



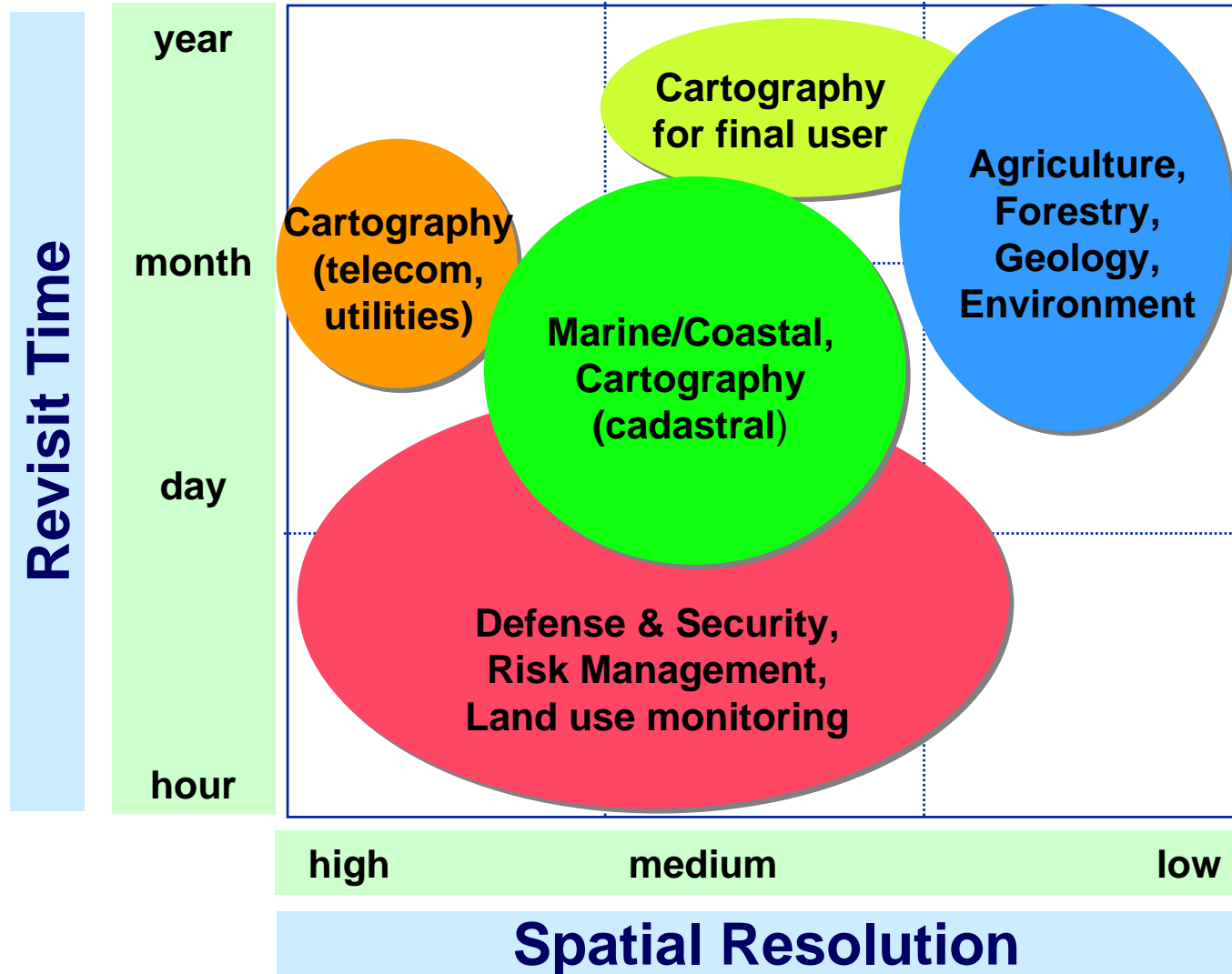
COSMO-SkyMed

Products and User Services

E. Lopinto
ASI - Italian Space Agency

- **To take appropriate decisions on strategic and operative context in a global environment**
- **To build and maintain an accurate image archive with worldwide coverage and implementing many options in terms of:**
 - ✓ **resolution**
 - ✓ **size**
 - ✓ **temporal sampling (revisit time)**

Application areas vs. revisit time & spatial resolution



Dual Use Needs

Civilian

❖ **Several Disciplines:**

Agriculture, Forest, Geology,
Environment,
Cartography

❖ **Open and Accessible**

Defense

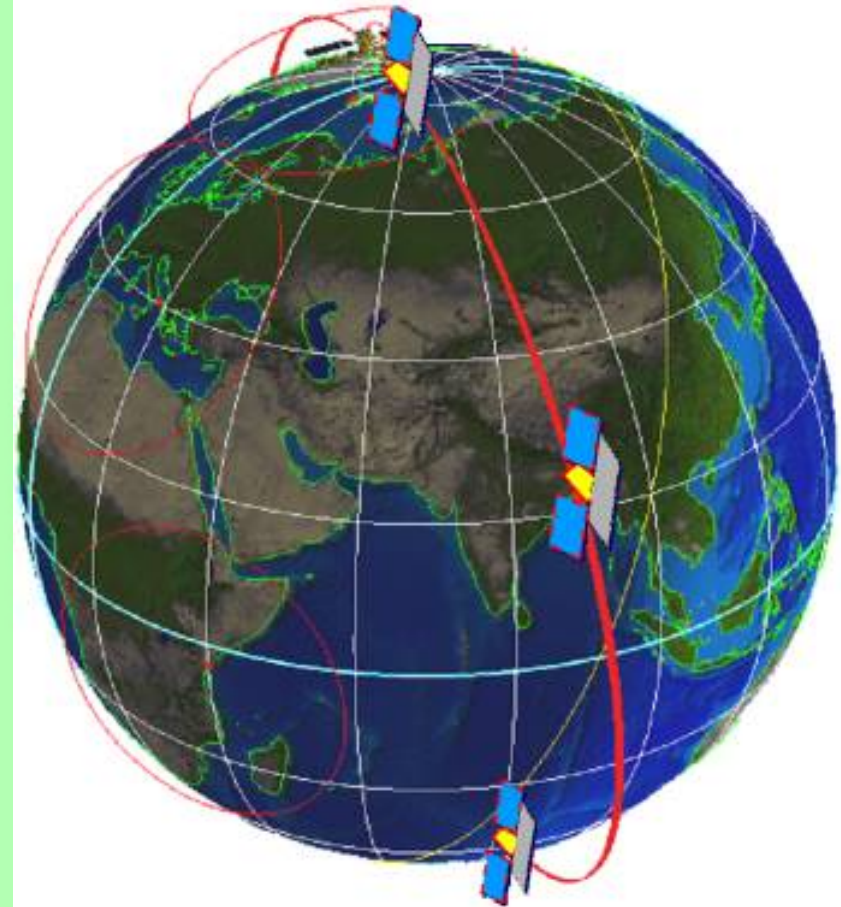
- **Priorities Management**
- **Confidentiality and Integrity**
- **Protected System**

**DUAL
SYSTEM**

Common

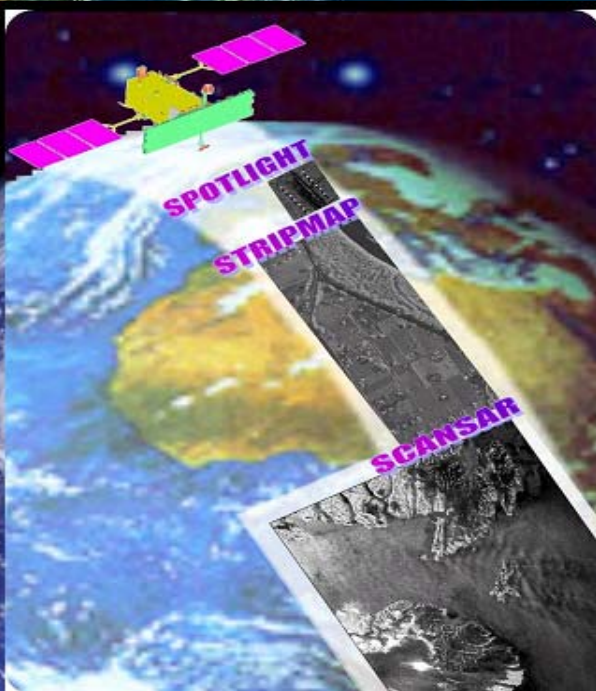
- **Wide information collection (Database)**
- **Flexibility**
 - ✓ Multi-mode operation (variety of sizes and resolutions)
 - ✓ Agility (reconfiguration and multiple acquisitions on a theater)
- **High Reactivity**
 - ✓ Response / Revisit Time
- **Availability & Sustainability of Services**

- **Global Coverage**
- **SAR Night/Day, All Weather Observations;**
- **Revisit Time of few hours;**
- **Response Time very short (on daily basis);**
- **High volume of daily acquired Images with High Resolution, Image Quality and Geo-location accuracy on different sizes, polarizations and points of view;**
- **Management of different classes of Users and of Priority;**
- **High level of Satellite and payloads agility to acquire multiple images on the same theatre;**
- **Staggered deployment and “graceful degradation”;**
- **Compatibility with Interferometric operations;**
- **Time Frame: 2006-2013.**





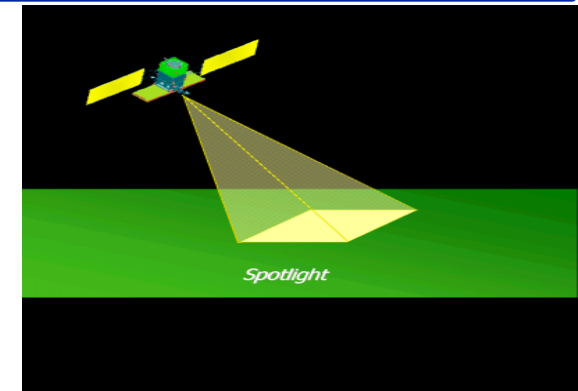
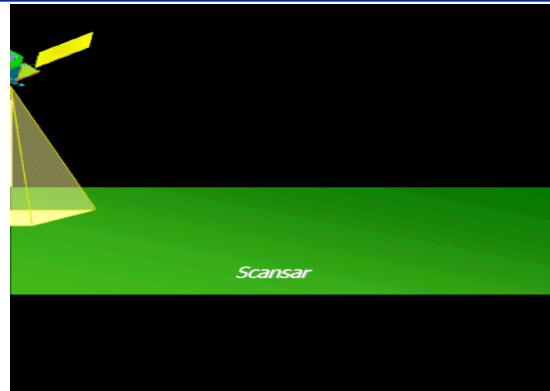
1800 Images/day
1500 Wide Field (Stripmap)
300 Narrow Field



Interferometric Campaigns

 **Tandem – like**  **Tandem**

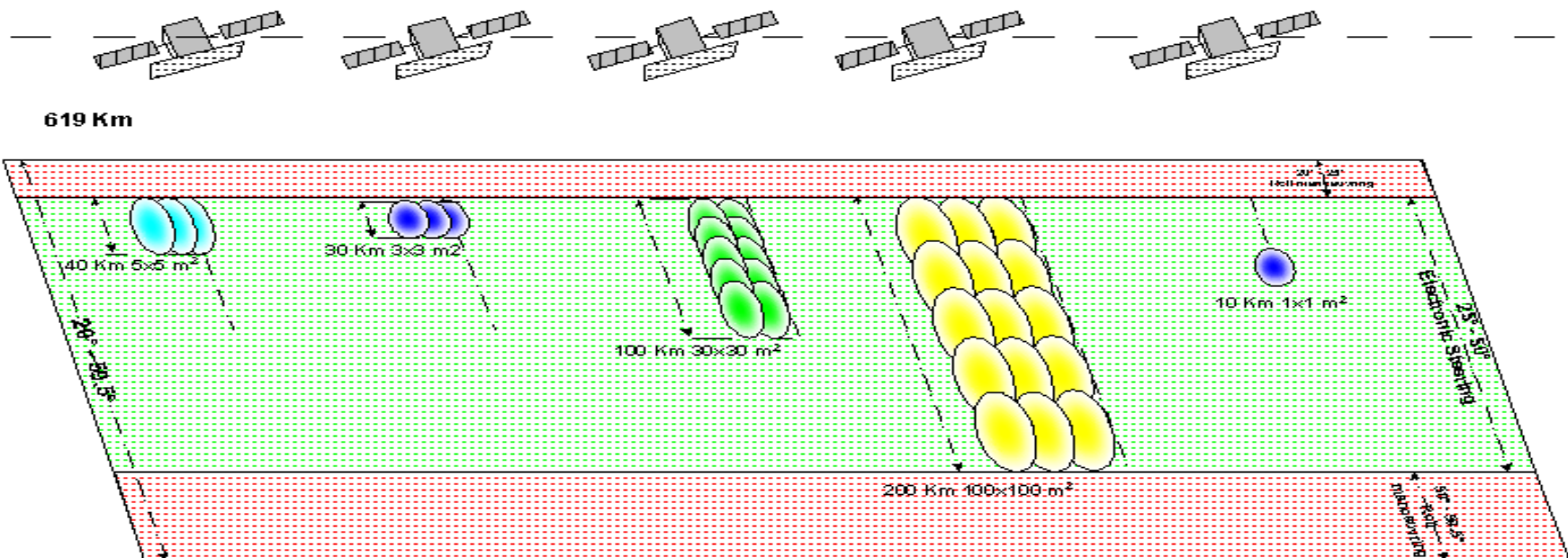
Acquisition modes



STRIPMAP

SCANSAR

SPOTLIGHT-2



COSMO-SkyMed

2005

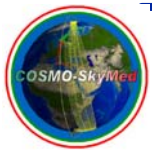
2006

2007

2008

2009

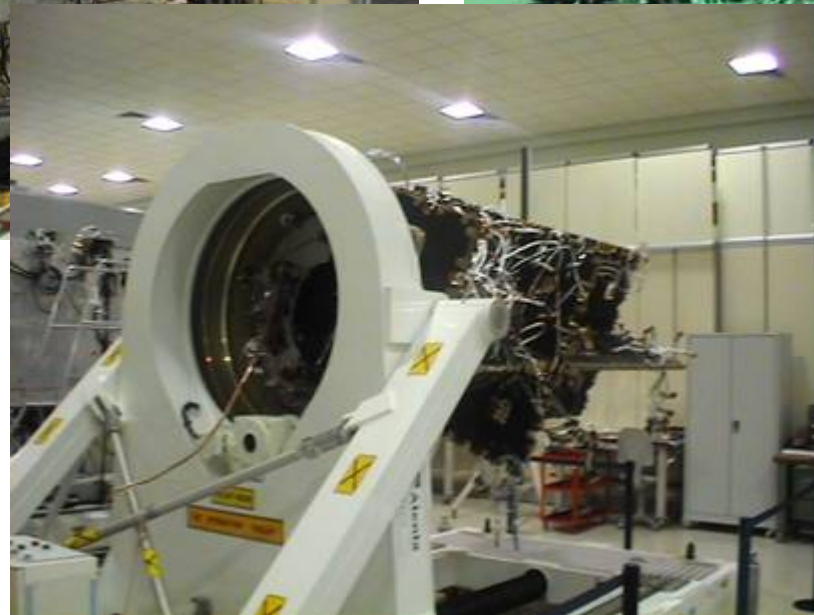
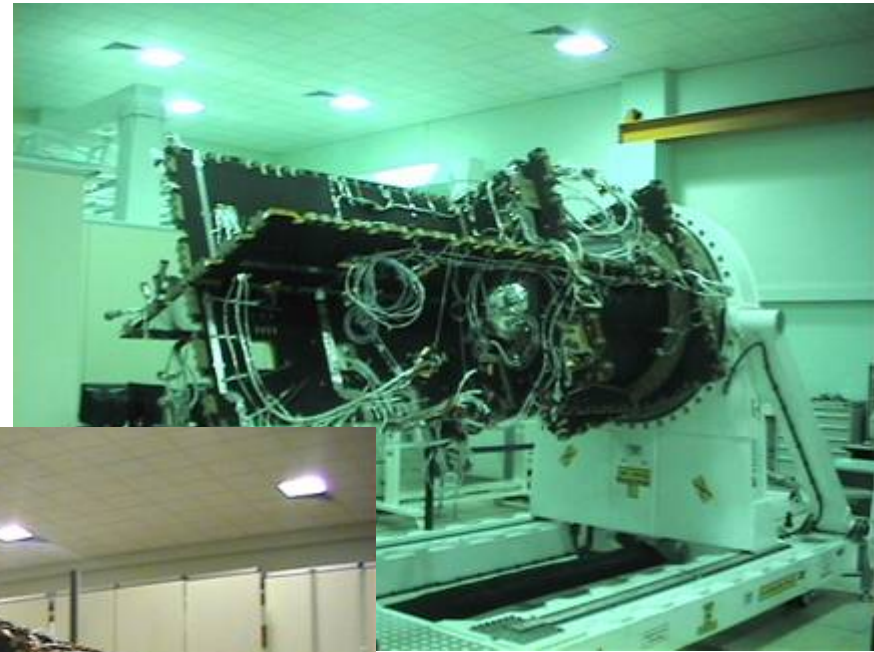
LAUNCH SCHEDULE



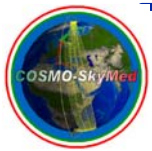
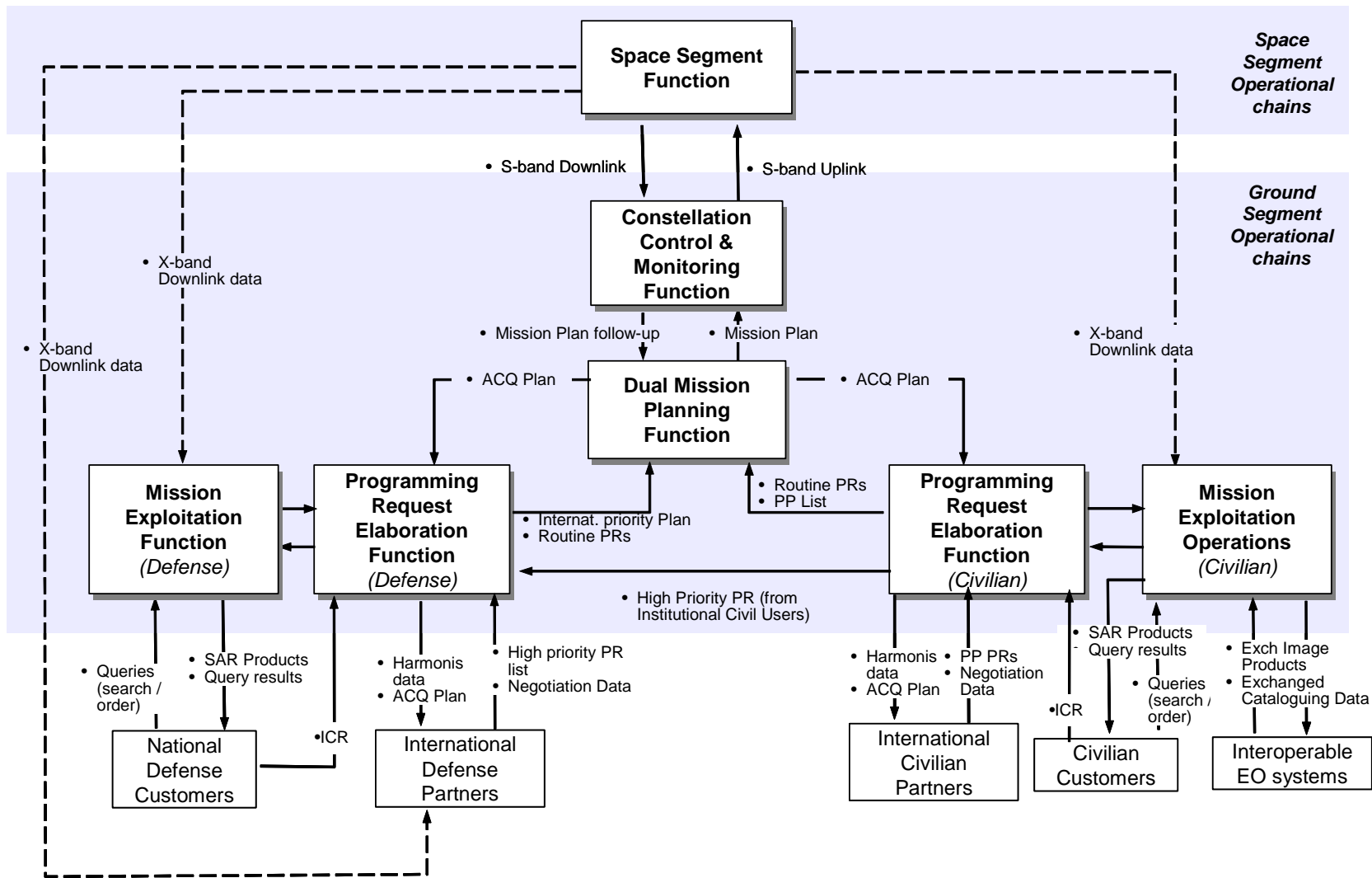
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Slide 8

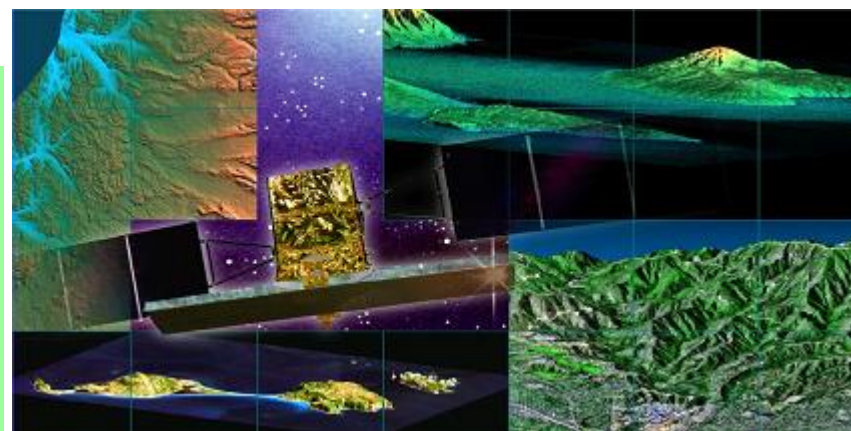
The satellite during manufacturing



The overall architecture



- **Ground Infrastructure** geographically distributed and inter-connected (fixed / mobile stations and comm.network);
- **Dual Use implementation:** *Security standards application, Integrity, Priority management, Plan Approval, Plan and data confidentiality;*
- **Reception/Elaboration/Distribution of the Observed data;**
- **GPS fiducial network;**
- **Calibration sites;**
- **Interoperability and Expandability** with other Systems (optics, RADAR in other bands, on other platform, etc...);
- **Multisensor capabilities** (common operational environment for various sensors);
- **Functional and Physical Redundancy;**
- **Integrated Logistics and Operative Support.**

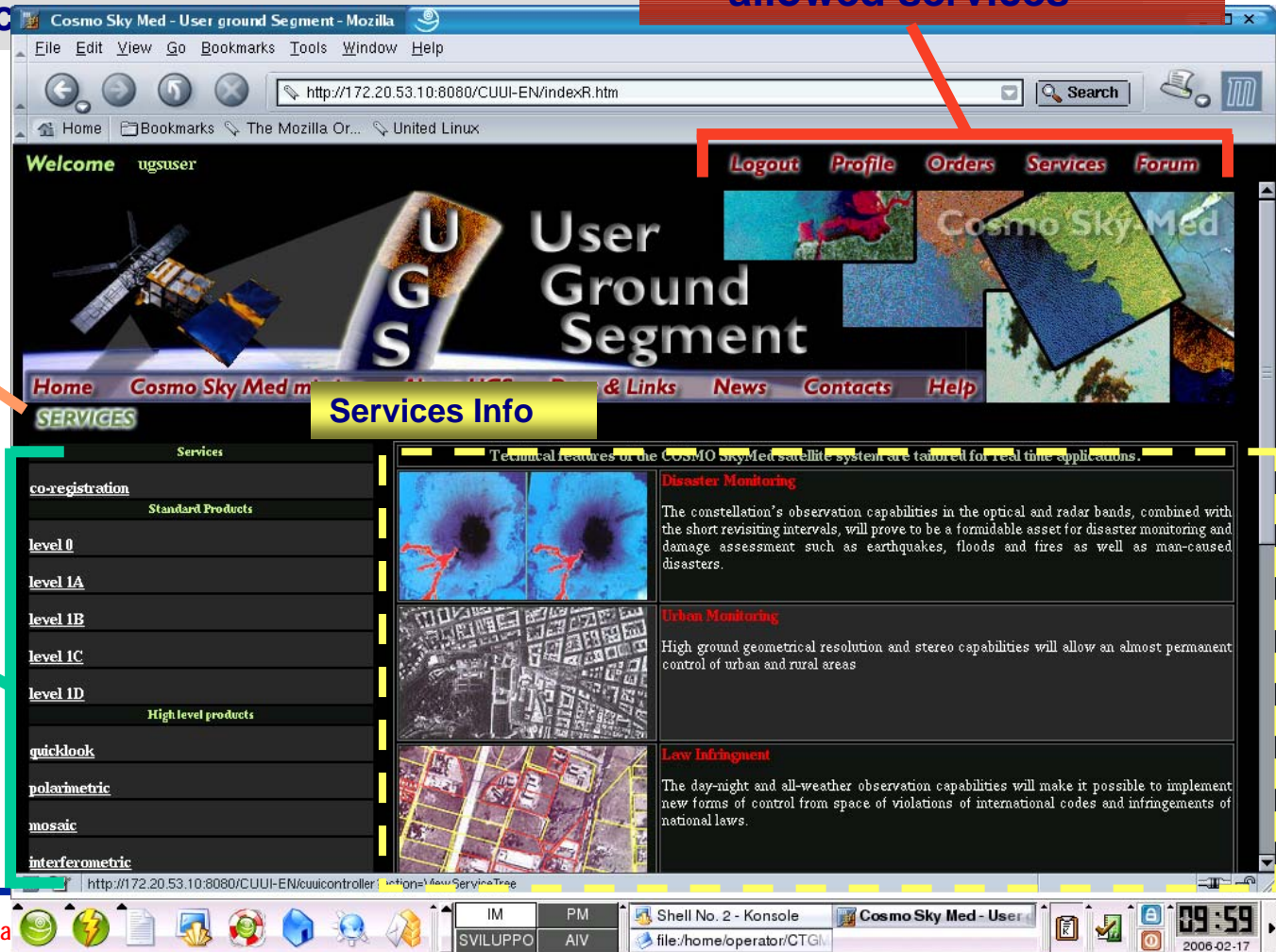


The User Service

The primary objective of COSMO system is the provision of services to fulfill the Customer's needs. The basic functions for the Civilian User are those related to a specific sequence:

1. the civilian user query the system for a Service Query

0. the civilian user logs into the system and gets general info about the mission and the allowed services



The screenshot shows the 'Cosmo Sky Med - User ground Segment - Mozilla' web browser window. The address bar displays 'http://172.20.53.10:8080/CUUI-EN/indexR.htm'. The page features a 'Welcome ugsuser' message and a navigation menu with links: Home, Cosmo Sky Med m, & Links, News, Contacts, Help. A 'Services Info' section is highlighted, showing a list of services: co-registration, level 0, level 1A, level 1B, level 1C, level 1D, quicklook, polarimetric, mosaic, and interferometric. To the right, technical features of the COSMO SkyMed satellite system are listed, including Disaster Monitoring, Urban Monitoring, and Law Infringement. The bottom of the browser window shows the taskbar with various icons and the system clock displaying 09:59 on 2006-02-17.

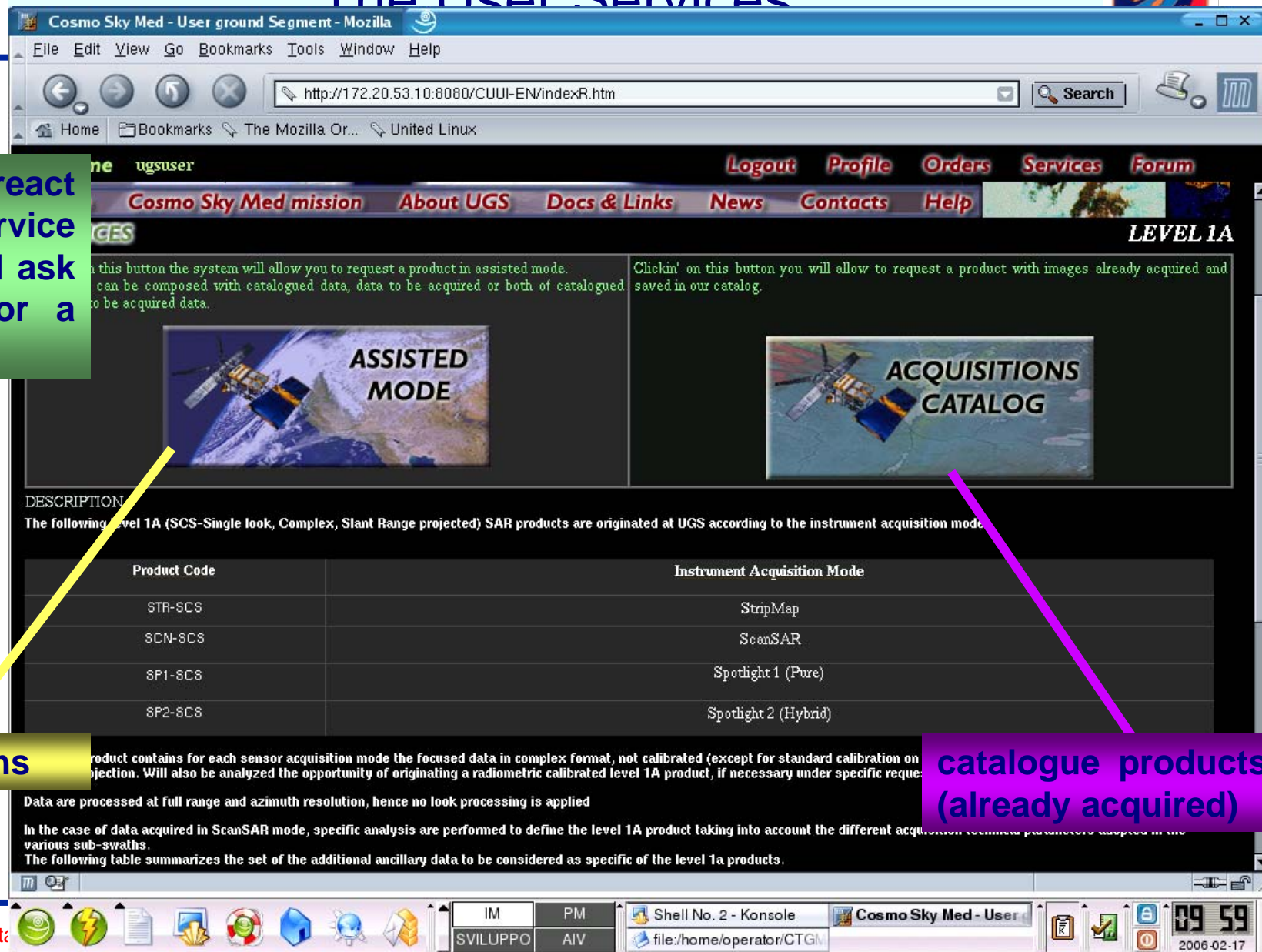
Products List



The User Services



2. the system react to the service request and ask the user for a choice



ASSISTED MODE

ACQUISITIONS CATALOG

DESCRIPTION

The following Level 1A (SCS-Single look, Complex, Slant Range projected) SAR products are originated at UGS according to the instrument acquisition mode.

Product Code	Instrument Acquisition Mode
STR-SCS	StripMap
SCN-SCS	ScanSAR
SP1-SCS	Spotlight 1 (Pure)
SP2-SCS	Spotlight 2 (Hybrid)

product contains for each sensor acquisition mode the focused data in complex format, not calibrated (except for standard calibration on projection). Will also be analyzed the opportunity of originating a radiometric calibrated level 1A product, if necessary under specific request.

Data are processed at full range and azimuth resolution, hence no look processing is applied

In the case of data acquired in ScanSAR mode, specific analysis are performed to define the level 1A product taking into account the different acquisition parameters adopted in the various sub-swaths.

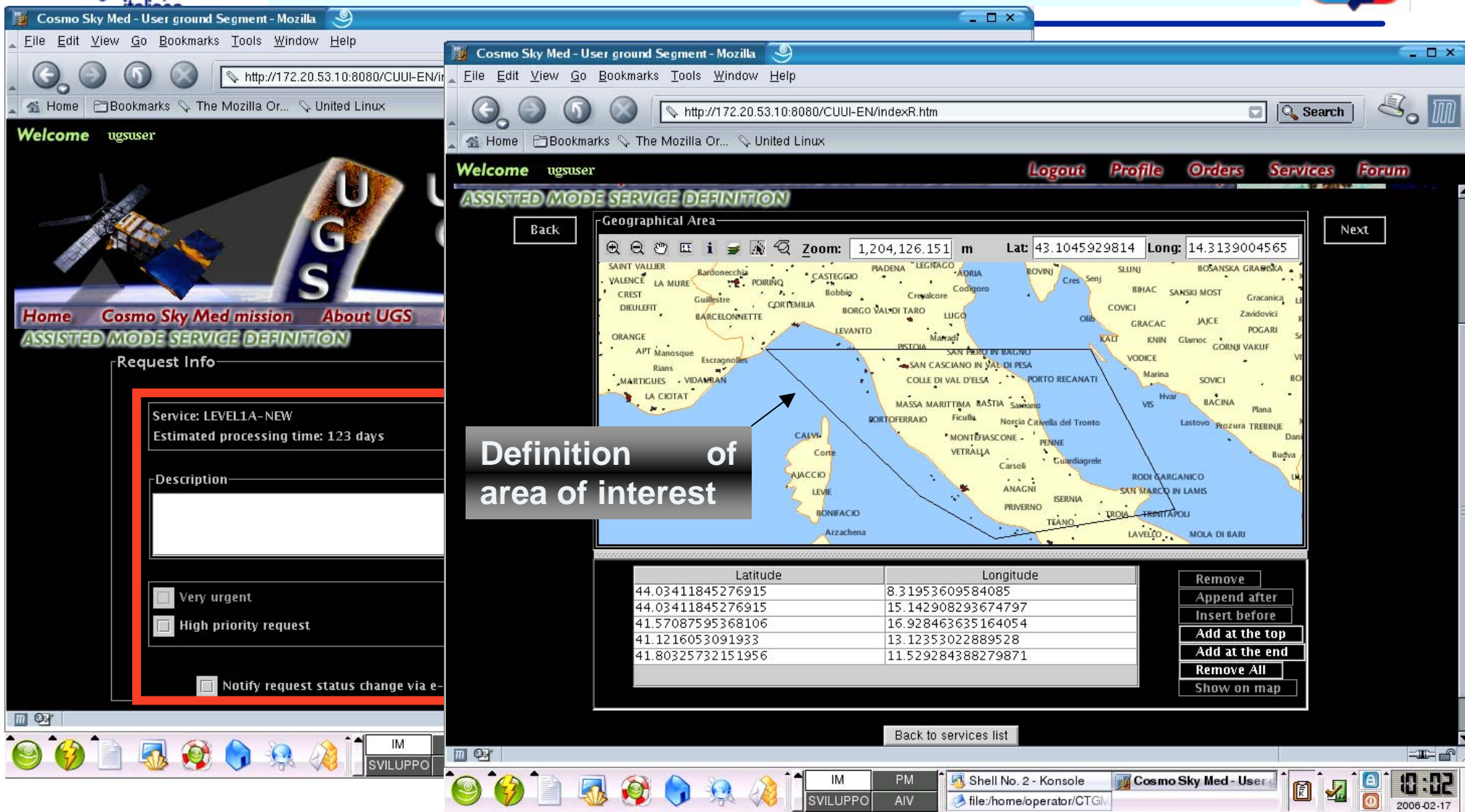
The following table summarizes the set of the additional ancillary data to be considered as specific of the level 1a products.

New acquisitions

catalogue products
(already acquired)



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Welcome ugsuser

[Home](#) [Cosmo Sky Med mission](#) [About UGS](#)

ASSISTED MODE SERVICE DEFINITION

[Back](#) [Next](#)

Geographical Area

Zoom: 1,204,126.151 m Lat: 43.1045929814 Long: 14.3139004565

Definition of area of interest

Latitude	Longitude
44.03411845276915	8.31953609584085
44.03411845276915	15.142908293674797
41.57087595368106	16.928463635164054
41.1216053091933	13.12353022889528
41.80325732151956	11.529284388279871

Request Info

Service: LEVEL1A-NEW
Estimated processing time: 123 days

Description

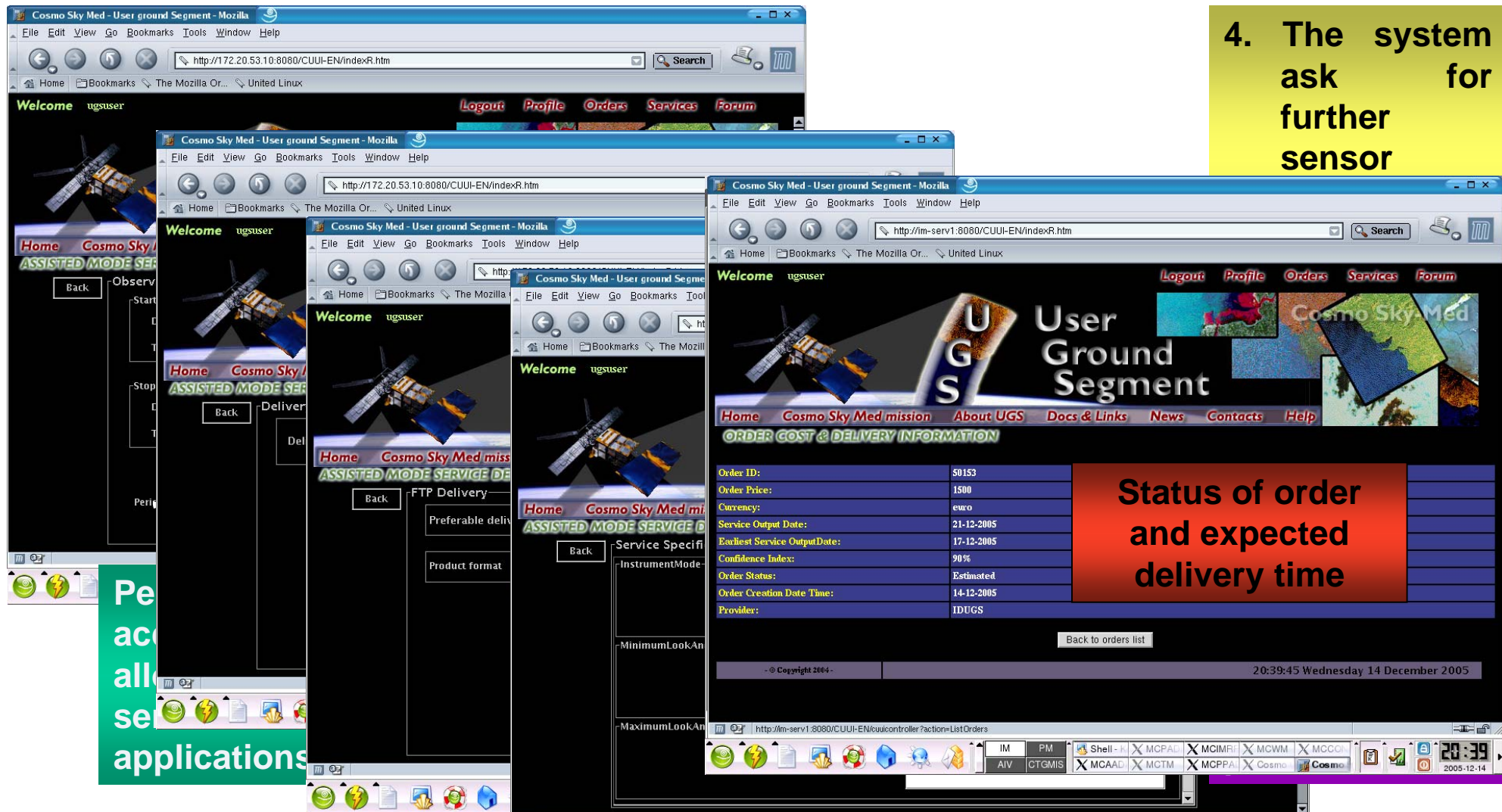
☐ Very urgent
☐ High priority request

☐ Notify request status change via e-mail

[Remove](#)
[Append after](#)
[Insert before](#)
[Add at the top](#)
[Add at the end](#)
[Remove All](#)
[Show on map](#)

[Back to services list](#)

4. The system ask for further sensor



Status of order and expected delivery time

Order ID:	50153
Order Price:	1500
Currency:	euro
Service Output Date:	21-12-2005
Earliest Service Output Date:	17-12-2005
Confidence Index:	90%
Order Status:	Estimated
Order Creation Date Time:	14-12-2005
Provider:	IDUGS

Back to orders list

20:39:45 Wednesday 14 December 2005

Cosmo Sky Med - User ground Segment - Mozilla

File Edit View Go Bookmarks Tools Window Help

http://172.20.53.10:8080/CUUI-EN/indexR.htm

Search

Home Bookmarks The Mozilla Project United Linux

Welcome uguser

Access control

System documentation & information

User Ground Segment

Home Cosmo Sky Med mission About UGS Docs & Links News Contacts Help

Guide

Additional User Services

Problem Solving

Bulletin Board

co-registration

Standard Products

level 0

level 1A

level 1B

level 1C

level 1D

High level products

quicklook

polarimetric

mosaic

interferometric

satellite system are tailored for real time applications.

observation capabilities in the optical and radar bands, combined with intervals, will prove to be a formidable asset for disaster monitoring and damage assessment such as earthquakes, floods and fires as well as man-caused disasters.

Urban Monitoring

High ground geometrical resolution and stereo capabilities will allow an almost permanent control of urban and rural areas

Law Enforcement

The day-night and all-weather observation capabilities will make it possible to implement new forms of control from space of violations of international codes and infringements of national laws.

http://172.20.53.10:8080/CUUI-EN/cuiccontroller?action=ViewServiceTree

IM PM SVILUPPO AIV

Shell No. 2 - Konsole

Cosmo Sky Med - User

file:/home/operator/CTG

09:59

2006-02-17

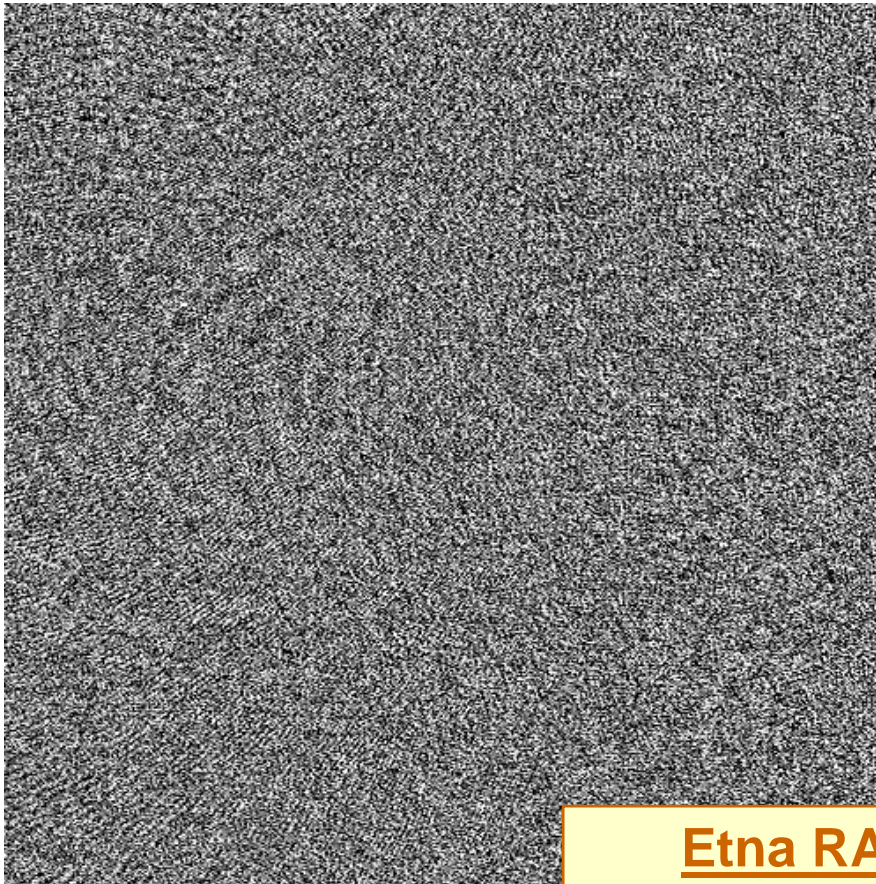
The Image Products

SAR Standard Products

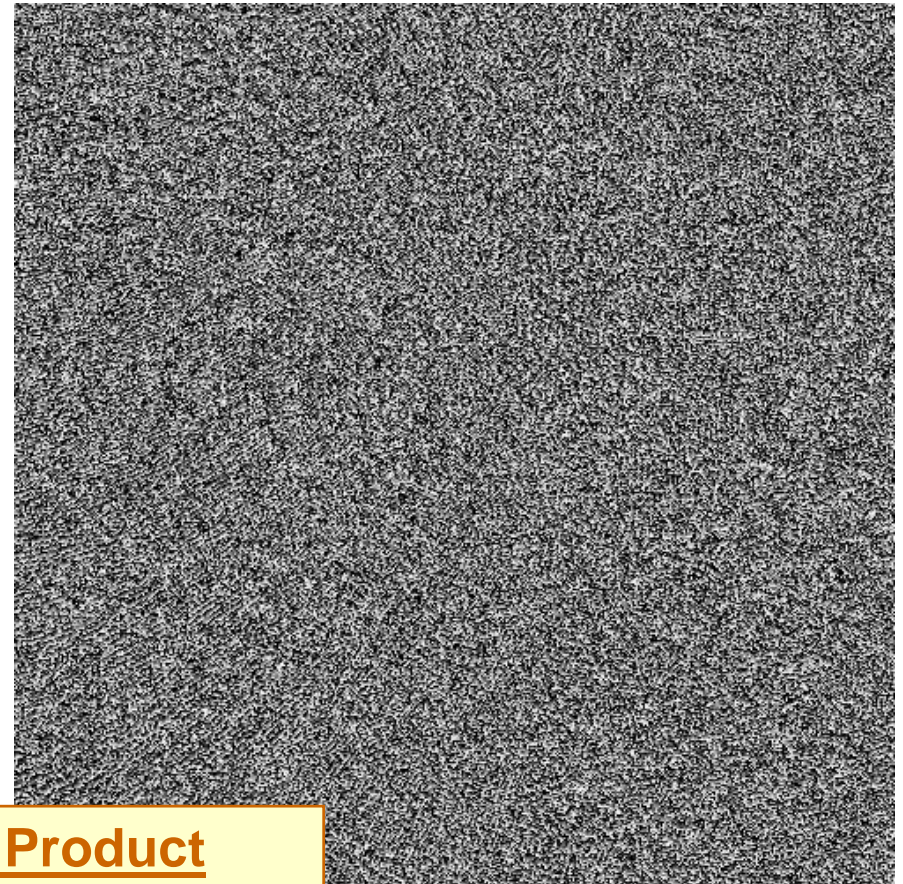
- **RAW** (Received SAR Echo Signal)
- **SCS** (Single look, Complex, Slant range)
- **DGM** (Detected, Ground projected, Multilook)
- **GEC** (Geo-coded, Ellipsoid corrected)
- **GTC** (Geo-coded, Terrain corrected)

Higher Level SAR Products

- Quick look
- **Speckle Filtered**
- Co-registered
- **Backscattering**
- Mosaic
- **DEM & Interferometric Products**
Coherence map; Interferograms



Modulus



Phase

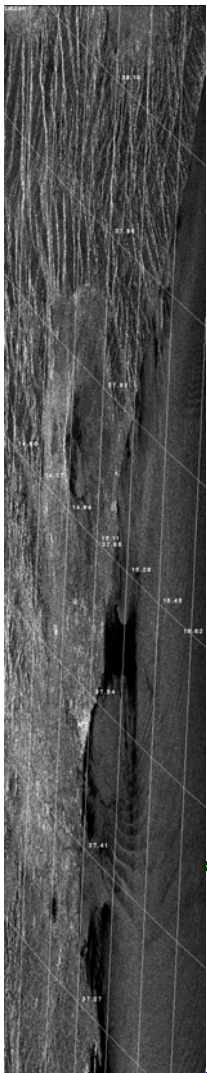
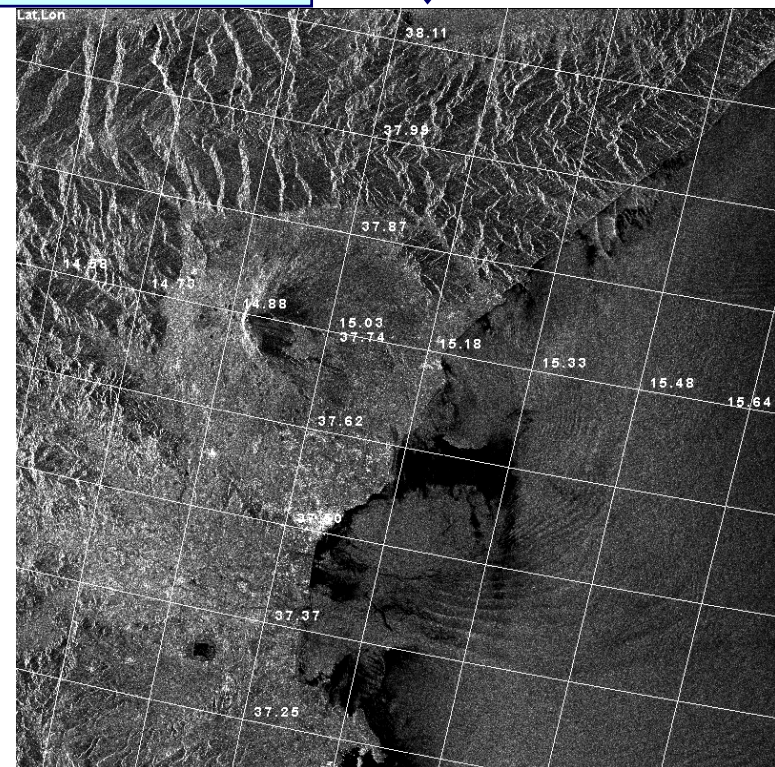
Etna RAW Product

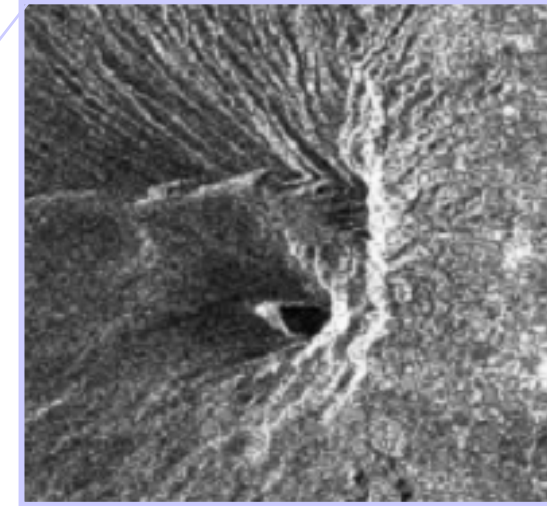
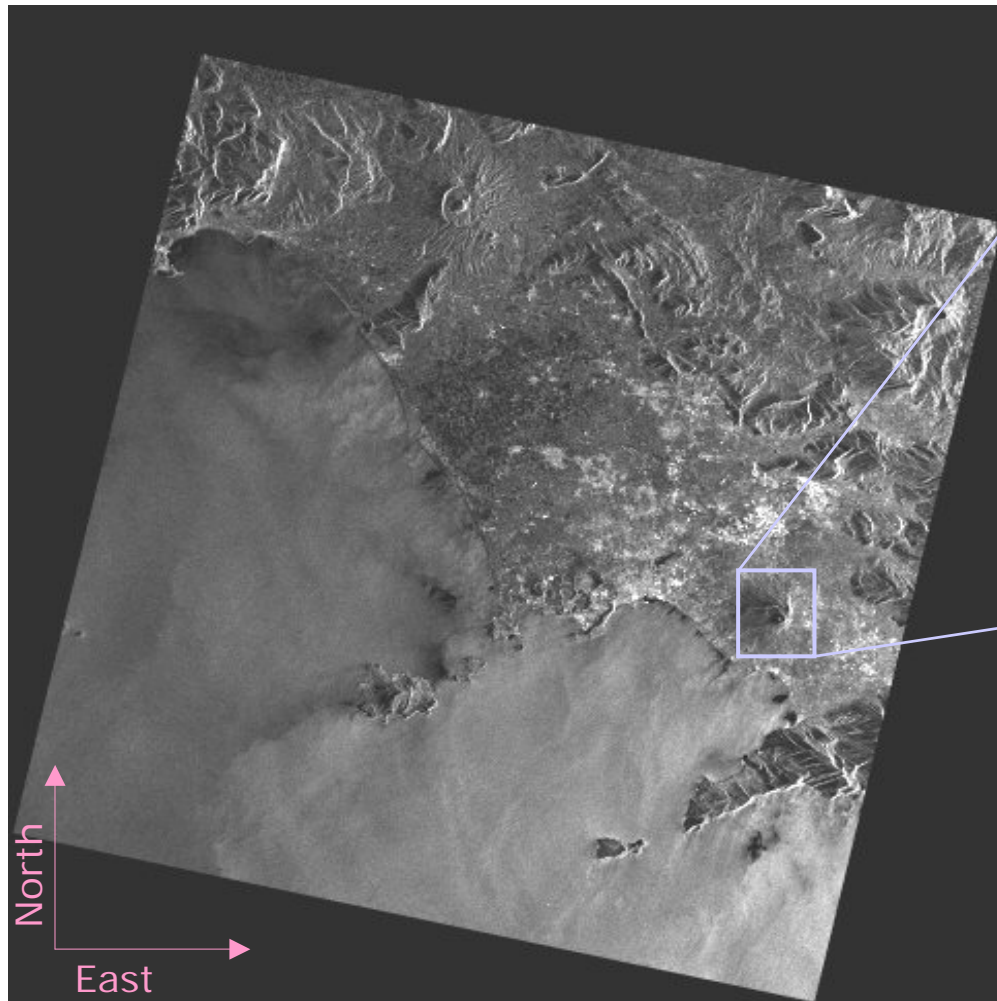
Standard Products Typologies

Etna as seen in ground range image (**DGM** product): note the reduction of the side looking distortions but the presence of a rotation with respect to North direction

In both images the grid is composed by lines at same latitude and same longitude (iso-lat, iso-lon)

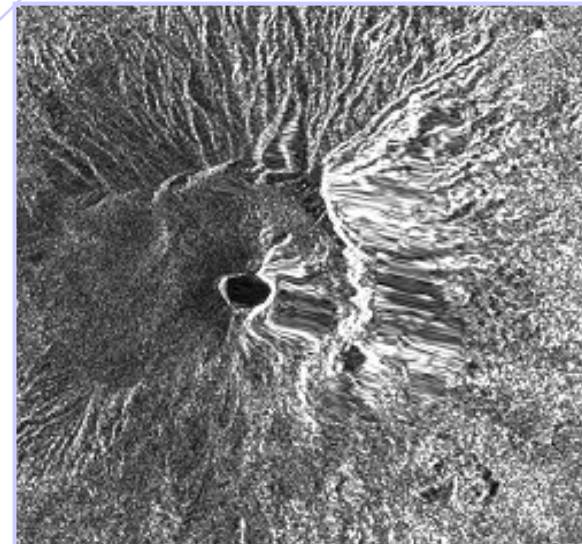
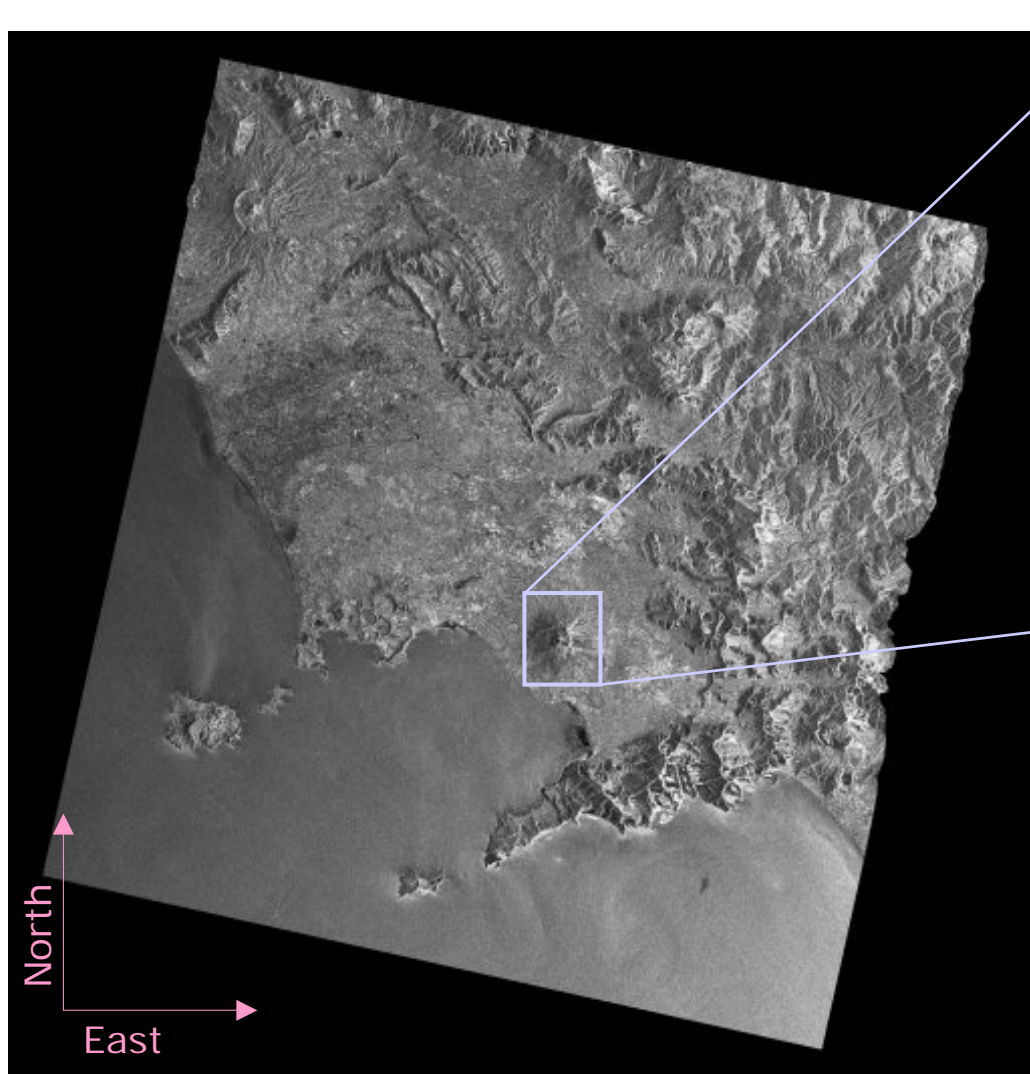
Etna as seen in a slant range image (**SCS** product modulus): note the magnitude of the the geometric distortions





GEC product

Vesuvio in a GEC image. Image is aligned with a cartographic map but distortions due to terrain height is still in place (see the compression of the right side of volcano)

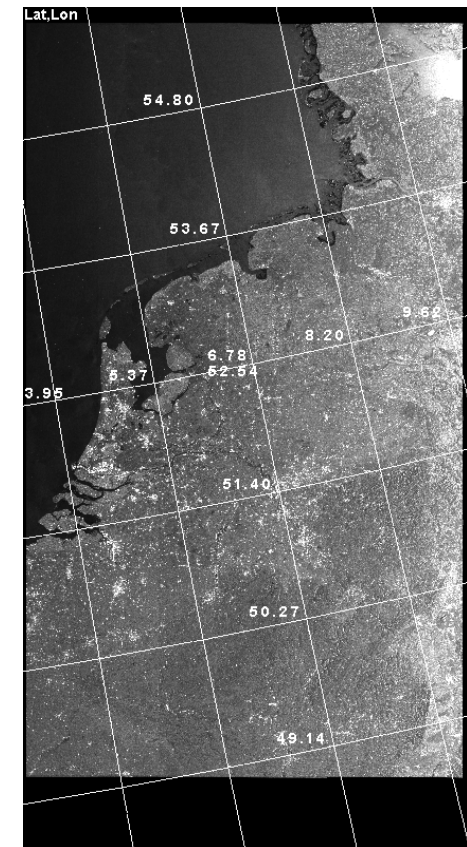
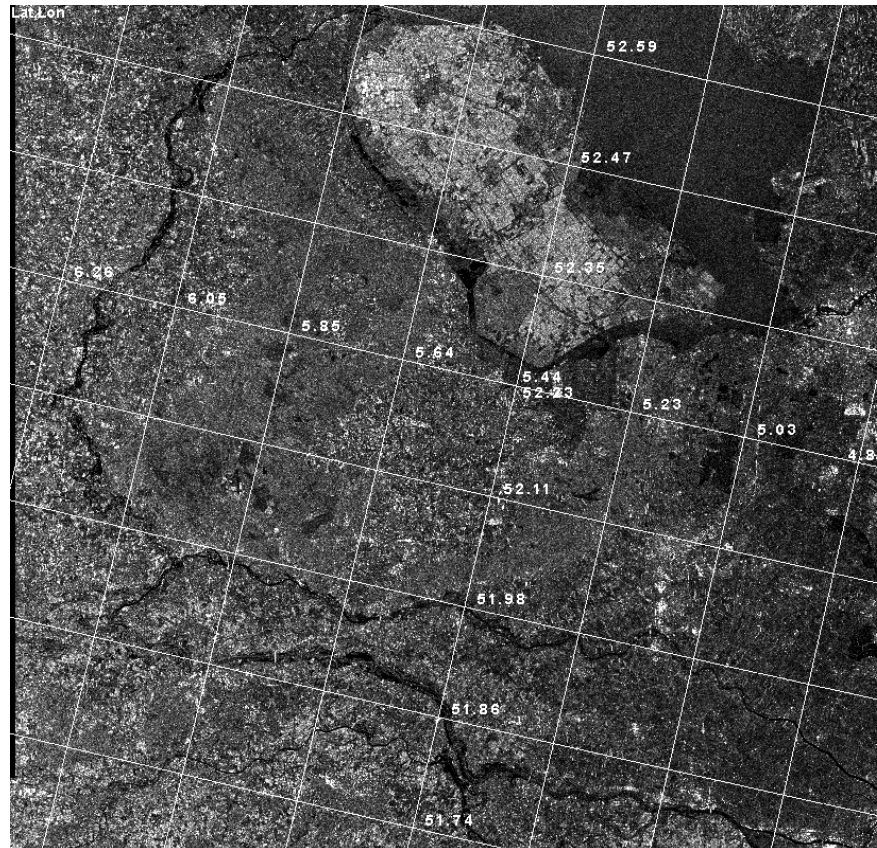


GTC product

Vesuvio. in a GTC image. Distortions due to terrain height are now compensated (see the right proportion of both sides of volcano)

❑ Quicklook

- generated with low resolution focusing of SAR RAW data or by spatial averaging the full resolution products, even non SAR
- has a lat,lon grid overlaid for easy retrieval of geo location info, radiometry stretched to 8 bit

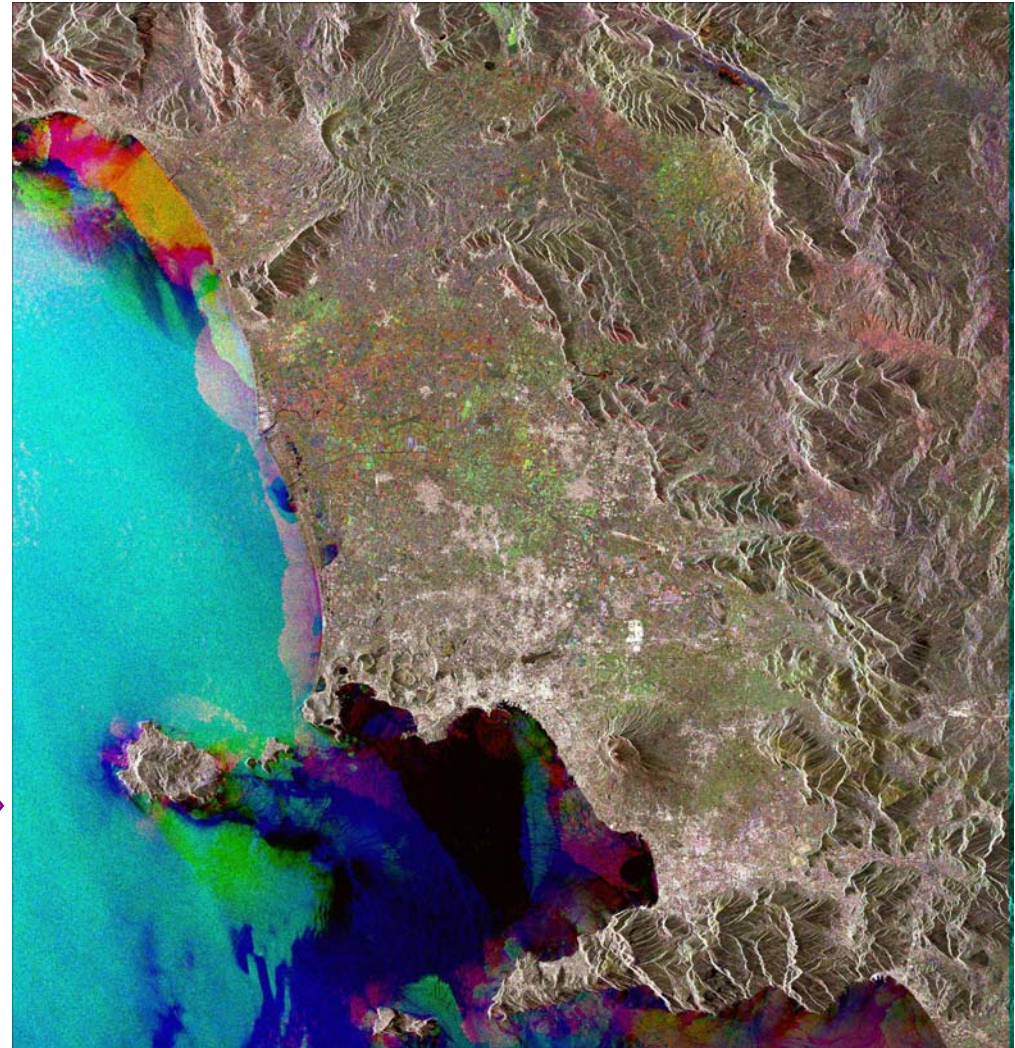
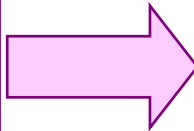


- ENIVISAT ASAR alternating polarization (100km x 100km) - Flevoland
- ENIVISAT ASAR ScanSAR (400km x 800km) - Netherland

❑ Coregistered

- Two or more images of the same earth zone are automatically distorted in order to make possible to geometrically superimpose them
- The corresponding product is a multilayer set of images useful for change detection, classification studies, false color representation

Vesuvio as seen in a false color DGM coregistered product, composed by 3 images acquired in different seasons



❑ Speckle filtered

- radar reflectance data but with a lower level of speckle noise
- many algorithms available, from Moving Window (improves the noise at expense of geometric resolution) up to sophisticated Gamma Map (image features contours and strong scatters are preserved by adaptive filtering)



Original



Moving Window filter

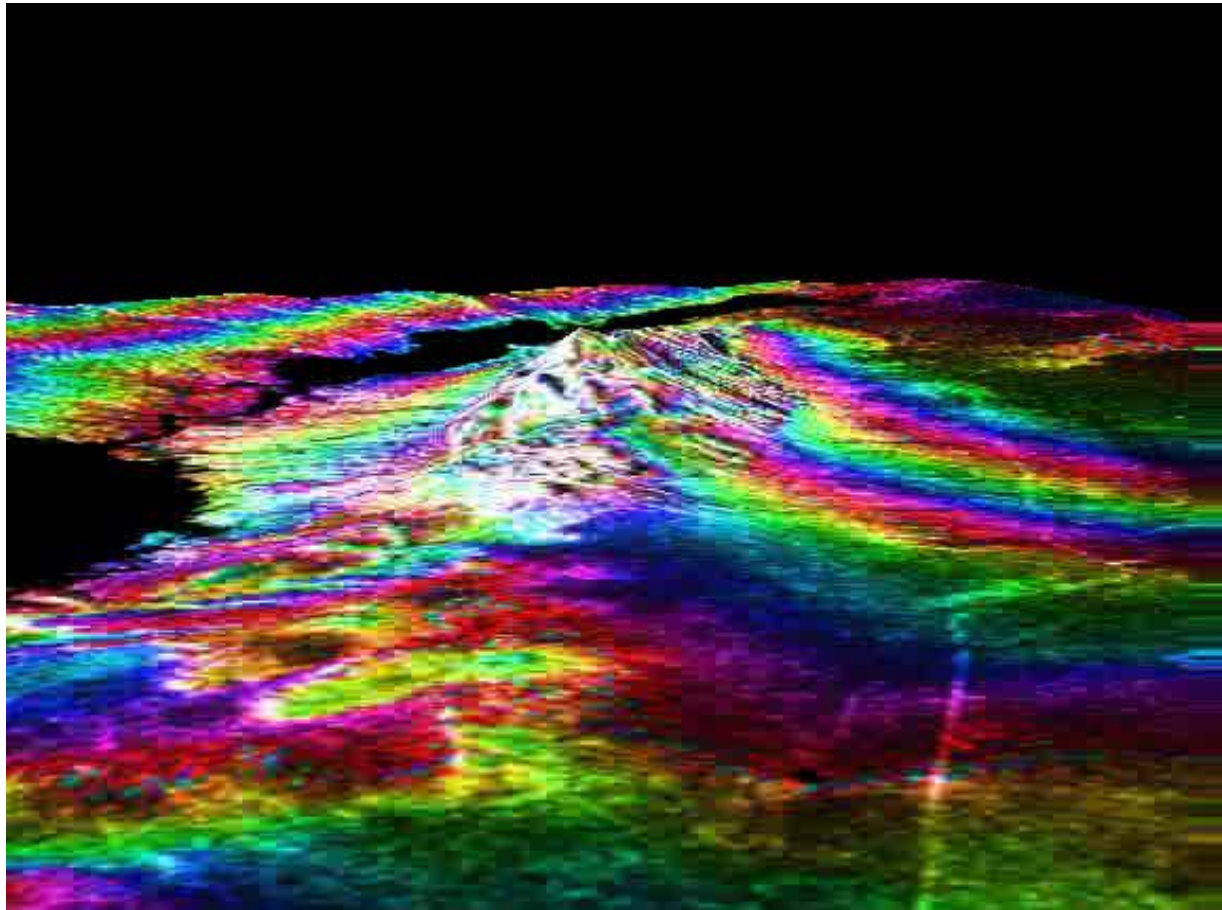


Gamma Map filter

Higher Level Products Typologies

□ DEM

- Generated by interferometric techniques: an earth zone is imaged twice within a very short time delay, the phase information of the complex SCS product gives the target to satellites distance, using some geometry the extraction of the height information is then possible
- Processing chain includes the generation of two Interferometric products: wrapped flattened phase and terrain corrected coherence

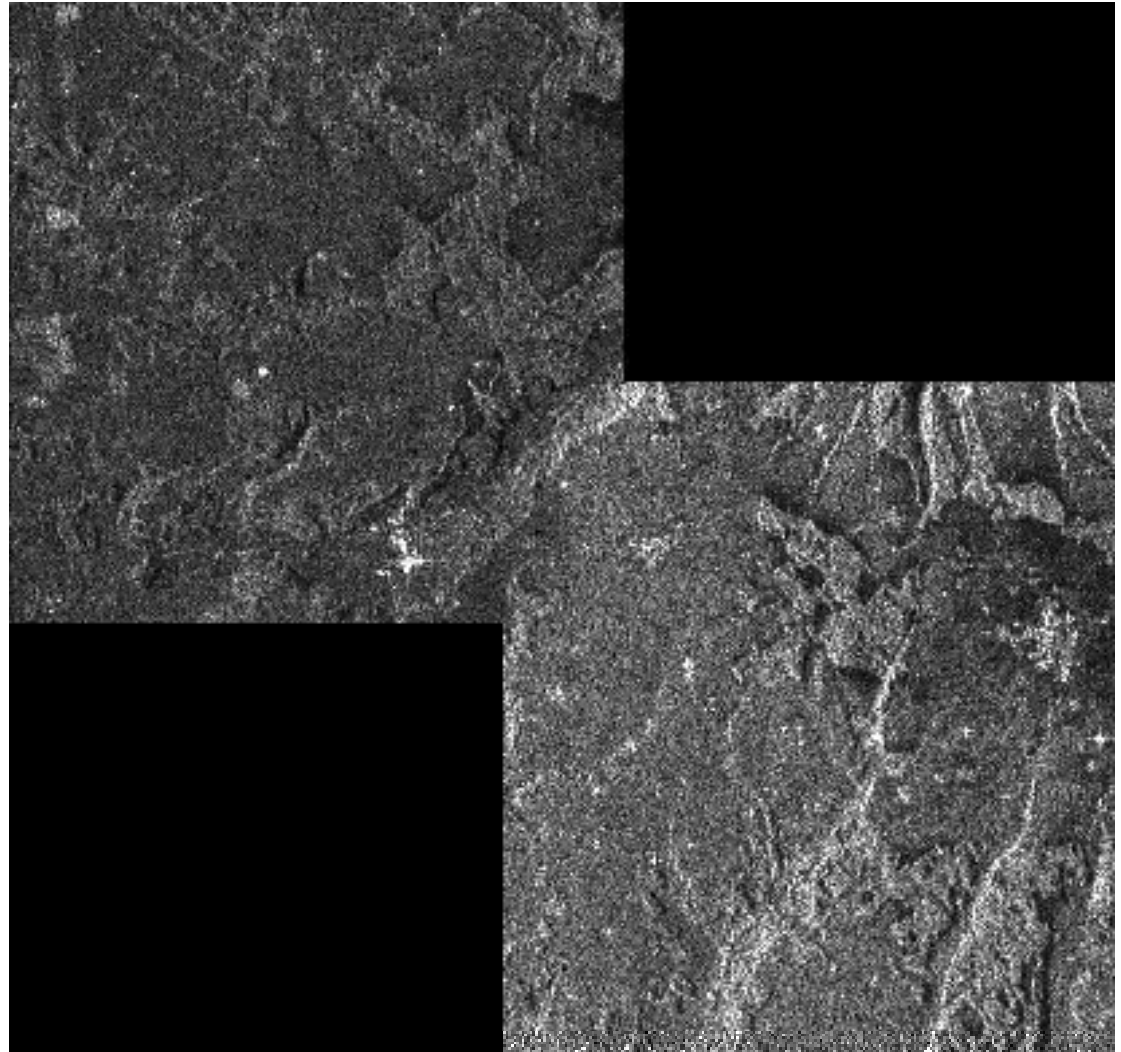


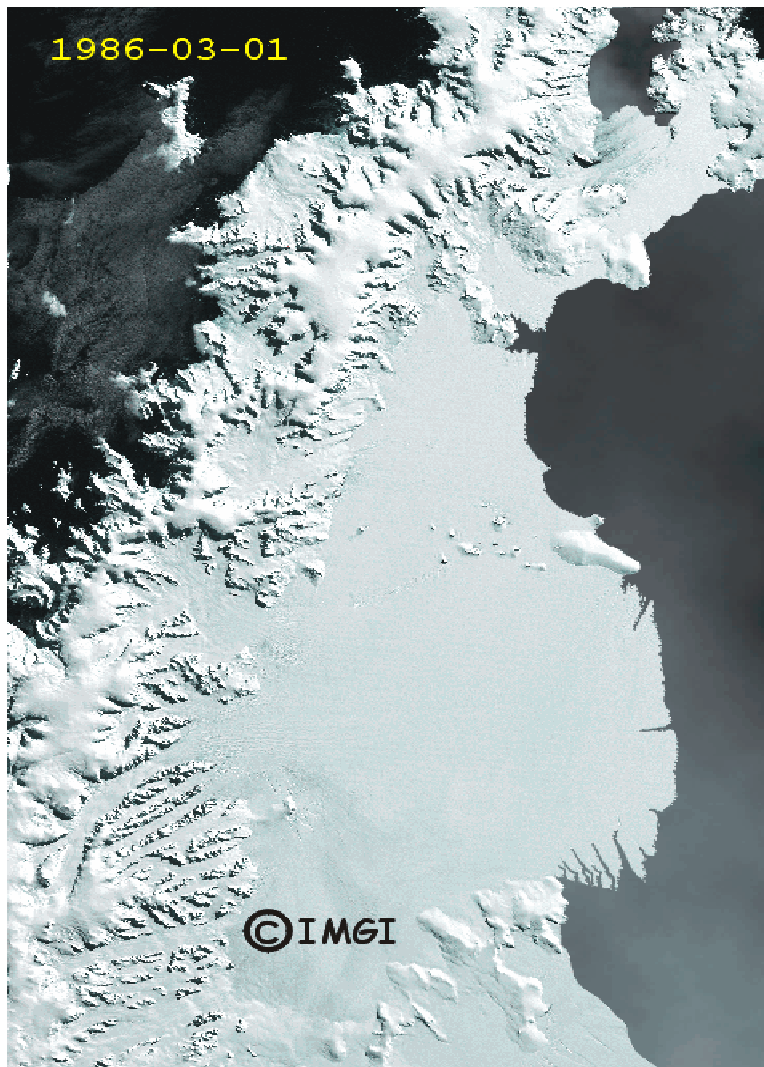
A Virtual Flight in a DEM generated with interferometry: color is associated with interferometric fringes, saturation with coherence

❑ Mosaiked

- generated joining a set of separate images acquired in the same geometry, in order to obtain a larger coverage
- automatic processing with compensation of the radiometric discontinuities at edges

Example of mosaiked product: note as even with a very small overlap, the processor correctly joins the components with a small discontinuity in radiometry





Antarctica Ice Evolution

The following COSMO characteristics are particularly suited for Marine Applications like Oil Spill and Sea Ship Detection:

- Short revisit time (few hours) allowing the gathering of the SAR images with an adequate time sampling. In Oil Slick applications this feature, in conjunction with suitable models, allows the forecasting of the slick position/velocity and hence the determination of the point and time of arrival of the oil in coasts or beaches
- Short response time (daily in routine mode) allowing the acquisition of scenes containing slow moving targets with an high probability of success
- Large swath (200km) with a medium spatial resolution (100m) allowing the monitoring of extended coverages, particularly suited for semi- or fully-automatic target detection algorithms (like ships)