European Flood Awareness System

EFAS *Bulletin*

April – May 2019

Issue 2019(3)

NEWS

New features

EFAS v3 released on 13 May 2019

EFAS version 3 (technical full name version 3.0.0) was released on 13 May 2019, with the 12 UTC being the first forecast in operations. The new release contains an update in the calculation of evapotranspiration, which now uses the Penman-Monteith formula. The change yields slightly wetter conditions, especially for the soil moisture and discharge, which can also influence the EFAS and ERIC reporting points. For more information on this change and previous changes to the EFAS versioning system, please see link EFAS v 3.0.0

EFAS forecasts now available as OGC WMS Service

EFAS forecasts are now available as OGC Web Map Service (WMS) for partners and non-registered users. You can import the EFAS maps into your preferred working environment via a web service. As for the forecasts on EFAS-IS, real-time data is only accessible to registered users, but forecasts older than 30 days are freely available for everyone. The link to the WMS Service can be found under the section EFAS web services.

EFAS data in the Copernicus Climate Data Store

The EFAS data has now been made available through the Copernicus Climate Data store to all users. There are two datasets on CDS; the EFAS forecasts, and EFAS historical simulations. The latter are simulations forced with observed precipitation and temperature over almost 30 years, from 1991-near real time. The EFAS forecasts are the operational forecasts with a delay of 30 days. The data is available to use under a Copernicus data license.

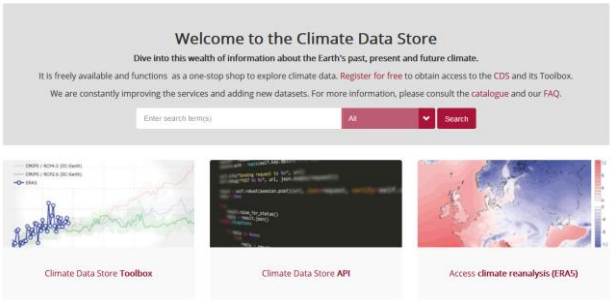

Figure 1. The Copernicus Climate data store

The first climatology that was available on CDS was EFAS version 2, and the new EFAS v3 has since then been made available.

The publication of EFAS data in CDS was a collaboration between the two Copernicus services C3S and CEMS-Floods. Links to the data can be found on the Data Download page. Note that the documentation of the data is kept on the CDS as well as on the EFAS wiki pages.

Meetings

14th EFAS annual meeting

The EFAS annual meeting in 2019 was held in Stresa, Italy, and was a joint meeting for all CEMS services. A total of 200 people attended the meeting. For a full report of the meeting relating to EFAS, please see article in this issue.

WMO RA VI Hydrology Forum 2019

The WMO Regional Association VI Hydrology Forum took place in Bratislava, Slovakia on 2-4 April 2019 and was hosted by the Slovak Hydrometeorological Institute. The Hydrology Forum is a platform for members of the WMO Regional Association VI (Europe) to exchange good practices and technical solutions in hydrology and promote approaches that will improve the cost-efficiency of monitoring systems.

56 experts from more than 30 countries of RA VI, from Iceland to Kazakhstan, participated in the meeting. It was focused on Hydrological data. The role of hydrological service, hydrological information and data, their availability and exchange. Hydrological products were discussed as well.

Country case studies on redesigning and outsourcing of the monitoring network, comparison of traditional and new measurement techniques and data availability were presented. Questions on open data, network redesign, traditional versus modern measurement techniques were addressed in smaller groups discussions. Within the section Dialogue with Stakeholders Eric Sprokkereef from the EFAS Dissemination Centre described recent developments in EFAS and GLOFAS. Furthermore, participants were apprised of WMO activities and UN global initiatives. All presentations are available at RA VI Hydrology Forum dedicated web page.

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 updates!

IUGG 2019
The 27th IUGG General Assembly marks the 100th anniversary of IUGG and is a special opportunity for participants from around the world to come together and share their science and culture. As usually, there will be a host of scientific activities, including special public lectures, keynote Union lectures and a wide variety of themed sessions. Scientific insights in hydrological forecasting will be presented in several sessions, covering applications at time scales from short to seasonal (see sessions).

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 28 formal and 17 informal EFAS flood notifications issued in April-May 2019 are summarised in Table 1. The locations of all notifications are shown in Figure 28 and Figure 30 in the appendix.

359 Flash flood notification were issued in April - May 2019. They are summarised in Table 2. The locations of all notifications are shown in Figure 29 and Figure 31 in the appendix.

Meteorological situation

by EFAS Meteorological Data Collection Centre

April
The meteorological situation in April 2019 was characterized by persisting high-pressure systems over northern Europe. Precipitation totals were above the long term means in the southern parts and mostly below in the northern parts of the EFAS domain. The monthly mean air temperature was in the southwestern, south-eastern and northeastern parts of the EFAS domain below the long term mean and in the central and northern parts above.

At the beginning of April, a high-pressure system was located over Scandinavia and northeastern Europe. A low-pressure system moved from Iceland via Great Britain and Ireland and dissipated in the Bay of Biscay. Later, one low-pressure system developed over the eastern Baltic Sea and another one over the Balkans. The later one caused heavy rain accompanied by Flash floods in the Aegean Sea. Both low-pressure systems did not move a lot before dissolving. By mid-April, the high-pressure system occurred again over Scandinavia. Meteorological events were mainly forced by upper-level activities. Around Easter, a low-pressure system moved from the Atlantic Ocean to the Iberian Peninsula causing floods in Spain. Remains from this system merged with another low-pressure system near Iceland, leading to intense precipitation events in northern Italy and southern France, forcing the high-pressure system to start moving eastward.

Monthly precipitation amounts were up to 414 mm in April 2019. The highest precipitation totals were observed at the Iberian Peninsula and the northern coast of the Mediterranean Sea and at the border between Turkey and Iraq (Figure 14). Nearly no precipitation, due to the persistent high-pressure systems, was observed in the Baltic and eastward and southward adjacent regions as well as some regions in Scandinavia causing a drought situation there. The northern part of the EFAS domain received less than normal and most regions of the southern part of the EFAS domain received more the normal precipitation amounts relative to long term means (Figure 15).

The monthly mean air temperatures ranged from -12°C to 28°C with the highest temperatures in the southern part and lowest temperatures in the northern and

mountainous parts of the EFAS domain (Figure 18). Temperature anomalies ranged from -6°C to 7°C, with many regions around the Mediterranean Sea and northeast Europe having below normal temperatures (Figure 19). Abnormally warm temperatures were observed in central and eastern Europe, Scandinavia, western Balkans and the southernmost regions of the EFAS domain.

May

The meteorological situation in May 2019 was characterized by high activity of low-pressure systems in most of the EFAS domain, except for northern Africa and the Iberian Peninsula which were influenced by persistent high-pressure systems. Precipitation totals were above the long term means in a large area from the central Mediterranean region to Scandinavia. The monthly mean temperature was above the long-term means in the east and west and below in the middle of the EFAS domain.

At the beginning of May, a large low-pressure system developed over Scandinavia, whereas a secondary depression caused intense rain and snowfall in the Alps and northern Italy. Another low-pressure system developed near Newfoundland and moved over the Atlantic Ocean and Great Britain and Ireland to Scandinavia and replaced the first one, bringing a lot of precipitation to Great Britain, France and northern Spain. A weak upper-level low-pressure system caused intense precipitation events in Romania. As the Azores high extended northward, a high-pressure ridge developed together with a high-pressure system at the ground, forcing the low-pressure system over Scandinavia to move northward and initiate the development of a small low-pressure system over northern Italy, moving in the next days around and causing intense precipitation and floods not only in Italy, but also in Slovenia, Croatia, Bosnia-Herzegovina and Corsica.

Later, another low-pressure system southeast of Greenland initiated the development of a secondary depression over the Bay of Biscay and the Iberian Peninsula, which moved over central Europe causing high precipitation totals in a region between central Germany and the Alps in the west, and western Ukraine in the east. Yet another low-pressure system developed over Scotland and moved via the North Sea to Scandinavia, causing a lot of precipitation over Great Britain, Scandinavia and Western Russia. In the last days of the month, an upper-level low-pressure system moved from the Central Mediterranean region to the Balkans and brought intense precipitation to this region, but also the Alps and Romania.

In May 2019, the highest monthly precipitation totals were observed in Italy, around the Adriatic Sea, Alps and Carpathian Mountains, but also in Scandinavia, northern Pyrenees and eastern Caucasus (Figure 16). Nearly no precipitation fell in some parts of the Iberian Peninsula and the southeaster part of the Mediterranean region. Less than normal precipitation fell in northwest Africa, the Iberian Peninsula, eastern Mediterranean region, Iceland, parts of Great Britain, France, western Alps and northern Germany, but also between the Black Sea and Caspian Sea and parts of Russia and Kazakhstan (Figure 17). More than normal precipitation was observed in the central Mediterranean region, southeast Europe and Scandinavia.

The monthly mean air temperature ranged from -7.7°C to 33.9°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 20). Temperature anomalies ranged from -8°C to 10 °C, with below normal temperatures in the middle of the EFAS domain and Scandinavia (Figure 21). Extremely high temperatures were observed in the southeast of the EFAS domain, Eastern Europe and the Asian parts of the EFAS domain as well as on the Iberian Peninsula and in northwest Africa.

Hydrological situation

by EFAS Hydrological Data Collection Centre

April

For the month of April, the highest concentration of stations that surpassed the lowest threshold level was in the Danube basin, with most stations in Croatia, Montenegro and Bosnia and Herzegovina and less in Hungary, the Slovak Republic, Rep. Serbia, Austria and Germany. There is also a remarkable concentration of stations across the Po basin in Italy and Norway. A more dispersed distribution of stations with exceedances occurred upstream the Dnieper basin, in Belarus, and the Guadalhorce and Minho rivers in Spain as well as the Jordan and Hiyon rivers in Israel. Only one station in Sweden presented exceedances, the Dalkarlsan river.

Stations that registered discharge values above the 90% quantile are mostly located across Norway, Finland and Sweden. This occurred less frequently for stations along the Inn, Drave and Isel rivers, upstream the Danube basin in Austria.

Stations registering values below the 10% quantile are mainly located in Central Europe, in the Rhine, Elbe, Oder, Vistula basins, upstream and midstream the Danube basin (Austria, Slovakia, Czech Republic, Romania and Rep. Serbia), and finally in the Dnieper basin. A lower concentration of stations is found across the United Kingdom (two stations in the Thames Basin), Sweden (Liden and Mossan rivers), and Spain in the Ebro and Ter basins.

May

For May, the highest concentration of stations that exceeded their lowest threshold level is located in the Danube basin, mainly in the Sava and Tisza river basins but also in tributaries in northern and central area, with most stations in Croatia, Montenegro and Bosnia-Herzegovina, Hungary, the Slovak Republic, Rep. Serbia and Germany. There is also a remarkable concentration of stations across the Po basin in Italy, Norway, Oder and Vistula basins in Poland and Rhine river basin in southern Germany and Northern Switzerland.

A more dispersed distribution of stations with exceedances occurred along the Dnieper river in Belarus and Ukraine and Dniester river, also in Ukraine and across the Neretva river in Bosnia-Herzegovina, Ammeran and Langsjonbacken rivers in Sweden, Mihno, Llobregat, Guadiaro and Andarax 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 the Sava and Tisza river basins, the Vistula river in southern Poland and Dnieper and Dniester river basins in western Ukraine. This occurred less frequently for stations along the Rhine river basin in Germany, western Danube river basin in Austria and Germany, Oder river basin in Poland, Ebro river basin in north-eastern Spain and the Thames river basin in England.

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

Publications

Zsoter, E., H. Cloke, E. Stephens, P. de Rosnay, J. Muñoz-Sabater, C. Prudhomme, and F. Pappenberger, How well do operational Numerical Weather Prediction configurations represent hydrology?. *J. Hydrometeor.,* https://doi.org/10.1175/JHM-D-18-0086.1

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 April to May 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, which is slightly different than we used previously and very difficult to beat.

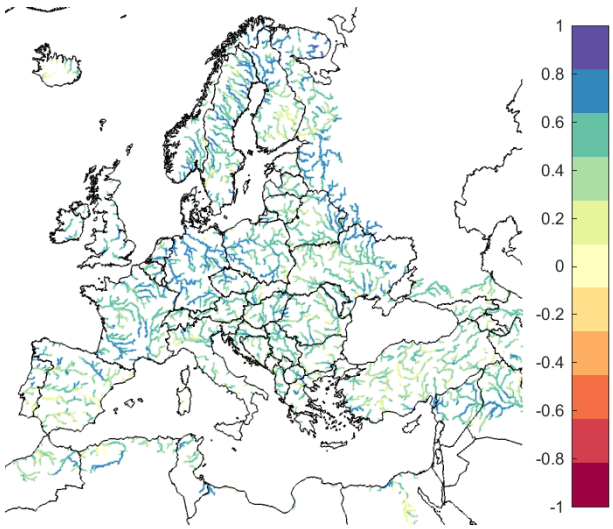

Figure 2. EFAS CRPSS at lead-time 1 day for the April-May 2019 period, for catchments >2000km2. The reference score is persistence of using previous day's forecast.

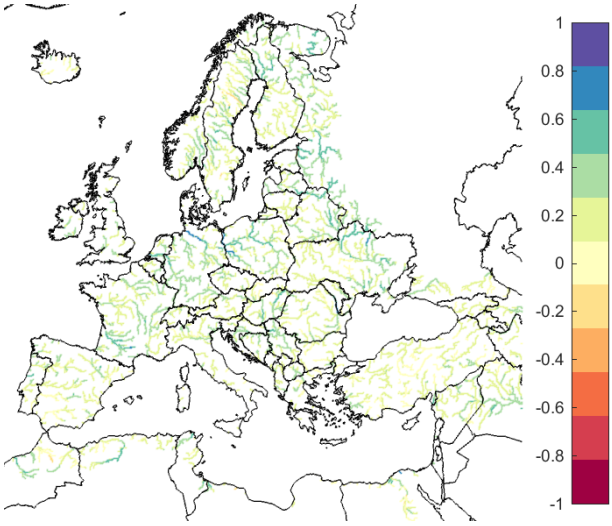

Figure 3. EFAS CRPSS at lead-time 5 days for the April-May 2019 period, for catchments >2000km2. The reference score is persistence of using previous day's forecast.

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 in the central and eastern parts of Europe over the period than in the northern and southern parts of Europe. The skill at day 5 was somewhat lower than usual for the period.

ARTICLES

Operational forecasting and warning systems for natural hazards–scientific outreach during EGU2019

by Ilias Pechlivanidis (SMHI, Sweden), Michaela Mikulicková (SMHU, Slovakia), Eric Sprokkereef (RWS, Netherlands)

Due to the high need from different sectors, there is a continuous effort to disseminate the challenges and highlight the innovation in operational and impact forecasting, preparedness and decision-making in natural hazards. Among the various events and workshops, the European Geosciences Union (EGU) 2019 General Assembly, and the WMO RA VI Hydrology Forum 2019 are couple to highlight.

EGU 2019

EGU 2019 was once again a great success, bringing together about 16,300 scientists from 113 countries in Vienna, Austria, on the 7-12 April. In particular, the HS4.3.1/NH1.35 PICO session "Operational forecasting and warning systems for natural hazards: challenges and innovation" has been gaining popularity among the various sessions in hydrological forecasting, supported from the HEPEX scientific initiative. Over the two session slots, 29 presentations were given overflowing the available space (Figure 4).

Figure 4. Delegates at the PICO session on operational forecasting and warning systems for natural hazards. Kyriakos Kandris (EMVIS Consultant Engineers) presents the Space-O operational platform.

The field of natural hazards covers a wide range of expertise, and consequently the PICO session attracted contributions from, among others, flooding, tsunami,

volcano, landslide, maritime, ecology, risk from extremes, response preparedness, impact forecasting, and disaster relief. The session was, as in the previous years, a step forward to bridge the gap between scientists, water managers, users, and decision-makers and allow co-evolution of knowledge. The 29 presenters highlighted the various efforts on the development and operation of services around the world with applications at scales from regional to global. Attention was given towards disseminating predictions in an easily understood, particularly from the users-side, manner.

A key message was that "A service is not ready when it is launched, but rather when it is understood by its users". Some presentations highlighted the efforts to support emergency services, e.g. the Copernicus Emergency Management Service, the Red Cross, and the Emergency Response Coordination Centre, which required timely provided information at local, regional and national scales. Services co-generated for addressing user-needs at sub-seasonal (up to a month ahead) to seasonal scales (up to a year ahead) seem to have been increased; however, services addressing societal needs up to few days ahead are present and continuously improved. A subset of the PICO presentations is given below.

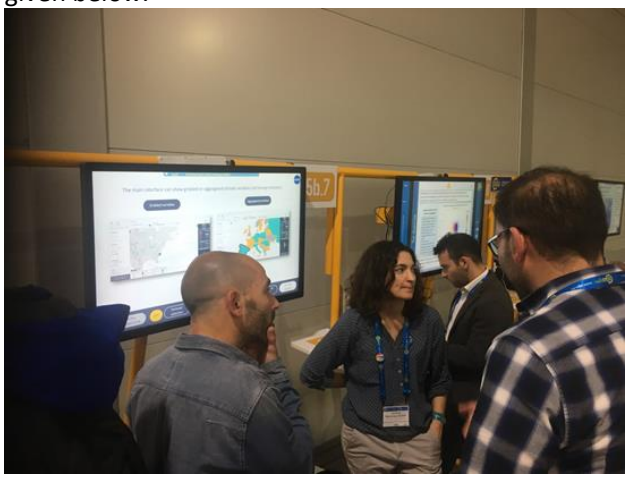

Figure 5. Andrea Manrique (BSC) presenting the S2S4E Decision Support Tool that provides operational sub-seasonal to seasonal forecasts for the renewable energy decision-makers.

To address the European user needs for the energy sector, industrial and research partners in the S2S4E project, funded by the Horizon 2020 programme and coordinated by the Barcelona Supercomputing Centre, developed an operational service to provide sub-seasonal to seasonal forecasts of essential climate variables and indicators, and consequently assist in renewable energy decision-making (Figure 5). The service integrates for the first time sub-seasonal and seasonal predictions in the same platform in a seamless way. The tool is designed for both the lay user and the advanced technician, displaying both basic and intuitive information for skill, information about extreme events and general climatology (see details).

Figure 6. Bart van den Hurk (previously at KNMI, and currently at Deltares) presenting the IMPREX risk outlook tool for extreme hydro-climatic events

To improve the way in which extreme European hydrological events are managed, research partners of the IMPREX project, funded by the Horizon 2020 programme and coordinated by KNMI, demonstrated the use of (semi-) operational products in a risk outlook tool in order to improve awareness and preparedness (Figure 6). The tool provides information at the seasonal timescale which allows planning and implementation of action in many operational environments and matches the timescale of droughts. In this demonstration of the IMPREX Risk Outlook Tool, openly available European hydro-meteorological forecast data resources were demonstrated, and historical forecasts were interpreted to provide seasonal forecast guidance and hence address the water-relevant concerns of users.

In summary, this PICO session brought together the expertise from a unique panel of scientists-managers-policy makers and gave them the opportunity to explore differences, similarities, problems and solutions between forecasting systems for varying natural hazards. It is not an easy task to thoroughly present the efforts at the international level; participation in similar sessions is therefore important and therefore highly recommended. A similar PICO will take place next year at EGU 2020 (Vienna, 3-8 May).

14th EFAS Annual Meeting 2019, Stresa, Italy

by EFAS Dissemination Centre

More than 200 people participated at the Copernicus Emergency Management Service (CEMS) 2019 annual meeting which took place in Stresa (Italy) on May 21-22. The meeting was organized by the Joint Research Centre (JRC) with the support from DG ECHO and DG GROW of the European Commission. CEMS provides information for emergency response in relation to different types of disasters, including meteorological hazards, geophysical hazards, deliberate and accidental man-made disasters and other humanitarian disasters as well as prevention, preparedness, response and recovery activities. The CEMS is composed of an on-demand mapping component providing rapid maps for emergency response and risk and recovery maps for prevention and planning and of the early warning and monitoring component which includes systems for floods, droughts and forest fires. Information about monitored and forecasted disasters is also disseminated to the European Emergency Response Coordination Centre (ERCC) to decide upon activation of aid mechanisms.

The European Flood Awareness System (EFAS) forms a central component of the CEMS-Flooding service and met this year for the 14th time, with 84 participants from more than 50 partner organisations and 6 poster presentations. The meeting this year focused on the new EFAS-IS, updates to the feedback mechanism, downloading and integrating EFAS data and the on-going 6 hourly calibration of LISFLOOD. Four parallel workshop sessions were held giving all partners opportunities to learn about new products and features and to contribute to the future development of the EFAS.

Joint sessions

The CEMS meeting was introduced by representatives from each of the five disciplines - risk & recovery mapping, rapid mapping, flood, forest fires and drought early warning & management - and followed by key note speeches by Roger Pulwarty, NOAA (Climate change, disaster risk and adaptation), Stefan Voigt, German Aerospace Center, DLR (The future of satellite mapping for disasters) and Florian Pappenberger, ECMWF (The future of weather hazards forecasting). A joint session was later held between the satellite mapping and EFAS communities, focussing on the role of the image pre-tasking for Rapid Mapping and examples of flood delineation along the Elbe and Vltava catchment.

Achievements during the last year

The EFAS DISS presented the five new partners that have joined EFAS since the last annual meeting - The National Environmental Agency of Georgia (NEA), Georgia; The Icelandic Meteorological Office (IMO), Iceland; Agenzia Regionale per la Protezione dell'Ambiente della Lombardia (ARPA Lombardia), Italy; Dipartimentodella ProtezioneCivile, Italy; and Confederación Hidrográfica del Segura (CH Segura), Spain - and provided a preliminary analysis of partner satisfaction over the period. It was also stressed that partners should take the opportunity to request EFAS training within their own institute, building on the successful training delivered to the Hydrometeorological Research Centre of Russia in 2018.

Figure 7. Peter Salamon, JRC, introduces the EFAS to the CEMS community.

The HDCC presented their successful mission to Georgia, after which the hydrological network in EFAS has been expanded considerably. In total, more than 1500 stations have been incorporated into the EFAS network during 2018 and 2019, predominantly from France, Iceland and Spain, but also Slovakia, Estonia, Croatia,

Lithuania and Georgia. The shift towards 6 hourly observations from the current daily aggregation was also presented, to support the on-going 6-hourly calibration of the LISFLOOD model. Similarly, the MDCC presented their work in generating 6 hourly grids of precipitation and temperature to support the new 6-hourly LISFLOOD model, and incorporation of new data providers from Meteo Swiss, Meteo Luxembourg, IMGW Poland, Finland FMI, the Environment Agency, England and Kosovo HMI.

Finally, EFAS COMP presented their extensive work in updating the EFAS interface (EFAS-IS) and new website, which was released in early 2019. In addition, the extended domain was made available in May 2018 and evapotranspiration routines were modified to use the Penman-Montieth formulation in early 2019 (LISVAP), with improvements primarily to the ERIC and seasonal forecast products. Improvements were also made to Reporting Point generation, alongside other "behind-the-scenes" changes that have optimised the operational system.

Feedback

EFAS DISS presented the new feedback procedure that has been introduced alongside the new EFAS-IS. Feedback can now be left directly within the interface, by either following a link within the formal notification email or, in the case of missed events, by clicking on the map viewer. It is hoped that this improvement will facilitate the feedback process and in doing so improve the quality of EFAS notifications.

What's next for EFAS?

Peter Salamon of the JRC presented the main developments that are planned for EFAS during the next year. These included:

- a move to a 6-hourly temporal resolution
- introduction of so-called fixed reporting points that are located at river gauges and can be queried at any time
- the SMUFF project, which will provide rapidly updating high resolution nowcasts of Flash flood hazard within EFAS
- introduction of version control within EFAS
- improvements to data access for EFAS, via the ECMWF MARS archive and WMS-T and SOS services
- availability of the LISFLOOD source code as an open source model

A session on open data was also held, following on from the fruitful discussion held during the previous annual meeting in Sweden in 2018. A case study was presented by the German meteorological institute (DWD), demonstrating the positive aspects of moving towards a more open data policy. The proposal presented by the JRC represents a compromise of the initial proposal presented one year ago, with more limited access to real-time datasets - focussing primarily on datasets used for model initialisation - and no provision of forecast products. A formal proposal and vote is planned for 2020's annual meeting.

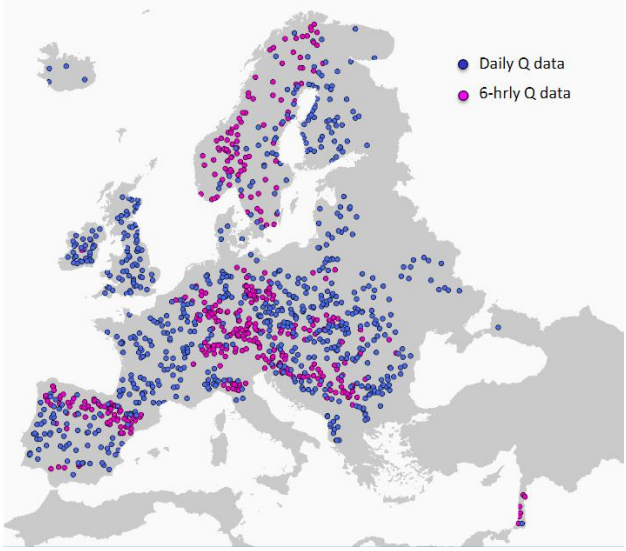

Figure 8. Calibration stations used in the new 6-hourly timestep LISFLOOD model.

Cinzia Mazzetti of the ECMWF provided a more detailed summary of the changes being made as part of the 6-hourly LISFLOOD calibration on the second day of the meeting. The calibration is based on 1150 stations (compared to 572 in the previous calibration), 359 of which include 6 hourly data, and is automated and run on the ECMWF's HPC cluster. Parameters that have been calibrated include groundwater constants, percolation and infiltration coefficients, soil bypass flow, snow melt, Manning's coefficients and reservoir adjustments. Initial results show significant improvement in the presented representative catchments in the Rhine and Po basins, with NSE and KGE criteria consistently between 0.7 and 0.8, compared to previously 0.1 to 0.6. The new calibration along with the 6-hourly model is planned to be released in 2020.

Workshops
Parallel workshops were held, focussing on:

- The new EFAS interface
- Downloading and integrating EFAS data

Attendees were divided into smaller groups for the first workshop and given the opportunity to provide feedback on the new EFAS interface and discuss potential improvements that can be made moving forwards. It was clear from all participants that the new interface is seen as a considerable improvement, providing a solid foundation for future product development within the EFAS system. A prioritised list of potential improvements will now be collated by both the EFAS DISS, COMP and JRC and included in a future development plan.

Figure 9. Discussion on the new EFAS-IS during one of the parallel subgroup discussions.

In the second workshop, partners were given the opportunity to look at new tools developed by COMP that will enable EFAS data to be more easily integrated their own operational systems. It is hoped that the tools can now be tested and feedback provided to improve the dissemination of EFAS products.

Summary
The joint CEMS meeting concluded with a message to all participants from Peter Billing of the DG ECHO, outlining the importance of the CEMS initiative at both the European and global scales and emphasising its uniqueness within the field of emergency management. The success of a joint meeting was immediately clear, with many networking opportunities and knowledge sharing across different disciplines. It is hoped that this can be repeated in the near future.

Report on the flooding in Crete, Greece in April 2019

by Richard Davies (FloodList)

A period of stormy weather caused flooding and landslides in Italy, Croatia and Bosnia and Herzegovina from 12 May 2019.

Italy
In Italy, heavy rain and overflowing rivers caused flooding in parts of the Emilia-Romagna Region. According to the region's meteorological agency Arpae Emilia-Romagna, several areas recorded more than 100 mm of rain in 24 hours on Sunday, 12 May, and around 70 mm the next day. The Savio River at Castiglione di Ravenna near Cesena jumped from 1.53 metres on 12 May to 9.8 metres the next evening. Vigili del Fuoco, the Italian Fire Service, carried out flood rescues in Cesena. Parts of the Bologna-Rimini train line was temporarily closed. For a detailed study of the Emilia-Romagna floods, please see the report below in this issue.

Figure 10. A bridge collapsed in Verucchio, near Rimini. Credit: Comune di Verucchio/Facebook.

Areas of Villafranca-San Martino in the province of Forlì-Cesena were flooded after the Montone river broke its banks. The Montone river at Ponte Vico jumped from 1.5 metres on 12 May to 8.83 metres on the evening of 13 May. Flooding also caused a bridge to collapse in Verucchio in the Province of Rimini.

Croatia
Heavy rain in Croatia also caused rivers to rise rapidly during this period. Civil Protection reported they had raised flood defences in Hrvatska Kostajnica and Karlovac. Local media said fire services have been called

on to rescue several people from flood waters. According to Croatia Water (Hrvatske vode) on 15 May the Una river stood at 4.64 metres at Hrvatska Kostajnica, and the Korana at 7.87 metres at Karlovac, both red alert levels. Meanwhile the Sava river at Jasenovac jumped to 8.05 m, which is orange alert level. Strong winds of had also affected parts of the country from 12 May, in particular in Zagreb, where 4 people were injured, and buildings, tree and power lines were damaged.

Figure 11. Flooding in Bosnia, May 2019. Credit: Federalna Uprava Civilne Zaštite

Bosnia and Herzegovina

In Bosnia and Herzegovina, Civil Protection Agency (Federalna Uprava Civilne Zaštite – FUCZ) said on 14 May that a state of natural disaster was declared in Sanski Most, Bosanska Krupa, Cazin, Ključ, Banovići, Usori, Tešanj and Doboj Jug as result of "abundant precipitation." Hundreds of Civil Protection staff were deployed to affected areas including Sanski Most, Usora and Doboj Jug. Houses and crops were damaged and power and water supply severely disrupted. Flooding and landslides blocked several roads and some schools were closed.

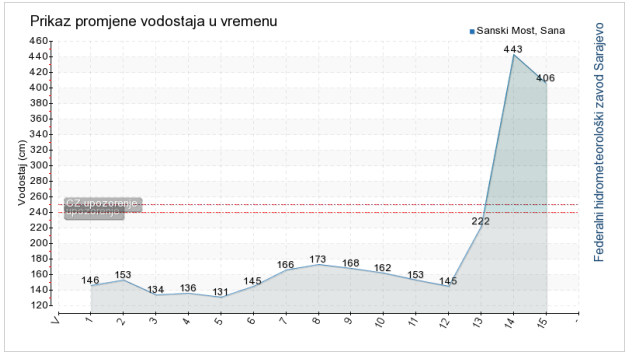

Figure 12. Sana River at Sanski Most, Bosnia, May 2019. Image; FHMZ

Federalni hidrometeorološki zavod (FHMZ), reported 84 mm of rain in Bihać in 24 hours to early 13 May and a further 53 mm the next day. The city of Banja Luka recorded 49mm to 13 May and 62 mm the next day. According to FHMZ, the Una river at Bihać reached 78cm on 14 May and the Sana at Sanski Most 4.23 metres.

EFAS notifications

There were several EFAS formal, informal and flash flood notifications issued before these events. Three flash flood notifications were issued for the Emilia-Romagna region several days ahead of the event, however they were a bit north of the most affected regions. Several formal and informal notifications were issued for the floods in Croatia and Bosnia-Herzegovina, notably for the Una and Korana river. In total 5 flash flood notifications were sent for those countries, and another 8 to neighbouring countries during the event.

Case study of the Emilia-Romagna floods in May 2019

by Ervin Zsoter, Christel Prudhomme and Corentin Carton De Wiart, EFAS Computational Centre

The weather was wetter than normal in many regions in Europe during May, such as most parts of Scandinavia and Central Europe. One area standing out was the central Mediterranean, being exceptionally wet during the whole of May. According to the ERA5 reanalysis, some parts of Italy did experience at least 2-3 times the monthly average rainfall. There were periods of heavy rain that lead to severe Flash floods and riverine floods in many areas, associated with increased landslide risk in some places.

Flood analysis

One of the badly hit areas was Emilia-Romagna which experienced severe floods on around 13 May. Some rivers were out of their banks with train lines closed and bridges damaged. The worst impacted area was the regions of the Savio and Marecchia rivers near San Marino, where in two days up to 150-200 mm rain was observed in the upstream part of these rivers. Other areas were also under severe flood threat, like the Secchia and Panaro rivers in the province of Modena, where precautionary measure, including road and bridge closures, were in place due to the expected high river levels.

The performance of EFAS forecasts was rather mixed for this event in Emilia-Romagna (Figure above). Analysis of the four hydro-meteorological forecast chains used in EFAS (with different meteorological forcings) run on 12 May at 00 UTC showed large differences between the forecasts. COSMO-LEPS- and DWD-driven forecasts (left) showed a good hydrological signal for the worst impacted area west and northwest of San Marino. This can be attributed to a good precipitation forecast, and associated river response in EFAS with 5- and 20-year level floods (DWD) and high probability of exceeding 20-year level flood (COSMO-LEPS).

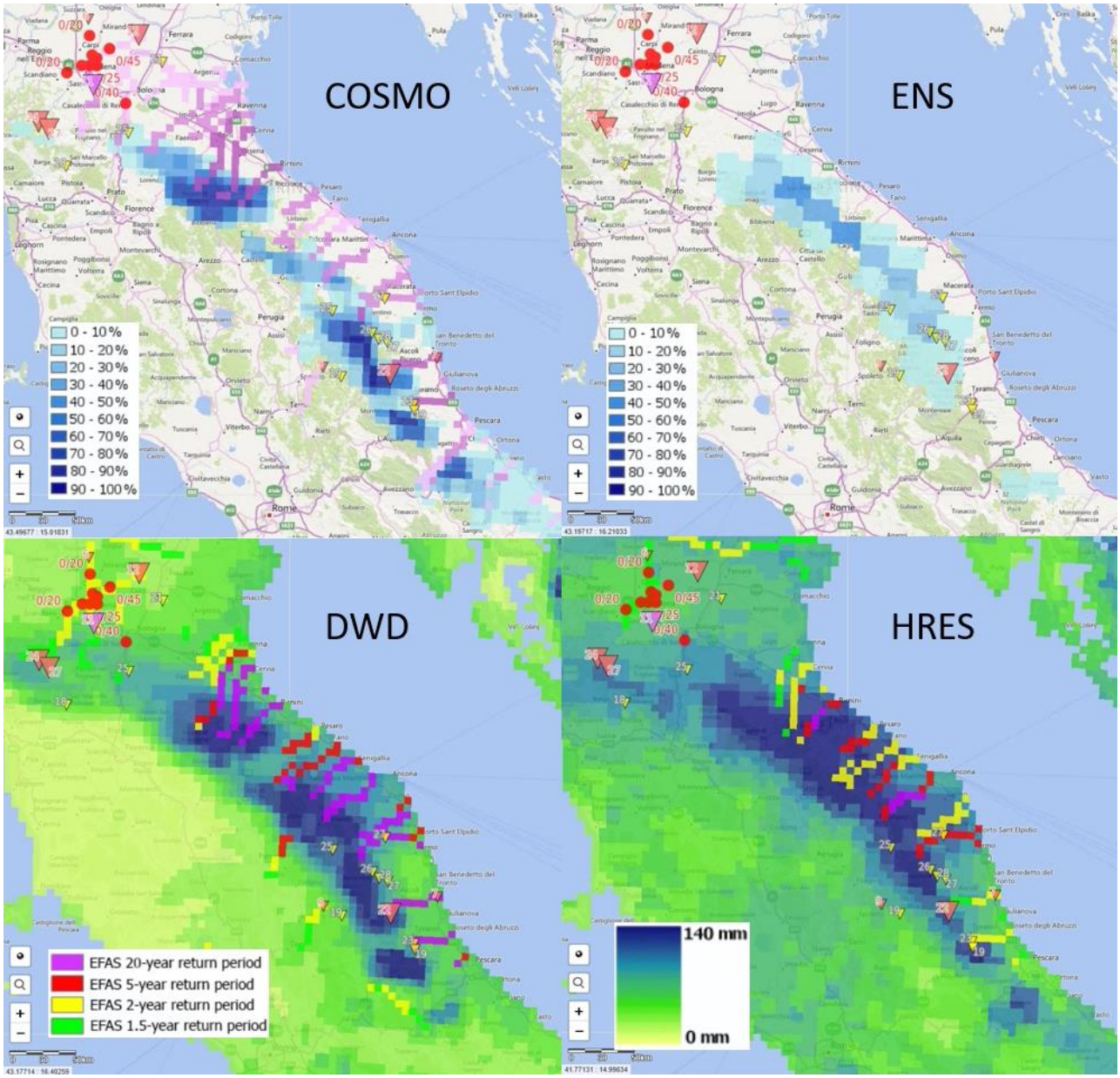

Figure 13. EFAS forecast from the 00 UTC run on 12 May 2019. Top left is the COSMO forecast of over 150 mm precipitation (5-day total) and probability over the 20-year level discharge. Top right is the same for the ENS forecasts (but with the 10-day precipitation total). Bottom left is the DWD precipitation forecast total (7 days) and the return period (1.5-, 2-, 5- and 20-year) exceedance information. Bottom right is the same for the HRES forecasts (but for 10-day precipitation total). All four maps have the EFAS 5-year reporting points (red dots with the ECMWF ENS and COSMO-LEPS 5-year exceedance probabilities provided) and the Flash flood reporting points (yellow triangles for 2-year, red for 5-year and purple for 20-year return period magnitude exceedance with the probability value provided) displayed.

The forecasts driven by ECMWF-HRES and ECMWF-ENS did not show the same severity in the flood signal, with muted river discharge response of ECMWF-HRES to surprisingly large 10-day precipitation total, and ECMWF-ENS showing no probability for flood greater than 20-year level, despite up to 20-30% probability of 10-day precipitation exceeding 150 mm in the area

Defining reporting points

The high uncertainty in the meteorological forcing, the large variation in the forecasts from one forecast run to another and the short duration of the event, made it difficult to define reporting points in EFAS (river basins where flood hazard is consistently forecasted to be large). Indeed, EFAS combines all the forecasts together creating a multi-model ensemble where the ECMWF-ENS, due to its high number of ensemble members, tends to have a larger weight in the outputs.

In addition, ECMWF-ENS forecasts are still simulated using a daily time step which leads to a smoothing of flood peaks in small, fast responding catchments as is the case for this event. Furthermore, due to the spatial resolution of the hydrological model in EFAS (25km^2 per pixel) small catchments as the Savio and Marecchia rivers (approx. 1000km^2) tend to have lower forecast skill. Finally, the COSMO-LEPS-driven Flash flood indicator missed some of the worst impacted rivers (despite showing signal both north and south of the region), possibly because of a relatively dry soil in the model south from Bologna.

Towards fixed reporting points

One of the issues with this event was the fact that no reporting point was shown in the worst hit area, so that flood forecasters could not investigate in detail the shape of the flood hydrographs. The introduction of fixed reporting points, where flood hydrographs are always produced for several river basins with available hydrological data, should help with such cases. Such an upgrade is currently investigated and will be fully tested in EFAS during the summer 2019, anticipated to be part of the production suite in the autumn. In addition, the way reporting points are identified and shown could also be revised, for example with more flexible rules regarding the forecast uncertainties. However, the multiplication of reporting points associated with lower probability of flooding might make the interpretation of the forecasts more difficult.

Planned model upgrades

Furthermore, it is foreseen to switch also the ECMWF-ENS driven EFAS forecasts using a 6-hourly time-step. For this purpose, a hydrologic model calibration using a 6-hourly time-step is currently ongoing and will be released in spring 2020. This is expected to improve forecast skill for fast responding catchments. Finally, preparations have already been started to increase the spatial resolution of the hydrological model with the aim to create higher-resolution EFAS forecasts in the coming years.

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: Participants of the Copernicus Emergency Management Service Annual Meeting, Stresa, Italy (Photo courtesy of Stéphane Ourevitch).

Appendix - figures

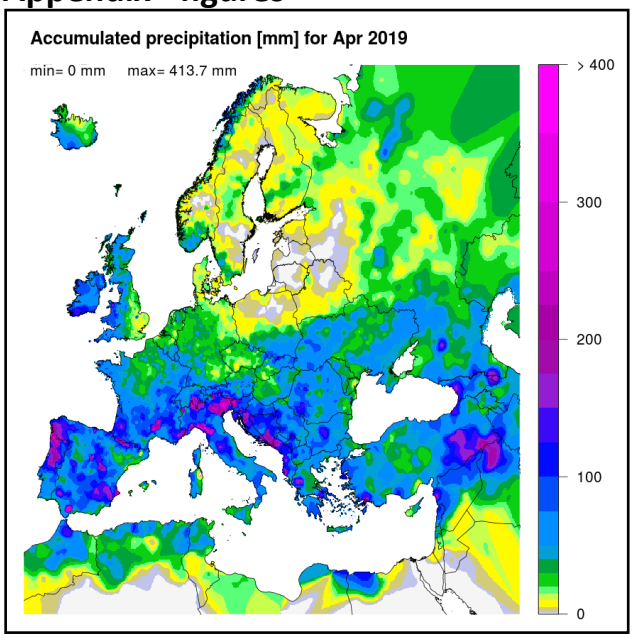

Figure 14. Accumulated precipitation [mm] for April 2019.

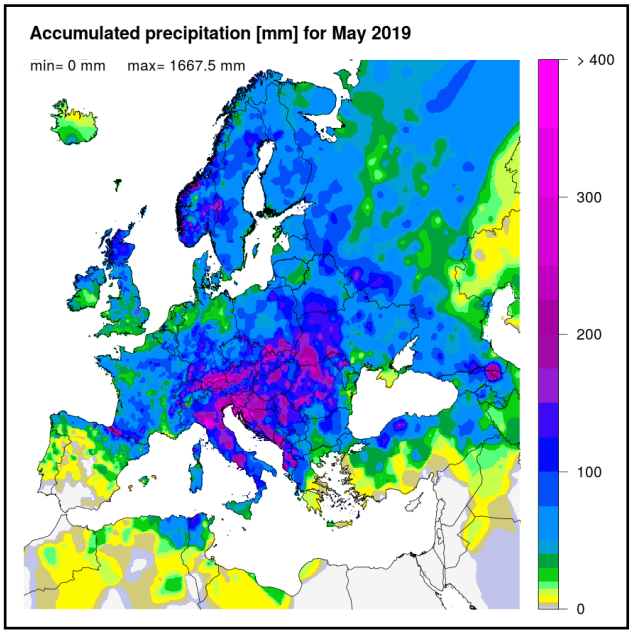

Figure 16. Accumulated precipitation [mm] for May 2019.

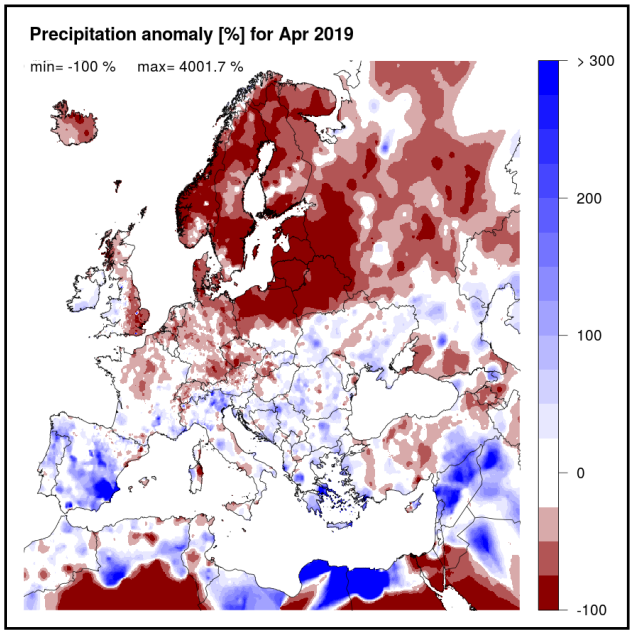

Figure 15. Precipitation anomaly [%] for April 2019, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

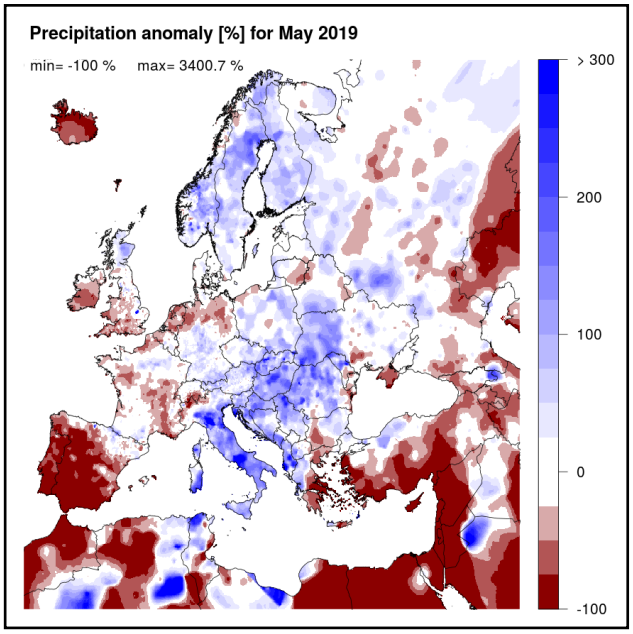

Figure 17. Precipitation anomaly [%] for May 2019, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

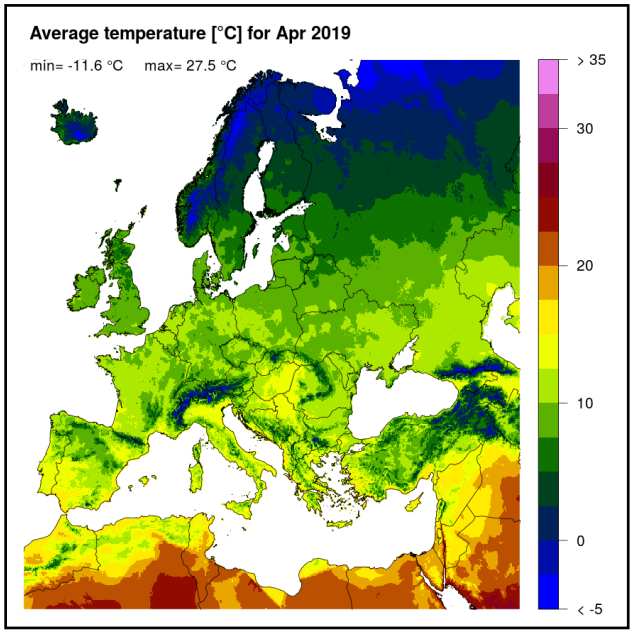

Figure 18. Mean temperature [°C] for April 2019.

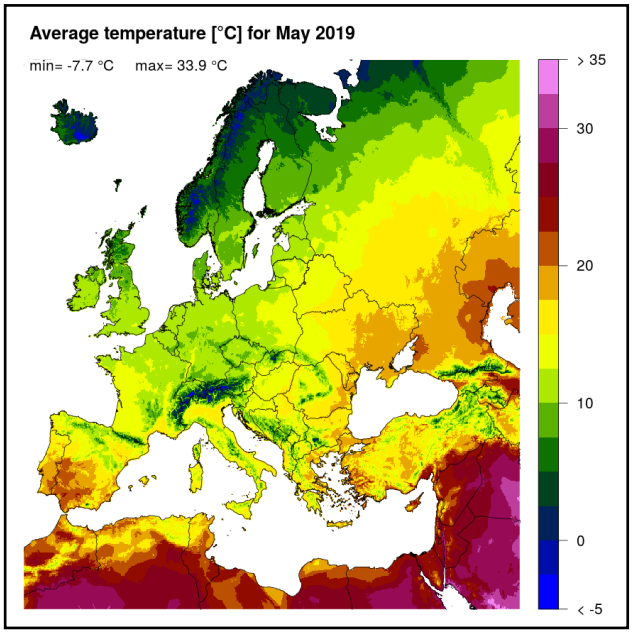

Figure 20. Mean temperature [°C] for May 2019.

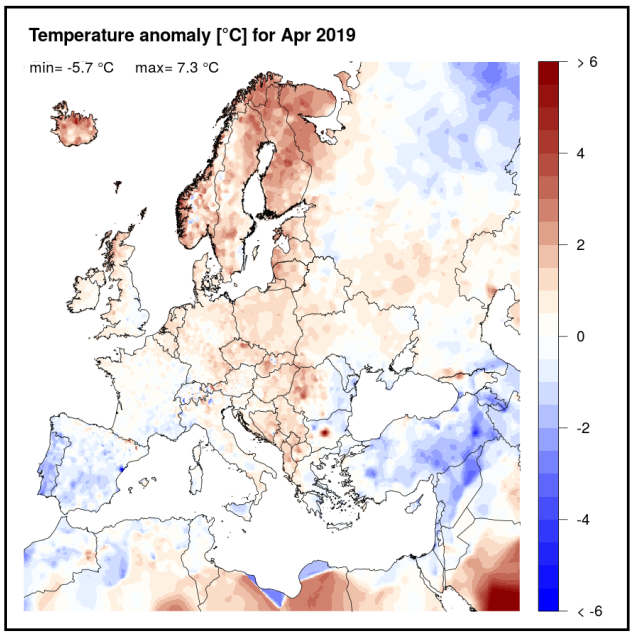

Figure 19. Temperature anomaly [°C] for April 2019, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

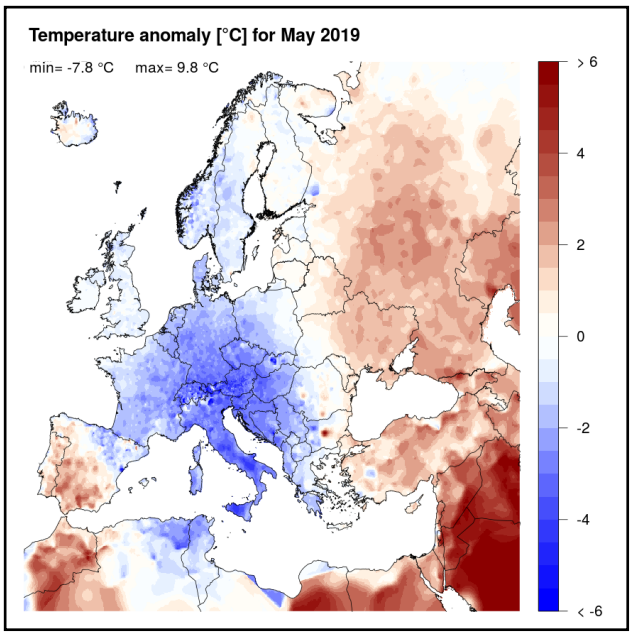

Figure 21. Temperature anomaly [°C] for May 2019, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

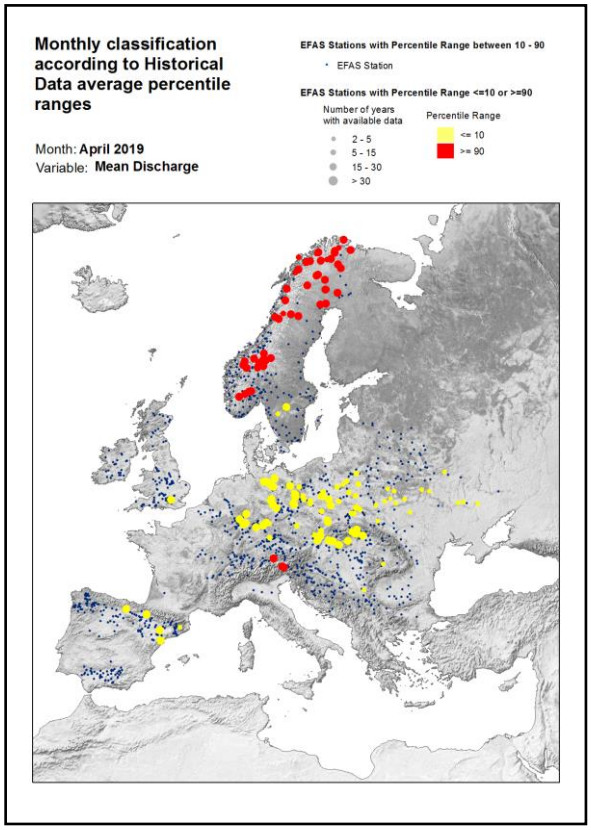

Figure 22. Monthly discharge anomalies April 2019.

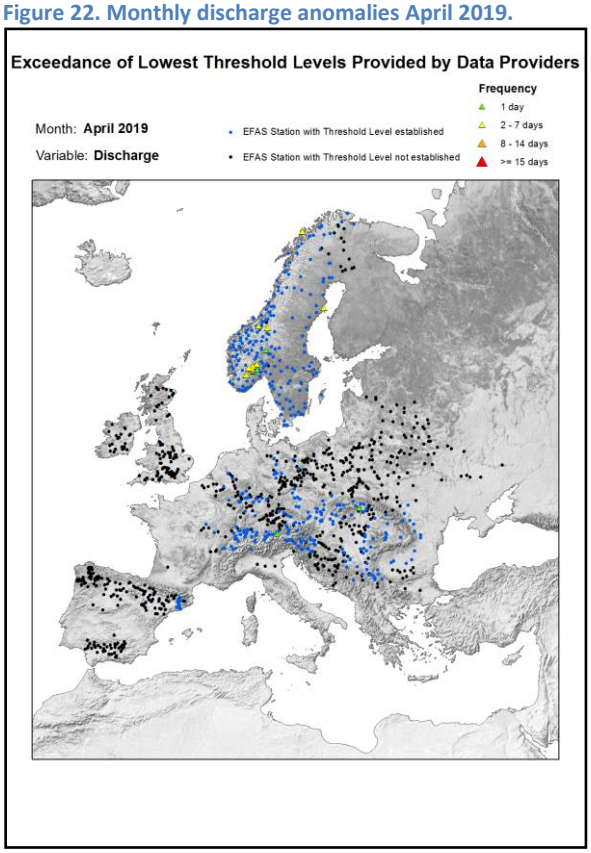

Figure 23. Lowest alert level exceedance for April 2019.

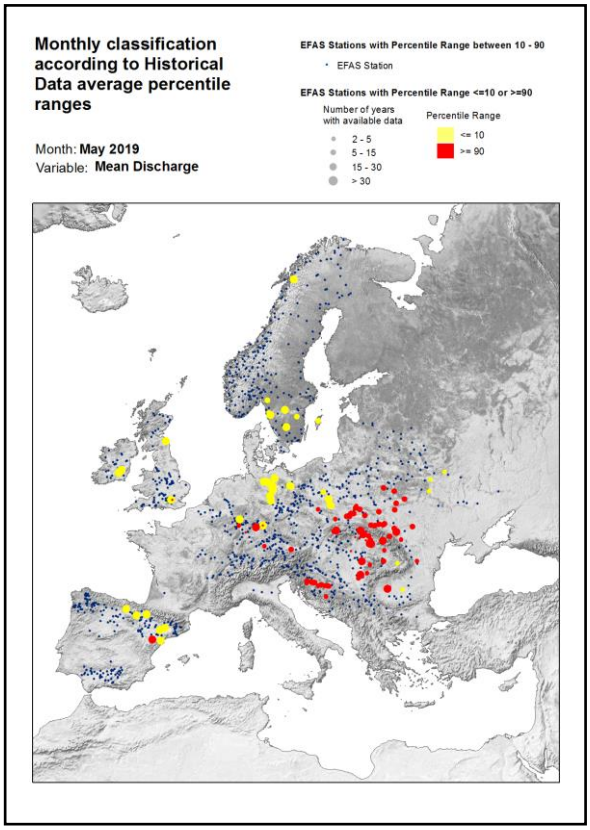

Figure 24. Monthly discharge anomalies May 2019.

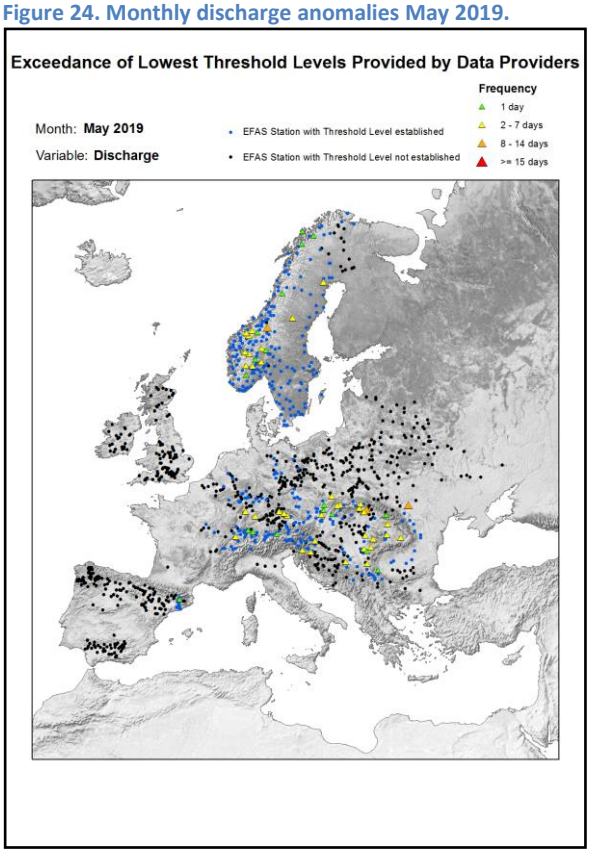

Figure 25. Lowest alert level exceedance for May 2019.

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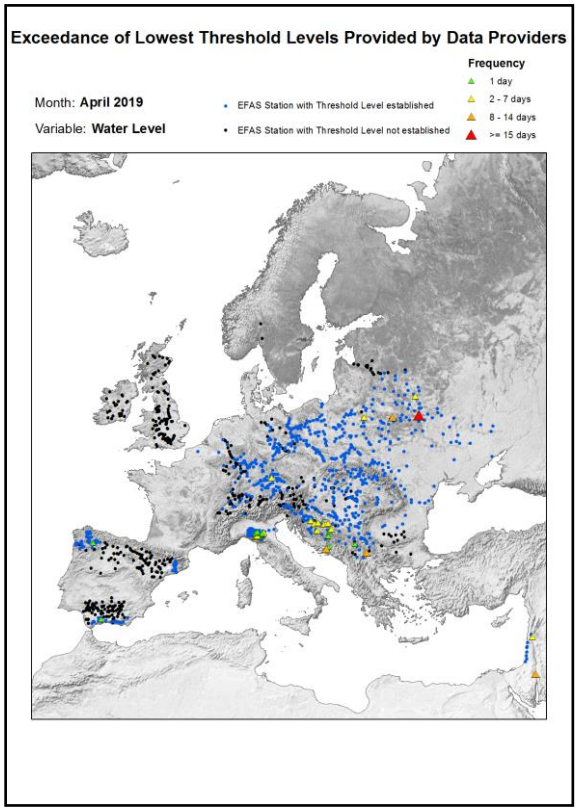

Figure 26. Lowest threshold exceedance for April 2019.

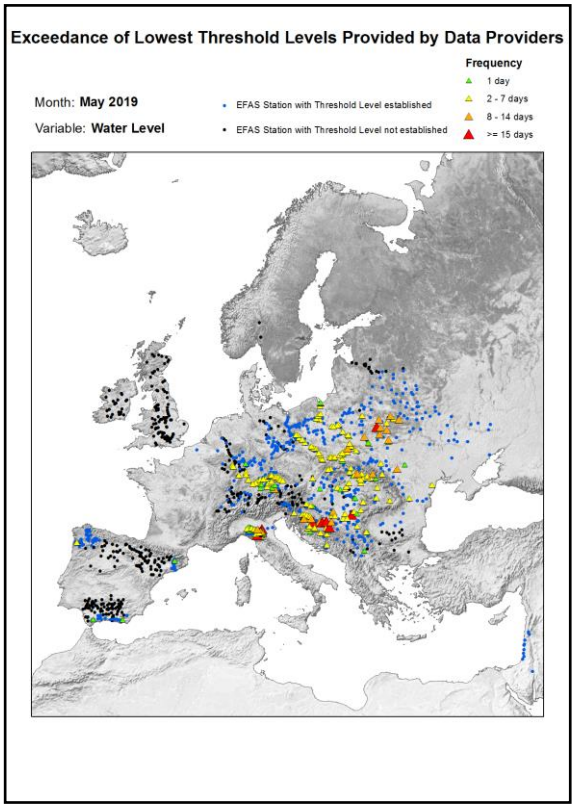

Figure 27. Lowest threshold exceedance for May 2019.

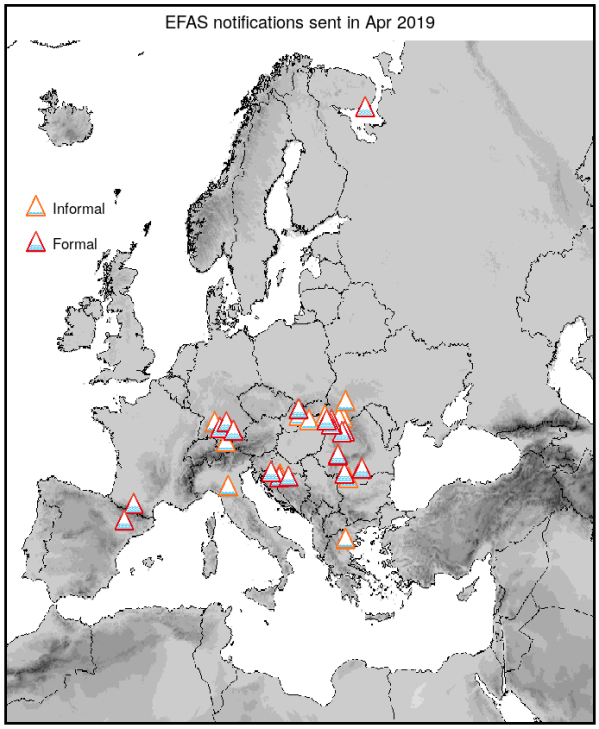

Figure 28. EFAS flood notifications sent for April 2019.

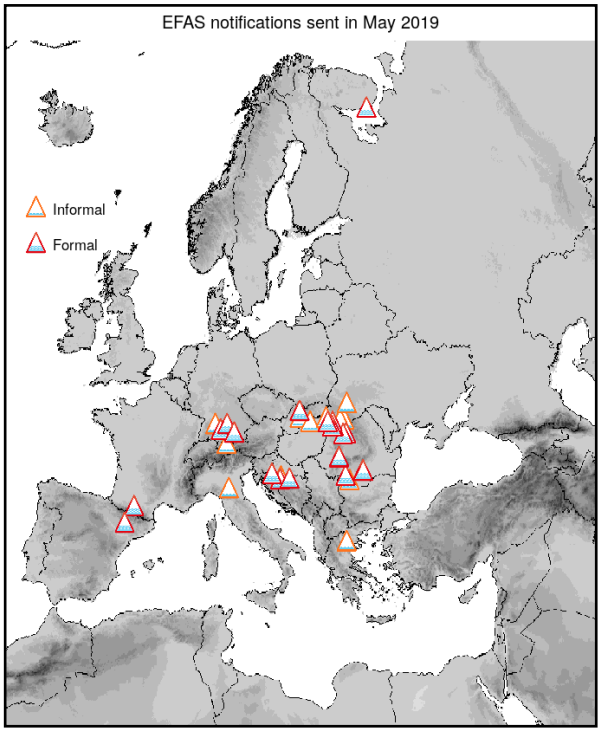

Figure 30. EFAS flood notifications sent for May 2019.

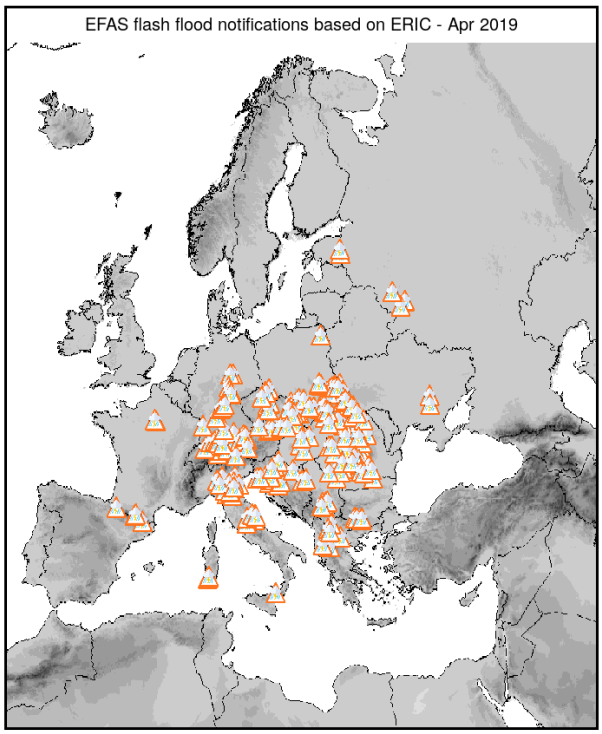

Figure 29. Flash flood notifications sent for April 2019.

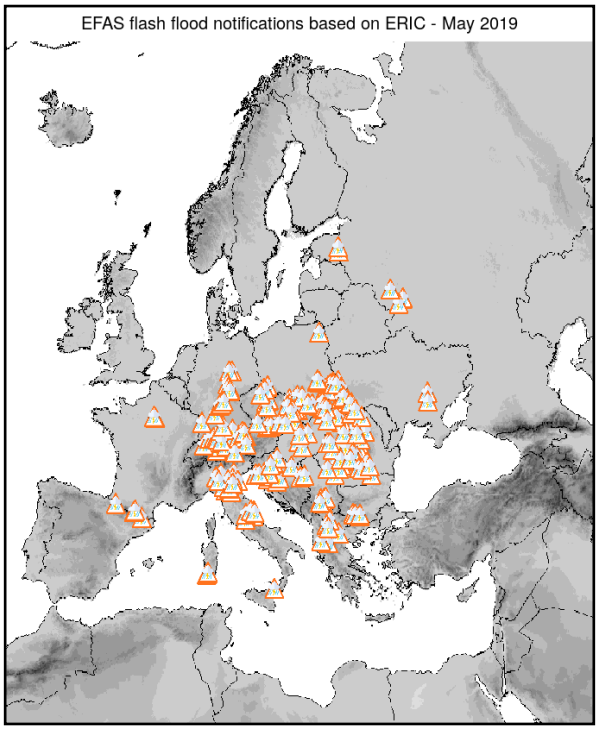

Figure 31. Flash flood notifications sent for May 2019.

Appendix - tables

Table 1. EFAS flood notifications sent in April - May 2019

Type	Forecast date	Issue date	Lead time	River	Country
Formal	31/03/2019 00UTC	01/04/2019	3	Vah	Slovakia
Formal	09/04/2019 12UTC	10/04/2019	5	Coastal catchment N. Atlantic	Iceland
Formal	14/04/2019 00UTC	14/04/2019	1	Blackwater Youghal	Ireland
Informal	16/04/2019 12UTC	17/04/2019	2	Coastal catchment N. Atlantic	Iceland
Informal	17/04/2019 12UTC	18/04/2019	4	Jucar	Spain
Formal	18/04/2019 12UTC	19/04/2019	3	Segura	Spain
Formal	29/04/2019 00UTC	29/04/2019	4	Prut	Ukraine
Formal	29/04/2019 00UTC	29/04/2019	2	Tamis	Romania
Formal	03/05/2019 00UTC	03/05/2019	4	Mures	Romania
Formal	08/05/2019 12UTC	09/05/2019	5	Una	B. & Herzegovina
Informal	10/05/2019 00UTC	10/05/2019	4	Aliakmonas	Greece
Formal	10/05/2019 00UTC	10/05/2019	4	Korana	Croatia
Formal	10/05/2019 12UTC	11/05/2019	3	Vrbas	B. & Herzegovina
Formal	10/05/2019 12UTC	11/05/2019	0	Mures	Romania
Informal	12/05/2019 12UTC	13/05/2019	2	Una	B. & Herzegovina
Formal	13/05/2019 12UTC	14/05/2019	1	Coastal Catchment White Sea	Russian Fed.
Formal	14/05/2019 00UTC	14/05/2019	3	Jiu	Romania
Formal	16/05/2019 00UTC	16/05/2019	2	Arges	Romania
Formal	18/05/2019 00UTC	18/05/2019	0	Tysa	Romania
Formal	18/05/2019 12UTC	19/05/2019	3	Mures	Romania
Formal	18/05/2019 12UTC	19/05/2019	0	Jiu	Romania
Informal	19/05/2019 00UTC	19/05/2019	2	Neckar	Germany
Formal	19/05/2019 00UTC	19/05/2019	2	Iller	Germany
Formal	19/05/2019 12UTC	20/05/2019	2	Isar	Germany
Formal	20/05/2019 00UTC	20/05/2019	3	Donau	Germany
Informal	20/05/2019 00UTC	20/05/2019	1	Lech	Austria
Formal	20/05/2019 00UTC	20/05/2019	2	Somes	Romania
Informal	20/05/2019 00UTC	20/05/2019	0	Dnister / Nistru	Ukraine
Informal	20/05/2019 00UTC	20/05/2019	1	Tysa	Ukraine
Formal	20/05/2019 12UTC	21/05/2019	3	Tisza	Ukraine
Formal	20/05/2019 12UTC	21/05/2019	3	Somes	Romania
Informal	21/05/2019 00UTC	21/05/2019	0	Tysa	Ukraine
Formal	21/05/2019 12UTC	22/05/2019	4	Tisza	Hungary
Formal	21/05/2019 12UTC	22/05/2019	3	Somes	Hungary
Formal	22/05/2019 00UTC	22/05/2019	0	Vah	Slovakia
Formal	22/05/2019 12UTC	23/05/2019	3	Salat	France
Informal	23/05/2019 00UTC	23/05/2019	0	Tysa	Ukraine
Informal	23/05/2019 00UTC	23/05/2019	0	Tysa	Romania
Formal	23/05/2019 12UTC	24/05/2019	1	Cinca	Spain
Formal	24/05/2019 12UTC	25/05/2019	3	Vah	Slovakia
Formal	25/05/2019 00UTC	25/05/2019	6	Mures	Romania
Informal	25/05/2019 12UTC	26/05/2019	3	Hron	Slovakia
Informal	26/05/2019 00UTC	26/05/2019	1	Secchia	Italy
Formal	26/05/2019 00UTC	26/05/2019	4	Isar	Germany
Informal	26/05/2019 00UTC	26/05/2019	3	Hornad	Slovakia
Informal	27/05/2019 00UTC	27/05/2019	1	Tisza	Ukraine
Formal	27/05/2019 12UTC	28/05/2019	4	Arges	Romania

Informal	30/05/2019 00UTC	30/05/2019	1	Dnister / Nistru	Ukraine
Informal	30/05/2019 00UTC	30/05/2019	4	Jiu	Romania

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

Table 2. EFAS Flash flood notifications sent in April - May 2019

Type	Forecast date	Issue date	Lead time	Region	Country
Flash flood	01/04/2019 12UTC	02/04/2019	66	North Yorkshire CC	United Kingdom
Flash flood	02/04/2019 00UTC	02/04/2019	72	None	United Kingdom
Flash flood	02/04/2019 00UTC	02/04/2019	42	Inverness & Nairn and	United Kingdom
Flash flood	03/04/2019 12UTC	04/04/2019	72	Lasithi	Greece
Flash flood	04/04/2019 00UTC	04/04/2019	54	Irakleio	Greece
Flash flood	04/04/2019 12UTC	05/04/2019	108	Blagoevgrad	Bulgaria
Flash flood	04/04/2019 12UTC	05/04/2019	36	Federacija Bosna i Herce-	B. & Herzegovina
Flash flood	04/04/2019 12UTC	05/04/2019	42	Herault	France
Flash flood	04/04/2019 12UTC	05/04/2019	48	Fthiotida	Greece
Flash flood	05/04/2019 00UTC	05/04/2019	36	None	Greece
Flash flood	07/04/2019 12UTC	08/04/2019	54	Sofia (stolitsa)	Bulgaria
Flash flood	07/04/2019 12UTC	08/04/2019	42	Pazardzhik	Bulgaria
Flash flood	08/04/2019 00UTC	08/04/2019	18	Repuplika Srpska	B. & Herzegovina
Flash flood	08/04/2019 12UTC	09/04/2019	24	Kyustendil	Bulgaria
Flash flood	11/04/2019 00UTC	11/04/2019	36	Federacija Bosna i Herce-	B. & Herzegovina
Flash flood	11/04/2019 12UTC	12/04/2019	66	Pazardzhik	Bulgaria
Flash flood	12/04/2019 12UTC	13/04/2019	24	Sofia	Bulgaria
Flash flood	12/04/2019 12UTC	13/04/2019	78	Dnipropetrovs'k	Ukraine
Flash flood	13/04/2019 00UTC	13/04/2019	60	Kherson	Ukraine
Flash flood	13/04/2019 00UTC	13/04/2019	54	Crimea	Ukraine
Flash flood	13/04/2019 00UTC	13/04/2019	78	Fthiotida	Greece
Flash flood	13/04/2019 12UTC	14/04/2019	54	South-West (IE)	Ireland
Flash flood	13/04/2019 12UTC	14/04/2019	54	South-West (IE)	Ireland
Flash flood	13/04/2019 12UTC	14/04/2019	60	South-East (IE)	Ireland
Flash flood	13/04/2019 12UTC	14/04/2019	60	Thessaly and Central	Greece
Flash flood	13/04/2019 12UTC	14/04/2019	54	South-West (IE)	Ireland
Flash flood	14/04/2019 00UTC	14/04/2019	54	Fokida	Greece
Flash flood	14/04/2019 12UTC	15/04/2019	30	South-West (IE)	Ireland
Flash flood	14/04/2019 12UTC	15/04/2019	42	Kharkiv	Ukraine
Flash flood	14/04/2019 12UTC	15/04/2019	42	Belgorod	Russian Fed.
Flash flood	16/04/2019 00UTC	17/04/2019	96	Huesca	Spain
Flash flood	16/04/2019 00UTC	17/04/2019	72	Segovia	Spain
Flash flood	16/04/2019 00UTC	17/04/2019	90	Zaragoza	Spain
Flash flood	16/04/2019 12UTC	17/04/2019	78	Valencia / Valencia	Spain
Flash flood	16/04/2019 12UTC	17/04/2019	78	Teruel	Spain
Flash flood	16/04/2019 12UTC	17/04/2019	102	Murcia	Spain
Flash flood	16/04/2019 12UTC	17/04/2019	48	Madrid	Spain
Flash flood	16/04/2019 12UTC	17/04/2019	96	Albacete	Spain
Flash flood	17/04/2019 00UTC	17/04/2019	84	Albacete	Spain
Flash flood	17/04/2019 00UTC	17/04/2019	78	Ciudad Real	Spain
Flash flood	17/04/2019 00UTC	17/04/2019	90	Murcia	Spain
Flash flood	17/04/2019 00UTC	17/04/2019	84	Granada	Spain
Flash flood	17/04/2019 00UTC	17/04/2019	90	Almeria	Spain
Flash flood	17/04/2019 00UTC	17/04/2019	66	Zaragoza	Spain

Flash flood	17/04/2019 00UTC	17/04/2019	60	Cuenca	Spain
Flash flood	17/04/2019 00UTC	17/04/2019	42	Toledo	Spain
Flash flood	17/04/2019 00UTC	17/04/2019	78	Albacete	Spain
Flash flood	17/04/2019 00UTC	17/04/2019	66	Cuenca	Spain
Flash flood	17/04/2019 00UTC	17/04/2019	66	Castellon / Castello	Spain
Flash flood	17/04/2019 00UTC	17/04/2019	66	Teruel	Spain
Flash flood	17/04/2019 12UTC	18/04/2019	24	Ciudad Real	Spain
Flash flood	18/04/2019 00UTC	18/04/2019	66	Jaen	Spain
Flash flood	18/04/2019 00UTC	18/04/2019	30	Soria	Spain
Flash flood	20/04/2019 00UTC	20/04/2019	42	Teruel	Spain
Flash flood	20/04/2019 12UTC	21/04/2019	72	Herault	France
Flash flood	21/04/2019 00UTC	21/04/2019	36	Alicante / Alacant	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	36	Valencia / Valencia	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	30	Albacete	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	30	Valencia / Valencia	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	30	Albacete	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	30	Valencia / Valencia	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	36	Albacete	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	30	Albacete	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	108	Cuenca	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	36	Valencia / Valencia	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	36	Murcia	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	36	Murcia	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	36	Murcia	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	24	Valencia / Valencia	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	30	Valencia / Valencia	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	36	Alicante / Alacant	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	36	Alicante / Alacant	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	36	Alicante / Alacant	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	36	Alicante / Alacant	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	36	Comunidad Valenciana	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	36	Alicante / Alacant	Spain
Flash flood	21/04/2019 00UTC	21/04/2019	30	Albacete	Spain
Flash flood	22/04/2019 12UTC	23/04/2019	66	Cuenca	Spain
Flash flood	25/04/2019 12UTC	26/04/2019	66	Telemark	Norway
Flash flood	25/04/2019 12UTC	26/04/2019	66	Vestfold	Norway
Flash flood	25/04/2019 12UTC	26/04/2019	66	Aust-Agder	Norway
Flash flood	26/04/2019 12UTC	27/04/2019	36	None	Sweden
Flash flood	26/04/2019 12UTC	27/04/2019	36	Cluj	Romania
Flash flood	26/04/2019 12UTC	27/04/2019	30	Caras-Severin	Romania
Flash flood	26/04/2019 12UTC	27/04/2019	42	Vastra Gotalands lan	Sweden
Flash flood	27/04/2019 00UTC	27/04/2019	24	Bihor	Romania
Flash flood	27/04/2019 00UTC	27/04/2019	24	Valcea	Romania
Flash flood	27/04/2019 00UTC	27/04/2019	24	Alba	Romania
Flash flood	27/04/2019 12UTC	28/04/2019	30	Presovsky kraj	Slovakia
Flash flood	28/04/2019 00UTC	28/04/2019	66	Neamt	Romania
Flash flood	28/04/2019 00UTC	28/04/2019	78	Harghita	Romania
Flash flood	28/04/2019 12UTC	29/04/2019	66	Cluj	Romania
Flash flood	28/04/2019 12UTC	29/04/2019	72	Chernivtsi	Ukraine
Flash flood	28/04/2019 12UTC	29/04/2019	72	Caras-Severin	Romania
Flash flood	28/04/2019 12UTC	29/04/2019	72	Ivano-Frankivs'k	Ukraine

Flash flood	28/04/2019 12UTC	29/04/2019	66	Bihor	Romania
Flash flood	29/04/2019 00UTC	29/04/2019	54	Alba	Romania
Flash flood	29/04/2019 00UTC	29/04/2019	54	Arad	Romania
Flash flood	29/04/2019 00UTC	29/04/2019	66	Valcea	Romania
Flash flood	29/04/2019 00UTC	29/04/2019	54	Hunedoara	Romania
Flash flood	29/04/2019 00UTC	29/04/2019	66	Sibiu	Romania
Flash flood	29/04/2019 00UTC	29/04/2019	66	Brasov	Romania
Flash flood	29/04/2019 00UTC	29/04/2019	60	Covasna	Romania
Flash flood	29/04/2019 00UTC	29/04/2019	60	Mures	Romania
Flash flood	29/04/2019 00UTC	29/04/2019	54	Arges	Romania
Flash flood	03/05/2019 12UTC	04/05/2019	60	Presovsky kraj	Poland, Slovakia
Flash flood	03/05/2019 12UTC	04/05/2019	60	Presovsky kraj	Slovakia
Flash flood	04/05/2019 00UTC	04/05/2019	60	Arges	Romania
Flash flood	04/05/2019 00UTC	04/05/2019	84	Neamt	Romania
Flash flood	04/05/2019 00UTC	04/05/2019	78	Sibiu	Romania
Flash flood	04/05/2019 00UTC	04/05/2019	84	Brasov	Romania
Flash flood	04/05/2019 12UTC	05/05/2019	66	Dambovita	Romania
Flash flood	05/05/2019 00UTC	05/05/2019	18	Modena	Italy
Flash flood	05/05/2019 00UTC	05/05/2019	54	Harghita	Romania
Flash flood	05/05/2019 00UTC	05/05/2019	42	Valcea	Romania
Flash flood	05/05/2019 12UTC	06/05/2019	36	Mures	Romania
Flash flood	06/05/2019 00UTC	06/05/2019	30	Cluj	Romania
Flash flood	06/05/2019 00UTC	06/05/2019	30	Alba	Romania
Flash flood	06/05/2019 00UTC	06/05/2019	24	Prahova	Romania
Flash flood	08/05/2019 12UTC	09/05/2019	36	Dnipropetrovs'k	Ukraine
Flash flood	09/05/2019 00UTC	09/05/2019	24	Kherson	Ukraine
Flash flood	09/05/2019 12UTC	10/05/2019	78	Bratislavsky kraj	Slovakia
Flash flood	09/05/2019 12UTC	10/05/2019	78	Trnavsky kraj	Slovakia
Flash flood	10/05/2019 00UTC	10/05/2019	90	Raski	Rep. Serbia
Flash flood	10/05/2019 00UTC	10/05/2019	84	Licko-Senjska Zupanija	Croatia
Flash flood	10/05/2019 00UTC	10/05/2019	54	Pskov	Russian Fed.
Flash flood	10/05/2019 00UTC	10/05/2019	84	Karlovacka Zupanija	Croatia
Flash flood	10/05/2019 00UTC	10/05/2019	96	Sisacko-Moslavacka Zupan-	Croatia
Flash flood	10/05/2019 00UTC	10/05/2019	90	Jugozapaden	Republic North
Flash flood	10/05/2019 00UTC	10/05/2019	90	Repuplika Srpska	B. & Herzegovina
Flash flood	10/05/2019 00UTC	10/05/2019	54	Louna-Eesti	Estonia
Flash flood	10/05/2019 00UTC	10/05/2019	84	Federacija Bosna i Herce-	B. & Herzegovina
Flash flood	10/05/2019 12UTC	11/05/2019	90	Pella	Greece
Flash flood	10/05/2019 12UTC	11/05/2019	90	Rasinski	Rep. Serbia
Flash flood	10/05/2019 12UTC	11/05/2019	72	Varazdinska Zupanija	Croatia
Flash flood	10/05/2019 12UTC	11/05/2019	24	Val-de-Marne	France
Flash flood	10/05/2019 12UTC	11/05/2019	84	Kosovska Mitrovica	Republic Of Ko-
Flash flood	10/05/2019 12UTC	11/05/2019	24	Paris	France
Flash flood	10/05/2019 12UTC	11/05/2019	72	Krapinsko-Zagorska Zupan-	Croatia
Flash flood	10/05/2019 12UTC	11/05/2019	90	Brcko	B. & Herzegovina
Flash flood	10/05/2019 12UTC	11/05/2019	84	Skopski	N. Macedonia
Flash flood	10/05/2019 12UTC	11/05/2019	90	Viroviticko-Podravska	Croatia
Flash flood	11/05/2019 00UTC	11/05/2019	24	Wiener Umland/Nordteil	Austria
Flash flood	11/05/2019 00UTC	11/05/2019	78	Sremski	Rep. Serbia
Flash flood	11/05/2019 12UTC	12/05/2019	42	Bologna	Italy
Flash flood	11/05/2019 12UTC	12/05/2019	42	Modena	Italy

Flash flood	11/05/2019 12UTC	12/05/2019	24	Jeleniogorski	Poland
Flash flood	11/05/2019 12UTC	12/05/2019	42	Ferrara	Italy
Flash flood	11/05/2019 12UTC	12/05/2019	42	Primorsko-Goranska	Croatia
Flash flood	12/05/2019 00UTC	12/05/2019	48	Poloski	N. Macedonia
Flash flood	12/05/2019 00UTC	12/05/2019	48	Teramo	Italy
Flash flood	12/05/2019 12UTC	13/05/2019	72	Hunedoara	Romania
Flash flood	12/05/2019 12UTC	13/05/2019	36	Korce	Albania
Flash flood	13/05/2019 12UTC	14/05/2019	48	Kaluga	Russian Fed.
Flash flood	13/05/2019 12UTC	14/05/2019	36	Rasinski	Rep. Serbia
Flash flood	13/05/2019 12UTC	14/05/2019	24	Elbasan	Albania
Flash flood	13/05/2019 12UTC	14/05/2019	36	Raski	Rep. Serbia
Flash flood	13/05/2019 12UTC	14/05/2019	36	Bryansk	Russian Fed.
Flash flood	14/05/2019 00UTC	14/05/2019	42	Smolensk	Russian Fed.
Flash flood	14/05/2019 12UTC	15/05/2019	42	Wiener Umland/Nordteil	Austria
Flash flood	14/05/2019 12UTC	15/05/2019	42	Mostviertel-Eisenwurzen	Austria
Flash flood	14/05/2019 12UTC	15/05/2019	18	Caras-Severin	Romania
Flash flood	14/05/2019 12UTC	15/05/2019	42	Waldviertel	Austria
Flash flood	14/05/2019 12UTC	15/05/2019	18	Mehedinti	Romania
Flash flood	15/05/2019 00UTC	15/05/2019	54	Gorj	Romania
Flash flood	15/05/2019 00UTC	15/05/2019	48	Jugozapaden	Republic Of
Flash flood	15/05/2019 00UTC	15/05/2019	6	Hunedoara	Romania
Flash flood	15/05/2019 00UTC	15/05/2019	42	Valcea	Romania
Flash flood	15/05/2019 00UTC	15/05/2019	54	Arges	Romania
Flash flood	15/05/2019 12UTC	16/05/2019	24	Messina	Italy
Flash flood	16/05/2019 00UTC	16/05/2019	84	Neamt	Romania
Flash flood	17/05/2019 12UTC	18/05/2019	48	Suwalski	Poland
Flash flood	18/05/2019 00UTC	18/05/2019	72	L'viv	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	48	Caras-Severin	Romania
Flash flood	18/05/2019 00UTC	18/05/2019	72	L'viv	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	36	L'viv	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	84	Ivano-Frankivs'k	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	72	L'viv	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	36	L'viv	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	36	L'viv	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	36	L'viv	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	72	L'viv	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	72	L'viv	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	72	L'viv	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	72	L'viv	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	72	L'viv	Ukraine
Flash flood	18/05/2019 00UTC	18/05/2019	48	Gorj	Romania
Flash flood	18/05/2019 12UTC	19/05/2019	60	Ternopil'	Ukraine
Flash flood	18/05/2019 12UTC	19/05/2019	60	L'viv	Ukraine
Flash flood	18/05/2019 12UTC	19/05/2019	78	Berchtesgadener Land	Austria, Ger-
Flash flood	18/05/2019 12UTC	19/05/2019	72	Bludenz-Bregenzer Wald	Austria
Flash flood	18/05/2019 12UTC	19/05/2019	72	Ausserfern	Austria
Flash flood	18/05/2019 12UTC	19/05/2019	72	Graubunden	Switzerland
Flash flood	18/05/2019 12UTC	19/05/2019	72	Rheintal-Bodenseegebiet	Austria
Flash flood	18/05/2019 12UTC	19/05/2019	72	Rosenheim, Landkreis	Austria, Ger-
Flash flood	18/05/2019 12UTC	19/05/2019	72	Salzburg Und Umgebung	Austria, Ger-
Flash flood	18/05/2019 12UTC	19/05/2019	72	Tiroler Unterland	Austria

Flash flood	19/05/2019 00UTC	19/05/2019	36	Bodenseekreis	Germany
Flash flood	19/05/2019 00UTC	19/05/2019	36	Aargau	Switzerland
Flash flood	19/05/2019 00UTC	19/05/2019	54	Bodenseekreis	Germany
Flash flood	19/05/2019 00UTC	19/05/2019	54	Ravensburg	Germany
Flash flood	19/05/2019 00UTC	19/05/2019	36	Schaffhausen	Switzerland
Flash flood	19/05/2019 12UTC	20/05/2019	48	Suceava	Romania
Flash flood	19/05/2019 12UTC	20/05/2019	48	Przemyski	Poland
Flash flood	19/05/2019 12UTC	20/05/2019	42	Arad	Romania
Flash flood	19/05/2019 12UTC	20/05/2019	42	Bihor	Romania
Flash flood	19/05/2019 12UTC	20/05/2019	48	Brasov	Romania
Flash flood	19/05/2019 12UTC	20/05/2019	48	Maramures	Romania
Flash flood	19/05/2019 12UTC	20/05/2019	48	Harghita	Romania
Flash flood	19/05/2019 12UTC	20/05/2019	48	Przemyski	Poland
Flash flood	19/05/2019 12UTC	20/05/2019	48	Transcarpathia	Ukraine
Flash flood	19/05/2019 12UTC	20/05/2019	42	Tiroler Oberland	Austria
Flash flood	19/05/2019 12UTC	20/05/2019	48	Rosenheim, Kreisfreie	Germany
Flash flood	19/05/2019 12UTC	20/05/2019	48	Covasna	Romania
Flash flood	19/05/2019 12UTC	20/05/2019	48	Mures	Romania
Flash flood	19/05/2019 12UTC	20/05/2019	42	Alb-Donau-Kreis	Germany
Flash flood	19/05/2019 12UTC	20/05/2019	36	Weilheim-Schongau	Germany
Flash flood	19/05/2019 12UTC	20/05/2019	36	Salzlandkreis	Germany
Flash flood	19/05/2019 12UTC	20/05/2019	48	Alba	Romania
Flash flood	19/05/2019 12UTC	20/05/2019	36	Borde	Germany
Flash flood	19/05/2019 12UTC	20/05/2019	36	Ortenaukreis	Germany, France
Flash flood	19/05/2019 12UTC	20/05/2019	48	Cluj	Romania
Flash flood	19/05/2019 12UTC	20/05/2019	48	Miesbach	Germany
Flash flood	19/05/2019 12UTC	20/05/2019	48	Lublin	Poland, Ukraine
Flash flood	19/05/2019 12UTC	20/05/2019	48	Chelmsko-zamojski	Poland
Flash flood	19/05/2019 12UTC	20/05/2019	48	Przemyski	Poland
Flash flood	19/05/2019 12UTC	20/05/2019	48	Przemyski	Poland
Flash flood	19/05/2019 12UTC	20/05/2019	48	Przemyski	Poland
Flash flood	20/05/2019 00UTC	20/05/2019	36	Valcea	Romania
Flash flood	20/05/2019 00UTC	20/05/2019	30	Chernivtsi	Ukraine
Flash flood	20/05/2019 00UTC	20/05/2019	24	Prahova	Romania
Flash flood	20/05/2019 00UTC	20/05/2019	42	Pinzgau-Pongau	Austria
Flash flood	20/05/2019 00UTC	20/05/2019	36	Traunstein	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	36	Sommerda	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	36	Hunedoara	Romania
Flash flood	20/05/2019 00UTC	20/05/2019	36	Dachau	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	30	Oberallgau	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	36	Gunzburg	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	36	Bad Tolz-Wolfratshausen	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	36	Ilm-Kreis	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	36	Hassberge	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	30	Rosenheim, Landkreis	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	36	Arges	Romania
Flash flood	20/05/2019 00UTC	20/05/2019	36	Kitzingen	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	36	Altotting	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	36	Weimarer Land	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	36	Saalfeld-Rudolstadt	Germany
Flash flood	20/05/2019 00UTC	20/05/2019	36	Hohenlohekreis	Germany

Flash flood	20/05/2019 00UTC	20/05/2019	36	Wurzburg, Kreisfreie Stadt	Germany
Flash flood	20/05/2019 12UTC	21/05/2019	42	Krosnienski	Poland
Flash flood	20/05/2019 12UTC	21/05/2019	42	Krosnienski	Poland
Flash flood	21/05/2019 00UTC	21/05/2019	84	Smolyan	Bulgaria
Flash flood	21/05/2019 00UTC	21/05/2019	60	Bielski	Poland
Flash flood	21/05/2019 00UTC	21/05/2019	48	Zilinsky kraj	Slovakia
Flash flood	21/05/2019 00UTC	21/05/2019	48	Moravskoslezsky kraj	Czech Republic
Flash flood	21/05/2019 00UTC	21/05/2019	48	Bielski	Poland
Flash flood	21/05/2019 00UTC	21/05/2019	48	Bielski	Poland
Flash flood	21/05/2019 00UTC	21/05/2019	30	Presovsky kraj	Slovakia
Flash flood	21/05/2019 00UTC	21/05/2019	30	Kosicky kraj	Slovakia
Flash flood	21/05/2019 00UTC	21/05/2019	48	Trenciansky kraj	Slovakia
Flash flood	21/05/2019 00UTC	21/05/2019	84	Pazardzhik	Bulgaria
Flash flood	21/05/2019 00UTC	21/05/2019	48	Moravskoslezsky kraj	Czech Republic
Flash flood	20/05/2019 12UTC	22/05/2019	66	Bratislavsky kraj	Slovakia
Flash flood	20/05/2019 12UTC	22/05/2019	60	Trnavsky kraj	Slovakia
Flash flood	21/05/2019 12UTC	22/05/2019	24	Tarnobrzeski	Poland
Flash flood	21/05/2019 12UTC	22/05/2019	24	Tarnobrzeski	Poland
Flash flood	21/05/2019 12UTC	22/05/2019	24	Tarnobrzeski	Poland
Flash flood	21/05/2019 12UTC	22/05/2019	48	Oswiecimski	Poland
Flash flood	21/05/2019 12UTC	22/05/2019	36	Liberecky kraj	Czech Republic
Flash flood	21/05/2019 12UTC	22/05/2019	24	Tarnobrzeski	Poland
Flash flood	22/05/2019 00UTC	22/05/2019	24	Stredocesky kraj	Czech Republic
Flash flood	22/05/2019 00UTC	22/05/2019	24	Pardubicky kraj	Czech Republic
Flash flood	22/05/2019 00UTC	22/05/2019	24	Kraj Vysocina	Czech Republic
Flash flood	22/05/2019 00UTC	22/05/2019	24	Jeleniogorski	Poland
Flash flood	22/05/2019 00UTC	22/05/2019	30	Zlinsky kraj	Czech Republic
Flash flood	22/05/2019 00UTC	22/05/2019	36	Nowotarski	Poland
Flash flood	22/05/2019 12UTC	23/05/2019	42	Nowosadecki	Poland
Flash flood	22/05/2019 12UTC	23/05/2019	24	Krosnienski	Poland
Flash flood	22/05/2019 12UTC	23/05/2019	66	L'viv	Ukraine
Flash flood	22/05/2019 12UTC	23/05/2019	66	Lublin	Poland, Ukraine
Flash flood	22/05/2019 12UTC	23/05/2019	24	Presovsky kraj	Slovakia
Flash flood	22/05/2019 12UTC	23/05/2019	24	Presovsky kraj	Poland, Slovakia
Flash flood	22/05/2019 12UTC	23/05/2019	24	Transcarpathia	Ukraine
Flash flood	22/05/2019 12UTC	23/05/2019	24	Zilinsky kraj	Slovakia
Flash flood	22/05/2019 12UTC	23/05/2019	24	Krakowski	Poland
Flash flood	23/05/2019 00UTC	23/05/2019	66	Pyrenees-Atlantiques	France
Flash flood	23/05/2019 00UTC	23/05/2019	48	Girona	Spain, France
Flash flood	23/05/2019 00UTC	23/05/2019	54	Lleida	Spain
Flash flood	23/05/2019 12UTC	24/05/2019	48	Ivano-Frankivs'k	Ukraine
Flash flood	23/05/2019 12UTC	24/05/2019	48	Ternopil'	Ukraine
Flash flood	23/05/2019 12UTC	24/05/2019	42	L'viv	Ukraine
Flash flood	24/05/2019 00UTC	24/05/2019	36	Ariege	France
Flash flood	24/05/2019 00UTC	24/05/2019	36	Chernivtsi	Ukraine
Flash flood	24/05/2019 00UTC	24/05/2019	36	Botosani	Romania
Flash flood	24/05/2019 12UTC	25/05/2019	30	Harghita	Romania
Flash flood	24/05/2019 12UTC	25/05/2019	24	Brescia	Italy
Flash flood	25/05/2019 00UTC	25/05/2019	48	Carbonia-Iglesias	Italy
Flash flood	25/05/2019 00UTC	25/05/2019	48	Cagliari	Italy
Flash flood	26/05/2019 00UTC	26/05/2019	78	Nitriansky kraj	Slovakia

Flash flood	26/05/2019 00UTC	26/05/2019	78	Trenciansky kraj	Slovakia
Flash flood	26/05/2019 00UTC	26/05/2019	78	Zilinsky kraj	Slovakia
Flash flood	26/05/2019 00UTC	26/05/2019	78	Banskobystricky kraj	Slovakia
Flash flood	26/05/2019 12UTC	27/05/2019	72	Bolzano-Bozen	Italy
Flash flood	26/05/2019 12UTC	27/05/2019	54	Liberecky kraj	Czech Republic
Flash flood	26/05/2019 12UTC	27/05/2019	48	Perugia	Italy
Flash flood	26/05/2019 12UTC	27/05/2019	42	Terni	Italy
Flash flood	26/05/2019 12UTC	27/05/2019	54	Jeleniogorski	Poland
Flash flood	26/05/2019 12UTC	27/05/2019	66	Vicenza	Italy
Flash flood	26/05/2019 12UTC	27/05/2019	90	Presovsky kraj	Slovakia
Flash flood	26/05/2019 12UTC	27/05/2019	84	Transcarpathia	Ukraine
Flash flood	26/05/2019 12UTC	27/05/2019	60	Lodi	Italy
Flash flood	27/05/2019 00UTC	27/05/2019	48	Verona	Italy
Flash flood	27/05/2019 00UTC	27/05/2019	48	Rovigo	Italy
Flash flood	27/05/2019 00UTC	27/05/2019	42	Jihocesky kraj	Czech Republic
Flash flood	27/05/2019 00UTC	27/05/2019	72	Wiener Umland/Nordteil	Austria
Flash flood	27/05/2019 00UTC	27/05/2019	72	Waldviertel	Austria
Flash flood	27/05/2019 12UTC	28/05/2019	48	Istarska Zupanija	Croatia
Flash flood	27/05/2019 12UTC	28/05/2019	54	Reggio Nell'Emilia	Italy
Flash flood	27/05/2019 12UTC	28/05/2019	42	Jugovzhodna Slovenija	Croatia, Slovenia
Flash flood	27/05/2019 12UTC	28/05/2019	18	Stredocesky kraj	Czech Republic
Flash flood	27/05/2019 12UTC	28/05/2019	72	Weinviertel	Austria, Slovakia
Flash flood	27/05/2019 12UTC	28/05/2019	72	Trnavsky kraj	Slovakia
Flash flood	27/05/2019 12UTC	28/05/2019	48	Szabolcs-Szatmar-Bereg	Hungary
Flash flood	28/05/2019 00UTC	28/05/2019	42	Parma	Italy
Flash flood	28/05/2019 00UTC	28/05/2019	36	Karlovacka Zupanija	Croatia
Flash flood	28/05/2019 00UTC	28/05/2019	24	Mantova	Italy
Flash flood	28/05/2019 00UTC	28/05/2019	36	Piacenza	Italy
Flash flood	28/05/2019 00UTC	28/05/2019	30	Primorsko-Goranska	Croatia
Flash flood	28/05/2019 00UTC	28/05/2019	36	Posavska	Slovenia
Flash flood	28/05/2019 12UTC	29/05/2019	48	Ascoli Piceno	Italy
Flash flood	28/05/2019 12UTC	29/05/2019	30	Modena	Italy
Flash flood	28/05/2019 12UTC	29/05/2019	30	Ferrara	Italy
Flash flood	28/05/2019 12UTC	29/05/2019	36	Fermo	Italy
Flash flood	28/05/2019 12UTC	29/05/2019	48	Macerata	Italy
Flash flood	29/05/2019 00UTC	29/05/2019	84	Brasov	Romania
Flash flood	29/05/2019 00UTC	29/05/2019	36	Jasz-Nagykun-Szolnok	Hungary
Flash flood	29/05/2019 00UTC	29/05/2019	36	Fejer	Hungary
Flash flood	29/05/2019 00UTC	29/05/2019	36	Bacs-Kiskun	Hungary
Flash flood	29/05/2019 00UTC	29/05/2019	84	Sibiu	Romania
Flash flood	29/05/2019 00UTC	29/05/2019	84	Valcea	Romania
Flash flood	29/05/2019 00UTC	29/05/2019	78	Arges	Romania
Flash flood	29/05/2019 00UTC	29/05/2019	78	Dambovita	Romania
Flash flood	29/05/2019 00UTC	29/05/2019	78	Ilfov	Romania
Flash flood	29/05/2019 00UTC	29/05/2019	78	Giurgiu	Romania
Flash flood	29/05/2019 12UTC	30/05/2019	24	Budapest	Hungary
Flash flood	29/05/2019 12UTC	30/05/2019	24	Bihor	Romania
Flash flood	29/05/2019 12UTC	30/05/2019	24	Ternopil'	Ukraine
Flash flood	29/05/2019 12UTC	30/05/2019	24	Ivano-Frankivs'k	Ukraine
Flash flood	29/05/2019 12UTC	30/05/2019	24	Chernivtsi	Ukraine

* 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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