ECMWF

European Flood Awareness System

EFAS *Bulletin*

December 2014 – January 2015

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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 in Pangbourne, January 2014, United Kingdom.
Photographer: Fredrik Wetterhall

EFAS news

EFAS tender

In December, the second generation of operational EFAS contracts including meteorological data collection, hydrological data collection, computations and dissemination was published. Like under the current outsourcing of EFAS, the new tenders are also framework contracts. The duration of the new contracts is 6 years.

New features and updates

A collection of all available EFAS videos including webcasts, online lectures and overview videos is now available under the "About" tab on www.efas.eu. This contains at the moment the EFAS overview video produced by the Norrköping Visualization Centre, an online training lecture of the EFAS principles provided during the Eumetrain event week for droughts, floods and landslides, and the use of H-SAF products in EFAS presented at the H-SAF and HEPEX workshops on coupled hydrology.

EFAS will support the "European Gravity Service for Improved Emergency Management (EGSIEM)" project as a test bed for its near-real time indicators for extreme hydrological events. EGSIEM is a Horizon 2020 project that has the aim to (1) establish a scientific combination service to deliver the best gravity products for applications in Earth and environmental science research, (2) to establish a near real-time and regional service to reduce the latency and increase the temporal resolution of the mass redistribution products, and (3) to establish a hydrological and early warning service to develop gravity-based indicators for extreme hydrological events and to demonstrate their value for flood and drought forecasting/monitoring services. The gravity-based indicators for floods will be incorporated into EFAS as added value product and to receive feedback from end-users in the EFAS community.

New partners

We welcome Hydrometeorological Service, Republic of Macedonia as new EFAS partner. They joined in December 2014.

EFAS results

Meteorological situation for December 2014 - January 2015

December started with heavy rains that hit Italy, Greece, Bulgaria and southern Romania which caused problems with flash-floods, flooded rivers and ice storms in the affected area. The weather in December 2014 was otherwise normal or drier than normal for most parts of Europe for the time of year, with the exception of Northwest Europe, including areas south of the Baltic Sea (Figure 3 and Figure 4). The end of the year saw heavy precipitation in Italy, Greece and Albania, which led to snow and flash floods.

The new year brought in a number of storms from the Atlantic, which resulted in wetter than normal weather in most of Northern and central Europe (Figure 5 and Figure 6). At the end of January southeast Europe (Greece, Albania and Macedonia) were hit with heavy precipitation which led to a number of flash floods in the area as well as extensive floods. The floods have continued into February.

Summary of EFAS flood alerts for December 2014 - January 2015

EFAS Flood Alerts and Flood Watches sent in December 2014 - January 2015 are summarized in Table 1 and their location are shown in Figure 7 and Figure 8.

Summary of flash flood watches for December 2014 - January 2015

In December 2014, 46 flash flood reporting points were detected by EPIC (Figure 9), 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 6 - 96 hours, with average lead time of 31 hours. The catchment size of flash flood alerts is in the range 55 - 4852 km^2, with an average size of 1100 km^2.

In January 2015, 130 flash flood reporting points were detected by EPIC (Figure 10), 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 - 120 hours, with average lead time of 44 hours. The catchment size of flash flood

alerts is in the range 56 - 4995 km^2, with an average size of 1400 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 9 and Figure 10.

Table 1: EFAS flood alerts sent in December 2014-January 2015

Type	Forecast date	Issue date	Lead time*	River	Country
Alert	07/12/2014 00 UTC	07/12/201	2	Vedea	Romania
Watch	07/12/2014 00 UTC	07/12/201	0	Danube, section Arges - Ialom	Romania
Watch	15/12/2014 00 UTC	15/12/201	1	Po, below Oglio	Italy
Watch	23/12/2014 12 UTC	24/12/201	0	Eider	Germany
Alert	09/01/2015 12 UTC	10/01/201	2	Peene	Germany
Watch	28/01/2015 00 UTC	28/01/201	2	Ebro, above Aragon	Spain
Watch	29/01/2015 00 UTC	29/01/201	2	Seman	Albania

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

Table 2: EFAS flash flood watches sent in December 2014-January 2015

Type	Forecast date	Issue date	Lead time*	River	Country
FF Watch	27/12/2014 12 UTC	28/12/201	30	Albania - Vjose	Albania
FF Watch	27/12/2014 12 UTC	28/12/201	42	Albania - Seman	Albania
FF Watch	27/12/2014 12 UTC	28/12/201	42	Albania - Mat	Albania
FF Watch	29/01/2015 00 UTC	29/01/201	42	Serbia and Montenegro - Lim	Montenegro
FF Watch	28/01/2015 12 UTC	29/01/201	66	Albania - Vjose	Albania
FF Watch	30/01/2015 00 UTC	30/01/201	24	Spain - Esla, below Orbigo	Spain
FF Watch	30/01/2015 00 UTC	30/01/201	30	Spain - Pas	Spain
FF Watch	30/01/2015 00 UTC	30/01/201	36	Spain - Segura	Spain
FF Watch	30/01/2015 00 UTC	30/01/201	36	Spain - Segura	Spain
FF Watch	29/01/2015 12 UTC	30/01/201	36	Spain - Orbigo	Spain
FF Watch	29/01/2015 12 UTC	30/01/201	36	Spain - Sil	Spain
FF Watch	29/01/2015 12 UTC	30/01/201	36	Spain - Esla, above Orbigo	Spain
FF Watch	29/01/2015 12 UTC	30/01/201	36	Spain - Esla, above Orbigo	Spain
FF Watch	29/01/2015 12 UTC	30/01/201	36	Spain - Deva	Spain
FF Watch	31/01/2015 00 UTC	31/01/201	36	Albania - Seman	Albania
FF Watch	30/01/2015 12 UTC	31/01/201	12	Albania - Vjose	Albania
FF Watch	30/01/2015 12 UTC	31/01/201	30	Spain - Guadiana Menor	Spain

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

Results from the recent survey on the Bulletin

by Fredrik Wetterhall and Florian Pappenberger

A survey at the EFAS general meeting in 2014 showed that the bulletin is appreciated, but that it is not fully distributed in the EFAS partner organisations. Therefore, an online questionnaire was sent out to the EFAS user community at the end of December 2014 (directly after the last bulletin was released) with more specific questions regarding the bulletin.

The survey was answered by 58 of the 265 who received the email (21%). The respondents were in general positive to the content of the bulleting which may be biased. The survey concluded that:

- Less than 7% stated that they never read the bulletin, over 40% answered that they sometimes do, and over 50% claimed that they often or always read it.
- The most appreciated features were the precipitation maps and the meteorological situation.
- Verification and Meteorologists' comment were ranked as the most important parts of the bulletin.
- The length and format of the current version of the bulletin was supported, and 44% are in favour of having everything online.
- Almost 60% are in favour of additional information online and a majority is positive to be able to give comments online
- Forecasters (>80%), followed by researchers and non-experts are the most important group that the bulletin should target according to the responses

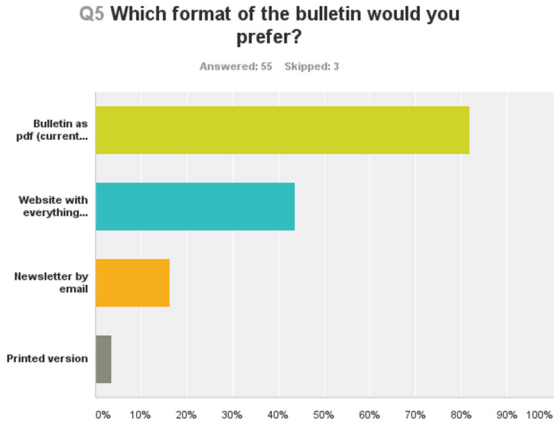

Figure 1: Response graph to Question 5: Which format of the bulletin would you prefer? The answers are (top to bottom). Current format (pdf), website, newsletter and printed

The survey is not a full account of all the opinions of the EFAS users, but it can give a hint as to what is expected from the bulletin. It is clear that many points are appreciated, but given that "Verification" ranked as very important (4.30) but did not receive as high ranking in the performance, indicates that there is room for improvement. There is still a need for a pdf-version of the bulletin, but there is also a clear initiative to improve many aspect of the bulletin.
The survey also allowed for any other comments to be raised and some of the constructive suggestions were:

- Better presentation of the institutes involved
- Improve the verification to include comparison with other NWPs and systems
- Include historical floods
- HEPEX-type blogs
- Reduce the number of issues
- Articles on how forecasters use EFAS

The conclusions drawn from the study and the online survey is that the current reporting on verification in the printed bulletin is appreciated but not adequate. It can be extended and improved (see below for discussion on the benchmark forecast). In the future, the scores should be published online to make them available on demand of the forecasters.

Towards a new verification

by Fredrik Wetterhall and Florian Pappenberger

Skill in a forecasting system is most often represented as a skill score, which is a measure to compare a score of a particular type against a *benchmark*, which is not a forecast in its real sense. A benchmark can be described as the "best possible forecast I can make without using forecast driving data". EFAS currently uses climatology (or naïve forecast) as the benchmark. This is known to be too easy to beat and therefore does not fully express the skill of the forecast. However, since climatology is easy to implement, this was done as a first step. To explore the best possible benchmark the EFAS team recently performed an extensive study to determine which the optimal benchmark was. The conclusion is that it depends on what part of the hydrograph you are interested in, and that more than one benchmark should be used. For more information on the study, please see Pappenberger et al. (2015) under team publications. Below is the abstract of the paper.

Abstract of: "How do I know if my forecasts are better? Using benchmarks in hydrological ensemble prediction"
"The skill of a forecast can be assessed by comparing the relative proximity of both the forecast and a benchmark to the observations. Example benchmarks include climatology or a naïve forecast. Hydrological ensemble prediction systems (HEPS) are currently transforming the hydrological forecasting environment but in this new field there is little information to guide researchers and operational forecasters on how

benchmarks can be best used to evaluate their probabilistic forecasts. In this study, it is identified that the forecast skill calculated can vary depending on the benchmark selected and that the selection of a benchmark for determining forecasting system skill is sensitive to a number of hydrological and system factors. A benchmark intercomparison experiment is then undertaken using the continuous ranked probability score (CRPS), a reference forecasting system and a suite of 23 different methods to derive benchmarks. The benchmarks are assessed within the operational set-up of the European Flood Awareness System (EFAS) to determine those that are 'toughest to beat' and so give the most robust discrimination of forecast skill, particularly for the spatial average fields that EFAS relies upon.
Evaluating against an observed discharge proxy the benchmark that has most utility for EFAS and avoids the most naïve skill across different hydrological situations is found to be meteorological persistency. This benchmark uses the latest meteorological observations of precipitation and temperature to drive the hydrological model. Hydrological long term average benchmarks, which are currently used in EFAS, are very easily beaten by the forecasting system and the use of these produces much naïve skill. When decomposed into seasons, the advanced meteorological benchmarks, which make use of meteorological observations from the past 20 years at the same calendar date, have the most skill discrimination. They are also good at discriminating skill in low flows and for all catchment sizes. Simpler meteorological benchmarks are particularly useful for high flows.
Recommendations for EFAS are to move to routine use of meteorological persistency, an advanced meteorological benchmark and a simple meteorological benchmark in order to provide a robust evaluation of forecast skill. This work provides the first comprehensive evidence on how benchmarks can be used in evaluation of skill in probabilistic hydrological forecasts and which benchmarks are most useful for skill discrimination and avoidance of naïve skill in a large scale HEPS. It is recommended that all HEPS use the evidence and methodology provided here to evaluate which benchmarks to employ; so forecasters can have trust in their skill evaluation and will have confidence that their forecasts are indeed better."

Current verification

The study was done using the test system and the new verification suite is currently being implemented in the operational suite. Therefore we cannot yet show the verification results in using the new benchmark so the verification result in Figure 2 is with the current verification method.

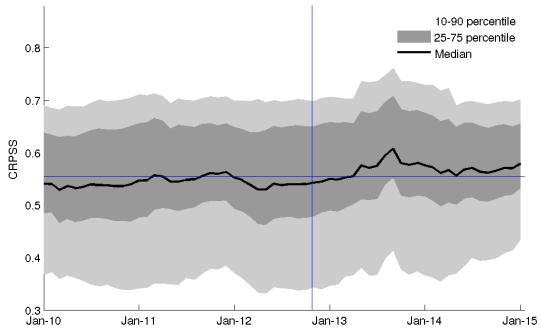

Figure 2. CRPSS for EFAS run by ECMWF ensemble 2010-2015 for the points in EFAS with an area of at least 4000 km.

The blue horizontal line in Figure 2 shows the mean performance over the entire period 2010-2015 and the vertical line indicates when EFAS went fully operational in October 2012.

Recent team publications

Alfieri, L., Burek, P., Feyen, L., and Forzieri, G.: Global warming increases the frequency of river floods in Europe, Hydrol. Earth Syst. Sci. Discuss., 12, 1119-1152, doi:10.5194/hessd-12-1119-2015, 2015. http://www.hydrol-earth-syst-sci-discuss.net/12/1119/2015/hessd-12-1119-2015-discussion.html

Pappenberger, F., Ramos, M.-H., Cloke, H. L., Wetterhall, F., Alfieri, L. Bogner, K., Mueller, A., Salamon, P., How do I know if my forecasts are better? Using benchmarks in Hydrological Ensemble Predictions, Journal of Hydrology, doi:10.1016/j.jhydrol.2015.01.024, 522, 697-713, 2015. http://www.sciencedirect.com/science/article/pii/S0022169415000414

Appendix - figures

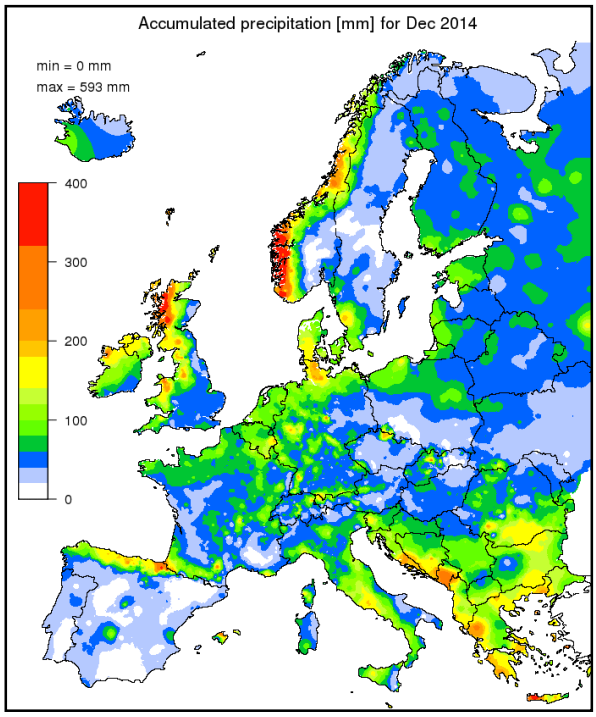

Figure 3: Accumulated precipitation [mm] for December 2014.

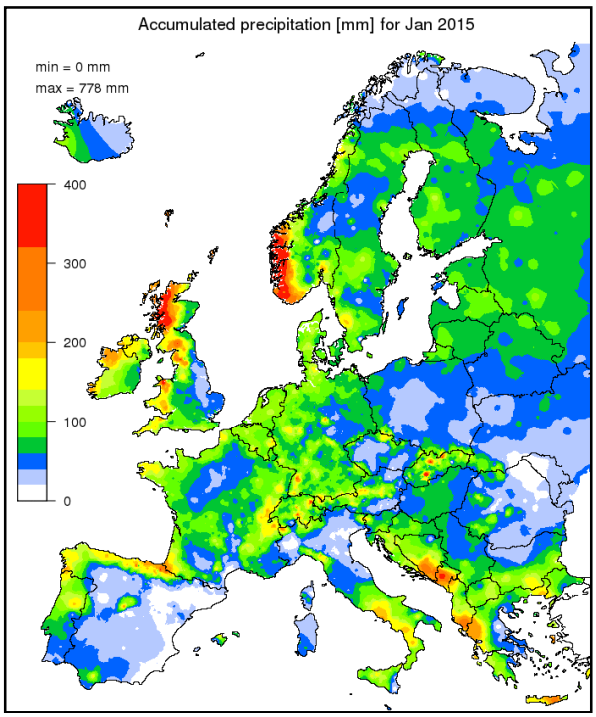

Figure 5: Accumulated precipitation [mm] for January 2015.

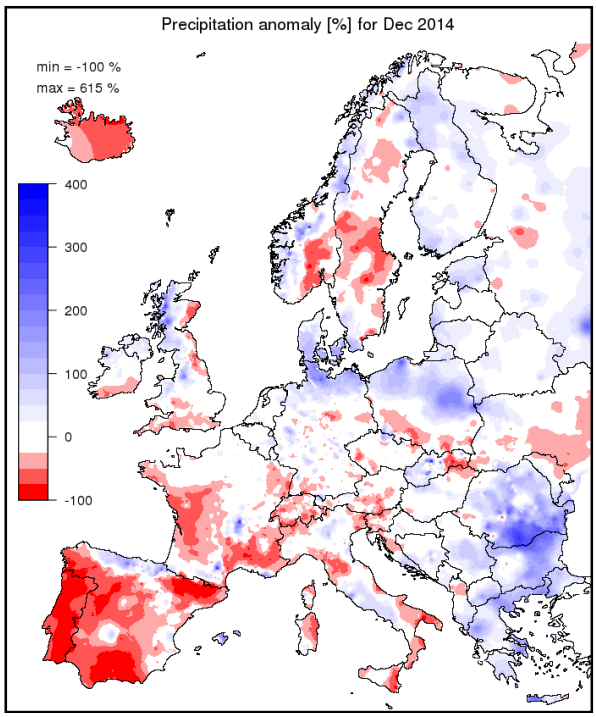

Figure 4: Precipitation anomaly [%] for December 2014, relatively to a long term average (1990-2011). Blue (red) denotes wetter (drier) conditions than normal.

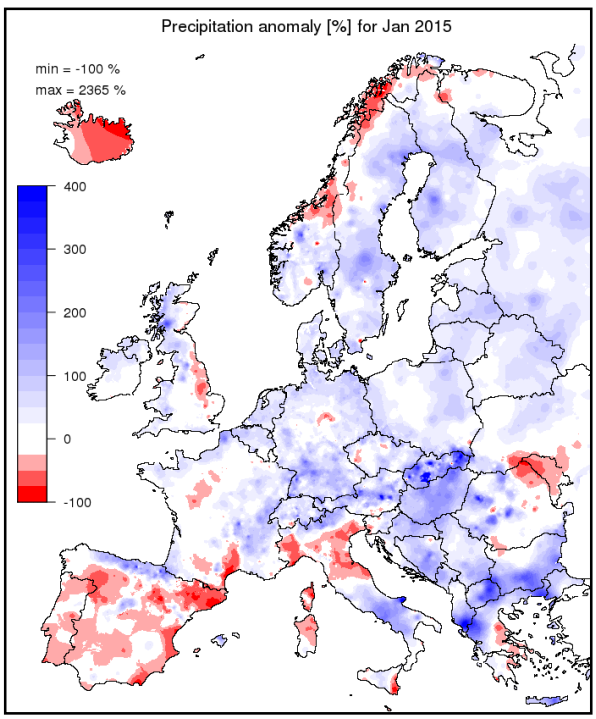

Figure 6: Precipitation anomaly [%] for January 2015, relatively to a long term average (1990-2011). Blue (red) denotes wetter (drier) conditions than normal.

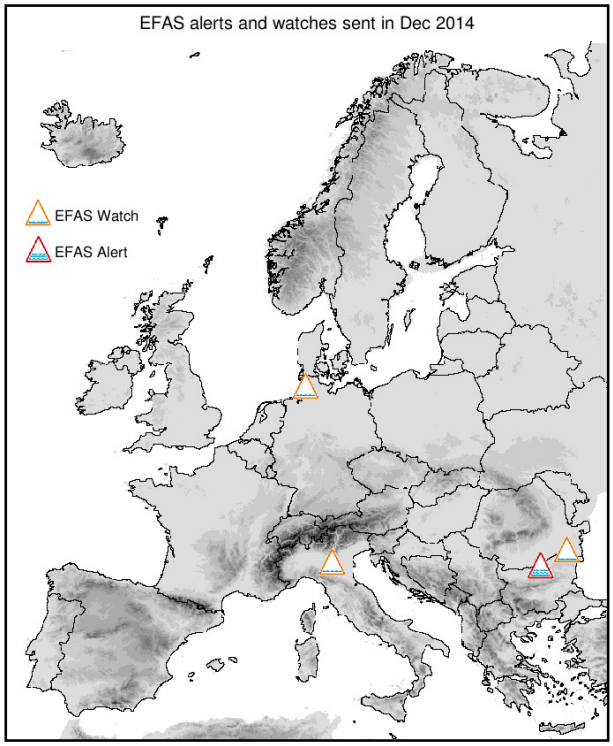

Figure 7: EFAS flood alerts and watches for December 2014.

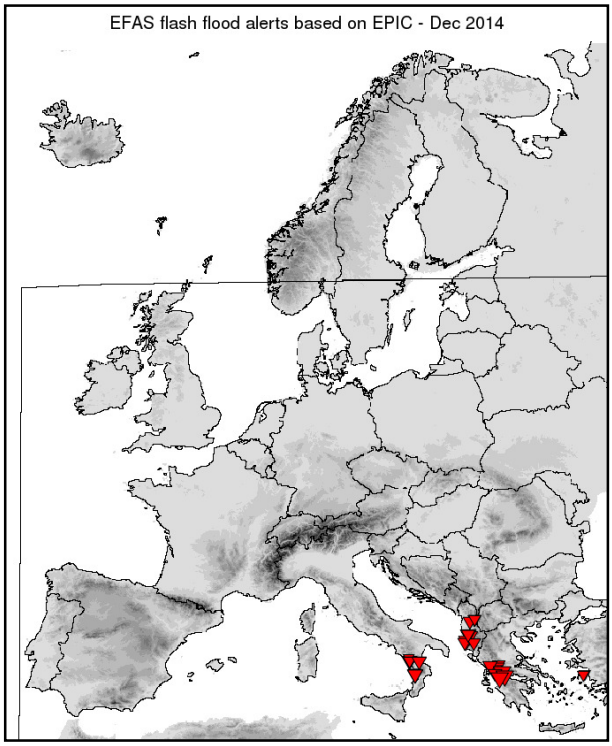

Figure 9: Flash flood reporting points for December 2014.

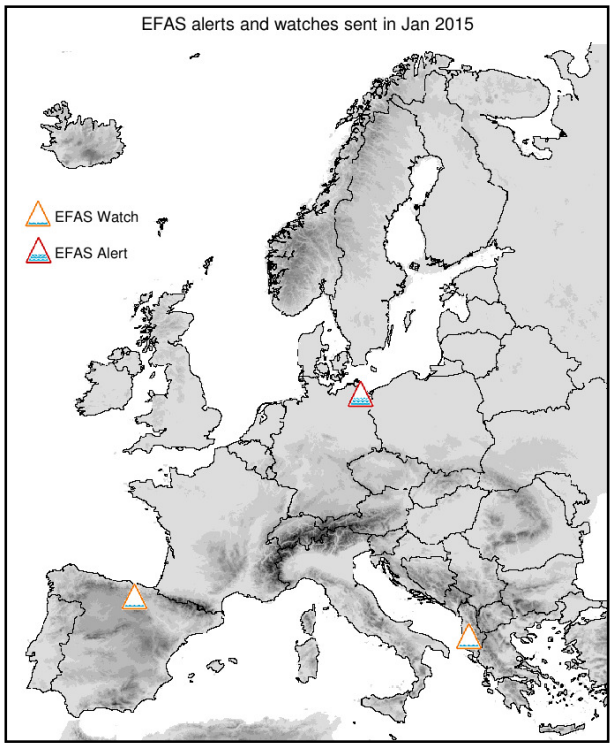

Figure 8: EFAS flood alerts and watches for January 2015.

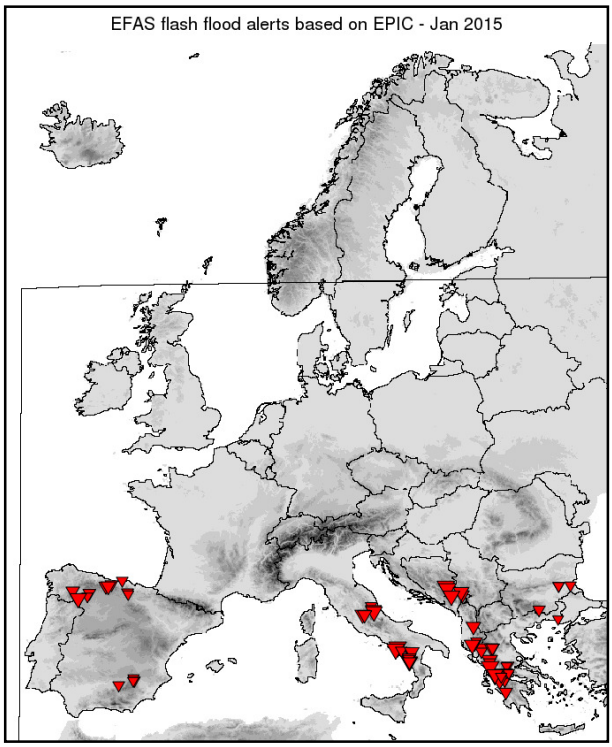

Figure 10. Flash flood reporting points for January 2015.

Acknowledgements

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- All data providers, including meteorological data providers, hydrological services and weather forecasting centres.
- The EFAS Operational Centres.