Joint Research Centre (JRC)

Crisis Management and Natural Disasters

Overview of JRC operational or pre-operational activities

A. Annunziato, D. Al-Khudhairy

http://www.jrc.ec.europa.eu/

Table of content

Disaster monitoring for earlier response

Global Security and Crisis Management

- Preparedness
- **Response**
- Recovery
- Prevention
- Risk reduction

Alert systems for natural disasters

- Real time systems: **GDACS, EFAS, GFDS, EFFIS**
- Physical and risk modelling
- Strong practitioners community
- Multidisciplinary scientific community

Introduction

- **JRC has developed operational systems to monitor and alerting for Natural Disasters**
  - Earthquake and Tsunami → GDACS
  - Tropical Cyclones → GDACS
  - Floods → GDACS, EFAS
  - Forest Fires → EFFIS

- **JRC role covers the whole cycle of disasters from Preparedness, Alerting, Response, Reconstruction**

- **Major users of JRC systems:**
  - Internal EU users (i.e. DG-ENV, DG-ECHO)
  - Member states (i.e. Portugal for Tsunami/Forest Fires)
  - International Organizations (i.e. UN agencies: OCHA)

GDACS, Earthquakes

- **JRC, in collaboration with UN-OCHA (United Nations Agency for Humanitarian Affairs) developed the** Global Disaster Alerts and Coordination System (**GDACS**)
  - Fully automatic system, available 24//7
  - Automatic gathering of natural events data: earthquakes, tsunamis, tropical storms, floods and volcanoes
  - Analysis and alert
  - Automatic reporting systems

- **More than 10000 users receive alerts from JRC in case of Natural Disaster**

- **Platform: http://www.gdacs.org**

Global Disaster Alert and Coordination System (GDACS)

GDACS: system for international disaster response **community**

Information gap in the initial response phase

10000 active users of 184 countries

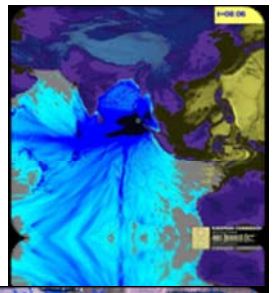
Secretariat: OCHA

Office for the Coordination of Humanitarian Affairs

JRC's role: alert and monitoring system

Earthquakes and tsunamis

- 13 scientific partners
- Tsunami modelling
- Impact modelling



Tropical cyclones

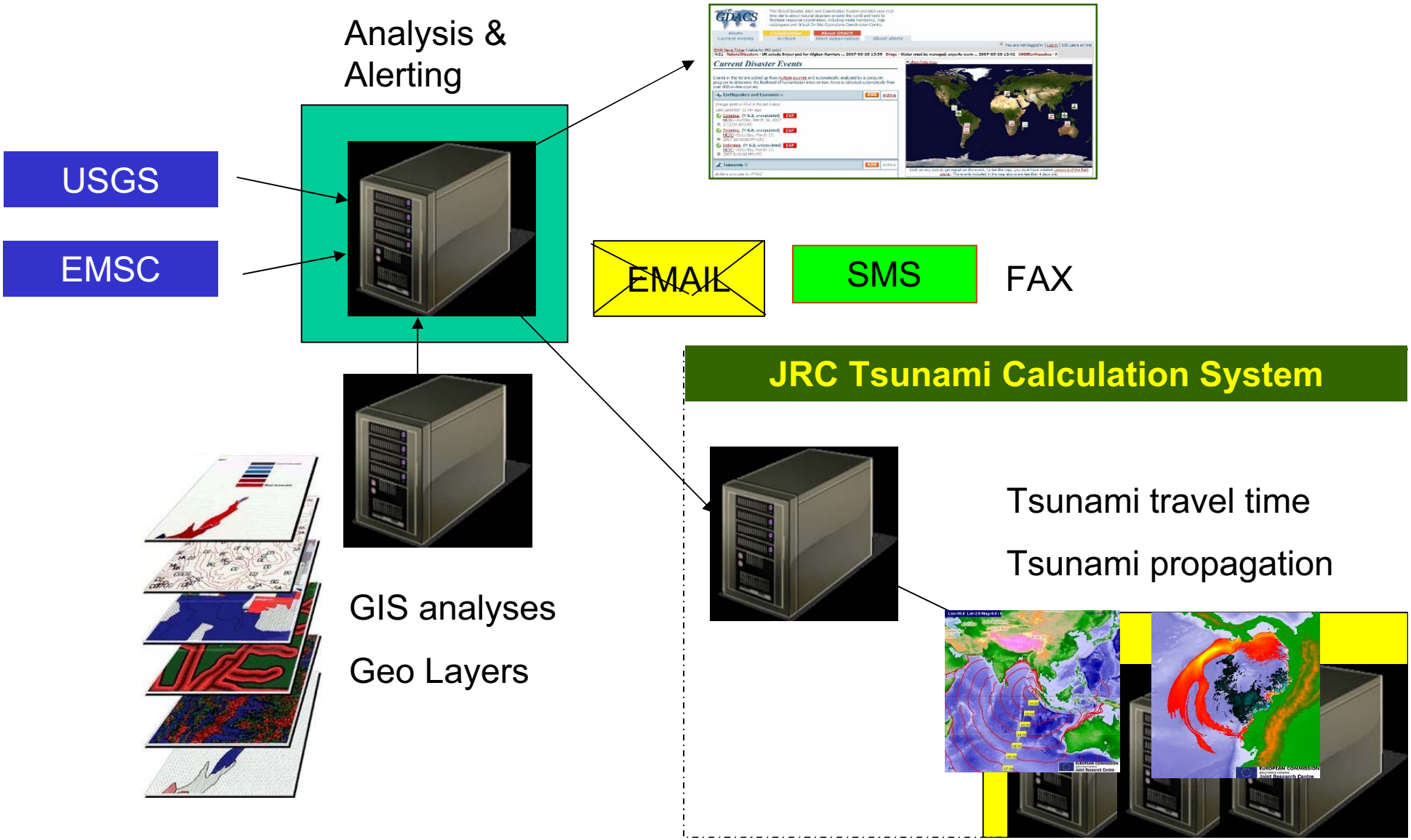
- 2 scientific partners
- Wind modelling
- Impact modelling

Volcanic eruptions, **Floo**

- 4 scientific partners
- No scientific monitoring network

GDACS

GDACS Architecture & functions

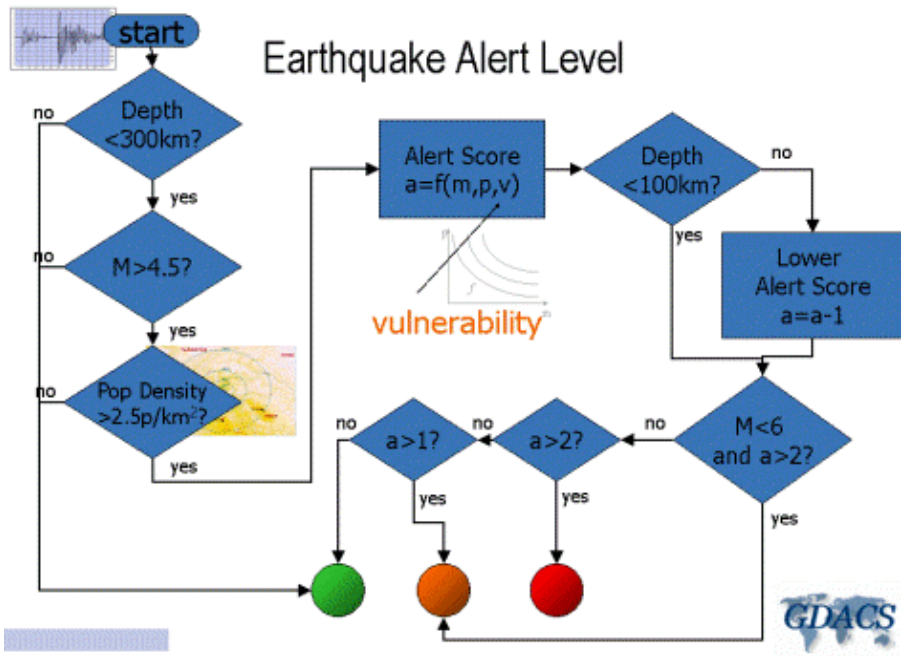


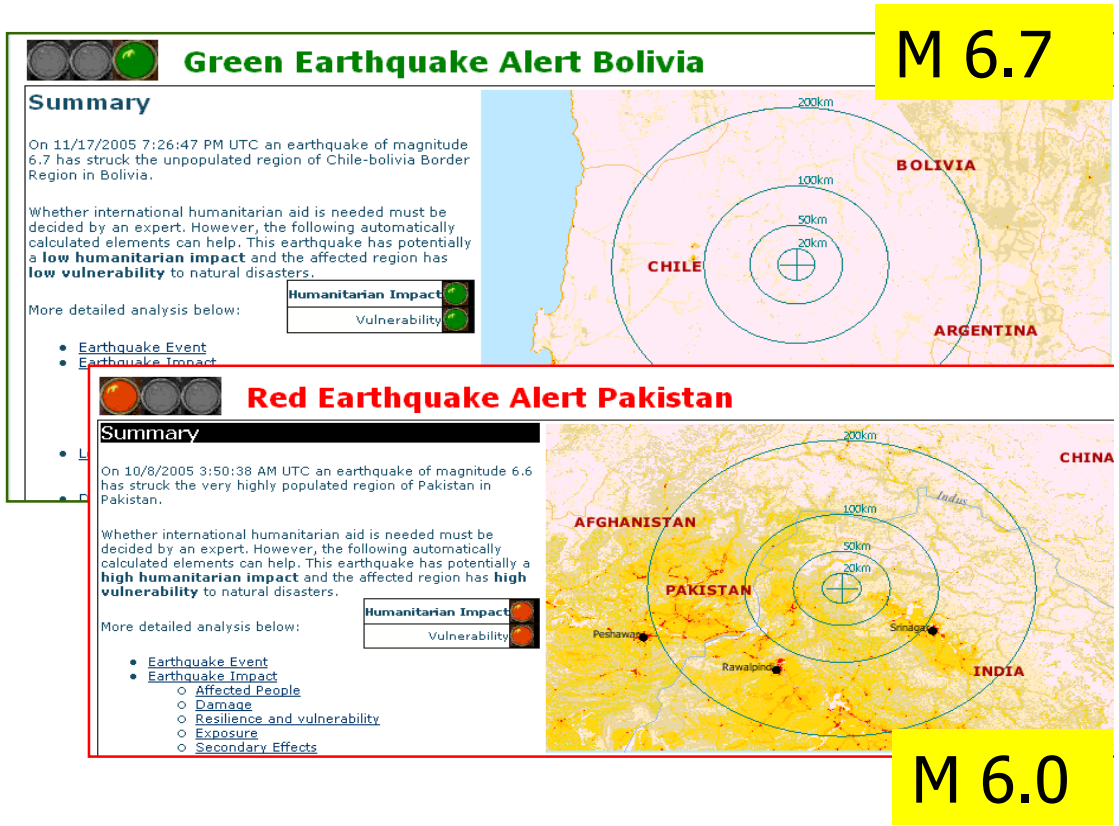
Earthquakes

Earthquakes

- impact model based on evaluation of the

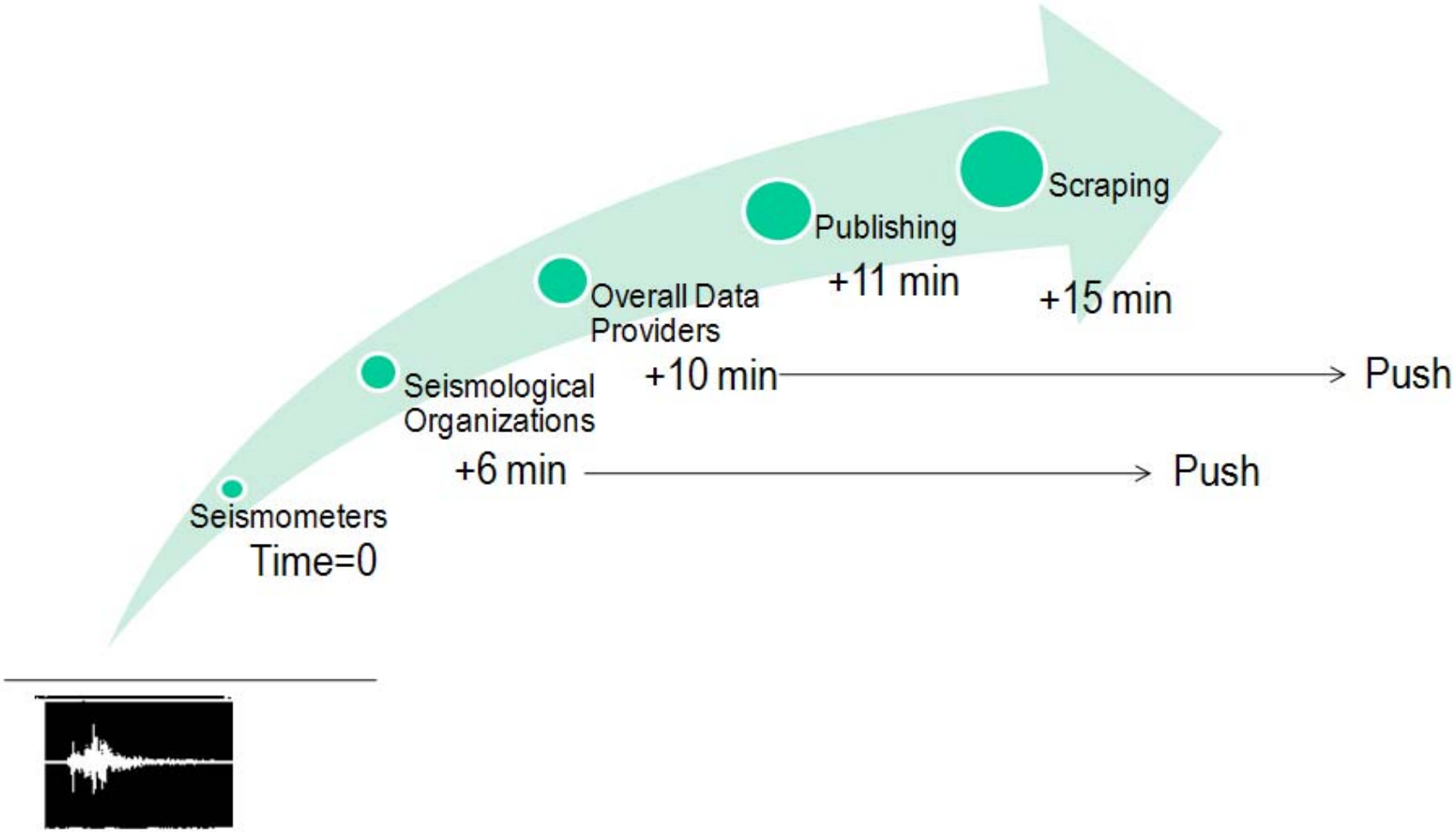
Alert Score = $F_{vulnerability} * F_{Population\ density} * F_{Magnitude}$





Issue: improvements in time detection

Improvement in the data availability through agreements with data providers



Tsunamis

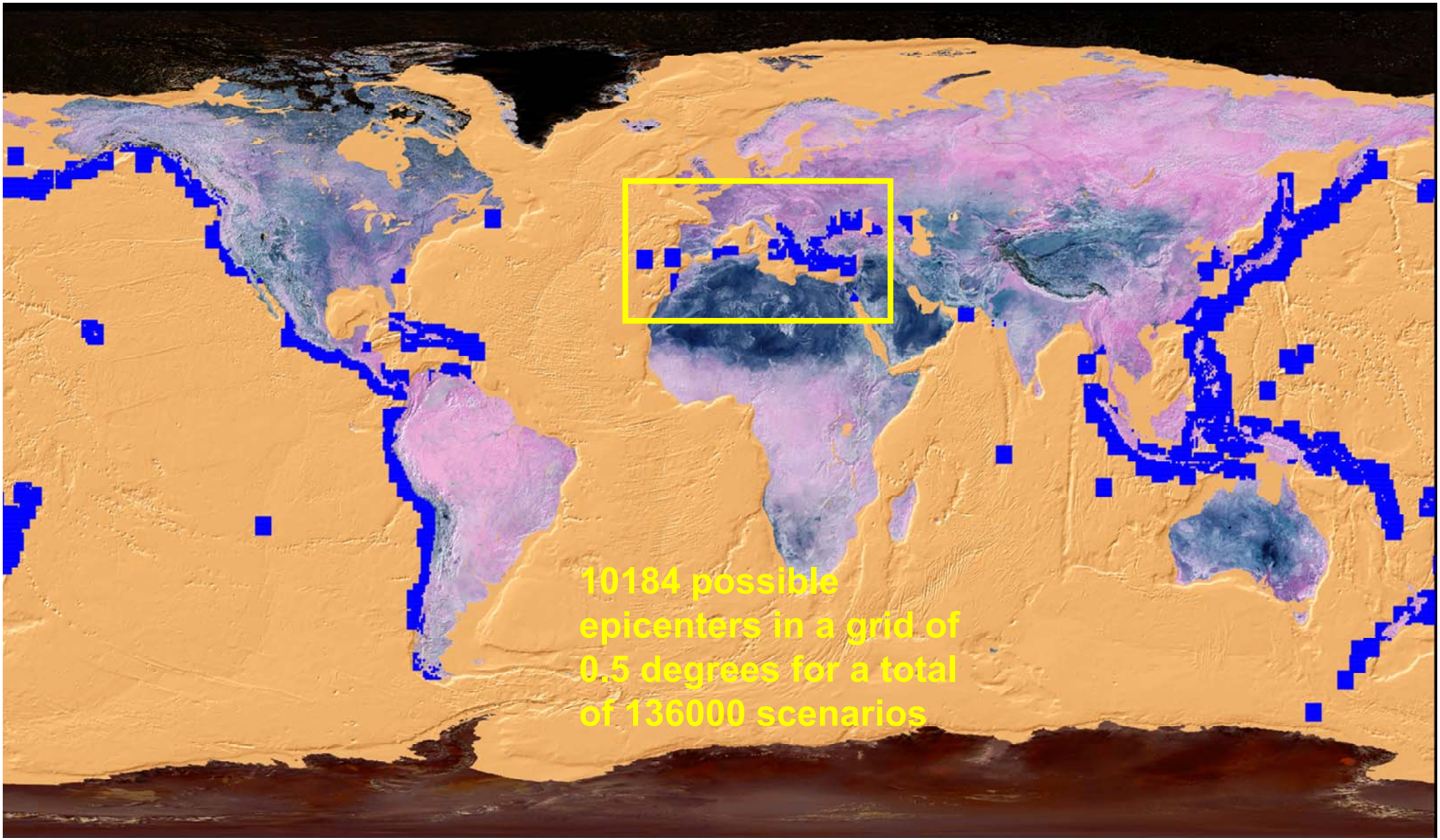
Tsunami models have been included in GDACS after 2004.
At the moment we have:

- **Online calculations initialized by several triggering mechanisms, to have as fast as possible start of the calculations (typical 30-40 min calculation time)**

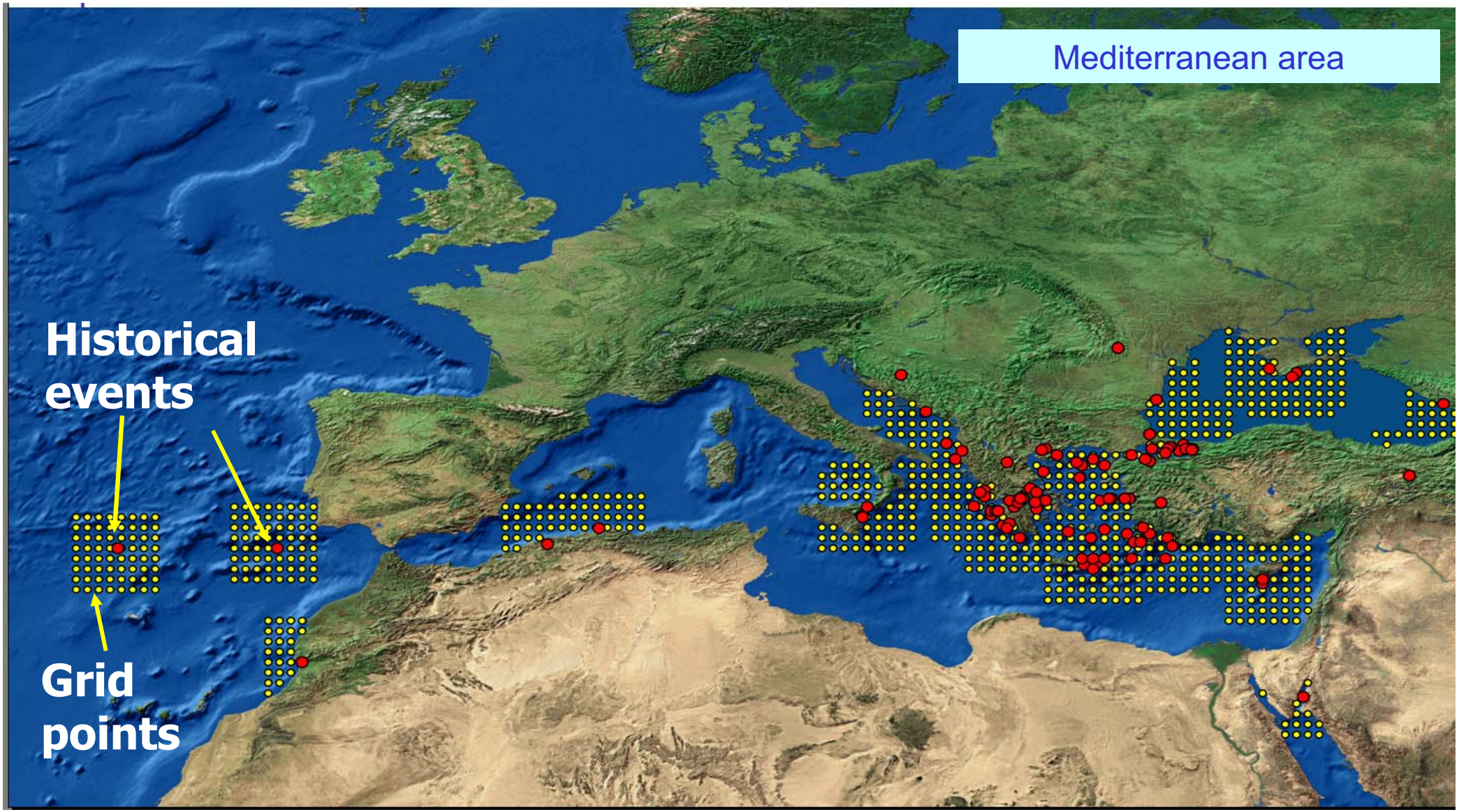
- **Grid calculations: a worldwide scenario database containing 136000 scenarios that can be requested and included in the web pages (immediately available on request)**

- **Tsunami Analysis Tool software to analyse ongoing events**
  - Developed to support Portugal Tsunami Early Warning System

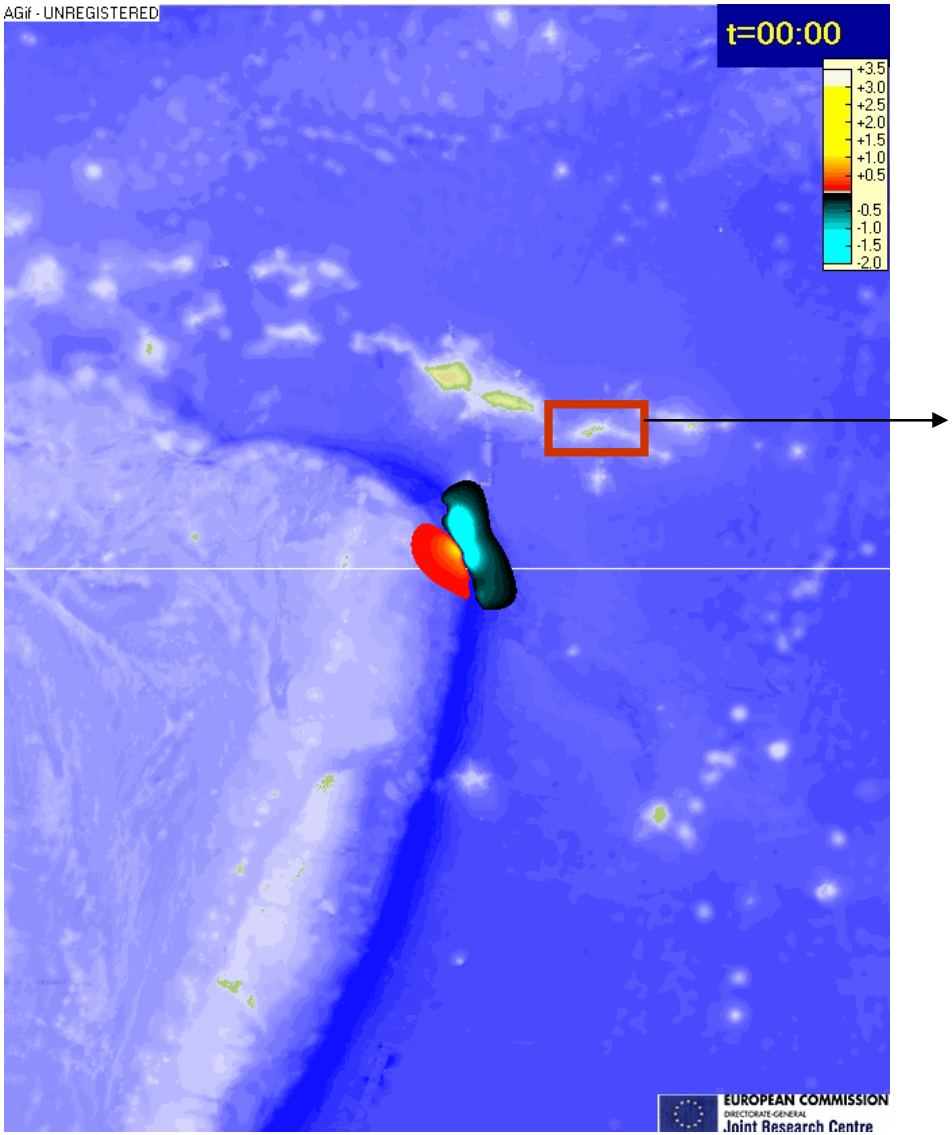
Tsunami calculation grid

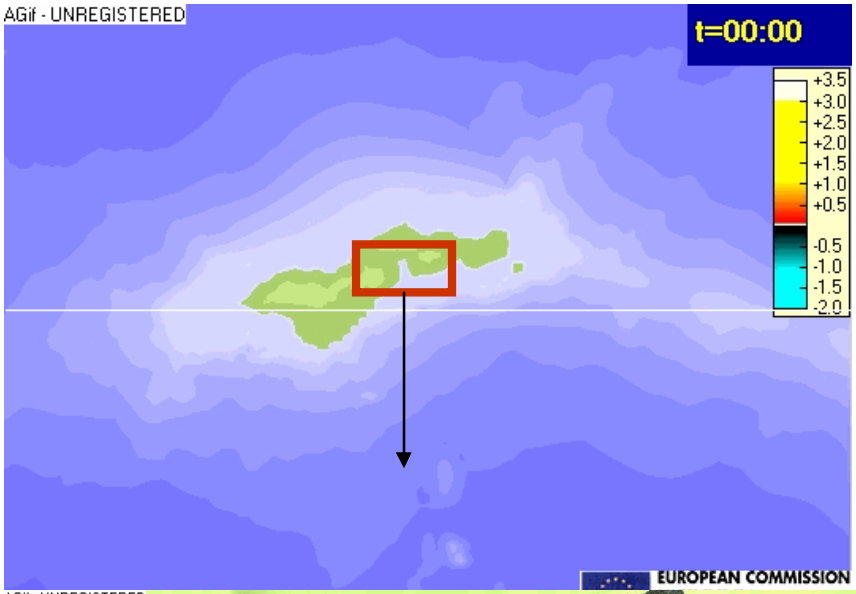


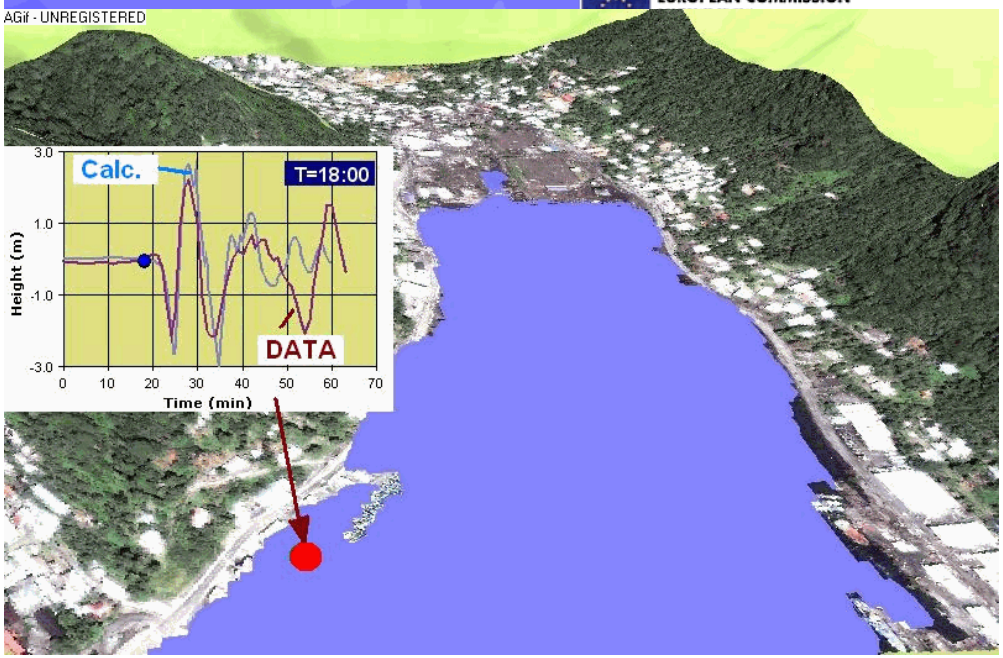
Tsunami calculation grid



Samoa event, 29 sep 2009

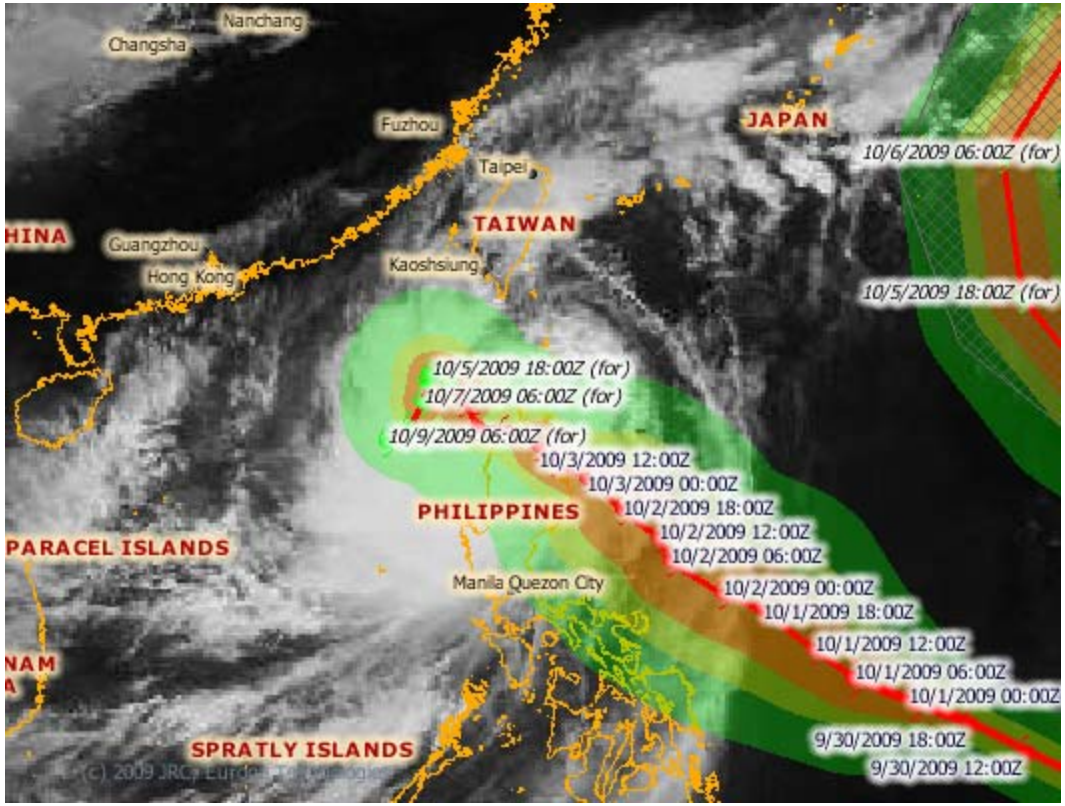






Tropical Cyclones

- Based on track information provided by the **Pacific Disaster Center**, JRC calculates areas around the track affected by high winds.
- Population and critical infrastructure.
- Depending on the wind speed and the population in the area, alert levels are set as follows:
  - **Population < 100000: Green alert**
  - **Population > 100000 in Cat1: Orange alert**
  - **Population > 100000 in Cat1, with maximum wind speeds of Cat3 or up: Red alert**
- Population potentially affected by storm surge (not yet part of the alert model).
- One important aspect that does influence the alert model is extreme rainfall, but no suitable models have been found and integrated as of now.



Parma-09 Tropical Cyclone

GDACS event report - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://www.gdacs.org/reports.asp?eventType=TC&ID=KETSANA-09_1&system=asgard&alertlevel=Orange&glide_no=TC-2009-000205-PHL&location=&country=&new=true

Vietnam (Kon Tum) (251160), Vietnam (Quang Nam-Da Nang) (1951763), Vietnam (Quang Ngai) (1169425).

Affected Cities

Estimated arrival time (UTC)	Wind speed (km/h)	Distance (km)	Name	Province	Country	City Class (1 to 6)
9/29/2009 03:30	165	72	Tam Ky	Quang Nam	Vietnam	3
01:45	165	68	Quang Ngãi	Quang Ngai	Vietnam	3

Affected Critical Infrastructures

No nuclear plants affected

Airports

Estimated arrival time (UTC)	Wind speed (km/h)	Distance (km)	Name	IATA Code	Country	Type	Runway
9/29/2009 02:15	165	70	Mo Duc		Vietnam	Local or private	
04:00	165	69	Minh Long		Vietnam	Local or private	
03:30	165	72	Duc Pho		Vietnam	Local or private	
06:30	159	65	Baldy		Vietnam	Local or private	
03:30	165	73	Tam Ky		Vietnam	Local or private	
05:15	165	72	Tien Phuoc		Vietnam	Local or private	
01:45	165	68	Chu Lai		Vietnam	Local or private	
9/28/2009 22:45	165	61	Cu Lao Re		Vietnam	Local or private	
9/29/2009 01:45	165	72			Vietnam	Local or private	
04:00	165	68	Ha Thanh		Vietnam	Local or private	

Ports

Estimated arrival time (UTC)	Wind speed (km/h)	Distance (km)	Name	Country
9/29/2009 00:00	165	68	Quang Ngai	Vietnam
9/28/2009 07:45	153	48	Triton Island	China

No dams affected

Event time line

Event time line

Date and time (forecasted in italic, current between red lines)	25/9 0h	25/9 6h	25/9 12h	25/9 18h	26/9 0h	26/9 6h	26/9 12h	26/9 18h	27/9 0h	27/9 6h	27/9 12h	27/9 18h	28/9 0h	28/9 6h	28/9 12h	28/9 18h	29/9 0h	29/9 6h	29/9 12h	*30/9 0h*
Advisory number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Wind speed	TD	TD	TD	TS	TS	TS	TS	TS	TS	TS	TS	TS	I	I	II	II	II	II	TS	*TD*
Population in cyclone Category I (thousand)																18	1954	2217		
Population in tropical storm (million)														3	3	7	10	10		
Population vulnerable to storm surge (thousand)																3	293	298		
Risk of wind damage																				
Affected cities																				

Impact details - Affected cities and critical infrastructure (advisory number: 19)

For each track point of the cyclone, a list of cities and critical infrastructure hit by high winds with speed bigger than hurricane strength is shown below. Click on the button Impact to see the data. (* = Data obtained from official tropical storm advisories)

Track

alertcolor	date time	advisory	coords	wind speed	wind gusts	Population in	Population in	Population vulnerable	country	impact report

GDACS event report - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://www.gdacs.org/reports.asp?eventType=TC&ID=KETSANA-09_1&system=asgard&alertlevel=Orange&glide_no=TC-2009-000205-PHL&location=&country=&new=true

9/28/2009 00:00	13	15.8, 112.8	I (33 m/s)	41 m/s					Not near land	
06:00	14	15.8, 111.9	I (41 m/s)	51 m/s	3.54 million			Vietnam	Impact	
12:00	15	16.1, 111	II (46 m/s)	56 m/s	3.43 million			Vietnam	Impact	
18:00	16	16, 110.2	II (46 m/s)	56 m/s	7.64 million	18.08 thousand	3.69 thousand	Vietnam	Impact	
9/29/2009 00:00	17	15.5, 109.5	II (46 m/s)	56 m/s	10.12 million	1.95 million	0.29 million	Vietnam	Impact	

Affected Population

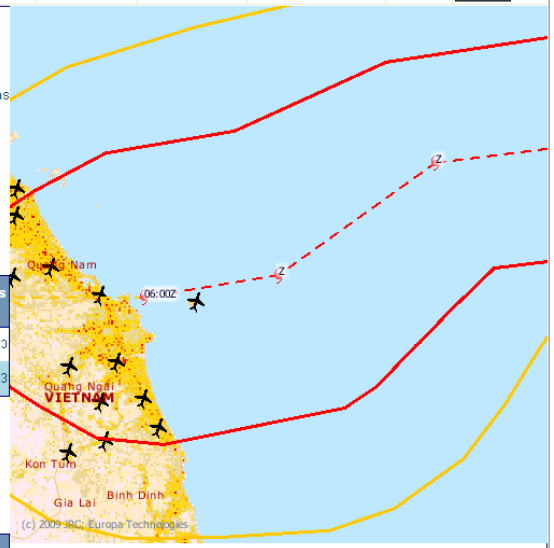
Up to **1.95 million people** can be affected by wind speeds of hurricane strength or above. In addition, **0.29 million people** are living in coastal areas below 5m and can therefore be affected by storm surge.

Affected Country (provinces) (population)

Vietnam (Kon Tum) (251160), Vietnam (Quang Nam-Da Nang) (1951763), Vietnam (Quang Ngai) (1169425).

Affected Cities

Estimated arrival time (UTC)	Wind speed (km/h)	Distance (km)	Name	Province	Country	City Class (1 to 6)
9/29/2009 03:30	167	72	Tam Ky	Quang Nam	Vietnam	3
01:45	167	68	Quang Ngãi	Quang Ngai	Vietnam	3



Affected Critical Infrastructures

No nuclear plants affected

Airports

Estimated arrival time (UTC)	Wind speed (km/h)	Distance (km)	Name	IATA Code	Country	Type	Runway
9/29/2009 02:15	167	70	Mo Duc		Vietnam	Local or private	
04:00	167	69	Minh Long		Vietnam	Local or private	
03:30	167	72	Duc Pho		Vietnam	Local or private	
03:30	167	73	Tam Ky		Vietnam	Local or private	
05:15	167	72	Tien Phuoc		Vietnam	Local or private	
01:45	167	68	Chu Lai		Vietnam	Local or private	
00:00	167	43	Cu Lao Re		Vietnam	Local or private	
01:45	167	72			Vietnam	Local or private	
04:00	167	68	Ha Thanh		Vietnam	Local or private	

Ports

Floods

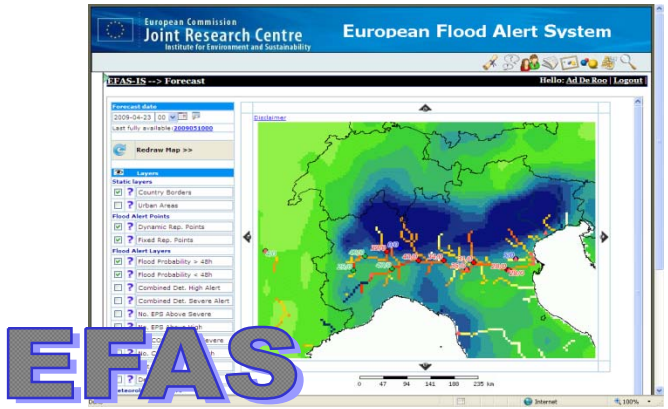
Flood event

Currently Europe only

Detection, confirmation, assessment

News Reporting

Forecast



>2 **+1** **-10** **days**

Time

Monitoring floods: state of the art

Global flood forecasting?

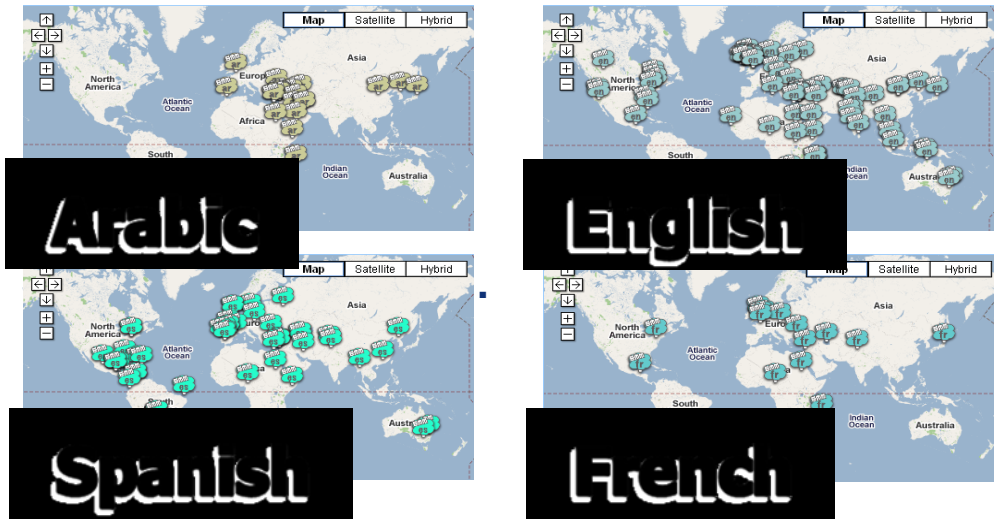
Modelling and forecasting:
no global coverage
National / regional systems:
EFAS, see later

Global discharge monitoring?

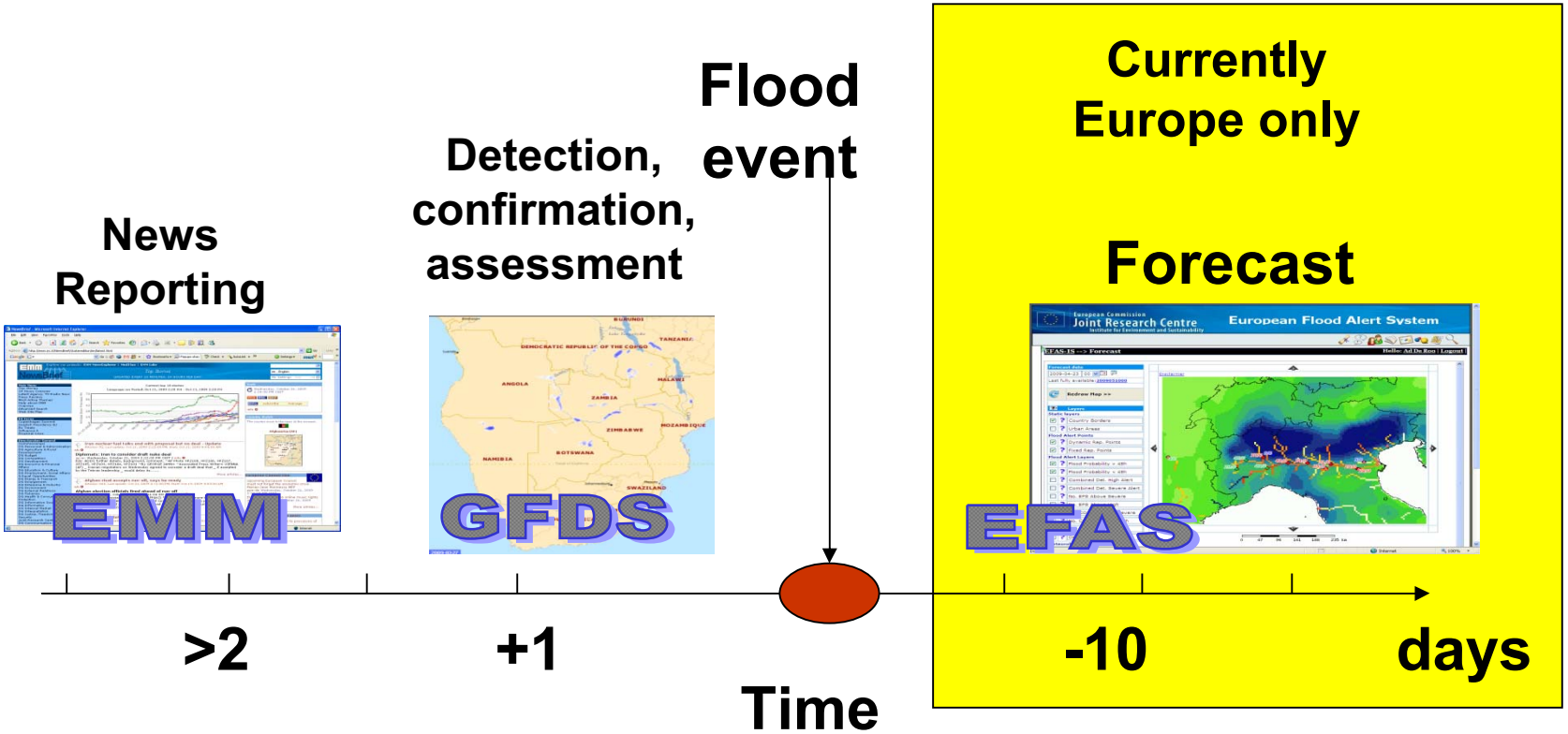
Global Runoff Data Centre:
no global / timely coverage
Costly: 1 million km of river globally (89M$/year for US)
Local systems: not interoperable

Media monitoring?

Dartmouth Flood Observatory, EM-DAT
Automatic media monitoring
Reporting is not systematic: language dependent; qualitative, biased



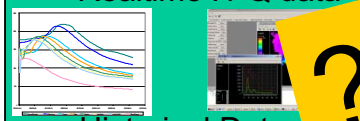
FLOOD FORECASTING (EFAS)



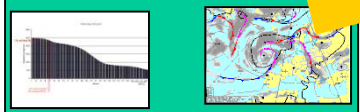
Adaptation: early warning systems
the European Flood Alert System (EFAS)

EU Flood GIS

Realtime H-Q data

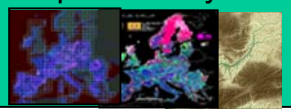


Historical Data

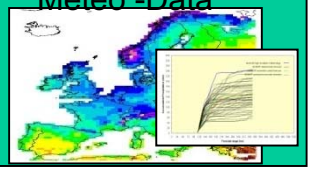


Static Data

Europ. Data Layers

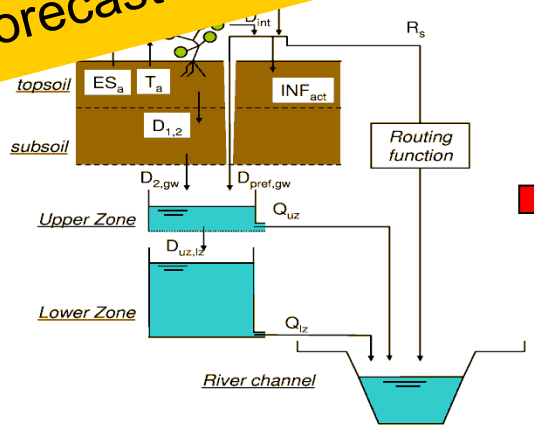


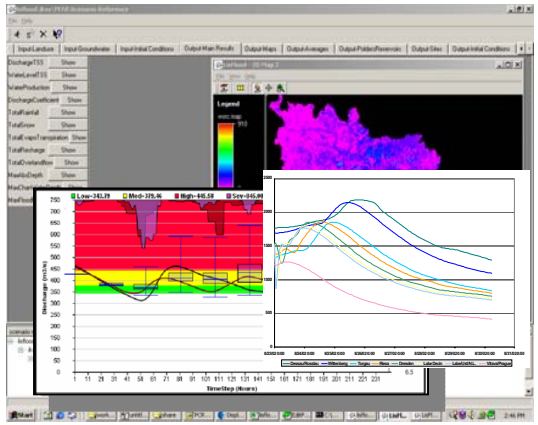
Meteo -Data

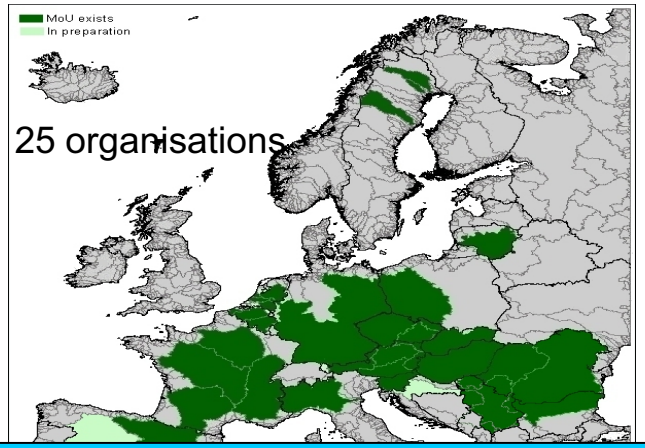


Expert Knowledge of Member States

? 120 forecasts daily







24/365 Web-Interface

Impact: earlier crisis preparedness actions by national civil protection (e.g. HU, RO)

Support to EU Flood Directive, river basin Action Plans for floods (Danube, Elbe), and EU Civil Protection (MIC)

European Commission
Joint Research Centre
Institute for Environment and Sustainability

European Flood Alert System

Po flood 2009 (28-29 April)

EFAS-IS --> Forecast

Hello: Ad De Roo | Logout |

Forecast date

2009-04-23 00

Last fully available: 2009051000

Redraw Map >>

Layers

Static layers

- Country Borders
- Urban Areas

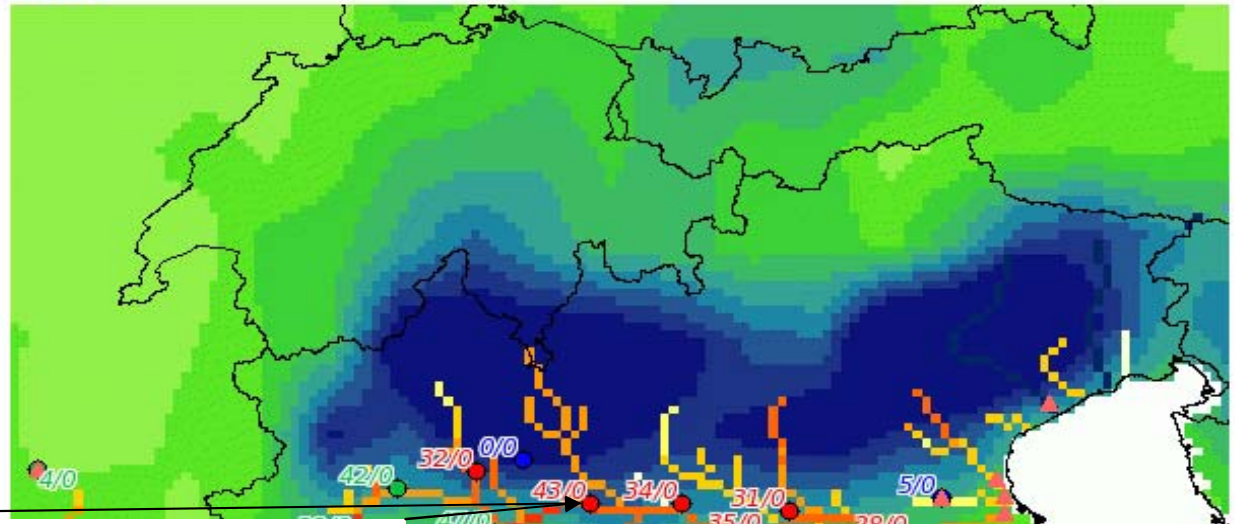
Flood Alert Points

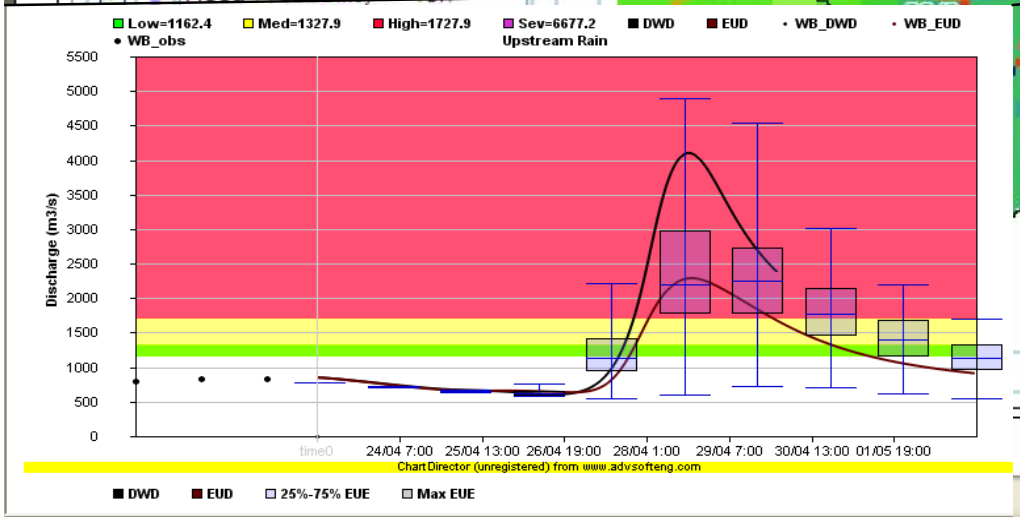
- Dynamic Rep. Points
- Fixed Rep. Points

Flood Alert Layers

- Flood Probability > 48h

Disclaimer

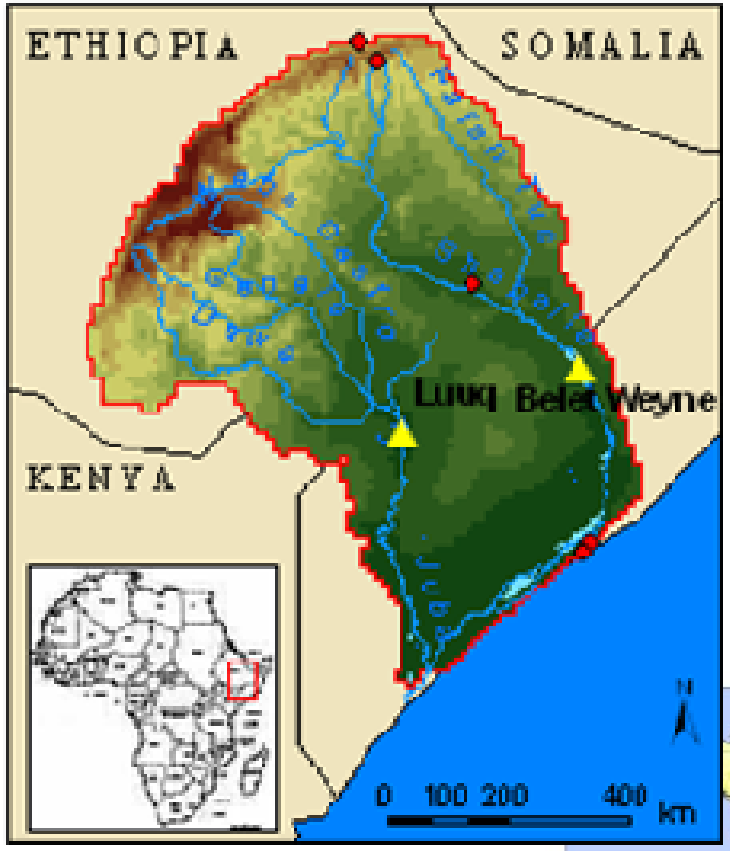


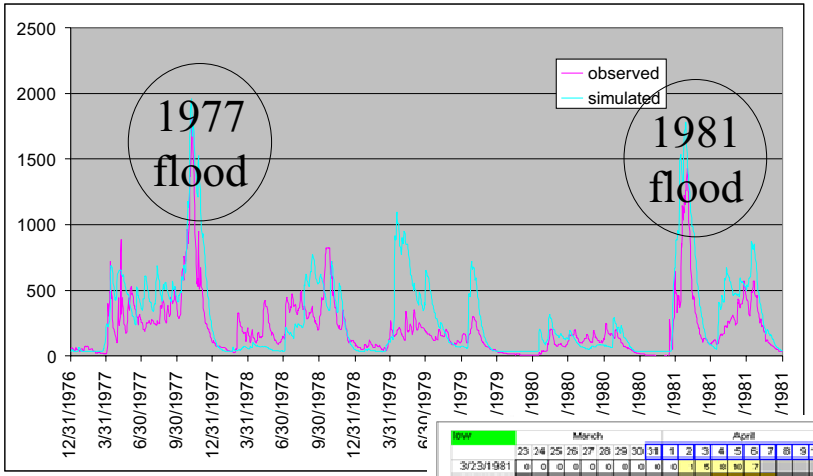


47 94 141 188 235 km

Internet 100%

Challenge: From European to African and Global forecasting systems

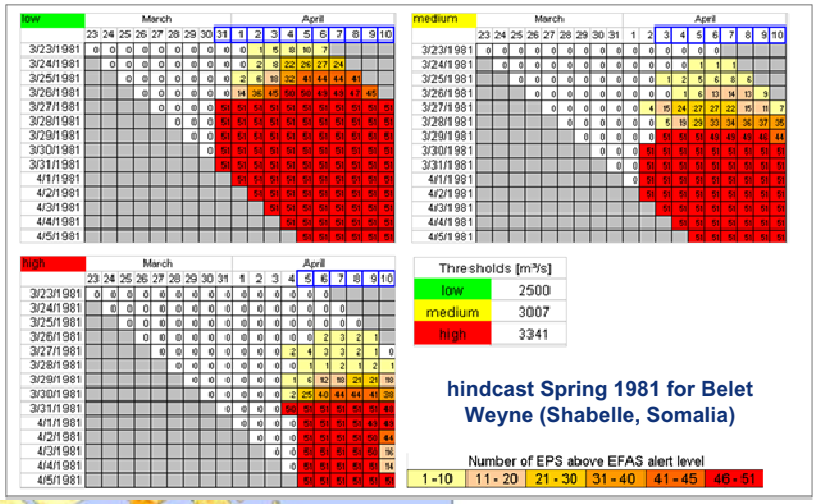




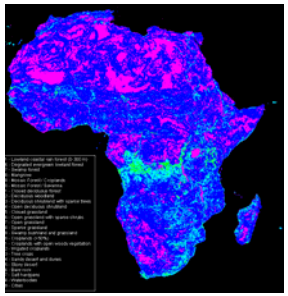
Two pilot studies:

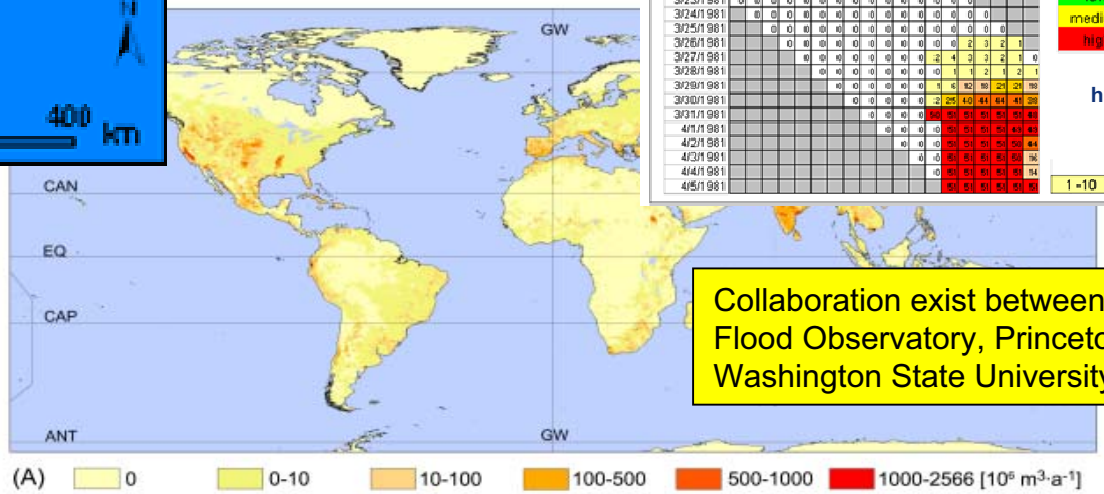
Juba &/ Shabelle river basins (Somalia/Ethiopia) ;

Zambesi river basin (Southern Africa)



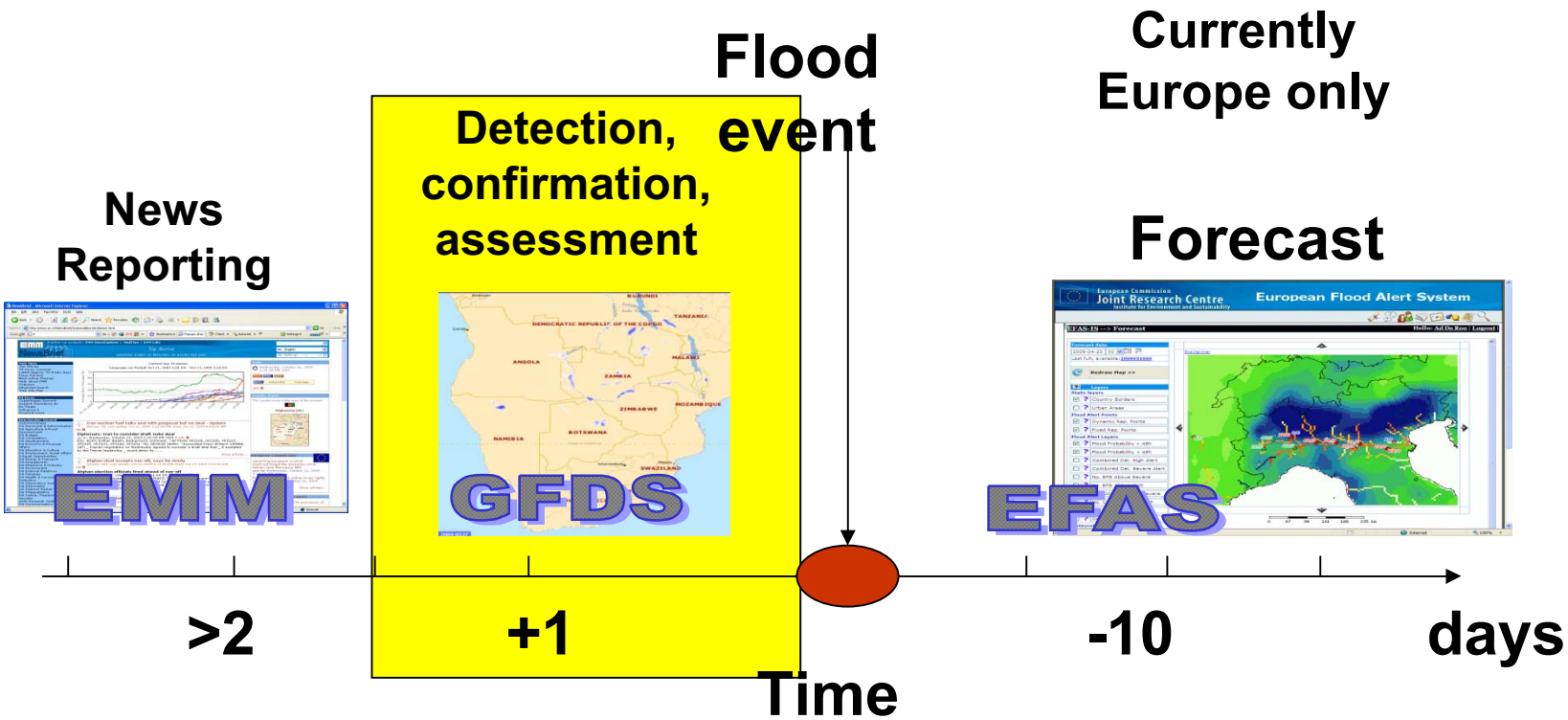
hindcast Spring 1981 for Belet Weyne (Shabelle, Somalia)





Collaboration exist between JRC and Dartmouth Flood Observatory, Princeton University, Washington State University

FLOOD DETECTION (GFDS)



Passive microwave remote sensing

Specifications for monitoring

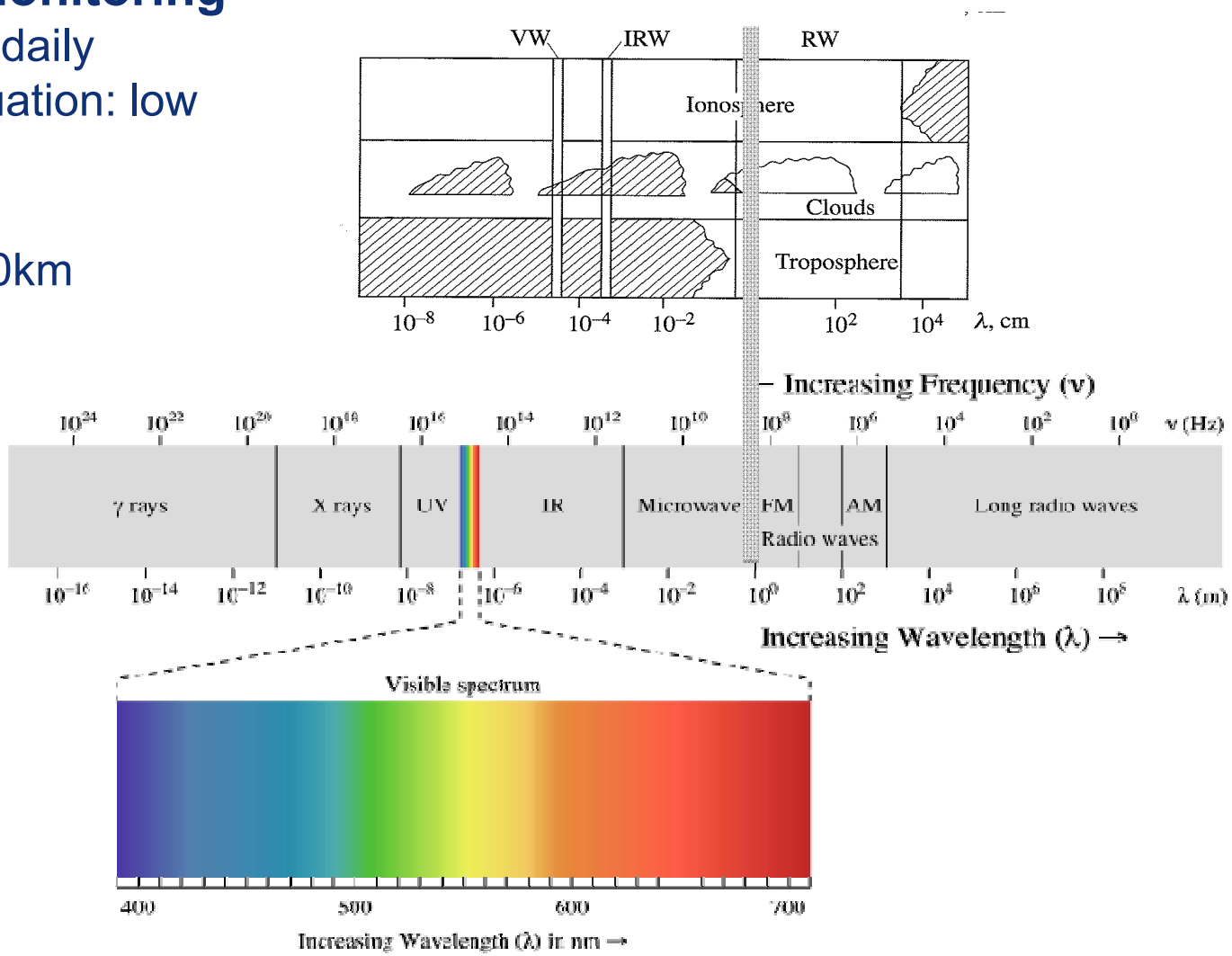
- Global revisit time: daily
- Atmospheric attenuation: low

AMSR-E

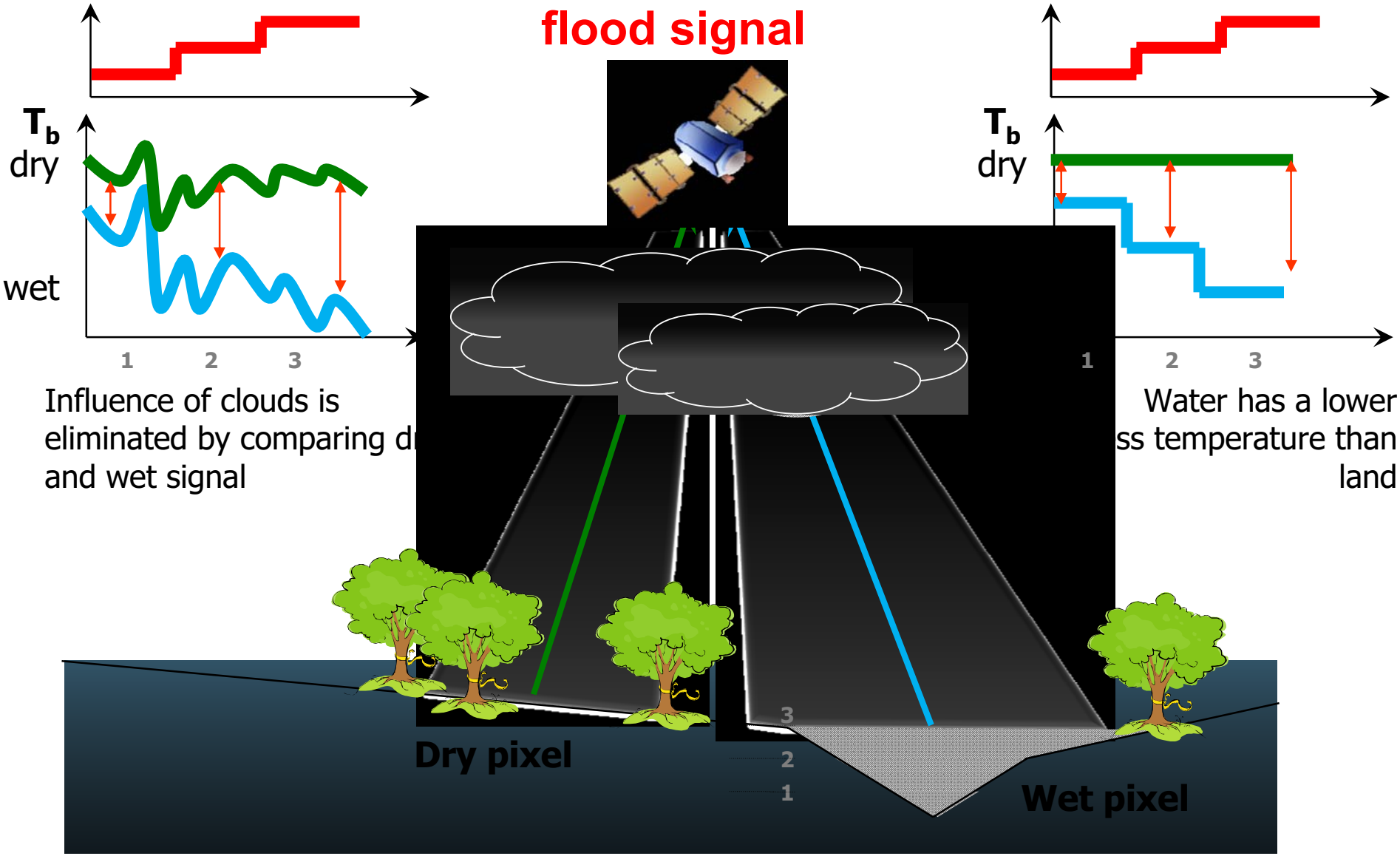
- Resolution: 10km
- Swath width: ~3000km
- Launch: 2002

Figure1
AMSR-E Instrument

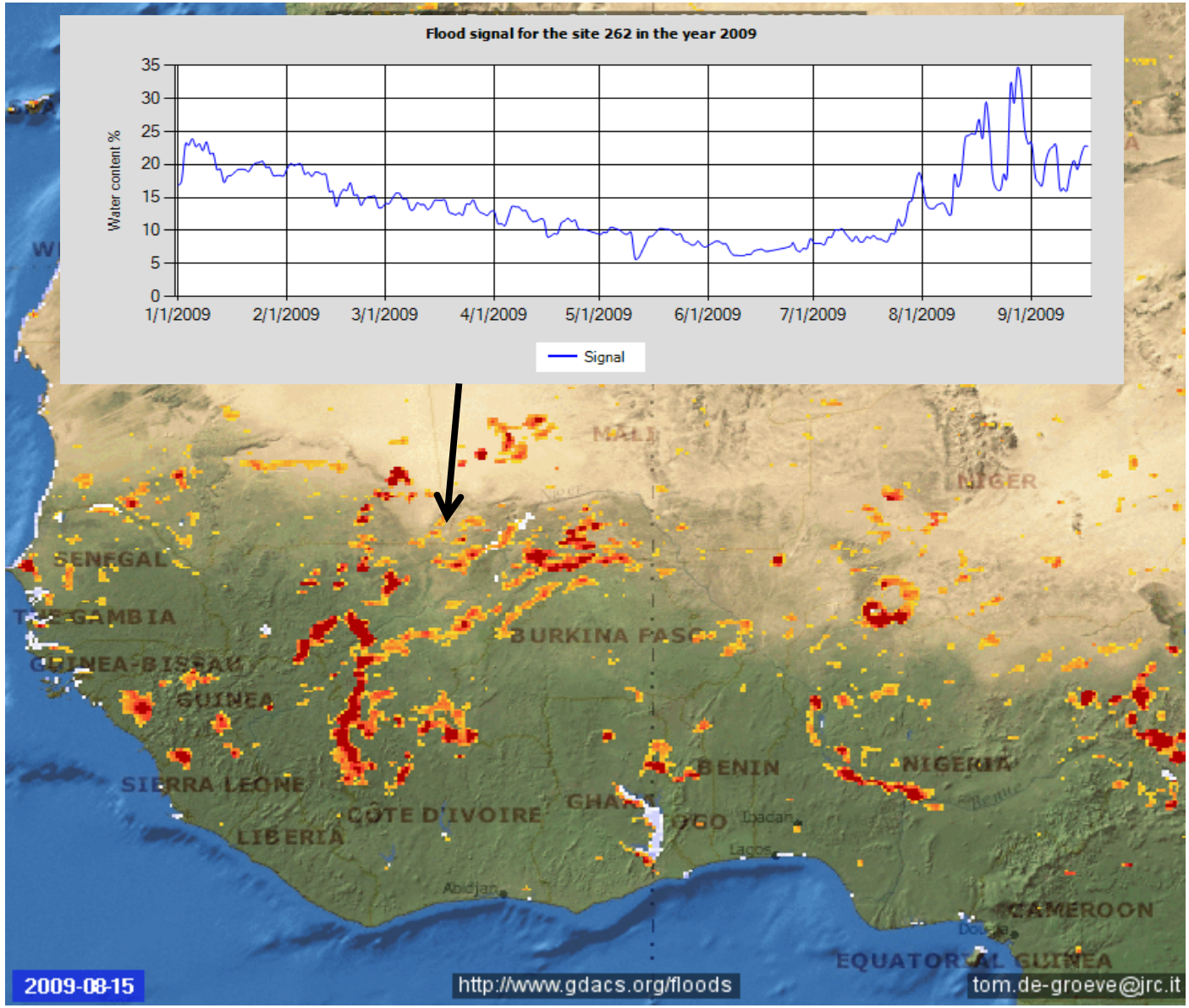
36.5GHz

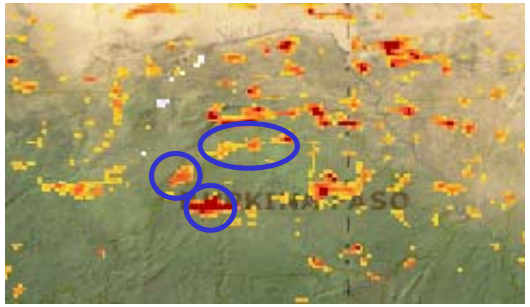


Novel normalization methodology: flood signal



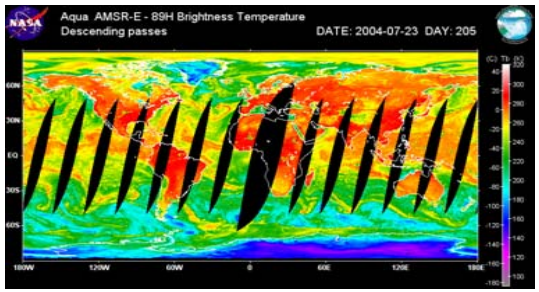
Global flood detection system





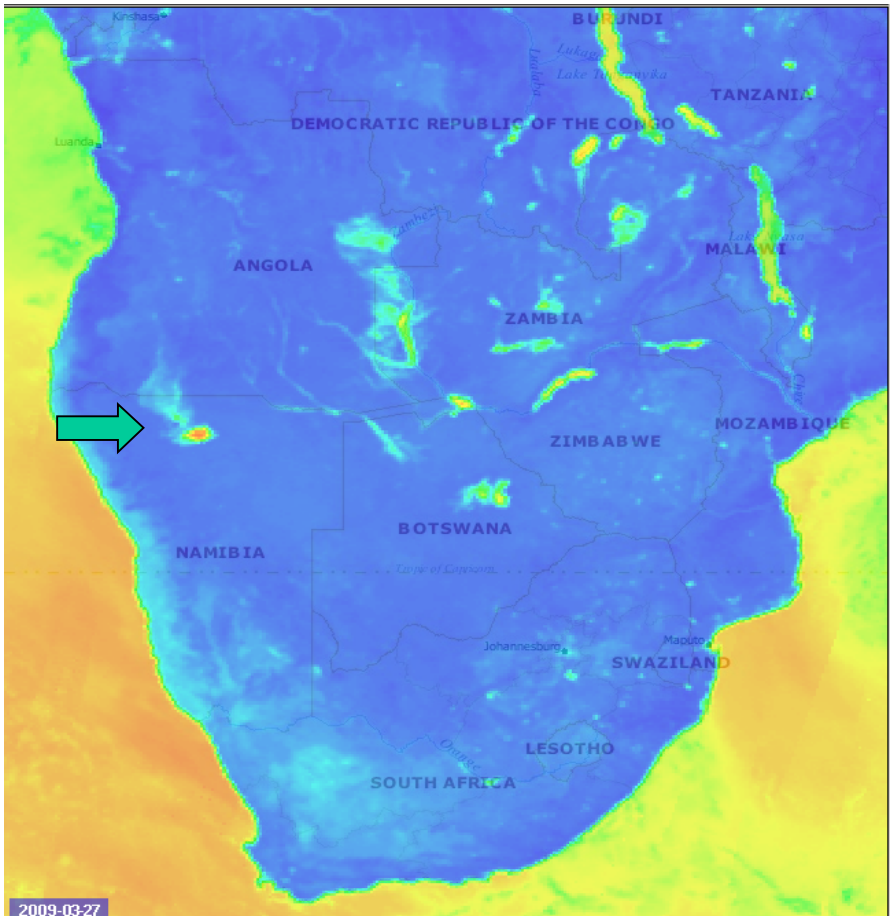
Burkina Faso, 6 Sept

Burkina Faso, 15 Sept



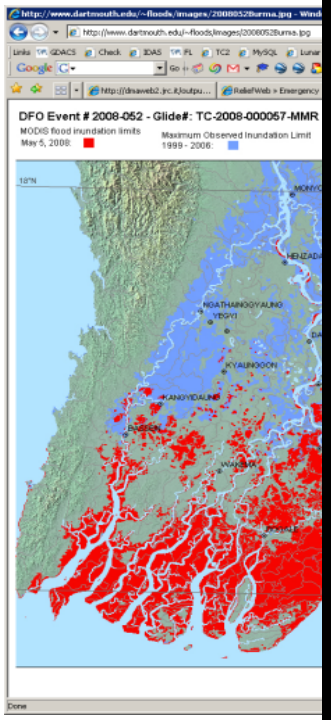
Flood signal

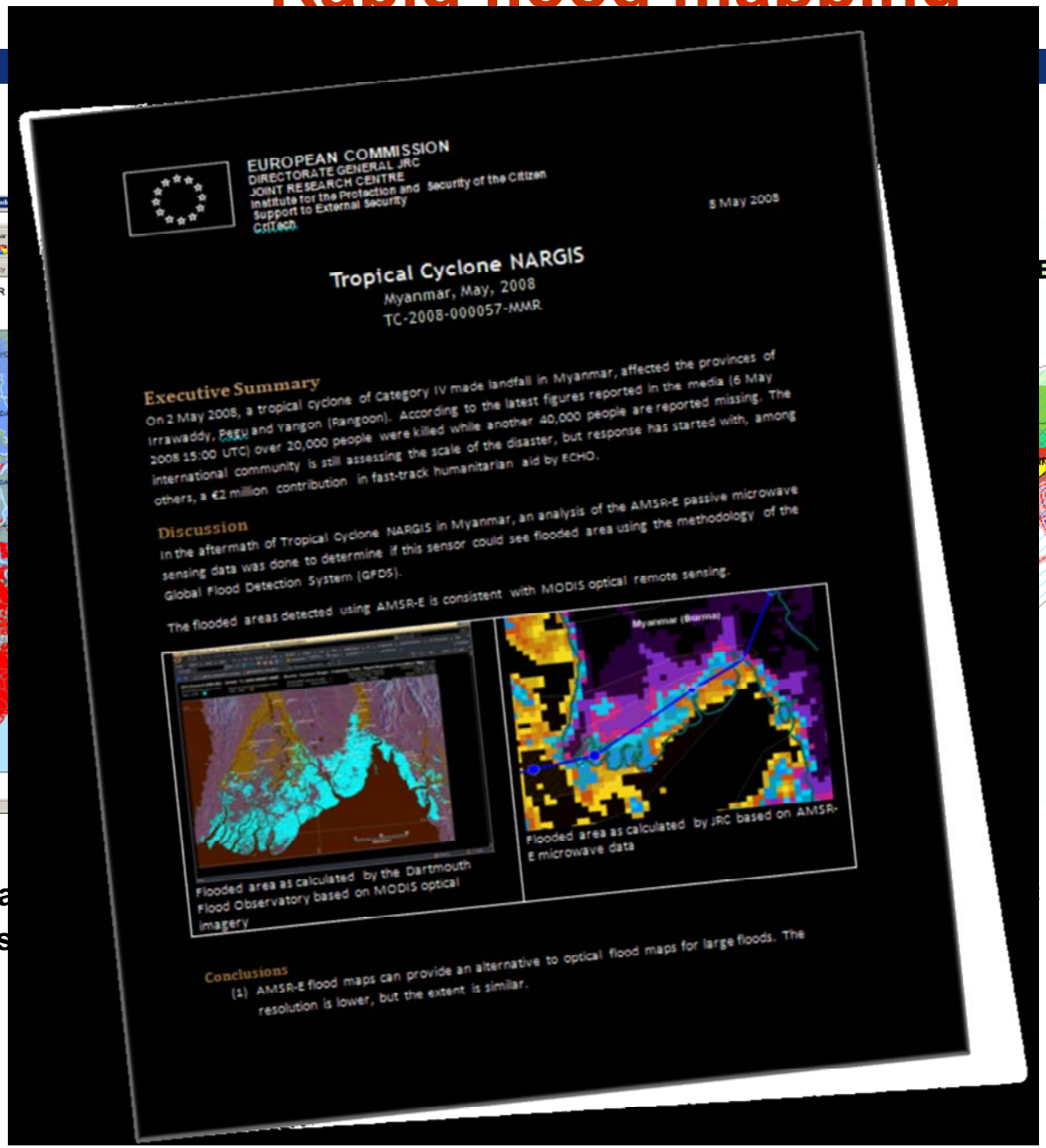
Brightness temperature (K)



Flood signal (M/C ratio)

Rapid flood mapping





EUROPEAN COMMISSION
DIRECTORATE GENERAL JRC
JOINT RESEARCH CENTRE
Institute for the Protection and Security of the Citizen
Support to External Security
CritTech

8 May 2008

Tropical Cyclone NARGIS

Myanmar, May, 2008
TC-2008-000057-MMR

Executive Summary

On 2 May 2008, a tropical cyclone of category IV made landfall in Myanmar, affected the provinces of Irrawaddy, Pegu and Yangon (Rangoon). According to the latest figures reported in the media (6 May 2008 15:00 UTC) over 20,000 people were killed while another 40,000 people are reported missing. The international community is still assessing the scale of the disaster, but response has started with, among others, a €2 million contribution in fast-track humanitarian aid by ECHO.

Discussion

In the aftermath of Tropical Cyclone NARGIS in Myanmar, an analysis of the AMSR-E passive microwave sensing data was done to determine if this sensor could see flooded area using the methodology of the Global Flood Detection System (GFDS).

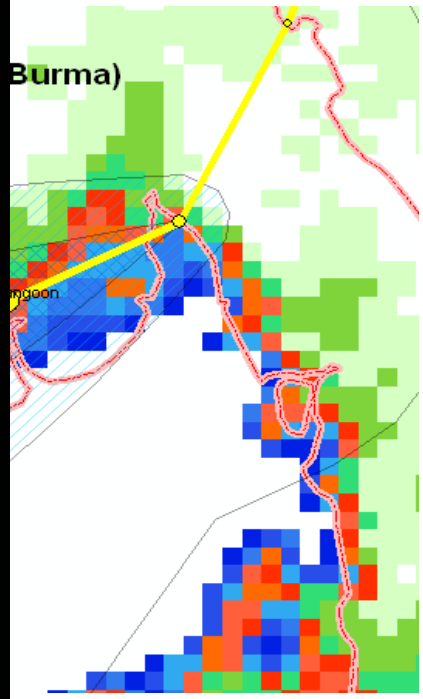
The flooded areas detected using AMSR-E is consistent with MODIS optical remote sensing.

Flooded area as calculated by the Dartmouth Flood Observatory based on MODIS optical imagery

Flooded area as calculated by JRC based on AMSR-E microwave data

Conclusions

(1) AMSR-E flood maps can provide an alternative to optical flood maps for large floods. The resolution is lower, but the extent is similar.

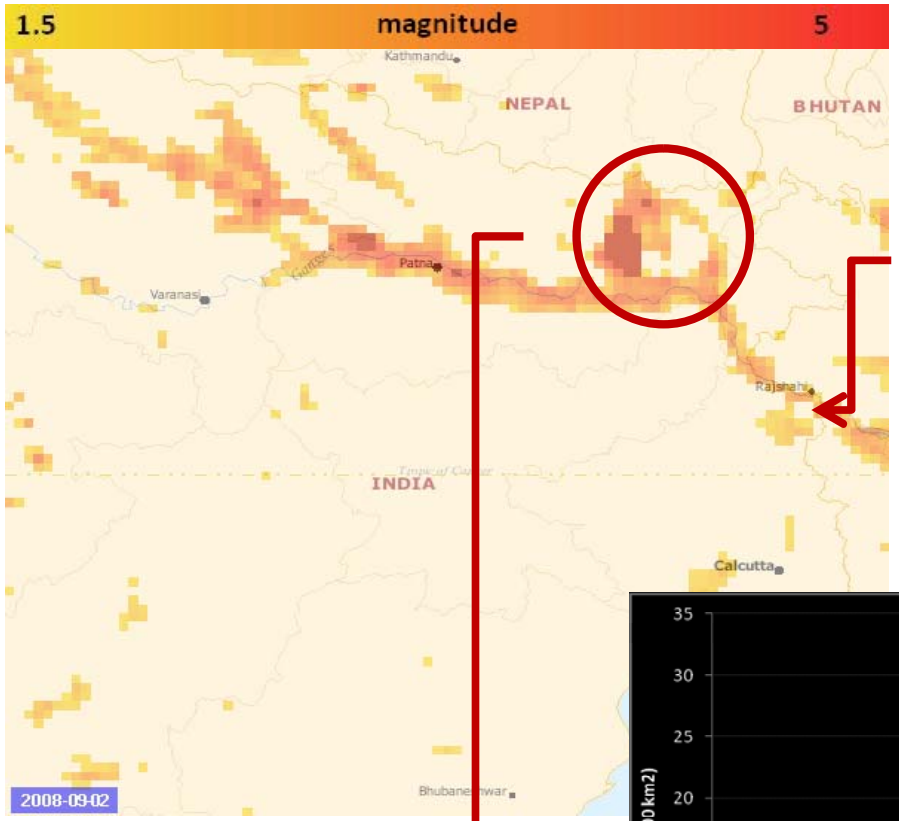


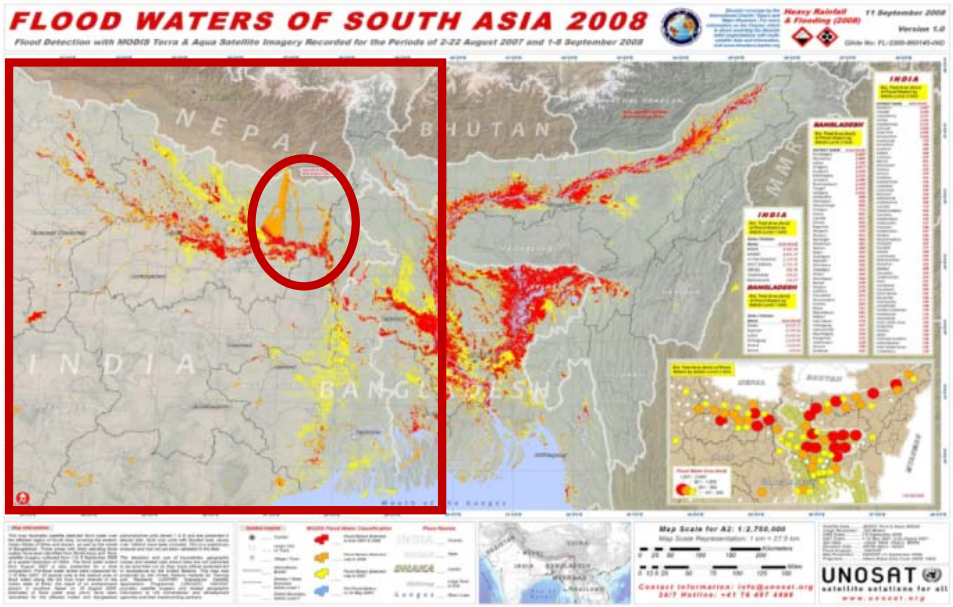
Flooded area ma

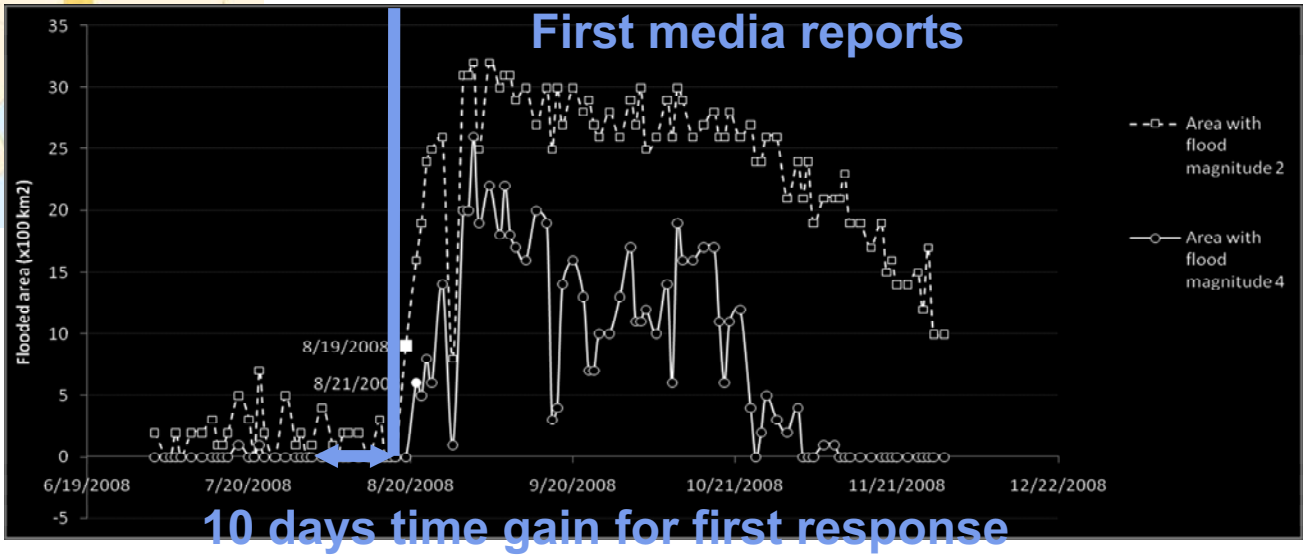
Observatory bas

based on AMSR-E

Map and observation site





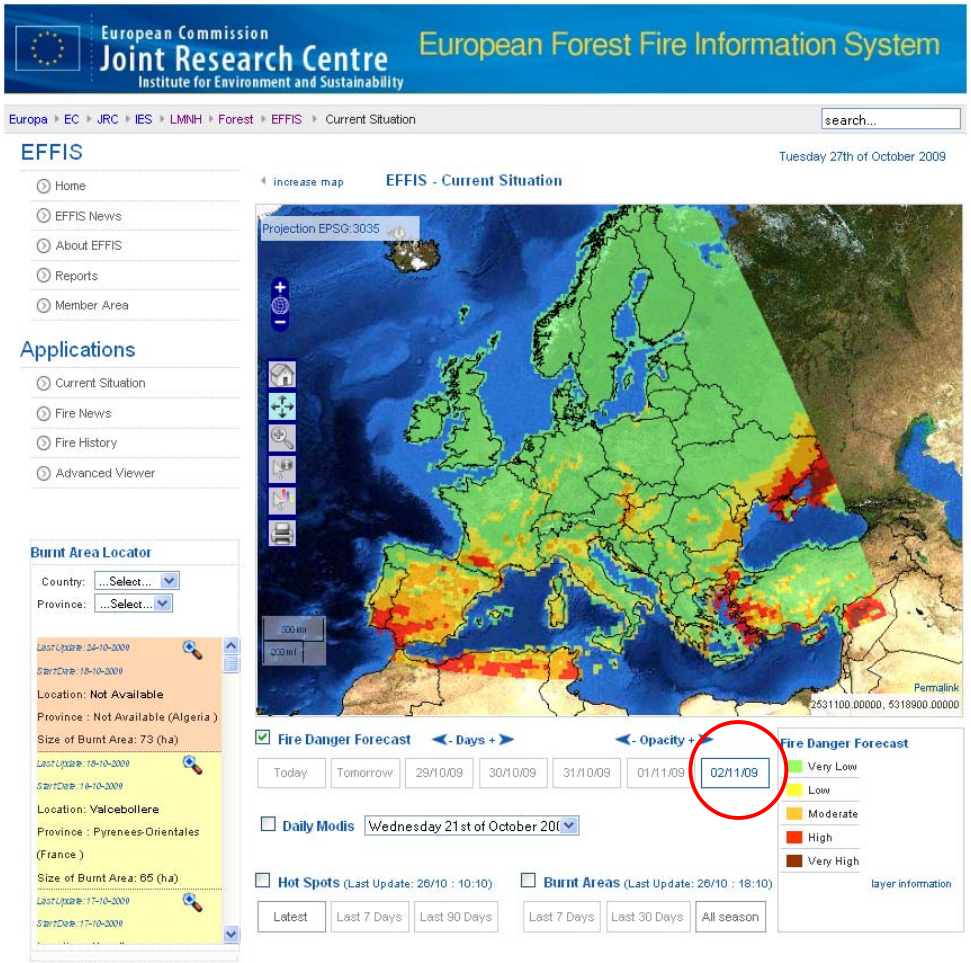


Forest Fires

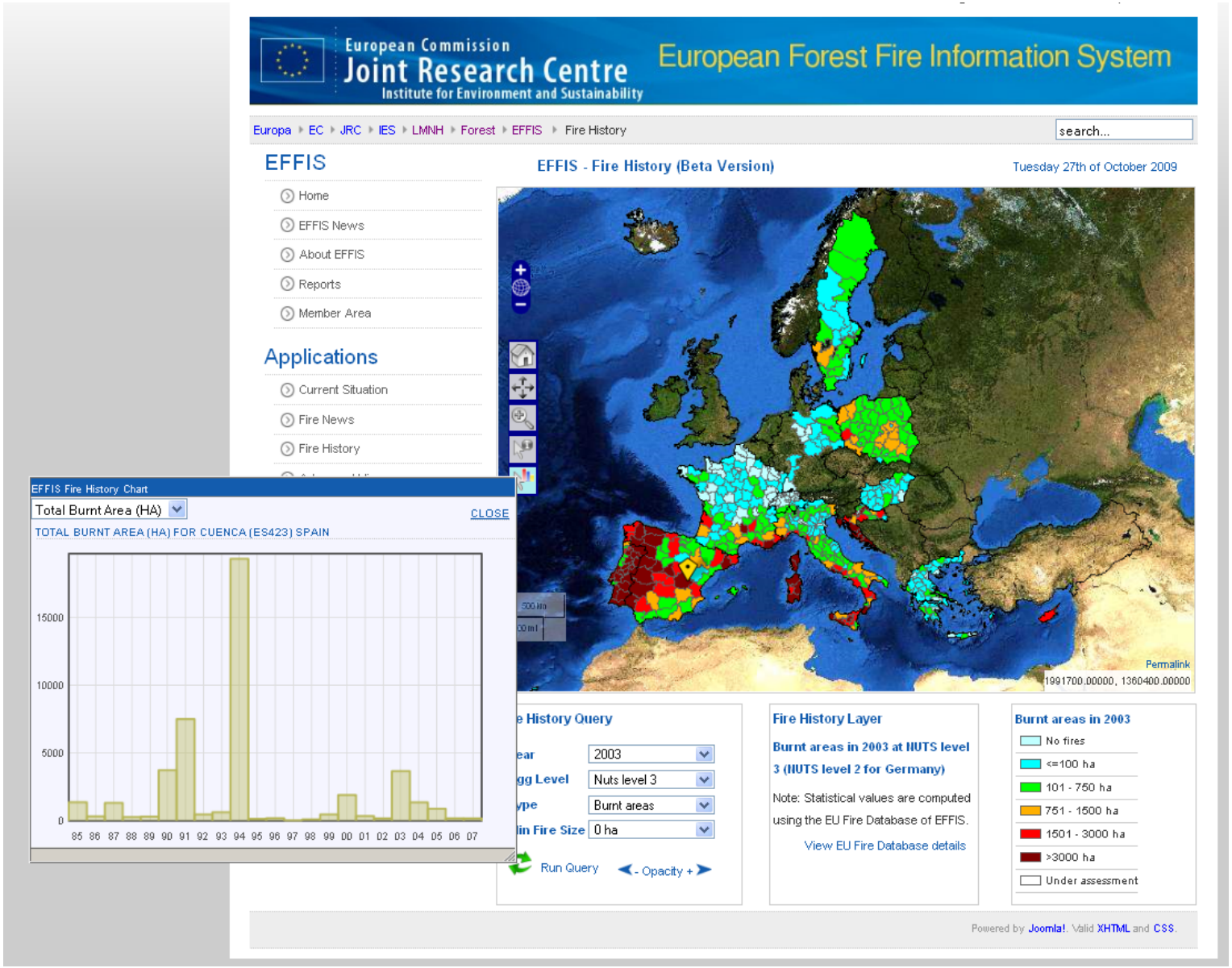
- The European Forest Fire Information System (**EFFIS**) supports the services in charge of the protection of forests against fires **in the EU and neighbour countries** and provides the European Commission services and the European Parliament with updated and reliable information on wildland fires in Europe.

- The most up to date information on the current fire season in Europe and in the Mediterranean area. This includes today meteorological fire danger maps and forecast up to **6 days**, daily updated **maps of burnt areas and damage assessment** derived from satellite imagery of the last **7 days**, maps of the latest **hot spots** and fire perimeters also updated daily.

Situation assessment (danger forecast, damage analysis)



GIS Tool for Forest Fires



Future plans

Earthquakes:

- Improve the vulnerability factor, including local effects and regional or municipal values, if available

Tsunami

- Completion of the vers. 2.0 of the scenario database, currently available in the Gulf of Cadiz

Tropical Cyclones

- Include inundation model for storm surge

Floods

- Forecasting: extend to worldwide coverage
- Detection: include additional sensors

Fires

- Fire risk assessment (including danger forecasting): EU and foreseen worldwide coverage.
- New modules on “socio-economic impact of fires” and “emissions and dispersion modeling” under development.

Conclusions

- **JRC has developed and is currently run several operational systems for Early Warning Systems**
  - GDACS system is used by more than 10000 users worldwide for earthquakes, tsunamis, volcanoes, tropical cyclones and flood *detection*
  - EFAS system is serving European Member States authorities with 10 days flood *forecasting*. Currently plans to extend to other world areas
  - Global Flood ***Detection*** System can already be used on a large scale
  - EFFIS system is currently forecasting Forest Fire Danger and assessing forest damages for European and neighbour countries
- **Plans are ongoing to improve the tools in several areas**
- **Data, methodologies and products exchange with other organizations would be highly beneficial**