European Flood Awareness System

EFAS *Bulletin*

December – January 2022

Issue 2022(1)

NEWS

New features

European multimodel seasonal forecasts now available on CDS

A new multi-model system providing monthly averages of discharge over the European domain with a lead time up to 7 months has been published on the Climate Data Store (CDS). The model consists of three hydrological models, LISFLOOD, E-HYPE and VIC forced with the ECMWF SEAS5 seasonal forecasts. The multi-model system provides gridded information on the same river network as EFAS, and the LISFLOOD model setup is the same as in the operational seasonal forecasts in EFAS. The system also provides multi-model catchment-based forecasts, using multiple parameterisation schemes of the E-HYPE model.

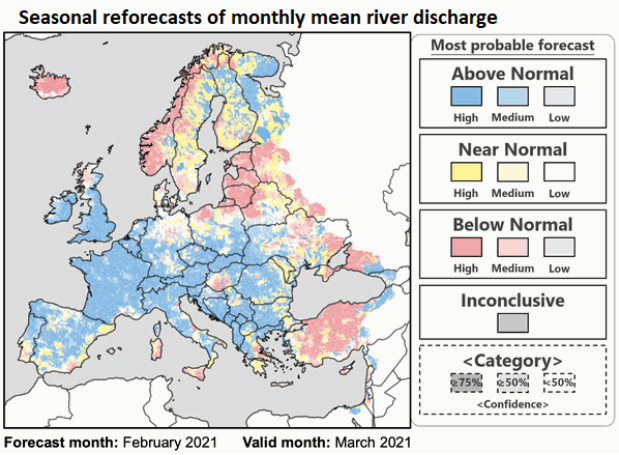

Figure 1: Screenshot of European multi-model seasonal forecast data on the CDS app

The system is the fruit of a collaboration between SMHI, WUR Wageningen, and EFAS-COMP through a Copernicus Climate Change Service contract. For more information, please see the links below.

Forecasts from January 2021 to present: https://bit.ly/3n1bW5Z

Reforecasts from 1993 to 2016: https://bit.ly/339ftIb

New EFAS partners

We gladly welcome the Danish Meteorological Institute, DMI (Denmark) as new EFAS full partner.

RESULTS

Summary of EFAS Flood and Flash Flood Notifications

The 36 formal and 43 informal EFAS flood notifications issued in December – January 2022 are summarised in Table 1. The locations of all notifications are shown in Figure 27 and Figure 29 in the appendix.

310 Flash flood notifications were issued in December – January 2022. They are summarised in Table 2. The locations of all notifications are shown in Figure 28 and Figure 30 in the appendix.

Meteorological situation

by EFAS Meteorological Data Collection Centre

December

December 2021 was characterized by lower than normal sea surface pressure over southeast Europe and the Atlantic Ocean, and above normal sea surface pressure over Scandinavia and the African parts of the EFAS domain. Monthly precipitation totals were above the long-term mean in the southeast and western Europe. Sums below the long-term mean were observed mainly in the western Mediterranean region, Scandinavia, and the eastern parts of the EFAS domain. Monthly mean air temperature values were below the long-term mean in the northern and African parts, and above the long-term mean over the remaining parts of the EFAS domain.

At the beginning of December, the Azores high was around its typical position and extended towards northern Africa. A strong low-pressure system was located over northwest Russia and dissipated within the next days while moving to the northeast. A weak low-pressure system was situated over the North Sea. It intensified and moved via Jutland to the Baltics, associated with strong winds and heavy precipitation. An upper-level trough extended towards the central Mediterranean region, forced the development of a weak low-pressure system over the eastern Mediterranean Sea and was cut-off. Another low-pressure system developed northward of Great Britain and Ireland and moved to the North Sea, and later to southeast Europe. At the same time, a high-pressure system developed over northwest Russia. It was associated with a cold wave in European Northern Russia, Scandinavia, and the Baltics as it forced cold

arctic air to flow to this region. A small but intense low-pressure system developed over the Atlantic, westward of Great Britain and Ireland. It experienced a rapid intensification while moving to Great Britain and Ireland, associated with very strong winds and heavy rains. It moved towards the North Sea and dissipated quickly. Within the next days, a high-pressure system developed over European Northern Russia and a low-pressure system developed southward of the Alps. The latter one was associated with heavy snowfall in the Alps and later in the Balkans. At the same time, an elongated trough from a low-pressure system over the North Atlantic caused heavy rains and snow at the northern Iberian Peninsula and the Pyrenees. By mid of December, a high-pressure system was established over central Europe and was connected with the one over European Northern Russia and the Azores high. They separated the above-mentioned low-pressure system, now located over the Aegean Sea, from the ones over the North Atlantic. As the high-pressure system over European Northern Russia dissipated and the central European high-pressure system moved to Great Britain and Ireland, low-pressure systems moved from the North Atlantic via Scandinavia to European Northern Russia. The associated trough reinforced the remains of the above-mentioned low-pressure system over the Aegean Sea, bringing heavy precipitation to the eastern and northern coasts of the eastern Mediterranean Sea. Around Christmas, an intense low-pressure system developed over northern Scandinavia, associated with strong winds. It moved later to the northeast and dissipated. In the last days of December, several low-pressure systems developed over the Atlantic Ocean. A high-pressure system moved from the Canary Islands to the Iberian Peninsula. Together, they moved mild subtropical air masses to western and central Europe.

The highest precipitation amounts were observed over the central and eastern Mediterranean region, east of the Black Sea, at the west coast of Scandinavia, Great Britain and Ireland, and at the north coast of the Iberian Peninsula (Figure 1). No or almost no precipitation fell in many African parts of the EFAS domain, east of the Caspian Sea, and the southeast coast of the Iberian Peninsula. Monthly precipitation totals above the long-term mean occurred mainly over southeast Europe, western Europe, and around the eastern Mediterranean Sea (Figure 2). Monthly totals below the long-term mean were reported mainly over Scandinavia, around the Caspian Sea, in central and eastern Europe, and around the western Mediterranean Sea.

The monthly mean air temperature ranged from -26.7°C to 22.2°C with the highest values in the southern parts of the EFAS domain. The lowest temperature values were reported in the northern, eastern, and mountainous parts (Figure 3). Air temperature anomalies ranged from -7.0°C to 8.0°C (Figure 4). Monthly mean air temperature values below the long-term mean occurred in northern and north-eastern Europe, and some regions of northern Africa, while positive air temperature anomalies appeared in the other parts of the EFAS domain

January

January 2022 was characterized by lower than normal sea surface pressure over the Arctic Ocean and northeast Europe and above normal sea surface pressure over the Atlantic Ocean, southwest Europe and the African parts of the EFAS domain. Monthly precipitation totals were above the long-term mean in the eastern Mediterranean region and Northeast Europe. Sums below the long-term mean were observed mainly in the central and western Mediterranean region and western Europe. Monthly mean air temperature values were below the long-term mean in the Mediterranean region and Iceland and above the long-term mean in northern and central Europe.

At the beginning of January, a high-pressure system was located over the western Mediterranean region and low-pressure systems over the Atlantic Ocean and northeast Scandinavia. An upper-level low-pressure system was situated over the southeast Mediterranean region. This constellation prolonged the warm spell in central Europe from the last days of the previous year to the first days of this year. The low-pressure system over the Atlantic moved northward and intensified in the north of Iceland. It moved across Scandinavia to the northern European part of Russia. At the same time, the high-pressure system over the western Mediterranean region dissipated. A trough located over the Atlantic Ocean moved to eastern Europe and stretched towards the Mediterranean Sea. A new high-pressure system developed over the Azores. While the high-pressure system from the Azores moved eastward and changed to a high-pressure zone from Great Britain and Ireland to European Russia, a low-pressure system developed under the above-mentioned trough

over the eastern Mediterranean Sea associated with heavy precipitation. Within the next days, this low-pressure system moved to the central Mediterranean region and the high-pressure zone dwindled to a high-pressure system over western Europe. A low-pressure system developed over the Denmark Strait. While moving across the Greenland Sea to the Barents Sea it intensified and caused strong winds and high precipitation amounts in northern Europe. The core of the low-pressure system split; one part moved to western Russia. A weak high-pressure zone extended from northern Africa to central Europe. A new intense low-pressure system developed over the Greenland Sea and moved to the Barents Sea. It caused again strong winds and heavy precipitation in northern and eastern Europe. As the corresponding trough moved eastward and the core area of the high-pressure zone to northwest Europe, cold air moved to the eastern Mediterranean region causing a cold spell especially in Turkey and Syria. This constellation also caused a warm spell in northern Europe. An upper-level trough swung from the northern Atlantic Ocean eastward and a small but strong low-pressure system developed over the Baltic Sea, while the high-pressure zone changed to a high-pressure system over Great Britain and Ireland. The low-pressure system moved southward and weakened, but the associated cold air caused a winter storm with high amounts of snow in the eastern Mediterranean region. The high-pressure system disappeared, and a new high-pressure system developed over the Azores Islands. In the same time, a low-pressure system moved from Newfoundland via Iceland to the Baltic Sea. The new high-pressure system shifted to the Bay of Biscay while a low-pressure system developed over the Labrador Sea. It moved via the Denmark Strait to the Norwegian Sea. It rapidly intensified while moving further to the Baltic Sea. Very strong winds affected large parts of northern, central, and eastern Europe. The low-pressure system weakened soon as it moved further eastward. By the end of January, this low-pressure system was located over the Baltic and a new low-pressure system was formed over the central Mediterranean region. A high-pressure system was situated between the Azores and Great Britain and Ireland.

The highest precipitation amounts were observed over the Norwegian Mountains, around the eastern Black Sea, eastern Mediterranean Sea, and the Pyrenees (Figure 1). No or almost no precipitation fell around the western Mediterranean Sea and in southeast Europe. Monthly precipitation totals above the long-term mean occurred mainly over northwest Scandinavia, eastern Europe and around the eastern Mediterranean Sea (Figure 2). Monthly totals below the long-term mean were reported in west and southeast Europe, south and northeast Scandinavia, and the western Mediterranean region.

The monthly mean air temperature ranged from -24.5°C to 20.8°C with the highest values in the southern parts of the EFAS domain. The lowest temperature values were reported in the northern, eastern, and mountainous areas (Figure 3). Air temperature anomalies ranged from -4.1°C to 7.7°C (Figure 4). Monthly mean air temperature values below the long-term mean occurred around the Mediterranean Sea and Iceland, while positive air temperature anomalies appeared in the other parts of the EFAS domain.

Hydrological situation

by EFAS Hydrological Data Collection Centre

December

During the month of December, the highest concentration of stations with exceedances is found mainly in the north of Spain, especially in the Ebro river basin and in a smaller number of stations in the Douro, Minho, Llobregat, Ter, Turia, Seco, and Algar basins. There is also a large number of stations that overpass their first threshold in Bosnia and Herzegovina, Croatia, and Slovenia (Danube river basin), and in northern and central Italy (Po, Tiber, Garigliano, and Badino basins). In the Danube river basin, there are more dispersed stations with exceedances in Serbia, Romania, Ukraine, Hungary, Austria, and Slovakia. There are also notable stations located in the Dnieper and Neman basins (Belarus and Lithuania), the Vistula, Oder, and Elbe basins (Poland and Germany), in the Rhine basin in Germany, and in the Scheld basin in Belgium. There are some exceedances too in center Norway, Ireland, and Iceland.

Regarding stations registering values above the 90% quantile, the more remarkable place is the Scandinavian Peninsula: Norway, Finland, and Sweden with 24, 10, and nine stations, respectively. In Spain, 21 stations exceeded the 90% quantile, mainly in the Ebro and Guadalquivir basins, and to a lesser extent in Jucar, Mijares, Seco, Algar, and Barbate basins. Along the

Danube river basin, 12 stations throughout the following countries overpassed the quantile: in Germany, Austria, Romania, Bosnia and Herzegovina, Serbia, Bulgaria. In a more isolated way, there are also some stations registering values above the 90% quantile in Ukraine, Belarus, Poland, Italy, and France.

Finally, and according to those stations registering values below the 10% quantile (38 in total), the highest concentration of them corresponded to the Danube basin, mainly the western area (Austria). Only one station is located in Hungary and another one in Serbia. Secondly, we also have a high density of stations fulfilling this criterion in Spain (Ebro, Guadalquivir, Guadalhorce, and Verde basins) and in central Italy. Finally, a lower density of stations under the 10% quantile occurred in Ukraine, Poland, Scandinavia, Germany, Iceland, and the United Kingdom.

January

During the month of January, the number of stations with exceedances is maintained when compared to the previous month. Most stations with exceedances can be found in Spain, as in December, with 30 stations in the Douro, Minho-Limia, Llobregat basins, and the eastern area (Turia, Serpis, and Seco basins). In second place is the concentration of stations in Germany (29 stations), mainly in the Rhine river basin and more isolated cases in the Danube and Elbe basins. In addition to German stations, there was also a high concentration of stations along the Danube in Bosnia & Herzegovina, Hungary, Slovenia, and southern Ukraine. There is also a notable concentration between Belarus, Poland and Lithuania (Dnieper, Neman, and Vistula basins). Some stations can be found too along Norway, and others more scattered in the Po river basin (Italy), Sweden and Iceland.

In January, 95 stations registered exceedances of the 90% quantile threshold. 62% of the stations were located in the Scandinavian Peninsula basins through Norway, Sweden, and Finland (47, five, and seven stations respectively). The situation was also remarkable the Danube basin, where 15 stations were spread throughout Austria, Romania, Ukraine, Germany, and Hungary. To a lesser degree, other stations over their 90% quantile were located in the Dniester and Dnieper basins in Ukraine (six stations), the south of France (four stations) and the Vistula basin (four stations). Moreover, three stations exceeded this value in the east of Spain, and also in Iceland, two more stations surpased their 90% quantile in the Hvala and Bakkahlaup basins. Isolated stations exceeding the 90% quantile can be seen in the Martat basin (Italy) and in the Elbe basin (Germany).

Finally, and according to the number of stations registering values below the 10% quantile, this has dramatically declined during January, summarizing a total of 19 stations that fulfill this criterion. The highest concentration of them corresponded to Spain, where six stations are in the Duero, Ebro, Guadalhorce, and Verde basins. In a more scattered pattern, we can find two stations in central Italy and another two in the south of Norway. Lastly, a considerable number of isolated stations also registering values below the 10% quantile can be found in the Thames river (England), Lahn river (Germany), Jökulsá á Fjöllum river (Iceland), Moll river (Austria), Oder river (Poland), Zagyva river (Hungary), Narew river (Belarus), and the Horyn and Narew rivers (Ukraine).

Verification

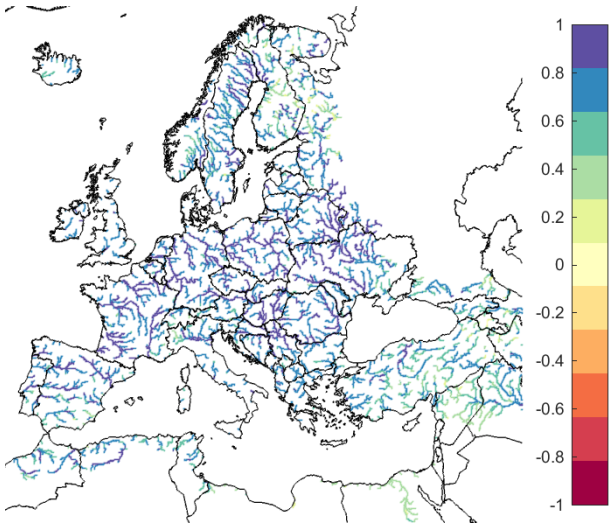

Figure 2: EFAS CRPSS at lead-time 1 day for December-January 2022, for catchments >2000km2. The reference score is persistence of using previous day's forecast.

Figure 2 and Figure 3 shows the EFAS headline score, the continuous ranked probability skill score (CRPSS) for lead times 1 and 5 days for December-January 2022 across the EFAS domain for catchments larger than 2000km^2. A CRPSS of 1 indicates perfect skill, 0 indicates that the performance is equal to that of the reference, and any value <0 (shown in orange-red on the maps) indicates the skill is worse than the

reference. The reference score is using yesterday's forecast as today's forecast, which is slightly different than we used previously and very difficult to beat.

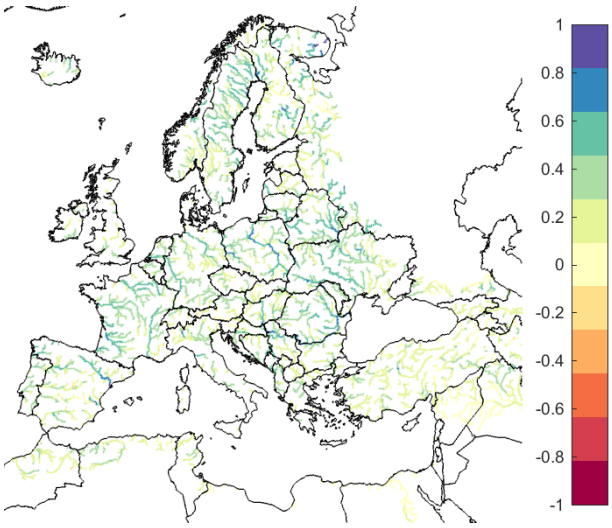

Figure 3. EFAS CRPSS at lead-time 5 days for December-January 2022 for catchments >2000km2. The reference score is persistence of using previous day's forecast.

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 4). 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.

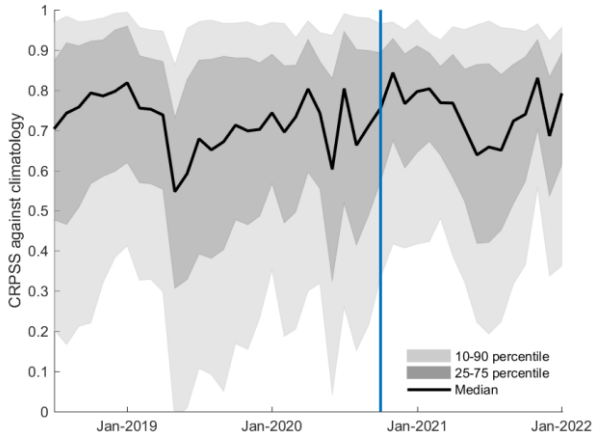

Figure 4. Monthly means of CRPSS the for lead-time 5 days for all the major river points in Europe with ECMWF ENS as forcing. Reference forecast was climatology. The skill is largest during the winter months, when there is less variation in the flow in large parts of Europe. The blue line indicates the release of EFAS 4.0.

ARTICLES

Danube Flood Risk Management Plan 2021 and EFAS

by Valéria Wendlová, Slovak Hydrometeorological Institute

International Commission for the Protection of the Danube River (ICPDR) adopted at its 24th Ordinary Meeting Danube Flood Risk Management Plan (DFRMP) Update 2021. The document is processed under the EU Directive 2007/60/EC on the assessment and management of flood risks (EU Floods Directive, FD) by all member states every six years.

The DFRMP Update 2021 – the first update to the plan firstly published in 2015 – represents a key step forward in the ICPDR's work towards sustainable flood risk management. It strengthens various aspects of flood risk management focusing on prevention, protection and preparedness, including measures for achieving the established objectives and calls for solidarity among all ICPDR Contracting Parties.

The main documents involve information and all data in numerical form and maps. First document which was processed was Preliminary Flood Risk Assessment (PHPR) and presented information on major flood events that occurred in the Danube River Basin District focusing primarily on the last two decades and assessed new areas with significant flood risk.

This document also provided a brief description of the methodology used at the national level for the identification of areas of potential significant flood risk as required by FD Article 5 as well as the methodology agreed by the ICPDR to identify the areas of potential significant flood risk in the Danube River Basin District including those having a transboundary character.

The PHPR report set the necessary basis for the update of flood hazard and flood risk maps and for the preparation of the Danube Flood Risk Management Plan Update 2021. At the same time, it provided the public and stakeholders with important evidence that

the areas with potential flood risk in the Danube River Basin are being taken care of for the benefit of all inhabitants and countries of the Danube River Basin.

Important parts of the document in DFRMP are Flood hazard maps and Flood risk maps. They were prepared for the catchments with the area larger than 4000 km^2 to ensure a coherent approach with river basin management planning. These maps show the potential adverse consequences associated with different flood scenarios and serve as an effective tool for information, as well as a valuable basis for priority setting and further technical, financial, and political decisions regarding flood risk management.

The ICPDR agreed upon the following objectives of the Flood risk management plan for the Danube River Basin District:

- Avoidance of new risks
- Reduction of existing risks
- Strengthening resilience
- Raising awareness
- Promoting the solidarity principle

These objectives focus on the reduction of potential adverse consequences of flooding for human health, the environment, cultural heritage and economic activity and address all aspects of flood risk management focusing on prevention, protection, preparedness, including flood forecasts and early warning systems and taking into account the characteristics of the Danube River Basin District.

Figure 5: Map of flood hazards and flooding scenarios as part of the Danube Flood Risk Management Plan 2021The Article 7(2) FD stipulates that Member States shall establish appropriate objectives for the management of flood risks for the areas identified under the Article 5(1), focusing on the reduction of potential adverse consequences of flooding for human health, the environment, cultural heritage and economic activity, and, if considered appropriate, on non-structural initiatives and/or on the reduction of the likelihood of flooding.

During the first flood risk management cycle the ICPDR flood experts were carefully considering if all appropriate objectives are able to sufficiently cover - at the basin-wide level - all needs for the management of flood risks. The main conclusion was that the defined objectives were broad and robust enough to accommodate all relevant topics including the impacts of the climate change.

The progress in achieving of basin-wide objectives of the DFRMP is addressed primarily through the implementation and communication of best practice projects and all countries provide some examples. By highlighting the successful cooperation between the Danube countries in international projects and/or joint initiatives (e.g., promoting the solidarity principle during Danube ice event 2017) on flood risk management the need for cooperation and coordination is underpinned.

The measures described in plan address all phases of the flood risk management cycle and focus particularly on:

- prevention (i.e., preventing damage caused by floods by avoiding construction of houses and industries in present and future flood-prone areas or by adapting future developments to the risk of flooding),
- protection (by taking measures to reduce the likelihood of floods and/or the impact of floods in a specific location such as restoring flood plains and wetlands) and
- preparedness (e.g. providing instructions to the public on what to do in the event of flooding).

Preparedness is a result of awareness and is based on the necessary information to make the individual recognize his possibilities of action. Problems associated with floods are often not sufficiently recognized and acknowledged. The authorities should ensure that the information concerning flood prevention and protection plans is transparent and easily accessible to the public. The information provided to the affected communities should also include communication of opportunities how they can adapt e.g., their land use practices to natural circumstances on floodplains. All measures linked to public information and awareness raising are most effective when they involve participation at all levels.

An important measure in DFRMP concerning the warning of the population is the EFAS. EFAS was developed in close collaboration with the ICPDR and the national hydro-meteorological services sharing the Danube River basin amongst others. The aim of EFAS is provide the time for preparedness measures before major flood events strike, particularly for large trans-national river basins such as the Danube, both on country as well as European level. This is achieved by providing complementary, added value information to the national hydrological services and by keeping the European Response and Coordination Centre informed about ongoing floods and about the possibility of upcoming floods across Europe. Since 2012 EFAS has been running fully operational as a part of the Copernicus Emergency Management Service.

EFAS provides the national authorities a wide range of flood forecast information such as medium-range flood forecasts with a lead time of 10-15 days, impact forecasts, flash flood forecasts with up to 48 hours lead time and seasonal outlooks for the coming months. The information can be accessed by the EFAS partners either through a password protected web site or through web services. All relevant flood forecasting authorities in the Danube River basin are EFAS partners.

Through collaboration at the Danube River basin as well as at the European scale EFAS fosters knowledge exchange and data sharing amongst the national hydro-meteorological authorities and hence is an essential tool to improve overall flood risk management in the Danube River Basin

The updated Plan presents the strategic basin-wide level measures to prevent and reduce damage to human health, the environment, cultural heritage and economic activity. Special attention in the DFRMP Update 2021 is given to measures employing areas which have the potential to retain flood water, such as natural floodplains as well as the other areas enabling controlled flooding. In the frame of their prioritization those measures were favoured which are sufficiently robust to the uncertainty in forecasting of climate change impacts. This robustness has been achieved through focusing on pollution risk in flood prone zones; on the application of non-structural measures when

possible; and on “no-regret” and “win-win” measures. The major ICPDR platform for a joint implementation of the strategic level measures are the transboundary projects supporting DFRMP. The progress in implementing DFRMP measures was assessed through evaluation of the achievements of international projects.

The elements of the Danube Flood Risk Management Plan will be periodically reviewed in future on a regular basis respecting the flood risk management planning periods, and after each review they will be updated to reflect the latest level of knowledge. Reporting on the Danube Flood Risk Management Plan implementation progress will be done via national representatives in the ICPDR Flood Protection Expert Group.

Flooding affects Navarre Region, Spain, December 2021

by Richard Davies, floodlist

Heavy rainfall accompanied by melting snow caused severe flooding and landslides in the Navarre and Aragon regions of Spain in December 2021.

On 09 December the Navarre government activated an emergency situation due to the flood threat from rising rivers including the Ebro, Ega, Bidasoa and Arga.

By 10 December the swollen Bidasoa river caused flooding in Elizondo, Baztan and Sunbilla. Some riverside communities along the Arga river were also affected, including areas of Pamplona and the towns of Huarte, Villava and Burlata. Dozens of people were evacuated from a care home in the municipality of Aranzadi. The following day the swollen Ebro river caused flooding in Tudela.

Figure 6: Floods in Pamplona, Spain, 10 December 2021. Credit: Ayuntamiento de Pamplona

One fatality was reported after heavy rain caused a landslide in the village of Sunbilla. One man was reported missing and later found dead after being swept away by the flooding Bidasoa river in Elizondo.

On 12 December, President of Navarre Region, María Chivite, said a total of 74 municipalities were affected and announced a request to declare a natural disaster which would allow access to aid from the Spanish government and the European Union.

According to figures from Spain’s Meteorological Agency (AEMET), in a 24 hour period to 09 December, Bera in Navarre recorded 126.2 mm of rain and Roncesvalles 92.6 mm. The following day Roncesvalles saw a further 134.2 mm, while Luzaide recorded 91.8 mm and Esteribar 82.8 mm.

The Arga in Pamplona reached 4.80 metres 10 December, while the Ebro River in Castejón reached 7.94 metres as of 11 December. The government of Navarra said the Ebro at Tudela reached 6.17 metres on 12 December, higher than the 5.85 m seen during the floods of 2015.

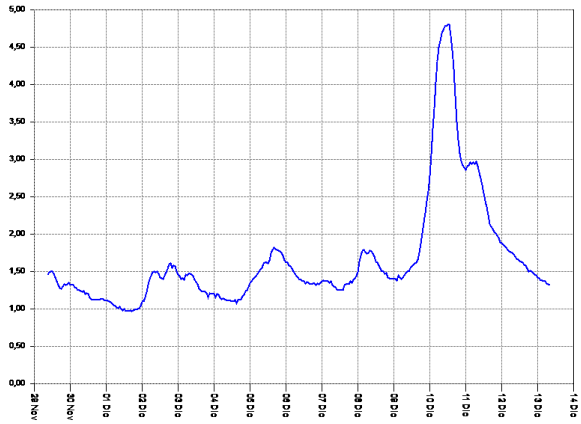

Figure 7: Levels of the Arga river at Pamplona, Spain, December 2021. Credit: Government of Navarre

Flooding along the Ebro later affected areas of in Aragon region including the capital Zaragoza, where the river reached at 5.52 metres on 14 December 2021. Areas along the river in the city were flooded and the Spanish Red Cross reported patients from a hospital in the city were evacuated.

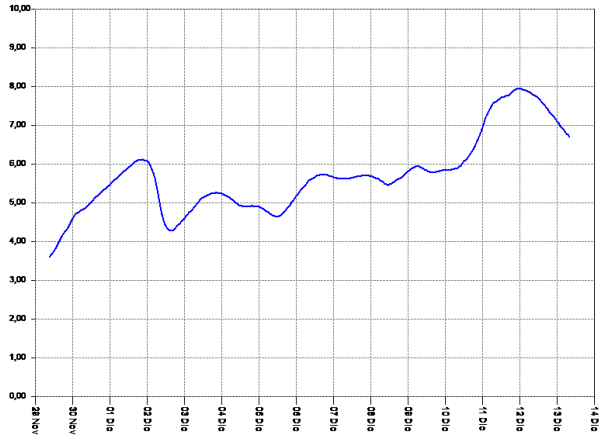

Figure 8: Levels of the Ebro River at Castejón, Spain, December 2021. Credit: Government of Navarre

The rapid mapping service from Copernicus EMS Mapping was activated to provide maps of flooded areas: https://emergency.copernicus.eu/mapping/list-of-components/EMSR555

Other areas of northern Spain saw heavy rainfall in late November 2021, when floods prompted rescues in Asturias and Cantabria and later the Basque Region.

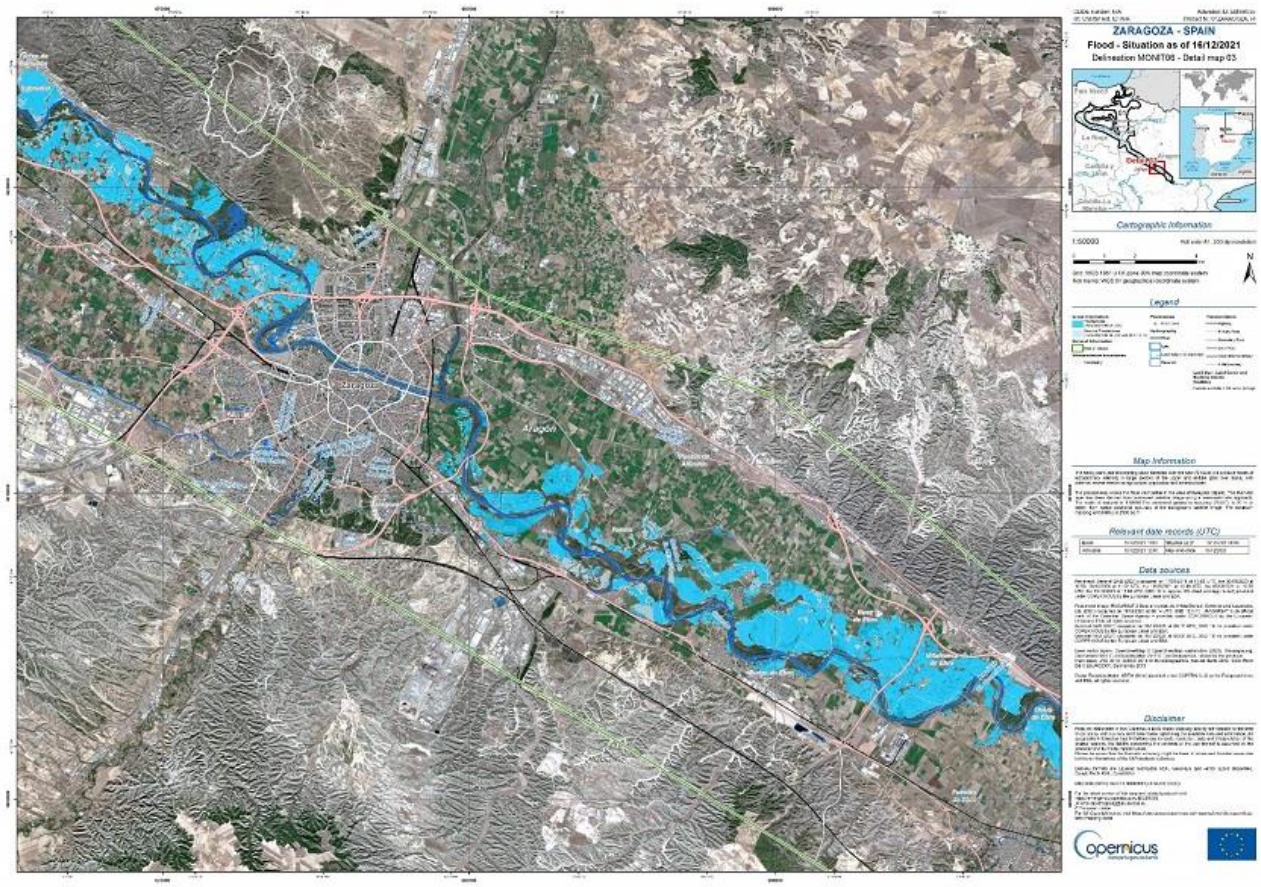

Figure 9: Copernicus EMS Map, floods in Zaragoza, Spain, December 2021. Credit: Copernicus EMS

Summary of EFAS Notifications in 2021

by Eric Sprokkereef

Figure 10 shows the number of formal, informal, and flash flood notifications issued each month throughout 2021. With a total number of 1856 EFAS notifications in the year 2021 the amount of notifications decreases by about 16% compared to the previous year. However, the year 2021 still ranks second in terms of the highest number of notifications, which is due to the last number of flash flood notifications issued. When compared to 2020, the EFAS Dissemination Centre (DISS) issued 39% less formal, 6% more informal and 15% less flash flood notifications. January was the most active month with 504 notifications, which is about 27% of the annual sum for 2021. January also saw the highest number of formal notifications, whereas the months August and September were relatively quiet in terms of flood notifications. In total, 147 formal, 169 informal, and 1540 flash flood notifications were issued in 2021.

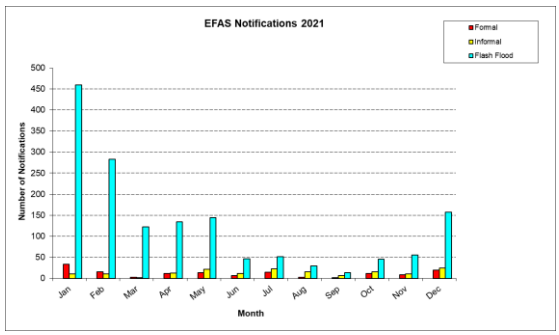

Figure 10: Number of EFAS formal (red), informal (yellow) and flash flood (blue) notifications issued in 2021

Remarkable periods in 2021 were: (i) the beginning and the end of January with floods in Italy, Albania, Greece, Bulgaria, and the Danube basin, (ii) in April and May

with floods in the Russian Federation, and (iii) early July with wide spread floods in the French, Luxembourg, Belgian, German, and Dutch parts of the Rhine and Meuse basins. This event is also subject of a detailed assessment that will be published early 2022.

For comparison, Figure 11 indicates the total number of EFAS notifications per year for the past 9 years. 2021 was relatively 'normal' for formal and informal notifications. The number of flash flood notifications decreased slightly compared to 2020. In January and February, the number of issued flash flood notifications was still quite high. We note that in mid-February the criteria for issuing flash flood notifications were modified. This has led to a clear decrease in the number of flash flood notifications issued from February onwards.

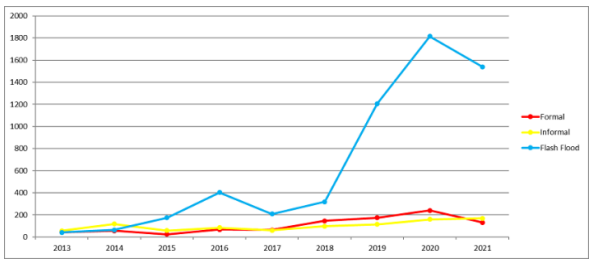

Figure 11: Total number of EFAS formal (red), informal (yellow) and flash flood (blue) notifications issued per year from 2013-2021

Figure 12 breaks down the number of notifications over the past 4 years into seasons (December, January, and February [DJF]; March, April, and May [MAM]; June, July, and August [JJA]; and September, October, and November [SON]).

The most active seasons in terms of river flooding over the past 3 years were all beaten by the winter season of 2021. The reason for that is the amount of flash flood notifications that has been issued in the months January and February in 2021. If one only looks on formal and informal notifications, then the most active seasons were winter 2020, spring 2018, summer 2020, and autumn 2019.

Based on the number of notifications issued from 2018-2021, the most formal flood notifications are issued in spring (66 per year on average), the most informal flood notifications in autumn (39 per year on average) and the most flash flood notifications in winter (473 per year on average). The figure for flash flood notifications is distorted due to the adjustment of the issuance criteria from February 2021. The season with the lowest amount of formal notifications is the summer (26 per year on average).

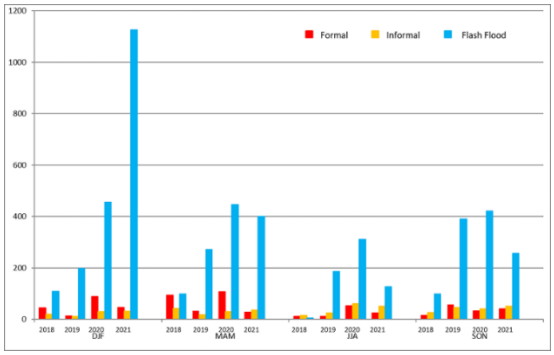

Figure 12: Number of EFAS formal (red), informal (yellow) and flash flood (blue) notifications issued per season over the past 4 years (2018-2021).

In 2021 in total 39 countries received 1856 notifications (147 formal, 169 informal, and 1540 flash flood notifications). Romania received the highest number of notifications (3 formal, 10 informal, and 135 flash flood notifications). The highest amount of formal notifications has been sent to the Russian Federation (23), followed by Greece (21). The highest amount of informal notifications was also sent to the Russian Federation (18), followed by France (16), and the highest amount of flash flood notifications to Romania and Bulgaria (135 and 134 respectively).

In 2020 EFAS DISS has started with the analysis of the results from the floodlist information system (https://floodlist.com/) on an operational basis, using the Global Reporting Tool (GRT). Reported flood situations for large river basin throughout the world are analyzed once a week. Verified information is released for publication on the Global Disaster Alerting Coordination System (GDACS; https://www.gdacs.org/) that is used by the UN and the EU to coordinate disaster relief actions. In total 914 flood reports have been verified and released for publication in GDACS by EFAS DISS in 2021. 152 events occurred in Africa, 299 in Asia, 162 in Europe, 130 in North America, 144 in South America, and 27 in Australia and Oceania.

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: Floods in Pamplona, Spain, 10 December 2021. Credit: Ayuntamiento de Pamplona

Appendix – figures

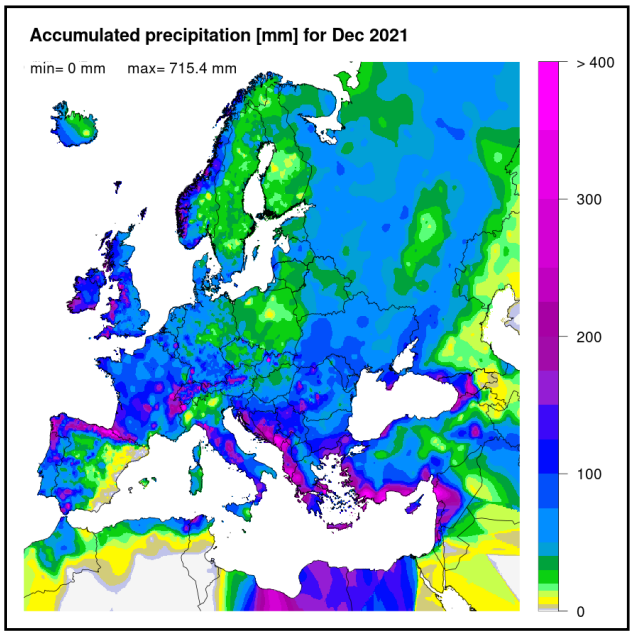

Figure 13: Accumulated precipitation [mm] for December 2021.

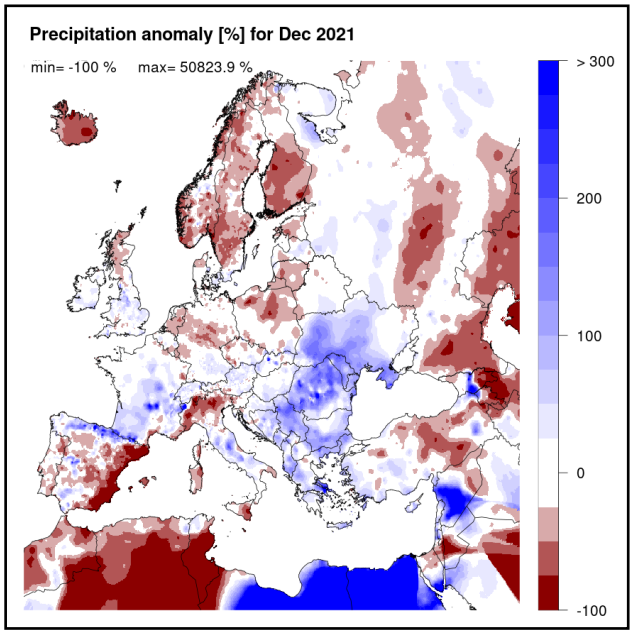

Figure 14: Precipitation anomaly [%] for December, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

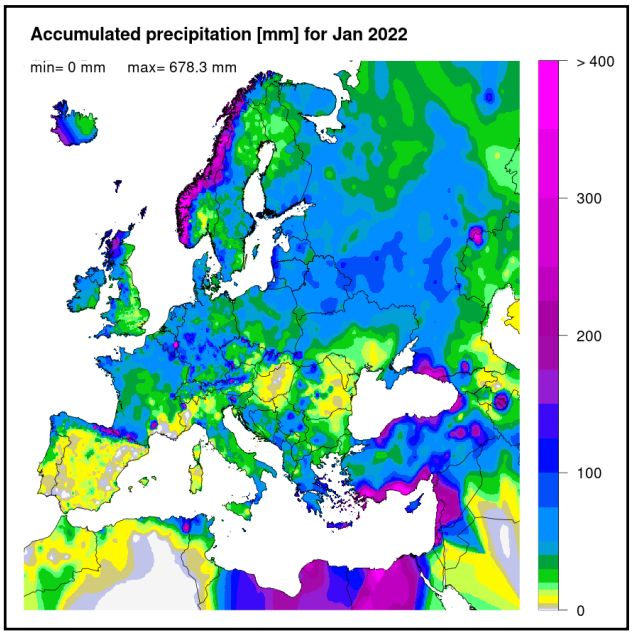

Figure 15: Accumulated precipitation [mm] for January 2022.

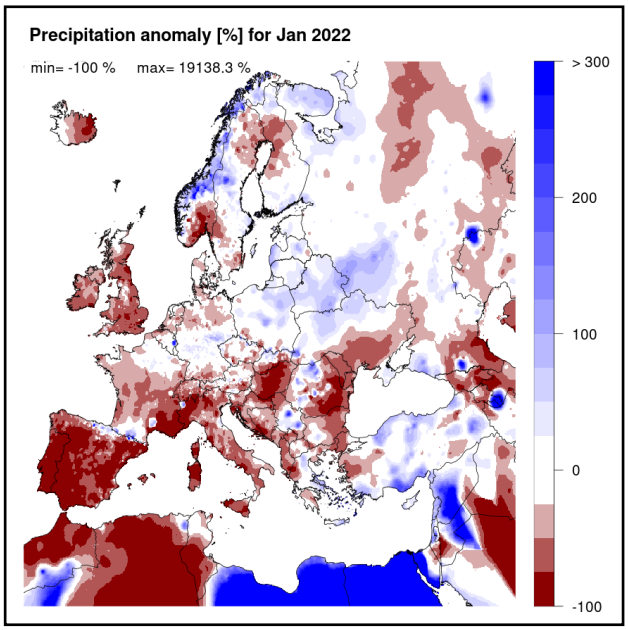

Figure 16: Precipitation anomaly [%] for January 2022 relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

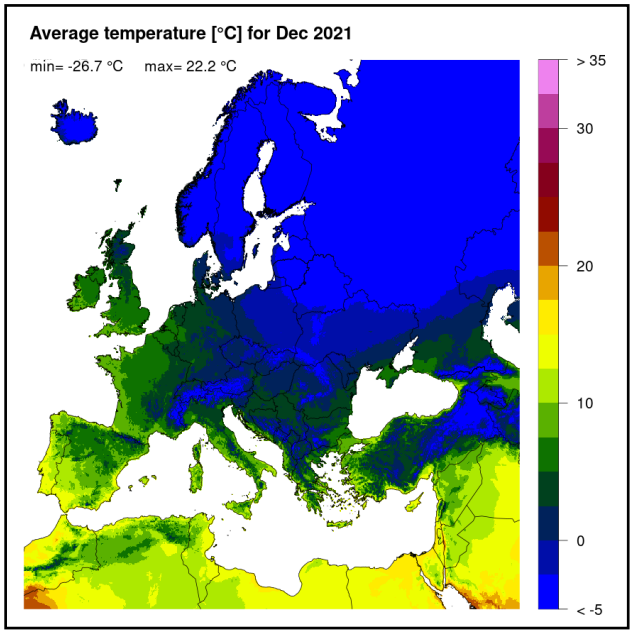

Figure 17: Mean temperature [°C] for December 2021.

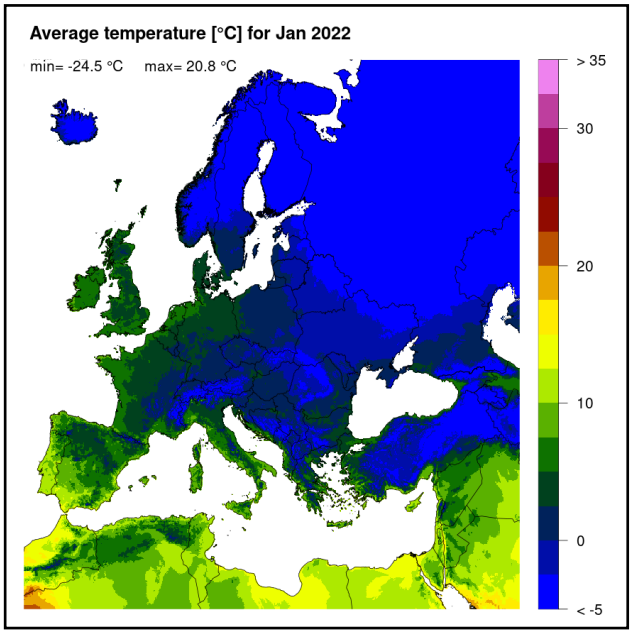

Figure 19: Mean temperature [°C] for January 2022.

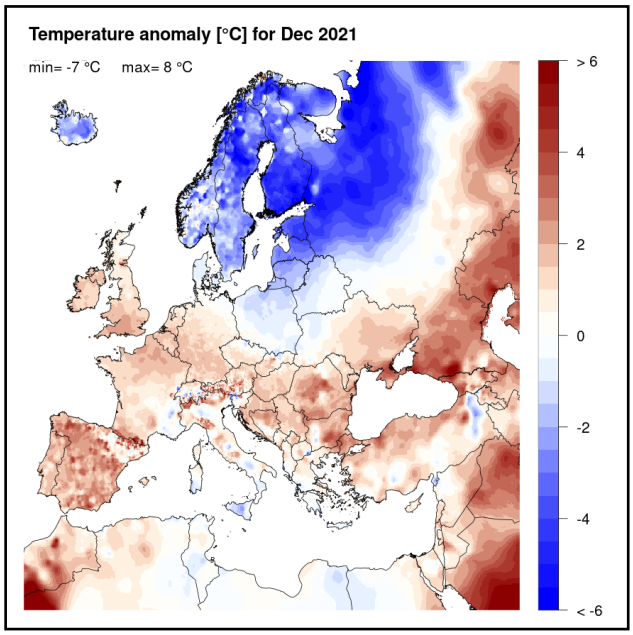

Figure 18: Temperature anomaly [°C] for December 2021, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal

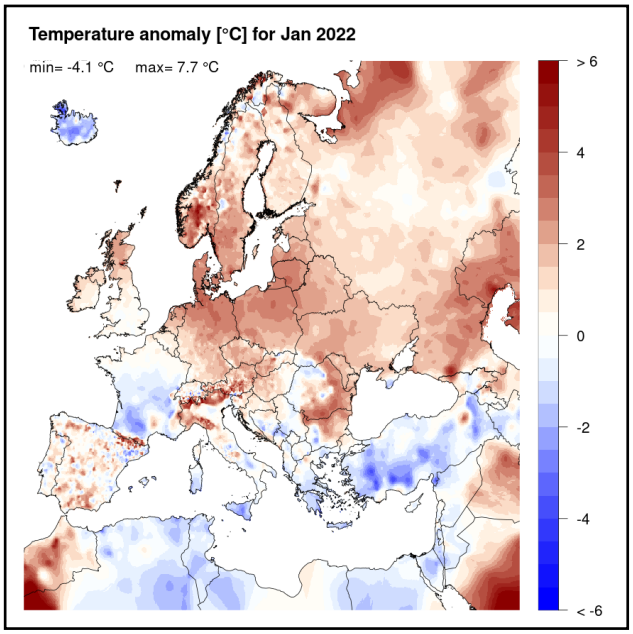

Figure 20: Temperature anomaly [°C] for January 2022, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

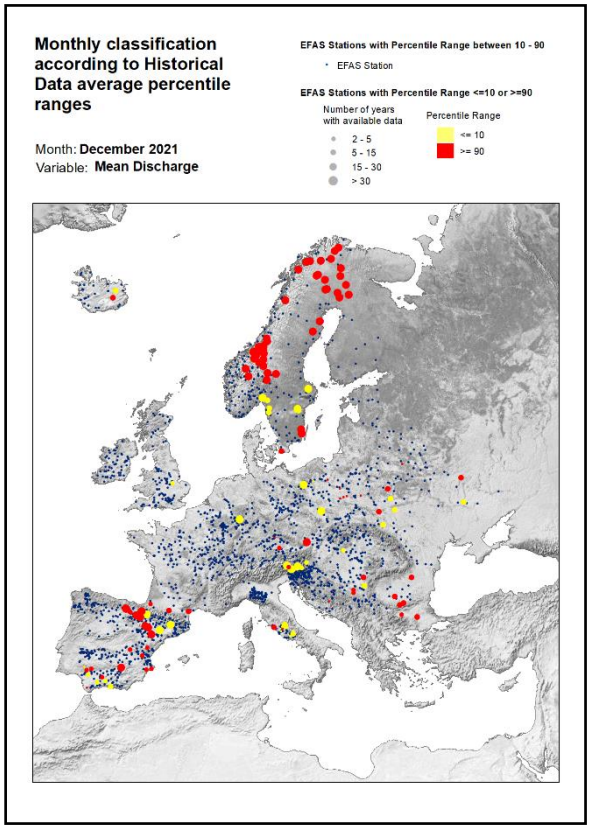

Figure 21: Monthly discharge anomalies December 2021.

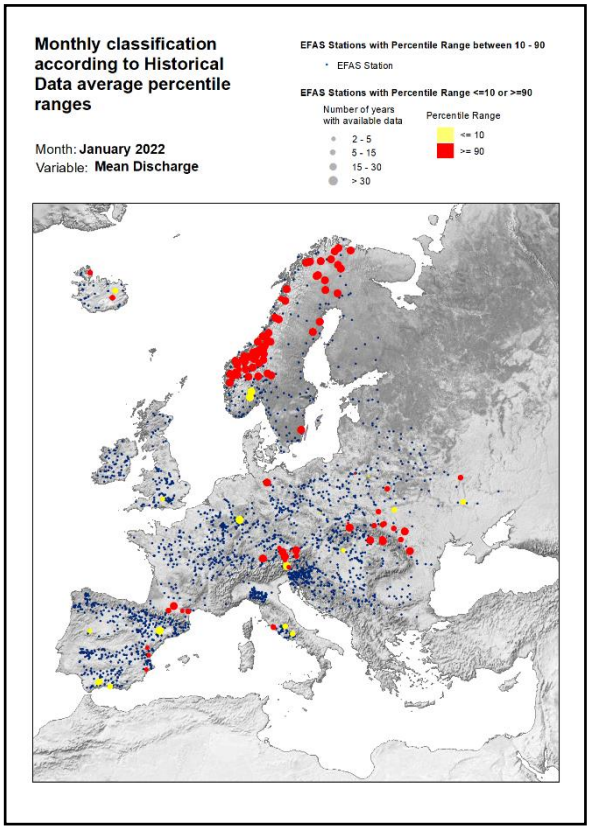

Figure 23: Monthly discharge anomalies January 2022.

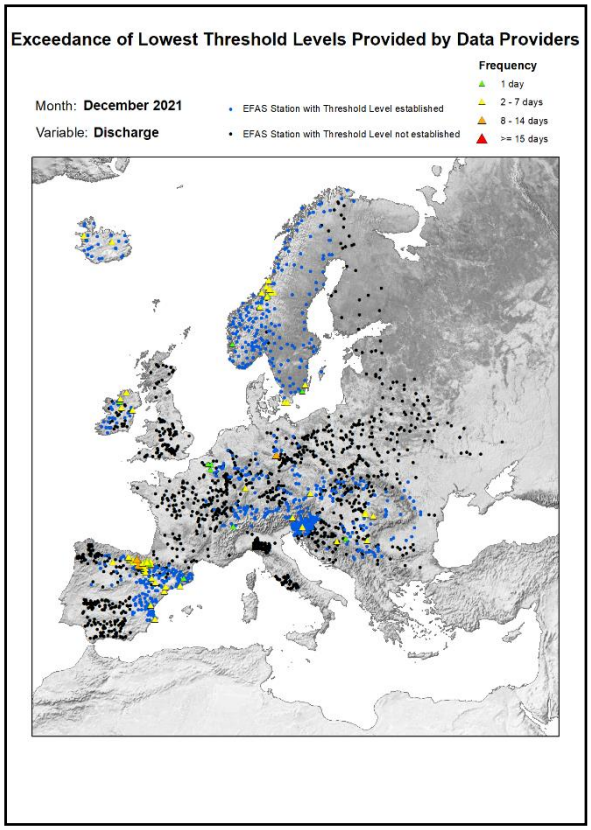

Figure 22: Lowest alert level exceedance for December 2021.

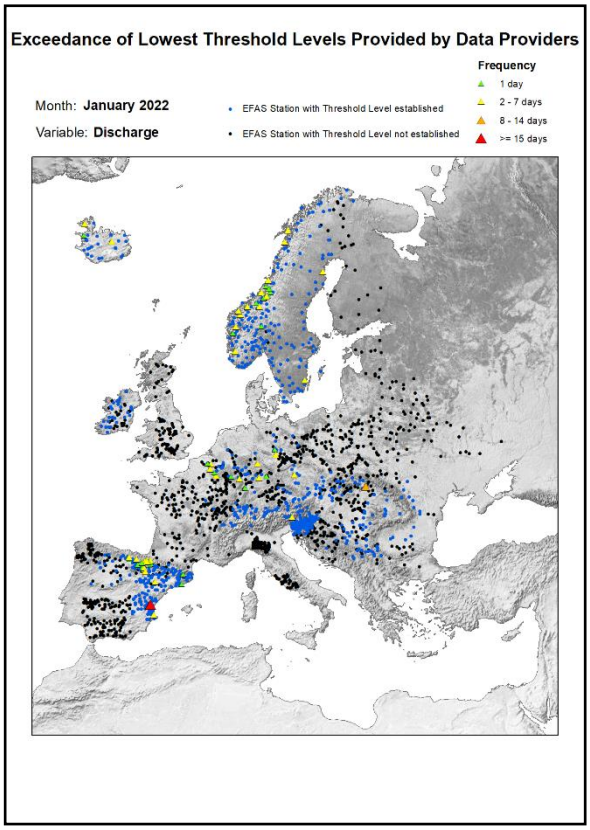

Figure 24: Lowest alert level exceedance for January 2022.

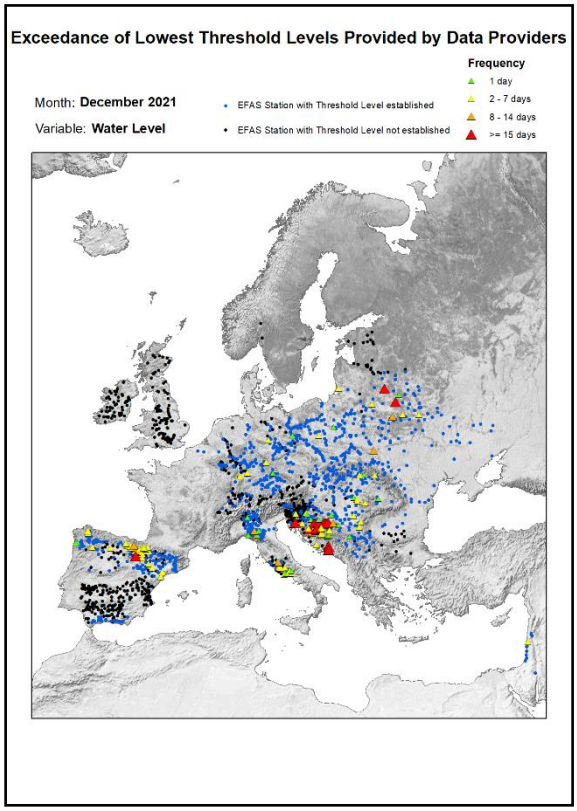

Figure 25: Lowest threshold exceedance for December 2021.

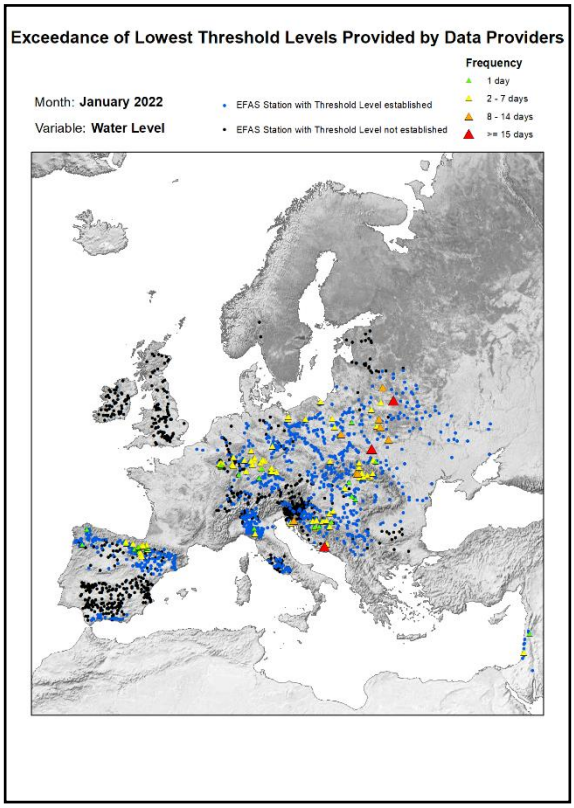

Figure 26: Lowest threshold exceedance for January 2022.

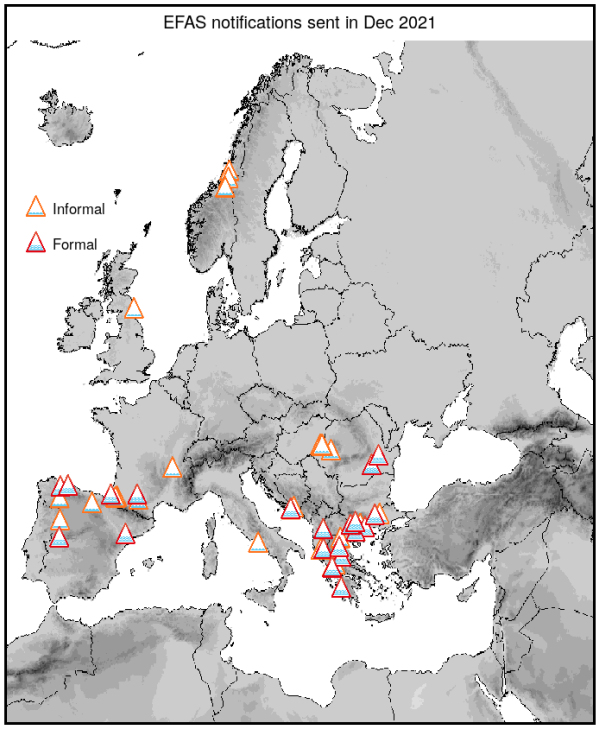

Figure 27: EFAS flood notifications sent for December 2021.

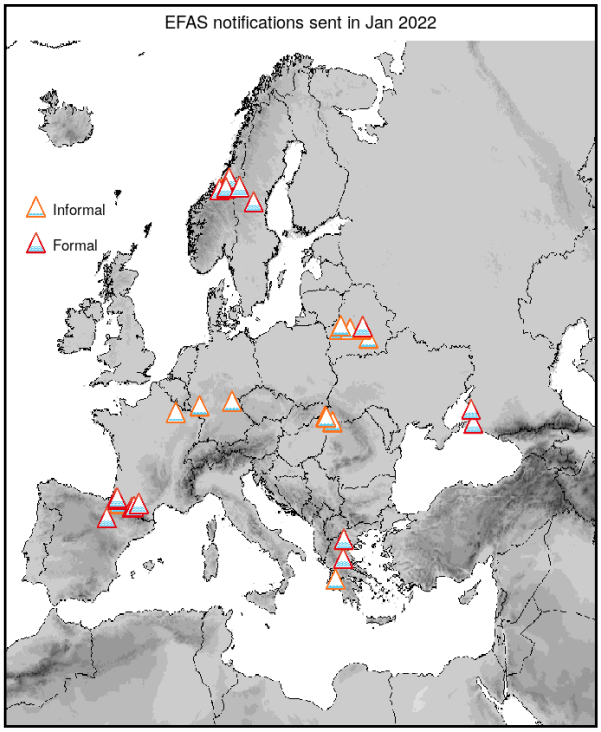

Figure 29: EFAS flood notifications sent for January 2022.

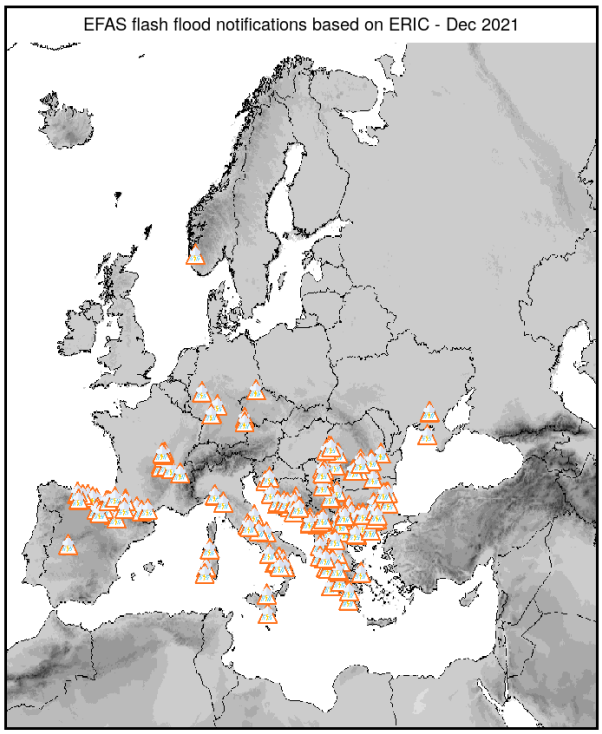

Figure 28: Flash flood notifications sent for December 2021.

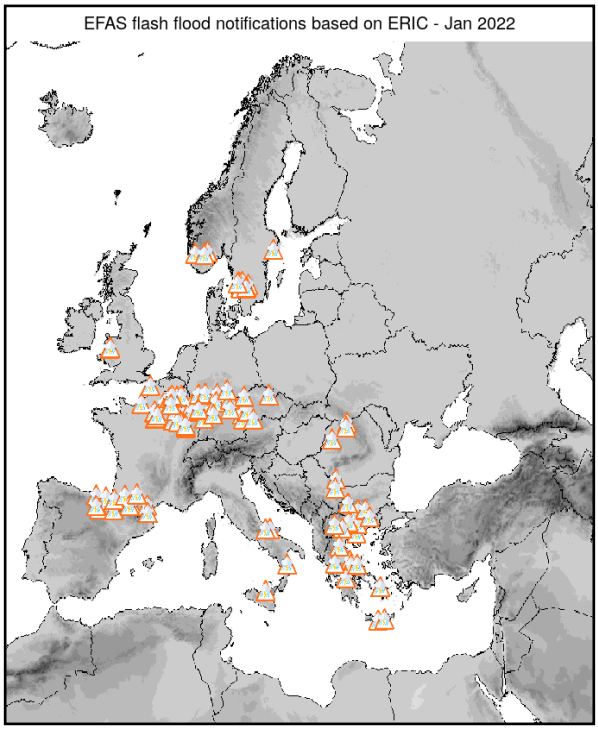

Figure 30: Flash flood notifications sent for January 2022.

Appendix - tables

Table 1: EFAS flood notifications sent in December – January 2022

Type	Forecast date	Issue date	Lead time	River	Country
Informal	30/11/2021 12UTC	44531	66	Drinos	Albania
Formal	30/11/2021 12UTC	44531	66	Vjosa	Albania
Informal	01/12/2021 00UTC	44531	54	Arachthos	Greece
Informal	03/12/2021 12UTC	44534	72	Nestos	Greece
Informal	04/12/2021 00UTC	44534	72	Strimonas	Greece
Informal	04/12/2021 12UTC	44535	12	COQUET	United Kingdom
Formal	05/12/2021 12UTC	44536	96	Navia	Spain
Formal	05/12/2021 12UTC	44536	90	Nalon	Spain
Formal	06/12/2021 00UTC	44536	150	Ebro	Spain
Formal	07/12/2021 00UTC	44537	18	Strimonas	Greece
Formal	07/12/2021 00UTC	44537	6	Nestos	Greece
Formal	07/12/2021 12UTC	44538	90	Aliakmonas	Greece
Formal	07/12/2021 12UTC	44538	84	Pineios	Greece
Formal	07/12/2021 12UTC	44538	66	STRUMA	Bulgaria
Formal	07/12/2021 12UTC	44538	6	MESTA (NESTOS)	Bulgaria
Formal	07/12/2021 12UTC	44538	60	Adour	France
Formal	07/12/2021 12UTC	44538	54	Neretva	Croatia
Informal	07/12/2021 12UTC	44538	6	Cua	Spain
Informal	07/12/2021 12UTC	44538	48	Neretva	Bosnia & Herzegovina
Formal	07/12/2021 12UTC	44538	84	Drini	North Macedonia
Informal	07/12/2021 12UTC	44538	54	Neretva	Croatia
Formal	08/12/2021 00UTC	44538	72	Alfeios	Greece
Formal	08/12/2021 00UTC	44538	60	Garonne	France
Informal	09/12/2021 00UTC	44539	12	Volturno	Italy
Informal	09/12/2021 12UTC	44540	6	Ebro	Spain
Formal	09/12/2021 12UTC	44540	60	Arda	Bulgaria
Informal	09/12/2021 12UTC	44540	24	Garonne	France
Formal	09/12/2021 12UTC	44540	12	Arachthos	Greece
Informal	09/12/2021 12UTC	44540	18	ACHELOOS POTAMOS	Greece
Informal	10/12/2021 00UTC	44540	0	Gave de Pau	France
Informal	10/12/2021 00UTC	44540	6	Gave	France
Formal	10/12/2021 00UTC	44540	60	Prahova	Romania
Formal	11/12/2021 00UTC	44541	66	Buzau	Romania
Informal	11/12/2021 12UTC	44542	24	Loudias	Greece
Informal	12/12/2021 12UTC	44543	30	Arda	Greece
Informal	16/12/2021 12UTC	44547	42	Namsen	Norway
Informal	16/12/2021 12UTC	44547	36	Byaelva	Norway
Informal	17/12/2021 00UTC	44547	30	Stjordalselva	Norway
Formal	19/12/2021 00UTC	44549	138	Tajo	Spain
Informal	19/12/2021 00UTC	44549	150	Duero	Spain
Informal	23/12/2021 00UTC	44553	60	Crisul Alb	Romania
Informal	24/12/2021 12UTC	44555	48	Crisul Alb	Hungary
Informal	24/12/2021 12UTC	44555	60	Koros	Hungary

Informal	27/12/2021 00UTC	44557	18	Crisul Negru	Hungary
Informal	27/12/2021 00UTC	44557	18	Crisul Negru	Romania
Informal	28/12/2021 00UTC	44558	36	Rhone	France
Informal	01/01/2022 00UTC	44562	54	NEMUNAS - NEMAN	Belarus
Informal	01/01/2022 00UTC	44562	60	Neman	Belarus
Informal	01/01/2022 00UTC	44562	54	Neman	Belarus
Informal	01/01/2022 00UTC	44562	60	Nyoman	Belarus
Informal	01/01/2022 12UTC	44563	48	Ptsich	Belarus
Formal	01/01/2022 12UTC	44563	84	Svisloch	Belarus
Informal	02/01/2022 12UTC	44564	48	Aisne	France
Informal	02/01/2022 12UTC	44564	42	Nahe	Germany
Informal	02/01/2022 12UTC	44564	48	Main	Germany
Informal	03/01/2022 00UTC	44564	60	Tisza	Ukraine
Informal	03/01/2022 00UTC	44564	54	Tisza	Hungary
Informal	03/01/2022 00UTC	44564	66	Latorica	Slovakia
Informal	03/01/2022 12UTC	44565	48	Latorica	Ukraine
Informal	04/01/2022 00UTC	44565	48	Pitch	Belarus
Informal	06/01/2022 00UTC	44567	90	Gave d'Oloron	France
Formal	07/01/2022 00UTC	44568	90	Pineios	Greece
Formal	07/01/2022 00UTC	44568	66	Garonne	France
Formal	07/01/2022 12UTC	44569	60	Gave	France
Formal	08/01/2022 00UTC	44569	60	Loudias	Greece
Formal	08/01/2022 00UTC	44569	54	Ebro	Spain
Formal	08/01/2022 00UTC	44569	42	Gave de Pau	France
Formal	08/01/2022 00UTC	44569	48	Salat	France
Formal	08/01/2022 00UTC	44569	48	Ariege	France
Informal	10/01/2022 12UTC	44572	6	Loudias	Greece
Formal	10/01/2022 12UTC	44572	72	Ljungan	Sweden
Formal	10/01/2022 12UTC	44572	60	Indalsälven	Sweden
Formal	10/01/2022 12UTC	44572	60	Orkla	Norway
Formal	10/01/2022 12UTC	44572	54	Byaelva	Norway
Formal	10/01/2022 12UTC	44572	66	Stjordalselva	Norway
Informal	11/01/2022 00UTC	44572	18	Acheloos	Greece
Informal	11/01/2022 12UTC	44573	42	Gaula	Norway
Formal	25/01/2022 00UTC	44586	138	Abin, Adagum	Russia
Formal	27/01/2022 00UTC	44588	168	Coastal Catchment Black Sea	Russia

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

Table 2: EFAS flash flood notifications sent in December – January 2022

Type	Forecast date	Issue date	Lead time	Region	Country
Flash Flood	30/11/2021 12UTC	44531	48	Campania	Italy
Flash Flood	30/11/2021 12UTC	44531	48	Sardegna	Italy
Flash Flood	30/11/2021 12UTC	44531	48	Asturias	Spain
Flash Flood	01/12/2021 00UTC	44531	48	Splitsko-dalmatinska zupanija	Croatia
Flash Flood	01/12/2021 00UTC	44531	48	Federacija Bosna i Hercegovina	Bosnia & Herzegovina

Flash Flood	01/12/2021 00UTC	44531	48	Sibensko-kninska zupanija	Croatia
Flash Flood	01/12/2021 12UTC	44532	48	Calabria	Italy
Flash Flood	01/12/2021 12UTC	44532	48	Ipeiros	Greece
Flash Flood	01/12/2021 12UTC	44532	48	Crna Gora	Montenegro
Flash Flood	01/12/2021 12UTC	44532	42	Dubrovacko-neretvanska zupanija	Croatia
Flash Flood	02/12/2021 00UTC	44532	18	Umbria	Italy
Flash Flood	02/12/2021 00UTC	44532	48	Blagoevgrad	Bulgaria
Flash Flood	02/12/2021 00UTC	44532	18	Lazio	Italy
Flash Flood	03/12/2021 00UTC	44533	30	Sicilia	Italy
Flash Flood	03/12/2021 00UTC	44533	18	Sterea Ellada	Greece
Flash Flood	03/12/2021 00UTC	44533	30	Sliven	Bulgaria
Flash Flood	03/12/2021 00UTC	44533	30	Yambol	Bulgaria
Flash Flood	03/12/2021 00UTC	44533	30	Shumen	Bulgaria
Flash Flood	03/12/2021 00UTC	44533	30	Varna	Bulgaria
Flash Flood	03/12/2021 00UTC	44533	48	Crimea	Ukraine
Flash Flood	03/12/2021 12UTC	44534	48	Cantabria	Spain
Flash Flood	03/12/2021 12UTC	44534	54	Gipuzkoa	Spain
Flash Flood	03/12/2021 12UTC	44534	54	Pyrenees-Atlantiques	France
Flash Flood	03/12/2021 12UTC	44534	48	Navarra	Spain
Flash Flood	04/12/2021 00UTC	44534	48	Shkoder	Albania
Flash Flood	04/12/2021 00UTC	44534	24	Kherson	Ukraine
Flash Flood	04/12/2021 12UTC	44535	48	Vlore	Albania
Flash Flood	04/12/2021 12UTC	44535	42	Basilicata	Italy
Flash Flood	04/12/2021 12UTC	44535	24	Federacija Bosna i Hercegovina	Bosnia & Herzegovina
Flash Flood	05/12/2021 00UTC	44535	12	Dubrovacko-neretvanska zupanija	Croatia
Flash Flood	05/12/2021 12UTC	44536	48	Blagoevgrad	Bulgaria
Flash Flood	05/12/2021 12UTC	44536	42	Pelagoniski	North Macedonia
Flash Flood	05/12/2021 12UTC	44536	30	Ipeiros	Greece
Flash Flood	05/12/2021 12UTC	44536	48	Kentriki Makedonia	Greece
Flash Flood	05/12/2021 12UTC	44536	36	Gjirokaster	Albania
Flash Flood	05/12/2021 12UTC	44536	36	Jugozapaden	North Macedonia
Flash Flood	06/12/2021 00UTC	44536	30	Severoistocen	North Macedonia
Flash Flood	06/12/2021 00UTC	44536	30	Kyustendil	Bulgaria
Flash Flood	06/12/2021 00UTC	44536	24	Dytiki Ellada	Greece
Flash Flood	06/12/2021 00UTC	44536	30	Pernik	Bulgaria
Flash Flood	06/12/2021 00UTC	44536	36	Anatoliki Makedonia, Thraki	Greece
Flash Flood	06/12/2021 00UTC	44536	30	Istocen	North Macedonia
Flash Flood	06/12/2021 00UTC	44536	18	Sterea Ellada	Greece
Flash Flood	06/12/2021 12UTC	44537	12	Sofia (stolitsa)	Bulgaria
Flash Flood	06/12/2021 12UTC	44537	36	Dambovita	Romania
Flash Flood	07/12/2021 12UTC	44538	42	Dubrovacko-neretvanska zupanija	Croatia
Flash Flood	07/12/2021 12UTC	44538	66	Gers	France

Flash Flood	07/12/2021 12UTC	44538	48	Navarra	Spain
Flash Flood	07/12/2021 12UTC	44538	66	Zaragoza	Spain
Flash Flood	07/12/2021 12UTC	44538	48	Gipuzkoa	Spain
Flash Flood	07/12/2021 12UTC	44538	66	Huesca	Spain
Flash Flood	07/12/2021 12UTC	44538	48	Cantabria	Spain
Flash Flood	07/12/2021 12UTC	44538	66	Araba/Alava	Spain
Flash Flood	07/12/2021 12UTC	44538	48	Burgos	Spain
Flash Flood	07/12/2021 12UTC	44538	72	Haute-Garonne	France
Flash Flood	07/12/2021 12UTC	44538	48	Calabria	Italy
Flash Flood	07/12/2021 12UTC	44538	48	Shkoder	Albania
Flash Flood	07/12/2021 12UTC	44538	36	Campania	Italy
Flash Flood	07/12/2021 12UTC	44538	48	Pyrenees-Atlantiques	France
Flash Flood	07/12/2021 12UTC	44538	48	Bizkaia	Spain
Flash Flood	07/12/2021 12UTC	44538	42	Federacija Bosna i Hercegovina	Bosnia & Herzegovina
Flash Flood	07/12/2021 12UTC	44538	66	Landes	France
Flash Flood	07/12/2021 12UTC	44538	48	Crna Gora	Montenegro
Flash Flood	08/12/2021 00UTC	44538	48	Blagoevgrad	Bulgaria
Flash Flood	08/12/2021 00UTC	44538	66	Puy-de-Dome	France
Flash Flood	08/12/2021 00UTC	44538	36	Splitsko-dalmatinska zupanija	Croatia
Flash Flood	08/12/2021 00UTC	44538	48	Cantabria	Spain
Flash Flood	08/12/2021 00UTC	44538	54	Asturias	Spain
Flash Flood	08/12/2021 00UTC	44538	54	Leon	Spain
Flash Flood	08/12/2021 12UTC	44539	18	Sibensko-kninska zupanija	Croatia
Flash Flood	08/12/2021 12UTC	44538	54	Aude	France
Flash Flood	08/12/2021 12UTC	44538	48	Hautes-Pyrenees	France
Flash Flood	08/12/2021 12UTC	44538	54	Ariege	France
Flash Flood	09/12/2021 00UTC	44539	48	Allier	France
Flash Flood	09/12/2021 00UTC	44539	42	Anatoliki Makedonia, Thraki	Greece
Flash Flood	09/12/2021 00UTC	44539	48	Sicilia	Italy
Flash Flood	09/12/2021 00UTC	44539	12	Basilicata	Italy
Flash Flood	09/12/2021 12UTC	44540	48	Kentriki Makedonia	Greece
Flash Flood	09/12/2021 12UTC	44540	24	Hautes-Pyrenees	France
Flash Flood	09/12/2021 12UTC	44540	24	Vlore	Albania
Flash Flood	09/12/2021 12UTC	44540	6	Shkoder	Albania
Flash Flood	09/12/2021 12UTC	44540	48	Gjirokaster	Albania
Flash Flood	09/12/2021 12UTC	44540	42	Sardegna	Italy
Flash Flood	09/12/2021 12UTC	44540	48	Peloponnisos	Greece
Flash Flood	09/12/2021 12UTC	44540	48	Dytiki Makedonia	Greece
Flash Flood	09/12/2021 12UTC	44540	42	Ipeiros	Greece
Flash Flood	09/12/2021 12UTC	44540	48	Ionia Nisia	Greece
Flash Flood	09/12/2021 12UTC	44540	48	Sterea Ellada	Greece
Flash Flood	09/12/2021 12UTC	44540	48	Plovdiv	Bulgaria
Flash Flood	09/12/2021 12UTC	44540	48	Dytiki Ellada	Greece
Flash Flood	09/12/2021 12UTC	44540	48	Thessalia	Greece
Flash Flood	10/12/2021 00UTC	44540	24	Campania	Italy
Flash Flood	10/12/2021 00UTC	44540	48	Prahova	Romania
Flash Flood	10/12/2021 00UTC	44540	42	Molise	Italy
Flash Flood	10/12/2021 00UTC	44540	48	Arges	Romania

Flash Flood	10/12/2021 00UTC	44540	48	Sliven	Bulgaria
Flash Flood	10/12/2021 00UTC	44540	6	Blagoevgrad	Bulgaria
Flash Flood	10/12/2021 00UTC	44540	48	Ilfov	Romania
Flash Flood	10/12/2021 00UTC	44540	48	Severoistocen	North Macedonia
Flash Flood	10/12/2021 00UTC	44540	42	Anatoliki Makedonia, Thraki	Greece
Flash Flood	10/12/2021 00UTC	44540	48	Giurgiu	Romania
Flash Flood	10/12/2021 00UTC	44540	48	Stara Zagora	Bulgaria
Flash Flood	10/12/2021 00UTC	44540	24	Basilicata	Italy
Flash Flood	10/12/2021 00UTC	44540	48	Pernik	Bulgaria
Flash Flood	10/12/2021 00UTC	44540	48	Buzau	Romania
Flash Flood	10/12/2021 00UTC	44540	12	Nievre	France
Flash Flood	10/12/2021 00UTC	44540	48	Jugoistocen	North Macedonia
Flash Flood	10/12/2021 00UTC	44540	48	Abruzzo	Italy
Flash Flood	10/12/2021 00UTC	44540	24	Calabria	Italy
Flash Flood	10/12/2021 00UTC	44540	48	Kyustendil	Bulgaria
Flash Flood	10/12/2021 00UTC	44540	48	Valcea	Romania
Flash Flood	10/12/2021 00UTC	44540	42	Kardzhali	Bulgaria
Flash Flood	10/12/2021 00UTC	44540	42	Vlore	Albania
Flash Flood	10/12/2021 12UTC	44541	36	Pelagoniski	North Macedonia
Flash Flood	10/12/2021 12UTC	44541	30	Istocen	North Macedonia
Flash Flood	10/12/2021 12UTC	44541	42	Brasov	Romania
Flash Flood	10/12/2021 12UTC	44541	24	Berat	Albania
Flash Flood	10/12/2021 12UTC	44541	36	Podunavska oblast	Serbia
Flash Flood	10/12/2021 12UTC	44541	36	Zajecarska oblast	Serbia
Flash Flood	10/12/2021 12UTC	44541	42	Branicevska oblast	Serbia
Flash Flood	10/12/2021 12UTC	44541	36	Elbasan	Albania
Flash Flood	10/12/2021 12UTC	44541	36	Burgas	Bulgaria
Flash Flood	11/12/2021 00UTC	44541	24	Pazardzhik	Bulgaria
Flash Flood	11/12/2021 00UTC	44541	24	Sicilia	Italy
Flash Flood	11/12/2021 00UTC	44541	12	Marche	Italy
Flash Flood	11/12/2021 00UTC	44541	24	Nisavska oblast	Serbia
Flash Flood	11/12/2021 00UTC	44541	30	Vrancea	Romania
Flash Flood	11/12/2021 12UTC	44542	12	Kardzhali	Bulgaria
Flash Flood	11/12/2021 12UTC	44542	24	Abruzzo	Italy
Flash Flood	11/12/2021 12UTC	44542	30	Sliven	Bulgaria
Flash Flood	11/12/2021 12UTC	44542	24	Branicevska oblast	Serbia
Flash Flood	11/12/2021 12UTC	44542	6	Plovdiv	Bulgaria
Flash Flood	11/12/2021 12UTC	44542	12	Kyustendil	Bulgaria
Flash Flood	11/12/2021 12UTC	44542	12	Sofia	Bulgaria
Flash Flood	11/12/2021 12UTC	44542	12	Pernik	Bulgaria
Flash Flood	11/12/2021 12UTC	44542	6	Ipeiros	Greece
Flash Flood	11/12/2021 12UTC	44542	18	Burgas	Bulgaria
Flash Flood	11/12/2021 12UTC	44542	12	Rasinska oblast	Serbia
Flash Flood	11/12/2021 12UTC	44542	12	Pazardzhik	Bulgaria
Flash Flood	11/12/2021 12UTC	44542	6	Blagoevgrad	Bulgaria
Flash Flood	11/12/2021 12UTC	44542	6	Sterea Ellada	Greece

Flash Flood	11/12/2021 12UTC	44542	6	Anatoliki Makedonia, Thraki	Greece
Flash Flood	11/12/2021 12UTC	44542	12	Kentriki Makedonia	Greece
Flash Flood	11/12/2021 12UTC	44542	6	Dytiki Ellada	Greece
Flash Flood	11/12/2021 12UTC	44542	6	Peloponnisos	Greece
Flash Flood	12/12/2021 00UTC	44542	6	Arges	Romania
Flash Flood	12/12/2021 00UTC	44542	6	Valcea	Romania
Flash Flood	12/12/2021 00UTC	44542	6	Buzau	Romania
Flash Flood	13/12/2021 00UTC	44543	36	Plovdiv	Bulgaria
Flash Flood	13/12/2021 12UTC	44544	36	Sterea Ellada	Greece
Flash Flood	13/12/2021 12UTC	44544	48	Rogaland	Norway
Flash Flood	16/12/2021 12UTC	44547	36	Kherson	Ukraine
Flash Flood	22/12/2021 12UTC	44553	48	Ustecky kraj	Czech Republic
Flash Flood	23/12/2021 12UTC	44554	48	Liguria	Italy
Flash Flood	23/12/2021 12UTC	44554	48	Toscana	Italy
Flash Flood	23/12/2021 12UTC	44554	48	Primorsko-goranska zupanija	Croatia
Flash Flood	23/12/2021 12UTC	44554	48	Licko-senjska zupanija	Croatia
Flash Flood	23/12/2021 12UTC	44554	48	Bihor	Romania
Flash Flood	24/12/2021 00UTC	44554	42	Zadarska zupanija	Croatia
Flash Flood	24/12/2021 00UTC	44554	42	Karlovacka zupanija	Croatia
Flash Flood	24/12/2021 12UTC	44555	36	Region Vojvodine	Serbia
Flash Flood	24/12/2021 12UTC	44555	48	Hunedoara	Romania
Flash Flood	24/12/2021 12UTC	44555	24	Avila	Spain
Flash Flood	24/12/2021 12UTC	44555	42	Sibensko-kninska zupanija	Croatia
Flash Flood	24/12/2021 12UTC	44555	42	Splitsko-dalmatinska zupanija	Croatia
Flash Flood	24/12/2021 12UTC	44555	42	Timis	Romania
Flash Flood	24/12/2021 12UTC	44555	48	Shkoder	Albania
Flash Flood	24/12/2021 12UTC	44555	42	Caras-Severin	Romania
Flash Flood	25/12/2021 00UTC	44555	42	Lazio	Italy
Flash Flood	25/12/2021 00UTC	44555	24	Federacija Bosna i Hercegovina	Bosnia & Herzegovina
Flash Flood	25/12/2021 00UTC	44555	48	Campania	Italy
Flash Flood	25/12/2021 12UTC	44556	42	Crna Gora	Montenegro
Flash Flood	25/12/2021 12UTC	44556	48	Vlore	Albania
Flash Flood	25/12/2021 12UTC	44556	42	Federacija Bosna i Hercegovina	Bosnia & Herzegovina
Flash Flood	25/12/2021 12UTC	44556	30	Sardegna	Italy
Flash Flood	25/12/2021 12UTC	44556	48	Dakovica	Kosovo
Flash Flood	25/12/2021 12UTC	44556	42	Kukes	Albania
Flash Flood	26/12/2021 00UTC	44556	30	Calabria	Italy
Flash Flood	26/12/2021 00UTC	44556	30	Republika Srpska	Bosnia & Herzegovina
Flash Flood	26/12/2021 00UTC	44556	30	Dubrovacko-neretvanska zupanija	Croatia
Flash Flood	26/12/2021 12UTC	44557	36	Arad	Romania
Flash Flood	26/12/2021 12UTC	44557	30	Timis	Romania
Flash Flood	26/12/2021 12UTC	44557	24	Gjirokaster	Albania
Flash Flood	26/12/2021 12UTC	44557	24	Podunavska oblast	Serbia
Flash Flood	26/12/2021 12UTC	44557	24	Region Vojvodine	Serbia

Flash Flood	26/12/2021 12UTC	44557	30	Sterea Ellada	Greece
Flash Flood	26/12/2021 12UTC	44557	30	Ipeiros	Greece
Flash Flood	27/12/2021 00UTC	44557	48	Puy-de-Dome	France
Flash Flood	27/12/2021 00UTC	44557	18	Bihor	Romania
Flash Flood	27/12/2021 00UTC	44557	48	Allier	France
Flash Flood	27/12/2021 12UTC	44558	48	Loire	France
Flash Flood	27/12/2021 12UTC	44558	36	Karlsruhe	Germany
Flash Flood	27/12/2021 12UTC	44558	48	Kardzhali	Bulgaria
Flash Flood	27/12/2021 12UTC	44558	48	Anatoliki Makedonia, Thraki	Greece
Flash Flood	27/12/2021 12UTC	44558	48	Rhone	France
Flash Flood	27/12/2021 12UTC	44558	42	Unterfranken	Germany
Flash Flood	28/12/2021 00UTC	44558	48	Yambol	Bulgaria
Flash Flood	28/12/2021 00UTC	44558	42	Haskovo	Bulgaria
Flash Flood	28/12/2021 00UTC	44558	36	Oberpfalz	Germany
Flash Flood	28/12/2021 00UTC	44558	24	Koblenz	Germany
Flash Flood	28/12/2021 00UTC	44558	24	Darmstadt	Germany
Flash Flood	28/12/2021 00UTC	44558	36	Saone-et-Loire	France
Flash Flood	28/12/2021 00UTC	44558	36	Nievre	France
Flash Flood	28/12/2021 00UTC	44558	42	Ain	France
Flash Flood	28/12/2021 00UTC	44558	48	Burgas	Bulgaria
Flash Flood	28/12/2021 00UTC	44558	48	Varna	Bulgaria
Flash Flood	28/12/2021 00UTC	44558	48	Shumen	Bulgaria
Flash Flood	28/12/2021 00UTC	44558	48	Sliven	Bulgaria
Flash Flood	28/12/2021 12UTC	44559	24	Niederbayern	Germany
Flash Flood	28/12/2021 12UTC	44559	30	Stara Zagora	Bulgaria
Flash Flood	29/12/2021 12UTC	44560	24	Haskovo	Bulgaria
Flash Flood	29/12/2021 12UTC	44560	24	Kardzhali	Bulgaria
Flash Flood	01/01/2022 00UTC	44562	24	Vastra Gotalands lan	Sweden
Flash Flood	01/01/2022 12UTC	44563	12	Jonkopings lan	Sweden
Flash Flood	02/01/2022 00UTC	44563	42	Bihor	Romania
Flash Flood	02/01/2022 12UTC	44564	48	Saarland	Germany
Flash Flood	02/01/2022 12UTC	44564	48	Prov. Namur	Belgium
Flash Flood	02/01/2022 12UTC	44564	42	Ardennes	France
Flash Flood	02/01/2022 12UTC	44564	48	Seine-et-Marne	France
Flash Flood	02/01/2022 12UTC	44564	54	Seine-Maritime	France
Flash Flood	02/01/2022 12UTC	44564	48	Essonne	France
Flash Flood	02/01/2022 12UTC	44564	48	Aisne	France
Flash Flood	02/01/2022 12UTC	44564	48	Moselle	France
Flash Flood	02/01/2022 12UTC	44564	30	Maramures	Romania
Flash Flood	02/01/2022 12UTC	44564	48	Unterfranken	Germany
Flash Flood	02/01/2022 12UTC	44564	48	Giessen	Germany
Flash Flood	02/01/2022 12UTC	44564	48	Kassel	Germany
Flash Flood	02/01/2022 12UTC	44564	48	Trier	Germany
Flash Flood	02/01/2022 12UTC	44564	36	Jonkopings lan	Sweden
Flash Flood	02/01/2022 12UTC	44564	48	Prov. Luxembourg (BE)	Belgium
Flash Flood	02/01/2022 12UTC	44564	48	Val-d'Oise	France
Flash Flood	02/01/2022 12UTC	44564	48	Oise	France
Flash Flood	02/01/2022 12UTC	44564	48	Oberpfalz	Germany
Flash Flood	02/01/2022 12UTC	44564	48	Niederbayern	Germany
Flash Flood	02/01/2022 12UTC	44564	48	Koblenz	Germany

Flash Flood	02/01/2022 12UTC	44564	48	Plzensky kraj	Czech Republic
Flash Flood	02/01/2022 12UTC	44564	48	Jihocesky kraj	Czech Republic
Flash Flood	02/01/2022 12UTC	44564	48	Karlsruhe	Germany
Flash Flood	02/01/2022 12UTC	44564	48	Darmstadt	Germany
Flash Flood	02/01/2022 12UTC	44564	48	Kralovehradecky kraj	Czech Republic
Flash Flood	02/01/2022 12UTC	44564	48	Val-de-Marne	France
Flash Flood	02/01/2022 12UTC	44564	48	Oberfranken	Germany
Flash Flood	02/01/2022 12UTC	44564	48	Marne	France
Flash Flood	03/01/2022 00UTC	44564	48	Stuttgart	Germany
Flash Flood	03/01/2022 00UTC	44564	36	Aisne	France
Flash Flood	03/01/2022 00UTC	44564	42	Vosges	France
Flash Flood	03/01/2022 00UTC	44564	42	Karlovarsky kraj	Czech Republic
Flash Flood	03/01/2022 00UTC	44564	42	Navarra	Spain
Flash Flood	03/01/2022 00UTC	44564	36	Prov. Hainaut	Belgium
Flash Flood	03/01/2022 00UTC	44564	36	Meuse	France
Flash Flood	03/01/2022 00UTC	44564	36	Nord	France
Flash Flood	03/01/2022 00UTC	44564	42	Bas-Rhin	France
Flash Flood	03/01/2022 00UTC	44564	42	Rheinhessen-Pfalz	Germany
Flash Flood	03/01/2022 00UTC	44564	42	Meurthe-et-Moselle	France
Flash Flood	03/01/2022 12UTC	44565	30	Mittelfranken	Germany
Flash Flood	03/01/2022 12UTC	44565	30	Thuringen	Germany
Flash Flood	03/01/2022 12UTC	44565	48	Bistrita-Nasaud	Romania
Flash Flood	06/01/2022 12UTC	44568	48	West Wales and The Valleys	United Kingdom
Flash Flood	07/01/2022 00UTC	44568	36	Sicilia	Italy
Flash Flood	07/01/2022 12UTC	44569	48	Navarra	Spain
Flash Flood	07/01/2022 12UTC	44569	30	Pas-de-Calais	France
Flash Flood	07/01/2022 12UTC	44569	48	Bizkaia	Spain
Flash Flood	07/01/2022 12UTC	44569	72	Gipuzkoa	Spain
Flash Flood	08/01/2022 00UTC	44569	12	West Wales and The Valleys	United Kingdom
Flash Flood	08/01/2022 00UTC	44569	24	Ardennes	France
Flash Flood	08/01/2022 00UTC	44569	48	Haute-Garonne	France
Flash Flood	08/01/2022 00UTC	44569	48	Zaragoza	Spain
Flash Flood	08/01/2022 00UTC	44569	48	Burgos	Spain
Flash Flood	08/01/2022 00UTC	44569	48	Araba/Alava	Spain
Flash Flood	08/01/2022 12UTC	44570	42	Pyrenees-Atlantiques	France
Flash Flood	08/01/2022 12UTC	44570	48	Tarn-et-Garonne	France
Flash Flood	08/01/2022 12UTC	44570	48	Kentriki Makedonia	Greece
Flash Flood	08/01/2022 12UTC	44570	48	Sicilia	Italy
Flash Flood	08/01/2022 12UTC	44570	54	Gers	France
Flash Flood	08/01/2022 12UTC	44570	48	Hautes-Pyrenees	France
Flash Flood	08/01/2022 12UTC	44570	48	Anatoliki Makedonia, Thraki	Greece
Flash Flood	08/01/2022 12UTC	44570	48	Pazardzhik	Bulgaria
Flash Flood	08/01/2022 12UTC	44570	48	Aude	France
Flash Flood	09/01/2022 00UTC	44570	36	Pyrenees-Orientales	France
Flash Flood	09/01/2022 00UTC	44570	48	Kardzhali	Bulgaria
Flash Flood	09/01/2022 00UTC	44570	48	Sofia (stolitsa)	Bulgaria
Flash Flood	09/01/2022 00UTC	44570	36	Puglia	Italy
Flash Flood	09/01/2022 00UTC	44570	48	Borska oblast	Serbia

Flash Flood	09/01/2022 00UTC	44570	48	Plovdiv	Bulgaria
Flash Flood	09/01/2022 00UTC	44570	36	Molise	Italy
Flash Flood	09/01/2022 00UTC	44570	48	Zajecarska oblast	Serbia
Flash Flood	09/01/2022 12UTC	44571	48	Kriti	Greece
Flash Flood	09/01/2022 12UTC	44571	30	Blagoevgrad	Bulgaria
Flash Flood	09/01/2022 12UTC	44571	48	Calabria	Italy
Flash Flood	09/01/2022 12UTC	44571	48	Sterea Ellada	Greece
Flash Flood	09/01/2022 12UTC	44571	48	Thessalia	Greece
Flash Flood	09/01/2022 12UTC	44571	36	Vardarski	North Macedonia
Flash Flood	09/01/2022 12UTC	44571	36	Jugoistocen	North Macedonia
Flash Flood	09/01/2022 12UTC	44571	48	Dytiki Makedonia	Greece
Flash Flood	10/01/2022 00UTC	44571	42	Dytiki Ellada	Greece
Flash Flood	10/01/2022 12UTC	44572	24	Ipeiros	Greece
Flash Flood	18/01/2022 00UTC	44579	42	Vastra Gotalands lan	Sweden
Flash Flood	18/01/2022 00UTC	44579	42	Jonkopings lan	Sweden
Flash Flood	18/01/2022 00UTC	44579	42	Hallands lan	Sweden
Flash Flood	25/01/2022 12UTC	44587	42	Vastra Gotalands lan	Sweden
Flash Flood	27/01/2022 12UTC	44589	42	Rogaland	Norway
Flash Flood	27/01/2022 12UTC	44589	48	Telemark	Norway
Flash Flood	27/01/2022 12UTC	44589	48	Aust-Agder	Norway
Flash Flood	28/01/2022 00UTC	44589	42	Vastra Gotalands lan	Sweden
Flash Flood	28/01/2022 00UTC	44589	42	Jonkopings lan	Sweden
Flash Flood	28/01/2022 00UTC	44589	42	Hallands lan	Sweden
Flash Flood	28/01/2022 12UTC	44590	30	Sterea Ellada	Greece
Flash Flood	29/01/2022 00UTC	44590	24	Kriti	Greece
Flash Flood	29/01/2022 00UTC	44590	36	Notio Aigaio	Greece
Flash Flood	29/01/2022 00UTC	44590	30	Stockholms lan	Sweden

* Lead time [hours] to the forecasted peak of the event

The European Flood Awareness System (EFAS) produces European overviews of ongoing and forecasted floods up to 10 days in advance and contributes to better protection of the European citizens, the environment, properties and cultural heritage. It has been developed at the European Commission's in-house science service, the Joint Research Centre (JRC), in close collaboration with national hydrological and meteorological services and policy DG's of the European Commission.

EFAS has been transferred to operations under the European Commission's COPERNICUS Emergency Management Service led by DG GROW in direct support to the EU's Emergency Response Coordination Centre (ERCC) of DG ECHO and the hydrological services in the Member States.

ECMWF has been awarded the contract for the EFAS Computational centre. It is responsible for providing daily operational EFAS forecasts and 24/7 support to the technical system.
A consortium of Swedish Meteorological and Hydrological Institute (SMHI), Rijkswaterstaat (RWS) and Slovak Hydro-Meteorological Institute (SHMU) has been awarded the contract for the EFAS Dissemination centre. They are responsible for analysing EFAS output and disseminating information to the partners and the ERCC.
A Spanish consortium (REDIAM and SOOLOGIC) has been awarded the contract for the EFAS Hydrological data collection centre. They are responsible for collecting discharge and water level data across Europe.
A German consortium (KISTERS and DWD) has been awarded the contract for the EFAS Meteorological data collection centre. They are responsible for collecting the meteorological data needed to run EFAS over Europe.
Finally, the JRC is responsible for the overall project management related to EFAS and further development of the system.

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