





# **European Flood Awareness System**

# **EFAS** Bulletin

# October – November 2022 Issue 2022(6)





#### NEWS

#### New features

#### 2nd Global Flood Forecasting and Monitoring Meeting - February 2023

The Copernicus Emergency Management Service (CEMS) is organising the '2nd Global Flood Forecasting and Monitoring Meeting' which will be hosted online via **Zoom Webinar** and the **Gather.Town** platform on **Wednesday 08 and Thursday 09 February 2023.** 



To register for the event, please click on the Zoom Webinar <u>registration link</u> to enter your details. Registration for the workshop **will remain open until 31 January 2023**.

The event focuses on recent advances in global flood forecasting and monitoring. The workshop will include sessions on developments to the Global Flood Awareness System (GloFAS) and the Global Flood Monitoring (GFM) products, to data access, use cases and applications, and open panel discussions.

Two sessions are scheduled over the two days of the workshop to accommodate people working in different time zones. The presentations will be held from **13:00 to 17:00 (UTC) during both days of the event**. A **draft agenda** is attached to this email. The full agenda of the workshop will be made to all registered participants shortly before the event.

The format of the workshop will be highly interactive, including discussions and booths in Gather.Town. Participants will have opportunities to connect with people from the GloFAS and GFM communities to discuss their work and expand their networks.

If you are interested to provide an **IGNITE presentation (max. 5 minutes)** during the meeting of a use case where you are already / or are planning on using GloFAS or GFM please send us an email to <u>info@globalfloods.eu</u>. We will collect all incoming expressions of interest and then inform the selected use cases in due time for more information.

We hope you will attend! The GloFAS and GFM teams

#### **New Partners**

We gladly welcome the Royal Meteorological Institute of Belgium and the VERBUND Energy4Business GmbH as new EFAS third party partners.

#### Release of EFAS v4.6 and changes to FTP

From **Tuesday 18th October**, there have been two changes associated with the completed migration of ECMWF's Production Data Store (ECPDS) and the EFAS hydrological forecasting chain to ECMWF's new supercomputer in Bologna.

**1. Relevant to all EFAS users** is that EFAS v4.6 which was released operationally on the 18th October. It introduced some minor changes to the system, as well as some general bug fixes. Here is a summary of the main changes:

- An updated LISFLOOD model version (v3.2.0) with the enhanced capability to handle inputs, improved computation performances and porting to python3 (available at: <u>https://github.com/ec-jrc/lisfloodcode/releases</u>)
- Improvements to the Rapid Impact Assessment methodology and information displayed in the EFAS-IS layer.
- A potential delay in the delivery of the COSMO-LEPS forecasts

For more technical information on the release of EFAS version 4.6, please see the <u>dedicated wiki page</u>.

**2. Relevant to users of the EFAS FTP service** is that from **12 UTC Tuesday 18th October** the data will no longer be available from the previous link (dissemination.ecmwf.int). Any users of the EFAS FTP service are requested to get in touch via the <u>ECMWF</u> <u>Support Portal</u> if they have not received an email about the changing link for the service.

### RESULTS

#### Summary of EFAS Flood and Flash Flood Notifications

The 18 formal and 29 informal EFAS flood notifications issued in October – November 2022 are summarised in Table 1. The locations of all notifications are shown in Figure 20 and Figure 22 in the appendix.

28 Flash flood notifications were issued in October – November 2022. They are summarised in

Table 2. The locations of all notifications are shown in Figure 21 and Figure 23 in the appendix.

#### Meteorological situation

As of February 2022, reporting of the meteorological situation by the Meteorological Data Collection Centre (MDCC) will no longer be published in the EFAS bulletin. Instead, the state of recent meteorology will be conducted by the Copernicus Climate Change Service (C3S) and published as monthly <u>Climate Bulletins</u>.

#### Hydrological situation

#### by EFAS Hydrological Data Collection Centre

#### October

During the month of October, there were 61 stations with exceedances. Most of the stations are in Italy (15), and in Croatia (14). In Italy, the exceedances are related to the water level threshold and mainly in the north of the country. The Po river basin has the most Italian stations with exceedances (13). In Croatia, all exceedances are related to the water level threshold too and stations are based mainly on the Danube river (13).

In addition, there are nine stations in Slovenia (discharge and water level) and the same number of stations with exceedance in Spain, where the Llobregat river stands out. Norway shows five stations with exceedance on discharge variable, and the remainder of the countries with exceedances show no more than three stations each. As for the river basins, the main one with values above the threshold is the Danube, with 23 stations in five different countries, standing out Croatia and Slovenia. With the exception of the Danube and Po rivers, the basins affected by exceedance rarely have more than one station.

In terms of the stations that recorded values above the 90% quantile, 53 exceeded this threshold in October. For another month, Spain is the country with the highest number of stations. The Spanish basins have 32 stations. Highlights in the eastern area the Jucar, standing out with ten stations, and the Ebro river with five station exceeding this threshold. The sum of 14 river basins has stations above this quantile in Spain. In Hungary and Ukraine, there are five stations that exceed this cliff. Other stations exceeded the 90% quantile value in Romania, Slovenia, and Serbia in more than one occasion.

By river basin, the Danube River again stands out with 12 stations, with exceedances along five countries, being Hungary the country with the highest number of stations. In addition to Danube and the aforementioned Jucar (10 stations), a sum of 23 different river basins shows exceedance over the 90% quantile.

Finally, and according to the number of stations recording average values below the 10% quantile, we can find a decrease of around 32%. In the month of October, there are 77 stations with average values below this cliff, which covers 15 different countries. This month, Spain is the country with the most stations (21), followed by France (18). Italy has seven stations

(21), followed by France (18). Italy has seven stations with values below this threshold, followed by England with six stations.

In terms of basins, this month the Ebro river is the one with the highest number of cases, with 14 station with an average discharge below the 10% quantile. The Danube river, in six different countries, has 12 stations in the same situation. In total, as many as 27 different basins have values below this limit.

#### November

During the month of November, there were 119 stations with exceedances, which is twice as many as in the previous month. The majority of stations wirh exceedances are in Spain (21), Norway (20) and all of them with exceedances related with discharge, compared to Italy (18) where exceedances are related to the water level threshold, in the north and center of the country. In Croatia, the water level threshold was also exceeded at 17 stations.

In addition, there are 11 stations in Bosnia and Herzegovina and nine in Ireland. Several countries have exceedances this month in minor size: Serbia (five), Slovenia (four), Germany and Iceland (three), Poland (two) and only one station with values above the threshold on Ukraine, Romania, Hungary, Sweden, Belgium and Kosovo.

As for the river basins, the main one with values above the threshold is again the Danube, with 37 stations in seven different countries, standing out Croatia and Bosnia-Herzegovina. The Minho River in Spain, is the next basin with the highest number of stations, nine in this case. Italian basins: Garigliano, Po and Tiber, together with the Spanish Turia, are the other basins with more than two stations exceeding the thresholds.

In terms of the stations that recorded values above the 90% quantile, 94 exceeded this threshold in November. As with the exceedance, Norway is the country with the most stations in this situation (38). Spain is the country with the second highest number of stations. The Spanish basins have 16 stations. In Ireland, 11 stations show values above this quantile. In Serbia there are seven stations that exceed this cliff, six in Ukraine, and five in Iceland. Other stations exceed the 90% quantile value in United Kingdom, Croatia, Romania, Switzerland, France, and Italy.

By river basin, it is the Glomma River (in Norway) the one that stands out with 11 stations. The Danube River shows exceedances across four countries, being in Serbia the highest number of stations (six). The Drammen (Norway) and Dniepper (Ukraine) have seven and five stations respectively. A sum of 48 different river basins show exceedance over the 90% quantile.

Finally, and according to the number of stations recording average values below the 10% quantile, we

can find an increase of around 40%. In the month of November, there are 108 stations with average values below this cliff, which affected 20 different countries.

This month, Spain and France are the countries with the most stations (19 each), followed by Poland with 14 stations. Germany has nine stations with values below this threshold, followed by Hungary with eight stations.

In terms of river basin, this month the Danube is the river with the highest number of cases, with 26 stations with an average discharge below the 10% quantile. The Oder River, in Germany and Poland, has 11 stations in the same situation. The Ebro River in Spain and the Loire River in France have ten and nine stations under this cliff. In total, as many as 34 different basins have values below this limit. Verification

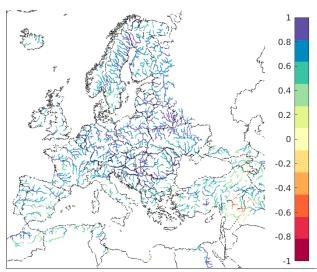


Figure 1: EFAS CRPSS at lead-time 1 day for October-November 2022, for catchments >2000km2. The reference score is persistence of using previous day's forecast.

Figure 1 and Figure 2 shows the EFAS headline score, the continuous ranked probability skill score (CRPSS) for lead times 1 and 5 days for October-November 2022 across the EFAS domain for catchments larger than 2000km<sup>2</sup>. 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.

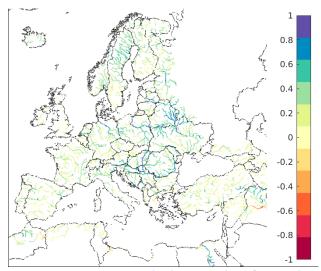


Figure 2. EFAS CRPSS at lead-time 5 days for October-November 2022 for catchments >2000km2. The reference score is persistence of using previous day's forecast.

These maps indicate that across much of Europe for forecasts are more skilful than persistence at both lead times. Regions shown in blue are those where EFAS forecasts are more skilful than persistence, with darker shading indicating better performance.

The skill of the forecast was quite good over the period, and similar to the same period last year (Figure 3). An inter-annual variability of the scores is to be expected. The long-term trend is neutral over the first two years since the domain was extended, but there is an indication of increase in skill with EFAS 4.0, especially for the areas with generally lower skill.

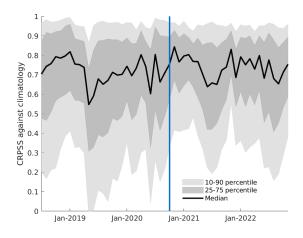


Figure 3. Monthly means of CRPSS the for lead-time 5 days for all the major river points in Europe with ECMWF ENS as forcing. Reference forecast was climatology. The skill is largest during the winter months, when there is less variation in the flow in large parts of Europe. The blue line indicates the release of EFAS 4.0.

#### ARTICLES

Floods in Greece, October 2022 by Richard Davies, <u>floodlist</u>

Torrential rain on 15 October 2022 triggered flash floods in Heraklion and Lasithi Regional Units on the island of Crete, Greece. At least 2 people died, and dozens were rescued or evacuated.

Figures show that in a 24-hour period to early 16 October, Sitia recorded 293.0 mm of rain, Kasteli 81.5 mm and Heraklion 142.7 mm. Strong winds were also reported in the region.



Figure 4: Flood damage in Agia Pelagia, Heraklion, Crete, 15 October 2022. Photo: Hellenic Red Cross

The <u>Greek Fire Department described</u> the flooding as "extreme" and said they received 453 calls for assistance in just one hour.

Two people died after vehicles were dragged by flood waters and swept into the sea on the coast of Agia Pelagia. In a separate incident, firefighters said they managed rescue 2 people from flood waters in the area of Lygaria.



Figure 5: Flood damage in Agia Pelagia, Heraklion, Crete, 15 October 2022. Photo: Hellenic Red Cross

Around 30 people had to be evacuated by emergency teams and transported to a safe place, including 9 tourists from an archaeological site in Sitia. Later the Red Cross reported around 1,200 people were affected or had been displaced by the floods.

The flooding caused significant damage, particularly in coastal areas where flood waters dumped debris, dragged vehicles and damaged buildings. Authorities said emergency teams were operating in the areas of Sitia, lerapetra, Livadia, Agia Pelagia, Lygaria and Heraklion, among others.



Figure 6: Flood damage in Agia Pelagia, Heraklion, Crete, 15 October 2022. Photo: Hellenic Red Cross

On 13 October Greece's National Meteorological Service and the General Secretariat of Civil Protection had issued warnings of severe weather in the country. Further warnings were issued on 16 October. Civil Protection asked all citizens to be vigilant in Crete and the southern islands of Rhodes, Karpathos, Kastellorizo and Kasos.

#### Floodlist Article - November 2022 by Richard Davies, <u>floodlist</u>

Heavy rain fell across Scotland from 16 November 2022, causing significant flooding across wide areas of the east of the country.



Figure 7:The Brothock Water in town near the harbour. Water levels are high but well contained due to large volumes being stored upstream in the FSAs. Credit: Angus Council

#### Rainfall

The UK's Met Office said close to a month's worth of rain fell across parts of Aberdeenshire and Angus in 48 hours to 18 November. As much as 140mm of rain was recorded in Charr in Aberdeenshire. The village of Aboyne in Aberdeenshire recorded 71.4mm of rain in 24 hours on 18 November.

📁 Met Office	* SEPA rain gauge						
Rainfall totals (last 48 hours)							
Charr, Aberdeenshire *	140 mm						
Mongour, Aberdeenshire *	110 mm						
Cabrach, Moray *	101 mm						
Glenmuick, Aberdeenshire *	97 mm						
Aboyne, Aberdeenshire	97 mm						
Invermark, Angus *	90 mm						

Figure 8: Rainfall in Scotland, UK, 16 to 18 November 2022. Image credit: UK Met Office

#### **Rivers**

Scottish Environment Protection Agency (SEPA) said "We are seeing significant impacts from rivers in parts of Aberdeenshire and Angus. Seven severe flood warnings are live in Kintore, Kemnay, Inverurie, Ballater and Aberdeen, Brechin and Finavon, and Tannadice."

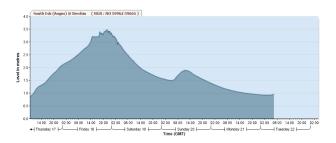


Figure 9: Levels of the South Esk River (Angus) Brechin, November 2022 Image credit: Scottish Environment Protection Agency (SEPA)

#### Damage

One person was reported missing after being swept away by flooding along the River Don near Monymusk in Aberdeenshire on the afternoon of Friday, 18 November. Aberdeenshire Council opened rest centres in Ballater, Aboyne, Inverurie and Kemnay for those needing help and who are unable to stay in their homes. Local media reported residents of Ballater were preparing for severe flooding as levels of the Muick and Dee rivers were rising. Around 40 caravans were evacuated from Ballater Caravan Park.



Figure 10: A view of operation 4 in The Dammy. This a low lying park area between Arbroath and St Vigeans where there is no river wall or deep bank and this area is a natural flood plain, so the design allows for water to lie here during flood events. Debris post

Rail services were severely impacted, and hundreds of travellers were left stranded. Several roads were flooded in Aberdeenshire as well as parts of Angus, Fife, and Dundee districts. Scottish Fire and Rescue Service said "Our Operations Control rooms are receiving a high number of emergency calls due to flooding in Brechin, Forfar and Dundee. We ask the public for their co-operation. Please only call if there is a serious emergency with risk to life."

Cars were seen partially submerged along a major road near Ladybank in Fife. Some residents evacuated their homes in Brechin. Localised flooding was reported in areas of Edinburgh, leaving vehicles stranded.

#### **Copernicus EMS**

Copernicus Emergency Management Service Mapping was activated on 18 November. See <u>EMSR640: Flood</u> in Scotland, United Kingdom for more.





Figure 11: Copernicus EMS image showing flooding along the River Don, Aberdeenshire, Scotland, United Kingdom in November 2022. Image: Emergency Management Service

#### **Arbroath Flood Protection Scheme**

Despite the heavy rainfall, a recently developed flood protection scheme in Arbroath, Angus, kept high waters of Brothock water away from buildings in the town.



Figure 12: Upstream side of the embankment at the Brothock Meadows flood storage area (FSA). The railing indicates the

entrance to the culvert, which was holding back water. The storage area worked well.

Eleanor Doyle, engineer at Angus Council, explained that there are three flood storage areas for the scheme, two of which are located out with the town and the third is located on parkland in Arbroath that is a historic flood plain area. The bank and wall protections along the Brothock through the towns were strengthened and heightened as required. The inclusion of the storage areas limited the height requirements for flood walls in the town which would have been required to be too excessive to contain a 1:200yr flood.

"The scheme is still to complete but thankfully operated as designed," Eleanor Doyle said.



Figure 13: A view of the downstream side of the embankments at the St Vigeans FSA. River levels are controlled and well below the bank levels.

See more about the Arbroath (Brothock Water) Flood Protection Scheme <u>here</u>.

## Acknowledgements

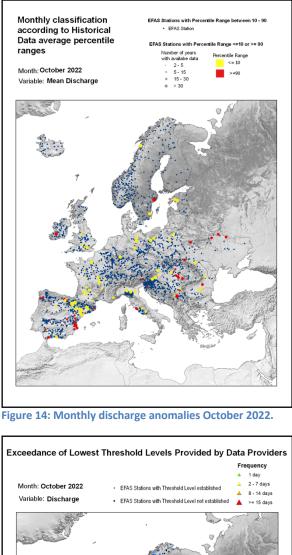
The following partner institutes and contributors are gratefully acknowledged for their contribution:

- DG DEFIS 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: Flood damage in Agia Pelagia, Heraklion, Crete, 15 October 2022. Photo: Hellenic Red Cross

## **Appendix** – figures

As of February 2022, reporting of the meteorological situation by the Meteorological Data Collection Centre (MDCC) will **no longer** be published in the EFAS bulletin. Instead, the state of recent meteorology will be conducted by the Copernicus Climate Change Service (C3S) and published as monthly <u>Climate Bulletins</u>.



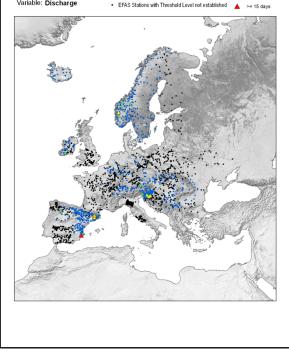


Figure 15: Lowest alert level exceedance for October 2022.

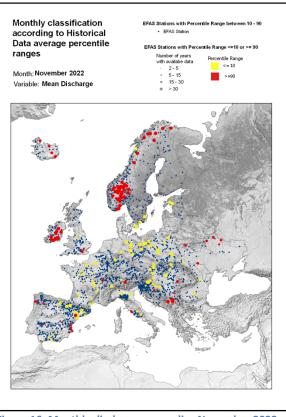


Figure 16: Monthly discharge anomalies November 2022.

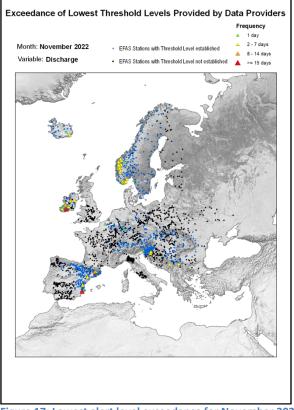


Figure 17: Lowest alert level exceedance for November 2022.

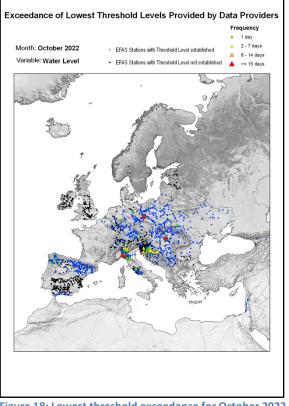


Figure 18: Lowest threshold exceedance for October 2022.

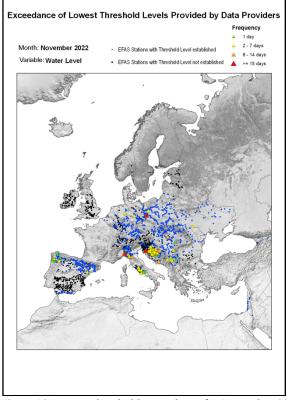


Figure 19: Lowest threshold exceedance for November 2022.

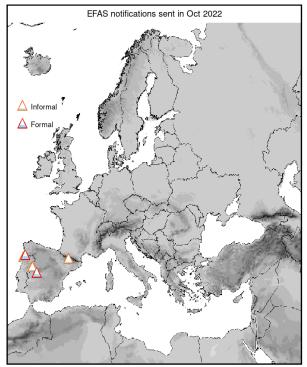


Figure 20: EFAS flood notifications sent for October 2022.

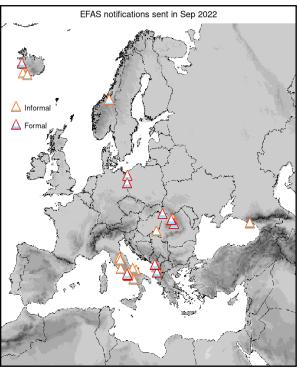


Figure 22: EFAS flood notifications sent for November 2022.

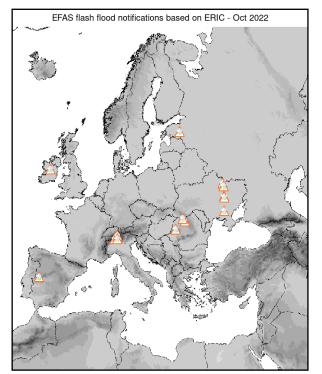


Figure 21: Flash flood notifications sent for October 2022.

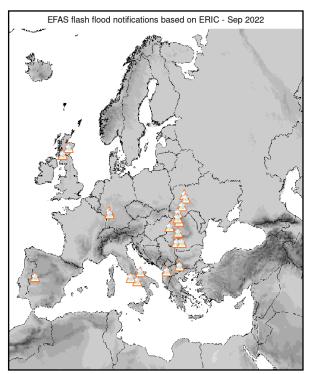


Figure 23: Flash flood notifications sent for November 2022.

# Appendix - tables

Туре	Forecast Date	Issue Date	Lead Time	River	Country
Informal	19/10/2022 12 UTC	19/10/2022	12	Vâsera	Spain
Informal	18/10/2022 12 UTC	19/10/2022	36	Agueda	Spain
Informal	18/10/2022 12 UTC	19/10/2022	42	Tietar	Spain
Informal	18/10/2022 12 UTC	19/10/2022	36	Agueda	Spain
Formal	21/10/2022 00 UTC	21/10/2022	0	Tietar	Spain
Informal	26/10/2022 12 UTC	27/10/2022	24	Cavado	Portugal
Formal	27/10/2022 12 UTC	28/10/2022	24	Lima	Portugal
Informal	03/11/2022 00 UTC	03/11/2022	30	Livenza	Italy
Informal	04/11/2022 00 UTC	04/11/2022	12	Sele	Italy
Informal	11/11/2022 00 UTC	11/11/2022	6	Coastal zone	Norway
Informal	11/11/2022 00 UTC	11/11/2022	6	Vosso	Norway
Informal	13/11/2022 12 UTC	14/11/2022	72	Cavado	Portugal
Formal	13/11/2022 12 UTC	14/11/2022	54	LAGARFLJOT	Iceland
Formal	16/11/2022 00 UTC	16/11/2022	84	Volturno	Italy
Formal	16/11/2022 00 UTC	16/11/2022	24	Sele	Italy
Informal	16/11/2022 12 UTC	17/11/2022	36	Dee	United Kingdom
Informal	16/11/2022 12 UTC	17/11/2022	24	Isla	United Kingdom
Informal	16/11/2022 12 UTC	17/11/2022	30	Don	United Kingdom
Informal	18/11/2022 12 UTC	19/11/2022	36	Sangro	Italy
Informal	21/11/2022 00 UTC	21/11/2022	42	Navia	Spain
Informal	20/11/2022 12 UTC	21/11/2022	36	Sele	Italy
Informal	20/11/2022 12 UTC	21/11/2022	36	Biferno	Italy
Informal	20/11/2022 12 UTC	21/11/2022	0	Volturno	Italy
Informal	22/11/2022 00 UTC	22/11/2022	18	Evinos	Greece
Informal	22/11/2022 00 UTC	22/11/2022	30	Acheloos	Greece
Informal	21/11/2022 12 UTC	22/11/2022	30	Lima	Portugal
Informal	21/11/2022 12 UTC	22/11/2022	18	Velino	Italy
Informal	21/11/2022 12 UTC	22/11/2022	18	Liri	Italy
Formal	24/11/2022 00 UTC	24/11/2022	48	VolturnoCalore	Italy
Informal	23/11/2022 12 UTC	24/11/2022	78	Neto	Italy
Informal	23/11/2022 12 UTC	24/11/2022	60	Coastal catchment Eastern Mediterranean Sea	Italy
Informal	23/11/2022 12 UTC	24/11/2022	60	Basento	Italy
Formal	23/11/2022 12 UTC	24/11/2022	66	OFANTO	Italy
Informal	23/11/2022 12 UTC	24/11/2022	60	Trigno	Italy
Informal	23/11/2022 12 UTC	24/11/2022	60	Biferno	Italy
Formal	23/11/2022 12 UTC	24/11/2022	0	Sele	Italy
Formal	23/11/2022 12 UTC	24/11/2022	0	Volturno	Italy
Informal	23/11/2022 12 UTC	24/11/2022	0	Volturno	Italy
Informal	24/11/2022 12 UTC	25/11/2022	0	Velino	Italy
Informal	27/11/2022 12 UTC	28/11/2022	0	Neto	Italy

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

Туре	Forecast Date	Issue Date	Lead Time	Region	Country
Flash	01/10/2022	01/10/2022	48	Dnepr	Ukraine
Flood	00 UTC	01/10/2022	10	2	Okidine
Flash	01/10/2022	01/10/2022	24	Danube	Romania
Flood	00 UTC	01/10/2022		Danabe	Kontanta
Flash	30/09/2022	01/10/2022	36	Danube	Romania
Flood	12 UTC	0-, -0, -0		20.000	
Flash	02/10/2022	02/10/2022	36		
Flood	00 UTC	,,			
Flash	02/10/2022	02/10/2022	30		
Flood	00 UTC				
Flash	02/10/2022	02/10/2022	48		
Flood	00 UTC	02, 10, 2022	10		
Flash	02/10/2022	03/10/2022	42	Narva	Estonia
Flood	12 UTC	00, 10, 2022	12		Lotonia
Flash	19/10/2022	19/10/2022	36	Тајо	Spain
Flood	00 UTC	13/10/2022	50	14,0	opun
Flash	23/10/2022	23/10/2022	48	Ро	Italy
Flood	00 UTC	23, 10, 2022	10	10	icary
Flash	24/10/2022	24/10/2022	24	Ро	Switzerland
Flood	00 UTC	24/10/2022	27	10	Switzenand
Flash	23/10/2022	24/10/2022	36	Ро	Switzerland
Flood	12 UTC	24/10/2022	50	10	Switzenand
Flash	23/10/2022	24/10/2022	36		
Flood	12 UTC	24/10/2022	50		
Flash	24/10/2022	25/10/2022	48	Dnepr	Ukraine
Flood	12 UTC	23/10/2022	-10	ысы	Okraine
Flash	24/10/2022	25/10/2022	48	Dnepr	Ukraine
Flood	12 UTC	23/10/2022	40	ынері	Okialite
Flash	27/10/2022	28/10/2022	18	Shannon	Ireland
Flood	12 UTC	20/10/2022	10	Sharmon	neidhu
Flash	02/11/2022	02/11/2022	48	Moel	Norway
Flood	00 UTC	02/11/2022	40	Wider	NOTWAY
Flash	03/11/2022	03/11/2022	36	Danube	Austria
Flood	00 UTC	03/11/2022	30	Dallube	Austria
Flash	03/11/2022	03/11/2022	36		
Flood	00 UTC	03/11/2022	30		
Flash	03/11/2022	03/11/2022	36	Tagliamento	Italy
Flood	00 UTC	03/11/2022	30	ragilamento	Italy
Flash	02/11/2022	03/11/2022	42	Ро	Italy
Flood	12 UTC	03/11/2022	42	FU	italy
Flash	04/11/2022	04/11/2022	42	Danube	Bosnia and
Flood	00 UTC	04/11/2022	42	Dallube	Herzegovina
Flash	04/11/2022	04/11/2022	10	Danuha	Bosnia and
Flood	00 UTC	04/11/2022	42	Danube	Herzegovina
Flash	03/11/2022	04/11/2022	30		
	12 UTC	04/11/2022	30		

#### Table 2: EFAS flash flood notifications sent in October – November 2022

Flash Flood	05/11/2022 12 UTC	06/11/2022	30	Greece (South)	Greece
Flash Flood	05/11/2022 12 UTC	06/11/2022	42	Common to Norway-Sweden	Sweden
Flash Flood	07/11/2022 00 UTC	07/11/2022	24	Common to Norway-Sweden	Sweden
Flash Flood	06/11/2022 12 UTC	07/11/2022	18	Norway	Norway
Flash Flood	06/11/2022 12 UTC	07/11/2022	18	Moel	Norway
Flash Flood	06/11/2022 12 UTC	07/11/2022	18	Norway	Norway
Flash Flood	09/11/2022 00 UTC	09/11/2022	12		
Flash Flood	10/11/2022 00 UTC	10/11/2022	30	Coastal Catchment Northern Atlantic Ocean	United Kingdom
Flash Flood	09/11/2022 12 UTC	10/11/2022	48	Norway	Norway
Flash Flood	14/11/2022 12 UTC	15/11/2022	42	Norway	Norway
Flash Flood	16/11/2022 00 UTC	16/11/2022	30	South England	United Kingdom
Flash Flood	16/11/2022 00 UTC	16/11/2022	48	Dnepr	Ukraine
Flash Flood Flash	16/11/2022 00 UTC 16/11/2022	16/11/2022	30	Danube	Romania
Flood Flash	00 UTC 15/11/2022	16/11/2022	24	Italy (Ligurian Sea/Tyrrhenian Sea)	Italy
Flood Flash	13/11/2022 12 UTC 17/11/2022	16/11/2022	36	Moraca/Bojana	Montenegro
Flood Flash	00 UTC 17/11/2022	17/11/2022	48	Danube	Romania
Flood Flash	00 UTC 17/11/2022	17/11/2022	48		
Flood Flash	00 UTC 17/11/2022	17/11/2022	36		
Flood Flash	00 UTC 16/11/2022	17/11/2022	36	Danube	Croatia
Flood Flash	12 UTC 16/11/2022	17/11/2022	48	Dee	United Kingdom
Flood Flash	12 UTC 16/11/2022	17/11/2022	42	Tweed	United Kingdom
Flood Flash	12 UTC 17/11/2022	17/11/2022	48	Scotland	United Kingdom
Flood Flash	12 UTC 17/11/2022	18/11/2022	24		
Flood Flash	12 UTC 19/11/2022	18/11/2022	36	Danube	Romania
Flood	00 UTC	19/11/2022	36	Danube	Croatia

Flash Flood	19/11/2022 00 UTC	19/11/2022	36	Danube	Croatia
Flash Flood	19/11/2022 00 UTC	19/11/2022	36	Danube	Croatia
Flash Flood	19/11/2022 00 UTC	19/11/2022	36	Danube	Croatia
Flash Flood	19/11/2022 00 UTC	19/11/2022	36	Danube	Croatia
Flash Flood	18/11/2022 12 UTC	19/11/2022	48	Danube	Romania
Flash Flood	18/11/2022 12 UTC	19/11/2022	48	Crni Drim / Drin	
Flash Flood	18/11/2022 12 UTC	19/11/2022	48	Danube	Serbia
Flash Flood	18/11/2022 12 UTC	19/11/2022	48	Danube	Serbia
Flash Flood	18/11/2022 12 UTC	19/11/2022	42	Danube	Romania
Flash Flood	18/11/2022 12 UTC	19/11/2022	42	Adriatic Coast	Bosnia and Herzegovina
Flash Flood	20/11/2022 00 UTC	20/11/2022	42	Strimonas(GR)/Struma(BG)	Bulgaria
Flash Flood	20/11/2022 00 UTC	20/11/2022	36	Strimonas(GR)/Struma(BG)	Bulgaria
Flash Flood	20/11/2022 00 UTC	20/11/2022	30	Danube	Serbia
Flash Flood	19/11/2022 12 UTC	20/11/2022	24	Danube	Croatia
Flash Flood	19/11/2022 12 UTC	20/11/2022	24	Drini i Lezhes	Albania
Flash Flood	19/11/2022 12 UTC	20/11/2022	24	Danube	Kosovo
Flash Flood	19/11/2022 12 UTC	20/11/2022	24	Danube	Serbia
Flash Flood	19/11/2022 12 UTC	20/11/2022	30	Danube	Romania
Flash Flood	19/11/2022 12 UTC	20/11/2022	30	Danube	Romania
Flash Flood	19/11/2022 12 UTC	20/11/2022	36	Dnepr	Ukraine
Flash Flood	21/11/2022 00 UTC	21/11/2022	30	Corsica	
Flash Flood	21/11/2022 00 UTC	21/11/2022	42	Danube	Croatia
Flash Flood	21/11/2022 00 UTC	21/11/2022	42	Moraca/Bojana	Montenegro
Flash Flood	21/11/2022 00 UTC	21/11/2022	42	Crni Drim / Drin	
Flash Flood	20/11/2022 12 UTC	21/11/2022	48	Danube	Croatia

Flash Flood	20/11/2022 12 UTC	21/11/2022	48	Sangro	Italy
Flash	20/11/2022	21/11/2022	48	Italy (Ligurian Sea/Tyrrhenian Sea)	Italy
Flood	12 UTC	21/11/2022	40	italy (Egunan Sca) i yinicinan Sca)	itary
Flash	22/11/2022	22/11/2022	48	Norway	Norway
Flood	00 UTC	,,		,	,
Flash	22/11/2022	22/11/2022	18	Crni Drim / Drin	
Flood	00 UTC	,,		····· ···· · · ··· · · · · · · · · · ·	
Flash	21/11/2022	22/11/2022	36	Crni Drim / Drin	
Flood	12 UTC	,, _0	00		
Flash	21/11/2022	22/11/2022	42	Danube	Croatia
Flood	12 UTC	22/11/2022	72	Danabe	cioatia
Flash	21/11/2022	22/11/2022	42	Danube	Croatia
Flood	12 UTC	22/11/2022	72	Danabe	Cioatia
Flash	21/11/2022	22/11/2022	30	Corsica	
Flood	12 UTC	22/11/2022	50	CUISICa	
Flash	22/11/2022	22/11/2022	40	Newsey	Newser
Flood	12 UTC	23/11/2022	48	Norway	Norway
Flash	22/11/2022	00/11/0000			<b>-</b> .
Flood	12 UTC	23/11/2022	48	Danube	Romania
Flash	25/11/2022				
Flood	00 UTC	25/11/2022	18	Norway	Norway
Flash	24/11/2022				
Flood	12 UTC	25/11/2022	48	Liri	Italy
Flash	26/11/2022				
Flood	00 UTC	26/11/2022	36	Italy (Adriatic Sea/Ionian Sea)	Italy
Flash	26/11/2022				
Flood	00 UTC	26/11/2022	24	Ofanto	Italy
Flash	26/11/2022	26/11/2022	30	Dnepr	Ukraine
Flood	00 UTC				
Flash	25/11/2022	26/11/2022	24	Biferno	Italy
Flood	12 UTC				·
Flash	25/11/2022	26/11/2022	24	Liri	Italy
Flood	12 UTC				,
Flash	25/11/2022	26/11/2022	48	Dnepr	Ukraine
Flood	12 UTC	,,			0
Flash	27/11/2022	27/11/2022	48	Norway	Norway
Flood	00 UTC	2771172022	10	Norway	Norway
Flash	26/11/2022	27/11/2022	48	Norway	Norway
Flood	12 UTC	27/11/2022	40	Norway	NOTWAY
Flash	26/11/2022	27/11/2022	10	Norway	Norway
Flood	12 UTC	27/11/2022	48	Norway	Norway
Flash	28/11/2022	20/11/2022	10	Constal zono	Casia
Flood	00 UTC	28/11/2022	18	Coastal zone	Spain
Flash	29/11/2022	20/44/2022	26		
Flood	00 UTC	29/11/2022	36	Italy (Adriatic Sea/Ionian Sea)	Italy
		ecasted neak of the e	vent		

\* 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 contractor, Ghenova Digital (formerly Soologic), has been awarded the contract for the EFAS Hydrological data collection centre. They are responsible for collecting discharge and water level data across Europe.

A German consortium (KISTERS and DWD) has been awarded the contract for the EFAS Meteorological data collection centre. They are responsible for collecting the meteorological data needed to run EFAS over Europe. Finally, the JRC is responsible for the overall project management related to EFAS and further development of the system.

#### **Contact details:**

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