images, and particularly LANDSAT images for an assessment of the NDVI (normalised difference vegetation index). This index can only be determined on a regional scale by processing satellite images. It is seen by the scientific community as a standard for assessing stress on vegetation and the consequent social and economic impact on agriculture. The COSMO-LAMI model is used for weather forecasting, simulating the evolution in time of a series of meteorological variables on a three-dimensional grid, which in our case covers the whole of the Basilicata region. Forecasts for up to 72 hours involve conducting a test on a 7 km grid and then switching to an operational 48-hour prediction on a 2.8 km grid. The model also involves inputting elements relating to the physical evolution of the phenomena underway by introducing specific boundary conditions. The forecasting products are based essentially on the COSMO atmospheric circulation model.

- **Participation in activities of the "Relevant Industrial Risks" working group coordinated by the ISPRA**, which involves using the **"ARIA 334"** program. Using this programme, "damage areas"

corresponding to "incident scenarios" for the RIR industries in Basilicata are identified on orthophotographs. The activity is constantly being brought up-to-date. This work was also the object of a revision for the thematic maps in the Agency's information system.

- **Air quality measurement campaigns**, conducted from 2008 to the present day, with a view to establishing the presence and concentration of the principal pollutants (PM10, SOX, O3, NOx, CH4, …). Satellite images are used to analyse findings obtained at sampling sites and to identify potential foreign (e.g. Saharan) sources, which may alter the real measurement conditions. The images used come from polar satellites - NOAA - and geostationary satellites.
- **Analysis of Saharan events**: given their complexity, the analysis of these phenomena demands the integrated use of measurements on the ground and from satellites, as well as generic and local-scale weather maps, and reconstructions of micro-meteorological parameters with the aid of modelling applications. In addition, because these are often phenomena on a supra-regional scale, it is very useful to obtain PM10 measurements for the neighbouring regions too. The different stages of the analysis consist in:
    1. analysing the data on the concentrations of dust acquired by the stations;
    2. comparing the results with the data from stations in neighbouring regions;
    3. analysing the general meteorological situation;
    4. reconstructing the micrometeorological situation with the aid of modelling applications;
    5. analysing the physical data obtained from remote sensing (AERONET network - http://aeronet.gsfc.nasa.gov/) to acquire two parameters indicative of the particles' thickness (Angstrom coefficient) and quantity in the column (AEROSOL OPTICAL THICKNESS), obtained by processing the remote sensing data acquired at the sites in the above-mentioned AERONET network;
    6. analysing the satellite images (MODIS – water and land sensors; http://rapidfire.sci.gsfc.nasa.gov/realtime). In the case of Saharan events, the satellite images acquired with the MODIS water and land sensors reveal moving masses of dust that travel towards and over the regions of southern Italy.
- **The ARPA Basilicata is one of the partners in the TeRN consortium** (Technologies for earth observation and natural risks), together with ENEA, TELESPAZIO, CREATEC (the Basilicata consortium of small and medium enterprises), RELuis (a network of university seismic engineering laboratories) and the CNR. TeRN is a consortium of businesses and organisations with a majority public ownership that was established in 2005 to promote research, technological development, innovation, technological transfer and service provision. One of the Consortium's latest activities is Phase 2 of the TeRN Project (currently underway) for promoting the development of earth observation technologies also involving the use of satellite technologies for monitoring coastal ecosystems, implementing systems for controlling areas at risk, integrating the available measurement technologies and methods for studying particulate in the atmosphere.
- For numerous institutional activities, such as surveys, localising and geo-referencing points, delineating geographical areas, etc, several of the Agency's offices rely on "Google Earth" orthophotographic maps and software, which enable virtual images of the Earth to be generated using satellite images obtained from terrestrial remote sensing, aerial photography and topographical data saved on a GIS platform.

Future projects and emerging needs:

- The proposed **"Forest Environment Awareness Platform for forest fire protection and prevention (FORESTA)" LIFE +2011** project, in cooperation with the CNR, the Basilicata Regional Authority's Department for the Environment and Civil Protection, and the University of Basilicata, to develop an information system for the prevention and management of forest fires. Among other things,

this project includes plans to use satellite images and remote sensing data to obtain near real-time prediction models of the risk of forest fires.

- The proposed **"**INtegrated Strategy for AIR quality Evaluation and Management - Particulate Matter - IN AIRE-PM (**IN AIRE)"** project, in partnership with the CNR IMAA, the University of Basilicata, is a candidate for EU Life+ 2011 financing and currently under assessment. The project aims to study the atmospheric particulate to discriminate anthropic from natural sources. Satellite observations, processed and stored by the DIFA using the SEVIRI sensor (Spinning Enhanced Visible and Infrared Imager) aboard the 2nd-generation Meteosat geostationary satellite platform) and the MODIS sensor (Moderate Resolution Imaging Spectroradiometer) aboard the Aqua and Terra earth-observing system of polar satellite platforms will be used as part of the activities to characterise the aerosol load. The products deriving from both these platforms will also be analysed by drawing comparisons with observations from the ground obtained from the regional air quality control network with a view to assessing their reliability in measuring and mapping the contribution of natural sources to the build-up of airborne dust on a regional scale.
- Proposed project for monitoring electromagnetic fields (EMF) generated by high frequencies (HF) with a survey of the radioelectric installations in the Province of Matera; acoustic monitoring of wind farms in the municipalities of Grottole and Rotondella. The project was approved by resolution of the directorate n. 228/2009 and presented in 2010 to apply for funding by the Basilicata Regional Authority. It involves the use of satellite images for locating, viewing and surveying the installations.
- Preparation of a **Regional Technical Map**, in the form of a topographical database on a scale of 1:5,000 and maps derived from it on various scales; the work was assigned to the ARPAB by the Basilicata Regional Authority with DGR 2117 of 23.12.2010. To implement this project, there are plans to conduct dedicated flights to generate orthophotographic maps with the level of detail needed to build the above-mentioned cartographic database. In future, the Technical Map project could be run alongside the use of satellite images for monitoring the state of the environment on different investigation scales. Among other things, this activity will enable searches for any site-specific and/or widespread sources of pollution in the various environmental matrices, and the analysis of the pollutants' dispersion and the monitoring of unstable slopes.
- A need has emerged to use satellite images in the near future for monitoring surface water quality (in lakes) and the seaside and coastal environment, and for applying the river functionality and lake contour functionality indexes.
- The use of satellite images can also be important when it comes to revising and redefining the beaches suitable for bathing, which were documented more than 20 years ago and are no longer consistent with the present-day morphological and anthropic conditions of the Basilicata coastline.

4. BASILICATA BASIN AUTHORITY (AdB)

Basilicata Basin Authority
c.so Umberto I, n.28
85100 Potenza
www.adb.basilicata.it
Communications manager
Arch. Marinella Gerardi
tel. +39 971 668077
magerard@regione.basilicata.it

The Basilicata AdB is responsible for the sectors relating to soil conservation and the management of the area's water resources, its activities mainly involving: studying the characteristics of the territory and environment; planning; programming and implementing intervention; measures and action for soil conservation, protection against hydrogeological risks (landslides and flooding) and prevention of the risks of water shortages.

The Basilicata Basin Authority (AdB) was established by Regional law n. 2 of 25 January 2001, implementing law L.183/89, and has been operational since March 2001.

It is an inter-regional organisation covering a large portion of the territory in the Basilicata Region and, to a lesser degree, in the regions of Puglia and Calabria, amounting to a total surface area of 8,820 km².

Among the various functions assigned to the AdB, right from the start it became clear that it was necessary to adopt and develop a territorial information system to support all data collection, planning and monitoring activities.

The fundamental goals of the Basilicata Basin Authority's territorial information system (SIT) are to provide an up-to-date and integrated picture of the real situation in the territory under its responsibility and to serve as a practical tool for the activities relating to planning, programming action and assessing its outcome.

Over the course of approximately ten years (2001-2011), the AdB's heritage of information has been constantly enriched by acquiring data and constantly updated information, deriving in the main from studies and research conducted on topics of interest.

As for the cartographic documentation fundamental to its activities, the AdB has used various supporting media because there is still no mapping technology available that covers the whole of the territory under its responsibility.

Below is a brief account of some of the AdB's activities conducted using orthophotographic material, aerial photography and detailed surveys.

Identification of areas at risk of landslides and of property at risk, based on orthophotography, aerial photography and field surveys.

From 2001 to 2008, the only cartographic support on a scale of 1:10,000 covering the whole territory that the AdB used in planning its activities consisted of the ex-AIMA (now AGEA – Agricultural Payments Agency) orthophotographs generated in the years 1996-97.

From 2009 onwards, the AdB was able to use a new, colour orthophotographic map prepared by the AGEA in 2008, together with aerial photographs acquired directly by the AdB on a scale of 1:33,000 during the years 2006-2010.

By means of photo-interpretation activities on the above-mentioned documents, cross-referenced with investigations in the field, the areas at risk of landslides were delineated on a cartographic basis and classified on various risk levels, from very high (R4) to moderate (R1).

The 2008 orthophotographic material also provided the knowledge base for research begun by the AdB in 2001, and currently being completed, relating to the location of properties of public interest. This investigation aims to assess the impact of the hydrogeological fragility of hillsides in the area and the likelihood of flooding along watercourses.

Identification of areas liable to flooding along watercourses and of the property at risk, based on orthophotographs, specific topographical surveys and investigations in the field.

Over the years, the AdB undertook various cross-sectional topographical surveys and particle size analyses to enable to obtain a detailed model of the areas liable to flooding along the principal watercourses in its territory.
Orthophotographic material was also generated at the same time, on a nominal scale of 1:5,000, covering a band a mean 2 km wide along the principal routes of the water courses.
The results obtained from these surveys were suitably reprocessed and organised into a specific database, to enable them to be managed more efficiently.

Activities preliminary to planning measures for protecting against coastal risks

With a view to better defining the areas liable to flooding and to characterising and quantifying the coastal dynamics, the Basilicata Basin Authority conducted a detailed morphological survey of the whole Ionian coastal plain using laser scanning technologies.
This survey covered a total surface area of approximately 40,000 ha, comprising a strip 5 km wide along the full extent of the Ionian coast in Basilicata, plus sectors of the floodplains of the rivers Bradano, Basento, Cavone, Agri and Sinni, immediately upstream from the coastal plain.
These data provide the fundamental reference material for the preparation of a draft plan begun in the last few months to safeguard against coastal risks.
Given the complexity of the AdB's activities, with a view to arriving at an ever more in-depth understanding of the environmental and anthropic characteristics of the territory and thus enable assessments of existing criticalities to be as detailed as possible, it is to be hoped that there will be opportunities in the near future to integrate its studies on detailed orthophotographic and topographical findings with new elements deriving from the interpretation of satellite images.
The purpose of this action would be to limit and/or mitigate the conditions anywhere in the territory that pose a risk, primarily to the inhabitants, but also to the property (e.g. urban buildings, infrastructure, historical properties, archaeological sites and areas of environmental value).

5. CNR-IMAA

Remote sensing experiences for monitoring the environment, from satellites and from the air, developed at the CNR's Institute of Methodologies for Environmental Analysis in Tito (PZ)

The Institute of Methodologies for Environmental Analysis (IMAA) is part of the Department for the Earth and Environment of the Italian National Research Council (CNR). Among the CNR's Institutes, the IMAA is currently the only one to have its main headquarters in Basilicata.

Ever since its establishment, the IMAA's research activities have focused on developing and integrating earth observation technologies with the aid of satellites, aircraft and ground-level observations with a view to studying the geophysical and environmental processes underway.

The Institute's activities are organised into the following four areas:

- earth observation from the ground, from the air and from satellites to study the atmosphere, hydrosphere, lithosphere and biosphere, and their interactions, to develop meteo-climatic applications and for the purpose of predicting, preventing and mitigating risks;
- chemical and physical characterisation of the soil and subsoil;
- development of advanced environmental monitoring methods based on the combination of chemical-physical, biological and ecological methods with in-situ and remote sensing;
- integrated methods for environment planning and modelling, and for geospatial data management and interoperability.

A strongly multidisciplinary approach has enabled the Institute to take a novel approach to studying geophysical and environmental processes of considerable complexity, anticipating the guidelines of the GMES (Global monitoring of Environment and Security) program and occupying a good position in the GEOSS (Global Earth Observation System of Systems) strategy.

In particular, the goals of the IMAA's research activity at the remote sensing laboratory are to study the atmosphere and the Earth's surface, in terms of the physical processes and their interactions, and also in terms of monitoring, studying and mitigating the main natural, environmental and anthropic risks.

Projects in Framework Programmes (FP6 and FP7) involving the CNR's IMAA

CNR-IMAA	Research organisation	G-MOSAIC	GMES services for Management of Operations, Situation Awareness and Intelligence for regional Crises	EC FP7	In progress (2009-2011)
		SAFER	Services and Applications for Emergency Response	EC FP7	In progress (2009-2011)
		ISTIMES	Integrated System for Transport Infrastructures surveillance and Monitoring by Electromagnetic Sensing	EC FP7	In progress (July 2009-June 2012)
		Uncertweb	The Uncertainty Enabled Model Web	EC FP7	In progress (2010-2012)
		DORIS	Ground Deformation Risk Scenarios: an Advanced Assessment Service	EC FP7	In progress (Oct 2010 - Sept 2013)
		EUROGEOSS	Global Earth Observation System of Systems	EC FP7	In progress (2009-2012)
		MODELPROBE	Model-driven soil probing, site assessment and evaluation	EC FP7	In progress (2008-2012)
		ACTRIS	Aereosols, Clouds and Trace gases Research Infrastructure Network	EC FP7	In progress (2011-2014)
		GEOVIQUA	Quality aware Visualisation for the Global Earth Observation system of systems	EC FP7	In progress (2011-2013)
		DORIS-NET	Downstream Observatory organised by Regions active in Space network	EC FP7	In progress (2011-2012)
		EGIDA	Coordinating Earth and Environmental cross-disciplinary projects to promote GEOSS	EC FP7	In progress (2010-2012)
		REACCESS	Risk of energy availability: common corridors for Europe supply security	EC FP7	Completed (2008-2010)
		GIGAS	GEOSS Inspire and GMES an action in support	EC FP7	Completed (2008-2010)

		EARLINET-ASOS	European Aerosol Research Lidar NETwork "Advanced Sustainable Observation System"	EC FP6	Completed (2006-2011)
		GEOMON	Global Earth Observation and Monitoring	EC FP6	Completed (2007-2011)
		EURORISK/PREVIEW	Prevention, Information and Early Warning pre-operational services to support risk management	EC FP6	Completed (2005-2008)
		GMOSS	Global Monitoring for security and stability	EC FP6	Completed (2004-2008)
		NEEDS	New Energy Externalities Developments for Sustainability	EC FP6	Completed (2004-2008)
		CYCLOPS	Cyber-Infrastructure for civil protection operative procedures	EC FP6	Completed (2006-2008)
		GRIDCC	Grid enabled Remote Instrumentation with Distributed Control and Computation	EC FP7	Completed (2004-2007)
		CIRCE	Assessment and evaluation of coastal risk	ASI	Completed (2010)
		MORFEO	Monitoring and assessment of hydrogeological risk through EO data	ASI	Completed (2007-2010)
		SAP4PRISMA	Development of algorithms and products for agricultural applications and monitoring the territory to support the PRISMA mission	ASI	In progress (2010-2014)
		SITGA	Study and implementation of a hyperspectral sensor for applications of military interest operating in the thermal infrared bandwidth (MWIR-LWIR)	Italian Ministry of Defence – TELEDIFE / Selex Galileo	In progress (2010-2013)
		RFI	Construction of a new instrumental system based on electromagnetic technologies for the control and monitoring of the historical landslide at Montenero-Petacciato. Bologna-Lecce railway line between km 428+100 and km 428+600	Italian Railways Network (private)	Completed (2009-2011)
		ENI-Val d'Agri	Development and integration of innovative earth observation technologies for monitoring hydrogeological disruptions in a test area of the Val d'Agri basin	ENI	In progress (2010-2012)

Further details of some of the experiences of the IMAA

ISTIMES - Integrated System for Transport Infrastructures surveillance and Monitoring by Electromagnetic Sensing

Objective: to develop an innovative system for monitoring civil infrastructure of strategic interest in areas at high natural risk by integrating data obtained by advanced electromagnetic sensors with web-based data management and data sharing infrastructure. This enables us to pursue another more general goal to provide better support for stakeholders' decision-making in emergency conditions, improving their understanding by providing real-time data and images of the state of the infrastructure.

DORIS - Ground Deformation Risk Scenarios: an Advanced Assessment Service

Objective: an advanced service for recording, mapping, monitoring and predicting ground deformations, integrating traditional data and technologies with innovative earth observation (EO) and non-EO sources to improve our understanding of complex phenomena, including landslides and subsidence, and to help the Civil Protection services manage the risks deriving from ground deformations.

GEOMON - Global Earth Observation and Monitoring

Objective: to support and analyse ground-based European observations of the atmosphere's composition, supplementing measurements obtained via satellite, with a view to quantifying and understanding changes underway. GEOMON is the first step towards creating an integrated system for observing the atmosphere on a pan-European scale, systematically monitoring greenhouse gases, reactive gases, aerosols and stratospheric ozone.

EARLINET-ASOS - European Aerosol Research LIdar NETwork "Advanced Sustainable Observation System"
Objective: to contribute to developing systematic observations and methods that meet urgent needs to produce data sets covering several years on a continental scale, which are needed to assess the impact of aerosols on the environment, on both a European and a global scale, and to support future satellite missions.

6. TeRN Consortium "Technologies for Earth Observation and Natural Risks"

The TeRN consortium's remote sensing experiences via satellite and from the air for monitoring the environment

CONTENTS

1 Introduction

The part-public, part-private TeRN Consortium "Technologies for Earth Observation and Natural Risks" was financed by the MIUR (Ref. DM28424) on 30 December 2005 in accordance with Art. 13 of the D.M. 593 of 8 August 2000, as part of a Framework Programme Agreement between the MIUR, the MEF and the Basilicata Regional Authority with a view to creating a technological district in the Basilicata region.

The rationale behind the TeRN Consortium's activities lies in developing and integrating different ground-based, aerial and satellite observation technologies, or Sensor Synergies, for monitoring and mitigating natural risks, focusing particularly on climatic, hydrogeological and seismic risks. The development of multi-source, multi-resolution and multifrequency observation systems (based on the combination of sensors on satellite platforms, installed in aircraft and/or airships with those of measurement networks on the ground and mobile systems for in situ surveys) continues to represent one of the scientifically most interesting issues with a very strong applicational impact (which is why they are the object of industrial competition), and they are among the priorities of numerous international programs (e.g. the GMES - Global Monitoring and Environment Security program and the GEOSS - Global Earth Observing System of Systems program).

The capacity to develop chains integrating multiplatform data (obtained from the ground, from the air and from satellites) with archival data enables tailored products to be developed to meet particular needs. The development of such integration chains is closely related to the development of the ICT technologies needed to deploy location-based services (especially regarding data interoperability, web sensors and web services, and grid middleware). Integrating observation technologies with ICT technologies is particularly crucial to the development of real-time and near real-time applications. The resulting technological platform is tested starting from the typical information requirements of the Civil Protection Department (real-time and near real-time products, reliability and availability of telecommunications networks, chains of ground, air and satellite data integration), which are particularly stringent and have a considerable influence in applicational terms.

These activities thus enable products, methods and technologies to be developed that are easy to apply in other settings, e.g. security, for monitoring and protecting our cultural heritage and monuments, for managing resources (water, farming, forestry) and for environmental issues. In particular, the TeRN Consortium is also active in:

- the development and integration of ground-based, airborne and satellite observation technologies for predicting, monitoring and mitigating natural risks;
- the development of innovative technologies for safeguarding monuments and properties of architectural value, for monitoring civil infrastructure of strategic interest in areas at high seismic and hydrogeological risk, particularly as concerns antiseismic building technologies and non-destructive diagnostic methods;
- the development of ICT technologies for the integration, sharing and interoperability of geospatial data obtained from sensors operating on heterogeneous platforms.

The TeRN Consortium comprises 51% of public partners and 49% of private partners, i.e.

- the Italian National Research Council, represented by the Institute of Methodologies for Environmental Analysis (IMAA), which also handles and coordinates the involvement of the network of the other CNR institutes;
- the RELUIS Inter-University Consortium, consisting of the Universities of Basilicata, Naples, Pavia and Trento, which coordinates the network of seismic engineering laboratories, serving as a reference on the national and international scene;
- the Basilicata Regional Authority's Regional Agency for Safeguarding the Environment, which has been actively involved for some time in environmental monitoring schemes and represents a reference end-user for the region;
- the ENEA (National Agency for New Technologies, Energy and Sustainable Economic Development), that is required by law to focus on "research and technological innovation, providing advanced services in the energy sectors, and the nuclear sector in particular, and for sustainable economic development", and for these purposes it uses the financial, instrumental and personnel resources of the Agency for New Technologies, Energy and the Environment", which was abolished as of the date of appointment of the commissioners;
- the e-Geos company, with head offices in Rome and Matera, in partnership with the Azienda Spaziale Italiana and Telespazio (Finmeccanica/Thales), will launch the applicational products for the Cosmo-SkyMed satellite system for earth observation on the world market;
- the CREATEC Consortium, or "Consortium for the environment and technological innovation", consists of approximately 20 small and medium enterprises in Basilicata operating in the field of environmental monitoring, earth observation and ICT technologies. These SMEs specialise in industrial research and the development of innovative systems, employing a total of approximately 500 people and generating a total turnover of approximately €45 million.

The organisational structure of the technological district for the earth observation and natural risks sector is a "triple helix" (with players including research institutes, local authorities and enterprises) consistent with European policies for technological clusters. This is an effective way to increase the competitiveness of the region's industrial system and promote its internationalisation. The system of governance is characterised by the legal form of the consortium, a solution that enables a clear, transparent governance and low management costs. The consortium is governed by a President, a Governing Council (GC), the shareholders' meeting and the Board of Statutory Auditors. The consortium relies on a technical-scientific committee that defines its strategies and plans the districts' activities.

2 Projects

2.1 International project

7th European Framework Programme

"ISTIMES - Integrated System for Transport Infrastructure surveillance and Monitoring by Electromagnetic Sensing". Financed as part of the Joint Call FP7-ICT-SEC-2007-1. Coordinator: TeRN Consortium.

"DORIS - Ground Deformation Risk Scenarios: an Advanced Assessment Service". Financed as part of the Call FP7-SPACE-2009-1. Partner: TeRN Consortium.

"DORIS_NET - Downstream Observatory organised by Regions active in Space networks". Financed as part of the Call FP7-SPACE-2010-1 Partner: TeRN Consortium.

2.2 Programs for supporting Regional Cooperation Schemes

"CAB Jagodina - Environmental characterisation and preliminary design for remediation of the FKS KABLOVA industrial site in Jagodina (Serbia)". FPA Balcans. Prime contractor: Basilicata Regional Authority. Implementer: TeRN Consortium.

“Hydro-Zen - Survey and characterisation of the environmental criticalities coming to bear on the water resources and support for the definition of a strategy for managing waste water in the city of Zenica (Bosnia Herzegovina)”. FPA Balcans. Prime contractor: Basilicata Regional Authority. Implementer: TeRN Consortium.

“WALL - Combating desertification: local methods for an efficient use of water resources and the soil; sustainable use of water tables and involvement of local players in a better use of the resources (Tunisia)”. FPA Mediterranean. Prime contractor: Basilicata Regional Authority. Implementer: TeRN Consortium.

2.3 National projects

TeRN project - “Technologies for Earth Observation and Natural Risks (TeRN)”. Submitted to the MIUR (Art. 13 D.M. 593 on 8 August 2000). Approved (D.D. n.1590 del 27/07/2006). Coordinator: TeRN Consortium.

Project for the “IMPRESAMBIENTE Centre of Technological Expertise in the environmental risk sector for promoting technological innovation and business competitiveness”. The TeRN Consortium has served as the fulcrum for this undertaking of the IMPRESAMBIENTE Centre, for which the main node is in the Basilicata Region, while secondary nodes are in the other five Regions involved in Objective 1. Approved (MUR memorandum n. 256 of 19 January 2007 - Notice 1854/2006). Partner: TeRN Consortium.

CIRCE project – “Control and monitoring of coastal risks”. Financed as part of the Italian Space Agency’s comparative selection process – open bidding procedure n° 3/2007. Partner: TeRN Consortium.

TeRN Phase II project - “Technologies for Earth Observation and Natural Risks”. Submitted to the MIUR (Art. 13 D.M. 593 of 8 August 2000). Approved (D.D. n.1028 of 23/12/2009). Coordinator: TeRN Consortium.

SESAMO project - “Integrated information system for the acquisition, management and sharing of environmental data for supporting decisions” ERDF Regional Plan for Sicily 2007-2013, Approved by decree n. 3410/3 of 04/08/2011. Coordinator: TeRN Consortium.

7. e-GEOS S.p.A

e-GEOS, which comprises Telespazio (80%) and the Italian Space Agency (20%), is a leader in the geospatial information services and products sector. It operates on the international market with a broad range of service applications and dedicated products for environmental monitoring, territorial control, land registries, natural resources and farmland management, prevention of risks deriving from natural events, infomobility and security.

e-GEOS is a unique player on the reference market thanks to its expertise and its technological and commercial assets, which translate into a portfolio of offers covering all levels of the value chain: from systems for acquiring and processing optical and radar, satellite and aerial data to products and services deriving from their application, with operating centres capable of assuring the utmost accessibility and usability of the information and products on offer, with high service levels.

On the international stage, e-GEOS has a role that derives from more than two decades of Telespazio’s presence on the earth observation market, which is now further reinforced by the contributions coming from the ASI, which guarantees the company’s exclusive rights to market the COSMO-SkyMed products worldwide.

COSMO-SkyMed is a constellation of four synthetic aperture radar (SAR) satellites in bandwidth X for use in earth observation. The system is fully operational with all satellites already in orbit and can guarantee a total coverage of our planet. COSMO-SkyMed works in any weather and lighting conditions (day and night), providing georeferenced images with a high spatial resolution, very rapid response times and the best revisiting time available.

e-GEOS is GOOGLE's sole Italian partner for "Google Earth Enterprise" geospatial solutions. This represents a further unique feature in terms of the products and services for organisations and enterprises needing to quickly and intuitively handle and use an abundance of geographical data and satellite or aerial images.

Fundamental parts of e-GEOS include the German controlled company GAF, which contributes - together with other companies in the Telespazio Group (Telespazio Argentina, the Spanish Aurensis and ISAF) - to reinforcing the portfolio on offer and the coverage of the principal international markets. The company's operational sites are in Matera and Rome. In particular, the e-GEOS space centre in Matera is where the data from various satellite missions are acquired and processed (COSMO-SkyMed, Envisat, ERS-2, Radarsat-1&2) to provide near real time services and products for emergency applications and monitoring. The company also owns the GeoEye-1 and IKONOS data acquisition and processing station in Neustrelitz (Germany), which is run by the controlled company Euromap and by the German Space Agency (DLR).

e-GEOS is among the main industrial players in the context of the European GMES programme (*Global Monitoring for the Environment and Security*) and, in the role of prime contractor, it manages projects such as the GMOSAIC, LIMES and MARISS. The company is now a world leader in the field of environmental monitoring and maritime surveillance: in the event of natural disasters or humanitarian emergencies, it actively cooperates with the EUSC (*European Union Satellite Centre*) and with various United Nations organisations e, providing rapid mapping services.

2 Projects

2.1 International projects

European Framework Programme VII

"SAFER - Services and Applications For Emergency Response". Financed as part of the Call FP7-SPACE-2007-1. Partner: e-GEOS.

"G-MOSAIC - GMES Services for the Management of Operations, Situation Awareness and Intelligence for regional Crises". Financed as part of the Call FP7-SPACE-2007-001. Prime contractor: e-GEOS.

"LinkER – Link Emergency Response". Financed as part of the call ENTR/08/028. Prime contractor: e-GEOS.

DOLPHIN - Development of Pre-operational Services for Highly Innovative Maritime Surveillance Capabilities. Collaborative Project (CP) financed as part of the call FP7- 2011-2013, Prime contractor: e-GEOS

SeaU- Multisensor Satellite Technologies for Oil Pollution Monitoring and Source Identification. Financed as part of the Call FP7, period 2011 – 2014. Partner: e-GEOS

Other international projects

"EURORISK/PREVIEW- Prevention, Information and Early Warning pre-operational services to support the management of risks. Financed as part of the Call FP6-SPACE, completed in 2008.

CleanSeaNet 2nd generation. Financed by the EMSA (European Maritime Safety Agency). Prime contractor e-GEOS.

MARISS- MARitime Security Service project scale-up. Financed by the ESA.

2.2 Programs supporting regional cooperation schemes

"CIRCE - Control and monitoring of coastal risk". Financed as part of the comparative selection process – open bidding procedure n° 3/2007 of the Italian Space Agency. Prime contractor: e-GEOS; partner: TeRN Consortium.

OPERA - OPerational Eo-based RAinfall-runoff forecast. Financed as part of the comparative selection process – open bidding procedure n° 3/2007 of the Italian Space Agency. Prime contractor: e-GEOS.

E. Veneto Region

1. **Information System and Cartography project unit**

The unit working on the Information System and Cartography project has for some time now been implementing a number of schemes for preparing cartographic tools and keeping them constantly up-to-date; over the years, this effort has provided the foundations for the planning activities of the organisations operating in the region, providing them with suitable tools for a thorough understanding of the territory.

The use of novel satellite technologies for updating topic-specific maps started in 2005, the year when the Veneto Regional Authority, and the unit working on the for the Information System and Cartography project in particular, took up the invitation to take part in the European project forming part of the GMES (Global Monitoring for the Environment and Security) program - initially called the GUS (GMES Urban Services) and later becoming part of the broader GSE Land project - promoted and financed by the ESA (European Space Agency), which involves the supply of dedicated territorial monitoring services using high-resolution satellite data.

During an experimental phase, the Veneto Regional Authority acquired a prototype of the GSE Land - Urban Atlas product relating to several sample areas in the Veneto region that had been identified by the ESA as one of the most representative areas in Europe in terms of its extent and geographical features, and had consequently been considered suitable for the large-scale development of the European project.

This first experimental phase was completed successfully, serving as an important test on the potential of the GSE Land product, and was followed by the implementation of the whole project. In December 2006, the Veneto Regional Authority decided to acquire the GSE-Land database for the whole territory of the region.

Another primary objective, recognised as a fundamental feature of the GMES program, is to increment the use of analytical tools deriving from the processing of satellite images to support European policies on the environment and safety, with a view to supporting an appropriate territorial planning given that the dimensions and geographical features of the Veneto region make it an area of Italy particularly suitable for developing the international LAND project within the GMES program.

1.1. The land coverage database project

The opportunity to extend this European project to the whole regional territory and consequently make it become an analytical tool suitable for all parties or users interested in the data it contains and in their immediate use led to an in-depth assessment and exchange of opinions between the various regional organisations that, each according to their own institutional responsibilities, showed great interest in the scheme. They foresaw its utility for the purposes of territorial planning (e.g. preparing the Regional Territorial Coordination Plan), and for other regional schemes relating to particular sectors, as well as for broader territorial management issues (the primary sector, parks and nature reserves, special law for Venice).

The benefits deriving from the project based on the use of satellite images consist in having acquired a land usage map for the whole region, with a database structure that is extremely accurate in monitoring land use (the expansion of urban areas, transformations underway and changes in land usage), especially for applications and studies relying on accurate geographical

data (consumption of farmland, definition of ecological corridors, territorial evolution of the Venetian lagoon's drainage basin).

Preparing the Land Coverage Map using the GSE Land method involved classifying the territory according to the MOLAND legend, consistent with the content of the CORINE Land Cover project, and building a database on a scale of 1:10,000 (MMU 0.25 ha) in the Gauss-Boaga West reference system, and a theme-specific accuracy in excess of 85% (for artificial formations) and 80% (for non-artificial formations), with a geometrical tolerance of <= 5m.

Various kinds of data are used to build the Land DB: in addition to the SPOT 5 satellite images in the multispectral (10 m) and panchromatic (2.5 m) bandwidths, other ancillary data used included: the TeleAtlas DB, the Numerical Regional Technical Map (CTRN), DEMs, forestry maps, road network graphs and orthophotographic material provided by the Veneto Regional Authority.

The database deriving from the GSE Land project, and its further analysis on levels 2, 3, 4 and 5, generated a set of indicators defined at European level, e.g. the percentage of each type of land use, the percentage of green areas in urban settings, green spaces open to the public, surface area of nature reserves, and so on, to generate pictures for supporting planning and recommendations for territorial management policies.

With the preparation of the land coverage map and the corresponding database, the Veneto Regional Authority has developed a product that exploits the territorial databases already existing in its Territorial Information System and can serve as a tool for sharing with all the regional organisations and local government bodies (Provincial Authorities, Local Authorities, Mountain Communities, etc.

1.2. Updating the Veneto land usage map

Figure 1 - Land coverage data obtained by the GSE Land Project, overlapping the satellite image obtained with the GeoEye1

Before going into the full program for updating the land usage map for the whole regional territory, the Veneto Regional Authority recently undertook an initial adaptation procedure to partially implement the GSE Land product, considered very useful with a view to the subsequent use of new products deriving from the European GMES program (that subsequently evolved operatively into the "Kopernikus" program), which is a part of the more extensive GEOLAND2 project. This project was financed by the European Commission as part of the 7th Framework Programme (FP7) and is concerned with supplying high-resolution land usage maps generated by processing satellite data obtained with the new radar and optical sensors.

New-generation satellite images, characterised by a geometrical resolution of the order of 1 m, will also be used to map the portion of territory to consider in more depth with a new project, called the "high-resolution GSE Land-Urban Atlas". Using the GeoEye1 technology will a land usage map to be generated in great geometrical and thematic detail, even to the point of delineating the single buildings.

One of the fundamental aspects of the Urban Atlas product consisted in an in-depth analysis (to level IV) of the density classes of the urban fabric. For the "HR Urban Atlas" product, the density classification will be implemented starting from the ultra-HR findings. In the prototyping phase, two alternative approaches will be developed:

- a separation of the urban fabric polygons into different density classes, based on the percentage coverage of sealed areas extracted by processing the GeoEye1 findings (soil sealing extraction);
- a separation of the urban fabric polygons into different density classes based on the percentage coverage of the surface area of buildings (built-up Regional Technical Atlas (RTA) combined with the buildings delineated on the GeoeEye1 data)

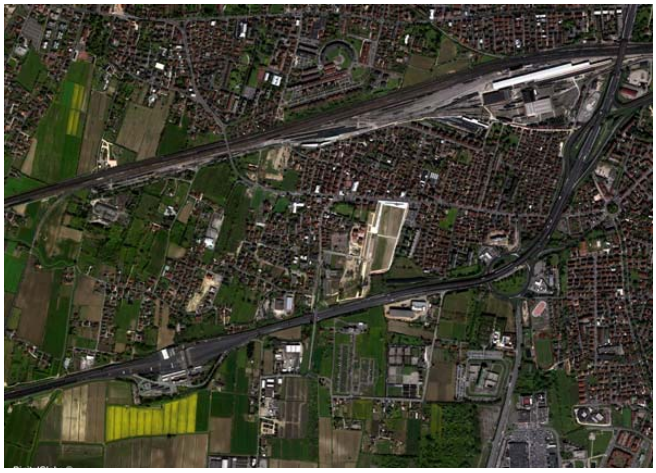


Figure 2 –Image recorded by the WorldView2 satellite

In the process of preparing the HR Urban Atlas it will be crucial to include the details in the Regional Technical Map, used as auxiliary input to develop the database and as the principal cartographic reference for checking the topological and geometrical congruence of the end product.

By combining the ultra-HR satellite data with the ancillary data available, the outcome will be a multilevel and multiscale land usage product, developed in the ESRI shapefile and GeoDatabase (mdb) formats. To be more specific, the end product will have the following three information levels, which constitute the f*eature class* of the Geodatabase and can be exported in ESRI shapefile format:

- Land coverage: polygonal-level land usage map with a high level of geometrical and thematic detail according to the specifications described in the following paragraphs;
- Buildings: polygonal-level detail of single buildings according to the of the Veneto Regional Authority's CTRN coding system;
- Transport network: polygonal-level detail of the road and railway networks.

1.3. Future needs

The activities completed so far have made ample use of satellite images and orthophotographic data, but with a prevalence of the latter, whereas from now on efforts will be made to increase the weight of the satellite images because they are becoming competitive from the economic standpoint vis-à-vis aerial photographs and they enable a faster database updating process. In addition to using optical satellites, the need has emerged to use satellites of the "synthetic aperture radar (SAR)" type, which enable filming at night and in cloud, and provide a more detailed resolution in the areas covered by the sensors. Images of this kind can be used to reproduce a digital model of the ground with a precision that would be unthinkable with currently-used methods.

2. DG for Safeguarding the Environment - Satellite technologies for the territory

2.1. Activities currently underway

Ever since 2003, as part of its institutional responsibilities, the DG for Safeguarding the Environment has been cooperating with the ARPAV and the Venetian Water Authority on an ambitious program called the "Project for territorial monitoring with remote sensing methods". The object of this scheme is to prepare a map of the Veneto lowland areas by conducting, among other things, an organic assessment of the landfills existing in the territory with the aid of infrared remote sensing methods, both via satellite and by means of treetop-level flights, in order to implement a system for identifying and monitoring potential sources of pollution that could have an impact on the environment and the hydrogeological system of the whole regional territory.

The experience gained by the technicians appointed to study the images acquired enables them to focus their attention on certain particular parameters (areas that have become bare or where the vegetation has withered, areas in the vicinity of industrial sites, etc), which have proved particularly reliable in identifying places with environmental criticalities demanding further in situ assessment.

The data acquired using the above-described methods were subsequently the object of an accurate comparison with the information available to the various territorial organisations, which meant involving the single municipal authorities in completing the scheme, since they were asked to provide specific information relating to areas within their municipal boundaries that, in the light of the criteria chosen in the context of the project, were considered suspect and/or potentially polluted.

All the material collected relating to each site examined was filed in an ad hoc database that is periodically brought up to date in the light of any developments, such as the implementation of a specific plan for the site's further characterisation or remediation.

2.2. Planned activities

Now that the remote sensing activity and the mapping of the territory with the above described methods is nearing completion, one of the priorities of the Directorate for Safeguarding the Environment is to continue - using the same approach – with its monitoring activity that, judging from the considerable body of data acquired so far, is capable of checking every significant change in relation to the current status of the areas examined.

In compliance with the requirements of the DM 18 March 2003, n. 101, and with a view to completing a general clean-up of the regional territory to remove all materials containing asbestos, there are plans currently underway to organise a global, systematic action involving the mapping of all civil and industrial roofing containing this hazardous mineral, with the aid of the previously-tested methods.

To pursue the above goals effectively, the DG for Safeguarding the Environment aims to develop its remote sensing activities, predicting a more direct, practical involvement of the ARPAV as the as the regional administration's competent technical and operational organisation.

3. **The ARPA Veneto**

The ARPAV is the Regional Agency for the Protection of the Environment in the Veneto area. The Agency pursues two strictly related goals, i.e. to protect the environment, the safety of the territory and the health of the population by means of environmental monitoring activities, and to prevent environmental risks by means of environmental research, training, information and education. These aims are pursued with the aid of the Agency's technical-scientific skills, and with the organisation and management of the Regional Environmental Information System.

The ARPA Veneto (or ARPAV) already has a centralized territorial-environmental information system for managing the data for which it is responsible and for linking up with other systems forming part of the Regional Environmental Information System for Monitoring Sources of Environmental Pressure (SIRAV). In developing this geographical information system, the ARPA Veneto has also relied on the use of analyses on data obtained from satellites and from the air, since these technologies are considered powerful tools for acquiring and managing environmental and territorial information. The experience gained by the Agency in the treatment of remote sensing data also derives from activities relating to specific projects undertaken by several of its departments on a regional scale (observatories and specialist centres). As a result, although the ARPAV acknowledges the validity of using remote sensing methods, it has not developed a reference centre for the purpose. Instead, the General Directorate service for organising and developing information systems constantly takes action to provide support for operators involved in using GIS tools and satellite analyses.

The ARPAV began to take an interest in remote sensing already in 2003, because the project for developing the SIRAV and its technological adaptation had included (among other things) two modules, one of which related to strengthening the methods for accessing geographical information, while the other focused specifically on remote sensing. The activities relating this latter module involved acquiring software, technologies and images for treating satellite data with a view to developing new environmental monitoring technologies, on the understanding that this would be fully integrated with the information already available or currently being developed at the regional organisations, and in accordance with its mission as a regional service institution.

In the subsequent development of the SIRAV, a small part of the funds for this module were used exclusively to acquire the software needed to process the images, in order to complete the activities and specific projects. This was decided in view of the need to connect the ARPAV's activities with the regional project for monitoring the territory using remote sensing methods, assigned to other organisations, but on which the ARPAV cooperated actively right from the start (2003). This project led to the development of the information system on contaminated sites, a necessary preliminary step before the preparation of the Regional Remediation Plan. The system is currently being transferred to the ARPAV together with the technologies and know-how used to identify areas potentially influenced by the presence of illegal landfills.
For the further development of its activities in the remote sensing sector, ARPAV is now working with the DG for Safeguarding the Environment and the Regional Secretariat for Infrastructure, the unit working on the Territorial Information System and Cartography project, and the Planning Observatory Service.

Brief outline of the ARPA Veneto's remote sensing experiences

Topic	Experience	Operational level	Service frequency	Sensor Platform
Monitoring water resources: Plan for safeguarding the water resources	Identification of bodies of surface water and of the spatial occupation of riverbeds	Underway	Continuous	Digital colour orthophotographic map, various years
Monitoring vegetation: Nature map	Identification and characterisation of plant coverage and habitat	Underway	Completed in 2010	Digital orthophotographic map and Landsat TM5 images
Monitoring water resources: glaciers	Measurement of the mass balance of glaciers	In preparation	Every few years	Images obtained from aeroplanes and helicopters
Monitoring water resources: glaciers	Isotopic characterisation of ice in relation to mass balance	In preparation	According to specific needs	Images obtained from aeroplanes and helicopters
Monitoring water resources: snow	Measurement of snow cover parameters	Underway	Continuous	Envisat, Cosmo, Modis
Monitoring the territory: Land usage	Measurement of the loss of land used for farming and forestry due to soil sealing caused by natural and artificial phenomena	Periodic	Every three years	Digital orthophotographic map, GMES ground coverage
Monitoring the territory: Environmental abuses	Identification of potentially contaminated sites	Underway	Continuous	IKONOS, LANDSAT 7, DEDALUS, ASTER

Further details

Monitoring water resources: the Plan for safeguarding the water resources

In 1999, the Veneto Regional Authority appointed the ARPAV to prepare a plan for safeguarding the water resources as a tool for making action plans on a hydrographical basin scale, which defined the set of measures needed to prevent and contain pollution, improve water quality, and maintain the natural self-cleansing capacity of the bodies of water to keep them suitable for sustaining diversified animal and vegetable species.

To comply with the resolution of the governing body of the Veneto Regional Authority, the ARPAV prepared a hydrographic network, making abundant use of digital colour orthophotographic maps dating from the years 1999, 2003 and 2006. The data acquisition activity still going on and the network is managed on a centralized geodatabase, with the added benefit of "special nodes" referring to hydraulic works, monitoring stations and drainage systems (both industrial and from public water treatment plants). Today, the hydrographic situation is typed in accordance with Directive 2000/60/EC and consistent with the classification into reservoirs of the regional territory as a whole, which can be divided into approximately 2000 basins with a minimum reference surface area of 10 km². Remote sensing technologies were used for these typing and reservoir classification activities, accompanied by the creation of DTMs with a 5 m elementary cell size, suitably integrated by performing a micro-survey of the lowland areas in co-operation with the Geography Department at Padua University, and subsequently integrated with any LIDAR

information available. The use of satellite and/or aerial information was indispensable in these activities.

Monitoring vegetation: Nature map:

The Nature map project was set up as part of the Framework Law n° 394/91 on nature reserves, which called for the development of a nationwide tool for "identifying the condition of the natural environment in Italy, highlighting its natural values and its vulnerability profiles".

The Nature map took practical shape in:

- a cartographic survey in vector format, describing the current state of the various habitats identified in the Italian territory, where the term habitat is used to mean a homogeneous territorial unit;
- a model-based, quantitative analysis in which each territorial unit is attributed quality and environmental vulnerability scores calculated on the basis of specific environmental indicators.

The cartographic data and the remote sensing images from the TM5 Landsat sensor (drawn from among those available for the summer of the years 2000 and 2001) were combined into a geographic information system (GIS) and the following cartographic products were generated:

"Landscape types and units" on a scale of 1:250,000 (ISPRA manuals and guidelines 17/2003);

"Habitats" on a scale 0f 1:50,000 (ISPRA manuals and guidelines 30/2004, and ISPRA manuals and guidelines 48/2009).

Monitoring water resources: glaciers

The planned activities refer to the recently-approved 3PCLIM project (Interreg IV Italy-Austria) that, among numerous other activities, also involved conducting an analysis on the changes occurring in the sources, mass balance and volume of several representative glaciers, also in relation to their extension during the Little Ice Age.

As part of a co-operation with the IDPA-CNR in Venice, moreover, an attempt will be made to correlate the mass balance of the last five years, established by means of comparisons with geo-radar and lidar data, with stratigraphic data obtained by analysing surface borings. The chemical data obtained will also enable a preliminary geo-chemical characterisation of the glacier. With the cooperation of ARPAV's technicians, the IDPA experts have collected a 12 m long boring from the Marmolada and completed its snow profile, in which the different snowfall seasons are distinguishable.

Monitoring water resources: snow

This is an activity conducted with the Florence CNR-IFAC on Monte Cherz (Arabba, Belluno) and involves characterising the snow cover by means of a microwave monitoring of characteristic parameters (snowflake size, water content, equivalent water) with tools on the ground, which will subsequently be correlated with instrumentation located on the Envisat and Cosmo satellites.

Monitoring the territory: environmental abuses

The activities conducted in this area have involved supporting the regional project for monitoring the territory with the aid of remote sensing methods. The purpose of the scheme is to create a map of environmental criticalities in the Veneto lowland areas, also conducting a thorough assessment of the landfills in the region, and identifying and monitoring contaminated sites. The use of remote sensing methods, both satellites and low-level flights, has enabled a system to be devised and adopted for identifying and monitoring potential sources of pollution liable to have an impact on the environmental and hydrogeological system of the whole region.

The project was developed in two successive stages: the first had a limited coverage, concerning the basin draining into the Venetian Lagoon, but this was subsequently extended to the whole area of the Veneto lowlands, and involved the territories of more than 380 municipalities.
The project began with a programmatic agreement, signed by the Veneto Regional Authority and the Venice Water Authority in 2003, and involved the ARPAV right from the early stages, requiring the cooperation of the Provincial Authorities, Local Authorities, Financial Police, Civil Guards, the Ecological Operative Unit (EOU), the Italian Forestry Commission, State Police and Provincial Police.
The database and the know-how relating to the methods of investigation and analysis employed in the scheme are currently being transferred to the ARPAV.
The remote sensing data used in the project included various medium-resolution satellite images acquired by the Landsat 7 platform with the ETM+ sensor (30x30 m pixels) between 2001 and 2004, as well as high-resolution satellite data acquired by the IKONOS satellite (1x1 m pixels), i.e. for the Venetian Lagoon's drainage basin in 2001 and for the whole Veneto lowland region in 2004. In the summer of 2005, tree-top flights were conducted using the Daedalus sensor that, by recording signals the thermal infrared range, enabled thermographic maps to be developed of numerous areas in the Veneto lowlands. ASTER satellite images were also acquired, again for the purpose of developing a number of thermographic maps.
The information obtained with the sensors was cross-referenced with the details provided by the Veneto Regional Authority and the ARPAV, then organised in the form of a GIS that enabled certain statistics to be extracted relating to the currently-identified illegal landfills, so that investigation activities in the field could focus on the sites most likely to be polluted. These sites are investigated using four methods:

1. new data acquisitions with sensors mounted on aeroplanes that record information in the thermal infrared frequency range;
2. surveys with treetop level helicopter flights conducted in cooperation with the Financial Police;
3. detailed information collected from Local Authorities;
4. sampling and chemical analyses.

Needs identified

Among the needs identified by the ARPAV, there is certainly the need to ensure the readily accessible availability of satellite images capable of ensuring a rapid updating of the territorial /environmental information. The availability of media for supporting a rapid updating process is certainly fundamental to enable ARPAV to serve its institutional purpose, but must be accompanied by the identification of analytical methods capable of providing the raw or processed data of interest equally rapidly. It is essential to be able to reiterate analyses within a short time span in order to consistently follow up the rapid evolution of the territory and environment. It is also indispensable to be able to share experiences and projects with other administrations.
The topics of particular interest to the ARPAV can be briefly outlined as follows.

1. Analysing changes with the aid of satellite data:
    - air quality monitoring;
    - identifying landfills and contaminated sites;
    - assessing the extent and trend of cementification of the land;
    - assessing land usage;
    - assessing land coverage;
    - monitoring glaciers;
    - monitoring avalanches;

- identifying waste drainage systems.

2. Aerial photogrammetry and stereoscopic viewing:
   - updating topographical databases.
3. Radar data mapping (SAR):
   - identifying flooded areas for emergency management purposes.
4. Extracting altimetric information on the territory:
   - generating DEMs from LIDAR data;
   - identifying the height of buildings.
5. Object-related classification:
   - identifying roofing containing asbestos in urban areas.

4. **Logistics project unit**

The unit responsible for the Logistics project has developed a series of schemes and studies that involve the use of satellite technologies, particularly in the context of European cooperation projects.

Generally speaking, these activities relate to the need to achieve a geo-referenced representation of the transportation infrastructure, needed to develop logistic activities and trace the routes taken by vehicles and goods in transit. This demands synergic analyses together with action for planning and managing the transportation (both private and public) of people.

In particular, a part of the European TrIM project (developed from 2008 to 2011 as part of the Interreg IVA Italy-Austria program) involved using an accurately geo-referenced graph developed with the aid of satellite technologies. Transport-related information was associated with this graph (functional characterisations, traffic flows, etc), developing an information platform suitable for conducting analyses for planning and management purposes. The implementation of this process in the context of the TrIM enabled its integration with the information structures of the Friuli Venezia Giulia Region and the Austrian Land Carinthia, thus extending its potential for use in broad strategic analyses.

The adoption of an advanced system for representing the infrastructure, together with the installation of GPS devices on vehicles and containers (integrated with other sensors that provide information, for instance, on how the vehicle has been loaded) enable advanced fleet management functionalities to be exploited. The Logistics project unit is further analysing the issue of how best to optimise goods transportation globally, not on single journey scale, but extended to the whole chain of displacements to be completed. The use of such solutions in accessible web portals will enable a reduction in the percentage of empty return journeys, particularly in the case of SMEs (which are common in our area). This will make it possible to achieve considerable advantages in terms of both environmental sustainability and the promotion of economic activities.

The Logistics project unit is also interested in applying these tools in the context of City Logistics and the management of hazardous goods (the relevance of which was emphasised in the recent Italian national logistics plan). In fact, the precision monitoring achievable using satellite technology has a key role in optimising the distribution of goods in an urban setting (enabling the achievement of a marked reduction in the pollutant emissions in these critical areas). In the case of hazardous goods, the need for an accurate and timely monitoring also complies with indispensable safety requirements. In addition to tracking a vehicle's path, this also entails preparing countermeasures to cope with any critical events, assessing the presence of the necessary infrastructure and any sensitive areas in the transport network. In the course of activities involved in the start-up phase (e.g. the TranSafeAlp project, financed by the European Alpine Space cooperation program) the topic of emergency management will consequently receive particular attention, as regards the management of short- and medium-term re-routing that will exploit, among other things, the opportunities offered by the integration of GMES technologies. This issue is particularly important for the transportation network in the Alps, which are a particular vulnerable area. Finally, further in-depth analyses are planned in the more general context of intermodal transportation, based on an approach that focuses on combining technologies and sources of information, and promoting an effective interaction between the various operators and logistic platforms in the territory.

5. **Land defence directorate**

Project name	Description	Application	Technical features	References	Year	Location	Municipality	Province
Investigations on the Rotolon landslide	Laser scanner recordings from the air on the slopes in the area of the Torrente Rotolon basin, in the Municipality of Recoaro Terme	Analysis of landsliding events occurring in the Torrente Rotolon basin in May 2009 and November 2010. Hydraulic and hydrogeological modelling for projects aiming to make the riverbed safe and restore its hydraulic functionalities.	Laser-scanner recording at 90° (density 8 dots/m²) using DTM of the ground with 5x5m and 2x2m grids. Hydrogeological modelling with dedicated software (2D Flow …)	Law 267/98, Dgr. 2945/2009	2010	Torrente Rotolon	Recoaro Terme	Vicenza
MassMove Project	The main goal of the MassMove project is to define minimum shared standards for assessing geological hazards intrinsic in land collapse and surface landsliding phenomena. The Veneto Regional Authority as identified four pilot areas in the provinces of	Laser scanner recordings from the ground and from the air for hydrogeological and geological investigations	Laser scanner recording from the ground and from the helicopter at 90° (density 4 dots/m²) and at 45° (density 10 dots/m²) using DTM of the ground with 5x5m and 2x2m grids. Geomechanical recordings, 2D and 3D modelling of rock falls. Preparation of a map showing susceptibility to instability and of a geological hazards map in the GIS environment.	DGR 1033/2008 , DGR 2983/2008 , DGR 624/2009	2010-2011		Alleghe, Rocca Pietore, Colle Santa Lucia, Caprile, Perarolo, Valle di Cadore, Valstagna	Belluno, Vicenza

	Belluno and Vicenza and is working on the theme of land collapse							
Extraordinary remote sensing plan	LIDAR - Extraordinary high-precision remote sensing plan of the environment for areas at high hydrogeological risk	Hydrogeological and hydraulic investigations	The geodetic reference, or geo-referencing, system used for the LIDAR data is the native ETRS89, also called WGS84, in the implementation of the ETRF89 (European Terrestrial Reference Frame 1989). DTM: digital model with 1 m x 1 m grid of the Earth's surface with no vegetation and no buildings; DTM: digital model with 2.5 m x 2.5 m grid coinciding with the marine and coastal areas; highly critical areas: 1.5 dots/m²; river routes: the river's width from bank to bank, plus a strip 350 m wide to left and right - 1.5	PCN - Ministry of the Environment and for Safeguarding the Territory and the Sea (MATTM)	Part 1 end of 2008 start of 2009	Regional territory completed or currently underway or being tested, km²	various	

			dots/m²; coastline: 800 m buffer - 1 point per m²					
Extraordinary remote sensing plan	SATELLITE INTERFEROMETRY	SAR satellite data, processed using interferometric methods, enabling the preparation of datasets capable of providing significant support for checking and monitoring land instability phenomena, and particularly land deformation relating to sliding slopes. Interferometric technology provides an excellent tool to combine with conventional hydrogeological instability analysis techniques.	http://www.pcn.minambiente.it/GN/leggi/LINEE%20GUIDA%20PER%20ANALISI%20DI%20DATI.pdf Satellite images (ERS1/2 and ENVISAT) are processed using the PSInSAR and PSP-DIFSAR technology.	PCN - Ministry of the Environment and for Safeguarding the Territory and the Sea (MATTM)		Whole region		

F. CNR IREA

The Institute for the Electromagnetic Monitoring of the Environment (IREA) is a part of the Italian National Research Council (CNR) that was established in April 2001, stemming from a rationalisation of the network of CNR research institutes decided by Legislative Decree on 30/01/1999. The IREA has its main headquarters in Naples and another office in Milan, and has been operating in the remote sensing sector ever since it was first established in the 1970s.
The Institute was created to meet the country's need for scientific and technological developments in the sectors of remote sensing, electromagnetic monitoring of the environment and territory, and geographical information systems, through the production and testing of ICT methods and technologies for acquiring, processing, pooling and interpreting data deriving from different types of sensor, both on the ground and carried by aeroplanes or satellites, for the purpose of providing information for use in territorial management, surveillance, security and risk assessment.
Being a research institution, it concentrates on designing and developing innovative methods and products consistent with the most recent discoveries in the application of remote sensing and digital space data treatment; one of the goals of this research is to generate products that can sometimes have a practical fallout and turn into services.
The Institute regularly runs training activities in cooperation with Italian and international research institutes and university departments, transferring its know-how on the use of remote sensing and ICT systems for processing geographical and remotely recorded information (e.g. geographical information Systems, GIS) at university courses and seminars, and for university degree dissertations and research doctorate theses.

The CNR IREA's activities are concentrated mainly in the following **areas of interest**:

a) Land use and coverage, land consumption monitoring (dynamics of the built environment and infrastructure, etc)
b) **Natural vegetation** (identifying the distribution of different species, monitoring phenological cycles, measurement and monitoring of mountain landscapes in relation to their neglect and to climate change, measurement and monitoring of forestry resources and their state of health, mapping of areas affected by forest fires, also for the Fire Registry, etc)
c) **Water** (assessing water quality parameters both inland and at sea, calculating the capacities of hydrographic basins, monitoring the extent of mountain snow cover and glaciers, etc)
d) **Agricultural systems** (estimating the biophysical parameters of crops, monitoring mountain pastures, identifying crop rotations, estimating agricultural production and phenological cycles, paying particular attention to identifying anomalies in rice crops in particular, etc)
e) **Climate change** (multiple-year anomalies in vegetation cycles or snow/glacier coverage on various scales, even extending to the continental scale, impact of climate on social dynamics at regional level, etc)
f) **Geology** (mapping geo-lithotypes, studies on landslide risks, assessing flooding phenomena, subsidence, etc)
g) **Risk assessment and analysis** in the above fields of application (e.g. fire risks, landslide risks, flooding risks and anthropic risks)
h) **Tourism and cultural heritage** (archaeological maps and geo-portal for use in local tourist schemes)

The resulting products are both static and dynamic, since applying satellite remote sensing solutions enables products to be generated at a highly competitive cost and covering lengthy periods of time, thereby highlighting within-year (seasonal) and between-year (climatic) variations, for instance.
Testing processes for extracting information from satellite data and treating it automatically, which is the main activity of the Milan branch, implies a strong commitment to data collection campaigns on the ground

to enable the calibration and validation of remote sensing data, thus ensuring very high product quality standards.
Satellite images are suitable for feeding data into specific models, such as hydrological models for calculating the capacity of rivers, and generating products evenly distributed over broad areas of territory.

An important challenge: remote sensing applications in regions with a high data concentration

Remote sensing applications can cover all areas of the planet but there is a marked discrepancy between their use in nations and regions where the available heritage of information is limited and scarcely reliable as opposed to areas such as Lombardy, where the territorial data available is extremely capillary, dependable, certified by the public administration and in digital format. For instance, satellite images of lighting at night can be used in the planet's desert areas to locate the resident population, whereas this would hardly be worthwhile in north-eastern Italy, where accurate censuses are routinely conducted.

This means not that remote sensing is not useful in regions with high concentrations of information, but that it has another role, becoming a means for integrating and supporting various functions. Where necessary, for instance, remote sensing images can ensure a constant updating of the available information (as in the case of monitoring snow cover, for which it would be unthinkable to keep running costly on-site campaigns); or they can be used to check the reliability and quality of other information (e.g. to help deal with the problem of illegal building), or to provide new sources of information not obtainable with traditional observation methods (e.g. information relating to the humidity in the soil, obtainable using infrared sensors as a source, for evaluating and locating areas at imminent risk of landslides).

That is why remote sensing skills in the strict sense must be completed, in the setting considered here, with advanced ICT expertise concerning how to combine advanced and distributed information systems, geographical information systems, space data infrastructure and decision supporting systems.

For some time now, the CNR IREA's activities have involved not only creating remote sensing products, but also combining them with **ICT environments developed for the analysis and integration of multi-sourced data**. In recent years, the Institute has gained a great deal of experience in the development of components for space data infrastructure according to the European **INSPIRE** directive (in force since 2007), and adopted in the information systems for most of the Italian Regions. Particular attention is also paid to developing products for **decision makers**, generally containing remote imaging data sets and based on decision supporting systems.

Many of the CNR IREA's activities refer to and are financed by projects in the **European GMES program**; to give an example, the Institute is a partner in the GEOLAND/GEOLAND2 Project, which develops GMES products and core services for the 'land' sector.
The Institute also has for some time been involved in the development of the so-called **GMES downstream services**, i.e. services based on GMES core products, creating new products that are more suitable for end users, e.g. for use by local public administrations. As part of the Geoland project, for instance, a system has been fine-adjusted that uses GMES-generated core maps (indicators of vegetation and precipitation) and creates indicators of anomalies in the annual behaviour of the vegetation in Africa.

The main employers of the CNR IREA in Milan are:

- European Commission: DG Environment, DG Enterprise (Space), DG Regional Policy
- ESA
- ASI

- Ministry of the Environment and MIUR, Italy
- Regional Authorities of Lombardy, Emilia Romagna, Veneto
- ARPA in Lombardy/Emilia-Romagna/Valle d'Aosta/Veneto/Umbria
- Environmental Monitoring Centre, Municipality of Sirmione, Italy
- ENI SpA
- Compagnia Generale per lo Spazio SpA

The CNR IREA has been certified in the **Questio regional database** for several years.

Summary table: some examples of the CNR IREA's activities in Milan

Topic	Product	Area of application	Sensor	Owner
Land use and coverage	Urbanised	Italy	NOAA, SPOT, Landsat, QuickBird, Ikonos	ASI, European Commission, Lombardy Regional Authority
	Types of vegetation	Italy, Africa		
	Geolithology	Italy		
Water	Amount of snow cover	Alps	MODIS, TM, NOAA	ESA, European Commission
	Map of water equivalent in snow	Lombard Alps	MODIS, TM, NOAA	European Commission
	Map of glacier cover and evolution	Italian Alps	TM, ASTER	ESA, ASI
	Estimation of the water capacity in Alpine basins	Lombardy Val D'Aosta Veneto	MODIS, TM, NOAA	ESA, European Commission
	Water quality	Lakes in Lombardy, and Lazio	Landsat, MODIS, MERIS, MIVIS	ESA, ASI, European Commission
	Water quality	Lake in Sweden and Hungary		
	Water quality	Coastal areas of Italy		
Agriculture	Maps and estimates of pasture production	Piedmont, Lombardy	Field Spec, Landsat,	CNR, JRC, Milan Faculty of Agriculture, Lombardy Regional Authority
	Maps and estimates of rice production	Piedmont, Lombardy, Europe, Asia, Africa	Landsat, MODIS	
	Estimate of nitrogen concentration in crops	Italy, Europe, Asia, Africa	Field Spec, MERIS	
Climate change	Assessment of the state of the environment and changes	Italy, Africa	NOAA, SPOT, Landsat, QuickBird, Ikonos	European Commission
Anthropic risk	Maps of oil spills	Sea and inland waters (lakes)	SAR, MODIS/MERIS/MIVIS	ASI
Hydrogeological risk	Maps of landslide risks	Lombardy, Trentino, Umbria, Basilicata	Landsat, SPOT, QuickBird, Ikonos	ASI
Fire risk	Maps of areas affected by fire	Italy - national parks	ASTER Landsat	Italian Ministry for the Environment
		Africa	NOAA, SPOT Vegetation Landsat	European Commission European Commission
	Fire risk maps	Italy (Lombardy, Sardinia), Greece, Spain		
Tourism and cultural heritage	Geoportal on water quality in Lake Garda	Lake Garda	Landsat, MODIS	CRA Sirmione
	Maps of archaeological areas	Italy	Landsat, MIVIS	CNR

G. Milan Polytechnic

The Milan Polytechnic's BEST (Building Environment Sciences and Technology) Department is an important institution in the field of space research with a view to the increasingly accurate and efficient production of satellite data for subsequent use based on development and diffusion methods of the so-called *downstream services*. This particular position qualifies the Polytechnic as a major scientific stakeholder for recommending potential services with a view to supporting global and local territorial activities.

a) Experiences and recommendations in the Earth observation field

- Suggestions concerning the Earth observation / GMES area relating to "sentinel data" services. Creation of a database of satellite images on a regional scale (an upgrade of the **Regional geo-portal**) for various uses, some of which are now partially available, and for multiple users (local authorities and other local administrations, private citizens, enterprises, etc); this could be a scheme to include in the NEREUS setting with a view to its inclusion in the **European INSPIRE**[11] **geo-portal.** Take-up of GMES sentinel data on a regional scale with a view to delivering primary data and mature complex processing models, through a diversification of the services (WMS, WPS, web chains, …). This is intended for public and private users, for both basic and advanced scientific applications, aiming to develop new models and studies starting from the availability of aggregated and disaggregated data, in addition to **modifiable** models that can be implemented using new datasets prompted by certain needs, contributing to providing a broader range of products and prompting an expansion of the potential, in the various sectors listed below, for exploiting geospatial data at the service of the territory on a local scale as well.

- The Milan Polytechnic has been the promoter of a spin-off company called TRE that already supplies services to the Lombardy Regional Authority for monitoring subsidence phenomena with a view to preventing hydrogeological risks (see above). Some of the developments of TRE's services in the sector for **monitoring** public and private **infrastructure**, e.g. dams, tunnels, underground railways, motorways, and other buildings with the aid of satellite data, are described below, along with recommendations for co-operative schemes involving TRE and the ICT and Re.Te laboratories (for research applied to the recovery of the local territory and extended urban system) at the BEST Department, with the Territorial Pole in Lecco.

- **GMES Urban Atlas**: the European Urban Atlas project promoted by the European Environmental Agency (EEA) aims to generate useful, independent information on all

[11] The INSPIRE geoportal represents the sole point for accessing the heritage of European environmental geo-information made available by all the Member States as established by the INSPIRE directive. The first stage, as decided in the public notice on the "Development of the technical components of the INSPIRE Geoportal at European level", will therefore involve combining the "View" and "Discovery" services of all the Member States.
Planetek Italy (with head offices in Bari and Rome) has been appointed to develop the new European INSPIRE Geoportal on behalf of the Institute for the Environment and Sustainability of the Joint Research Centre (JRC), which will replace the current prototype produced by the JRC at operational level. The proposal advanced by Planetek Italy, prime contractor of the RTI with the German lat/lon (www.lat-lon.de), was selected from among 17 bids presented by the major operators in the European geomatic sector. Its design proposal is based entirely on open-source technologies and the OGC standard, adopted by both Planetek Italy and lat/lon.

environmental issues (pollution, biodiversity, climate change, waste, energy efficiency/ dispersion, land use, control of urban development, etc) and in various sectors (energy, fishing, tourism, waste transportation, …) (http://www.eea.europa.eu/data-and-maps/data/urban-atlas). As part of this project, the Polytechnic proposes an example of a possible implementation of the Urban Atlases on a sensitive scale in future developments, e.g. of the "urban" and "local" territory. In fact, an urban scale of the territory would necessitate the addition of high-precision satellite data with a view to improving our understanding of phenomena underway, correlating them more effectively with detailed information (from on site data collection) capable of intercepting the complexity of the territory, interpreting behaviour and phenomena, supporting system scholarisation, needs for sustainable measures, and urban territorial planning. There are various aspects to orient the supply and demand in certain strategic directions:

1) Integration of satellite data and 'on site data collection' (airborne, UAV, field data) that the GMES is demanding for the generation of services for the Regional and Local Authorities: these can address the **set-up of experimental services and processes** for a better understanding of **local territorial dynamics and extensive urban systems in complex territories,** in close synergy with the relevant local administrations and research centres; this demands a further analysis of possible synergies underexploited and underestimated at local level in the process of comprehension of the territories.
2) **Added value for the micro-enterprises in the Lombard aerospace technological district** for the experimental development of data acquisitions for use in the civilian field from **UAVs/microdrones/quadricopters and the implementation of multi-sensor mobile platforms** that the Milan Polytechnic is testing for some sectors, such as the built environment, cultural heritage, environment (water, riverbanks, analysing and uncovering secondary canal systems that have partially disappeared, farmland, humid corridors, energy analyses on buildings).
3) **Need to develop multiscale, multi-temporal 3D hydromorphological and ecological models** for "**Water and Territory**" applications, starting from satellite, aerial and in situ data of various kinds (for fisheries, biodiversity, migratory and humid corridors, anthropic environment, ...). There is evidence of a further need to produce increasingly accurate models for use in controlling the evolving dynamics, exploiting and safeguarding ecosystems, simulating scenarios, guiding mitigation and prevention measures (for flooding, etc) in order to comply with the European directive (for the regional implementation of the European Commission's "Water Framework Directive" [WFD] 2000/60/EC).
4) **Historical territorial atlases: inclusion of the historical dimension in the spatial databases (SDI). Start-up of services for accessing and correlating temporal series of satellite images with historical and present-day cartographic series in land registries,** with a view to providing data needed by local administrations, research centres and professionals studying the territory, by making available diversified time sequences (from the satellite data to the historical cartographic data). The geoportal **www.atlantestoricoLombardy.it** financed by the Fondazione Cariplo (Milan Polytechnic Milan State Archives, Lombardy Regional Authority, Territorial Agency, CS PIM, and the Gorgonzola Local Authority) has provided 28,000 historical land registry maps of the territory in the province of Milan, and sample geo-referenced layers for the city of Milan and certain river courses, highlighting the potential, and the need for growth of regional-scale "structured" services for correlating with satellite images documenting

changes underway in the territory, the evolution of riverbeds, and supporting the design of mitigation, conservation and territorial exploitation measures, the protection of the anthropic landscape, sustainable measures, analyses on urban and archaeological stratifications, etc. (experimental sample POLIMI, ASMI and CNR).

5) **Sustainable and cultural tourism** (the production of geospatial maps and web services for integrating data and accessing data for adding value to the territorial heritage). **As stated in the Agenda for a sustainable and competitive European tourism (2007)**, it is essential to "offer real opportunities in terms of their attractiveness as a place in which to live and work, and their role as a reservoir of natural resources and highly valued landscapes". As claimed by the **European Tourism Sustainability Group,** "more than any other economic activity, tourism can develop synergies in close interaction with environment and society". Experiments underway on a **regional level in the context of the economic and cultural territorial districts** could exploit the development of web services based on advanced geospatial data with the prospect of growth in the sector through synergies with private and public partnerships, now mature and ready for a more articulated development capable of intercepting and supporting growth in the area of SMEs operating in the cultural tourism sectors, offering services that appeal to citizens.

There is evidence of a further need to produce geospatial maps for supporting services relating to the development of sustainable tourism (with a view to generating thematic maps, itineraries, historical reconstructions and business services). Integrating satellite data with historical maps and developing historical geoportals for reconstructing scenarios (Real Time panoramic views, value-added landscapes, territorial contextualisation of architectural and historical heritage, identification of historical routes and itineraries over the centuries, archaeological finds and traces) could prompt the development of correlated advanced web services (smart devices, I-phone services, ...) and potential synergies with the Ministry for the Cultural Heritage and Landscape to produce portals designed to make full use of thematic territorial areas.

6) **Energy efficiency: generating data and services at regional and urban level.** Since the topic of energy efficiency is generally believed to have **under-exploited satellite and aerospace technologies**, which have grown up and are now mature enough to be of great help in activities for **guiding such a strategic sector as energy**, the **Milan Polytechnic** (BEST Department) is developing some proposals designed to make better use of **aerospace technologies and satellite data integrated with data networks and mobile sensors** to build an intelligent thermal urban map with a view to improving our understanding of the Urban Heat Island (UHI) phenomena correlating with the thermal energy dispersion from buildings, and the types of surface and building technologies needed to support the goals of Europe 2020.

The project is being developed with the D'Appolonia group, in a cooperation forming part of the European E2BA (Energy Efficiency Building Association) platform, together with the Brussels delegation of the Lombardy Regional Authority and the Casa della Lombardia, which includes the POLIMI, a network of enterprises, and some European research centres.

The objective is to create a useful tool for the Regional and Local Authorities so that they can interact, in their efforts to fulfil the EU2020 parameters, by **simulating scenarios**, following up the trends of action to contain energy dispersion, overheating phenomena and thermal energy dispersion, by means of focused policies (envelope retrofitting, new

types of flooring, green roofing, green cities, smart grids, ...). At the same time, this tool could be used to boost active involvement with a view to improving public awareness and orienting them towards the choice of sustainable energy with the aid of customisable comparative data.
The project involves basic research steps, European-level technological developments, and territorial-level start-ups.
It will be proposed as a service for building a new information layer in the urban atlases extending on a regional scale.

— **Use of GNSS-related positioning services**. Right now, six main fields of use have been identified for the data coming from the processing work done by positioning services based on GSS observations:

- reference systems: regional participation in the national effort to maintain a unified geodetic reference system containing all geomatic activities;
- general cartography: supported by general services, the GNSS findings solve all the problems of pooling and contextualising cartographic material, especially as concerns land registry surveys;
- monitoring: from territorial (e.g. for checking landslides) to structural monitoring (e.g. major works, dams, bridges, etc.)
- public works: testing these works and assessing the consistency of the works actually built with the original plans is considerably facilitated by GNSS surveys on characteristic points;
- infomobility and logistics: the locating service can be used in kinematic mode for fleet control (e.g. trains, public transport, fire brigade, police forces, etc) and for logistics (traffic control and storage of crates/containers); combined with ground navigation methods, moreover, precision farming operations, procedures for implementing structural projects, and so on can be automated;
- safety at construction sites: research is underway on the application of GNSS sensors to ensuring individual worker safety at construction sites, especially sites extending linearly over lengthy distances.

H. Committee for Promoting the Lombard Aerospace District

THE AEROSPACE SECTOR IN LOMBARDY

Lombardy can boast a lengthy tradition in the aerospace sector, dating back to the industrial settlement established in the first decade of the last century. Since then, its aeronautical industry (to which the space industry was subsequently added) has continued to evolve and become rooted in the territory with its highly specialised industrial fabric.

There are currently more than 185 enterprises employing approximately 15,000 people and generating a turnover of €4 billion each year. The sector's exports from the region in 2010 amounted to €1.7 billion, corresponding to 30% of all Italian aerospace exports.

The Lombard aerospace system is characterised by a strong integration between businesses that range from industries serving as international prime contractors - for fixed wing, rotary wing, vertical flight and space – and a complex system of SMEs that operate on several levels in the industrial chain. Another feature of the Lombard cluster is its in-depth technological integration, which makes it one of the few areas in the world with the capacity to produce complete aircraft with all their parts and components. In fact, the region has the technological skills and advanced scientific expertise capable of covering the whole aerospace chain from the fixed to the rotary wing, from materials to equipment to the most qualified flight systems, and right up to technologies applicable to the space sector. For the space sector in particular, there are enterprises potentially capable of producing satellites as well as scientific payloads, sensors, instrumentation and subsystems for satellite platforms and, more in general, there are businesses engaged in the fields of space exploration and observation as well as earth observation.
In 2009, the Lombardy Regional Authority acknowledged the Lombard aerospace network's importance by means of its Driade regional public notice and it subsequently became strongly committed to the formal establishment of a technological district dedicated to this sector.

THE COMMITTEE FOR PROMOTING THE LOMBARD AEROSPACE DISTRICT

The Committee for Promoting the Lombard Aerospace District was established in February 2009 by a pool of eight enterprises representative of the main types of business operating in the aerospace sector, in terms of their size and manufacturing specialisation, together with the Varese Provincial Industrialists Association. In the course of over two years of operation, the Committee has been opened to the territory, the system of universities and research centres, and other industrial entities, and now has approximately 75 core members and animates the whole network.

The **objective** of the Committee for Promoting the Lombard Aerospace District is to facilitate the independent growth of the SMEs in the sector by:

- stimulating growth in the supply chain by supporting innovation and creating best practices;
- supporting the internationalisation and the marketing of the SMEs;
- creating opportunities for cooperation between enterprises;
- implementing training programs;
- seeking funding opportunities.

To achieve these goals, the Committee has created several workgroups that carry forward a series of activities intended for all the Committee's members. The following are a few examples of the activities undertaken so far:

- **Scientific technical team (NTS)**, which coordinates the R&D activities, covering a vast range of products, services and technologies
- **Space workgroup**, which cooperates in close synergy with the scientific technical team on research topics and keeps in touch with the Regional Authority in the context of the NEREUS network
- **Supply chain workgroup**, which promotes industrial cooperation between enterprises and the diffusion of best practices (e.g. KPIs; LEAN; E-scouting ; web sites, …)
- **Internationalisation & marketing workgroup,** which deals with the joint participation in international events in the sector and handles relationships with international networks and other such organisations (e.g. participation in the EACP-European Aerospace Cluster Partnership; participation in air shows and trade fairs, …)
- **Training workgroup**, which organises educational and training activities and schemes for secondary education, university courses and professional training designed to serve the needs of businesses in the sector (e.g. H&A Master – LIUC, course for teachers at technical institutes, Pavia University Summer School, ...)

I. Compagnia Generale per lo Spazio (CGS)

The CGS, *Compagnia Generale per lo Spazio* is one of the largest companies in Italy developing space systems and it has been active on the aerospace market for 25 years. The company has its head offices in Milan. In the area of territorial satellite technologies, CGS contributes to various applicational areas:

- ***Satellites***: turnkey systems for scientific missions and other applications, particularly small satellites for the Italian Space Agency (ASI) and the commercial market. CGS is a partner on the team that developed the German SAR-LUPE constellation, which provides X-band SAR data, and it is developing several more satellites for commercial telecommunications and Earth observation missions, including the PRISMA hyperspectral mission for the ASI.
- ***Earth observation***: products and services for environmental monitoring using remote sensing data for the ESA, the ASI and commercial projects. Main applications: monitoring glaciers and snow, and related information services (e.g. for hydroelectric plants), natural risks (e.g. volcanic areas, landslides and fire), air quality. CGS provides local administrations (e.g. Provincial and Local Authorities) with territorial monitoring solutions.
- ***Applications and navigation***: solutions and services for security, fleet management and border control are handled by the sister company Telematic Solutions. CGS and Telematic Solutions are already developing products and applications compatible with Galileo, the new European satellite navigation system.
- ***Research***: significant investments have been made in research for space applications in cooperation with major Italian universities and research institutes. It is worth mentioning the activities involved in the development of radio software for telecommunications and navigation, and of algorithms for processing and compressing satellite observation data.

As for **Earth observation**, CGS contributes with its own know-how, acquired in various application fields. The knowledge it gained from working on ASI pilot projects is of considerable relevance to the region: CGS is prime contractor for the Quitsat project (Gas and PM in the troposphere), the PROSA project (precipitation, snow and soil humidity), and the Morpheus project (landslides), and it also plays a part in the SIGRI (forest fires) and COASTSAT (coastline monitoring) projects. These schemes are financed by the Italian Space Agency to develop dedicated applications for dealing with natural risks and those caused by human activities. The settings for implementing of these projects are broad but the priorities relate to floods, landslides, fires, earthquakes, volcanic risks, air quality, sea pollution by hydrocarbons, coastal management, all topics of strategic importance for those concerned with territorial management. Implementing these services for demonstration purposes involves the use of Earth observation technologies as the priority grounds for their development. The products generated rely on currently-available data from space missions, focusing particularly on the Italian missions (and especially the COSMO-SkyMed).

CGS is also involved in GMES. In the EVOSS - volcanic risk (emergency response) project currently underway in which it acts as industrial project leader and takes responsibility for developing the data deployment service. In the area of air quality assessment, CGS contributes the experience it gained from the PROMOTE scheme (PROtocol MOniToring for the GMES Service Element

Atmosphere). This know-how has been completed by the ESA TEMIS, GEMS projects, and the currently running 7th Framework Programme MACC and PASODOBLE schemes.
In the regional context, CGS is involved - together with ARPA Emilia-Romagna - in supplying software for preparing maps of daily mean PM10 and PM2.5 levels with a resolution of 10x10 km2 over northern Italy. This experience has also involved Bolzano, where CGS has installed its remote sensing operational base. More in detail, it has produced a complete system for satellite data reception, filing, classification, processing and interpretation to supply Bolzano's Provincial Government with territorial services relating to snow, ice and aerosol monitoring. In a place called Corno del Renon, at an altitude of 2300 m asl, it has installed a band-X antenna for receiving satellite data, which are transmitted via a radio link from the station on top of the mountain to the EURAC (European Academy) in Bolzano, where the data-processing system is located.
CGS has also handled territorial observation and monitoring activities for the purposes of supporting precision agriculture.

The company also has a great deal of experience in the fields of **Navigation** and **Telecommunications**, gained from working on ESA, EU and ASI projects, as well as from its own in-house research activities. Its experience covers both GNSS signal processing and application algorithms, and GNSS receivers. CGS has been involved in various research projects and studies on GNSS systems and receivers, e.g. GREHDA (GALILEO Software Receiver for High Dynamic Applications), SWAN (SoftWare systems for Navigation Applications), GNSSGEO (Feasibility of GNSS Sensors for AOCS Applications in GEO and Higher Altitudes) and GReS (GPS/GALILEO Receiver for Space Applications). The Infosat, NEAR TO NEEDS, AIS and Web Solutions for Waste projects are all of considerable importance to the region.

EARTH OBSERVATION

i. Precision agriculture

CGS has applied Earth observation technologies to applications in viticulture. Aerial scans of vineyards have been developed and the map generated shows how well the vegetation is flourishing, enabling an assessment of the condition of the vines. This information was obtained repeatedly on the vineyard at various stages of its growing season to provide information on the health of the growing vines and help the winemaker in the distribution of pesticides and other products for protecting the plants, as concerns both the ideal timing of the treatments and the precise localisation of the product. In addition to reducing the costs of such treatments, this application can help to reduce the doses of chemical agents applied, and consequently also their environmental impact. Expert wine makers also know well that bunches of grapes collected from different parts of their vineyards can produce different quality wines and these technologies help them to conduct a differential grape harvest.

This type of investigation was also conducted using a UAV (unmanned aerial vehicle), i.e. an aircraft remote controlled from the ground, from a fixed or mobile station, and fitted with an on board electronic system capable of controlling its in-flight stability and flight path. Optical sensors for territorial observations are installed on board (the payload). Low-level flights can also be repeated several times as the crops grow to enable an ongoing monitoring service. For each flight, and within just a few hours, cultivated surface areas of hundreds of hectares can be covered and, if they belong to different owners, the costs of the service can be shared. Unlike remote imaging data obtained from optical satellites, the UAV system can acquire significant images even on cloudy or rainy days. The images give a historical account of the growth in time and space of the crops being monitored, which can be checked from one year to the next to establish any delay or anticipation of their various phases of seasonal growth

ii. MORFEO

The MORFEO project, followed up by the Lombardy Regional Authority as an "end user", is one of the projects financed by the ASI (Italian Space Agency) in the context of the Program on natural risks and those caused by human activities. Its goal is to construct and demonstrate a prototype system for supporting decisions made by Civil Protection services on landslide risks, based on the use of Earth observation (EO) technologies and data integrated

with traditional information, data and technologies. The MORFEO partnership will include Lombard universities (Milan Bicocca University, Milan Polytechnic) and the CGS. Other parties in the MORFEO Project (Bari Polytechnic, Planetek S.p.A., etc.) have been involved in studying the Lombard areas proposed as "test sites" (Cortenova, Garzeno, Madesimo, the Esino Lario basin, and the coastal area of the Lecco branch of Lake Como). MORFEO is part of a broader scheme focusing on R&D for technologies that can make full use of satellite data, with a particular focus on the COSMO-SkyMed mission.
(For further information http://www.protezionecivile.regione.Lombardy.it/shared/ccurl/671/23/SafetyNews68.pdf)

iii. QUITSAT

Quitsat is an Italian project, run by CGS and financed by the Italian Space Agency. The project is concerned with air quality through their shared use of observations coming from satellite sensors and data obtained on the ground, collected by the DOAS spectrometer and the multispectral solar radiometers, using the lidar techniques and atmospheric chemical transport models. The system implemented consists of three subsystems, dedicated to:
- monitoring: providing measurements of the concentrations on the ground of $PM_{2.5}$, NO_2, O_3, SO_2, HCHO, using the Earth observation data functions, ground data and transport models;
- prediction: providing measurements of the concentrations and spatial distribution of PMs and gaseous pollutants in the short term;
- planning: dedicated to supporting planning for air quality based on assessing the impact of sustainable emission scenarios.

iv. PROSA

The pilot project for "Civil protection against flooding: Nowcasting", managed by CGS, involves the development, implementation and demonstration of a prototype system dedicated to the innovative dynamic characterisation of meteo-hydrological quantities on the ground. The system relies on the use of data coming from Earth observation satellites combined with information, data and traditional technologies. The project aims to help the public administration gain a better understanding of the meteorological systems that generate flooding phenomena. In particular, the main goals include:

- coupling satellite (optical and radar) data with limited area models (LAM);
- supplying microwave (MW) e visible-infrared (Vis-IR) algorithms for retrieving data on precipitation;
- combining data obtained in the ground, in the atmosphere, and by radar-satellite to identify the characteristics of the nowcasting procedures;
- developing algorithms for establishing the humidity in the soil from satellite and microwave data;
- estimating the extent of snow cover and its water equivalent from optical satellite and microwave images.

PROSA is financed by the Italian Space Agency (ASI**)** as part of its Earth observation program.

v. SIGRI

CGS is involved in the SIGRI project, which concerns the construction of a demonstrator system capable of generating products based on Earth observation data (Meteosat Second Generation, MODIS, multispectral optical data, SAR data), possibly integrated with data from other sources (territorial information, cartography, and so on) to support the management of forest fires in their various stages: before, during and after the event.

The project also aims to promote research and the development of new methods and new product for use in managing forest fire risks, based on data from new missions such as COSMO-SkyMed, SAOCOM/SIASGE and Pleiades.

The system will be able to operate in strategic, tactical and legislative mode, and each operating mode corresponds to a specific product with features designed to meet the needs of the reference user, i.e. the Civil Protection Department:

- in strategic mode, usually working outside the forest fire season, the system can provide products for supporting the prediction and prevention of the phenomenon, e.g. risk maps, geo spatial and temporal hazard maps, maps showing the regeneration of burnt vegetation;
- in tactical mode, for use during the forest fire season, the system can generate useful products for managing events already underway, from reporting the event to identifying hotspots using Meteosat Second Generation satellites, to simulating the fire's propagation, to dynamic vulnerability mapping;
- in legislative mode, at the end of the forest fire season, the system can generate high-resolution spatial maps (on a land registry scale) of areas hit by fire to improve the application of current legislation in these areas.

SIGRI is financed by the Italian Space Agency (ASI) as part of its Earth observation program.

NAVIGATION

vi. WEB solutions for waste management

CGS has developed a system for waste management , comprising:

- a semiautomatic waste separator capable of:
  - *receiving, semi-automatically separating and storing waste;*
  - *weighing, photographing and generally conducting measurements on waste received;*
  - *memorising data and processing information on the waste and its users;*
  - *transmitting data and information to one or more control centres;*
  - *receiving data and information from one or more control centres;*
- devices for installing on waste collection trucks, for recording data such as:
  - *status of the power takeoff;*
  - *ignition panel (key on);*
  - *"target" point reached;*
  - *polygon circumscribing an operational area;*
- a web-based system that enables all the information on waste collected and transported to be recorded, processed and viewed.

vii. INFOSAT

CGS has developed a prototype GNSS-based service for improving mobility in urban and rural areas. The Infosat project (a satellite navigation application to support the management of vehicle traffic) is financed by the ASI with a view to studying, defining and implementing a prototype GNSS-based service. In particular, this project has involved building services relating to traffic monitoring and the automatic monitoring of traffic passing through motorway tolls, or in areas where traffic is restricted, and also to support emergency rescue services.

CGS is also involved in the preparation of a system AIS for managing fleets, based on satellite technologies and capable of improving the present-day AIS system and achieving a planetary coverage. The CAPRI, AIS System Study and Fenice are the main projects financed by the ESA in which CGS is involved.

TELECOM

viii. NEAR TO NEEDS

CGS has developed the preoperational NEAR TO NEEDS project (telemediciNE via sAtellite to bRidge iTalian and rOmaniaN hEalthcare and EDucational Services), the object of which is to develop and validate a telemedicine service via satellite for supporting diagnostics, treatment and training activities. This service has been tested at two local medical centres, one in Italy (in Treviso) and one in Romania (in Timisoara). The medical organisation it serves is accessible to the population at both the sites involved in the experiment.

J. Selex Galileo

SELEX Galileo is a company in the Finmeccanica Group and one of the principal players in the European space industry, capable of delivering a vast array of scientific instruments, sensors, equipment and subsystems for satellite platforms, operating in various fields.

- ***Earth observation:***
  - *Sea and Land Surface Temperature Radiometer (SLSTR)*, for the Sentinel 3 mission, as part of the GMES program. This is an infrared radiometer in the ASTR (Along-Track Scanning Radiometer) family, conceived for accurately measuring the temperature of the Earth's surface and oceans for applications in climatology, meteorology, and monitoring vegetation, deforestation phenomena and glacier shrinkage.
  - *Global Ozone Monitoring Experiment (GOME)*, an optical spectrometer that operates in the ultraviolet bandwidth, designed for measuring the quantity of ozone contained in the atmosphere and its distribution at the various elevations on a daily basis. The information obtained and transmitted by GOME is pooled monthly to build seasonal ozone distribution maps, which are used by climatologists to obtain long-term predictions on the evolution of the atmosphere. The GOME tool will be used on all the METOP satellites, in the Eumetsat Polar System.
  - *PRISMA Optical Payload*, an optical instrument based on a hyperspectral camera that operates in the visible and near-infrared fields and a panoramic camera in the visible field. PRISMA is one of the Italian Space Agency's missions, currently under development, the aim of which is to monitor the territory and the water, and to prevent environmental disasters.
  - *Laser Transmitter Assembly (TXA)*, a solid-state laser source developed for the European Space Agency for the ADM Aeolus mission. This highly-sophisticated tool will enable wind speed (in all three axes) to be measured with an accuracy of 2 m/s anywhere in world. Starting from this instrument, which represents the technological frontier in terms of laser radar for space applications, SELEX Galileo has derived a version for the (joint ESA-JAXA) Earth Care mission dedicated to studying interactions between clouds, radiation and aerosol processes.
- ***Navigation***:
  - *Passive Hydrogen MASER (PHM)*, the ultra-high stability atomic clock conceived for precision positioning applications and qualified for a working life of at least 12 years. The PHM has been chosen and used in the satellites in the Galileo constellation.
- ***Telecommunications***:
  - *Travelling Wave Tube Amplifiers*, operating in the frequency bandwidths from L to Ka, at power levels up to 150W, used in the telecommunications segment of the Eutelsat 2, Telecom 2, Helios 1, Hot Bird 5, SICRAL and SICRAL 1bis satellites.

- *Solid State Power Amplifiers*, operating in the frequency bandwidths UHF, L, S and X, at power levels up to 100 W, used in the telecommunications segment of the Artemis, SICRAL and SICRAL 1b satellites.

- ***Space exploration***:
  - *Visible Infrared Thermal Imaging Spectrometer (VIRTIS)*, a spectrometer that operates in the visible bandwidth and up to the medium-infrared, used in the European Space Agency's VENUS Express mission for studying the planet Venus, and its ROSETTA mission dedicated to observing the Churyumov-Gerasimenko comet. The same technology was subsequently used in the American DAWN mission, based on a bilateral agreement between the ASI and the NASA.
  - *Visible Infrared Mapping Spectrometer (VIMS)*, an optical tool developed for the ASI as the Italian contribution to the NASA Cassini mission. Its main scientific purpose is to provide high-resolution multispectral images for studying the composition of the rings around Saturn.
  - *Robotic arms (EUROPA and DEXARM)*, right-handed manipulators with up to 7 degrees of freedom for uses in activities outside the vehicle at the International Space Station, or for applications in planetary exploration (in robotic missions or for supporting human teams).
  - *Robotic drilling and sampling systems*, such as the drill, sampler and distribution system, currently on their way to collect samples (up to 20 cm deep) from the core of the Churyumov-Gerasimenko comet, as part of the Rosetta mission, and to deliver them to a suite of scientific instruments for in situ analyses. Now SELEX Galileo is developing the drill for the ESA's ExoMars mission, for collecting samples from the Martian soil down to 2 m in depth.

SELEX Galileo has been operating in the space sector ever since the 1960s, and now provides useful equipment for all the types of application described above, including photovoltaic generators, conditioning and power distributor units, and attitude sensors.

K. Other projects and players identified

The following list of projects refers to schemes in which there are currently no NEREUS partners directly involved, but which might easily be considered for scientific, industrial and institutional cooperative schemes.

Navigation

Fleet management

1. S.I.T.T. project for managing waste transportation

The Lombardy Regional Authority, together with the Irealp, has promoted the S.I.T.T. project (implemented by Allix srl) for a trans-frontier transportation information system, the purpose of which is to monitor the transit of hazardous waste, an activity that is particularly hazardous to the safety of the environment and the population. The tracking, management and recycling of waste also forms the object of EC and national/regional legislation (the management and traceability of a "green list" is planned in Annexe VII of the EC Regulation 1013/06).

The system has been designed to serve a dual purpose, of reducing the cost of managing the documentation of waste disposal activities and ensuring that the vehicles in transit are monitored in real time. This has been achieved by developing software that is easily integrated in the regional information system.

The vehicles are fitted with a GPS/GPRS localisation system so that their position can be identified precisely, then encrypted data on their location can be sent to the control room. The information coming from the vehicles is collected and sent to a protected server where it is integrated with the details of the journey for waste disposal purposes.

In cooperation with the Irealp, software has also been developed for post-processing the location data to improve the accurate identification of the vehicle's position.

2. Fleet management for monitoring goods

Another important need for public and private operators is to manage fleets of vehicles efficiently so as to optimise their environmental impact and reduce running costs, with the aid satellite navigation systems (GPS/EGNOS – GSM/GPRS). On this topic, a project has been implemented by Allix s.r.l., financed by the Lombardy Regional Authority and the Chambers of Commerce in Varese. This is a SW and HW system that enables with the delivery of accurate data relating to the route taken by vehicles over a given time period with a view to reducing pointless management costs and providing a more realistic estimate of the cost of covering certain stretches of journey. The system is also capable of integrating applications that enable a better route planning, so that the "historical details" of the journey, i.e. the distance covered in kilometres, the hours of driving and the duration of stoppages, can be compared directly on the cartographic media. Such planning activities enable any problems and wastage to be highlighted, helping to identify various appropriate solutions for improving the efficiency of the fleet's management.

Satellite localisation services designed for fleet management are also provided by Qascom in Bassano del Grappa (Vicenza, Italy).

Telecom

Satellite networks / Telemedicine

3. Telesal

The pilot telemedicine project "TELESAL" (Telecommunications for Health) is a remote medical care program based on satellite technologies promoted and financed by the Italian Space Agency, with the Lombardy Regional Authority as one of its partners.

The aim of TELESAL is to develop a "preoperational technological and applicational architecture" for broadband satellite communications interoperable with existing terrestrial communications networks (Internet, mobile telephony, etc) that can serve the purposes of the institutional telemedicine services planned by the Ministry of Health and local institutional users, in the two specific sectors of the mobile emergency services (e.g. "112") and home care. The development of telemedical services stems from primary needs of the public health care system to:

- provide quality care outside the hospital too, thereby also reducing the logistic congestion of the public health infrastructure;
- ensure an effective and capillary public health service even in areas not served adequately by information and communication services on the ground, and in operating conditions of total ground, air and maritime mobility;
- to extend the diffusion of remote medical and public health training schemes as far as possible, even to areas not served adequately by land-based and ICT networks;
- to provide public health support for other countries.

Various services may be made available to public bodies, and to hospitals in particular, e.g. video-assisted medical care, remote diagnostics, screening and remote consulting, applicable in settings ranging from the “critical” care typically provided by the 112 emergency callout service to models of home care for patients living far away from adequately equipped services. In future, a sort of domestic terminal will be used (which has already been developed), with low-cost access via satellite for the broadband transfer of all the data recorded by various diagnostic sensors provided by the public administration at the patient's own home.

TELESAL can undeniably exploit the practical support of advanced for diagnostics and prevention technologies, in the field of neoplastic diseases too. Specific experiments and demonstrations have been completed with reference to mammographic screening schemes made available by TELESAL, for instance, using a special mobile vehicle. The contribution of the Lombardy Regional Authority has been important in this project. The following is a list of the organisations in Lombardy that are involved:

- Lombardy Regional Authority
- Humanitas hospital institution
- European Cancer Institute
- Telbios (a telemedicine company)

Other TELESAL partners include: Kell, Space Engineering, D'Appolonia, Eurosoft, ITS, Techsema, Uni RM 1: Dept of Haematology, Uni RM 1: Dept of Chemistry, Uni RM 1: Dept of Histology, Uni RM 2: Dept of Electronic Engineering, Uni RM 2: Dept of Neurosciences, Uni Napoli “Federico II”: DEOMC, Uni Perugia: Faculty of Medicine, Ministry of Health, Regional Authorities of Tuscany, Campania, Basilicata, Liguria, Molise, Puglia and Umbria, Società Italiana Sistema 118, CIRM, Costa Crociere, Fondazione Santa Lucia, Policlinico Tor Vergata, Alitalia.