European Flood Awareness System

EFAS *Bulletin*

December 2016 – January 2017

Issue 2017(1)

NEWS

Seasonal Outlook Operational

A new EFAS product, the Seasonal Outlook, went operational on the 12th of December 2016 after a period of testing. It can be accessed via the EFAS interface, under "Hydrological Layers". This new product displays the river flow anomaly and its probability of occurrence for the next 8 weeks for 74 regions across Europe (see Figure 1). Each region can be clicked on to bring up a hydrograph displaying the forecast and relevant climatological thresholds. For more information on the seasonal outlook, click here. If you have any feedback on this product, you can contact us via the EFAS-IS forum, or by emailing Louise Arnal at ECMWF (louise.arnal@ecmwf.int).

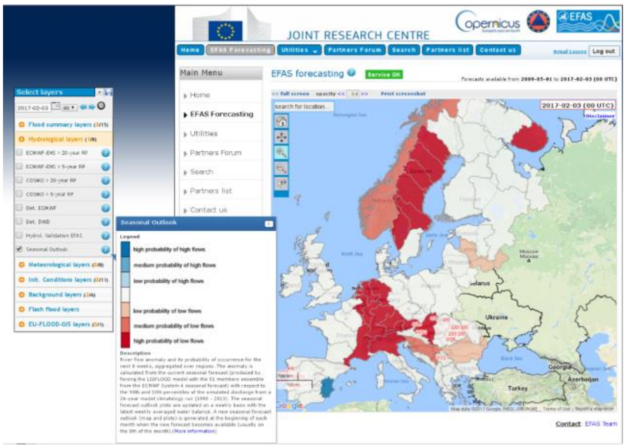

Figure 1. Screenshot of the new EFAS Seasonal Outlook product, which went operational on 12th December 2016.

Meetings

WMO Project Workshop

The WMO project "South-East European Multi-Hazard Early Warning Advisory System (SEE-MHEWS-A)" held its first workshop in the former Yugoslav Republic of Macedonia in February 2017, with support from USAID.

The SEE-MHEWS will strengthen regional cooperation and address gaps in forecasting and warning provision at the national and regional levels across SE Europe – particularly in transboundary areas. A multi-hazard early warning system will be developed, incorporating tools for forecasters into one harmonised forecasting platform. Existing observational and forecast products will be included in the system, but new products will also be developed.

Representatives from hydrological, meteorological and marine institutes were present from Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Greece, Hungary, Israel, Jordan, Kosovo (UNSCR 1244/99), Lebanon, Montenegro, Republic of Moldova, Romania, Serbia, Slovenia, The former Yugoslav Republic of Macedonia, Turkey and Ukraine. Consultation with the meteorological, hydrological and marine institutes of each country was supported by the UK Met Office, ECMWF, SMHI, ZAMG, KNMI, ESSL, CMA (China), Hydrometeorological Centre of Russia, Sava River Commission and the Euro-Mediterranean Center on Climate Change.

Conclusions from the first workshop will be used to inform a second set of workshops later this year, focusing on modelling, observations and system development. Commitment of key stakeholders will then be established and a comprehensive implementation plan developed and agreed by the National Meteorological and Hydrological Services of each country.

RESULTS

Summary of EFAS Flood and Flash Flood Notifications

The 9 formal and 5 informal EFAS flood notifications issued in December 2016 - January 2017 are summarised in Table 1 alongside feedback for two forecasted events. The locations of all notifications are shown in Figure 14 and Figure 16 in the appendix.

19 Flash Flood watches, summarised in Table 2, were issued from December 2016 to January 2017. The locations are shown in Figures 15 and 17.

An overview of EFAS notifications issued throughout 2016 is discussed in Feature Article 2 and compared with previous years.

Meteorological Situation

By EFAS Meteorological Data Collection Centre

December

At the beginning of December, low pressure over northern Europe, particularly Scandinavia, and high pressure over continental Europe dominated the atmospheric circulation. A few low pressure systems occurred in southern Europe leading to lots of rain and flooding in Spain, between Malaga and Gibraltar. This event is discussed in the case study Feature article.

The high pressure system over continental Europe moved north while the low pressure strengthened in the north. This led to westerly winds over central Europe in mid-December. Further, the high pressure moved to the north covering the UK, and the low pressure systems over the Atlantic and eastern Scandinavia moved south. Over the following days, most of the low pressure systems in the south dissipated while a low pressure system over the western Mediterranean remained and high pressure dominated the mid to southern parts of Europe again.

The low pressure systems over the Atlantic moved to the north of Europe, with two strengthening centres over Greenland and Scandinavia and a low pressure system over the Eastern Mediterranean. This resulted in heavy rain on December 28th in Turkey causing flooding in southern parts of the country. Two people lost their lives, public services were closed and flights were cancelled. According to the government, 140mm of rainfall accumulated in just 10 hours.

Additionally, the accumulated precipitation values (see figure 6) indicate high precipitation amounts along the west coasts of Norway and Scotland (> 400 mm) and low precipitation across central Europe (0 mm). The precipitation anomalies (shown in figure 7) display dry conditions in central Europe and wetter than average conditions in central Norway, Poland and eastern Spain. The average temperature was between < -5°C and 0°C in the northern and central parts of Europe, and 7°C – 16°C in Portugal, Spain, and southern Italy (see figure 10). The temperatures were warmer than average in Scandinavia, the Pyrenees and the Alps, and slightly colder anomalies were observed in northern France and the southeastern Mediterranean (temperature anomalies are shown in figure 12).

January

At the beginning of January low pressure systems dominated the conditions in north-eastern parts of Europe, while central and southern Europe were influenced by high pressure systems. A stable high pressure system occurred over the Atlantic and moved in the direction of the strengthening low pressure system over northern Europe. As a result, storm surges caused flooding in northwestern Poland, along Germany's northeast coast, and in coastal areas of Denmark on January 4th. In Germany, the sea level increased to more than 1.70m above normal in Wismar.

In mid-January, the low pressure system over northern Europe strengthened and moved to central Europe, which caused flooding along the east coast of England and damaged over 550,000 homes between 13th and 14th January. A high pressure system occurred over northern parts of Europe and Scandinavia, and the low pressure system over central Europe strengthened, which led to heavy precipitation and strong winds in several parts of southern Italy between 22nd and 24th January. The 24-hour precipitation sum was 95mm in Lamezia, and between 53 and 66mm in Sicily. These events caused storm damage, flooding and landslides.

In general, the precipitation anomalies (shown in figure 9) display drier than average conditions across much of Europe, especially in Iceland and North Italy, and higher precipitation in southern parts of Europe, including Valencia, Corse, Sardinia, Sicily, parts of Macedonia and Turkey. These correspond to the regions with the largest observed precipitation accumulations of up to 300 mm (see figure 8). High precipitation sums were also measured on the western coast of Norway and the Pyrenees (> 400 mm), while in the other parts of Europe the accumulated precipitation was between 0 and 100 mm (figure 8).

Figure 12 shows that the average temperatures in northern Europe and the continental regions were mostly below -5 °C. Southern Europe and maritime regions saw temperatures between 0 and 10 °C. The temperature anomalies (figure 13) show warmer than average conditions in parts of northern Europe and lower temperature anomalies were observed across the rest of Europe.

Verification

Figure 2 shows the EFAS headline score, the Continuous Ranked Probability Skill Score (CRPSS) for one lead time, for the December to January period across the EFAS domain for catchments larger than 2000km². 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.

The map shown in 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, Figures 18 and 19. These maps indicate that across much of Europe for December and January, EFAS forecasts are more skilful than persistence at all lead times. Regions shown in blue are those where EFAS forecasts are more skilful than persistence, with darker shading indicating better performance.

At shorter lead times, for example days 3 and 5 (figures 2 and 18), some catchments in the eastern part of the domain show a worse performance than persistence, however from day 7 onwards (see figure 19) this is much improved. The skill compared to persistence over Iceland improves with lead time, particularly in eastern parts, but at shorter lead times the persistence shows higher skill than EFAS.

Figure 2. EFAS CRPSS at lead time 3 days for the December 2016 - January 2017 period, for catchments >2000km². The reference score is persistence.

FEATURES

Case Study: Two Flood Events in southern Spain

by Richard Davies, Floodlist.com

Flooding struck twice in the space of 15 days in parts of Spain during December 2016, in which at least 7 people lost their lives.

Andalusia

Torrential rain between the 3rd and 5th of December caused flooding along a stretch of the coast from Malaga to Gibraltar. Aemet issued a red alert (highest level) for the provinces of Malaga and Cadiz early on Sunday, 04 December. According to Aemet figures, Estepona recorded 222.0 mm of rain in 24 hours to 4th December, while Marbella recorded 213.4 mm during the same period.

Unfortunately, two people lost their lives in these floods. One fatality was reported in the tourist area of Estepona on the Costa del Sol, where the victim died in the flooded basement of a building. Further down the coast towards Gibraltar, a man died when his car was swept away by flood water on the outskirts of La Línea de la Concepción, Cádiz. Emergency services in Andalusia responded to more than 1,400 flood and rain related incidents. Guardia Civil helicopters were called into operation to rescue stranded victims.

Flooding in Los Alcázares, Murcia, Spain, on 19th and 20th December 2016.

Valencia and Murcia

Around two weeks later severe flooding struck again, this time centred around Valencia and Murcia.

Heavy rain began around 16 December. Agencia Estatal de Meteorología (AEMET) in Valencia report that around 400 mm of rain fell between 16th and 19th December in Beniarrés (433.2 mm) and Pinet (398.6 mm).

Flooding in Los Alcázares, Murcia, Spain, on 19th and 20th December 2016.

Hundreds were evacuated from their homes and emergency services in Murcia alone reported having to rescue at least 350 people from their homes and cars in Los Alcazares, Murcia, San Javier and Torre Pacheco.

Sadly, five fatalities were reported. One man died when he was trapped in a flooded cave in Xàtiva, situated near the banks of the river Albaida in the province of Valencia. Also in Valencia, a man died after his car was swept away and overturned in a flash flood in Castellon. Another victim was swept away by flood water and dragged into the sea in Cala Finestrat, near the tourist resort of Benidorm. Two victims died in flood water in separate incidents in Los Alcázares in Murcia.

EFAS Notifications

During the first event, 2 flash flood notifications were issued for the Malaga and Cadiz regions, on the 1st and 3rd of December respectively. Ahead of the second event, 4 informal notifications and 1 formal were issued, and 9 flash flood notifications were issued during this second event. The details of these notifications are shown in tables 1 and 2 in the Appendix.

Photo Credit

Photos were taken from helicopters of the Dirección General de Seguridad Ciudadana y Emergencias, Murcia, and were originally published by the Centro de Emergencias 112 Región de Murcia, via Twitter.

Summary of EFAS Notifications Issued in 2016

and comparison with previous years

by Rebecca Emerton (ECMWF) and Eric Sprokkereef (RWS)

Figure 3 shows the number of formal, informal and flash flood notifications issued each month throughout 2016. 2016 was an active year for flash flood events, with more than 25 flash flood alerts per month in 8 months of the year; November was clearly the most active month with 92 flash flood notifications issued. January, February and November saw the most formal flood notifications issued, while the early spring and late summer were very quiet in terms of flood notifications. In total, 67 formal, 84 informal and 402 flash flood notifications were issued during 2016.

For comparison, Figure 4 indicates the total number of EFAS notifications issued per year for the past 5 years (4 years for flash flood notifications). 2016 has seen the most flash flood and formal flood notifications issued, while 2014 saw the most informal flood notifications, followed by 2016.

Figure 5 also breaks down the number of notifications issued over the past 5 years (4 years for flash floods) into seasons (December-January-February [DJF], March-April-May [MAM], June-July-August [JJA] and September-October-November [SON]). For each season, 2016 saw more flash flood notifications than 2014 and 2015. For winter, DJF, 2016 saw the most formal and informal flood notifications from 2012-2016.

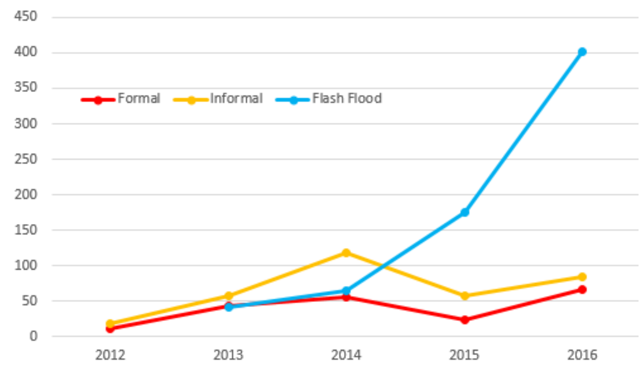

Figure 4. Total number of EFAS formal (red), informal (orange) and flash flood (blue) notifications issued per year from 2012-2016 (2014-2016 for flash flood notifications).

The most active seasons in terms of river flooding over the past 5 years are the spring (MAM) of 2013 and 2014, autumn (SON) of 2014 and 2016, and winter (DJF) 2016.

Based on the number of notifications issued from 2012-2016; typically, the most formal flood notifications are issued in spring (MAM, 15 on average), informal notifications the DJF winter season (averaging 24), and flash flood notifications (based on 2014-2016) the SON season (averaging 102). The season with the fewest formal and informal flood notifications tends to be summer (JJA, averaging 4 formal and 10 informal notifications), and spring (MAM) tends to see the fewest (5 on average) flash flood notifications issued.

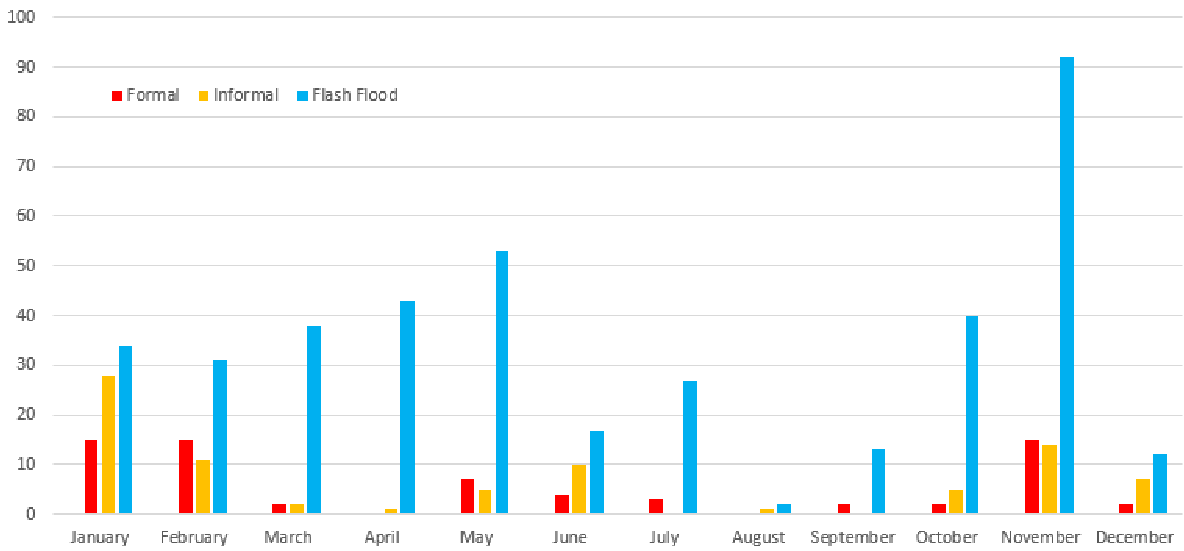

Figure 3. Number of EFAS formal (red), informal (orange) and flash flood (blue) notifications issued in 2016.

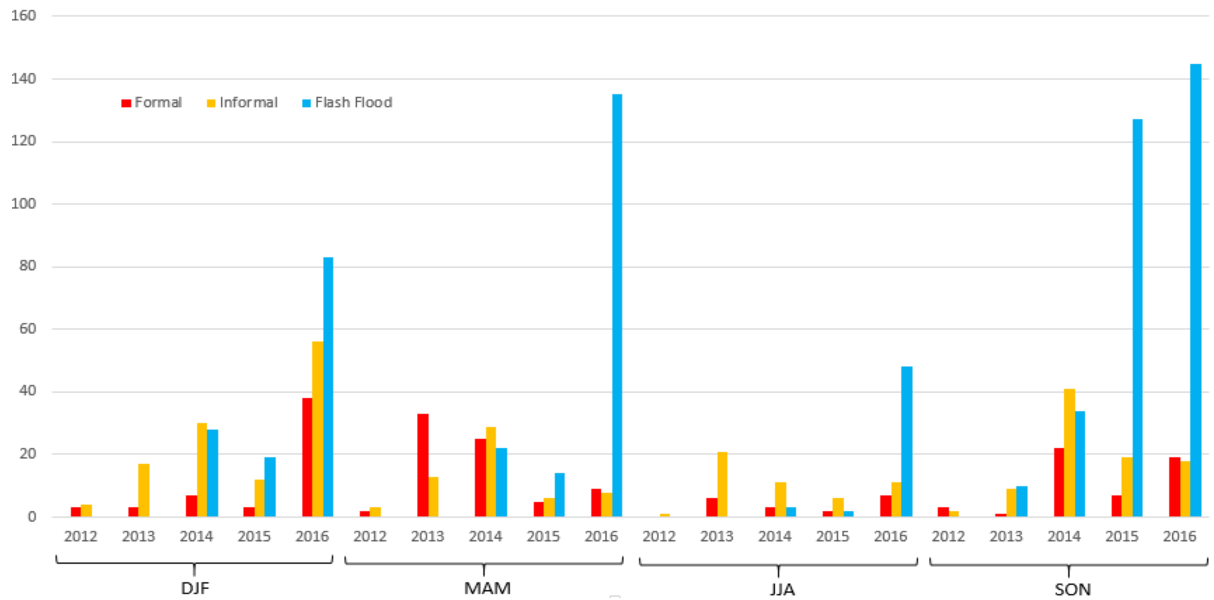

Figure 5. Number of EFAS formal (red) and informal (orange) notifications issued per season over the past 5 years, and number of EFAS flash flood (blue) notifications issued per season over the past 3 years (since the first notification in October 2013).

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
- Eric Sprokkereef, Dissemination Centre (RWS)

Cover image: This photo was taken from helicopters of the Dirección General de Seguridad Ciudadana y Emergencias, Murcia, during the event in mid-December 2016, and was originally published by the Centro de Emergencias 112 Región de Murcia, via Twitter.

Appendix - figures

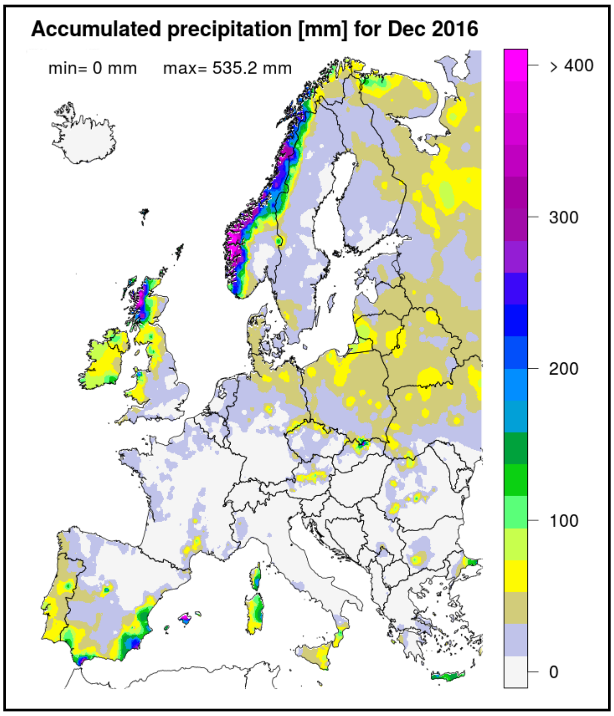

Figure 6: Accumulated precipitation [mm] for Dec 2016.

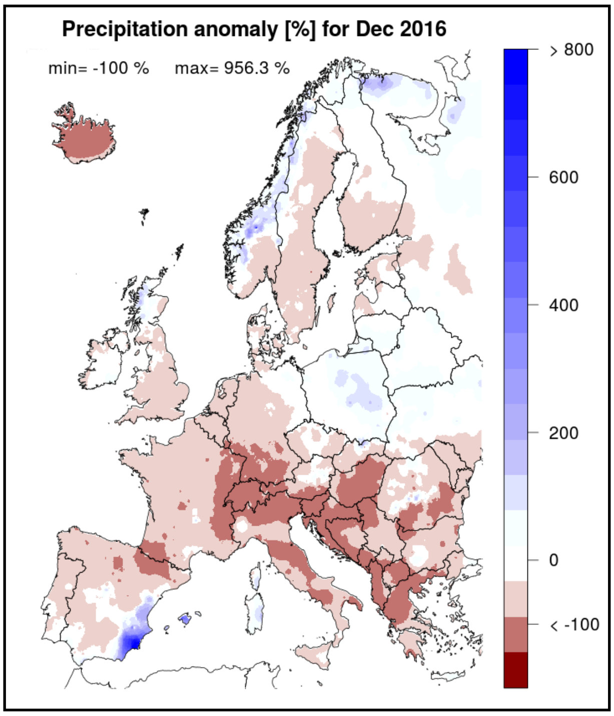

Figure 7: Precipitation anomaly [%] for Dec 2016, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

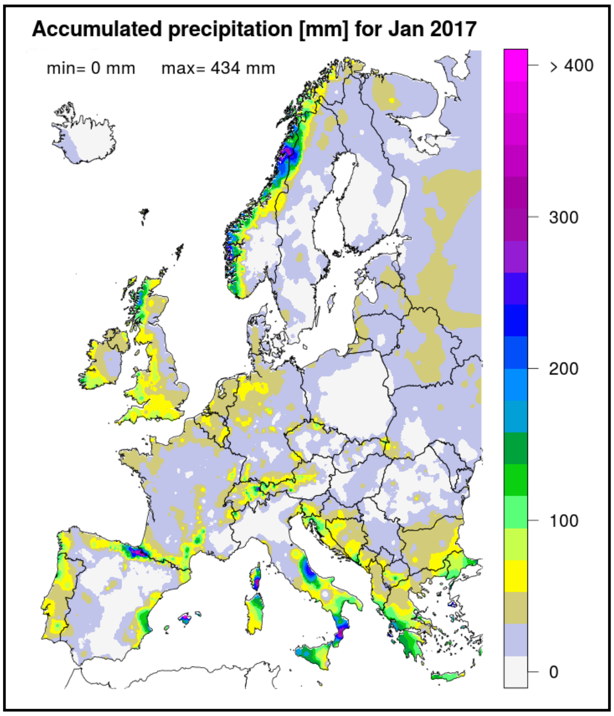

Figure 8: Accumulated precipitation [mm] for Jan 2017.

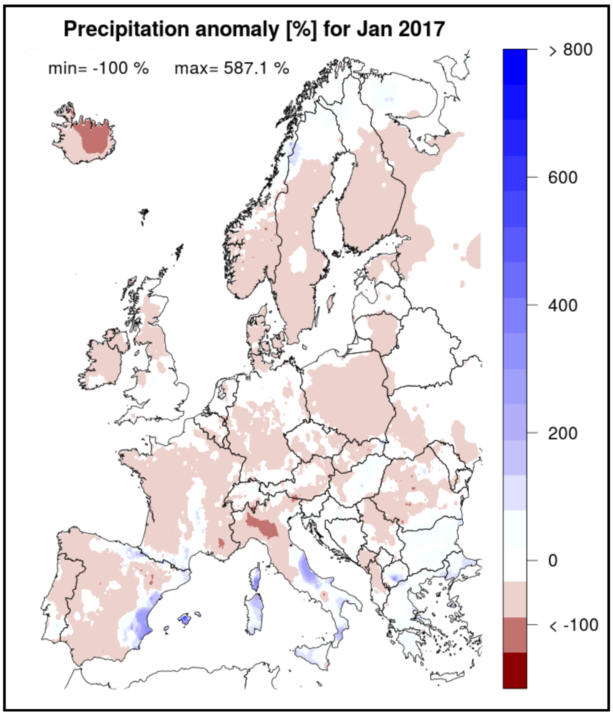

Figure 9. Precipitation anomaly [%] for Jan 2017, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

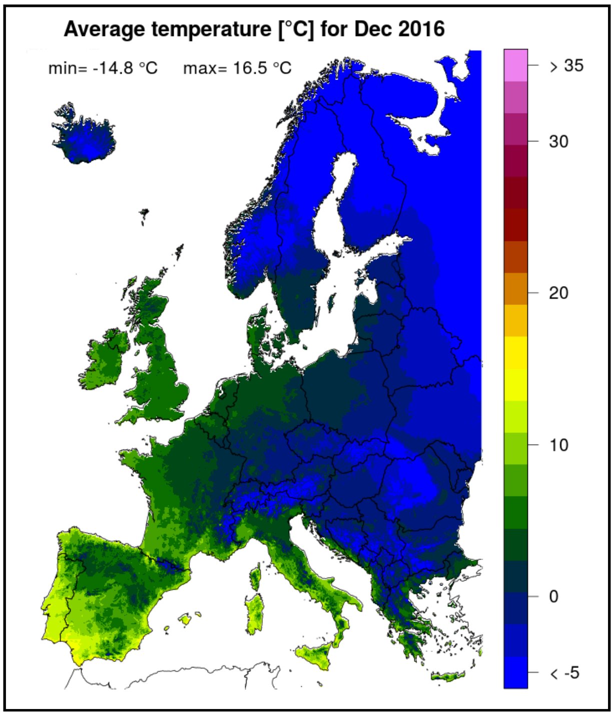

Figure 10: Mean temperature [°C] for Dec 2016.

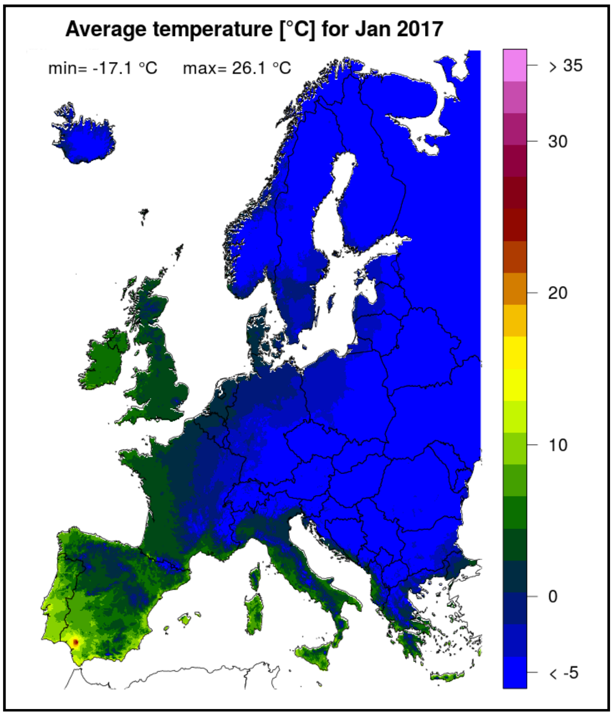

Figure 12: Mean temperature [°C] for Jan 2017.

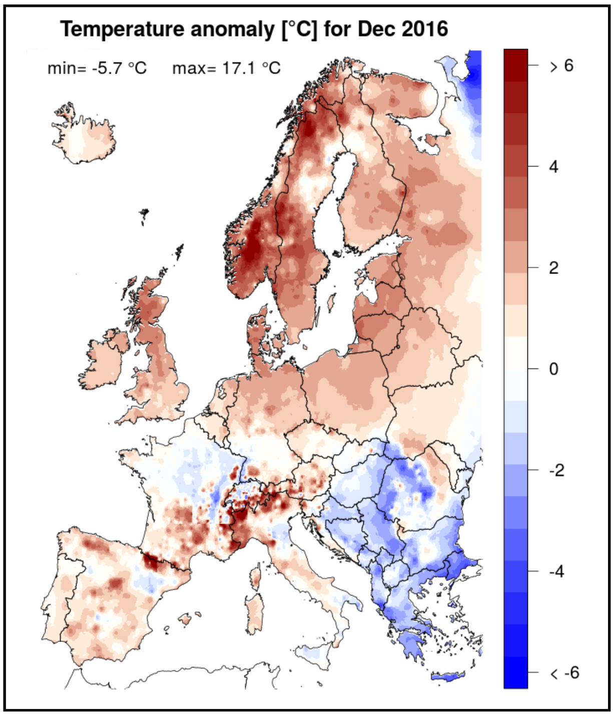

Figure 11: Temperature anomaly [°C] for Dec 2016, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

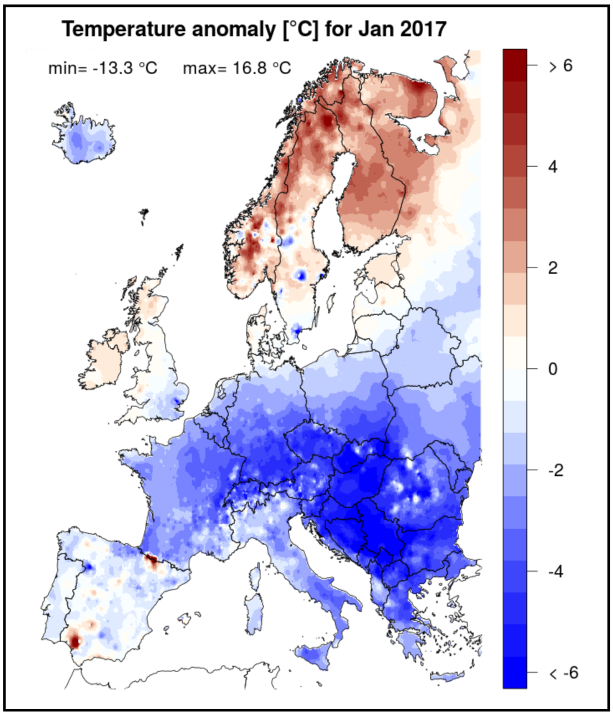

Figure 13: Temperature anomaly [°C] for Jan 2017, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

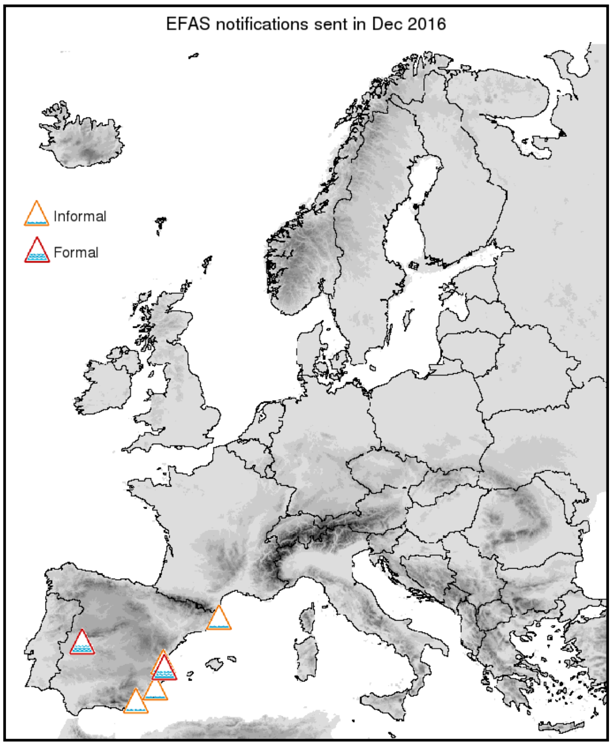

Figure 14: EFAS flood notifications sent for Dec 2016.

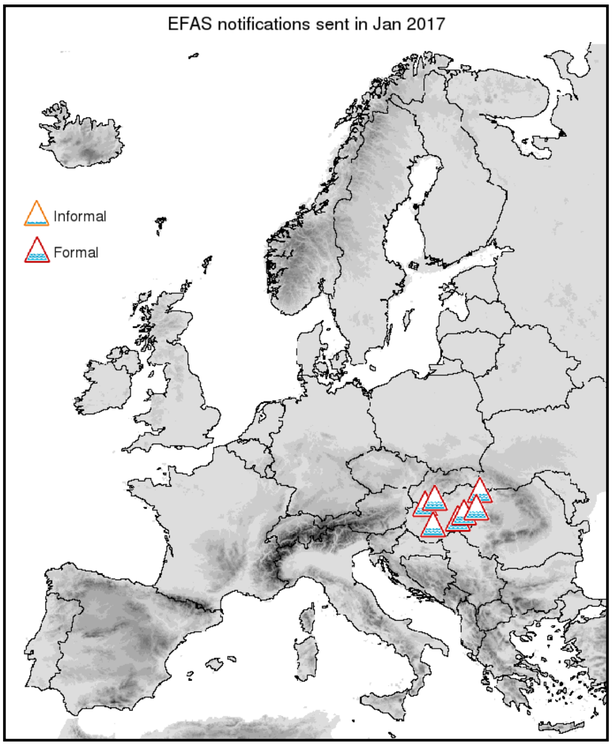

Figure 16: EFAS flood notifications sent for Jan 2017.

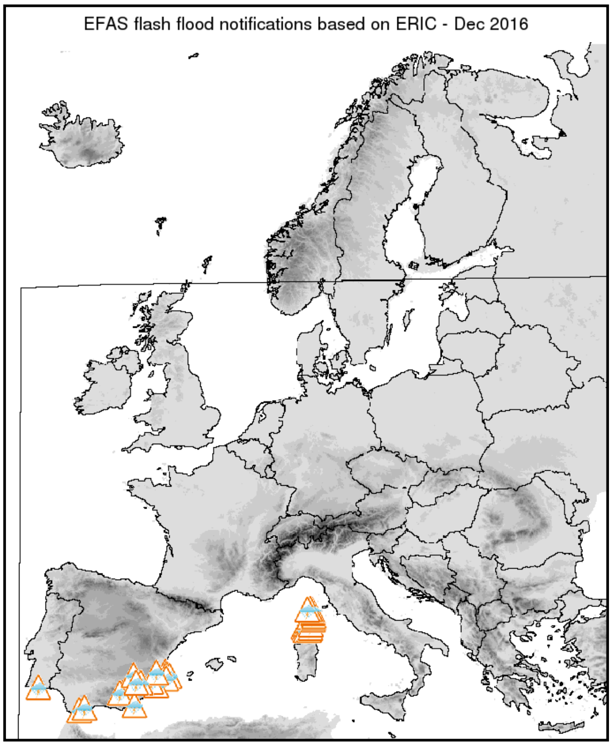

Figure 15: Flash flood notifications sent for Dec 2016.

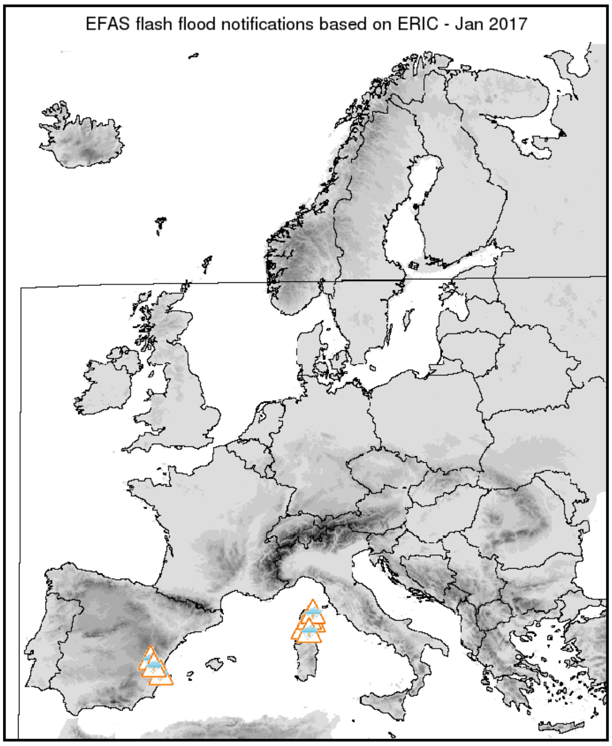

Figure 17. Flash flood notifications sent for Jan 2017.

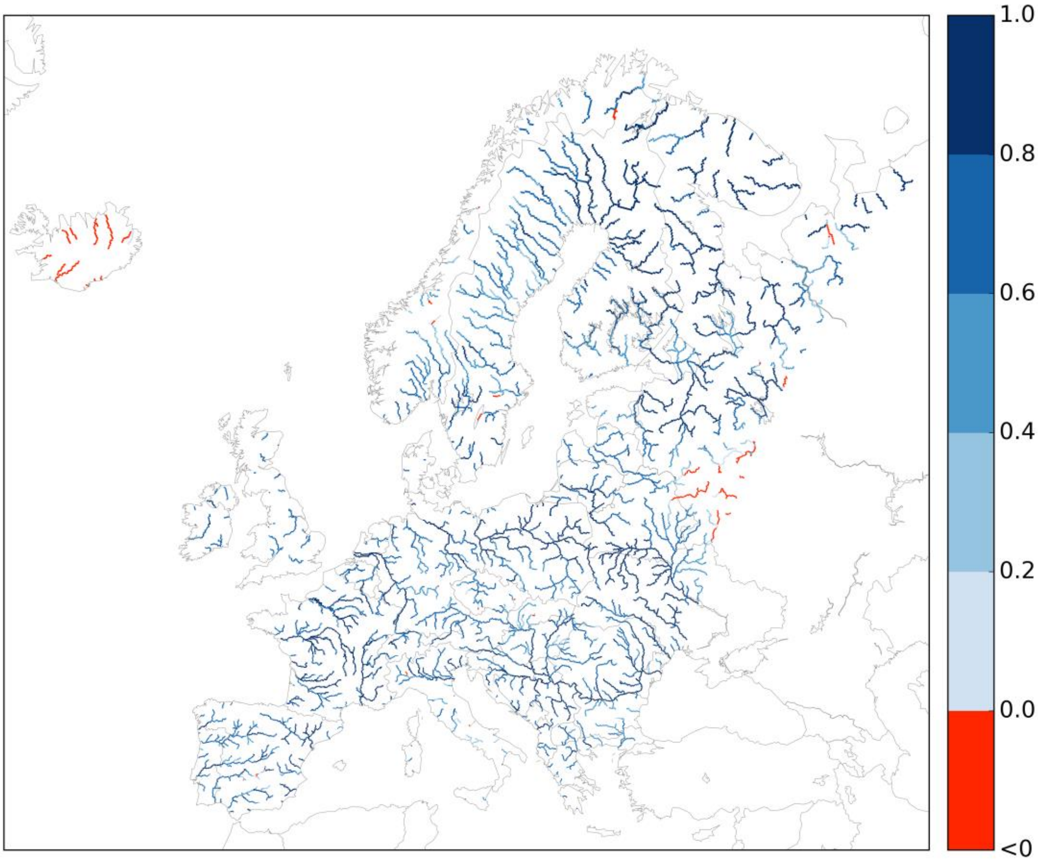

Figure 18. EFAS CRPSS at lead time 5 days for the December 2016 - January 2017 period, for catchments >2000km². The reference score is persistence.

Figure 19. EFAS CRPSS at lead time 10 days for the December 2016 - January 2017 period, for catchments >2000km². The reference score is persistence.

Appendix - tables

Table 1: EFAS flood notifications sent in December 2016 - January 2017. Feedback is shown below the corresponding notification.

Type	Forecast date	Issue date	Lead Time*	River	Country
Formal	01/12/2016 00 UTC	01/12/2016	3	Tietar	Spain
This flood event was not observed, likely because the reservoirs were empty and the ground was very dry.					
Informal	12/12/2016 00 UTC	12/12/2016	5	Turia	Spain
Informal	12/12/2016 00 UTC	12/12/2016	7	Ter	Spain
Informal	13/12/2016 12 UTC	14/12/2016	6	Spain - coastal zone	Spain
Formal	16/12/2016 00 UTC	16/12/2016	3	Jucar, below Cabriel	Spain
Event occurred on predicted day in wider region (many different rivers & places), with magnitude comparable to prediction.					
Informal	16/12/2016 00 UTC	16/12/2016	1	Almanzora	Spain
Informal	13/01/2017 00 UTC	13/01/2017	2	Berettyó	Hungary
Formal	29/01/2017 00 UTC	29/01/2017	6	Hortobágy-Berettyó	Hungary
Formal	28/01/2017 12 UTC	29/01/2017	5	Berettyó	Hungary
Formal	29/01/2017 12 UTC	30/01/2017	7	Ipel	Slovakia, Hungary
Formal	29/01/2017 12 UTC	30/01/2017	5	Szamos	Hungary
Formal	29/01/2017 12 UTC	30/01/2017	5	Lower Koros section	Hungary
Formal	31/01/2017 00 UTC	31/01/2017	6	Malý Dunaj	Slovakia
Formal	31/01/2017 00 UTC	31/01/2017	2	Kapos	Hungary

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

Table 2: EFAS flash flood notifications sent in December 2016 - January 2017.

Type	Forecast date	Issue date	Lead Time*	Country	Region
Flash Flood	01/12/2016 00 UTC	01/12/2016	84	Portugal	Algarve
Flash Flood	01/12/2016 00 UTC	01/12/2016	102	Spain	Malaga
Flash Flood	03/12/2016 00 UTC	03/12/2016	60	Spain	Cadiz
Flash Flood	13/12/2016 12 UTC	14/12/2016	114	Spain	Murcia
Flash Flood	14/12/2016 12 UTC	15/12/2016	96	Spain	Almeria
Flash Flood	16/12/2016 00 UTC	16/12/2016	54	Spain	Granada
Flash Flood	15/12/2016 12 UTC	16/12/2016	60	Spain	Albacate
Flash Flood	15/12/2016 12 UTC	16/12/2016	90	Spain	Valencia
Flash Flood	17/12/2016 00 UTC	17/12/2016	60	Spain	Alicante
Flash Flood	18/12/2016 12 UTC	18/12/2016	42	France	Corse-du-Sud
Flash Flood	18/12/2016 00 UTC	18/12/2016	54	France	Haute-Corse
Flash Flood	17/12/2016 12 UTC	18/12/2016	54	Spain	Alicante
Flash Flood	17/12/2016 12 UTC	18/12/2016	54	Spain	Valencia
Flash Flood	18/01/2017 12 UTC	19/01/2017	48	Spain	Valencia
Flash Flood	20/01/2017 00 UTC	20/01/2017	78	France	Corse-du-Sud
Flash Flood	20/01/2017 12 UTC	21/01/2017	30	Spain	Valencia
Flash Flood	20/01/2017 12 UTC	21/01/2017	60	France	Haute-Corse
Flash Flood	20/01/2017 12 UTC	21/01/2017	60	France	Corse-du-Sud
Flash Flood	27/01/2017 00 UTC	27/01/2017	18	Spain	Valencia

*Lead time [hours] until 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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