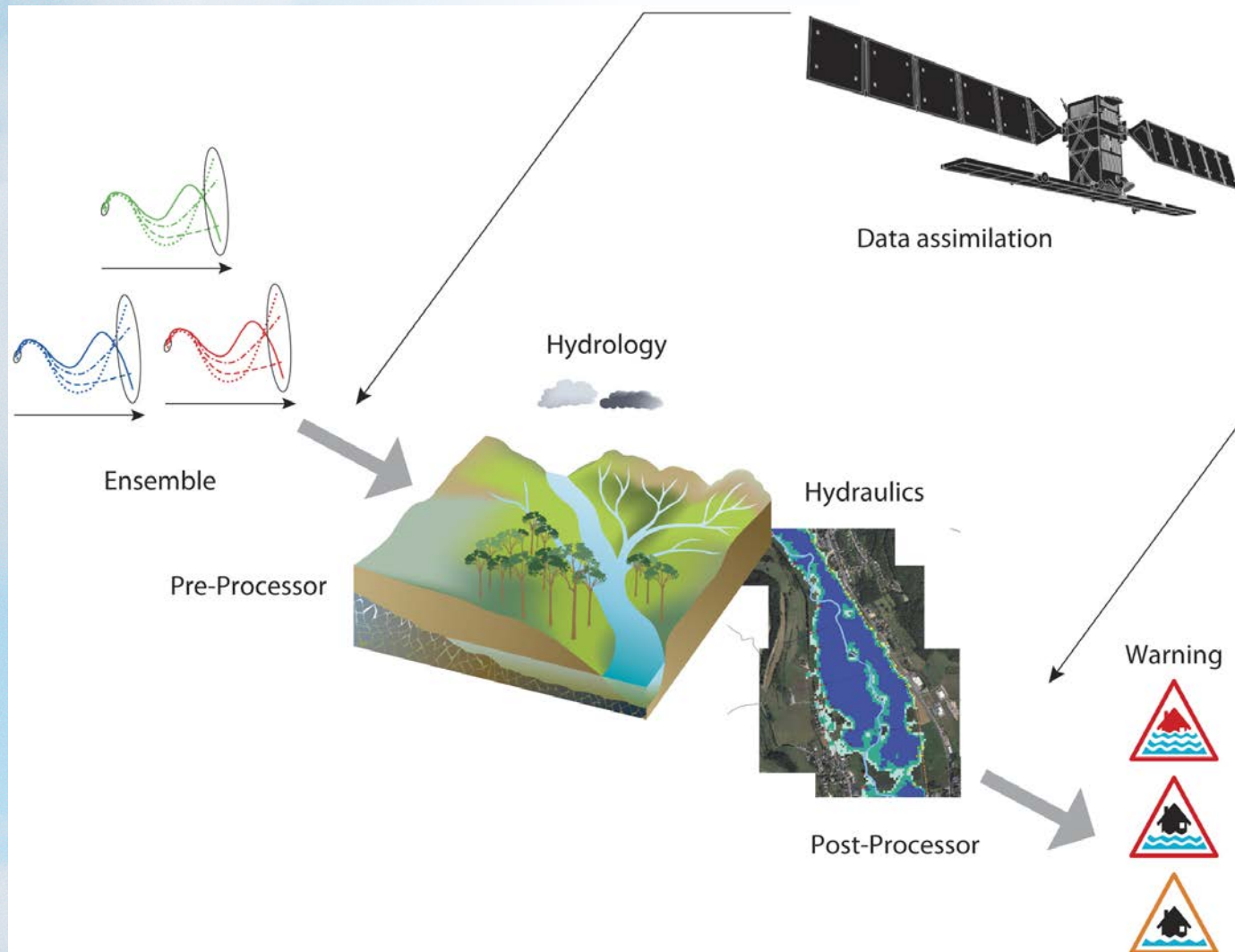


Increasing the limits of predictability of floods by using NWP ensemble forecasts

Florian Pappenberger
European Centre for Medium-Range Weather Forecasts

Forecasting chain using Ensemble Numerical Weather Predictions



Applications

- Floods
- Droughts
- Agriculture
- River navigation
- Water quality/temperature
- Energy e.g. run-of-the-river plant
- Wildfire
- Malaria
- And many more, just browse user community on www.hepex.org !



Applications

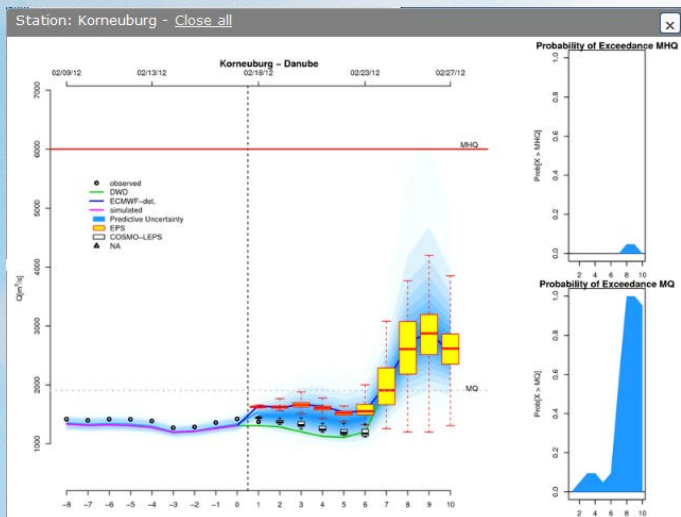
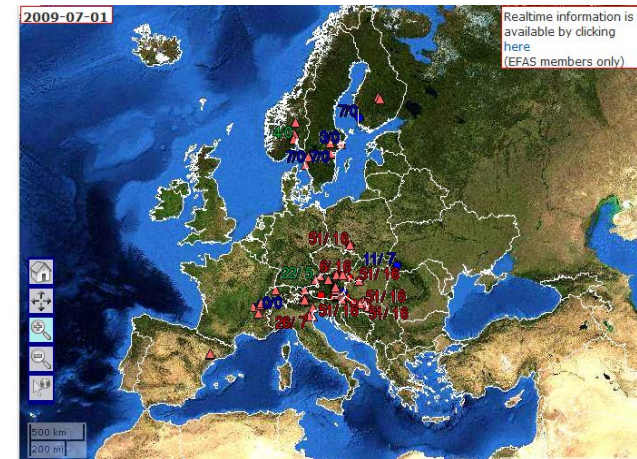
● Floods

- Droughts
- Agriculture
- River navigation
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- Wildfire
- Malaria
- And many more, just browse user community on www.hepex.org !



European Flood Awareness System (EFAS)

- Need: lack of coherent flood information and coordination in Europe for trans-national flood events, e.g. during Elbe and Danube floods in 2002
- Value of EFAS: better preparedness and improved disaster and crisis management in Europe with trans-national flood early warning information to civil protection and other authorities
- Operations : Since 2012, daily flood forecasts provided 24/7 to >30 Member States authorities

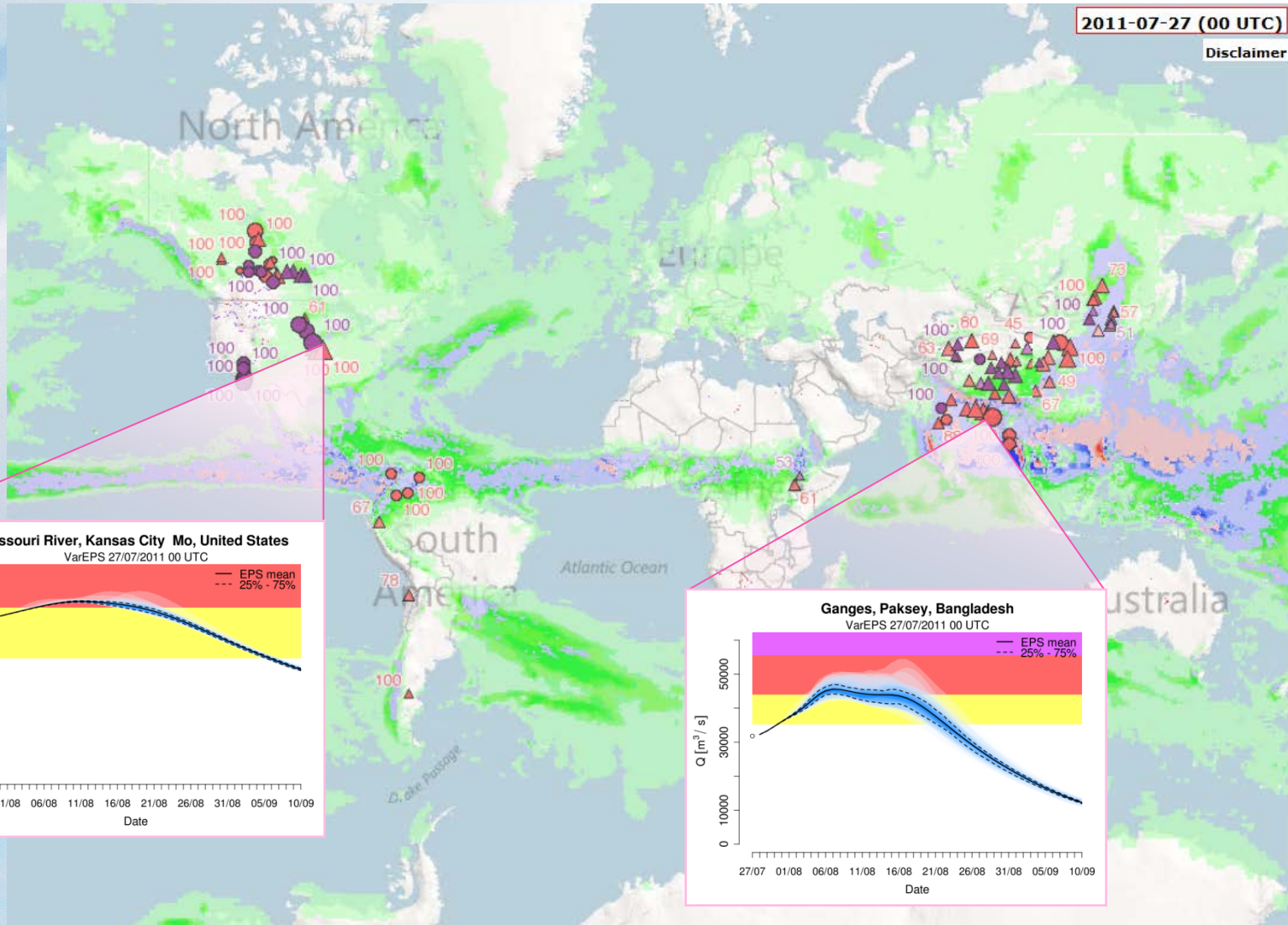


- 2013/2014 - >40 updates and new features e.g.
 - land slide risk information
 - SOS and Map servers
 - improved model
 - including of HSAF layers

The Global Flood Awareness Systems

2011-07-27 (00 UTC)

Disclaimer

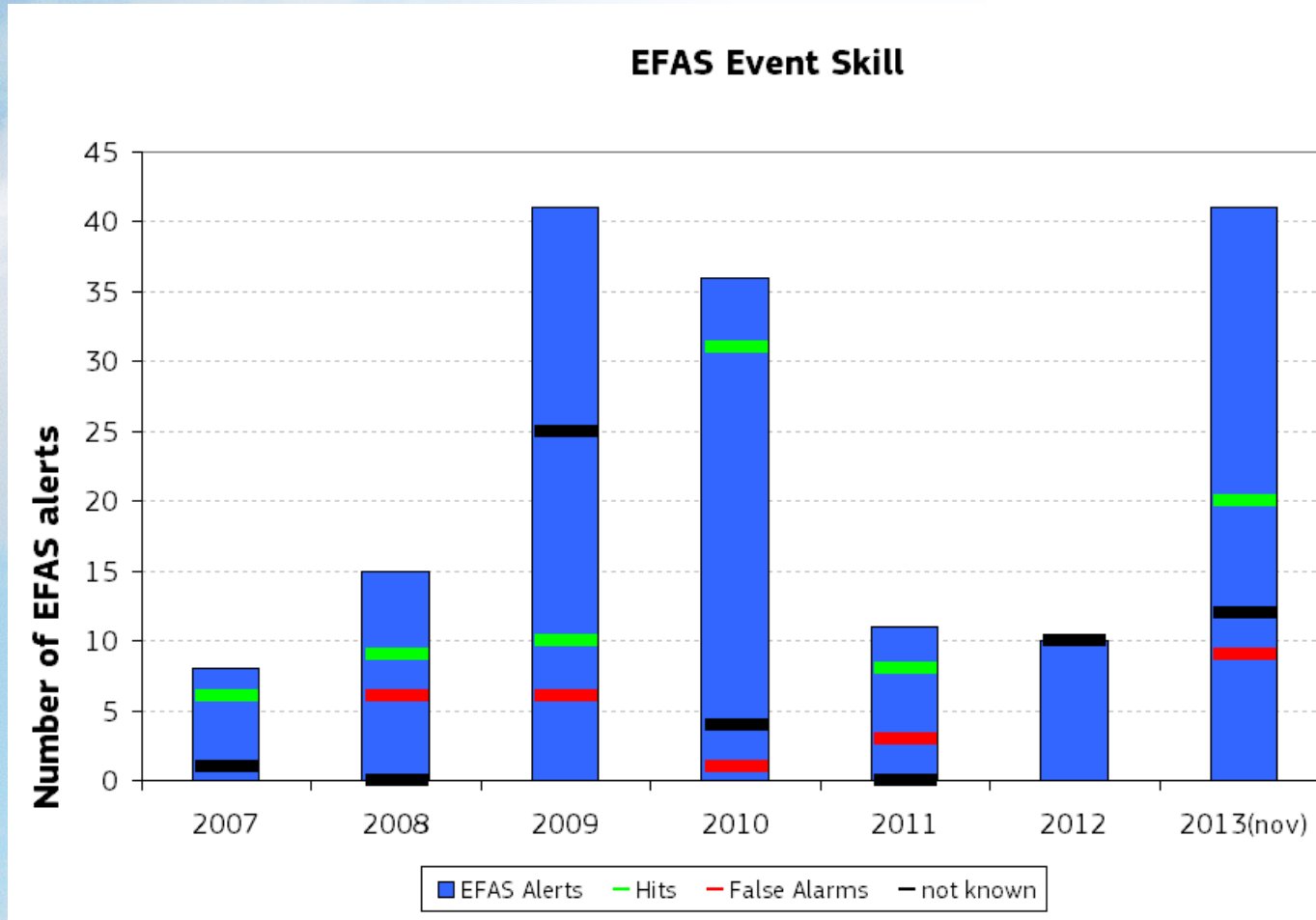


1. Federal Ministry of Agriculture, Forestry, Environment and Water Management (HZB) Austria,
2. Hydrological Information Centre (HIC) Belgium
3. NL Integraal Waterbeleid - NV De Scheepvaart (nv De Scheepvaart) Belgium
4. The Emergency Response Coordination Centre (ERCC) Belgium
5. National Institute of Meteorology and Hydrology (NIMH) Bulgaria
6. Meteorological and Hydrological Service (DHMZ) Croatia
7. Czech Hydro-Meteorological Institute (CHMI) Czech Republic
8. Finnish Environment Institute (SYKE) Finland
9. Ministère de l'Ecologie et du Développement Durable Service Central d'Hydrométéorologie et d'Appui à la Prévision des Inondations (SCHAPI) France
10. Landesamt für Umwelt, Wasserwirtschaft und Gewerbeaufsicht Rheinland-Pfalz (LUWGRLP) Germany
11. Bayerisches Landesamt für Umwelt (LfU) Germany
12. Landesamt für Umwelt, Gesundheit und Verbraucherschutz (LUA) Germany
13. Saxon State Agency for Environment and Geology (SLUG) Germany
14. Bundesanstalt fuer Gewaesserkunde (BfG) Germany
15. Deutscher Wetterdienst (DWD) Germany

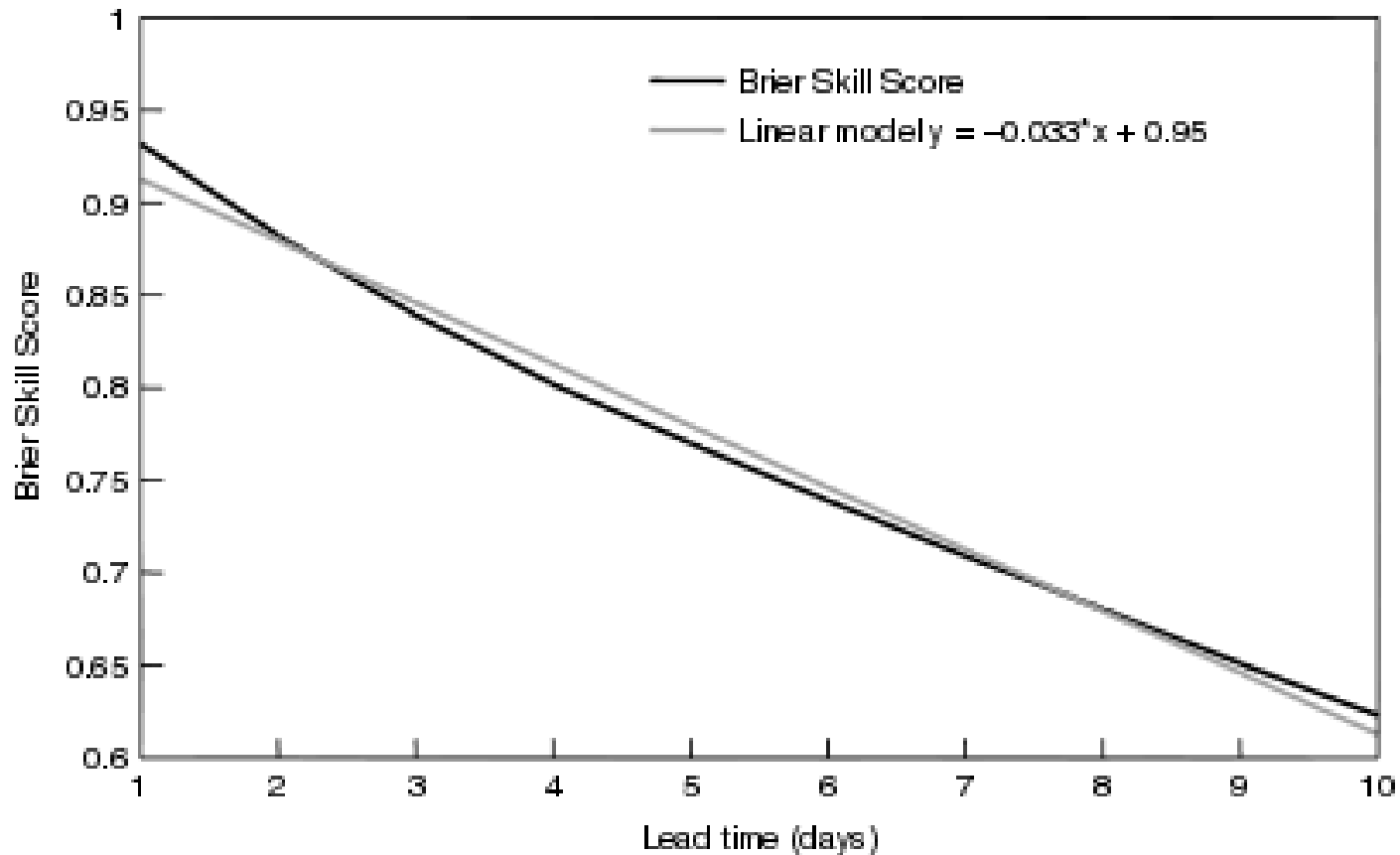
EFAS updates in 2013-2014

- Visualization of return period hydrographs for high and medium reporting points
- Visualization of satellite information (soil moisture, snow water equivalent, snow anomaly HSAF!) for comparison with the model initial conditions
- Incorporation of **landslide risk information** into the EFAS Flash Flood Watches plus visualization of the landslide susceptibility map
- EFAS Web Map Service (EFAS WMS) to display numerous layers currently available on www.efas.eu directly in your working environment
- EFAS Sensor Observation Service (EFAS SOS) to access the data values of the post-processed real time hydrographs
- New calibrated LISFLOOD setup for Europe
- Updated EFAS return periods based on the new calibration
- Updated post-processing real time hydrograph based on the new calibration
- Bugfixes in DWD forecast
- Visualization of initial conditions and anomalies
- Modification of the EFAS alert sending procedure for the Danube by splitting it into upper, middle and lower Danube.
-

EFAS Alert skill



Limits of predictability?



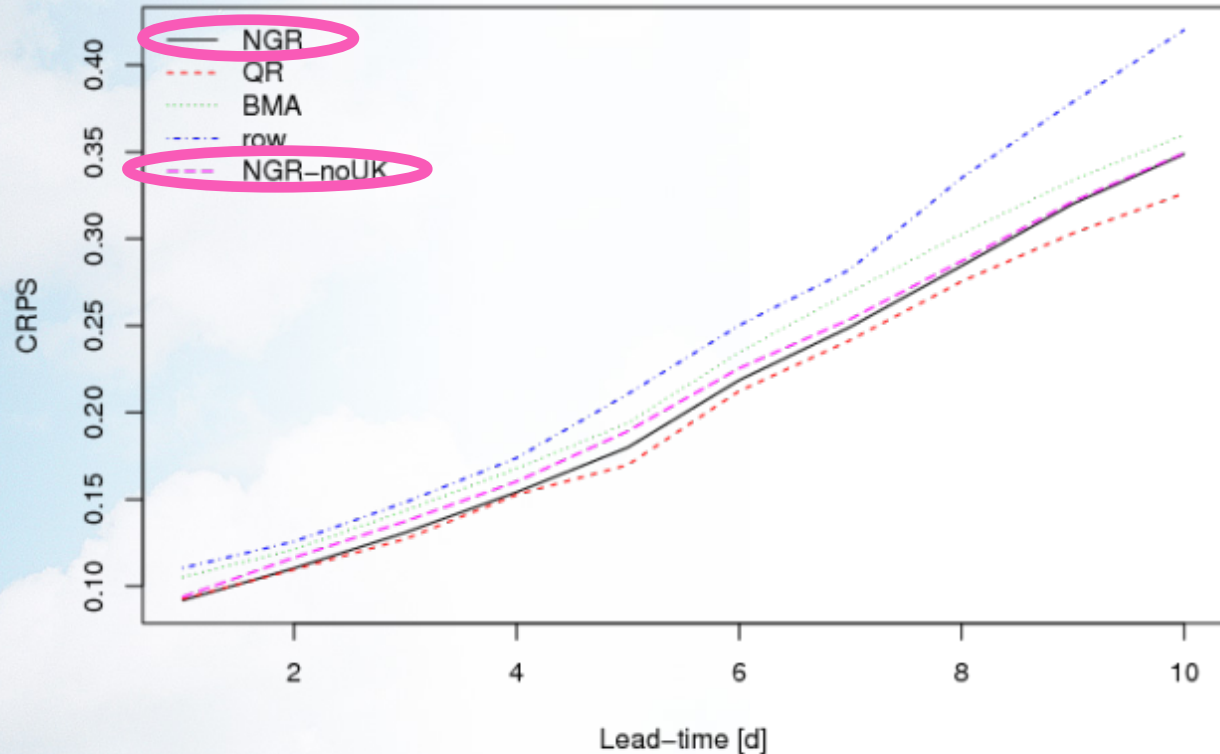
Average skill in Europe for rivers ~28 days

- Pappenberger, F. et al./ 2011, The impact of weather forecast improvements on large scale, Hydrological Processes, 25(7)
- Thielen, J. et al., 2009, Monthly-, medium- and short range flood warning: testing the limits of predictability, Meteorological Applications, 16 (1), 77-90

Extending limits of predictability - Merging NWP forecasts

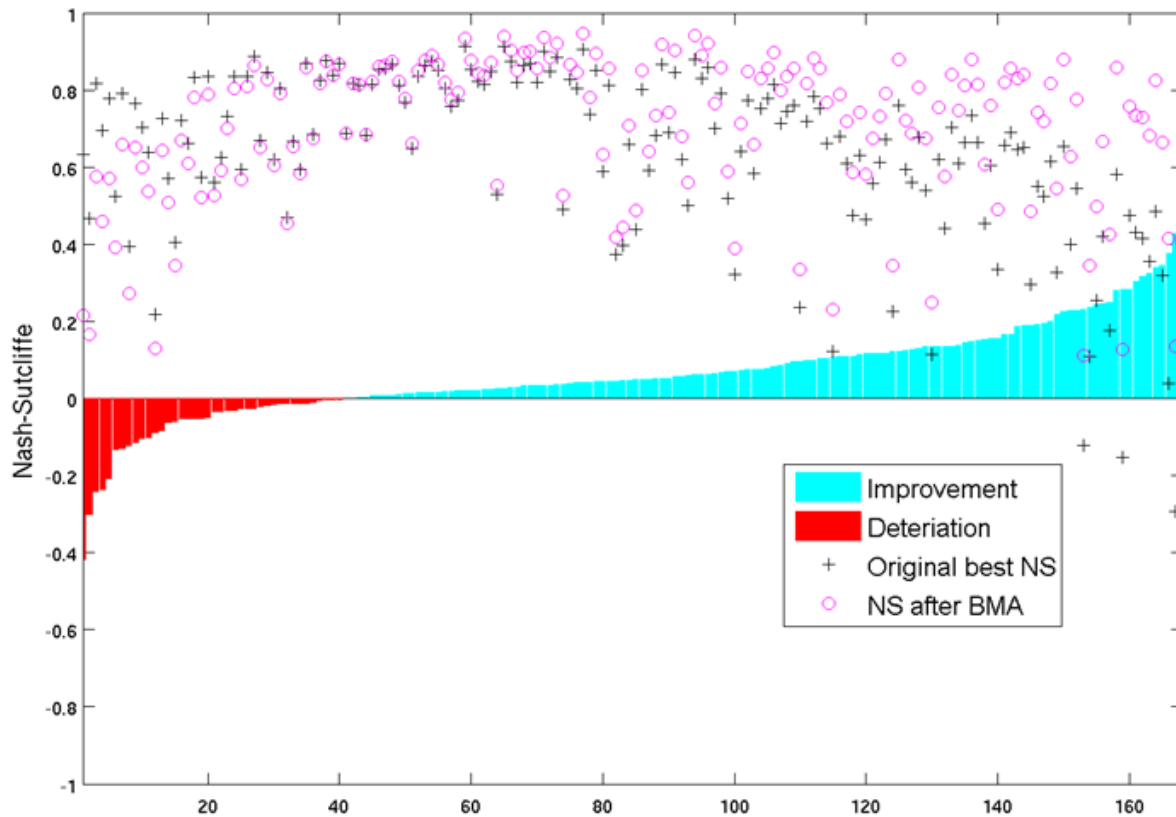
Add UKMO forecast to EFAS suite
(currently ECMWF ENS, ECMWF HighRes, DWD, COSMO-LEPS)

Already evidence of this from TIGGE studies (see presentation by Ervin Zoster)



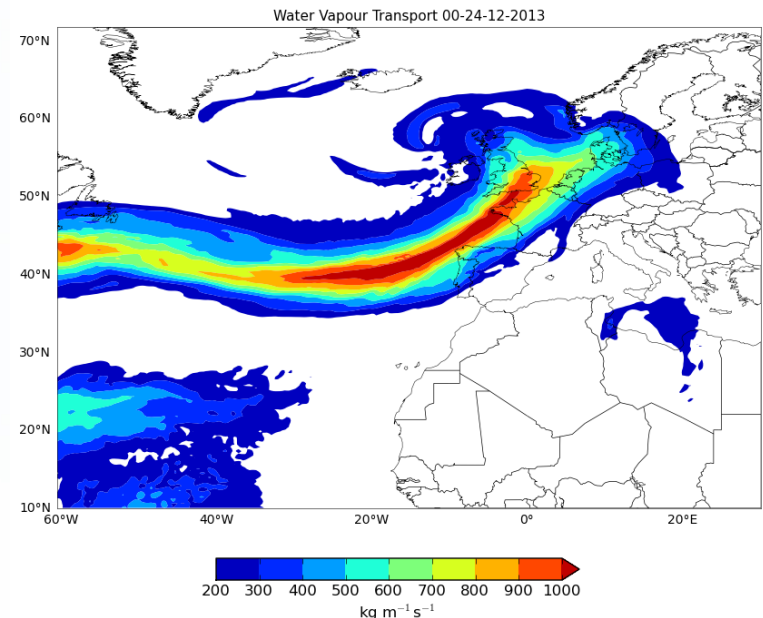
Extending limits of predictability - Multi-model Hydrology

- Combining the current hydrological model (LISFLOOD), ECMWF land surface scheme (HTESSEL – see Balsamo presentation tomorrow) and E-HYPE (SMHI)



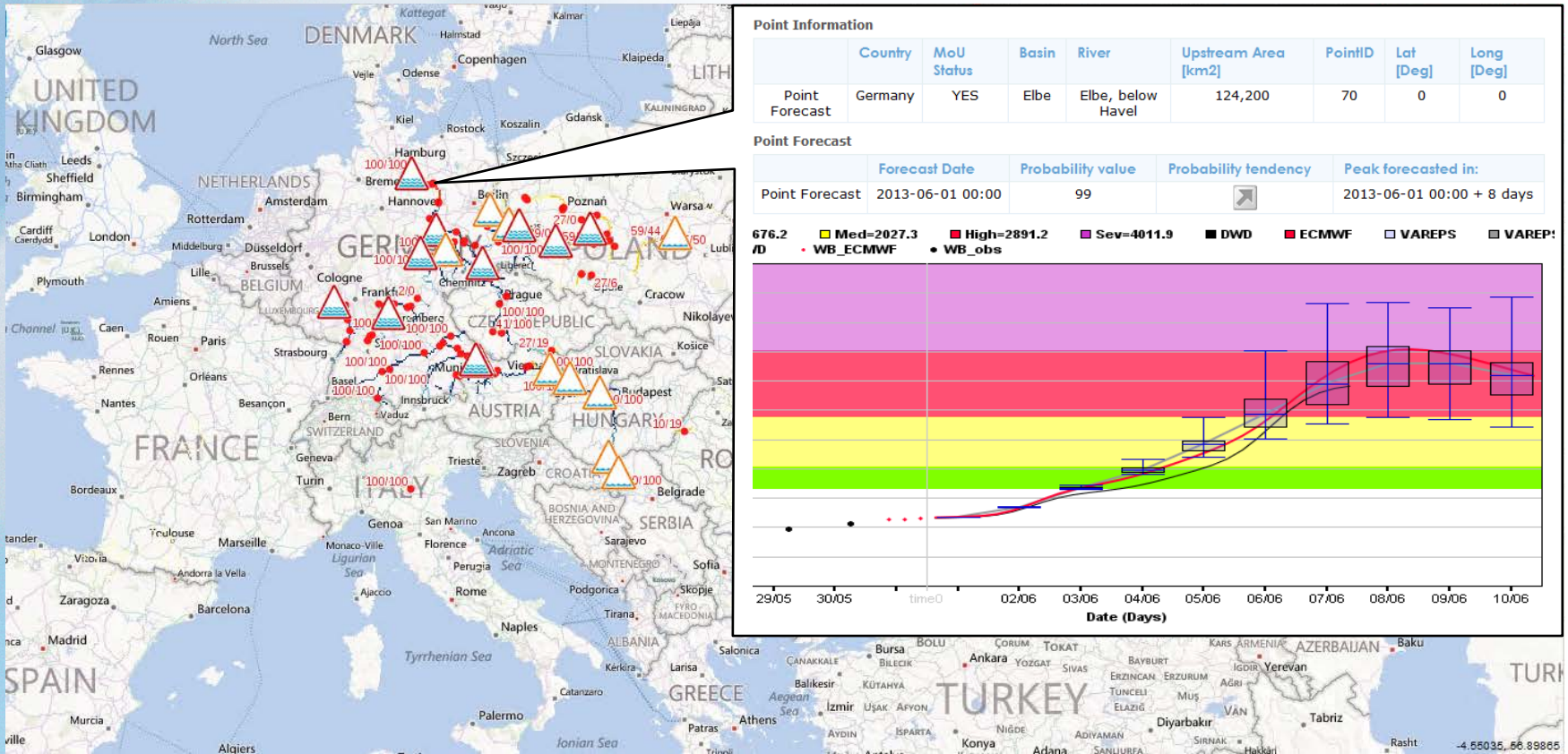
Extending limits of predictability - Atmospheric Rivers

- Regions of high water vapour transport across mid-latitudes within extratropical cyclones.
- Responsible for heavy rainfall and floods across Europe, particularly in winter.
- Identification of ARs in Ensemble forecasts in the medium-range proves more skilful than using precipitation forecasts.
- Early Warning system based on ARs



Floods in Central Europe – June 2013

Elbe at Wittenberge (DE), 1/6/2013



More details in

Pappenberger et al., 2013. Floods in Central Europe in June 2013, ECMWF Newsletter 136.

Haiden et al. 2014 . Floods in Central Europe, TechMemo (see weather room)

Presentation by Thomas Haiden later

The Balkan Floods



To demonstrate the added value of hydrological ensemble predictions (HEPS) for emergency management and water resources sectors to make decisions that have important consequences for economy, public health and safety.

HEPEX

Hydrologic Ensemble Prediction Experiment



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← [What is a good forecast?](#)

[Numerical simulation of 2010 Pakistan Flood in the Kabul River basin using lagged ensemble rainfall forecasting](#) →

21

Days

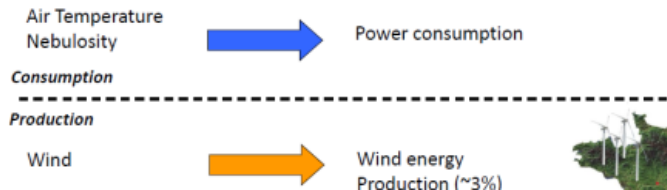
until the [HEPEX Anniversary Meeting](#)

Operational Highlight: use of ensemble hydrometeorological forecasts at EDF (French producer of energy)

Posted on [February 28, 2014](#) by [Matthieu Le Lay](#)

As other energy companies, [EDF](#) (French producer of energy) is a weather-sensitive company.

Natural hazards (floods, droughts, storms, heat waves) affect both aspects of energy consumption and production.



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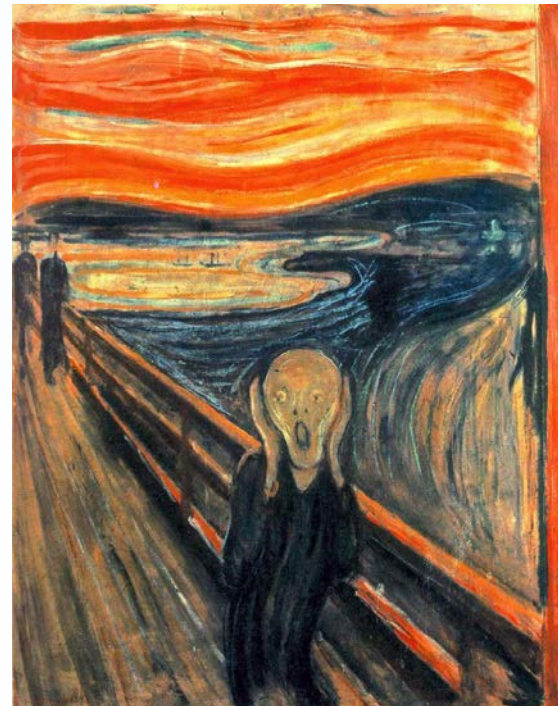
▾

www.hepex.org

Thanks for listening! QUESTIONS????

For references: florian.pappenberger@ecmwf.int

“ In case of flooding “

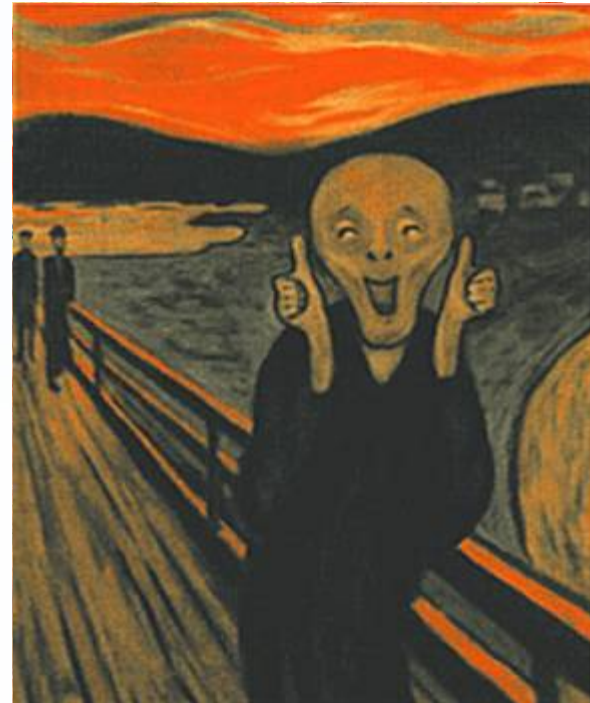


Thanks for listening! QUESTIONS????

For references: florian.pappenberger@ecmwf.int

*“ In case of flooding “
come to next meetings*

1. **HEPEX, Tenth Anniversary Workshop**, 24-26th June 2014, Maryland, USA
2. **Seasonal Forecasting – Current Challenges and Potential Benefits for Decision Making in the Water Sector**, 15-16 October 2014, BfG, Koblenz, Germany
3. **H-SAF and HEPEX workshops on coupled hydrology**, 2-7 November 2014, ECMWF

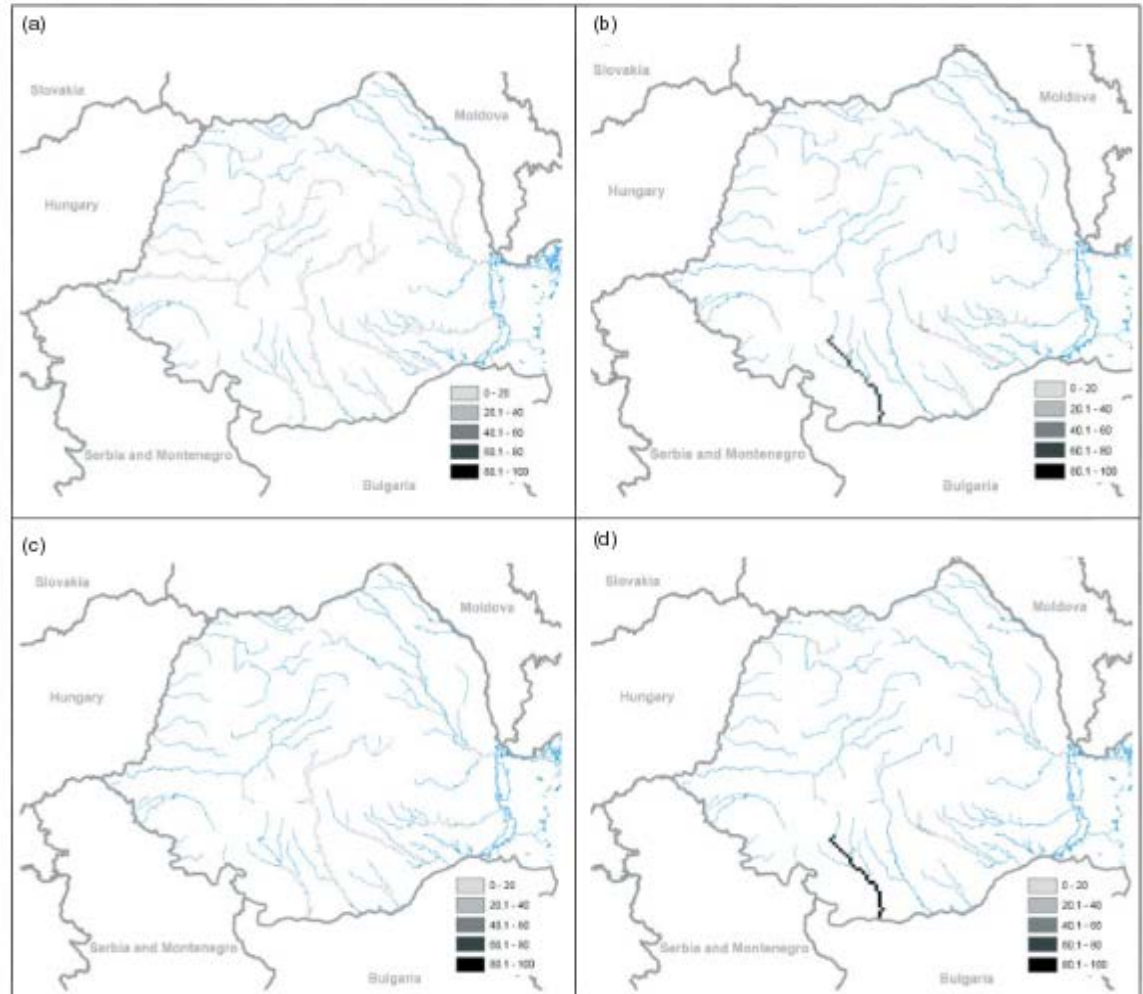


Extending limits of predictability - Merging NWP forecasts

Merge monthly-, medium-, and short-range flood warning on the example of floods in Romania October 2007

Found that with an 'intelligent' (BMA style) merging forecast horizon extends lead time significantly

Overview maps of EPS above EFAS severe threshold for (a) ECMWF ENS on 19 October 2007 1200, (b) Cosmo-LEPS on 19 October 2007 1200, (c) ECMWF ENS on 21 October 2007 1200, and (d) Cosmo-LEPS on 21 October 2007 1200



Thielen, J., Bogner, K., Pappenberger F., Kalas, M., del Medico, M., de Roo, A., 2009, Monthly-, medium- and short range flood warning: testing the limits of predictability, *Meteorological Applications*, 16 (1), 77-90