European Flood Awareness System

EFAS *Bulletin*

February – March 2018

Issue 2018(2)

NEWS

New features

The EFAS extended domain will be launched on the 16 May. EFAS Dissemination centre held a webinar on 9 April, and the documentation of the new domain is available through EFAS-IS at:
https://www.efas.eu/home.html

Meetings

HEPEX workshop in Melbourne
The HEPEX community had its seventh International Workshop in Melbourne in February. The theme was "Breaking the barriers" with the idea of identifying challenges in research and practice regarding hydro-meteorological ensemble forecasting. There were many presentations which related to EFAS, where aspects of the seasonal outlooks, flash floods and developments on the sub-seasonal scale where presented by members of the EFAS computational centre. For a full report from the workshop, please see:
https://hepex.irstea.fr/summary-of-the-2018-hepex-breaking-the-barriers-workshop-melbourne-australia/

CLARA workshop in Stockholm
Fredrik Wetterhall from the EFAS CC attended the CLARA Multi-User forum workshop in Stockholm 6-7 March. CLARA (Climate forecast enabled knowledge services) is a Horizon 2020 project with the aim to develop advanced climate services using the Copernicus Climate Change Services. Fredrik showed EFAS seasonal forecasts and the current development of the sub-seasonal forecasts for the project.

EFAS Annual Meeting
The 13th EFAS Annual Meeting was held in Norrköping, Sweden, 13-14 of March 2018 and was hosted by the EFAS Dissemination Centre. 69 participants, representing 35 different organizations (27 partners) and EFAS partner authorities, attended the meeting. For a longer report on the meeting, please see separate article in this bulletin.

RESULTS

Summary of EFAS Flood and Flash Flood Notifications

The 39 formal and 29 informal EFAS flood notifications issued in February-March 2018 are summarised in Table 1. The locations of all notifications are shown in Figure 22 and Figure 24 in the appendix.

140 Flash flood notifications, summarised in Table 2, were issued from February to March 2018. The locations are shown in Figure 23 and Figure 25 in the appendix.

Meteorological situation

by EFAS Meteorological Data Collection Centre

February 2017
In the beginning of February, a strong low-pressure system located over Scandinavia expanded towards central Europe and weakened. Simultaneously a stable low-pressure system influenced the weather conditions in the Mediterranean region and caused strong winds, heavy precipitation and high waves, which led to flash floods in Malta on 10 February. An average of 65 mm of rain was measured on the Maltese islands in 36 hours, which is more than the monthly average precipitation for this month. In some areas, approximately 100 mm of rain was recorded within 24 hours. After this event, the low-pressure system moved eastwards and mostly high-pressure systems dominated Europe.

Towards the end of February, a very strong and stable low-pressure system formed over the eastern part of the Mediterranean region. This led to heavy rainfall in Greece, which in turn caused overflowing of the Pinios River and its tributaries in the Trikala region. Farmlands were inundated and areas around several villages were affected by flooding, like Valtino, Farkadona, Exalofos, Eleftherochori, Matsoukiotika and Dendrochori. Close to the village of Zagora in the Magnesia region, a weather station recorded 676 mm of rain between 21 and 26 February. In the rest of Europe, strong high-pressure systems dominated and led to stable atmospheric conditions without any occurrence of other flood events during February.

In February, the Balkans and the Mediterranean region, except for the southern parts of Spain, were significantly wetter than normal (Figure 10 Figure 11).

The rest of Europe experienced drier than normal conditions. In addition, the accumulated precipitation sums had a maximum of 415.9 mm, which correlated with both flood events in Malta and Greece.

In general, the average temperature ranged from -21.9°C to a maximum of 14.6°C and fell below zero degrees throughout most of Europe (Figure 14). Most regions of central Europe, Scandinavia and eastern Europe measured average temperatures of less than -5°C. This cold led to negative temperature anomalies in Europe, except for a few parts of northeastern Russia and most regions of the Balkans (Figure 15).

March 2018

The weather conditions in the beginning of March were nearly everywhere influenced by low-pressure systems except for some parts of Scandinavia. The storm Emma (also named Ulrike) brought high tides combined with strong winds and waves, causing coastal flooding in parts of southwestern England on the 4 March. Following this event heavy rain and melting snow caused flooding and landslides in Albania on 5 March. Shkodër County in the northwest of the country was the worst affected area, where both the Drin and Bojana rivers overflowed.

A new strong low-pressure system moved eastwards, where high precipitation amounts together with snowmelt led to flooding and landslides in Croatia and Bosnia-Herzegovina between 12 and 13 March. One of these landslides destroyed six houses in Hrvatska Kostajnica, Sisak-Moslavina County, but no fatalities have been reported. The same scenario took place in Romania between 13 and 16 March. The worst flooding was reported in the counties of Covasna and Brașov in the Transylvania region. Around 300 people were evacuated and about 400 buildings were damaged by the floods.

The situation persisted after mid-March: At least one person died and another was missing after a storm in Andalusia, southern Spain on 17 March. The storm brought strong winds with gusts of over 28 m/s, snow in higher areas, as well as heavy rain which caused flooding and landslides until 19 March. Castell de Ferro in Granada recorded 70 mm of precipitation in 6 hours late 17 March. After that, high-pressure systems dominated the weather conditions in central Europe and Scandinavia, but were soon replaced by low-pressure systems. Parts of northern Greece, south-eastern Bulgaria and northwestern Turkey experienced floods due to rivers in the Balkans were overflowing their banks. Consequently, roads and wide areas of farmland were flooded on 25 March. Towards the end of March, high-pressure systems were only located over eastern Europe and the Balkans.

In March, high precipitation amounts with up to 1120 mm were measured in Portugal, parts of Spain, northern Italy and along the coastline of the Balkans (Figure 12 and Figure 13). The accumulated precipitation sums correlated with the flood events during this month and indicated wetter conditions in these areas. Iceland, Scandinavia, parts of central and eastern Europe experienced positive precipitation anomalies.

Furthermore, the average temperature ranged from -17.3°C to a maximum of 16.5°C in the Mediterranean region (Figure 16). In general, most European countries were colder than average, with the exception of parts of the Balkan countries and areas bordering on the Mediterranean Sea (Figure 17).

Hydrological situation

by EFAS Hydrological Data Collection Centre

Over the past two months, the highest concentration of stations that surpassed the minimum discharge or stage warning levels were found in the central and western areas of the Danube basin (Serbia, Bulgaria, Slovakia and Romania), along the Sava river, across the Dnieper river basin (Belarus and north-western Ukraine), the Po river (northern Italy) and the Minho river basin in north-western Spain. Other stations which also surpassed their minimum warning levels were in the Vistula river basin in Ukraine and Belarus, across the central and eastern area of the Rhine river basin, the Don and Dniester river basins (north-eastern and southern Ukraine respectively), Israel, south-eastern Sweden, the central area of Norway, western side of the Danube river basin (Germany), the Elbe river basin (Czech Republic), the Meusse river basin (Belgium) and the Llobregat river basin in north-eastern Spain.

The stations which have presented stage or discharge values above the 90% quantile were the ones in the river basins of southern and northern Spain, in almost the entire Danube river basin, in the southern Rhine river basin (mainly in Switzerland), and the Scandinavian river basins. This occurred less frequently to a small number of stations in the UK (Thames, Stour and Welland river basins), Ireland (Barrow river basin) and in the Dniester and Dnieper river basins in the Ukraine.

Stations in northern and central areas of the Elbe and Rhine river basins in Germany, in basins across Norway, Spain (the Ebro, Guadalquivir, Douro and Mediterranean river basins), the Danube river basin in Austria, Slovakia, Ukraine, Czech Republic, Romania and Bulgaria, the Po river basin (Italy), in the Dniester and Dnieper river basins in Ukraine, and basins in Israel, Sweden and the UK did not reach the 10% quantile for discharge or stage values.

Verification

Figure 1 - Figure 2 shows the EFAS headline score, the Continuous Ranked Probability Skill Score (CRPSS) for lead times 3, 5 and 10 days 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.

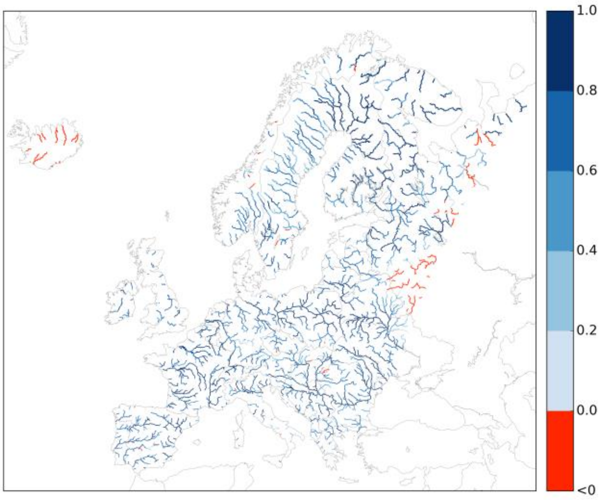

Figure 1. EFAS CRPSS at lead-time 3 days the February-March 2017 period, for catchments >2000km2. The reference score is persistence.

These maps indicate that across much of Europe for 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.

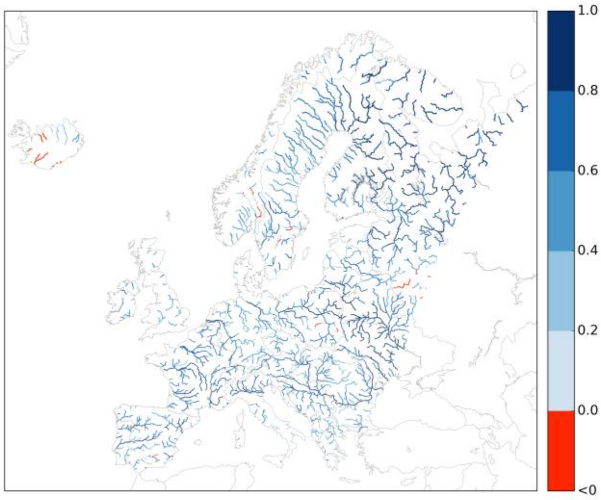

Figure 2. EFAS CRPSS at lead-time 10 days the February-March 2017 period, for catchments >2000km2. The reference score is persistence.

Publications

Arnal, L., Cloke, H. L., Stephens, E., Wetterhall, F., Prudhomme, C., Neumann, J., Krzeminski, B., and Pappenberger, F.: *Skilful seasonal forecasts of streamflow over Europe?,* Hydrol. Earth Syst. Sci., 22, 2057-2072, https://doi.org/10.5194/hess-22-2057-2018, 2018

Skøien, J., Salamon, P., Alagic, E., Alobeiaat, A., Andreenko, A., Bari, D., Ciobanu, N., Doroshenko, V., El-Ashmawy, F., Givati, A., Kastrati, B., Kordzakhia, M., Petrosyan, Z., Spalevic, M., Stojov, V., Tuncok, K., Verdiyev, A., Vladikovic, D. and Zaimi, K**.,** *Assessment of the capacity for flood monitoring and early warning in Enlargement and Eastern/ Southern Neighbourhood countries of the European Union*, EUR 29073 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-79-77771-4, doi:10.2760/18691, JRC108843

FEATURES

EFAS Annual meeting in Norrköping, Sweden 13-14 March 2018

by Sara-Sofia Asp and Elinor Andersson

The EFAS 13th annual meeting was held in Norrköping, Sweden. It was officially opened by Mr. Rolf Brennerfelt, General Director at SMHI. The meeting featured general EFAS information, three workshops, six poster presentations, two partner presentations about extreme flooding events, and two partner presentations about new developments in their organisation. The focus of the meeting was partner networking and sharing experiences. Minutes and presentations from the meeting are available on EFAS-IS www.efas.eu/home.

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 their work regarding communication with data providers. They also announced that one of the consortium members, Elimco, has changed their name to Soologic. EFAS METEO gave a general overview of the data processes and what has been done since last year. They also gave information about their new interpolation method and data in the new domain. Both data collection centres encouraged all the partners to share their data. The computational centre went through their key activities during last year, such as model upgrades and the work on the extended domain.

Figure 3. Participants of the EFAS annual meeting

Future of EFAS

Peter Salamon (JRC) presented what is next for EFAS. The extension of the EFAS domain will happen in spring 2018, and will open up for more EFAS partners. Among other things, Peter talked about incorporation of social media into EFAS, new developments and the new EFAS web interface.

Foreseen changes to the Union Civil Protection Mechanism legislation

This year DG-ECHO was present at EFAS annual meeting and held a presentation on foreseen changes to the Union Civil Protection Mechanism legislation. Within the civil protection mechanism any member state can request assistance. During 2017 there were 32 activations of the service, mostly for forest fires.

Figure 4. Presentation of the new EFAS web interface by Laura Baracchi, COMMpla

New EFAS-IS interface

The developers of the new EFAS-IS interface, Commpla, had a longer presentation with a discussion session and user survey. They went through the objectives, the map viewer functionalities and the layout for the new interface. Some new features will be a dashboard where you can have personal settings, and the ability to access the webpage in different languages.

Presentations on extreme events and new developments from EFAS partners

Two presentations were held covering extreme events. Elena Anghel from Institutul National de Hidrologie si Gospodarire a Apelor (INGHA) held a presentation about a flash flood event in 2017 in Romania. Vesela Stoyanova from the National Institute of Meteorology and Hydrology in Bulgaria presented a summary of all received EFAS flood notifications of 2017.

Two presentations were held covering new developments from EFAS partners. Amir Givati from Israeli Hydrological Service presented "The advantage of using data assimilation and ensemble of precipitation for flood forecasting in Israel" and Alexey Romanov from the Hydrometeorological Research Centre of Russia presented "Some problems of channel hydrodynamics and data processing from UAV (Unmanned Aerial Vehicles)".

Workshops

The attendees were divided into three groups and were given the opportunity to participate in three different workshops. Workshops were held on the following topics:

- How to mutually benefit from information exchange between EFAS and partners
- How to use EFAS WMS and SOS web services and data archiving
- Added value from the new products in EFAS-IS

All the workshops started with a presentation. During each workshop, the participants were engaged in different activities with the aim of gaining more knowledge.

Open data

Peter Salamon (JRC) held a longer session about EFAS and open data. EFAS currently shares only archived data older than one month whereas the real-time flood forecasts are restricted to EFAS partners only. The focus of this session was to start discussing with all EFAS-partners if and how we can make more information public but still protect the relevant authorities interests and responsibilities regarding flood forecasting. Many questions were asked and fruitful discussions took place. Many partners acknowledged that the trend towards open data cannot be stopped but that we need to find solutions that flood warnings, which are responsibility of the relevant national/regional authorities, have a strong and consistent message towards the public and relevant stakeholders. Through its strong community the EFAS partner network has a chance to influence and even lead this future development in flood forecasting.

Figure 5. EFAS dinner at the Louise De Geer conference centre

Summary

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 attend a guided tour around the Norrköping industrial landscape and enjoy an excellent dinner at the conference centre Louis De Geer.

Case study: South-eastern European floods in March 2018

by Richard Davies, FloodList

Heavy rain and melting snow caused flooding and landslides in several countries in south-eastern Europe during March 2018. Copernicus Emergency Mapping Service was activated to monitor the flooding in Albania, Croatia and Greece. Flooding was also reported in Romania, Bosnia and Herzogovina, Serbia, Montenegro, Bulgaria and northern Turkey.

Albania

In Albania, Shkodër County in the north-west was the worst affected area, where the Drin and Bojana rivers overflowed from around 9 March. Several villages were left isolated by the flood water, which at one point covered 2,285 hectares of land according to local authorities. Flooding was also reported in areas of Durrës County. Several minor landslides were also reported across the country. Copernicus monitored flooding in city of Shkodër, Grilë, Dajç, Gomsiqe, and Barbullush, well into late March.

Figure 6. Caption: Floods in Shkodër (Scutari), Albania, 18 March 2018. Credit: Copernicus.

Croatia

In Croatia, fire service, civil defense and military personnel were deployed to assist flooded communities in parts of Sisak-Moslavina and Karlovac counties. A landslide in Hrvatska Kostajnica, Sisak-Moslavina County, on 13 March, left several houses destroyed or damaged. No fatalities were reported. Streets and homes were also flooded in the area after the Una River overflowed. The river stood at 4.54 metres on 13 March.

Figure 7. Landslide damage in Hrvatskoj Kostajnici, Sisak-Moslavina County, Croatia, 13 March 2018. Credit: National Protection and Rescue Directorate Croatia (DUZS)

Elsewhere in Croatia, the Korana River in Karlovac was at red level warning stage on 13 March, standing at 7.81 metres. Disaster officials said the rising Sava River was a cause for concern, in particular at Jasenovac where levels were at orange warning stage, standing as at 8.54 metres.

The situation continued into late March, where Copernicus monitored flooding in areas along the Sava, including Kutina and Novska in Sisak-Moslavina County, and Lijevi Dubrovčak, Zagreb County.

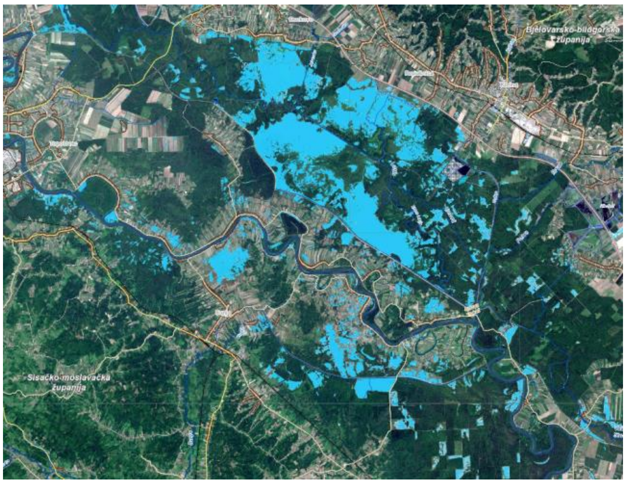

Figure 8. Floods in Kutina, Sisak-Moslavina County, Croatia, 24 March 2018. Credit: Copernicus

Bosnia and Herzegovina

The overflowing Una River also caused flooding in Bihac and Bosanska Krupa in Bosnia and Herzegovina. Levels of the river had increased by almost 30 cm in 24 hours from 12 March 2018 and by 13 March stood at 1.40 metres. The overflowing Sana River at Sanski Most also caused some flooding. As of 13 March, the river stood at 3.91 metres.

Romania

In Romania, the worst of the flooding was in the counties of Covasna and Brașov, where hundreds of homes were damaged. On 14 March 2018, seven people were rescued after they were left isolated by flooding in areas around Șercaia and Mândra in Braşov County. Evacuations were carried out in the village of Căpeni, Covasna County due to flood threat from the River Olt.

EFAS forecasts for the event

EFAS sent a formal notification for Lonja, Ilova & Pakra Rivers on the 6 March, a week before the event occurred, followed by more formal notifications for the concurring events in the Sava river basin. A flash-flood warning was sent for Covasna in Romania on the

13 March warning for flash floods on the 14th. Several other countries and regions were affected by the wet conditions in early to mid-March, and 14 formal flood and 21 flash flood notifications were sent during this period over the south-east European region.

Update on the development of a National flood forecasting and warning service for Ireland

by Jim Casey and Oliver Nicholson, OPW, Ireland

Background

The exceptional and in some areas record breaking rainfall that caused some of the worst flooding ever experienced in Ireland began in November 2015 and continued until early January 2016. This weather was punctuated by a series of Atlantic Storms, including Storms Desmond, Eva and Frank. Rainfall totals over the period were 189% of normal, making it the wettest winter ever recorded.

The first flood events of this period were witnessed in the north-west on 15 November 2015 and the last flood peaks occurred on 5 January 2016 along the middle and lower Shannon catchment. Flooding was widespread, and the country was in a state of sustained flood emergency for almost two months.

Government Decision

Because of this unprecedented flooding, the Government decided to establish a National Flood Forecasting and Warning Service. Following on from this decision work is proceeding with a first stage implementation of the service that involves the following elements:

- establishment of a National Flood Forecasting Service as a new operational unit within Met Éireann, Ireland's National Meteorological Service, and
- establishment of an independent Oversight Unit within the Office of Public Works (OPW), the lead agency in Ireland for flood risk management.

The service will deal with flood forecasting from fluvial and coastal sources. When established it will involve the issuing of flood forecasts and general alerts. Given the complexities involved in establishing, designing, developing and testing this new service, it is anticipated that the first stage of the service will take at least 5 years before it is operational.

Progressing the Service

The OPW and Met Éireann are working closely together to progress this new service. A Steering Group, including representatives from the OPW, the Department of Housing, Planning, and Local Government, Met Éireann, Department of Agriculture, Food and the Marine, and the Local Authorities has been established to steer, support and oversee the establishment of the new service.

Key progress to date includes:

- Appointment of initial staff in Met Éireann and OPW to support the management, planning and implementation of the new service
- Appointment of the Chief Hydrometeorologist for the Flood Forecasting Centre in Met Éireann following an open competition
- Preparation and agreement of an implementation plan comprising a number of phases, including an initial set-up phase and a development and trial phase
- Engagement with national and international experts to explore options for hydrological models and data handling platforms
- Putting arrangements in place to enhance capacity for interim flood forecasting capability in Met Éireann through appointing two contract hydrometeorological specialists to act in a support role by preparing flood guidance reports, building hydrological expertise and training Met Éireann staff in hydrology
- Preparation and issuing of a detailed tender brief for hydrological flood forecasting model review, development and trialling (to provide overview and assessment of suitability of models for operational fluvial flood forecasting in Ireland) as outlined in the paragraphs below.

Hydrological Flood Forecasting Models - Review Development and Trialling

In tandem with the recruitment of the contract hydrometeorologists, the OPW and Met Éireann collaborated on the preparation of a tender for "the provision of services for the review, development and trial of a range of hydrological models and integrator systems for use in operational fluvial flood forecasting in Ireland" at both catchment and national scales.

This contract is expected to commence shortly, and will involve a comprehensive literature review of a number of hydrological models and integrator software systems and shall recommend at least three such hydrological models and three integrator software systems considered best suited for the purposes of operational fluvial flood forecasting in Ireland. Following the literature review, each of the recommended hydrological models shall be used to build, calibrate, and validate catchment scale models for five representative catchments in Ireland, including amongst others, the Shannon catchment (Figure 9).

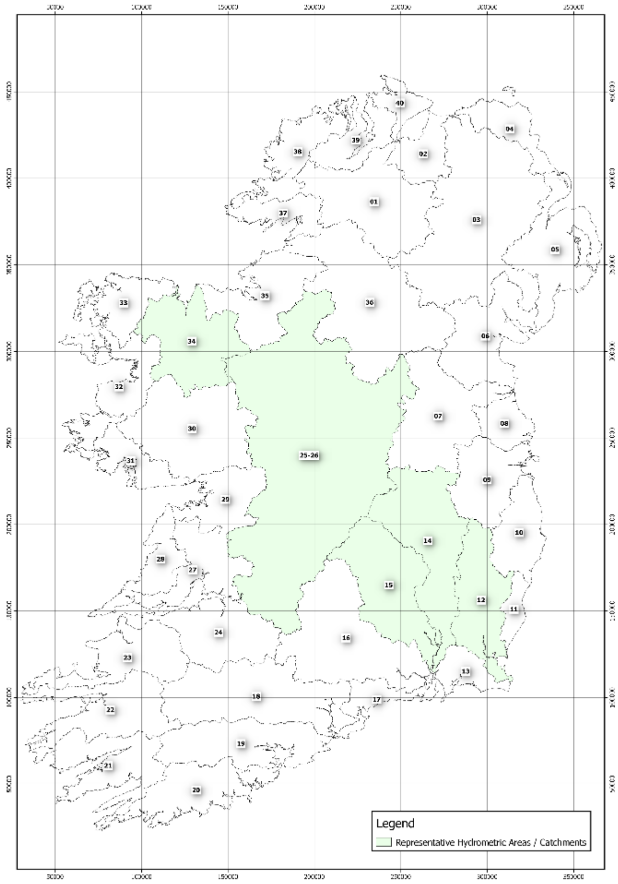

Figure 9. The five representative catchments being modelled (shaded light green)

The examination of available integrator software systems for potential use in conjunction with the operational flood forecasting models will be vital for deciding on how best to facilitate the visualisation of model input and outputs and dissemination of forecast information to relevant stakeholders.

The validated catchment models will then be used in conjunction with the three recommended integrator software systems, to conduct a number of specified forecasting trials.

It is expected that the outcomes of this work (due in late 2019) will be to propose the preferred model(s) to be used for operational fluvial flood forecasting in Ireland and the integrator software that will be used in conjunction with the preferred model(s).

Acknowledgements

The following partner institutes and contributors are gratefully acknowledged for their contribution:

- DG GROW - 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
- Jim Casey and Oliver Nicholson, OPW, Ireland

Cover image: Participants at the 13th annual EFAS meeting in Norrköping, Sweden, 13-14 March.

Appendix - figures

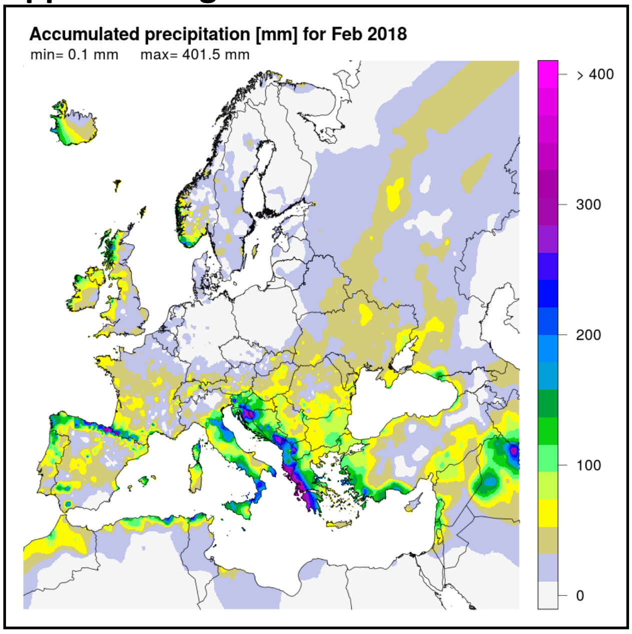

Figure 10. Accumulated precipitation [mm] for February 2017.

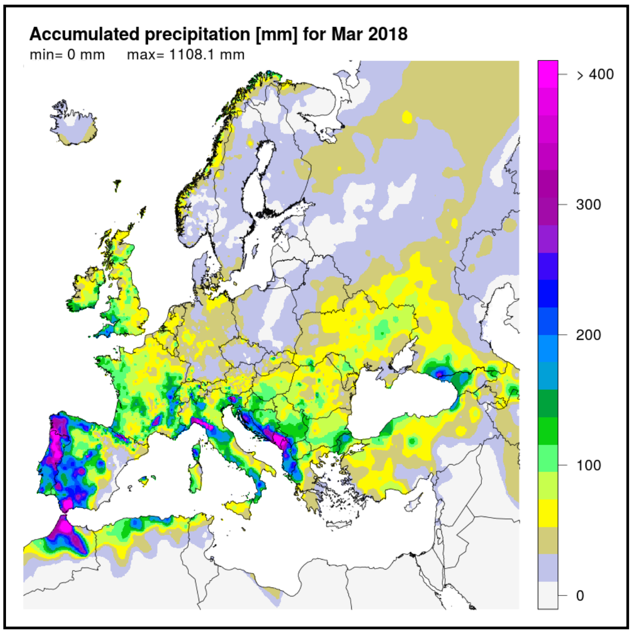

Figure 12. Accumulated precipitation [mm] for March 2017.

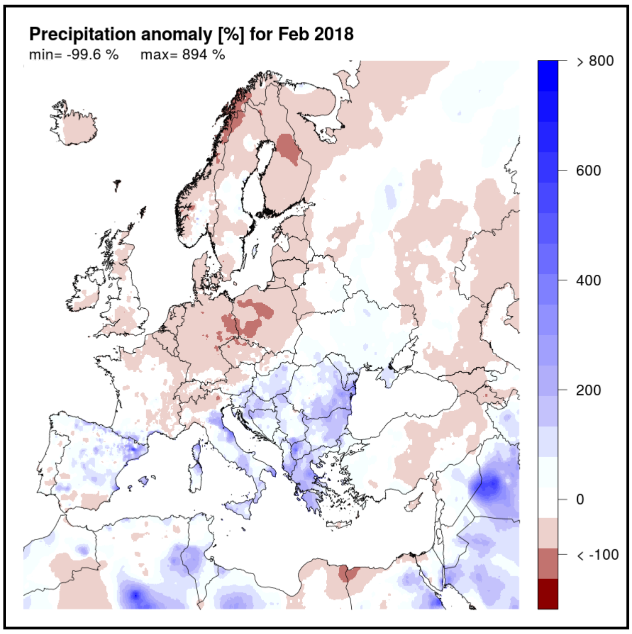

Figure 11. Precipitation anomaly [%] for February 2017, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

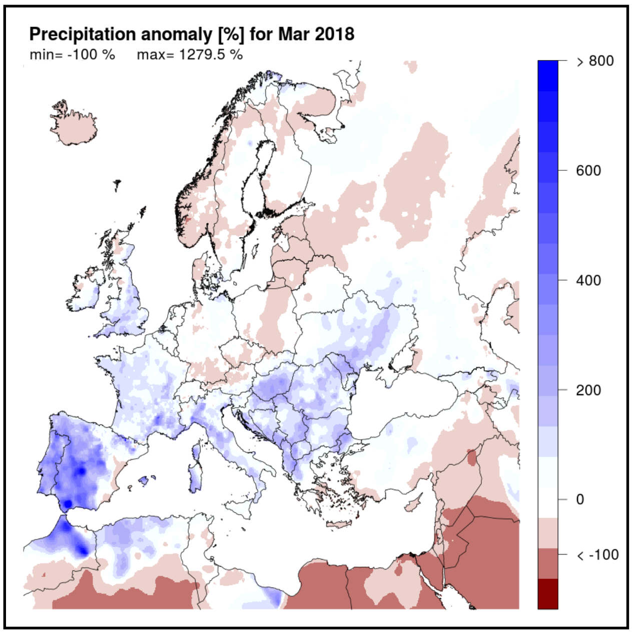

Figure 13. Precipitation anomaly [%] for March 2017, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

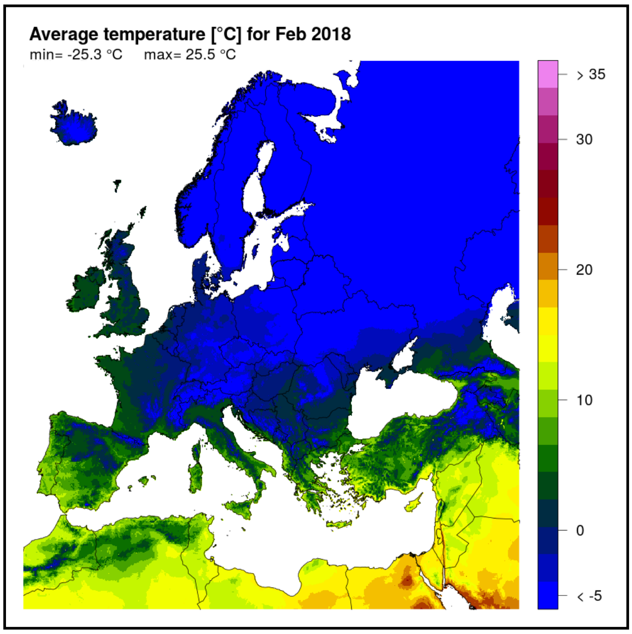

Figure 14. Mean temperature [°C] for February 2017.

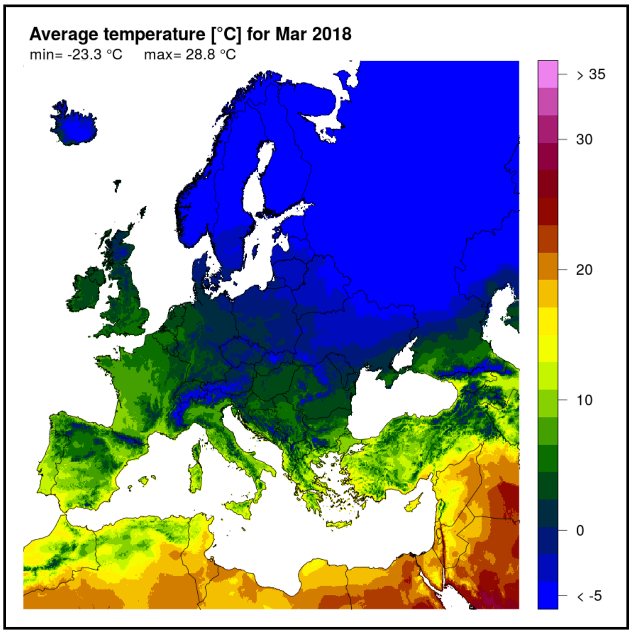

Figure 16. Mean temperature [°C] for March 2017.

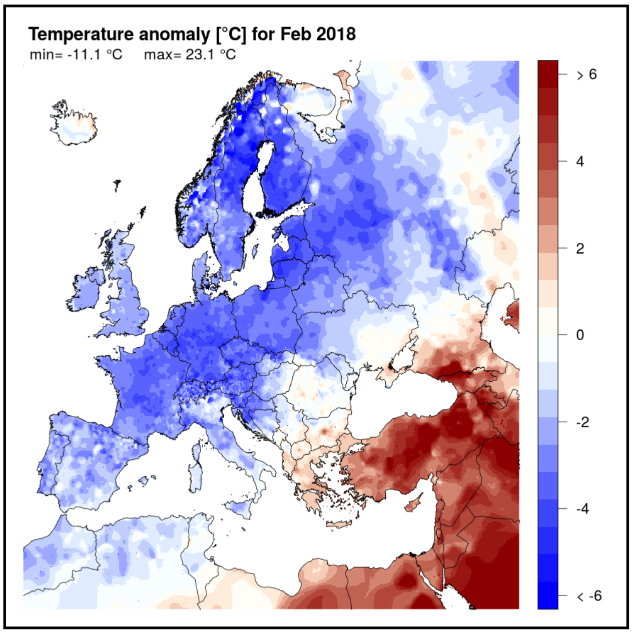

Figure 15. Temperature anomaly [°C] for February 2017, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

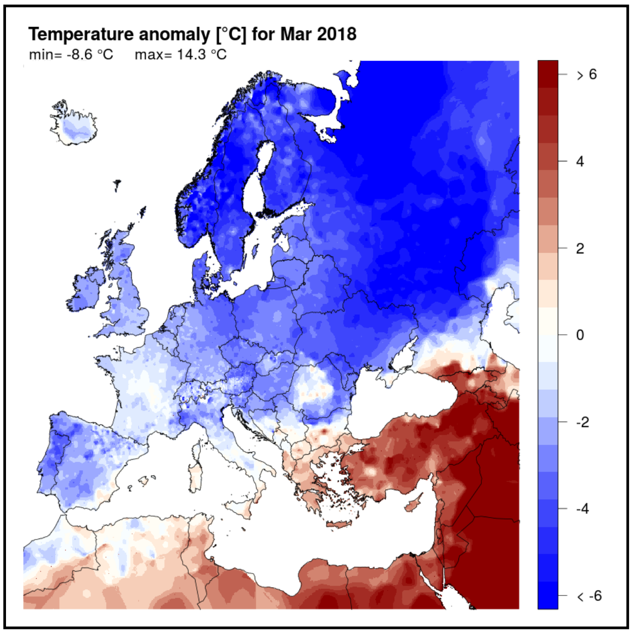

Figure 17. Temperature anomaly [°C] for March 2017, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

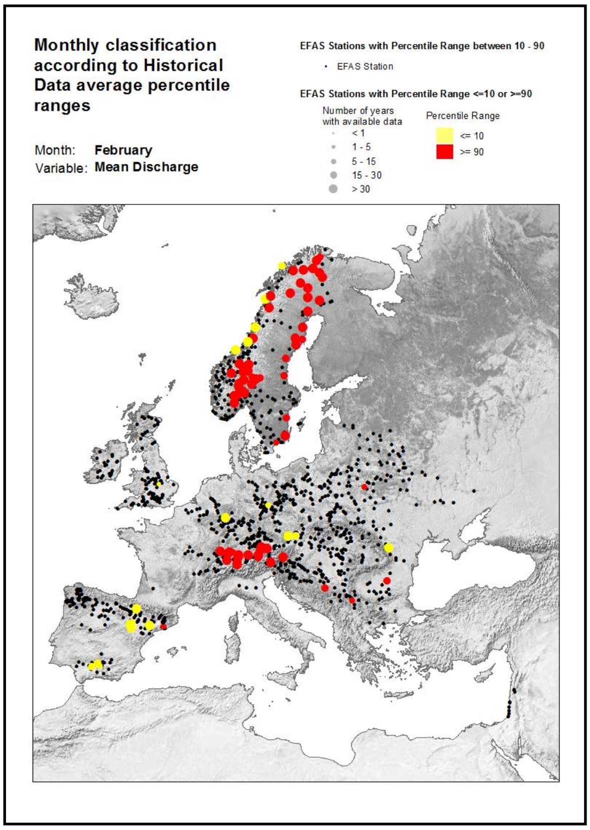

Figure 18. Monthly discharge anomalies February 2017.

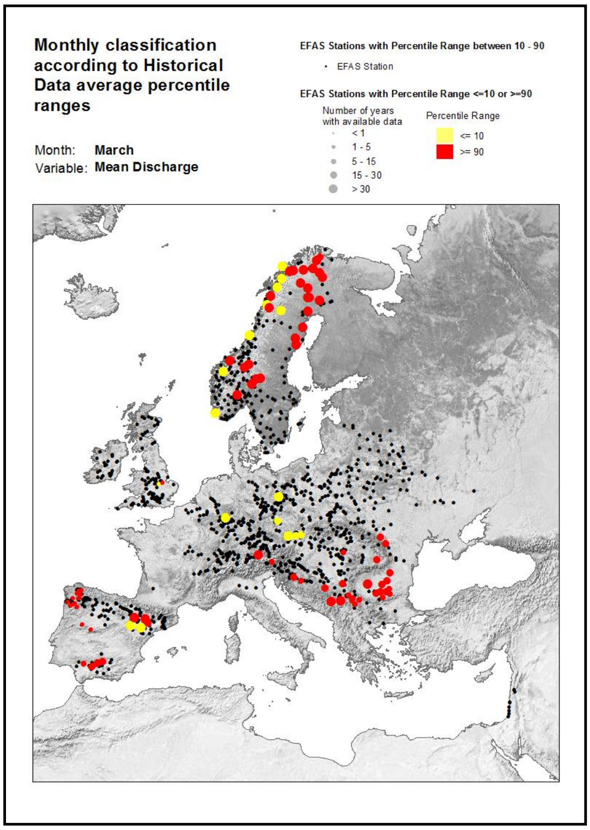

Figure 20. Monthly discharge anomalies March 2017.

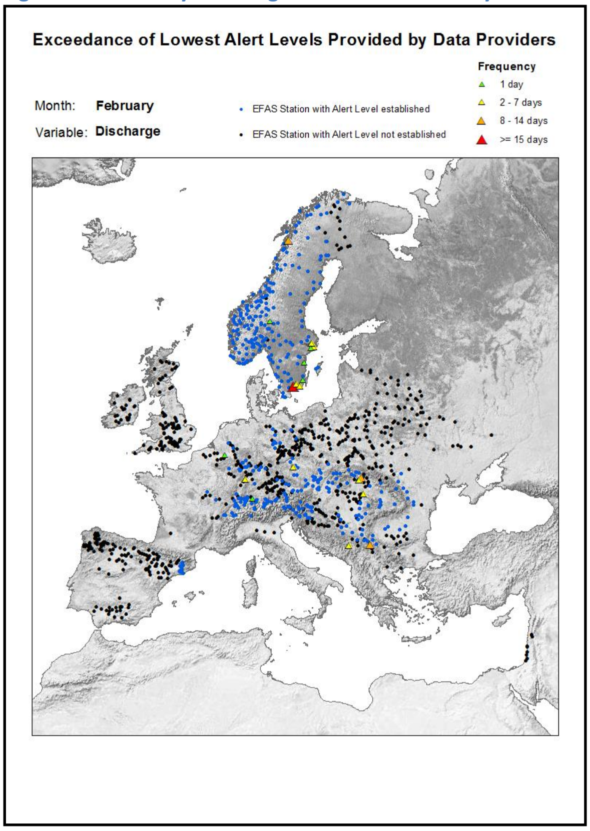

Figure 19. Lowest alert level exceedance for February 2017.

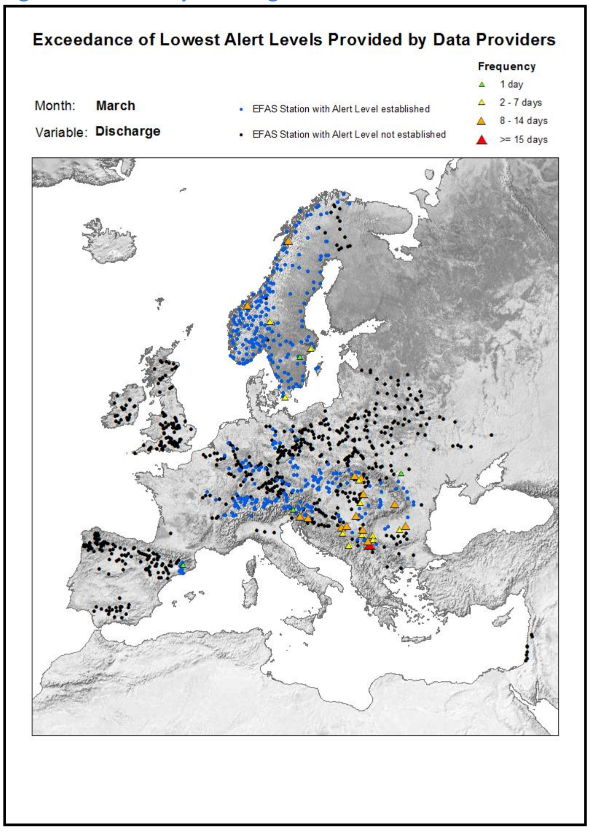

Figure 21. Lowest alert level exceedance for March 2017.

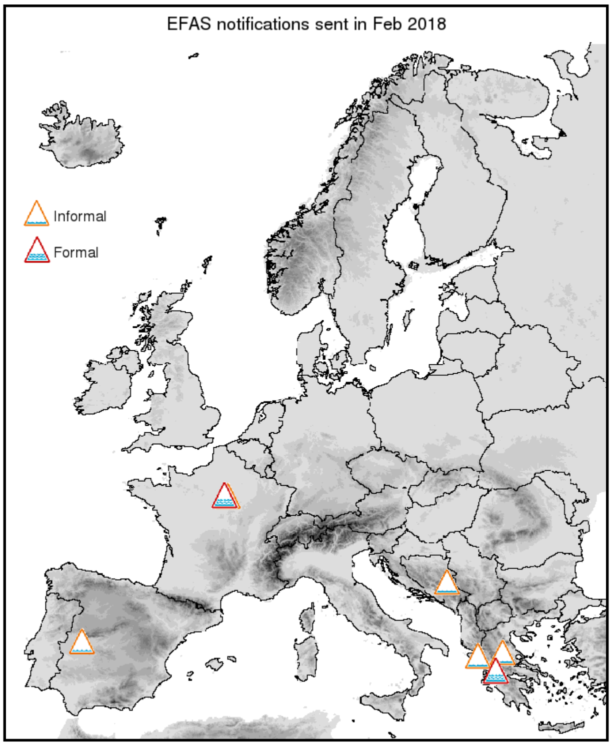

Figure 22. EFAS flood notifications sent for February 2017.

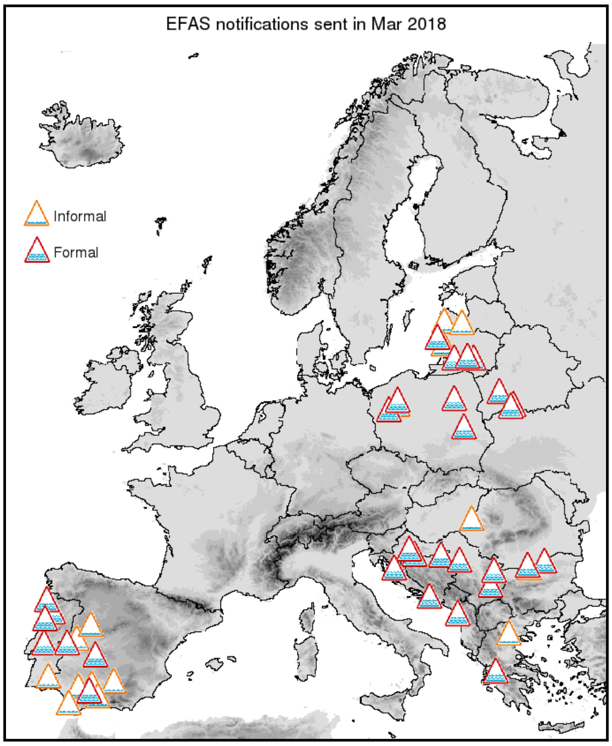

Figure 24. EFAS flood notifications sent for March 2017.

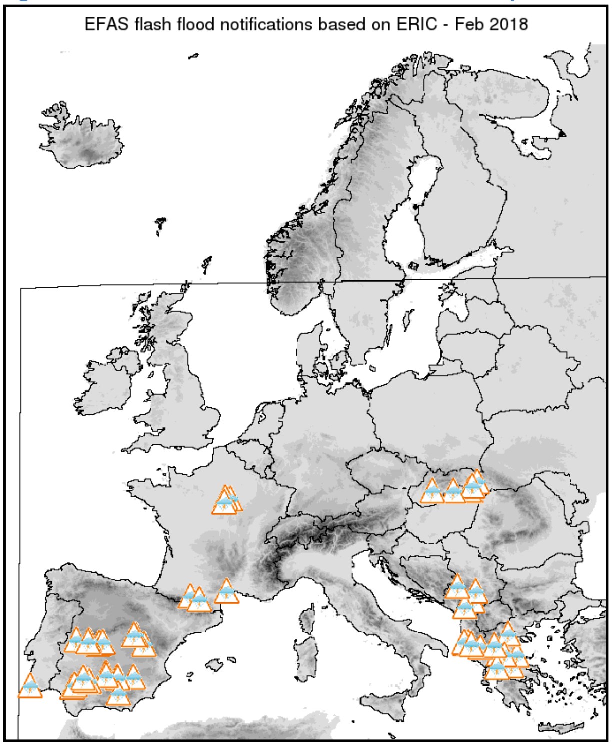

Figure 23. Flash flood notifications sent for February 2017.

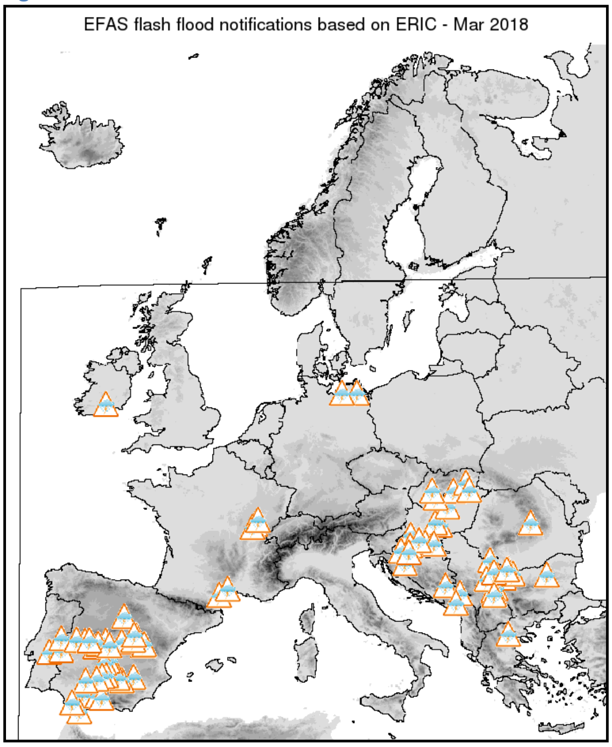

Figure 25. Flash flood notifications sent for March 2017.

Appendix - tables

Table 1. EFAS flood notifications sent in February - March.

Type	Forecast date	Issue date	Lead time*	River	Country
Informal	02/02/2018 00 UTC	02/02/2018	1	Tara	Bosnia and Her-
Informal	02/02/2018 12 UTC	03/02/2018	1	Pinios	Greece
Informal	03/02/2018 00 UTC	03/02/2018	0	Thyamis	Greece
Formal	12/02/2018 12 UTC	13/02/2018	4	Seine, section Loing - Marne	France
Formal	14/02/2018 12 UTC	15/02/2018	6	Akheloos	Greece
Informal	21/02/2018 12 UTC	22/02/2018	7	Tietar	Spain
Formal	22/02/2018 00 UTC	22/02/2018	4	Akheloos	Greece
Informal	23/02/2018 00 UTC	23/02/2018	0	Seine, above Yonne	France
Informal	02/03/2018 12 UTC	03/03/2018	1	Genil	Spain
Informal	02/03/2018 12 UTC	03/03/2018	6	Guadiana, above Zujar	Spain
Informal	02/03/2018 12 UTC	03/03/2018	7	Tejo, section Alagon to Zezere	Spain
Formal	03/03/2018 12 UTC	04/03/2018	5	Vouga	Portugal
Informal	03/03/2018 12 UTC	04/03/2018	4	Guadalimar	Spain
Formal	04/03/2018 12 UTC	05/03/2018	5	Coastal zone	Portugal
Informal	04/03/2018 12 UTC	05/03/2018	7	Tejo, section Zezere - Sorraia	Portugal
Formal	05/03/2018 00 UTC	05/03/2018	5	Pripyat, above Yaselda	Belarus
Formal	05/03/2018 00 UTC	05/03/2018	3	Timok	Serbia
Formal	05/03/2018 00 UTC	05/03/2018	7	Wieprz	Poland
Formal	05/03/2018 00 UTC	05/03/2018	6	Notec	Poland
Formal	05/03/2018 00 UTC	05/03/2018	6	Gwda	Poland
Informal	05/03/2018 00 UTC	05/03/2018	3	Danube, section Olt - Yantra	Bulgaria
Formal	05/03/2018 12 UTC	06/03/2018	6	Shchara	Belarus
Informal	05/03/2018 12 UTC	06/03/2018	4	Tormes	Spain
Formal	06/03/2018 00 UTC	06/03/2018	4	Duoro, below Tormes	Portugal
Formal	06/03/2018 00 UTC	06/03/2018	6	Lonja, Ilova & Pakra	Croatia
Formal	06/03/2018 00 UTC	06/03/2018	8	Narew, above Bug	Poland
Informal	06/03/2018 12 UTC	07/03/2018	5	Guadalimar	Spain
Formal	07/03/2018 00 UTC	07/03/2018	8	Neris	Lithuania
Formal	07/03/2018 00 UTC	07/03/2018	6	Neman, section Nevezis -	Lithuania
Informal	07/03/2018 00 UTC	07/03/2018	2	Genil	Spain
Informal	09/03/2018 00 UTC	09/03/2018	0	Guadalete	Spain
Formal	09/03/2018 12 UTC	10/03/2018	3	Coastal zone	Albania
Informal	09/03/2018 12 UTC	10/03/2018	1	Guadalquivir, below Genil	Spain
Formal	10/03/2018 00 UTC	10/03/2018	3	Yaselda	Belarus
Formal	10/03/2018 00 UTC	10/03/2018	8	Sava, below Drina	Serbia
Formal	10/03/2018 00 UTC	10/03/2018	2	Neman, section Sheshule -	Lithuania
Formal	10/03/2018 12 UTC	11/03/2018	5	Sava, above Drina	Croatia
Formal	10/03/2018 12 UTC	11/03/2018	2	Barta	Latvia
Formal	10/03/2018 12 UTC	11/03/2018	2	Juna Morava, above Nisava	Serbia
Informal	10/03/2018 12 UTC	11/03/2018	2	Minija	Lithuania
Formal	12/03/2018 12 UTC	13/03/2018	0	Juna Morava, above Nisava	Serbia
Formal	12/03/2018 12 UTC	13/03/2018	4	Lower Neretva	Croatia
Formal	12/03/2018 12 UTC	13/03/2018	0	Tejo, section Zezere - Sorraia	Portugal
Formal	12/03/2018 12 UTC	13/03/2018	0	Tejo, section Alagon to Zezere	Spain
Informal	12/03/2018 12 UTC	13/03/2018	1	Venta	Latvia
Informal	12/03/2018 12 UTC	13/03/2018	0	Lielupe	Latvia

Formal	13/03/2018 00 UTC	13/03/2018	2	Olt	Romania
Formal	13/03/2018 00 UTC	13/03/2018	0	Akheloos	Greece
Informal	13/03/2018 00 UTC	13/03/2018	1	Tormes	Spain
Informal	13/03/2018 00 UTC	13/03/2018	0	Gwda	Poland
Formal	13/03/2018 12 UTC	14/03/2018	0	Guadiana, above Zujar	Spain
Formal	14/03/2018 12 UTC	15/03/2018	0	Coastal zone	Albania
Formal	14/03/2018 12 UTC	15/03/2018	7	Danube, section Lom - Arges	Romania
Formal	16/03/2018 00 UTC	16/03/2018	1	Gacka	Croatia
Formal	16/03/2018 00 UTC	16/03/2018	3	Akheloos	Greece
Formal	16/03/2018 00 UTC	16/03/2018	4	Sava	Croatia
Informal	16/03/2018 12 UTC	17/03/2018	2	Guadalquivir, section Guada-	Spain
Informal	16/03/2018 12 UTC	17/03/2018	1	Guadiana, below Zujar	Portugal
Informal	17/03/2018 12 UTC	18/03/2018	2	Sebes Koros, Crisul Repede	Hungary
Formal	22/03/2018 12 UTC	23/03/2018	0	Genil	Spain
Informal	22/03/2018 12 UTC	23/03/2018	0	Genil	Spain
Informal	23/03/2018 12 UTC	24/03/2018	2	Coastal zone	Greece
Informal	24/03/2018 12 UTC	25/03/2018	0	Guadalquivir, section Guada-	Spain
Formal	25/03/2018 00 UTC	25/03/2018	4	Timok	Serbia
Formal	26/03/2018 00 UTC	26/03/2018	3	Olt	Romania
Informal	29/03/2018 00 UTC	29/03/2018	5	Alagon	Spain
Formal	30/03/2018 00 UTC	30/03/2018	2	Gacka	Croatia
Informal	30/03/2018 12 UTC	31/03/2018	2	Coastal zone	Albania

* 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

Type	Forecast date	Issue date	Lead time*	Region	Country
Flash flood	01/02/2018 00 UTC	01/02/2018	60	Banskobystricky	Slovakia
Flash flood	01/02/2018 00 UTC	01/02/2018	60	Banskobystricky	Slovakia
Flash flood	01/02/2018 12 UTC	02/02/2018	54	Eszak-Alfold	Hungary
Flash flood	01/02/2018 12 UTC	02/02/2018	54	Eszak-Magyarorszag	Hungary
Flash flood	01/02/2018 12 UTC	02/02/2018	54	Zakarpats'ka Oblast'	Ukraine
Flash flood	01/02/2018 12 UTC	02/02/2018	54	Kosicky	Slovakia
Flash flood	02/02/2018 00 UTC	02/02/2018	48	Ipeiros	Greece
Flash flood	02/02/2018 00 UTC	02/02/2018	54	Ditiki Makedonia	Greece
Flash flood	02/02/2018 00 UTC	02/02/2018	54	Sterea Ellada	Greece
Flash flood	02/02/2018 00 UTC	02/02/2018	42	Vlorë	Albania
Flash flood	02/02/2018 00 UTC	02/02/2018	48	Gjirokastër	Albania
Flash flood	02/02/2018 00 UTC	02/02/2018	36	Kukës	Albania
Flash flood	02/02/2018 00 UTC	02/02/2018	42	Zlatibor	Serbia
Flash flood	02/02/2018 12 UTC	03/02/2018	30	Rrafshi i Dukagjinit	Kosovo**
Flash flood	02/02/2018 12 UTC	03/02/2018	36	Rrafshi i Kosoves	Kosovo**
Flash flood	05/02/2018 12 UTC	06/02/2018	18	Herault	France
Flash flood	08/02/2018 00 UTC	08/02/2018	72	THessalia	Greece
Flash flood	09/02/2018 12 UTC	10/02/2018	36	Kentriki Makedonia	Greece
Flash flood	13/02/2018 12 UTC	14/02/2018	24	Gjirokastër	Albania
Flash flood	13/02/2018 12 UTC	14/02/2018	24	Vlorë	Albania
Flash flood	14/02/2018 12 UTC	15/02/2018	42	THessalia	Greece
Flash flood	15/02/2018 00 UTC	15/02/2018	24	Sterea Ellada	Greece
Flash flood	16/02/2018 00 UTC	16/02/2018	30	France - Yonne	France

Flash flood	16/02/2018 00 UTC	16/02/2018	30	Loiret	France
Flash flood	16/02/2018 00 UTC	16/02/2018	30	Seine-et-Marne	France
Flash flood	19/02/2018 12 UTC	20/02/2018	36	Haute-Garonne	France
Flash flood	19/02/2018 12 UTC	20/02/2018	36	Ariege	France
Flash flood	24/02/2018 00 UTC	24/02/2018	60	THessalia	Greece
Flash flood	24/02/2018 12 UTC	24/02/2018	126	Guadalajara	Spain
Flash flood	24/02/2018 12 UTC	24/02/2018	126	Guadalajara	Spain
Flash flood	24/02/2018 12 UTC	24/02/2018	120	Caceres	Spain
Flash flood	24/02/2018 12 UTC	24/02/2018	120	Caceres	Spain
Flash flood	25/02/2018 00 UTC	25/02/2018	108	Cuenca	Spain
Flash flood	25/02/2018 12 UTC	26/02/2018	90	Caceres	Spain
Flash flood	25/02/2018 12 UTC	26/02/2018	90	Toledo	Spain
Flash flood	25/02/2018 12 UTC	26/02/2018	96	Toledo	Spain
Flash flood	25/02/2018 12 UTC	26/02/2018	96	Toledo	Spain
Flash flood	26/02/2018 00 UTC	26/02/2018	84	Cordoba	Spain
Flash flood	26/02/2018 00 UTC	26/02/2018	84	Cordoba	Spain
Flash flood	26/02/2018 00 UTC	26/02/2018	84	Cordoba	Spain
Flash flood	26/02/2018 00 UTC	26/02/2018	84	Cordoba	Spain
Flash flood	26/02/2018 00 UTC	26/02/2018	90	Cordoba	Spain
Flash flood	27/02/2018 00 UTC	27/02/2018	54	Cordoba	Spain
Flash flood	27/02/2018 00 UTC	27/02/2018	54	Sevilla	Spain
Flash flood	27/02/2018 00 UTC	27/02/2018	60	Algarve	Portugal
Flash flood	28/02/2018 00 UTC	28/02/2018	72	Albacete	Spain
Flash flood	28/02/2018 00 UTC	28/02/2018	78	Granada	Spain
Flash flood	28/02/2018 00 UTC	28/02/2018	84	Ciudad Real	Spain
Flash flood	28/02/2018 00 UTC	28/02/2018	84	Ciudad Real	Spain
Flash flood	28/02/2018 00 UTC	28/02/2018	84	Ciudad Real	Spain
Flash flood	28/02/2018 00 UTC	28/02/2018	72	Ciudad Real	Spain
Flash flood	28/02/2018 00 UTC	28/02/2018	78	Jaen	Spain
Flash flood	28/02/2018 00 UTC	28/02/2018	78	Jaen	Spain
Flash flood	01/03/2018 00 UTC	01/03/2018	48	Cadiz	Spain
Flash flood	01/03/2018 00 UTC	01/03/2018	48	Cadiz	Spain
Flash flood	01/03/2018 12 UTC	02/03/2018	18	Aude	France
Flash flood	01/03/2018 12 UTC	02/03/2018	18	Herault	France
Flash flood	02/03/2018 12 UTC	03/03/2018	42	Caceres	Spain
Flash flood	02/03/2018 12 UTC	03/03/2018	48	Ciudad Real	Spain
Flash flood	02/03/2018 12 UTC	03/03/2018	48	Jaen	Spain
Flash flood	02/03/2018 12 UTC	03/03/2018	48	Cordoba	Spain
Flash flood	02/03/2018 12 UTC	03/03/2018	48	Cordoba	Spain
Flash flood	03/03/2018 00 UTC	03/03/2018	48	Toledo	Spain
Flash flood	04/03/2018 00 UTC	04/03/2018	84	Montenegro	Montenegro
Flash flood	05/03/2018 12 UTC	06/03/2018	84	Veliko Tarnovo	Bulgaria
Flash flood	06/03/2018 12 UTC	07/03/2018	96	Toledo	Spain
Flash flood	06/03/2018 12 UTC	07/03/2018	96	Caceres	Spain
Flash flood	06/03/2018 12 UTC	07/03/2018	90	Caceres	Spain
Flash flood	06/03/2018 12 UTC	07/03/2018	90	Caceres	Spain
Flash flood	06/03/2018 12 UTC	07/03/2018	48	Montana	Bulgaria
Flash flood	07/03/2018 12 UTC	08/03/2018	78	Guadalajara	Spain
Flash flood	07/03/2018 12 UTC	08/03/2018	90	Guadalajara	Spain
Flash flood	07/03/2018 12 UTC	08/03/2018	78	Ciudad Real	Spain
Flash flood	07/03/2018 12 UTC	08/03/2018	78	Ciudad Real	Spain

Flash flood	07/03/2018 12 UTC	08/03/2018	78	Ciudad Real	Spain
Flash flood	08/03/2018 00 UTC	08/03/2018	78	Jaen	Spain
Flash flood	08/03/2018 00 UTC	08/03/2018	66	Cordoba	Spain
Flash flood	08/03/2018 12 UTC	09/03/2018	42	Beira Interior Sul	Portugal
Flash flood	09/03/2018 00 UTC	09/03/2018	18	Badajoz	Spain
Flash flood	09/03/2018 12 UTC	10/03/2018	24	Alto Alentejo	Portugal
Flash flood	09/03/2018 12 UTC	10/03/2018	24	Soria	Spain
Flash flood	09/03/2018 12 UTC	10/03/2018	102	Pcinja	Serbia
Flash flood	10/03/2018 00 UTC	10/03/2018	72	Montana	Bulgaria
Flash flood	10/03/2018 00 UTC	10/03/2018	18	Cuenca	Spain
Flash flood	10/03/2018 12 UTC	11/03/2018	24	Cote-d'Or	France
Flash flood	11/03/2018 00 UTC	11/03/2018	48	Bor	Serbia
Flash flood	11/03/2018 00 UTC	11/03/2018	48	Nisava	Serbia
Flash flood	11/03/2018 00 UTC	11/03/2018	66	Pcinja	Serbia
Flash flood	11/03/2018 00 UTC	11/03/2018	48	Zajecar	Serbia
Flash flood	11/03/2018 00 UTC	11/03/2018	48	Dolj	Romania
Flash flood	11/03/2018 12 UTC	12/03/2018	12	Jaen	Spain
Flash flood	11/03/2018 12 UTC	12/03/2018	90	Ciudad Real	Spain
Flash flood	11/03/2018 12 UTC	12/03/2018	84	Toledo	Spain
Flash flood	11/03/2018 12 UTC	12/03/2018	84	Toledo	Spain
Flash flood	11/03/2018 12 UTC	12/03/2018	84	Toledo	Spain
Flash flood	12/03/2018 00 UTC	12/03/2018	36	Mecklenburg-Vor-	Germany
Flash flood	12/03/2018 00 UTC	12/03/2018	54	Jablanica	Serbia
Flash flood	12/03/2018 00 UTC	12/03/2018	78	Albacete	Spain
Flash flood	12/03/2018 00 UTC	12/03/2018	24	Vratsa	Bulgaria
Flash flood	12/03/2018 00 UTC	12/03/2018	72	Guadalajara	Spain
Flash flood	12/03/2018 00 UTC	12/03/2018	72	Guadalajara	Spain
Flash flood	12/03/2018 00 UTC	12/03/2018	72	Cuenca	Spain
Flash flood	12/03/2018 00 UTC	12/03/2018	72	Soria	Spain
Flash flood	12/03/2018 12 UTC	13/03/2018	18	Veliko Tarnovo	Bulgaria
Flash flood	12/03/2018 12 UTC	13/03/2018	36	Covasna	Romania
Flash flood	13/03/2018 00 UTC	13/03/2018	48	Madrid	Spain
Flash flood	13/03/2018 12 UTC	14/03/2018	24	Jablanica	Serbia
Flash flood	13/03/2018 12 UTC	14/03/2018	24	Pcinja	Serbia
Flash flood	13/03/2018 12 UTC	14/03/2018	72	Banskobystricky kraj	Slovakia
Flash flood	13/03/2018 12 UTC	14/03/2018	48	Saone-et-Loire	France
Flash flood	14/03/2018 00 UTC	14/03/2018	36	Cote-d'Or	France
Flash flood	14/03/2018 00 UTC	14/03/2018	24	South-East (IE)	Irish Republic
Flash flood	15/03/2018 00 UTC	15/03/2018	66	Koprivnicko-krizevacka	Croatia
Flash flood	15/03/2018 00 UTC	15/03/2018	72	Zagrebacka zupanija	Croatia
Flash flood	15/03/2018 00 UTC	15/03/2018	72	Sisacko-moslavacka zupan-	Croatia
Flash flood	15/03/2018 00 UTC	15/03/2018	84	Sevilla	Spain
Flash flood	15/03/2018 00 UTC	15/03/2018	84	Cordoba	Spain
Flash flood	15/03/2018 00 UTC	15/03/2018	72	Granada	Spain
Flash flood	15/03/2018 12 UTC	16/03/2018	54	Bjelovarsko-bilogorska	Croatia
Flash flood	15/03/2018 12 UTC	16/03/2018	78	Jaen	Spain
Flash flood	16/03/2018 00 UTC	16/03/2018	42	Del-Dunantul	Hungary
Flash flood	16/03/2018 00 UTC	16/03/2018	42	Viroviticko-podravska	Croatia
Flash flood	16/03/2018 00 UTC	16/03/2018	42	Osjecko-baranjska zupanija	Croatia
Flash flood	16/03/2018 00 UTC	16/03/2018	48	Federacija Bosna i Herce-	Bosnia and Her-
Flash flood	16/03/2018 12 UTC	17/03/2018	30	Varazdinska zupanija	Croatia

Flash flood	19/03/2018 00 UTC	19/03/2018	18	Jablanica	Serbia
Flash flood	24/03/2018 00 UTC	24/03/2018	48	Kentriki Makedonia	Greece
Flash flood	29/03/2018 00 UTC	29/03/2018	84	Eszak-Magyarorszag	Hungary
Flash flood	29/03/2018 12 UTC	30/03/2018	72	Kosicky kraj	Slovakia
Flash flood	30/03/2018 00 UTC	30/03/2018	54	Banskobystricky kraj	Slovakia
Flash flood	30/03/2018 00 UTC	30/03/2018	48	Mecklenburg-Vor-	Germany
Flash flood	30/03/2018 12 UTC	31/03/2018	42	Montana	Bulgaria
Flash flood	31/03/2018 00 UTC	31/03/2018	18	Koprivnicko-krizevacka	Croatia
Flash flood	31/03/2018 00 UTC	31/03/2018	24	Montenegro	Montenegro
Flash flood	31/03/2018 00 UTC	31/03/2018	24	Republika Srpska	Bosnia and Her-
Flash flood	31/03/2018 00 UTC	31/03/2018	24	Del-Dunantul	Hungary
Flash flood	31/03/2018 00 UTC	31/03/2018	36	Kozep-Dunantul	Hungary
Flash flood	31/03/2018 00 UTC	31/03/2018	36	Eszak-Alfold	Hungary
Flash flood	31/03/2018 00 UTC	31/03/2018	30	Nitriansky kraj	Slovakia

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

** The designation of Kosovo is without prejudice to positions on status, and it is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo Declaration of Independence.

The European Flood Awareness System (EFAS) produces European overviews of ongoing and forecasted floods up to 10 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 GROW 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 SOOLOGIC) 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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