European Flood Awareness System

EFAS *Bulletin*

April – May 2017

Issue 2017(3)

NEWS

News and updates

Development of new EFAS web portal

The EFAS Computational centre has contracted the re-development of the EFAS web portal to the software development company COMMpla, who also developed the web portal for the two other COPERNICUS services that are managed by ECMWF. The new platform will be modernised in its appearance and will add more functionality for the user in terms of getting information as well as better enable web services. To gather input from the users in terms of requirements, COMMpla now have put together an online survey which who is interested in and want to contribute to the new portal can take. Before you take the survey, please remember to have a look at the early mock-ups that has been produced, you will find them and the survey when you click on the link:

https://www.surveymonkey.com/r/K75GWDZ

Please note that the survey closes on Wed 28 June. The delivery of the new portal is planned for autumn 2018, and we will keep you updated on the progress.

Meetings

EFAS at the ERICHA Training, 26-27 April 2017, Madrid, Spain.

The project "Integrating a European Rainfall-InduCed Hazard Assessment system (ERICHA)" aims at integrating the OPERA radar based flash flood products that have been developed in previous projects HAREN and EDHIT, into the Copernicus European Flood Awareness System (EFAS) with the purpose to ensure their real-time availability beyond the duration of the project. The main benefit of the ERICHA products is its high spatial and temporal resolution (producing high-resolution rainfall forecasts every 15 minutes with lead times up to 6 hours) and its complementarity to systems based on Numerical Weather Prediction (NWP) models. The latter quite often do not have adequate resolution to resolve convective storms which can in many cases be very local and with lifetimes of a few hours.

A training on ERICHA was organized at the National Spanish Civil Protection facilities in Madrid, Spain, to demonstrate the ERICHA products as well as to approach professional meteorological forecasters and Civil Protection agencies to present the advancements and to gather feedback from external experienced users. Peter Salamon provided an overview of the flash flood indicators available in Copernicus EFAS and demonstrated how the integration of the radar based OPERA products into EFAS offer the end-user a tool for the seamless monitoring, nowcasting and forecasting of flash floods in Europe. Case studies were analysed, where the workshop participants could test and evaluate the available forecasts and provide feedback for further developments. A final presentation was given related to the new EFAS rapid risk assessment tool that allows the end-user to predict the possible impact of forecasted floods in terms of affected population, economic damages, critical infrastructure affected, etc.

EFAS training for the ERCC duty officers, 10-11 May 2017, Brussels, Belgium.

Peter Salamon provided a training on EFAS and GloFAS to the duty officers of DG ECHO's Emergency Response Coordination Centre (ERCC). This included a brief overview of the main concepts, a hands-on session with the web interfaces and an introduction to new developments. Very positive feedback was given for the new development of the rapid impact assessment based on the EFAS forecasts.

IMPREX General Assembly 31 May to 2 June 2017

The second General Assembly of the Horizon 2020 IMPREX (IMproving PRedictions and management of hydrological EXtremes) project was held at ECMWF from 31 May to 2 June. About 60 participants from the 23 partner organisations took part in this meeting. This year, the meeting focused mainly on the various modelling concepts and reported on progress of the project so far. One of the key results that were discussed was the comparison between different hydrological seasonal forecasts over Europe, including the recently developed EFAS seasonal forecast. The results of this study will be published later this

New publications

Cloke, Hannah L., Florian Pappenberger, Paul J Smith and Fredrik Wetterhall, (2017), How do I know if I've improved my continental scale flood early warning system? *Environmental Research Letters*, Volume 12, Number 4.

Emerton, R., H. L. Cloke, E. M. Stephens, E. Zsoter, S. J. Woolnough, and F. Pappenberger, Complex picture for likelihood of ENSO-driven flood hazard, Nature Communications 2017; 8: 14796.

RESULTS

Summary of EFAS Flood and Flash Flood Notifications

The 2 formal and 1 informal EFAS flood notifications issued in April-May 2017 are summarised in Table 1. The locations of all notifications are shown in Figure 21 and Figure 23 in the appendix.

18 Flash flood notifications, summarised in Table 2, were issued from April to May 2017. The locations are shown in Figure 22 and Figure 24 in the appendix.

Meteorological Situation

by EFAS Meteorological Data Collection Centre

Meteorological situation for April 2017

In early April, a low-pressure system was located over the North Atlantic, and an associated high-pressure system influenced parts of Scandinavia and northern Europe. In the rest of Europe, a few weaker low-pressure systems dominated the weather conditions. The high-pressure system expanded eastwards and affected almost all of Europe. During this process, a relative strong low-pressure system over Svalbard strengthened and expanded to southern Europe. Both systems moved to the eastwards, wherefore high pressure occurred over the central parts Europe.

In mid-April, the low-pressure system over Scandinavia diminished and a high pressure expanded to northern and central Europe. Overall, some local low- and high-pressure systems were spread over Europe, without any particular features. Towards the end of April a low-pressure system developed over Scandinavia and moved towards the previously established high-pressure over northern and central Europe. The low-pressure system over and was replaced by a high-pressure system. In the rest of Europe, small local low-pressure systems occurred. This explains why the weather conditions did not caused any major floods.

Overall, the accumulated precipitation for April (Figure 9) was high at the coast of Norway and northern United Kingdom, as well as in mountainous regions: the Alps at the border between Italy and Slovenia (> 400 mm) and Tatra Mountains (~ 350 mm) in Slovakia. The precipitation anomalies were dry (negative) in western and southern parts of Europe, especially in some regions of Portugal and Iceland (Figure 10). In northeastern and eastern Europe, more precipitation than normal was recorded, with the exception of parts of the Ukraine.

The maximum of the average temperature in April (19.5°C) was observed in Seville, Spain (Figure 13). The temperature in the mountainous regions, as well as in Iceland and Scandinavia fells below the zero degree mark and reached about -13.5°C. The temperature anomalies for May divided Europe into two parts: southern Europe experienced significantly higher temperatures than normal, especially in the mountains (f. ex. Pyrenees, Balkan Mountains) and urban areas (Figure 14). In addition, some parts of the Ukraine are up to 2°C warmer than normal. In the rest of Europe, negative anomalies were recorded.

Meteorological situation for May 2017

In the start of May, northern Scandinavia was influenced by a low-pressure system. A weak high-pressure system close to Greenland strengthened and displaced the low pressure, which in turn moved eastwards. The high-pressure expanded towards parts of central and northeastern Europe. In the rest of Europe, local high and low-pressure systems dominated the weather conditions. On 10 May a low pressure strengthened over Scandinavia and moved southwards. The high-pressure system diminished and went eastwards and a new high-pressure system then developed over Scandinavia and Iceland. Sporadic high-pressure affected the north-west, and weak low-pressure systems dominated the rest of Europe at the latter part of May.

The accumulated precipitations sums of May indicated a maximum of 234.7 mm in northern Portugal. Precipitation was in general well spread over central and eastern Europe without causing any floods (Figure 11). In most parts of Europe, the precipitation anomalies were below normal, especially in Iceland, southern parts of Spain and Sicily as well as in Sardinia (Figure 12). More rainfall than normal was observed in some western and eastern European countries. The average temperatures (max. 22.2 °C) were mostly above the zero degree level, except in parts of Iceland, Scandinavia and mountainous areas (min. -9.3°C, Figure 15). The temperature anomalies again split Europe: In the southwestern and southeastern half, as well as Iceland and parts of southern Scandinavia experienced higher temperatures than normal (Figure 16). In contrast, the temperature anomaly in northeastern Europe was negative.

Hydrological situation

By EFAS Hydrological Data Collection Centre

During April, observed daily average discharge values for gauging stations from the northern and central Norway, northern Sweden and Finland surpassed the 90% quantile value (Figure 17). This same threshold has been also exceeded by stations present along the catchments of the Danube (river Wertach), The Wistula (river Poprad) the Llobregat, and Duagava. For May, the situation was quite similar for the previously mentioned catchments (except Duagava), although new stations also have come to surpass the 90% quantile value (Figure 19), more specifically for the rivers Louro (Minho- Sil), Llobregat, Maigue (Shannon), Rednitz (Rhein), Orava and Cheremosh (Danube), Stryi (Dniester), Jubilee (Thames) and Parma, Taro, Nure (Po).

Out of the 813 stations for which warning levels were available, for both stage and discharge values alike, 40 exceeded the minimum warning level provided at least 1 day during April (Figure 18). This occurred for stations that are situated along the catchments of the Danube, Rhine, Po, Dnieper and LLobregat rivers. The rivers, Stokhid (Dnieper), Tisza (Danube) and Gatta (Po), have surpassed the minimum alert level for a period of over 15 days. During May, only 27 stations exceeded the lowest warning value provided (Figure 20). This occurred for stations that are situated along the catchments of the Danube, Rhine, Po, Elba and Minho rivers. The rivers Dunbe, Tisza, Dalj (Danube) and Riglio, Gatta (Po) surpassed the minimum alert level for a period of over 15 days.

Verification

Figure 1 shows the EFAS headline score, the Continuous Ranked Probability Skill Score (CRPSS) for one lead-time, for the April to May period across the EFAS domain for catchments larger than 2000km^2. The reference score is the persistence forecast. A CRPSS of 1 indicates perfect skill, 0 indicates that the performance is equal to that of the reference, and any value <0 (shown in red on the maps) indicates the skill is worse than persistence.

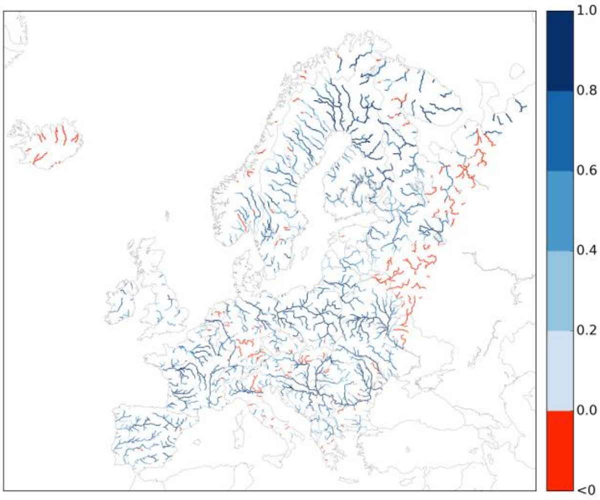

Figure 1. EFAS CRPSS at lead-time 1 day for the April-May 2017 period, for catchments >2000km2. The reference score is persistence.

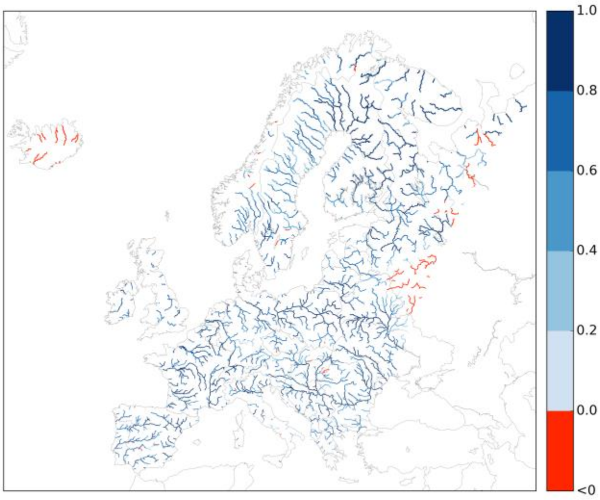

Figure 2. EFAS CRPSS at lead-time 3 days the April-May 2017 period, for catchments >2000km2. The reference score is persistence.

The map shown in Figure 2 displays the CRPSS at 3 days lead-time. The corresponding maps for 5 and 10 days lead-time are shown in the Appendix, Figure 25 and Figure 26.These maps indicate that across much of Europe for February and March, EFAS forecasts are more skilful than persistence at all lead times. Regions shown in blue are those where EFAS forecasts are more skilful than persistence, with darker shading indicating better performance.

FEATURES

Presentation of the hydrometeorological service at the Slovenian Environment Agency

by Andrej Golob, Slovenian Environment Agency (ARSO)

The National hydrometeorological service at the Slovenian Environment Agency has been in continuing development over the past years, which was initiated by the extensive European project BOBER, followed by participating in several national and multinational projects. Through various development phases, the focus was on making advancements in all associated fields of work in order to improve and expand our services for the public and other end users.

The foundation of improving our models and products was the construction of a measuring infrastructure comprising 147 hydrological stations, 92 meteorological stations and an additional meteorological radar. These now enable real-time access to large amount of environmental data. Investments were also made on modernisation of the computer infrastructure and the purchase of a supercomputer. The super computer serves the operational model as well as research and development of the complex meteorological models.

Secondly, this newly acquired data and infrastructure provide the backbone of the national hydrological forecasting system with the use of the MIKE software by DHI. It provides the hydrological forecasting service (currently consisting of nine forecasters) a vital operational tool for monitoring and forecasting the state of Slovenian rivers.

Figure 3. The hydrological forecasting room of the Slovenian national hydrometeorological service.

The forecasting system covers hydrological and hydrodynamic models divided into 4 spatial domains; one each for the major river basins in Slovenia, i.e. Sava, Soča and Mura river basin, and the full Slovenia model that consists of 227 sub catchments. The latter is considered a semi-distributed model with an average catchment size of 90 km^2, and is as such primarily designed for forecasting smaller scale flash floods.

Point measurements and processed radar estimates are used as meteorological input data in the analysis period of the model simulations. The forecasts are run by deterministic and ensemble ALADIN model as well as ECMWF output. The result of the system are hourly updated discharge and water level forecasts for up to 6 days. Additionally, catchment average rainfall and specific runoff data are analysed to assist the forecaster to nowcast even sub-scale local flash floods.

Complementing the model results and the essential forecaster skill and experience, we recognize an added value in the organizational aspect of having the meteo and hydro offices working side by side. It enables daily or more frequent consultations that provide helpful information, especially regarding NWP uncertainty. Both offices issue forecasts and warnings in text, audio and graphical format, composed in accordance with the Meteoalarm colour-coded warning levels based on potential impact. We have introduced supplementary dissemination of information through social media channels with the goal of improving our services to the users.

As an active regional and European partner, we are also participating in 3 hydrological forecasting systems – Southeast European Flash Flood Guidance System developed with support of the WMO, Sava River Basin Flood Forecasting and Warning System that is currently in development phase based on the Delft-FEWS system by Deltares, and of course our common EFAS system.

The extension of EFAS system, focusing on the flash flood forecasting and nowcasting is considered exceptionally valuable for Slovenia, as it is a mountainous country with a diverse climate. Consequently, our future goal is to increase our position as an active user, data provider and participant in composing the future EFAS guideline.

FloodList launches new flood event map and search tool

by Richard Davies, FloodList

A new tool listing flood events around the world has been launched by FloodList.com. The flood events map is the culmination of over 18 months' work and was made possible through funding from the Copernicus programme.

Flood events database and map tool

Working with EFAS partners, the FloodList team have developed an online flood events database to store relevant data about each flood event, such as flood type, cause, dates, location, magnitude and damage. The data is published via an API where it can be imported into a range of web applications; including the newly launched flood events map tool: (http://floodlist.com/map/world-flood-map).

The tool currently includes data from flood events from early 2016 onwards, with data from current flood events added daily. Users can filter by year, month, continent, region and country, to fine tune a search. More filter options are planned for the future.

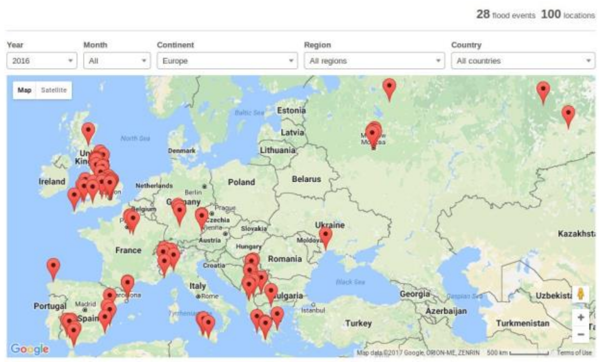

Figure 4. Floods events in Europe in 2016

The locations of each flood event are shown on a map and users can click on map markers to find links to relevant reports and articles where available (Figure 4Figure 5. A list of flood events also shows in a table form below the map, where the data can be sorted into any preferred order.

The tool is currently at the "soft launch" stage with further developments planned. Feedback from the EFAS community is welcome (link: http://floodlist.com/about-us/contacts).

Figure 5. Global flood events in 2016

Flood reporting community

As part of the next stage of the project, the FloodList team hopes to develop a network of "flood watchers" around the world. This flood reporting community will be able to input relevant data for flood events in their area into the online flood events database.

About FloodList

FloodList.com (http://floodlist.com/) is a news and flood reporting service, documenting major flood events around the world. News reports on current floods, plus articles on issues such as forecasting, prevention and recovery are published daily. FloodList.com started in 2008 as a website to help victims of the major floods affecting parts of the US Midwest. Since then it has developed into a popular news source for flood events and receives approximately 70,000 to 100,000 visitors per month. Please contact FloodList for further information. http://floodlist.com/about-us/contacts

Addressing the challenges and highlighting the innovation towards the prediction of natural hazards - report from a PICO session at EGU 2017

by Femke Davids (Deltares, the Netherlands), Michael Cranston (RAB Consultants/University of Dundee, Scotland), Ilias Pechlivanidis (SMHI, Sweden), Jan Szolgay (Slovak University of Technology, Slovakia)

The European Geosciences Union General Assembly (EGU 2017) was yet another great success, bringing together about 14,500 scientists from 107 countries to Vienna, Austria, on 23-28 April. A popular session was the PICO session "Operational forecasting and warning systems for natural hazards: challenges and innovation", supported from the HEPEX scientific community. Over the two session slots (in total 3 hours) about 27 presentations were given overflowing the available space (Figure 6).

Figure 6. Delegates at the PICO session on operational forecasting and warning systems for natural hazards

Often, the sharing of knowledge and experience about developments are limited to the particular field (e.g. flood forecasting or landslide warnings) for which the operational system is used. This PICO was a step forward to bridge the gap between scientists and practitioners in operational forecasting for the numerous water-related natural hazards. The presenters highlighted the various efforts on the setup/improvement of operational systems around the globe and the focus on disseminating predictions in an easily understood, particularly from the end-user side, manner.

Real-world case studies of system implementations configured at local, regional and national scales were presented, including trans-boundary issues. It is very positive to note that a number of services targets supporting emergency services. The new opportunities identified were physically based modelling, coupling meteorological and hydrological forecasts, ensemble forecasting and real time control. Nevertheless, monitoring and forecasting were key aspects for river floods, ocean and marine works, bridge management, surge hazards, water quality etc. Although, the majority of the services focus on the short and medium time scale, quite some services explored the added value in sub-seasonal and seasonal time scales.

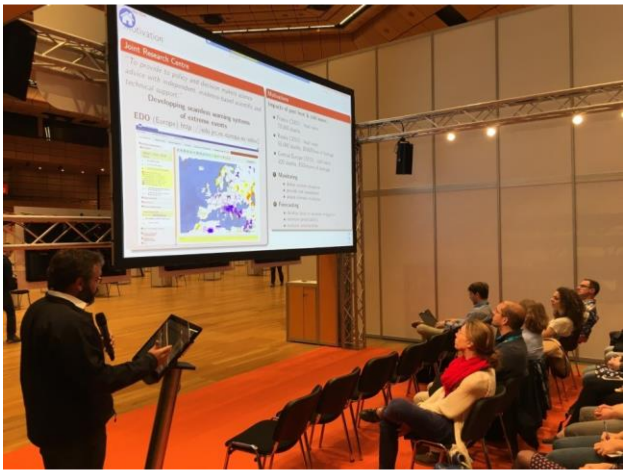

Figure 7. Christophe Lavaysse presenting an operational system to monitor and forecast extreme temperature anomalies in Europe

Over the European continent, the Institute for Environment and Sustainability (European Commission) developed an operational system to monitor and forecast extreme temperature anomalies to help decision makers, users and emergency services to trigger different type of emergencies depending on the intensity of the event or even the related uncertainties (Figure 7). The service achieves a relatively good reliability of the forecasted temperature and hence forecasts can be used to predict heat and cold waves up to 15 days ahead.

A group of HEPEX-connected institutions has designed a live game of a forecasting system to demonstrate the large number of decisions that has to be taken in operational forecasting services. The game was designed to highlight the complexities behind decision making in terms of pathways that can be selected, timescales cost and timing of effective actions. The game attracted significant attention with the players being the protagonists of an interactive story driven by challenges, exploration and problem-solving (Figure 8). The challenges when managing the actions of a forecasting team, the sequential decisions that affect the service in preparation to and during a flood event, and finally deal with the consequences of the forecasts issued.

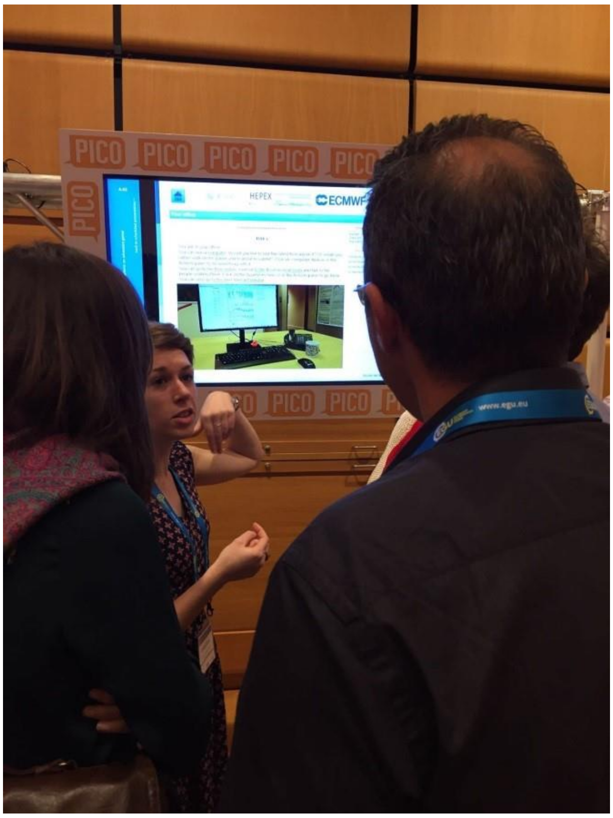

Figure 8. Louise Arnal (University of Reading and ECMWF, UK) running a dynamic and diagnostic game on the design and operation of flood forecasting systems.

In summary, this PICO session brought together the expertise from a unique panel of scientists, managers and policy makers and gave them the opportunity to explore differences, similarities, problems and solutions between forecasting systems for varying natural hazards. It is definitely not an easy task to thoroughly present the efforts at the international level, we therefore recommend you to participate in similar sessions in the coming conferences, workshops and assemblies. We are very much looking forward to seeing you again at EGU 2018.

Acknowledgements

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

- DG GROW - Copernicus and DG ECHO for funding the EFAS Project
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- The EFAS Operational Centres
- Andrej Golob, Slovenian Environment Agency (ARSO)
- Richard Davies, Floodlist.com
- Femke Davids (Deltares, the Netherlands), Michael Cranston (RAB Consultants / University of Dundee, Scotland), Ilias Pechlivanidis (SMHI, Sweden), Jan Szolgay (Slovak University of Technology, Slovakia)

Cover image: Screenshot from the online flood events database developed by Floodlist.com in collaboration with the EFAS Computational Centre.

Appendix - figures

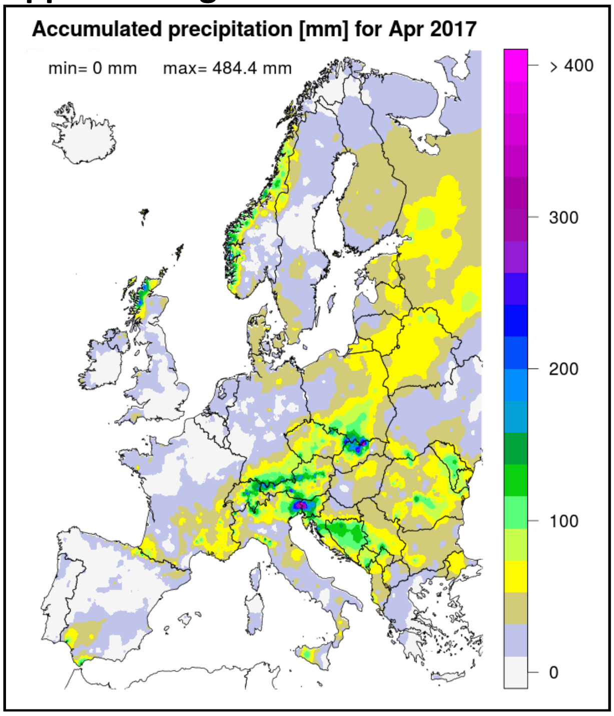

Figure 9. Accumulated precipitation [mm] for Apr 2017.

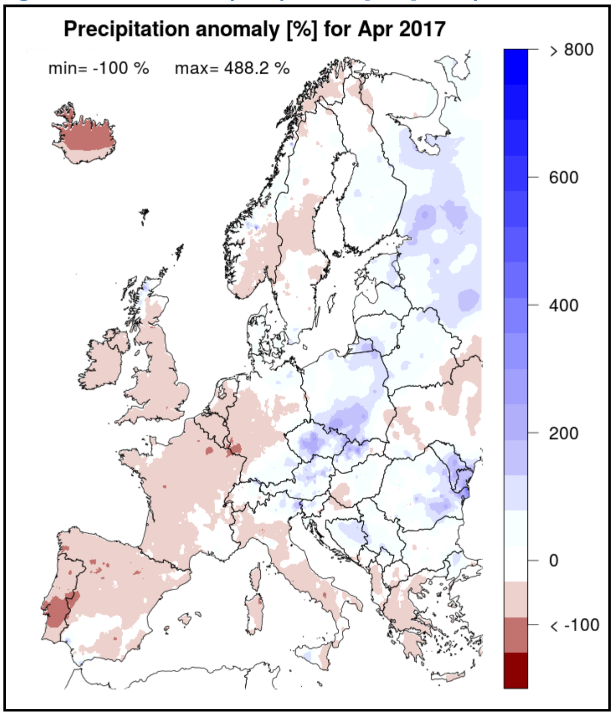

Figure 10. Precipitation anomaly [%] for Apr 2017, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

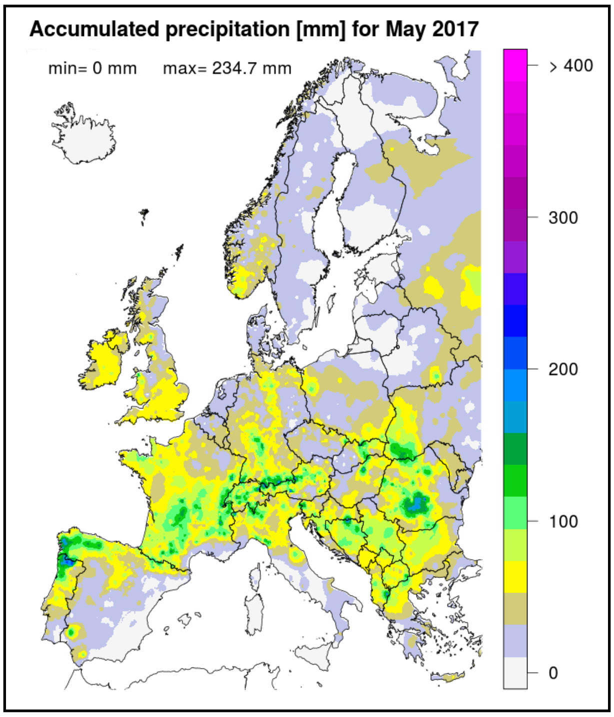

Figure 11. Accumulated precipitation [mm] for May 2017.

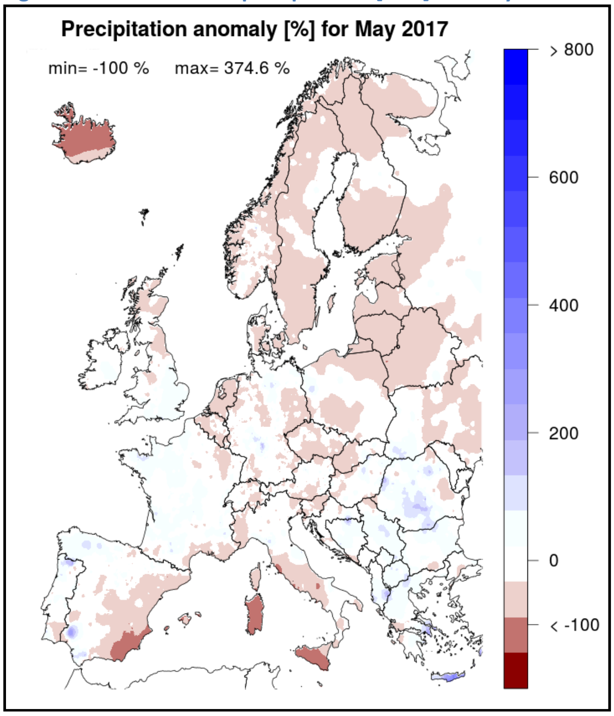

Figure 12. Precipitation anomaly [%] for May 2017, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

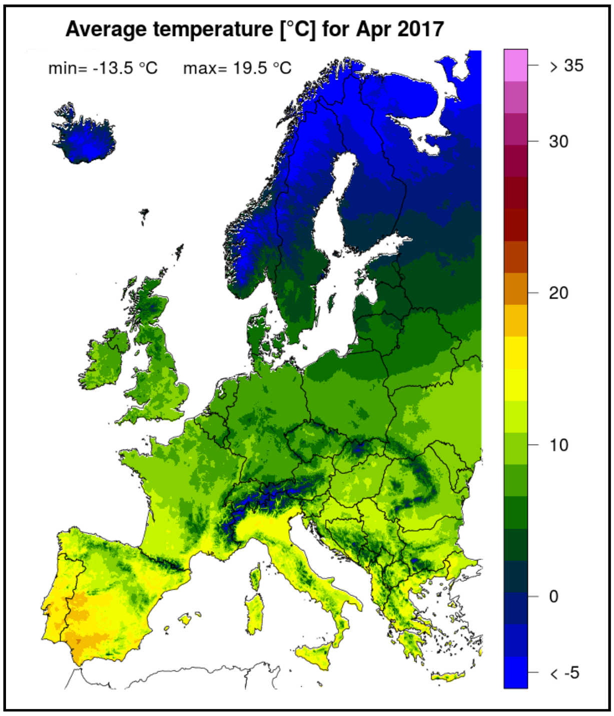

Figure 13. Mean temperature [°C] for Apr 2017.

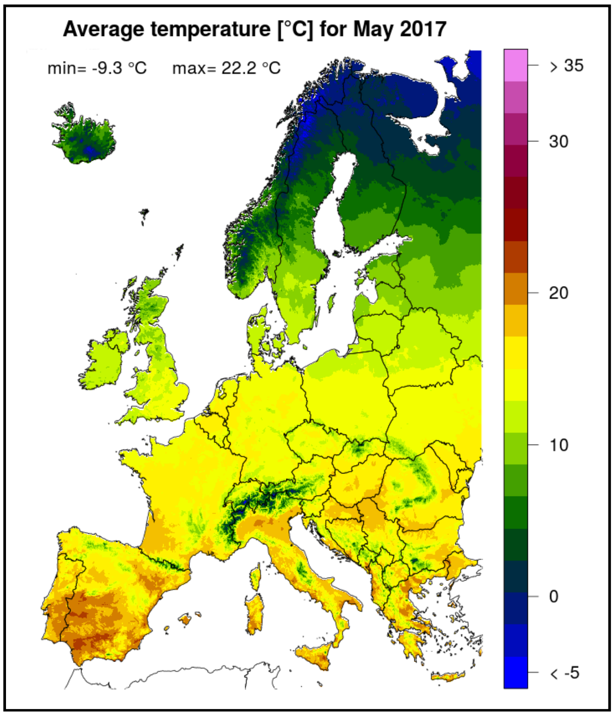

Figure 15. Mean temperature [°C] for May 2017.

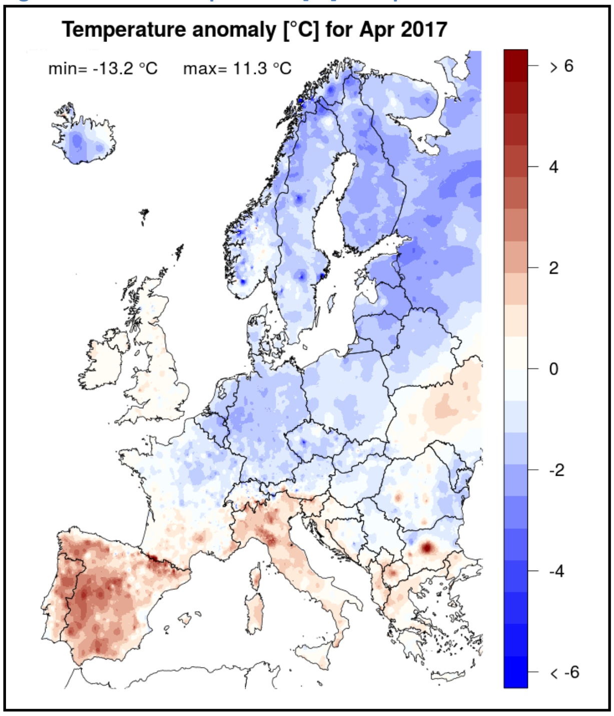

Figure 14. Temperature anomaly [°C] for Apr 2017, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

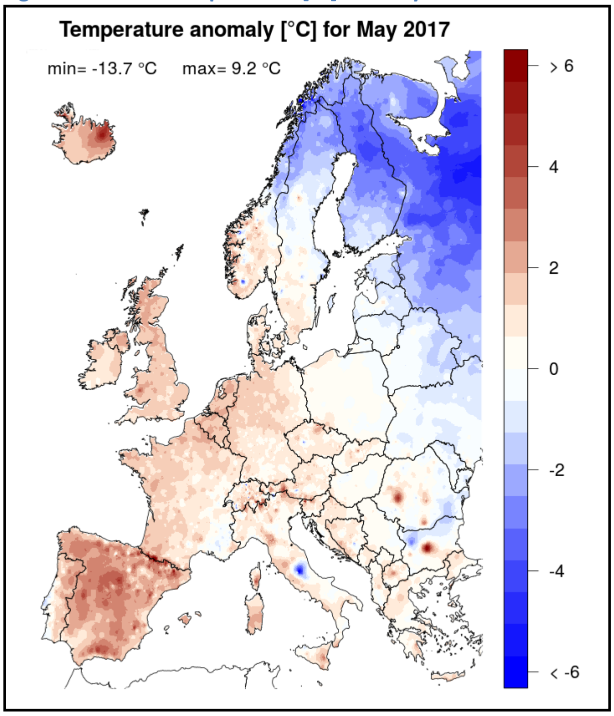

Figure 16. Temperature anomaly [°C] for May 2017, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

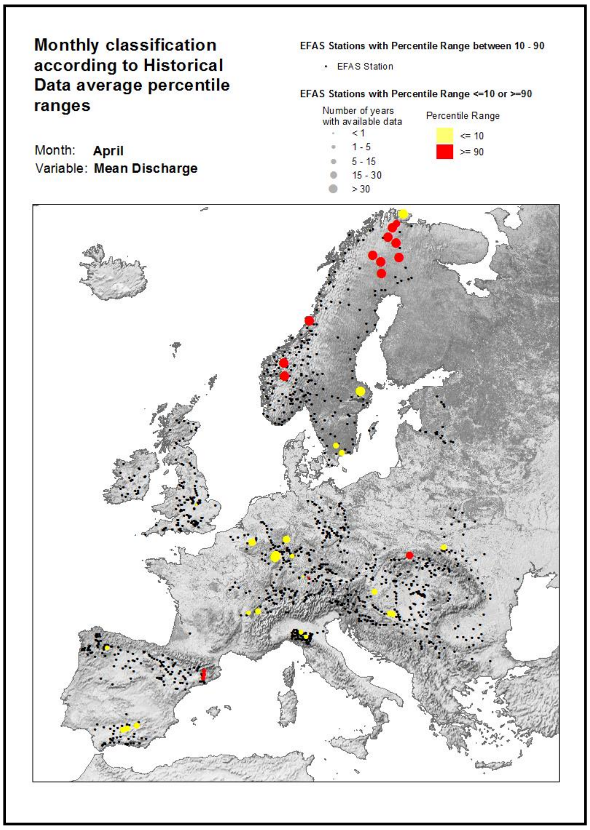

Figure 17. Monthly discharge anomalies Apr 2017.

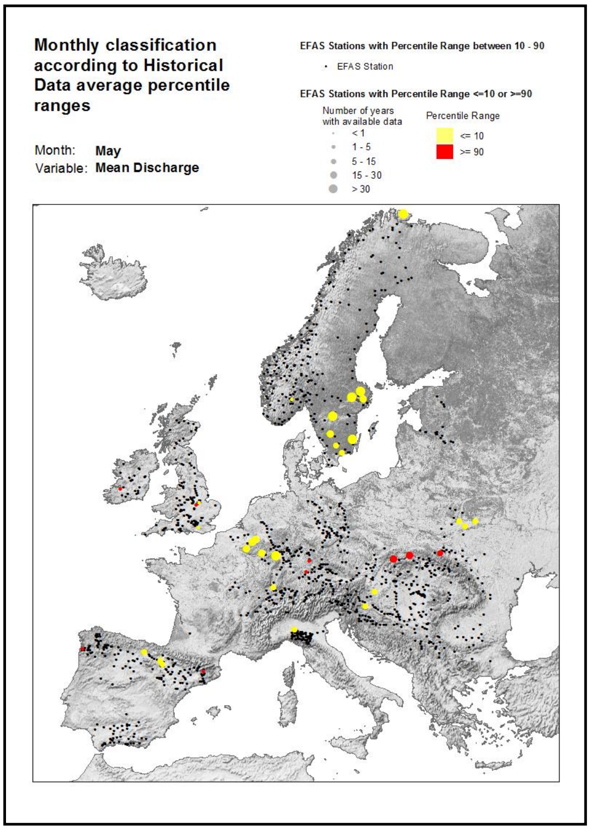

Figure 19. Monthly discharge anomalies May 2017.

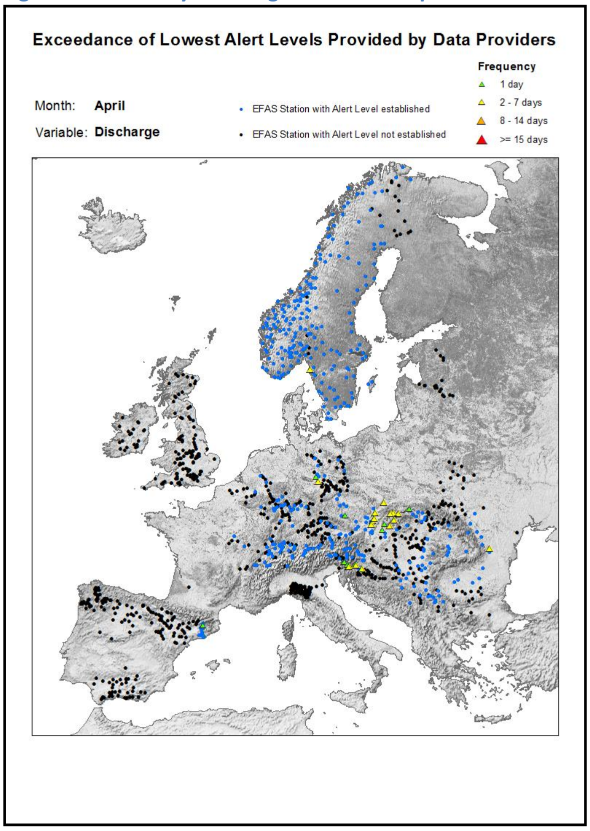

Figure 18. Alert level exceedance for Apr 2017.

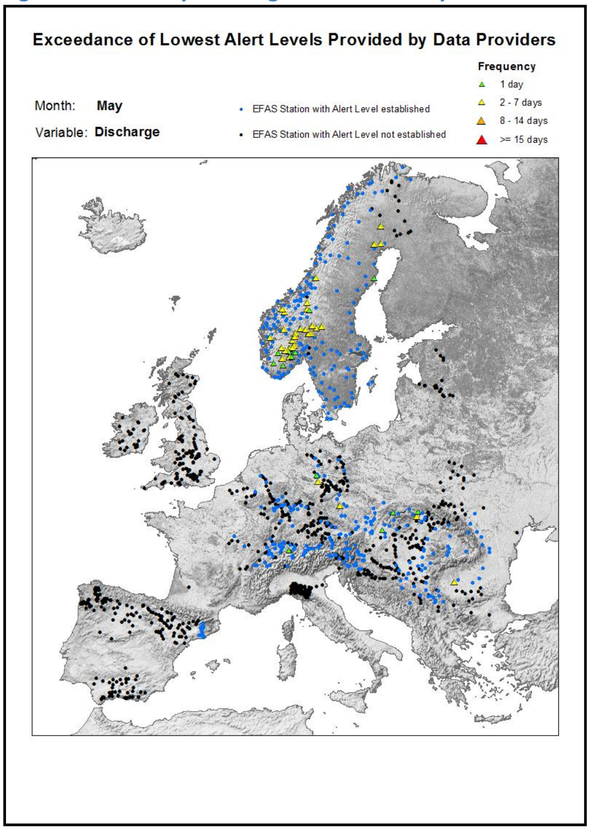

Figure 20. Alert level exceedance for May 2017.

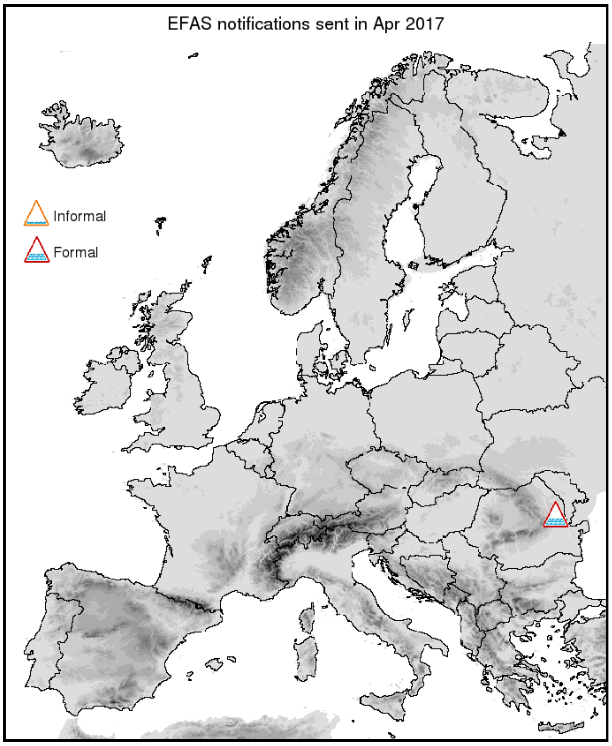

Figure 21. EFAS flood notifications sent for Apr 2017.

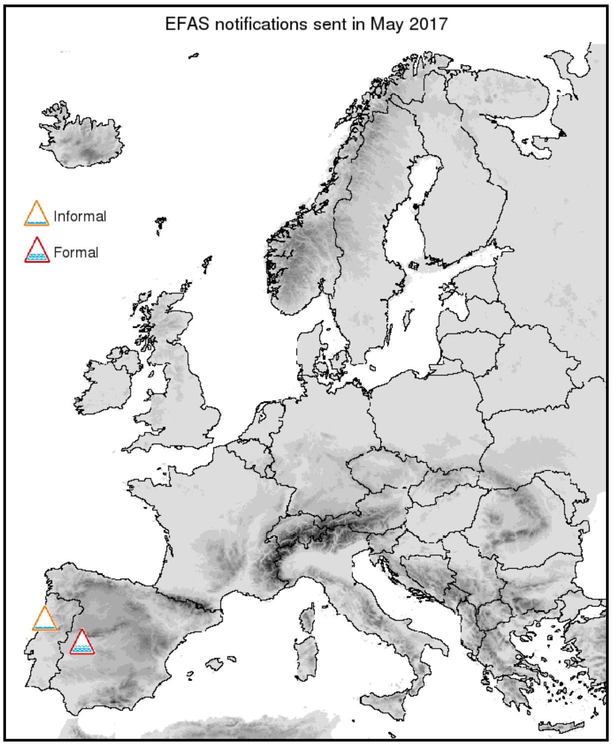

Figure 23. EFAS flood notifications sent for May 2017.

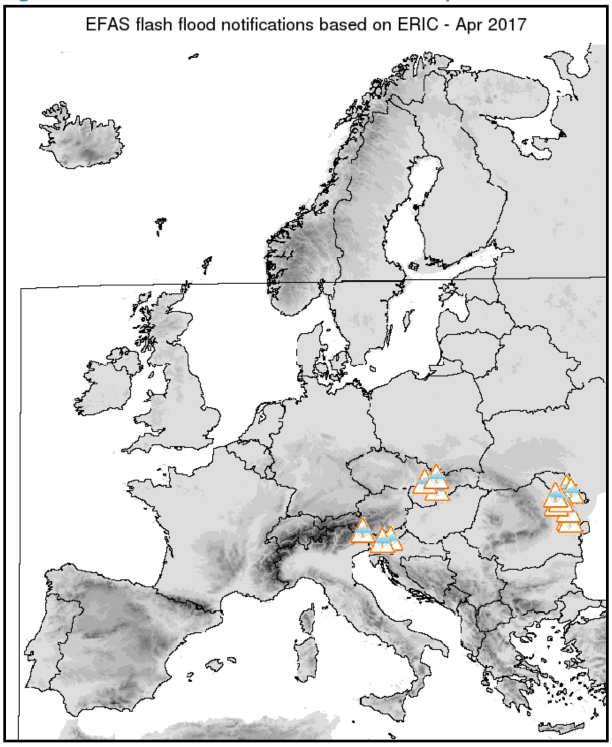

Figure 22. Flash flood notifications sent for Apr 2017.

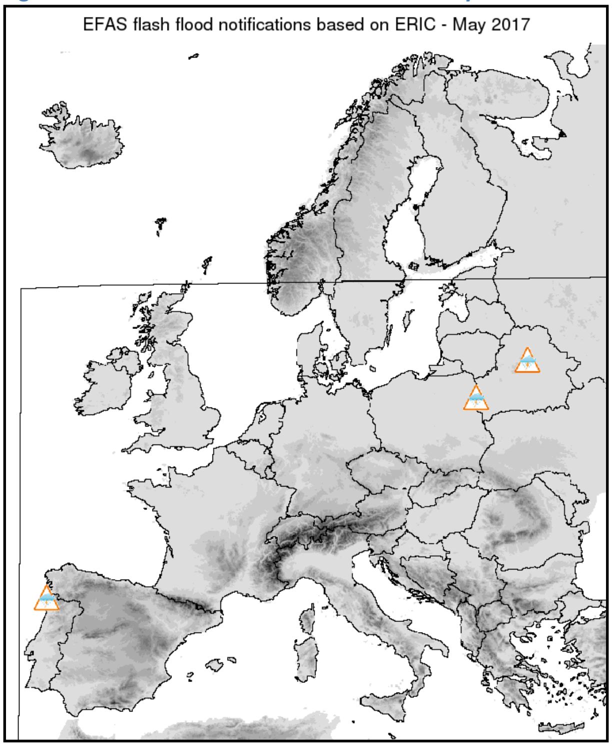

Figure 24. Flash flood notifications sent for May 2017.

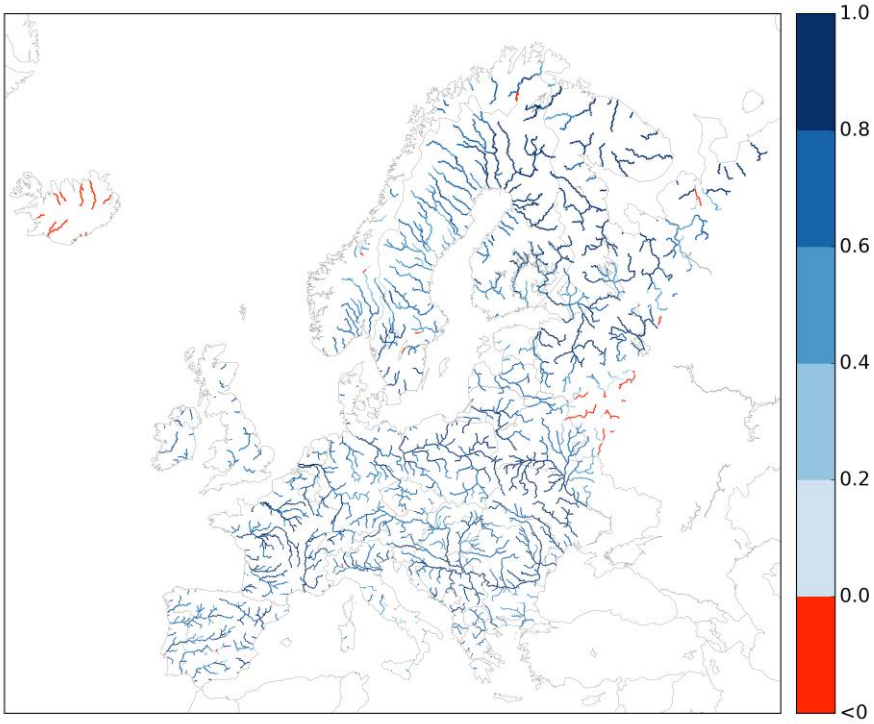

Figure 25. EFAS CRPSS at lead-time 5 days for the April-May 2017 period, for catchments >2000km^2. The reference score is persistence.

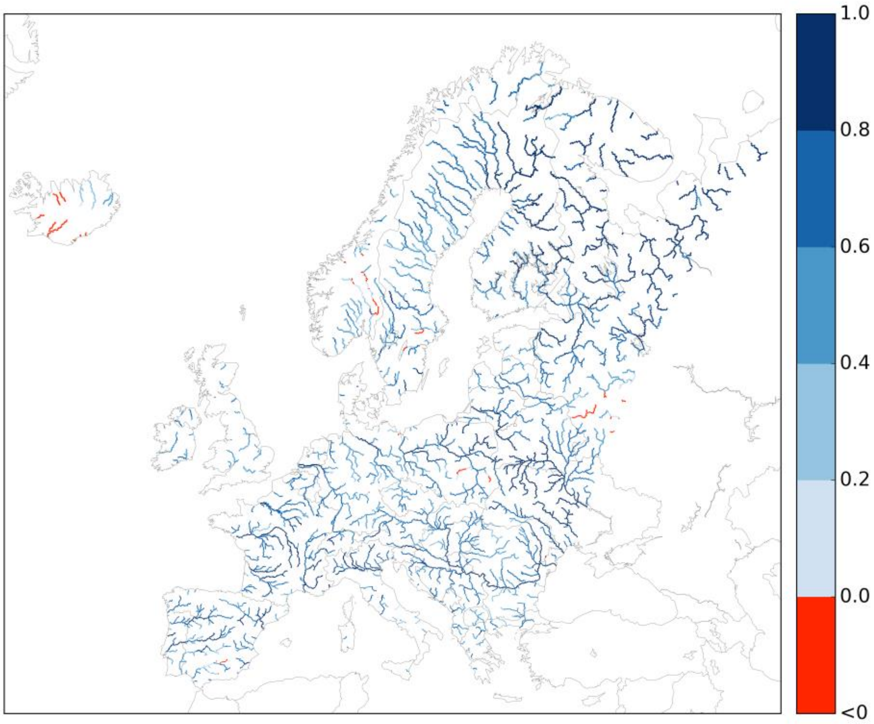

Figure 26. EFAS CRPSS at lead-time 10 days for the April-May 2017 period, for catchments >2000km^2. The reference score is persistence.

Appendix - tables

Table 1. EFAS flood notifications sent in April - May 2017.

Type	Forecast date	Issue date	Lead time*	River	Country
Formal	20/04/2017 12 UTC	21/04/2017	4	Tutova	Romania
Formal	07/05/2017 00 UTC	07/05/2017	4	Tietar	Spain
Informal	09/05/2017 12 UTC	10/05/2017	2	Vouga	Portugal

* 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 2017.

Type	Forecast date	Issue date	Lead time*	Region	Country
Flash flood	06/04/2017 12 UTC	07/04/2017	42	Lapusna, Ungheni	Moldova
Flash flood	06/04/2017 12 UTC	07/04/2017	42	Lapusna, Ungheni	Moldova
Flash flood	06/04/2017 12 UTC	07/04/2017	42	Iasi	Romania
Flash flood	07/04/2017 00 UTC	07/04/2017	30	Chisinau, Gaugazia, Orhei	Moldova
Flash flood	07/04/2017 00 UTC	07/04/2017	30	Chisinau, Gaugazia, Orhei	Moldova
Flash flood	07/04/2017 00 UTC	07/04/2017	30	Chisinau, Gaugazia, Orhei	Moldova
Flash flood	07/04/2017 00 UTC	07/04/2017	30	Vaslui	Romania
Flash flood	19/04/2017 12 UTC	20/04/2017	30	Cahul, Gagauzia	Moldova
Flash flood	19/04/2017 12 UTC	20/04/2017	30	Cahul, Gagauzia	Moldova
Flash flood	26/04/2017 12 UTC	27/04/2017	54	Zilinsky kraj	Slovakia
Flash flood	27/04/2017 00 UTC	27/04/2017	24	Karnten	Austria
Flash flood	27/04/2017 00 UTC	27/04/2017	42	Trenciansky kraj	Slovakia
Flash flood	27/04/2017 12 UTC	28/04/2017	36	Banskobystricky	Slovakia
Flash flood	27/04/2017 12 UTC	28/04/2017	24	Osrednjeslovenska, Savinjska	Slovenia
Flash flood	27/04/2017 12 UTC	28/04/2017	24	Osrednjeslovenska, Savinjska	Slovenia
Flash flood	06/05/2017 12 UTC	07/05/2017	42	Minskaya voblasts'	Belarus
Flash flood	07/05/2017 00 UTC	07/05/2017	30	Podlaskie	Poland
Flash flood	10/05/2017 12 UTC	11/05/2017	42	Minho-Lima	Portugal

* 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 15 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 ENTR 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 ELIMCO) 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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