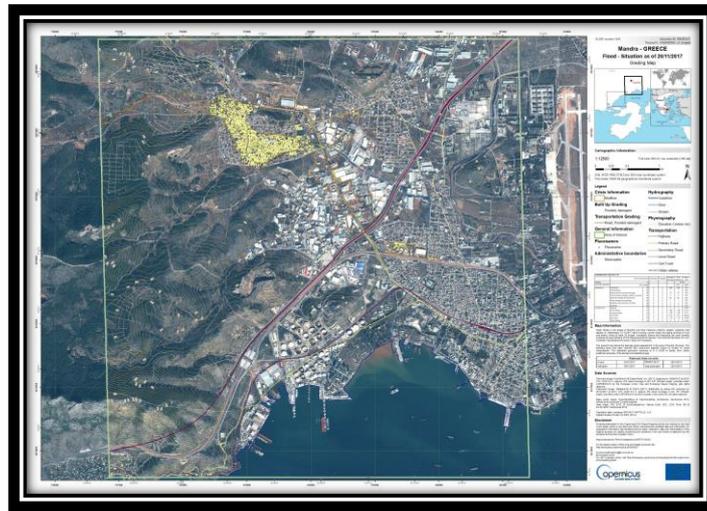


European Flood Awareness System

EFAS *Bulletin*

October – November 2017

Issue 2017(6)



NEWS

Upcoming events

The 13th EFAS annual meeting will take place in Norrköping, Sweden, 13-14 March 2018. The focus will be partner networking and sharing experiences. To register, please follow the link below and fill in the registration form (one entry per registrant):

<https://www.surveymonkey.com/r/W87RNFV>

The registration is open until **12 February 2017**. For more information, please visit the EFAS web portal or contact the EFAS Dissemination Centre via info@efas.eu. We look forward to seeing you there!

User survey and first demonstration of new EFAS-IS

The development of the new EFAS web interface is advancing, and we now invite all interested to access the new web site and provide feedback. It is still under development and not all features are available or finalised. However, it is important that users can influence the development in the process. On <https://www.efas.eu/home> you can find information on how to access the web site, a link to the online survey and a tutorial video to give you an overview of the project and the platform. The survey will be open until **12 January 2018**.

New developments

GloFAS seasonal outlook

On 10 November 2017, the new GloFAS seasonal outlook was released. This is the world's first operational global scale seasonal river flow forecast, and has been developed in collaboration with the University of Reading and ECMWF. The forecasts are displayed as three new "Seasonal Outlook" layers in the GloFAS user interface and are updated once per month, using the latest ECMWF seasonal forecasting system, SEAS5.

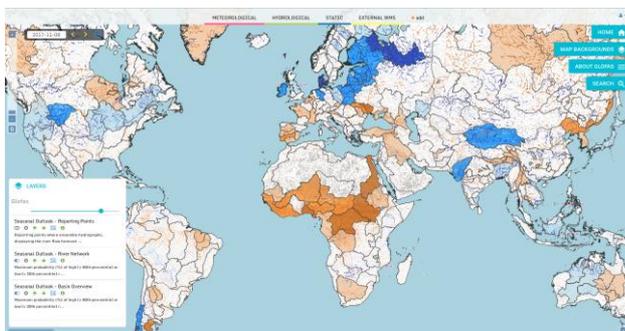


Figure 1. Screenshot of the GloFAS seasonal forecasts.

These new layers are designed to give an overview of whether river flow is likely to be unusually high or low over the next four months, for the global river network. For more information and to view the forecasts, visit www.globalfloods.eu.

Meetings

32nd meeting of the Flood Protection Expert Group of the ICPDR, 10 October, Brussels, Belgium

The latest developments for EFAS, relevant for the Danube river basin countries were presented. This included (1) the seasonal flood outlook, (2) the rapid flood risk assessment and its link to the pre-tasking of satellite images of the Copernicus EMS – rapid mapping, (3) the incorporation of radar based flash flood monitoring and nowcasting into the EFAS flash flood information, (4) the foreseen release of the new calibration and (5) the work ongoing to modernize the EFAS web interface and the EFAS data services.

16th Copernicus User Forum, 13 October, Brussels, Belgium

The Copernicus Emergency Management Service (EMS) was presented in detail to the Member States representatives during the 16th Copernicus User Forum in Brussels. All current EMS components, meaning floods (EFAS & GloFAS), forest fires (EFFIS & GWIS) and mapping (rapid as well as risk & recovery mapping) as well as the future drought component (EDO) presented their relevant news, developments and user experiences of the past year. Examples of the past summer (fires, hurricanes, floods) presented by users (Federal Office of Civil Protection and Disaster Assistance, Germany; Office of Public Works, Ireland; Emergency Response Coordination Centre, DG ECHO) demonstrated the relevance of the service for users who are directly and actively using the various service components.

22nd Working Group Floods meeting and the related workshop on "Risk indicators and assessment", 18-19 October, Tallinn, Estonia

The purpose of the Working Group on Floods (WG-F) is to provide a forum for support for the implementation of the Floods Directive. During the 22nd Working Group Floods meeting a presentation was given outlining relevant news and developments regarding flood related work done at the JRC. This included also an

overview of recent new developments under Copernicus EMS EFAS.

FATHUM meeting, 16-17 November, Ispra, Italy

FATHUM meaning “Forecasts for Anticipatory Humanitarian action” is a multi-institutional, interdisciplinary project led by the University of Reading, UK. The project aims at linking together research on forecast predictability and skill, complex drivers of risk, multi-actor perspectives on successful implementation and financing mechanisms to catalyse and facilitate the scale-up of Forecast-based Financing (FbF) for effective, appropriate and impactful action before a disaster. The meeting between the JRC and FATHUM project leads aimed at sharing current research results and future planning with the intention to streamline efforts done under GloFAS with the FATHUM project.

Copernicus cross service meeting between Emergency Management Service (EMS) and the Climate Change Service (C3S), 22 November, Reading, United Kingdom

The EMS runs various mapping and early warning services to provide relevant users with a large selection of high quality products to provide support during all phases of the emergency management worldwide. C3S¹ is Copernicus Climate Change Service aiming at the development/collection of authoritative, quality-assured information about the past, current and future states of the climate in Europe and worldwide. C3S builds a range of sectorial applications that aim at providing information that will help societal and business sectors improve decision-making and planning regarding climate mitigation and adaptation. The meeting between the two services aimed at sharing the current state of the services and to identify areas of potential collaboration. This includes, for example, the accessibility of archived EFAS simulations through the Climate Data Store or synergies in the collection and gridding of historic meteorological observations.

3rd Copernicus in situ data coordination workshop 15 November 2017, Copenhagen, Denmark

The Copernicus In Situ Component² maps the landscape of in situ data availability, identifies data access gaps or bottlenecks, supports the provision of crosscutting data and manages partnerships with data providers to improve access and use conditions. During the 3rd Copernicus in situ data coordination workshop

the current status of the EUMETNET data license agreement with the Copernicus services was presented. This data license agreement will facilitate greatly the access to hydro-meteorological data for all Copernicus services and will therefore further improve the work performed by the Copernicus EMS Meteorological and Hydrological Data Collection Centers.

New partners

We gladly welcome the Swiss Federal Office for the Environment as a new EFAS partner and the Centre for Coordination of Critical Infrastructure Protection from Ministry of Internal Affairs in Romania as a new EFAS third party partner.

RESULTS

Summary of EFAS Flood and Flash Flood Notifications

The 15 formal and 12 informal EFAS flood notifications issued in October-November 2017 are summarised in Table 1. The locations of all notifications are shown in Figure 23 and Figure 25 in the appendix.

77 Flash flood notifications, summarised in Table 2, were issued from October to November 2017. The locations are shown in Figure 24 and Figure 26 in the appendix.

Meteorological Situation

by EFAS Meteorological Data Collection Centre

Meteorological situation for October 2017

In the beginning of October, a high-pressure system located over Scandinavia was replaced by a low-pressure system, which was moving slowly east and strengthening. High-pressure dominated the weather conditions in the rest of Europe. A very strong low-pressure system localized over Iceland and extending to northwestern Europe led to heavy precipitation in northern England causing floods in parts of the county of Cumbria, UK between 11 and 12 October. In some areas, up to 211 mm were recorded in 24 hours.

In mid-October the situation did not change; on the one hand high-pressure systems dominated central Europe, on the other hand the weakened ex-hurricane

¹ <https://climate.copernicus.eu/>

² <https://insitu.copernicus.eu/>

Ophelia brought 40 m/s winds, high waves and storm surges to parts of Ireland and the UK on 16 October. Strong winds caused high seas lead to localized coastal flooding in parts of Ireland. Severe floods in Cádiz and Málaga province, Andalusia, occurred because of the low-pressure moving towards Spain, which caused torrential, highly localized rainfall with up to 112 mm measured in 24 hours on 18 October. The high precipitation sums also led to rock fall in the western part of the province Málaga. Followed by the event of ex-hurricane Ophelia in mid-October, storm Brian brought strong winds, high waves and rain to parts of Ireland and the UK on 21 October. Some minor flooding was reported in several cities in Ireland and parts of northern England. Capel Curig in Conwy County, North Wales, recorded the highest rainfall in the country with 48.4 mm between 20 and 21 October.

Towards the end of the month, mostly strong low-pressure systems occurred in Europe, which triggered flooding in the province of Burgas in the southeast of Bulgaria resulting in five victims between 24 and 25 October. In contrast, southwestern Europe was influenced by high-pressure weather conditions.

In general, the precipitation anomalies displayed drier conditions in northern Scandinavia, southern England, Spain, France and the entire Mediterranean region (Figure 11 Figure 12). However, eastern Germany, most parts of the Balkans and Eastern Europe were wetter than normal. Some data errors occurred in Iceland, because one data provider always delivered 0 mm precipitation totals from the meteorological stations. The highest accumulated precipitation with 634 mm was measured in coastal areas in Ireland and Norway, a result of strong low-pressure systems.

The average temperatures for October ranged from -5.5°C to a maximum of 23.9°C (Figure 15). Most parts of Europe were warmer than average, with the exception of southern Italy, parts of the Balkans, Russia and southern Finland (Figure 16).

Meteorological Situation for November 2017

Low-pressure systems influenced the weather conditions in Scandinavia and northern Europe in the beginning of November. Some high-pressure systems occurred in central and southern Europe, which slowly moved towards the East. During the 11-20 November, a strong low-pressure system was located over the Mediterranean Sea and led to heavy rainfall as well as

strong winds, especially in Greece. The most severely affected locations were the Greek islands Corfu and Igoumenitsa, where in some areas a precipitation total of more than 100 mm in 24 hours was recorded, resulting in one fatality. Furthermore, the high precipitation amounts led to flooding in areas of West Attica Region in Greece on 15 November, which damaged in total 955 buildings and 23 humans lost their lives. This event was considered as one of the worst in the Greek history. For more detail on the event, see the case study presented in this bulletin. In contrast, central Europe was mostly dominated by high-pressure systems in the mid of this month.

Due to a very strong low-pressure system, a storm caused major flooding in parts of the UK and Ireland between 22 and 23 November. Some areas recorded around 90 mm of rain in 24 hours and measured wind speeds up to 36 m/s in North Wales. Towards the end of November, this system was expanded to the south and caused torrential rain, leading to floods in Andalusia, the province of Malaga, Granada, Seville and Cadiz on 29 November. Grazalema in Cádiz recorded the highest levels of precipitation with 88.5 mm on this day. Overall, the weather conditions in Europe were determined by low-pressure, which also caused floods in central areas of Albania after around 150 mm rainfall in the last 24 hours of this month. Heavy precipitation totals was also reported in the neighbouring countries Macedonia, Croatia and Montenegro.

The accumulated precipitation sums indicated a maximum of 591.2 mm and correlated with the flood events during this month (Figure 13). Most parts of the Balkans were wetter than normal (Figure 14). Spain, France, Corse, Sardinia and parts of northern Europe displayed drier than normal conditions. In Iceland, there were some missing precipitation values. In addition, the average temperature for November ranged from -13°C to 18.5°C (Figure 17). In eastern and parts of central European countries as well as in Spain the influence of high-pressure systems could explain the positive temperature anomalies (Figure 18).

Hydrological situation

By EFAS Hydrological Data Collection Centre

Over the past two months, the highest concentration of stations which surpassed their minimum discharge and stage warning levels were in southern Norway and Sweden, in the Po river (northern Italy), in the Danube basin along the Sava and Tisza rivers as well as in the eastern Rhine river Basin (Figure 19 and Figure 21). Other stations which also surpassed their minimum warning levels are sparsely distributed throughout the territory in the higher section of the Danube and in the northern of Danube river basin in south-eastern Ukraine.

The 90% quantile for discharge and stage values has been surpassed by stations in the northern and centre areas of the Elbe river basin in Germany, the Danube river basin in Austria and Slovakia, the Oder river basin along the borderline between Germany and Poland, the Po river basin, the Daugava river basin in Latvia, as well as by a number of stations throughout southern Norway and eastern Sweden (Figure 20Figure 22. This occurrence was less frequent for stations found in the river basins in northern and southern Spain, as well as for stations found halfway the Rhine river basin in Germany, the Danube river basin across Romania, Croatia, Bulgaria and some stations in Ireland and England.

The stations that have presented stage and discharge values below the 10% quantile were in the river basins in southern and northern Spain, in the Danube river basin in Serbia, Austria and Romania and in the Po river basin. This happened less frequently to a small number of stations of the Welland river basin in the UK and a small basin in northern Norway. Other stations with a similar behaviour have been found in the river basins of the Dnieper in Ukraine, Lago Maggiore in Switzerland as well as river Scheldt in Belgium.

Verification

Figure 2 shows the EFAS headline score, the Continuous Ranked Probability Skill Score (CRPSS) for one lead-time, for the October to November period across the EFAS domain for catchments larger than 2000km². 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.

The map shown in Figure 3 displays the CRPSS at 3 days lead-time. The corresponding maps for 5 and 10 days lead-time are shown Figure 4 and Figure 5. These maps indicate that across much of Europe for 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.

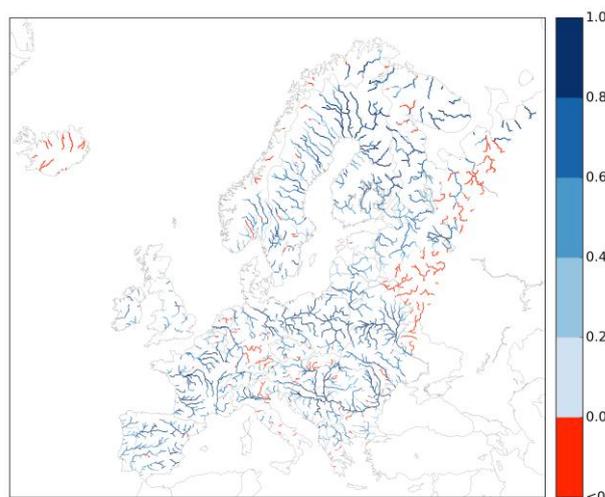


Figure 2. EFAS CRPSS at lead-time 1 day for the October-November 2017 period, for catchments >2000km². The reference score is persistence.

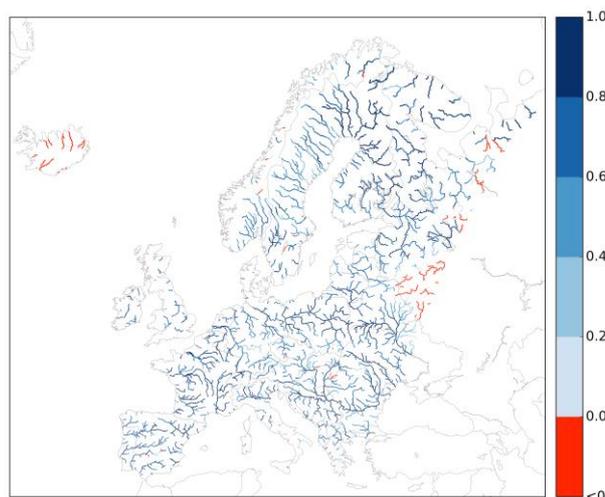
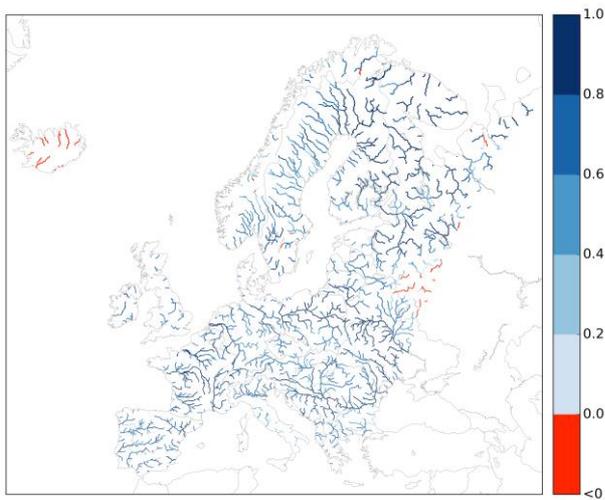


Figure 3. EFAS CRPSS at lead-time 3 days the October-November 2017 period, for catchments >2000km². The reference score is persistence.



gauge observations and hydrological modeling, *Hydrol. Earth Syst. Sci.*, 21, 6201-6217, <https://doi.org/10.5194/hess-21-6201-2017>, 2017.

Figure 4. EFAS CRPSS at lead-time 5 days the October-November 2017 period, for catchments >2000km². The reference score is persistence.

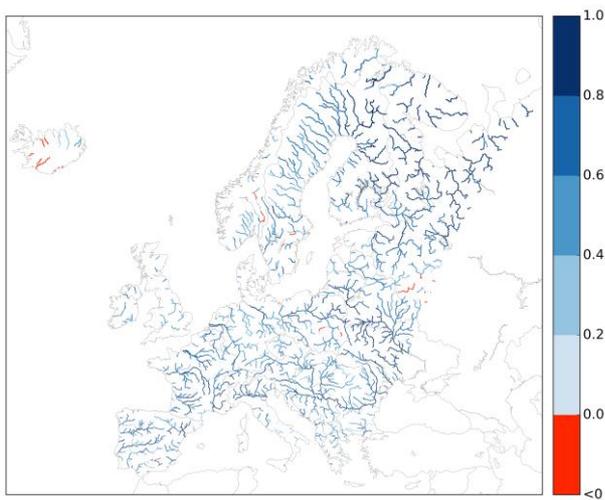


Figure 5. EFAS CRPSS at lead-time 10 days the October-November 2017 period, for catchments >2000km². The reference score is persistence.

Publications

Arnal, L., Cloke, H. L., Stephens, E., Wetterhall, F., Prudhomme, C., Neumann, J., Krzeminski, B., and Pappenberger, F.: Skilful seasonal forecasts of streamflow over Europe?, *Hydrol. Earth Syst. Sci. Discuss.*, <https://doi.org/10.5194/hess-2017-610>, in review, 2017.

Beck, H. E., Vergopolan, N., Pan, M., Levizzani, V., van Dijk, A. I. J. M., Weedon, G. P., Brocca, L., Pappenberger, F., Huffman, G. J., and Wood, E. F.: Global-scale evaluation of 22 precipitation datasets using

FEATURES

Flood Forecasting and Warning System in the Sava River Basin

by Mirza Sarač, ISRBC Secretariat

The international Sava River Basin Commission established a joint Hydrological Information System platform for the Sava River Basin in 2015 (Sava HIS – www.savahis.org) in cooperation with relevant national institutions from the Sava River Basin. The cooperation was set up under the *Framework Agreement for the Sava River Basin* for the exchange and use of the hydrological and meteorological information and data. Sava HIS was established taking into account *Policy on the Exchange of Hydrological and Meteorological Data and Information in the Sava River Basin*, prepared by the Sava Commission in close cooperation with WMO. The Policy was signed by national hydro-meteorological services and two water agencies in 2014.

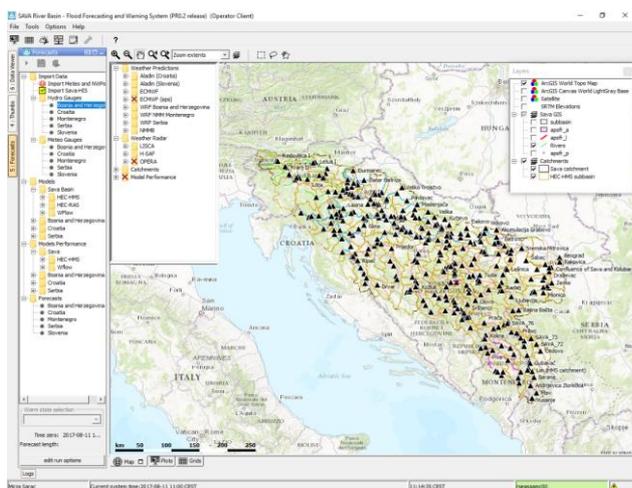


Figure 6. Screen shot of Sava FFWS application

Sava HIS represents a tool for collecting, storing, analysing and reporting a sufficiently high quality hydrological and meteorological data as a component of Geographical Information System for the Sava River Basin (Sava GIS – www.savagis.org).

The overall objective of Sava HIS is to support the countries in the Sava River basin in sharing and disseminating hydrologic and meteorological data, information and knowledge about the water resources. Those data and information are used for decision-making system in all aspects of water resources

management, in the wide range of operational applications as well as in research. Since the Water ML 2.0 format (the WMO exchange standard via web services) was implemented in Sava HIS, the system has enabled storage of water observations data and spatial information in a standard format as well as supporting data sharing and publication via web services for further use.

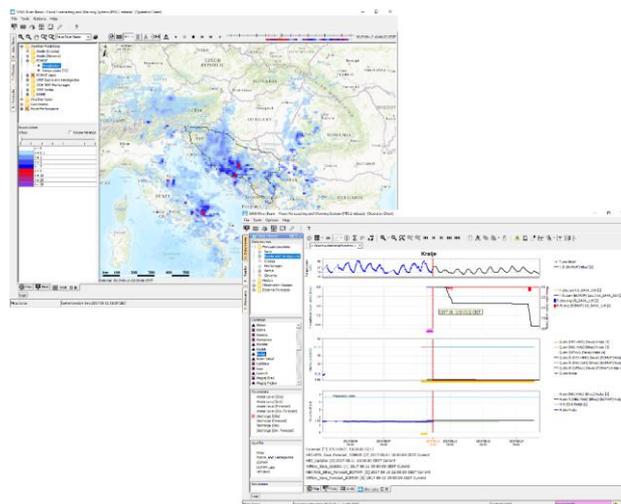


Figure 7. Screen shot of Sava FFWS application

Currently, the Sava countries are in the process of establishing a Flood Forecasting and Warning System in the Sava River Basin (Sava FFWS) which will be finalized by the end of August 2018. Based on the Delft-FEWS platform, Sava FFWS will be implemented as an open shell platform for managing the data handling and forecasting process, allowing a wide range of external data and models to be integrated. This concept is particularly important for the five cooperating Sava countries, where different forecasting systems and models are in use.

Sava FFWS will integrate Sava HIS as a data hub for the collection of real-time hydrological and meteorological data. These include Sava GIS for presentation of spatial layers, as well as various numerical weather prediction models (ECMWF, Aladin, WRF, NMMB), available weather radar and satellite imagery (OPERA/ERICHA and H-SAF products), outputs of the existing national forecasting systems, different meteorological, hydrological and hydraulic models. All data will be easily 'plugged' into a common platform. The resulting system will enable the five countries involved to take the right management decisions and implement operational measures to prevent and mitigate severe flood

and drought situations based on reliable forecasts of water levels and discharges with a long lead-time within area of an entire river basin.

With these systems developed through the cooperation of countries within the scope of work of the Sava Commission, the Sava countries should be better prepared for emergency situations like the one that occurred in May 2014, when disastrous floods in the Sava basin resulted in 79 casualties and substantial economic damage. Sava HIS and Sava FFWS are a very special regional concepts taking into account that the Sava River Basin (97,700 km²) is shared by five countries: Slovenia, Croatia, Bosnia and Herzegovina, Montenegro and Serbia where each country has its own models, monitoring systems, forecasting systems, water authorities and interests. This regional, basin-wide concept will bridge differences and support collaboration in the field of water management, keeping the countries' own autonomy in monitoring, modelling and forecasting, and remain open to developing its own models and supplementary forecasting initiatives.

The system brings added value to existing or developing systems, expecting that a common forecasting platform with well-trained staff should provide better preparedness and optimized mitigation measures to significantly help reduce consequences of floods.

EFAS training for Croatia

by Michaela Mikuličková, EFAS Dissemination Centre

EFAS training for our Croatian partner took place in Zagreb, Croatia in the premises of the Meteorological and Hydrological Service of Croatia (DHMZ) on 11-12 October 2017. It was held by Michaela Mikuličková from Slovak Hydrometeorological Institute (SHMU, a member of EFAS Dissemination Centre consortium). The training was held in English with occasional use of Croatian and Slovakian. The participants were hydrological forecasters, weather forecasters and persons responsible for control, archiving and distribution of hydrological data.

The training was divided into presentations and practical exercises. It included an introduction, EFAS general information, information about the LISFLOOD model, probabilistic forecasting, meteorological input and EFAS notifications. A lot of time was dedicated to EFAS thresholds and flash floods, and difference between

EFAS's and national service approaches. Information on new products, such as the Rapid flood hazard assessment, Seasonal outlook and ERICHA radar information, and web services were provided as well. The practical exercise consisted of hands-on sessions with explanation of the EFAS interface and descriptions of specific layers together with Croatian case studies from November 2016 and September 2017.



Figure 8. Participants of the training in Zagreb.

The Croatian colleagues appreciate the added value of EFAS to their national service and welcomed a chance to learn more about its possibilities. Similar training could be provided also for other EFAS partners. EFAS Dissemination Centre would like to encourage partners to ask for it on info@efas.eu.

Case study: Floods in the Attica Region, Greece, November 2017

by Richard Davies, FloodList

Devastating flash floods hit the areas of Mandra, Nea Peramos and Megara in West Attica, Greece on Wednesday, 15 November 2017. The floods were some of the worst in the region's history and Greek Civil Protection described the situation as unprecedented. The General Secretary for Civil Protection declared the area a State of Emergency.

Deaths, Rescues, Evacuations

Fire services said that on 15 November they received 984 calls for assistance and rescued 96 people from flooded homes or cars in the affected areas of Nea Peramos, Mandra and Megara. The Fire Service set up a team of over 150 personnel operating with around 50 vehicles in order to deal with the situation.

By late 15 November, a total of fifteen deaths had been reported. This number increased during the following days as emergency services recovered more bodies. As of 21 November, over 20 people had lost their lives in the flooding. The Prime Minister declared a three-day national mourning for those who lost their lives in the tragedy.



Figure 9. Flash floods in Nea Peramos, West Attica , taken 15 November. Credit: Stavros Dimakopoulos, used with permission.

Damage

Local media reported that the heavy rain had turned roads into raging torrents. Cars were overturned or dragged along streets. Hundreds of homes were damaged and power supply cut. Many roads were blocked, including the Athens-Korinthos highway. Images of the aftermath showed affected areas swamped with mud and debris. Special technical departments of the Ministry of Infrastructure and Transport carried out inspections in the wake of the flooding and found that a total of 955 buildings had been damaged, including over 600 homes, over 300 businesses and 7 public buildings. The government announced that owners of buildings found to have suffered damage will be entitled to compensation.

Rain

The heavy rainfall was extremely localised. Metar.gr reported that 67.2 mm of rain fell in 24 hours in Vilia, municipality Mandra-Eidyllia, West Attica between 14 and 15 November 2017. Accuweather figures for the

Moni Panachrantou weather station, 74 mm of rain fell in 24 hours to 16 November and a further 64 mm the following day. Moni Panachrantou is located about 5 km away from Megara, up a steep 800-metre rise.



Figure 10. Flood damage in Nea Peramos, West Attica , taken 18 November. Credit: Stavros Dimakopoulos, used with permission

Copernicus

Copernicus Emergency Management Service was activated (EMSR257) on 19 November, 2017, to provide maps of the [affected areas](#). Copernicus EMS Mapping products will be used mainly by the local authorities (Region of Attika, Municipalities) for recovery and restoration planning of the affected area.

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: Grading map over Mandra, Greece. 2017-11-22. Courtesy of the COPERNICUS EMS Rapid Mapping, mapping activation EMSR257.

Appendix - figures

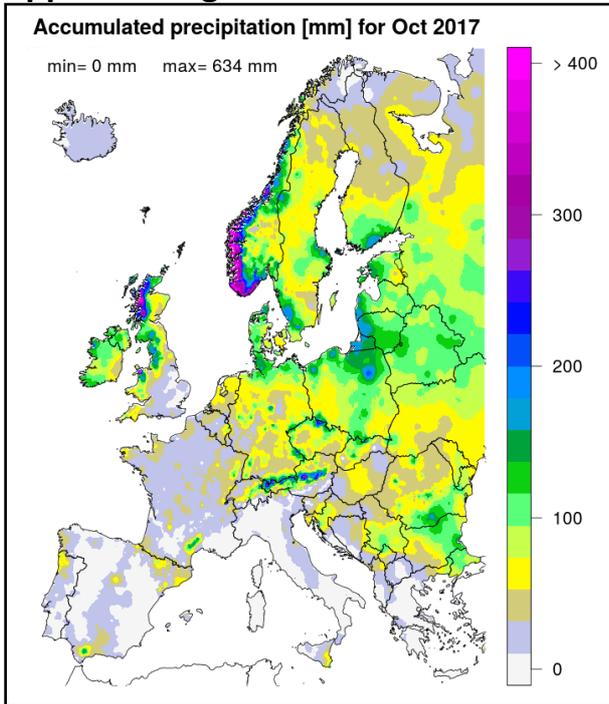


Figure 11. Accumulated precipitation [mm] for October 2017.

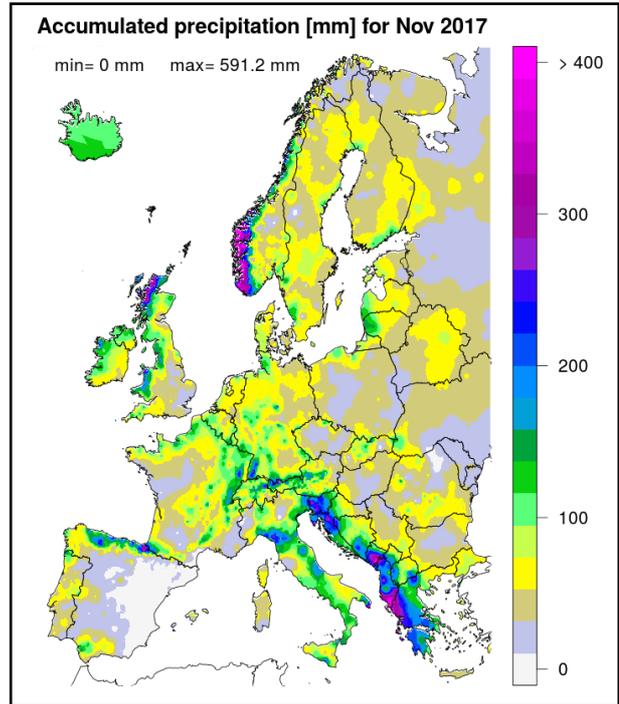


Figure 13. Accumulated precipitation [mm] for November 2017.

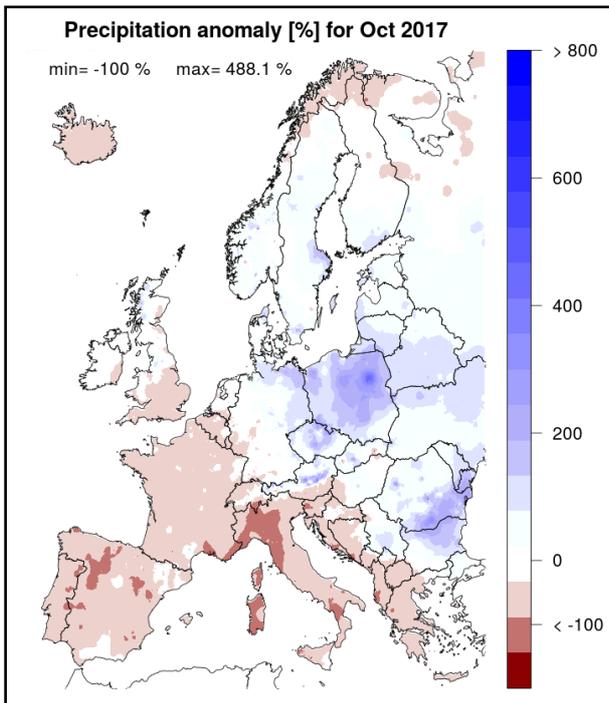


Figure 12. Precipitation anomaly [%] for October 2017, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

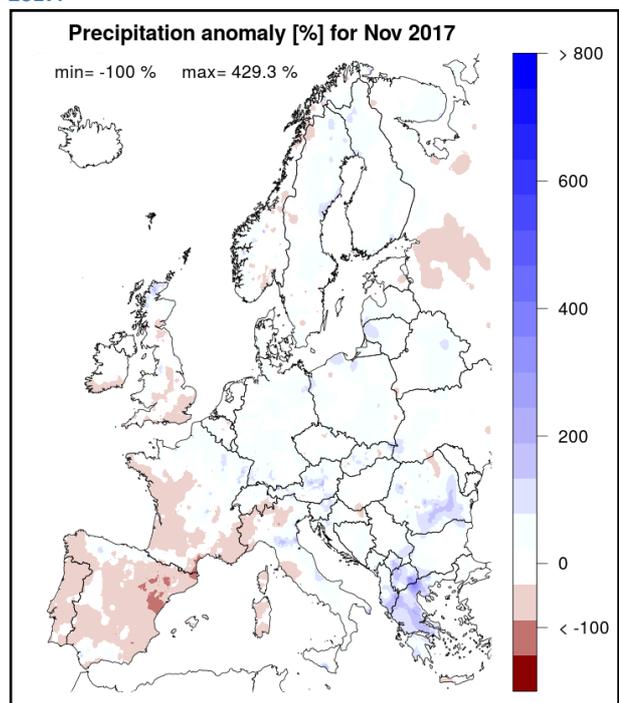


Figure 14. Precipitation anomaly [%] for November 2017, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

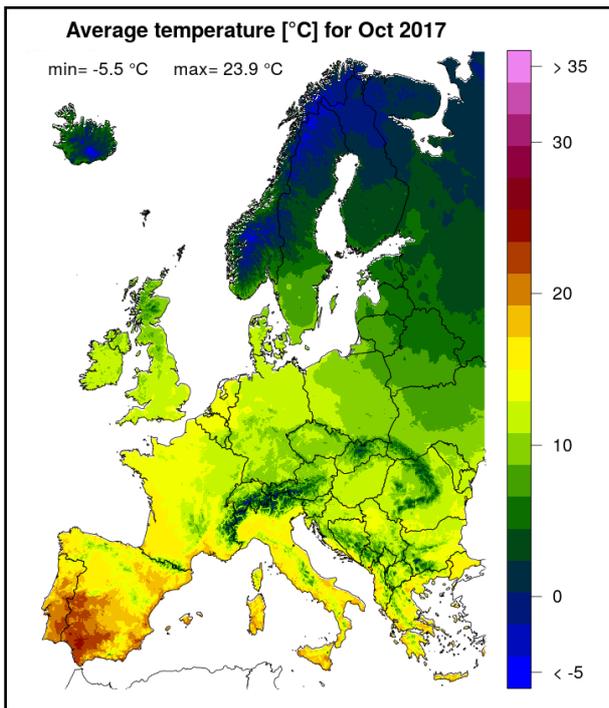


Figure 15. Mean temperature [°C] for October 2017.

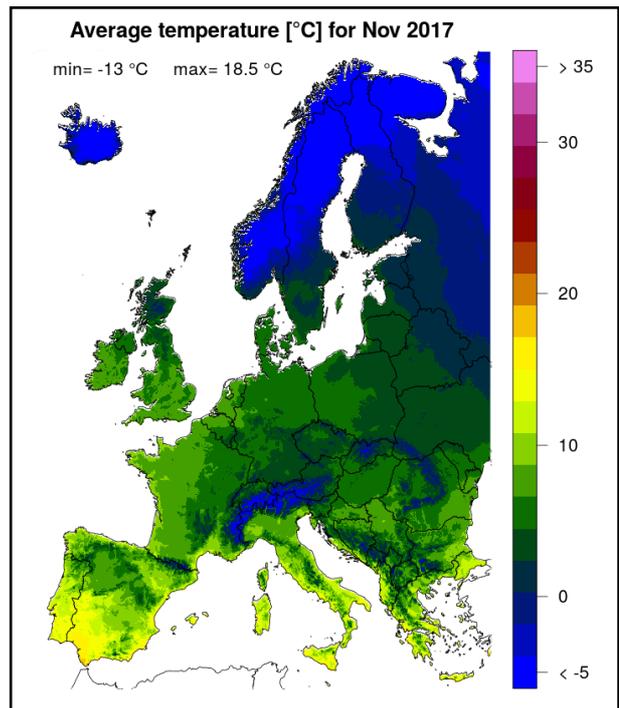


Figure 17. Mean temperature [°C] for November 2017.

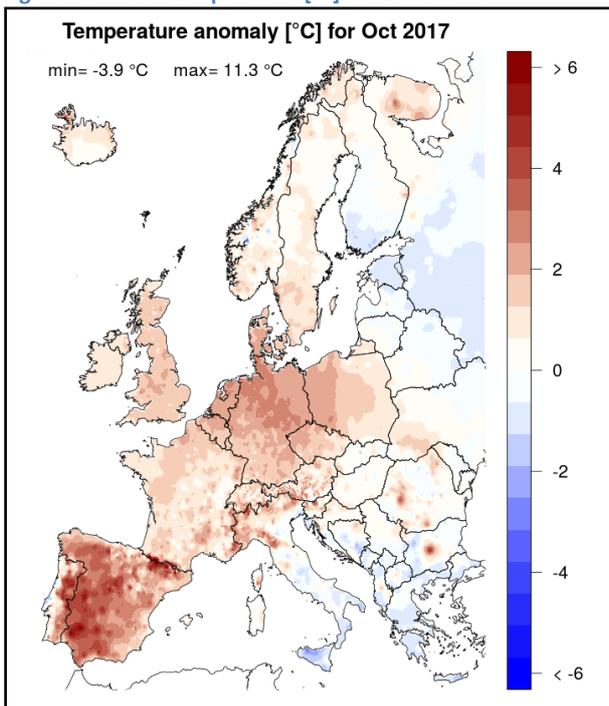


Figure 16. Temperature anomaly [°C] for October 2017, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

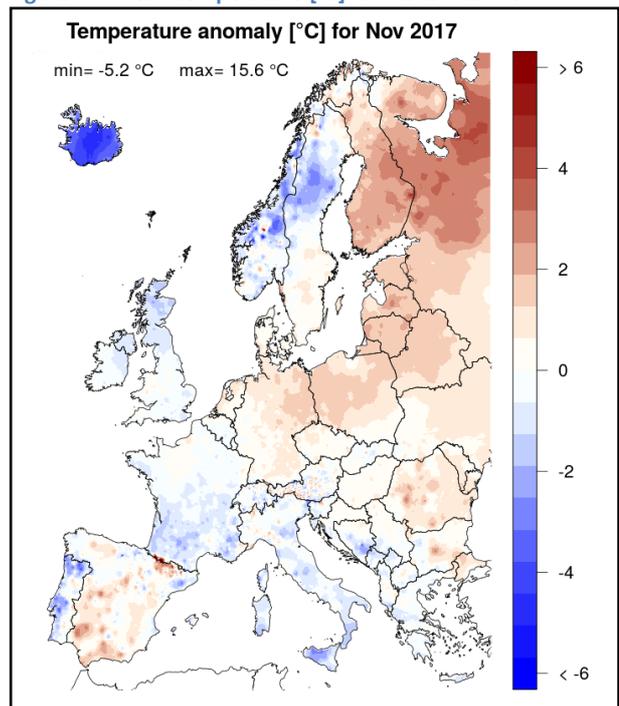


Figure 18. Temperature anomaly [°C] for November 2017, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

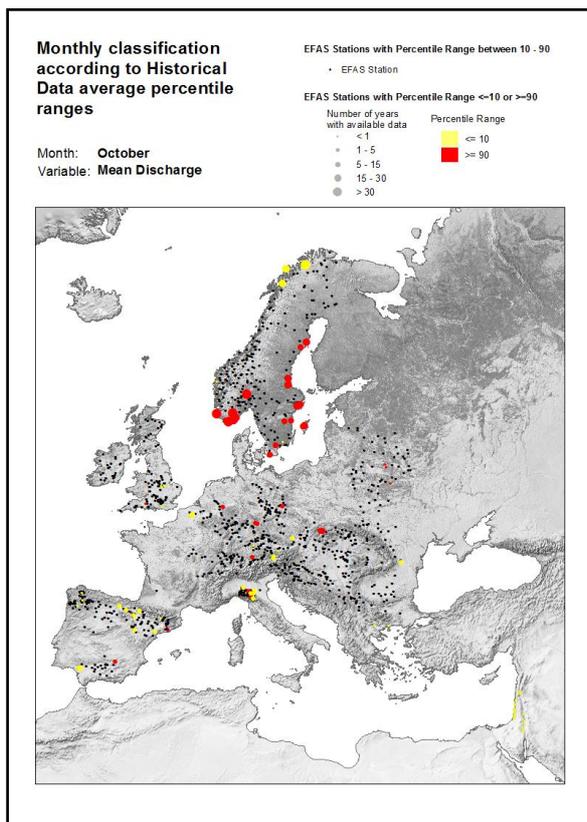


Figure 19. Monthly discharge anomalies October 2017.

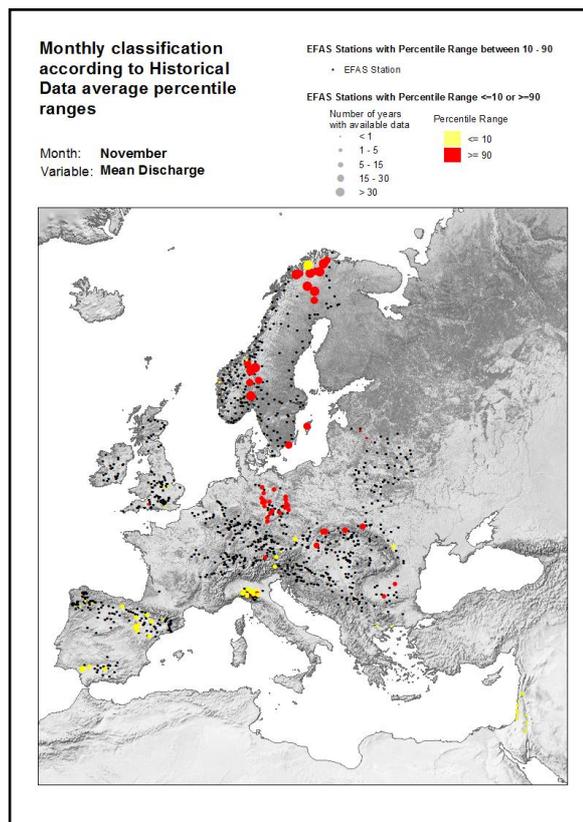


Figure 21. Monthly discharge anomalies November 2017.

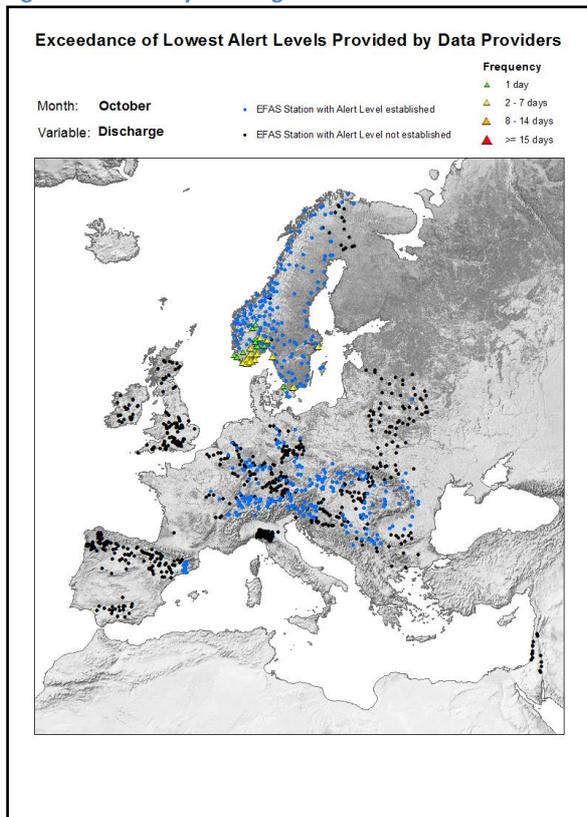


Figure 20. Lowest alert level exceedance for October 2017.

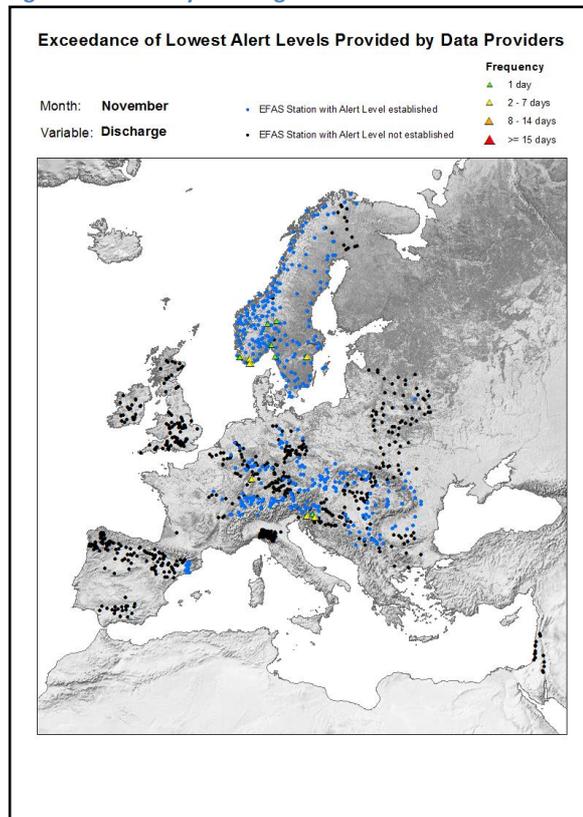


Figure 22. Lowest alert level exceedance for November 2017.

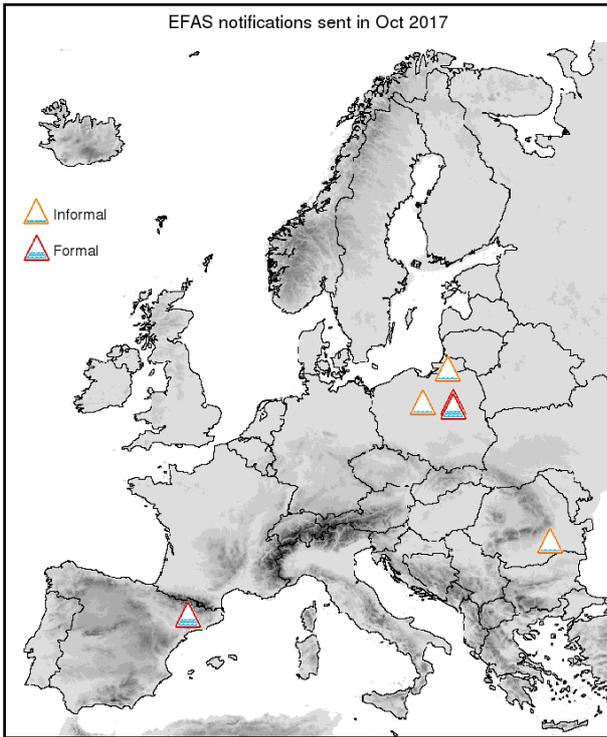


Figure 23. EFAS flood notifications sent for October 2017.

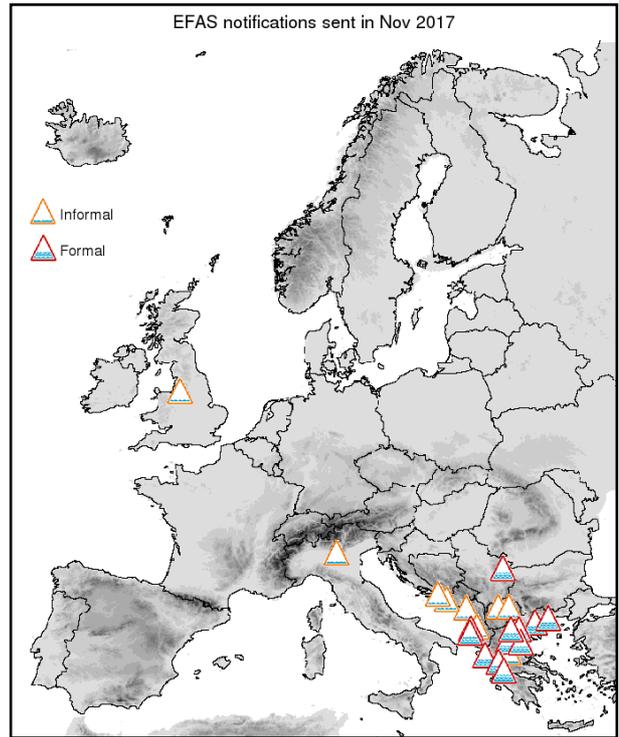


Figure 25. EFAS flood notifications sent for November 2017.

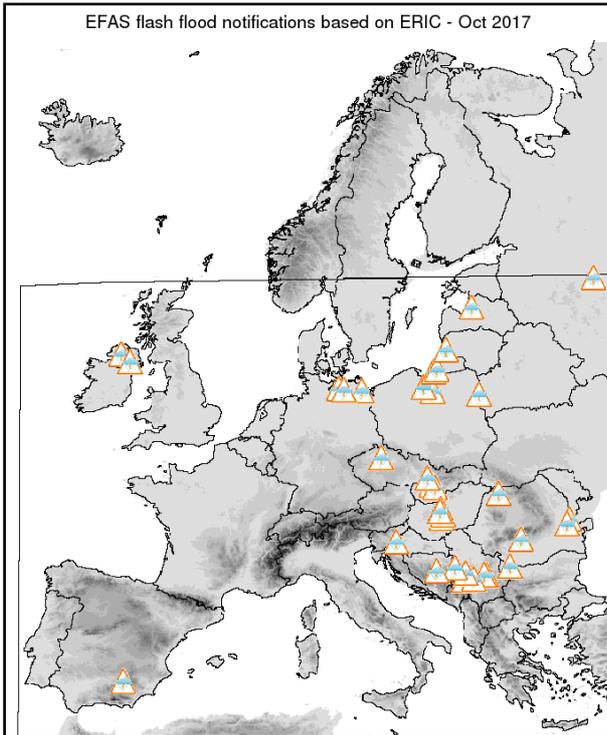


Figure 24. Flash flood notifications sent for October 2017.

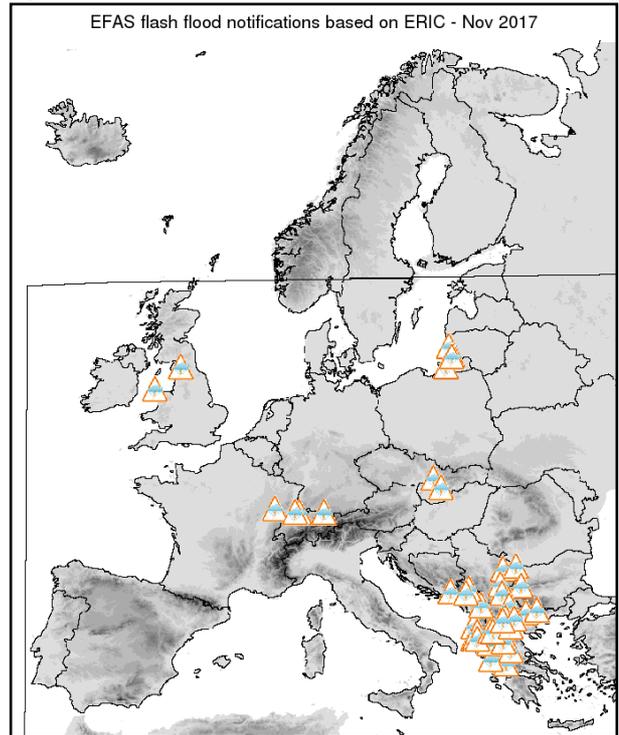


Figure 26. Flash flood notifications sent for November 2017.

Appendix - tables

Table 1. EFAS flood notifications sent in October - November 2017.

Type	Forecast date	Issue date	Lead time*	River	Country
Formal	08/10/2017 00 UTC	08/10/2017	5	Bug, below Mukhavyets	Poland
Formal	18/10/2017 00 UTC	18/10/2017	1	Segre	Spain
Informal	22/10/2017 12 UTC	23/10/2017	3	Ialomita (Yalomita)	Romania
Formal	25/10/2017 12 UTC	26/10/2017	3	Narew, above Bug	Poland
Informal	29/10/2017 12 UTC	30/10/2017	0	Wista, section Bzura-Drweca	Poland
Informal	30/10/2017 00 UTC	30/10/2017	0	Lyna	Russia
Informal	04/11/2017 00 UTC	04/11/2017	1	Po, below Oglio	Italy
Informal	09/11/2017 00 UTC	09/11/2017	4	Lower Neretva	Croatia
Formal	11/11/2017 00 UTC	11/11/2017	4	Alikamonas (sub-catchment)	Greece
Informal	11/11/2017 00 UTC	11/11/2017	2	Trebisnica	Bosnia and H.
Formal	14/11/2017 00 UTC	14/11/2017	3	Pinios	Greece
Informal	18/11/2017 12 UTC	19/11/2017	3	Mersey	United Kingdom
Formal	24/11/2017 00 UTC	24/11/2017	6	Arachthos	Greece
Formal	24/11/2017 00 UTC	24/11/2017	6	Akheloos	Greece
Formal	25/11/2017 00 UTC	25/11/2017	6	Greece - coastal zone	Greece
Formal	25/11/2017 12 UTC	26/11/2017	6	Nestos	Greece
Formal	27/11/2017 00 UTC	27/11/2017	4	Seman	Albania
Informal	27/11/2017 00 UTC	27/11/2017	3	Shkumbin	Albania
Formal	27/11/2017 12 UTC	28/11/2017	3	Shkumbin	Albania
Formal	28/11/2017 00 UTC	28/11/2017	4	Axios	Greece
Formal	28/11/2017 00 UTC	28/11/2017	3	Aliakmonas	Greece
Informal	28/11/2017 00 UTC	28/11/2017	3	Bregalnica	Macedonia
Formal	28/11/2017 12 UTC	29/11/2017	4	Strimonas	Greece
Formal	29/11/2017 00 UTC	29/11/2017	3	Timok	Serbia
Informal	29/11/2017 00 UTC	29/11/2017	1	Moraca	Albania
Informal	29/11/2017 12 UTC	30/11/2017	2	Pinios	Greece
Informal	30/11/2017 00 UTC	30/11/2017	1	Vardar (Axios),Bregalnica	Macedonia

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

Table 2. EFAS flash flood notifications sent in October - November 2017.

Type	Forecast date	Issue date	Lead time*	River	Country
Flash flood	02/10/2017 12 UTC	03/10/2017	78	Klaipėdos apskritis	Lithuania
Flash flood	05/10/2017 00 UTC	05/10/2017	18	Mecklenburg-Vorpomm.	Germany
Flash flood	05/10/2017 00 UTC	05/10/2017	18	Mecklenburg-Vorpomm.	Germany
Flash flood	05/10/2017 00 UTC	05/10/2017	18	Mecklenburg-Vorpomm.	Germany
Flash flood	07/10/2017 12 UTC	08/10/2017	24	Cahul	Moldova
Flash flood	07/10/2017 12 UTC	08/10/2017	24	Kaliningradskaya	Romania
Flash flood	08/10/2017 00 UTC	08/10/2017	48	Mayskaya	Russia
Flash flood	09/10/2017 12 UTC	10/10/2017	36	Pieriga	Latvia
Flash flood	18/10/2017 00 UTC	18/10/2017	36	Jaen	Spain
Flash flood	19/10/2017 00 UTC	19/10/2017	24	Northern Ireland	United Kingdom
Flash flood	19/10/2017 00 UTC	19/10/2017	24	Northern Ireland	United Kingdom
Flash flood	21/10/2017 00 UTC	21/10/2017	66	Trenciansky	Slovakia
Flash flood	21/10/2017 12 UTC	22/10/2017	78	Federacija Bosna	Bosnia and H.
Flash flood	21/10/2017 12 UTC	22/10/2017	30	Spodnjeposavska	Slovenia

Flash flood	22/10/2017 00 UTC	22/10/2017	66	Valcea	Romania
Flash flood	22/10/2017 00 UTC	22/10/2017	72	Moravica	Serbia
Flash flood	22/10/2017 00 UTC	22/10/2017	72	Raska	Serbia
Flash flood	22/10/2017 00 UTC	22/10/2017	66	Macva	Serbia
Flash flood	22/10/2017 00 UTC	22/10/2017	42	Kozep-Dunantul	Hungary
Flash flood	22/10/2017 00 UTC	22/10/2017	42	Kozep-Magyarország	Hungary
Flash flood	22/10/2017 12 UTC	23/10/2017	60	Serbia - Zapadna Morava,	Serbia
Flash flood	22/10/2017 12 UTC	23/10/2017	30	Del-Alfold	Hungary
Flash flood	22/10/2017 12 UTC	23/10/2017	30	Del-Dunantul	Hungary
Flash flood	23/10/2017 00 UTC	23/10/2017	48	Montana	Bulgaria
Flash flood	23/10/2017 00 UTC	23/10/2017	48	Nisava, Zlatibor	Serbia
Flash flood	23/10/2017 00 UTC	23/10/2017	48	Rasina	Serbia
Flash flood	26/10/2017 00 UTC	26/10/2017	36	Kaliningradskaya	Russia
Flash flood	27/10/2017 00 UTC	27/10/2017	54	Stredocesky	Czech Republic
Flash flood	27/10/2017 12 UTC	28/10/2017	54	Podlaskie	Poland
Flash flood	27/10/2017 12 UTC	28/10/2017	48	Maramures	Romania
Flash flood	28/10/2017 12 UTC	29/10/2017	24	Pomorskie	Poland
Flash flood	28/10/2017 12 UTC	29/10/2017	24	Warminsko-Mazurskie	Poland
Flash flood	28/10/2017 12 UTC	29/10/2017	24	Trenciansky	Slovakia
Flash flood	29/10/2017 00 UTC	29/10/2017	12	Trenciansky	Slovakia
Flash flood	30/10/2017 12 UTC	31/10/2017	24	Tverskaya	Russia
Flash flood	01/11/2017 00 UTC	01/11/2017	42	Kaliningradskaya	Russia
Flash flood	01/11/2017 12 UTC	02/11/2017	30	Kaliningradskaya	Russia
Flash flood	02/11/2017 00 UTC	02/11/2017	18	Neman	Russia
Flash flood	10/11/2017 00 UTC	10/11/2017	60	Basel-Stadt	Switzerland
Flash flood	10/11/2017 12 UTC	10/11/2017	48	Baden-Wurttemberg	Germany
Flash flood	10/11/2017 12 UTC	10/11/2017	54	Haute-Saone	France
Flash flood	10/11/2017 12 UTC	11/11/2017	66	Banskobystricky	Slovakia
Flash flood	10/11/2017 12 UTC	11/11/2017	66	Banskobystricky	Slovakia
Flash flood	11/11/2017 00 UTC	11/11/2017	36	Bayern	Germany
Flash flood	12/11/2017 00 UTC	12/11/2017	24	Trenciansky	Slovakia
Flash flood	12/11/2017 12 UTC	13/11/2017	102	Kentriki Makedonia	Greece
Flash flood	12/11/2017 12 UTC	13/11/2017	90	Jugoistochen	FYROM
Flash flood	12/11/2017 12 UTC	13/11/2017	102	Pelagoniski	FYROM
Flash flood	12/11/2017 12 UTC	13/11/2017	36	Montenegro	Montenegro
Flash flood	13/11/2017 12 UTC	14/11/2017	78	Vardarski	FYROM
Flash flood	14/11/2017 12 UTC	15/11/2017	66	Ditiki Makedonia	Greece
Flash flood	14/11/2017 12 UTC	15/11/2017	48	Korasa	Albania
Flash flood	15/11/2017 00 UTC	15/11/2017	54	Thessalia	Greece
Flash flood	19/11/2017 00 UTC	19/11/2017	24	Klaipedos	Lithuania
Flash flood	21/11/2017 12 UTC	22/11/2017	30	North West	United Kingdom
Flash flood	22/11/2017 00 UTC	22/11/2017	24	Wales	United Kingdom
Flash flood	28/11/2017 00 UTC	28/11/2017	96	Pcinja	Serbia
Flash flood	28/11/2017 00 UTC	28/11/2017	114	THraki	Greece
Flash flood	28/11/2017 00 UTC	28/11/2017	102	Istochen	FYROM
Flash flood	28/11/2017 00 UTC	28/11/2017	90	Ditiki Makedonia	Greece
Flash flood	28/11/2017 00 UTC	28/11/2017	84	Ipeiros	Greece
Flash flood	28/11/2017 00 UTC	28/11/2017	84	Berat	Albania
Flash flood	28/11/2017 00 UTC	28/11/2017	102	Gjirokaster	Albania
Flash flood	28/11/2017 00 UTC	28/11/2017	102	Ipeiros	Albania
Flash flood	28/11/2017 00 UTC	28/11/2017	96	Korce	Albania

Flash flood	28/11/2017 00 UTC	28/11/2017	102	Vlore	Albania
Flash flood	28/11/2017 00 UTC	28/11/2017	96	Fier	Albania
Flash flood	28/11/2017 00 UTC	28/11/2017	78	Vlore	Albania
Flash flood	28/11/2017 00 UTC	28/11/2017	72	Montenegro	Montenegro
Flash flood	28/11/2017 12 UTC	29/11/2017	96	Jablanica	Serbia
Flash flood	29/11/2017 00 UTC	29/11/2017	72	Sofiya	Bulgaria
Flash flood	29/11/2017 00 UTC	29/11/2017	78	Stereia Ellada	Greece
Flash flood	29/11/2017 00 UTC	29/11/2017	72	Kentriki Makedonia	Greece
Flash flood	29/11/2017 00 UTC	29/11/2017	54	Elabasan	Albania
Flash flood	29/11/2017 00 UTC	29/11/2017	36	Republika Srpska	Bosnia and Her-
Flash flood	29/11/2017 12 UTC	30/11/2017	60	Zajecar	Serbia
Flash flood	29/11/2017 12 UTC	30/11/2017	54	Montana	Bulgaria

* 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 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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