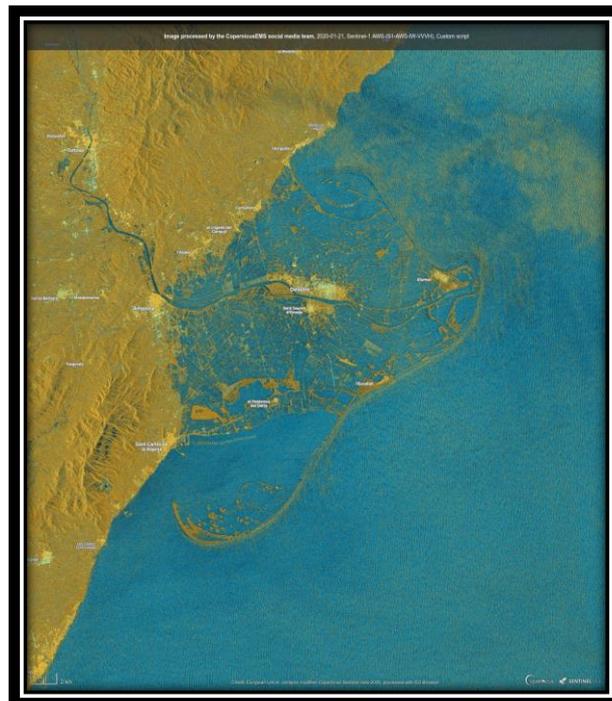

European Flood Awareness System

EFAS *Bulletin*

December 2019 – January 2020

Issue 2020(1)



NEWS

New features

EFAS data on CDS gets DOI

The EFAS data on CDS have now been given digital object identifiers (DOI) to make it easier to link to and reference the data. The following DOI's should now be used in publications and links:

EFAS forecasts:

<https://doi.org/10.24381/cds.9f696a7a>

EFAS historical simulations:

<https://doi.org/10.24381/cds.e3458969>

EFAS-MDCC integrated Spanish meteorological station data from AEMET

In January 2020, the EFAS-MDCC team integrated the meteorological station data from the Spain state meteorological agency (AEMET) into the operational processing routines. AEMET station data are downloaded every 6 hours from the AEMET Open Data portal. In total, data for 823 stations is loaded into the EFAS-MDCC database. Available data for precipitation, temperature, wind, relative humidity, solar radiation, sunshine duration and dew-point temperature are processed. Precipitation and temperature data for about 690 stations and wind speed data for nearly 600 stations are included into the gridded precipitation fields produced every day in the early morning as input for the EFAS forecasts. Solar radiation data from the available 34 stations is also used in the gridded solar radiation fields.



Figure 1. AEMET stations in Spain

EFAS-MDCC would like to thank AEMET very much for providing their data through the Open Data portal and for providing help to resolve questions from their data users.

EFAS version 3.5 release

EFAS version 3.5 is planned to be released on Thursday 5 March 2020. It contains updates on static maps (rivers drainage network in Albania) and on the LISFLOOD model. Managing of riverbed and floodplain flow in LISFLOOD has been improved and all outputs are now saved in double precision. EFAS 3.5 is not a major update since the impact on the discharge is very limited. However, since the model was updated over Albania it comes with a new EFAS climatology.

There were several changes to the web interface, including several bug fixes. Here is a summary:

- EFAS version numbering is now shown in the Layer List
- Buttons were added to hide and remove all layers in the Layer list
- A button was also added in the pop-up of the reporting points that explain the graphs with a hyperlink to the wiki page
- Changes to the feedback forms submissions were made so that only one partner can submit a feedback for a specific notification, but at the same time the same notification can receive different feedbacks from different partners.
- The symbols and legend for the Reporting Points to highlight basins <2000 Km2 were changed
- The colours of the notifications and legend in the viewer were changed to be clearer
- The Country Borders layer from the static layer tab, this layer will be visible only to the partners that can see the other restricted layers as the water Balance. Other users will only be able to use the country borders layer by changing the background map.

For more information on this and previous releases, please see the [EFAS wiki](#).

New partner

We gladly welcome the Regional Civil Protection of Friuli Venezia Giulia Region, Italy as new EFAS partner.

RESULTS

Summary of EFAS Flood and Flash flood Notifications

The 80 formal and 17 informal EFAS flood notifications issued in December 2019-January 2020 are summarised in Table 1. The locations of all notifications are shown in Figure 32 and Figure 34 in the appendix.

528 Flash flood notification were issued in December 2019 - January 2020. They are summarised in Table 2. The locations of all notifications are shown in Figure 33 and Figure 35 in the appendix.

Meteorological situation

by EFAS Meteorological Data Collection Centre

December 2019

The meteorological situation in December 2019 was characterised by a lower than normal monthly mean surface pressure centred in the northern parts and extending over the majority of the EFAS domain reflecting the recurring occurrence of low-pressure systems, whereas it was higher than normal in the western African parts of the EFAS domain. Monthly precipitation totals were below normal mainly in the eastern and southern parts as well as in the northwest and centre of the EFAS domain. The highest positive monthly precipitation anomalies were observed around the Mediterranean region. Monthly mean air temperatures were above normal over the whole EFAS domain except for Iceland.

At the beginning of December, three low-pressure systems were active in the EFAS-domain: one located over the north-western parts of the Iberian Peninsula, one over the Black Sea and the third north of Scandinavia. A high-pressure system was located over central and southeast Europe while another high-pressure system was located over the Atlantic Ocean. The low-pressure system over the Black Sea caused intense precipitation eastward and southward of the Black Sea with the highest daily totals at the south-eastern coast. It was replaced by the eastward moving high-pressure system, located before over southeast Europe. The low-pressure system north of Scandinavia moved slowly eastward and other low-pressure systems over the Atlantic influenced this region, therefore many days with precipitation occurred at the Scandinavian west coast. The low-pressure system at the Iberian Peninsula

moved around in this region and caused intense precipitation events at the Spanish and French Mediterranean coasts.

In the following days, the remaining high-pressure systems weakened or moved to the Azores, so most of the EFAS-domain was influenced by low-pressure systems causing large-scale precipitation. A weak low-pressure system at the eastern Mediterranean region caused heavy precipitation in Israel and Lebanon. Another low-pressure system developed over northern Africa, moved to the central and eastern Mediterranean region and caused intense precipitation at the Balkan Peninsula. At the same time, a large low-pressure system was located over Scandinavia and caused high precipitation totals in Great Britain and Ireland as well as in southern Norway. In addition, another low-pressure system intensified as it moved from Greenland via Iceland to the region between Norway and Greenland and caused intense precipitation in Portugal, Spain and France. Then again, yet another low-pressure system moved from Greenland to Great Britain and Ireland and caused the formation of a low-pressure system over the Adriatic Sea with intense precipitation at the eastern coast.

A cold air advance at the eastern Atlantic was related to the low-pressure system over Great Britain and Ireland and initiated the development of a low-pressure system over northern Africa, which later caused intense precipitation in the central Mediterranean region. This was followed by a low-pressure system which moved from Newfoundland to the region westward of Great Britain and Ireland and caused intense precipitation at the Iberian Peninsula. Within the next days, a low-pressure system formed over the Gulf of Lyon and moved eastward causing heavy precipitation in southern France, northern Italy and Croatia. In the days until the end of December, the eastern Mediterranean region was influenced by low-pressure systems causing heavy precipitation especially at the coastal regions. The remaining EFAS domain was influenced by high-pressure systems or weak pressure gradients, except for Scandinavia in the last three days of the month.

In December 2019, the highest precipitation totals were observed in the northwest of the Iberian Peninsula, the Mediterranean east coast as well as the Scandinavian west coast (Figure 18). No or only very little precipitation fell in parts of northern Africa and

around the Caspian Sea. More than normal precipitation was observed in many parts of southwest and northeast Europe and the eastern Mediterranean region (Figure 19). Less than normal precipitation fell in Iceland, central Europe, westward and eastward of the Black Sea, the western parts of northern Africa and the southeast part of the EFAS domain.

The monthly mean air temperature ranged from -20.7°C to 21.3°C with the highest values in the southern parts and lowest in the northern and mountainous parts of the EFAS domain (Figure 22). Air temperature anomalies ranged from -3.7°C to 8.4°C (Figure 23). Monthly mean air temperature values were above the long-term mean in the majority of the EFAS domain and only in Iceland below the long-term mean.

January 2020

The meteorological situation in January 2020 was characterized by higher than normal monthly mean surface pressure in the south and centre of the EFAS domain and lower than normal mean surface pressure in the east and north of the EFAS domain. Monthly precipitation totals were below the long-term mean in the majority of the EFAS domain. Positive precipitation anomalies are often associated with heavy precipitation events. Monthly mean air temperatures were above the long-term mean in the east and centre of the EFAS domain and below the long-term mean in the south of the EFAS domain and on Iceland.

Similarly, to the last days of December 2019, the eastern Mediterranean region was influenced by low-pressure systems causing heavy precipitation associated with flash floods also at the beginning of January 2020. The remaining EFAS domain was influenced by high-pressure systems and one low-pressure system, which moved from Iceland across northern Scandinavia towards the Arctic. Another low-pressure system developed over the Atlantic Ocean eastward of Newfoundland and moved via Iceland towards the north. The connected upper-level trough developed a steep wave at its southern rim. From this wave, a small and weak upper-level low-pressure system was cut off over central Europe and moved towards the Mediterranean region. It intensified while spinning around in the southern Mediterranean region for some days and brought substantial amounts of precipitation to northern Africa. In the same days, one more low-pressure system moved from the Atlantic Ocean via Great Britain and Ireland, North and Baltic Sea to Russia and

brought moderate precipitation amounts along its track. Yet another low-pressure system moved from the Atlantic Ocean between Iceland and Great Britain and Ireland towards the Norwegian Sea and caused strong winds in Great Britain and Ireland as well as in Iceland.

A secondary low-pressure system developed at the western ridge and moved on a similar, slightly southward shifted, track, and caused again strong winds in Great Britain and Ireland, whereas Eastern Europe was influenced by a high-pressure system. One more low-pressure system developed at the Atlantic Ocean and moved towards the Iberian Peninsula and the Azores high extended northward at its back and developed a new core at Great Britain and Ireland. The low-pressure system stayed for some time at the Strait of Gibraltar and later moved to the northwest towards the Atlantic Ocean. It brought a lot of precipitation at the Iberian Peninsula including heavy precipitation with associated floods in southeast Spain, southern France and the Balears. In the next days, the Icelandic low extended towards the Baltic Sea. A low-pressure system was cut off over Eastern Europe and another low-pressure system from the Atlantic Ocean merged with the western part of the before mentioned Icelandic low and shifted its core southward, moving to the Norwegian Sea to be replaced by another low-pressure system from the Atlantic Ocean. By the end of the month, the northern parts of the EFAS domain were influenced by low-pressure systems with strong winds, the Azores high was extended towards the Iberian Peninsula, and the eastern Mediterranean region and Eastern Europe had weak pressure gradients.

In January 2020, the highest precipitation totals were observed at the Norwegian and Scottish west coast, the northwest and southeast coast of the Iberian Peninsula and the east coast of the Mediterranean and Black Sea (Figure 20). No or only very little precipitation fell in some parts of Italy, westward of the Black and northern Aegean Sea as well as parts of northern Africa. More than normal precipitation was observed in Scandinavia, Scotland, southeast of the Iberian Peninsula, the Balears and the eastern Mediterranean region (Figure 21). Large areas in central, southern and eastern Europe, Iceland and the African parts of the EFAS domain experienced less than normal precipitation.

The monthly mean air temperature ranged from -22.1°C to 18.3°C with the highest values in the southern parts and lowest in the northern and mountainous parts of the EFAS domain (Figure 24). Air temperature anomalies ranged from -5.3°C to 9.5°C (Figure 25). Monthly mean air temperature values were above the long-term mean in the east and centre of the EFAS domain and only on Iceland and in southern parts of the EFAS domain below the long-term mean.

Hydrological situation

by EFAS Hydrological Data Collection Centre

December 2019

For the month of December, the highest concentration of stations that exceeded their lowest threshold level was in the Po river basin in Italy, the Mihno-Sil and the Limia river basins, in northwestern Spain, and the Danube river basin in Croatia, Serbia, Slovenia, southern Austria, Slovakia and Ukraine (Figure 30). A more dispersed distribution of stations with exceedances occurred in southern Sweden, western Norway and Neretva river basin, in Bosnia & Herz. In addition, there were isolated stations exceeding the lowest threshold level in southern Rhine (Germany), Dnieper (Ukraine), Oder (Poland), Neman (Belarus) and Llobregat (northwestern Spain) river basins.

Stations in the Danube river basin in Serbia, Germany, Austria, Romania and Czech Republic, as well as those located in the Elbe river basin in Germany and Czech Republic, and the Oder river basin in Poland and Germany, mainly registered values lower than the 10% quantile (Figure 26). We also found stations showing values below 10% in the Vistula (Poland and Ukraine) and Dnieper (Ukraine) river basins. Besides those listed above, other isolated stations also showing values below the 10% quantile are in the Rhine (Germany), Maritsa (Bulgaria), Thames (United Kingdom), Skien and Glomma (Norway) and Kemijoki (Finland) river basins.

Contrastingly, stations that recorded discharge values above the 90% quantile are mostly located in Spanish river basins (such as Guadalquivir, Douro, Ebro, Minho-Sil, Llobregat and Ter), in the Danube river basin (Austria, Slovakia, Slovenia and Hungary), as well as in Norwegian and Swedish river basins (). To a minor extent, other stations also exceeding the 90% quantile

occurred in basins in northern Finland and northern Italy (in this latter case, particularly in the Po river basin). Values above 90% quantile were also registered in isolated stations distributed across United Kingdom (Thames and Nene rivers), France (Garonne river), Belarus (Daugava river), Ukraine (Dnieper river) and Poland (river Oder).

January 2020

For January, the highest number of stations that exceeded their lowest threshold level was in Norwegian basins, especially in the northern part of the country. A fewer number of stations with exceedances occurred in the Llobregat river basin in northeastern Spain, the Po river basin in Italy, basins in southern Sweden, Israel, as well as southwestern Danube river basin in Austria, Croatia and Bosnia & Herz. (Figure 31). In addition to the previous ones, we also find isolated stations exceeding the lowest threshold level in the rivers Oder and Vistula, in Poland, the Minho river in northwestern Spain, the Neretva river in Bosnia & Herz., the Elbe river in Germany and the Neman river in Belarus.

Stations in the Elbe river basin in Germany and Czech Republic, in the Oder river basin (Germany and Poland), together with stations in the Dnieper basin (Ukraine), and the eastern Danube river basin in Serbia, Romania, Hungary and Ukraine, mainly registered values lower than the 10% quantile (Figure 28). We can also find stations showing values below 10% in the Rhine and Danube river basins in Germany. Besides those listed above, other isolated stations also showing values below the 10% quantile are located in the Danube (Czech Republic, Austria, Croatia and Bosnia & Herz.), Maritsa (Bulgaria), Thames (England), Ebro (Spain), Vistula (Poland) and Kemijoki (Finland) river basins.

Contrastingly, stations that recorded discharge values above the 90% quantile are mostly in Norwegian, Sweden and Finnish river basins, as well as in several Spanish river basins, such as Guadalquivir, Douro, Ebro, Llobregat and Ter. To a minor extent, other stations also exceeding the 90% quantile occurred in western Danube (Austria and Germany), Thames, Welland and Trent river basins in England, as well as in the Swiss southern Rhine river basin. Values above the 90% quantile were also registered in isolated stations in Ukraine (Dnieper river) and Daugava, in Latvia.

Verification

Figure 2 and Figure 3 shows the EFAS headline score, the Continuous Ranked Probability Skill Score (CRPSS) for lead times 1 and 5 days for the December 2019 to November period across the EFAS domain for catchments larger than 2000km². 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.

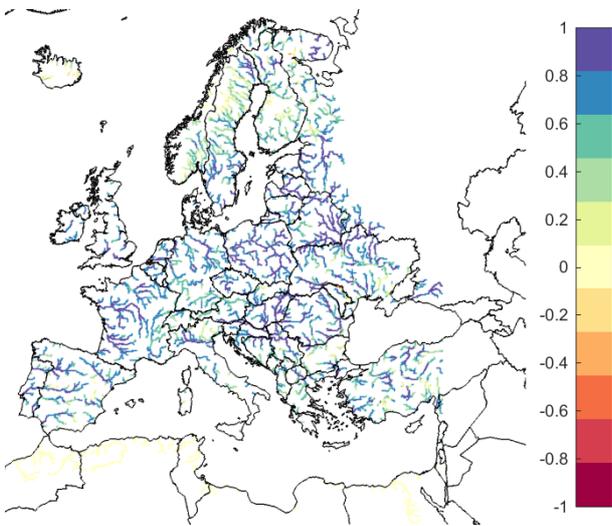


Figure 2. EFAS CRPSS at lead-time 1 day for the December 2019-January 2020 period, for catchments >2000km². The reference score is persistence of using previous day's forecast.

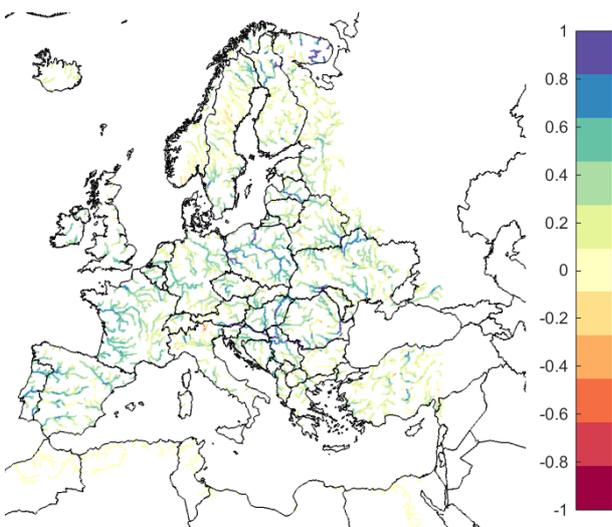


Figure 3. EFAS CRPSS at lead-time 5 days for the December 2019-January 2020 period, for catchments >2000km². The reference score is persistence of using previous day's forecast.

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 of the forecast was quite good, although the skill is still slightly lower than for the same period last year (Figure 4). The scores for 2019 are very good considering the wet autumn in large parts of Europe whereas the unusual dry summer last year affected the results and gave very positive scores. An interannual variability of the scores is to be expected.

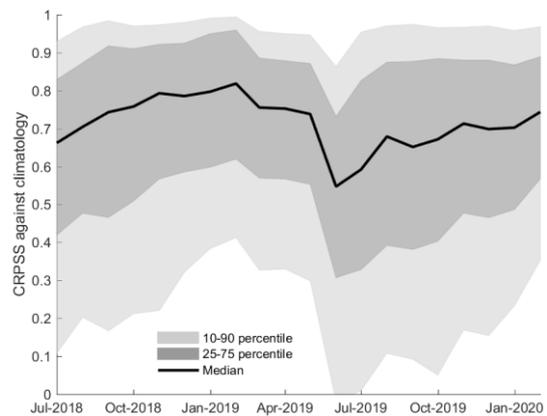


Figure 4. Monthly means of CRPSS the for lead-time 5 days for all the major river points in Europe with ECMWF ENS as forcing. Reference forecast was climatology. The skill is largest during the winter months, when there is less variation in the flow in large parts of Europe.

Long-term experiments of the current EFAS system, are being run, and a more comprehensive verification is expected with the release of EFAS v4.0, which will happen later this year.

ARTICLES

Summary of EFAS Notifications in 2019

by EFAS Dissemination Centre

Figure 5 shows the number of formal, informal and flash flood notifications issued each month throughout 2019. With a total number of 1496 EFAS notifications 2019 was by far the busiest of the past five years for the EFAS consortium. Compared to 2018 the Dissemination Center issued 19% more formal, 19% more informal and 279% more flash flood notifications.

November was the most active month with 337 notifications, which is about 23% of the total number of notifications of 2019. December saw the most formal notifications issued, while the periods from February till April and July till September were relatively quiet in terms of flood notifications. In total 175 formal, 115 informal and 1206 flash flood notifications were issued in 2019.

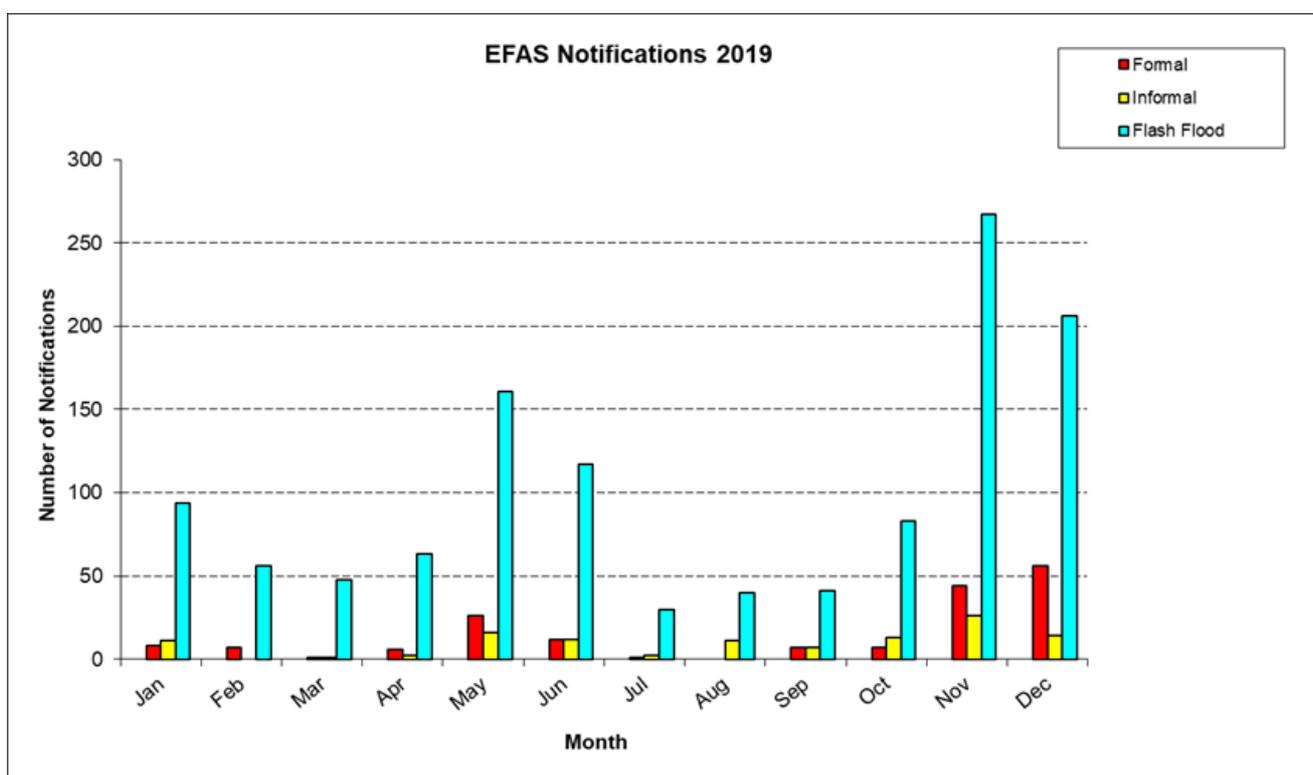


Figure 5. Number of EFAS formal (red), informal (yellow) and flash flood (blue) notifications issued in 2019.

Remarkable periods in 2019 were the second and third week of January with floods in Greece and Spain, the first and the third week of May with large spread floods over Romania, the Balkan and the Elbe and Danube catchments in Slovakia and Germany and the months of November and December with an enormous amount of notifications for France, Spain, Italy and the United Kingdom.

For comparison, Figure 6 indicates the total number of EFAS notifications issued per year for the past 7 years. 2019 was a very wet year for all three types of notifications, but the increase in flash flood notifications was sensational.

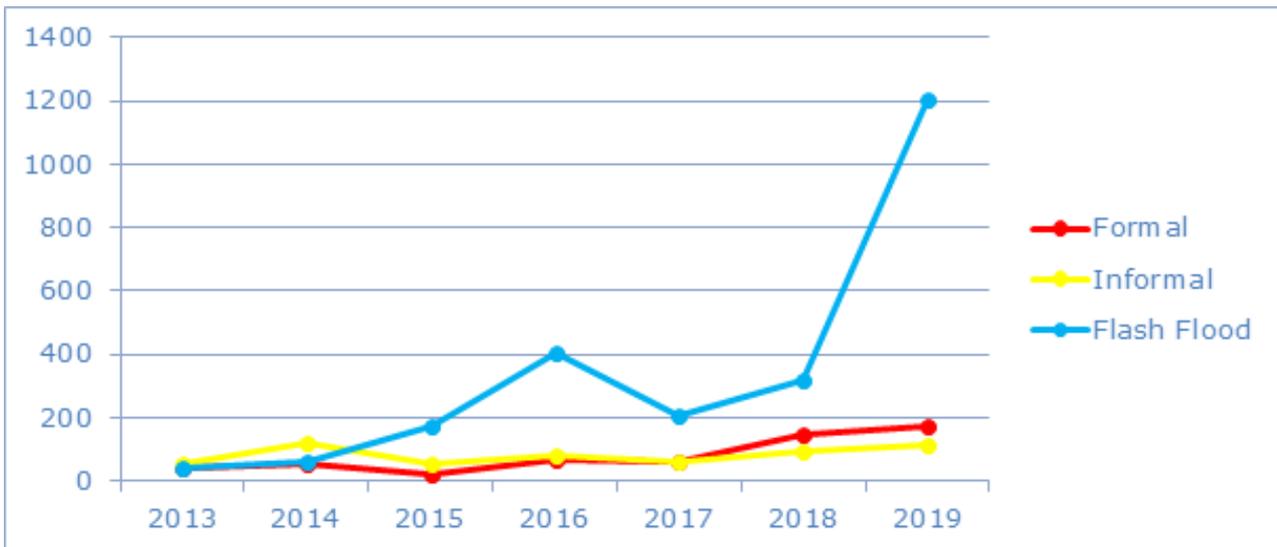


Figure 6. Total number of EFAS formal (red), informal (yellow) and flash flood (blue) notifications issued per year from 2013-2019.

Figure 3 breaks down the number of notifications over the past 7 years into seasons (December-January-February [DJF], March-April-May [MAM], June-July-August [JJA] and September-October-November [SON]).

reason for that is the amount of flash flood notifications that has been issued in all seasons of 2019. If you only look at formal and informal notifications, then the most active seasons were the winter of 2016, the spring of 2018 and the summer and autumn of 2019.

The most active seasons in terms of river flooding over the past 7 years were all beaten by the year 2019. The

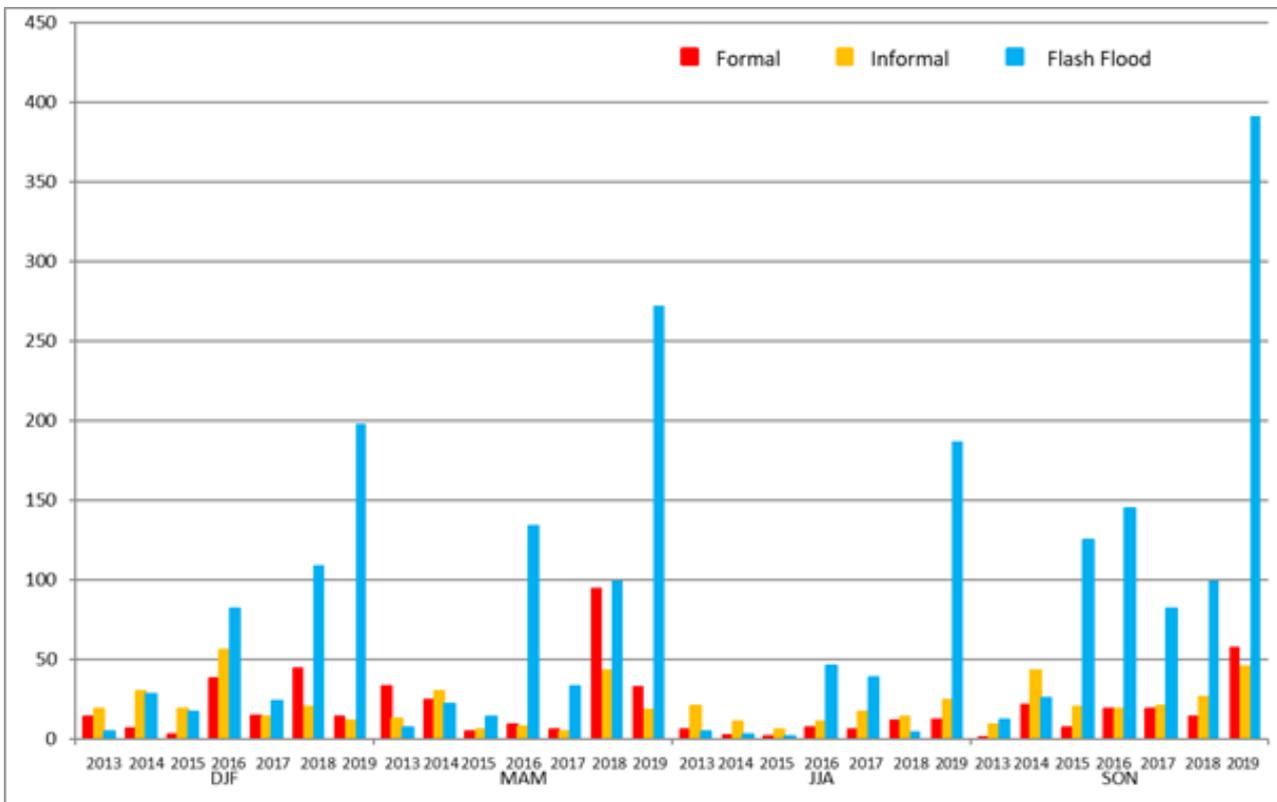


Figure 7. Number of EFAS (red), informal (orange) and flash flood (blue) notifications issued per season over the past 7 years (2013-20219).

Based on the number of notifications issued from 2013-2019, the most formal flood notifications are issued in spring (29 per year on average), informal notifications in winter (26 per year on average) and flash flood notifications in autumn (126 per year on average). The season with the fewest formal notifications is the summer (about 7 per year on average).

In 2019 in total 37 countries received 1496 notifications (175 formal, 115 informal and 1206 flash flood notifications). Italy received the highest number of notifications (14 formal, 18 informal and 150 flash flood notifications). The most formal notifications were sent to France (32), followed by Spain (31), the most informal notifications to the United Kingdom (20) and the most flash flood notifications to Italy (150), followed by Greece, Spain and the United Kingdom (all about 120).

EFAS partner survey 2019

by Bettina Matti, EFAS Dissemination Centre

The 14th EFAS Annual Meeting took place in Stresa, Italy between the 21 and 22 of May 2019, and the participants were invited to answer the yearly survey regarding the satisfaction of the EFAS performance in

general, the service and the products. A link for a web-based survey was made available to all EFAS partners. 36 responses were received, compared to 43 in 2018 and 22 in 2017. It is noted however that in 2018 the survey was sent to all partners; the response rate for 2019 is therefore very positive. The survey was, as in previous years, anonymous.

The survey responses are summarised according to the following categories:

- Overall satisfaction
- Skill, performance and trust
- EFAS services
- EFAS products and added value
- Satisfaction with the EFAS centres
- Future developments

Overall satisfaction

No major changes in overall satisfaction were reported in comparison to the previous two years (Figure 8). It is noted however that satisfaction in overall performance during the past 12 months (question 3) has decreased, with four rating the performance as “low” and fewer rating it as very high. This may be related to the decrease in satisfaction relating to flash flood notifications (question 12).

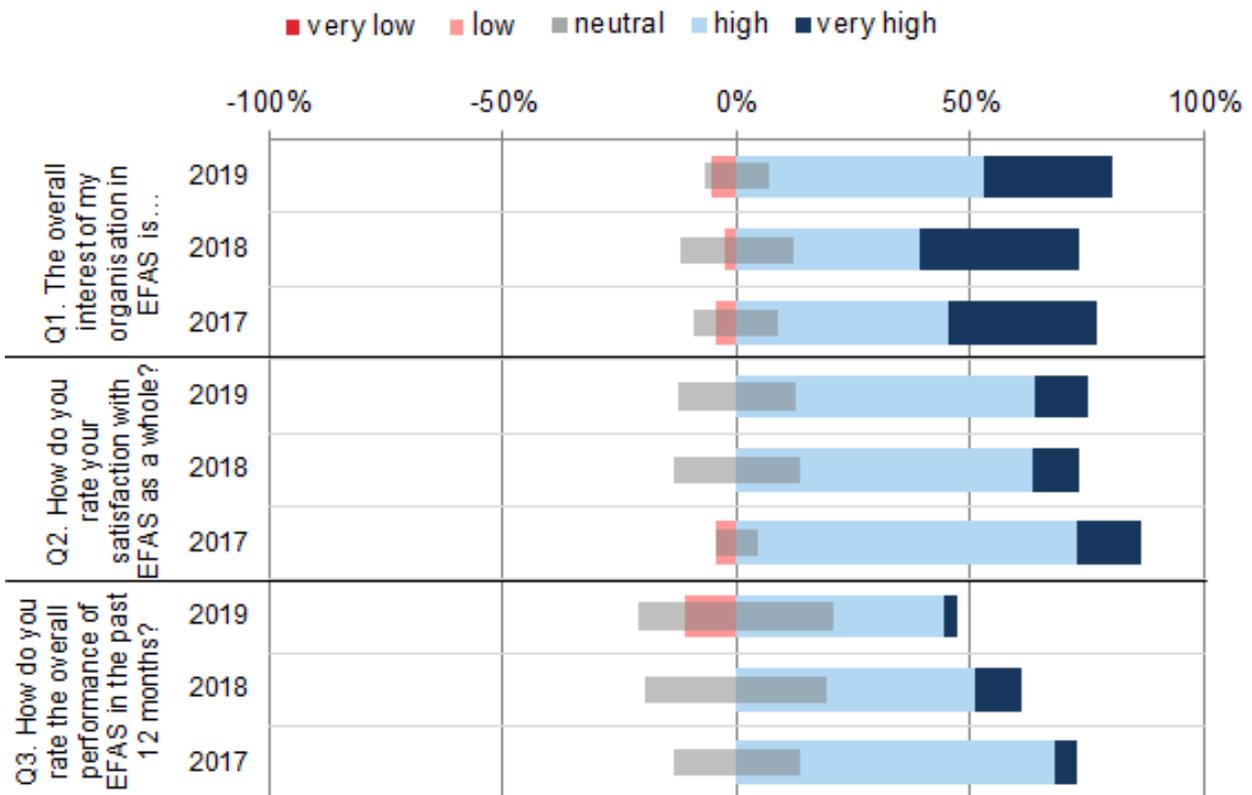


Figure 8. Average user response on overall satisfaction with the EFAS.

Skill, performance and trust

In general, most questions showed a slight increase in satisfaction compared with previous years (Figure 9).

Notable changes are that model skill is not used, and that more partners are taking the EFAS notifications more seriously when they are received.

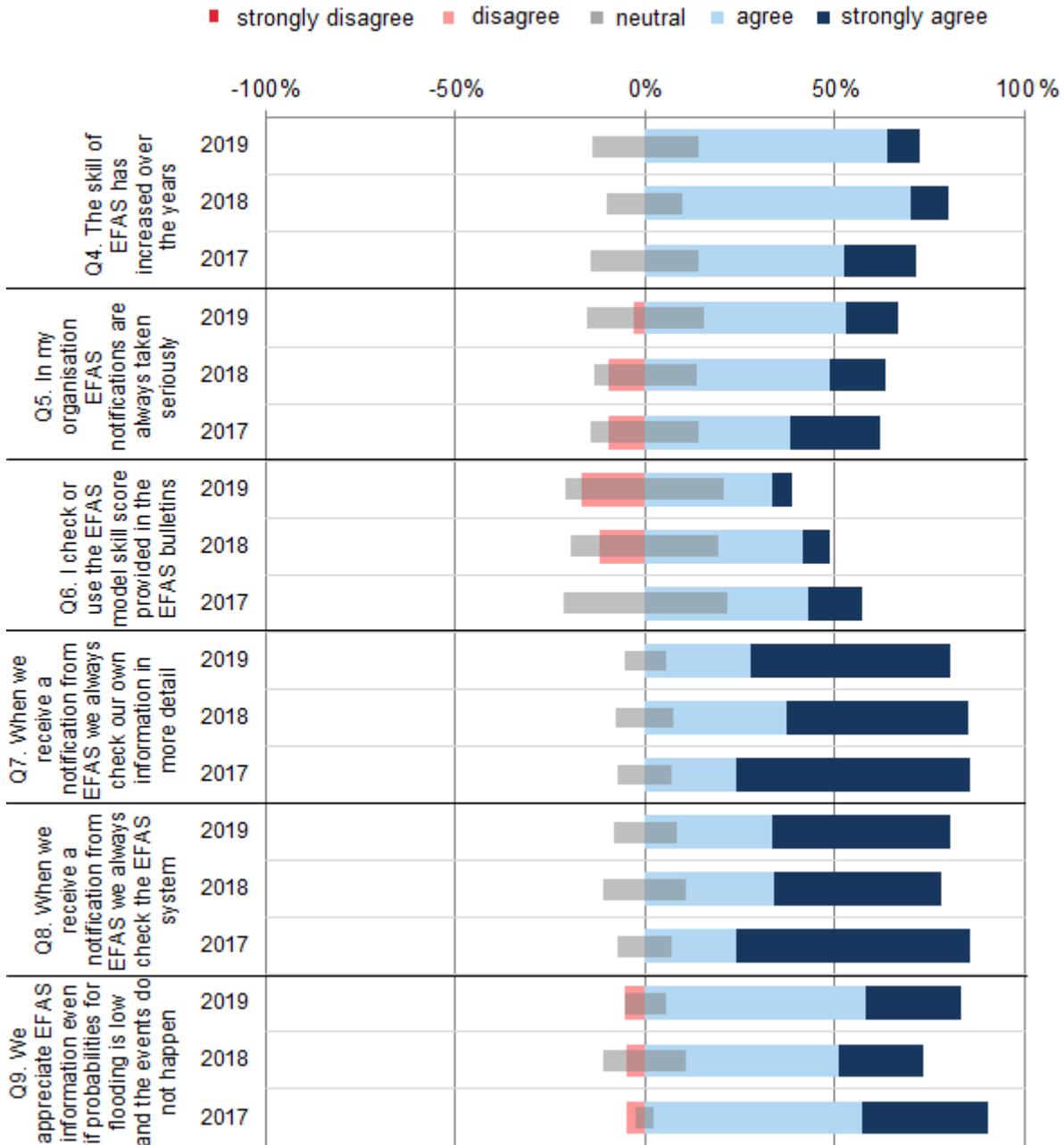


Figure 9. Average user response on skill, performance and trust with the EFAS

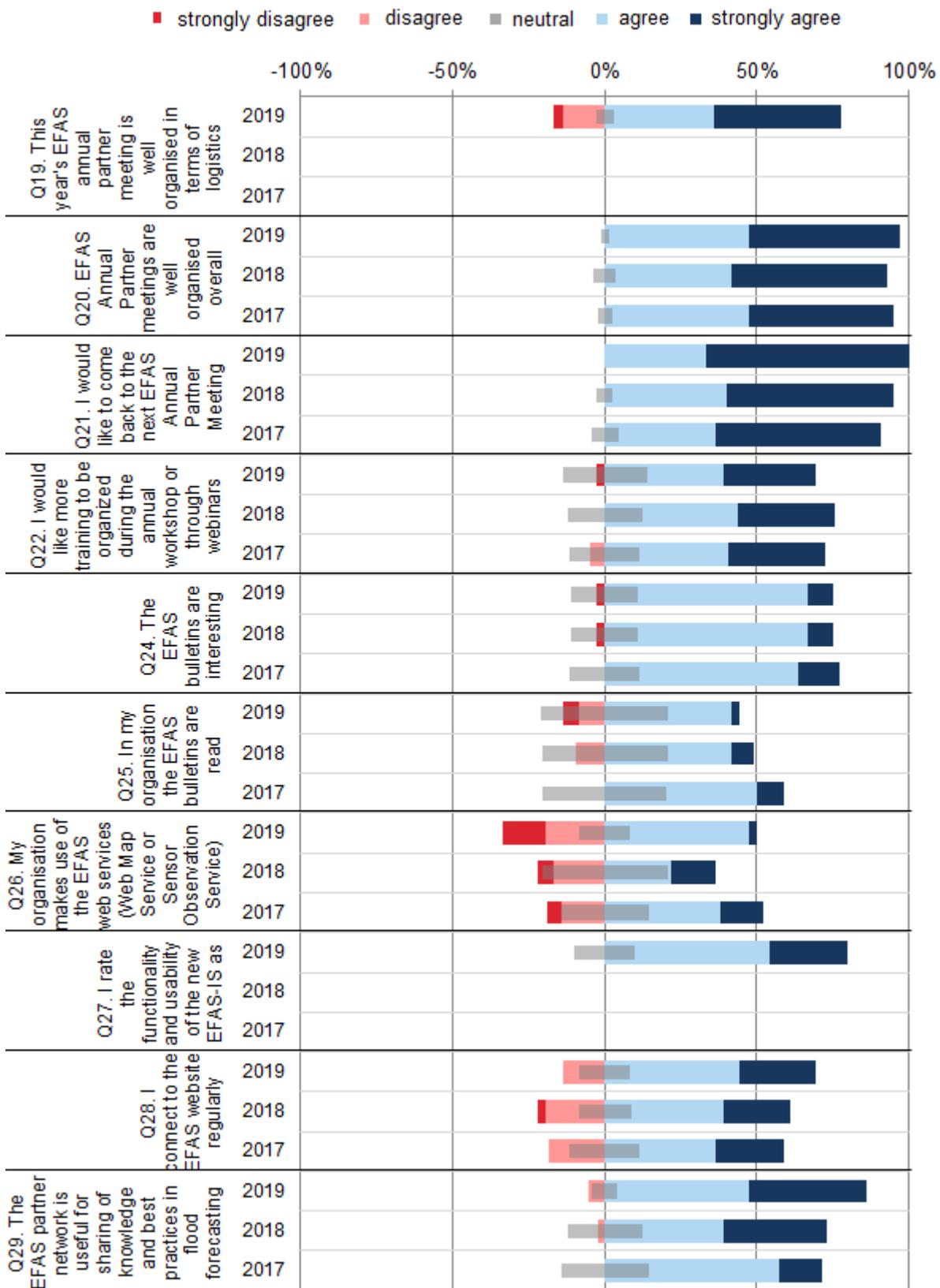


Figure 10. Average user response to EFAS services.

EFAS services

In general, there are no significant changes between the responses received for 2019 and in previous years (Figure 10). A notable change is that fewer organisations are using the EFAS web services, and that fewer

partners are reading the EFAS Bulletins. All users are positive towards the new EFAS-IS, with 28 responding with “high” or “very high”.

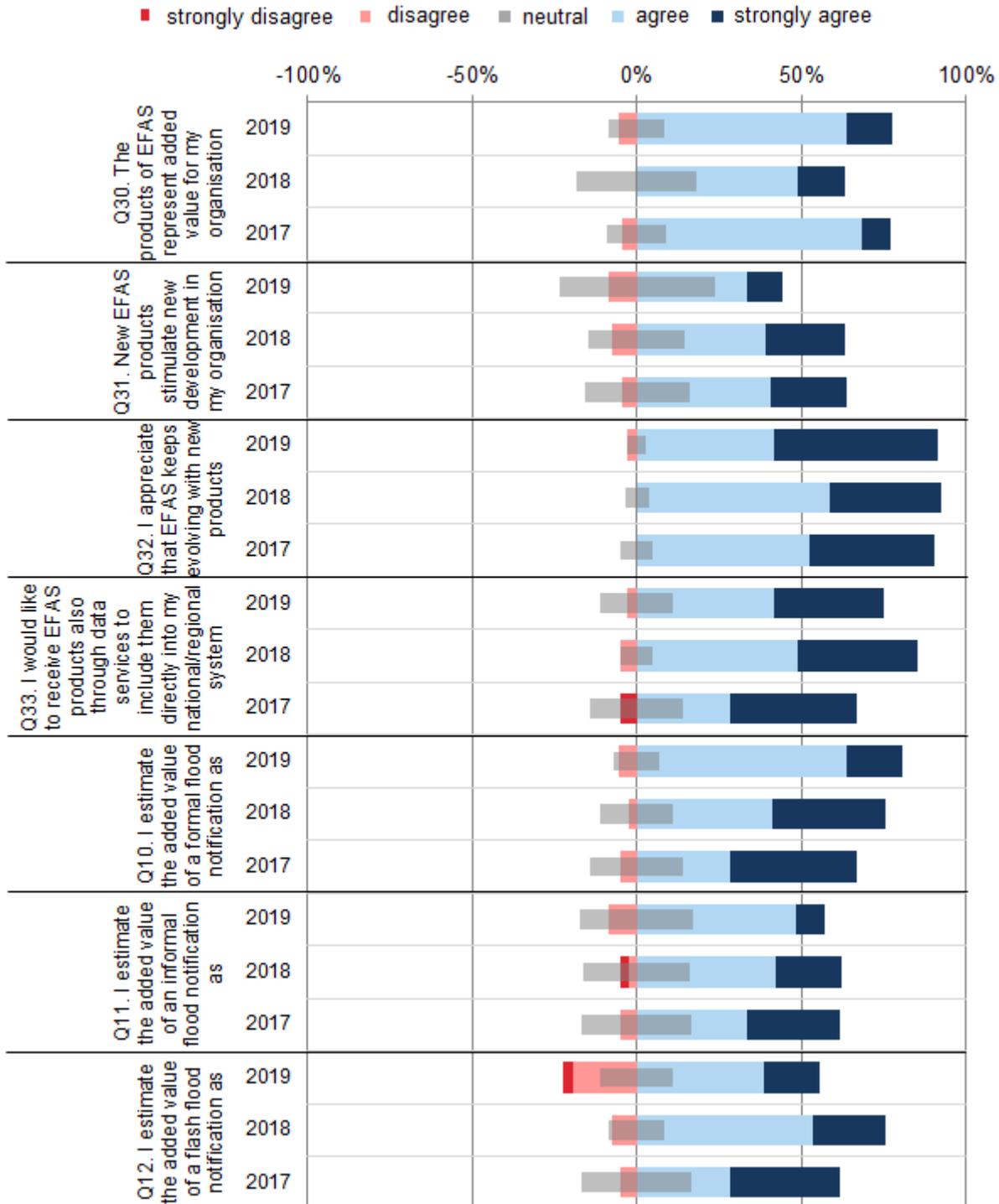


Figure 11. Average user response to EFAS products and added value.

A wide range of topics for future EFAS webinars were lifted. Many of these have previously been covered by the EFAS DISS, implying that previous webinars need to be re-advertised to partners (see “Possible improvements”). Topics requested were:

- The EFAS interface
- Nowcasting and Ericha
- Forecast criteria and improved understanding (probabilities, flash flood thresholds, uncertainties, ensemble post-processing, runoff generation during extreme rainfall)
- Calibration and model verification
- New EFAS products
- How to work with MARS and access data
- Hydrological modelling and LISFLOOD
- Seasonal prediction
- Impact forecasting

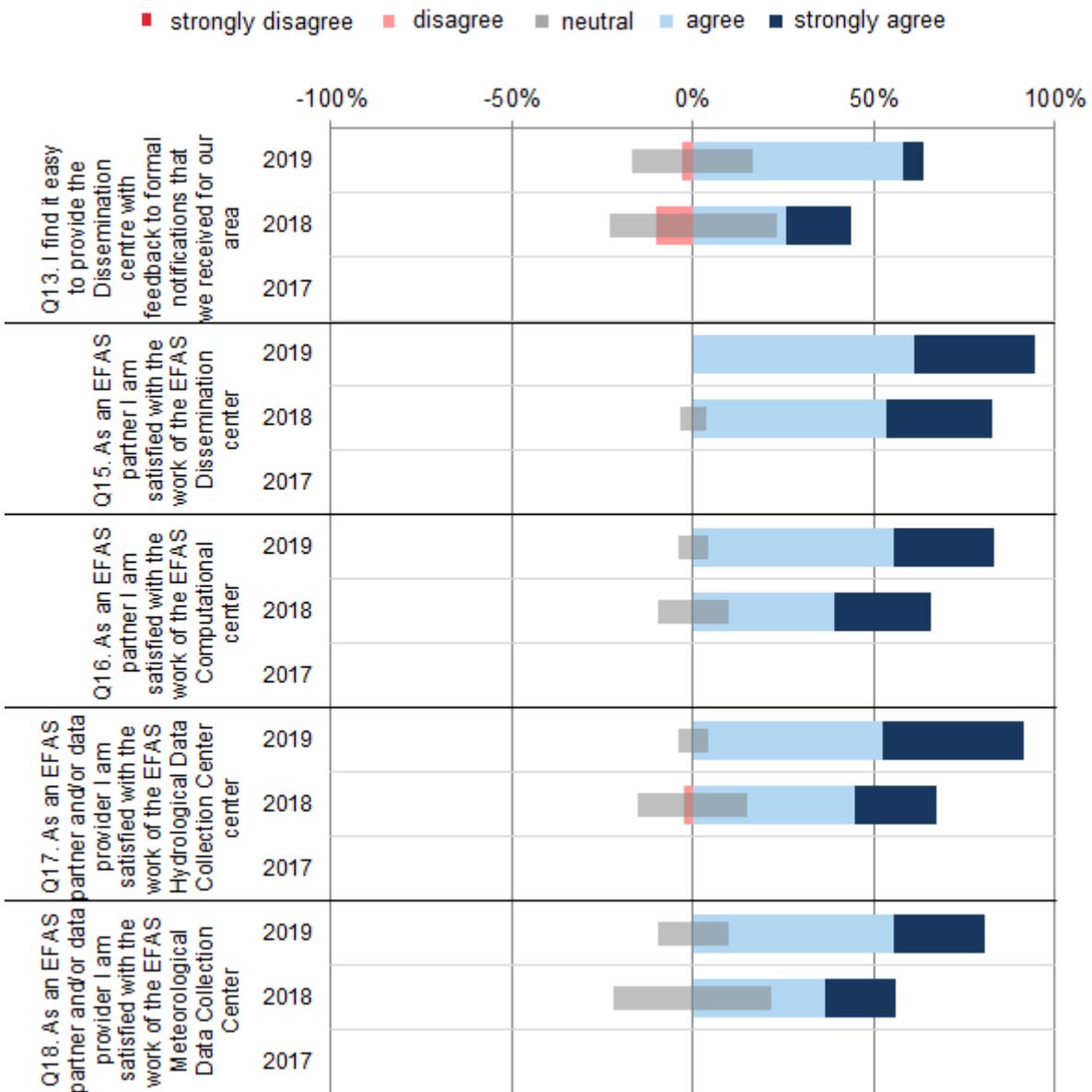


Figure 12. Average user response on formal notification feedback collection and the satisfaction of the work of the different EFAS centers.

EFAS products and added value

In general, most questions show either a very small increase or decrease but no major change (Figure 11). An encouraging trend is seen in added value from both formal and informal notifications. A prominent negative trend is seen in the added value of flash floods (question 12), relating presumably to the change in notification criteria during 2019. This may also correspond to the increase in negative answers to question 3.

In terms of feedback, an increase in the number of positive responses regarding the feedback process is observed (Figure 12). Partners commented that the new process enables “more flexibility” and that the “survey is simplified”, but that “sometimes it is difficult to provide an answer”. In addition, further automation of the process was suggested, although no details provided.

Satisfaction with each of the EFAS centres has also increased from last year (this question was first asked 2018).

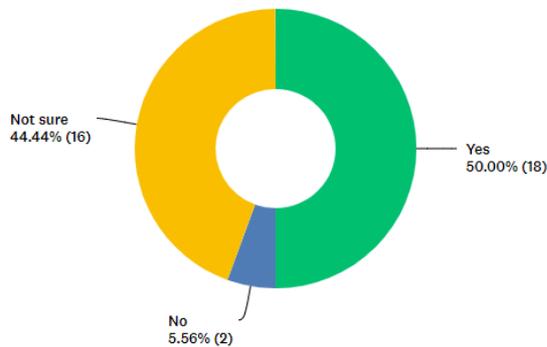


Figure 13. User responses to the question “I support the EFAS open data policy as presented during this year's meeting”.

Future developments

Several questions were asked relating to future developments in either the EFAS products or the availability of EFAS data. In addition, partners were asked whether they were aware that the possibility exists to activate EMS Mapping for satellite imagery support in cases of flooding. Encouragingly, more than 70% are aware of this service.

A discussion on making EFAS data more open was also held at the 14th Annual Meeting, following on from the same discussion at the previous meeting. The new proposal suggests only presenting certain initial condition

layers, rather than all datasets, and is summarised in Figure 13. Previously, 20% (8 people) replied that data should not be made more open, compared to 6% this year (2 people). 50% replied “yes” (18 people), compared to 37% (15 people) previously. Approximately half of the partners remain uncertain, as last year.

Lastly, participants were asked what future services they would like to see included in EFAS. The results were relatively equal:

1. Continue increasing the skill of existing products (*score = 3.28*)
2. More weather forecasts in addition to ECMWF, DWD and COSMO-LEPS (e.g. GFS) (*score = 3.03*)
3. Coastal flood forecasts (*score = 2.45*)

Partners were also able to provide specific suggestions for future services. Responses were:

- Inclusion of additional hydrological models
- Storm surge forecasts
- Flash flood and informal notification skill indicators
- Dam influence in flood notifications
- Improvements to seasonal forecasting
- ICON-EU-EPS
- Inclusion of the point rainfall post-processed ensemble forecasts from ECMWF, with probabilities of precipitation type
- Cross-cutting products using data from other Copernicus services

Updated product generation for EFAS improves performance and usability

by Corentin Carton de Wiart, Louise Arnal, Maurizio Latini, Blazej Krzeminski, Tiago Quintino and Christel Prudhomme, EFAS Computational Centre and ECMWF

On 8 October EFAS released an improved hydrological forecast layer (Figure 14). The layer shows a combination of 1) dynamically created reporting points where a flood signal is forecasted in the next 10 days (red and yellow squares), and 2) physical stations for which no flood is forecasted, but where hydrological information is shared by EFAS partners (grey and blue squares). This new design gives users a complete and coherent overview of all stations at which EFAS medium-range forecasts are accessible. It also enables partners who have shared their hydrological data with the EFAS consortium to monitor the hydrological evolution of their catchments of interest at any time, something that was not possible beforehand.

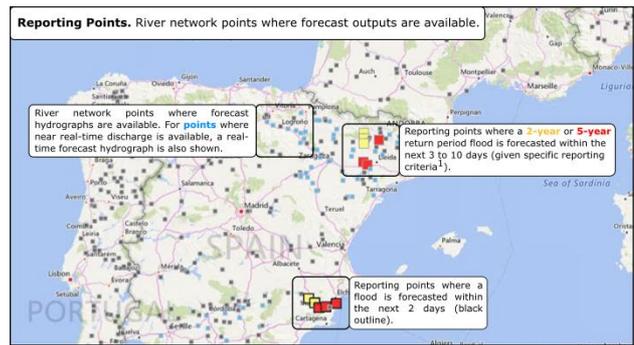


Figure 14. EFAS reporting point layer.

The improved design facilitates the work of the forecasters on duty of the EFAS dissemination centres (the Hydro-Meteorological Services of Sweden, Netherlands and Slovakia) as stations with an expected flood are quickly identifiable (red and yellow squares). In addition, EFAS partner can easily identify stations for which post-processed forecast are available as those stations are highlighted in blue. For all reporting points detailed forecast information in the form of discharge hydrographs, time series of temperature or precipitation, forecast overview tables, etc. (Figure 15) are available.

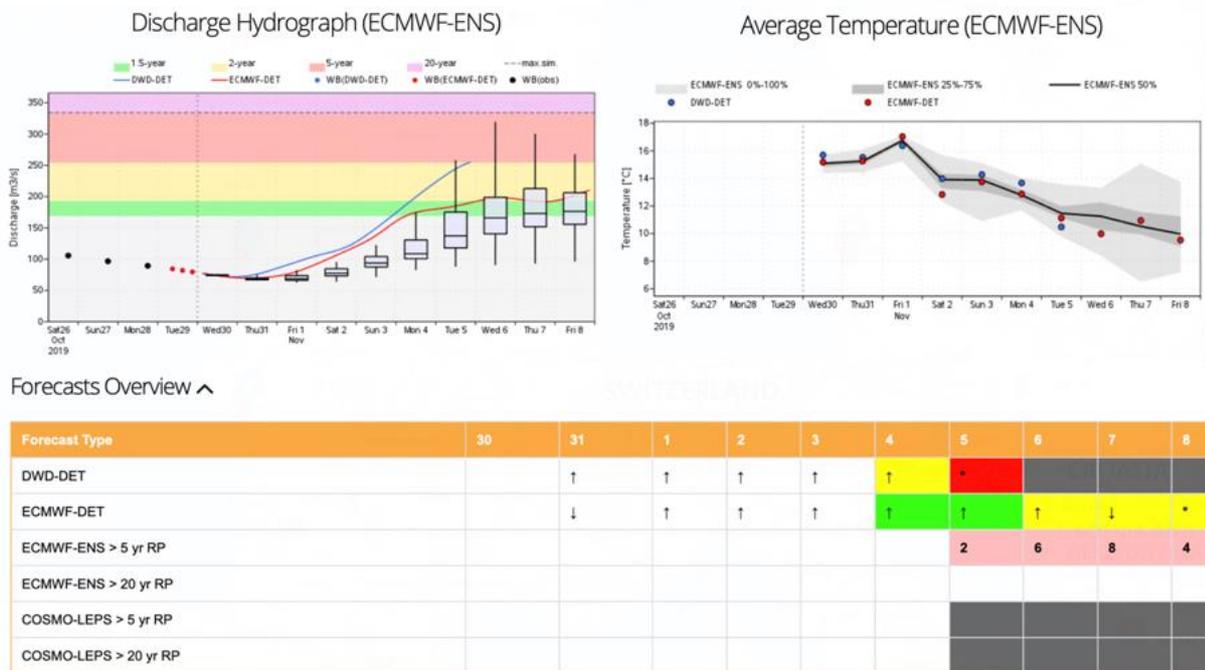


Figure 15. Example of EFAS reporting points products.

New python framework for production

On the production side, the number of points for which detailed forecast information is produced at each forecast has increased from a few dozens of dynamic points (where a flood signal is forecasted) to around 2000 static points (points where EFAS partners share hydrological data with EFAS). Using the legacy system, the increased complexity and computing requests would have prevented ECMWF to meet its Service Level Agreement regarding forecast dissemination time.

The expected ever-increasing number of EFAS partners – and therefore number of reporting points – together with the envisaged increase in resolution of the EFAS system motivated a full review of the existing product generation chain to enable greater scalability and prepare for future upgrades. This was also an opportunity to reduce the complexity of the legacy tools that make up the operational suite, which used a mix of programming languages, such as Python, R, PCRaster, C++ and bash scripts. The new product generation was designed with the following ideas in mind:

- Gather common functionalities of flood forecasting in a shared framework
- Improve modularity of the system, allowing easier implementation of new features
- Improve maintainability using modern software engineering processes
- Promote collaborative development practices between hydrologists and computer-scientists
- Introduce parallel computing and data hypercubes in the process, preparing the system for the next resolution upgrade

A new Python framework called “danu” was developed to support these improvements. As the use of Python can result in a drop of efficiency for heavy operations, typically involving looping over the grid points, the framework delegates these parts to dedicated libraries, such as:

- Numpy/Scipy
- Xarray/Dask/Multiprocessing
- PCRaster (Python interface only)
- GDAL

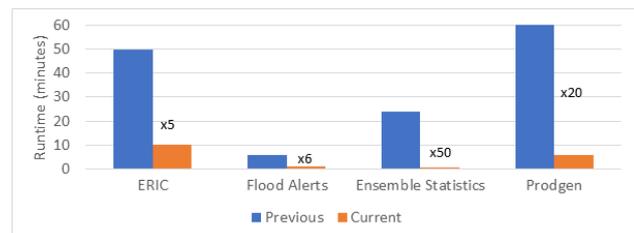


Figure 16. Runtime for different EFAS components and resulting speedup.

Using parallelism in compute intensive parts of the workflow, for instance when calculating statistics over the ensemble members, also led to a dramatic improvement resulting in one to two orders of magnitude faster runtime (Figure 16). Porting the multiple processes into a single framework also made it possible to optimize filesystem I/O by avoiding data transfers, which was a major performance bottleneck. Having demonstrated the increased efficiency after code refactoring, the same exercise was also conducted for the flash flood product generation (ERIC), sharing as much as possible the libraries between the different product generation chains. The reduction of runtime on key parts of the considered EFAS workflow is illustrated in the figure above.

These performance improvements were achieved thanks to a close collaboration between the scientists that developed the system and computer-scientists that reworked it, creating a positive feedback where technical developments empower the science to go further. The tools developed in the python framework “danu”, and this successful collaboration between teams are now applied on other environmental forecast modelling chains, such as those developed for the EU-funded SMUFF project “Seamless probabilistic multi-source forecasting of heavy rainfall hazards for European flood awareness”.

Storm Gloria hits Spain and France in January 2020

by Richard Davies (FloodList)

The storm Gloria wrought havoc across parts of Spain and France during late January 2020.

Spain

The storm affected wide areas of Spain from 20 January, in particular along the southern and eastern coasts, bringing strong winds, high waves, storm surge and torrential rain. AEMET reported wind gusts of 115 km/h in Oliva, Valencia, on 20 January and 106 km/h in Barcelona the next day. Huge waves, reportedly up to 14.8 metres, smashed into coastal areas of Valencia, Catalonia and the Balearic Islands.



Figure 17. Flood damage in Campanillas, Malaga, Spain. Credit: Junta de Andalucía

Several areas recorded more than 180mm of rainfall in 24 hours during the storm, including Barx in Valencia Province (190.4mm on 20 January), Horta de Sant Joan in Tarragona Province (227.4mm on 21 January), Sant Hilari in Girona (183.2 mm on 22 January) and Coín in Málaga (183.0 mm on 23 January). Severe flooding was reported in areas around Girona after the Ter river broke its banks on 23 January. The overflowing Guadalhorce and Campanillas rivers caused flash flooding also

caused damage in the province of Málaga on 24 January. The Guadalhorce river reached 4.70 metres on 25 January, with floods leaving residents trapped in their homes in Cártama.

Images from CEMS - Mapping show that the storm surge on the east coast of Spain swept 3 km inland in the Ebro river delta south of Barcelona (cover image). The mayor of Deltebre, Lluís Soler, estimated around 30 km² of rice fields have been flooded by seawater and said “the delta is in emergency!” By 23 January, Spanish media reported 4 storm-related deaths in Catalonia, 5 in Valencia, 2 in Andalusia, 1 in Castile and León and 1 in the northern region of Asturias. Four people were reported as still missing in Catalonia and the Balearic Islands.

France

Storm Gloria also brought heavy rain to parts of southwestern France from 20 January. On 23 January, MétéoFrance said: “The equivalent of 4 to 5 months of rain fell in 72 hours in Roussillon. These intense rains caused exceptional floods in the departments of Aude and Pyrénées-Orientales.” According to MétéoFrance figures, in a period from 20 January to 23 January, 418 mm of rain fell in Arles-sur-Tech, 351 mm in Amélieles-Bains and 365 mm in Serralongue.

Around 1,500 people were evacuated in several towns near Perpignan in Pyrénées-Orientales after levels of the Agly river rose quickly. The Agly at Rivesaltes reached 7.41 metres in the early hours of 23 January, 2020, equaling its second highest level on record, set in 2014. The highest level of 7.66 metres was set in 2013. Around 250 people were also evacuated in Aude due to flooding from the Aude river. In Coursan, the Aude river reached 8.25 metres on 23 January, equalling the highest-level set in 2010.

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: Storm surge flooded 3 km inland along Spain's eastern coast 20 to 22 January 2020. Credit: Copernicus EMS.

Appendix - figures

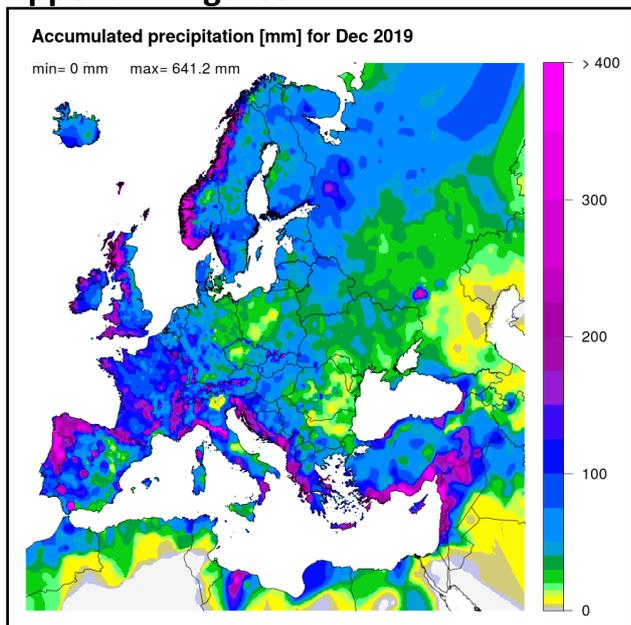


Figure 18. Accumulated precipitation [mm] for Dec. 2019.

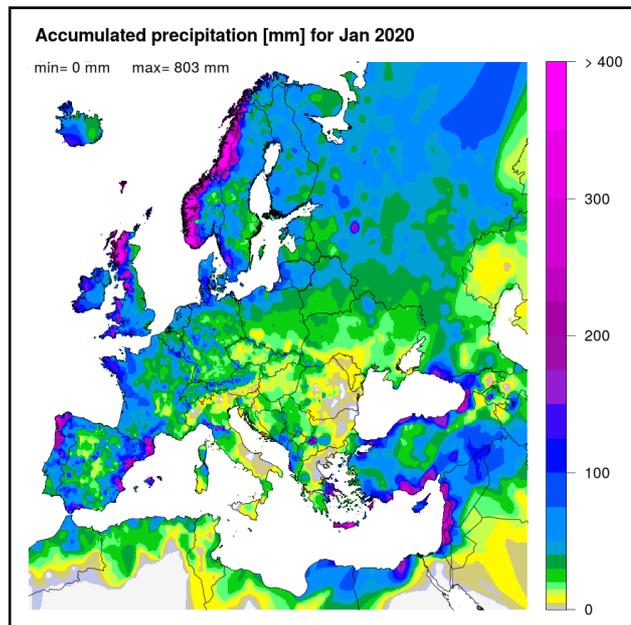


Figure 20. Accumulated precipitation [mm] for January 2020.

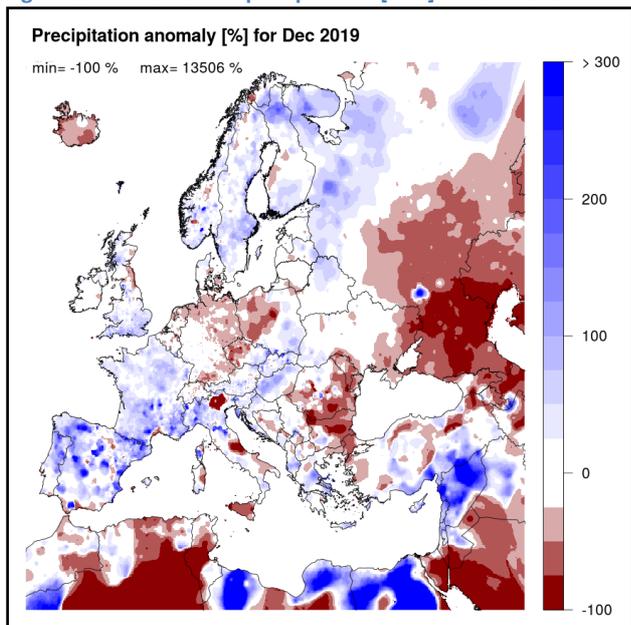


Figure 19. Precipitation anomaly [%] for December 2019, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

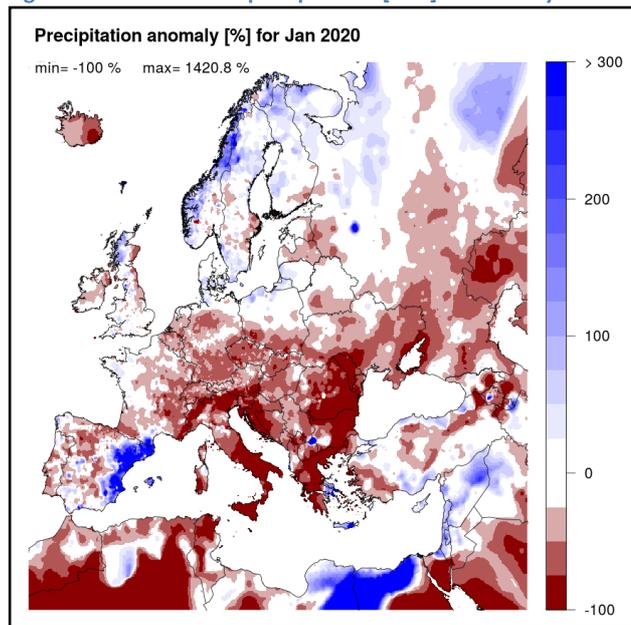


Figure 21. Precipitation anomaly [%] for January 2020, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

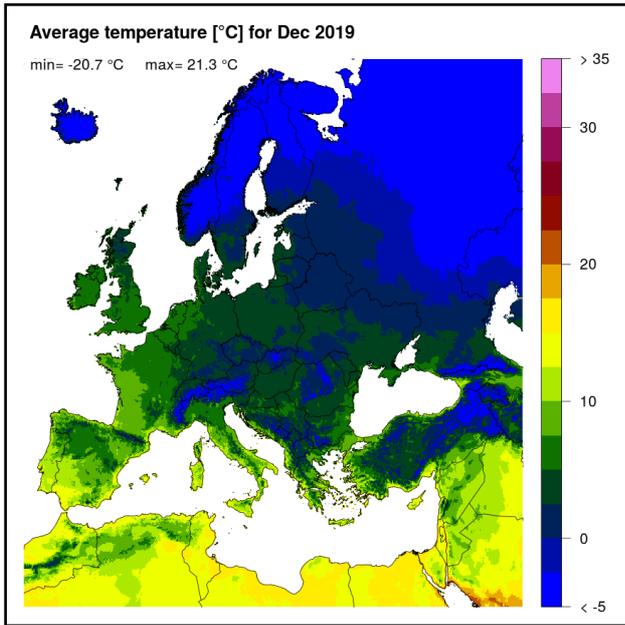


Figure 22. Mean temperature [$^{\circ}\text{C}$] for December 2019.

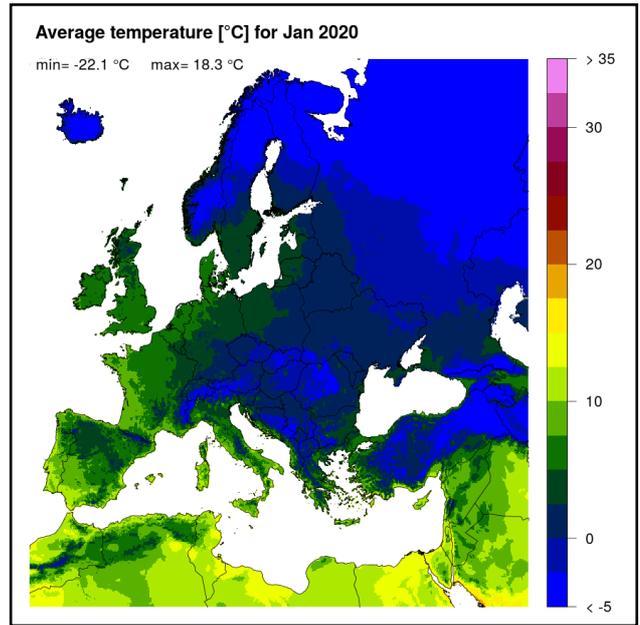


Figure 24. Mean temperature [$^{\circ}\text{C}$] for January 2020.

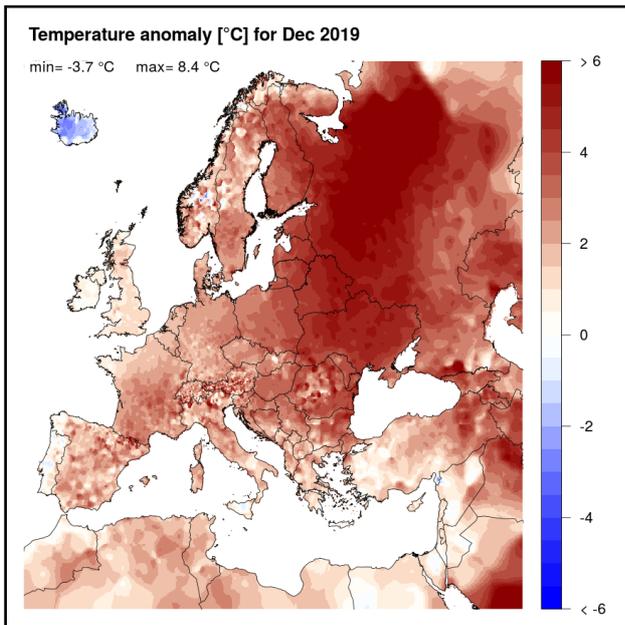


Figure 23. Temperature anomaly [$^{\circ}\text{C}$] for December 2019, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

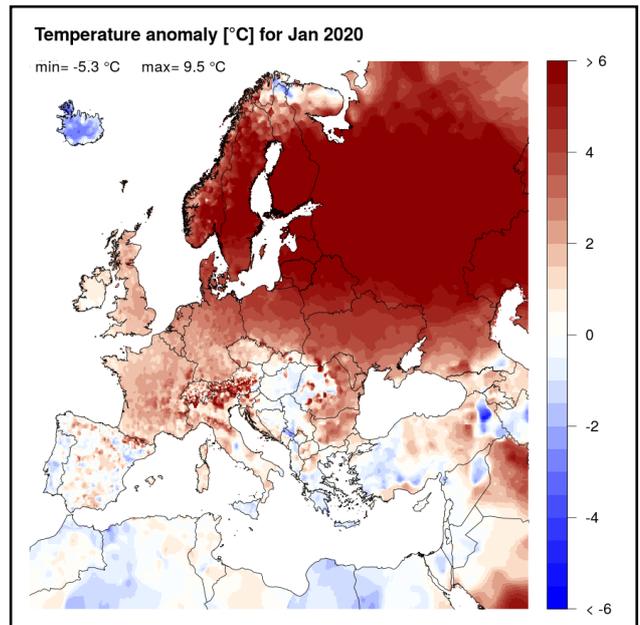


Figure 25. Temperature anomaly [$^{\circ}\text{C}$] for January 2020, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

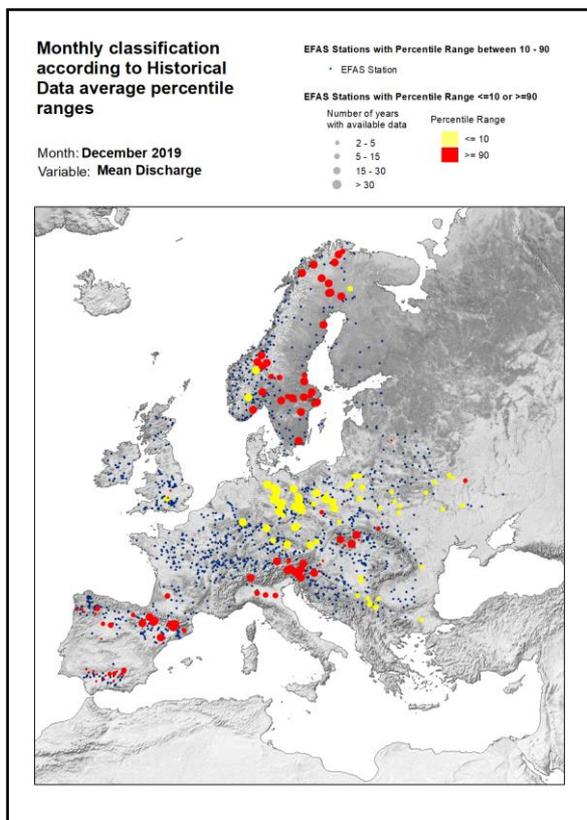


Figure 26. Monthly discharge anomalies December 2019.

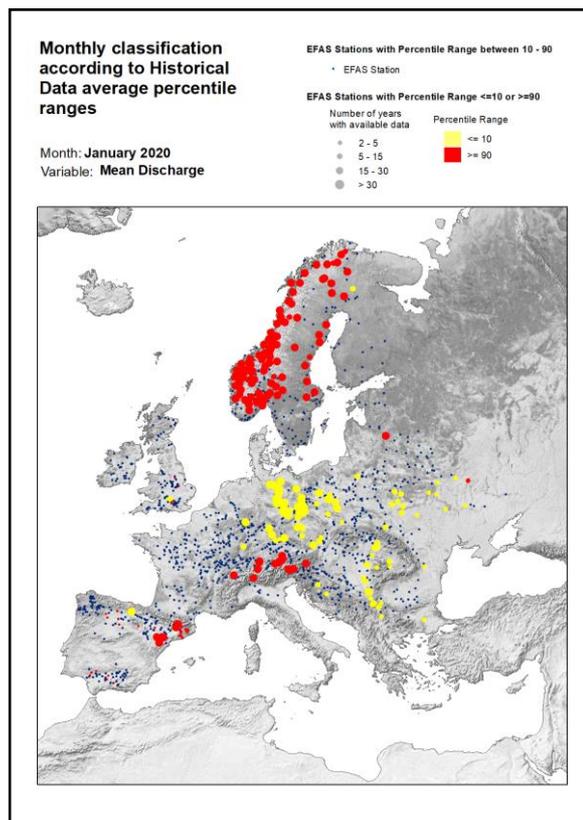


Figure 28. Monthly discharge anomalies January 2020.

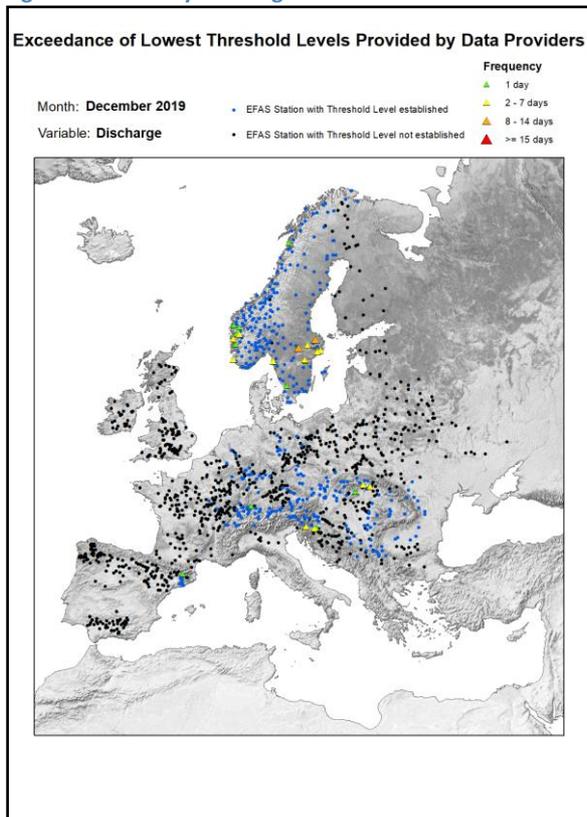


Figure 27. Lowest alert level exceedance for December 2019.

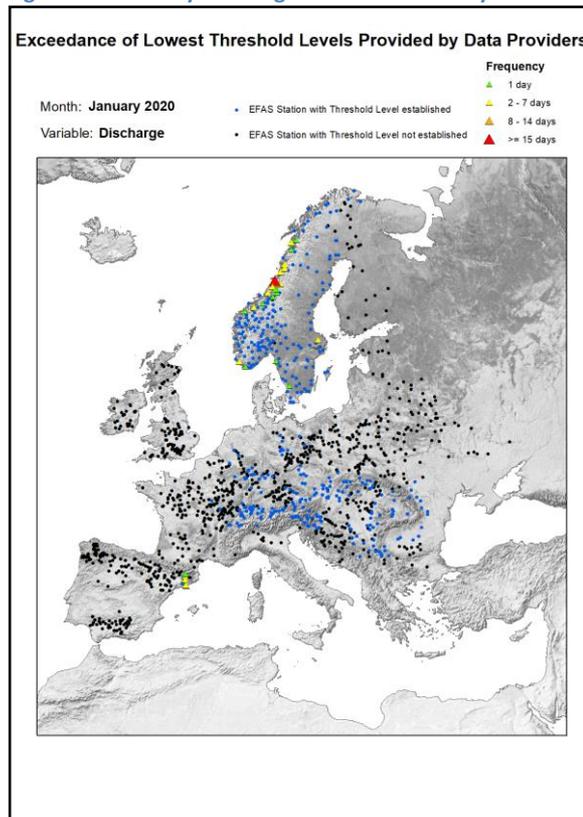


Figure 29. Lowest alert level exceedance for January 2020.

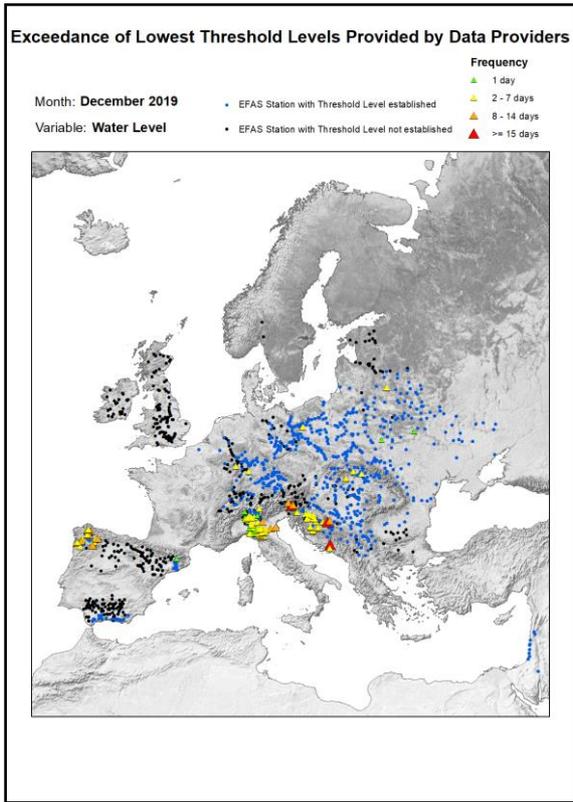


Figure 30. Lowest threshold exceedance for December 2019.

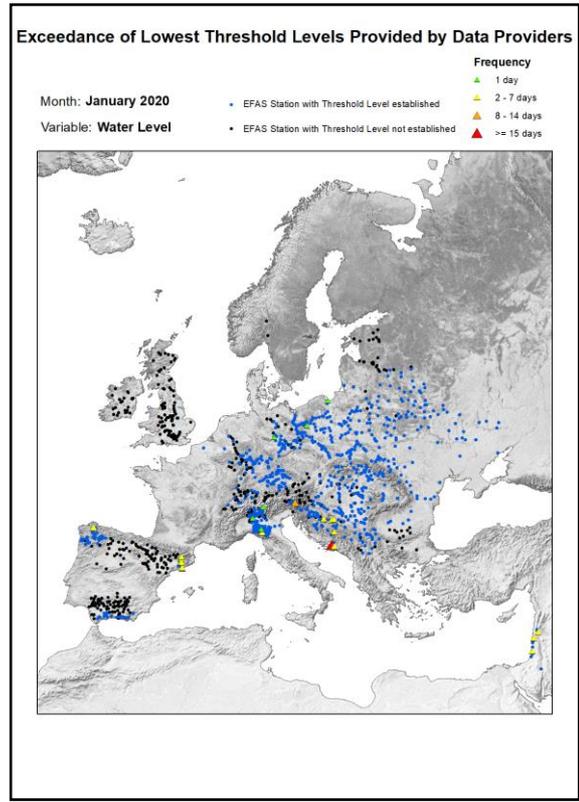


Figure 31. Lowest threshold exceedance for January 2020.

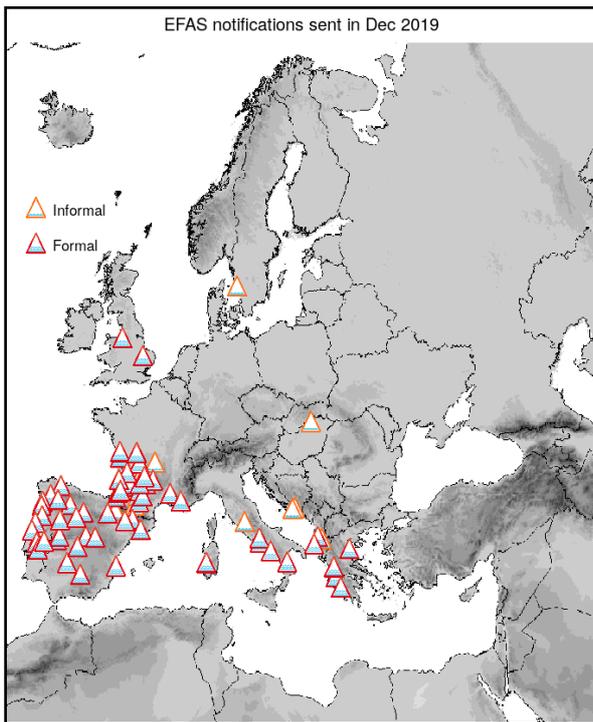


Figure 32. EFAS flood notifications sent for December 2019.

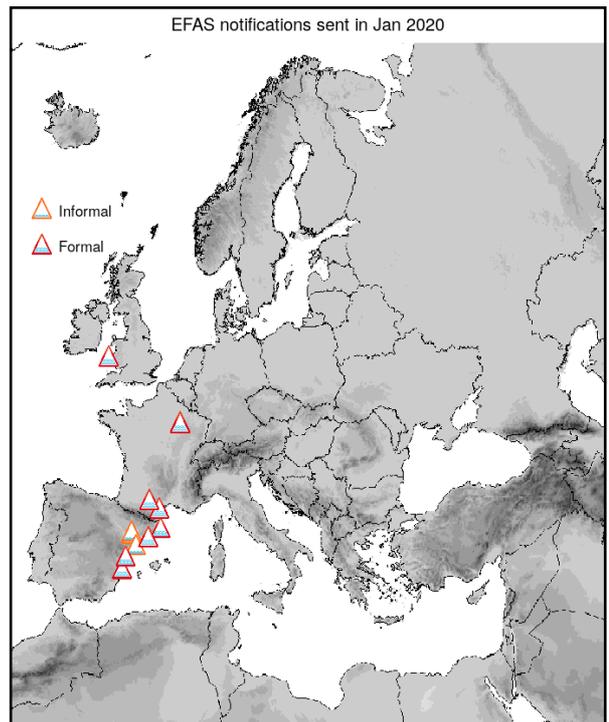


Figure 34. EFAS flood notifications sent for January 2020.

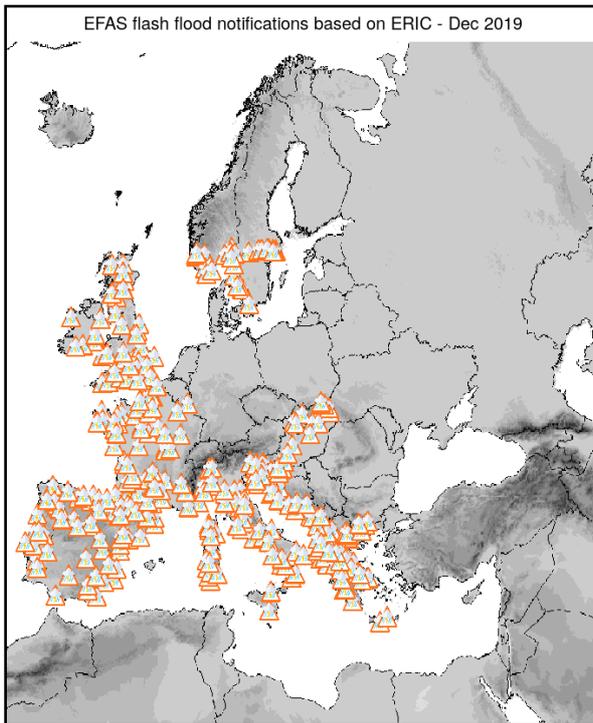


Figure 33. Flash flood notifications sent for December 2019.

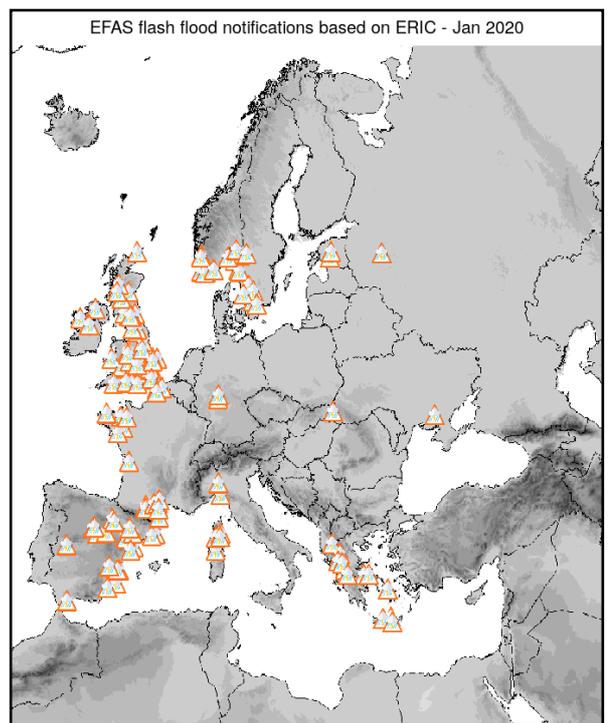


Figure 35. Flash flood notifications sent for January 2020.

Appendix - tables

Table 1. EFAS flood notifications sent in December 2019 - January 2020

Type	Forecast date	Issue date	Lead time	River	Country
Formal	01/12/2019 12UTC	02/12/2019	1	Jucar	Spain
Formal	08/12/2019 12UTC	09/12/2019	2	Mersey	United Kingdom
Formal	08/12/2019 12UTC	09/12/2019	2	Pineios	Greece
Formal	09/12/2019 00UTC	09/12/2019	4	Cele	France
Formal	09/12/2019 00UTC	09/12/2019	4	Sor	France
Formal	09/12/2019 12UTC	10/12/2019	4	Dordogne	France
Formal	09/12/2019 12UTC	10/12/2019	4	Garonne	France
Formal	09/12/2019 12UTC	10/12/2019	6	Aveyron	France
Formal	09/12/2019 12UTC	10/12/2019	5	Lot	France
Formal	09/12/2019 12UTC	10/12/2019	3	Midouze	France
informal	09/12/2019 12UTC	10/12/2019	4	Eyre	France
Formal	09/12/2019 12UTC	10/12/2019	5	Vezeze	France
Formal	09/12/2019 12UTC	10/12/2019	5	Isle	France
Formal	09/12/2019 12UTC	10/12/2019	4	Ariege	France
informal	10/12/2019 00UTC	10/12/2019	4	Salat	France
informal	10/12/2019 00UTC	10/12/2019	3	Irati	Spain
Formal	10/12/2019 00UTC	10/12/2019	4	Gave	France
informal	10/12/2019 00UTC	10/12/2019	1	Devoll	Albania
Formal	11/12/2019 00UTC	11/12/2019	3	Navia	Spain
Formal	11/12/2019 00UTC	11/12/2019	3	Aragn	Spain
informal	11/12/2019 00UTC	11/12/2019	2	Sioule	France
Formal	11/12/2019 12UTC	12/12/2019	3	Adour	France
informal	11/12/2019 12UTC	12/12/2019	2	Aragn	Spain
Formal	12/12/2019 00UTC	12/12/2019	5	Alagon	Spain
Formal	12/12/2019 00UTC	12/12/2019	4	Tajo	Spain
informal	12/12/2019 00UTC	12/12/2019	2	Save	France
Formal	12/12/2019 00UTC	12/12/2019	5	Mino	Spain
Formal	12/12/2019 00UTC	12/12/2019	4	MINHO	Portugal
Formal	12/12/2019 00UTC	12/12/2019	3	Lima	Portugal
Formal	12/12/2019 12UTC	13/12/2019	5	TAMEGA	Portugal
Formal	13/12/2019 00UTC	13/12/2019	3	Esla	Spain
Formal	13/12/2019 00UTC	13/12/2019	0	Sil	Spain
Formal	13/12/2019 00UTC	13/12/2019	4	Zezeze	Portugal
Formal	14/12/2019 00UTC	14/12/2019	2	Vienne	France
Formal	15/12/2019 00UTC	15/12/2019	1	Charente	France
Formal	15/12/2019 12UTC	16/12/2019	2	Dordogne	France
Formal	15/12/2019 12UTC	16/12/2019	4	Jarama	Spain
Formal	15/12/2019 12UTC	16/12/2019	4	Arlanza	Spain
Formal	16/12/2019 00UTC	16/12/2019	4	Ardeche	France
Formal	16/12/2019 12UTC	17/12/2019	2	Zujar	Spain
Formal	17/12/2019 00UTC	17/12/2019	3	Noguera Pallaresa	Spain
Formal	17/12/2019 00UTC	17/12/2019	3	Gllago	Spain
Formal	17/12/2019 00UTC	17/12/2019	3	Verdon	France
Formal	17/12/2019 00UTC	17/12/2019	3	Guadalquivir	Spain
Formal	17/12/2019 00UTC	17/12/2019	4	Volturmo	Italy
Formal	17/12/2019 00UTC	17/12/2019	5	Acheloos	Greece

Formal	17/12/2019 00UTC	17/12/2019	1	Aveyron	France
Formal	17/12/2019 12UTC	18/12/2019	4	Shkumbini	Albania
informal	18/12/2019 00UTC	18/12/2019	0	Viskan	Sweden
Formal	18/12/2019 00UTC	18/12/2019	3	Tirso	Italy
Formal	18/12/2019 00UTC	18/12/2019	2	Llobregat	Spain
Formal	18/12/2019 00UTC	18/12/2019	3	Sele	Italy
Formal	18/12/2019 00UTC	18/12/2019	3	Garigliano	Italy
Formal	18/12/2019 00UTC	18/12/2019	5	Arachthos	Greece
Formal	18/12/2019 12UTC	18/12/2019	3	Charente	France
Formal	18/12/2019 12UTC	18/12/2019	2	Great Ouse	United Kingdom
Formal	18/12/2019 12UTC	19/12/2019	4	Alfeios	Greece
Formal	18/12/2019 12UTC	19/12/2019	4	Vjose	Albania
Formal	19/12/2019 00UTC	19/12/2019	3	Coastal zone	Italy
Formal	19/12/2019 00UTC	19/12/2019	2	Vienne	France
informal	19/12/2019 12UTC	20/12/2019	2	Nera	Italy
Formal	19/12/2019 12UTC	20/12/2019	2	Svre niortaise	France
Formal	19/12/2019 12UTC	20/12/2019	0	Sorraia	Portugal
Formal	19/12/2019 12UTC	20/12/2019	3	Tagus	Portugal
Formal	19/12/2019 12UTC	20/12/2019	1	Tajo	Spain
Formal	19/12/2019 12UTC	20/12/2019	0	Vouga	Portugal
Formal	19/12/2019 12UTC	20/12/2019	0	Mondego	Portugal
Formal	19/12/2019 12UTC	20/12/2019	4	Duero	Spain
informal	20/12/2019 00UTC	20/12/2019	2	Saj	Slovakia
informal	20/12/2019 12UTC	21/12/2019	2	Neretva	Croatia
informal	20/12/2019 12UTC	21/12/2019	2	Neretva	Bosnia & Herz.
Formal	20/12/2019 12UTC	21/12/2019	1	Tajo	Spain
Formal	20/12/2019 12UTC	21/12/2019	2	Tajo	Spain
Formal	20/12/2019 12UTC	21/12/2019	2	Truyere	France
Formal	20/12/2019 12UTC	21/12/2019	4	Garonne	France
Formal	20/12/2019 12UTC	21/12/2019	3	Sor	France
Formal	20/12/2019 12UTC	21/12/2019	4	Lot	France
Formal	20/12/2019 12UTC	21/12/2019	2	Dordogne	France
Formal	20/12/2019 12UTC	21/12/2019	2	Dronne	France
Formal	21/12/2019 00UTC	21/12/2019	2	Eyre	France
Formal	21/12/2019 12UTC	22/12/2019	0	Pisuerga	Spain
Formal	21/12/2019 12UTC	22/12/2019	1	Midouze	France
Formal	22/12/2019 00UTC	22/12/2019	3	Vienne	France
informal	27/12/2019 12UTC	28/12/2019	0	Garonne	France
informal	27/12/2019 12UTC	28/12/2019	0	Noguera Ribagorzana	Spain
Formal	14/01/2020 12UTC	15/01/2020	0	Teifi	United Kingdom
Formal	16/01/2020 12UTC	17/01/2020	3	Jucar	Spain
Formal	17/01/2020 00UTC	17/01/2020	2	Ter	Spain
Formal	18/01/2020 12UTC	19/01/2020	2	Llobregat	Spain
Formal	19/01/2020 00UTC	19/01/2020	3	Aude	France
Formal	19/01/2020 00UTC	19/01/2020	1	Mijares	Spain
Informal	19/01/2020 12UTC	20/01/2020	2	Segre	Spain
Informal	20/01/2020 00UTC	20/01/2020	2	Cinca	Spain
Formal	20/01/2020 00UTC	20/01/2020	3	Sor	France
Informal	24/01/2020 12UTC	25/01/2020	2	Ebro	Spain
Formal	29/01/2020 12UTC	30/01/2020	5	Saulx	France
Formal	29/01/2020 12UTC	30/01/2020	6	Marne	France

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

Table 2. EFAS flash flood notifications sent in December 2019 - January 2020

Type	Forecast date	Issue date	Lead time	Region	Country
Flash Flood	01/12/2019 00UTC	01/12/2019	84	Valencia / Valencia	Spain
Flash Flood	01/12/2019 00UTC	01/12/2019	66	Granada	Spain
Flash Flood	01/12/2019 00UTC	01/12/2019	66	Almeria	Spain
Flash Flood	01/12/2019 00UTC	01/12/2019	78	Albacete	Spain
Flash Flood	01/12/2019 00UTC	01/12/2019	84	Murcia	Spain
Flash Flood	01/12/2019 00UTC	01/12/2019	84	Comunidad Valenciana	Spain
Flash Flood	01/12/2019 00UTC	01/12/2019	42	Istarska Zupanija	Croatia
Flash Flood	01/12/2019 00UTC	01/12/2019	48	Pisa	Italy
Flash Flood	01/12/2019 00UTC	01/12/2019	30	Cuneo	Italy
Flash Flood	30/11/2019 12UTC	01/12/2019	60	Viterbo	Italy
Flash Flood	30/11/2019 12UTC	01/12/2019	48	Reggio Nell'Emilia	Italy
Flash Flood	30/11/2019 12UTC	01/12/2019	48	Osrednjeslovenska	Slovenia
Flash Flood	30/11/2019 12UTC	01/12/2019	48	Gorizia	Italy
Flash Flood	30/11/2019 12UTC	01/12/2019	48	Modena	Italy
Flash Flood	30/11/2019 12UTC	01/12/2019	48	Karlovacka Zupanija	Croatia
Flash Flood	30/11/2019 12UTC	01/12/2019	60	Ravenna	Italy
Flash Flood	30/11/2019 12UTC	01/12/2019	48	Goriska	Slovenia
Flash Flood	30/11/2019 12UTC	01/12/2019	48	Zagrebacka Zupanija	Croatia
Flash Flood	30/11/2019 12UTC	01/12/2019	24	Iserre	France
Flash Flood	30/11/2019 12UTC	01/12/2019	60	Licko-Senjska Zupanija	Croatia
Flash Flood	30/11/2019 12UTC	01/12/2019	60	Firenze	Italy
Flash Flood	30/11/2019 12UTC	01/12/2019	48	Bologna	Italy
Flash Flood	30/11/2019 12UTC	01/12/2019	60	Arezzo	Italy
Flash Flood	30/11/2019 12UTC	01/12/2019	54	Prato	Italy
Flash Flood	30/11/2019 12UTC	01/12/2019	48	Jugovzhodna Slovenija	Slovenia
Flash Flood	30/11/2019 12UTC	01/12/2019	60	Forli-Cesena	Italy
Flash Flood	30/11/2019 12UTC	01/12/2019	48	Pistoia	Italy
Flash Flood	01/12/2019 12UTC	02/12/2019	78	Castellon / Castello	Spain
Flash Flood	01/12/2019 12UTC	02/12/2019	72	Valencia / Valencia	Spain
Flash Flood	01/12/2019 12UTC	02/12/2019	36	Perugia	Italy
Flash Flood	01/12/2019 12UTC	02/12/2019	42	Rieti	Italy
Flash Flood	01/12/2019 12UTC	02/12/2019	84	Cataluna	Spain
Flash Flood	01/12/2019 12UTC	02/12/2019	90	Pyrenees-Orientales	France
Flash Flood	01/12/2019 12UTC	02/12/2019	48	Terni	Italy
Flash Flood	01/12/2019 12UTC	02/12/2019	48	Roma	Italy
Flash Flood	01/12/2019 12UTC	02/12/2019	36	Sibensko-Kninska Zupanija	Croatia
Flash Flood	01/12/2019 12UTC	02/12/2019	42	Rimini	Italy
Flash Flood	01/12/2019 12UTC	02/12/2019	78	Castellon / Castello	Spain
Flash Flood	02/12/2019 00UTC	02/12/2019	18	Sisacko-Moslavacka Zupan-	Croatia
Flash Flood	02/12/2019 00UTC	02/12/2019	24	Federacija Bosna i Herce-	Bosnia & Herz.
Flash Flood	02/12/2019 00UTC	02/12/2019	18	Karlovacka Zupanija	B. & H.,Croatia
Flash Flood	02/12/2019 00UTC	02/12/2019	24	Zadarska Zupanija	Croatia
Flash Flood	02/12/2019 12UTC	03/12/2019	72	Corse-du-Sud	France
Flash Flood	02/12/2019 12UTC	03/12/2019	54	Cagliari	Italy
Flash Flood	02/12/2019 12UTC	03/12/2019	66	Tarragona	Spain
Flash Flood	03/12/2019 00UTC	03/12/2019	48	Oristano	Italy

Flash Flood	03/12/2019 00UTC	03/12/2019	24	Korce	Albania
Flash Flood	03/12/2019 00UTC	03/12/2019	54	Olbia-Tempio	Italy
Flash Flood	03/12/2019 00UTC	03/12/2019	48	Carbonia-Iglesias	Italy
Flash Flood	03/12/2019 00UTC	03/12/2019	60	Sassari	Italy
Flash Flood	03/12/2019 12UTC	04/12/2019	42	Zaragoza	Spain
Flash Flood	03/12/2019 12UTC	04/12/2019	42	Barcelona	Spain
Flash Flood	03/12/2019 12UTC	04/12/2019	36	Medio Campidano	Italy
Flash Flood	03/12/2019 12UTC	04/12/2019	72	Rogaland	Norway
Flash Flood	03/12/2019 12UTC	04/12/2019	48	Catanzaro	Italy
Flash Flood	03/12/2019 12UTC	04/12/2019	72	Aust-Agder	Norway
Flash Flood	03/12/2019 12UTC	04/12/2019	60	Crotone	Italy
Flash Flood	03/12/2019 12UTC	04/12/2019	42	Teruel	Spain
Flash Flood	03/12/2019 12UTC	04/12/2019	66	Taranto	Italy
Flash Flood	04/12/2019 00UTC	04/12/2019	42	Scotland	United Kingdom
Flash Flood	04/12/2019 12UTC	05/12/2019	42	Lecce	Italy
Flash Flood	05/12/2019 00UTC	05/12/2019	30	Hallands lan	Sweden
Flash Flood	05/12/2019 00UTC	05/12/2019	48	Varmlands lan	Sweden
Flash Flood	05/12/2019 00UTC	05/12/2019	48	Stockholms lan	Sweden
Flash Flood	05/12/2019 00UTC	05/12/2019	48	Sodermanlands lan	Sweden
Flash Flood	06/12/2019 12UTC	07/12/2019	36	Caithness & Sutherland	United Kingdom
Flash Flood	07/12/2019 00UTC	07/12/2019	36	Vastra Gotalands lan	Sweden
Flash Flood	07/12/2019 00UTC	07/12/2019	36	Hallands lan	Sweden
Flash Flood	08/12/2019 00UTC	08/12/2019	12	Varmlands lan	Sweden
Flash Flood	08/12/2019 00UTC	08/12/2019	12	Skane lan	Sweden
Flash Flood	08/12/2019 12UTC	09/12/2019	48	Dumfries & Galloway	United Kingdom
Flash Flood	08/12/2019 12UTC	09/12/2019	66	Korce	Albania
Flash Flood	08/12/2019 12UTC	09/12/2019	60	Elbasan	Albania
Flash Flood	08/12/2019 12UTC	09/12/2019	72	Karditsa, Trikala	Greece
Flash Flood	08/12/2019 12UTC	09/12/2019	54	East Cumbria	United Kingdom
Flash Flood	08/12/2019 12UTC	09/12/2019	72	Grebena, Kozani	Greece
Flash Flood	08/12/2019 12UTC	09/12/2019	78	Fthiotida	Greece
Flash Flood	08/12/2019 12UTC	09/12/2019	72	Attica	Greece
Flash Flood	08/12/2019 12UTC	09/12/2019	54	Glasgow City	United Kingdom
Flash Flood	08/12/2019 12UTC	09/12/2019	48	Scotland	United Kingdom
Flash Flood	09/12/2019 00UTC	09/12/2019	60	Kilkis	Greece
Flash Flood	09/12/2019 00UTC	09/12/2019	36	Perth & Kinross and Stirling	United Kingdom
Flash Flood	09/12/2019 00UTC	09/12/2019	60	Thessaloniki	Greece
Flash Flood	09/12/2019 00UTC	09/12/2019	48	None	Greece
Flash Flood	09/12/2019 00UTC	09/12/2019	42	Vlore	Albania
Flash Flood	09/12/2019 00UTC	09/12/2019	60	Pelagoniski	N. Macedonia
Flash Flood	09/12/2019 00UTC	09/12/2019	54	Jugozapaden	N. Macedonia
Flash Flood	09/12/2019 00UTC	09/12/2019	36	Aberdeen City and Aber-	United Kingdom
Flash Flood	09/12/2019 00UTC	09/12/2019	42	Kerkira	Greece
Flash Flood	09/12/2019 00UTC	09/12/2019	60	Pella	Greece
Flash Flood	09/12/2019 12UTC	10/12/2019	42	Magnisia	Greece
Flash Flood	09/12/2019 12UTC	10/12/2019	48	Fokida	Greece
Flash Flood	09/12/2019 12UTC	10/12/2019	48	Larisa	Greece
Flash Flood	09/12/2019 12UTC	10/12/2019	48	Boiotia	Greece
Flash Flood	09/12/2019 12UTC	10/12/2019	42	Kastoria	Greece
Flash Flood	09/12/2019 12UTC	10/12/2019	42	Varmlands lan	Sweden
Flash Flood	09/12/2019 12UTC	10/12/2019	42	Hallands lan	Sweden

Flash Flood	09/12/2019 12UTC	10/12/2019	42	Vastra Gotalands lan	Sweden
Flash Flood	09/12/2019 12UTC	10/12/2019	42	Ostfold	Norway
Flash Flood	09/12/2019 12UTC	10/12/2019	42	Akershus	Norway
Flash Flood	09/12/2019 12UTC	10/12/2019	42	Vestfold	Norway
Flash Flood	09/12/2019 12UTC	10/12/2019	36	Aust-Agder	Norway
Flash Flood	09/12/2019 12UTC	10/12/2019	36	Vest-Agder	Norway
Flash Flood	09/12/2019 12UTC	10/12/2019	36	Rogaland	Norway
Flash Flood	10/12/2019 00UTC	10/12/2019	36	Stereia Ellada	Greece
Flash Flood	10/12/2019 00UTC	10/12/2019	36	Kentriki Makedonia	Greece
Flash Flood	10/12/2019 00UTC	10/12/2019	36	Thessalia	Greece
Flash Flood	10/12/2019 00UTC	10/12/2019	36	Dytiki Makedonia	Greece
Flash Flood	10/12/2019 12UTC	11/12/2019	66	Leicestershire, Rutland and	United Kingdom
Flash Flood	10/12/2019 12UTC	11/12/2019	78	Gers	France
Flash Flood	10/12/2019 12UTC	11/12/2019	78	Pyrenees-Atlantiques	France
Flash Flood	10/12/2019 12UTC	11/12/2019	60	Lincolnshire	United Kingdom
Flash Flood	10/12/2019 12UTC	11/12/2019	72	Lozere	France
Flash Flood	10/12/2019 12UTC	11/12/2019	78	Lot-et-Garonne	France
Flash Flood	10/12/2019 12UTC	11/12/2019	54	Charente-Maritime	France
Flash Flood	10/12/2019 12UTC	11/12/2019	78	Hautes-Pyrenees	France
Flash Flood	10/12/2019 12UTC	11/12/2019	78	Haute-Garonne	France
Flash Flood	10/12/2019 12UTC	11/12/2019	78	Ariege	France
Flash Flood	10/12/2019 12UTC	11/12/2019	78	Pyrenees-Orientales	France
Flash Flood	10/12/2019 12UTC	11/12/2019	78	Tarn	France
Flash Flood	10/12/2019 12UTC	11/12/2019	60	Leon	Spain
Flash Flood	10/12/2019 12UTC	11/12/2019	60	Zamora	Spain
Flash Flood	10/12/2019 12UTC	11/12/2019	66	Segovia	Spain
Flash Flood	10/12/2019 12UTC	11/12/2019	60	Bizkaia	Spain
Flash Flood	10/12/2019 12UTC	11/12/2019	60	Cantabria	Spain
Flash Flood	10/12/2019 12UTC	11/12/2019	60	Lugo	Spain
Flash Flood	10/12/2019 12UTC	11/12/2019	72	Navarra	Spain
Flash Flood	10/12/2019 12UTC	11/12/2019	72	Zaragoza	Spain
Flash Flood	10/12/2019 12UTC	11/12/2019	60	Burgos	Spain
Flash Flood	10/12/2019 12UTC	11/12/2019	72	Huesca	Spain
Flash Flood	10/12/2019 12UTC	11/12/2019	72	Aveyron	France
Flash Flood	10/12/2019 12UTC	11/12/2019	78	Tarn-et-Garonne	France
Flash Flood	10/12/2019 12UTC	11/12/2019	72	Lot	France
Flash Flood	10/12/2019 12UTC	11/12/2019	66	West Wales and The Val-	United Kingdom
Flash Flood	10/12/2019 12UTC	11/12/2019	60	Araba/Alava	Spain
Flash Flood	10/12/2019 12UTC	11/12/2019	72	Somme	France
Flash Flood	10/12/2019 12UTC	11/12/2019	72	Seine-Maritime	France
Flash Flood	10/12/2019 12UTC	11/12/2019	54	Charente	France
Flash Flood	10/12/2019 12UTC	11/12/2019	66	Gironde	France
Flash Flood	10/12/2019 12UTC	11/12/2019	66	Dordogne	France
Flash Flood	10/12/2019 12UTC	11/12/2019	72	Landes	France
Flash Flood	10/12/2019 12UTC	11/12/2019	78	Aude	France
Flash Flood	11/12/2019 00UTC	11/12/2019	60	Corse-du-Sud	France
Flash Flood	11/12/2019 12UTC	12/12/2019	36	Ourense	Spain
Flash Flood	11/12/2019 12UTC	12/12/2019	54	Sardegna	Italy
Flash Flood	11/12/2019 12UTC	12/12/2019	54	Haute-Corse	France
Flash Flood	11/12/2019 12UTC	12/12/2019	60	Herault	France
Flash Flood	11/12/2019 12UTC	12/12/2019	42	Manche	France

Flash Flood	11/12/2019 12UTC	12/12/2019	54	Campania	Italy
Flash Flood	11/12/2019 12UTC	12/12/2019	42	North Yorkshire	United Kingdom
Flash Flood	11/12/2019 12UTC	12/12/2019	54	Lazio	Italy
Flash Flood	11/12/2019 12UTC	12/12/2019	60	Calabria	Italy
Flash Flood	11/12/2019 12UTC	12/12/2019	60	Sicilia	Italy
Flash Flood	11/12/2019 12UTC	12/12/2019	54	Highlands and Islands	United Kingdom
Flash Flood	12/12/2019 00UTC	12/12/2019	54	Elbasan	Albania
Flash Flood	12/12/2019 00UTC	12/12/2019	48	Grad Zagreb	Croatia
Flash Flood	12/12/2019 00UTC	12/12/2019	48	Zagrebacka zupanija	Croatia
Flash Flood	12/12/2019 00UTC	12/12/2019	48	Karlovacka zupanija	Croatia
Flash Flood	12/12/2019 00UTC	12/12/2019	48	Bjelovarsko-bilogorska	Croatia
Flash Flood	12/12/2019 00UTC	12/12/2019	48	Sisacko-moslavacka zupan-	Croatia
Flash Flood	12/12/2019 00UTC	12/12/2019	42	Istarska zupanija	Croatia
Flash Flood	12/12/2019 00UTC	12/12/2019	24	Gipuzkoa	Spain
Flash Flood	12/12/2019 00UTC	12/12/2019	54	Korce	Albania
Flash Flood	12/12/2019 00UTC	12/12/2019	60	Cantal	France
Flash Flood	12/12/2019 00UTC	12/12/2019	54	Ipeiros	Greece
Flash Flood	12/12/2019 00UTC	12/12/2019	54	Sterea Ellada	Greece
Flash Flood	12/12/2019 00UTC	12/12/2019	54	Dytiki Ellada	Greece
Flash Flood	12/12/2019 00UTC	12/12/2019	54	Peloponnisos	Greece
Flash Flood	12/12/2019 00UTC	12/12/2019	60	Kriti	Greece
Flash Flood	12/12/2019 00UTC	12/12/2019	42	Primorsko-notranjska	Slovenia
Flash Flood	12/12/2019 12UTC	13/12/2019	36	Crna Gora	Montenegro
Flash Flood	12/12/2019 12UTC	13/12/2019	42	Gjirokaster	Albania
Flash Flood	12/12/2019 12UTC	13/12/2019	42	Vlore	Albania
Flash Flood	12/12/2019 12UTC	13/12/2019	60	Anatoliki Makedonia,	Greece
Flash Flood	12/12/2019 12UTC	13/12/2019	42	Berat	Albania
Flash Flood	13/12/2019 00UTC	13/12/2019	18	Toscana	Italy
Flash Flood	13/12/2019 00UTC	13/12/2019	18	Highlands and Islands	United Kingdom
Flash Flood	13/12/2019 00UTC	13/12/2019	36	Jugoistocen	N. Macedonia
Flash Flood	13/12/2019 00UTC	13/12/2019	18	Molise	Italy
Flash Flood	13/12/2019 00UTC	13/12/2019	48	Blagoevgrad	Bulgaria
Flash Flood	13/12/2019 00UTC	13/12/2019	24	Sibensko-kninska zupanija	Croatia
Flash Flood	13/12/2019 00UTC	13/12/2019	36	Kentriki Makedonia	Greece
Flash Flood	13/12/2019 00UTC	13/12/2019	18	Highlands and Islands	United Kingdom
Flash Flood	13/12/2019 12UTC	14/12/2019	18	Elbasan	Albania
Flash Flood	13/12/2019 12UTC	14/12/2019	18	Korce	Albania
Flash Flood	14/12/2019 00UTC	14/12/2019	24	Eure-et-Loir	France
Flash Flood	14/12/2019 00UTC	14/12/2019	42	Indre-et-Loire	France
Flash Flood	14/12/2019 00UTC	14/12/2019	48	Charente-Maritime	France
Flash Flood	14/12/2019 00UTC	14/12/2019	30	Lugo	Spain
Flash Flood	15/12/2019 00UTC	15/12/2019	54	Cotes-dArmor	France
Flash Flood	15/12/2019 00UTC	15/12/2019	30	Lugo	Spain
Flash Flood	15/12/2019 00UTC	15/12/2019	54	Morbihan	France
Flash Flood	15/12/2019 00UTC	15/12/2019	30	Area Metropolitana do	Portugal
Flash Flood	15/12/2019 00UTC	15/12/2019	54	Ille-et-Vilaine	France
Flash Flood	15/12/2019 12UTC	16/12/2019	54	East Anglia	United Kingdom
Flash Flood	15/12/2019 12UTC	16/12/2019	54	Bedfordshire and Hertford-	United Kingdom
Flash Flood	15/12/2019 12UTC	16/12/2019	60	Piemonte	Italy
Flash Flood	15/12/2019 12UTC	16/12/2019	108	Surrey, East and West Sus-	United Kingdom
Flash Flood	16/12/2019 00UTC	16/12/2019	24	Zamora	Spain

Flash Flood	16/12/2019 00UTC	16/12/2019	36	Finistere	France
Flash Flood	16/12/2019 00UTC	16/12/2019	60	Lombardia	Italy
Flash Flood	16/12/2019 00UTC	16/12/2019	24	Regiao de Coimbra	Portugal
Flash Flood	16/12/2019 00UTC	16/12/2019	24	Beiras e Serra da Estrela	Portugal
Flash Flood	16/12/2019 12UTC	17/12/2019	48	Gard	France
Flash Flood	16/12/2019 12UTC	17/12/2019	54	Sardegna	Italy
Flash Flood	16/12/2019 12UTC	17/12/2019	48	Herault	France
Flash Flood	16/12/2019 12UTC	17/12/2019	48	Ticino	Switzerland
Flash Flood	16/12/2019 12UTC	17/12/2019	42	Vastra Gotalands lan	Sweden
Flash Flood	16/12/2019 12UTC	17/12/2019	48	Orebro lan	Sweden
Flash Flood	16/12/2019 12UTC	17/12/2019	48	Vastmanlands lan	Sweden
Flash Flood	16/12/2019 12UTC	17/12/2019	48	Sodermanlands lan	Sweden
Flash Flood	16/12/2019 12UTC	17/12/2019	48	Stockholms lan	Sweden
Flash Flood	16/12/2019 12UTC	17/12/2019	48	Ostfold	Norway
Flash Flood	17/12/2019 00UTC	17/12/2019	48	Dublin	Ireland
Flash Flood	17/12/2019 00UTC	17/12/2019	48	Cornwall and Isles of Scilly	United Kingdom
Flash Flood	17/12/2019 00UTC	17/12/2019	48	West Wales and The Val-	United Kingdom
Flash Flood	17/12/2019 00UTC	17/12/2019	48	East Wales	United Kingdom
Flash Flood	17/12/2019 00UTC	17/12/2019	54	Corse-du-Sud	France
Flash Flood	17/12/2019 00UTC	17/12/2019	42	South-West	Ireland
Flash Flood	17/12/2019 00UTC	17/12/2019	48	Morbihan	France
Flash Flood	17/12/2019 00UTC	17/12/2019	42	South-East	Ireland
Flash Flood	17/12/2019 00UTC	17/12/2019	48	Mid-East	Ireland
Flash Flood	17/12/2019 00UTC	17/12/2019	48	Devon	United Kingdom
Flash Flood	17/12/2019 00UTC	17/12/2019	60	Ourense	Spain
Flash Flood	16/12/2019 12UTC	18/12/2019	48	Vastmanlands lan	Sweden
Flash Flood	17/12/2019 12UTC	18/12/2019	60	Ille-et-Vilaine	France
Flash Flood	17/12/2019 12UTC	18/12/2019	78	Herefordshire, Worcester-	United Kingdom
Flash Flood	17/12/2019 12UTC	18/12/2019	54	Hampshire and Isle of	United Kingdom
Flash Flood	17/12/2019 12UTC	18/12/2019	36	Finistere	France
Flash Flood	17/12/2019 12UTC	18/12/2019	36	Dorset and Somerset	United Kingdom
Flash Flood	18/12/2019 00UTC	18/12/2019	24	West	Ireland
Flash Flood	18/12/2019 00UTC	18/12/2019	18	Northern Ireland	United Kingdom
Flash Flood	18/12/2019 00UTC	18/12/2019	24	Eastern Scotland	United Kingdom
Flash Flood	18/12/2019 00UTC	18/12/2019	60	Istarska zupanija	Croatia
Flash Flood	18/12/2019 00UTC	18/12/2019	48	Asturias	Spain
Flash Flood	18/12/2019 00UTC	18/12/2019	48	Cantabria	Spain
Flash Flood	18/12/2019 00UTC	18/12/2019	12	Stockholms lan	Sweden
Flash Flood	18/12/2019 00UTC	18/12/2019	12	Sodermanlands lan	Sweden
Flash Flood	18/12/2019 12UTC	18/12/2019	54	Soria	Spain
Flash Flood	18/12/2019 12UTC	18/12/2019	42	Vendee	France
Flash Flood	18/12/2019 12UTC	18/12/2019	60	Cuenca	Spain
Flash Flood	18/12/2019 12UTC	18/12/2019	42	Guadalajara	Spain
Flash Flood	18/12/2019 12UTC	18/12/2019	42	Kent	United Kingdom
Flash Flood	18/12/2019 12UTC	18/12/2019	42	Haute-Garonne	France
Flash Flood	18/12/2019 12UTC	18/12/2019	42	Pyrenees-Atlantiques	France
Flash Flood	18/12/2019 12UTC	18/12/2019	30	North Yorkshire	United Kingdom
Flash Flood	18/12/2019 12UTC	18/12/2019	48	Alentejo Central	Portugal
Flash Flood	18/12/2019 12UTC	18/12/2019	48	Essex	United Kingdom
Flash Flood	18/12/2019 12UTC	18/12/2019	48	Bedfordshire and Hertford-	United Kingdom
Flash Flood	18/12/2019 12UTC	18/12/2019	48	Pyrenees-Orientales	France

Flash Flood	18/12/2019 12UTC	18/12/2019	36	Oeste	Portugal
Flash Flood	18/12/2019 12UTC	18/12/2019	42	Loire-Atlantique	France
Flash Flood	18/12/2019 12UTC	18/12/2019	48	East Yorkshire and North-	United Kingdom
Flash Flood	18/12/2019 12UTC	18/12/2019	42	Ariege	France
Flash Flood	18/12/2019 12UTC	18/12/2019	48	Haute-Loire	France
Flash Flood	18/12/2019 12UTC	18/12/2019	48	Lozere	France
Flash Flood	18/12/2019 12UTC	18/12/2019	48	Ciudad Real	Spain
Flash Flood	18/12/2019 12UTC	18/12/2019	42	Eure-et-Loir	France
Flash Flood	18/12/2019 12UTC	18/12/2019	48	Essonne	France
Flash Flood	18/12/2019 12UTC	18/12/2019	36	Leziria do Tejo	Portugal
Flash Flood	18/12/2019 12UTC	18/12/2019	42	Orne	France
Flash Flood	18/12/2019 12UTC	18/12/2019	42	La Rioja	Spain
Flash Flood	18/12/2019 12UTC	18/12/2019	42	Loir-et-Cher	France
Flash Flood	18/12/2019 12UTC	18/12/2019	48	Loiret	France
Flash Flood	18/12/2019 12UTC	19/12/2019	60	Lombardia	Italy
Flash Flood	18/12/2019 12UTC	19/12/2019	54	Piemonte	Italy
Flash Flood	18/12/2019 12UTC	19/12/2019	60	Emilia-Romagna	Italy
Flash Flood	18/12/2019 12UTC	19/12/2019	54	Liguria	Italy
Flash Flood	18/12/2019 12UTC	19/12/2019	60	Toscana	Italy
Flash Flood	19/12/2019 00UTC	19/12/2019	54	Albacete	Spain
Flash Flood	19/12/2019 00UTC	19/12/2019	54	Granada	Spain
Flash Flood	19/12/2019 00UTC	19/12/2019	54	Osrednjeslovenska	Slovenia
Flash Flood	19/12/2019 00UTC	19/12/2019	54	Marche	Italy
Flash Flood	19/12/2019 00UTC	19/12/2019	48	Umbria	Italy
Flash Flood	19/12/2019 00UTC	19/12/2019	48	Lazio	Italy
Flash Flood	19/12/2019 00UTC	19/12/2019	60	Abruzzo	Italy
Flash Flood	19/12/2019 00UTC	19/12/2019	60	Molise	Italy
Flash Flood	19/12/2019 00UTC	19/12/2019	60	Campania	Italy
Flash Flood	19/12/2019 00UTC	19/12/2019	36	Luxembourg	Luxembourg
Flash Flood	19/12/2019 00UTC	19/12/2019	30	Huesca	Spain
Flash Flood	19/12/2019 00UTC	19/12/2019	36	Ardennes	France
Flash Flood	19/12/2019 00UTC	19/12/2019	36	Nord	France
Flash Flood	19/12/2019 00UTC	19/12/2019	30	Seine-Maritime	France
Flash Flood	19/12/2019 00UTC	19/12/2019	54	Sardegna	Italy
Flash Flood	19/12/2019 00UTC	19/12/2019	48	Corse-du-Sud	France
Flash Flood	19/12/2019 00UTC	19/12/2019	30	Valladolid	Spain
Flash Flood	19/12/2019 00UTC	19/12/2019	24	Zamora	Spain
Flash Flood	19/12/2019 00UTC	19/12/2019	42	Cadiz	Spain
Flash Flood	19/12/2019 00UTC	19/12/2019	48	Friuli-Venezia Giulia	Italy
Flash Flood	19/12/2019 12UTC	20/12/2019	42	Karlovacka zupanija	Croatia
Flash Flood	19/12/2019 12UTC	20/12/2019	42	Licko-senjska zupanija	Croatia
Flash Flood	19/12/2019 12UTC	20/12/2019	48	Dubrovačko-neretvanska	Croatia
Flash Flood	19/12/2019 12UTC	20/12/2019	48	Splitsko-dalmatinska	Croatia
Flash Flood	19/12/2019 12UTC	20/12/2019	48	Federacija Bosna i Herce-	Bosnia & Herz.
Flash Flood	19/12/2019 12UTC	20/12/2019	48	Sibensko-kninska zupanija	Croatia
Flash Flood	19/12/2019 12UTC	20/12/2019	48	Zadarska zupanija	Croatia
Flash Flood	19/12/2019 12UTC	20/12/2019	24	Hautes-Alpes	France
Flash Flood	19/12/2019 12UTC	20/12/2019	36	Vest-Agder	Norway
Flash Flood	19/12/2019 12UTC	20/12/2019	30	Badajoz	Spain
Flash Flood	19/12/2019 12UTC	20/12/2019	30	Baixo Alentejo	Portugal
Flash Flood	19/12/2019 12UTC	20/12/2019	42	Aust-Agder	Norway

Flash Flood	19/12/2019 12UTC	20/12/2019	24	Segovia	Spain
Flash Flood	19/12/2019 12UTC	20/12/2019	24	Haute-Marne	France
Flash Flood	19/12/2019 12UTC	20/12/2019	24	Isere	France
Flash Flood	19/12/2019 12UTC	20/12/2019	30	Var	France
Flash Flood	19/12/2019 12UTC	20/12/2019	42	Valencia / Valencia	Spain
Flash Flood	19/12/2019 12UTC	20/12/2019	30	Cordoba	Spain
Flash Flood	20/12/2019 00UTC	20/12/2019	60	Jugozapaden	N. Macedonia
Flash Flood	20/12/2019 00UTC	20/12/2019	60	Gjirokaster	Albania
Flash Flood	20/12/2019 00UTC	20/12/2019	60	Elbasan	Albania
Flash Flood	20/12/2019 00UTC	20/12/2019	36	Obalno-kraska	Slovenia
Flash Flood	20/12/2019 00UTC	20/12/2019	30	Primorsko-notranjska	Slovenia
Flash Flood	20/12/2019 00UTC	20/12/2019	30	Jugovzhodna Slovenija	Slovenia
Flash Flood	20/12/2019 00UTC	20/12/2019	60	Vlore	Albania
Flash Flood	20/12/2019 00UTC	20/12/2019	60	Diber	Albania
Flash Flood	20/12/2019 00UTC	20/12/2019	60	Cantal	France
Flash Flood	20/12/2019 00UTC	20/12/2019	60	Charente	France
Flash Flood	20/12/2019 00UTC	20/12/2019	60	Dordogne	France
Flash Flood	20/12/2019 00UTC	20/12/2019	60	Nievre	France
Flash Flood	20/12/2019 00UTC	20/12/2019	36	Regiao de Coimbra	Portugal
Flash Flood	20/12/2019 00UTC	20/12/2019	48	Banskobystricky kraj	Slovakia
Flash Flood	20/12/2019 00UTC	20/12/2019	48	Kosicky kraj	Slovakia
Flash Flood	20/12/2019 00UTC	20/12/2019	42	Calabria	Italy
Flash Flood	20/12/2019 00UTC	20/12/2019	42	Basilicata	Italy
Flash Flood	20/12/2019 00UTC	20/12/2019	54	Transcarpathia	Ukraine
Flash Flood	20/12/2019 00UTC	20/12/2019	48	Nitriansky kraj	Slovakia
Flash Flood	20/12/2019 00UTC	20/12/2019	48	Trenciansky kraj	Slovakia
Flash Flood	20/12/2019 00UTC	20/12/2019	48	Zilinsky kraj	Slovakia
Flash Flood	20/12/2019 00UTC	20/12/2019	48	Eszak-Magyarorszag	Hungary
Flash Flood	20/12/2019 00UTC	20/12/2019	42	Crna Gora	Montenegro
Flash Flood	20/12/2019 00UTC	20/12/2019	42	Republika Srpska	Bosnia & Herz.
Flash Flood	20/12/2019 00UTC	20/12/2019	42	Shkoder	Albania
Flash Flood	20/12/2019 12UTC	21/12/2019	48	Sodermanlands lan	Sweden
Flash Flood	20/12/2019 12UTC	21/12/2019	30	Istarska zupanija	Croatia
Flash Flood	20/12/2019 12UTC	21/12/2019	30	Primorsko-goranska zupan-	Croatia
Flash Flood	20/12/2019 12UTC	21/12/2019	48	Kukes	Albania
Flash Flood	20/12/2019 12UTC	21/12/2019	48	Lezhe	Albania
Flash Flood	20/12/2019 12UTC	21/12/2019	48	Tirane	Albania
Flash Flood	20/12/2019 12UTC	21/12/2019	54	Ipeiros	Greece
Flash Flood	20/12/2019 12UTC	21/12/2019	54	Dytiki Makedonia	Greece
Flash Flood	20/12/2019 12UTC	21/12/2019	54	Thessalia	Greece
Flash Flood	20/12/2019 12UTC	21/12/2019	54	Sterea Ellada	Greece
Flash Flood	20/12/2019 12UTC	21/12/2019	24	Goriska	Slovenia
Flash Flood	20/12/2019 12UTC	21/12/2019	18	Corse-du-Sud	France
Flash Flood	21/12/2019 00UTC	21/12/2019	42	Sisacko-moslavacka zupan-	Croatia
Flash Flood	21/12/2019 00UTC	21/12/2019	42	Zagrebacka zupanija	Croatia
Flash Flood	21/12/2019 00UTC	21/12/2019	48	Tarn	France
Flash Flood	21/12/2019 00UTC	21/12/2019	42	Dytiki Ellada	Greece
Flash Flood	21/12/2019 00UTC	21/12/2019	42	Peloponnisos	Greece
Flash Flood	21/12/2019 00UTC	21/12/2019	36	Presovsky kraj	Slovakia
Flash Flood	21/12/2019 00UTC	21/12/2019	54	Fier	Albania
Flash Flood	21/12/2019 00UTC	21/12/2019	54	Berat	Albania

Flash Flood	21/12/2019 00UTC	21/12/2019	42	Kentriki Makedonia	Greece
Flash Flood	21/12/2019 00UTC	21/12/2019	30	Aveyron	France
Flash Flood	21/12/2019 00UTC	21/12/2019	42	Anatoliki Makedonia,	Greece
Flash Flood	21/12/2019 12UTC	22/12/2019	30	Smolyan	Bulgaria
Flash Flood	21/12/2019 12UTC	22/12/2019	30	Grad Zagreb	Croatia
Flash Flood	21/12/2019 12UTC	22/12/2019	18	Stockholms lan	Sweden
Flash Flood	21/12/2019 12UTC	22/12/2019	42	Bjelovarsko-bilogorska	Croatia
Flash Flood	21/12/2019 12UTC	22/12/2019	30	Blagoevgrad	Bulgaria
Flash Flood	21/12/2019 12UTC	22/12/2019	42	Koprivnicko-krizevacka	Croatia
Flash Flood	21/12/2019 12UTC	22/12/2019	42	Varazdinska zupanija	Croatia
Flash Flood	21/12/2019 12UTC	22/12/2019	30	Korce	Albania
Flash Flood	22/12/2019 00UTC	22/12/2019	48	Aust-Agder	Norway
Flash Flood	22/12/2019 00UTC	22/12/2019	48	Sicilia	Italy
Flash Flood	22/12/2019 00UTC	22/12/2019	42	Eszak-Magyarorszag	Hungary
Flash Flood	22/12/2019 00UTC	22/12/2019	42	Eszak-Alfold	Hungary
Flash Flood	22/12/2019 00UTC	22/12/2019	48	Presovsky kraj	Slovakia
Flash Flood	22/12/2019 00UTC	22/12/2019	54	Podkarpackie	Poland
Flash Flood	22/12/2019 12UTC	23/12/2019	24	Kozep-Dunantul	Hungary
Flash Flood	22/12/2019 12UTC	23/12/2019	24	Campania	Italy
Flash Flood	22/12/2019 12UTC	23/12/2019	24	Del-Dunantul	Hungary
Flash Flood	25/12/2019 00UTC	25/12/2019	54	Herefordshire, Worcester-	United Kingdom
Flash Flood	25/12/2019 00UTC	25/12/2019	54	Somme	France
Flash Flood	25/12/2019 12UTC	26/12/2019	42	Dorset and Somerset	United Kingdom
Flash Flood	25/12/2019 12UTC	26/12/2019	42	Berkshire, Buckingham-	United Kingdom
Flash Flood	25/12/2019 12UTC	26/12/2019	42	Shropshire and Stafford-	United Kingdom
Flash Flood	25/12/2019 12UTC	26/12/2019	48	Nord	France
Flash Flood	25/12/2019 12UTC	26/12/2019	42	West Wales and The Val-	United Kingdom
Flash Flood	25/12/2019 12UTC	26/12/2019	42	Surrey, East and West Sus-	United Kingdom
Flash Flood	26/12/2019 00UTC	26/12/2019	24	Eure	France
Flash Flood	26/12/2019 00UTC	26/12/2019	30	Nievre	France
Flash Flood	26/12/2019 00UTC	26/12/2019	30	Calvados	France
Flash Flood	26/12/2019 00UTC	26/12/2019	24	Yvelines	France
Flash Flood	26/12/2019 00UTC	26/12/2019	24	Oise	France
Flash Flood	26/12/2019 00UTC	26/12/2019	30	Seine-et-Marne	France
Flash Flood	26/12/2019 00UTC	26/12/2019	24	Seine-Maritime	France
Flash Flood	26/12/2019 00UTC	26/12/2019	30	Yonne	France
Flash Flood	26/12/2019 00UTC	26/12/2019	30	Saone-et-Loire	France
Flash Flood	27/12/2019 12UTC	28/12/2019	60	Rogaland	Norway
Flash Flood	28/12/2019 00UTC	28/12/2019	54	Kriti	Greece
Flash Flood	28/12/2019 12UTC	29/12/2019	60	Attiki	Greece
Flash Flood	28/12/2019 12UTC	29/12/2019	60	Stereia Ellada	Greece
Flash Flood	01/01/2020 00UTC	01/01/2020	54	Kriti	Greece
Flash Flood	02/01/2020 00UTC	02/01/2020	24	Rogaland	Norway
Flash Flood	03/01/2020 00UTC	03/01/2020	48	Highlands and Islands	United Kingdom
Flash Flood	04/01/2020 12UTC	05/01/2020	60	Kriti	Greece
Flash Flood	04/01/2020 12UTC	05/01/2020	48	Attiki	Greece
Flash Flood	04/01/2020 12UTC	05/01/2020	48	Stereia Ellada	Greece
Flash Flood	05/01/2020 12UTC	06/01/2020	60	Rogaland	Norway
Flash Flood	05/01/2020 12UTC	06/01/2020	60	Vest-Agder	Norway
Flash Flood	06/01/2020 00UTC	06/01/2020	30	Notio Aigaio	Greece
Flash Flood	06/01/2020 12UTC	07/01/2020	60	Leicestershire, Rutland and	United Kingdom

Flash Flood	06/01/2020 12UTC	07/01/2020	60	Shropshire and Stafford-	United Kingdom
Flash Flood	06/01/2020 12UTC	07/01/2020	60	Gloucestershire, Wiltshire	United Kingdom
Flash Flood	06/01/2020 12UTC	07/01/2020	72	Derbyshire and Notting-	United Kingdom
Flash Flood	07/01/2020 00UTC	07/01/2020	60	Herefordshire, Worcester-	United Kingdom
Flash Flood	07/01/2020 00UTC	07/01/2020	54	North Yorkshire	United Kingdom
Flash Flood	07/01/2020 00UTC	07/01/2020	60	Lincolnshire	United Kingdom
Flash Flood	07/01/2020 00UTC	07/01/2020	66	East Anglia	United Kingdom
Flash Flood	07/01/2020 00UTC	07/01/2020	60	Bedfordshire and Hertford-	United Kingdom
Flash Flood	07/01/2020 00UTC	07/01/2020	60	Berkshire, Buckingham-	United Kingdom
Flash Flood	07/01/2020 00UTC	07/01/2020	66	Essex	United Kingdom
Flash Flood	07/01/2020 12UTC	08/01/2020	54	Inner London - East	United Kingdom
Flash Flood	07/01/2020 12UTC	08/01/2020	54	Surrey, East and West Sus-	United Kingdom
Flash Flood	07/01/2020 12UTC	08/01/2020	60	Kent	United Kingdom
Flash Flood	07/01/2020 12UTC	08/01/2020	60	Darmstadt	Germany
Flash Flood	07/01/2020 12UTC	08/01/2020	60	Giessen	Germany
Flash Flood	07/01/2020 12UTC	08/01/2020	42	East Yorkshire and North-	United Kingdom
Flash Flood	08/01/2020 00UTC	08/01/2020	42	East Wales	United Kingdom
Flash Flood	08/01/2020 12UTC	09/01/2020	48	Kronobergs lan	Sweden
Flash Flood	08/01/2020 12UTC	09/01/2020	48	Skane lan	Sweden
Flash Flood	09/01/2020 00UTC	09/01/2020	60	Border	Ireland
Flash Flood	09/01/2020 12UTC	10/01/2020	48	Eastern Scotland	United Kingdom
Flash Flood	09/01/2020 12UTC	10/01/2020	54	West Central Scotland	United Kingdom
Flash Flood	09/01/2020 12UTC	10/01/2020	48	Cumbria	United Kingdom
Flash Flood	09/01/2020 12UTC	10/01/2020	54	Vest-Agder	Norway
Flash Flood	09/01/2020 12UTC	10/01/2020	54	Rogaland	Norway
Flash Flood	09/01/2020 12UTC	10/01/2020	60	Vastra Gotlands lan	Sweden
Flash Flood	09/01/2020 12UTC	10/01/2020	60	Vastra Gotlands lan	Sweden
Flash Flood	09/01/2020 12UTC	10/01/2020	48	West	Ireland
Flash Flood	09/01/2020 12UTC	10/01/2020	60	Midland	Ireland
Flash Flood	09/01/2020 12UTC	10/01/2020	48	Southern Scotland	United Kingdom
Flash Flood	09/01/2020 12UTC	10/01/2020	48	Northumberland and Tyne	United Kingdom
Flash Flood	10/01/2020 12UTC	11/01/2020	18	Highlands and Islands	United Kingdom
Flash Flood	10/01/2020 12UTC	11/01/2020	54	Louna-Eesti	Estonia
Flash Flood	11/01/2020 00UTC	11/01/2020	24	Vastra Gotlands lan	Sweden
Flash Flood	11/01/2020 12UTC	12/01/2020	36	Novgorod	Russian Federa-
Flash Flood	11/01/2020 12UTC	12/01/2020	30	Kesk-Eesti	Estonia
Flash Flood	12/01/2020 12UTC	13/01/2020	60	Cotes-dArmor	France
Flash Flood	12/01/2020 12UTC	13/01/2020	66	Finistere	France
Flash Flood	12/01/2020 12UTC	13/01/2020	54	West Wales and The Val-	United Kingdom
Flash Flood	12/01/2020 12UTC	13/01/2020	54	Gloucestershire, Wiltshire	United Kingdom
Flash Flood	12/01/2020 12UTC	13/01/2020	72	Shropshire and Stafford-	United Kingdom
Flash Flood	12/01/2020 12UTC	13/01/2020	54	Morbihan	France
Flash Flood	12/01/2020 12UTC	13/01/2020	54	Ille-et-Vilaine	France
Flash Flood	12/01/2020 12UTC	13/01/2020	54	East Wales	United Kingdom
Flash Flood	12/01/2020 12UTC	13/01/2020	72	Hampshire and Isle of	United Kingdom
Flash Flood	12/01/2020 12UTC	13/01/2020	66	Herefordshire, Worcester-	United Kingdom
Flash Flood	12/01/2020 12UTC	13/01/2020	36	Surrey, East and West Sus-	United Kingdom
Flash Flood	12/01/2020 12UTC	13/01/2020	72	Bedfordshire and Hertford-	United Kingdom
Flash Flood	12/01/2020 12UTC	13/01/2020	54	Kent	United Kingdom
Flash Flood	12/01/2020 12UTC	13/01/2020	72	Essex	United Kingdom
Flash Flood	13/01/2020 00UTC	13/01/2020	54	Manche	France

Flash Flood	13/01/2020 00UTC	13/01/2020	54	Varmlands lan	Sweden
Flash Flood	13/01/2020 00UTC	13/01/2020	36	Ostfold	Norway
Flash Flood	13/01/2020 00UTC	13/01/2020	30	Aust-Agder	Norway
Flash Flood	13/01/2020 00UTC	13/01/2020	54	Kriti	Greece
Flash Flood	13/01/2020 12UTC	14/01/2020	42	Devon	United Kingdom
Flash Flood	13/01/2020 12UTC	14/01/2020	18	Vestfold	Norway
Flash Flood	13/01/2020 12UTC	14/01/2020	42	Vastra Gotalands lan	Sweden
Flash Flood	13/01/2020 12UTC	14/01/2020	42	Hallands lan	Sweden
Flash Flood	13/01/2020 12UTC	14/01/2020	30	North Yorkshire	United Kingdom
Flash Flood	13/01/2020 12UTC	14/01/2020	42	Dorset and Somerset	United Kingdom
Flash Flood	13/01/2020 12UTC	14/01/2020	42	Berkshire, Buckingham-	United Kingdom
Flash Flood	13/01/2020 12UTC	14/01/2020	42	East Anglia	United Kingdom
Flash Flood	13/01/2020 12UTC	14/01/2020	42	Lincolnshire	United Kingdom
Flash Flood	14/01/2020 00UTC	14/01/2020	36	Jonkopings lan	Sweden
Flash Flood	14/01/2020 00UTC	14/01/2020	24	Akershus	Norway
Flash Flood	17/01/2020 00UTC	17/01/2020	4	Liguria	Italy
Flash Flood	17/01/2020 12UTC	18/01/2020	42	Segovia	Spain
Flash Flood	17/01/2020 12UTC	18/01/2020	18	Lombardia	Italy
Flash Flood	18/01/2020 00UTC	18/01/2020	60	Alicante / Alacant	Spain
Flash Flood	18/01/2020 12UTC	19/01/2020	60	Corse-du-Sud	France
Flash Flood	18/01/2020 12UTC	19/01/2020	48	Valencia / Valencia	Spain
Flash Flood	18/01/2020 12UTC	19/01/2020	60	Sardegna	Italy
Flash Flood	18/01/2020 12UTC	19/01/2020	54	Murcia	Spain
Flash Flood	19/01/2020 00UTC	19/01/2020	60	Girona	Spain
Flash Flood	19/01/2020 00UTC	19/01/2020	60	Barcelona	Spain
Flash Flood	19/01/2020 00UTC	19/01/2020	60	Haute-Corse	France
Flash Flood	19/01/2020 12UTC	20/01/2020	54	Tarragona	Spain
Flash Flood	19/01/2020 12UTC	20/01/2020	48	Albacete	Spain
Flash Flood	19/01/2020 12UTC	20/01/2020	60	Zaragoza	Spain
Flash Flood	20/01/2020 00UTC	20/01/2020	60	Pyrenees-Orientales	France
Flash Flood	20/01/2020 00UTC	20/01/2020	48	Lleida	Spain
Flash Flood	20/01/2020 00UTC	20/01/2020	48	Guadalajara	Spain
Flash Flood	20/01/2020 00UTC	20/01/2020	48	Teruel	Spain
Flash Flood	20/01/2020 00UTC	20/01/2020	54	La Rioja	Spain
Flash Flood	20/01/2020 00UTC	20/01/2020	54	Navarra	Spain
Flash Flood	20/01/2020 00UTC	20/01/2020	48	Soria	Spain
Flash Flood	20/01/2020 00UTC	20/01/2020	30	Castellon / Castello	Spain
Flash Flood	20/01/2020 12UTC	21/01/2020	60	Haute-Garonne	France
Flash Flood	20/01/2020 12UTC	21/01/2020	60	Haute-Garonne	France
Flash Flood	20/01/2020 12UTC	21/01/2020	36	Segovia	Spain
Flash Flood	20/01/2020 12UTC	21/01/2020	60	Ariege	France
Flash Flood	21/01/2020 00UTC	21/01/2020	48	Huesca	Spain
Flash Flood	21/01/2020 00UTC	21/01/2020	54	Tarn	France
Flash Flood	21/01/2020 12UTC	22/01/2020	48	Herault	France
Flash Flood	21/01/2020 12UTC	22/01/2020	48	Aveyron	France
Flash Flood	21/01/2020 12UTC	22/01/2020	24	Aude	France
Flash Flood	22/01/2020 00UTC	22/01/2020	18	Valencia / Valencia	Spain
Flash Flood	23/01/2020 12UTC	24/01/2020	24	Malaga	Spain
Flash Flood	23/01/2020 12UTC	24/01/2020	30	Corse-du-Sud	France
Flash Flood	24/01/2020 00UTC	24/01/2020	30	Caceres	Spain
Flash Flood	24/01/2020 12UTC	25/01/2020	36	Albacete	Spain

Flash Flood	25/01/2020 00UTC	25/01/2020	60	Ipeiros	Greece
Flash Flood	25/01/2020 00UTC	25/01/2020	60	Thessalia	Greece
Flash Flood	25/01/2020 00UTC	25/01/2020	60	Sterea Ellada	Greece
Flash Flood	25/01/2020 00UTC	25/01/2020	60	Korce	Albania
Flash Flood	25/01/2020 00UTC	25/01/2020	60	Dytiki Makedonia	Greece
Flash Flood	25/01/2020 12UTC	26/01/2020	48	Dytiki Ellada	Greece
Flash Flood	26/01/2020 00UTC	26/01/2020	54	Pas-de-Calais	France
Flash Flood	26/01/2020 12UTC	27/01/2020	36	East Anglia	United Kingdom
Flash Flood	26/01/2020 12UTC	27/01/2020	66	Transcarpathia	Ukraine
Flash Flood	27/01/2020 00UTC	27/01/2020	18	Surrey, East and West Sus-	United Kingdom
Flash Flood	27/01/2020 12UTC	28/01/2020	42	Varmlands lan	Sweden
Flash Flood	28/01/2020 00UTC	28/01/2020	24	Kherson	Ukraine
Flash Flood	28/01/2020 00UTC	28/01/2020	42	Highlands and Islands	United Kingdom
Flash Flood	28/01/2020 12UTC	29/01/2020	54	Charente-Maritime	France
Flash Flood	29/01/2020 12UTC	30/01/2020	48	Northumberland and Tyne	United Kingdom
Flash Flood	29/01/2020 12UTC	30/01/2020	48	North Yorkshire	United Kingdom
Flash Flood	30/01/2020 00UTC	30/01/2020	54	Surrey, East and West Sus-	United Kingdom
Flash Flood	30/01/2020 00UTC	30/01/2020	36	Cumbria	United Kingdom
Flash Flood	30/01/2020 00UTC	30/01/2020	54	Pas-de-Calais	France
Flash Flood	30/01/2020 00UTC	30/01/2020	54	Nord	France
Flash Flood	30/01/2020 00UTC	30/01/2020	30	Hallands lan	Sweden
Flash Flood	30/01/2020 00UTC	30/01/2020	30	Skane lan	Sweden
Flash Flood	30/01/2020 00UTC	30/01/2020	54	Kent	United Kingdom

* 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.

Contact details:

European Centre for Medium-Range Weather Forecasts (ECMWF)
Shinfield Park, Reading,
RG2 9AX, UK

Tel: +44-118-9499-303

Fax: +44-118-9869-450

Email: comp@efas.eu

www.efas.eu

www.ecmwf.int