



SINOPIAE

MULTI-SCALE MONITORING OF ANTHROPOGENIC EFFECTS ON AIR QUALITY AND CLIMATE CHANGE IN LOMBARDY REGION

Branka Cuca

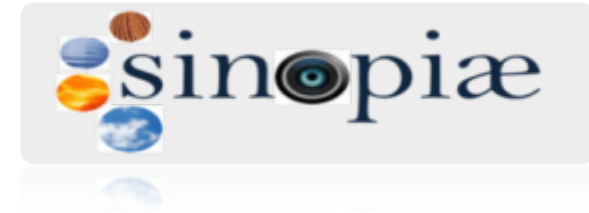
Politecnico di Milano
SINOPIAE consortium
LOMBARDY REGION
ITALY



POLITECNICO DI MILANO



Objectives of Sinopiae



- Objective of the project is a creation of a **prototype system** that operates in the Lombardy region for the **multi-scale monitoring of environmental parameters** such as: the concentration of atmospheric constituents to the surface (gas and aerosol) in urban and non-natural components and man-made aerosols; thermal dispersion in urban areas; direct climatic effects of natural and anthropogenic aerosols .
- The system will help to **better understand the weather and climatic processes induced by human activities at the regional scale**. This will be performed through modules able to assess the effects of air pollution (gas and aerosol), also on lakes and glaciers, the dispersion energy on an urban scale, the direct effects of aerosols on the radiation budget of the surface-atmosphere system at the regional scale and the interaction of emission scenarios of air pollutants and energy in the urban environment.
- The projects foresees the **integration of multi-source observations** from ground-sensors, airborne and satellite data and through the use of models that consider the meteorology, the transport and the dispersion and the chemistry of pollutants and their interaction with the radiative aspects.
- **Funding:** Lombardy Region
- **Prime contractor:** CGS (Compagnia Generale per lo Spazio)
- **Duration:** 2013 - 2014

STUDY 1. NI Air Quality monitoring

PM satellite-based & EC Directive



July 17th 2007 - MODIS/Terra

PM2.5 [$\mu\text{g}/\text{m}^3$]

February 10th 2008 - MODIS/Terra

PM2.5 [$\mu\text{g}/\text{m}^3$]

2008 yearly average MODIS-based

PM2.5 [$\mu\text{g}/\text{m}^3$]

$25 \mu\text{g}/\text{m}^3$

2008 yearly average MODIS-based

PM10 [$\mu\text{g}/\text{m}^3$]

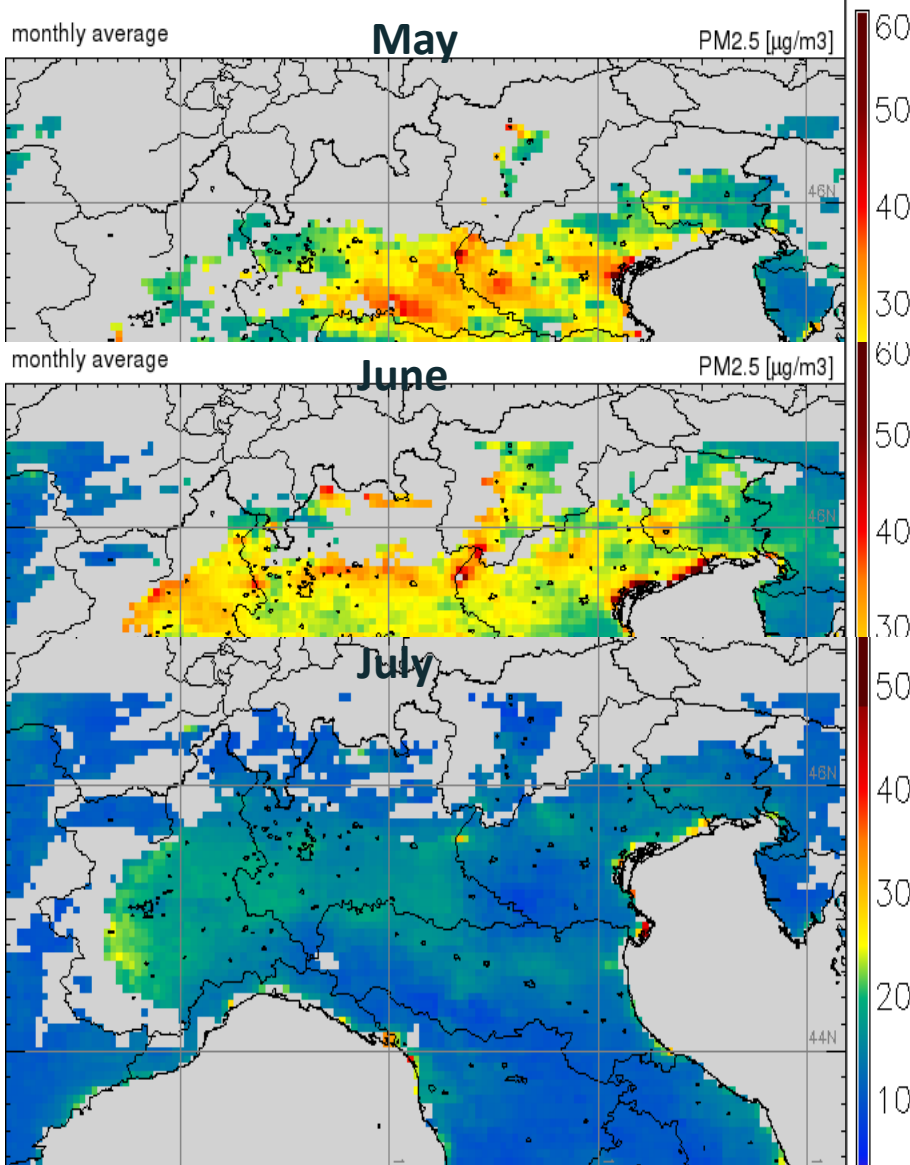
2008- PM10 MODIS-based

% exceedances above 50 $\mu\text{g}/\text{m}^3$

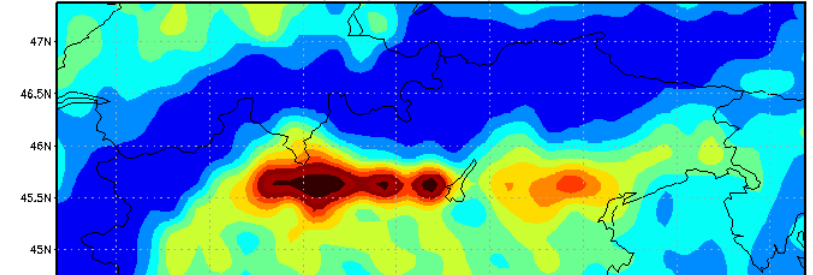
$40 \mu\text{g}/\text{m}^3$

$>50 \mu\text{g}/\text{m}^3$ for 35 days/year, as 10 %

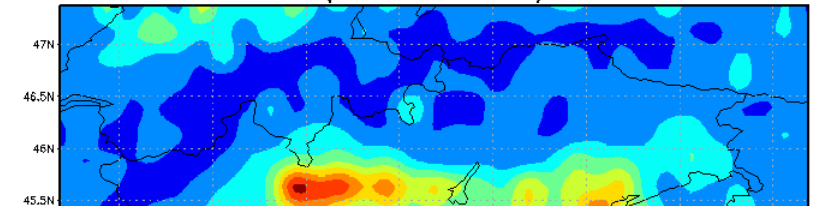
NI Air Quality monitoring: monthly PM & NO2 / 2008



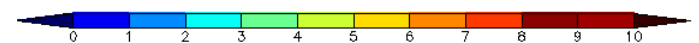
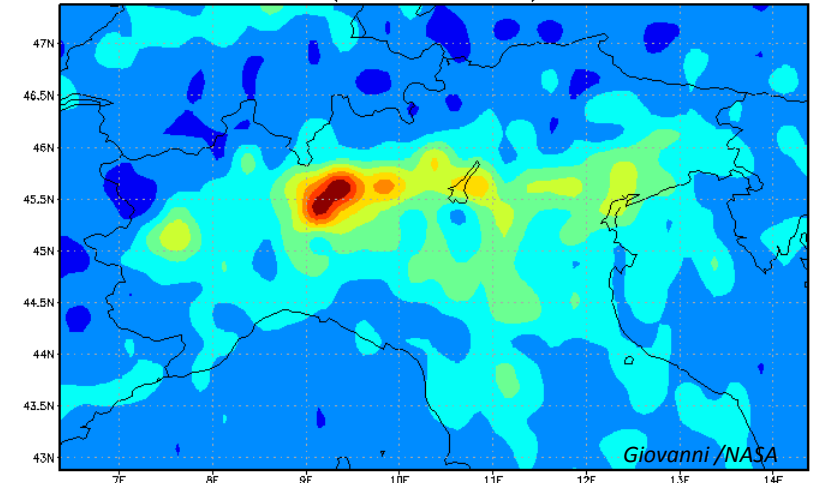
OMNO2G.003 NO2 Tropospheric Column Amount (Clear, 0-30% Cloud) [10^{15} molec/ cm^2] (01May2008 - 31May2008)



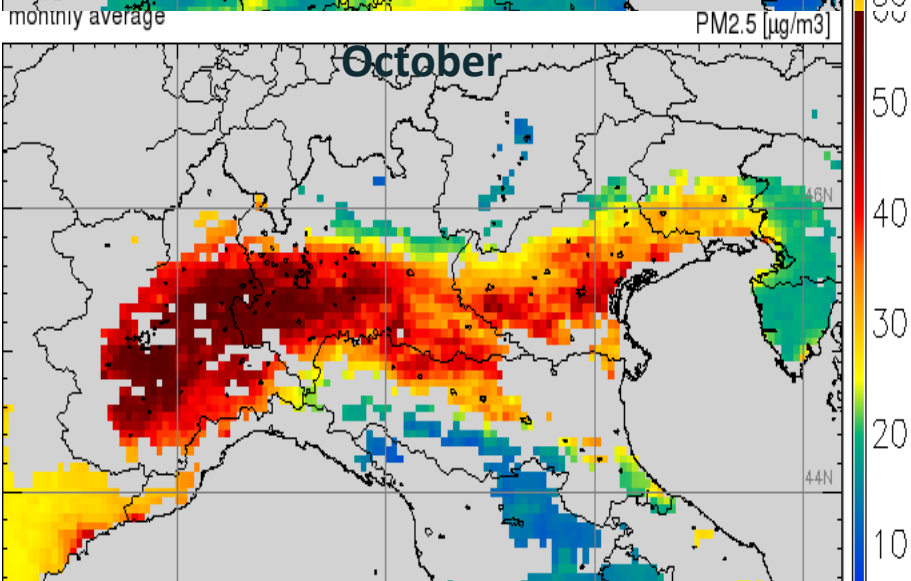
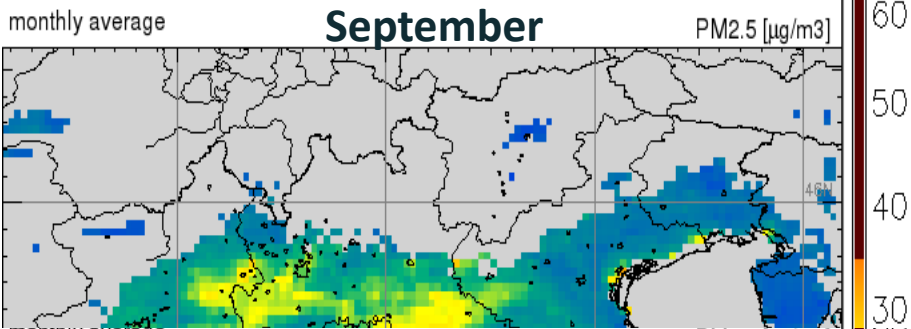
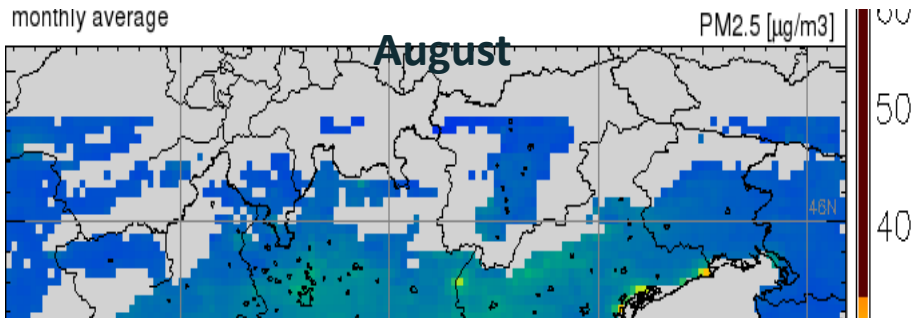
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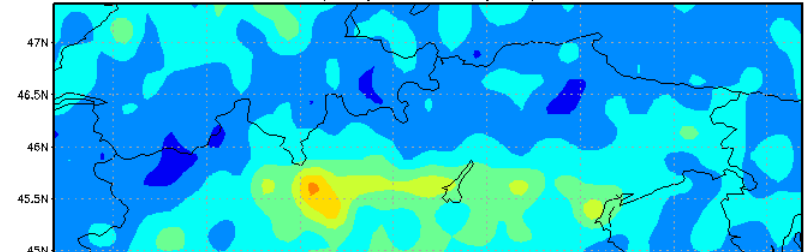
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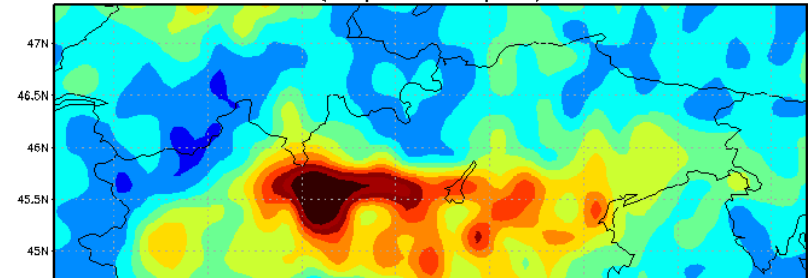
NI Air Quality monitoring: monthly PM & NO2 / 2008



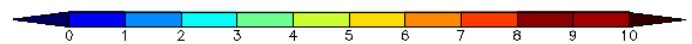
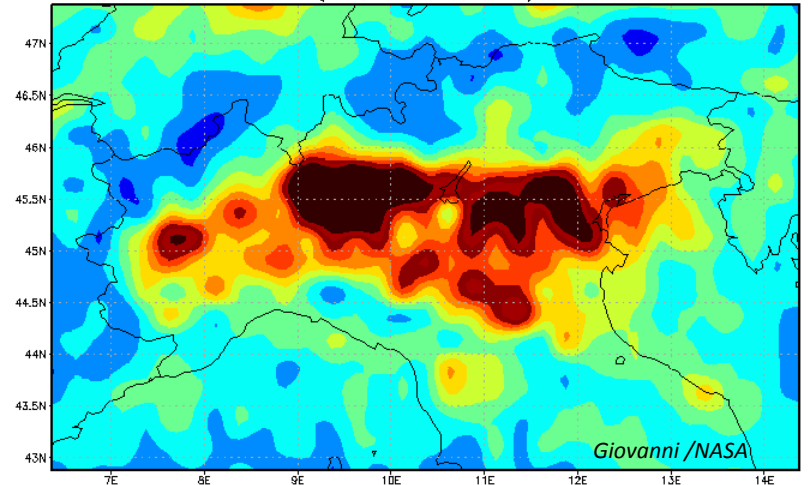
OMNO2G.003 NO2 Tropospheric Column Amount (Clear, 0-30% Cloud) [10^{15} molec/cm²] (01Aug2008 - 31Aug2008)



OMNO2G.003 NO2 Tropospheric Column Amount (Clear, 0-30% Cloud) [10^{15} molec/cm²] (01Sep2008 - 30Sep2008)

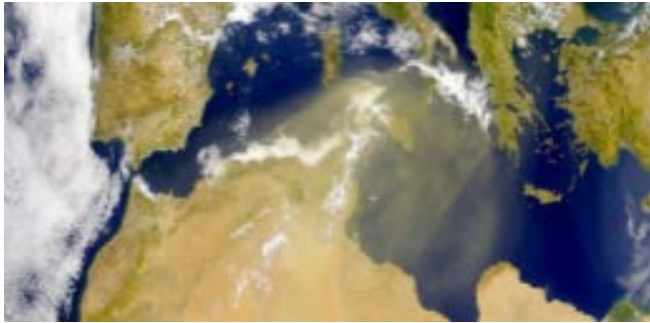


OMNO2G.003 NO2 Tropospheric Column Amount (Clear, 0-30% Cloud) [10^{15} molec/cm²] (01Oct2008 - 31Oct2008)

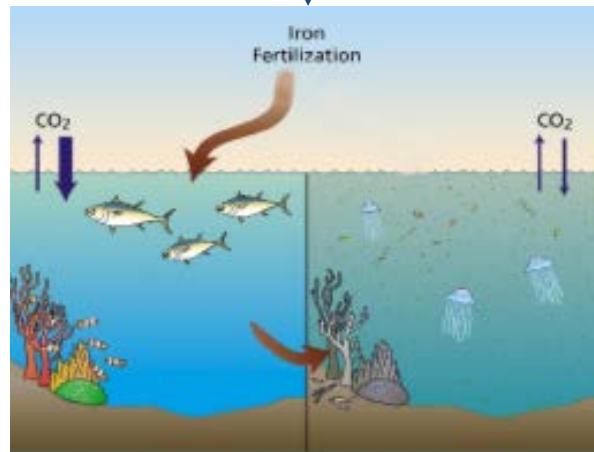


STUDY 2. Garda Lake Water Quality

Desert dust deposition effects



Saharan dust
(Saharan sand rich in trace metals)



Increase of nutrients
thanks to trace metals in
water and consequent
phytoplankton
development



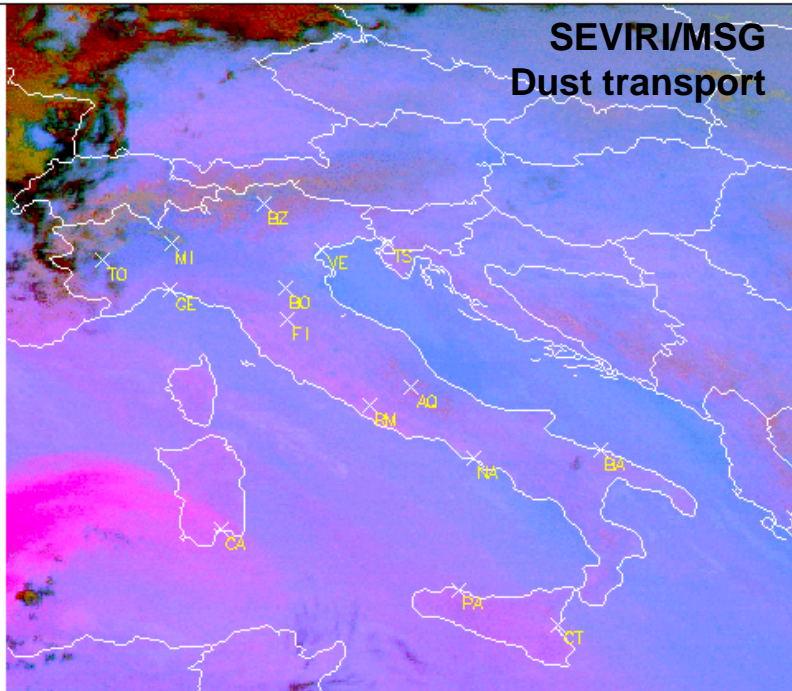
Potential increase of
chl-a concentration

Garda Lake WQ: Saharian dust event & deposition impact

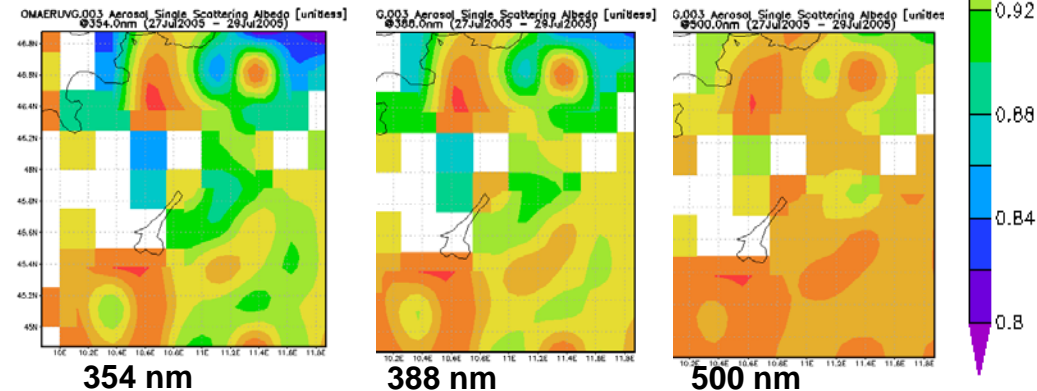
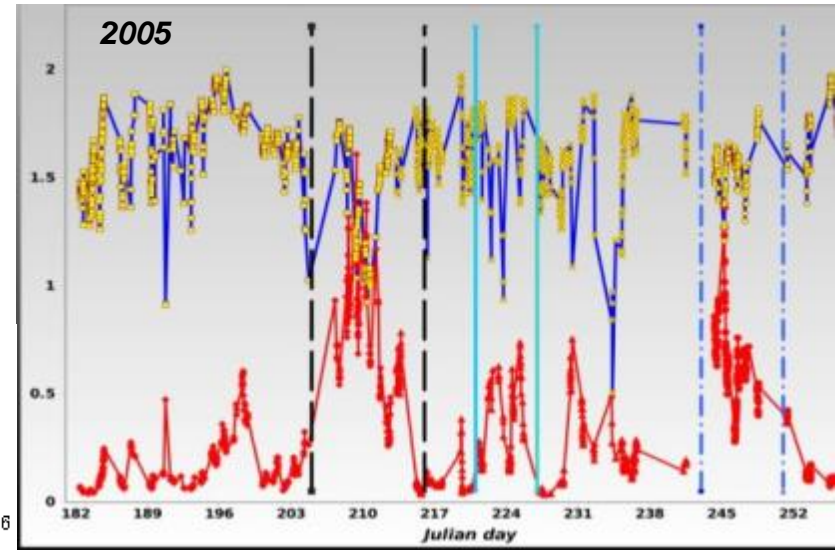
Saharan dust event identification 2005 July 28



- BTD RGB (IR12.0-IR10.8, IR10.8-IR8.7, IR10.8) 2005 07 28 01:00

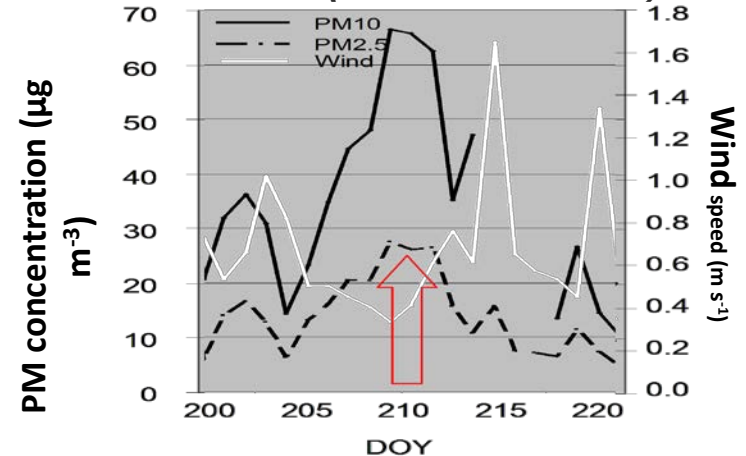


AOD & Angstrom parameter - Ispra (VA)



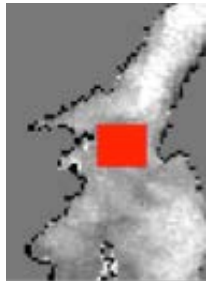
OMI UV SSA: 27-29 July '05 : dust SSA increase with wavelength

PM in-situ (Bosco Fontana)

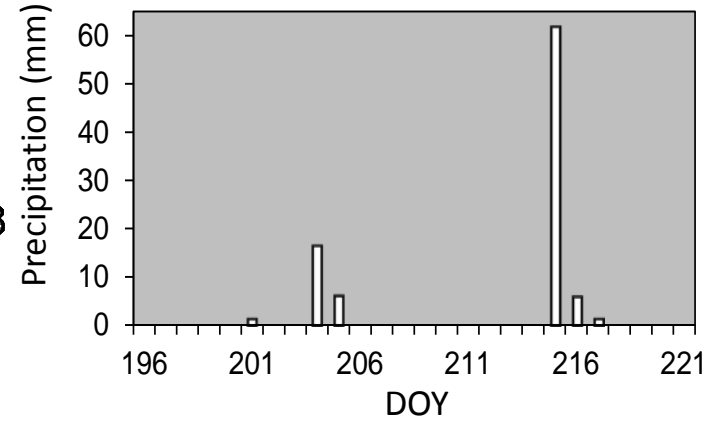
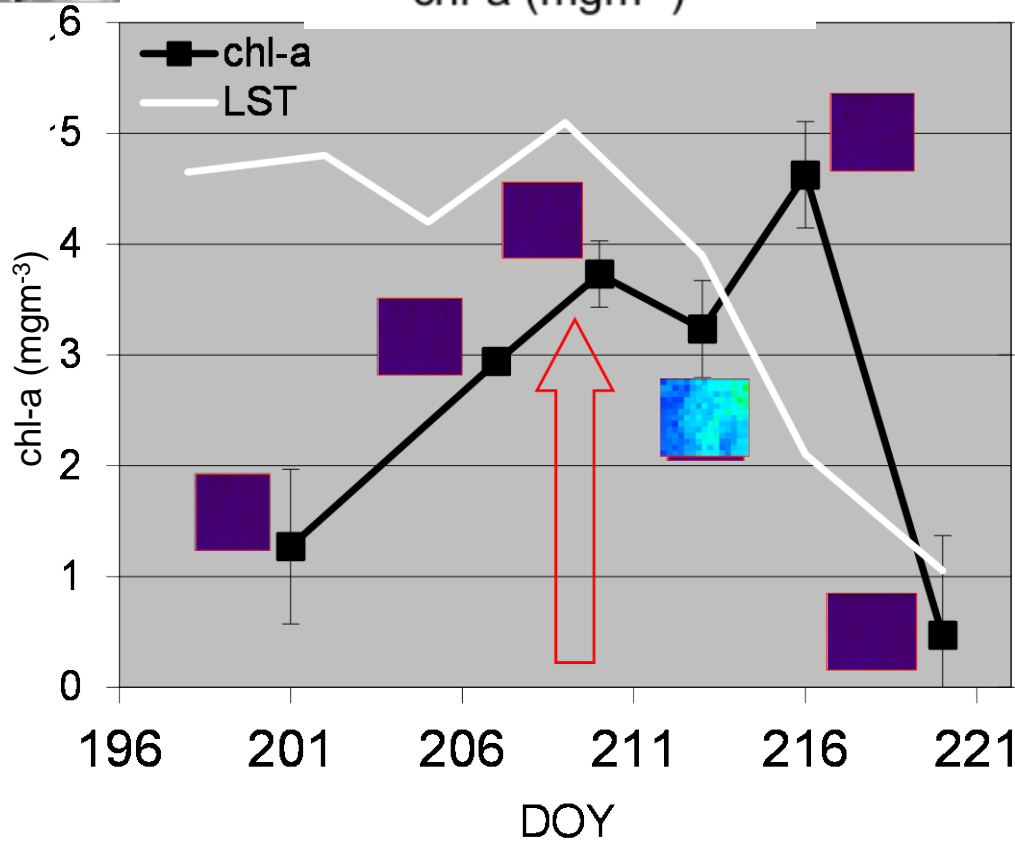
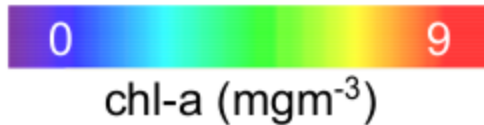


Garda Lake WQ: Saharian dust event & deposition impact

Saharan dust event identification 2005 July 28



Deposition impacts



Allows wet deposition and impacts water quality

Chl-a concentration: good agreement between in situ and MERIS estimation.

Chl-a increase is due to dust deposition

STUDY 3. Correlation between the T° increase in urban areas and the energetic dispersion of buildings



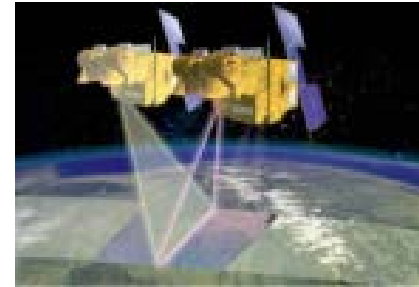
Innovation:

- New instruments for control and monitoring at urban – district – building scale
- Development of multi-sensor UAV platforms (Polimi)

Copernicus (GMES) Services in response to Grand challenges of Horizon2020

- Energy management and Monitoring (heat island, implementation of Urban Atlas, urban energy dispersion models)
- Orientation of actions, directives and policies regarding retrofiting; impact on overall climate change.

Satellite images



> 700 km

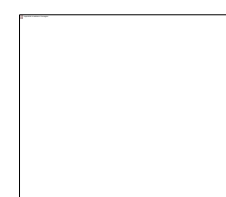
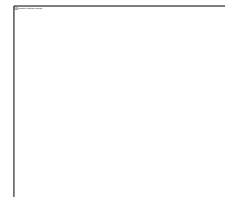
Aerial images



UAVs



Close-range images



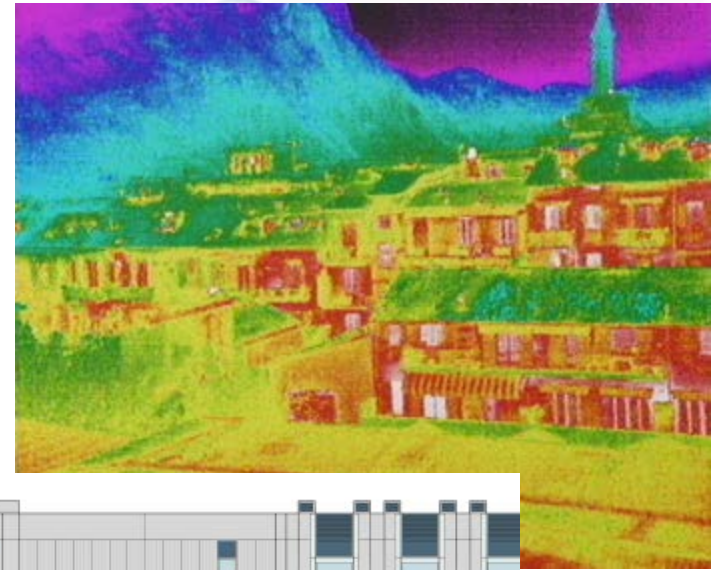
< 1 m



Detection of heat loss in buildings with different technologies to address the energy efficiency policies



Case studies in Milan and Lecco
Milan: University building (POLIMI)
Building façade: 2 monitoring campaigns (winter and summer)



Milan (Politecnico building)



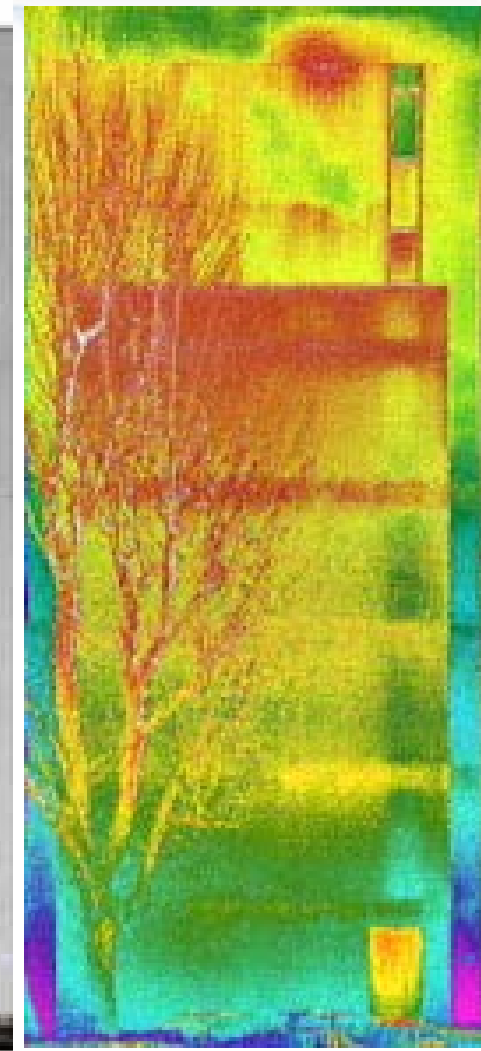
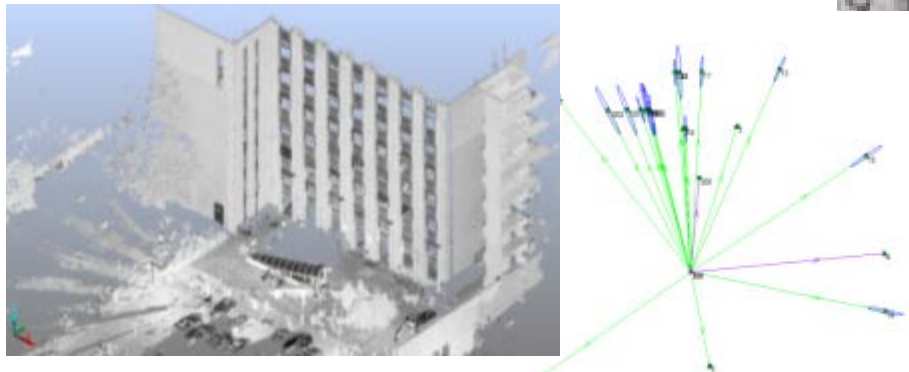
Winter 2012 /Summer 2013

Hand held FLIR Tau 640;

Integration with RGB images and
laser data; UAV flights.

RGB orthophoto \rightarrow GSD = 2 mm

IR orthophoto \rightarrow GSD = 2 cm

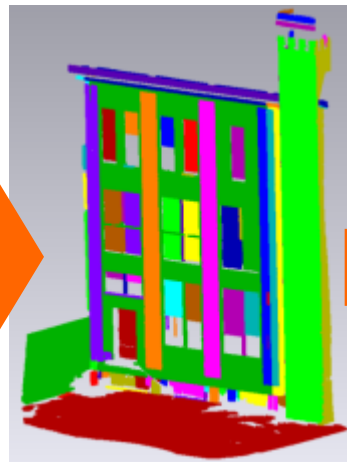
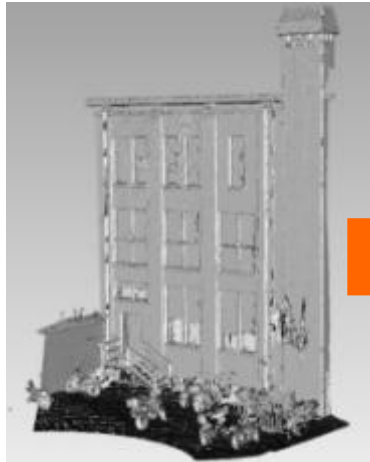
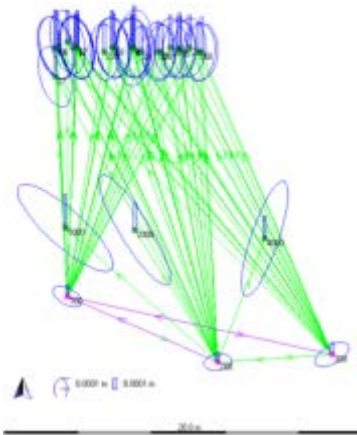
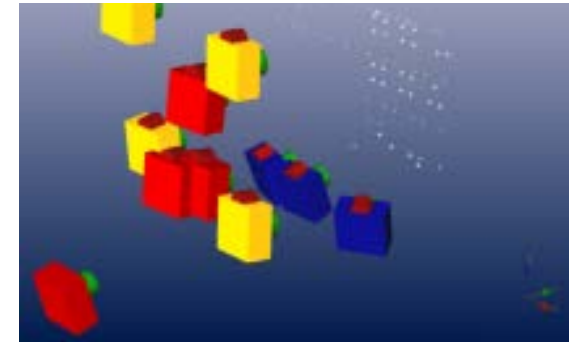
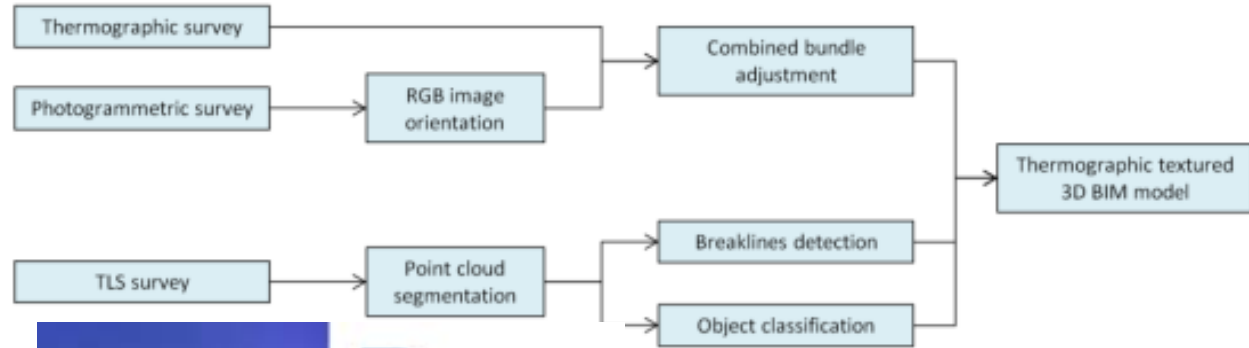


Another hand held FLIR camera for building inspection \rightarrow T° values

Workflow

Photogrammetric data processing
Image orientation
IR texture mapping

Towards a BIM/GIS
integration for Energy
Efficiency of Buildings



Main conclusions

- Holistic approach to tackle one of the main priorities on the Regional Agenda: Air Quality
- Optimization of resources: Regional funds employed on important issues for both (1) citizens and (2) scientific and industry players on the territory
- First exercise of Aerospace cluster in Lombardy Region
- Effective collaboration of triple-helix:

PA – Research – Industry

→ Research and Development meet Societal challenges



THANK YOU FOR YOUR KIND ATTENTION!

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