European Flood Awareness System

EFAS *Bulletin*

June – July 2019

Issue 2019(4)

NEWS

Flood report
The detailed assessment report on two flood events in Spain and Italy in October 2018 has now been published on the EFAS website. The report aims to provide a thorough understanding of the EFAS forecasts, EFAS model performance and EFAS limitations by discussing the two flood events.

Second phase of SEE-MHEWS-A
In July, ECMWF got involved in the second phase of the project "South-East European Multi-Hazard Early Warning Advisory System" (SEE-MHEWS-A), which aims to strengthen the existing early warning capacity in the region. The project was initiated in 2014 by the World Meteorological Organization (WMO) and is currently funded by the World Bank. For 18 months, the project will test a prototype of a flood early warning system using local information and multiple models to better characterize the flood risk in selected catchments in the region. For more information, please see the website https://public.wmo.int/en/projects/see-mhews-a.

New partners

We gladly welcome the Water Management Agency of Luxembourg and the General Secretariat for Civil Protection, Greece as new EFAS partners.

Upcoming events

ANYWHERE final conference
The countdown to the H202- project ANYWHERE's final conference has already started. This event will be held in Brussels (Belgium), on 29-30 October 2019, at the Square Brussels Convention Centre.
Check http://anywhere-h2020.eu/ for more details.

HEPEX/H SAF workshop
In late November, two scientific initiatives, HEPEX and H-SAF, jointly organize a workshop at ECMWF to highlight and strengthen the link between satellite products and hydrological downstream applications, the theme of the workshop is: "Satellite inspired hydrology in an uncertain future". To steer more the interest the H-SAF team will present the H-SAF soil moisture, snow and precipitation products. Find more information here.

RESULTS

Summary of EFAS Flood and Flash flood Notifications

The 14 formal and 14 informal EFAS flood notifications issued in June-July 2019 are summarised in Table 1. The locations of all notifications are shown in Figure 21 and Figure 23 in the appendix.

195 Flash flood notification were issued in June - July 2019. They are summarised in Table 2. The locations of all notifications are shown in Figure 22 and Figure 24 in the appendix.

Meteorological situation

by EFAS Meteorological Data Collection Centre

June 2019
The meteorological situation in June 2019 was characterized by stable high-pressure systems over central and eastern Europe and low-pressure systems westward as well as upper-level low pressure systems at the Balkans and eastern Mediterranean regions. Precipitation totals were below the long term means in large parts of the EFAS domain. The monthly mean temperature was above the long-term means in the middle and south, below in the west and east of the EFAS domain.

At the beginning of June, most parts of the EFAS domain were influenced by high-pressure systems, except for northern Scandinavia. An upper-level low-pressure system was located over the central Mediterranean region and caused heavy precipitation and hail in southern Italy. It moved to the Balkans and caused heavy precipitation with floods and landslides. Meanwhile, the low-pressure system from northern Scandinavia moved north-eastward and initiated the formation of a new low-pressure system over Russia while dissipating. Another low-pressure system moved from the Atlantic Ocean via Great Britain and Ireland to the region between Iceland and Norway. A secondary low-pressure system developed over Great Britain and moved to the North Sea, where the signature in the lower levels weakened but was stable in the upper levels, which moved southwards to France and then back northwards initiating the formation of a low-pressure system at the surface again which resulted in precipitation over France and Great Britain mainly. This low-

pressure system then moved out over the sea between Great Britain, Iceland and Norway.

In the other parts of the EFAS domain no large pressure gradients occurred, but these conditions allowed for the formation of intense convective precipitation over central and south-eastern Europe. A small low-pressure system moved from Newfoundland across the Azores to the Bay of Biscay and joined the above-mentioned low-pressure system. Another low-pressure system over the Kara Sea and secondary low-pressure systems over Scandinavia brought precipitation to Scandinavia and northern Russia. In the last days of June one more low-pressure system over the eastern Atlantic Ocean caused a southerly flow bringing warm air masses from northern Africa to central and western Europe. High pressure eastward and to the north of this system inhibited cloud formation processes giving good conditions for the large-scale heat wave to come. A new temperature record was set in France while many other stations in several European countries set new records for the highest temperature in June.

In June 2019, the highest monthly precipitation totals were observed in the Norwegian mountains, western Alps, Great Britain, Ireland and the Balkans mainly caused by convective events (Figure 7). Nearly no precipitation fell in some parts of the Iberian Peninsula, France, Italy and Greece but also in the south and east of the Mediterranean Sea. Less than normal precipitation fell in large parts of the EFAS domain (Figure 8). More than normal precipitation fell in the northwest of the Iberian Peninsula, parts of France, Great Britain, Ireland, western and northern Scandinavia, the Balkans and parts of Turkey. Also, some spots in other regions received more than normal precipitation amounts. The large relative anomalies in the south and southeast of the EFAS domain originated from small precipitation amounts in a typically precipitation free season.

The monthly mean air temperature ranged from -4.4°C to 38°C with the highest temperatures in the southern and eastern parts and lowest temperatures in the northern and mountainous parts of the EFAS domain (Figure 11). Temperature anomalies ranged from -5.8°C to 10.4°C with abnormally low temperatures in western part of the Northwest Africa, western Iberian Peninsula, Great Britain, northern Iceland, northern Scandinavia and the eastern parts of Russia (Figure 12). Nearly in all other regions, temperatures rose above normal.

July 2019

The meteorological situation in July 2019 was characterized in the first days by a low-pressure system over Scandinavia, later by a large high-pressure system and in the last days by a low-pressure system moving from the Atlantic Ocean to Southeast Europe. Monthly precipitation totals were above the long-term means in the northern Mediterranean region, eastern Europe and northeastern part of Great Britain and Ireland and below the long-term means in other regions. The monthly mean air temperature was below the long-term means in the east and outermost west of the EFAS domain and above the long-term means in the remaining parts of the EFAS domain.

At the beginning of July, a low-pressure system was located over Scandinavia while a high-pressure system covered the southern parts of the EFAS domain. As the low-pressure system was stable over Scandinavia and caused large-scale precipitation in the northeast of the EFAS domain, the high-pressure system weakened, and an upper-level trough developed west of Great Britain and the Iberian Peninsula leading to a cut-off upper-level low-pressure system westward of the Iberian Peninsula. Heavy precipitation developed in unstable air masses in several parts in the centre of the EFAS domain and caused flash floods. The next days were characterized by weak air pressure gradients and an outflow of cold air over eastern Europe. These conditions led to the formation of convective precipitation with notable events e.g. in the Netherlands, Great Britain and Ireland, Norway, Italy and Greece, but also other regions in the EFAS domain.

A high-pressure ridge developed in the western Mediterranean region and central Europe in the last third of July, which initiated - in conjunction with a low-pressure system located between Great Britain and Iceland - a flow of very hot sub-tropical air masses towards western and central Europe setting new air temperature records at several stations. A low-pressure system moved over the Atlantic Ocean to the region westward of Great Britain and Ireland and weakened the high-pressure ridge. Several small and weak low-pressure systems developed following westward of the Iberian Peninsula, southern France and central Europe as well as in western Russia causing intense precipitation events with flash-floods and landslides in several regions within the EFAS domain except the southern Mediterranean region and northern Scandinavia.

In July 2019, the highest monthly precipitation totals were observed in and southward of the Alps, eastward of the Black Sea, Scotland, southwest Norway and Russia (Figure 9Figure 7). On the other hand, no or nearly no precipitation was observed in most of the African and south-eastern parts of the EFAS domain, southern Iberian Peninsula and parts of northern France. More than normal precipitation fell in northeast Spain and the northern central and eastern Mediterranean region, Scotland and eastern Europe (Figure 10). Less than normal precipitation fell in many regions southward and eastward of the Mediterranean Sea, southern Iberian Peninsula, southern Great Britain and Ireland, large parts of Scandinavia, Iceland and in an area forms from northern France to the central Ukraine.

The monthly mean air temperature ranged from -1.2°C to 38.9°C with the highest values in the southern and eastern parts and lowest values in the northern and mountainous parts of the EFAS domain (Figure 13). Air temperature anomalies ranged from -7.3°C to +9°C with abnormally low temperatures in the eastern parts of the EFAS domain, especially in western Russia, the southwestern Iberian Peninsula and north-western Africa (Figure 14). The other regions of the EFAS domain had positive air temperature anomalies.

Hydrological situation

by EFAS Hydrological Data Collection Centre

June 2019

For the month of June, the highest concentration of stations that exceeded their lowest threshold level is in the Danube basin, mainly in the Danube main stream, the Sava and Tisza rivers but also in tributaries in western, northern and central area, with most stations in western Austria, south-eastern Germany, R. Serbia, Croatia, Bosnia-Herzegovina, Hungary, the Slovak Republic, Hungary, Romania and Slovenia. There is also a remarkable concentration of stations across the Po basin in Italy, the Rhine basin in Switzerland and southern Germany, Vistula basin in Poland and western Dnieper river basin in Belarus and Ukraine. A more dispersed distribution of stations with exceedances occurred in northern Norway and Sweden, the Neretva basin in Bosnia-Herzegovina, Elbe river basin in Germany, Don and Dniester basin in Ukraine, the Dnieper river in Belarus, Minho-Sill and Guadalhorce river basins in Spain and Hyron river in Israel.

Stations that registered discharge values above the 90% quantile are mostly located across the Danube river basin, mainly in upper Danube in the borderline between Austria and Germany, the Sava and Tisza rivers, eastern Danube in Romania and, in western Ukraine, the Dnieper and Dniester basins. This occurred less frequently for stations along the Rhine river basin in Switzerland, Scotland stations, central area of England and southern Norway. The Gota river basin in Sweden and Oder river basin had only one station fulfilling this condition.

Stations registering values below the 10% quantile are mainly located in the Elbe and Rhine river basins in Germany, the Oder basin in Poland and Ebro basin in Spain. A lower concentration of stations is found in south-eastern Sweden basins, Dnieper river basin in northern Ukraine, the Thames river in England, the Barrow basin in Ireland, Glomma river in south-eastern Norway and Daugava river basin in Latvia.

July 2019

For the month of July, the highest concentration of stations that exceeded their lowest threshold level is in the western Danube basin in Austria and Germany, the Rhine river basin in southern Germany and Switzerland and the Po river basin in Italy. A more dispersed distribution of stations with exceedances occurred in Danube river basin in Hungary and R. Serbia, in northern Norway, Dnieper river basin in Ukraine and Mihno river basin in Spain.

In general, stations that registered discharge values above the 90% during the month of July were very few. They are mostly located in England, Norway, the Rhine river basin in Germany, Danube river basin in Germany and Bulgaria, Ebro river basin in Spain, Dnieper river basin in Ukraine, the Rhône river basin in France and Naatamo river basin in Finland.

Stations registering values below the 10% quantile are mainly located in the Elbe river basin in Germany and western Czech Republic and the Oder river basin in Poland. A lower concentration of stations is found across the Rhine river basin in Germany and Danube river basin in Austria, Germany and Slovakia, Dnieper river basin in northern Ukraine and Ebro river basin in Spain.

Finally, isolated stations are found in Dniester river basin in Ukraine, Sheldt and Meuse river basins in Belgium, Glomma river and Sandvinvadnet Lake in Norway, Motala strom, Alsteran and Ronneby river basins in Sweden, the Thames in England, the Barrow and Munster Blackwater river basins in Ireland, Meuse river basin in Belgium, Llobregat, Ter, Douro and Guadalquivir river basins in Spain and Daugava river basins in Latvia.

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 June to July period across the EFAS domain for catchments larger than 2000km^2. 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.

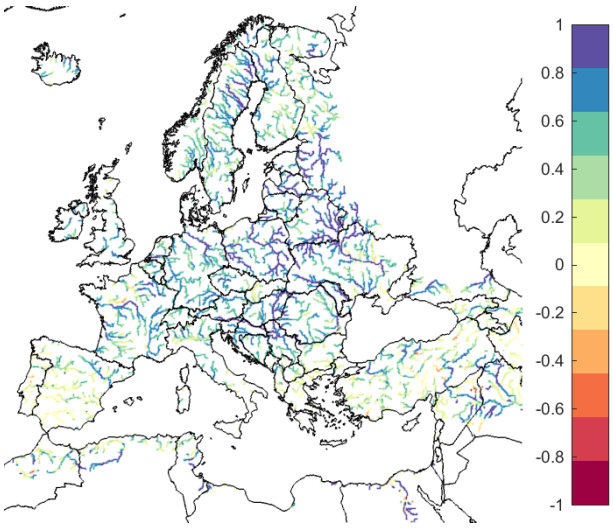

Figure 1. EFAS CRPSS at lead-time 1 day for the June-July 2019 period, for catchments >2000km2. The reference score is persistence of using previous day's forecast.

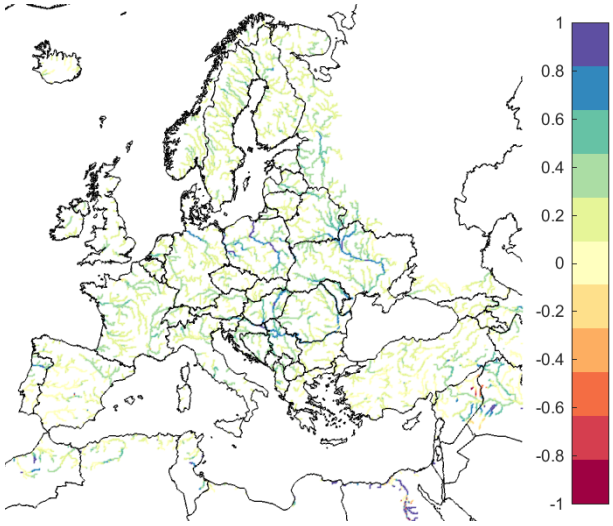

Figure 2. EFAS CRPSS at lead-time 5 days for the June-July 2019 period, for catchments >2000km2. The reference score is persistence of using previous day's forecast.

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 over the period were better quite good in most parts of Europe, apart from the Mediterranean region. This is not unusual during the dry season. For a longer report of the skill assessment over the first year of the new domain, please see feature article below.

ARTICLES

Report on the flooding in Crete, Greece in June 2019

by Richard Davies (FloodList)

Intense heavy rainfall in north-eastern Spain caused flash flooding in the Navarre region on 08 July 2019. According to Meteo Navarra (http://meteo.navarra.es/), the town of Guetádar recorded 158.9 mm of rain on 08 July and the town of Tafalla recorded 100.2 mm. Much of the rain fell in the space of a few hours.

The rain caused the Cidacos (Zidacos) river to break its banks, flooding areas around the towns of Tafalla, Olite, Pueyo, Pitillas and Beire. A state of disaster was declared soon after in the municipality of Tafalla. One fatality was reported because of the floods after a man drowned in his vehicle in the municipality of Ezprogui, around 20km north-east of Tafalla. Local Civil Protection said that levels of the Cidacos river at Olite jumped from 0.18 metres at 18:00 on 08 July to 5.75 metres just 6 hours later, and the flow rate from 0.3 to 262.3 m^3/s. The regional government of Navarre said levels of the Cidacos reached the highest on record during this time.

Figure 3. Damage caused by the overflowing Cidacos river in Tafalla, Navarre, Spain, 09 July 2019. Photo credit: Gobierno de Navarra.

The Navarra government said that the material damage caused by the flooding was far-reaching, affecting cars, garages, basements, shops, industrial buildings, sports areas and the N-121 road between Pamplona and Tudela. According to initial government estimates, damage to the N-121 would take 1 to 2 months to repair. Dozens of other roads, including parts of the AP-15, were also damaged. Rail transport was interrupted, as was power supply to thousands of homes.

Images on twitter shows cars being dragged along streets by flood water. The regional fire service said that the following day they were continuing to find abandoned cars trapped in flood waters.

First skill assessment of the new EFAS domain

by Fredrik Wetterhall, EFAS Computational Centre

The extended EFAS domain was put in operations on the 16 May 2018, and it is now time to make an assessment over the performance over this first year. The assessment of skill scores where done over the period 1 June 2018-31 July 2019, well over a year. The skill was computed using the continuous ranked probability skill score (CRPSS). The proxy for observations were the simulations forced with observations. For this validation, the catchments in Africa were omitted.

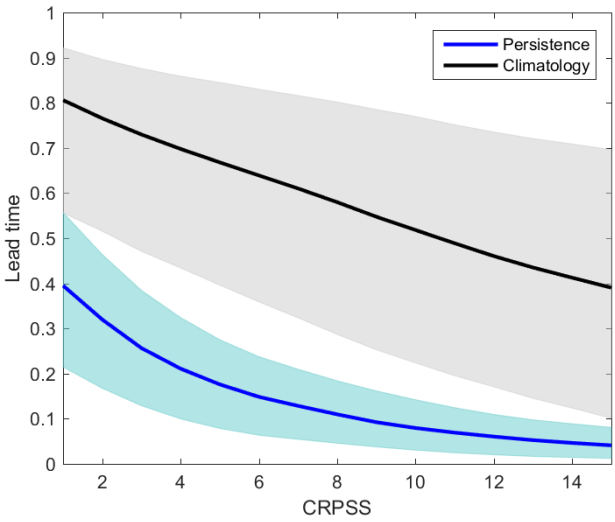

Figure 4. EFAS headline score CRPS Skill score over the entire period for all grid points which have an upstream area of >=2000 km² as a function of lead time. Persistence (blue line) uses the forecast from the previous day as the reference, which is a very difficult forecast to beat. The black line represents CRPSS against climatology, which is comprised of simulated hydrological time serios for previous years. The shaded area denotes the 10th and 90th percentile of the scores respectively.

Current skill of the forecasts

The CRPSS for the first 15 days of forecasts shows a good skill against climatology (Figure 4), whereas using the previous day's forecast as your reference forecast shows a more rapidly decreasing skill. Any skill above 0 is considered better than the reference forecast.

The performance shows a strong spatial variability, where the model performs generally better in the northern part of Europe than in the south. It can be noted that the larger rivers perform on average better than smaller rivers (Figure 5)

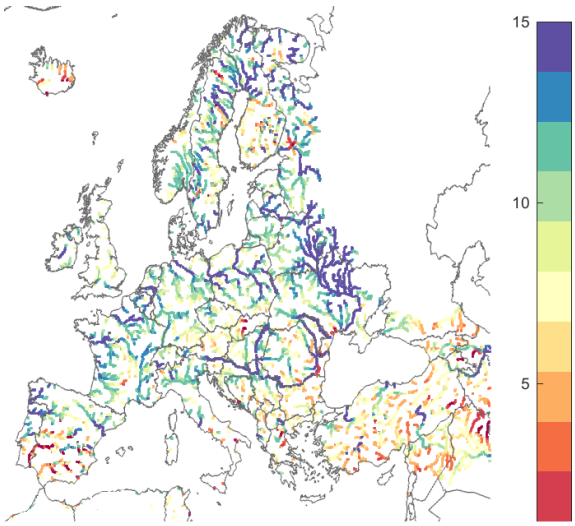

Figure 5. Number of weeks before the CRPSS goes below 0.1 for all the points in Europe (left) and for all major river points (area >=2000km^2). Reference forecast was persistence. Blue colour indicates a good performance, and red colour indicates a less good performance.

The skill also varies greatly over the year, which can be seen in Figure 6. The skill in winter is normally higher than in summer, because most rivers are at their lowest flow during that season. The variability is small, which makes it easier to predict. It is yet not enough data to say something more substantial about the long-term score development of EFAS.

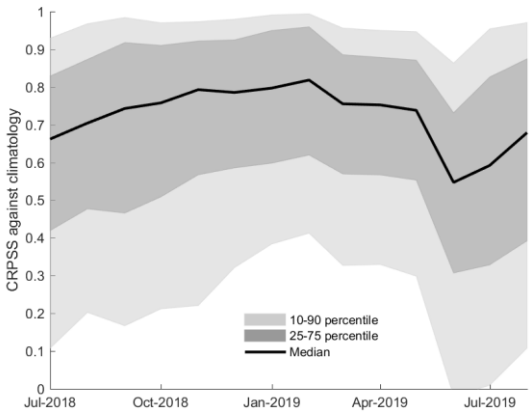

Figure 6. Monthly means of CRPSS for lead time 5 days for all the major river points in Europe over the test period against climatology. The skill is largest during the winter months, when there is less variation in the flow in large parts of Europe.

Plans for verification

The plans for EFAS verification will follow several development paths. Firstly, the points where we have observational data in near-real time will be used for an assessment of the skill of the forecasts against observations. This will give a better understanding of the real value of the system in those points. Secondly, hindcast experiments will be able to give an idea of the development of the scores over time. Such experiments will take time to run and will be presented at a later stage.

Thirdly, verification of the issued notifications is a priority. Currently, there is not enough feedback to properly assess this, but the new web interface will enable a more systematic assessment of this skill.

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: Damage caused by the overflowing Cidacos river in Tafalla, Navarre, Spain, 09 July 2019. Photo credit: Gobierno de Navarra.

Appendix - figures

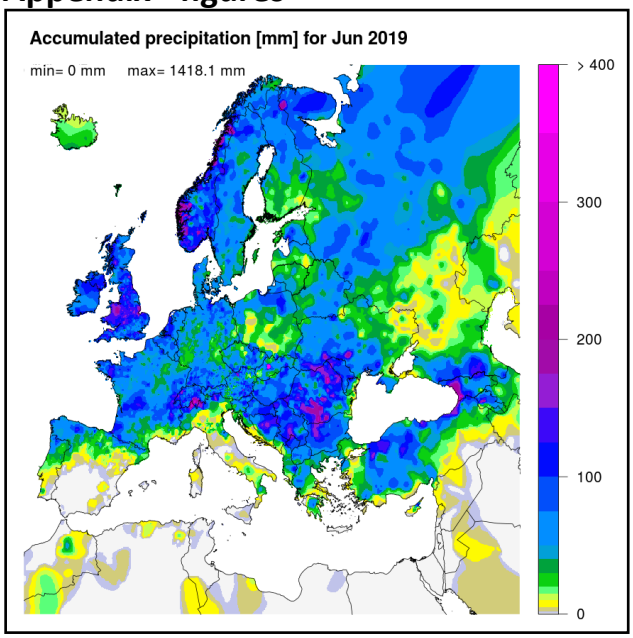

Figure 7. Accumulated precipitation [mm] for June 2019.

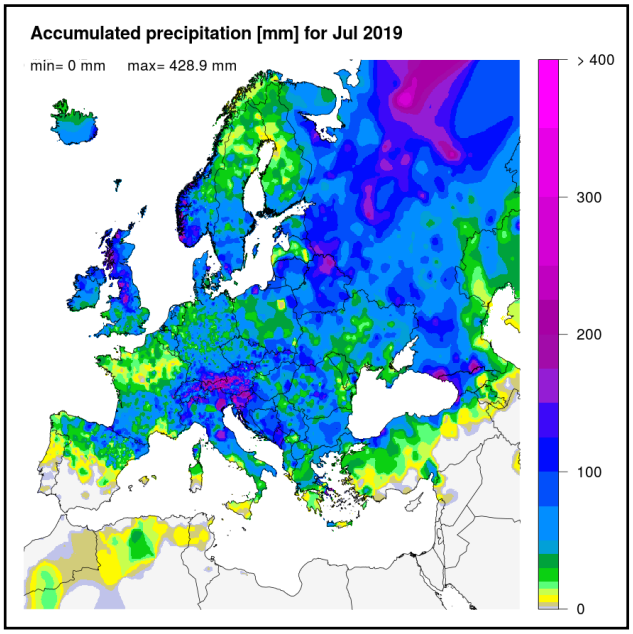

Figure 9. Accumulated precipitation [mm] for July 2019.

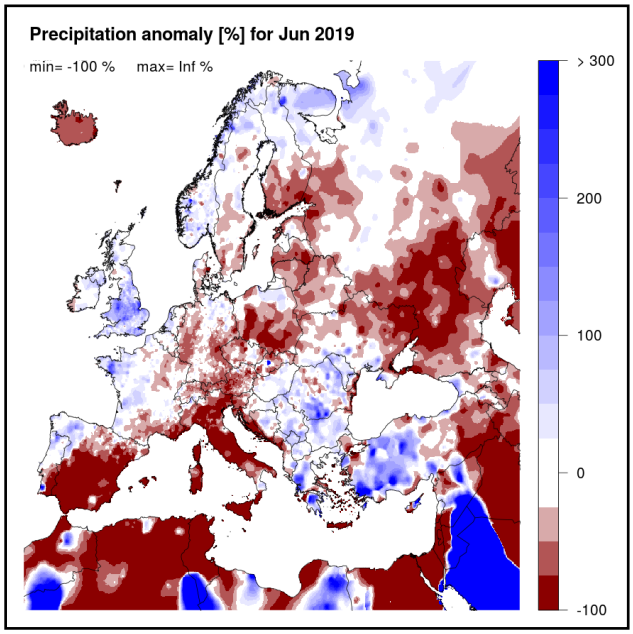

Figure 8. Precipitation anomaly [%] for June 2019, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

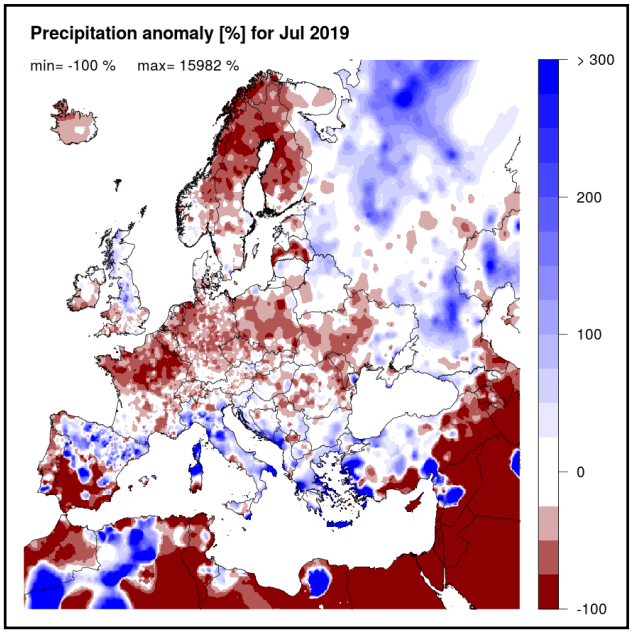

Figure 10. Precipitation anomaly [%] for July 2019, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

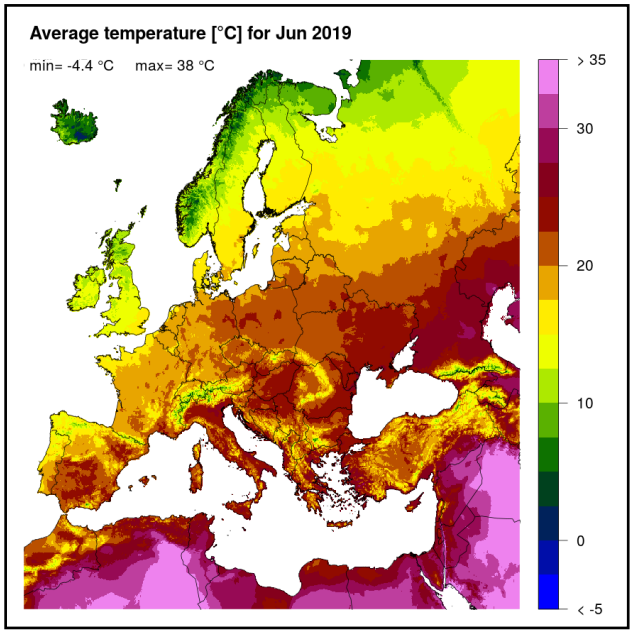

Figure 11. Mean temperature [°C] for June 2019.

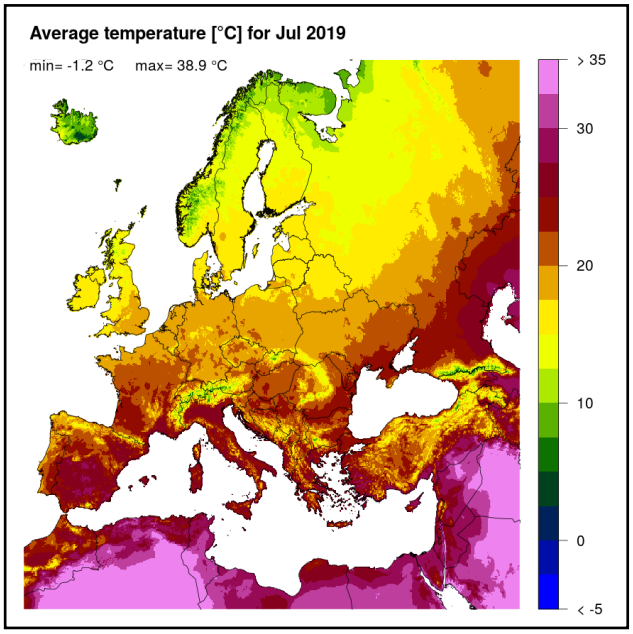

Figure 13. Mean temperature [°C] for July 2019.

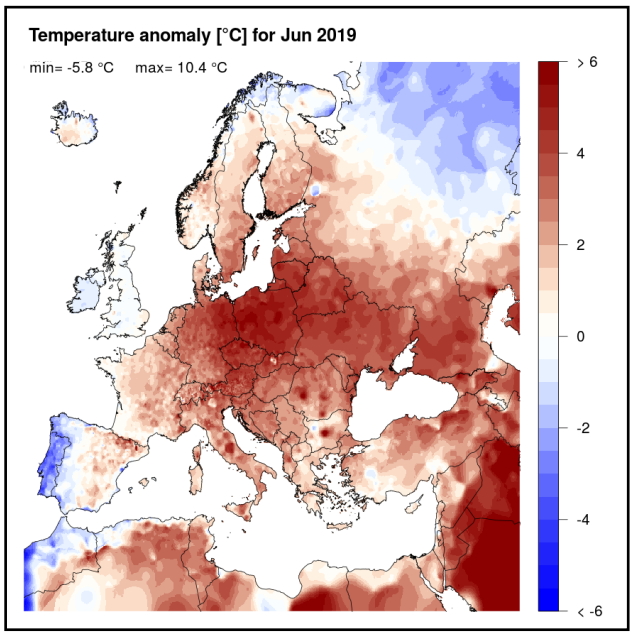

Figure 12. Temperature anomaly [°C] for June 2019, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

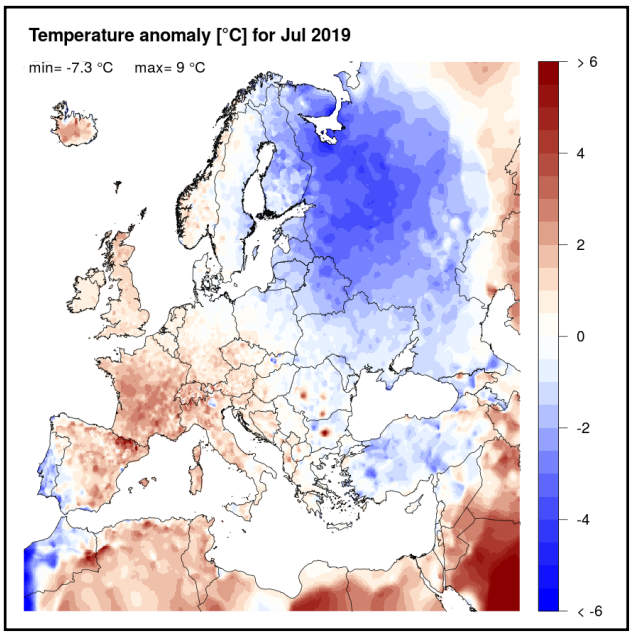

Figure 14. Temperature anomaly [°C] for July 2019, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

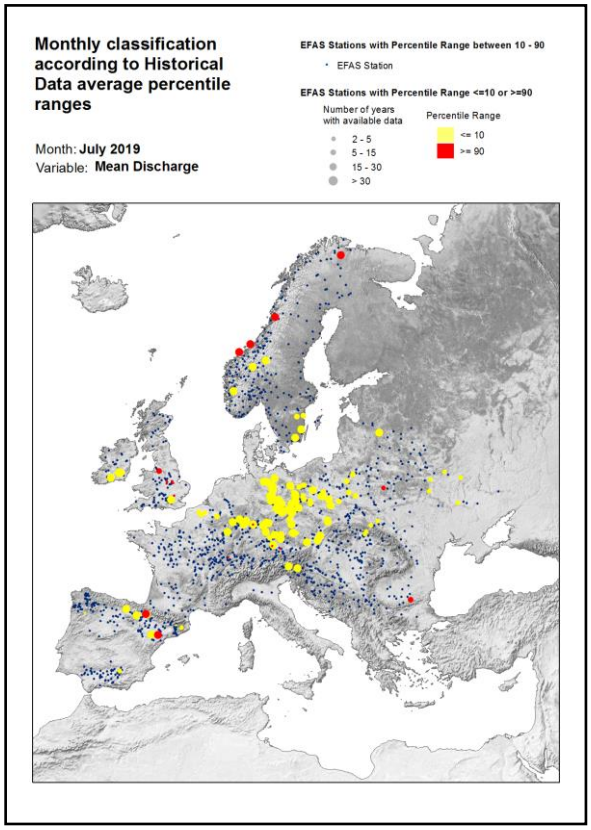

Figure 15. Monthly discharge anomalies June 2019.

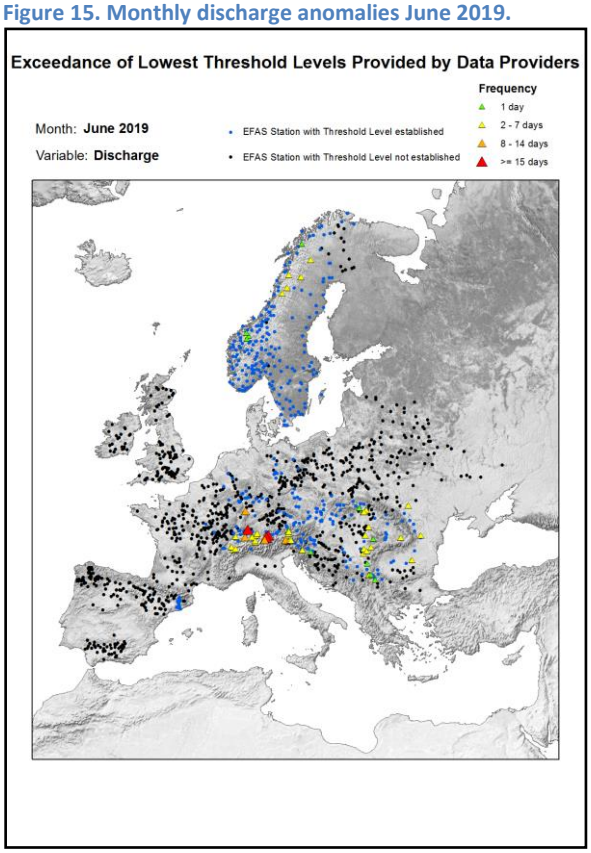

Figure 16. Lowest alert level exceedance for June 2019.

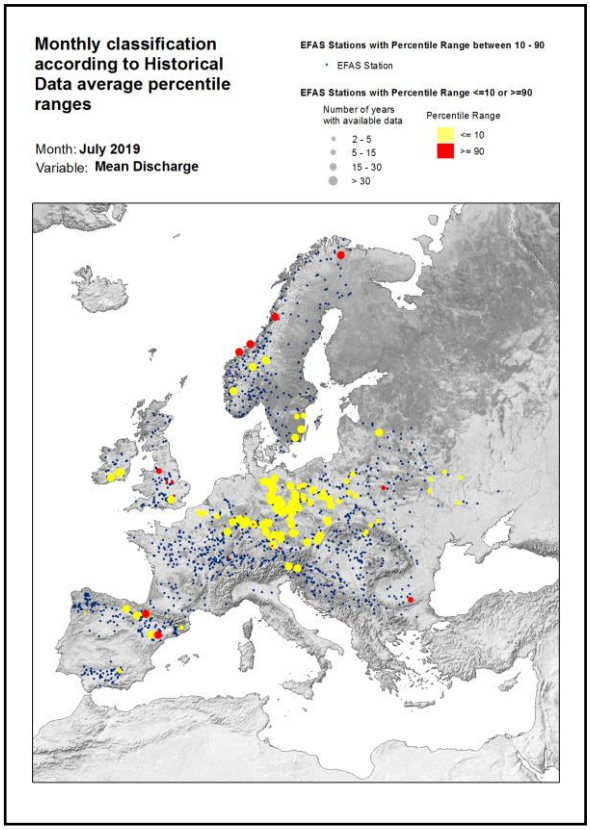

Figure 17. Monthly discharge anomalies July 2019.

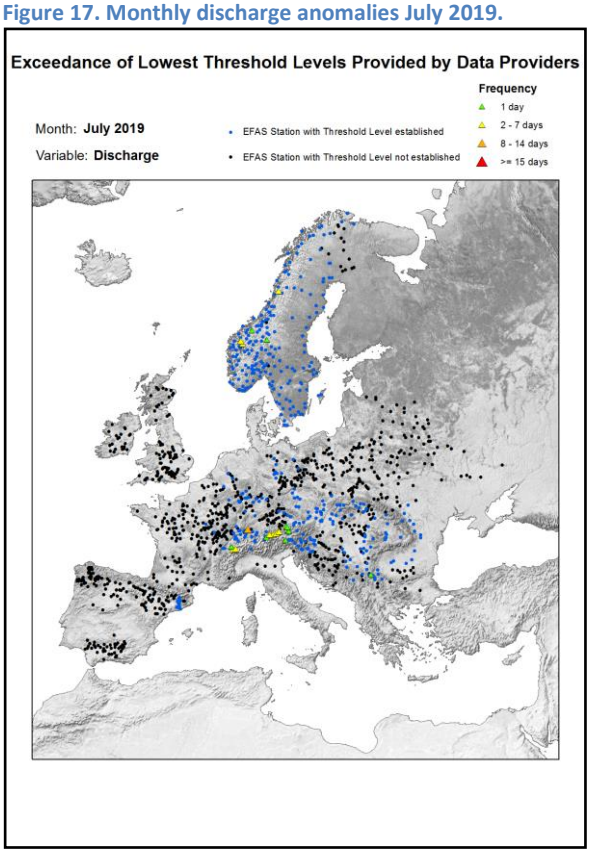

Figure 18. Lowest alert level exceedance for July 2019.

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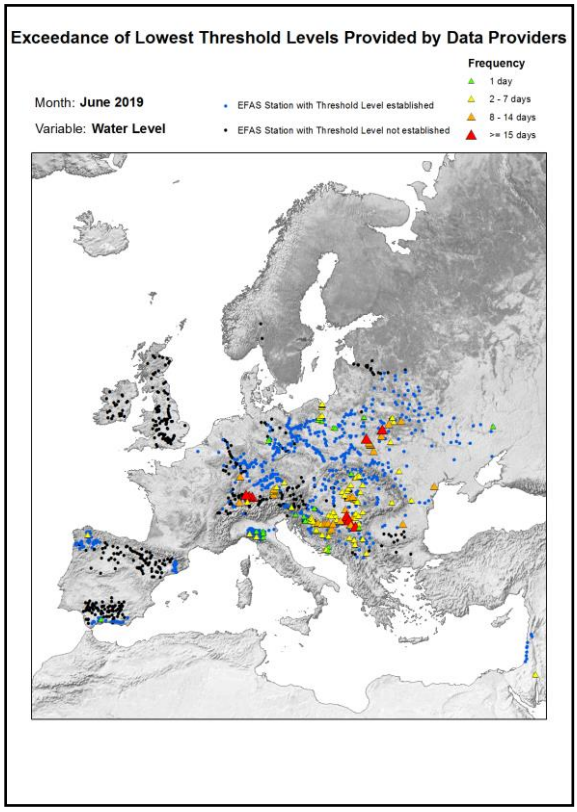

Figure 19. Lowest threshold exceedance for June 2019.

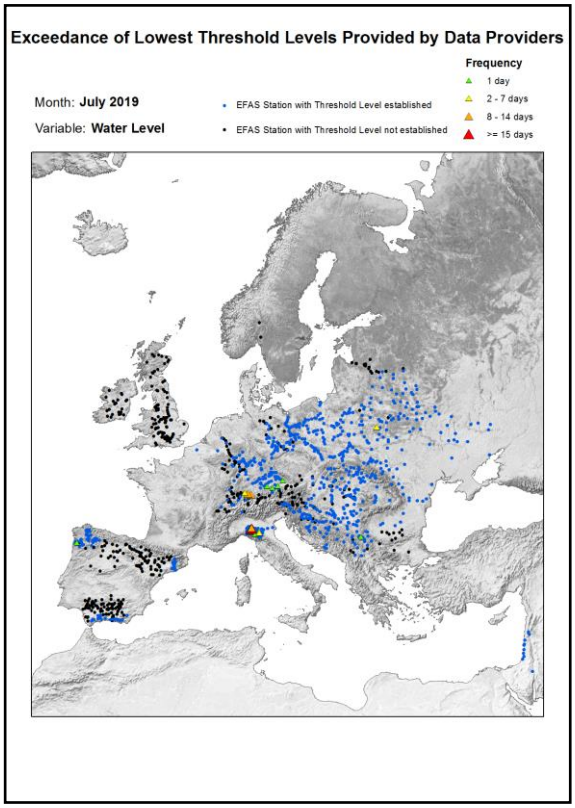

Figure 20. Lowest threshold exceedance for July 2019.

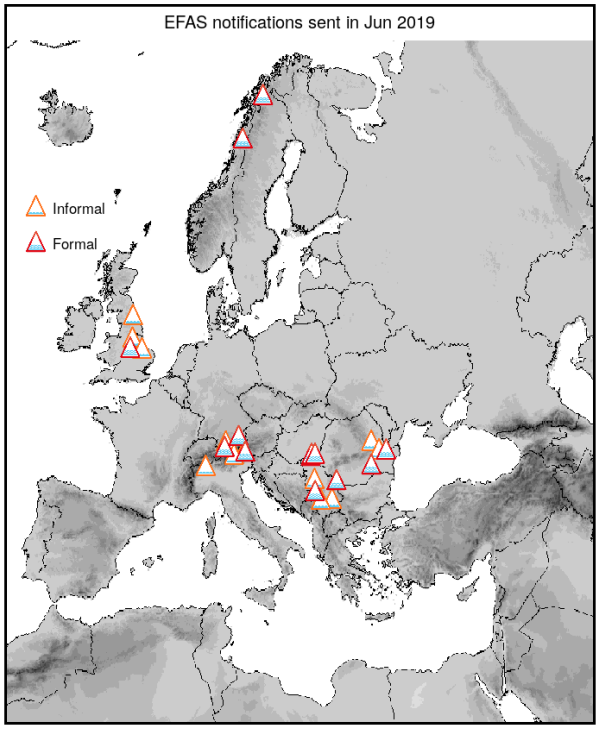

Figure 21. EFAS flood notifications sent for June 2019.

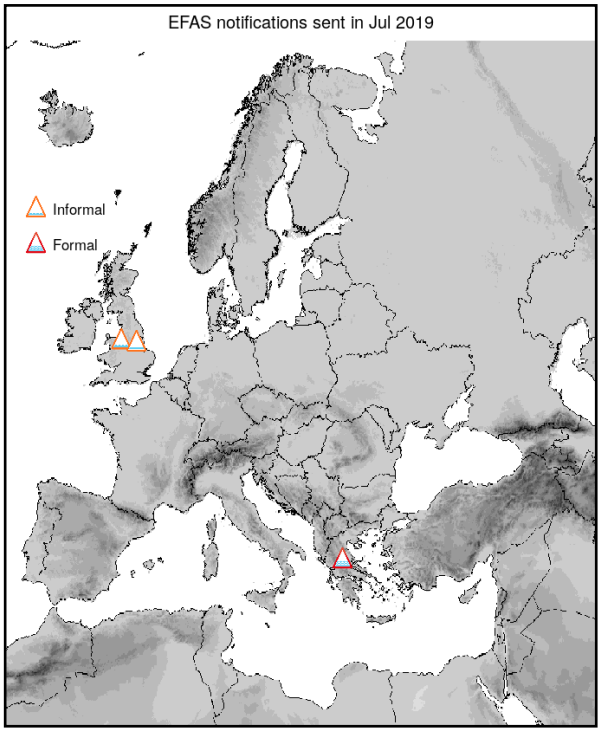

Figure 23. EFAS flood notifications sent for July 2019.

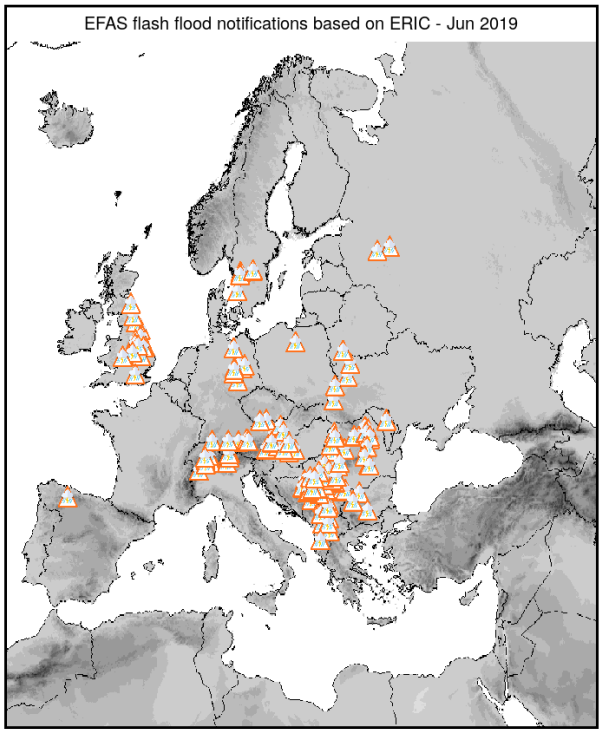

Figure 22. Flash flood notifications sent for June 2019.

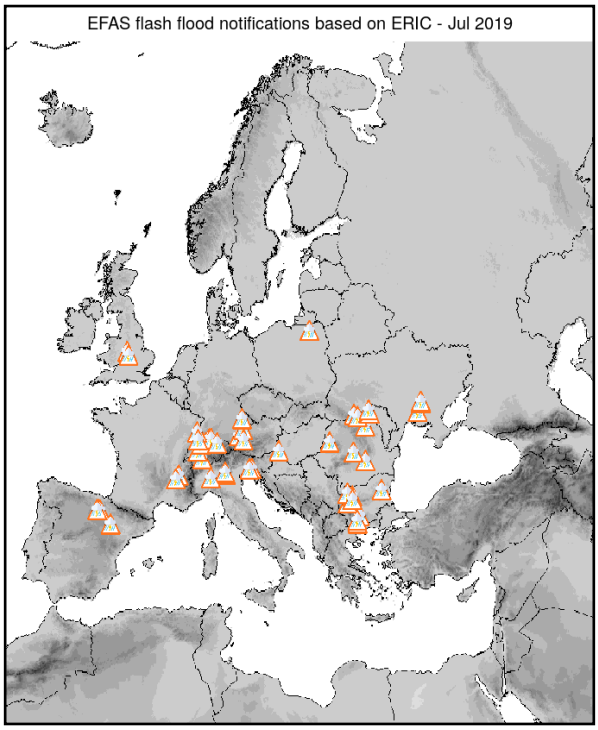

Figure 24. Flash flood notifications sent for July 2019.

Appendix - tables

Table 1. EFAS flood notifications sent in June - July 2019

Type	Forecast date	Issue date	Lead time*	River	Country
Informal	01/06/2019 00UTC	01/06/2019	0	Kolubara	R. Serbia
Formal	02/06/2019 00UTC	02/06/2019	2	Zapadna Morava	R. Serbia
Informal	02/06/2019 00UTC	02/06/2019	1	Toplica	R. Serbia
Informal	02/06/2019 12UTC	03/06/2019	1	Trotus	Romania
Informal	02/06/2019 12UTC	03/06/2019	1	Ibar	R. Serbia
Formal	03/06/2019 00UTC	03/06/2019	2	Ialomita	Romania
Informal	03/06/2019 12UTC	04/06/2019	2	Siret, above Buzau	Romania
Formal	04/06/2019 00UTC	04/06/2019	5	Tisza	Hungary
Formal	04/06/2019 00UTC	04/06/2019	5	Tisza	R. Serbia
Formal	04/06/2019 12UTC	05/06/2019	4	Mures	Hungary
Formal	05/06/2019 00UTC	05/06/2019	2	Rana	Norway
Formal	05/06/2019 12UTC	06/06/2019	2	Coastal Catchment Norwegian	Norway
Formal	06/06/2019 00UTC	06/06/2019	5	Donau	Romania
Formal	08/06/2019 00UTC	08/06/2019	3	Donau	Romania
Formal	09/06/2019 00UTC	09/06/2019	6	Inn	Austria
Informal	09/06/2019 00UTC	09/06/2019	2	Don	United Kingdom
Formal	09/06/2019 00UTC	09/06/2019	3	Trent	United Kingdom
Informal	09/06/2019 12UTC	10/06/2019	2	Welland	United Kingdom
Informal	09/06/2019 12UTC	10/06/2019	0	Wear	United Kingdom
Informal	10/06/2019 00UTC	10/06/2019	2	Toce	Italy
Informal	11/06/2019 00UTC	11/06/2019	5	Drau	Austria
Informal	12/06/2019 12UTC	13/06/2019	3	Lech	Austria
Informal	13/06/2019 12UTC	14/06/2019	0	Adige	Italy
Formal	17/06/2019 12UTC	18/06/2019	3	Inn	Germany
Formal	18/06/2019 12UTC	19/06/2019	7	Drau	Austria
Formal	15/07/2019 00UTC	15/07/2019	2	Pineios	Greece
Informal	27/07/2019 12UTC	28/07/2019	1	Trent	United Kingdom
Informal	27/07/2019 12UTC	28/07/2019	1	Mersey	United Kingdom

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

Table 2. EFAS Flash flood notifications sent in June - July 2019

Type	Forecast date	Issue date	Lead time*	Region	Country
Flash Flood	31/05/2019 12UTC	01/06/2019	24	Zlatiborski	R. Serbia
Flash Flood	31/05/2019 12UTC	01/06/2019	36	Vukovarsko-Srijemska	Croatia
Flash Flood	31/05/2019 12UTC	01/06/2019	24	Moravicki	R. Serbia
Flash Flood	31/05/2019 12UTC	01/06/2019	36	Federacija Bosna i Herce-	B. & Herzegovina
Flash Flood	01/06/2019 00UTC	02/06/2019	60	Hunedoara	Romania
Flash Flood	01/06/2019 12UTC	02/06/2019	36	Pleven	Bulgaria
Flash Flood	01/06/2019 12UTC	02/06/2019	48	Zlatiborski	B. & Hez., R. Ser-
Flash Flood	01/06/2019 12UTC	02/06/2019	42	Kukes	Albania
Flash Flood	01/06/2019 12UTC	02/06/2019	42	Jugozapaden	N. Macedonia
Flash Flood	01/06/2019 12UTC	02/06/2019	48	Urosevac	R. Kosovo*
Flash Flood	01/06/2019 12UTC	02/06/2019	48	Prizren	R. Kosovo*
Flash Flood	01/06/2019 12UTC	02/06/2019	54	Rasinski	R. Serbia

Flash Flood	01/06/2019 12UTC	02/06/2019	60	Zajecarski	R. Serbia
Flash Flood	01/06/2019 12UTC	02/06/2019	48	Toplicki	R. Serbia
Flash Flood	01/06/2019 12UTC	02/06/2019	48	Raski	R. Serbia
Flash Flood	01/06/2019 12UTC	02/06/2019	54	Montana	Bulgaria, Roma-
Flash Flood	01/06/2019 12UTC	02/06/2019	66	Mehedinti	Romania, R. Ser-
Flash Flood	01/06/2019 12UTC	02/06/2019	66	Neamt	Romania
Flash Flood	01/06/2019 12UTC	02/06/2019	72	Alba	Romania
Flash Flood	01/06/2019 12UTC	02/06/2019	48	Kosovska Mitrovica	R. Kosovo*
Flash Flood	02/06/2019 00UTC	02/06/2019	24	Plovdiv	Bulgaria
Flash Flood	02/06/2019 00UTC	02/06/2019	30	Vidin	Bulgaria
Flash Flood	02/06/2019 00UTC	02/06/2019	42	Dolj	Romania
Flash Flood	02/06/2019 00UTC	02/06/2019	48	Bacau	Romania
Flash Flood	02/06/2019 00UTC	02/06/2019	48	Borski	R. Serbia
Flash Flood	02/06/2019 00UTC	02/06/2019	36	Pecki	R. Kosovo
Flash Flood	02/06/2019 00UTC	02/06/2019	42	Poloski	N. Macedonia
Flash Flood	02/06/2019 12UTC	03/06/2019	24	Elbasan	Albania
Flash Flood	02/06/2019 12UTC	03/06/2019	30	Pristina	R. Kosovo
Flash Flood	02/06/2019 12UTC	03/06/2019	42	Harghita	Romania
Flash Flood	02/06/2019 12UTC	03/06/2019	42	Iasi	Romania
Flash Flood	02/06/2019 12UTC	03/06/2019	42	Suceava	Romania
Flash Flood	02/06/2019 12UTC	03/06/2019	36	Pomoravski	R. Serbia
Flash Flood	02/06/2019 12UTC	03/06/2019	24	Branicevski	R. Serbia
Flash Flood	02/06/2019 12UTC	03/06/2019	42	Macvanski	R. Serbia
Flash Flood	02/06/2019 12UTC	03/06/2019	36	Grad Beograd	R. Serbia
Flash Flood	03/06/2019 00UTC	03/06/2019	24	Orhei	Moldova
Flash Flood	03/06/2019 00UTC	03/06/2019	30	Mures	Romania
Flash Flood	03/06/2019 00UTC	03/06/2019	42	Prahova	Romania
Flash Flood	03/06/2019 00UTC	03/06/2019	36	Podunavski	R. Serbia
Flash Flood	03/06/2019 00UTC	03/06/2019	54	Moravicki	R. Serbia
Flash Flood	03/06/2019 12UTC	04/06/2019	36	Kolubarski	R. Serbia
Flash Flood	03/06/2019 12UTC	04/06/2019	42	Arad	Romania
Flash Flood	04/06/2019 12UTC	05/06/2019	24	Bihor	Romania
Flash Flood	04/06/2019 12UTC	05/06/2019	24	Sremski	R. Serbia
Flash Flood	04/06/2019 12UTC	05/06/2019	24	Grad Beograd	R. Serbia
Flash Flood	04/06/2019 12UTC	05/06/2019	24	Kolubarski	R. Serbia
Flash Flood	04/06/2019 12UTC	05/06/2019	24	Timis	Romania
Flash Flood	05/06/2019 12UTC	06/06/2019	30	Orhei	Moldova
Flash Flood	06/06/2019 00UTC	06/06/2019	36	Satu Mare	Romania
Flash Flood	06/06/2019 00UTC	06/06/2019	30	Bihor	Romania
Flash Flood	07/06/2019 00UTC	07/06/2019	96	Valle d'Aosta/Vallee D'Ao-	Italy
Flash Flood	07/06/2019 00UTC	07/06/2019	42	Neamt	Romania
Flash Flood	08/06/2019 12UTC	09/06/2019	72	Ticino	Switzerland
Flash Flood	08/06/2019 12UTC	09/06/2019	72	Valais	Switzerland
Flash Flood	08/06/2019 12UTC	09/06/2019	72	Verbano-Cusio-Ossola	Italy
Flash Flood	08/06/2019 12UTC	09/06/2019	72	Uri	Switzerland
Flash Flood	08/06/2019 12UTC	09/06/2019	72	Graubunden	Switzerland
Flash Flood	09/06/2019 00UTC	09/06/2019	60	Lincolnshire	United Kingdom
Flash Flood	09/06/2019 00UTC	09/06/2019	54	Konstanz	Germany
Flash Flood	09/06/2019 12UTC	10/06/2019	30	Neamt	Romania
Flash Flood	09/06/2019 12UTC	10/06/2019	78	Hartlepool and Stockton-	United Kingdom
Flash Flood	09/06/2019 12UTC	10/06/2019	78	North Yorkshire CC	United Kingdom

Flash Flood	09/06/2019 12UTC	10/06/2019	36	Potsdam-Mittelmark	Germany
Flash Flood	09/06/2019 12UTC	10/06/2019	36	Potsdam, Kreisfreie Stadt	Germany
Flash Flood	09/06/2019 12UTC	10/06/2019	42	Brandenburg an der Havel,	Germany
Flash Flood	09/06/2019 12UTC	10/06/2019	42	Havelland	Germany
Flash Flood	09/06/2019 12UTC	10/06/2019	48	Konstanz	Switzerland,
Flash Flood	09/06/2019 12UTC	10/06/2019	36	Halle (Saale), Kreisfreie	Germany
Flash Flood	10/06/2019 00UTC	10/06/2019	30	Ludwigslust-Parchim	Germany
Flash Flood	10/06/2019 00UTC	10/06/2019	36	Bern	Switzerland
Flash Flood	10/06/2019 00UTC	10/06/2019	30	Borde	Germany
Flash Flood	10/06/2019 00UTC	10/06/2019	30	Salzlandkreis	Germany
Flash Flood	10/06/2019 00UTC	10/06/2019	42	Vastra Gotalands lan	Sweden
Flash Flood	10/06/2019 00UTC	10/06/2019	42	Vastra Gotalands lan	Sweden
Flash Flood	10/06/2019 00UTC	10/06/2019	42	Hallands lan	Sweden
Flash Flood	10/06/2019 00UTC	10/06/2019	36	East Riding of Yorkshire	United Kingdom
Flash Flood	10/06/2019 00UTC	10/06/2019	36	Barnsley, Doncaster and	United Kingdom
Flash Flood	10/06/2019 00UTC	10/06/2019	36	North Nottinghamshire	United Kingdom
Flash Flood	10/06/2019 00UTC	10/06/2019	36	Lincolnshire	United Kingdom
Flash Flood	10/06/2019 00UTC	10/06/2019	30	Magdeburg, Kreisfreie	Germany
Flash Flood	10/06/2019 00UTC	10/06/2019	36	North and North East Lin-	United Kingdom
Flash Flood	10/06/2019 12UTC	11/06/2019	30	Ostergotlands lan	Sweden
Flash Flood	11/06/2019 00UTC	11/06/2019	30	Bolzano-Bozen	Italy
Flash Flood	11/06/2019 00UTC	11/06/2019	42	Trento	Italy
Flash Flood	12/06/2019 00UTC	12/06/2019	30	Tyneside	United Kingdom
Flash Flood	12/06/2019 00UTC	12/06/2019	30	Northumberland	United Kingdom
Flash Flood	13/06/2019 00UTC	13/06/2019	30	Elblaski	Poland
Flash Flood	17/06/2019 00UTC	17/06/2019	60	Lincolnshire	United Kingdom
Flash Flood	17/06/2019 12UTC	18/06/2019	42	Lincolnshire	United Kingdom
Flash Flood	17/06/2019 12UTC	18/06/2019	48	Cambridgeshire CC	United Kingdom
Flash Flood	17/06/2019 12UTC	18/06/2019	42	Leicestershire CC and Rut-	United Kingdom
Flash Flood	17/06/2019 12UTC	18/06/2019	42	Leicestershire CC and Rut-	United Kingdom
Flash Flood	17/06/2019 12UTC	18/06/2019	48	Cambridgeshire CC	United Kingdom
Flash Flood	19/06/2019 12UTC	20/06/2019	72	Tiroler Oberland	Austria
Flash Flood	20/06/2019 00UTC	20/06/2019	36	Salzburg Und Umgebung	Austria
Flash Flood	20/06/2019 00UTC	20/06/2019	24	Miesbach	Germany
Flash Flood	20/06/2019 00UTC	20/06/2019	24	Berchtesgadener Land	Germany
Flash Flood	21/06/2019 00UTC	21/06/2019	54	Niederosterreich-Sud	Austria
Flash Flood	21/06/2019 12UTC	22/06/2019	54	Vas	Hungary
Flash Flood	21/06/2019 12UTC	22/06/2019	54	Brest	Belarus
Flash Flood	21/06/2019 12UTC	22/06/2019	54	Nordburgenland	Austria
Flash Flood	21/06/2019 12UTC	22/06/2019	42	Rivne	Ukraine
Flash Flood	21/06/2019 12UTC	22/06/2019	24	Tiroler Oberland	Austria
Flash Flood	21/06/2019 12UTC	22/06/2019	36	L'viv	Ukraine
Flash Flood	21/06/2019 12UTC	22/06/2019	36	Volyn	Ukraine
Flash Flood	21/06/2019 12UTC	22/06/2019	54	Wiener Umland/Nordteil	Austria
Flash Flood	21/06/2019 12UTC	22/06/2019	48	Wiener Umland/Sudteil	Austria
Flash Flood	21/06/2019 12UTC	22/06/2019	54	Gyor-Moson-Sopron	Hungary
Flash Flood	22/06/2019 00UTC	22/06/2019	60	Republika Srpska	B. & Herzegovina
Flash Flood	22/06/2019 00UTC	22/06/2019	24	Weilheim-Schongau	Germany
Flash Flood	22/06/2019 00UTC	22/06/2019	24	Graz	Austria
Flash Flood	22/06/2019 00UTC	22/06/2019	30	Lublin	Poland, Ukraine
Flash Flood	22/06/2019 00UTC	22/06/2019	36	Sudburgenland	Austria

Flash Flood	22/06/2019 00UTC	22/06/2019	24	West- und Sudsteiermark	Austria
Flash Flood	22/06/2019 00UTC	22/06/2019	48	Kolubarski	R. Serbia
Flash Flood	22/06/2019 00UTC	22/06/2019	36	Fejer	Hungary
Flash Flood	22/06/2019 00UTC	22/06/2019	42	Somogy	Hungary
Flash Flood	22/06/2019 00UTC	22/06/2019	60	Macvanski	R. Serbia
Flash Flood	22/06/2019 12UTC	23/06/2019	24	Veszprem	Hungary
Flash Flood	22/06/2019 12UTC	23/06/2019	24	Jihocesky kraj	Czech Republic
Flash Flood	22/06/2019 12UTC	23/06/2019	42	Caras-Severin	Romania
Flash Flood	22/06/2019 12UTC	23/06/2019	24	Neamt	Romania
Flash Flood	22/06/2019 12UTC	23/06/2019	24	Weinviertel	Austria, Slovakia
Flash Flood	22/06/2019 12UTC	23/06/2019	24	Oststeiermark	Austria
Flash Flood	22/06/2019 12UTC	23/06/2019	24	Waldviertel	Austria
Flash Flood	22/06/2019 12UTC	23/06/2019	24	Bratislavsky kraj	Slovakia
Flash Flood	22/06/2019 12UTC	23/06/2019	24	Zala	Hungary
Flash Flood	23/06/2019 00UTC	23/06/2019	36	Sremski	R. Serbia
Flash Flood	23/06/2019 00UTC	23/06/2019	30	Branicevski	R. Serbia
Flash Flood	23/06/2019 00UTC	23/06/2019	24	Juzno-Banatski	R. Serbia
Flash Flood	23/06/2019 00UTC	23/06/2019	36	Sremski	R. Serbia
Flash Flood	23/06/2019 00UTC	23/06/2019	30	Srednje-Banatski	R. Serbia
Flash Flood	23/06/2019 12UTC	24/06/2019	42	Worcestershire	United Kingdom
Flash Flood	23/06/2019 12UTC	24/06/2019	30	Leon	Spain
Flash Flood	23/06/2019 12UTC	24/06/2019	30	Bacau	Romania
Flash Flood	23/06/2019 12UTC	24/06/2019	42	West Surrey	United Kingdom
Flash Flood	23/06/2019 12UTC	24/06/2019	24	Hunedoara	Romania
Flash Flood	23/06/2019 12UTC	24/06/2019	30	Mehedinti	Romania, R. Ser-
Flash Flood	25/06/2019 00UTC	25/06/2019	36	Sofia	Bulgaria
Flash Flood	26/06/2019 12UTC	27/06/2019	42	Covasna	Romania
Flash Flood	26/06/2019 12UTC	27/06/2019	48	Tver'	Russian Federa-
Flash Flood	27/06/2019 00UTC	27/06/2019	30	Novgorod	Russian Federa-
Flash Flood	27/06/2019 00UTC	27/06/2019	30	Brasov	Romania
Flash Flood	27/06/2019 00UTC	27/06/2019	18	Salaj	Romania
Flash Flood	27/06/2019 00UTC	27/06/2019	30	Prahova	Romania
Flash Flood	05/07/2019 12UTC	06/07/2019	60	Bihor	Romania
Flash Flood	06/07/2019 12UTC	07/07/2019	60	Kherson	Ukraine
Flash Flood	06/07/2019 12UTC	07/07/2019	30	Zala	Hungary
Flash Flood	06/07/2019 12UTC	07/07/2019	54	Dnipropetrovs'k	Ukraine
Flash Flood	06/07/2019 12UTC	07/07/2019	54	Mykolayiv	Ukraine
Flash Flood	08/07/2019 00UTC	08/07/2019	78	Smolyan	Bulgaria
Flash Flood	08/07/2019 00UTC	08/07/2019	36	Zaragoza	Spain
Flash Flood	08/07/2019 00UTC	08/07/2019	24	La Rioja	Spain
Flash Flood	08/07/2019 00UTC	08/07/2019	36	La Rioja	Spain
Flash Flood	08/07/2019 00UTC	08/07/2019	36	La Rioja	Spain
Flash Flood	08/07/2019 00UTC	08/07/2019	72	Sofia (stolitsa)	Bulgaria
Flash Flood	08/07/2019 12UTC	09/07/2019	60	Vratsa	Bulgaria
Flash Flood	08/07/2019 12UTC	09/07/2019	66	Shumen	Bulgaria
Flash Flood	10/07/2019 00UTC	10/07/2019	30	Blagoevgrad	Bulgaria
Flash Flood	10/07/2019 00UTC	10/07/2019	30	Drama	Greece
Flash Flood	12/07/2019 12UTC	13/07/2019	48	Vratsa	Bulgaria
Flash Flood	13/07/2019 00UTC	13/07/2019	60	Prahova	Romania
Flash Flood	13/07/2019 12UTC	14/07/2019	24	Sofia	Bulgaria
Flash Flood	13/07/2019 12UTC	14/07/2019	42	Brasov	Romania

Flash Flood	14/07/2019 00UTC	14/07/2019	30	Neamt	Romania
Flash Flood	14/07/2019 00UTC	14/07/2019	30	Chernivtsi	Ukraine
Flash Flood	14/07/2019 12UTC	15/07/2019	36	Riscani	Moldova
Flash Flood	14/07/2019 12UTC	15/07/2019	36	Edinet	Moldova
Flash Flood	14/07/2019 12UTC	15/07/2019	36	Botosani	Moldova, Rom.
Flash Flood	14/07/2019 12UTC	15/07/2019	24	Suceava	Romania
Flash Flood	21/07/2019 00UTC	21/07/2019	24	Elcki	Poland
Flash Flood	25/07/2019 12UTC	26/07/2019	72	Valais	Switzerland
Flash Flood	26/07/2019 12UTC	27/07/2019	72	Straubing, Kreisfreie Stadt	Germany
Flash Flood	26/07/2019 12UTC	27/07/2019	54	Gorizia	Italy
Flash Flood	26/07/2019 12UTC	27/07/2019	60	Rosenheim, Landkreis	Germany
Flash Flood	26/07/2019 12UTC	27/07/2019	48	Udine	Italy
Flash Flood	26/07/2019 12UTC	27/07/2019	60	Altotting	Germany
Flash Flood	27/07/2019 00UTC	27/07/2019	36	Solothurn	Switzerland
Flash Flood	27/07/2019 00UTC	27/07/2019	42	Haut-Rhin	France
Flash Flood	27/07/2019 00UTC	27/07/2019	36	Haut-Rhin	France
Flash Flood	27/07/2019 00UTC	27/07/2019	36	Bern	Switzerland
Flash Flood	27/07/2019 00UTC	27/07/2019	30	Isere	France
Flash Flood	27/07/2019 00UTC	27/07/2019	36	Drome	France
Flash Flood	27/07/2019 00UTC	27/07/2019	42	Konstanz	Switzerland
Flash Flood	27/07/2019 00UTC	27/07/2019	36	Aargau	Switzerland
Flash Flood	27/07/2019 00UTC	27/07/2019	42	Zurich	Switzerland
Flash Flood	27/07/2019 00UTC	27/07/2019	42	Schaffhausen	Switzerland
Flash Flood	27/07/2019 12UTC	28/07/2019	24	Mantova	Italy
Flash Flood	27/07/2019 12UTC	28/07/2019	24	Pavia	Italy
Flash Flood	27/07/2019 12UTC	28/07/2019	42	Pinzgau-Pongau	Austria
Flash Flood	27/07/2019 12UTC	28/07/2019	36	Rheintal-Bodenseegebiet	Austria
Flash Flood	27/07/2019 12UTC	28/07/2019	24	Brescia	Italy
Flash Flood	28/07/2019 00UTC	28/07/2019	24	Staffordshire CC	United Kingdom
Flash Flood	28/07/2019 00UTC	28/07/2019	12	Coventry	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.

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