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The European Flood Awareness System (EFAS) produces European overviews of ongoing and forecasted floods up to 15 days in advance and contributes to better protection of the European citizens, the environment, properties and cultural heritage. It has been developed at the European Commission's in house science service, the Joint Research Centre (JRC), in close collaboration with national hydrological and meteorological services and policy DG's of the European Commission.

EFAS has been transferred to operations under the European Commission's COPERNICUS Emergency Management Service led by DG ENTR in direct support to the EU's Emergency Response Coordination Centre (ERCC) of DG ECHO and the hydrological services in the Member States.

ECMWF has been awarded the contract for the EFAS Computational centre. It is responsible for providing daily operational EFAS forecasts and 24/7 support to the technical system.

A consortium of Swedish Meteorological and Hydrological Institute (SMHI), Rijkswaterstaat (RWS) and Slovak Hydro-Meteorological Institute (SHMU) has been awarded the contract for the EFAS Dissemination centre. They are responsible for analysing EFAS output and disseminating information to the partners and the MIC.

A Spanish consortium (REDIAM and ELIMCO) has been awarded the contract for the EFAS Hydrological data collection centre. They are responsible for collecting discharge and water level data across Europe.

The work related to the EFAS Meteorological data collection centre has been outsourced but onsite the JRC. Finally, the JRC is responsible for the overall project management related to EFAS and further development.

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Cover image: Flooding at Lago Maggiore 11 November 2014, Ispra, Italy.
Photographer: Milan Kalas

EFAS news

Meetings

H-SAF/HEPEX workshop on coupled hydrology, 3-7 November 2014, Reading, UK

ECMWF organised a joint H-SAF/HEPEX workshop on coupled hydrology where a presentation was given by Peter Salamon about the use of H-SAF data in a hydrologic ensemble prediction system such as EFAS. The presentation outlined the use of H-SAF snow water equivalent and soil moisture data in EFAS for model validation purposes and as added value information for the forecasters. The presentation can be found online as a HEPEX Webinar at: https://www.youtube.com/watch?v=mTXPW6cJb5Y.

New partners

We welcome the Institute of GeoSciences, Energy, Water and Environment, Polytechnic University of Tirana, Albania as a new EFAS partner.

EFAS results

Meteorological situation for October -November 2014

The weather in October was in general wet for the mid and eastern part of Europe, whereas the northern and southernmost regions were drier than normal (Figure 7 and Figure 8). However, southern Europe also experienced heavy, localised rainfall which led to numerous floods and flash floods. The west coast of Norway and northwest Scotland saw extreme rainfall on the last week of October. This which led to a severe flood in the western part of Norway, which is further discussed in the Meteorologist's comment below.

November was dominated by an atmospheric blocking situation which brought consistent storms to the north-central Mediterranean coast and the southern Alps with intense rainfall and snowfall (for the Alps). The blocking continued until mid-November and led to a large number of floods, especially for the southern Alps, southern France and eastern Spain (Figure 9 and Figure 10). Also eastern Ireland and northern UK experienced heavy rainfall.

Summary of EFAS flood alerts for October - November 2014

EFAS Flood Alerts and Flood Watches sent in October - November 2014 are summarized in Table 1 and their location are shown in Figure 11 and Figure 12.

Summary of flash flood watches for October - November 2014

In October 2014, 116 flash flood reporting points were detected by EPIC (Figure 13), having probabilities higher than 60% of exceeding the high threshold (5-year return period). The forecast lead time of the predicted storm peaks is in the range 6 - 72 hours, with average lead time of 33 hours. Catchment size of flash flood alerts is in the range 51 - 4915 km^2, with average size of 623 km^2.

In November 2014, 171 flash flood reporting points were detected by EPIC (Figure 14), having probabilities higher than 60% of exceeding the high threshold (5-year return period). The forecast lead time of the predicted storm peaks is in the range 6 - 108 hours, with average lead time of 36 hours. Catchment size of flash flood alerts is in the range 51 - 4864 km^2, with average size of 1066 km^2.

Based on these points EFAS Flash Flood watches have been sent to the corresponding EFAS partners as summarized in Table 2 and shown in Figure 13 and Figure 14.

Table 1: EFAS flood alerts sent in October-November 2014

Type	Forecast date	Issue date	Lead time*	River	Country
Watch	03/10/2014 12 UTC	03/10/201	2	Dee	United Kingdom
Watch	05/10/2014 00 UTC	05/10/201	3	Tietar	Spain
Watch	05/10/2014 00 UTC	05/10/201	4	Tormes	Spain
Alert	06/10/2014 00 UTC	06/10/201	3	Tietar	Spain
Watch	06/10/2014 12 UTC	07/10/201	4	Rhone, section Isere - Durance	France

Watch	09/10/2014 00 UTC	09/10/201	1	Loing	France
Alert	22/10/2014 00 UTC	22/10/201	2	Jiu	Romania
Alert	22/10/2014 00 UTC	22/10/201	2	Jiu	Romania
Watch	22/10/2014 00 UTC	22/10/201	3	Lonja, Ilova & Pakra	Croatia
Watch	30/10/2014 12 UTC	31/10/201	4	Po, section Dora Baltea - Tanaro	Italy
Alert	01/11/2014 12 UTC	02/11/201	3	Adda	Italy
Watch	01/11/2014 12 UTC	02/11/201	3	Ticino	Italy
Watch	05/11/2014 00 UTC	05/11/201	0	Maas	France
Watch	07/11/2014 00 UTC	07/11/201	0	Sava, above Kupa	Slovenia
Alert	09/11/2014 00 UTC	09/11/201	2	Drava	Croatia
Watch	08/11/2014 12 UTC	09/11/201	2	Po, section Dora Baltea - Tanaro	Italy
Watch	09/11/2014 12 UTC	10/11/201	2	Oglio	Italy
Watch	09/11/2014 12 UTC	10/11/201	1	Po, section Dora Baltea - Tanaro	Italy
Alert	10/11/2014 12 UTC	11/11/201	1	Tietar	Spain
Alert	12/11/2014 00 UTC	12/11/201	1	Bann	United Kingdom
Watch	12/11/2014 00 UTC	12/11/201	0	Po, below Oglio	Italy
Watch	12/11/2014 00 UTC	12/11/201	3	Rhone, section Isere - Durance	France
Watch	12/11/2014 00 UTC	12/11/201	2	Irish Republic - costal zone	Irish Republic
Watch	12/11/2014 00 UTC	12/11/201	1	Shannon	Irish Republic
Watch	11/11/2014 12 UTC	12/11/201	2	Tormes	Spain
Watch	11/11/2014 12 UTC	12/11/201	2	Bann	United Kingdom
Watch	11/11/2014 12 UTC	12/11/201	2	Dee	United Kingdom
Alert	13/11/2014 00 UTC	13/11/201	1	Irish Republic - costal zone	Irish Republic
Watch	13/11/2014 00 UTC	13/11/201	0	Po, section Adda - Oglio	Italy
Watch	13/11/2014 00 UTC	13/11/201	2	Po, section Dora Baltea - Tanaro	Italy
Watch	13/11/2014 00 UTC	13/11/201	1	Erne	Irish Republic
Watch	12/11/2014 12 UTC	13/11/201	1	Slaney	Irish Republic
Watch	15/11/2014 00 UTC	15/11/201	0	Ticino	Italy
Watch	14/11/2014 12 UTC	15/11/201	0	Po, below Oglio	Italy
Watch	21/11/2014 12 UTC	22/11/201	4	Herault	France
Alert	25/11/2014 00 UTC	25/11/201	4	Segre	Spain
Watch	25/11/2014 00 UTC	25/11/201	2	Tietar	Spain
Watch	24/11/2014 12 UTC	25/11/201	3	Po, below Oglio	Italy
Alert	26/11/2014 12 UTC	27/11/201	3	Aude	France
Alert	27/11/2014 12 UTC	28/11/201	3	Tanaro	Italy
Watch	28/11/2014 00 UTC	28/11/201	2	Po, above Dora Baltea	Italy
Watch	27/11/2014 12 UTC	28/11/201	1	Cardoner	Spain
Watch	29/11/2014 12 UTC	30/11/201	0	Ebro, section Gallego - Jalon	Spain

Lead time [days] to the first forecasted exceedance of the 5-year simulated discharge threshold.

Table 2: EFAS flash flood watches sent in October-November 2014

Type	Forecast date	Issue date	Lead time*	River	Country
FF Watch	03/10/2014 12 UTC	03/10/2014	18	Not defined	United Kingdom
FF Watch	06/10/2014 00 UTC	06/10/2014	12	Spey	United Kingdom
FF Watch	22/10/2014 00 UTC	22/10/2014	42	Traun	Austria
FF Watch	22/10/2014 00 UTC	22/10/2014	42	Drau (Drava)	Austria
FF Watch	22/10/2014 00 UTC	22/10/2014	42	Inn, above Salzach	Germany
FF Watch	21/10/2014 12 UTC	22/10/2014	54	Salzach	Austria
FF Watch	23/10/2014 00 UTC	23/10/2014	36	Gacka	Croatia

FF Watch	23/10/2014 00 UTC	23/10/2014	36	Kupa	Croatia
FF Watch	23/10/2014 00 UTC	23/10/2014	36	Kupa	Croatia
FF Watch	23/10/2014 12 UTC	24/10/2014	24	Gacka	Croatia
FF Watch	01/11/2014 00 UTC	01/11/2014	108	Adda	Italy
FF Watch	01/11/2014 00 UTC	01/11/2014	102	Ticino	Italy
FF Watch	02/11/2014 12 UTC	03/11/2014	66	Saone, below Doubs	France
FF Watch	02/11/2014 12 UTC	03/11/2014	66	Doubs	France
FF Watch	02/11/2014 12 UTC	03/11/2014	66	Not defined	France
FF Watch	02/11/2014 12 UTC	03/11/2014	72	Var	France
FF Watch	02/11/2014 12 UTC	03/11/2014	66	Saone, below Doubs	France
FF Watch	02/11/2014 12 UTC	03/11/2014	66	Saone, below Doubs	France
FF Watch	02/11/2014 12 UTC	03/11/2014	66	Saone, below Doubs	France
FF Watch	02/11/2014 12 UTC	03/11/2014	66	Isere	France
FF Watch	02/11/2014 12 UTC	03/11/2014	72	Po, section Dora Baltea - Tanaro	Italy
FF Watch	04/11/2014 00 UTC	04/11/2014	24	Not defined	France
FF Watch	04/11/2014 00 UTC	04/11/2014	24	Coastal zone	France
FF Watch	04/11/2014 00 UTC	04/11/2014	24	Not defined	France
FF Watch	04/11/2014 00 UTC	04/11/2014	24	Not defined	France
FF Watch	04/11/2014 00 UTC	04/11/2014	24	Not defined	France
FF Watch	04/11/2014 00 UTC	04/11/2014	24	Saone, below Doubs	France
FF Watch	04/11/2014 00 UTC	04/11/2014	24	Saone, below Doubs	France
FF Watch	04/11/2014 00 UTC	04/11/2014	24	Saone, below Doubs	France
FF Watch	06/11/2014 00 UTC	06/11/2014	36	Tay	United Kingdom
FF Watch	06/11/2014 00 UTC	06/11/2014	24	Coastal zone	United Kingdom
FF Watch	06/11/2014 00 UTC	06/11/2014	30	Coastal zone	United Kingdom
FF Watch	06/11/2014 00 UTC	06/11/2014	36	Not defined	United Kingdom
FF Watch	06/11/2014 00 UTC	06/11/2014	30	Coastal zone	United Kingdom
FF Watch	27/11/2014 00 UTC	27/11/2014	90	Not defined	France
FF Watch	27/11/2014 00 UTC	27/11/2014	90	Not defined	France
FF Watch	29/11/2014 00 UTC	29/11/2014	24	Jalon	Spain
FF Watch	28/11/2014 12 UTC	29/11/2014	36	Ebro, section Aragon - Jalon	Spain
FF Watch	28/11/2014 12 UTC	29/11/2014	36	Not defined	Spain
FF Watch	28/11/2014 12 UTC	29/11/2014	36	Ebro, below Segre	Spain

* Lead time [hours] to the forecasted peak of the rain.

Meteorologist's comments

by Linus Magnusson and Fredrik Wetterhall

Extreme precipitation in Norway

During the last week in October, western Norway was hit by extreme rainfall leading to severe floodings. Western Norway is already one of the wettest regions in Europe but October 2014 was extreme with 473 mm in Bergen compared to the average of 271 mm. The heavy rainfall during the end of October was due to a strong south-westerly flow bringing warm and moist air towards southern Scandinavia. The orographic enhancement gave rise to the severity of the event (Scotland was also affected during the period).

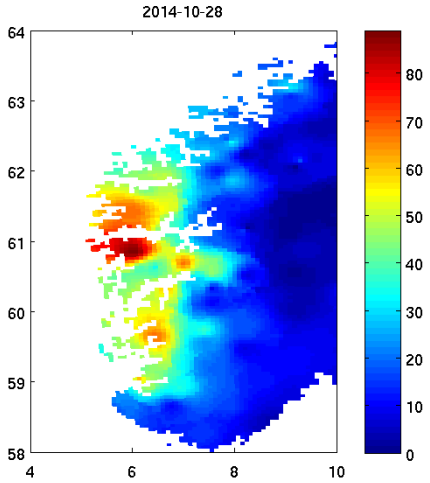

Figure 1. Precipitation (mm) in Norway for 28 October from the EFAS precipitation data.

The large-scale flow was well predicted and monthly forecasts from 2-3 weeks in advance included a significant wet anomaly for western Norway. The peak in the rainfall occurred on the 28 October with severe flash floods and floodings in small and medium sized rivers. Figure 1 shows the gridded observations of precipitation for 28 October from the EFAS database. The maximum reported point precipitation during this period was 130 mm and three stations had more than 100 mm.

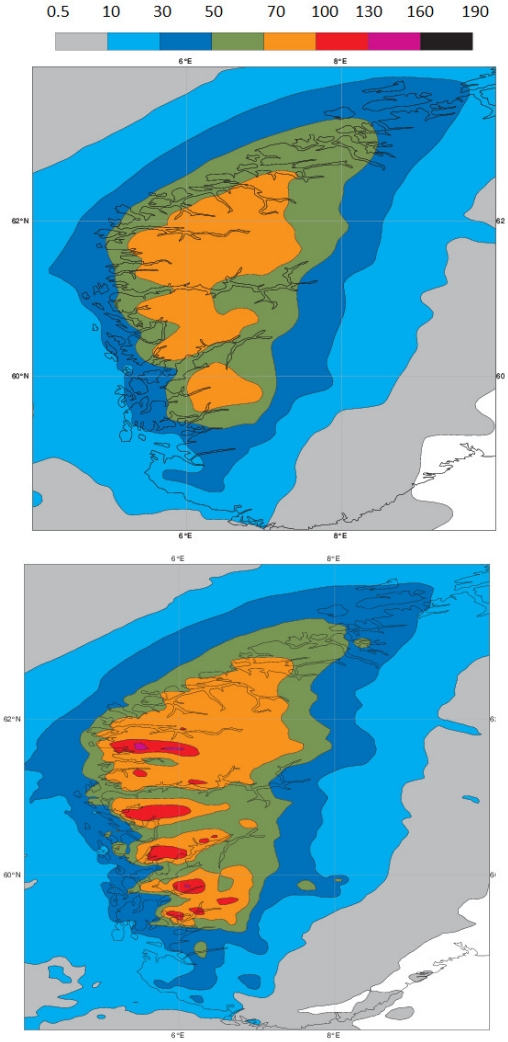

Figure 2. Top panel shows the 24-hour precipitation forecast from the 27 October 12 UTC for the current operational high resolution ECMWF model (upper panel) and. The bottom panel shows the same forecast but with a future version of the IFS-model (41r1) and the T1279 cubic grid (corresponding to 8 km grid resolution).

The forecast for the 28 October with the current model version shows a large area with more than 70 mm/24h (Figure 2, top panel), which indicates an underestimation of the peak intensity. With the future version, the precipitation pattern is much improved (Figure 2, bottom panel). The higher resolution gives a pattern following the orography better and the new physics package is likely to contribute to more intense precipitation (as also demonstrated for the cases of flooding in central Europe 2013 and Balkan 2014). This new model version will soon be more carefully tested with the full EFAS system to see the benefits of the improvements.

Flooding in France

During the autumn the countries around Mediterranean experienced several events of extreme rainfall which led to a large number of flash flood watches, flood watches and warnings (Table 1, Table 2, Figure 11-Figure 14). These events were in many cases very localised, which meant they were very difficult both to forecast and verify. During such an event on the evening of 6 October, Prades-le-lez north of Montpellier in southern France, received 260 mm in 6 hours. During this day Montpellier reported dry conditions and the other nearby stations had less than 10 mm. However, on the same day Toulon on the southern tip experienced heavy rain. According the EFAS observational data, a nearby station to Prades-le-lez received 20-30 mm, but still far from the measured extreme.

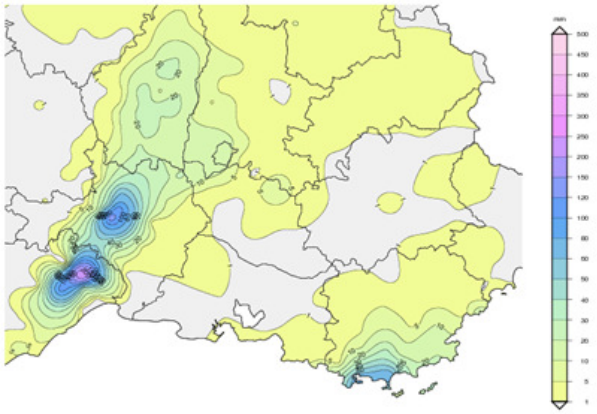

Figure 3. Observed precipitation 6 October 06UTC to 7 October 06UTC interpolated from Meteo-France. The scale goes from 1 mm up to 500 mm. (Courtesy of Meteo-France)

The localised very intense rainfall is clear from the interpolated data from Meteo-France (Figure 3). The severe event north of Montpellier was missed by the ECMWF forecast, as can be seen in Figure 4 (top panel). The ensemble forecast is from 00UTC 5 October and shows(probability for more than 20 mm/24h. The bottom panel shows the Meteo-France ensemble from 06UTC on the 5 October (shared via the TIGGE-

LAM project), which had a better signal for the worst affected area.

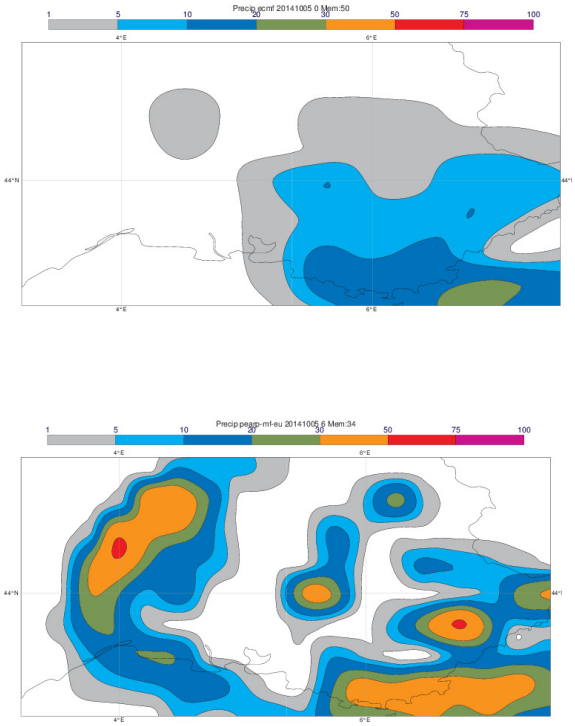

Figure 4. Probability for more than 20 mm/24h in ensemble forecasts for 6 October (issued 5 October 00UTC) from ECMWF (top) and Meteo-France bottom (issued 5 October 06UTC).

With the added information from Meteo-France this event would have been spotted and this highlights the vulnerability of a system based on only one forecast.

Verification

Figure 5 show CRPSS of EFAS driven by ECMWF ENS for a lead time of 5 days. Only catchments >4000km^2 are shown and the score is a 12-month average. The skill of the forecast is improving time, but there are inter-annual fluctuations.

The forecast bias for October-November indicates that the forecasted discharge was underestimated for most of the Mediterranean area (Figure 6, red color). The southern Balkan coast and the mid parts of Italy deviate from this pattern (Figure 6, blue color). One reason for this was that the forecast did not pin-point the exact location of the precipitation for this period, and that the amount was underestimated for the areas which were most affected by the floods.

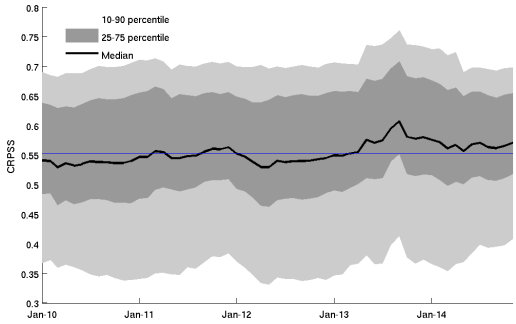

Figure 5. CRPSS for the period Jan 2010 - Nov 2014 for catchments >4000km^2 and lead time 5 days. The blue line denotes the mean over the entire period.

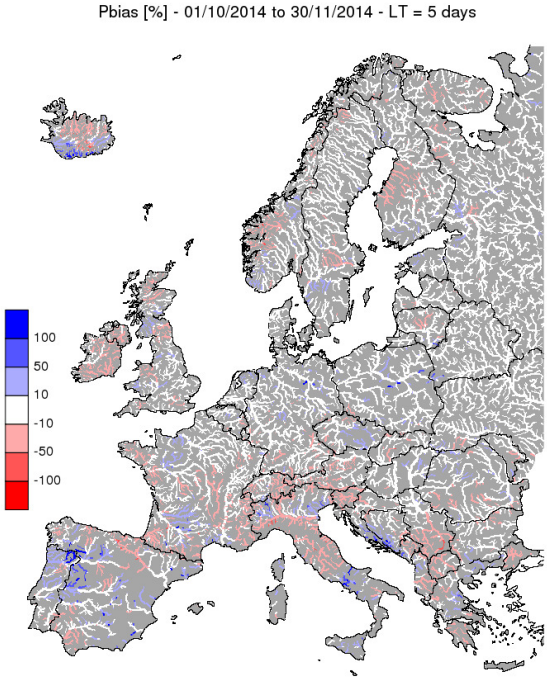

Figure 6. Percentage bias for lead time 5 days for EFAS driven by ECMWF ENS for October-November 2014. Blue (red) indicates that the forecast is wetter (drier) than the control rum with observed data.

Recent team publications

Lavers D.A., Pappenberger, F., Zoster, E., 2014, Extending medium-range predictability of extreme hydrological events in Europe, Nature Communications 5, Article nr: 5382, doi:10.1038/ncomms6382

Pagano, T.C., Wood, A.W., Ramos, M.H., Cloke, H.L, Pappenberger, F., Clark, M.P, Cranston, M., Kavetski, D., Mathevet, T., Sorooshian, S. and Verkade, J.S., 2014: Challenges of Operational River Forecasting. J. Hydrometeor, 15, 1692–1707. doi: http://dx.doi.org/10.1175/JHM-D-13-0188.1

Appendix - figures

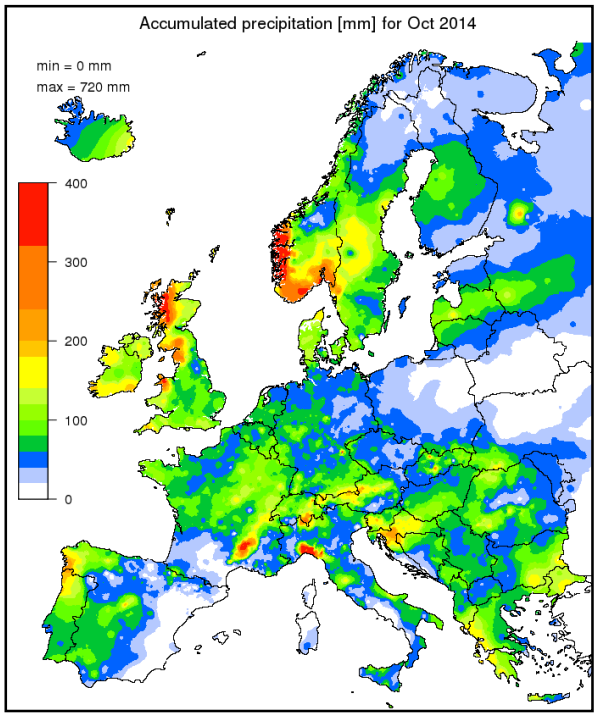

Figure 7: Accumulated precipitation [mm] for October 2014.

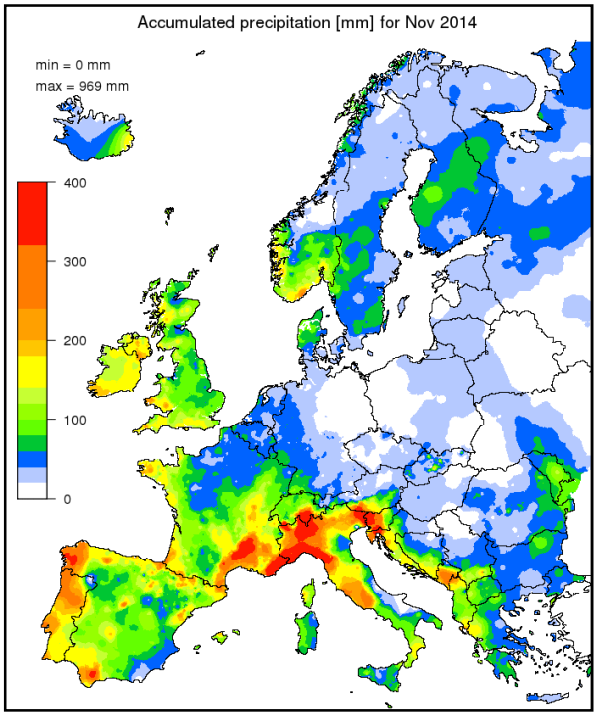

Figure 9: Accumulated precipitation [mm] for November 2014.

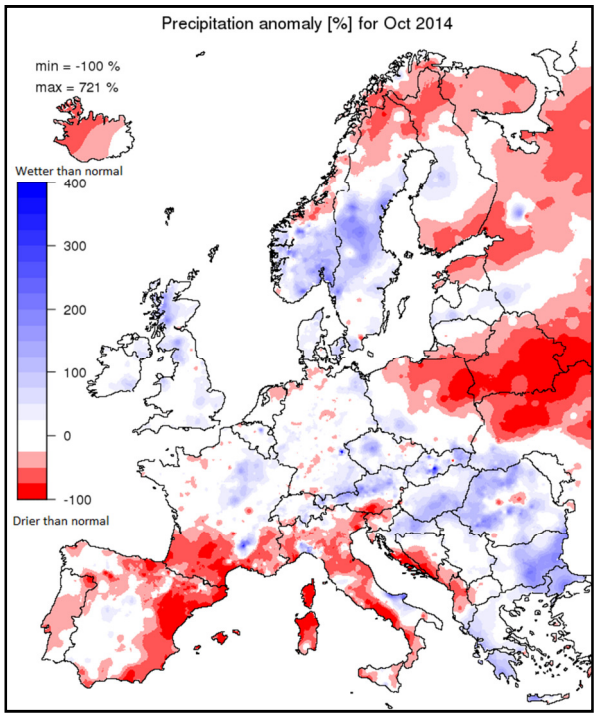

Figure 8: Precipitation anomaly [%] for October 2014, relatively to a long term average (1990-2011). Blue (red) denotes wetter (drier) conditions than normal.

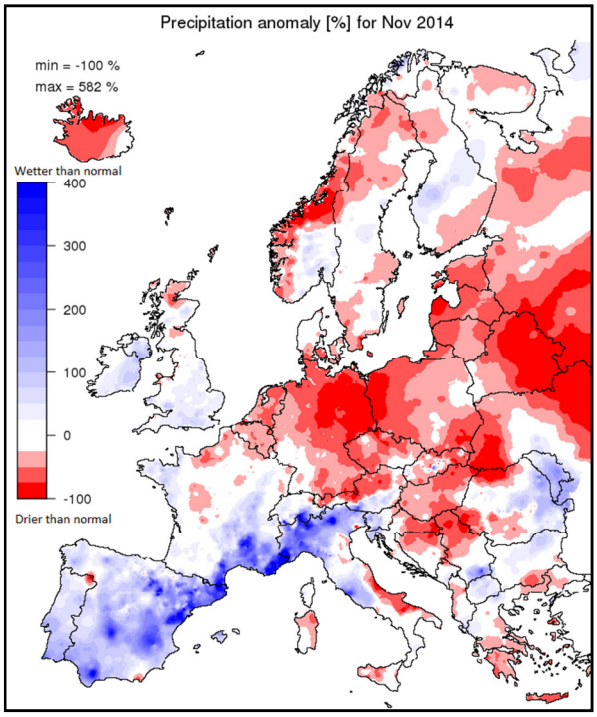

Figure 10: Precipitation anomaly [%] for November 2014, relatively to a long term average (1990-2011). Blue (red) denotes wetter (drier) conditions than normal.

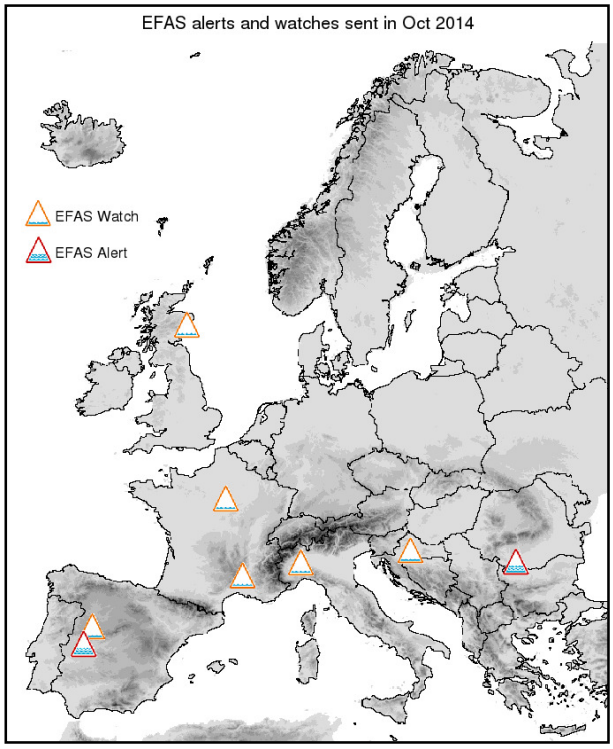

Figure 11: EFAS flood alerts and watches for October 2014.

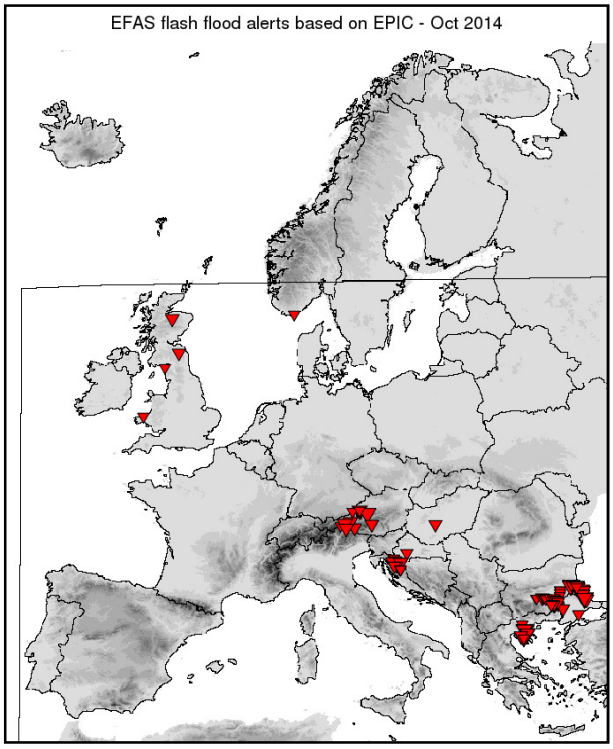

Figure 13: Flash flood reporting points for October 2014.

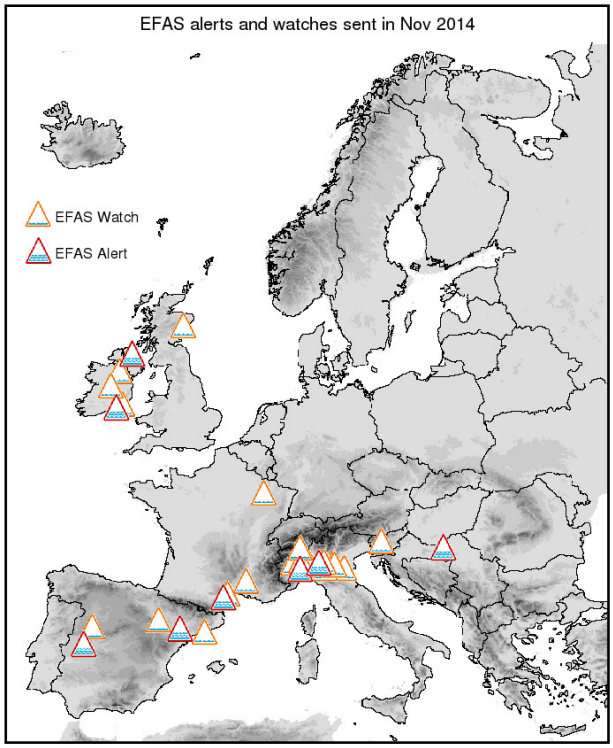

Figure 12: EFAS flood alerts and watches for November 2014.

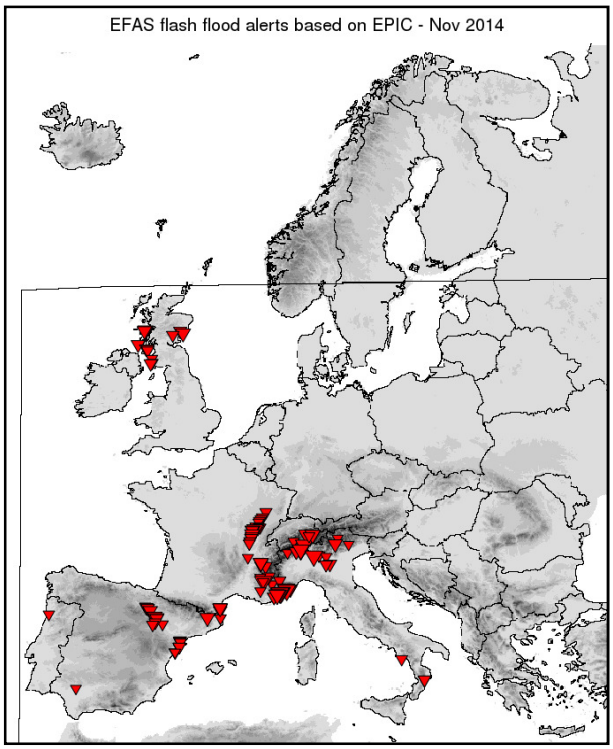

Figure 14: Flash flood reporting points for November 2014.

Acknowledgements

The following partner institutes are gratefully acknowledged for their contribution:

- DG Enterprise - Copernicus and DG ECHO for funding the EFAS Project.
- All data providers, including meteorological data providers, hydrological services and weather forecasting centres.
- The EFAS Operational Centres.