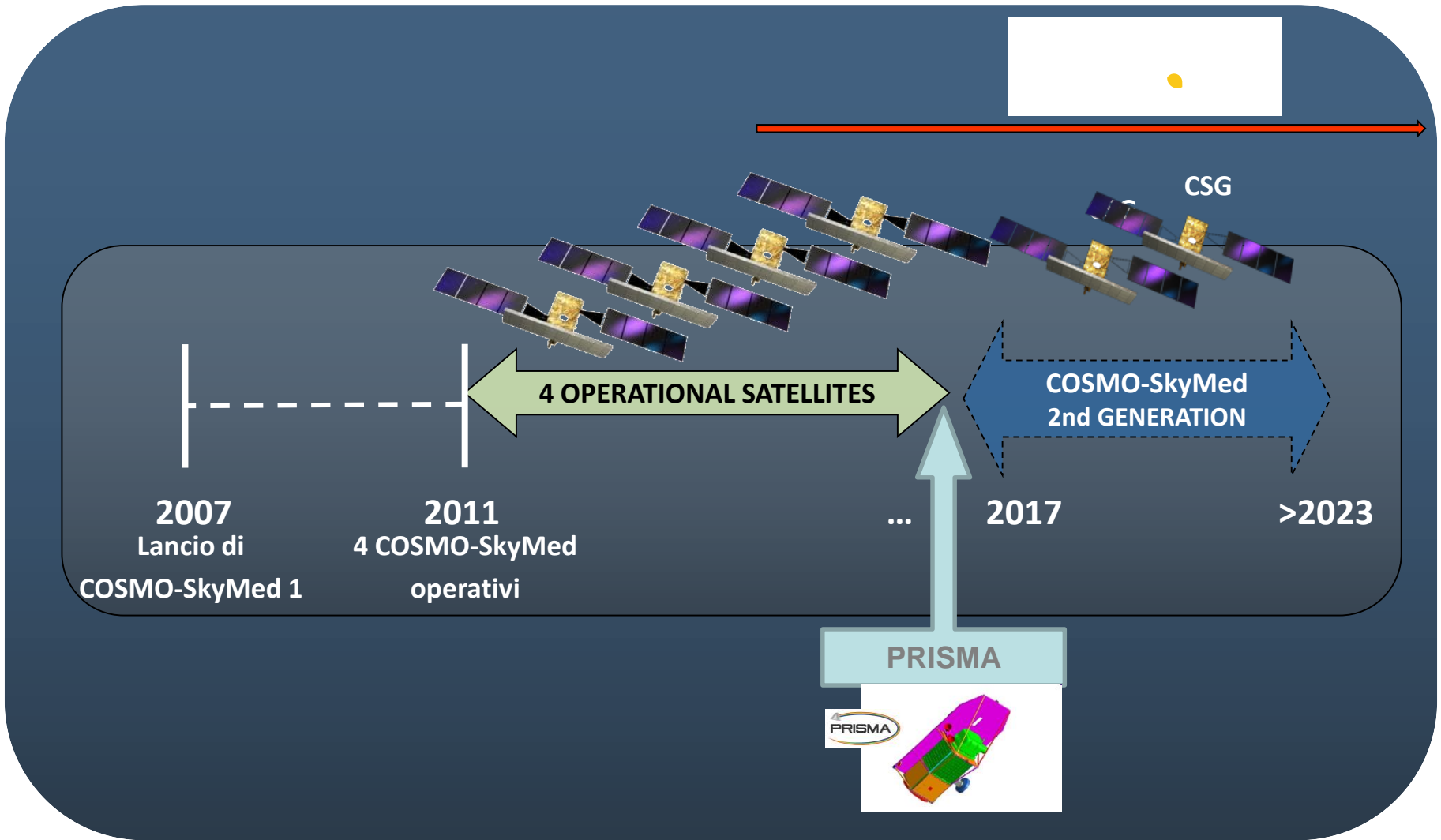


*“Contribution of national missions
to the climate monitoring activities”*

ASI – Laura Candela

The Italian Space Segment

Earth Observation

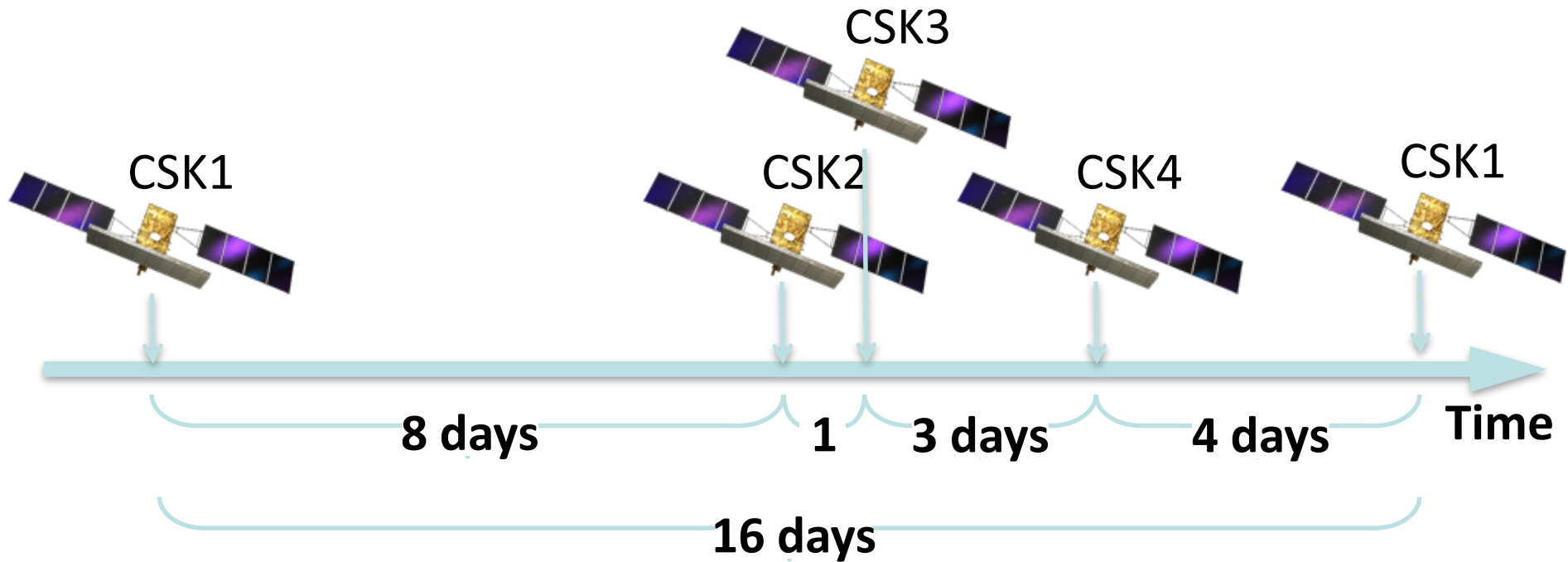


Capability to Multiple imaging modes / resolutions



COSMO-SkyMed

Earth Observation



COSMO-SkyMed SECOND GENERATION

CSK

CSG

High Res
Defense use

Finer Resolution
Defence use

Resolution: 1 m
Single Polarization
Size 10 km x 10 km
Civilian and Defence use

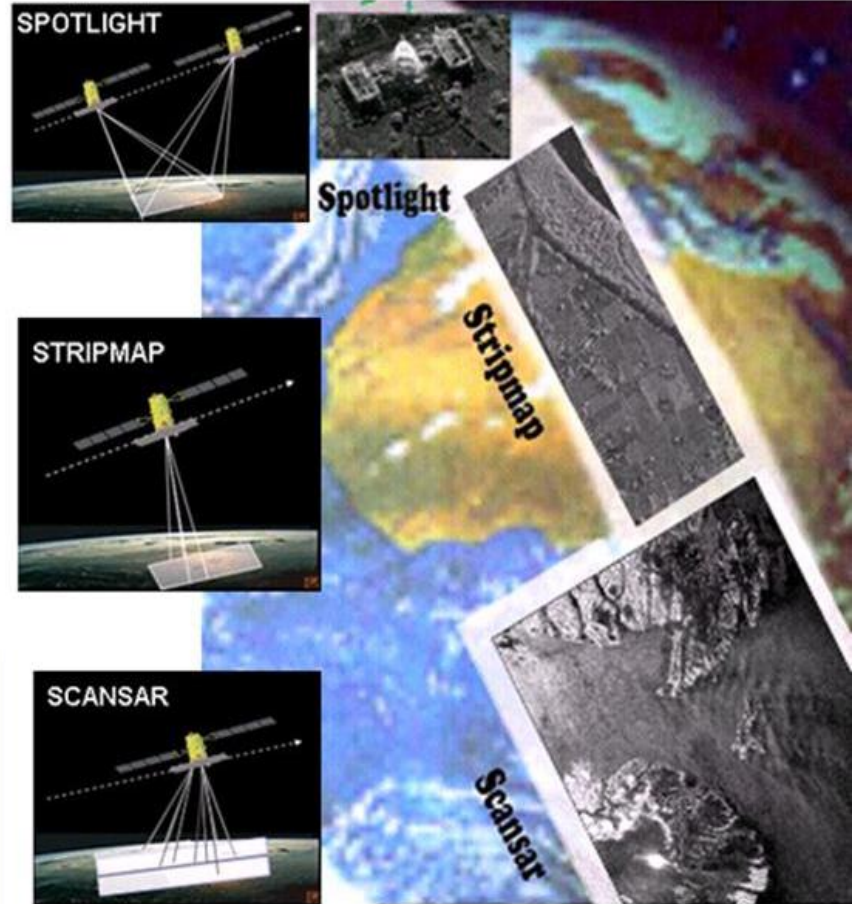
Resolution: xx m
Single/Dual Polarization
Size xx km xx km
or
Resolution: xx m
Single/Dual Polarization
Size 10 km x 10 km
Civilian and Defence use

Resolution: 3 m
Single Polarization
Swath Size 40 km
Civilian and Defence use

Resolution : 3 m
Swath Size Dual Pol 40 km
Swath Size QUADPOL 15 km
Civilian and Defence use

Resolution: 30 m
Single Polarization
Swath Size: 100 km
or
Resolution : 100 m
Single Polarization
Swath Size: 200 Km
Civilian and Defence use

Resolution : 4 x 20 m
Double Polarization
Swath Size : 100 km
or
Resolution : 6 x 40 m
Double Polarization
Swath Size: 200 Km
Civilian and Defence use



Narrow field images

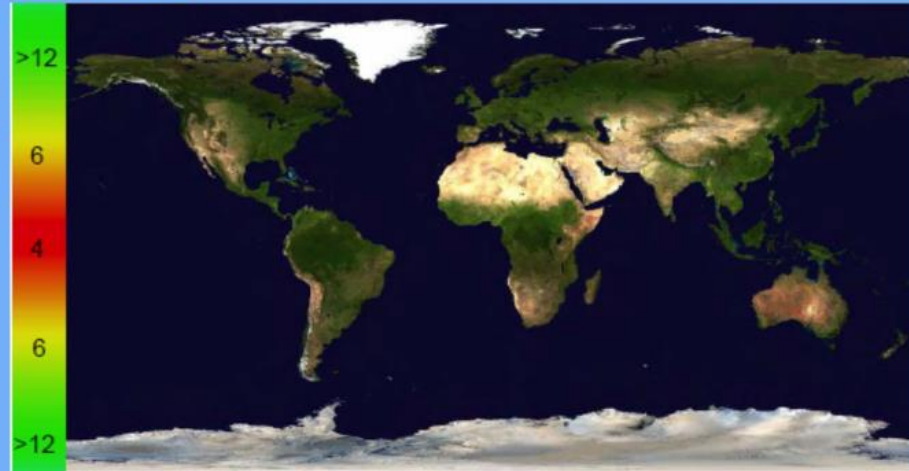
Wide field images

- Effects of global warming in the coldest regions on Earth:
 - polar regions regular monitoring
 - SAR data are able to provide information on the ice coverage, and size and shape of ice floes*
- Effects of natural disasters caused by global changes
 - *Floods, landslides ...*

Revisit time

In polar regions, due to its polar orbit, the COSMO-SkyMed 4-satellites can offer unique opportunities in term of time revisit and high coverage. At 70° latitude up to 8 right-looking and 8 left-looking acquisitions are feasible, then right and left looking modes for each of the 4 satellites allows the coverage of large areas in a short time like in the case of the north-east and north-west pass covered in only 24 hours.

Acquisitions per day(4 satellites)
(<https://ftp.sovzond.ru/forum/2014/reports/Morucci.pdf>)



Acquisition Plan – Ice Sheet

- To acquire a set (about 90) of sites and glaciers (also called supersites) with high-resolution X-band sensors,
on the base of the priority level identified by the scientific community in Greenland and Antarctic (3 levels).

- To perform the coverage of the Antarctic coast

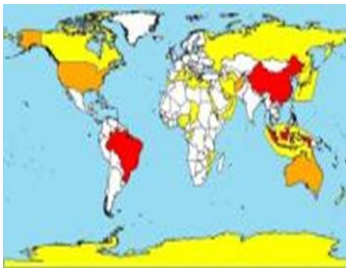
Approach, General recommendations

- Polarization HH
- Stripmap acquisition mode (Time series)
- with a incidence angle range 25 and 45 degrees (even 57 to cover South Pole).



BACKGROUND MISSION

Started in May 2011



- The background mission applies a systematic low priority acquisition strategy, so to obtain regular, repetitive and comparable acquisitions and to minimize possible conflicts with existing user requests.
- Create an archive of images also dedicated to interferometric applications.
- Maximize the system exploitation during the operation lifetime of the constellation.

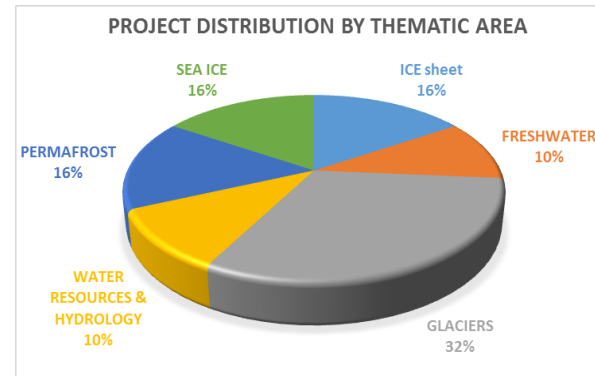
COSMO-SkyMed SYSTEM EXPLOITATION

FOCUS ON POLAR AREAS STUDIES

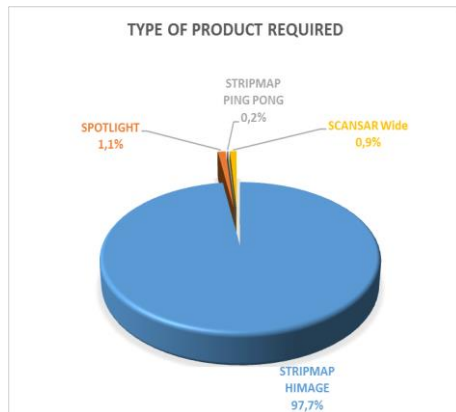
The studies, on-going or concluded, conducted in the framework of agreements or projects activated with ASI by several Institutional users

Over the three-year period 2013-2015, 240 projects have been activated, the 8% of them regards studies of polar areas.

The majority have been activated in the framework of **ASI-CSA JOINT AO**, due to a strong interest in this topic from the Canadian researchers (22% of 48 projects). The interest on these area is continuing in the framework of **CURRENT CSK OPEN CALL** (published on **25 February 2015** and **PERMANENTLY OPEN**



Distribution per thematic area of institutional projects on polar studies based on COSMO-SkyMed data exploitation (2013-2015)

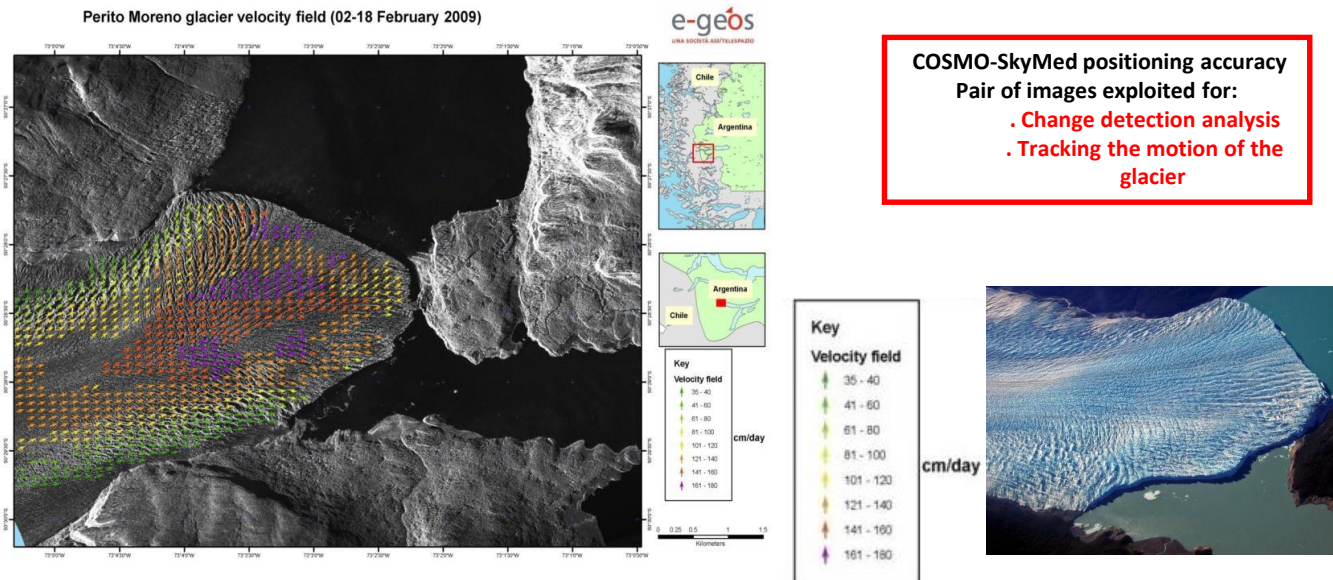


The users have required mostly STRIPMAP HIMAGE over all thematic areas to carry out interferometric studies. The SPOTLIGHT sensor mode have been required mainly for permafrost studies, instead SCANSARWIDE for glaciers monitoring.

- Italy participates in ESA CCI+

Ice Sheets

Ice velocity is one of the fundamental parameters in the study of glacier's dynamics.



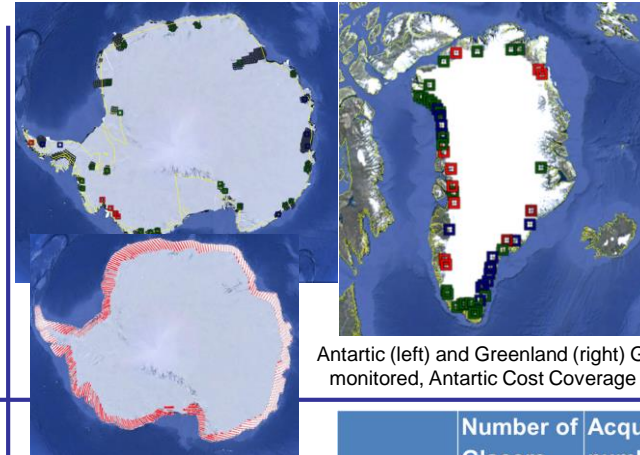
Example of automated extraction of the glacier velocity field based on a pair of COSMO-SkyMed High resolution (Spotlight 2) images collected on Perito Moreno glacier (Argentina) with a time interval of 16 days and the same observing geometry (Date: 2009/02/02 and 2009/02/18, pol. VV, Inc. Angle 40°)

Greenland and Antarctica 2014 and onwards

Approach:

Acquisition geometries of plans chosen in order

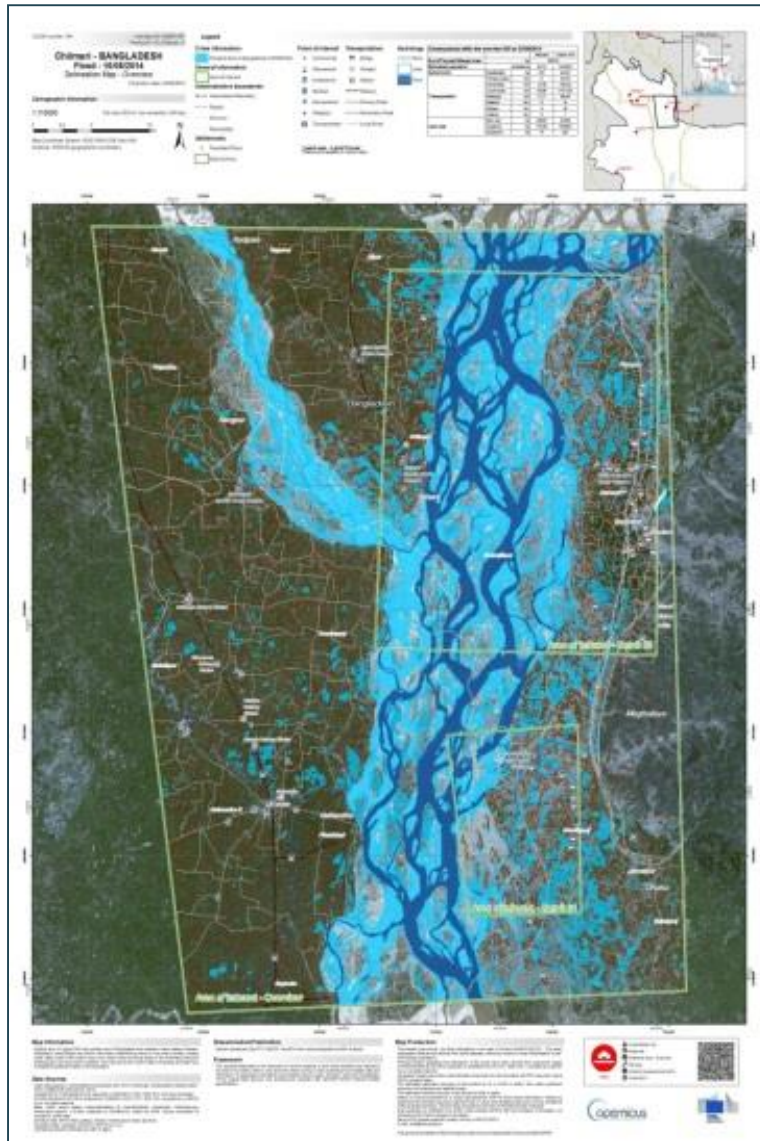
- ❑ Stripmap mode (3-5 m res., 40 km swath),
- ❑ HH, asc/ desc directions, right look side,
- ❑ incidence angles between 25° - 45° ,
- ❑ Time resolution of 4 or 8 dais (glaciers lev3, higher proirity), 16 days (glaciers lev 2 and 1, antartic coast)
- ❑ ScanSAR wide region mode (30 m resolution, 100 km swath)
- ❑ ScanSAR huge region mode (100 m resolution, 200 km swath)



Antartic (left) and Greenland (right) Glacier monitored, Antartic Cost Coverage (left)

	Number of Glacers acquired	Acquisition number per orbital cycle
Greenland	53 (11 level 3 16 level 2 26 level 1)	156
Antartica	33 (6 level 3 6 level 2 21 level 1)	244
Antartic Coast	-	496

- **EMSR097: Floods in Bangladesh**



The synergic use of COSMO-SkyMed and S1

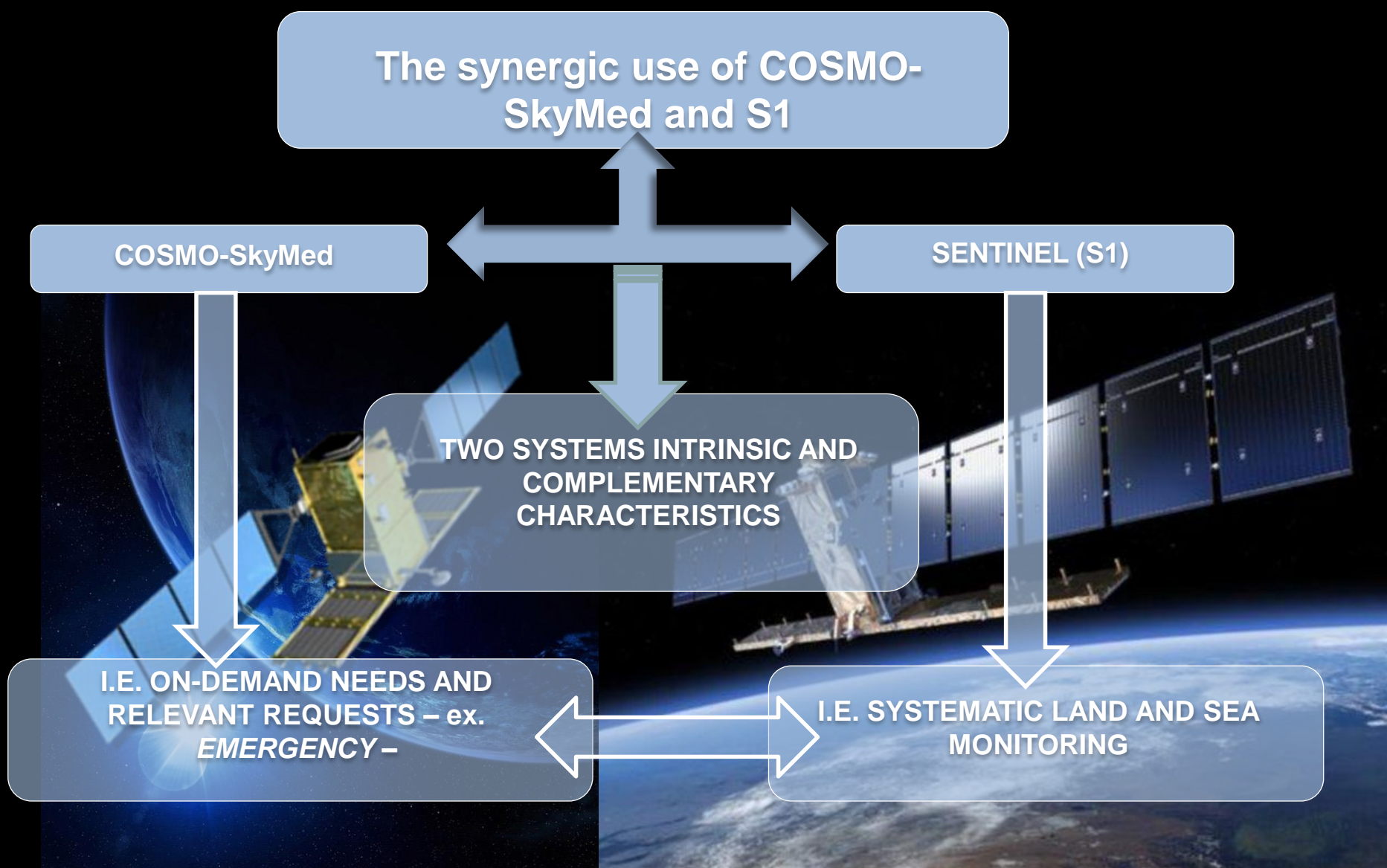
COSMO-SkyMed

SENTINEL (S1)

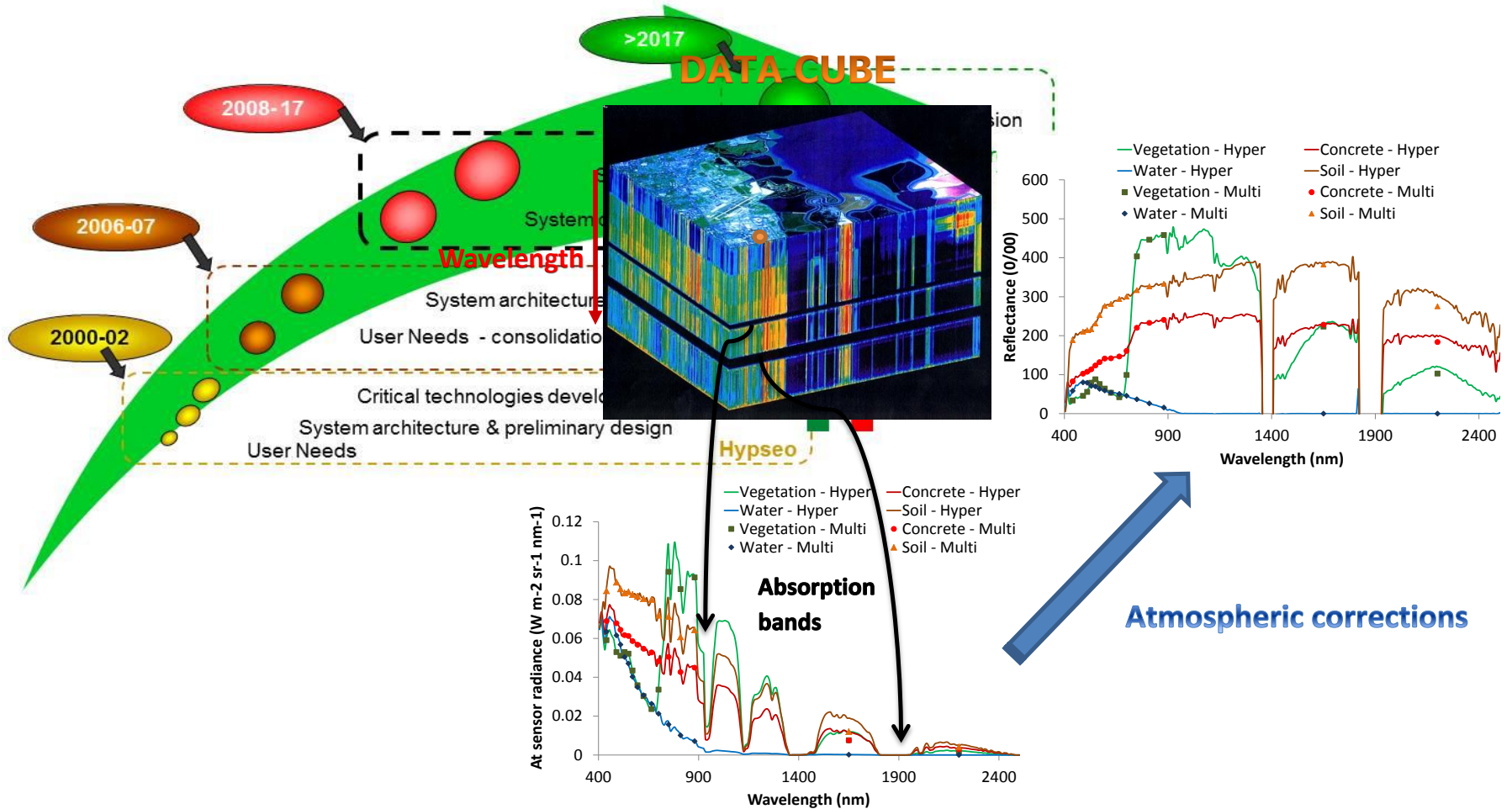
TWO SYSTEMS INTRINSIC AND COMPLEMENTARY CHARACTERISTICS

I.E. ON-DEMAND NEEDS AND RELEVANT REQUESTS – ex. EMERGENCY –

I.E. SYSTEMATIC LAND AND SEA MONITORING



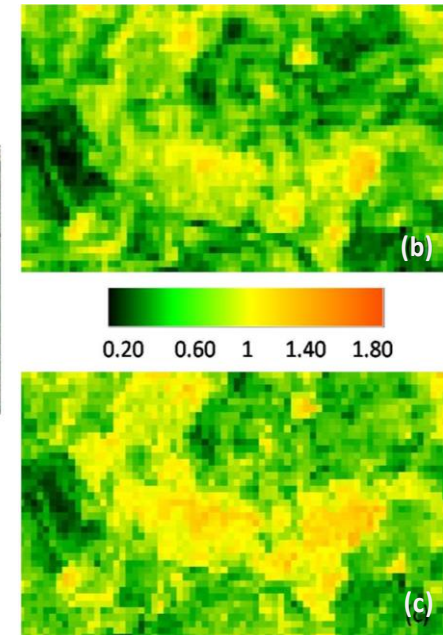
PRISMA



Vegetation

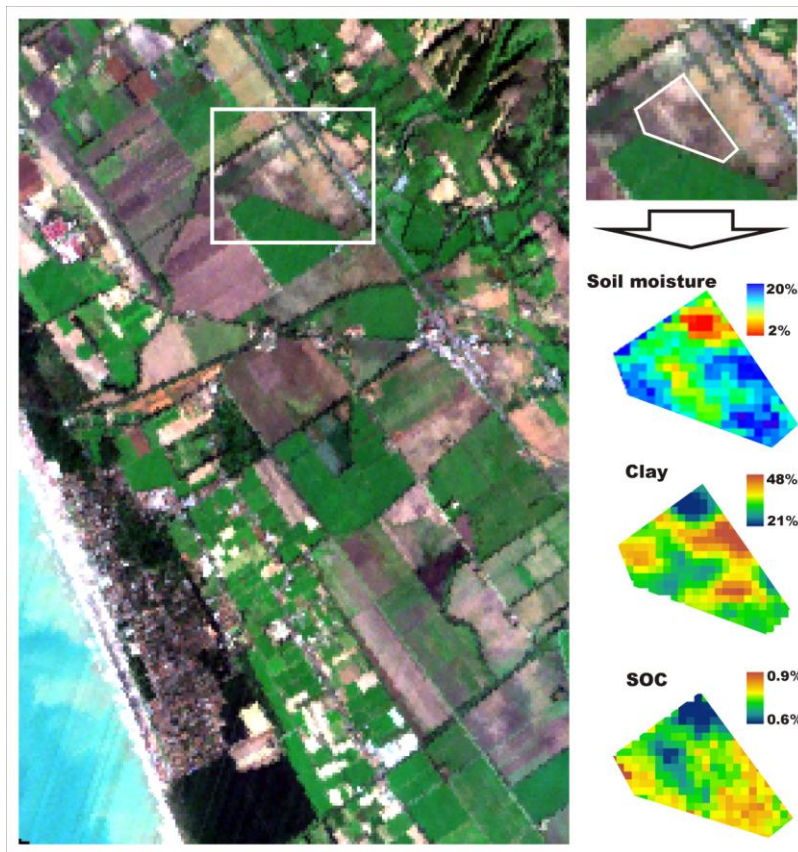
In the framework of forestry and agriculture PRISMA can provide

- Estimation and mapping of soil organic carbon (SOC) in agricultural fields that is a relevant variable in the quantification of the balance of greenhouse gasses (GHGs) and in studies dealing with the mitigation of climatic change
- Mapping of vegetation stress (water, chemical)
- Vegetation Classification



MSI (Moisture Stress Index) maps from Landsat TM (Box (b)), acquired on 27 July 2003) and Hyperion (Box (c)), acquired on 26 July 2003) data. In the Box (a) it is shown the orto-photo with the dominant Corine Land Cover class (Natural grassland with trees and shrubs). MSI values based on hyperspectral information capture worse conditions in terms of water deficit/stress with respect to values derived from multispectral data. This is in line with the climatic trend of the year 2003, which was characterized by extremely high temperatures over the whole Europe and also for the investigated area located in Northern Sicily.

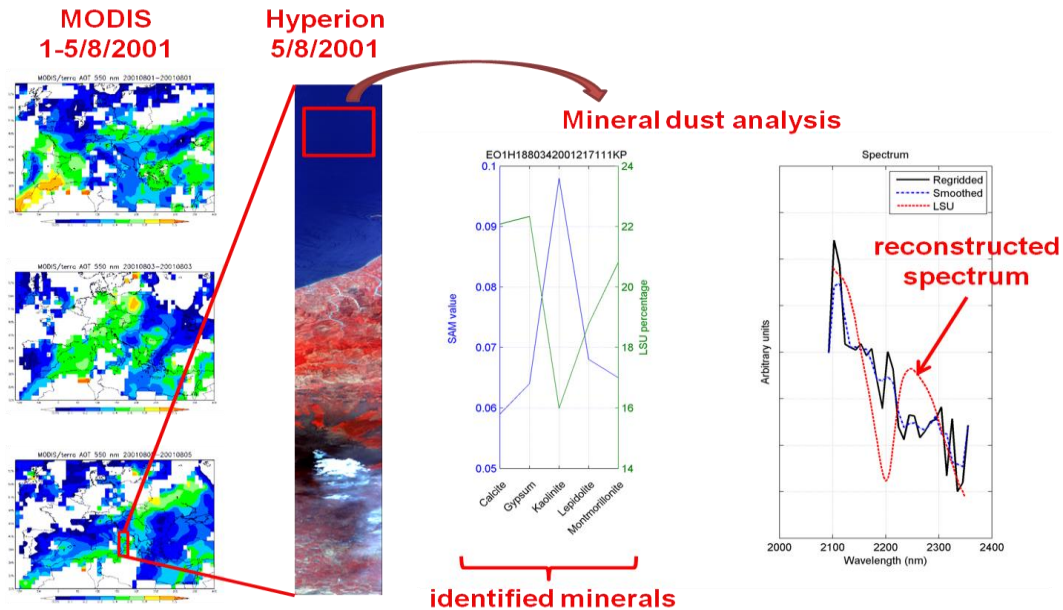
Vegetation



Hyperspectral satellite image (Hyperion) acquired in Maccarese (Rome) and estimated soil variables maps concerning soil moisture, clay and soil organic carbon (SOC).

Aerosol

Hyperspectral satellite observations may be fruitfully applied to better characterize atmospheric aerosol and their effects on the climate system.



Identification of key minerals in desert dust suspended in the atmosphere from a Hyperion image during the Saharan dust event of August 2001 over Southern Italy. The MODIS images on the left show the daily sequence of the Aerosol Optical Depth (AOD) over South-Western Europe. The Hyperion scene in the centre was acquired north of Sicily, and the reflectance between 2100 and 2350 nm over the sea is analyzed. Key minerals in dust were recognized by Spectral Angle Mapper (SAM) method, and the relative abundance by Linear Spectral Unmixing (LSU). The uncertainty in the estimated abundance is very high due to the instrument noise

Volcanoes

The carbon dioxide (CO_2) gas by absorbing electromagnetic radiation in several regions of solar spectrum, plays an important role on the earth radiation budget, although his concentration is low compared to other atmospheric gases (N_2 , O_2).

Hyperspectral data can provide:
Identification and estimate of volcanic gas emission in the atmosphere



Simulation of volcanic carbon dioxide content from Mt. Etna summit craters based on PRISMA characteristics.

Volcanoes

Volcanic plumes have an impact on the climate



Left: Strombolian explosion picture. Right: Measurement of volcanic carbon dioxide content from Strombolian explosion retrieved using airborne MIVIS hyperspectral data acquired on 1997 with 3 m of ground spatial resolution (from Spinetti et al., 2012).

Vs. Copernicus

Earth Observation

*Extended Collaborative Ground Segment:
the italian downstream services*

