



The wettest summer – heavy rainfall events of 2007
and other large scale flooding events

Development of the European Flood Awareness System

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With contributions the Environmental forecasts team and
colleagues from the JRC



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414mm rainfall (average England Wales) from May to July 2007
Wettest summer since records began 1766

4X average June rainfall in parts North York moors and South Pennines

30,000 people had to leave their home in hull

40,000 people lost power in Sheffield (substation inundated)

> 55,000 homes and businesses affected across the country

7,000 people were rescued

800 properties flooded in Tewkesbury

13 people died

£4bn losses, including ~ £3bn insurable



UK RAINFALL
% of monthly

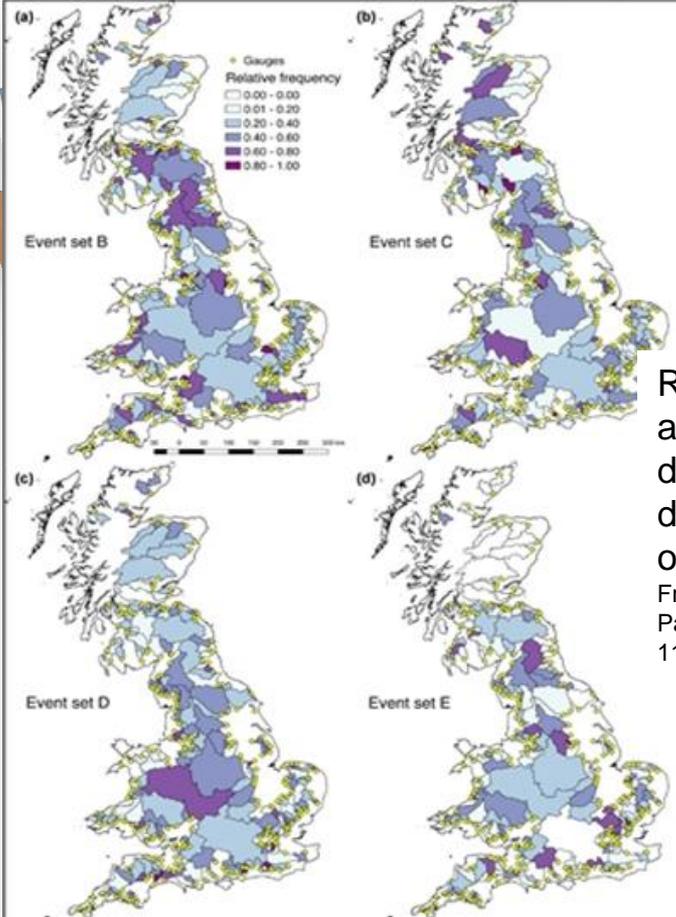


and July
Environment Agency

Source: Environment Agency



...not a unique event....



CHRISTMAS WEATHER ALERT: Britain to face the WORST Xmas floods for 15 years

MS threaten to batter Britain for the next fortnight as forecasted Xmas floods for two years.

HAN RAO
 PUBLISHED: 00:00, Fri, Dec 11, 2015 | UPDATED: 20:31, Fri, Dec 11, 2015

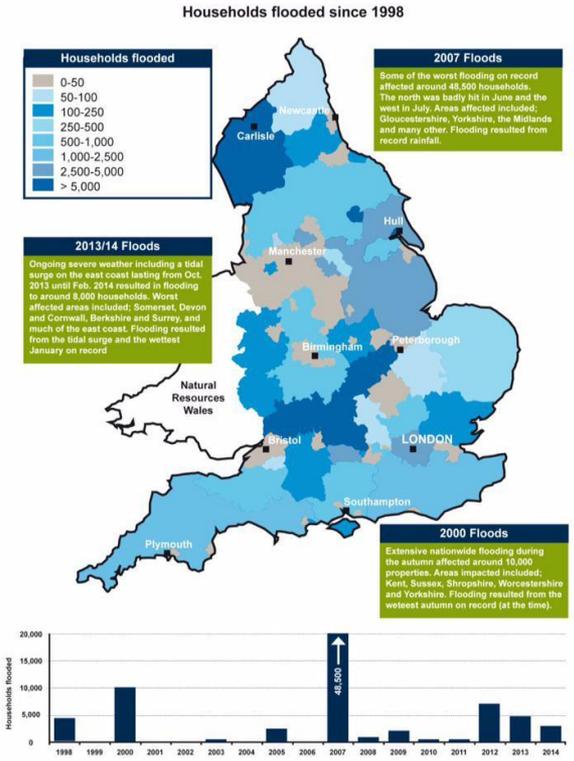
Relative frequency for peak flow annual maxima to occur together; derived from observations; the darker the colour, the most occurrence.

From Paolo De Luca et al 2017 Environ. Res. Lett. 12 114009 doi:10.1088/1748-9326/aa868e



has been battered by floods

Figure A1 Households flooded since 1998



John Curtin, executive Director of Flood & Coastal Risk Management, Environment Agency



... and not unique in Europe...



Dresden, 2002

BBC NEWS

You are in: World: Europe
Thursday, 15 August, 2002, 16:46 GMT 17:46 UK

News Front Page World

Floods wreak havoc in Germany



FLOOD IMPACT

European havoc

- ▶ Flood lessons
- ▶ In pictures
- ▶ Art saved
- ▶ Slovakia's relief

Germany ravaged

- ▶ Footing the bill
- ▶ Dresden's treasures

Prague drama

- ▶ Czechs warned
- ▶ Flight before the flood
- ▶ A seal's odyssey

Freak phenomenon?

- ▶ What's behind storms
- ▶ The El Nino factor
- ▶ Flash floods

FORUM

- ▶ The BBC's Michael Fish took your questions

TALKING POINT

- ▶ Are you affected?

Some parts of Dresden can barely be seen

A dam has burst in south-eastern Germany as flood waters sweep northwards from the Czech Republic, spreading chaos in Europe's worst floods for more than a century.

The dam at Bitterfeld collapsed around midday, sending the Mulde River cascading towards the town, whose 16,000 inhabitants are being urgently evacuated.

A large chemical plant at Bitterfeld is unlikely to be flooded, the authorities say, but there are fears of environmental damage after a chlorine gas leak from a Czech plant near the German border.

▶ Click here to see a map of the region

The swollen Elbe is surging towards Dresden,

Vltava, Pr...

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Environment

Death toll from floods nears 100

Susie Steiner

Mon 19 Aug 2002 14.27 BST

The towns of Bitterfeld and Wittenberg in Germany suffered continued flooding this morning as the rivers Elbe and Mulde burst their banks.

In the eastern town of Wittenberg seven dykes burst along the Elbe in the early hours of this morning. "Vast amounts of water are flooding into the city," a spokesman for Wittenberg rescue workers told Reuters. "We are evacuating nearby areas."



... with devastating impacts...



3 large rivers: Vltava, Elbe, Danube
9 countries: Czech Republic, Slovakia, Italy, Germany, Romania, Austria, Hungary, Serbia, Turkey

July 1997

3 countries: Czech Republic, Poland, Germany

~25bn€ Losses

Millions €

~4.5bn€ Losses

106 killed

54 killed



Flooding in central Europe, August 2002

June 2009

9 countries: Czech Republic, Poland, Slovakia, Austria, Hungary, Germany, Romania, Serbia, Turkey

33 killed

Losses: more than €3bn

Ten dead in Czech floods, central Europe on alert

NOVY ZDOK, Czech Republic (Reuters) - At least 10 people died in flooding in the western Czech Republic, and rising river levels prompted flood warnings across central Europe following heavy rains this week.

SOURCE: MUNICH RE., FEDERATION.

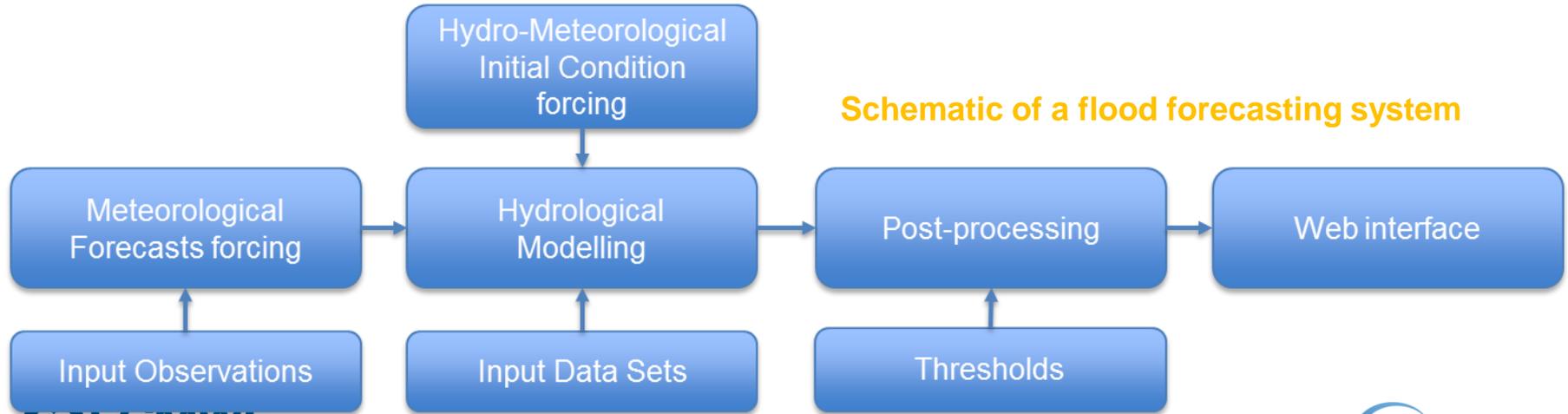


Impacts

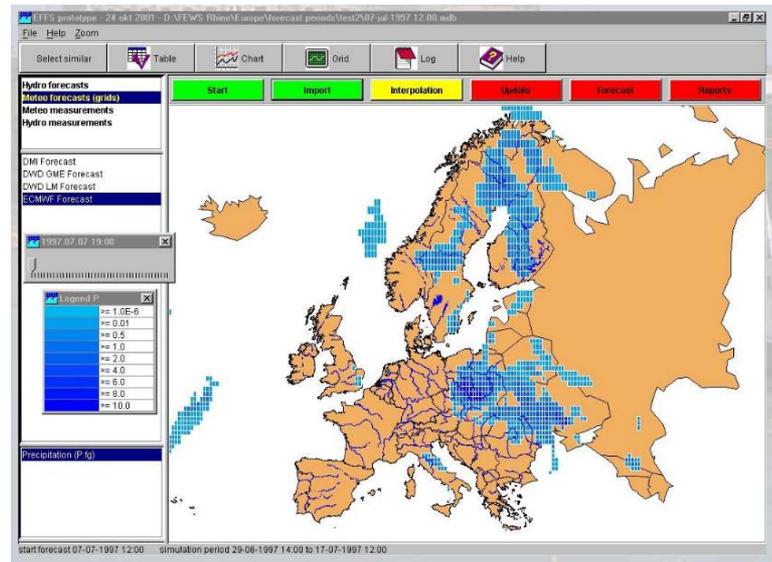
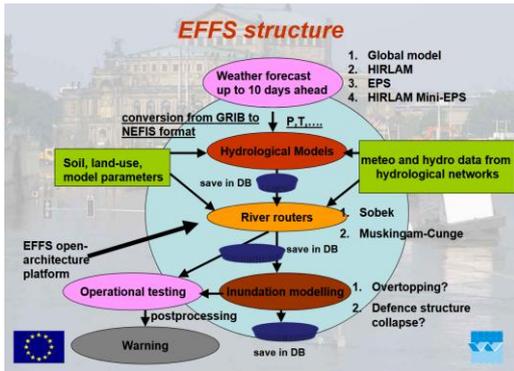
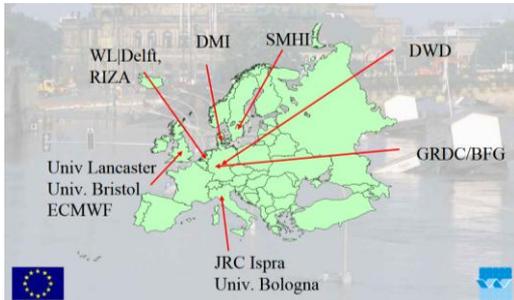
- National and international economic disruption
- Devastating impacts to thousands of citizens
- Prioritisation of response required
- Emergency and rescue services stretched

Knowledge

- Fragmented information
- Inconsistent forecasts across agencies/ nations
- Variable quality of information
- Difficult large-scale planning and organisation of aid



The European Flood Forecasting System EFFS (FP5 project)



EFFS Prototype



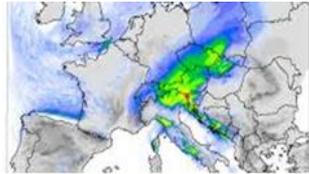
JRC develops a European-scale Flood Forecasting System (EFFS)



EFFS in action: 2002 floods



DWD deterministic weather forecast



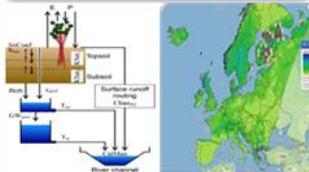
Meteorological Forecasts forcing

Input Observations

Hydro-Meteorological Initial Condition forcing

Hydrological Modelling

Input Data Sets



Lisflood gridded Model

Post-processing

Thresholds



Prototype real-time forecasting system for the Danube

Web interface



EFFS provides real-time flood information in Central Europe

JRC develops a European-scale Flood Forecasting System (EFFS)

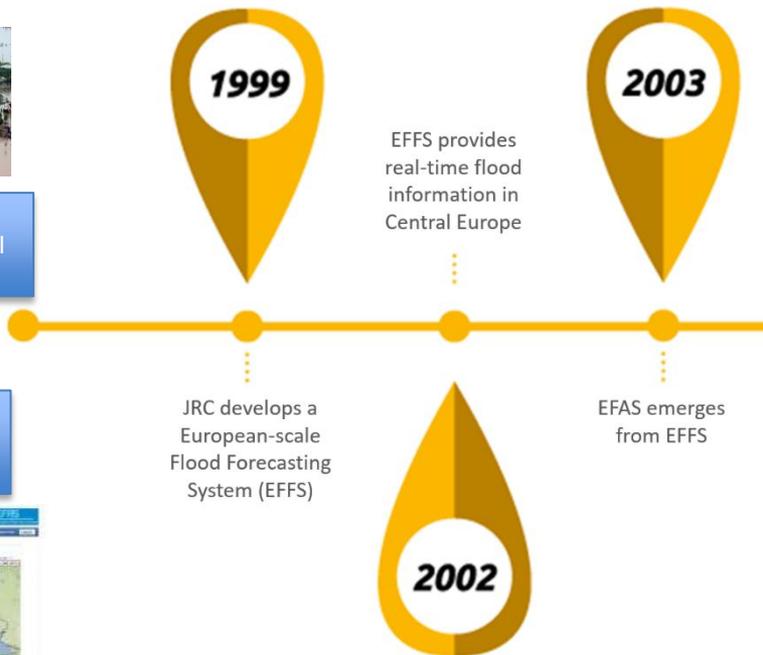
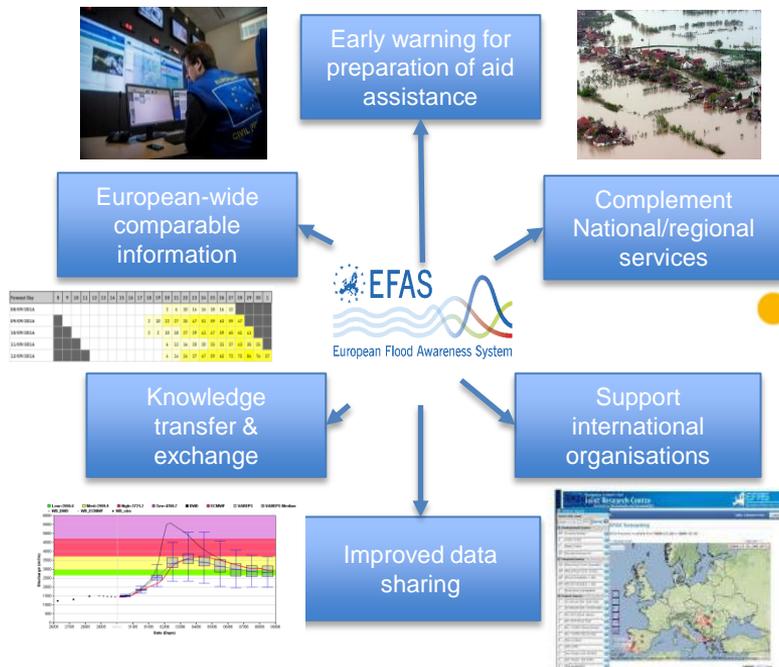


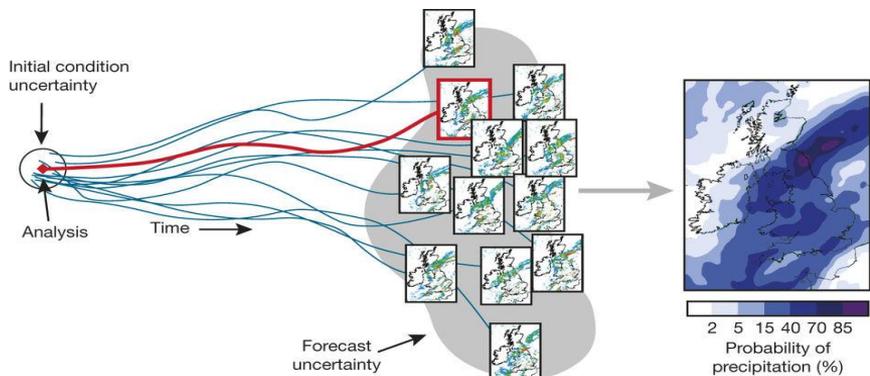


EFFS becomes EFAS, funded by European Commission

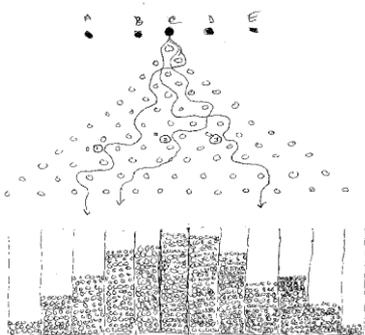


Experts from Austria, Czech Republic, Germany, Hungary, and Slovakia at JRC to co-develop EFAS

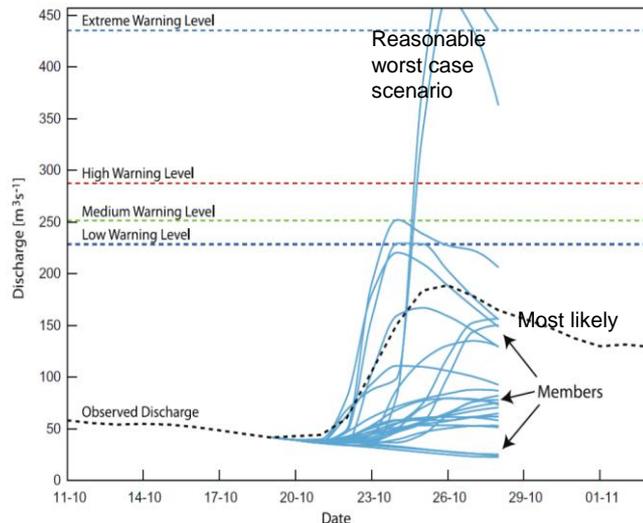




Source: Bauer et al., Nature, 10.1038/nature14956



Source: <http://www.meteor.iastate.edu/gccourse>



**Ensemble
Forecast
Hydrograph**

Source: Cloke & Pappenberger (2009) Ensemble Flood Forecasting. Journal of Hydrology

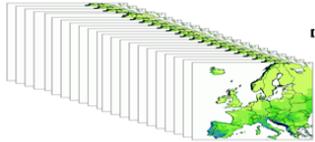




ECMWF ensemble forecasts prototyped in EFAS



ECMWF ensemble weather forecast



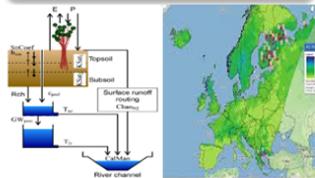
Meteorological Forecasts forcing

Input Observations

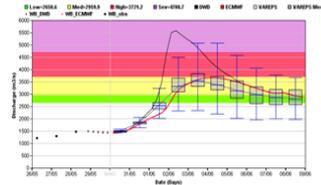
Hydro-Meteorological Initial Condition forcing

Hydrological Modelling

Input Data Sets



Lisflood gridded Model



Post-processing

Thresholds



Prototype real-time forecasting system for the Danube



JRC develops a European-scale Flood Forecasting System (EFFS)



EFFS provides real-time flood information in Central Europe



EFAS emerges from EFFS



ECMWF ensemble meteorological forecasts integrated in EFAS



EFAS becomes a Copernicus Emergency Management Service



Meteorological Data Collection Centre

Hydrological Data Collection Centre



1999

Hydro-Meteorological Initial Condition forcing

EFAS provides real-time flood information in

Dissemination Centre



2005
2010

EFAS part of CEMS & EFAS consortium created



Meteorological Forecasts forcing

Hydrological Modelling

Post-processing

Web interface

Operational EFAS test system & EFAS partner network established

Input Observations

Input Data Sets

Thresholds

JRC develops European-scale Flood Forecasting system

Emergency Management



2002

2004

2011

Computational Centre



Emergency Management



EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS



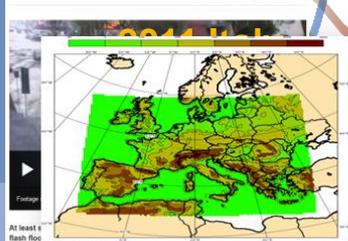
Project Management



EFAS is fully operational; EPIC Flash Flood layer added



Italy floods: Six killed in port city Genoa



Spain

2012 Wales

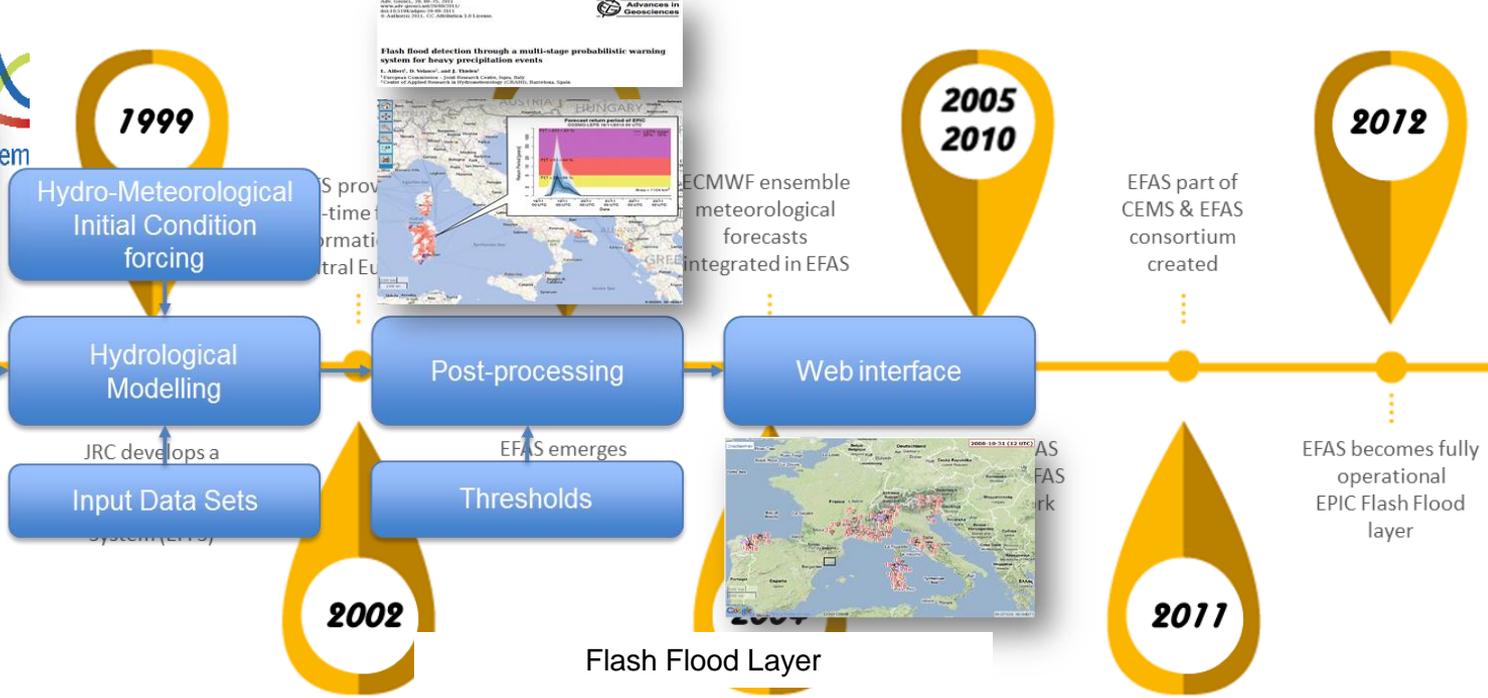


2012 Wales

Weather: Britain on flood alert as a month's worth of rain falls in 24 hours



SHORT-RANGE WEATHER FORECASTS

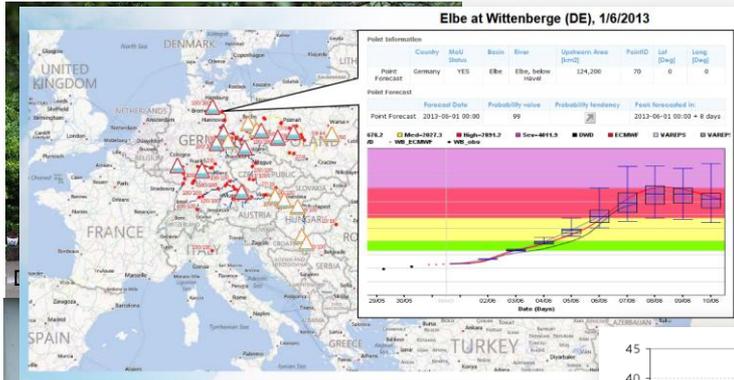




2013 central European flooding: EFAS stress test



European



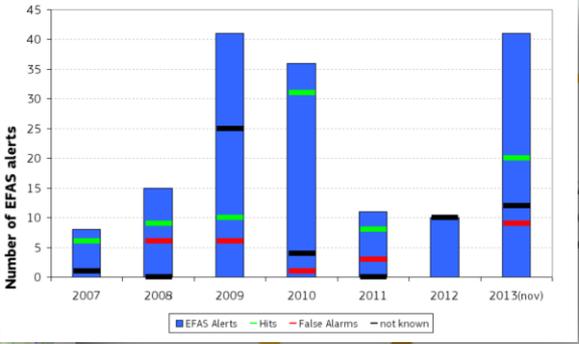
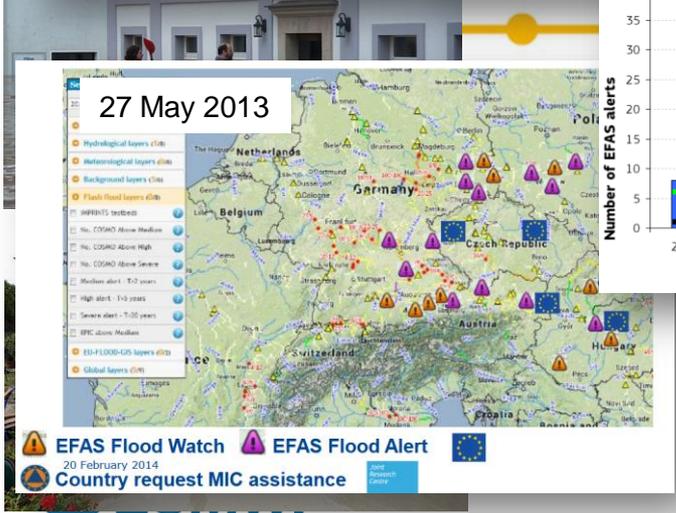
ECMWF ensemble meteorological forecasts integrated in EFAS



EFAS part of CEMS & EFAS consortium created



EFAS stress tested during June 2013 central European flooding



EFAS worked

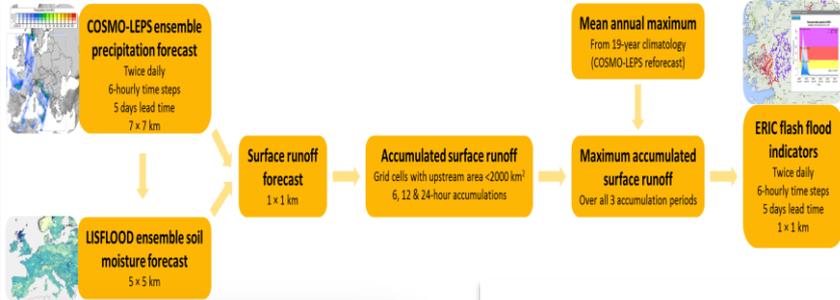


EFAS becomes fully operational





Improved Flash Flood Indicator; Notification system



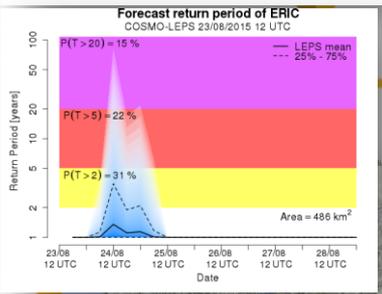
EFAS part of CEMS & EFAS consortium



EFAS stress tested during June 2013 central European flooding



ERIC replaces EPIC Formal and information notifications created



- Formal Notifications (leadtime; persistence; Severity; location; surface area)**
- Informal Notifications (location; surface area)**
- Flash flood Notifications (leadtime; severity; location)**

Notifications to restricted users only

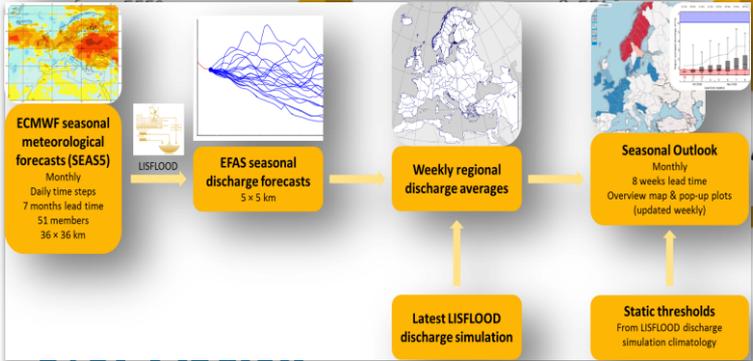
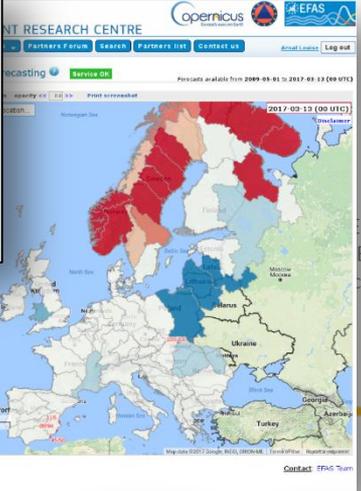
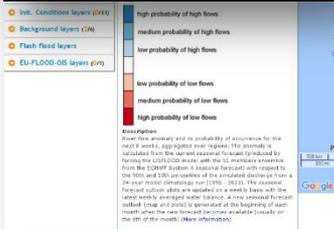
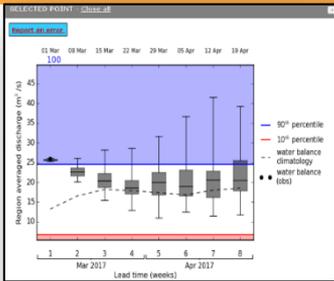


EFAS SOS and WMS services





EFAS Seasonal – hydrological outlooks up to 8 weeks ahead



EFAS part of EMS & EFAS consortium created



EFAS becomes fully operational



EFAS stress tested during June 2013 central European flooding



EFAS SOS and WMS services



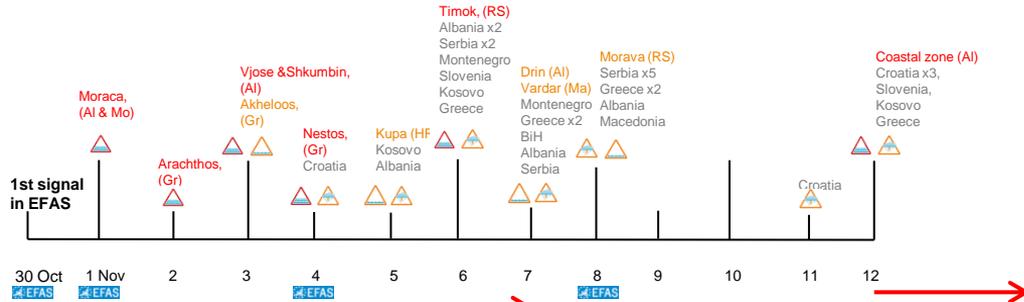
ERIC replaces EPIC Formal and information notifications created



EFAS Seasonal – hydrological outlook



EFAS in action: Balkan Floods 8-14 Nov 2016

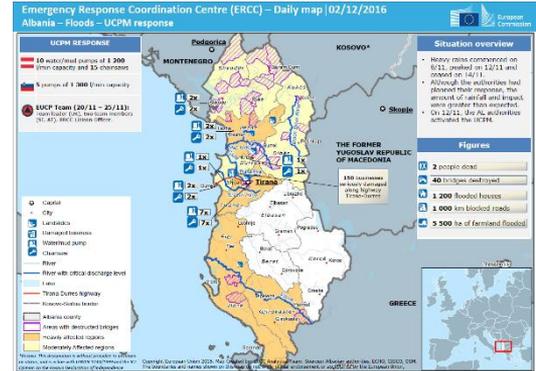


- Formal Flood Notification
- Informal Flood Notification
- Flash Flood Notification

8 Formal Notifications (Albania, Greece, Montenegro, Serbia)

5 Informal Notifications (Albania, Croatia, Greece, Macedonia, Serbia)

13 Flash flood Notifications (Albania, Bosnia&Hercegovina, Croatia, Greece, Kosovo, Macedonia, Montenegro, Serbia, Slovenia)

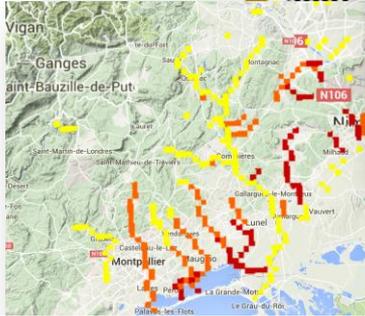




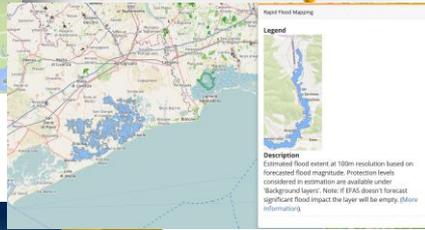
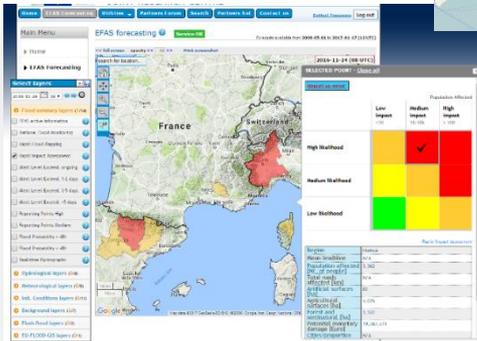
ERICHA Nowcasting and Impact forecasting



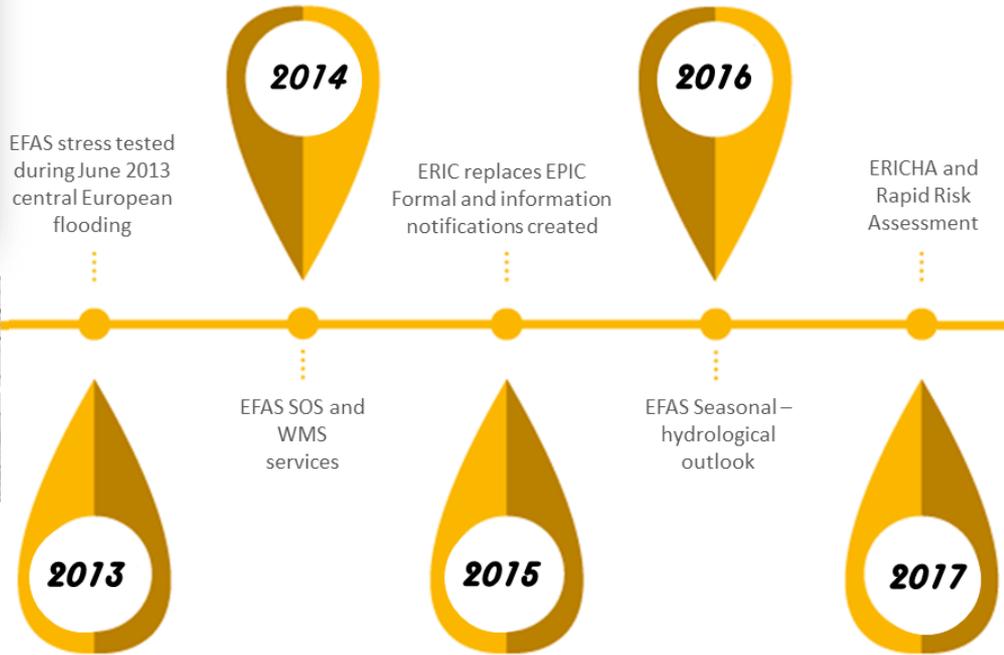
ERICHA
Radar-based forecast
15mn up to 3 hours



Impact mapping for rapid
risk assessment

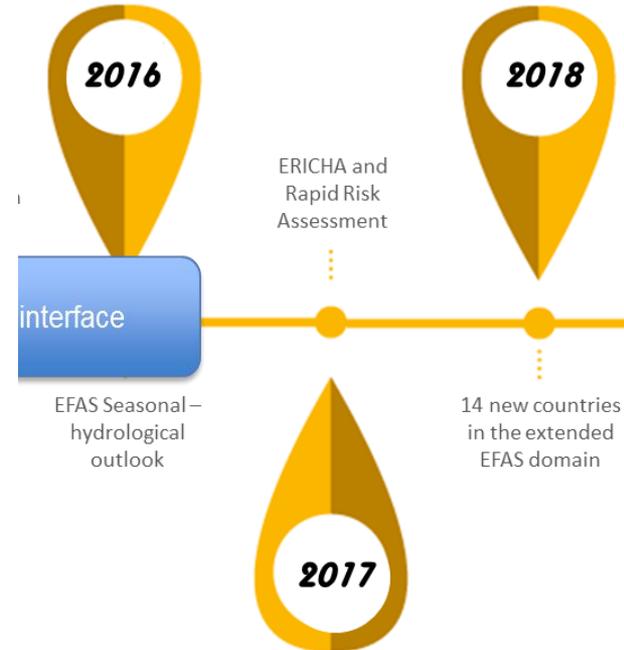


Max Median Severity
+
Inundation catalogue
+
Population
Infrastructure
Land cover





EFAS extended domain



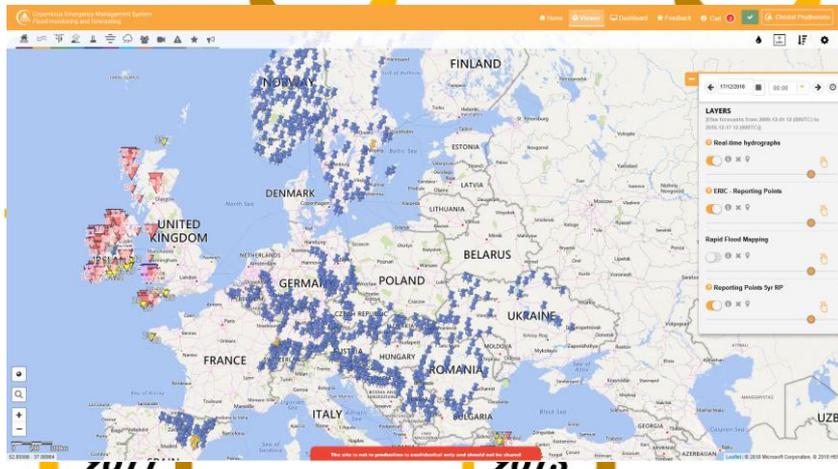


2012

2014

2016

2018



ERIC replaces EPIC
normal and information
notifications created

ERICHA and
Rapid Risk
Assessment

EFAS Seasonal –
hydrological
outlook

14 new countries
in the extended
EFAS domain

2015

2017

2019...

New web interactive interface and easier access to forecasts to registered users

(EFAS-)Diss



Concept
Users needs



External
research projects
EFAS partners



(EFAS-)Hydro



JRC

(EFAS)-
Meteo



Products &
Service



Test &
efficiency



**Only possible through
collaboration and sharing**

Thank you

Christel.Prudhomme@ecmwf.int