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# European Flood Awareness System

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## EFAS *Bulletin*

December 2018 – January 2019

Issue 2019(1)



## NEWS

### *New features*

#### **EFAS new web interface**

The new EFAS web interface went fully operational on 30 January 2019 and replaced the old web site which have been used from the start of EFAS. The update allows many new features, and we invite everyone to test them and provide feedback. A webinar showing the new EFAS interface has also been published under Resources-Webinars. The webinar shows the most important features of the web interface in comparison with the previous. Note that it assumes that you are already familiar with the EFAS products. For a direct link to the webinar, click [here](#).

#### **Contribute to the fitness check of the EU's Water Framework Directive and Floods Directive!**

An Open Public Consultation is being carried out via the EU platform "EU Survey", which aims at collecting as many views as possible on how the EU's Water Framework Directive and Floods Directive have respectively brought about changes to the sustainable management of water and improvement in the state of water bodies, and to the strategies to reduce the risk of flooding across the EU.

All citizens and the wider community of stakeholders are welcome to express their views. You can participate in the consultation (which will remain open until **11th March 2019**) by filling in the on-line questionnaire, available at the web-site below.

[https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2017-5128184/public-consultation\\_en](https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2017-5128184/public-consultation_en)

#### **New handbook of hydrometeorological ensemble forecasting**

The HEPEX "Handbook of Hydrometeorological Ensemble Forecasting" has now finally been published in its entirety. It is a comprehensive reference on all aspects of hydrometeorological ensemble forecasts and contains 51 chapters on topics ranging from pre-processing of data, modelling to case studies and decision making. For more information, please see [here](#).

### *New partners*

We gladly welcome Dipartimento della Protezione Civile, Italy as new EFAS partner and the BeAWARE research project (Centre of Research & Technology - Hellas, Greece) as new research partner.

## RESULTS

### *Summary of EFAS Flood and Flash Flood Notifications*

The 11 formal and 12 informal EFAS flood notifications issued in December 2018-January 2019 are summarised in Table 1. The locations of all notifications are shown in Figure 20 and Figure 22 in the appendix.

244 flash flood notifications were issued from December 2018 - January 2019. They are summarised in Table 2. The locations of all notifications are shown in Figure 21 and Figure 23 in the appendix.

### *Meteorological situation*

*by EFAS Meteorological Data Collection Centre*

#### **December 2018**

The meteorological situation in December 2018 was more versatile than in the month before. The first 10 days of the month were characterized by the northward shifted Azores high pressure system, which caused low precipitation totals in northwestern Africa and the Iberian Peninsula. An intense cyclonic activity was observed northward of this high-pressure system. Two larger low-pressure systems moved from the Atlantic Ocean via Britain and Ireland and the North Sea to Scandinavia causing strong winds and intense large-scale precipitation events. A small low-pressure system in the eastern Mediterranean region caused several floods in this region.

In mid-month, the above mentioned high-pressure system split into two systems, where the northern moved via Scandinavia to northwestern Russia. A small low-pressure system dropped off in the western Mediterranean region. Later, another low-pressure system moved from the Atlantic Ocean to Britain and Ireland and caused large-scale precipitation amounts in western and central Europe. The end of December was characterized by a stable high-pressure system over southwestern and central Europe. Intense precipitation events occurred in the eastern Mediterranean region.

In December 2018 precipitation amounts were up to 700 mm/month. The highest amounts were observed in the eastern Mediterranean Region, Britain and Ireland, the west coast of Norway, northwestern Iberian

Peninsula and the Alps ((Figure 6)). Notable is the large gradient in precipitation totals between the Alps and northern Italy. Large positive precipitation anomalies were in the eastern Mediterranean region but also in central and eastern Europe (Figure 7). Largest negative anomalies occurred in northwestern Africa, the Iberian Peninsula and south of the Alps.

Most regions had positive temperature anomalies (Figure 10-Figure 11). Negative temperature anomalies are found in western Russia, parts of Scandinavia, southern Portugal, the Balkans and around the Aegean Sea.

### **January 2019**

The meteorological situation in the beginning of January was characterized by a persistent high-pressure system at Britain and Ireland and low-pressure over Scandinavia and eastern Europe, causing a stable flow of cold moist air leading to intense snow fall from the Alps to the Carpathian Mountains and Balkans and the northward mountains. The return period of the 14-day snowfall in Austria was between 10 and 100 years, according a report from ZAMG. The daily snowfall in Germany had a return period below 15 years (no analysis of accumulated snow amounts) according to a report from DWD. The central and eastern part of the Mediterranean region was influenced by a weak low-pressure system.

In mid-January, an intense low-pressure system moved to Scandinavia, forcing the high-pressure system to move from the Britain and Ireland westward to the Atlantic Ocean. As the high-pressure systems weakened and in conjunction with this low-pressure over Scandinavia, several troughs swept from the Atlantic Ocean to the Mediterranean Sea.

Towards the end of the month, low-pressure system over Iceland forced a cold air outbreak over Ireland, Great Britain and France to the central Mediterranean Sea, forcing the formation of an intense low-pressure system. This system moved eastward and caused intense precipitation at the southwest as well as the northeast coast of the Mediterranean Sea, especially in Greece and Turkey, where also thunderstorms with hail and tornados occurred. Southern Italy received large amounts of snow. Later a low-pressure system moved from the Atlantic Ocean via Britain and Ireland

and the North Sea to the Baltic Sea. Intense precipitation was also reported from northern Spain at the end of January.

Precipitation amounts were up to 730 mm in January 2019. The highest precipitation totals were observed at the northeastern coast of the Mediterranean Sea, namely Turkey and Greece, the eastern coast of the Black Sea, northern coast of Tunisia and Algeria, northern Spain, the Alps, southern Iceland, northern Scotland and the west coast of Norway (Figure 8). Monthly precipitation totals were above normal in most of these regions (Figure 9). Less than normal precipitation was observed in Britain and Ireland, Iceland, and Spain except the northern parts and France except the southwestern regions, northern Italy, Scandinavia except some regions in Norway and Finland, northern Africa except some coastal areas and around the Caspian Sea. Where the positive precipitation anomalies in the eastern Mediterranean region can be linked to the low-pressure system by end of January, the negative precipitation anomalies in western Europe were caused by the high-pressure system in the beginning of January.

The monthly mean temperature ranged from -29°C to 21 °C with the highest temperatures in the southeastern and the lowest temperatures in the northeastern parts of the EFAS domain (Figure 12). Temperature anomalies ranged from -9°C to 9.5°C, where most regions had below normal temperatures (Figure 13). Above normal temperatures were found in the southeastern parts of the EFAS domain as well as around the Black Sea and Caspian Sea, in Russia, around the western Baltic Sea and in Ireland.

### *Hydrological situation*

*by EFAS Hydrological Data Collection Centre*

During the months December 2018 and January 2019, most of the stations that surpassed the minimum discharge and/or stage threshold levels were concentrated along the basins in Norway, western Danube river basin in Germany and Austria, southern Danube in Serbia, Croatia and Bosnia and Herzegovina, Rhine river basin in Germany and Switzerland, Oder and Vistula river basins in Poland, Dnieper river basin in Belarus and western Ukraine, Mihno-Sil river basin in Spain and Po river basin in Italy. A more dispersed distribution of stations with exceedances occurred

across Mediterranean basins in southern and north-eastern Spain, Neretva river basin in Bosnia and Herzegovina and Jordan and Yarkon river basins in Israel. Most of stations that registered discharge values above the 90% quantile were located across Norway, the western Danube river basin in Austria and Germany and the southern Rhine river basin in Germany and Switzerland. This occurred less frequently for stations located in Elbe river basin in Germany, Danube river basin in northern Romania, Oder and Vistula river basins in Poland, Dnieper river basin in northern Ukraine, across Spain in Ebro, Guadalquivir, Douro, Minho-Sil, Ter and Llobregat river basins and isolated stations in Sweden, Ireland and England.

Stations that did not surpass the 10% quantile for discharge values were mainly located across Sweden and basins in Central Europe: Elbe and Rhine in Germany, Oder in Poland and northern Danube river basin in Czech Republic and Slovakia. This occurred less frequently in Eastern and southern Danube river basin in Romania and Serbia, for basins in England and Ireland, southern Norway, Dnieper river basin in Ukraine as well as for some isolated stations along the Ebro river basin in Spain, Daugava river basin in Latvia and the Scheldt river basin in Belgium. The hydrological situation is shown in Figure 14 - Figure 19.

**Publications**

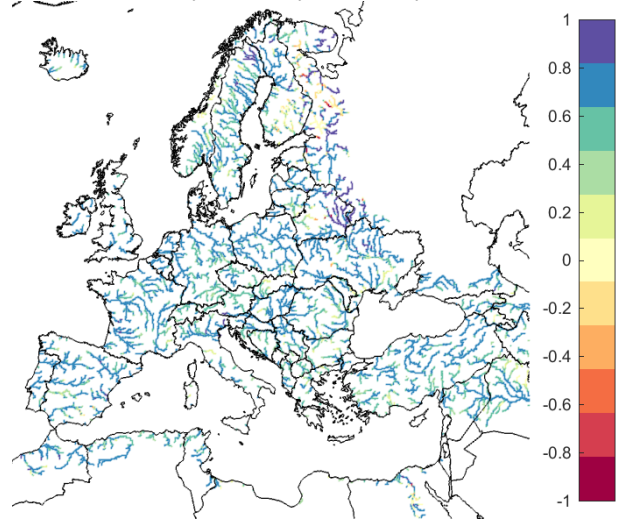
Duan, Q., Pappenberger, F., Wood, A., Cloke, H.L, Schaake, J.C, (2019), Handbook of Hydrometeorological Ensemble Forecasting, pp 1260, Springer Nature, Berlin, <https://doi.org/10.1007/978-3-642-39925-1>

Pappenberger, F., Cloke, H.L., Baugh, C (2019): Cartograms for Use in Forecasting Weather-Driven Natural Hazards, The Cartographic Journal, DOI: 10.1080/00087041.2018.1534358

**Verification**

Figure 1 and Figure 2 shows the EFAS headline score, the Continuous Ranked Probability Skill Score (CRPSS) for lead times 1 and 5 days for the December to January period across the EFAS domain for catchments larger than 2000km<sup>2</sup>. 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 orange-red on the maps) indicates the skill is worse than the reference. The reference score is using yesterday's forecast as today's forecast, which is slightly different

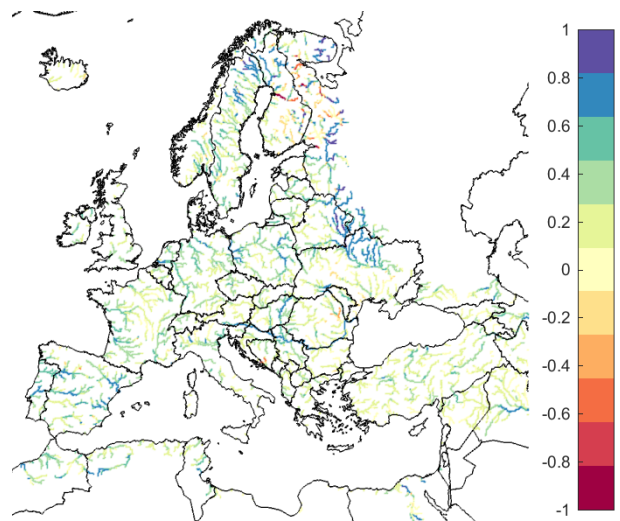
than we used previously and very difficult to beat.



**Figure 1. EFAS CRPSS at lead-time 1 days for the December 2018-January 2019 period, for catchments >2000km<sup>2</sup>. The reference score is persistence of using previous day's forecast.**

These maps indicate that across much of Europe for forecasts are more skilful than persistence at both lead times. Regions shown in blue are those where EFAS forecasts are more skilful than persistence, with darker shading indicating better performance.

The skill during the winter months were highest in the north- and north-eastern part of Europe. This is to be expected as the river discharges this time of year are quite low, and this is easier to predict than high flows.



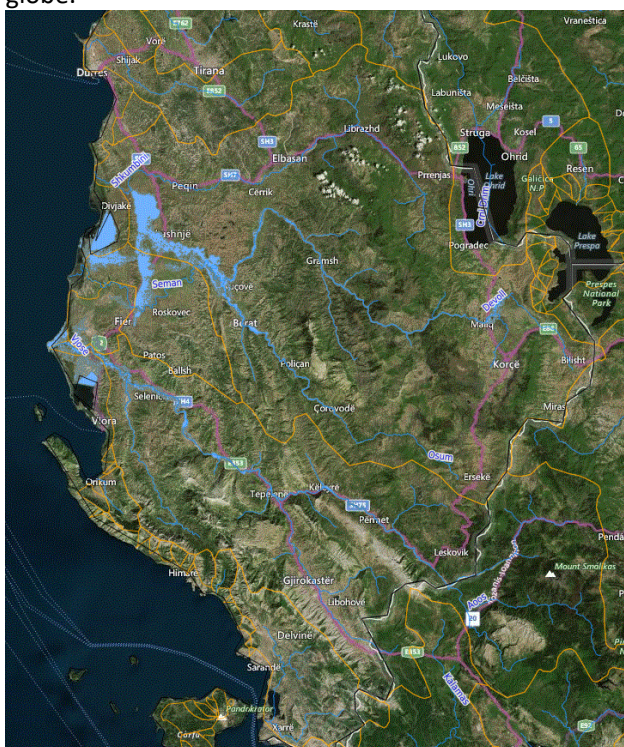
**Figure 2. EFAS CRPSS at lead-time 5 days for the December 2018-January 2019 period, for catchments >2000km<sup>2</sup>. The reference score is persistence of using previous day's forecast.**

## FEATURES

### *The ARISTOTLE consortium and EFAS*

by Richard Alpfjord Wylde, SMHI

European Natural Hazard Scientific Partnership, also known as ARISTOTLE, is a project financed by the European Commission’s DG-ECHO that delivers world leading multi-hazard advice to the Emergency Response Coordination Centre (ERCC) in Brussels. The consortium is made up of 12 expert institutions within the hazard areas of severe weather, flooding, volcanoes, earthquakes and tsunamis. 24/7 expert advice is delivered by the consortium for events across the globe.



**Figure 3. Example of outputs from the Rapid Flood Mapping layer in EFAS, showing predicted flooding along the Vjosa, Seman and Shkumbin rivers during November 2017.**

The operational component of the flooding hazard in the partnership is delivered by the Swedish Meteorological and Hydrological Institute (SMHI) and the European Centre for Medium-Range Weather Forecasts (ECMWF). The current remit for flooding is within Europe only, and here the EFAS system is used. Later the service will provide global coverage – partially via the Global Flood Awareness System (GloFAS) – with assistance from Centro Internazionale in Monitoraggio Ambientale (CIMA) in Italy.

All reporting and decision making within ARISTOTLE is impact based. To do this, the Rapid Impact Assessment tool within EFAS is used to produce information about:

- Potentially flooded areas
- Affected urban areas (%) and population counts
- Critical infrastructure affected
- Potential monetary damages and comparison with historical data, from the European Environment Agency

The latest phase of the service began in October 2018 and has so far provided detailed assessment reports on tropical cyclone Usagi in Vietnam, tsunamis in New Caledonia and Indonesia, volcanic eruptions in Italy and Guatemala and severe weather and flooding in Lebanon, Italy and Bosnia Herzegovina.



**Figure 4. Visits to the ERCC operational center during the previous pilot project (2016-2018).**

Training sessions for the ERCC operational staff will be held during February 2019, building on previous training delivered during the previous pilot project (2016-2018).

### *Flash floods in northern Spain, January 2019*

by Richard Davies (FloodList).

Heavy rain from 22 to 25 January 2019 caused flooding and landslides in the Principality of Asturias, a region of northwest Spain. According to statistics from Spain’s AEMET, Aller in Asturias recorded 220 mm of rain in 3 days to 22-24 January, with 115 mm of that total falling in 24 hours on 23 January. Confederación Hidrográfica del Cantábrico reported that 84 mm of rain fell in 24 hours on January 25 in Ruento and 72 mm fell in La Gándara during the same period.



**Figure 5. Search and rescue teams in Tineo, Asturias, Spain January 2019. Published by: Servicio de Emergencia del Principado de Asturias (SEPA)/Bomberos de Asturias.**

Several rivers in the region exceeded alert levels, in particular the Narcea River at Quinzanas, which reached 4.026 m on 23 January, well above the alert level of 2.9 m. The Sella River at Arriondas reached 6.82 m on 24 January, where the alert level is 6.5 m. Also on 24 January, the Nalón River at El Condado reached 4.52 m, above alert level of 3.6 m. The heavy rain prompted authorities in Asturias to activate the region's flood plan - Plan de Inundaciones del Principado de Asturias (PLANIPA) – early on 23 January.

The Asturias Emergency Coordination Centre said it received a total of 2,205 calls for assistance during the severe weather. Several roads and schools were closed and severe damage to agriculture was also reported. Around 40 patients were evacuated from a hospital in Arriondas on Thursday 24 January due to flooding. Emergency services said that four people died as a result of the severe weather. One of the victims was swept away by flooding from an overflowing river in Tineo. The other victims died in separate incidents in Laviana, Mieres and Salas when their vehicles were either swept from the roads or caught in landslides.

## **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

**Cover image:** Screenshot from the new EFAS web interface, 2019-02-25

Appendix - figures

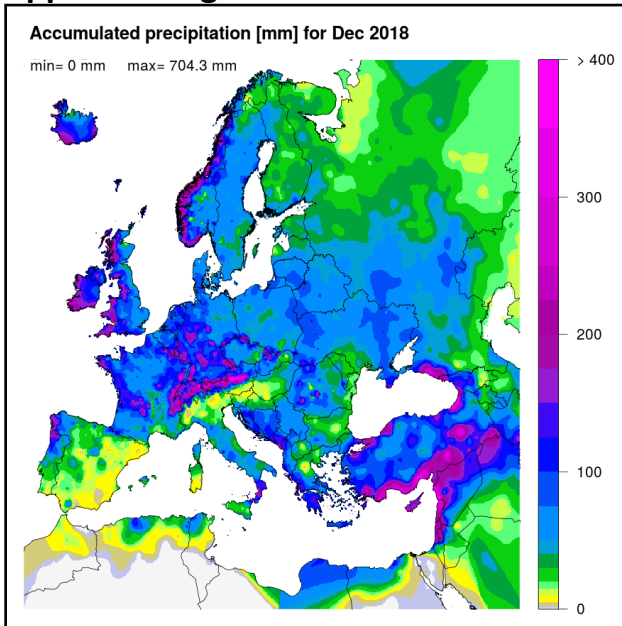


Figure 6. Accumulated precipitation [mm] for December 2018.

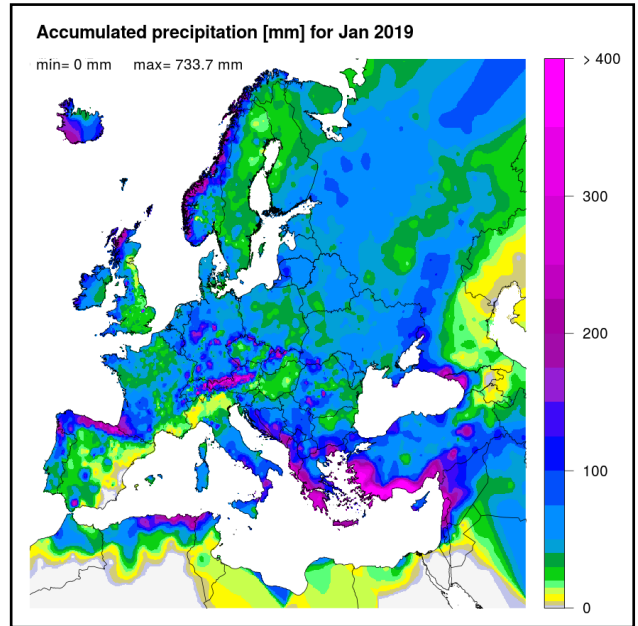


Figure 8. Accumulated precipitation [mm] for January 2019.

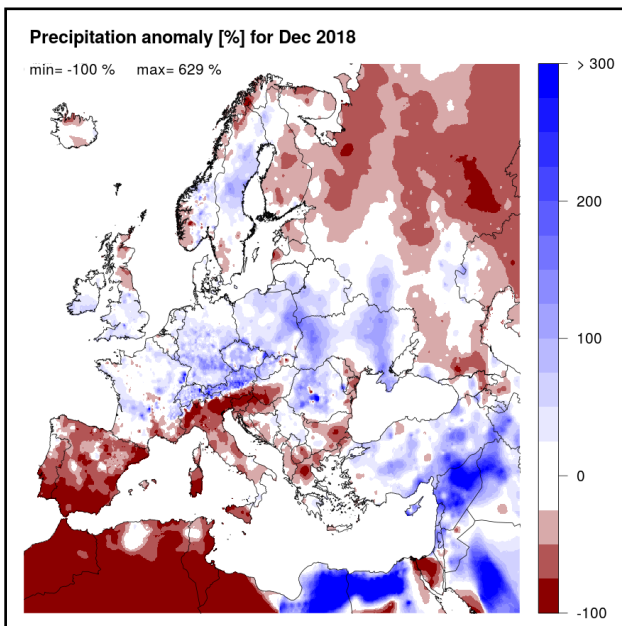


Figure 7. Precipitation anomaly [%] for December 2018, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

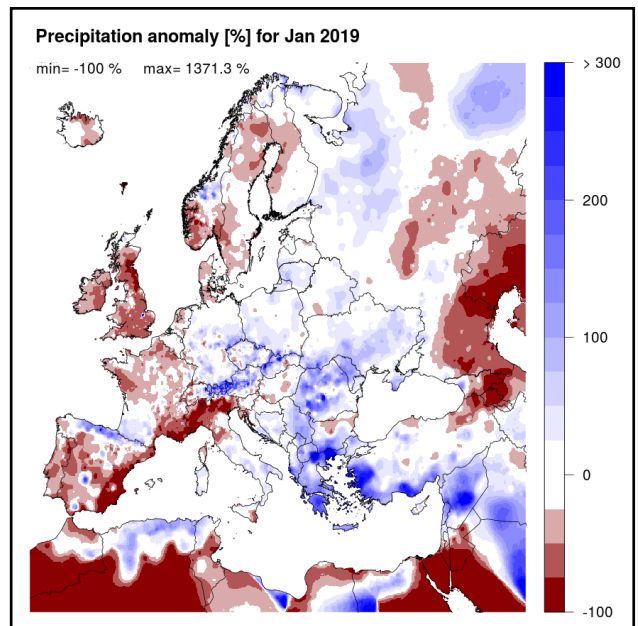


Figure 9. Precipitation anomaly [%] for January 2019, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.



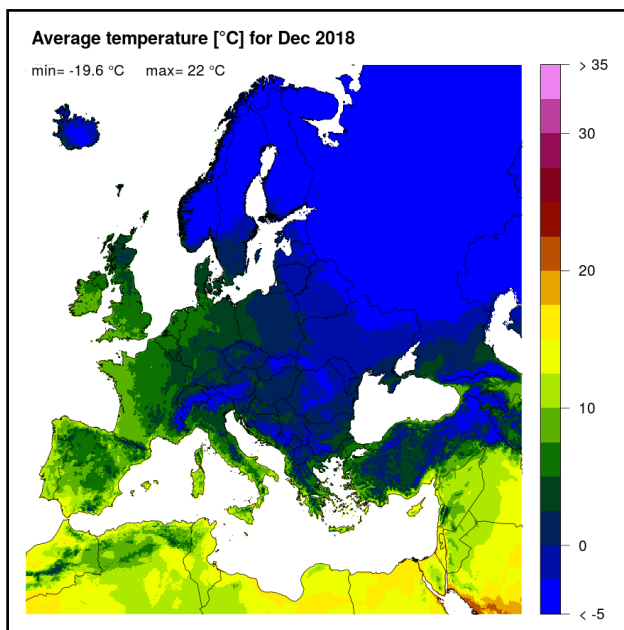


Figure 10. Mean temperature [ $^{\circ}\text{C}$ ] for December 2018.

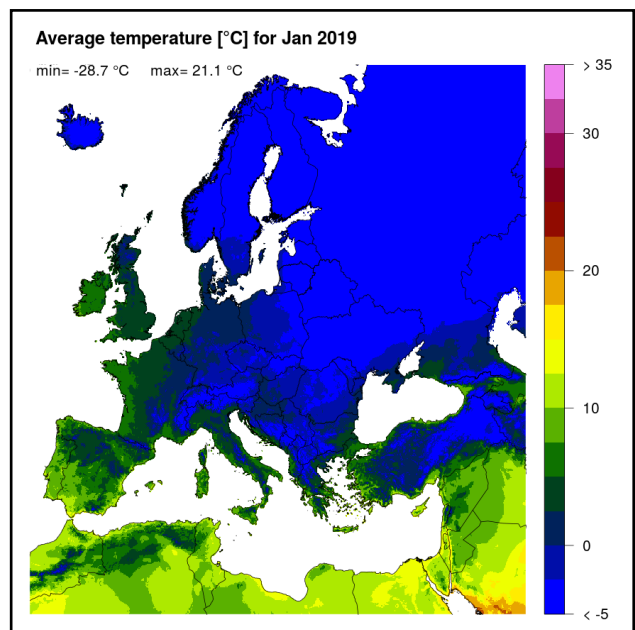


Figure 12. Mean temperature [ $^{\circ}\text{C}$ ] for January 2019.

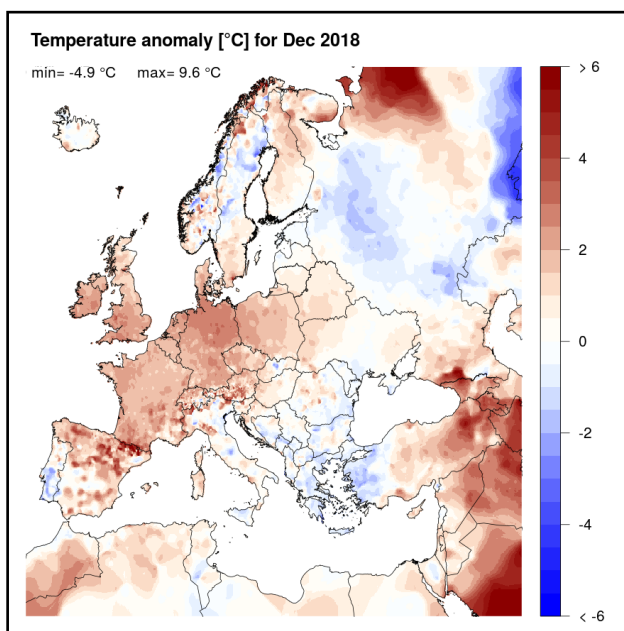


Figure 11. Temperature anomaly [ $^{\circ}\text{C}$ ] for December 2018, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

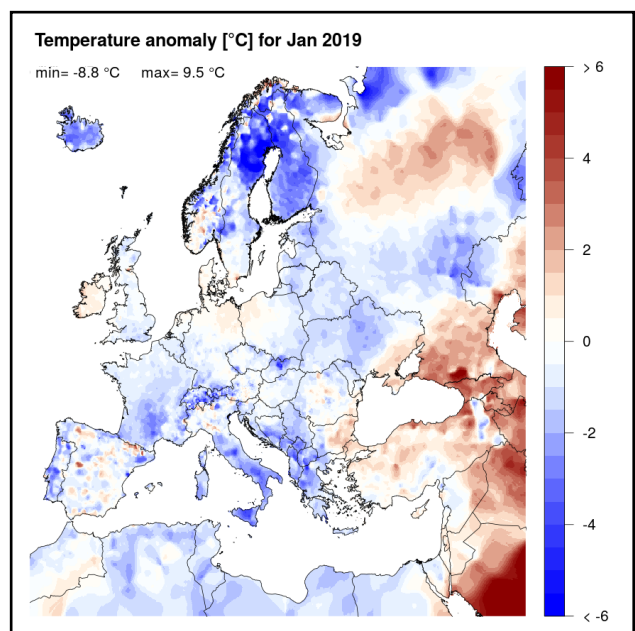


Figure 13. Temperature anomaly [ $^{\circ}\text{C}$ ] for January 2019, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

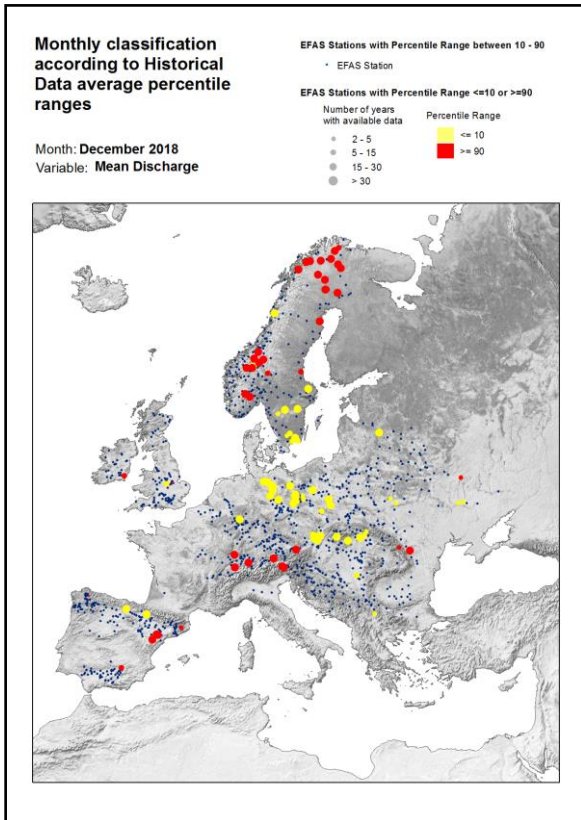


Figure 14. Monthly discharge anomalies December 2018.

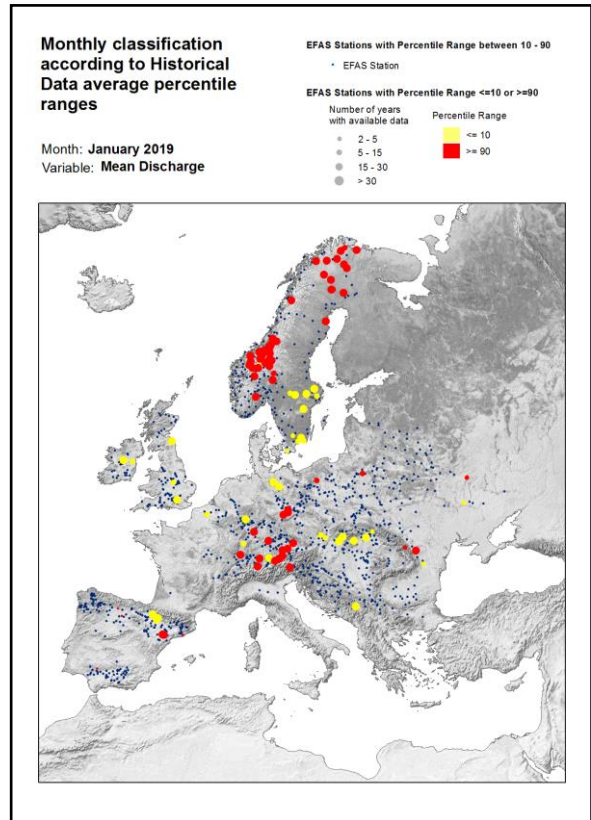


Figure 16. Monthly discharge anomalies January 2018.

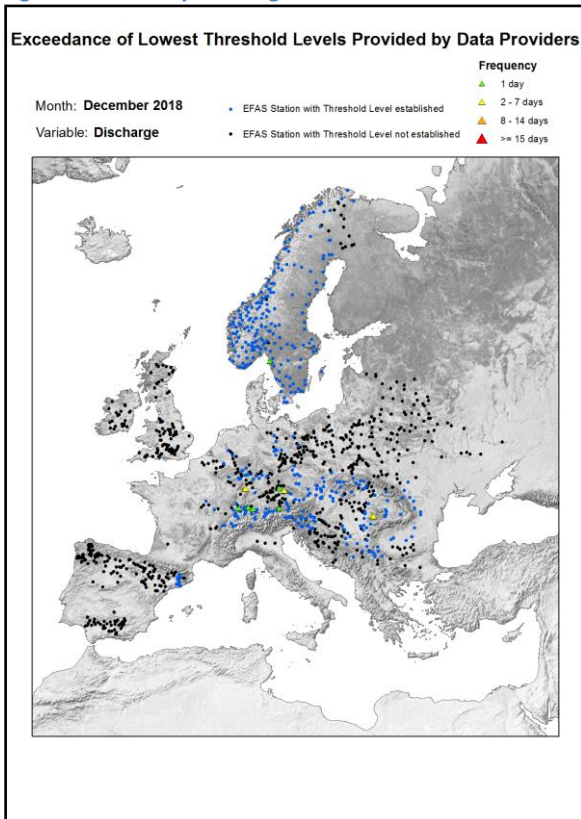


Figure 15. Lowest alert level exceedance for December 2018.

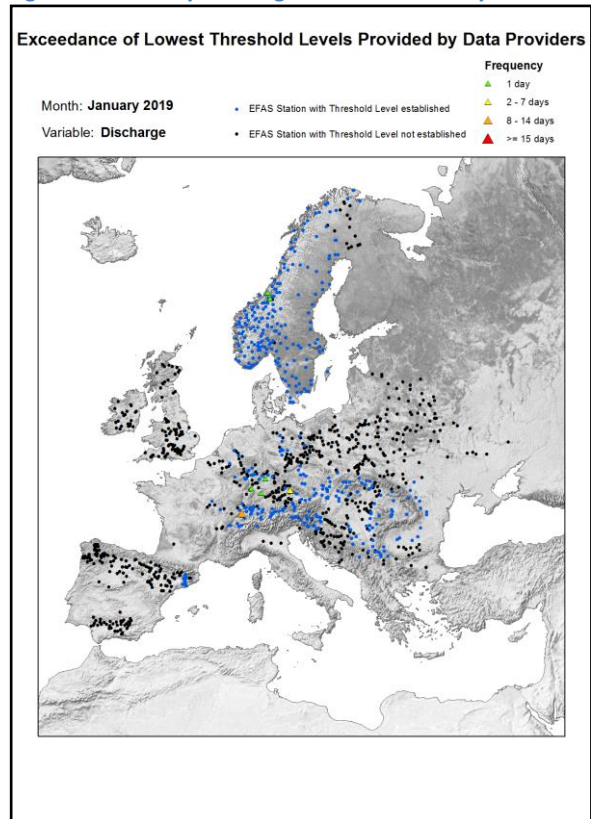


Figure 17. Lowest alert level exceedance for January 2018.

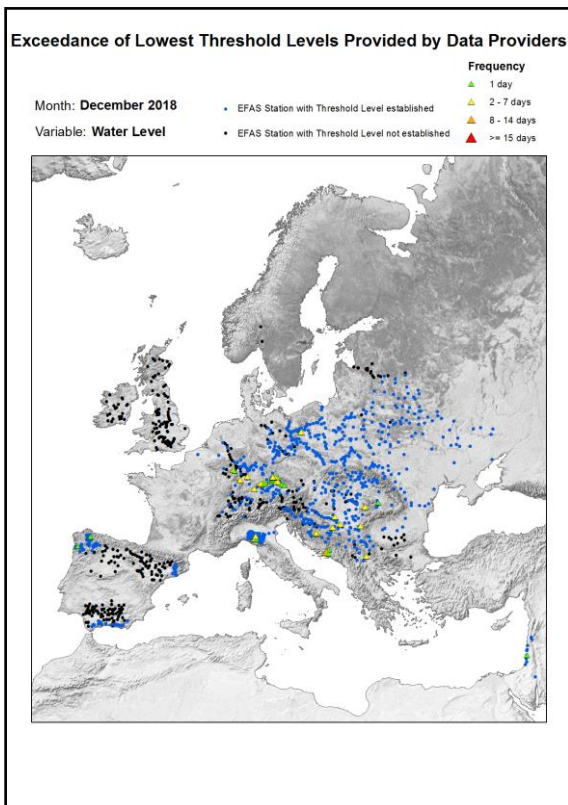


Figure 18. Lowest threshold exceedance for December 2018.

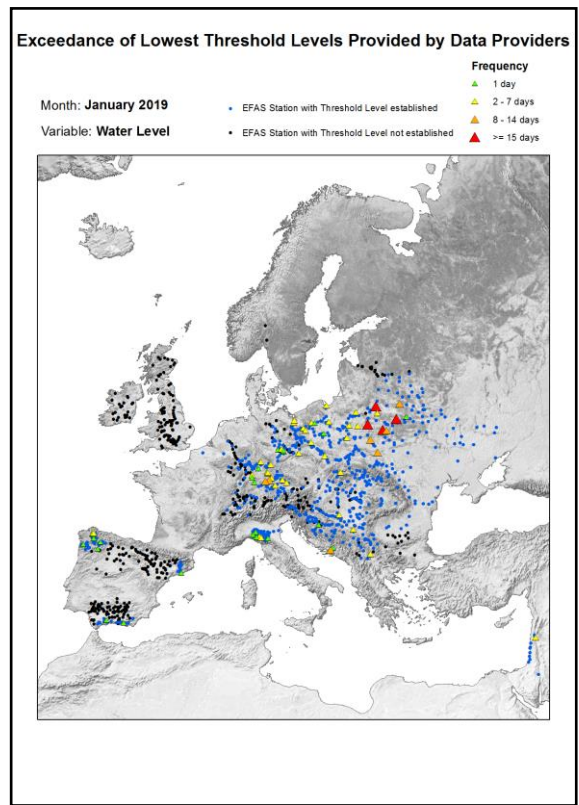


Figure 19. Lowest threshold exceedance for January 2018.



Figure 20. EFAS flood notifications sent for December 2018.

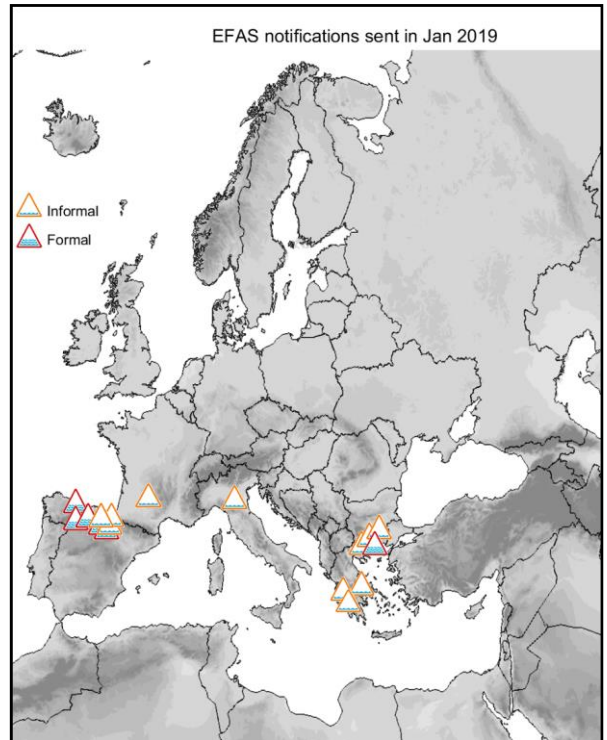


Figure 22. EFAS flood notifications sent for January 2019.

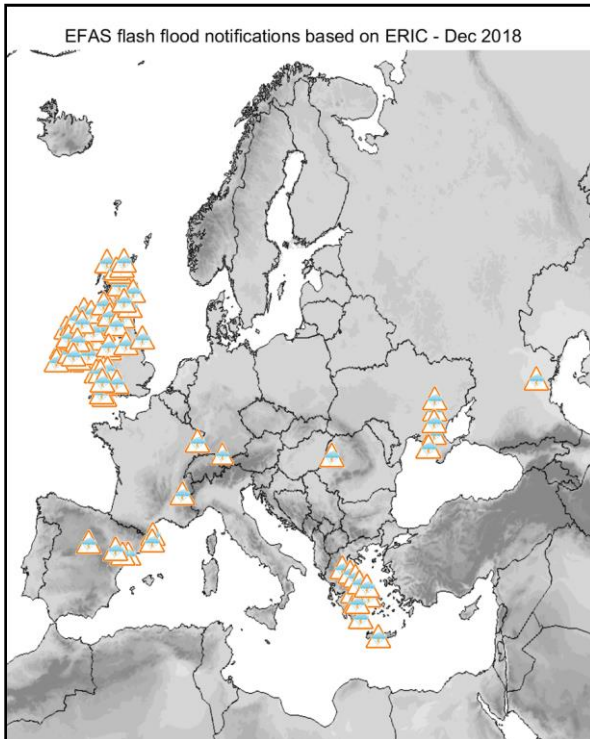


Figure 21. Flash flood notifications sent for December 2018.

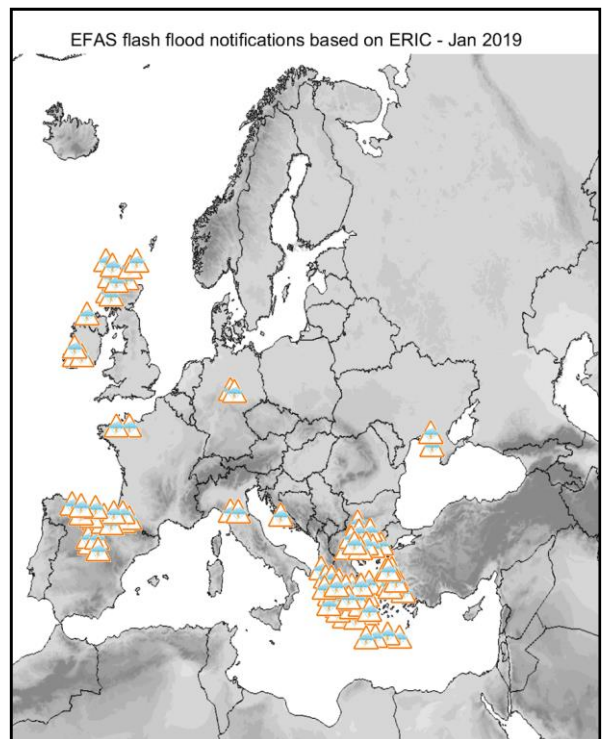


Figure 23. Flash flood notifications sent for January 2019.

## Appendix - tables

**Table 1. EFAS flood notifications sent in December 2018 - January 2019**

Type	Forecast date	Issue date	Lead time*	River	Country
Informal	21/12/2018 12UTC	22/12/2018	3	Thur	Switzerland
Informal	01/01/2019 00UTC	01/01/2019	1	Kifisos	Greece
Informal	09/01/2019 00UTC	09/01/2019	2	Alfeios	Greece
Formal	18/01/2019 00UTC	18/01/2019	7	Alfeios	Greece
Formal	20/01/2019 00UTC	20/01/2019	3	Narcea	Spain
Informal	20/01/2019 00UTC	20/01/2019	3	Arga	Spain
Informal	20/01/2019 00UTC	20/01/2019	3	Nela	Spain
Formal	20/01/2019 12UTC	21/01/2019	3	Ebro, above Aragon	Spain
Formal	21/01/2019 00UTC	21/01/2019	3	Coastal Catchment	Greece
Formal	21/01/2019 00UTC	21/01/2019	4	Ebro	Spain
Informal	21/01/2019 00UTC	21/01/2019	1	Ega	Spain
Formal	21/01/2019 12UTC	22/01/2019	3	Strimonas	Greece
Informal	22/01/2019 12UTC	23/01/2019	8	Acheloos	Greece
Formal	22/01/2019 12UTC	23/01/2019	3	Esla	Spain
Formal	22/01/2019 12UTC	23/01/2019	1	Pisuerga	Spain
Formal	22/01/2019 12UTC	23/01/2019	2	Ebro, above Aragon	Spain
Informal	23/01/2019 12UTC	24/01/2019	2	Mesta	Greece
Informal	24/01/2019 00UTC	24/01/2019	2	Arda	Bulgaria
Formal	26/01/2019 12UTC	27/01/2019	1	Coastal Catchment	Greece
Formal	27/01/2019 12UTC	28/01/2019	3	Acheloos	Greece
Informal	29/01/2019 00UTC	29/01/2019	1	Strimonas	Greece
Informal	29/01/2019 12UTC	30/01/2019	3	Cele	France
Informal	30/01/2019 00UTC	30/01/2019	3	Po	Italy

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

**Table 2. EFAS flash flood notifications sent in December 2018 - January 2019**

Type	Forecast date	Issue date	Lead time*	Region	Country
Flash Flood	01/12/2018 12 UTC	02/12/2018	90	Mid-West	Ireland
Flash Flood	01/12/2018 12 UTC	02/12/2018	90	South-East (IE)	Ireland
Flash Flood	01/12/2018 12 UTC	02/12/2018	96	Meath	Ireland
Flash Flood	01/12/2018 12 UTC	02/12/2018	90	South-East (IE)	Ireland
Flash Flood	01/12/2018 12 UTC	02/12/2018	90	South West Wales	United Kingdom
Flash Flood	04/12/2018 12 UTC	05/12/2018	18	South-West (IE)	Ireland
Flash Flood	04/12/2018 12 UTC	05/12/2018	66	Wales	United Kingdom
Flash Flood	04/12/2018 12 UTC	05/12/2018	66	Devon CC	United Kingdom
Flash Flood	04/12/2018 12 UTC	05/12/2018	72	England	United Kingdom
Flash Flood	04/12/2018 12 UTC	05/12/2018	72	None	United Kingdom
Flash Flood	04/12/2018 12 UTC	05/12/2018	66	Bridgend and Neath Port	United Kingdom
Flash Flood	04/12/2018 12 UTC	05/12/2018	66	Wales	United Kingdom
Flash Flood	05/12/2018 00 UTC	05/12/2018	72	Caithness & Sutherland	United Kingdom
Flash Flood	05/12/2018 00 UTC	05/12/2018	72	Caithness & Sutherland	United Kingdom
Flash Flood	05/12/2018 00 UTC	05/12/2018	72	Caithness & Sutherland	United Kingdom
Flash Flood	06/12/2018 12 UTC	07/12/2018	72	South Ayrshire	United Kingdom

Flash Flood	06/12/2018 12 UTC	07/12/2018	60	East Ayrshire and North	United Kingdom
Flash Flood	07/12/2018 12 UTC	08/12/2018	42	Chorley & West Lancashire	United Kingdom
Flash Flood	08/12/2018 00 UTC	08/12/2018	24	Border	Ireland
Flash Flood	09/12/2018 12 UTC	10/12/2018	96	South-East (IE)	Ireland
Flash Flood	10/12/2018 00 UTC	10/12/2018	54	Dnipropetrovs'k	Ukraine
Flash Flood	10/12/2018 00 UTC	10/12/2018	48	Crimea	Ukraine
Flash Flood	10/12/2018 00 UTC	10/12/2018	84	South-East (IE)	Ireland
Flash Flood	10/12/2018 00 UTC	10/12/2018	90	South-East (IE)	Ireland
Flash Flood	10/12/2018 00 UTC	10/12/2018	90	South-East (IE)	Ireland
Flash Flood	10/12/2018 00 UTC	10/12/2018	90	South-East (IE)	Ireland
Flash Flood	10/12/2018 00 UTC	10/12/2018	90	South-East (IE)	Ireland
Flash Flood	10/12/2018 00 UTC	10/12/2018	90	South-East (IE)	Ireland
Flash Flood	10/12/2018 00 UTC	10/12/2018	90	South-West (IE)	Ireland
Flash Flood	10/12/2018 00 UTC	10/12/2018	90	South-West (IE)	Ireland
Flash Flood	10/12/2018 00 UTC	10/12/2018	90	South-West (IE)	Ireland
Flash Flood	10/12/2018 00 UTC	10/12/2018	90	South-East (IE)	Ireland
Flash Flood	10/12/2018 00 UTC	10/12/2018	90	South-West (IE)	Ireland
Flash Flood	10/12/2018 00 UTC	10/12/2018	90	South-West (IE)	Ireland
Flash Flood	10/12/2018 12 UTC	11/12/2018	42	Kherson	Ukraine
Flash Flood	11/12/2018 00 UTC	11/12/2018	78	Girona	Spain
Flash Flood	12/12/2018 00 UTC	12/12/2018	54	Tarragona	Spain
Flash Flood	12/12/2018 00 UTC	12/12/2018	36	None	Ireland
Flash Flood	12/12/2018 00 UTC	12/12/2018	42	South-West (IE)	Ireland
Flash Flood	12/12/2018 00 UTC	12/12/2018	36	Kerry	Ireland
Flash Flood	12/12/2018 00 UTC	12/12/2018	42	South-West (IE)	Ireland
Flash Flood	12/12/2018 00 UTC	12/12/2018	54	Teruel	Spain
Flash Flood	12/12/2018 00 UTC	12/12/2018	48	Teruel	Spain
Flash Flood	12/12/2018 00 UTC	12/12/2018	54	Girona	Spain
Flash Flood	13/12/2018 00 UTC	13/12/2018	72	West	Ireland
Flash Flood	13/12/2018 00 UTC	13/12/2018	66	West	Ireland
Flash Flood	13/12/2018 00 UTC	13/12/2018	72	West	Ireland
Flash Flood	13/12/2018 00 UTC	13/12/2018	72	Louth	Ireland
Flash Flood	13/12/2018 00 UTC	13/12/2018	72	West	Ireland
Flash Flood	13/12/2018 00 UTC	13/12/2018	72	Midland	Ireland
Flash Flood	13/12/2018 00 UTC	13/12/2018	72	North of Northern Ireland	United Kingdom
Flash Flood	13/12/2018 00 UTC	13/12/2018	72	East of Northern Ireland	United Kingdom
Flash Flood	13/12/2018 00 UTC	13/12/2018	72	West and South of North-	United Kingdom
Flash Flood	13/12/2018 00 UTC	13/12/2018	72	West and South of North-	United Kingdom
Flash Flood	13/12/2018 00 UTC	13/12/2018	78	None	United Kingdom
Flash Flood	13/12/2018 00 UTC	13/12/2018	78	Dumfries & Galloway	United Kingdom
Flash Flood	13/12/2018 00 UTC	13/12/2018	84	Perth & Kinross and Stirling	United Kingdom
Flash Flood	13/12/2018 00 UTC	13/12/2018	72	Aberdeen City and Aber-	United Kingdom
Flash Flood	13/12/2018 00 UTC	13/12/2018	84	Caithness & Sutherland	United Kingdom
Flash Flood	13/12/2018 00 UTC	13/12/2018	72	North Yorkshire CC	United Kingdom
Flash Flood	13/12/2018 00 UTC	13/12/2018	72	South West Wales	United Kingdom
Flash Flood	13/12/2018 12 UTC	14/12/2018	60	Midland	Ireland
Flash Flood	14/12/2018 12 UTC	15/12/2018	102	South Lanarkshire	United Kingdom
Flash Flood	14/12/2018 12 UTC	15/12/2018	102	Lochaber, Skye & Lochalsh,	United Kingdom
Flash Flood	14/12/2018 12 UTC	15/12/2018	102	Angus and Dundee City	United Kingdom
Flash Flood	14/12/2018 12 UTC	15/12/2018	102	Inverness & Nairn and	United Kingdom
Flash Flood	14/12/2018 12 UTC	15/12/2018	102	Lochaber, Skye & Lochalsh,	United Kingdom
Flash Flood	14/12/2018 12 UTC	15/12/2018	102	South Ayrshire	United Kingdom

Flash Flood	14/12/2018 12 UTC	15/12/2018	36	North of Northern Ireland	United Kingdom
Flash Flood	14/12/2018 12 UTC	15/12/2018	102	Devon CC	United Kingdom
Flash Flood	14/12/2018 12 UTC	15/12/2018	102	South West Wales	United Kingdom
Flash Flood	14/12/2018 12 UTC	15/12/2018	96	Midland	Ireland
Flash Flood	14/12/2018 12 UTC	15/12/2018	96	Mid-West	Ireland
Flash Flood	15/12/2018 12 UTC	16/12/2018	24	Guadalajara	Spain
Flash Flood	16/12/2018 00 UTC	16/12/2018	72	Boiotia	Greece
Flash Flood	16/12/2018 00 UTC	16/12/2018	72	Larisa	Greece
Flash Flood	16/12/2018 00 UTC	16/12/2018	72	Magnisia	Greece
Flash Flood	16/12/2018 00 UTC	16/12/2018	72	Magnisia	Greece
Flash Flood	16/12/2018 00 UTC	16/12/2018	72	Irakleio	Greece
Flash Flood	18/12/2018 00 UTC	18/12/2018	102	Isere	France
Flash Flood	21/12/2018 12 UTC	22/12/2018	66	Bas-Rhin	France
Flash Flood	22/12/2018 00 UTC	22/12/2018	78	Crimea	Ukraine
Flash Flood	22/12/2018 12 UTC	23/12/2018	48	Oberallgau	Germany
Flash Flood	22/12/2018 12 UTC	23/12/2018	36	South-East (IE)	Ireland
Flash Flood	23/12/2018 00 UTC	23/12/2018	48	Kherson	Ukraine
Flash Flood	23/12/2018 12 UTC	24/12/2018	24	Bihor	Romania
Flash Flood	24/12/2018 00 UTC	24/12/2018	24	Dnipropetrovs'k	Ukraine
Flash Flood	29/12/2018 00 UTC	29/12/2018	84	Magnisia	Greece
Flash Flood	29/12/2018 12 UTC	30/12/2018	84	None	Greece
Flash Flood	30/12/2018 12 UTC	31/12/2018	48	Irakleio	Greece
Flash Flood	30/12/2018 12 UTC	31/12/2018	48	Attica	Greece
Flash Flood	30/12/2018 12 UTC	31/12/2018	48	Anatoliki Attiki	Greece
Flash Flood	31/12/2018 00 UTC	31/12/2018	30	Kentrikos Tomeas Athinon	Greece
Flash Flood	31/12/2018 00 UTC	31/12/2018	36	Argolida, Arkadia	Greece
Flash Flood	31/12/2018 00 UTC	31/12/2018	30	Peloponnese, Western	Greece
Flash Flood	31/12/2018 00 UTC	31/12/2018	42	Eiboia	Greece
Flash Flood	01/01/2019 00 UTC	01/01/2019	60	Irakleio	Greece
Flash Flood	01/01/2019 12 UTC	02/01/2019	48	Irakleio	Greece
Flash Flood	07/01/2019 00 UTC	07/01/2019	90	Irakleio	Greece
Flash Flood	07/01/2019 00 UTC	07/01/2019	84	Lakonia, Messinia	Greece
Flash Flood	07/01/2019 12 UTC	08/01/2019	72	Peloponnese, Western	Greece
Flash Flood	08/01/2019 00 UTC	08/01/2019	60	Lesbos, Limnos	Greece
Flash Flood	08/01/2019 00 UTC	08/01/2019	66	None	Greece
Flash Flood	08/01/2019 00 UTC	08/01/2019	60	Argolida, Arkadia	Greece
Flash Flood	08/01/2019 00 UTC	08/01/2019	60	Ileia	Greece
Flash Flood	08/01/2019 12 UTC	09/01/2019	54	Xios	Greece
Flash Flood	08/01/2019 12 UTC	09/01/2019	48	Xania	Greece
Flash Flood	08/01/2019 12 UTC	09/01/2019	48	Crete	Greece
Flash Flood	09/01/2019 12 UTC	10/01/2019	42	Crimea	Ukraine
Flash Flood	09/01/2019 12 UTC	10/01/2019	42	Kherson	Ukraine
Flash Flood	09/01/2019 12 UTC	10/01/2019	24	Ebros	Greece
Flash Flood	10/01/2019 12 UTC	11/01/2019	48	Fthiotida	Greece
Flash Flood	10/01/2019 12 UTC	11/01/2019	36	Lesbos, Limnos	Greece
Flash Flood	10/01/2019 12 UTC	11/01/2019	66	Aegean	Greece
Flash Flood	11/01/2019 00 UTC	11/01/2019	36	Eiboia	Greece
Flash Flood	11/01/2019 00 UTC	11/01/2019	72	Nordhausen	Germany
Flash Flood	11/01/2019 12 UTC	12/01/2019	24	Argolida, Arkadia	Greece
Flash Flood	12/01/2019 12 UTC	13/01/2019	66	Irakleio	Greece
Flash Flood	12/01/2019 12 UTC	13/01/2019	60	Xania	Greece

Flash Flood	12/01/2019 12 UTC	13/01/2019	60	Rethimni	Greece
Flash Flood	13/01/2019 12 UTC	14/01/2019	60	Lasithi	Greece
Flash Flood	13/01/2019 12 UTC	14/01/2019	54	Crete	Greece
Flash Flood	13/01/2019 12 UTC	14/01/2019	72	Orkney Islands	United Kingdom
Flash Flood	13/01/2019 12 UTC	14/01/2019	72	Caithness & Sutherland	United Kingdom
Flash Flood	13/01/2019 12 UTC	14/01/2019	72	Caithness & Sutherland	United Kingdom
Flash Flood	14/01/2019 12 UTC	15/01/2019	42	None	United Kingdom
Flash Flood	15/01/2019 12 UTC	16/01/2019	24	Irakleio	Greece
Flash Flood	18/01/2019 12 UTC	19/01/2019	48	Segovia	Spain
Flash Flood	19/01/2019 12 UTC	20/01/2019	102	Anatoliki Attiki	Greece
Flash Flood	19/01/2019 12 UTC	20/01/2019	102	Ditiki Attiki	Greece
Flash Flood	19/01/2019 12 UTC	20/01/2019	102	Aitoloakarnania	Greece
Flash Flood	19/01/2019 12 UTC	20/01/2019	108	Lakonia, Messinia	Greece
Flash Flood	19/01/2019 12 UTC	20/01/2019	96	Peloponnese, Western	Greece
Flash Flood	19/01/2019 12 UTC	20/01/2019	114	Aegean	Greece
Flash Flood	20/01/2019 00 UTC	20/01/2019	96	Lesbos, Limnos	Greece
Flash Flood	20/01/2019 00 UTC	20/01/2019	90	Argolida, Arkadia	Greece
Flash Flood	20/01/2019 12 UTC	21/01/2019	90	Aegean	Greece
Flash Flood	21/01/2019 12 UTC	22/01/2019	72	Xanthi	Greece
Flash Flood	21/01/2019 12 UTC	22/01/2019	72	Drama	Greece
Flash Flood	21/01/2019 12 UTC	22/01/2019	84	Rethimni	Greece
Flash Flood	21/01/2019 12 UTC	22/01/2019	102	Xania	Greece
Flash Flood	21/01/2019 12 UTC	22/01/2019	102	Irakleio	Greece
Flash Flood	21/01/2019 12 UTC	22/01/2019	60	Asturias	Spain
Flash Flood	21/01/2019 12 UTC	22/01/2019	66	Asturias	Spain
Flash Flood	21/01/2019 12 UTC	22/01/2019	66	Palencia	Spain
Flash Flood	21/01/2019 12 UTC	22/01/2019	66	Cantabria	Spain
Flash Flood	21/01/2019 12 UTC	22/01/2019	66	Burgos	Spain
Flash Flood	21/01/2019 12 UTC	22/01/2019	60	Burgos	Spain
Flash Flood	21/01/2019 12 UTC	22/01/2019	60	Navarra	Spain
Flash Flood	22/01/2019 00 UTC	22/01/2019	54	Leon	Spain
Flash Flood	22/01/2019 00 UTC	22/01/2019	48	Cantabria	Spain
Flash Flood	22/01/2019 00 UTC	22/01/2019	54	Araba/Alava	Spain
Flash Flood	22/01/2019 00 UTC	22/01/2019	48	Epirus and Western Mace-	Greece
Flash Flood	22/01/2019 00 UTC	22/01/2019	42	Thesprotia	Greece
Flash Flood	23/01/2019 12 UTC	24/01/2019	72	Orkney Islands	United Kingdom
Flash Flood	23/01/2019 12 UTC	24/01/2019	78	Border	Ireland
Flash Flood	24/01/2019 00 UTC	24/01/2019	54	Sofia	Bulgaria
Flash Flood	24/01/2019 12 UTC	25/01/2019	30	Peloponnese, Western	Greece
Flash Flood	24/01/2019 12 UTC	25/01/2019	30	Lakonia, Messinia	Greece
Flash Flood	24/01/2019 12 UTC	25/01/2019	30	Argolida, Arkadia	Greece
Flash Flood	24/01/2019 12 UTC	25/01/2019	30	Ileia	Greece
Flash Flood	24/01/2019 12 UTC	25/01/2019	60	Scotland	United Kingdom
Flash Flood	24/01/2019 12 UTC	25/01/2019	60	Scotland	United Kingdom
Flash Flood	24/01/2019 12 UTC	25/01/2019	48	Aegean	Greece
Flash Flood	24/01/2019 12 UTC	25/01/2019	30	Xios	Greece
Flash Flood	24/01/2019 12 UTC	25/01/2019	48	Lesbos, Limnos	Greece
Flash Flood	24/01/2019 12 UTC	25/01/2019	24	Thessaly and Central	Greece
Flash Flood	24/01/2019 12 UTC	25/01/2019	24	Ditiki Attiki	Greece
Flash Flood	24/01/2019 12 UTC	25/01/2019	36	Peiraias, Nisoi	Greece
Flash Flood	24/01/2019 12 UTC	25/01/2019	24	Eiboia	Greece



Flash Flood	25/01/2019 00 UTC	25/01/2019	48	Nordhausen	Germany
Flash Flood	25/01/2019 00 UTC	25/01/2019	42	Lochaber, Skye & Lochalsh,	United Kingdom
Flash Flood	25/01/2019 00 UTC	25/01/2019	36	Scotland	United Kingdom
Flash Flood	25/01/2019 00 UTC	25/01/2019	48	Eilean Siar (Western Isles)	United Kingdom
Flash Flood	25/01/2019 00 UTC	25/01/2019	30	Serres	Greece
Flash Flood	25/01/2019 00 UTC	25/01/2019	30	Drama	Greece
Flash Flood	25/01/2019 00 UTC	25/01/2019	24	Kilkis	Greece
Flash Flood	25/01/2019 00 UTC	25/01/2019	24	Jugoistocen	The Former Yugo-
Flash Flood	25/01/2019 12 UTC	26/01/2019	24	Caithness & Sutherland	United Kingdom
Flash Flood	26/01/2019 00 UTC	26/01/2019	24	Nordhausen	Germany
Flash Flood	26/01/2019 12 UTC	27/01/2019	78	Aitoloakarnania	Greece
Flash Flood	26/01/2019 12 UTC	27/01/2019	84	Axala	Greece
Flash Flood	26/01/2019 12 UTC	27/01/2019	78	Ileia	Greece
Flash Flood	26/01/2019 12 UTC	27/01/2019	126	Argolida, Arkadia	Greece
Flash Flood	26/01/2019 12 UTC	27/01/2019	84	Lakonia, Messinia	Greece
Flash Flood	26/01/2019 12 UTC	27/01/2019	54	Gipuzkoa	Spain
Flash Flood	26/01/2019 12 UTC	27/01/2019	60	Pyrenees-Atlantiques	France
Flash Flood	26/01/2019 12 UTC	27/01/2019	60	Pyrenees-Atlantiques	France
Flash Flood	26/01/2019 12 UTC	27/01/2019	60	Pyrenees-Atlantiques	France
Flash Flood	27/01/2019 00 UTC	27/01/2019	36	None	Croatia
Flash Flood	27/01/2019 00 UTC	27/01/2019	42	Vlore	Albania
Flash Flood	27/01/2019 00 UTC	27/01/2019	90	Drama	Greece
Flash Flood	27/01/2019 00 UTC	27/01/2019	84	Xanthi	Greece
Flash Flood	27/01/2019 00 UTC	27/01/2019	84	Macedonia and Thrace	Greece
Flash Flood	27/01/2019 00 UTC	27/01/2019	66	Epirus and Western Mace-	Greece
Flash Flood	27/01/2019 12 UTC	28/01/2019	54	Arta, Prebeza	Greece
Flash Flood	27/01/2019 12 UTC	28/01/2019	54	Eiritania	Greece
Flash Flood	27/01/2019 12 UTC	28/01/2019	54	Peloponnese, Western	Greece
Flash Flood	27/01/2019 12 UTC	28/01/2019	84	Aegean	Greece
Flash Flood	28/01/2019 00 UTC	28/01/2019	60	Kilkis	Greece
Flash Flood	28/01/2019 00 UTC	28/01/2019	60	Thasos, Kabala	Greece
Flash Flood	28/01/2019 00 UTC	28/01/2019	60	Jugoistocen	The Former Yugo-
Flash Flood	28/01/2019 00 UTC	28/01/2019	24	Thesprotia	Greece
Flash Flood	28/01/2019 00 UTC	28/01/2019	48	Zakinthos	Greece
Flash Flood	28/01/2019 00 UTC	28/01/2019	42	Ithaki, Kefallinia	Greece
Flash Flood	28/01/2019 00 UTC	28/01/2019	84	Rethimni	Greece
Flash Flood	28/01/2019 00 UTC	28/01/2019	84	Xania	Greece
Flash Flood	28/01/2019 00 UTC	28/01/2019	84	Irakleio	Greece
Flash Flood	28/01/2019 12 UTC	29/01/2019	48	Blagoevgrad	Bulgaria
Flash Flood	28/01/2019 12 UTC	29/01/2019	48	Smolyan	Bulgaria
Flash Flood	28/01/2019 12 UTC	29/01/2019	48	Serres	Greece
Flash Flood	28/01/2019 12 UTC	29/01/2019	72	Segovia	Spain
Flash Flood	28/01/2019 12 UTC	29/01/2019	72	Segovia	Spain
Flash Flood	28/01/2019 12 UTC	29/01/2019	72	Guadalajara	Spain
Flash Flood	28/01/2019 12 UTC	29/01/2019	36	Fokida	Greece
Flash Flood	28/01/2019 12 UTC	29/01/2019	36	Thessaly and Central	Greece
Flash Flood	28/01/2019 12 UTC	29/01/2019	72	Lesbos, Limnos	Greece
Flash Flood	29/01/2019 00 UTC	29/01/2019	18	Bretagne	France
Flash Flood	29/01/2019 00 UTC	29/01/2019	18	Manche	France
Flash Flood	29/01/2019 12 UTC	30/01/2019	60	Aitoloakarnania	Greece
Flash Flood	29/01/2019 12 UTC	30/01/2019	60	Epirus and Western Mace-	Greece

Flash Flood	29/01/2019 12 UTC	30/01/2019	54	South-West (IE)	Ireland
Flash Flood	29/01/2019 12 UTC	30/01/2019	60	South-West (IE)	Ireland
Flash Flood	30/01/2019 00 UTC	30/01/2019	78	Modena	Italy
Flash Flood	30/01/2019 00 UTC	30/01/2019	78	Modena	Italy
Flash Flood	30/01/2019 00 UTC	30/01/2019	42	Mid-West	Ireland
Flash Flood	30/01/2019 12 UTC	31/01/2019	30	South-East (IE)	Ireland
Flash Flood	30/01/2019 12 UTC	31/01/2019	72	Bretagne	France
Flash Flood	30/01/2019 12 UTC	31/01/2019	72	Cotes-d'Armor	France
Flash Flood	30/01/2019 12 UTC	31/01/2019	72	Bretagne	France
Flash Flood	30/01/2019 12 UTC	31/01/2019	36	Pyrenees-Atlantiques	France
Flash Flood	30/01/2019 12 UTC	31/01/2019	72	Corse-du-Sud	France
Flash Flood	30/01/2019 12 UTC	31/01/2019	66	Corse-du-Sud	France
Flash Flood	31/01/2019 00 UTC	31/01/2019	36	Cadiz	Spain
Flash Flood	31/01/2019 00 UTC	31/01/2019	36	Malaga	Spain
Flash Flood	31/01/2019 00 UTC	31/01/2019	30	Lot-et-Garonne	France
Flash Flood	31/01/2019 00 UTC	31/01/2019	30	Tarn-et-Garonne	France
Flash Flood	31/01/2019 00 UTC	31/01/2019	66	Cantabria	Spain
Flash Flood	31/01/2019 00 UTC	31/01/2019	66	Asturias	Spain
Flash Flood	31/01/2019 00 UTC	31/01/2019	24	Gipuzkoa	Spain
Flash Flood	31/01/2019 00 UTC	31/01/2019	24	Haskovo	Bulgaria
Flash Flood	31/01/2019 00 UTC	31/01/2019	54	Reggio Nell'Emilia	Italy
Flash Flood	31/01/2019 00 UTC	31/01/2019	78	Federacija Bosna i Herce-	Bosnia And Herze-
Flash Flood	31/01/2019 00 UTC	31/01/2019	78	Splitsko-Dalmatinska	Croatia
Flash Flood	31/01/2019 00 UTC	31/01/2019	78	Dubrovacko-Neretvanska	Croatia

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\* 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 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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