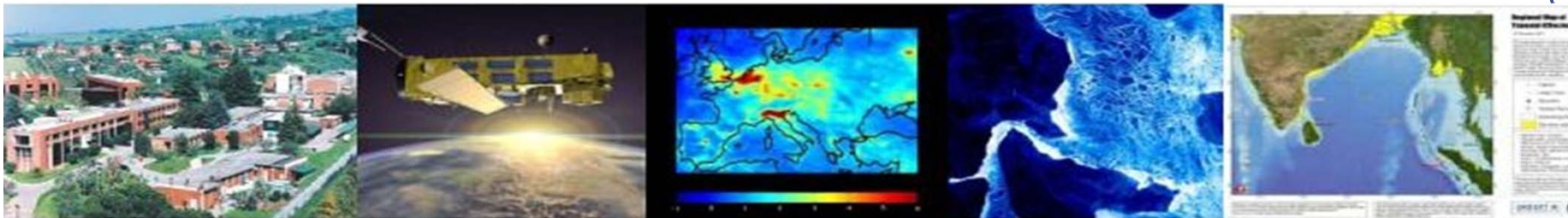


Industry Workshop Satellite EO for Insurance

Disaster Risk Management Applications



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International Charter Space & Major Disasters

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- ✓ **ESA operates satellite missions** (ERS, ENVISAT: tools for crisis mapping)
- ✓ **participates to the International Charter** Space & Major Disasters
- *EO data*
- ✓ **has EO application development programmes**
- ✓ **participates to international activities** to support EO utilisation
- *Support the development of EO capacities for users*



International Charter Space & Major Disasters (CHARTER)

Group on Earth
Observations

Global EO System of Systems (GEOSS & CEOS)



Integrated Global Observation Strategy (IGOS)

European Space Agency
Agence spatiale européenne

• Emergency Response,

- Rapid Crisis Mapping & Damage Assessment,
- Situation Mapping.

• Prevention, Preparedness, Recovery, Reconstruction

- Detailed Damage Mapping,
- Risks Assessment.
(Floods, Fires, Geo-Hazards)

• All phases

- Reference Mapping,
- Digital Elevation and Digital Terrain models,
- LU/LC cover Mapping,
- Asset Mapping.



**Available Globally,
Operational/Pre-operational**

Disaster management users (**civil protections, UN, aid workers**) have limited time to spend on technology if it is not **directly useful & operational** within their working environment





MINISTÈRE DE L'INTÉRIEUR
DIRECTION GÉNÉRALE DE LA PROTECTION CIVILE

Information Needs

- **Reference maps**
 - Place names, human and economical assets, infrastructures
 - Updated background (especially outside EU)
 - Available **within 6 hours**
 - Scale 1:100,000 (overview) – 1:25,000 (tactical)
 - TAKING ADVANTAGE OF EXISTING GIS AND MODELS
- **Fast damage maps**
 - Destroyed / flooded areas, landslides...
 - In Europe & Mediterranean basin, available **within 24 hours**, daily update before 17:00 UTC
 - GARANTEED SERVICE
 - TAKING ADVANTAGE OF AVAILABLE FORECASTS
 - Scale 1:50,000 (overview) – 1:10000 (tactical)

Information needs, after DDSC

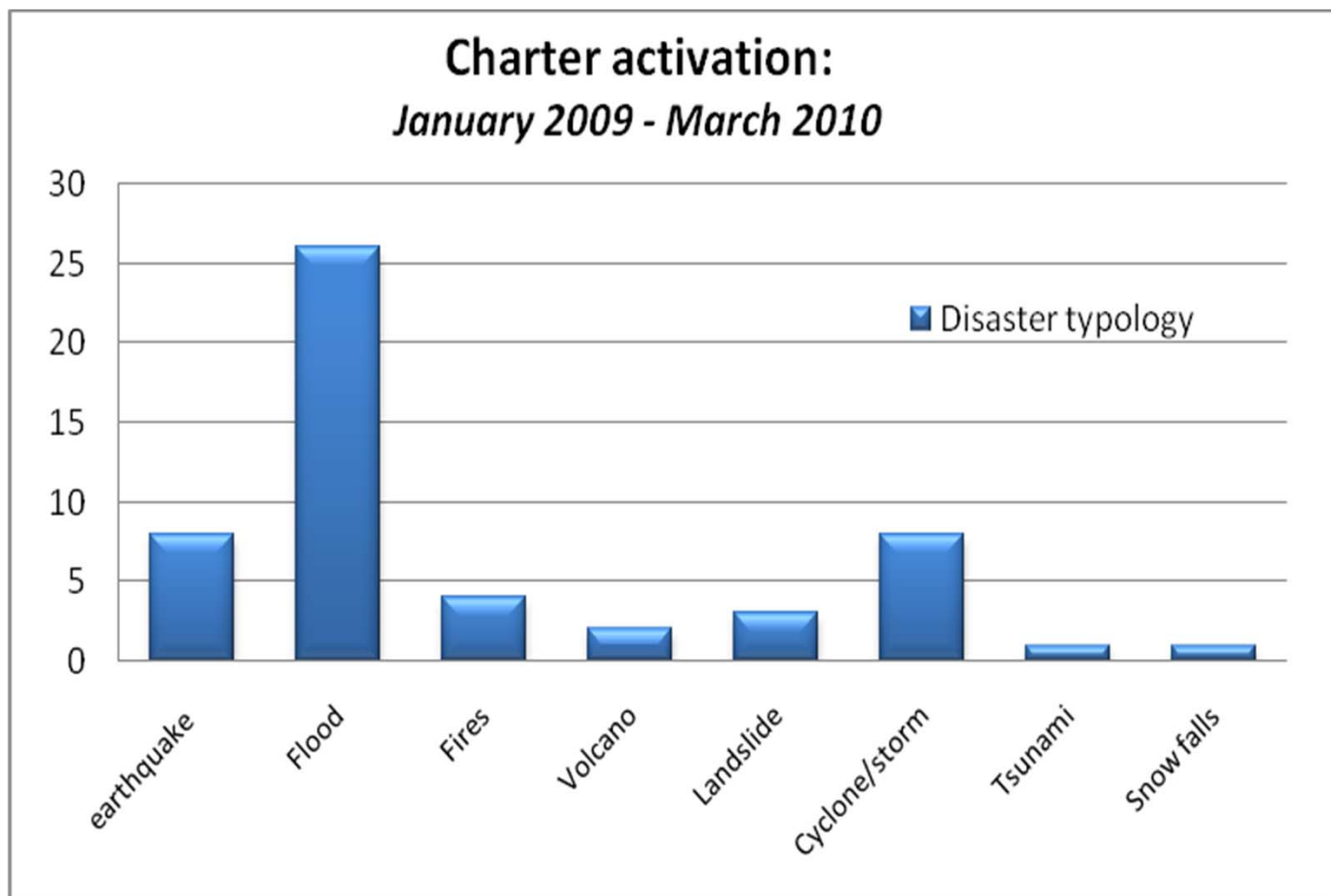


The International Charter Space & Major Disasters

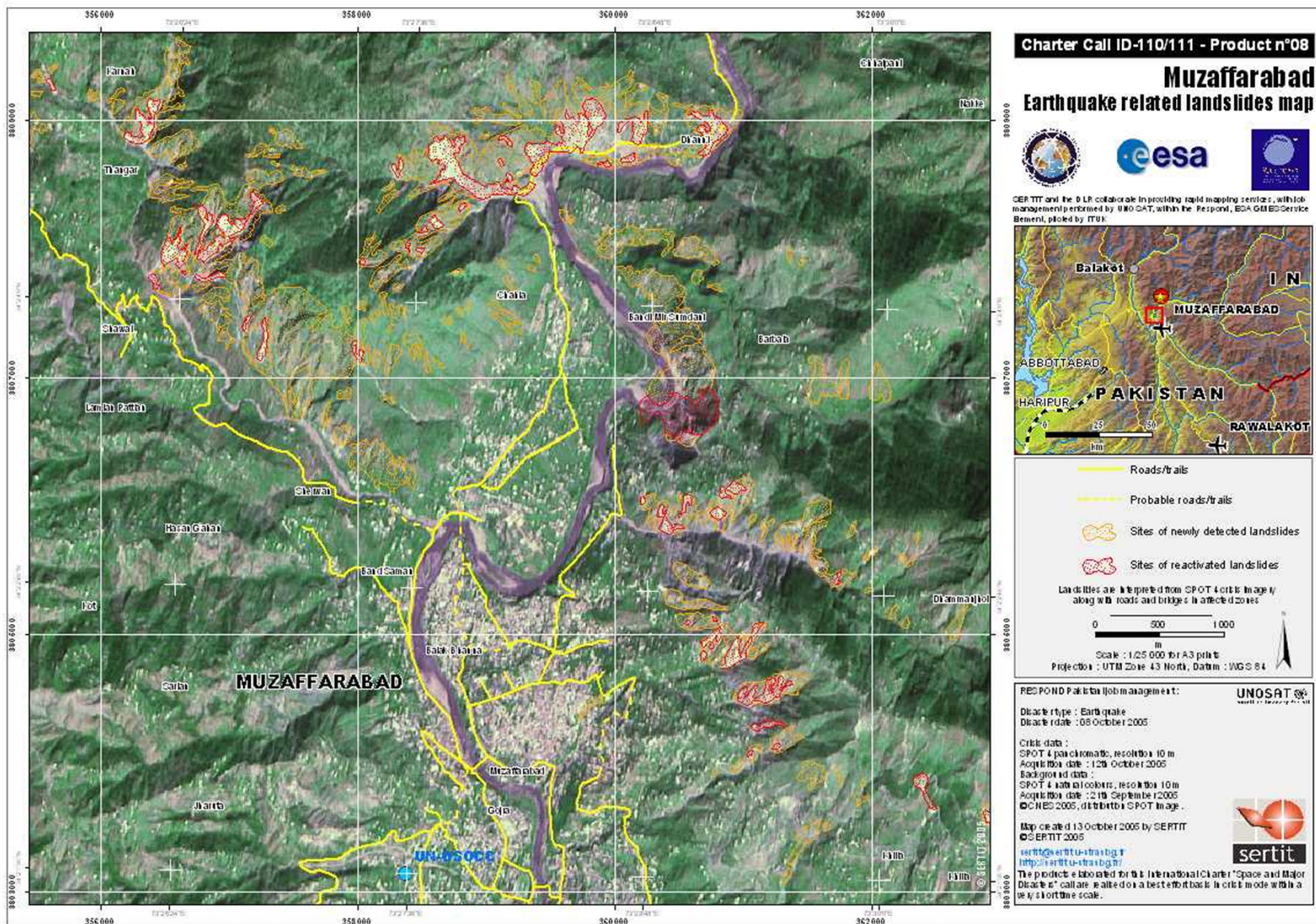
- Initiated in 2000 by CNES and ESA, joined by CSA, NOAA, ISRO, CONAE, JAXA, USGS, BNSC/DMCii, CNSA, ROSCOSMOS, INPE, DLR & KARI (14 members currently)
- **Unified system of space data acquisition / delivery in case of natural or human-made disasters (at no cost, best effort basis)**
- **Data delivery to civil protection agencies, emergency & rescue services; UN cooperating body since 2003**
- The only bodies authorized to request the services of the Charter are the **Authorized Users**.
- Operational : 24 hrs on-duty-operator
- **Charter activations increasing** (50 most important events per year)
- **Examples of activations : Cyclone Giovanna (Madagascar), Flooding (Brazil), Wildfires (Chile), Tsunami/Earthquake/Nuclear (Japan), Flood (Australia), Landslide (Brazil), Earthquake (New Zealand), Flood & Landslide (Japan), Earthquake & landslide (India).**

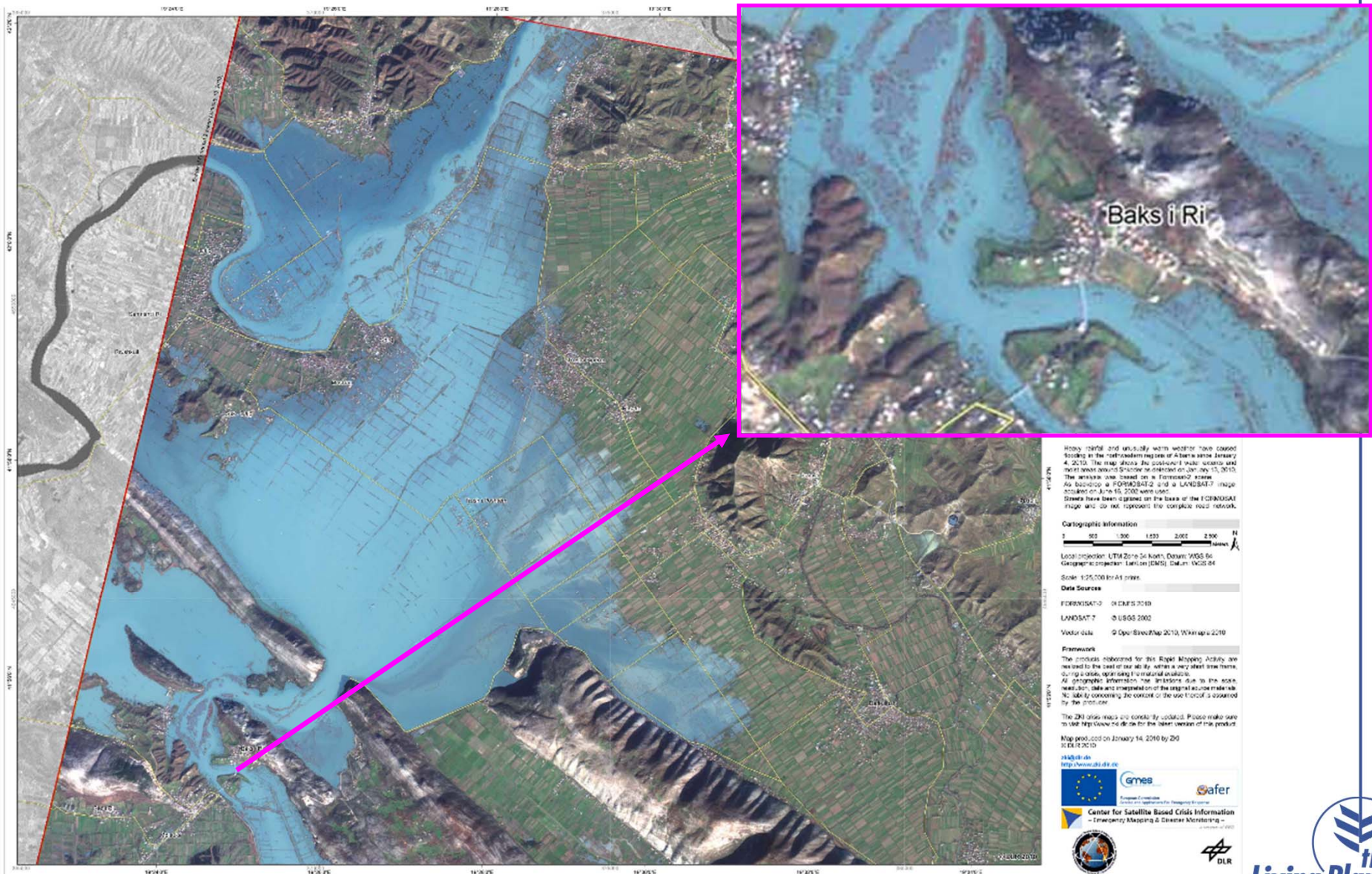
*European Space Agency
Agence spatiale européenne*





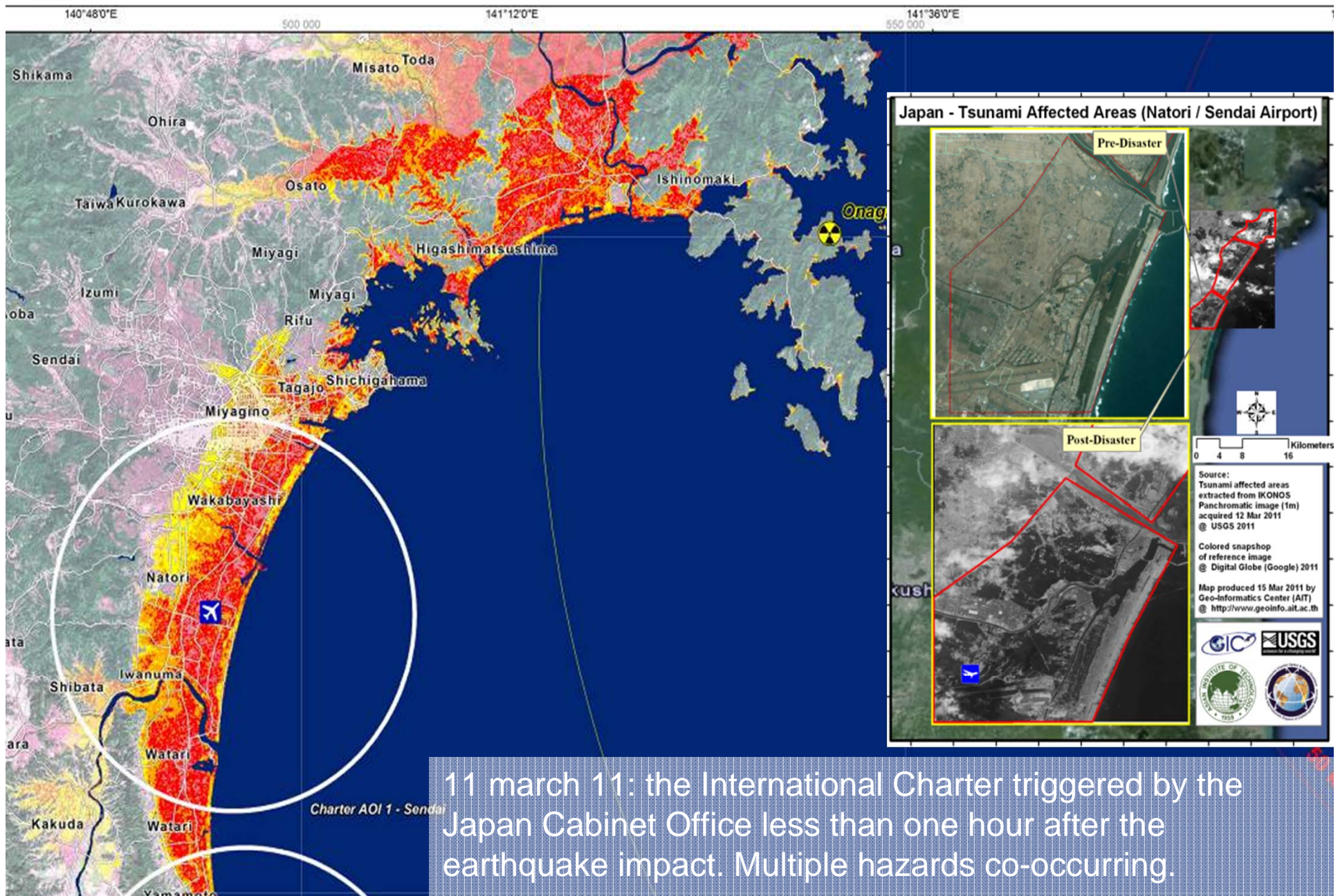
« There are 2 types of disasters, floods and other disasters »

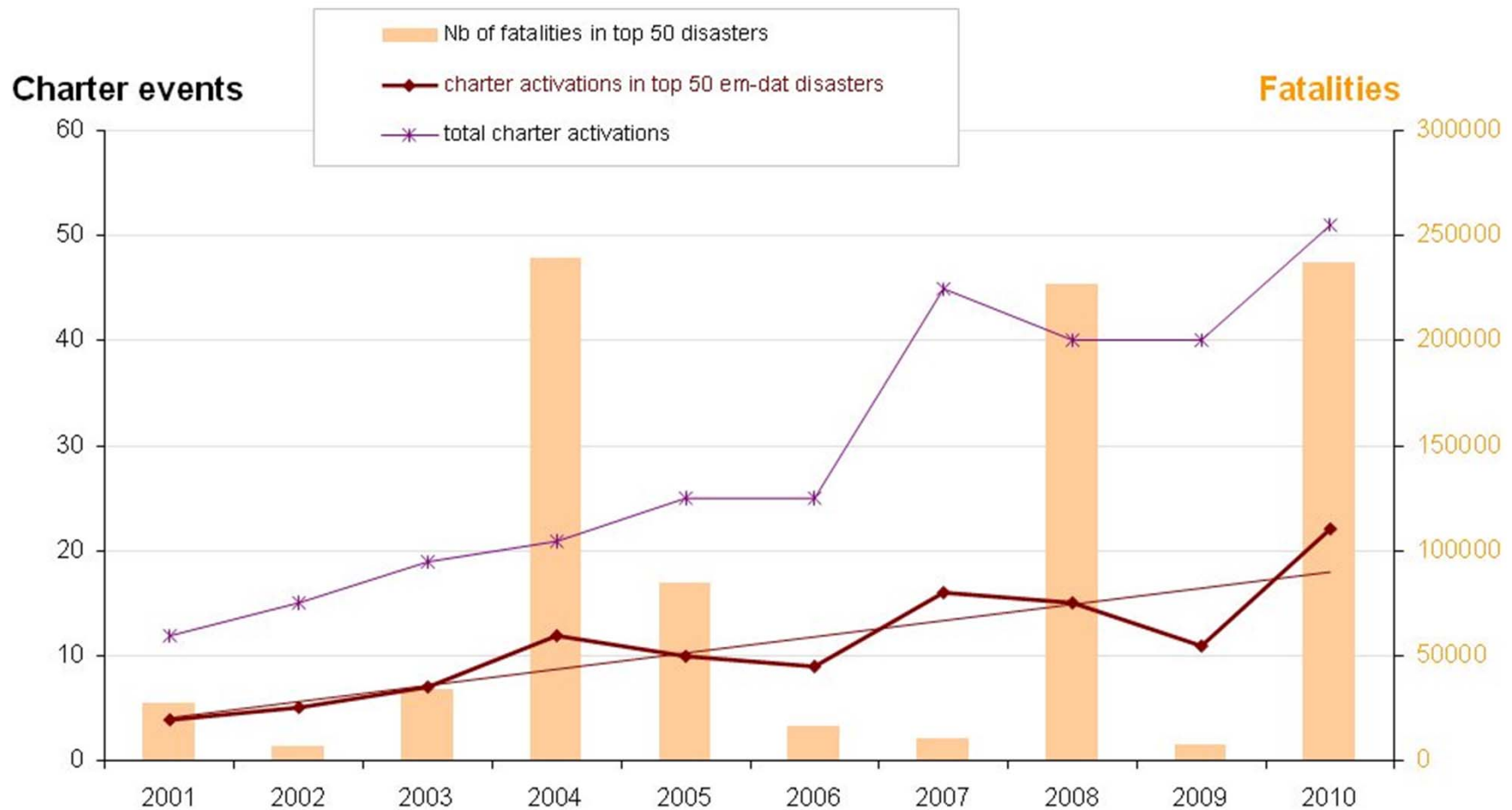




Fire Mapping, Greece

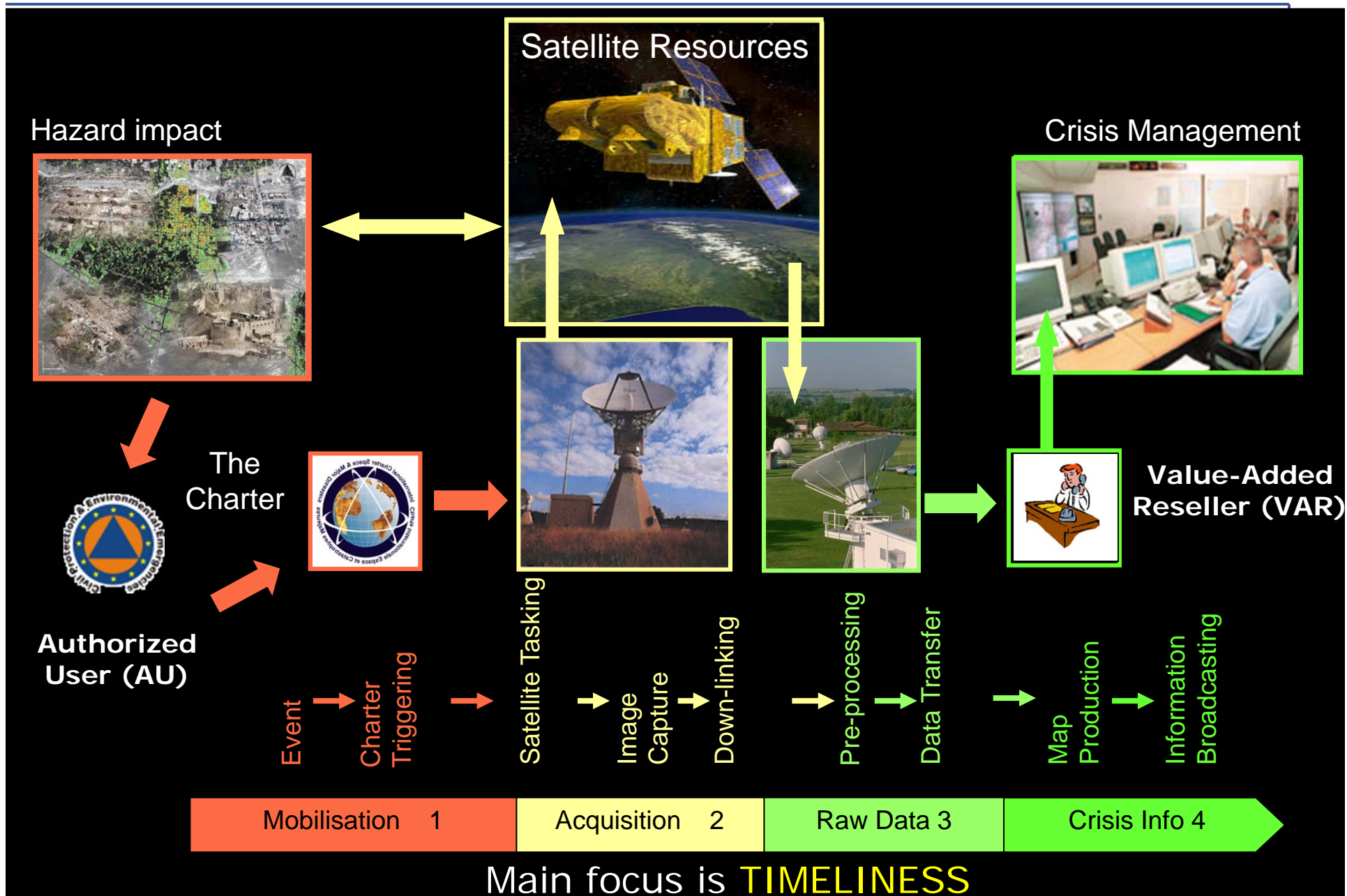






Top (pink): Charter activations per year; Middle (red) portion of Charter events part of the 50 most severe disasters recorded in the EM-DAT database of CRED. Orange bars represent the yearly total of mass disasters recorded by CRED.

Triggering the Satellite EO response:



Requirement: daily observations. To which extent does a given combination of EO missions meet this requirement?

Example based on a small group of 4 presently available EO missions:

- ❑ RADARSAT & COSMOSkyMed (SARs) and SPOT & RapidEye (Optical) → requirement met at 100%

Newly available missions:

- ❑ Pléiades alone → requirement met at 100% (provided a cloud free sky) post 2013:
- ❑ Sentinel-1 mission alone → requirement met at 84% (all weather)
- ❑ Radarsat Constellation → requirement met at 100% (all weather)

	Satellite data	Aerial data
Availability	24/7 world-wide with a rush production capacity Access to imagery globally independent from politics	Depending on the authorisations to fly
Spatial Res.	60-250cm at best using VHR Optical imagery	Up to better than 10cm
Coverage & Revisit	Revisit :Generally high with up to several acquisitions/day Coverage: from 15km to 150km swath (east-west) for a single scene	Revisit: One off / possibly several times a day
Timeliness	Between 1 and 3 days after an event	36h after acquisition
Cost	Access to data at no cost (systematic in the framework of the Int. Charter) not counting data analysis	N/A

- **Emergency Response,**

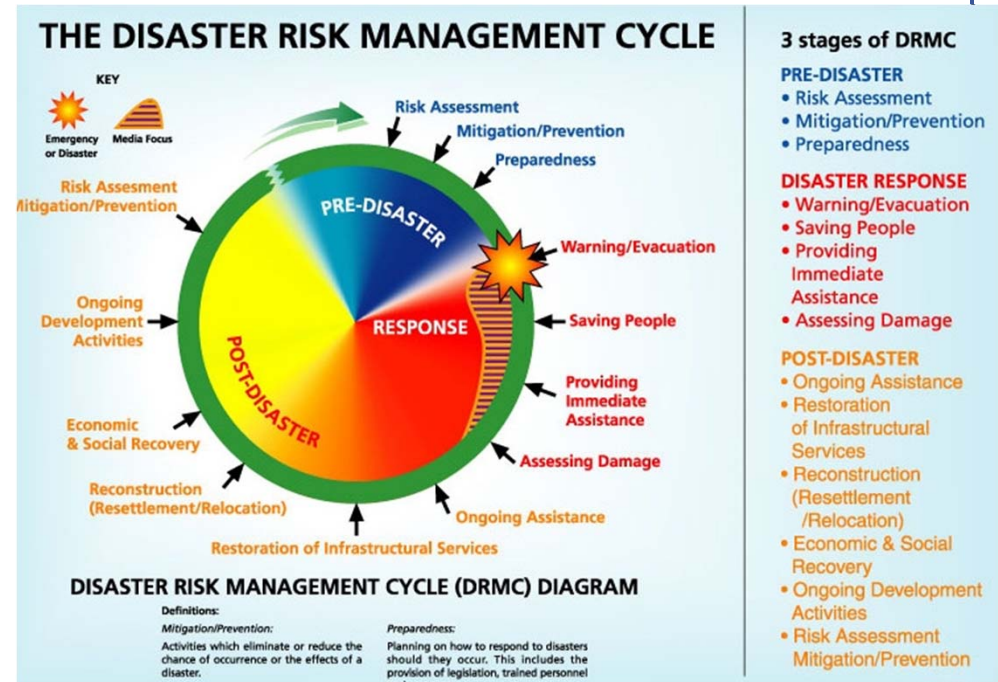
- Rapid Crisis Mapping & Damage Assessment,
- Situation Mapping.

- **Prevention, Preparedness, Recovery, Reconstruction**

- Detailed Damage Mapping,
- Risks Assessment.
(Floods, Fires, Geo-Hazards)

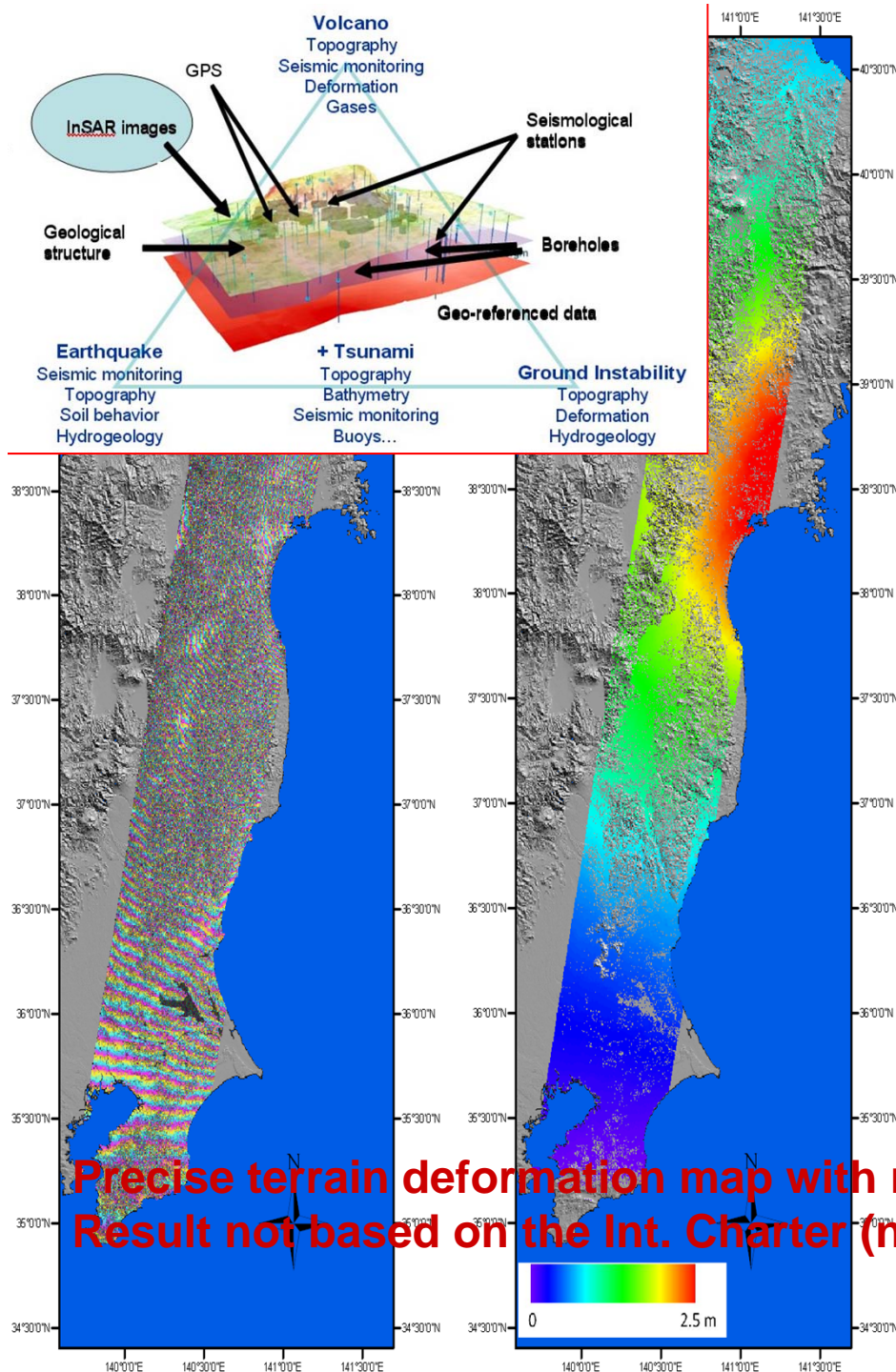
- **All phases**

- Reference Mapping,
- Digital Elevation and Digital Terrain models,
- LU/LC cover Mapping,
- Asset Mapping.

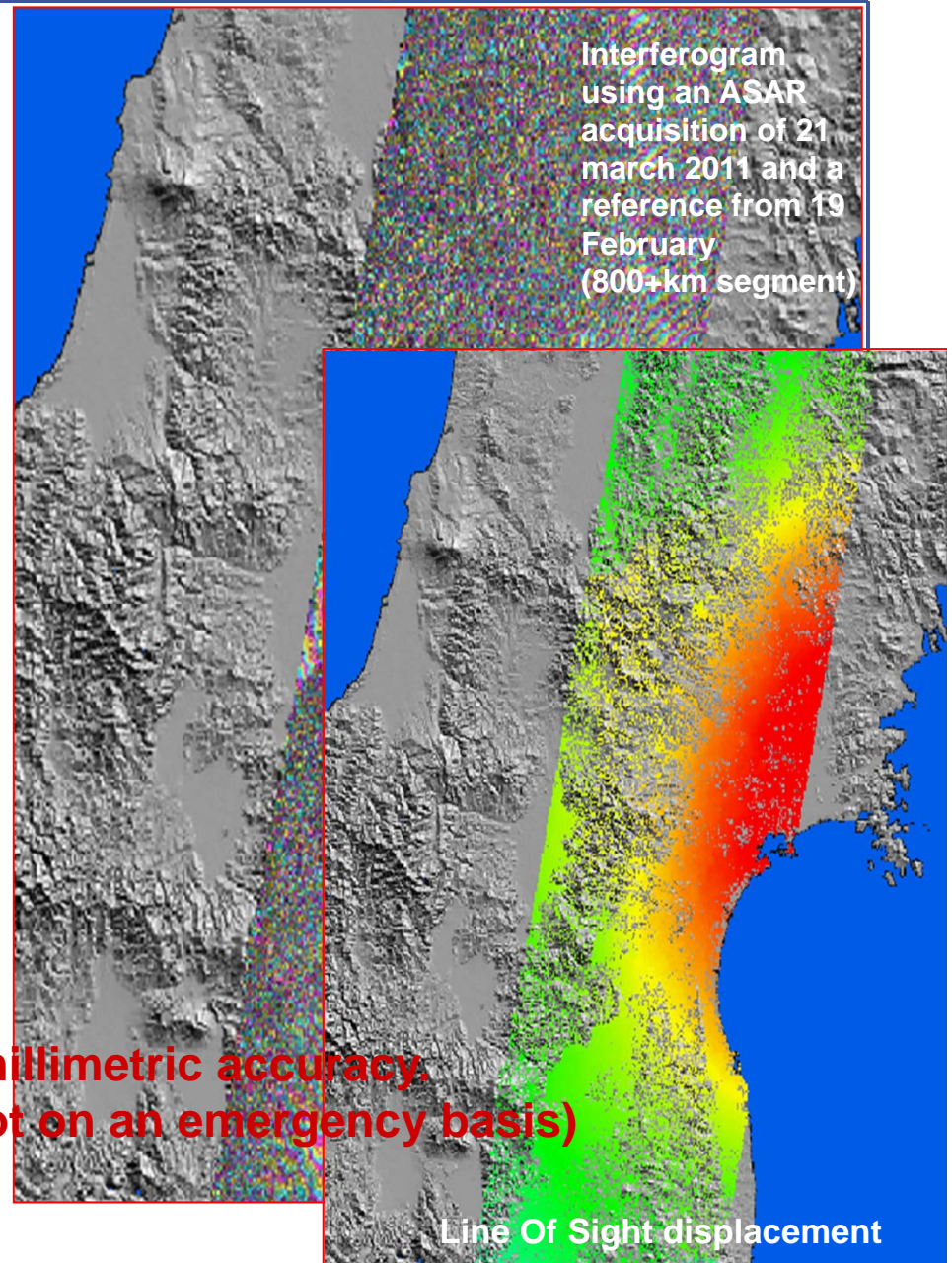


**Risk Assessment Services
not
Near-Real-Time Production**

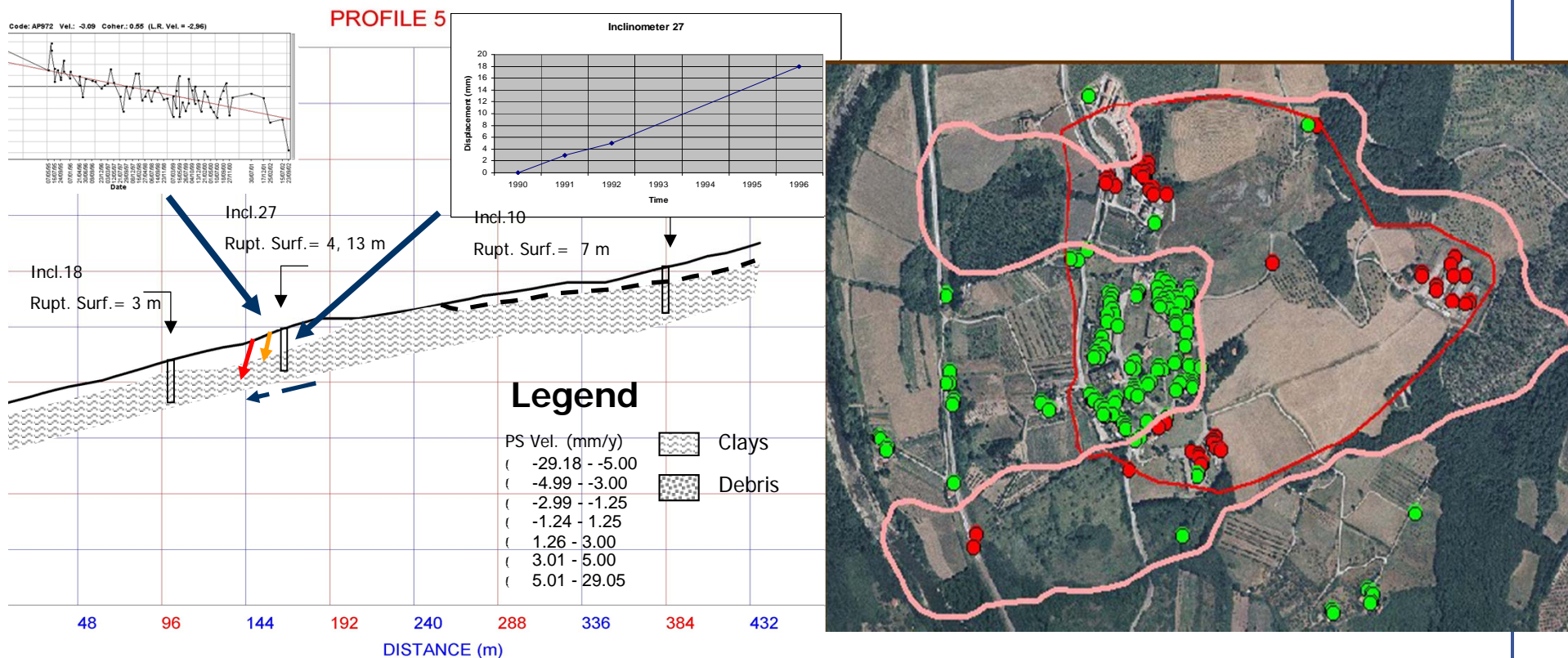
SAR Interferometry: Envisat co-seismic strip over Honshu island



**Precise terrain deformation map with millimetric accuracy.
Result not based on the Int. Charter (not on an emergency basis)**



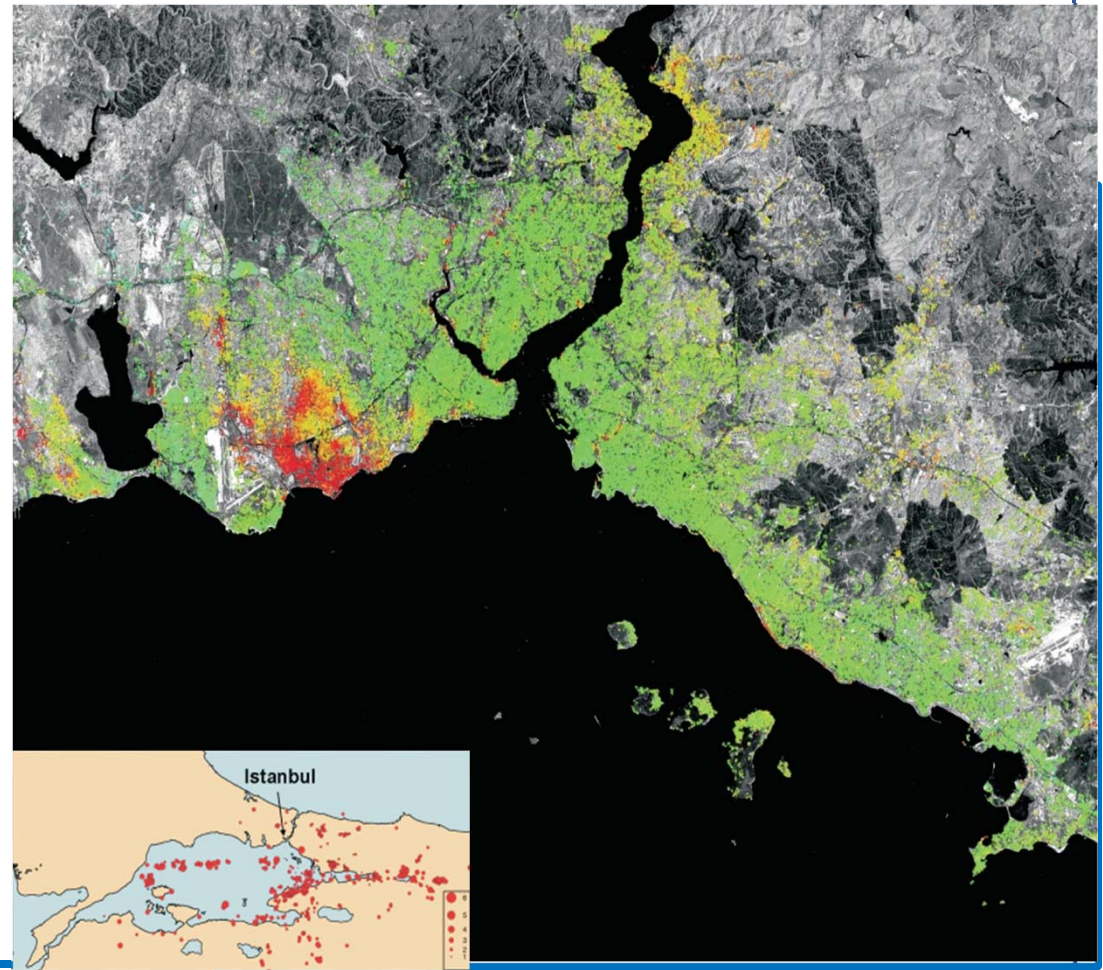
Landslide Risk Mapping in Italy



Left: Example of integration of geologic information with ground measurements (inclinometric readings) and PS-derived information, to define or refine a model of an existing landslide.

Right: product used by the Arno AdB to refine the limits of the Risk-zones for which it is legally responsible (Red: previous R3/4 area, Pink: revised R3/4 area)

- Much of the destruction caused by the 1999 Izmit earthquake was concentrated to **the West of the city**. By contrast the eastern city is built mostly on solid rock and is generally stable, though critical zones are revealed by the PSI study.
- A clear sign of **unconsolidated soft sediments** that can severely amplify seismic ground motion.
- EO allowed to provide **subsidence data with a detail level** nearly impossible to achieve in most circumstances



“TerraFirma data indicates where we should focus on our efforts in earthquake preparation.” Kandilli Observatory and Earthquake Research Institute (KOERI).

Global Monitoring
for Environment
and Security (GMES)



ESA: Space Component

EC: Services & Operations

EO



*European Space
Agence spatiale européenne*

Needs



Solutions



**Public
Policy**



Sentinel 1 – SAR imaging

All weather, day/night applications, interferometry

2012, 2014+



Sentinel 2 – Multispectral imaging

Land applications: urban, forest, agriculture,..
Continuity of Landsat, SPOT

2013,
2014+



Sentinel 3 – Ocean and global land monitoring

Wide-swath ocean colour, vegetation, sea/land
surface temperature, altimetry

2013, 2014+

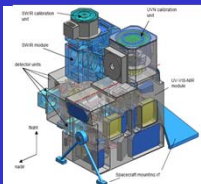


Sentinel 4 – Geostationary atmospheric

Atmospheric composition monitoring, trans-
boundary pollution

2018

+



Sentinel 5 and Precursor – Low-orbit atmospheric

Atmospheric composition monitoring

2015, 2020

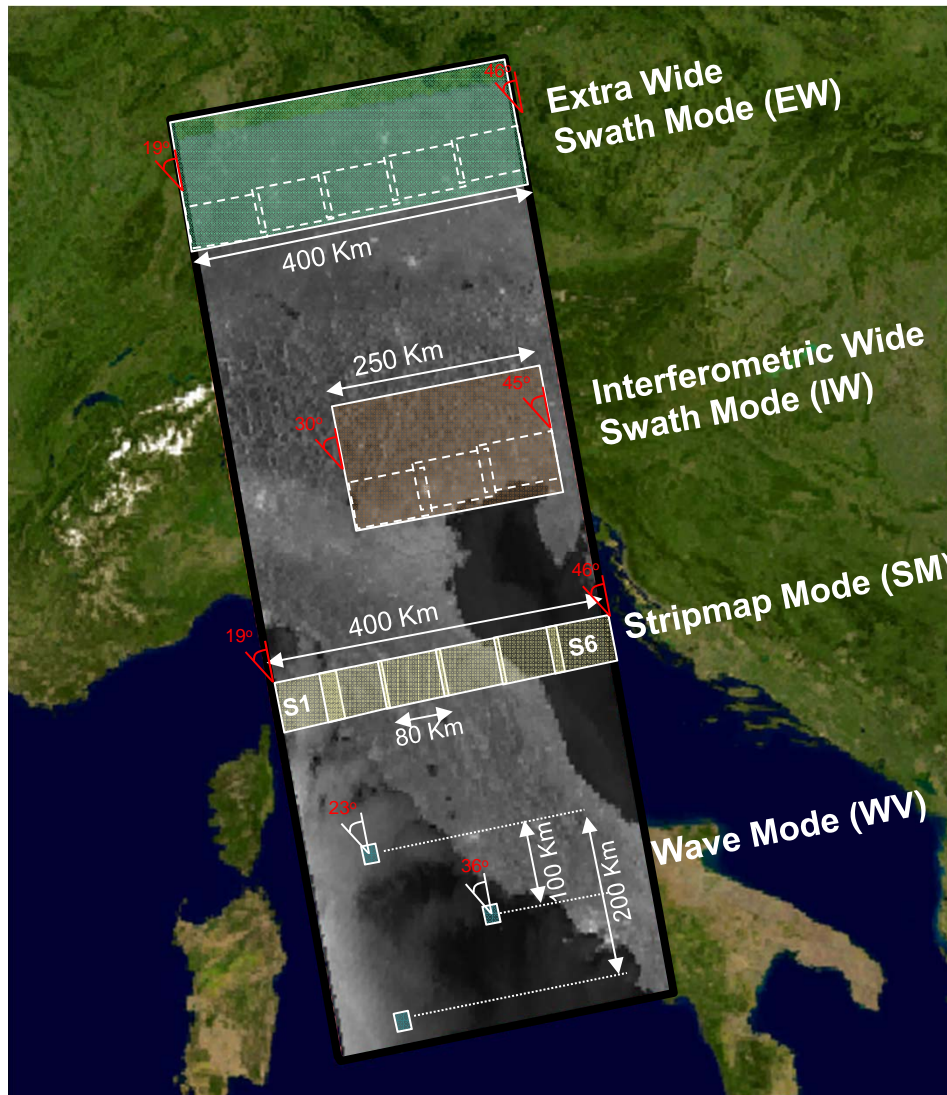


- Carpet coverage,
Data monsters !
- Development &
Deployment A & B
units 2.3 B€,
- Free, open & easy
access to data,
- Long-term continuity
of observations (25+
years),
- Used together with
VHR national
European missions.

Main objectives of the Sentinel operations strategy

- provide data to GMES services and for use by Member States according to their specified requirements
- ensure systematic and routine operational activities:
 - with a high level of automation
 - with pre-defined operations to the maximum extent possible
- minimize the number of potential conflicts during operations, therefore solve anticipated conflicts a priori, in particular in the elaboration of pre-defined mission observation scenarios

Sentinel-1 SAR: 2 major modes



Sentinel-1 SAR can be operated in 4 exclusive imaging modes with different resolution and coverage:

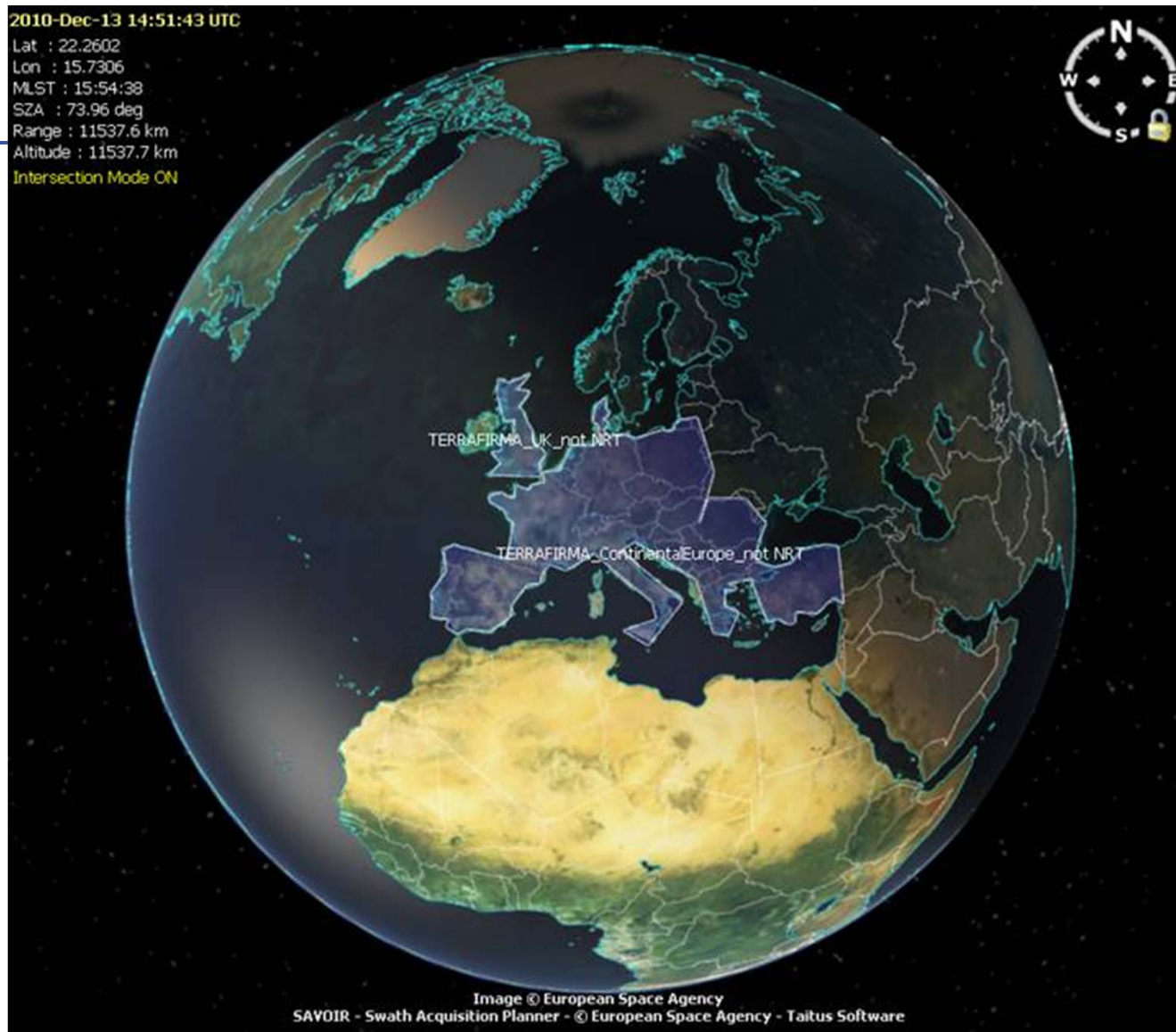
Mode Rate	SAR Mode
High Bit Rate (HBR)	IW
	EW
	SM (S1 → S6)
Low Bit Rate (LBR)	WV

Polarisation schemes for IW, EW and SM:

- single polarisation: HH or VV
- dual polarisation: HH+HV or VV+VH

For Wave mode: HH or VV

For all of these operating modes, the same family of products is available to users.



Example: Priority areas for geo-hazard risks in Europe
 (source: GSE Terrafirma).

2010-Dec-13 14:51:43 UTC

Lat : 24.3557

Lon : 11.0943

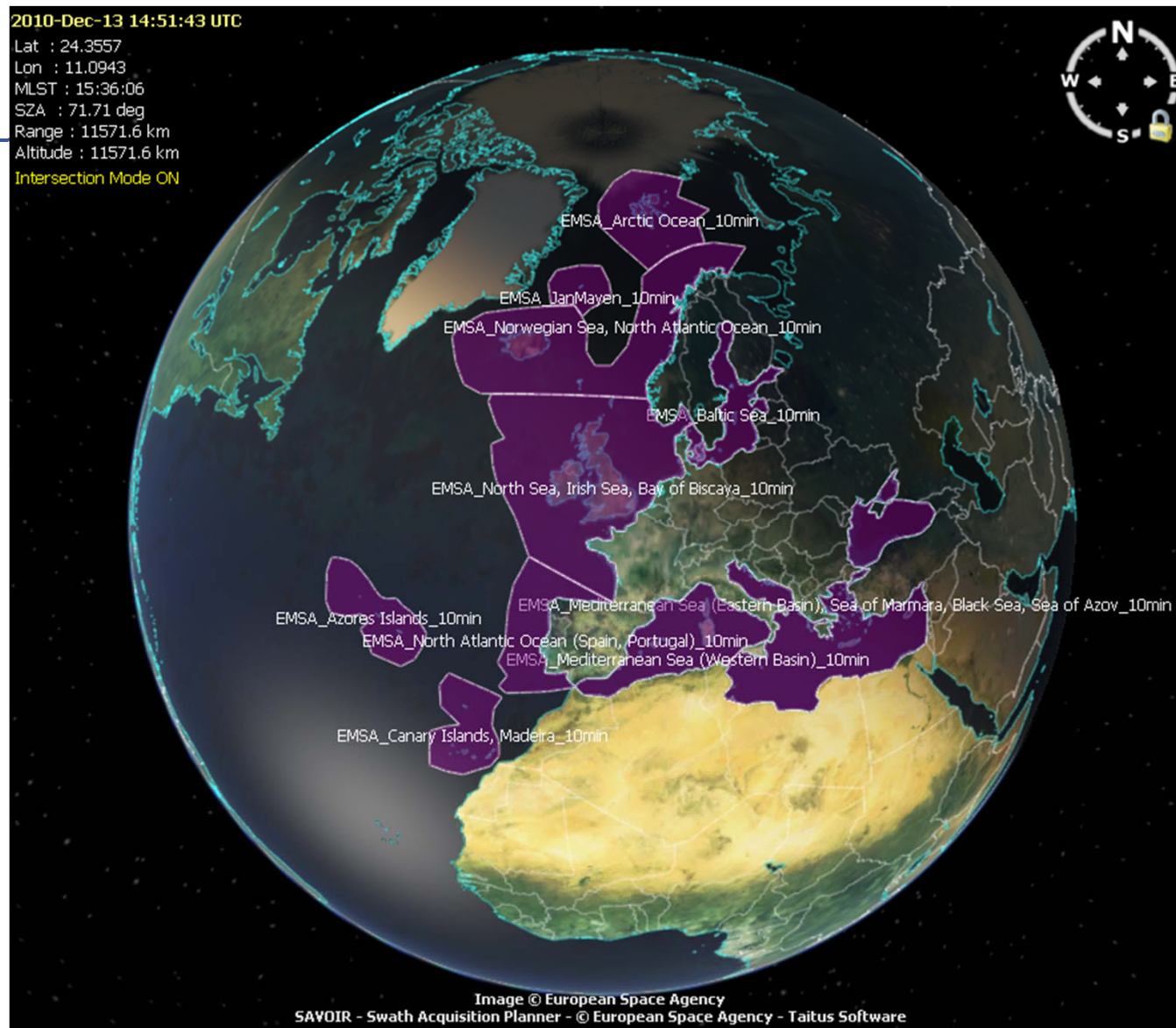
MLST : 15:36:06

SZA : 71.71 deg

Range : 11571.6 km

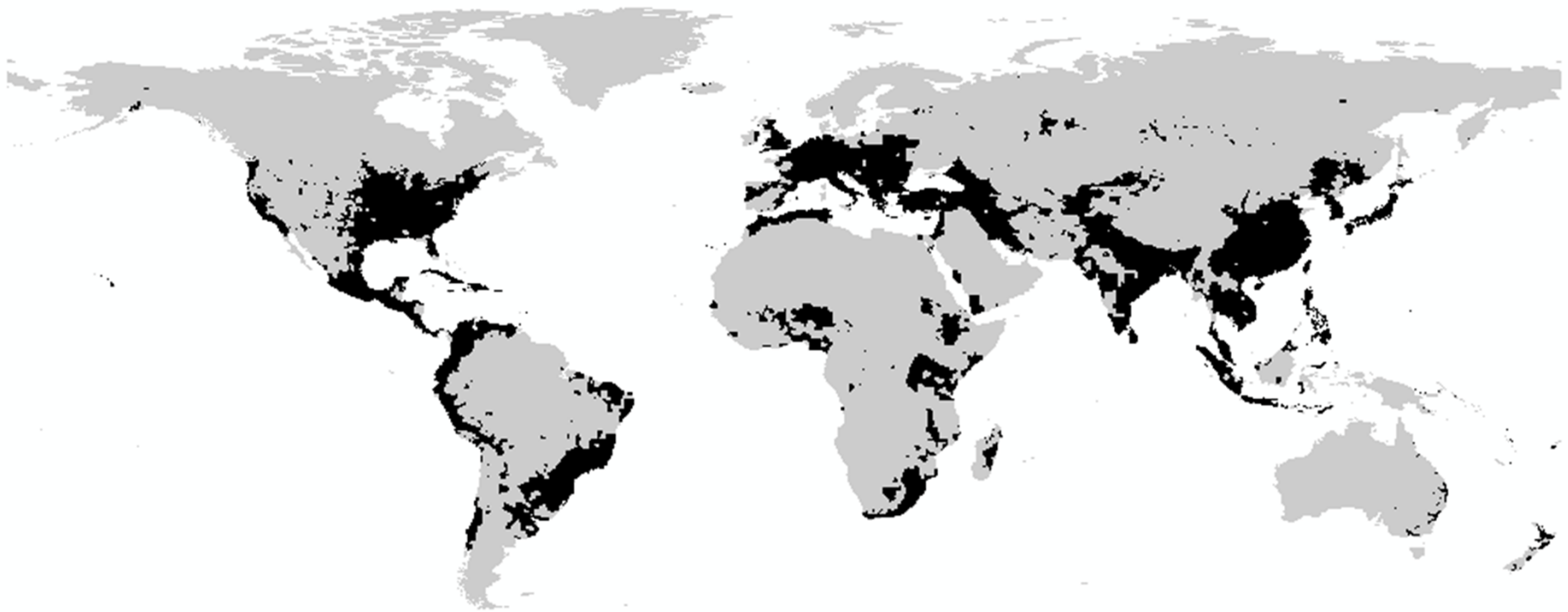
Altitude : 11571.6 km

Intersection Mode ON

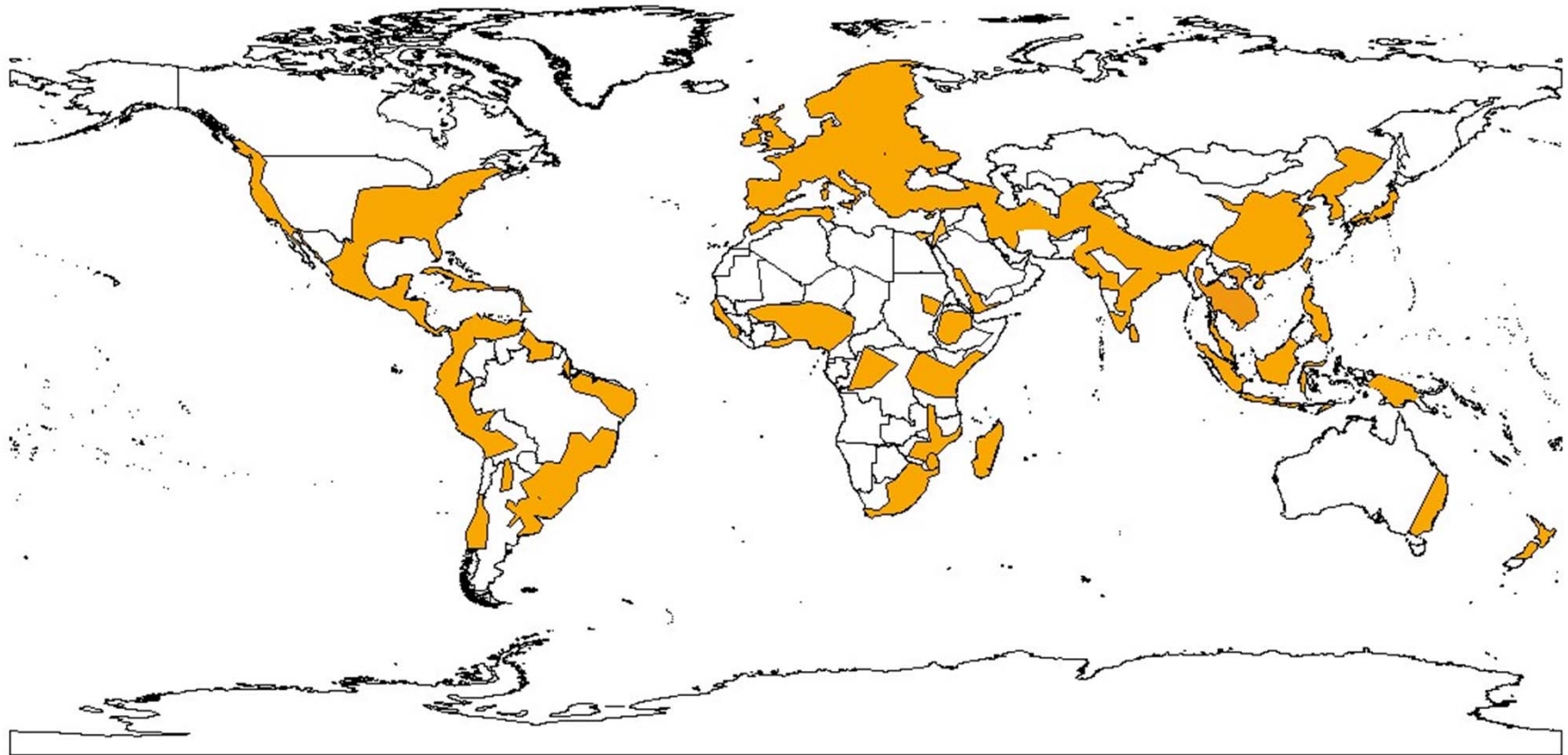


Sentinel-1 RT (10 min) requirements from EMSA (CleanSeaNet 2nd gen.)

European Space Agency
Agence spatiale européenne



Example: areas derived from global hazard datasets (including data from University of Columbia/World Bank).



Example: Priority areas for hazard risk management concerning Floods, Landslides, Earthquakes and Volcanoes.
(source: GSE Respond, priority areas derived from global hazard datasets including data from University of Columbia/World Bank).



During Full Operational Capability operations

- Systematic (or very frequent) mapping of tectonic / subsidence / landslides / volcano areas to support operational services and “operational science” based on INSAR
 - Need to provide pairs in both ascending / descending passes
 - Regular mapping of areas prone to risks to acquire strategic background data (e.g. for flood)
 - Regular mapping of areas to support GMES security services
 - Regular mapping (based on seasons) for glacier & snow monitoring
 - Regular global coverage of all land areas (frequency TBD), supporting among others crop monitoring, forest mapping (e.g. REDD), based on seasonal requirements
- **A (single) main mode of operations: IW Mode**
(in dual-polarisation (HH+HV) or in single polarisation)



Risk Management Cycle

	Prevention	Early Warning / Alert	Crisis Response	Post Disaster Needs Assessment	Recovery/ Rehabilitation/ Reconstruction
EO contribution	Risk Assessment	Monitoring hot spots Prediction Alert	crisis mapping damage assessment	damage assessment debris mapping/monitoring	Broad range of services
How it is used	thematic information requires interpretation & local experts	EO suitable for a few themes only (hydromet hazards)	Rapid service partial information to decision makers & in-field	Detailed Mapping JRC & UNITAR/UNOSAT work with WB	

- EO can contribute to a wide range of risk management applications (both for **prevention & disaster response**)
- Example of achievement: the Italian government is purchasing INSAR data for **the complete territory**; the Swiss government has EO measurements included in **the official definition of its risk assessment methods, etc**
- 50+ Geological Surveys are engaged via Service Level Agreements to exploit **terrain deformation services for geo-hazard risk assessment**

- **Earth Observation can contribute** to risk management.
- Space technologies **can deliver key information** that brings benefit to the *definition, planning, implementation, monitoring & assessment* of risk management operations.
- **the International Charter is growing**: more users (CPAs and International Humanitarian community), Rapid Mapping services being adopted by them, increased performance.
- It is opportune and timely to assess how EO based hazard mapping can be **used in the insurance sector**



Thank You !

The ESA Earth Observation programmes

... understanding our planet

... securing our environment

... benefiting our economy