EARTH OBSERVATION TECHNOLOGIES TO SUPPORT AGROSECTOR IN LOMBARDY: EXPERIENCES AND PROSPECTIVE OF RL-SPACE4AGRI AND FP7-ERMES PROJECTS

Mirco Boschetti, **Massimo Antoninetti***

CNR-IREA, UOS Milano, *Nereus representative
Via Bassini 15, 20133 Milano

Info: boschetti.m@irea.cnr.it www.irea.cnr.it

PRESENTATION CONTENT

- What agriculture needs
- International Framework
- Earth Observation for vegetation monitoring: information in space and time
- What is now available
- From global to regional services: IREA contribution to regional services development
  - FP7-SPACE ERMES
  - RL-CNR Space4AGRI
- Social/Economic benefit expectation from space sector

AGRO-SECTOR THREATS & CHALLENGES

- **The agricultural sector is facing important global challenges due to:**
  - the pressure of the continuous demand of food,
  - the increased price-competition produced by market globalization and food price volatility (G20 Agriculture Action Plan)
  - the needs of more environmentally and economically sustainable farming systems.
- **The Earth Observation (EO) satellites can significantly contribute to these topics by proving reliable real time information on crop distribution, status and seasonal dynamics.**

INTERNATIONAL FRAMEWORK

GEOGLAM
Global Agricultural Monitoring

G20 FRANCE 2011 NEW WORLD NEW IDEAS

G20 Final Declaration

44. We commit to improve market information and transparency in order to make international markets for agricultural commodities more effective. To that end, we launched:

- The "Agricultural Market Information System" (AMIS) in Rome on September 15, 2011, to improve information on markets ...;
- The **"Global Agricultural Geo-monitoring Initiative" (GEO-GLAM)** in Geneva on September 22-23, 2011. This initiative will coordinate satellite monitoring observation systems in different regions of the world in order to enhance crop production projections and weather forecasting data.

- The G20 Cannes Summit (November 2011) Action Plan on Food Price Volatility and Agriculture

- Reaffirmed GEOGLAM commitment at the 2012 G-20 Los Cabos Declaration & in Agriculture Ministers Report

G20 GEOGLAM GOAL:

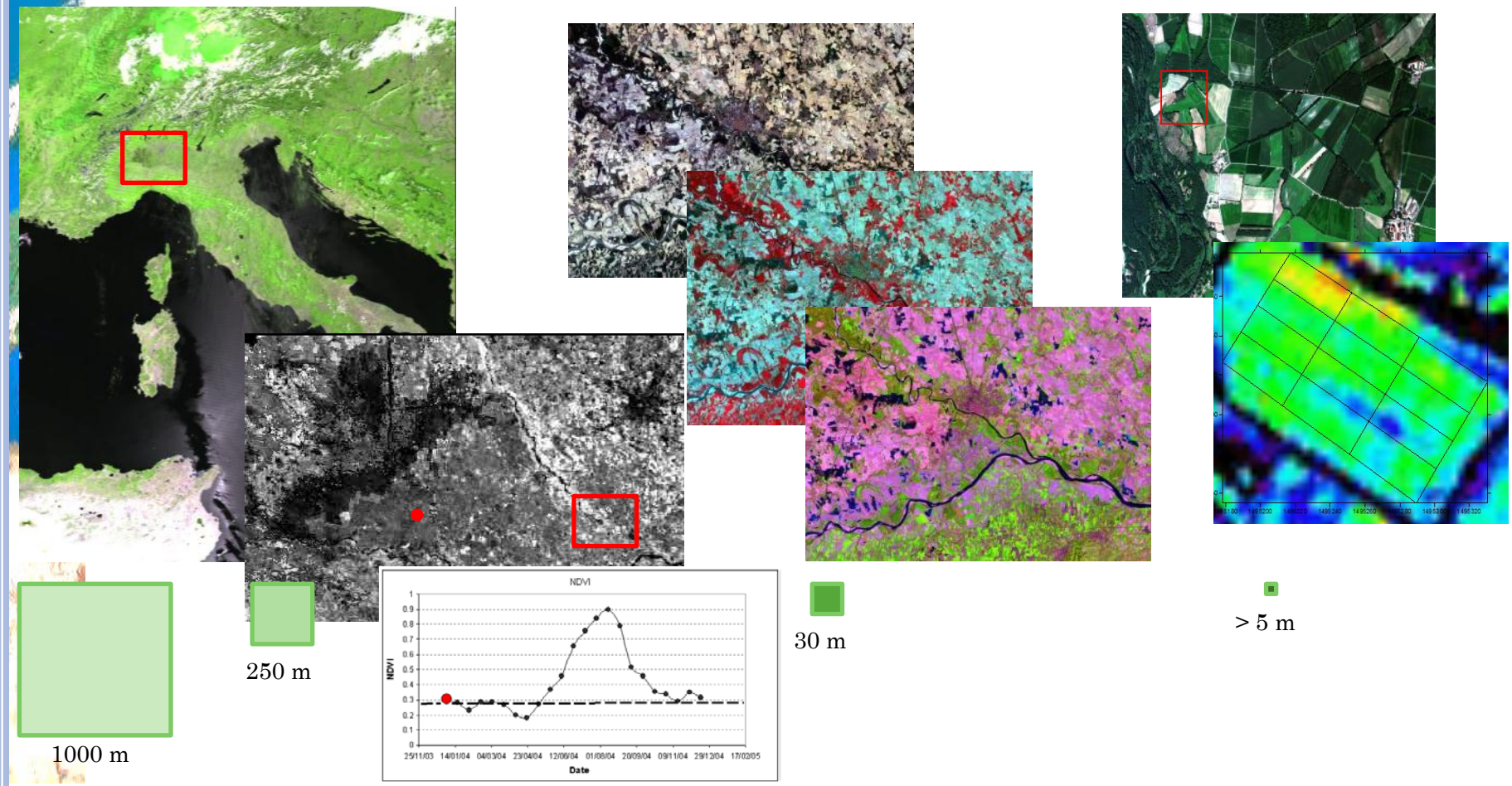
To strengthen the international community's capacity to **produce and disseminate relevant, timely and accurate forecasts of agricultural production** at national, regional and global scales through the use of EO

Outcome: an improved and more harmonized systems of systems taking advantage of new satellite assets and methods and a higher level of international coordination

GEOGLAM is implemented in the framework of GEO **(Group on Earth Observation -** open to all member States of the United Nations and to the European Commission**)**

Earth Observation

- **Peculiarity and contribution for vegetation monitoring**



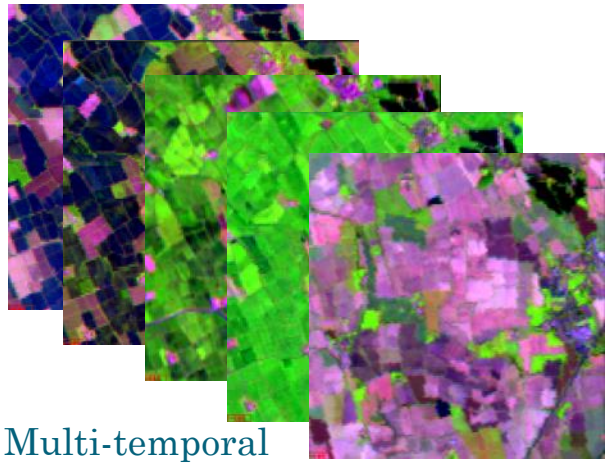
Synoptic view | Multi-temporal analysis | Multi-spectral analysis | Spatial dimension of phenomena

Istituto per il Rilevamento Elettromagnetico dell'Ambiente

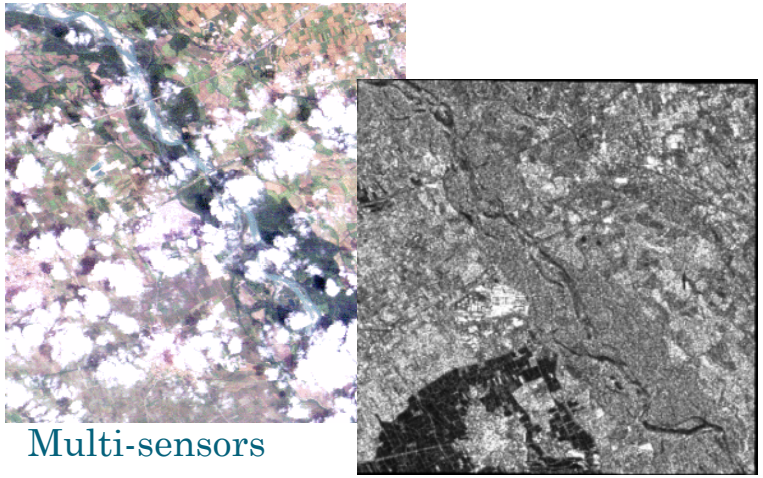
Boschetti.m@irea.cnr.it

EO FOR AGRICULTURAL MONITORING

- **From space data to information**

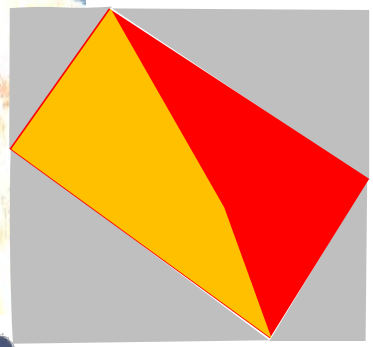


Multi-temporal

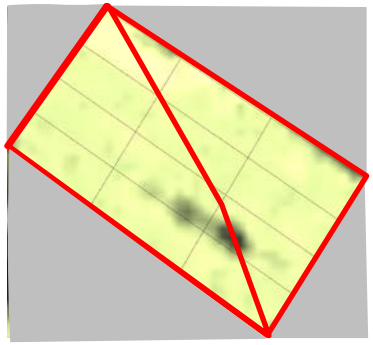


Multi-sensors

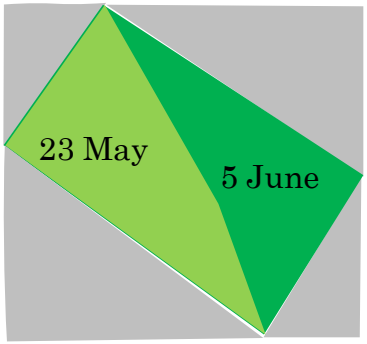
Crop type map



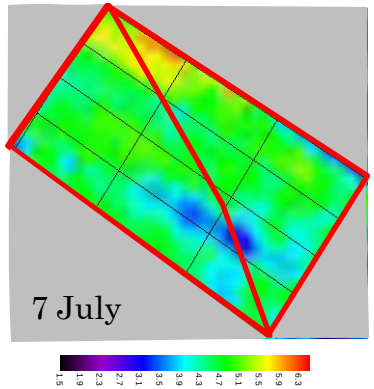
Soil variability map



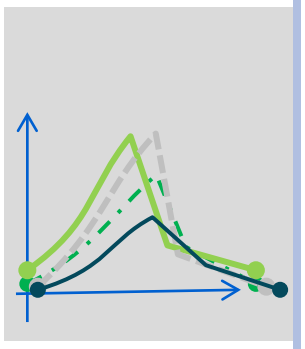
Crop sowing date map



Crop LAI map

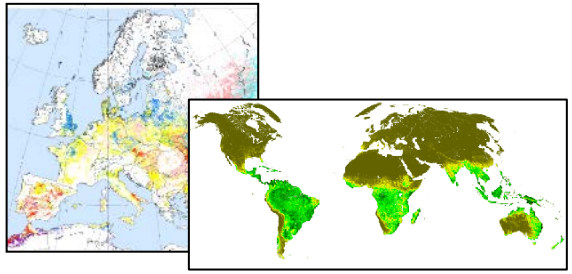
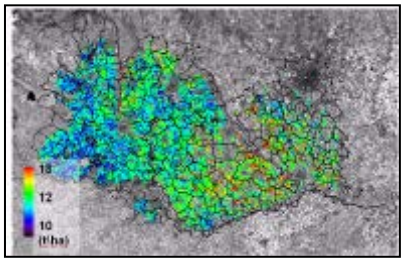
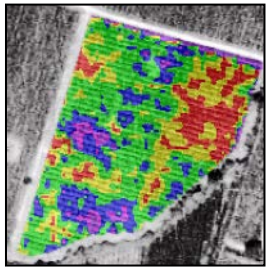


Crop LAI trend



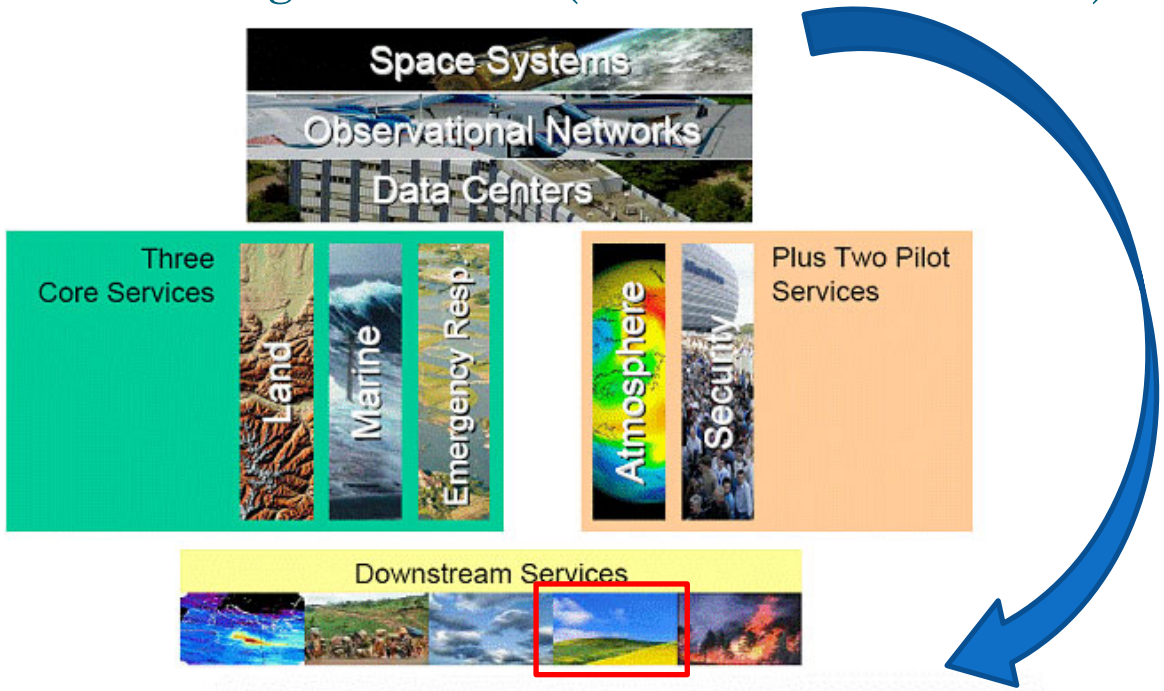
EO FOR AGRICULTURAL MONITORING

- **Maturity of different application sectors**

	Continental/global	Regional	Local
Sclale			
Applic.	Food security Price volatility control Early warning	Support to policy and planning Early warning	Agro-consulting Farm management (PF) CAP payment/damage control
Users	DG-Agri EuropAid UNEP/UE/FAO	Regional authorities Consortium	Agri-consulting/Company authority Insurance company
Characteristics requirements	Operational service Data acquisition assurance	Local knowledge Added value	

EARTH OBSERVATION TECHNOLOGIES TO SUPPORT AGROSECTOR IN LOMBARDY:

- **What IREA does**
- Develop of methods to process EO space data to provide reliable geo-product for regional/local (downstream services)



- Agro-sector
  - Land cover
  - Biophysical parameter estimation
  - Phenological monitoring
  - Crop production estimation

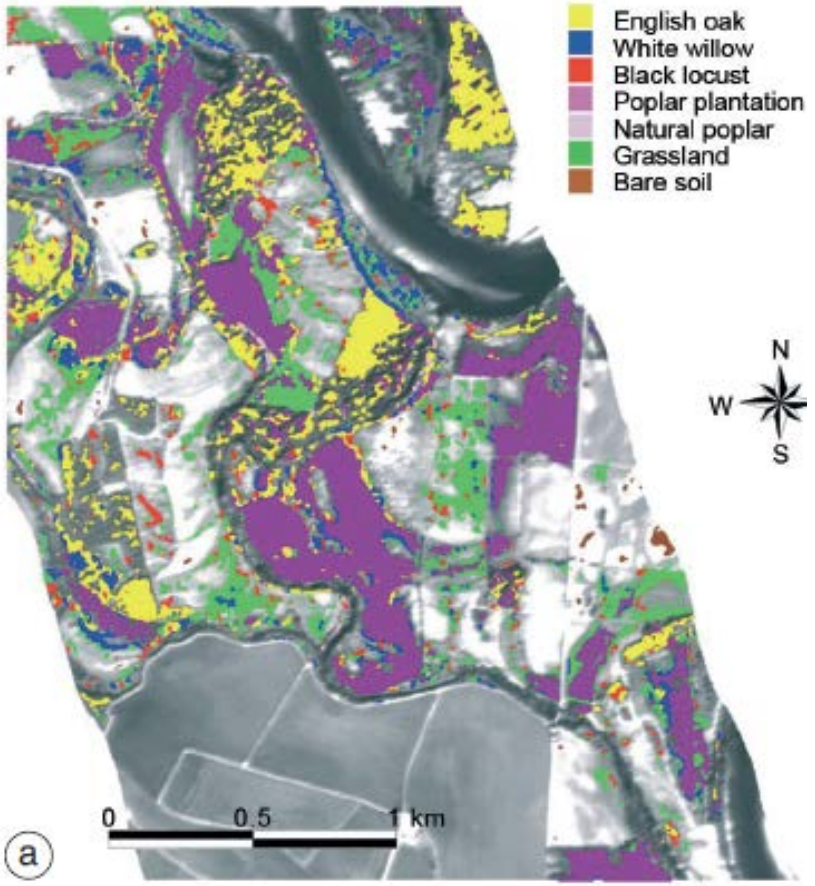
EARTH OBSERVATION TECHNOLOGIES TO SUPPORT AGROSECTOR IN LOMBARDY:

- **What IREA does**
  - Land cover

ANNALS OF GEOPHYSICS, VOL. 49, N. 1, February 2006

The contribution of hyperspectral remote sensing to identify vegetation characteristics necessary to assess the fate of Persistent Organic Pollutants (POPs) in the environment

Mirco Boschetti (1), Pietro Alessandro Brivio (1), Daniela Carnesale (1) and Antonio Di Guardo (2)
(1) *Istituto per il Rilevamento Elettromagnetico dell'Ambiente (IREA), CNR, Milano, Italy*
(2) *Gruppo di Modellistica Ambientale, Dipartimento di Biologia Strutturale e Funzionale, Università degli Studi dell'Insubria, Varese, Italy*



Boschetti.m@irea.cnr.it

EARTH OBSERVATION TECHNOLOGIES TO SUPPORT AGROSECTOR IN LOMBARDY:

- **What IREA does**
  - Biophysical parameter estimation

Field Crops Research 111 (2009) 119–129

Contents lists available at ScienceDirect

Field Crops Research

journal homepage: www.elsevier.com/locate/fcr

Plant nitrogen concentration in paddy rice from field canopy hyperspectral radiometry

Daniela Stroppiana [a,*], Mirco Boschetti [a,b], Pietro Alessandro Brivio [a], Stefano Bocchi [b]

[a] CNR-IREA, Institute for Electromagnetic Sensing of the Environment, Via Bassini 15, 20133 Milano, Italy
[b] DI.PRO.VE., Department of Crop Science, University of Milano, Via Celoria 2, 20133 Milano, Italy

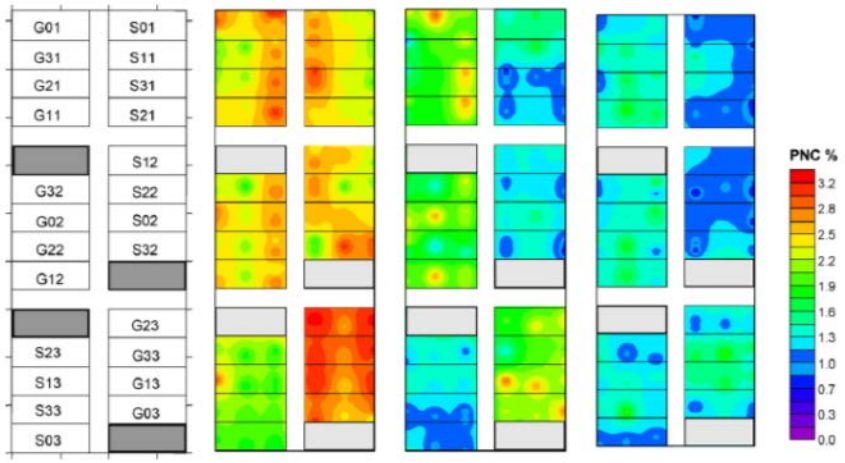


Fig. 9. PNC maps derived from radiometric field measurements for the year 2006; grey blocks identify plots where rice was not sown. A schematic of the experimental design is also shown (Sij and Gij is Selenio cv. and Gladio cv., respectively, i is fertilization level and j replicate).

EARTH OBSERVATION TECHNOLOGIES TO SUPPORT AGROSECTOR IN LOMBARDY:

What IREA does

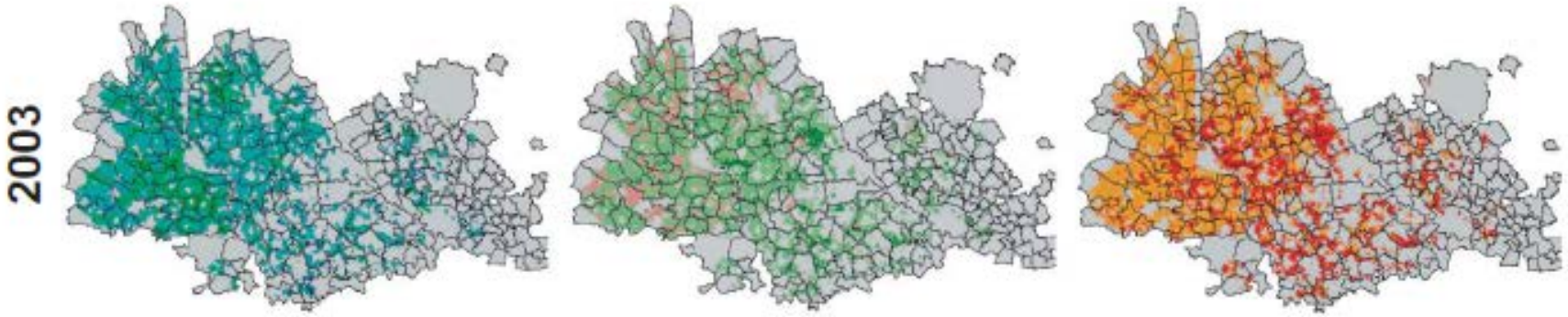
- Phenological monitoring

International Journal of Remote Sensing
Vol. 30, No. 18, 20 September 2009, 4643–4662

Taylor & Francis
Taylor & Francis Group

Multi-year monitoring of rice crop phenology through time series analysis of MODIS images

M. BOSCHETTI*†‡, D. STROPPIANA†, P. A. BRIVIO† and S. BOCCHI‡
†IREA-CNR, Institute for Electromagnetic Sensing of the Environment, Via Bassini 15, 20133 Milano, Italy
‡Department of Crop Science, Section of Agronomy, University of Milano, Via Celoria 2, 20133 Milano, Italy



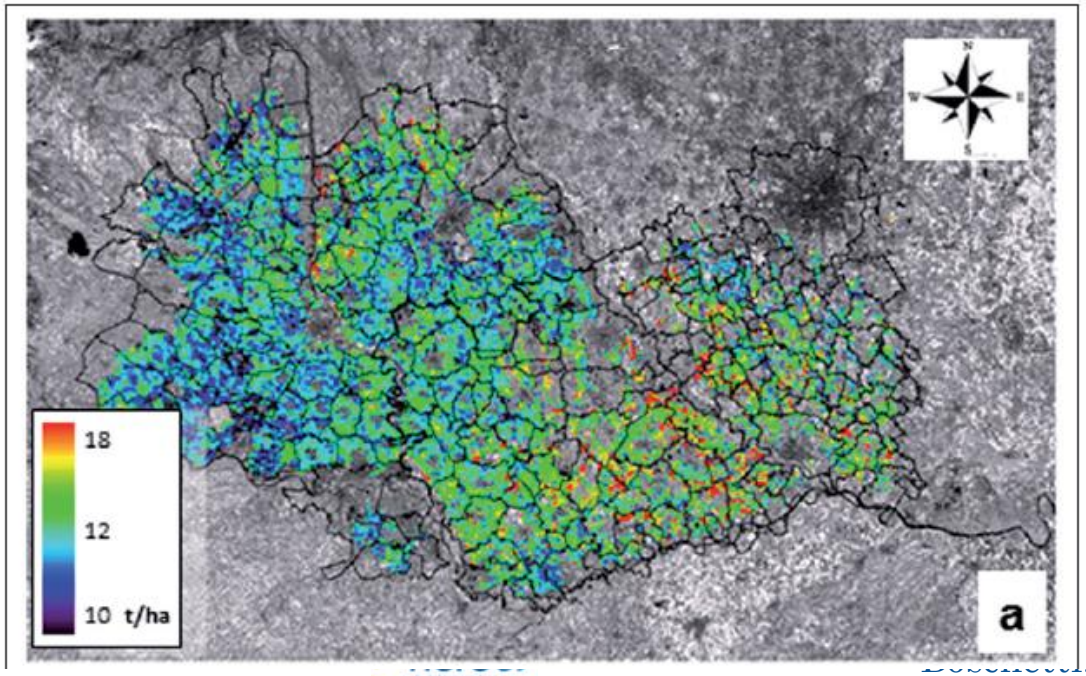
EARTH OBSERVATION TECHNOLOGIES TO SUPPORT AGROSECTOR IN LOMBARDY:

- **What IREA does**
  - Crop production

Italian Journal of Remote Sensing - 2011, 43 (3): 63-81
doi: 10.5721/ItJRS20114335

Estimation of rice production at regional scale with a Light Use Efficiency model and MODIS time series

Mirco Boschetti[1], Daniela Stroppiana[1], Roberto Confalonieri[2], Pietro Alessandro Brivio[1], Alberto Crema[1] and Stefano Bocchi[2]



Istituto per il Rilevamento Elettromagnetico dell'Ambiente

Boschetti.m@irea.cnr.it

EARTH OBSERVATION TECHNOLOGIES TO SUPPORT AGROSECTOR IN LOMBARDY

- **On going project**

Space 4 Agri

RegioneLombardia

Consiglio Nazionale delle Ricerche

ERMES

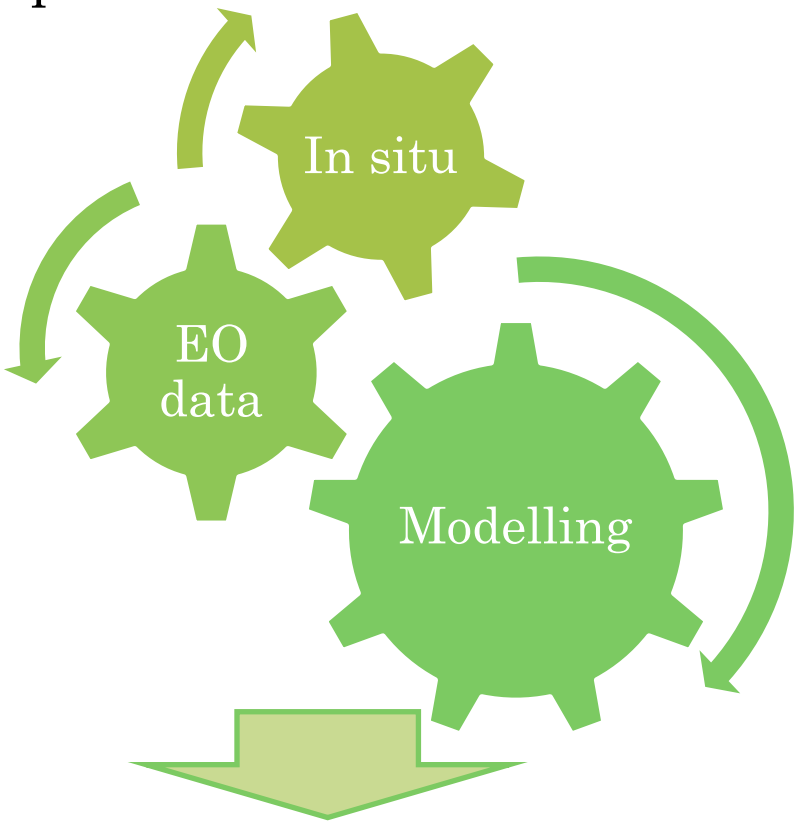
Earth obseRvation Model based RicE information Service

SEVENTH FRAMEWORK PROGRAMME

opernicus
The European Earth Observation Programme

EARTH OBSERVATION TECHNOLOGIES TO SUPPORT AGROSECTOR IN LOMBARDY

- **The IREA approach: from data to info**
  - integration of EO data, in situ observation and modelling components



RegioneLombardia

Space 4 Agri

Tecnologie satellitari e web 2.0 per il settore agricolo in Lombardia

Istituto per il Rilevamento Elettromagnetico dell'Ambiente

Boschetti.m@irea.cnr.it

Framework

- Framework Agreement Regione Lombardia/CNR

Objectives

- Exploit the **Aerospace Earth Observation sector** for developing Copernicus downstream services and supporting REGIONAL business, public administrations and citizens
- Meet the **needs expressed by DG Agricoltura,** Regione Lombardia (e.g. Workshop "Agrispazio Space Application Contest 2012", Milano 29/11/12) and shared with ARPA Lombardia, to develop solution to support planning and management in the Agrifood sector favoring sustainable development able to face climatic changes and to coping with challenges brought by globalization

RegioneLombardia

Space 4 Agri

Objective: to develop methods for creatng reliable information for agro bulletins (e.g. crop type and phenology maps, alarm on crop water stress)

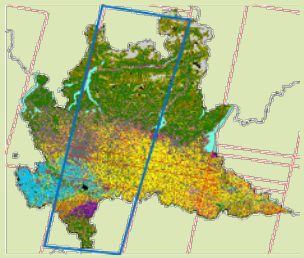
Components

AERO

UAV

IN SITU

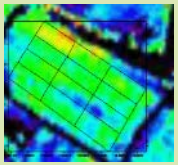
Smart application



SPACE

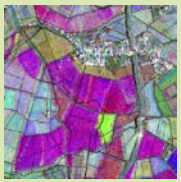
Satellite data

Expected products



HR EO data acquisition

- Early crop maps
- Phenological monitoring
- Water stress indicator



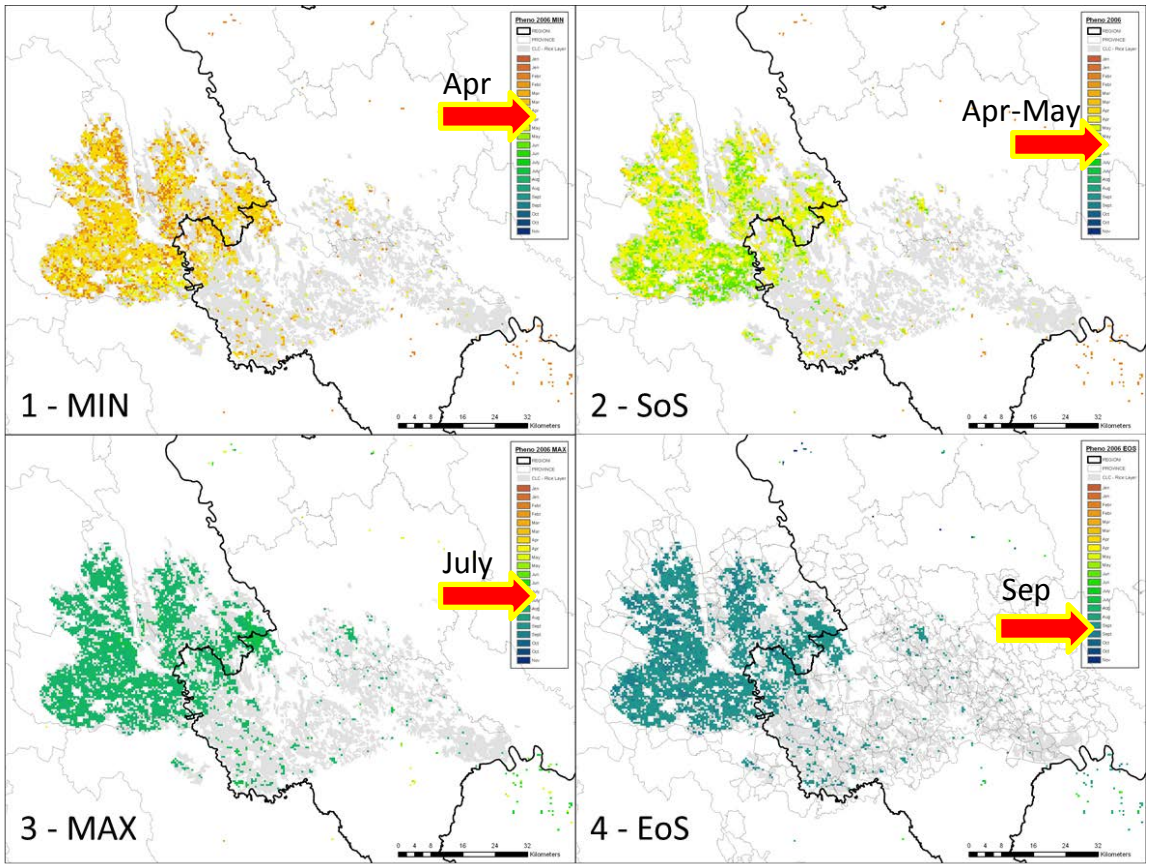
Smart tools to **acquire field data and return info to user**

Istituto per il Rilevamento Elettromagnetico dell'Ambiente

Boschetti.m@irea.cnr.it

Time series satellite data -> phenology

SPACE
Satellite data



Istituto per il Rilevamento Elettromagnetico dell'Ambiente

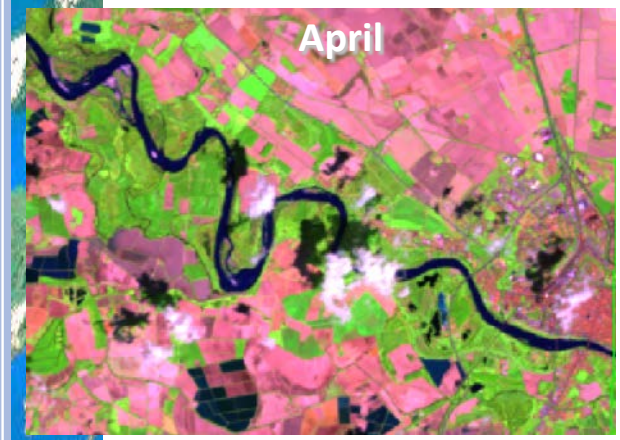
Boschetti.m@irea.cnr.it

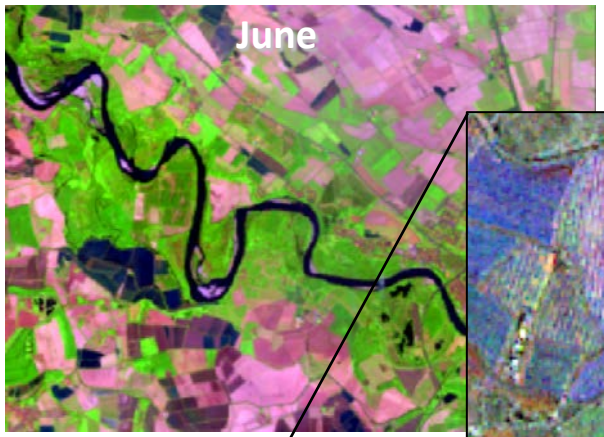
RegioneLombardia

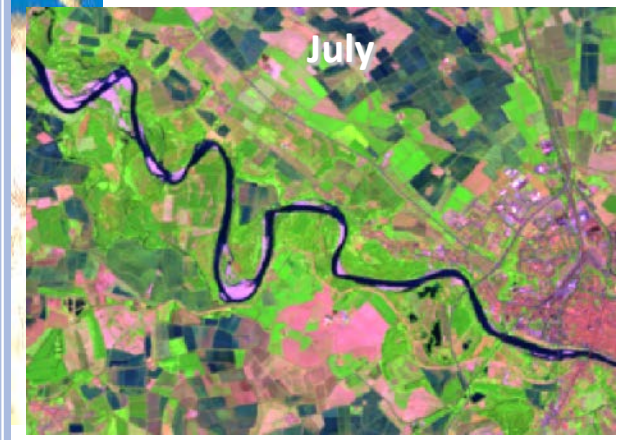
Space 4 Agri

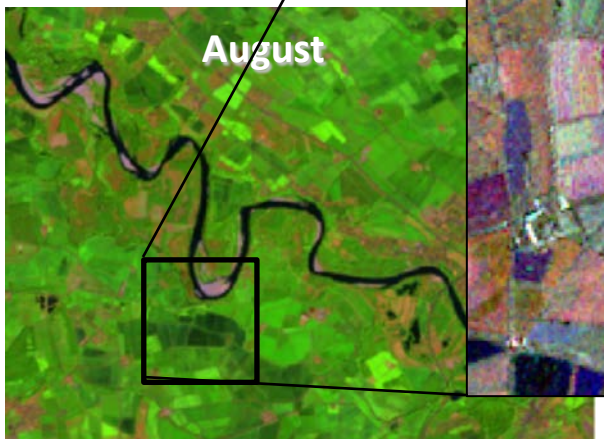
Integration of HR optical and sar data

SPACE
Satellite data









Landsat 8, OLI, 30 metri multispettrale

Cosmo-Skymed, 3 metri, Band X

Istituto per il Rilevamento Elettromagnetico dell'Ambiente

nereus

Boschetti.m@irea.cnr.it

Istituto per il Rilevamento Elettromagnetico dell'Ambiente

Boschetti.m@irea.cnr.it

ERMES

Earth obseRvation Model based RicE information Service

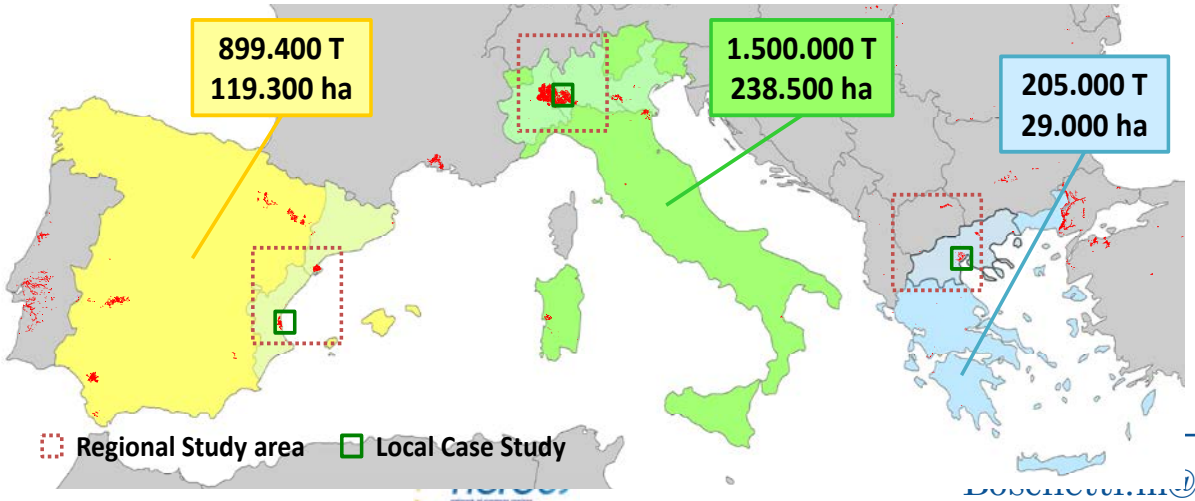
- **Framework**

  FP7 Space Call - Stimulating development of downstream services and service evolution - **Time**: 2014-2016

- **Partners**

  Coordinator

- **Study area**



ERMES

Earth obseRvation Model based RicE information Service

End user and requirements

USER	Typology and peculiarity	Service interest
DG Agr. Regione Lombardia (RL)	**Public authority**. RL is Vice-President of NEREUS and it is promoting through RCO GMES technologies	Regional Agro-monitoring Service.
ENTE RISI (ER)	**Public research body.** Responsible of the official rice statistics in Italy	Innovation in rice monitoring devoted to yield estimation. Provide decision support to producers
C.R.D.O.	**Private non-profit corporation**. in charge of promoting in Spain the production of rice	Operative customised farming information service to support rice farming
DEMETER	**Public research body.** Mandate in the cereal crops research	Regional and Local Service.
Chalasytra B	**Private non-profit corporation**. Agricultural cooperative aiming at for economic and social growth of the members	Regional and Local Service.
KANAKAS BROS Ltd	**Private**. production and trading of agricultural products and foods	Regional yield forecasting.
Allianz Re	**Private.** insurance company	Local Service to assess production variability, damages and lossess.

ERMES

Earth obseRvation Model based RicE information Service

- **AIM**
  - develop a prototype of **downstream service** dedicated to rice sector to
    - contribute to **the regional authorities** in the implementation of agro-environmental policies;
    - **provide independent reliable information** to the agro-business sector.
    - **support farming activities** for sustainable management practices;
  - The long term goal is to extend and adapt the service to Asian and African markets, in order to **boost European competitiveness** and contribute to a **sustainable development**.

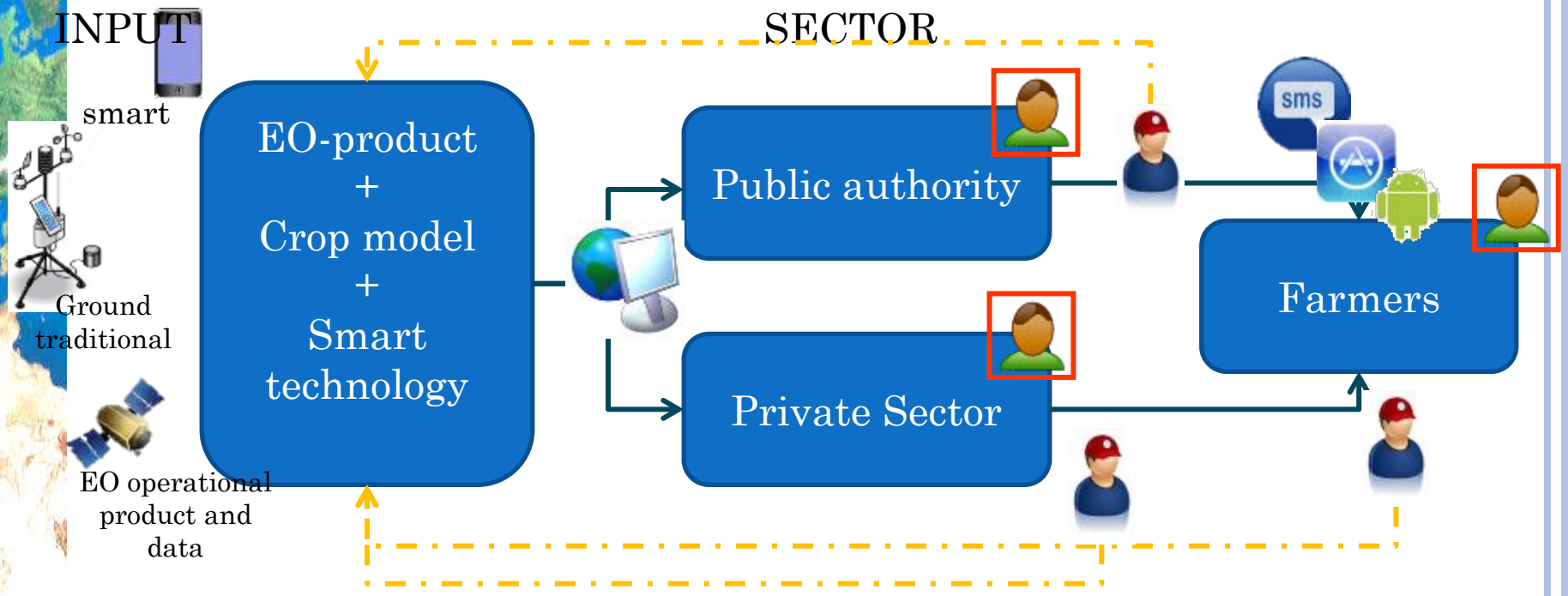
Istituto per il Rilevamento Elettromagnetico dell'Ambiente

Boschetti.m@irea.cnr.it

ERMES

Earth obseRvation Model based RicE information Service

- Data-information-service scheme



Istituto per il Rilevamento Elettromagnetico dell'Ambiente

Boschetti.m@irea.cnr.it

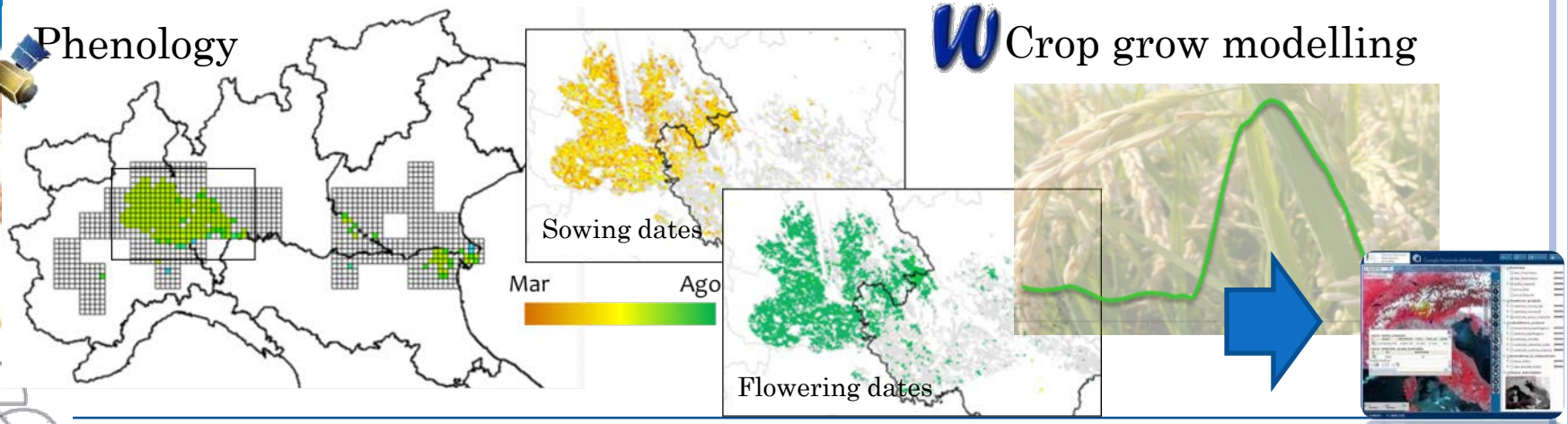
ERMES

Earth obseRvation Model based RicE information Service

Regional Products

Input EO-products	Code	Geo-information	Delivery time	Spatial coverage/ Resolution
Rice crop map	EI_R1	Crop monitoring*,**	Apr-Oct. bi-monthly	Simulation unit
Phenology	EI_R2	Yield forecast**	Jul-Sept. 2 bulletins	Simulation unit
Biopar	EI_R3	Risk alert (biotic abiotic)**	In case	Simulation unit
Meteo variable	EI_R4	Yield estimation and grain quality**	October. 1 bulletins	Simulation unit

Phenology



Crop grow modelling

Istituto per il Rilevamento Elettromagnetico dell'Ambiente

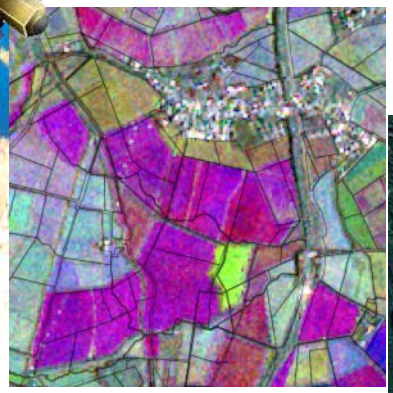
Boschetti.m@irea.cnr.it

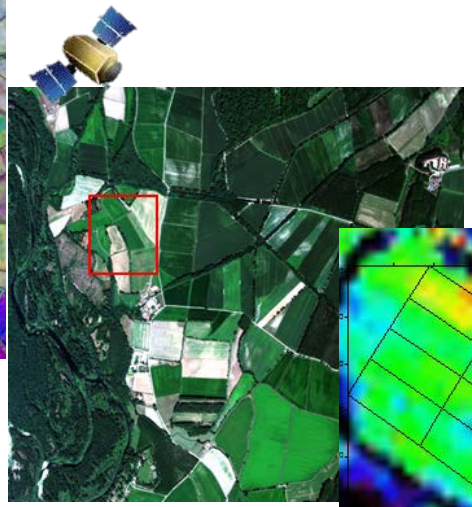
ERMES

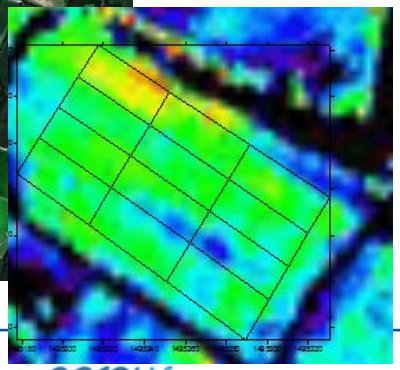
Earth obseRvation Model based RicE information Service

Local Products

Input EO-products	Code	Geo-information	Delivery time	Spatial coverage/ Resolution
Cultivated area	EI_L1	Yield pattern**	October	<20 m
Soil/biomass constant patterns maps				
Seasonal patterns	EI_L2	Risk alert (biotic abiotic)**	In case via Smart app	Farm
	EI_L3	Crop damage*,**	October.	<20 m







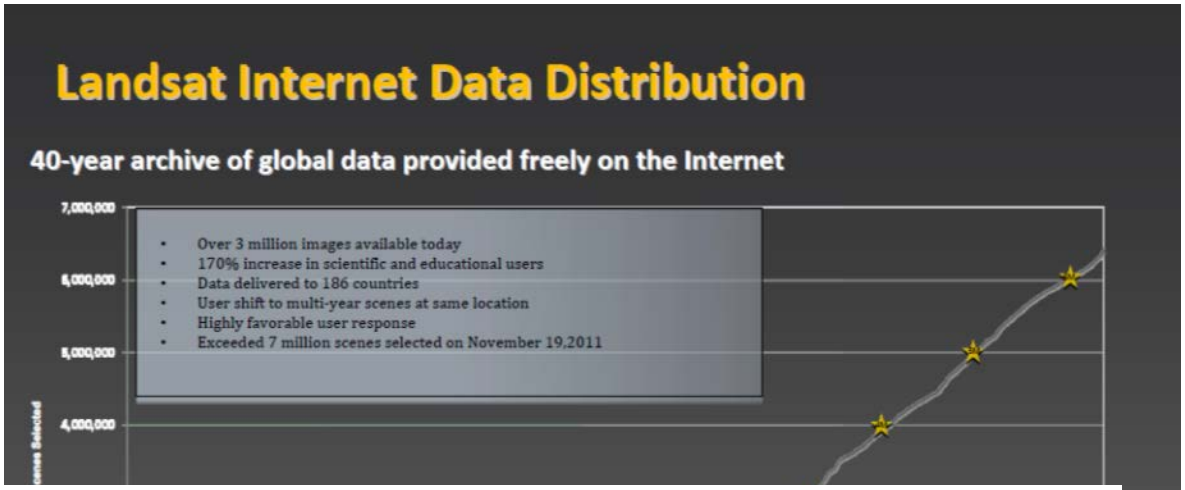
Farm WEB-GIS

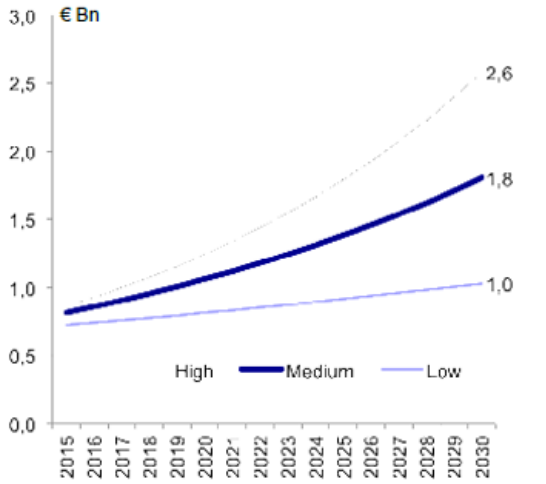
Smart App

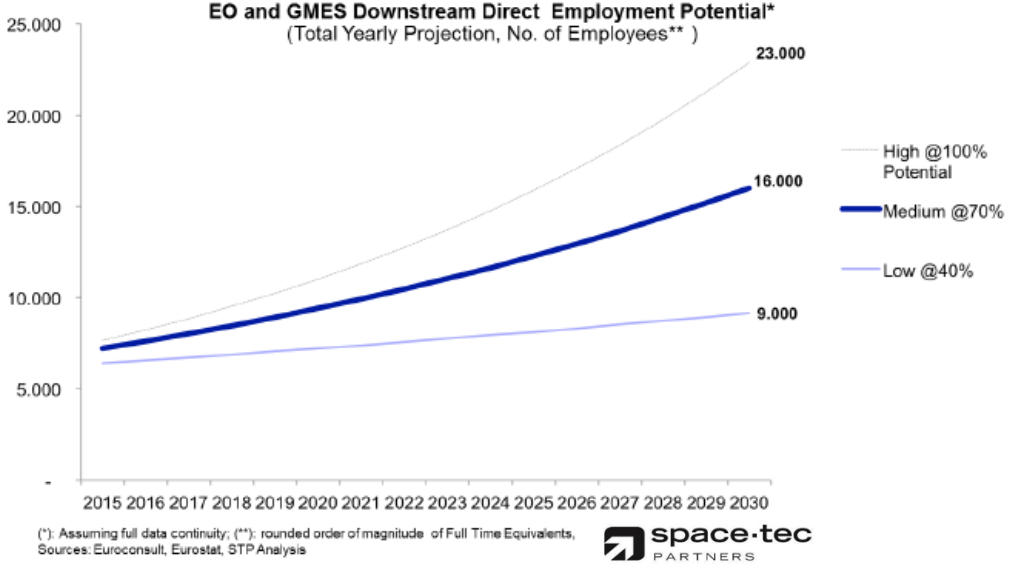
Istituto per il Rilevamento Elettromagnetico dell'Ambiente

Boschetti.m@irea.cnr.it

EXPECTATIONS - 1



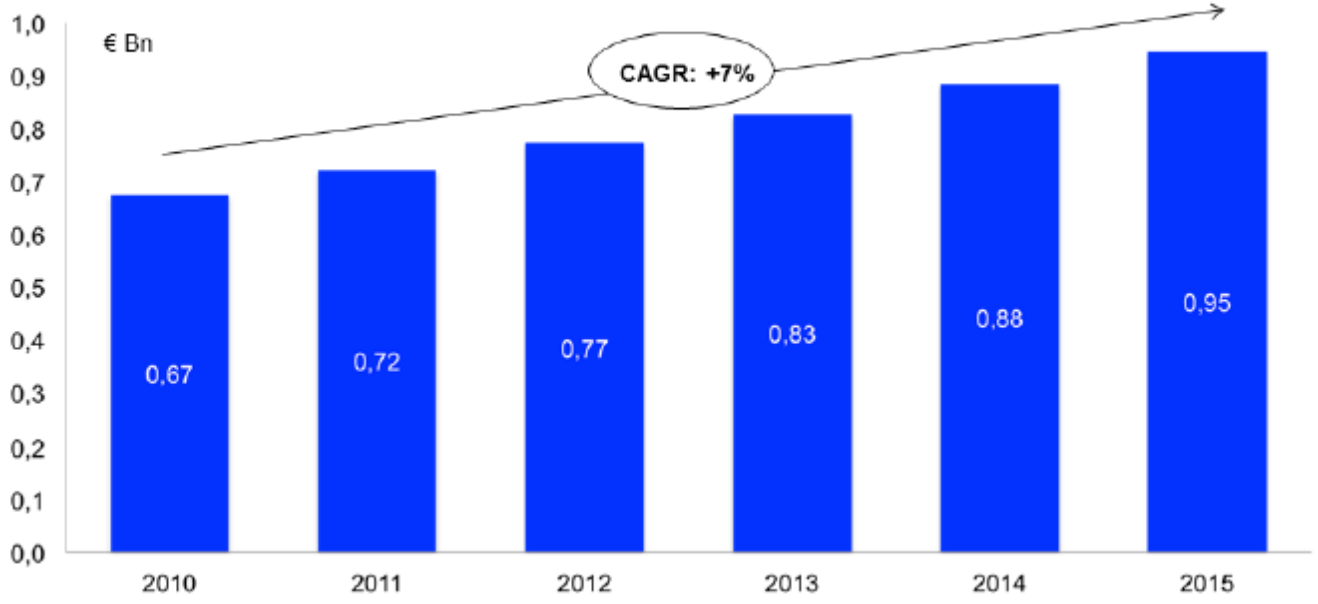




EXPECTATIONS - 2

Long Term Forecast EO Downstream Services Market Potential in Europe
(Selected Market Segment Analysis, Indicative Figures of Turnover in € Million)

Earth Observation Downstream Services Market Forecast
(Europe 2010-2015, Turnover in Euro Billion)



CAGR: Compound Annual Growth Rate
Source: Euroconsult (2011), STP Analysis

space·tec PARTNERS

surance

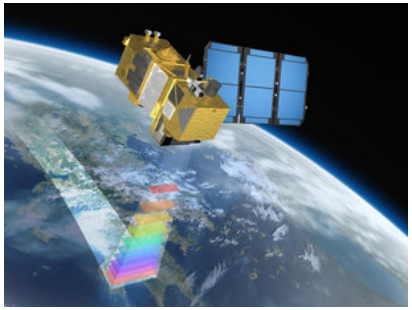
of crude oil and natural gas

sport

space·tec PARTNERS

CONCLUSION

- ....



opernicus
The European Earth Observation Programme

The maturity of **Copernicus products** and the advent of **Sentinel data represent** the right framework to develop specific EO based added value products for agriculture sector.
In particular the complementary information of Sentinel SAR and Optical data at high resolution will provide a new opportunity to guarantee operational customised information on crop status **making regional agro-monitoring feasible** and **local agro-consulting possible.**