European Flood Awareness System

EFAS *Bulletin*

February – March 2015

Issue 2015(2)

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 in Zaragoza, Spain. Photo taken 1 March 2015.
Photo: https://www.flickr.com/photos/anvica/

EFAS news

Meetings

Boris Teunis (RWS) and Cristina Alionte Eklund (SMHI) were on an EU mission to Albania following the floods in February. A detailed report on the outcome of this mission is provided later in the Bulletin.

New partners

EFAS welcomes the Service Public de Wallonie, Belgium, and the Hydrometeorological Institut of Kosovo as new EFAS partners.

EFAS results

Meteorological situation for February - March 2015

The wet weather over southern Europe from previous months continued into February with heavy rainfall that led to floods in many parts of southeast Europe (Figure 9). Flood watches were sent out for the Danube and Great Morava River but there were reported floods in many other countries, including Greece, Albania and Macedonia. Later in the month, northern Spain and southern France were hit by heavy precipitation that led to flash floods in the Pyrenees and flood alerts for the Ebro River in Spain. For the central, eastern and northern Europe the weather was drier than normal, with the exception of parts of Norway and Scotland.

March showed a similar pattern as February with heavy precipitation over south-eastern Europe and the Mediterranean countries (Figure 11). The weather for the rest of Europe was normal or drier than normal, except for northwest Scotland (Figure 12).

Summary of EFAS flood alerts for February - March 2015

EFAS Flood Alerts and Flood Watches sent in February - March 2015 are summarized in Table 1 and their location are shown in Figure 13 and Figure 14.

Summary of flash flood watches for February - March 2015

In February 2015, 28 flash flood reporting points were detected by EPIC (Figure 15), having probability 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 24 - 66 hours, with average lead time of 40 hours. Catchment size of flash flood alerts is in the range 52 - 2279 km^2, with average size of 539 km^2.

In March 2015, 141 flash flood reporting points were detected by EPIC (Figure 16), having probability 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 12 - 72 hours, with average lead time of 32 hours. Catchment size of flash flood alerts is in the range 51 - 4915 km^2, with average size of 1114 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 15 and Figure 16.

Table 1: EFAS flood alerts sent in February-March 2015

Type	Forecast date	Issue date	Lead time*	River	Country
Watch	01/02/2015 00 UTC	01/02/2015	0	Danube, section Arges - Ialom	Romania
Watch	02/02/2015 12 UTC	03/02/2015	0	Ebro, section Huerva - Cinca	Spain
Watch	03/02/2015 12 UTC	04/02/2015	2	Morava, above Nisava	Serbia
Watch	08/02/2015 00 UTC	08/02/2015	0	Morava, above Nisava	Serbia
Alert	22/02/2015 00 UTC	22/02/2015	4	Ebro, section Huerva - Cinca	Spain
Alert	22/02/2015 00 UTC	22/02/2015	4	Ebro, section Gallego - Jalon	Spain
Alert	22/02/2015 00 UTC	22/02/2015	4	Ebro, section Aragon - Jalon	Spain
Alert	22/02/2015 00 UTC	22/02/2015	3	Ebro, section Aragon - Jalon	Spain
Watch	23/02/2015 00 UTC	23/02/2015	3	Lonja, Ilova & Pakra	Croatia

Watch	23/02/2015 00 UTC	23/02/2015	2	Hron	Slovakia
Watch	22/02/2015 12 UTC	23/02/2015	3	Morava, above Nisava	Serbia
Watch	03/03/2015 00 UTC	03/03/2015	2	Morava, above Nisava	Serbia
Alert	17/03/2015 00 UTC	17/03/2015	0	Morava, above Nisava	Serbia
Alert	21/03/2015 00 UTC	21/03/2015	1	Ebro, section Gallego - Jalon	Spain
Watch	21/03/2015 12 UTC	22/03/2015	3	Turia	Spain
Watch	27/03/2015 12 UTC	28/03/2015	1	Sava, below Drina	Serbia

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

Table 2: EFAS flash flood watches sent in February-March 2015

Type	Forecast date	Issue date	Lead time*	River	Country
FF Watch	05/02/2015 00 UTC	05/02/2015	30	Italy - Po, section Adda - Oglio	Italy
FF Watch	24/02/2015 00 UTC	24/02/2015	54	Spain - Aragon	Spain
FF Watch	23/02/2015 12 UTC	24/02/2015	66	France - Gave	France
FF Watch	23/02/2015 12 UTC	24/02/2015	66	France - Gave	France
FF Watch	23/02/2015 12 UTC	24/02/2015	66	France - Garonne, above Ariege	France
FF Watch	04/03/2015 00 UTC	04/03/2015	36	Serbia and Montenegro – coastal	no value
FF Watch	03/03/2015 12 UTC	04/03/2015	48	Albania – Moraca	Albania
FF Watch	04/03/2015 12 UTC	05/03/2015	36	Albania – Vjose	Albania
FF Watch	06/03/2015 12 UTC	07/03/2015	30	UK - Orrin & Black Water	United
FF Watch	16/03/2015 00 UTC	16/03/2015	36	no value	France

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

Report from Early warning mission to Albania

by Boris Teunis, RWS

After the floods in Albania in early February, the government of Albania requested EU assistance for emergency relief. Several countries offered assistance and EU sent a civil protection team for coordination. After this mission it was decided that a second two-week EU civil protection mission would take place with focus on improvement of early warning and emergency management. The team for this visit consisted of three people; one covering early warning and the other focused on emergency management. The EU asked for assistance from JRC in filling the early warning position. JRC forwarded the request to the EFAS partners and SMHI, Sweden (Cristina Eklund) and RWS, the Netherlands (Boris Teunis) each provided a member of staff for one week to cover this role.

The aim of the team was to contribute to the broader Post Disaster Needs Assessment (PDNA) on the topics of early warning and emergency management. The team worked on identifying the current situation of early warning and civil protection in order to assess the steps required to improve prevention, preparedness, early warning and response. Following the PDNA, the EU, WB and UN will determine the next steps to support the implementation of the recommendations.

Figure 1. The EU expert team for the first week from left to right: Peter Glerum, Gabrielle Proietti and Cristina Eklund. Behind them is Shemsi Prençi, the director of the Albanian civil protection.

The early warning experts focused on the technical and organizational part of early warning, on risk analysis and awareness. Regarding risk analysis, large areas still lack flood hazard and flood risk maps. Ideally advanced modelling would result in detailed maps, but alternatively an interactive approach using the knowledge of inhabitants can deliver similar results. Such an approach has the advantage that planning and raising awareness can be combined with analysis. Raising awareness is especially important because many inhabitants recently moved to the flood risk areas. They therefore miss the historical knowledge about risks and the possibilities for dealing with up-coming floods.

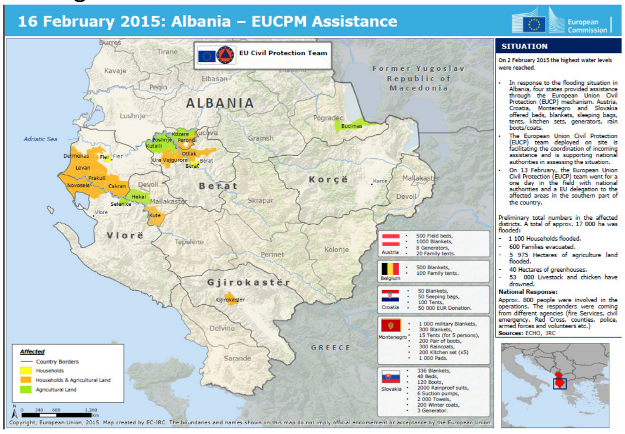

Figure 2. The areas In Albania that were affected by the flooding. Map from EU humanitarian aid and civil protection website.

For early warning, the availability of data from automatic hydro-meteorological stations is essential. Although these stations are available, processes for maintenance and procedures for data handling are lacking. This seriously diminishes the availability of the necessary data. It is very positive that the Albanian warning centre has a daily process and bulletin to warn for floods and other natural disasters. Several steps can be made to increase performance of EFAS for Albania. Historical data are available and transmitting these to the EFAS hydrological data collection centre will most likely have a positive effect. In addition, an improvement of the river network is a relatively easy step which will improve the usefulness of the EFAS output

Release of a new ECMWF model cycle

by Fredrik Wetterhall and Linus Magnusson, ECMWF

If all goes well, ECMWF will release its new model cycle 41r1 on 12th May this year. This will replace the old cycle 40r1 which have been in use since November 2013. The model has changed significantly since the last version, and although the increase in horizontal resolution will be saved for the next upgrade, there are large improvements in the ECMWF deterministic and ensemble forecasts which will have impact on the hydrological modelling in EFAS.

One of the most important improvements is in the cloud physics, where the precipitation formation in the clouds has substantially improved (see the case study of the European floods in 2013 in the August – September bulletin from last year). There have also been modifications to the convection scheme, activation of the lake model along with a new land-sea mask and orography. Users can now also get as output the risk for super-cooled “freezing rain”.

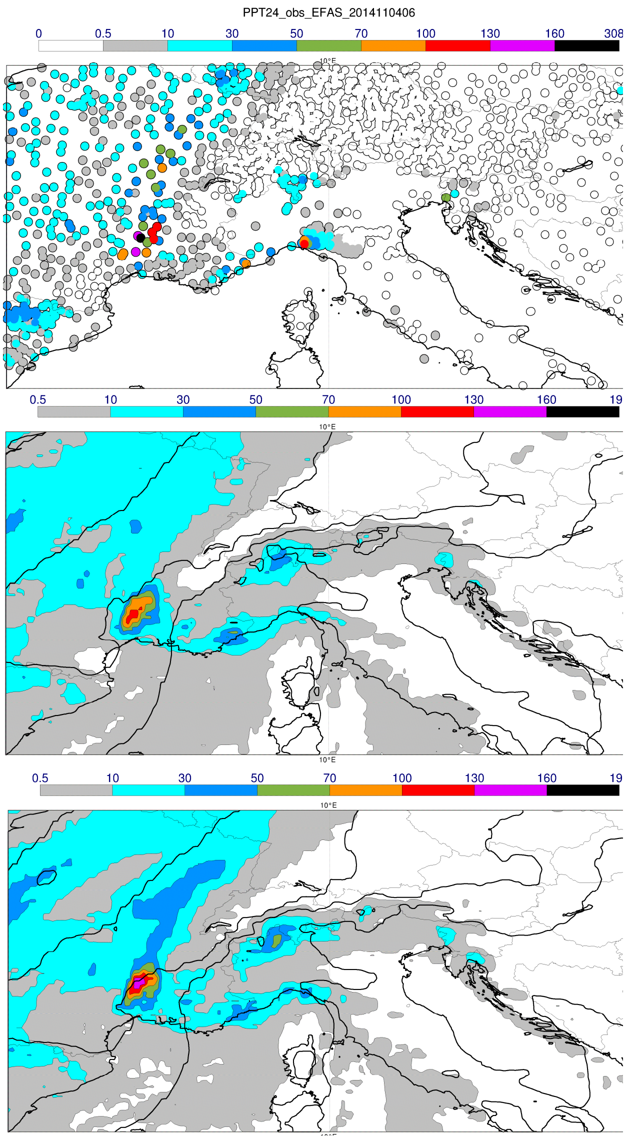

Figure 3. Accumulated precipitation from 3-4 November 2014 (06UTC-06UTC) from observations (top), forecasted 31 October 12UTC from current operational suite (middle) and with the new suite (bottom).

So how do these changes affect EFAS? To be able to test the implications, the release of a new model version is always accompanied by an experimental model suite which runs in parallel in order to test the impact of the new model version. We ran an EFAS experiment from November 2014 to February 2015 to test how the new model cycle would perform with regards to EFAS.

The new model cycle captures extreme precipitation better than the current one, as can be seen in a case study from an intense precipitation event in November 2014 (Figure 3). The estimates of both the location and intensity of the precipitation improve compared to the current operational model. The improvement in precipitation is also reflected in the discharge. Figure 4 shows the continuous ranked probability skill score over the European domain, where new model cycle shows improvement or neutral scores for most part of the continent. There are areas in Northern Finland and Sweden where the new cycle performed worse, however since we are looking at winter time there are large uncertainties in snow-dominated catchments.

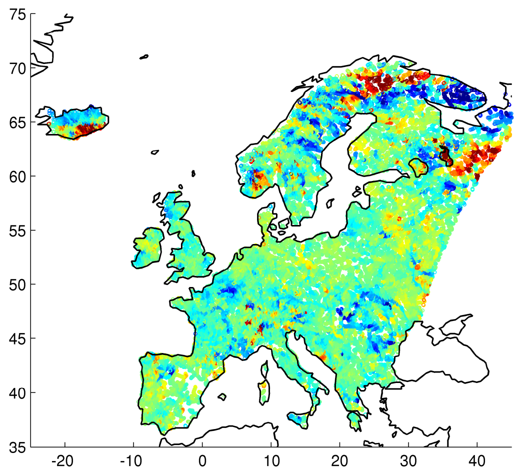

Figure 4. Continuous ranked probability skill score for modelled discharge at lead time 2 days. Blue (red) means that the new model performs better (worse) than the operational model. Green-yellow means that there is no difference in performance.

The mean absolute error is smaller for the new suite than the current (Figure 5), and this is true both for the ensemble forecast and the deterministic forecast. The gain in the forecast quality is going to be most pronounced in the high intensity rainfall cases (Figure 3), as well as for high discharges.

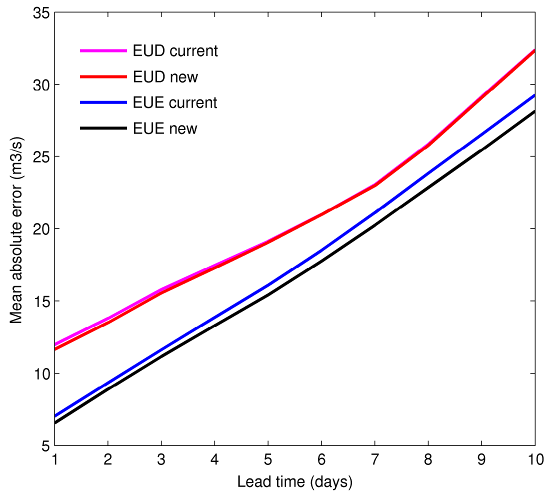

Figure 5. Mean absolute error over 679 test basins over the EFAS domain

Figure 6 shows the hit rate averaged over the entire domain. The hit rate is estimated by counting the number of forecast hits and dividing with the total number of forecast hits and misses for different probabilities of being above a threshold. In this case the threshold is the 2-year return period. A score of 1 is a perfect forecast. Here it is clear that the new model outperforms the current one. The new model however has more false alarms (not shown) which indicates that it also enhances the forecasts that are wrong. In short it is more sensitive to extreme events.

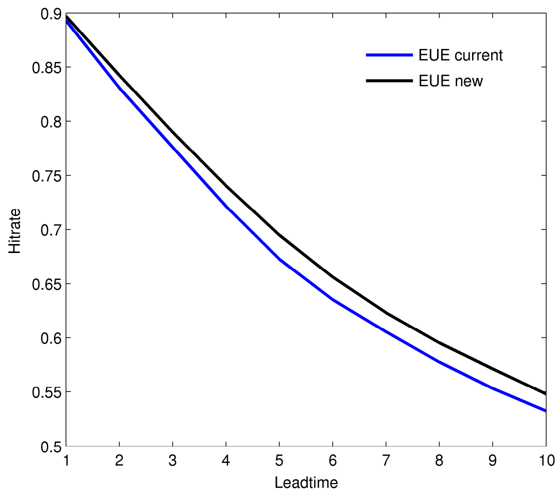

Figure 6. Hit rate over the 2-year return period threshold as a function of Lead time. The hit rate is averaged of the entire domain and probabilities for issuing a hit.

The results should be taken with care, since there was an error in the implementation of the new climate fields which caused 5km-northward shift of the forecasts. This error has since then been rectified and new experiments have been started, however these were not ready at the time of this bulletin.

Nevertheless, the results are promising in terms of how the modelling of the important surface variables (i. e. temperature, evapotranspiration and precipitation) are constantly improving. The current model improvement are mainly a result of better model physics as well as improved climate fields (land-sea mask, orography). The big improvement can however be expected in the next resolution upgrade which is planned for next year. The new resolution will be in 8-10 km for the high resolution model in comparison to the 16 km resolution in the current version.

Verification

When looking at the EFAS verification scores for the last period, there has been a drop in performance which is quite significant for the last months (Figure 7). One explanation to the drop in performance can be found in the ECMWF forecasts of precipitation, which has a similar drop in performance (Figure 8). This winter was indeed difficult to predict due to its high variability and the scores for other operational global NWP's dropped as well.

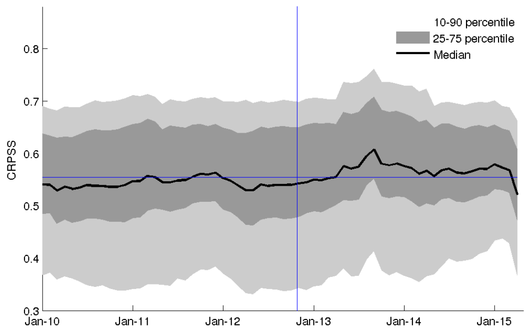

Figure 7. CRPSS over for EFAS discharge forecasts driven by ECMWF's ensemble forecasts over the entire domain.

This highlights the necessity to use verification scores over long time periods to filter out climate variability, which will affect the predictability and in turn the performance of the forecasts on a seasonal to annual basis. As shown above, the new model cycle did perform better than the current one, so we might expect that the scores will improve in the future. However, there will always be times when the scores deteriorate due to variability of the predictability of the weather itself.

Figure 8. The day at which CRPSS the ECMWF ensemble forecast of precipitation drops below 10%. This is a secondary headline score for ECMWF.

Recent team publications

Nobert, S., Krieger, K and Pappenberger, F., 2015, Understanding the roles of modernity, science, and risk in shaping flood management, WIREs Water 2015. doi: 10.1002/wat2.1075

Revilla-Romero, B., Thielen, J., Salamon, P., De Groeve, T., and Brakenridge, G. R.: Evaluation of the satellite-based Global Flood Detection System for measuring river discharge: influence of local factors, Hydrol. Earth Syst. Sci., 18, 4467-4484, doi:10.5194/hess-18-4467-2014

Appendix - figures

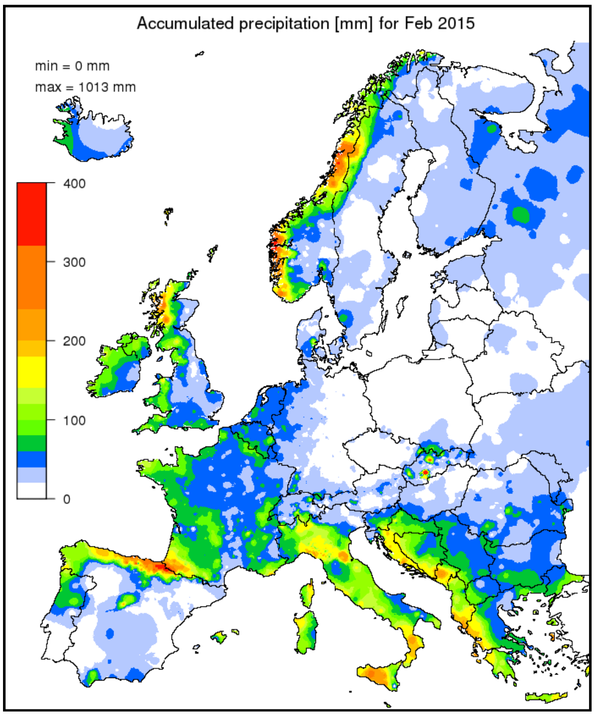

Figure 9: Accumulated precipitation [mm] for February 2015.

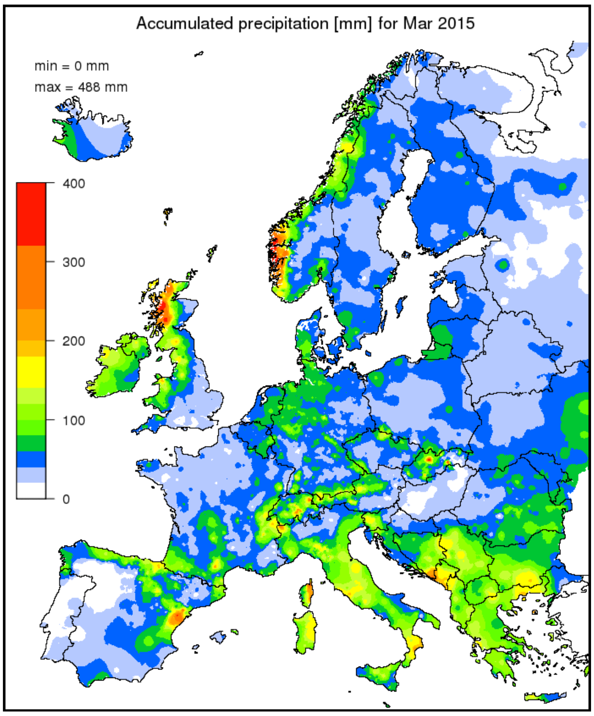

Figure 11: Accumulated precipitation [mm] for March 2015.

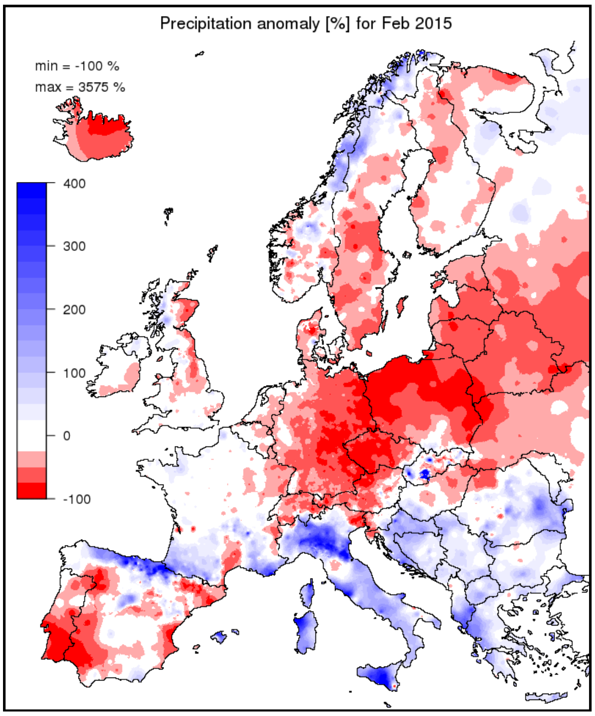

Figure 10: Precipitation anomaly [%] for February 2015, relatively to a long term average (1990-2011). Blue (red) denotes wetter (drier) conditions than normal.

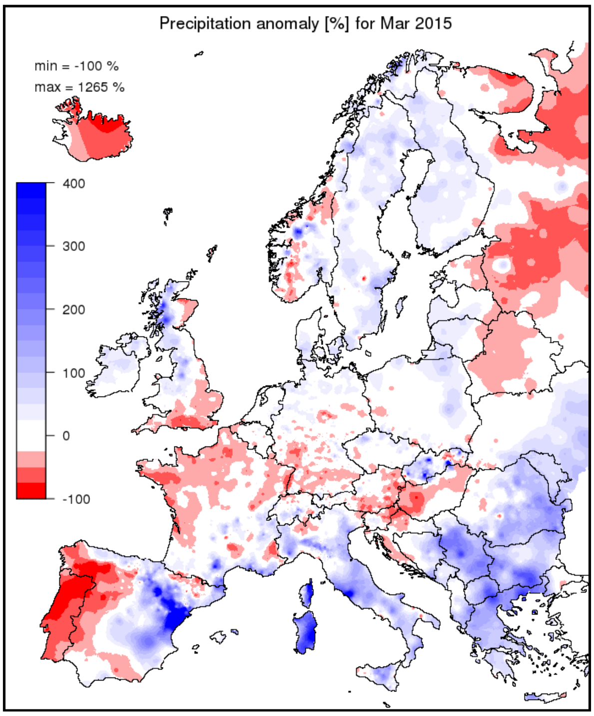

Figure 12: Precipitation anomaly [%] for March 2015, relatively to a long term average (1990-2011). Blue (red) denotes wetter (drier) conditions than normal.

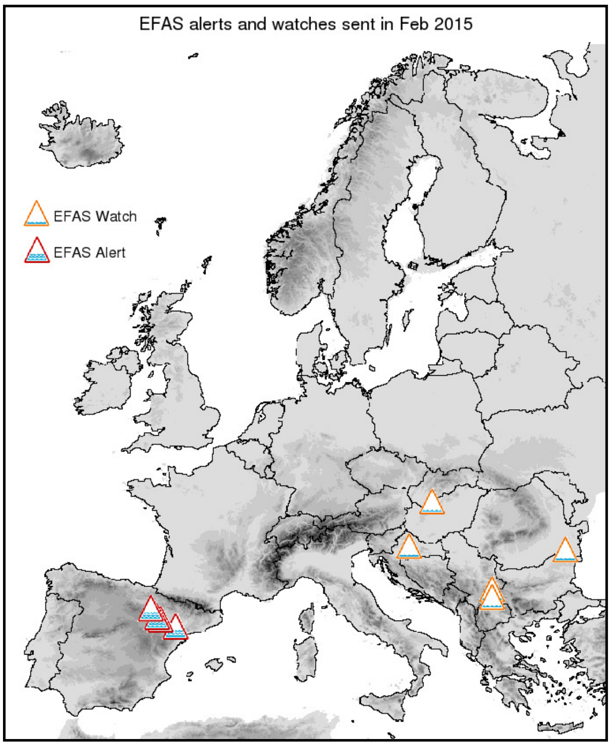

Figure 13: EFAS flood alerts and watches for February 2015.

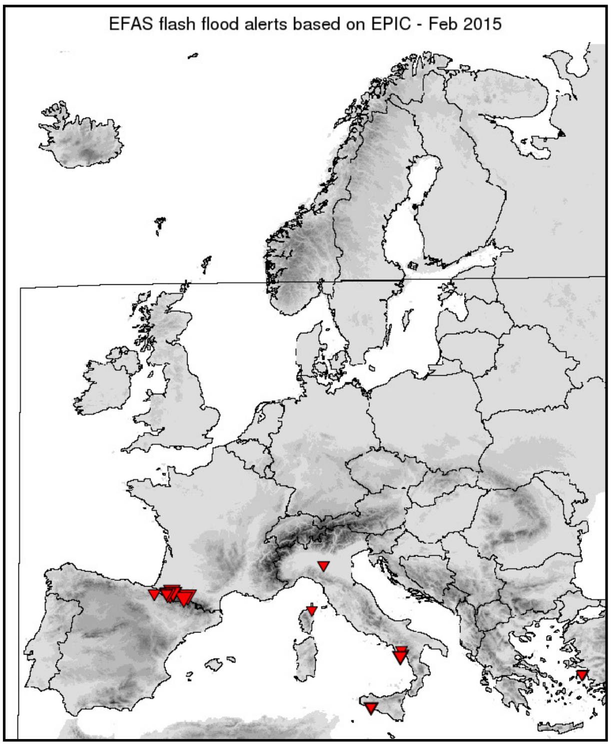

Figure 15: Flash flood reporting points for February 2015.

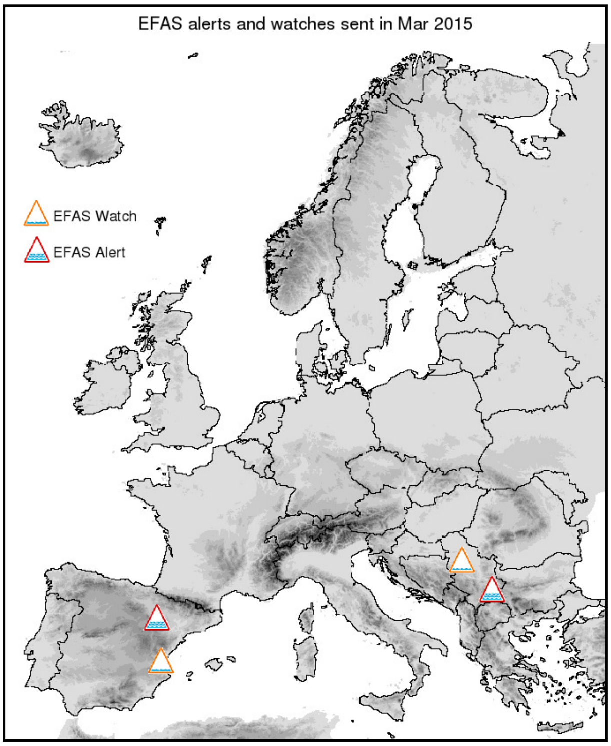

Figure 14: EFAS flood alerts and watches for March 2015.

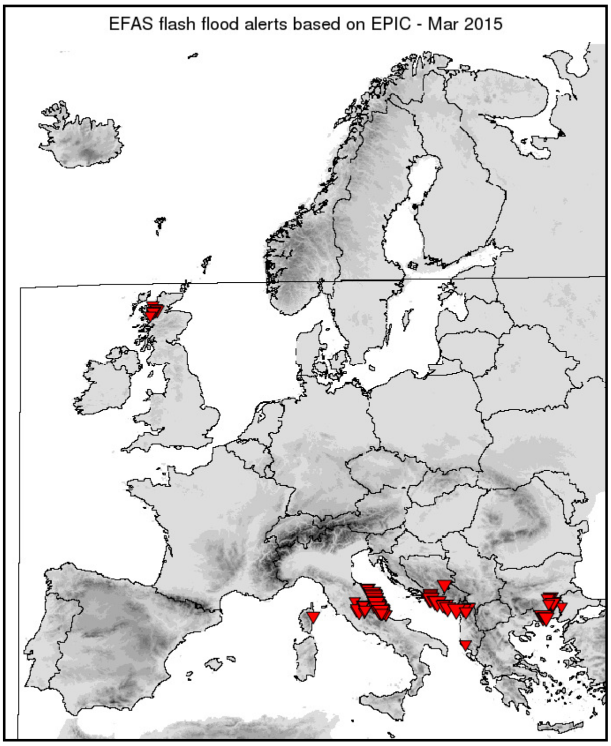

Figure 16. Flash flood reporting points for March 2015.

Acknowledgements

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- All data providers, including meteorological data providers, hydrological services and weather forecasting centres
- The EFAS Operational Centres
- Boris Teunis of RWS for providing the report from the Albania meeting
- Linus Magnusson for providing the precipitation analysis of the new model cycle