



Global Monitoring for Environment and Security

GMES in support of Emergency Management

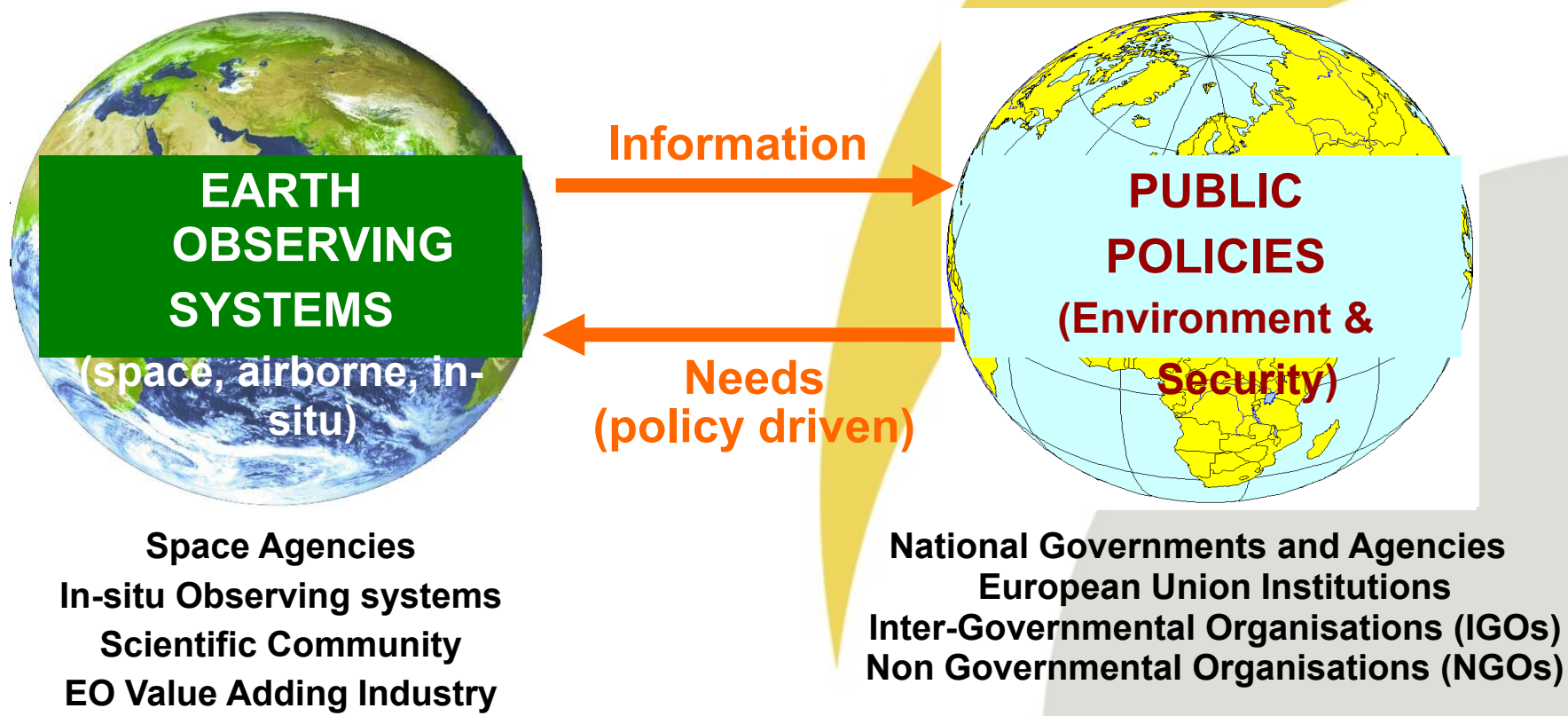
Virginia Puzzolo
European Commission
DG Enterprise - GMES Bureau





Overall GMES objectives

to provide information services to policy-makers and other users





GMES components

GMES consists of **3 components**:

1. Space Component

- Existing or planned European space infrastructure
- Space infrastructure co-financed by the EU and ESA
- ESA is the coordinator, development and procurement agent for and on behalf of the EU

2. In-Situ Component

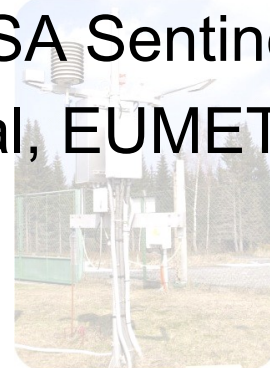
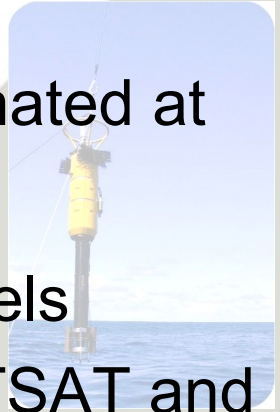
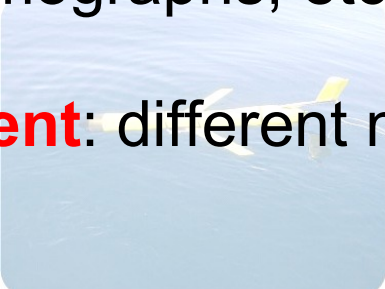
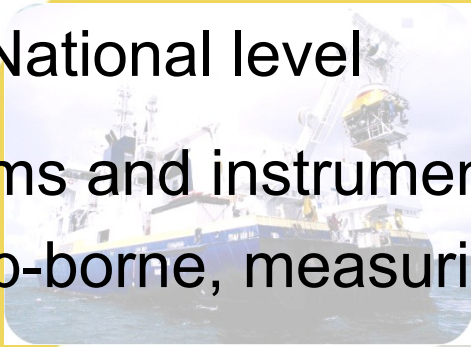
- facilities, instruments and services at national, regional and intergovernmental levels inside and outside the EU.
- EEA supports the EC for the coordination of access to in situ data and products for services

3. Service component

- Marine, atmosphere, land, emergency at pre-operational stage
- Need for contribution of GMES to security and climate change monitoring

Observational infrastructures

- **In-situ component:** co-ordinated at National level
 - air-, sea- and ground-based systems and instruments (e.g. airborne, balloons, floats, ship-borne, measuring stations, seismographs, etc)
- **Space component:** different missions co-ordinated at European level
 - Dedicated GMES missions: the ESA Sentinels
 - Contributing missions: EU National, EUMETSAT and third parties

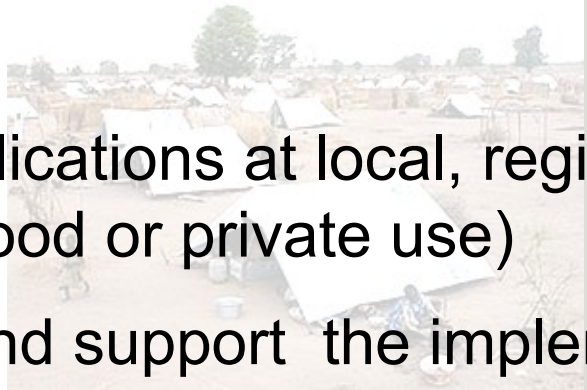
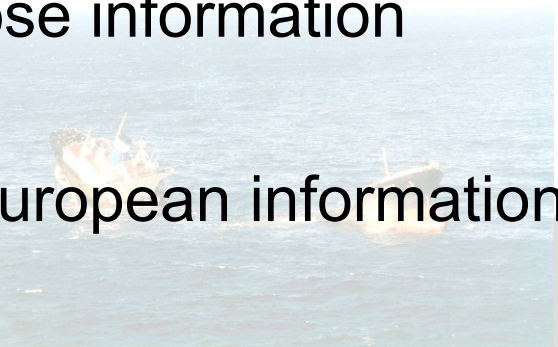


Core services

- Provide standardized multi-purpose information capacity for Europe
- Requested by the EU: link with European information needs

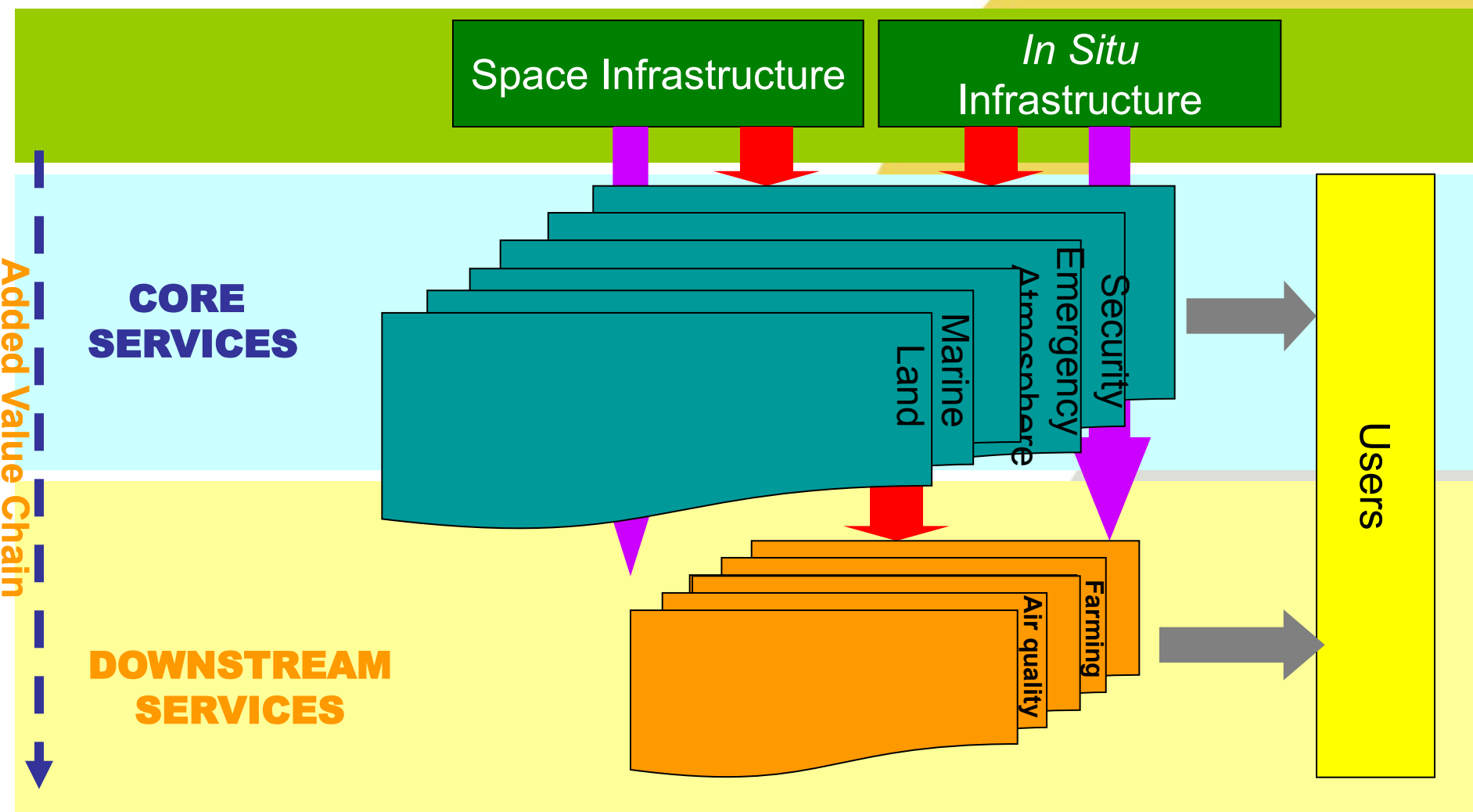
Downstream services

- Tailored for specific applications at local, regional, national levels (public good or private use)
- EU should encourage and support the implementation of these service layer





Overall architecture





GMES Core Services

Three on Earth systems:



Land



Marine



Atmosphere

Three horizontal:



Emergency Response



Security

Climate Change

To support ERCS users during crises due to:

- **natural disasters**
 - floods
 - Forest fires
 - volcanoes
 - earthquake
 - landslides
 - tsunamis
 - Storms
- **man-made disasters**
 - humanitarian aid
 - chemical hazards

= all actors involved in the crisis management

- **Civil Protection:**

- National Civil Protection Services of Europe
- DG ENV (European CP Unit)
- more globally all risk management actors in Europe at different territorial scales

- **Humanitarian Aid:**

- DG RELEX, DG ECHO
- NGOs

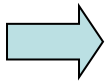
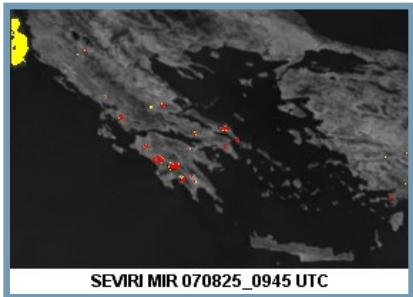
- **Security crises:**

- European Council
- Member States

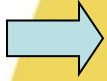


Four main types of products:

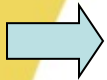
Early warning



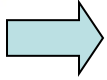
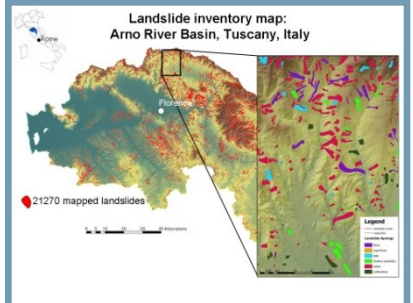
Reference maps



Assessment maps



Thematic maps



For headquarters,
decision-makers
and in-field operatives
In Europe and worldwide



Rapid mapping on demand in case of humanitarian crises, natural disasters, and man-made emergency situations within & outside Europe

- **Reference maps** available within 6 hours over crisis area
- **Damage assessment maps** available within 24 hours & daily updated
- **Situation maps and forecasts** of evolution of situations within the few days-weeks after crisis

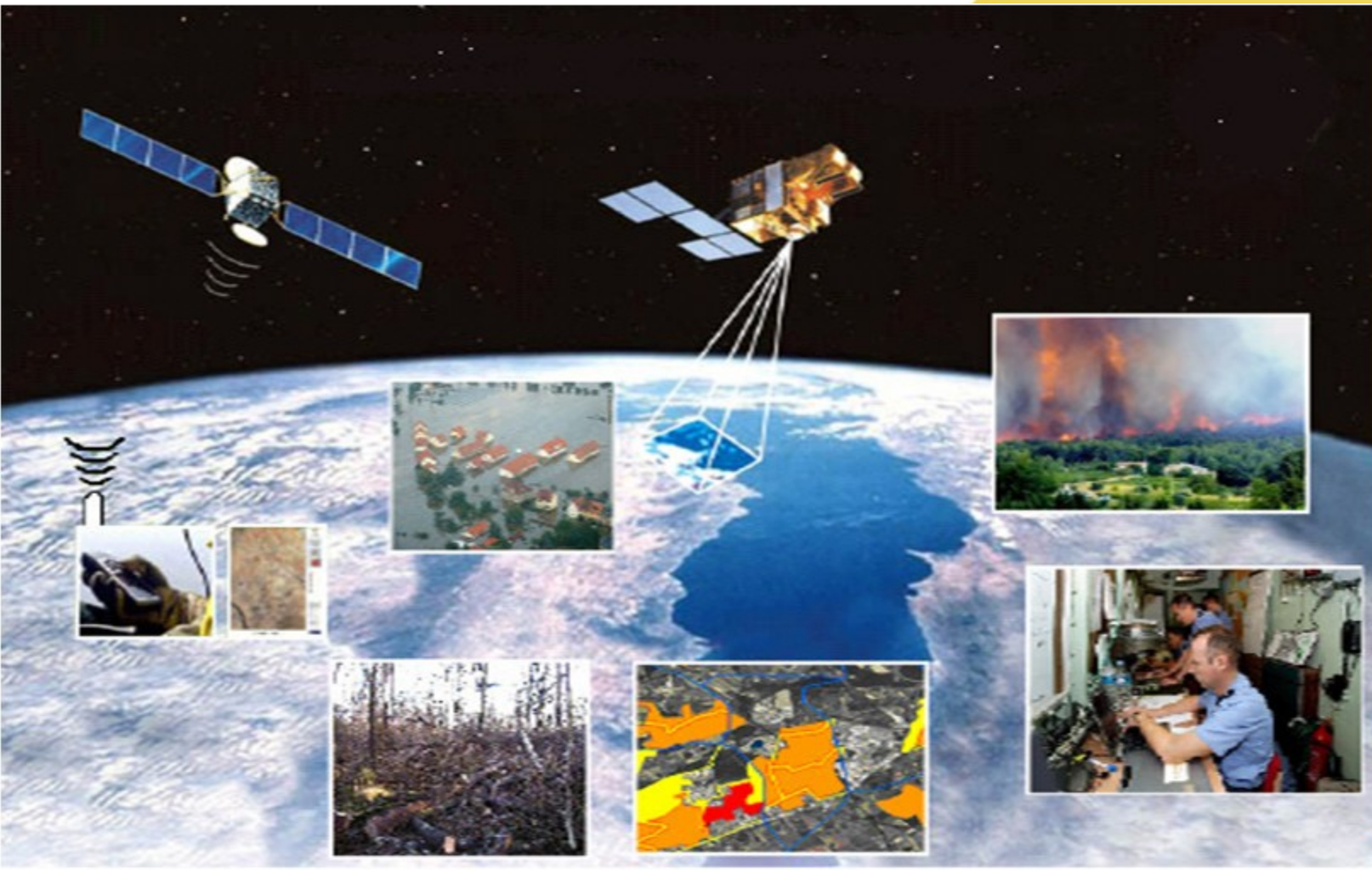


extension of the service towards crisis-prevention and post-crisis management part of the cycle:

- hazard and risk analysis,
- **forecasting and early warnings**

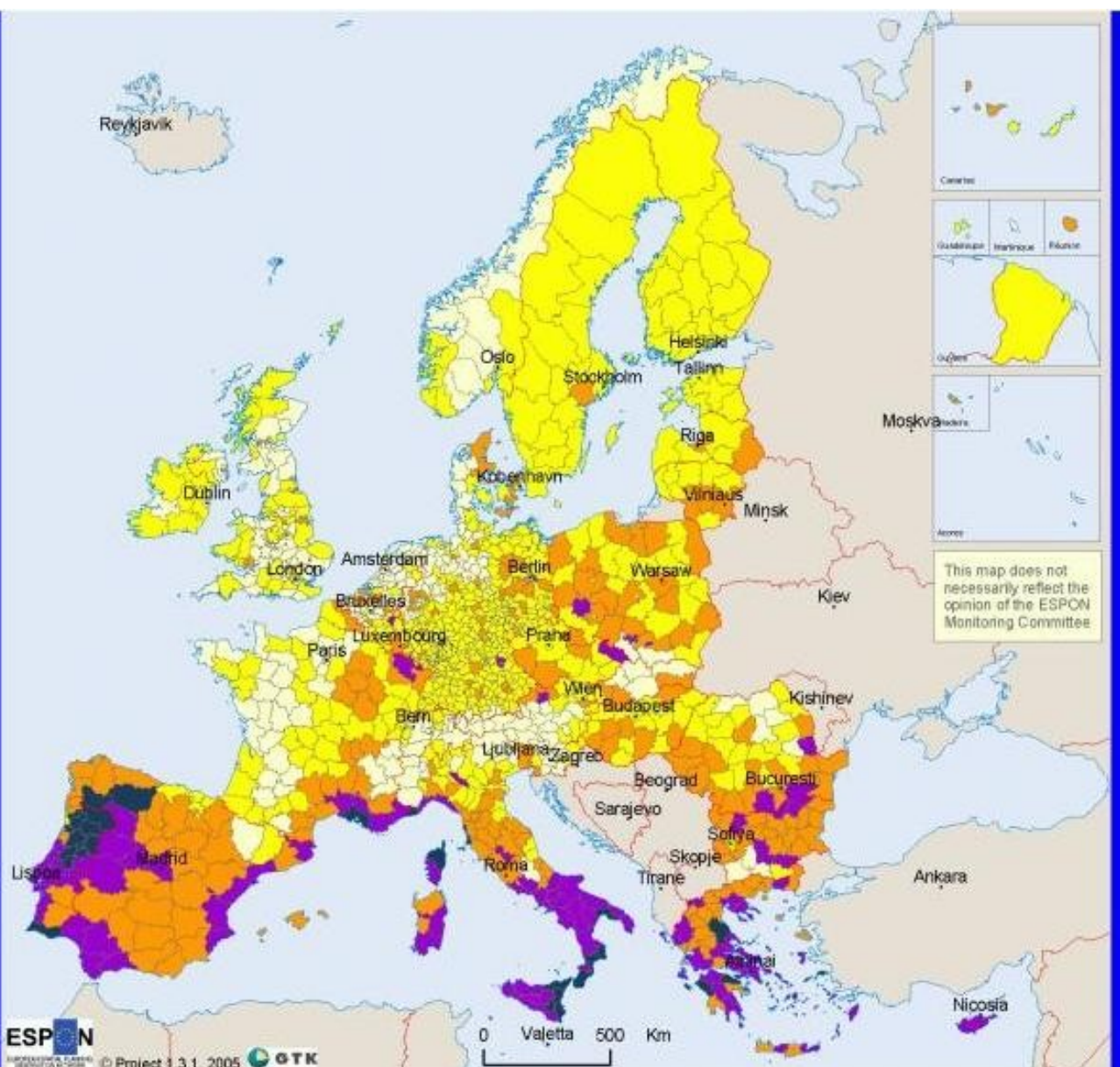


Examples



Forest fires in Europe

Example: the summer 2007 event in Greece



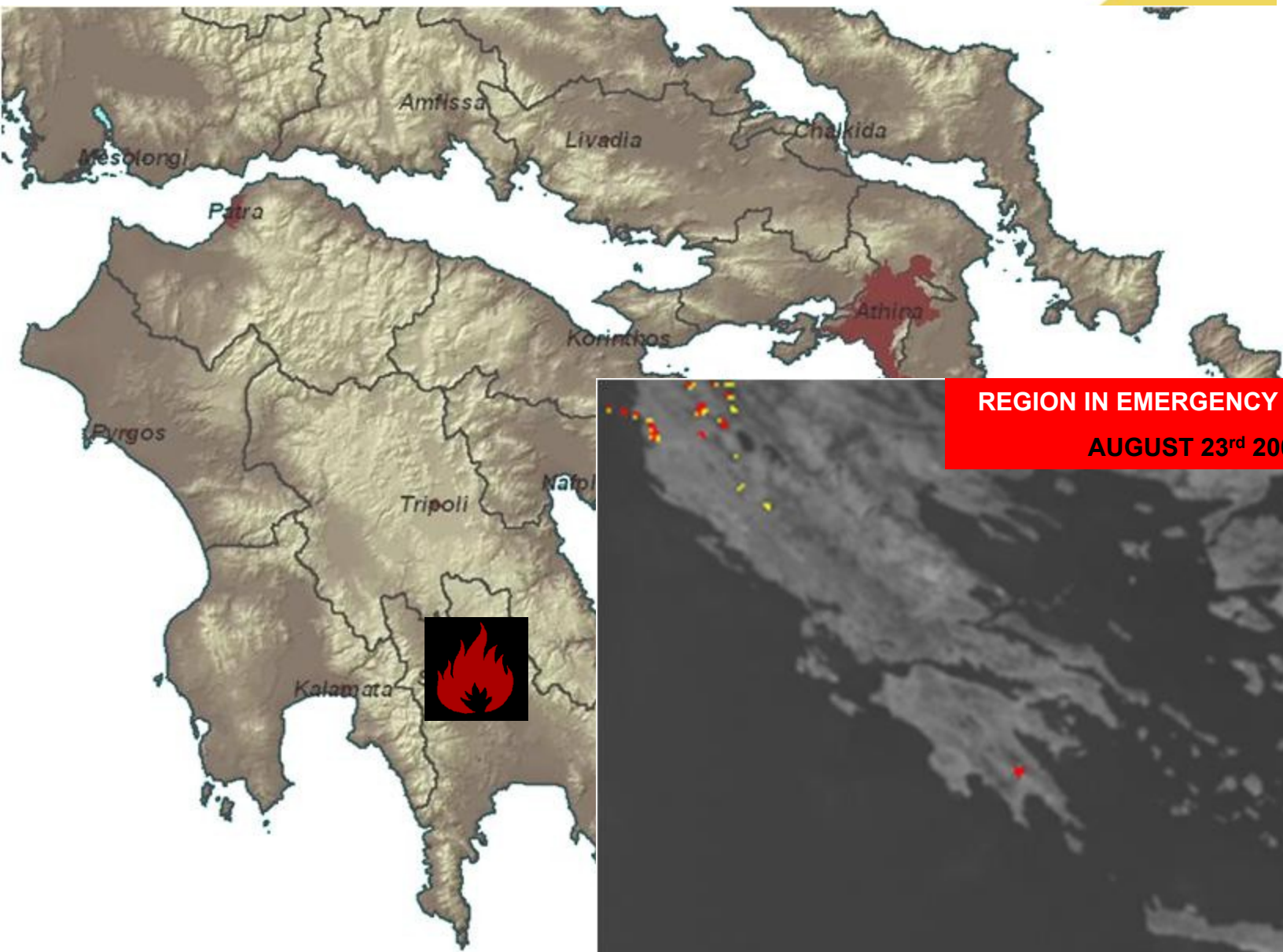
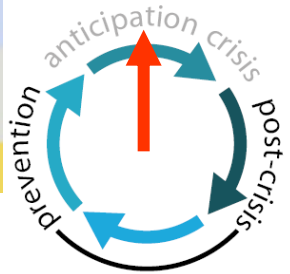

Canarias
 Madeira Madeira Madeira
 Açores
 Moskva
 This map does not necessarily reflect the opinion of the ESPON Monitoring Committee

Forest fire hazard

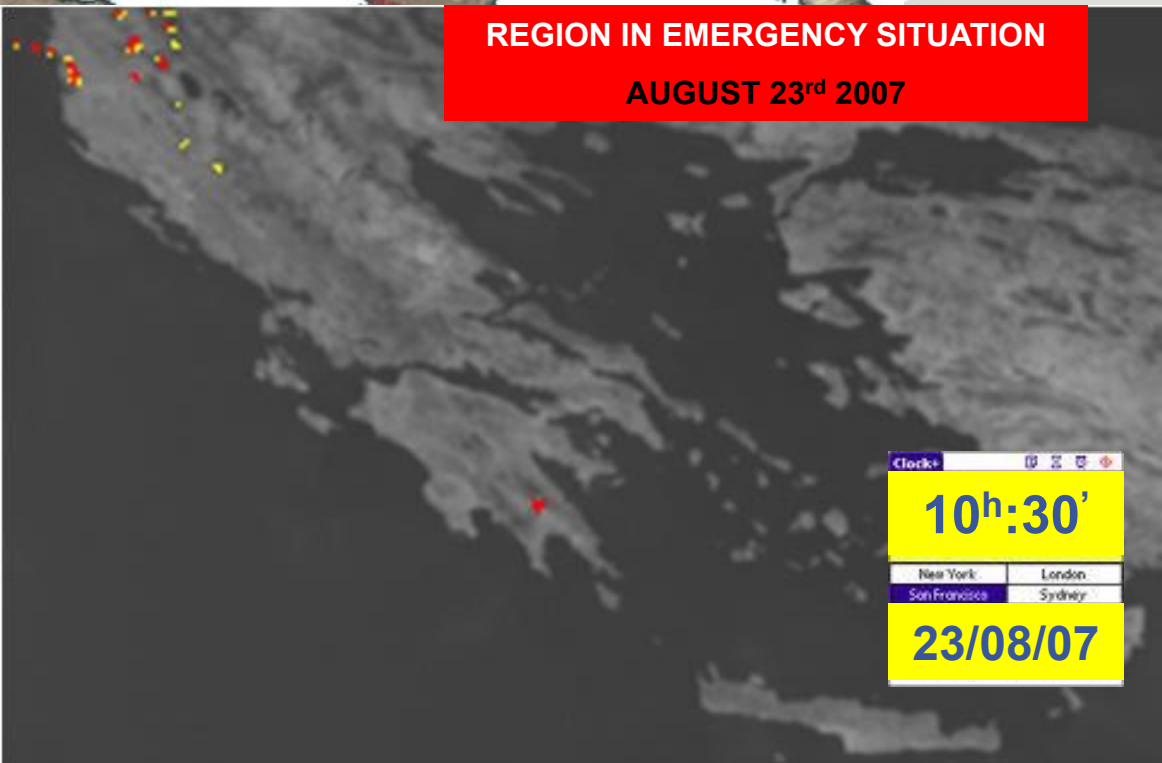
| | | | | | |
|----------|-----|----------|------|-----------|-----------------|
| Very low | Low | Moderate | High | Very high | Non ESPON space |
|----------|-----|----------|------|-----------|-----------------|



Early warning and alert Hot spot detection and monitoring



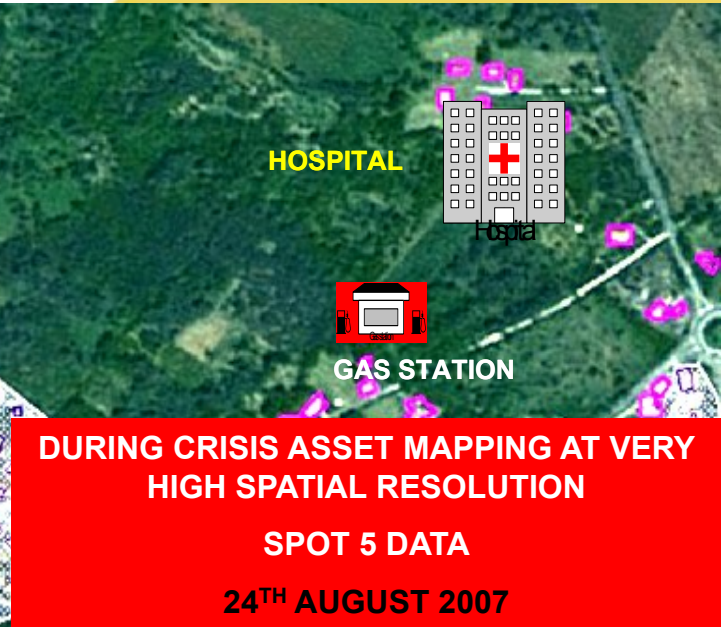
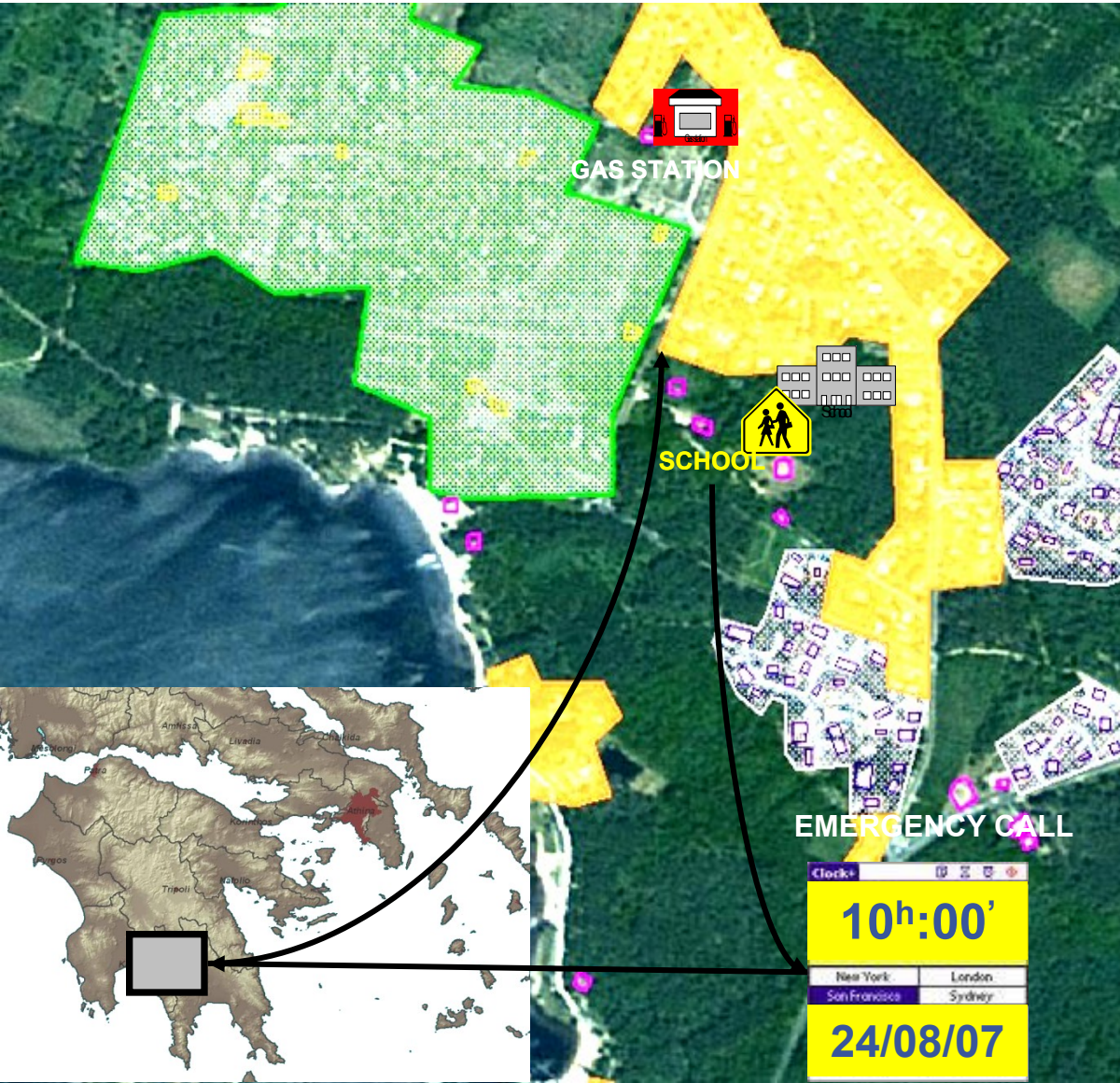
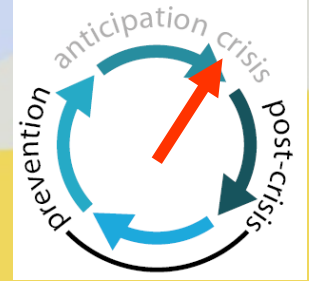
REGION IN EMERGENCY SITUATION
AUGUST 23rd 2007



| | |
|---------------|--------|
| Clocks | |
| 10h:30' | |
| New York | London |
| San Francisco | Sydney |
| 23/08/07 | |



Asset mapping



DURING CRISIS ASSET MAPPING AT VERY HIGH SPATIAL RESOLUTION

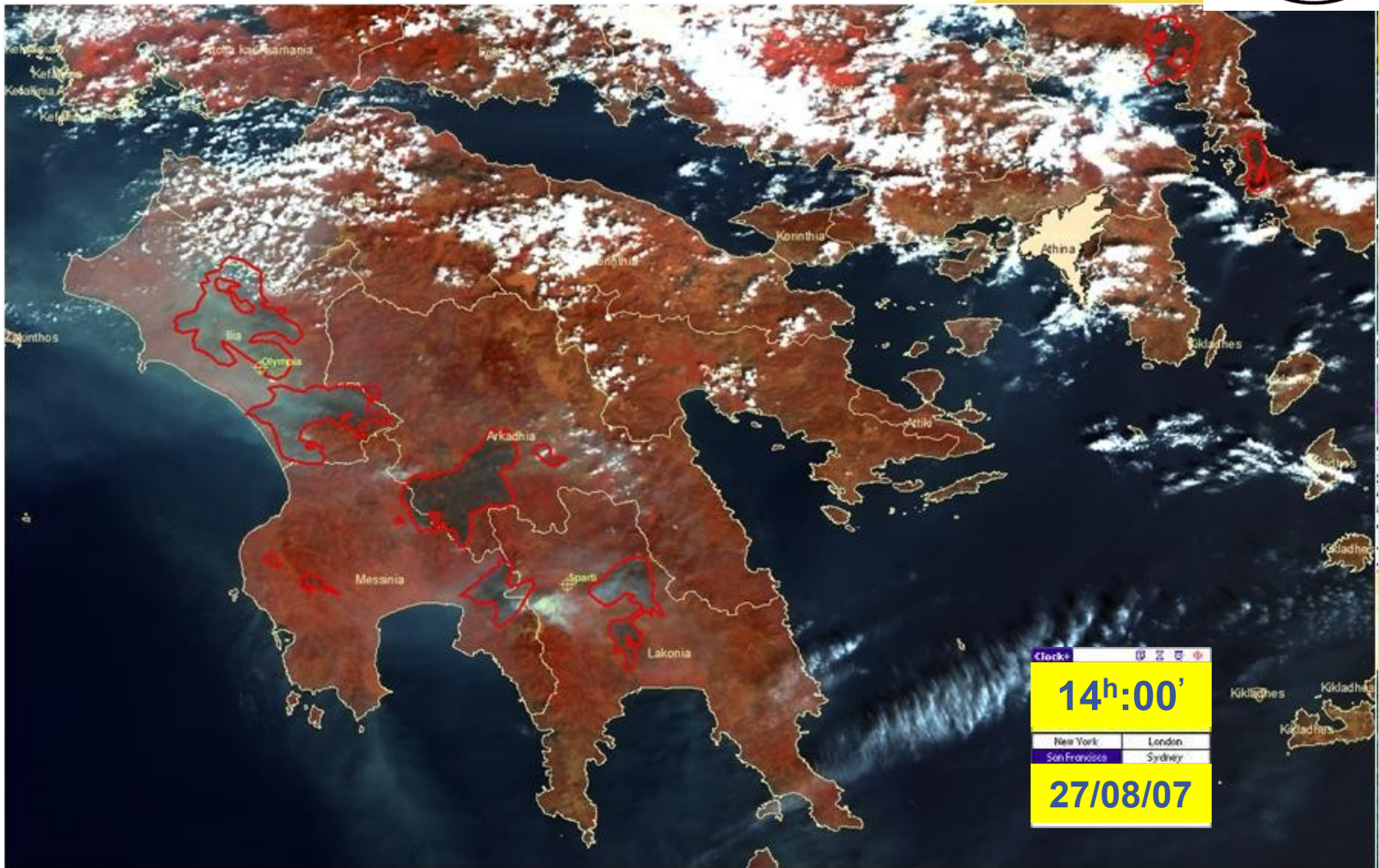
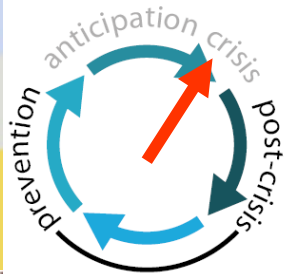
SPOT 5 DATA

24TH AUGUST 2007



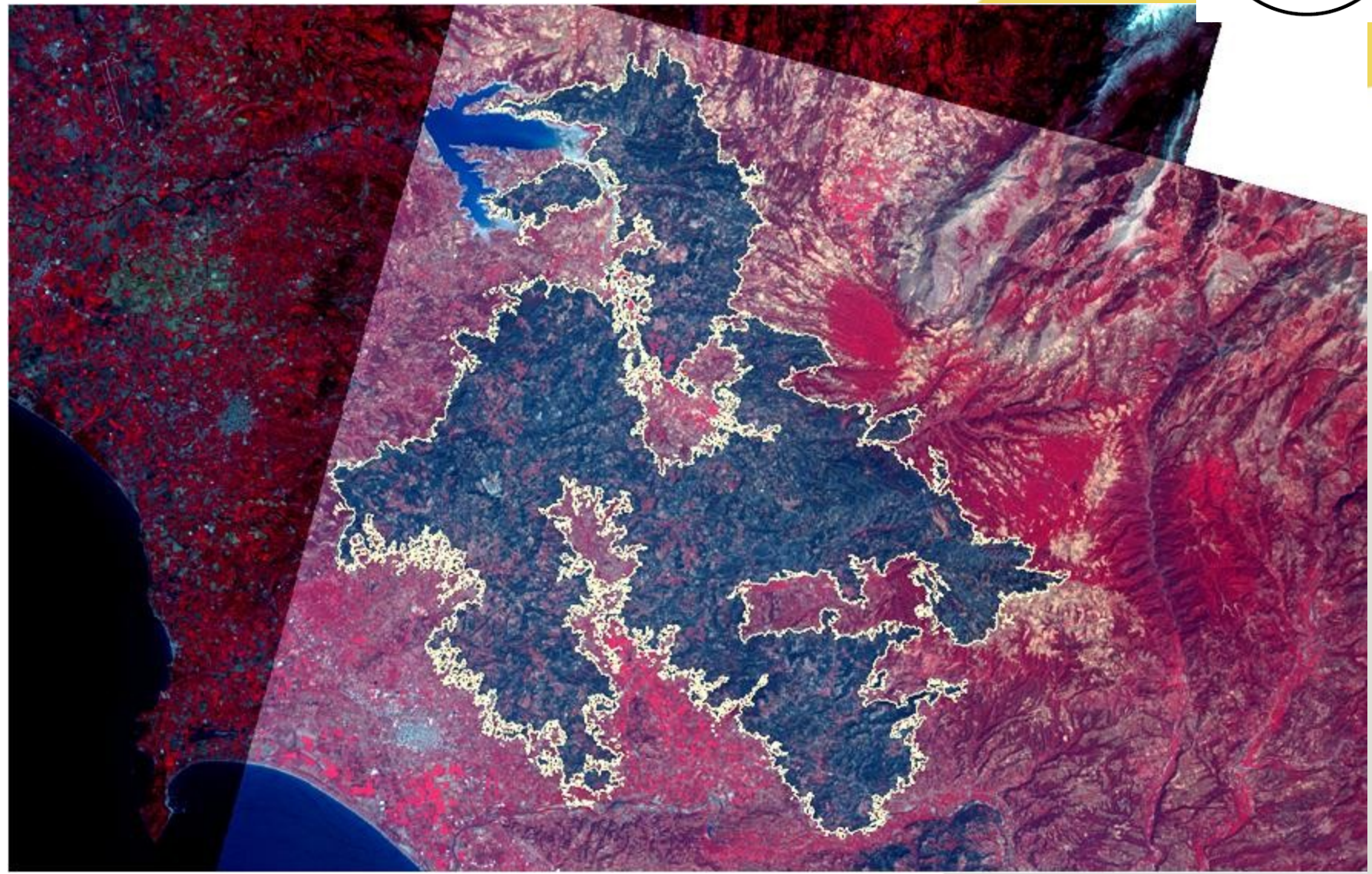
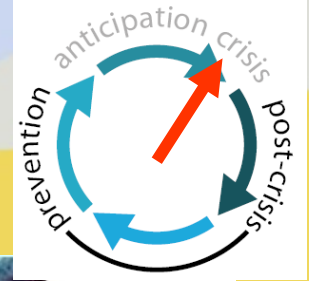


Rapid mapping

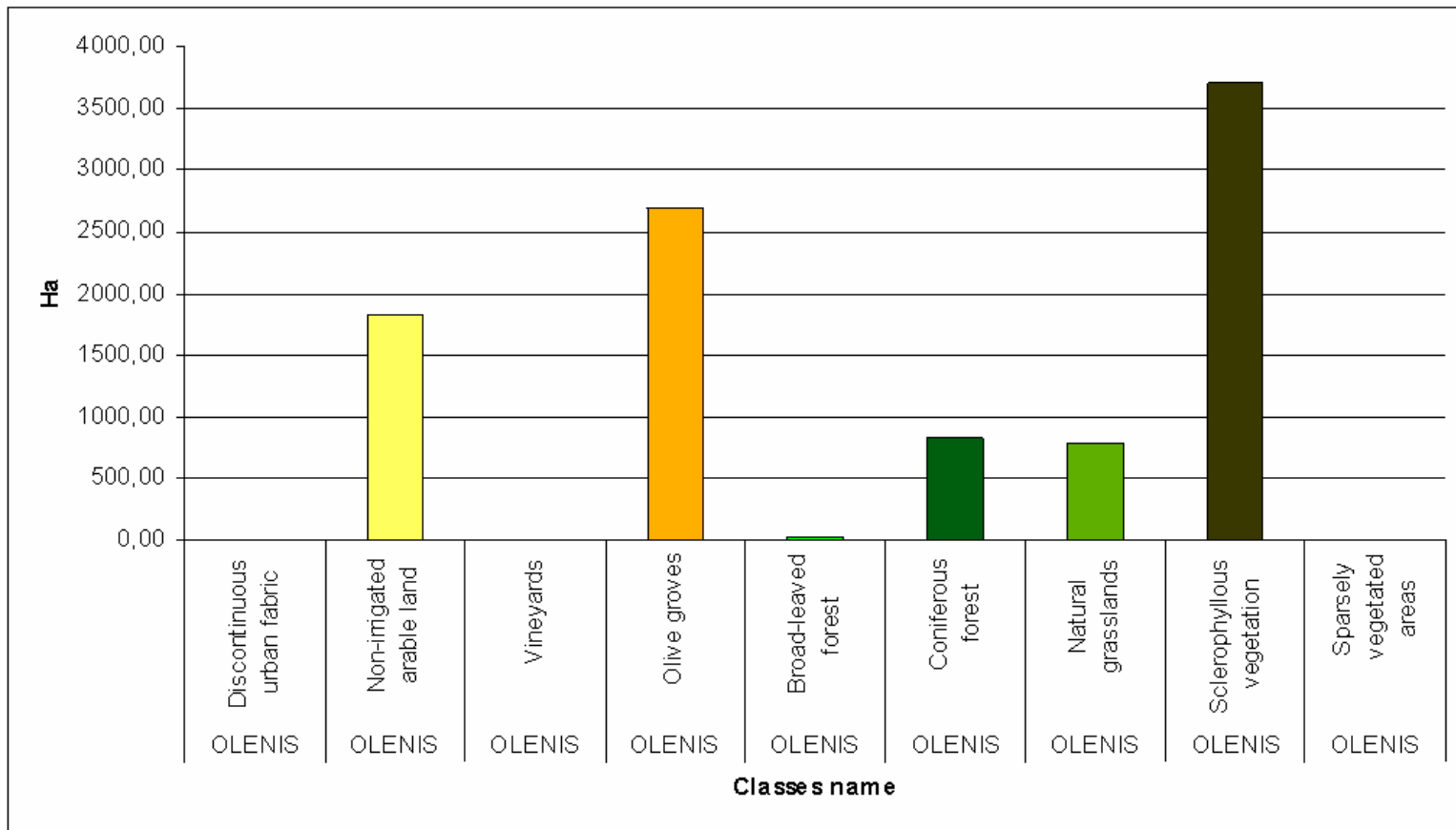
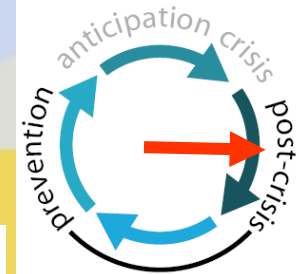




Rapid fire mapping during crisis



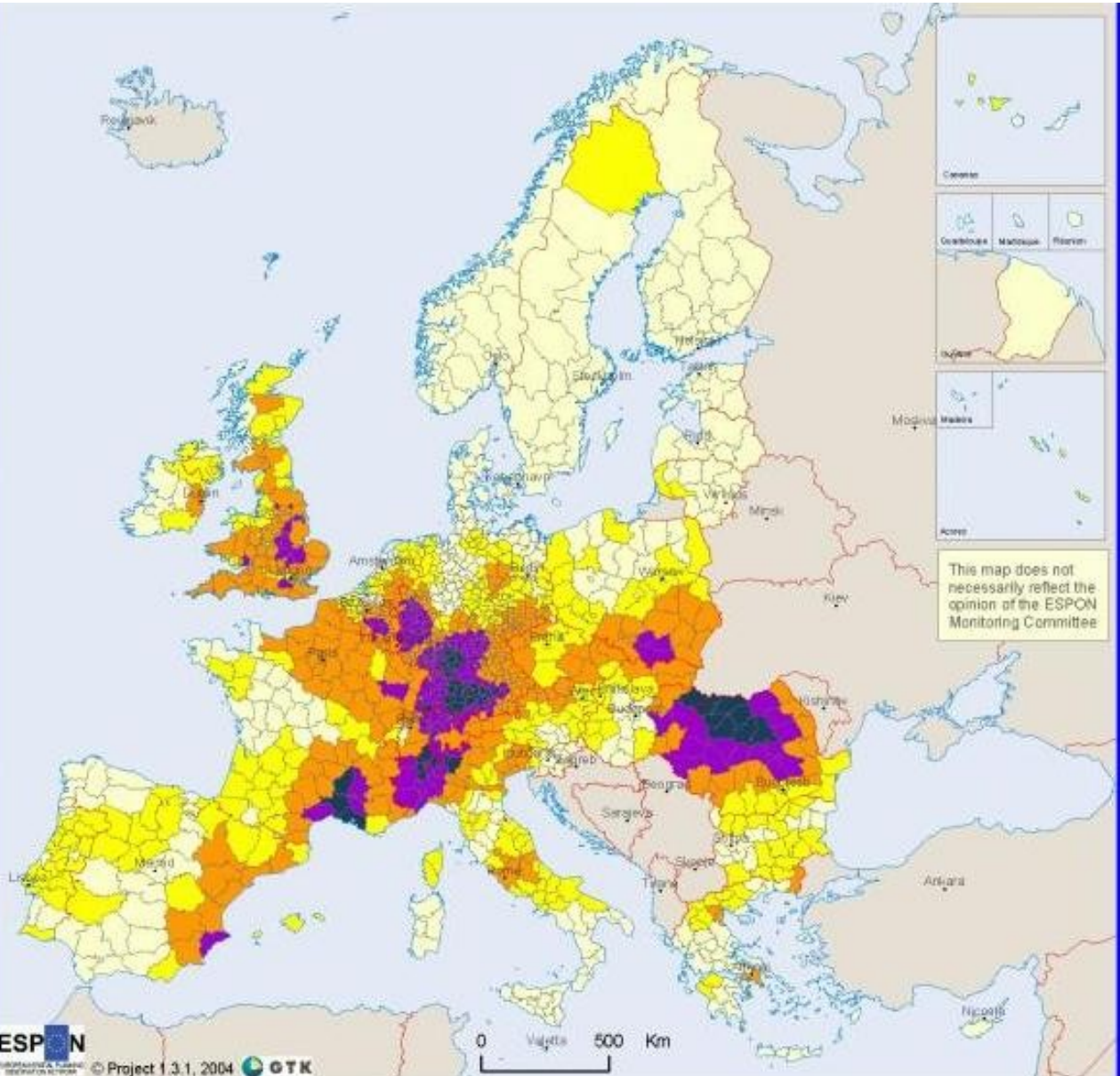
Damage assessment





Floods management in Europe

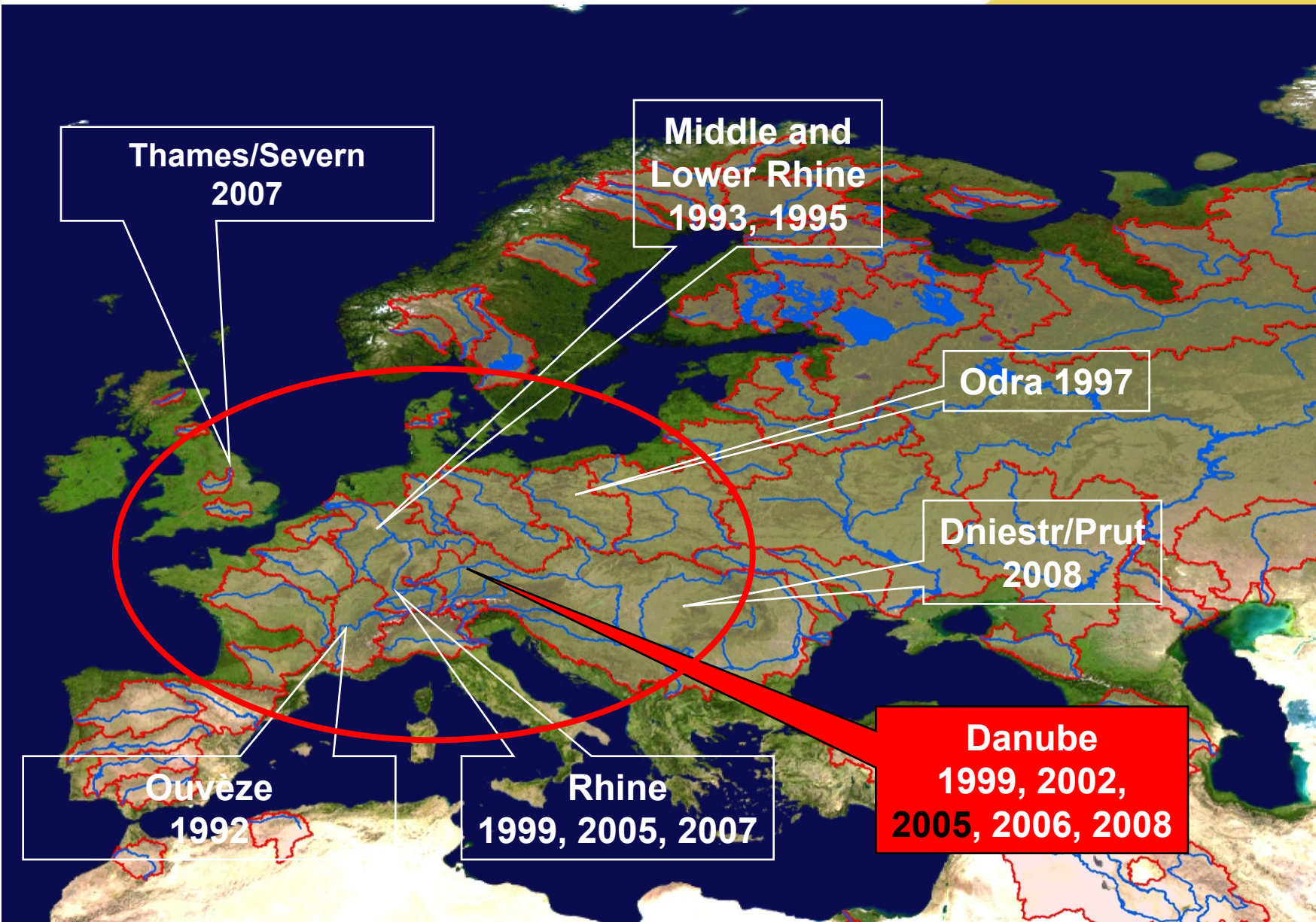
Example: The Bavarian Danube region event



Cyprus
Crested Ibis Maldives Pitcairn
Iceland
Madagascar
Moldova Monaco
Azores

This map does not necessarily reflect the opinion of the ESPON Monitoring Committee







Hazard map



REGION IN EMERGENCY SITUATION
AUGUST 22rd 2005

River Iller and
City of Kempten



Assets map



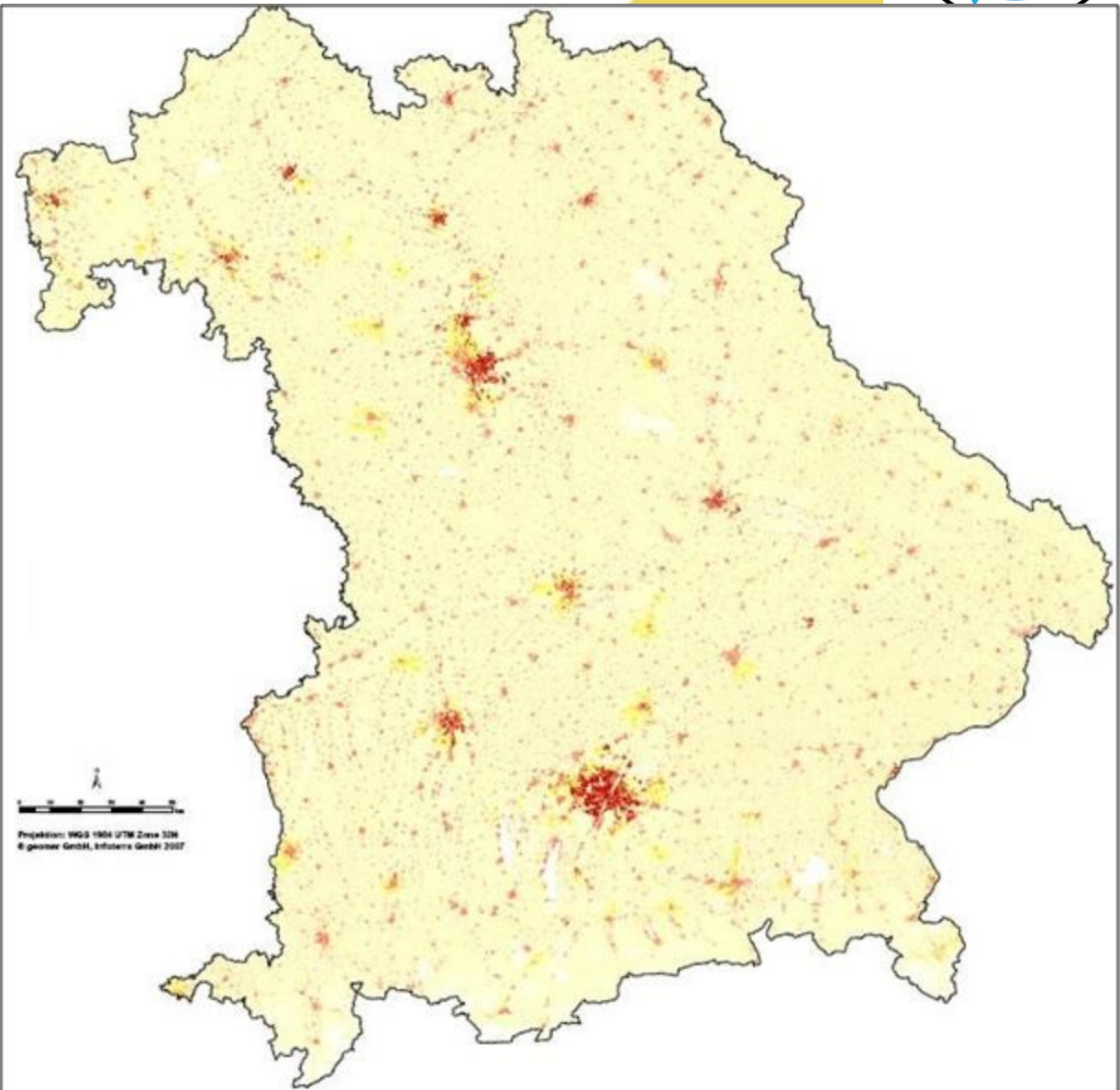
Input data:

- Land cover information
- Statistics on municipality level

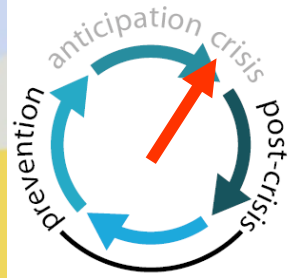
Result:

Assets map [€/m²]

| Community (ID) | Auto-mobiles | Motor-cycles | Household goods | Residential buildings |
|----------------|--------------|--------------|-----------------|-----------------------|
| 9161000 | 2671,47 | 56,58 | 12622,88 | 15242,46 |
| 9162000 | 20013,52 | 460,32 | 129120,50 | 155916,36 |
| 9163000 | 986,17 | 26,91 | 6109,15 | 7376,96 |
| 9171111 | 209,60 | 5,54 | 1387,60 | 1675,56 |
| 9171112 | 301,54 | 7,54 | 2179,17 | 2631,41 |
| 9171113 | 179,96 | 5,37 | 1172,65 | 1416,00 |
| 9171114 | 73,60 | 2,74 | 485,72 | 586,51 |
| 9171115 | 23,05 | 1,36 | 165,49 | 199,81 |
| 9171116 | 23,54 | 1,02 | 146,19 | 176,51 |
| 9171117 | 151,25 | 6,39 | 1014,11 | 1224,51 |



Damage potential map



Input data:

- Assets map
- Flood extent map

Result:

- Map showing **high** **medium** and **low** damage potential [€/m²]

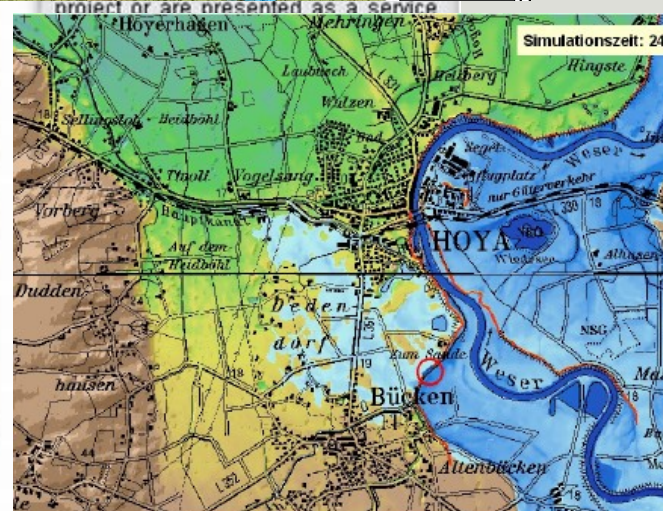
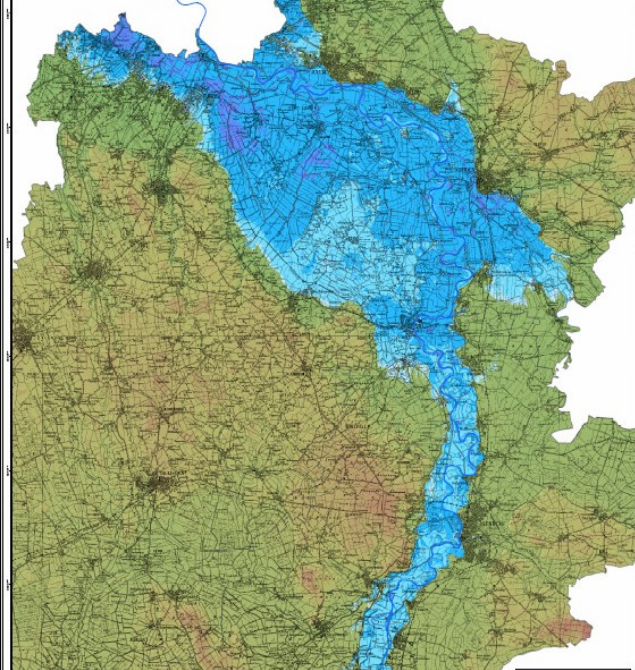
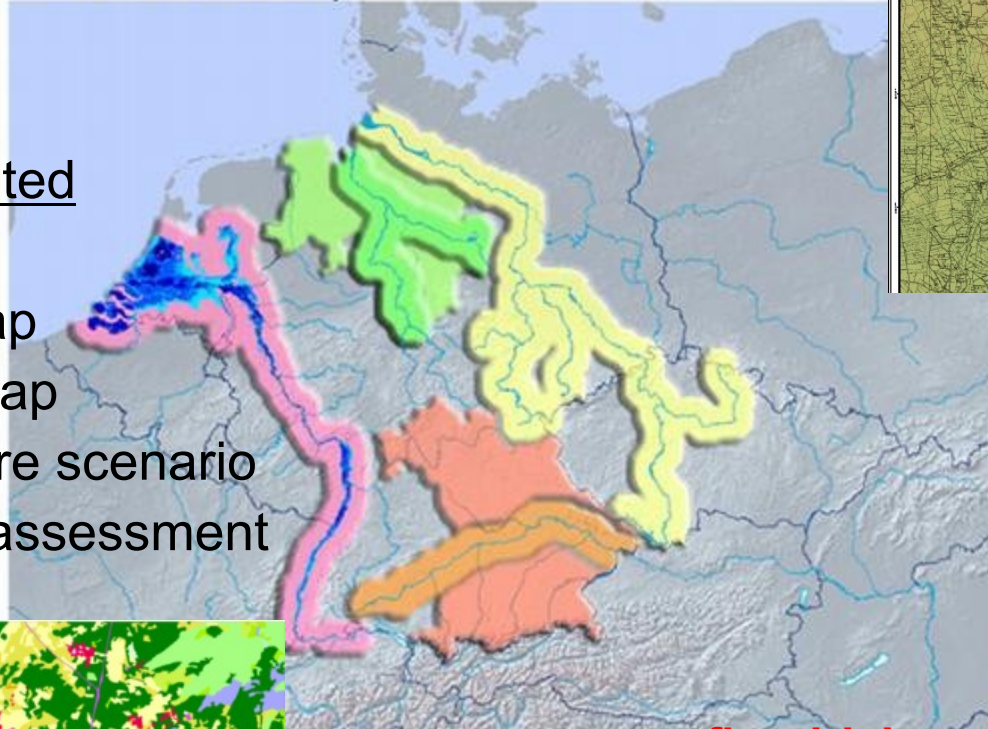




Flood Information

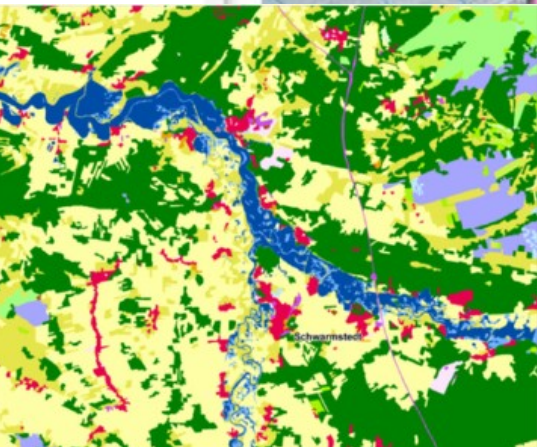


flood information system



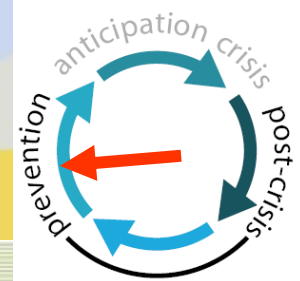
- Implemented
- Products:
- Extent map
- Hazard map
- Dam failure scenario
- Damage assessment

www.floodrisk.eu



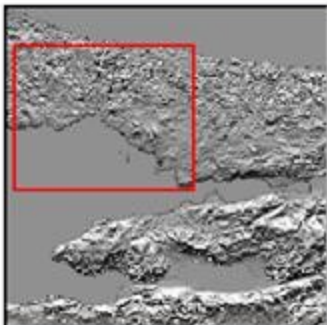


Seismic areas monitoring sub-service



Knowledge & Prevention

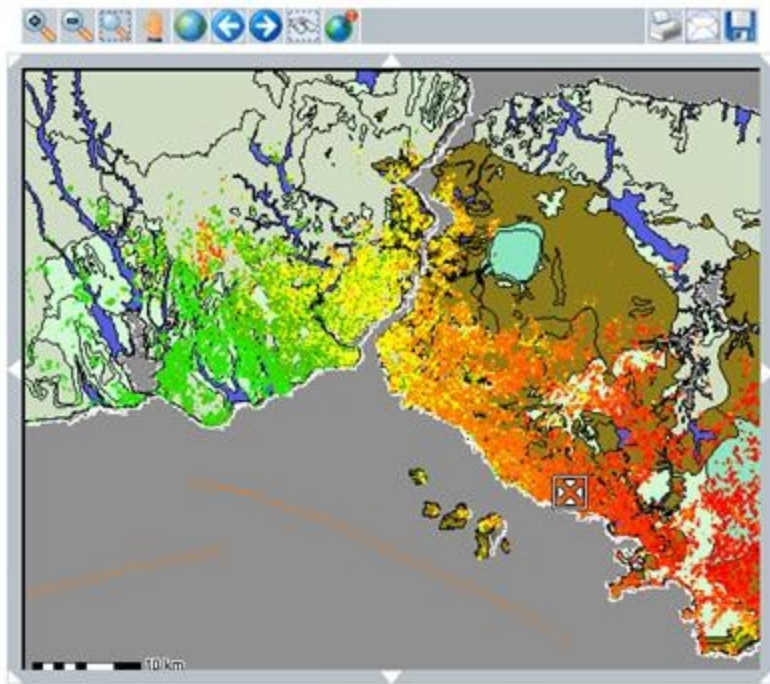
USER:dpc1(Site:Turkey, Istanbul)



Time Query Layers

Start: 11-12-200 [1995] [v]

End: 11-12-200 [Query]



| Geology | DESCENDING |
|---|------------------|
| | [mm/year] |
| ■ | $v < -8$ mm/year |
| ■ | $-8 \leq v < -5$ |
| ■ | $-5 \leq v < -3$ |
| ■ | $-3 \leq v < -1$ |
| ■ | $-1 \leq v < +1$ |
| ■ | $+1 \leq v < +3$ |
| ■ | $+3 \leq v < +5$ |
| ■ | $+5 \leq v < +8$ |
| ■ | $v > +8$ mm/year |

- Istanbul test site
 - Background Images & Data
 - EarthQuakes_Data
 - All_Epicenters
 - CSEM_2000
 - CSEM_2001
 - CSEM_2002
 - CSEM_2003
 - CSEM_2004
 - CSEM_2005
 - CSEM_2006
 - Epicenters_1995
 - Geological Data
 - SAR mean velocity map
 - DESCENDING

Download K&P Crisis Post Crisis

Additional Data Info [Reset Info](#)

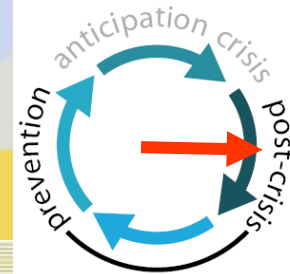
Layer 'DESCENDING'
 Feature 22288:
 lon = '686636.690'
 lat = '4529167.000'
 vel_mm_y = '-5'
 elevation = '72.0'
 BUFF_DIST = '4.000000000000e+001'



Soil Velocity Maps by multi-temporal SAR Interferometry

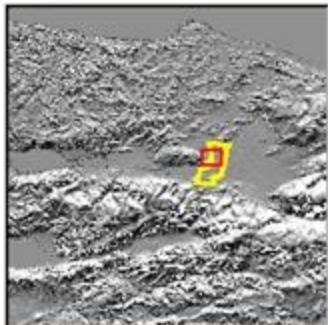


Surface displacement maps and Damage maps

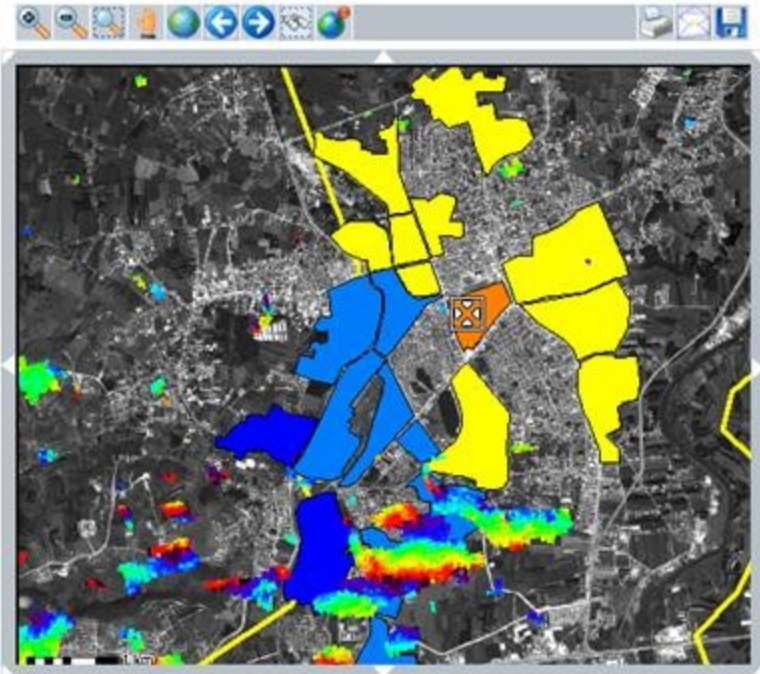


PREVIEW Post Crisis
USER:dpc1(Site:Turkey, Adapazari)

Download K&P Crisis Post Crisis
Additional Data Info [Reset Info](#)



Time Query Layers
Start: 11-12-200 -all-
End: 11-12-200 Query



- Adapazari test site
 - Background Images & Data
 - Shaded relief
 - DEM
 - BackgroundImage_IRS
 - Test_site_area
 - Elevation contours
 - EarthQuakes_Data
 - Geological Data
 - SAR mean velocity map
 - Damage Maps
 - Damage classification
 - Updated Damage Map
 - Ground_Truth
 - SAR Displacement Map
 - Coseismic Interferometric p
 - 12aug1999-16sep1999
 - 13aug1999-17sep1999

LEGEND

| Test_site_area | Updated Damage Map | 12aug1999-16sep1999 [mm/year] |
|----------------|--|-------------------------------|
| | <ul style="list-style-type: none">Damage grade 1Damage grade 2Damage grade 3Damage grade 4Damage grade 5 | |

Layer 'Updated Damage Map'
Feature 16:
DamageGrade = '4'

- Surface displacement maps from DIFSAR.
- Damage assessment maps from SAR and optical remote sensing,

Destroyed building as « pancake »

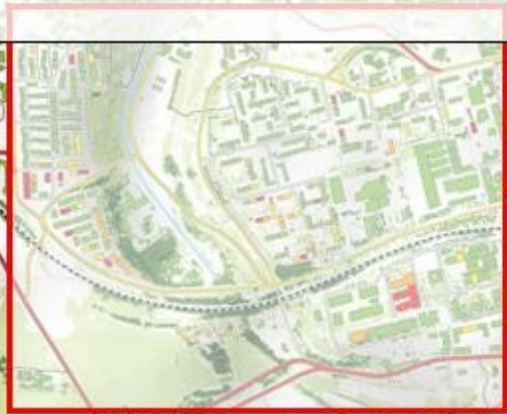
Collapsed ground floor



Before

After

Field picture



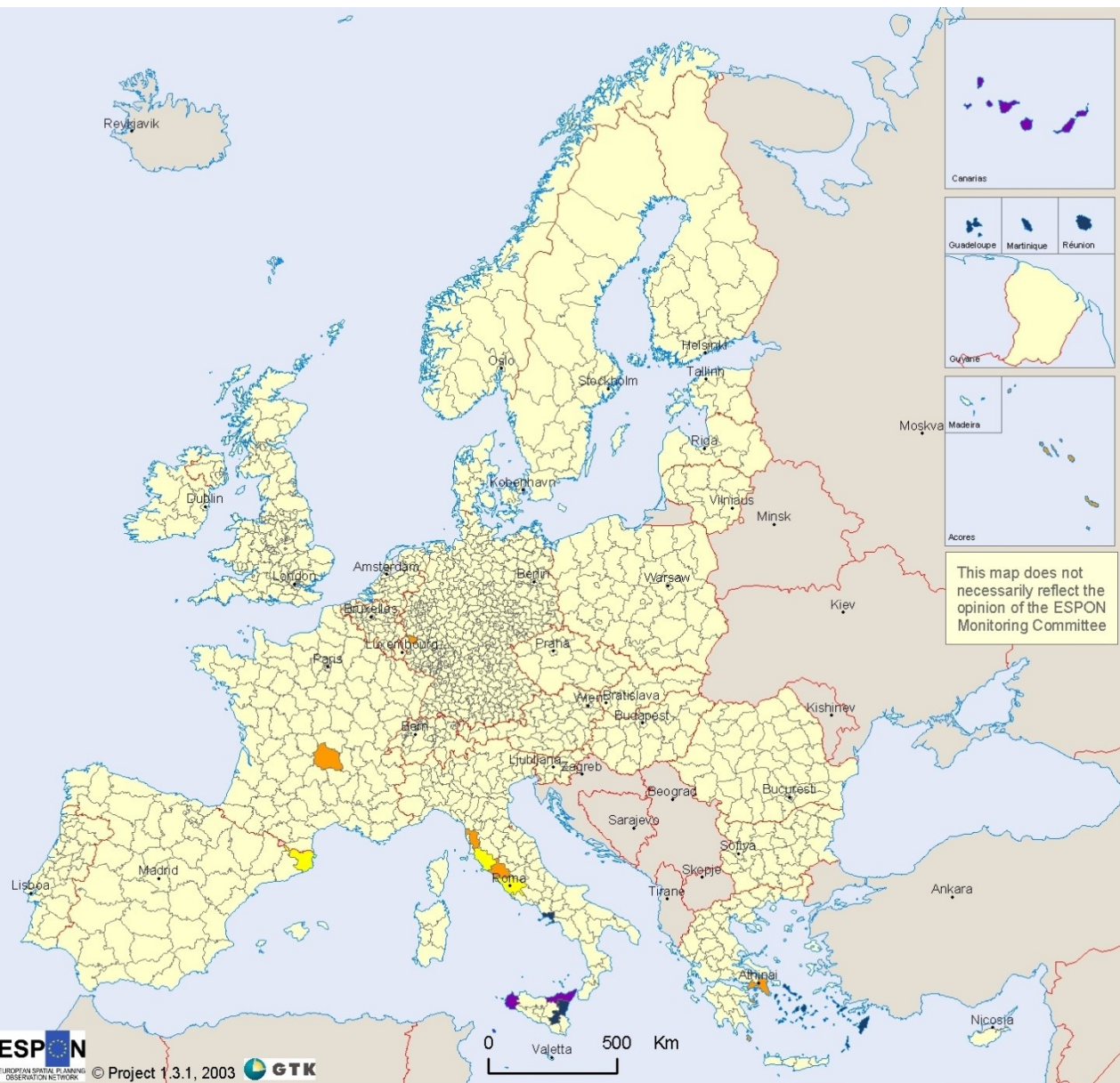
Dégât au bâtiment selon échelle EMS98
Building damage according to the EMS98 scale

| | |
|---|---|
|  Grade 1 & 2 |  Grade 4 |
|  Grade 3 |  Grade 5 |



Volcanic risk in Europe

Example: Mount Etna Eruptions

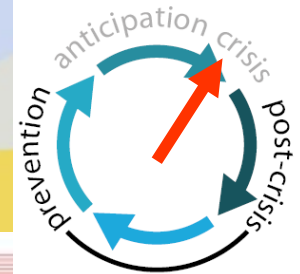


Known volcanic eruptions

- No eruptions
- The status of eruption is uncertain
- Last eruption before 1800 AD
- Last eruption after 1800 AD
- Particularly hazardous volcanoes
- Non ESPON space



Volcanic monitoring



PREVIEW Crisis
 USER:dpc1(Site:Italy, Sicily)

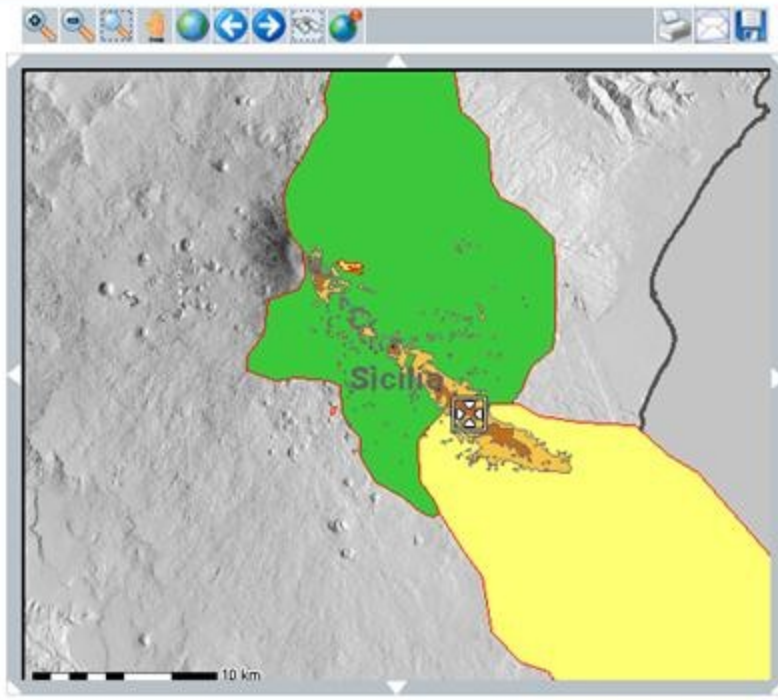


Time Query Layers

Start: 11-12-2001 [calendar icon] [all-] [dropdown]

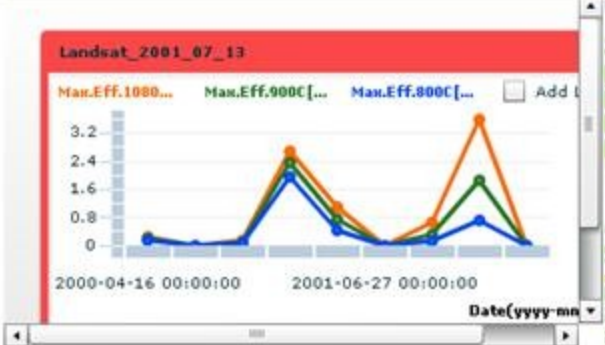
End: 11-12-2001 [calendar icon] [Query]

- PREVIEW ETNA test site
 - Background Images & Data
 - SAR mean velocity map
 - EarthQuakes_Data
 - Ash Detection
 - Plume SO2
 - Lava_Flow
 - SAR Displacement Map
 - GPS Data

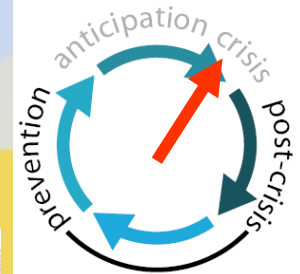


| | | | |
|--|--|--|------------------------------------|
| Limiti Amministrativi delle Regioni Italiani | Sector SE-S Plume extension maximum 800 Km Yellow Volcanic Ash Green Clouds | 29-7-2001 09:52 GMT SO2 columnar abundance | Eruptive period Lava Flow |
| | <input type="checkbox"/> Ash <input type="checkbox"/> Cloud | <input type="checkbox"/> 0,5 - 5 g/mq <input type="checkbox"/> 5 - 18 g/mq <input type="checkbox"/> 18 - 15 g/mq | <input type="checkbox"/> lava_flow |

Download K&P Crisis Post Crisis
 Additional Data Info [Reset Info]



Ash detection



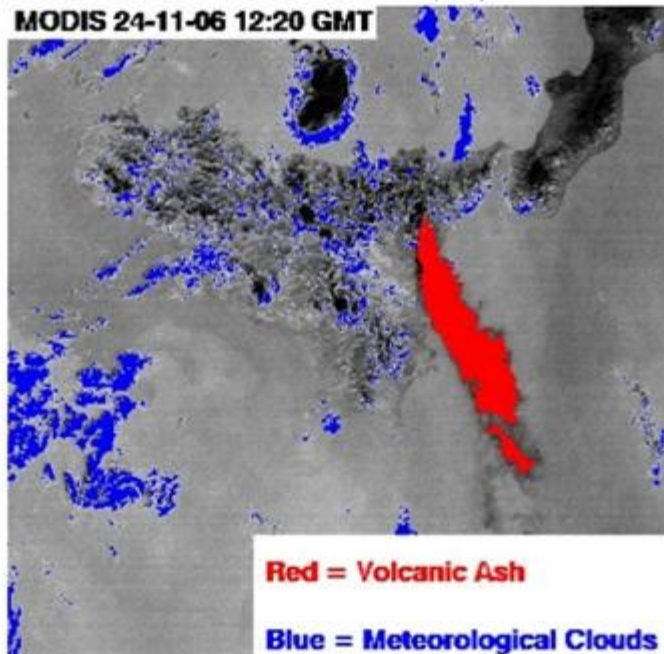
PREVIEW NASA-MODIS Observation Report
 PROPOSES TO DEVELOP NEW OR ANHANCED INFORMATION SERVICES FOR RISK MANAGEMENT **INGV**



Volcanic ash detection

MODIS 24 nov 2006 12:20 (GMT)

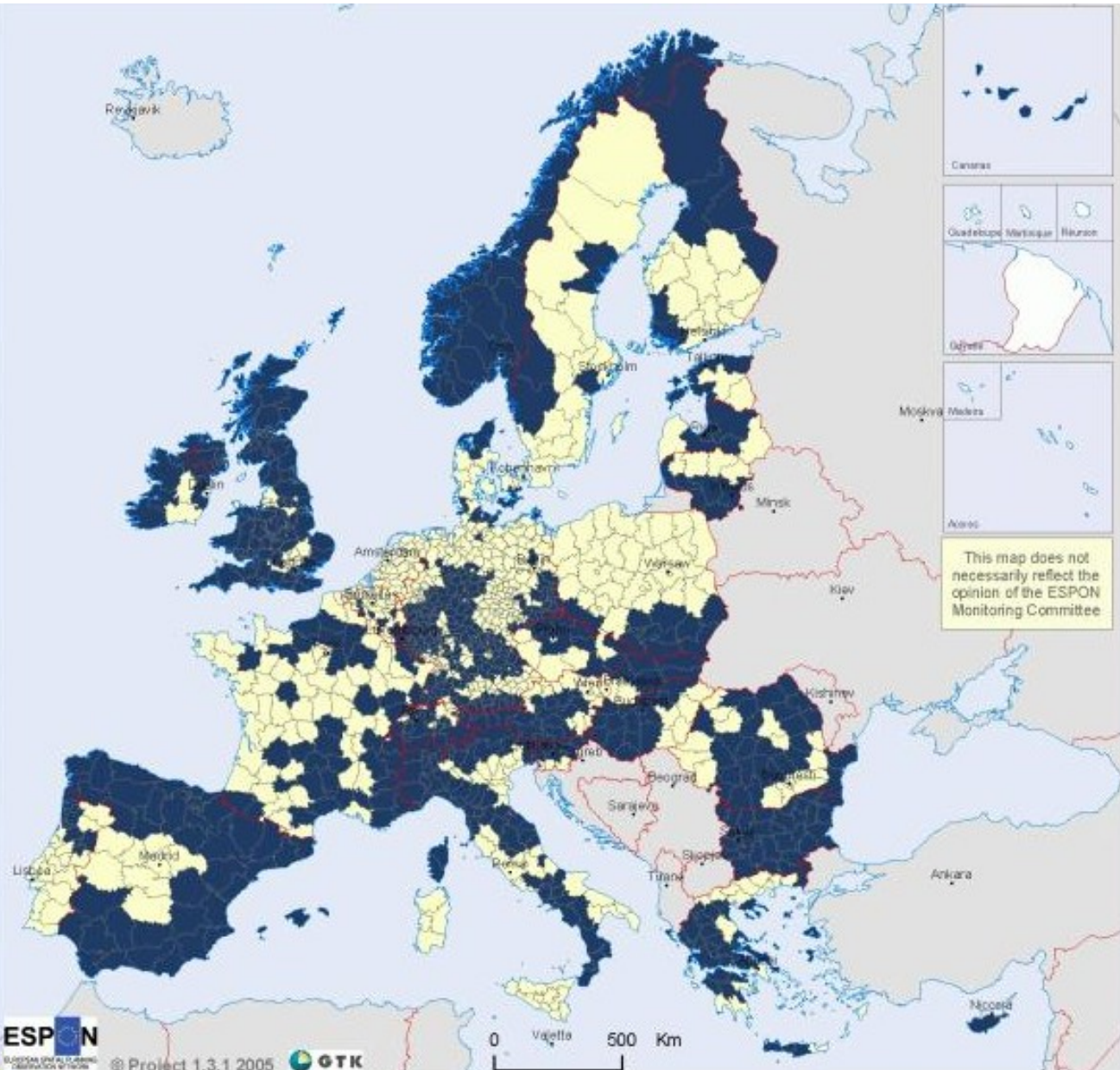
MODIS 24-11-06 12:20 GMT



Posted on: 2008-02-22 16:28:20

| Plume Direction | Ash Content Maximum Extension, Length-Width (Km) | Maximum Plume Altitude | Minimum Plume Brightness Temperature (°C) | Ash Loading |
|-----------------|--|------------------------|---|-------------|
| SE | 90-25 | 4500-5000 m a.s.l. | -7 | 4600 t |

Landslides impact in EU

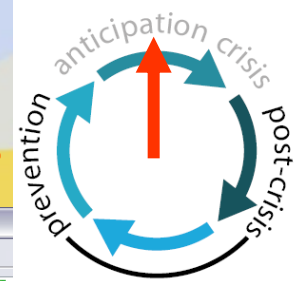


Areas with landslide hazard

- Low hazard
- High hazard
- Nodata
- Non ESPON space



Forecasting and Early Warning of Shallow Rapid Slope Movements



wGis-WebGis - Mozilla Firefox

File Modifica Visualizza Vaj Segnalibri Strumenti ?

http://spatial.telespazio.it/preview/wgis/start_simple.html?mainMap=previewll-sv2.xml

Personalizzazione coll... Windows WindowsMedia

PREVIEW Landslides services
Geophysical cluster

TASK AREA

Home Page x:400325.67y:4860745.5 scale 1:52,976

Info

Datasets

- Administrative Boundaries**
- DTM**
 - DTM_5m
- Area of Interest**
- Leaf Area Index - MODIS**
- Rainfall**
- Soil Saturation**
- Safety Factor Map**
 - 2006-09-15(00:00)
No Value
 - 0.8 < x < 1.0
 - 1.0 < x < 1.1
 - 1.1 < x < 1.3
 - x > 1.3
 - 2006-09-14(14:00)
 - 2006-09-14(01:00)
- Base Data**
 - Soil depth**
 - 0 cm < x < 5 cm
 - 5 cm < x < 20 cm
 - 20 cm < x < 30 cm
 - 30 cm < x < 70 cm
 - 70 cm < x < 1 m
 - 1 m < x < 6 m
- Satellite Image**



Monitoring of deep seated slow moving landslides

wGis-WebGis - Mozilla Firefox

File Modifica Visualizza Vai Segnalibri Strumenti ?

http://spatial.telespazio.it/preview/wgis/start.html?mainMap=previewll-sv1.xml

Personalizzazione coll... Windows WindowsMedia

Landslides services
Geophysical cluster

TASK AREA

Plot Add Layer Info Datasets

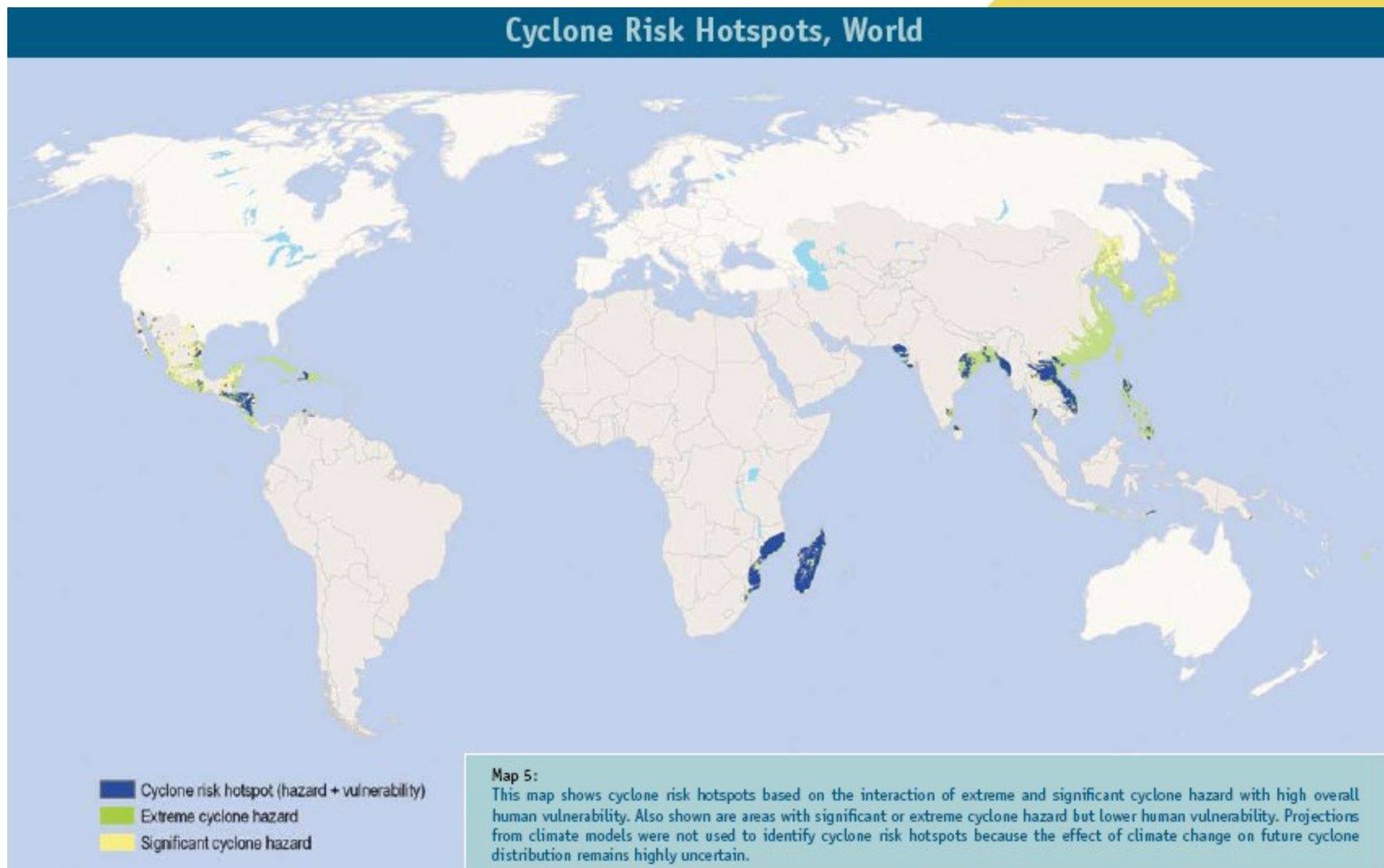
- Administrative Boundaries
- In-situ measurements
 - ER Tomography
 - Tomography
 - Ground SAR
 - Plot
- Interferometry:ERS-SAR Descending 1995-2000
 - MeanVelocity (mm/y)
 - less or equal than -30
 - from -29 to -20
 - from -19 to -15
 - from -14 to -10
 - from -9 to -5
 - from -4 to -2
 - from -1 to 1
 - from 2 to 4
 - more or equal than 5
- Landslides Inventory
- Susceptibility
- Orthophoto Image
 - Orthophoto Image flight 2000

Completato



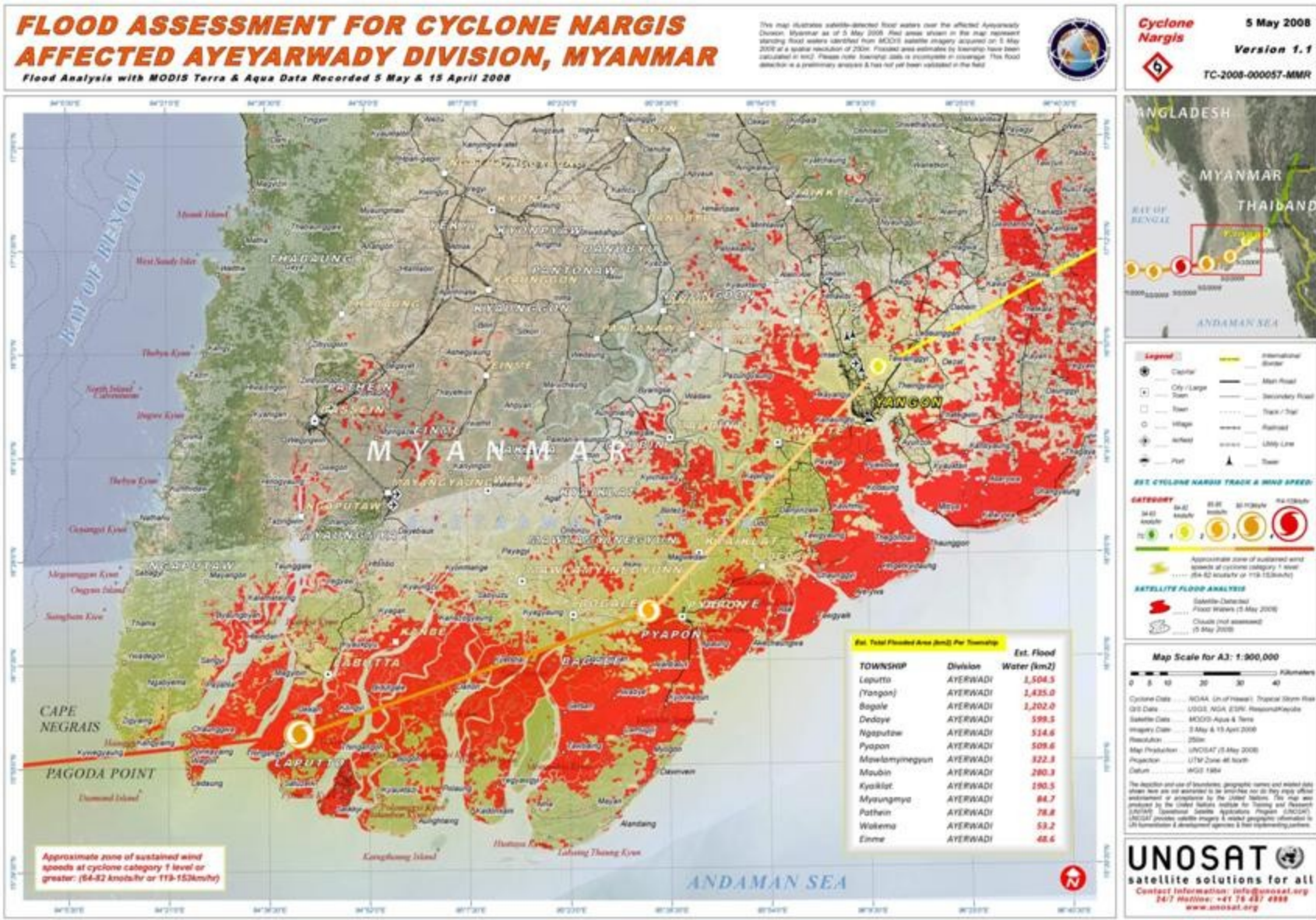
Humanitarian Aid

Example: Myanmar disaster (may-june 2008)



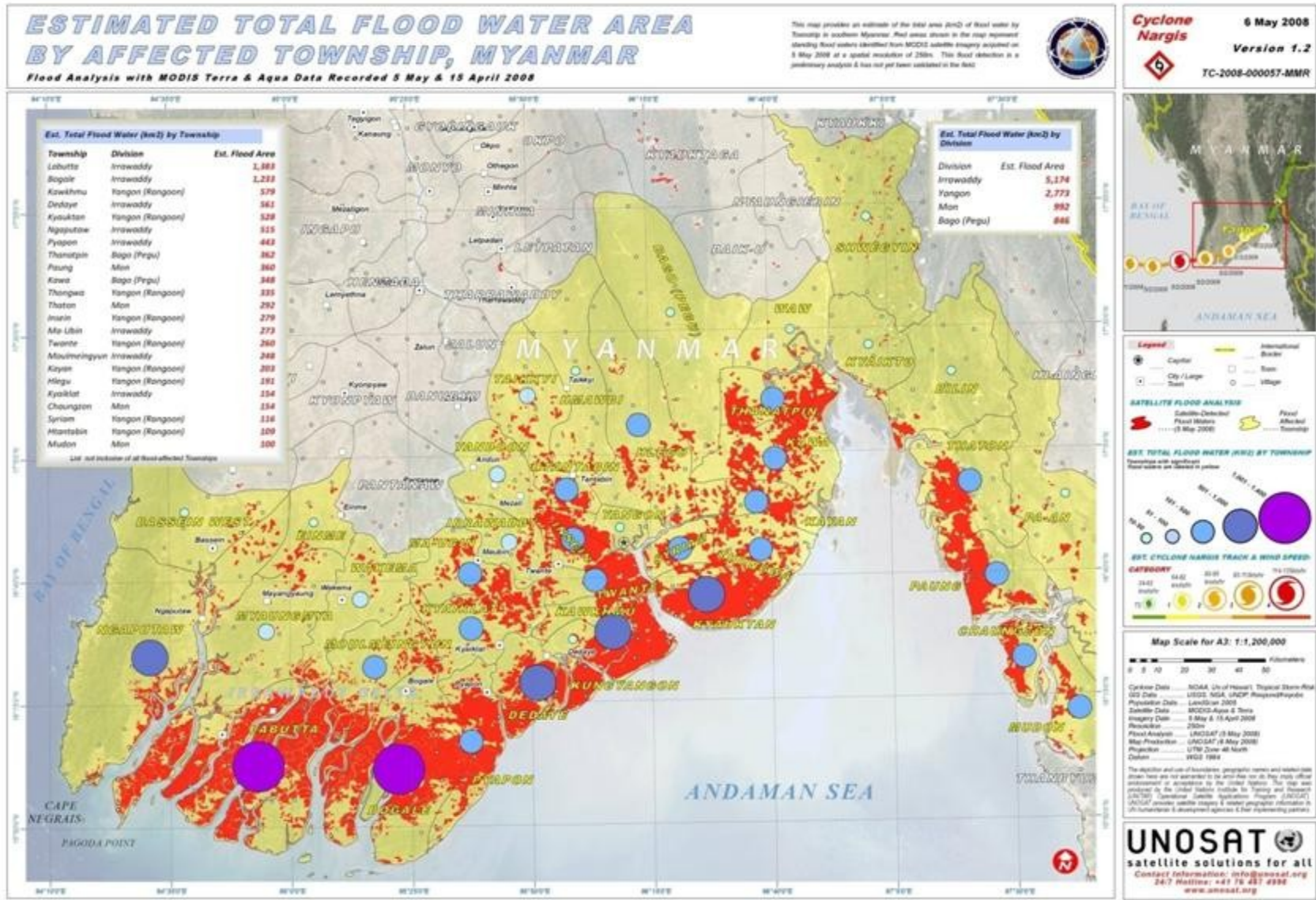


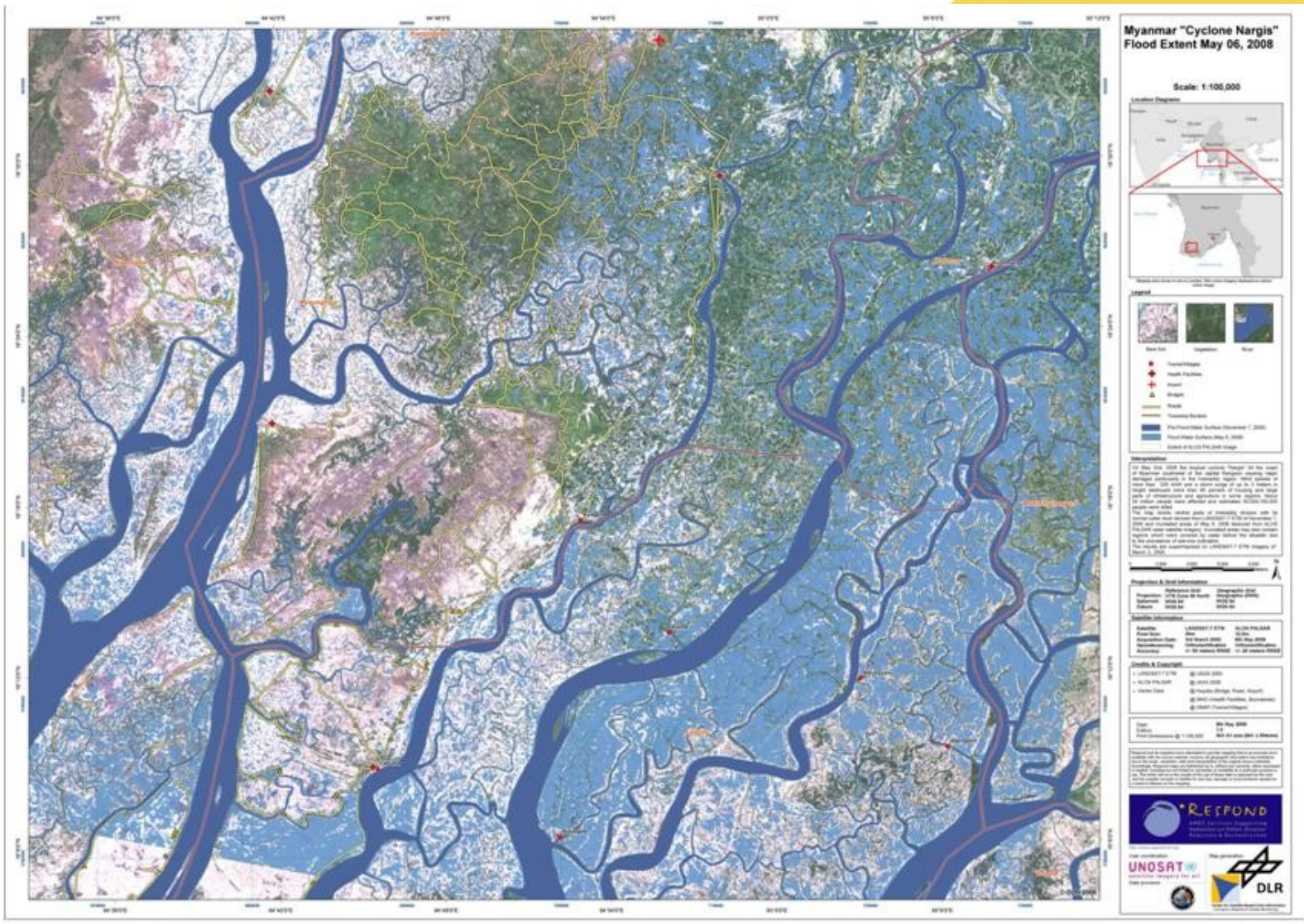
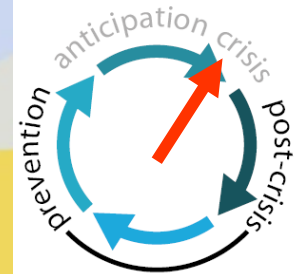
Emergency response after the Nargis cyclone





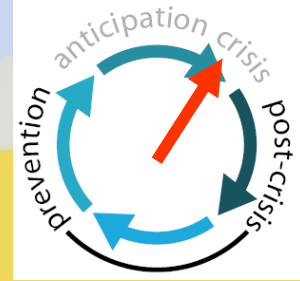
The first days: understanding the situation on the ground







Flood extent map



Charter Call 203 - SERTIT Product No 07
Myanmar "Nargis Typhoon"
Irrawady delta - Coastal areas
 Scale: 1:400,000
 Flooding observed the 18th of May 2008

Legend

- Observed flooded areas after Nargis
- Observed flooded areas after Nargis and frequently under water during the monsoon
- Areas frequently under water during the monsoon season
- Permanent water during dry season
- Settlements/villages
- Airport
- Roads
- Trails
- Railroads
- Urban areas
- Vegetation
- Bare soils

Interpretation

Hydrological situation after the passage of the Nargis Typhoon, over the coastal areas of Irrawady delta, the 18th of May 2008 analysed with ENVISAT WVM NH ASAR images, compared with 16 dry and wet season images acquired by the ENVISAT ASAR sensor in 2007-2008.

Projection & Grid Information

Reference Grid: Geographic Grid
 Projection: UTM Zone 47 North
 Spheroid: WGS 84
 Datum: WGS 84
 Geographic Grid: Geographic (DMS)
 Spheroid: WGS 84
 Datum: WGS 84

Cross-Substrate Metadata

Substrate: ENVISAT
 Pixel Size: 75m
 Acquisition Date: 18th May 2008
 Geometric processing: Georectification and orthorectification

Credits & Copyright

ENVISAT ASAR data used for impact analysis © ESA 2007-2008
 © SERTIT 2008
 Background cartographic information: © USGS 2000 - SRTM 90m, Landsat 7 ETM+ © NOAA, © ESRI, © NGA - vector layer databases

Date: 19 May 2008
 Edition: 1.0
 Print @ 1:400,000 ISO A3 size (A20 x 297mm)

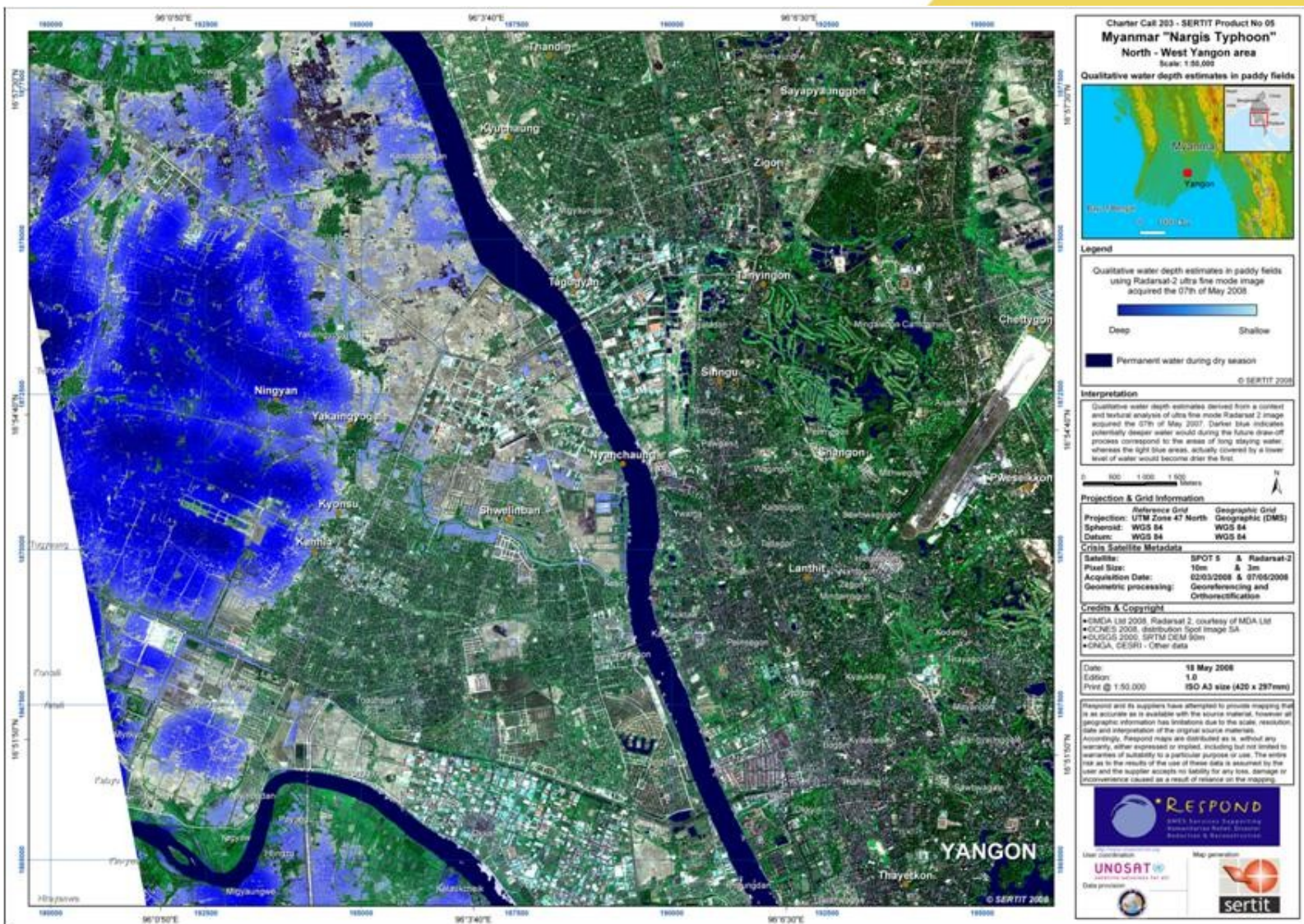
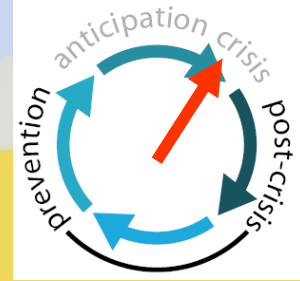
Response and its suppliers have attempted to provide mapping that is as accurate as is available with the source material. However, all geographic information has limitations due to the scale, resolution, date and interpretation of the original source materials. Accordingly, Response maps are distributed as is, without any warranty, either expressed or implied, including but not limited to warranties of suitability for a particular purpose or use. The entire risk as to the results of the use of these data is assumed by the user and the supplier accepts no liability for any loss, damage or compensation caused as a result of reliance on the mapping.

RESPOND
 ENVISAT Services Supporting
 Environmental Action, Research
 & Reconstruction

User Contribution: UNOSAT
 Data provision: sertit



Water deep maps in paddy fields





ERCS Pre-operational services

Pre-operational services for Crisis management support:

- **ESA GMES Service Element (GSE):**
 - **RESPOND** for Humanitarian Relief
 - **RISK-EOS** for Civil Protection
- **FP6 and FP7 projects:**
 - **PREVIEW (FP6)**
 - portfolio of specific services on Floods, Landslides, Volcanoes, Earthquake monitoring and windstorm risk and forecast
 - general services: asset mappings, disaster intensity assessment and damage rapid mapping
 - **SCHEMA (FP6)**
 - assessment of the vulnerability to tsunami.
 - Test areas: Mediterranean coast, Atlantic Ocean and Black sea
 - work connected to UNESCO IOC
 - **SAFER (FP7)** will start Jan 2009, continuity of previous ones, validation of pre-operational project



FP7 SAFER Project Portfolio of products

Flood products

- **Flood risk maps** based on hydraulic simulation and historical data based on RISKEOS approach
- **Plain flood Early Warning** based on EFAS
- **Flash Flood Early warning** based on RISKEOS FFEW and PREVIEW, connected with meso-scale meteo forecasting

Fire Products

- **Global Fire Risk Index**: fire danger mapping, daily delivery
- **Fire Monitoring at Medium Resolution**: NRT mapping of active fires

Landslide mapping

- **Landslide monitoring**: mapping ground movements for single large landslides, using InSAR data (interferometry) and geological expertise

Volcanoes - Earthquakes monitoring



Preparatory Action 2008

Objective: to support the implementation of the operational GMES emergency service establishing the necessary interfaces between the users and the providers to allow service integration into the user's operational workflow.

Tasks:

- building interfaces between users and ERCS providers;
- testing and validating the interfaces and information workflows;
- organising training and communication activities for users.

Tool:

- Call for tender
- Duration: 3 years
- Budget: 3 Meuros

Kick-off: 27.01.2009



Credits – acknowledgments

- Infoterra Group / Astrium Services
- National Observatory of Athens / Institute of space applications and remote sensing - NOA
- International Charter Space & Natural Disasters
- German Aerospace Centre - DLR
- Centre National d'Etudes Spatiales – CNES
- European Space Agency – ESA
- SERTIT, Strasbourg
- Bavarian Environment Agency, Munich
- City of Kempten
- Federal Institute of Hydrology, Koblenz
- Geomer GmbH, Heidelberg
- Institute of Hydraulic Engineering, Stuttgart
- Institute for Meteorology and Climate Research, Karlsruhe
- Leibniz Institute of Ecological and Regional Development, Dresden
- Institute Nazionale di Geofisica e Vulcanologia
- UNOSAT
- JRC
- EC funded projects: PREVIEW, BOSS4GMES
- ESA funded projects: RISKEOS, RESPOND



Useful links

- **GMES:**
<http://ec.europa.eu/gmes/overview.htm>
- **Emergency Response portal:**
<http://www.gmes.info/195.0.html>
- **Examples:**
<http://boss4gmes.customers.arjuna.eu/index.php?id=mmp#section=2>
www.preview-risk.com
<http://www.respond-int.org/respondlive/>
<http://www.risk-eos.com/>



Thank you for your attention !

virginia.puzzolo@ec.europa.eu