European Flood Awareness System

EFAS *Bulletin*

February – March 2017

Issue 2017(2)

NEWS

News and updates

New layers: Rapid flood risk assessment
Two new layers for rapid flood risk assessment has been added to EFAS-IS; rapid flood mapping and rapid impact assessment. These will aid the forecasters to estimate the flood extent as well as the potential impact of a flood. For more information on these layers, please visit the EFAS web portal.

New layers: ERICHA rainfall and flash flood hazard
Three new flash flood layers have been added: nowcasts of 1h rainfall accumulation, daily rainfall accumulation and flash flood hazard. All products derive from the European radar network OPERA and are the result of three consecutive EC Civil Protection Prevention projects: HAREN, EDHIT and ERICHA. For a full description of the new layers, please visit the EFAS web portal.

New feature: Hydrological situation
A new feature starting in this bulletin is an overview of the hydrological situation alongside four new maps to describe the 90th and 10th percentile of flow calculated against climatology as well as exceedance of the lowest alert level for discharge (Figure 14-Figure 17). The maps are produced by the Hydrological Data Collection Centre using the available hydrological observations. The maps are also accompanied by an overview of the past two months.

Meetings

The 12th EFAS Annual Meeting was held in De Bilt, Netherlands, 28-29 of March 2017 and was hosted by the EFAS Dissemination Centre. 74 participants, representing 43 different organizations (34 partners) and EFAS partner authorities, including four invited speakers attended the meeting. For a longer report on the meeting, please see separate article in this bulletin.

70 scientists, developers and emergency managers from across Europe came together at ECMWF 15-17 March for a meeting for the H2020 project **ANYWHERE**. The basic idea of the project is to develop a new pan-European multi-hazard platform and associated decision support tools for of weather impacts, such as damage from windstorms, floods and heat waves. The project will rely on nowcasts and early warning systems available from European national meteorological and hydrological services to "… add value to existing services by harnessing cutting-edge technology to produce forecasts of impacts for specific locations or communities,", in the words of the project coordinator Professor Daniel Sempere-Torres from the Polytechnic University of Catalonia (UPC). ANYWHERE started in June 2016 and will run for three years. For more about the project: http://anywhere-h2020.eu/

A webinar covering **flash flooding** was held during February. Around 60 participated at this webinar.

New partners

We would like to welcome Federal Hydrometeorological Institute BiH and Republic Hydro Meteorological Service of Republic of Srpska, both from Bosnia & Hercegovina to the EFAS community. We also welcome the Sava River Watershed Agency Sarajevo, Watershed Agency for Adriatic Sea Mostar and Public Institution Vode Srpske as new third party partners.

RESULTS

Summary of EFAS Flood and Flash Flood Notifications

The 8 formal and 9 informal EFAS flood notifications issued in February-March 2017 are summarised in Table 1. The locations of all notifications are shown in Figure 18 and Figure 20 in the appendix.

35 Flash Flood notifications, summarised in Table 2, were issued from February to March 2017. The locations are shown in Figure 19 and Figure 21.

Meteorological situation

By EFAS Meteorological Data Collection Centre

Meteorological situation for February 2017
A very strong low pressure system was located over Iceland In the beginning of February extending in southeasterly direction over Europe. In contrast, a high pressure system was built up over Scandinavia and southern and southwestern European regions. These systems were strengthened and a new very strong low pressure system over the North Atlantic influenced the weather conditions in Central Europe. The following days the situation changed and the high pressure system originally located over Scandinavia dominated all

of Europe with the exception of southwestern Portuguese, Spanish and French land areas. As a consequence, heavy rain with up to 200 mm caused flooding in parts of the French Occitan region on 14th of February.

In mid-February, the low pressure system over parts of Portugal and Spain moved eastwards. Meanwhile, a high pressure system dominated northern Europe, expanded to southern European countries and was displaced by a new strong low pressure system located in northern Scandinavia. On 19 February, the low pressure system over southern Spain led to storms and 152.6 mm of rain in 24 hours in the province of Malaga, which resulted in widespread flash flooding damaging infrastructure.

The high pressure system in front of western Europe grew stronger and interacted with other systems in northern Europe. Towards the end of the month, the low pressure system located over Scandinavia enforced to the south and covered most parts of Europe, except for some southern European countries. At the same time a very strong low pressure system over Ireland and the UK was developing, but without causing larger floods.

The accumulated precipitation sums for February (Figure 6) indicate selective high amounts near coastal regions such as in the northern UK, Spain, Italy, Croatia and Montenegro as well as in some mountainous areas with up to 400 mm in total. Scandinavia and most countries in Eastern Europe recorded mostly 20 – 40 mm. The precipitation anomalies display drier conditions in Scandinavia and Iceland, which correlates with the low accumulated precipitation sums (Figure 7). Furthermore, Eastern Europe (except Romania) and the Balkan countries were drier than normal. Most regions of Portugal, Spain, Southern France and northern Italy had more rainfall than usual.

The average temperature in north, northeastern Europe and the Alps fell below the zero degree mark, while in the Mediterranean countries as well as in western regions, such as Ireland and the UK, the temperature reached ~10°C (Figure 10). In Portugal and southern Spain, temperatures above 10°C were recorded. In general, the temperature anomalies illustrate significant more warm-temperate conditions up to 6°C throughout Europe (Figure 11).

Meteorological Situation for March 2017

A relative persistent and strong low pressure system developed over Scandinavia, north and central Europe in the first half of March 2017. In contrast, southern and eastern European were under the influence of high pressure systems. The low pressure system was extended to the south and developed into a secondary low pressure system over the Balkan region, while in the most other European countries, except Scandinavia, high pressure systems dominated. Later in March a local low pressure system led to heavy rainfall and flooding in parts of southeastern Spain – values as high as 137.4 mm in 24 hours were recorded on 13 March in Alicante. Then the situation changed and high pressure led to stable weather conditions. Towards the end of March, the strong low pressure system in northern Europe and Scandinavia was displaced by a new enhancing high pressure system over Ireland, which influenced further parts of central and southern Europe.

Overall, the accumulated precipitation on the Atlantic coastal and mountain areas was clearly higher than in the rest of Europe (Figure 8). The heavy rainfall event in Alicante is evident in this map. The precipitation anomalies display dry conditions in Iceland without any precipitation measured during this month (Figure 9). Parts of Norway, Spain, Italy and the Balkan region show negative precipitation anomalies. Higher precipitation sums were only observed in northwest Europe, including France, eastern Spain and some areas in northeastern Europe.

The average temperature was significant lower in Scandinavia, Iceland and the mountain areas than in the rest of Europe (~ -5°C, Figure 12). Substantially higher temperatures up to 16°C were measured In the Mediterranean region. The temperature anomalies show lower values only in Iceland and Portugal (Figure 13). Eastern Europe recorded temperature anomalies up to 6°C in March 2017.

Hydrological situation February - March 2017

The observed daily average discharge values for the gauging stations from the northern and central Norway, northern Sweden and Finland have surpassed the 90% quantile value (Figure 14). This same threshold has been also exceeded by stations present along the catchments of the Danube (throughout Germany and

Austria), the Elbe, the Ebro and Po. For the month of March, the observed situation is quite similar for the previously mentioned catchments, although new stations also have come to surpass the 90% quantile value (Figure 16), more specifically those that are found in the catchments of the rivers Narva (Estonia), Guadalquivir, Llobregat and Miño-Sil (Spain).

Out of the 813 stations for which warning levels were available, for both stage and discharge values alike, 109 exceeded the minimum warning level provided at least 1 day during the month of February (Figure 15). This occurred for stations that are situated along the catchments of the Elbe, Danube, Rhine, Po and Miño rivers. During the March, only 23 stations exceeded the lowest warning value provided, mostly stations that are in the catchments of the Elbe and Danube rivers (Figure 16).

The warning levels have frequently been surpassed throughout the catchment of the Danube although during February, the stage values for the station of Gatta belonging to the catchment of the river Po have been constantly above the minimum warning level.

Verification

Figure 1 shows the EFAS headline score, the Continuous Ranked Probability Skill Score (CRPSS) for one day lead time, for the February to March period across the EFAS domain for catchments larger than 2000km^2. The reference score is the persistence forecast. A CRPSS of 1 indicates perfect skill, 0 indicates that the performance is equal to that of the reference, and any value <0 (shown in red on the maps) indicates the skill is worse than persistence.

Figure 2 displays the CRPSS at 3 days lead-time. The corresponding maps for 5 and 10 days lead-time are shown in the Appendix, Figure 22 and Figure 23.These maps indicate that across much of Europe for February and March, EFAS forecasts are more skilful than persistence at all lead times.

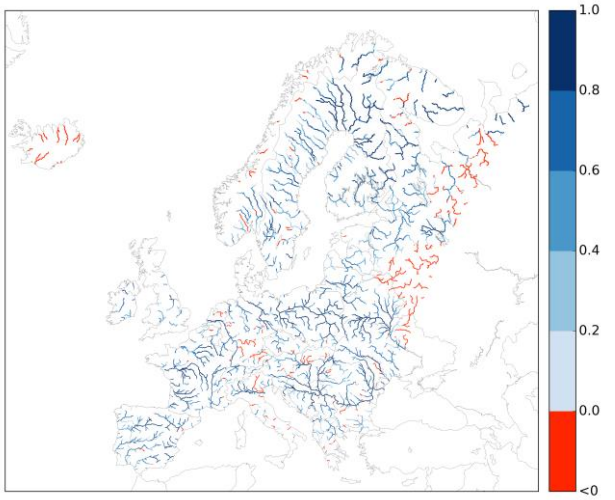

Figure 1. EFAS CRPSS at lead-time 1 day for the February-March 2017 period, for catchments >2000km2. The reference score is persistence.

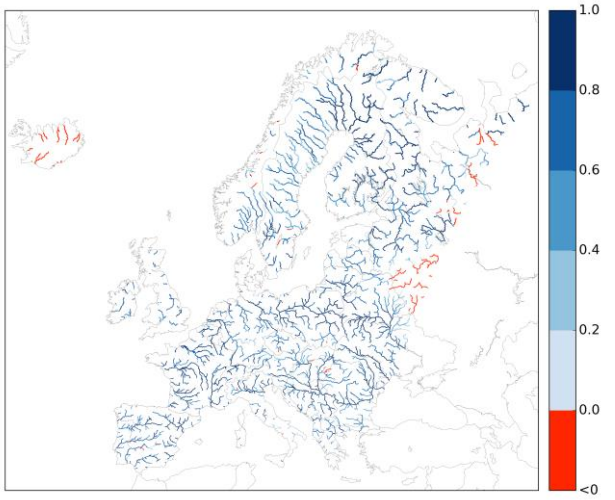

Figure 2. EFAS CRPSS at lead-time 3 days the February-March 2017 period, for catchments >2000km2. The reference score is persistence.

At shorter lead times, for example day 3 and 5, some catchments in the eastern part of the domain show a worse performance than persistence, which was also seen in the skill score analyses of the December 2016 - January 2017. The ongoing work with the eastwards extension will potentially improve the scores and we will come back to this topic when the eastwards extension is finalised.

FEATURES

EFAS 12th annual meeting 2017

by Sara-Sofia Asp, Michaela Mikuličková and Eric Sprokkereef

The EFAS 12th annual meeting in de Bilt, Netherlands, was opened by a welcome speech held by Mr. Pieter Jansen, Director at RWS Water Management. During the meeting 13 presentations, 3 workshops, 9 posters and 2 partner reports were presented.

Information from EFAS centres

EFAS DISS informed the audience about new partners who have joined since the last annual meeting, how many notifications had been issued during the last year and about training opportunities for EFAS partners. From the hydrological data collection centre information was given about new infrastructure, about how to share data and their web interface. EFAS METEO gave a general overview of what has been done since last year. Both data collection centres encouraged all the partners to share their data. The computational centre focused on their organization and updates during the previous year.

Future of EFAS

Future visions and changes for EFAS were presented by Peter Salamon (JRC). New features are layers with seasonal outlook, Rapid Risk Assessment maps and a new flash flood layers built on nowcasting of processed radar data. Extension of the EFAS domain and addition of new partners is also ongoing. Expected release for the extended domain is during the second half of 2017. EFAS-IS is also being redesigned with expected release during first half of 2018. Additional webinars will be offered in the following year.

Presentations on extreme events

Two presentations were held covering extreme events. The first was about the flood event in Gdansk, Poland in July 2016. In July, they received a large amount of rain that caused flooding in the area. Two persons were killed, buildings were flooded and reservoirs damaged. The second presentation was from the flash floods in Bavaria, Germany in May-June 2016. Precipitation forecasts for the event failed to predict the event, both spatially and temporally. No notification or warnings were issued for the area.

Figure 3. Peter Salamon from the JRC presents what is next for EFAS.

Back-to-back meeting with Meteoalarm

This year a part of the EFAS annual meeting was a back-to-back meeting with the Meteoalarm community. This part took place at RWS in Utrecht. During the back-to-back meeting, presentations were given and an interactive session took place in parallel groups. Vera Mazzara from ERCC talked about the ERCC's organization, mission and mandate. From Copernicus, Francoise Villette gave an overview of the Copernicus program and its services. Presentations on the first results of the ARISTOTLE and ANYWHERE projects and the Common Alerting Protocol (CAP) were held.

During the interactive session, four main topics were addressed:

- the process to get hydrological warnings in Meteoalarm;
- possibilities and need to filter public warnings from Meteoalarm into EFAS;
- how to deal with feedback on alerts and flash floods;
- how do we tackle flash flood warnings from a hydrological and from a metrological part.

Workshops

In the second day, several workshops took place. Before the workshops started, Michaela from the EFAS Dissemination centre gave a presentation about the new electronic feedback form and the importance of

receiving feedback. Amir Givati and Mirza Sarač presented new developments in Israeli and Sava flood forecasting systems.

Workshops were held on the following topics: *Using seasonal forecasts in hydrology* by Louise Arnal (ECMWF), *the new Rapid Risk assessment* by Milan Kalaš (JRC) and *Flash Flood Forecasting using ERICHA radar data products in EFAS* by Daniel Sempere-Torres (Universitat Politecnica de Catalunya). All the workshops started with a presentation. During and after each workshop the audience had the chance to use their own computers, to play around with the information in EFAS-IS. Many questions were asked and fruitful discussions took place.

Overall, it was a very busy meeting with a lot of good dialogue and interactions both during presentation and during breaks. The attendees also had the opportunity to visit the forecast room at KNMI and enjoy an excellent dinner at a historical fortress.

Figure 4. Participants on the way to the conference dinner

Case Study: Flooding in Southern Spain, February and March 2017

by Richard Davies, Floodlist.com

Storms in southern Spain during the period February to March 2017 caused significant flood events in the cities of Málaga and Alicante.

Malaga, February 2017

Heavy rain in the Province of Málaga on 19 February 2017, caused damage to homes, roads and vehicles. The city of Málaga was the worst affected area. Emergency services responded to 230 incidents during the heavy rainfall although there were no reported fatalities or injuries.

Several roads were severely damaged and some buildings flooded. Floodwater swept through the city's streets, dragging vehicles along with it. A landslide triggered by the heavy rain was reported along the A-45 highway in Casabermeja, around 20 km north of Málaga. Spain's meteorological office, AEMET, said that the port of Málaga recorded 152.6 mm of rain in 24 hours on 19 February, with as much as 130.06 mm of that total falling in a 6-hour period.

Alicante, March 2017

Parts of southeast Spain, in particular Alicante, saw torrential rainfall and some flooding on 13 March. 2017. As much as 137.4 mm of rain was recorded in Alicante in 24 hours on 13 March. The mean total rainfall for March is 23 mm according to WMO figures.

Other areas also saw excessive rainfall. AEMet said that in a 30-hour period to 13 March, Pinet (Valencia) recorded 172mm of rain, Barx (Valencia) 153 mm and Murla (Alicante) 153 mm. Local media reported that a

man had to be rescued from his vehicle after floodwater swept his car into the Serpis river.

Figure 5. Floods in Playa de San Juan, Alicante, March 2017. Photo: Office of the Mayor of Alicante

During the evening of 13 March, the municipality if Alicante activated the *Municipal Action Protocol* in response to the storm and heavy rain, referred to locally as *Temporal de Levante*. A statement by Alicante municipality said that flooding had affected seven locations in the and around the city, with Villafranqueza and Playa de San Juan among the worst affected.

Parque La Marjal

Local water company, Aguas de Alicante, said that much of the city was protected from more severe flooding by the Parque La Marjal, an urban park designed to store storm water during times of flood threat.

Aguas de Alicante said via Social Media (https://twitter.com/AMAEM_Oficial/status/841588330752028673) "Parque La Marjal passes the *Temporal de Levante* test running at full performance during heavy rains yesterday". Storing floodwater in the park "avoided a major disaster in Alicante" Aguas de Alicante stated.

Acknowledgements

The following partner institutes and contributors 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 & weather forecasting centres
- The EFAS Operational Centres
- Richard Davies, Floodlist.com

Cover image: Participants of the 12th EFAS annual meeting, De Bilt, the Netherlands

Appendix - figures

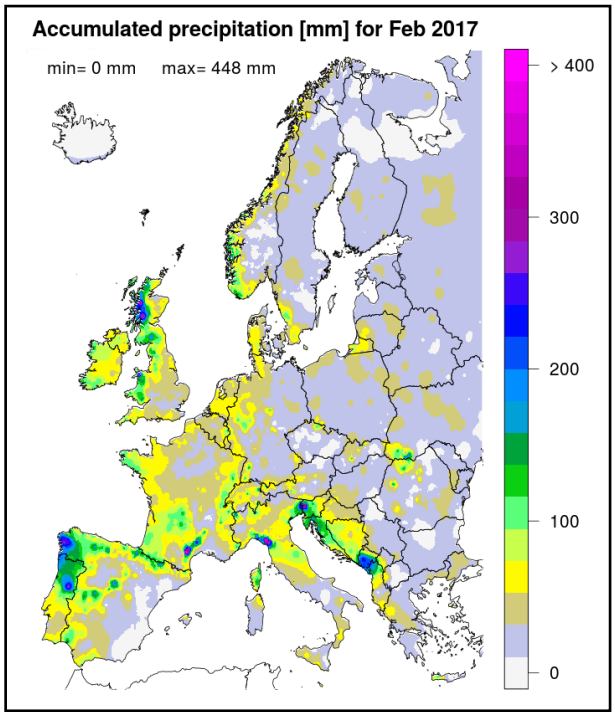

Figure 6. Accumulated precipitation [mm] for Feb 2017.

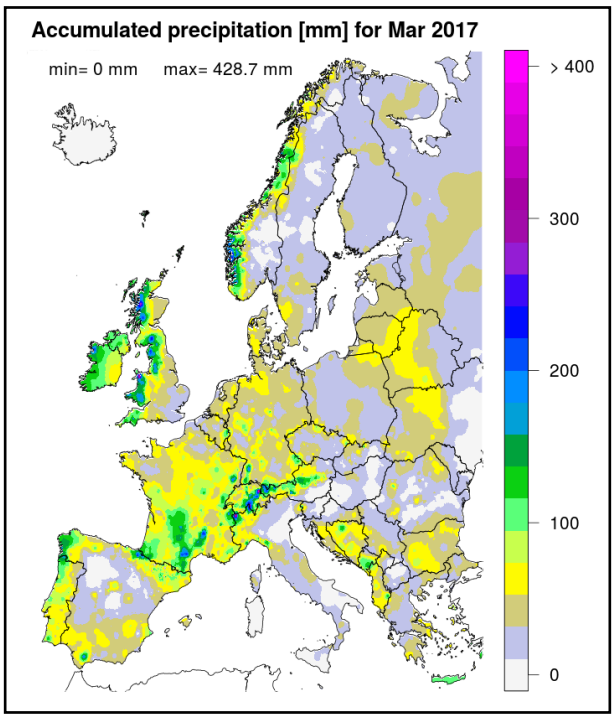

Figure 8. Accumulated precipitation [mm] for Mar 2017.

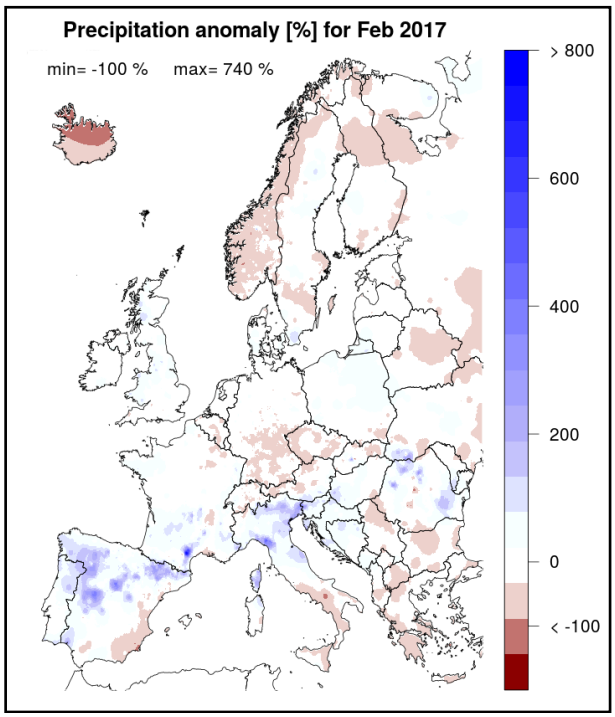

Figure 7. Precipitation anomaly [%] for Feb 2017, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

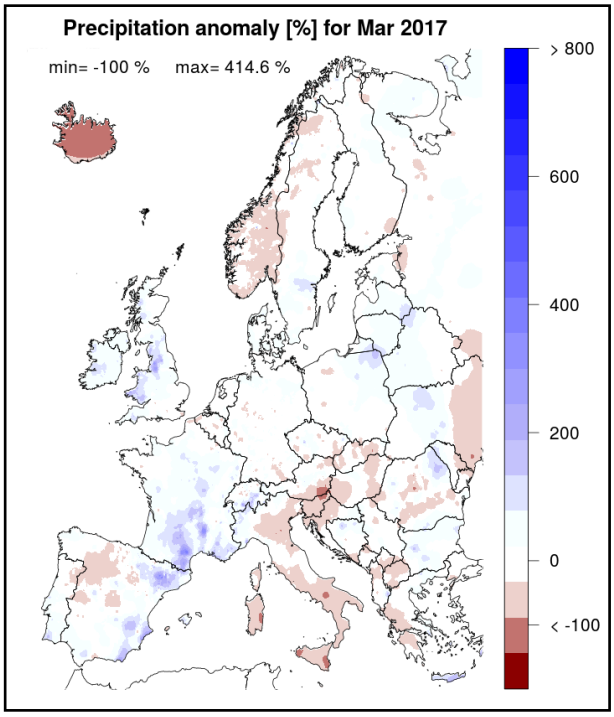

Figure 9. Precipitation anomaly [%] for Mar 2017, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

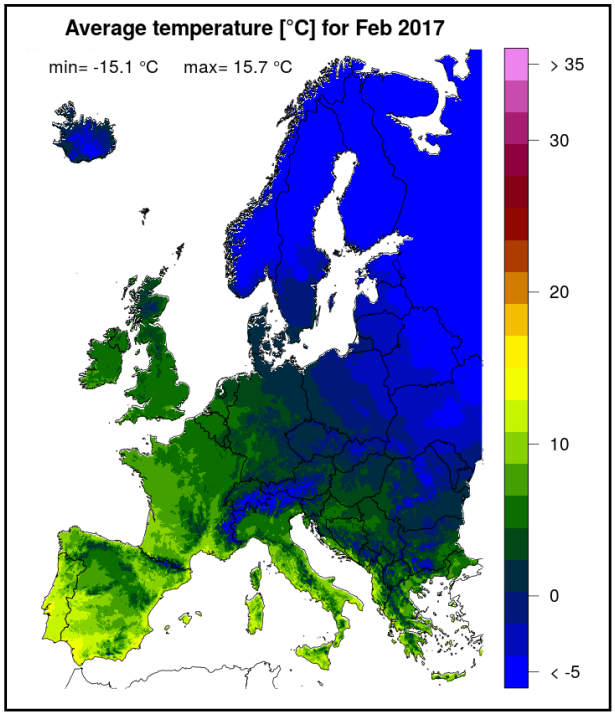

Figure 10. Mean temperature [°C] for Feb 2017.

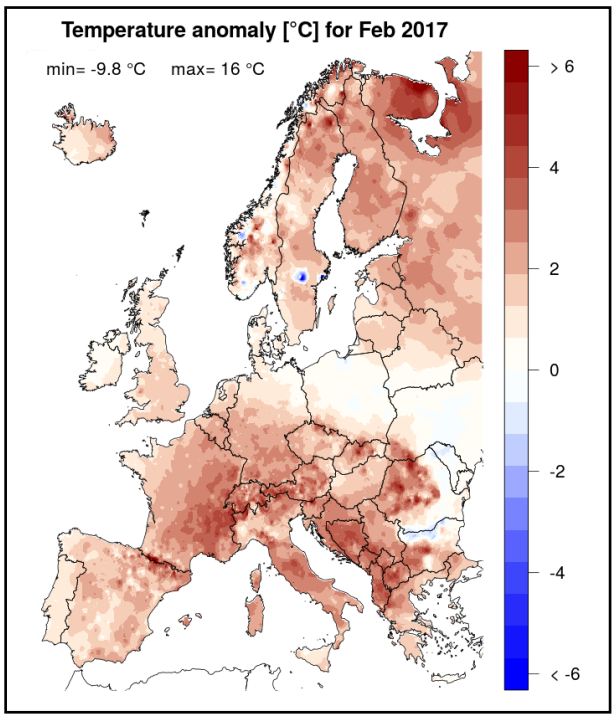

Figure 11. Temperature anomaly [°C] for Feb 2017, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

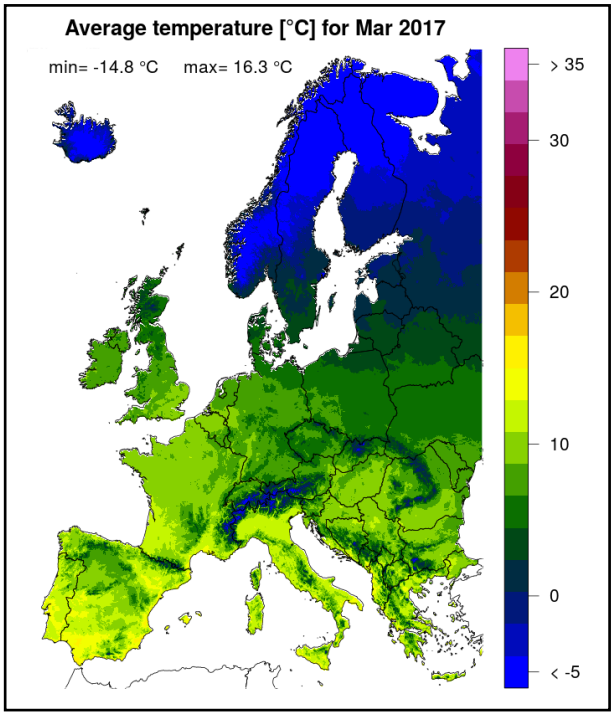

Figure 12. Mean temperature [°C] for Mar 2017.

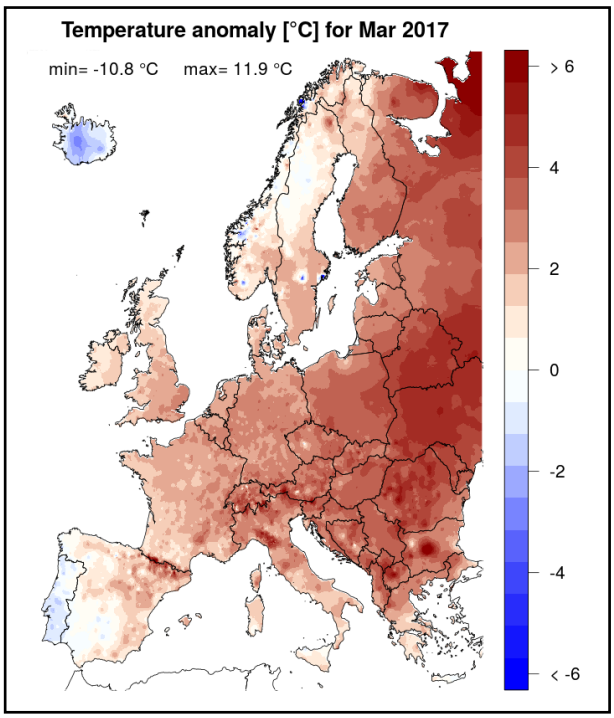

Figure 13. Temperature anomaly [°C] for Mar 2017, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

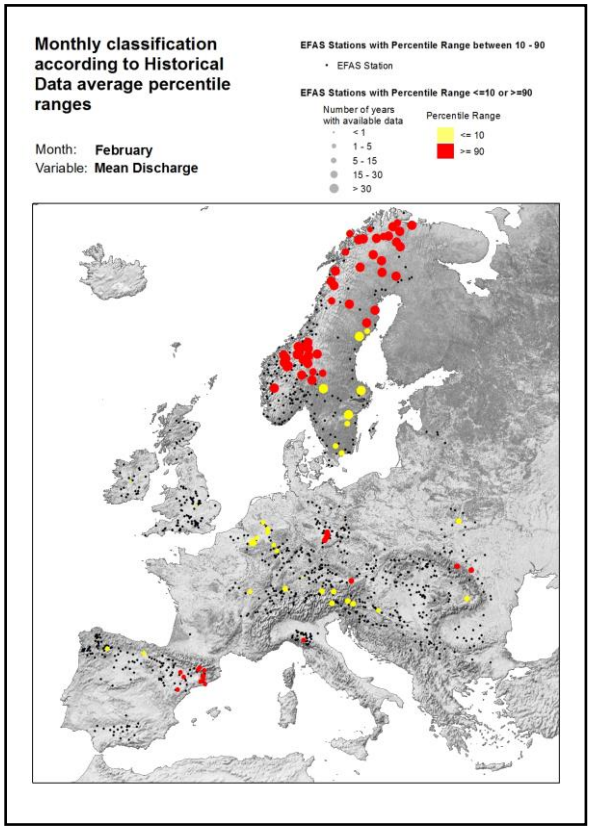

Figure 14. Monthly discharge anomalies Feb 2017.

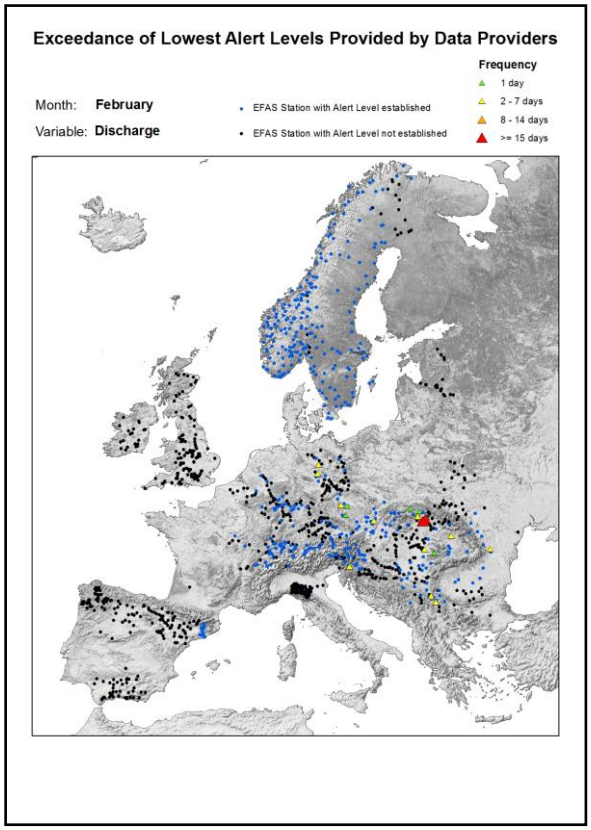

Figure 15. Alert level exceedance for Feb 2017.

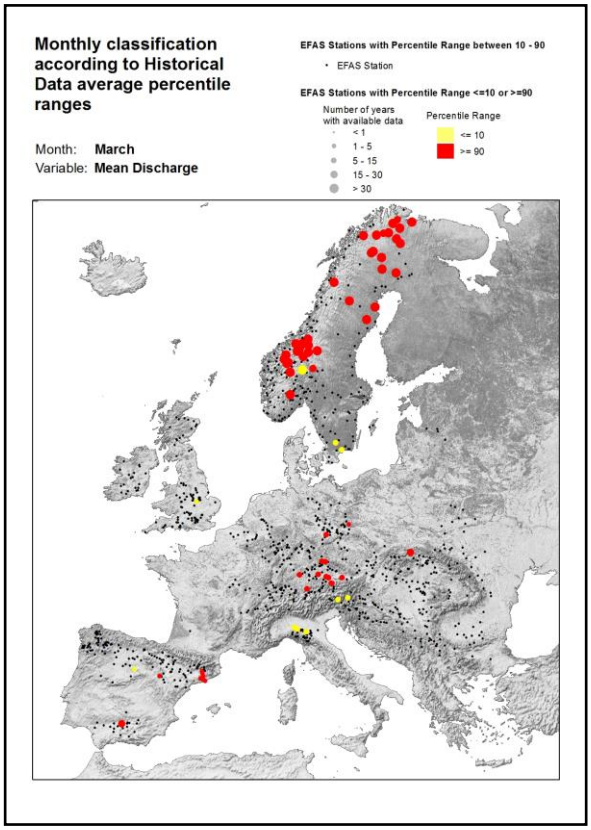

Figure 16. Monthly discharge anomalies March 2017.

Figure 17. Alert level exceedance for March 2017.

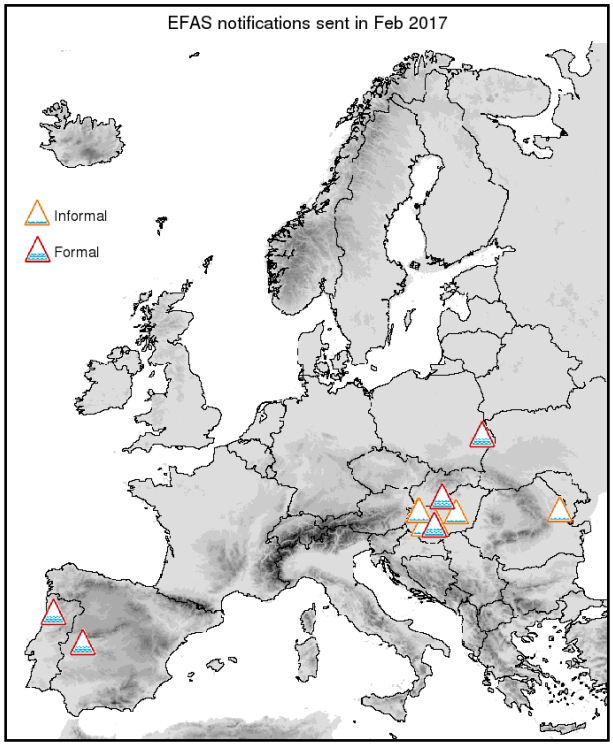

Figure 18. EFAS flood notifications sent for Feb 2017.

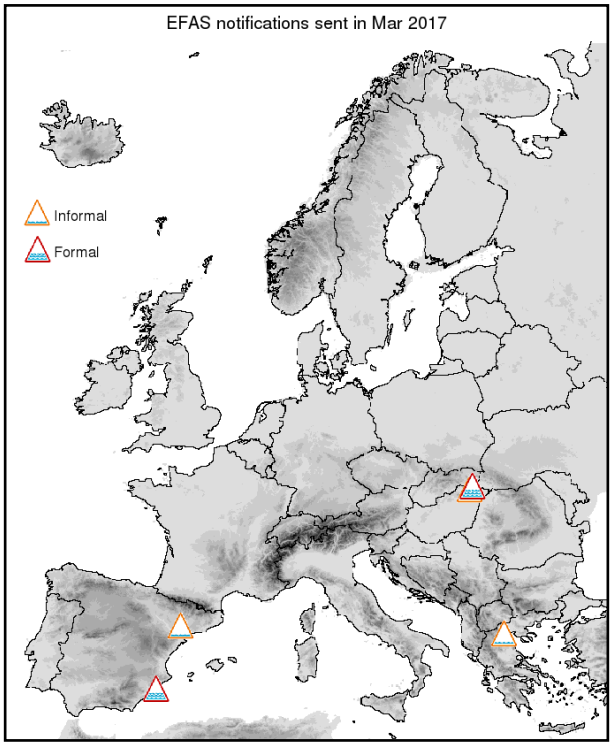

Figure 20. EFAS flood notifications sent for Mar 2017.

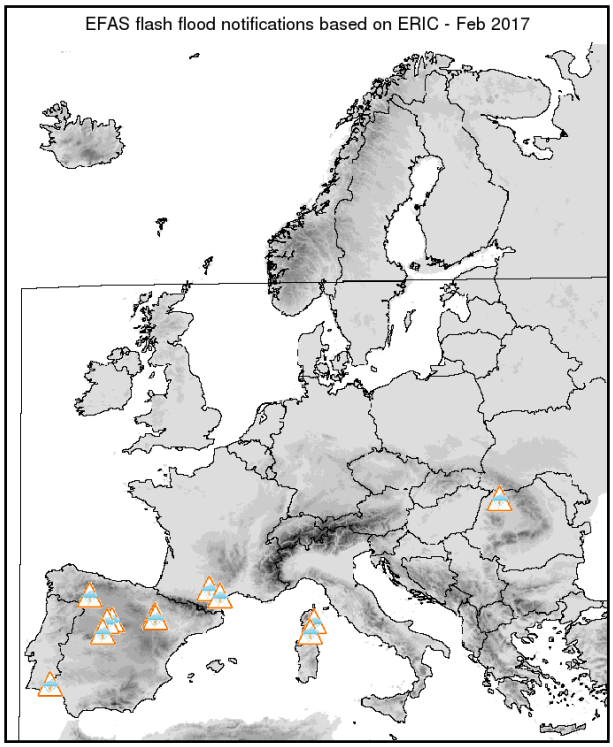

Figure 19. Flash flood notifications sent for Feb 2017.

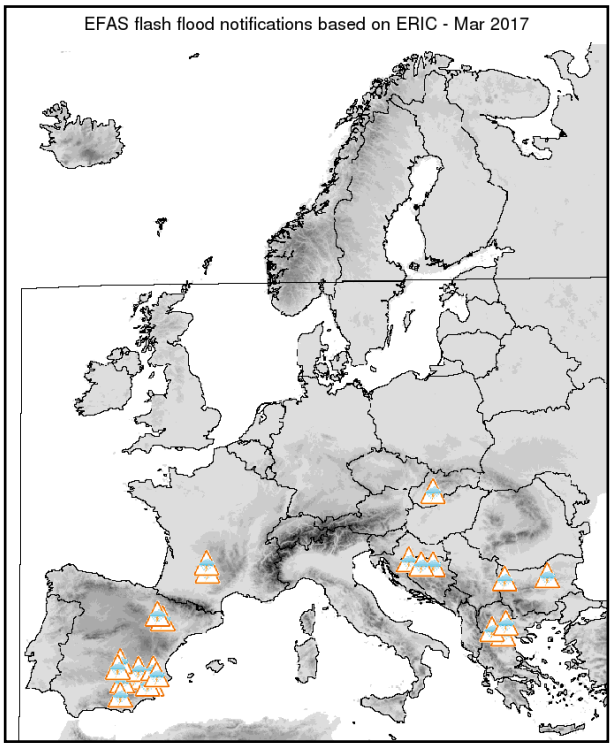

Figure 21. Flash flood notifications sent for Feb 2017.

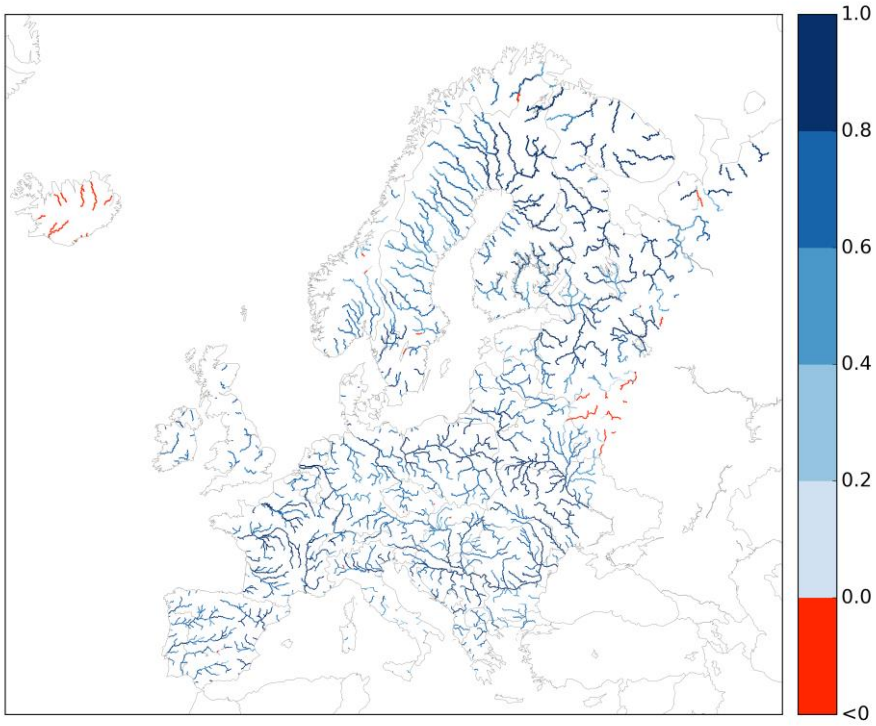

Figure 22. EFAS CRPSS at lead-time 5 days for the February-March 2017 period, for catchments >2000km². The reference score is persistence.

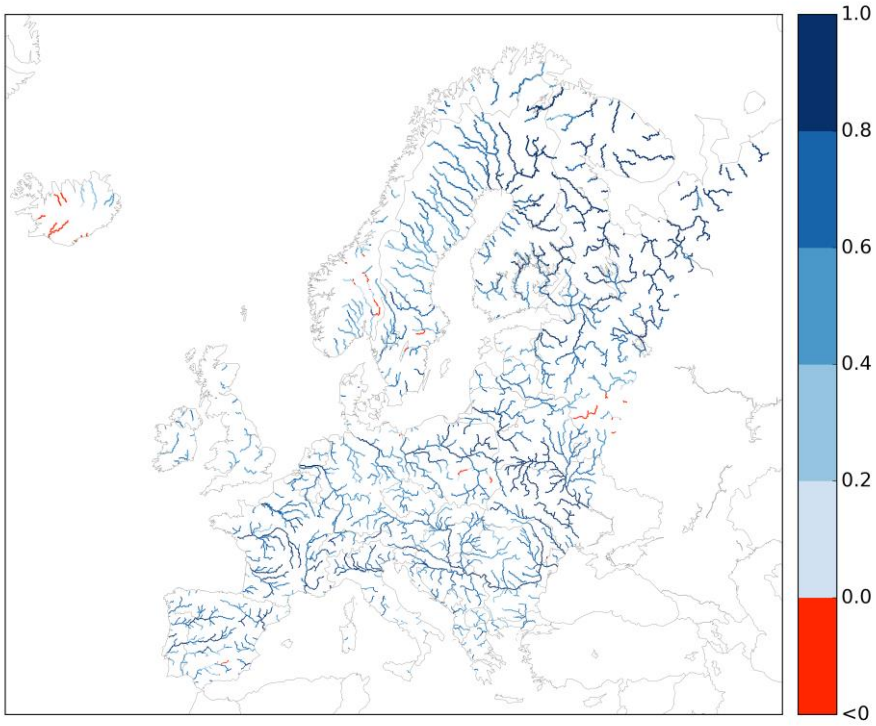

Figure 23. EFAS CRPSS at lead-time 10 days for the February-March 2017 period, for catchments >2000km². The reference score is persistence.

Appendix - tables

Table 1. EFAS flood notifications sent in February - March 2017. Feedback is shown below the corresponding notification.

Type	Forecast date	Issue date	Lead time*	River	Country
Formal	01/02/2017 12 UTC	02/02/2017	2	Duoro, below Tormes	Portugal
Formal	01/02/2017 12 UTC	02/02/2017	2	Tietar	Spain
Informal	02/02/2017 00 UTC	02/02/2017	1	Zagyva	Hungary
Informal	02/02/2017 12 UTC	03/02/2017	2	Tutova	Romania
Informal	03/02/2017 00 UTC	03/02/2017	2	Raab, Raba	Hungary
Formal	03/02/2017 12 UTC	04/02/2017	2	Zala-Balaton-Sio	Hungary
Informal	04/02/2017 00 UTC	04/02/2017	1	Zala-Balaton-Sio	Hungary
Informal	04/02/2017 12 UTC	05/02/2017	2	Zala-Balaton-Sio	Hungary
Informal	05/02/2017 00 UTC	05/02/2017	2	Raab, Raba	Hungary
Formal	08/02/2017 12 UTC	09/02/2017	4	Tietar	Spain
Formal	16/02/2017 00 UTC	16/02/2017	6	Wieprz	Poland
Formal	16/02/2017 12 UTC	17/02/2017	5	Ipel	Slovakia
Formal	04/03/2017 00 UTC	04/03/2017	3	Bodrog	Slovakia
Informal	07/03/2017 00 UTC	07/03/2017	1	Coastal zone	Greece
Informal	07/03/2017 12 UTC	08/03/2017	1	Bodrog	Hungary
Formal	12/03/2017 12 UTC	13/03/2017	2	Coastal zone	Spain
Informal	24/03/2017 12 UTC	25/03/2017	1	Segre	Spain

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

Table 2. EFAS flash flood notifications sent in February - March 2017.

Type	Forecast date	Issue date	Lead time*	Region	Country
Flash flood	02/02/2017 12 UTC	03/02/2017	42	Maramures	Romania
Flash flood	07/02/2017 12 UTC	08/02/2017	48	Corse-du-Sud	France
Flash flood	07/02/2017 12 UTC	08/02/2017	54	Haute-Corse	France
Flash flood	11/02/2017 00 UTC	11/02/2017	48	Algarve	Portugal
Flash flood	11/02/2017 00 UTC	11/02/2017	60	Leon	Spain
Flash flood	11/02/2017 00 UTC	11/02/2017	60	Zaragoza	Spain
Flash flood	11/02/2017 00 UTC	11/02/2017	60	Zaragoza	Spain
Flash flood	11/02/2017 00 UTC	11/02/2017	54	Segovia	Spain
Flash flood	11/02/2017 00 UTC	11/02/2017	54	Segovia	Spain
Flash flood	11/02/2017 00 UTC	11/02/2017	54	Avila	Spain
Flash flood	11/02/2017 12 UTC	12/02/2017	78	Aude	France
Flash flood	13/02/2017 00 UTC	13/02/2017	36	Tarn	France
Flash flood	03/03/2017 00 UTC	03/03/2017	30	Lot	France
Flash flood	03/03/2017 00 UTC	03/03/2017	30	Aveyron	France
Flash flood	05/03/2017 00 UTC	05/03/2017	30	Banskobystricky kraj	Slovakia
Flash flood	06/03/2017 00 UTC	06/03/2017	60	Federacija Bosna	Bosnia and Her-
Flash flood	06/03/2017 00 UTC	06/03/2017	60	Republika Srpska	Bosnia and Her-
Flash flood	06/03/2017 12 UTC	07/03/2017	42	Sisacko-moslavacka	Croatia
Flash flood	07/03/2017 00 UTC	07/03/2017	54	Kentriki Makedonia	Greece

Flash flood	07/03/2017 00 UTC	07/03/2017	54	Pelagoniski	Macedonia
Flash flood	07/03/2017 00 UTC	07/03/2017	42	Jugoistochen	Macedonia
Flash flood	10/03/2017 00 UTC	10/03/2017	30	Montana	Bulgaria
Flash flood	11/03/2017 12 UTC	12/03/2017	72	Murcia	Spain
Flash flood	11/03/2017 12 UTC	12/03/2017	78	Valencia	Spain
Flash flood	11/03/2017 12 UTC	12/03/2017	72	Valencia	Spain
Flash flood	12/03/2017 12 UTC	13/03/2017	42	Ciudad Real	Spain
Flash flood	12/03/2017 12 UTC	13/03/2017	48	Ciudad Real	Spain
Flash flood	12/03/2017 12 UTC	13/03/2017	54	Granada	Spain
Flash flood	12/03/2017 12 UTC	13/03/2017	36	Veliko Tarnovo	Bulgaria
Flash flood	13/03/2017 00 UTC	13/03/2017	24	Murcia	Spain
Flash flood	13/03/2017 00 UTC	13/03/2017	36	Albacete	Spain
Flash flood	13/03/2017 00 UTC	13/03/2017	24	Jaen	Spain
Flash flood	13/03/2017 00 UTC	13/03/2017	30	Albacete	Spain
Flash flood	24/03/2017 00 UTC	24/03/2017	36	Zaragoza	Spain
Flash flood	24/03/2017 00 UTC	24/03/2017	36	Zaragoza	Spain

* Lead time [hours] to the forecasted peak of the event

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 ERCC.

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.

A German consortium (KISTERS and DWD) has been awarded the contract for the EFAS Meteorological data collection centre. They are responsible for collecting the meteorological data needed to run EFAS over Europe.

Finally, the JRC is responsible for the overall project management related to EFAS and further development of the system.

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