Learning from EFAS to develop European Flash Flood Early Warning capacity

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European Commission - Joint Research Centre

EFAS – a success story for research

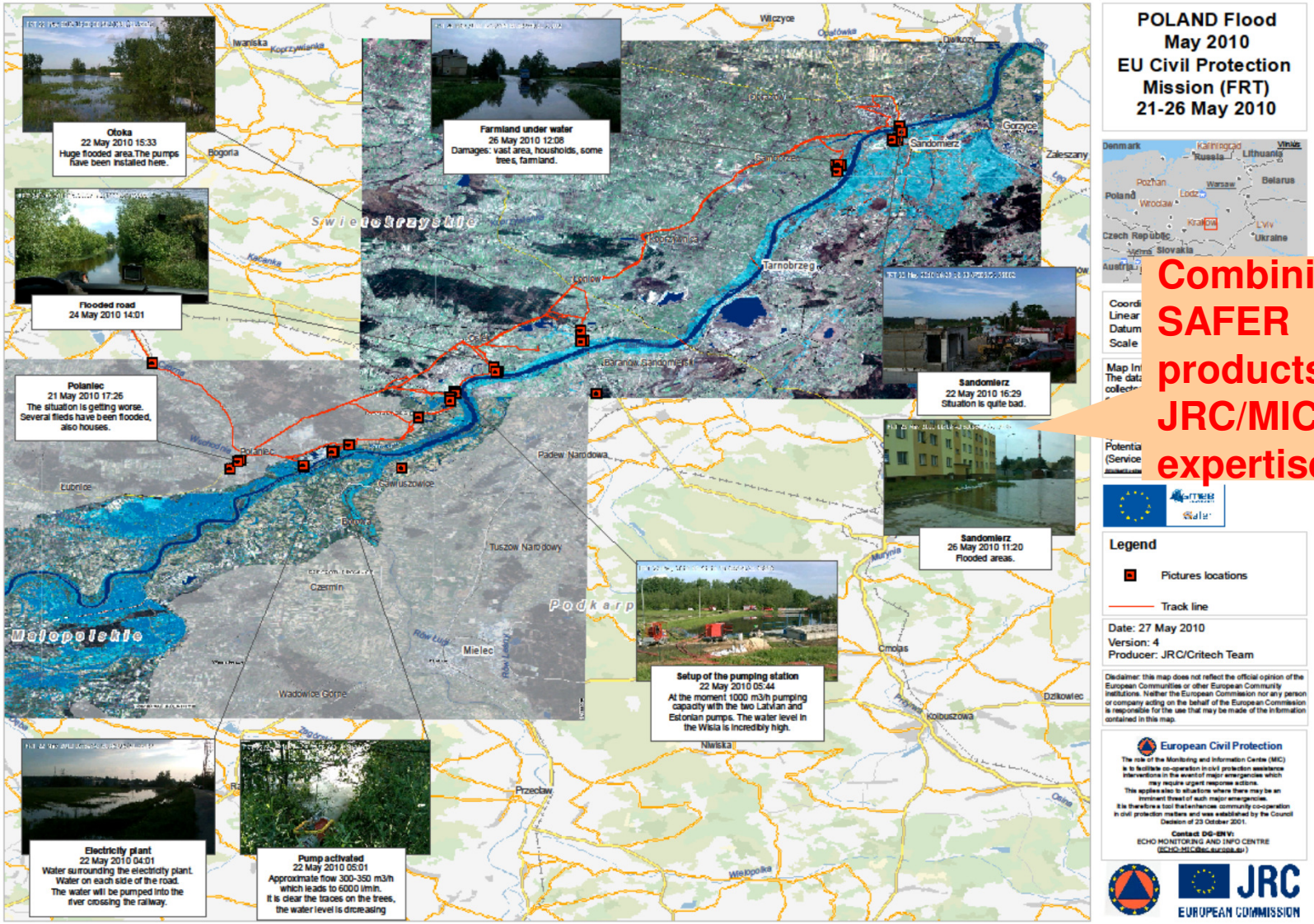
- 1999-2002 European Flood Forecasting System (EFFS) DG RTD FP5
- 2003 Launch of the development of a European Flood Alert System
  - » Building up a partner network
  - » Adapting and improving the EFFS based system for operational flood forecasting across Europe
  - » Collect real-time and historic data from meteorological and hydrological stations (EU-FLOOD-GIS and ETN-R)
  - » Research on hydrological ensemble forecasting, post-processing, exploration, visualization, collaboration with scientific community
- 2005 Start of pre-operational dissemination of results to partners
- 2007 Launch of web-interface for partners
- 2010 EFAS information to National Civil Protection through the MIC
- 2011 EFAS adopted as GMES Emergency Response Service
- 2012 Transfer from research to operations within MS organizations
  - » DISS (SE, SK, NL), COMP (ECWMF), HYDRO (ES)

GMES Emergency Response Service (ERS)

To provide reinforced European monitoring and Earth Observation capacity to support Emergency Response to crisis within and outside Europe

- Natural disasters : floods, fires, earthquakes, landslides, volcanic eruptions, tsunamis, storms…
- Man-made disasters : industrial and chemical hazards
- Humanitarian crisis

Poland floods May-June 2010



POLAND Flood
May 2010
EU Civil Protection Mission (FRT)
21-26 May 2010

Combining SAFER products and JRC/MIC expertise

Legend

- Pictures locations
- Track line

Date: 27 May 2010
Version: 4
Producer: JRC/Critech Team

European Civil Protection

The role of the Monitoring and Information Centre (MIC) is to facilitate co-operation in civil protection assistance interventions in the event of major emergencies which may require urgent response actions.
This applies also to situations where there may be an imminent threat of such major emergencies.
It is therefore a tool that enhances community co-operation in civil protection matters and was established by the Council Decision of 23 October 2001.

Contact DG-ENV:
ECHO MONITORING AND INFO CENTRE
(ECHO-MIC@ec.europa.eu)

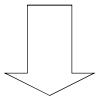
JRC
EUROPEAN COMMISSION

Early Warning Systems at EU level

- for preparedness a EU level Civil Protection mechanism
- for cross-border disasters (e.g. floods)
- for *anticipating activations of GMES Emergency response service* (e.g. SAFER)
- complementary to national Early Warning Systems,though it is not an alternative

Parallels between EFAS & flash flood early warning systems

EFAS	IMPRINTS
Lack of data for calibration and validation	Many catchments are ungauged
River geometries and structures mostly not known	Flash floods can happen anywhere, unknown terrain
Reservoir operations not known	Reservoir operations not known
NWP rainfalls become increasingly uncertain from day 3 onwards	NWP of convective rainfalls leading to flash floods highly uncertain



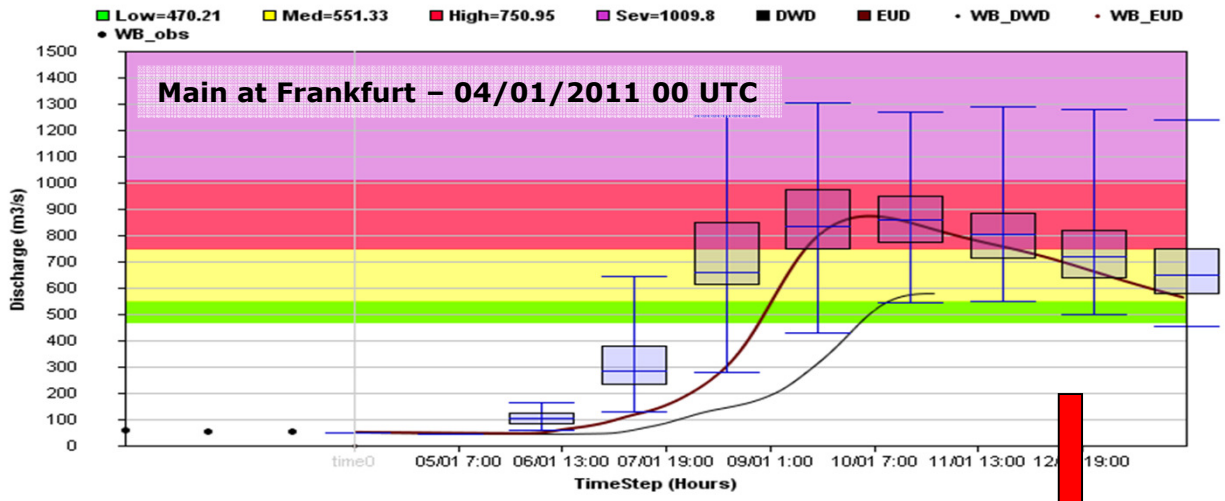
Can we transfer concepts from EFAS to flash flood application?

Riverine floods – developing within a few days – time scale of several days

Elbe, 2002. © UFZ, Potsdam

European Flood Awareness System

Hydrological modeling



DATA

Real-time data (EU-FLOOD-GIS/ETN-R)

Historical Data

Static Data

Europ. Data Layers

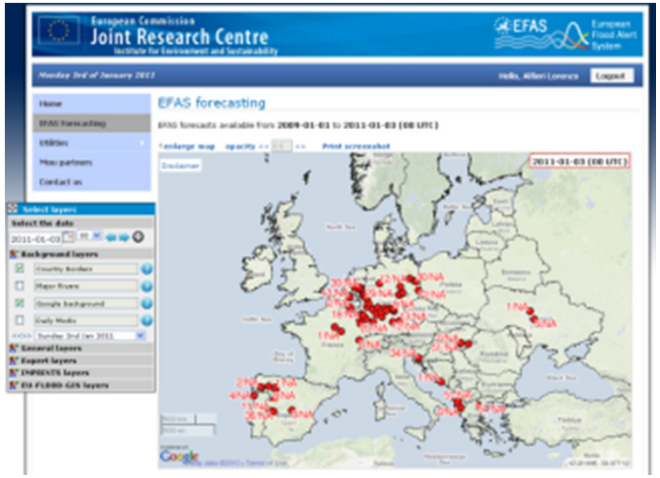
Meteo -Data

Expert Knowledge of Member States

EFAS partner network

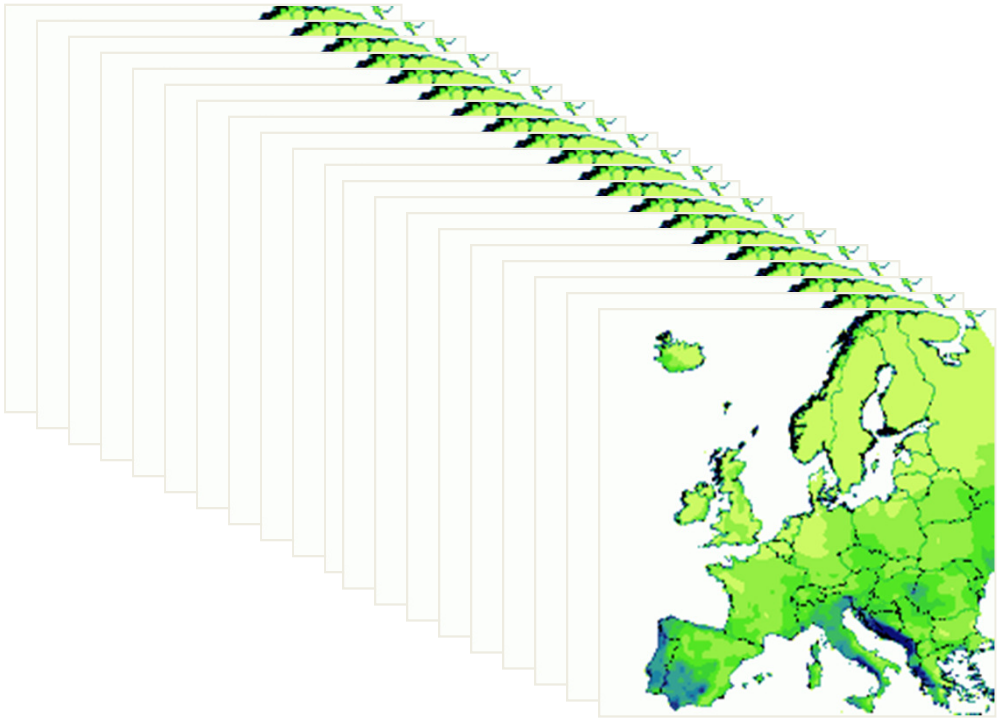
Alert email

EFAS user interface



Weather forecasts

122 weather forecasts daily



Deterministic forecasts:

ECMWF (10 days, 25 km grid, 00 and 12 UTC)

DWD(7 days, 7 km grid, 00 and 12 UTC)

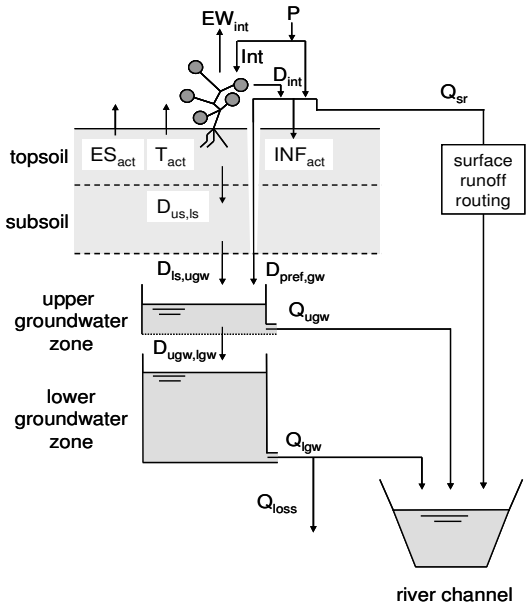
Ensemble forecasts:

ECMWF-VAREPS (10 days, 51 members, 32 km grid, 00 and 12 UTC)

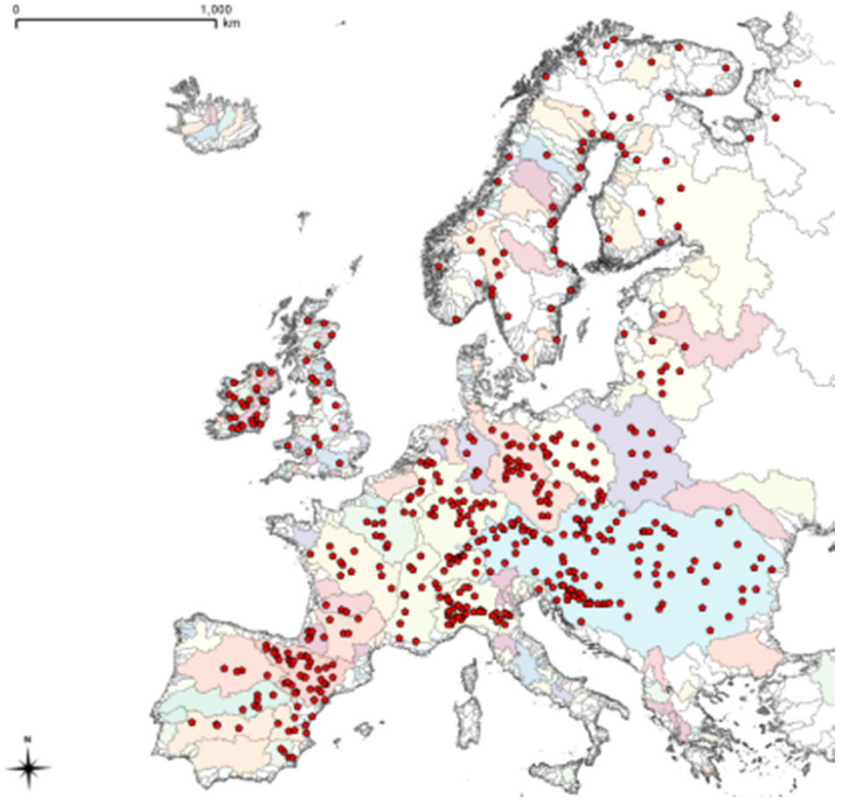
COSMO-LEPS (5.5 days, 16 members, 7 km grid, 12 UTC)

Multi-model input improves the evaluation of the uncertainty

Hydrological modeling



LISFLOOD: Physically based, distributed rainfall-runoff-routing model



Latest calibration in Nov-2011:

- 481 station used
- 9 parameters
- Up to 7 years of daily data

Grid resolution: 5 km

Temporal resolution: 6 hours

Flash floods – developing within a few hours – time scale ~1 day

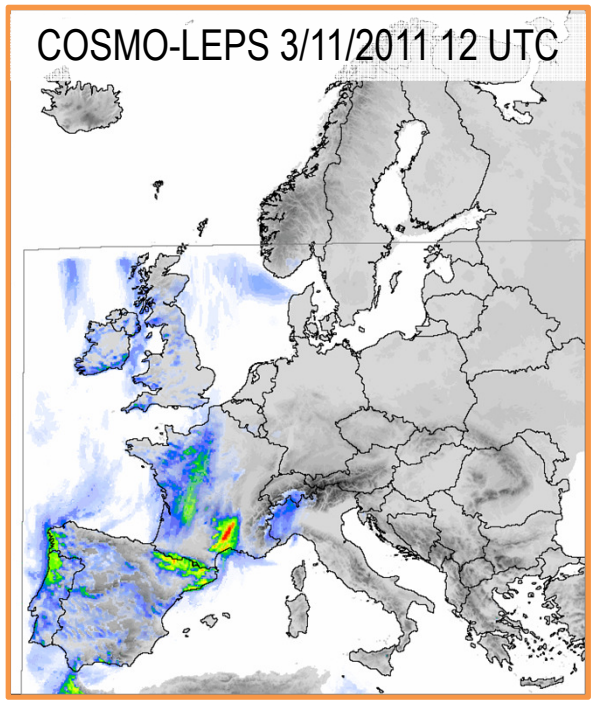
Regional flash flood early warning system

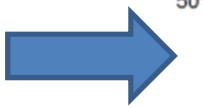
1st step: Use of a simple indicator to predict extreme rain-storms potentially leading to flash floods

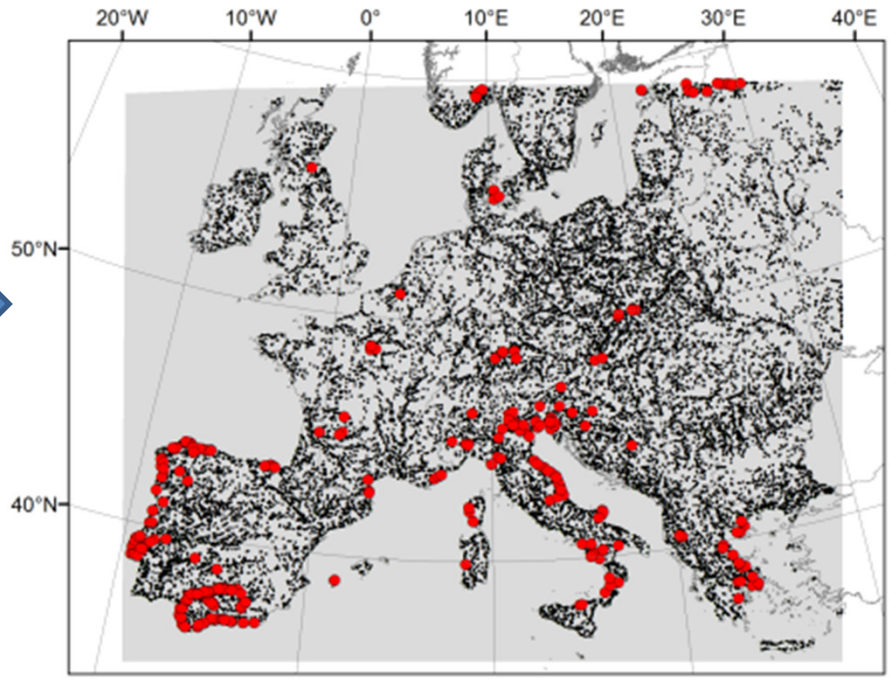
EPIC - European Precipitation Index based on simulated Climatology (Alfieri *et al*., 2011, 2012)

42 confirmed events between 12/2009 and 9/2011

- Average forecast lead time: **32 hours**
- > **50%** of alerts in catchments smaller than **300 km²**

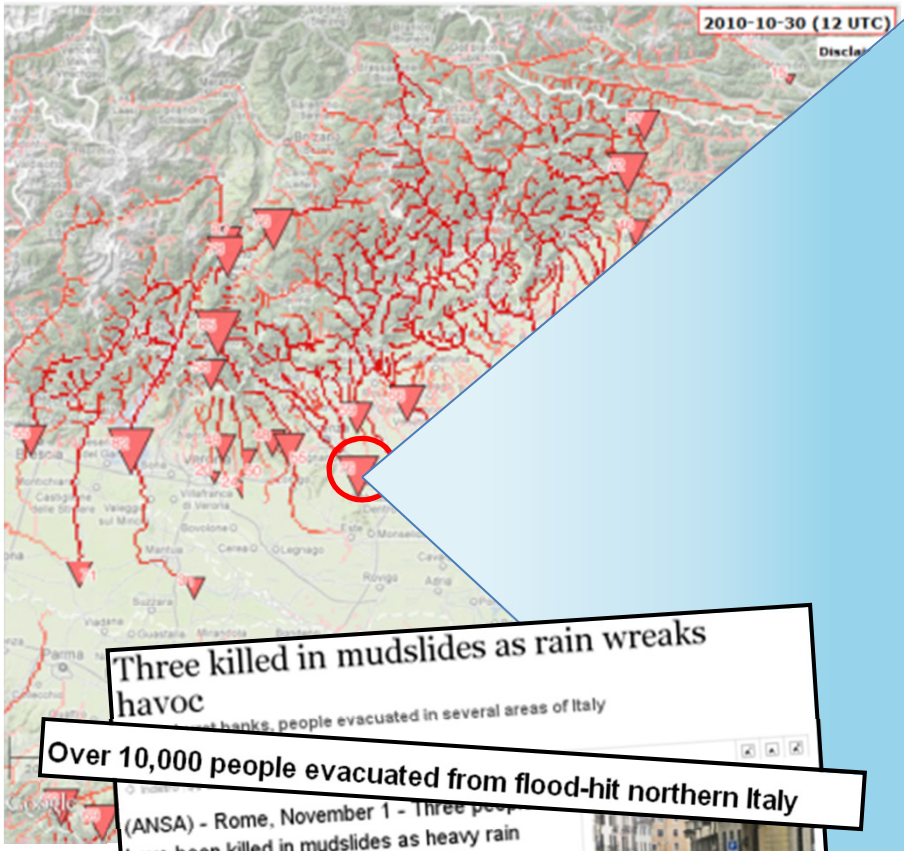






EPIC for flash flood detection

EPIC time plot for COSMO-LEPS forecast on 30/10/2010 12 UTC, for the north-western Italy.



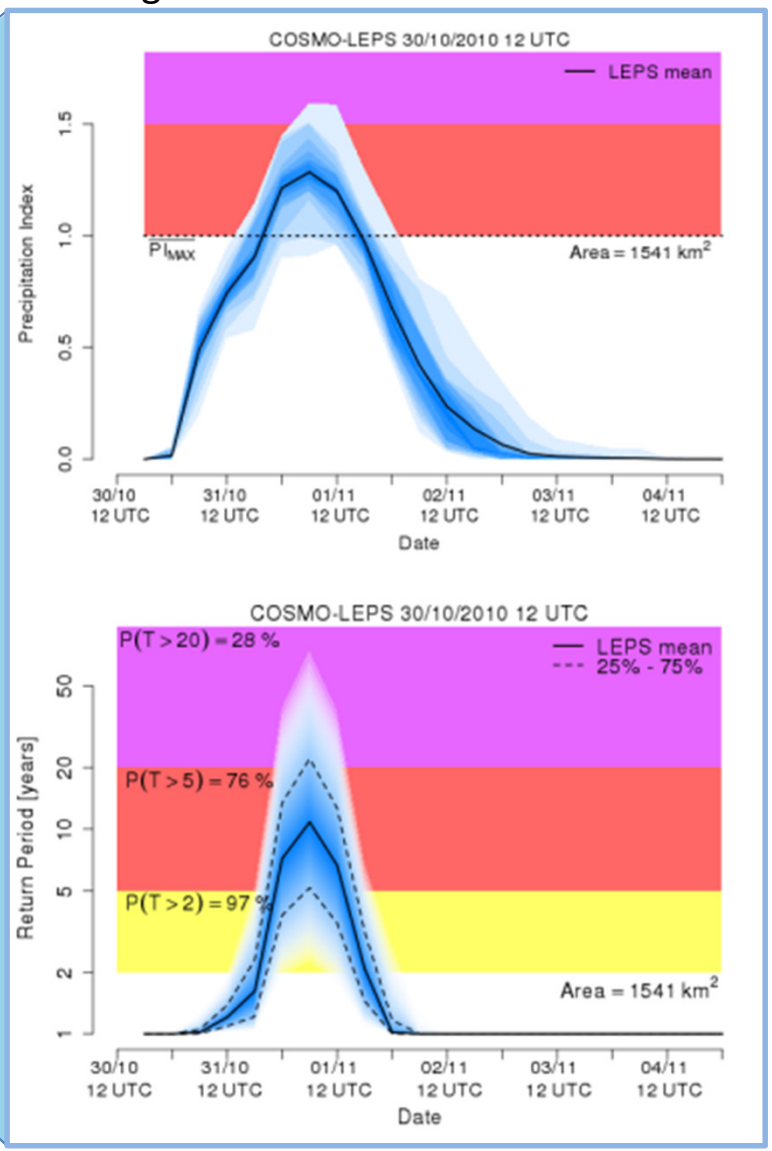
Three killed in mudslides as rain wreaks havoc

Over 10,000 people evacuated from flood-hit northern Italy

(ANSA) - Rome, November 1 - Three people have been killed in mudslides as heavy rain wreaked havoc in northern and central Italy for a third day on Monday.

A 39-year-old mother and her two-year-old son died when a mudslide hit their home near the Tuscan town of Massa Carrara Sunday night and a 38-year-old man was killed after another landslide hit a nearby village.

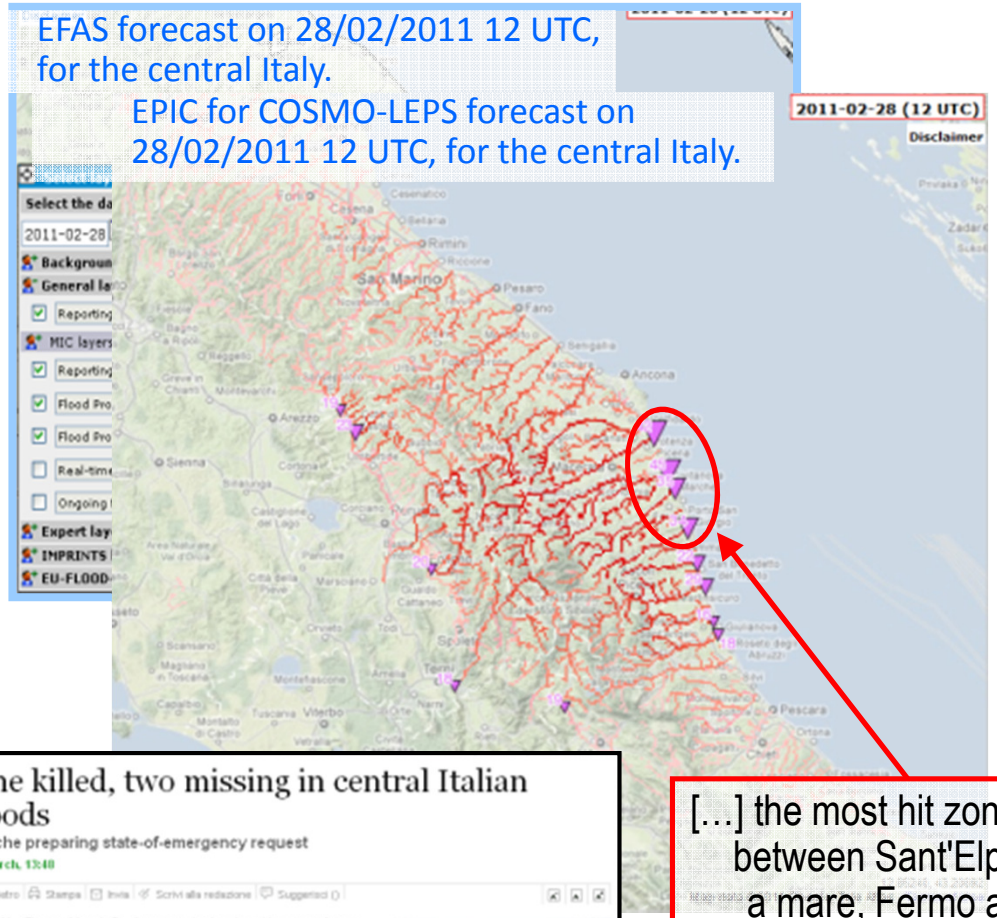
Bacchiglione River near Padova

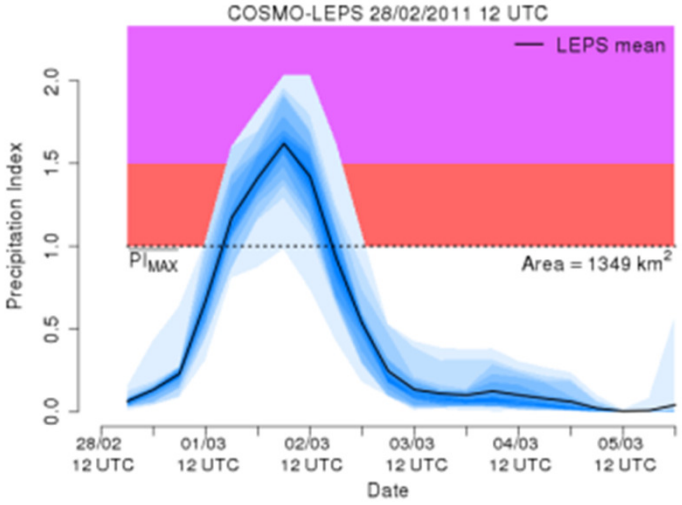


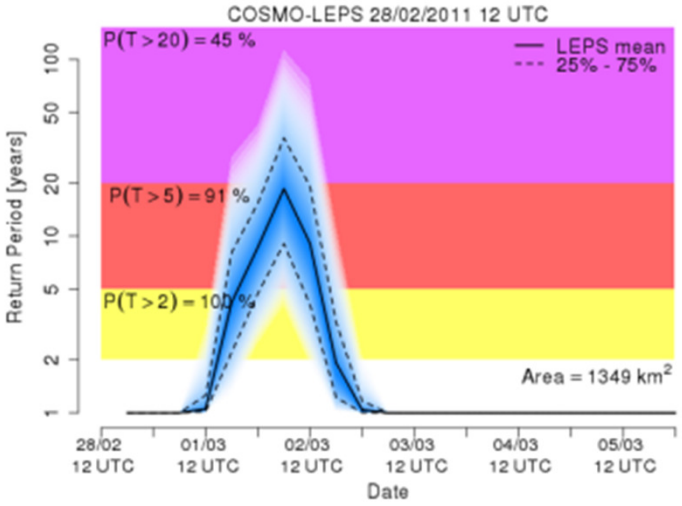
EPIC for flash flood detection

EFAS forecast on 28/02/2011 12 UTC, for the central Italy.

EPIC for COSMO-LEPS forecast on 28/02/2011 12 UTC, for the central Italy.







One killed, two missing in central Italian floods

Marche preparing state-of-emergency request

02 March, 13:40

(ANSA) - Rome, March 2 - A woman is dead and two people are missing after the central Adriatic Marche region was battered by flooding in the night, prompting the regional government to prepare a request for the declaration of a state of emergency.

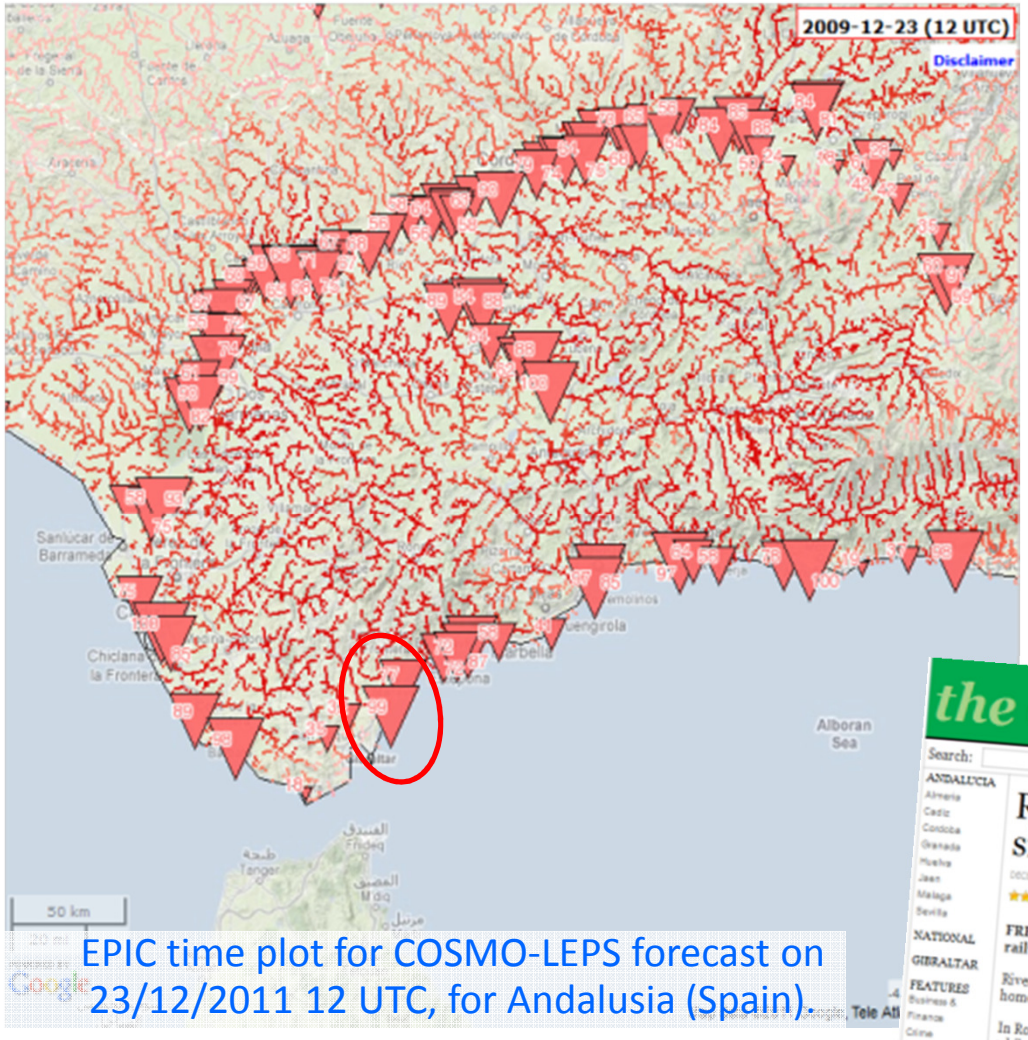
The dead woman is an 85-year-old who seems to have drowned after falling into a river at Venarotta near Ascoli Piceno as the region suffered gale-force winds and its most intense rainfall in 40 years.

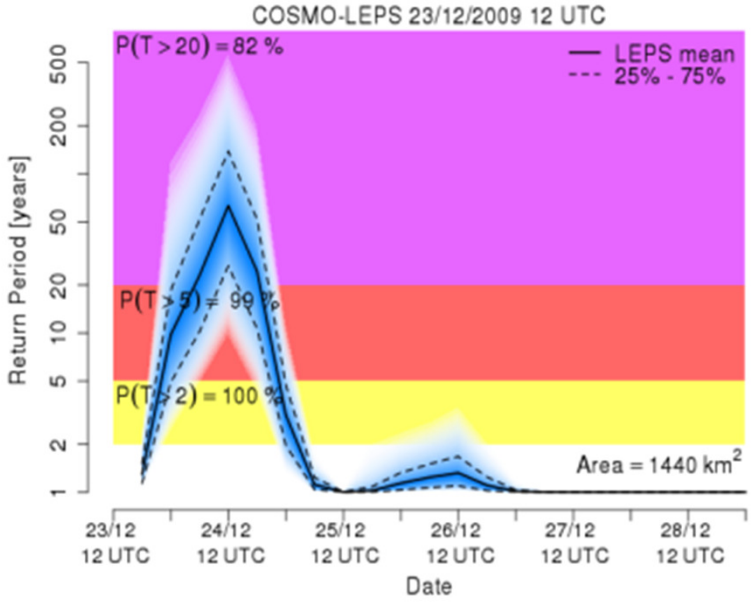
Her body was found by firefighters after her daughter raised the alarm when she failed to return from Mass on Tuesday evening.

[…] the most hit zone, between Sant'Elpidio a mare, Fermo and Ascoli Piceno […]

[…] the region suffered its most intense rainfall in 40 years […]

Andalusia – 24th December 2009





EPIC time plot for COSMO-LEPS forecast on 23/12/2011 12 UTC, for Andalusia (Spain).

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Record rainfall sees worst floods since 1940s

(11 votes, average: 4.45 out of 5)

FREAK flooding has led to the closure of hundreds of roads and railways around Andalucia.

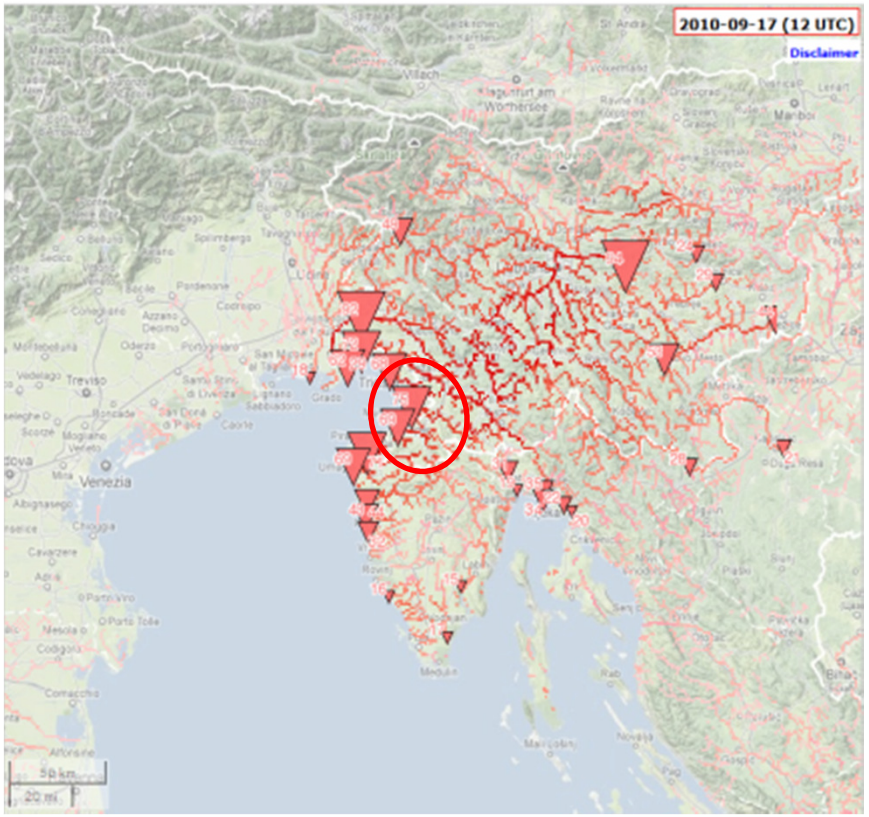
Rivers burst their banks in many parts of the region, leading to hundreds of homes being flooded over the Christmas period.

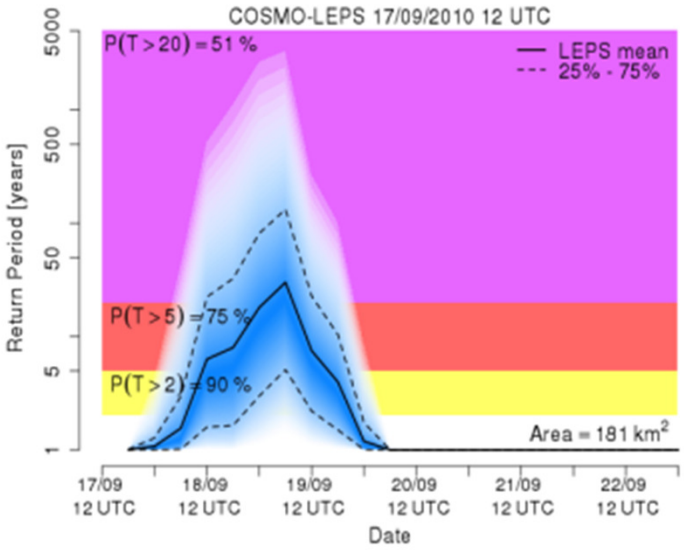
In Ronda a number of horses were allegedly swept to their death at La Indiana, while a horse was also killed when a river flooded in Setenil.

Dozens of homes were flooded in the La Indiana and Llano de la Cruz areas of Ronda, as well as in nearby Benaoján and Jimera de Líbar.

Photograph by Karl Smallman

Slovenia – 18th - 19th September 2010





2010 Slovenia floods

From Wikipedia, the free encyclopedia

The **2010 Slovenia floods**, on the weekend of 17–19 September 2010, were caused by heavy rains in Slovenia, resulting in one of the worst floods in the country's history. Among the regions affected were the capital Ljubljana, the Zasavje region, Laško, the Slovenian Littoral and the Lower Carniola region.[1][2][3] Initial damage was estimated to reach €15 million.[4] Three people were killed.[1][2]

In Ljubljana, the river Gradaščica – together with the Mali graben stream – flooded several parts of the Vič Community Quarter, and record water levels were reached.[5][7][8] Several transformers were shut down to prevent accidents, leaving some 3,000 people without electricity.[9]

In Zagorje ob Savi, a great part of the town was flooded by the Sava river and several landslides were reported.[10][6]

The town of Laško was flooded by the Savinja river and road connections were cut by the flood waters.[11][12]

In the Littoral region, the Rižana and Dragonja rivers flooded several roads, closing all three border crossings with Croatia in the region. Parts of Portorož Airport and the Sečovlje salt fields were flooded as well.[11] Vipava river was flooding in the northern Littoral.[6]

The Sava, Krka and Kolpa rivers flooded in the Lower Carniola. The towns of Krško, Brežice and Otočec were partially flooded.[6]

In Upper Carniola, the town of Žiri was affected by Poljanska Sora. In Železniki, a town that was most affected in the floods exactly three years before,[12] no bigger problems were reported.[13]

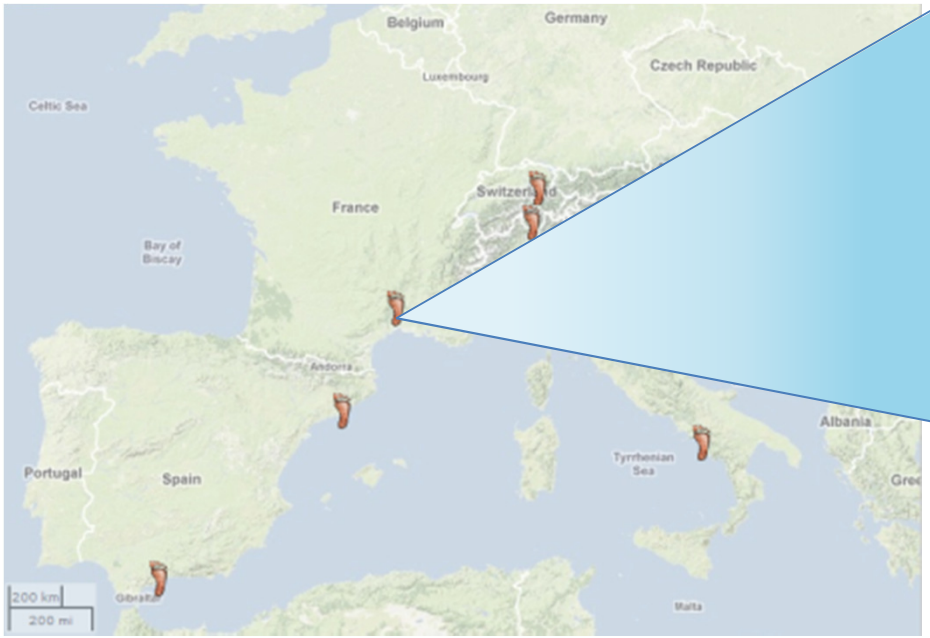
Some parts of Croatia along the Sava river were also flooded,[14] around 20 people were evacuated around Zagreb.[15]

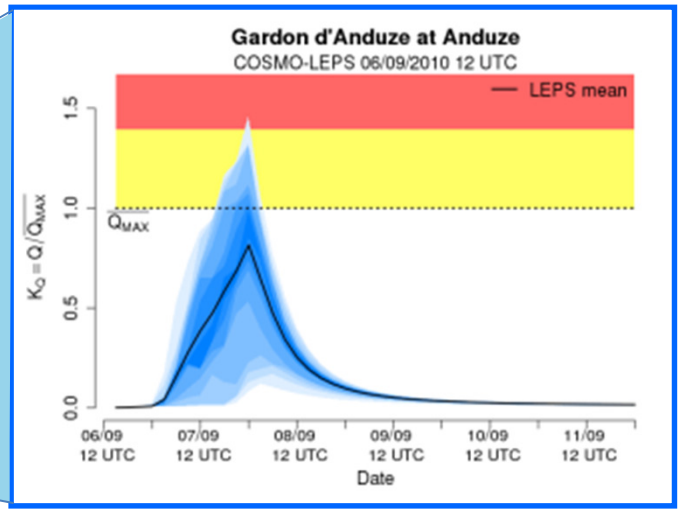
By Monday, 20 September, the water levels began to decrease, although landslides in some regions remained a threat.[16] Four days after the flooding, the area of Dobrepolje municipality was still 6 meters above the usual water-level.[17]

Regional flash flood early warning system

Testbed	Country	Outlet	Upstream area [km^2]
Gardon d'Anduze	France	Anduze	550
Guadalhorce	Spain	Cartama	2931
Linth	Switzerland	Mollis	600
Llobregat	Spain	Sant Joan Despì	4880
Sele	Italy	Ponte Barizzo	3235
Verzasca	Switzerland	Lavertezzo	186

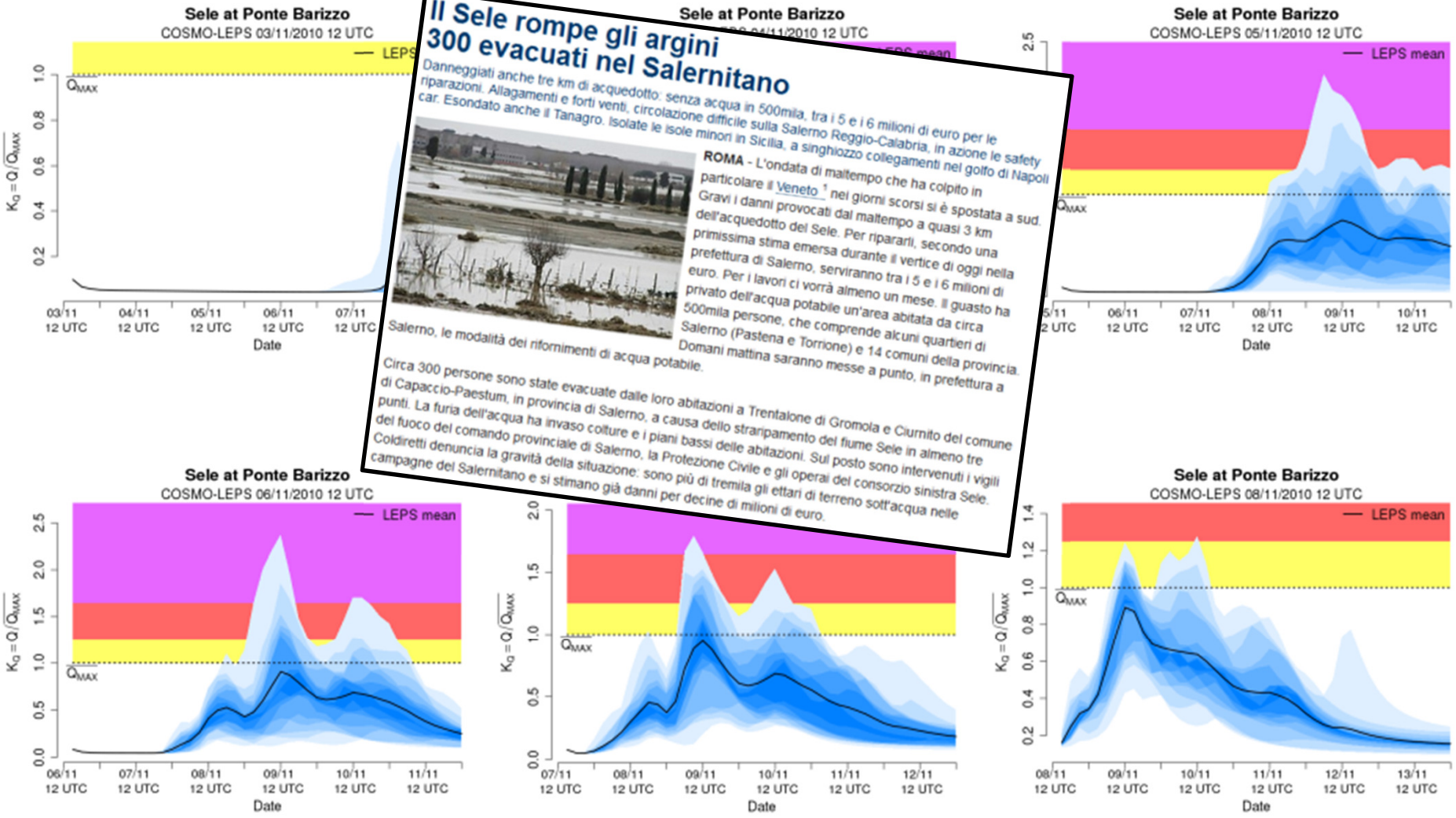
2nd step: Exploring ensemble streamflow forecast for IMPRINTS testbeds





1 km grid size
3-hour time step

An example – Sele 10/11/2010



Il Sele rompe gli argini 300 evacuati nel Salernitano

Danneggiati anche tre km di acquedotto: senza acqua in 500mila, tra i 5 e i 6 milioni di euro per le riparazioni. Allagamenti e forti venti, circolazione difficile sulla Salerno Reggio-Calabria, in azione le safety car. Esondato anche il Tanagro. Isolate le isole minori in Sicilia, a singhiozzo collegamenti nel golfo di Napoli

ROMA - L'ondata di maltempo che ha colpito in particolare il Veneto [1] nei giorni scorsi si è spostata a sud. Gravi i danni provocati dal maltempo a quasi 3 km dell'acquedotto del Sele. Per ripararli, secondo una primissima stima emersa durante il vertice di oggi nella prefettura di Salerno, serviranno tra i 5 e i 6 milioni di euro. Per i lavori ci vorrà almeno un mese. Il guasto ha privato dell'acqua potabile un'area abitata da circa 500mila persone, che comprende alcuni quartieri di Salerno (Pastena e Torrione) e 14 comuni della provincia. Domani mattina saranno messe a punto, in prefettura a Salerno, le modalità dei rifornimenti di acqua potabile.

Circa 300 persone sono state evacuate dalle loro abitazioni a Trentalone di Gromola e Ciurnito del comune di Capaccio-Paestum, in provincia di Salerno, a causa dello straripamento del fiume Sele in almeno tre punti. La furia dell'acqua ha invaso colture e i piani bassi delle abitazioni. Sul posto sono intervenuti i vigili del fuoco del comando provinciale di Salerno, la Protezione Civile e gli operai del consorzio sinistra Sele. Coldiretti denuncia la gravità della situazione: sono più di tremila gli ettari di terreno sott'acqua nelle campagne dei Salernitano e si stimano già danni per decine di milioni di euro.

Conclusions

- A research project such as IMPRINTS can develop into successful operational systems (e.g. EFFS – EFAS)
- Partner networks between different end-users, researchers and operational services are essential
- IMPRINTS shows great potential for improving early warning capability for flash floods through the concept of forecasting chain using models and data at different space-time scales
- Potential of extending IMPRINTS testbed studies to regional scales, e.g. Mediterranean

More information:

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

http://efas-is.jrc.ec.europa.eu/

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