European Flood Awareness System

# EFAS *Bulletin*

## August – September 2016

Issue 2016(5)

The European Flood Awareness System (EFAS) produces European overviews of ongoing and forecasted floods up to 15 days in advance and contributes to better protection of the European citizens, the environment, properties and cultural heritage. It has been developed at the European Commission's in house science service, the Joint Research Centre (JRC), in close collaboration with national hydrological and meteorological services and policy DG's of the European Commission.

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

ECMWF has been awarded the contract for the EFAS Computational centre. It is responsible for providing daily operational EFAS forecasts and 24/7 support to the technical system.

A consortium of Swedish Meteorological and Hydrological Institute (SMHI), Rijkswaterstaat (RWS) and Slovak Hydro-Meteorological Institute (SHMU) has been awarded the contract for the EFAS Dissemination centre. They are responsible for analysing EFAS output and disseminating information to the partners and the ERCC.

A Spanish consortium (REDIAM and ELIMCO) has been awarded the contract for the EFAS Hydrological data collection centre. They are responsible for collecting discharge and water level data across Europe.

A German consortium (KISTERS and DWD) has been awarded the contract for the EFAS Meteorological data collection centre. They are responsible for collecting the meteorological data needed to run EFAS over Europe.

Finally, the JRC is responsible for the overall project management related to EFAS and further development of the system.

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Cover image: Floods in Skopje, August 2016. Photo courtesy of Macedonia Ministry of Interior.

# NEWS

## *Meetings*

**Early Warning System Expert Group meeting**
DG ECHO's ERCC organised an Early Warning System Expert Group meeting on 22 September 2016 in Brussels with the objective to discuss and update the situation of Early Warning Systems for Natural Disasters. Peter Salamon presented some of the latest developments of the European Flood Awareness System. This included the increased availability of training videos and webinars as well as a seasonal outlook of floods. Furthermore, he presented the development of a rapid risk assessment tool, which will enable EFAS users to identify regions where the forecasted floods will have a major impact. This tool will also be used in the future to pre-task the acquisition of satellite images for the Copernicus rapid mapping to increase the timeliness of the rapid mapping products for the emergency responders.

## *Training*

**EFAS Training in Ukraine**
Martina Holubecka from the EFAS Dissemination Centre held an EFAS training within the 21st Slovakia-Ukraine Working Group of Hydrometeorology in Stryi, Ukraine on 28th September 2016. This training meeting was requested by a Ukrainian EFAS partner; State Emergency Service of Ukraine - Ukrainian Hydrometeorological Center (UHC). The Center has been an EFAS partner for a year and had not yet been trained.

Martina provided information about the present state of the EFAS System and EFAS network. She mentioned the possibilities and advantages of using the meteorological and hydrological EFAS products and the probabilistic forecasts. Also, the specification of threshold levels and importance of national data provided to EFAS was explained, and the structure of the EFAS-IS and detailed description of all layers were presented. Training was held in English and Slovak languages and some parts were translated to Russian.

The high interest in the EFAS products stimulated Ukrainian colleagues to increase the number of contacts during events. This training allowed the Ukrainian operational hydrologists to better understand EFAS and its results and utilise it in their daily work.

There is the possibility to hold training meetings in partners' premises for every EFAS partner. If you are interested, please contact the EFAS Dissemination Centre (info@efas.eu). This could be a valuable opportunity, particularly for new partners.

Participants of the EFAS training in Stryi, Ukraine

# RESULTS

## *Summary of EFAS Flood and Flash Flood Notifications for August - September 2016*

The 3 EFAS formal and informal flood notifications sent in August - September 2016 are summarised in Table 2; their locations are shown in Figure 15 and Figure 17.

15 Flash Flood watches, summarised in Table 3, were sent to the corresponding EFAS partners. The locations are shown in Figure 16 and Figure 18.

## *Verification*

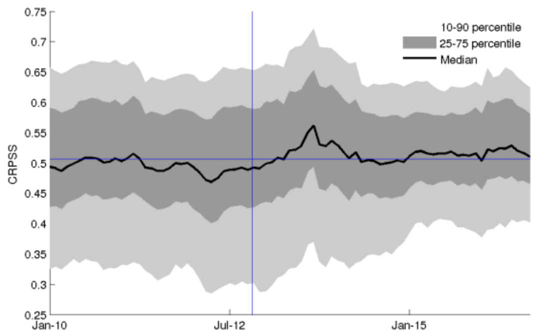


**Figure 1. CRPSS for EFAS using the ECMWF ENS, for catchments > 2000 km², with a lead time of 5 days. The scores are filtered with a 12-month running average and the reference forecast is the climate. The horizontal blue line indicates the mean CRPSS, and the vertical blue line is the date EFAS went operational.**

Figure 1 shows the EFAS headline score, the Continuous Ranked Probability Skill score (CRPSS) run by the ECMWF ensemble forecast. The score is calculated for catchments larger than 2000 km$^2$ and the reference score is the climate run of the water balance. The last few months have seen a slight decrease in the CRPSS, but it is still above the mean score.

## *Meteorological Situation for August 2016*

*By EFAS Meteorological Data Collection Centre*

In the beginning of August a low pressure system over Scandinavia and a small low pressure system over parts of the Mediterranean Sea, as well as a strengthening high pressure system from the west to the east of Central Europe occurred. The low pressure system over Macedonia led to a thunderstorm in Skopje in the night from August 6$^{th}$ to 7$^{th}$ (see Features section). More precipitation fell in a few hours (Figure 8) compared to the average precipitation sums from August (27 mm), September (36 mm) and October (42 mm).

Floods occurred in large parts of Greece from August 6th to 7th. Also, Albania (76 mm) and Montenegro (100 mm) faced problems with high precipitation amounts (Figure 7).

From mid- to end of August, a small low pressure system from Iceland moved towards Europe and a strong high pressure system over Central Europe moved to Scandinavia. The low pressure system dissolved and the high pressure dominated the meteorological conditions.

The high pressure system over large areas of Central Europe resulted in very low accumulated precipitation, between 0 and 20 mm (Figure 7). Local effects do need to be taken into account; the Alps for example experienced precipitation sums exceeding 200 mm (Figure 7). Further to this, the low pressure system over Scandinavia and western Russia resulted in extensive precipitation (Figures 7, 8).

The precipitation anomalies display drier conditions across large parts of Europe, especially in Spain and Portugal, and higher precipitation in Scandinavia, in the Balkan area and in western Russia (Figure 8).

The average temperatures in southern Europe reached 25°C, while in Central Europe the temperature was ~20°C and the north reached only 10°C. The Alps averaged ~15°C (Figure 11). The temperature anomalies show cooler values in Scandinavia and the Balkan region, and higher values in France, Spain, Portugal, and western Russia (Figure 12).

## *Meteorological Situation for September 2016*

In the beginning of September, the high pressure system over Central Europe dominated while the low pressure system in the north was weak. In mid-September, the low pressure in the northwest of Europe strengthened and the high pressure system over Central Europe was still persistent.

Floods in north and southwest England occurred after thunderstorms and heavy rainfall on September 13$^{th}$ (Figure 9). Some parts of the island experienced the warmest day of 2016 and the highest temperature measurement for the last 100 years in September. Floods in southern and eastern England between September 15th and 16th caused landslides. These events severely damaged the train lines.

A strong low pressure in the northeast of Europe, as well as a small low pressure system over Russia and high pressure over Central Europe dominated the atmospheric circulation in the end of September. The precipitation anomalies (Figure 10) demonstrate drier conditions in most parts of Europe and wetter conditions in Greece, Italy, Macedonia and Albania.

The accumulated precipitation indicates less total precipitation compared to August, and low to average precipitation sums over Central Europe (Figure 9). In addition, high precipitation in parts of Italy and Greece exceeded 150 mm and the northwest of the UK and the southwest of Norway measured 300 mm.

In general, the average temperatures decreased towards autumn in southern Europe (> 22°C) and Central Europe (> 12 – 18°C). Towards the east and north of Europe a temperature gradient with lower temperatures than 10°C can be recognized (Figure 13).

Additionally, the temperature anomalies illustrate extremely high values over Europe, especially in south Norway and Germany. Mountainous areas are affected by higher temperatures, with only a slight cooling in parts of Italy, Macedonia and Iceland (Figure 14).

# FEATURES

## *Case Study: Macedonia Floods August 2016*

*by Richard Davies, Floodlist.com*

A severe thunderstorm and heavy rainfall during the night between 06 and 07 August, 2016, resulted in devastating flash floods in parts of Skopje, the capital of Macedonia. Macedonia's Ministry of Interior later confirmed that 22 people had died in the floods. Local media reported that around 70 people were injured.

### Rainfall

According to WMO figures, 92.9 mm of rain was recorded in a 24-hour period between 06 and 07 August at Skopje-Zajcev Rid in the northwest of the city. This equates to around 3 times the amount normally seen for the whole of August in the city. Most of the rain reportedly fell in a three-hour period during the night.

Flooding in Skopje. Photo courtesy of Macedonia Ministry of Interior

### Damage

The worst affected areas were the northern suburbs of Skopje, in particular Butel, Cento and upper Lisice, and the nearby villages of Stajkovci and Aračinovo (note: also referred to as Haracinovo in some reports), around 10 km northeast of the city. Tetovo, around 30km west of the capital, was also affected.

The floods caused major damage to buildings and the road network, including parts of the city's ring road. Cars were swept hundreds of metres from roads. Skopje police said at least 70 vehicles had been trapped by flooding in the Stajkovci area. Several homes were also damaged and over one thousand people had to be evacuated. Police and military carried out rescue and evacuation operations.

Later, Aon Benfield, the reinsurance intermediary, reported that the floods in Macedonia caused at least $100 million losses and left 3,500 structures damaged.

Flooding caused major damage to the road network. Photo courtesy of Macedonia Ministry of Interior.

### Response

The EU's Civil Protection Mechanism was activated on 08 August, and the first EU experts were deployed on 09 August to assess the damage caused and to provide recommendations to the national and local civil protection authorities. The European Commission also provided Copernicus satellite imagery to the emergency services operating in the affected areas.

Copernicus Emergency Management Service (EMS) Mapping was activated on 08 August, and during the following days provided reference maps, delineation maps and grading maps (e.g. figure 2).

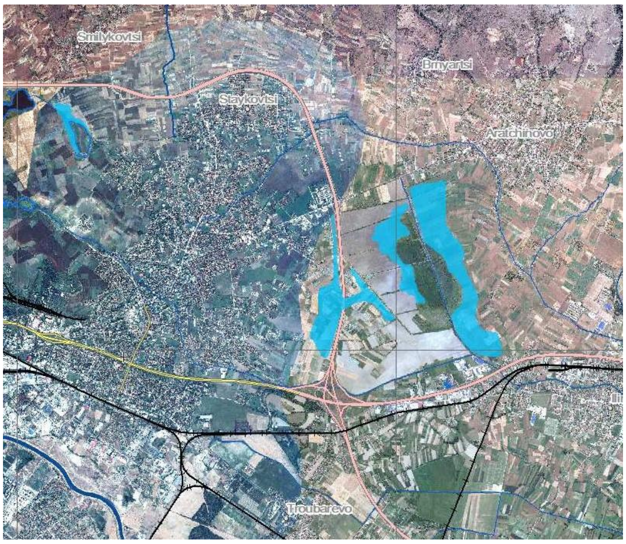


Figure 2. Copernicus flood map for Skopje floods, August 2016

## *Towards Impact-Based Warnings*

*by Richard Wylde, SMHI*

The ability to provide accurate and timely hydrometeorological forecasts continues to improve, both within national and continental scale warning systems. At the same time, socio-economic costs that are often associated with hydrometeorological hazards – including loss of life and damage to property – are increasing. Part of this increase is driven by a mismatch between the way that forecasts are issued and the interpretation of forecasts by end users.

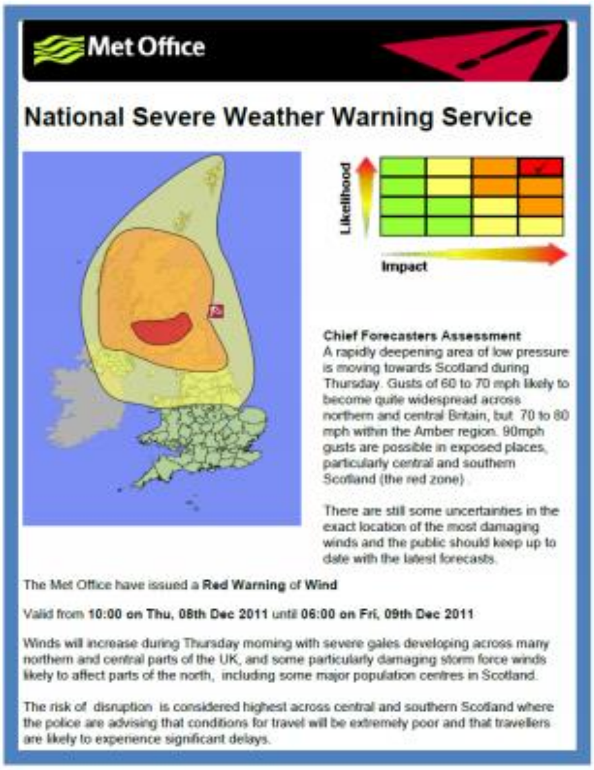


**Figure 3. UK Met Office's impact based National Severe Weather Warning Service**

The WMO provide a useful example of this mismatch. Tropical Cyclone Fitow made landfall on the Chinese mainland in October 2013. Warnings were issued according to fixed, hazard-based criteria. An orange alert for rainfall was issued at 0500 local time when the storm reached Shanghai. Two hours later, rainfall intensities had increased and the warning was upgraded to its highest level of red. Unfortunately, the storm's landfall coincided with the first day of school and work after the Chinese national holiday, when Shanghai's 23 million inhabitants were attempting to commute to work, and the red warning came too late. Seven people were killed and economic losses reached EUR 4.5 million. The need therefore to combine existing static, hazard-based warnings with more flexible estimates of exposure (what time of day will the event occur, how many people are going to be affected, where vulnerable populations are located) is quite clear, so that the right level of warning is issued.

Recognising the need for better communication of forecasts, a number of impact-based forecasting systems are now in operation around the world. The UK Met Office for example now provide impact-based warnings within their National Severe Weather Service, combining likelihood and impact to provide a spatially varying risk rating (Figure 3). The associated Flood Forecasting Centre (a joint effort between the UK Environment Agency and the UK Met Office) are also trialling a pre-operational impact-based flash flood warning service this year.

In Sweden, SMHI are working to move from hazard-based warnings to impact-based warnings. This is particularly important within the hydrological warning service, where warning criteria are currently based upon static return period exceedances, the impacts of which can be location dependent (Figure 4). A pilot project is therefore underway in which real-time estimates of inundated area will be produced using detailed 2D hydraulic models. Estimates of exposed population and infrastructure will then be calculated. An important element of this work is the integration of expertise from a number of different agencies across Sweden, including those with responsibility for hydroelectric power, roads and railways, forests, and local government.

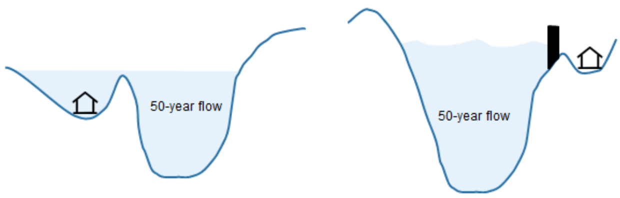


**Figure 4. Schematic demonstrating the challenges associated with hazard based hydrological warnings. The 50-year return period exceedance flow can have very different impacts depending upon location.**

Impact-based forecasts will also soon be available from EFAS, through the rapid risk assessment tool. This will provide estimates of inundated area for each reporting point within the EFAS domain, from which impact assessments can be derived. ARISTOTLE, a European Consortium funded project between 15 geophysical and hydrometeorological organisations across Europe, will be one of the primary users of this information. The ARISTOTLE consortium has the responsibility to provide the Emergency Response Coordination Centre (ERCC) with timely expert advice before or after the occurrence of severe weather, flooding, earthquakes or volcanic events, with a particular emphasis on multi-hazard and impact-based information. Examples of the impact-based products that will be routinely generated for the flooding component of the project are shown below (Table 1 and Figure 5). The consortium will become operational in February 2017.

**Table 1. Sample impacts table from the ARISTOTLE project, derived using outputs from the EFAS risk assessment tool.**

| Region | Population affected | Transportation impacts | Affected cities (population) |
|---|---|---|---|
| Loir-et-Cher | > 10,000 | 7 major roads<br>4 major rail segments | Romorantin-Lanthenay (17,900) |
| Essonne | > 10,000 | 4 major roads<br>3 major rail segments | Corbeil-Essonnes (40,300) |
| Loiret | > 10,000 | 5 major roads<br>4 major rail segments | Châlette-sur-Loing (14,600) |
| Seine-et-Marne | > 10,000 | 13 major roads<br>8 major rail segments | Coulommiers (13,100)<br>Nemours (12,898) |

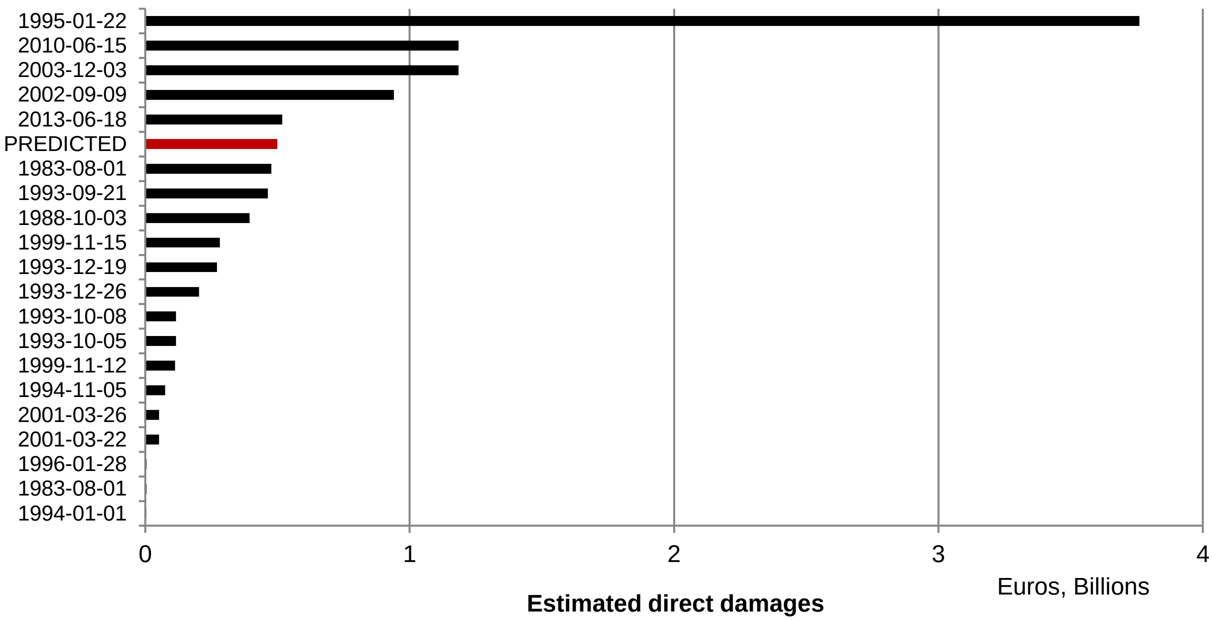


**Figure 5. Estimated (EFAS) and observed direct damages, computed from the European Environment Agency's past flood archive and used to contextualise the severity of the predicted event.**

## *Regional Conference on South East European Multi-Hazard Early Warning Systems*

*by Borivoj Terek, DHMZ*

Following the successful conclusion of the project "Building Resilience to Disasters in the Western Balkans and Turkey" in 2014, and responding to the needs identified by the beneficiaries, the World Meteorological Organization (WMO), in cooperation with the U.S. Agency for International Development (USAID), has initiated a new project entitled "South East European Multi-Hazard Early Warning Advisory System (SEE-MHEWS-A)" which aims to strengthen existing early warning capacities in the region. The project is funded by USAID and the Office of U.S. Foreign Disaster Assistance, and will be run with the Finnish Meteorological Institute.

Therefore the Regional Conference on South-East European Multi-Hazard Early Warning Systems has marked the start of the SEE-MHEWS-A project. The Regional Conference was organised through three events:

1. Project kick-off meeting on 5th October 2016;
2. Workshop on Common Alerting Protocol (CAP) on 6-7th October 2016;
3. Informal Conference of SEE Directors of NMHSs (ICSEED) meeting on 6-7th October 2016.


**Petteri Taalas, Secretary General of WMO, during his opening speech**

The objectives of the Conference were:
1. To introduce the SEE-MHEWS-A project and its first phase of implementation;
2. To establish commitment to the project by the Directors of the Hydrometeorological Services;
3. To provide training on CAP implementation;
4. To establish the cooperative foundation for project implementation.

**SEE-MHEWS-A session at the Regional Conference on South-East European Multi-Hazard Early Warning Systems**

The introductory meeting was a kick-off meeting of the SEE-MHEWS-A project. Some high level commissioners of the WMO took part in the meeting including Petteri Taalas, Secretary General of WMO. "South-East Europe has experienced a significant number of severe meteorological and hydrological events in recent years. Heavy rainfall has caused floods and landslides. Droughts have increased the incidence of forest fires. People have suffered under prolonged heat and cold waves. These natural hazards have had significant impacts: human lives have been lost, property and infrastructure damaged, and the functioning of key sectors impaired," said Mr. Taalas at the launch of the new project.

A vision for a regional SEE-MHEWS-A project as well as a common platform of the system was presented by the WMO project team during the kick-off meeting. SEE-MHEWS-A will provide operational forecasters with effective and tested tools for forecasting hazardous weather events and their possible impacts. On a single virtual platform, the system will support the provision of accurate forecasts and warnings for hazard-related decision-making by national authorities. It will also provide a unique operational platform that enables common cross-border standard operative procedures to support decision-making for Disaster Risk Reduction at all levels.

The Workshop on Common Alerting Protocol (CAP) has introduced main features of CAP–enabled alerting systems taking into account identification on alerting authorities, benefits of implementing CAP, presenting some tools for creating CAP alerts, authentication of the users and dissemination options using web based browser software.

During the 15th session of the ICSEED, the directors expressed their willingness to participate on SEE-MHEWS-A project. ICSEED is an annual meeting of the NMHSs directors coming from the south-eastern Europe belt of countries starting from Slovenia in the north-west to Turkey in the south-east. For this occasion, directors of NHMSs of Ukraine, Moldova, Israel and Jordan have joined the meeting as well as some high commissioners of WMO, representatives of World bank in Europe, and ECMWF. During the meeting the directors have expressed their commitment to continue long-term cooperation on the topics of common interest in the region. The next ICSEED meeting is going to take place in Belgrade, Republic of Serbia.

**Group photo at the SEE-MHEWS-A meeting**

More information is available from the WMO website.

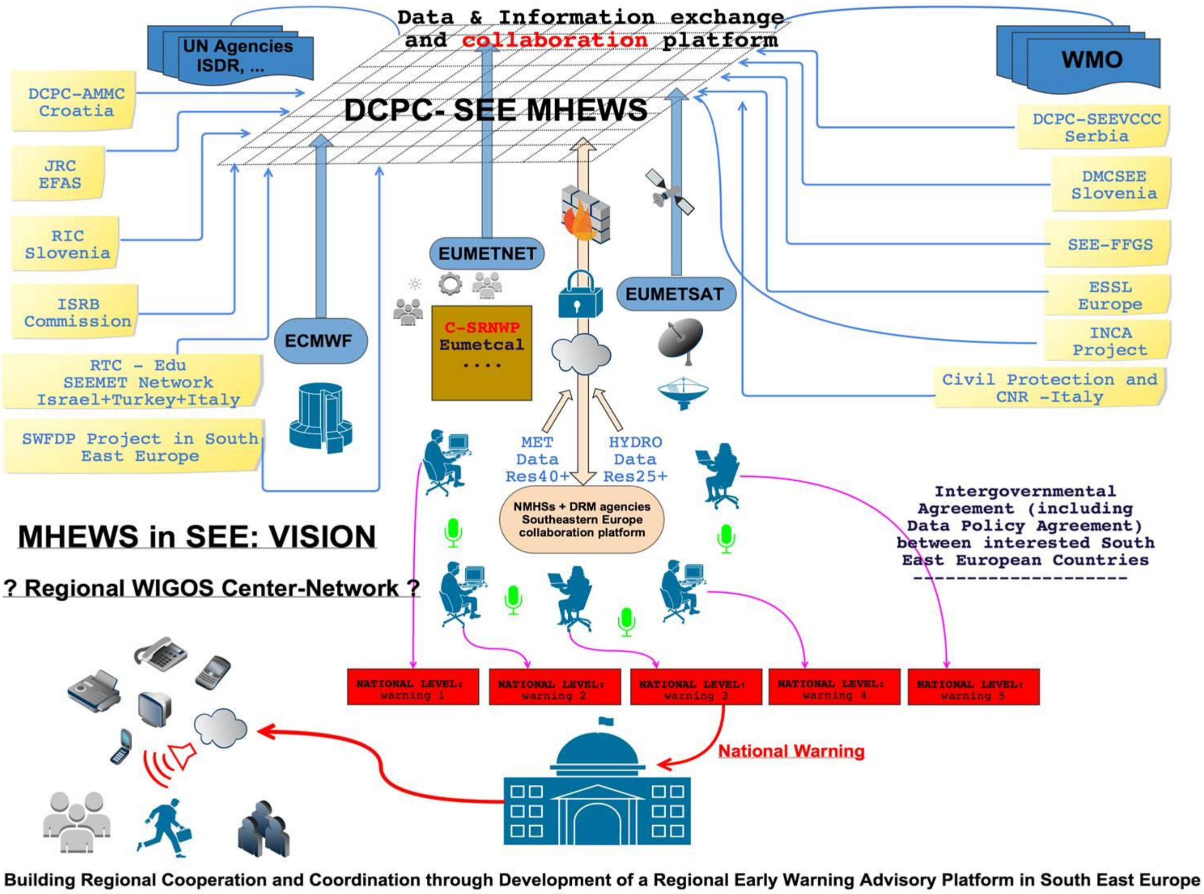


**Figure 6. Conceptual vision of the SEE-MHEWS-A system (Milan Dacić, WMO)**

## Appendix - figures

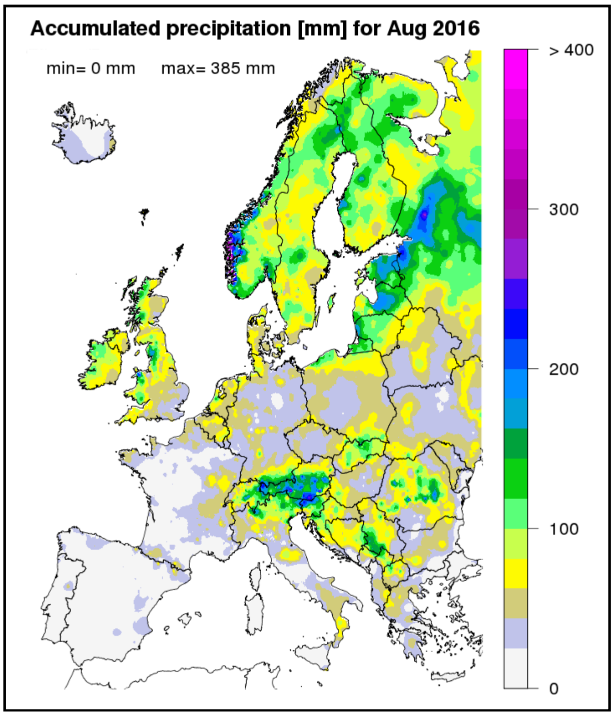


Figure 7: Accumulated precipitation [mm] for August 2016.

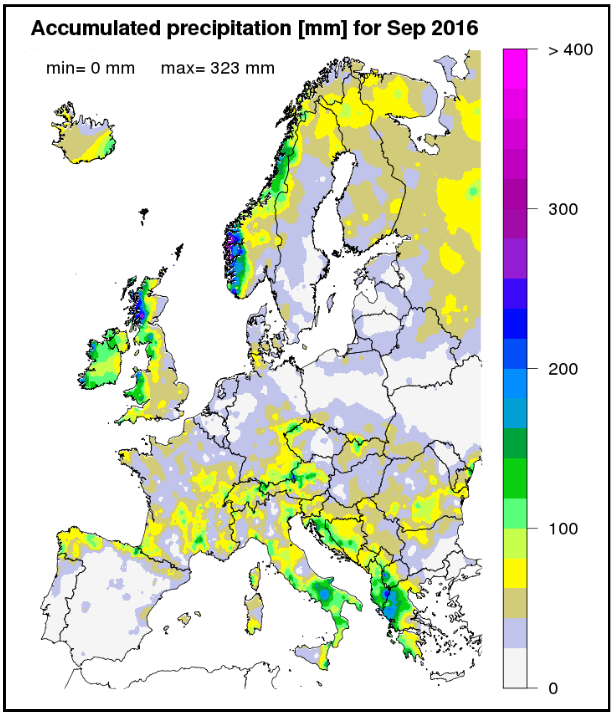


Figure 9: Accumulated precipitation [mm] for Sept 2016.

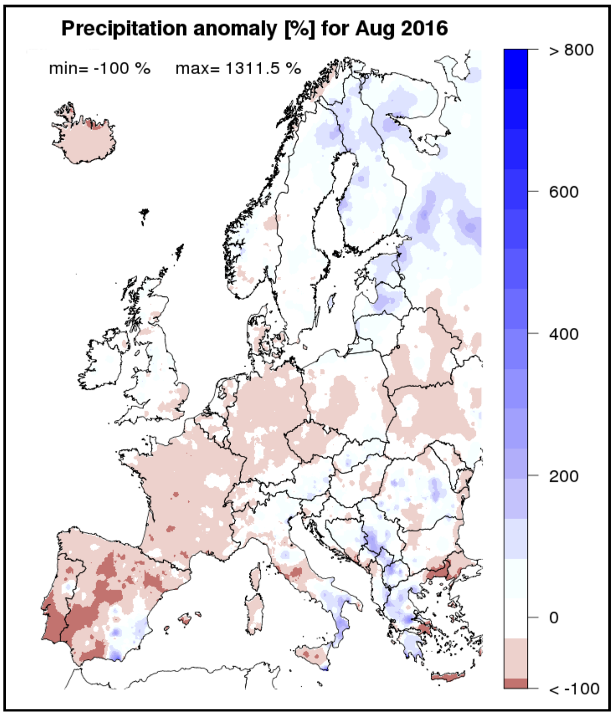


Figure 8: Precipitation anomaly [%] for August 2016, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

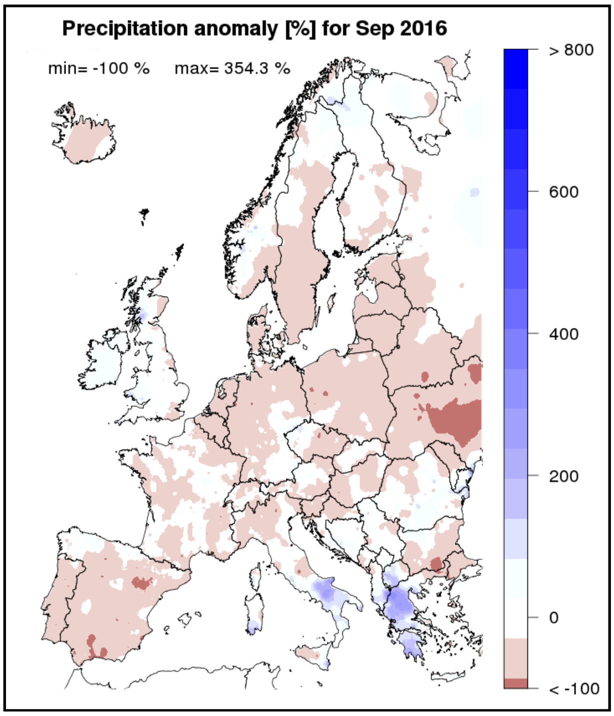


Figure 10. Precipitation anomaly [%] for Sept 2016, relative to a long-term average (1990-2013). Blue (red) denotes wetter (drier) conditions than normal.

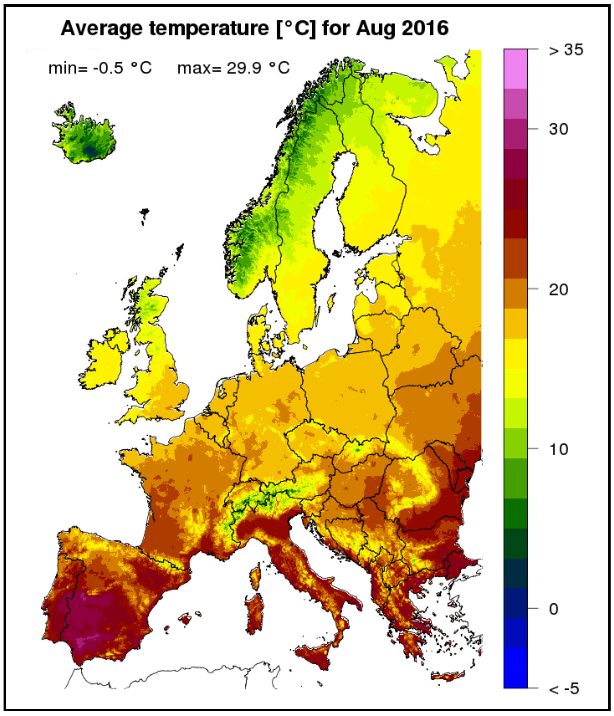


Figure 11: Mean temperature [°C] for August 2016.

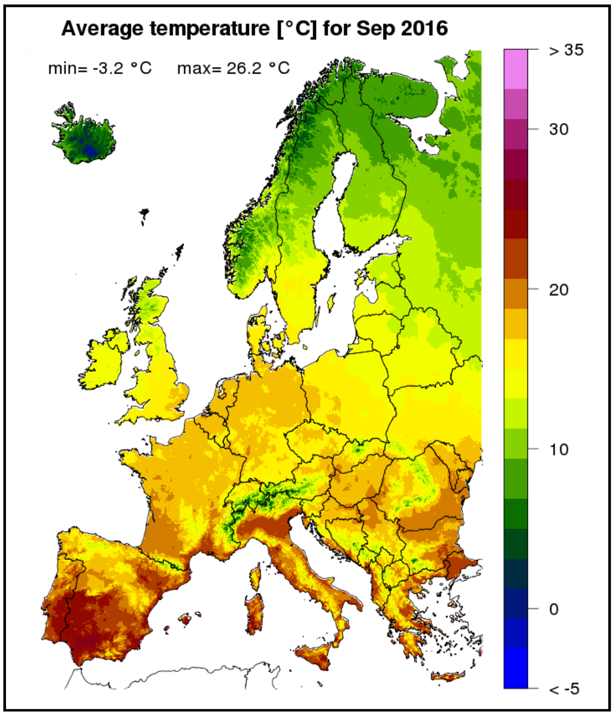


Figure 13: Mean temperature [°C] for Sept 2016.

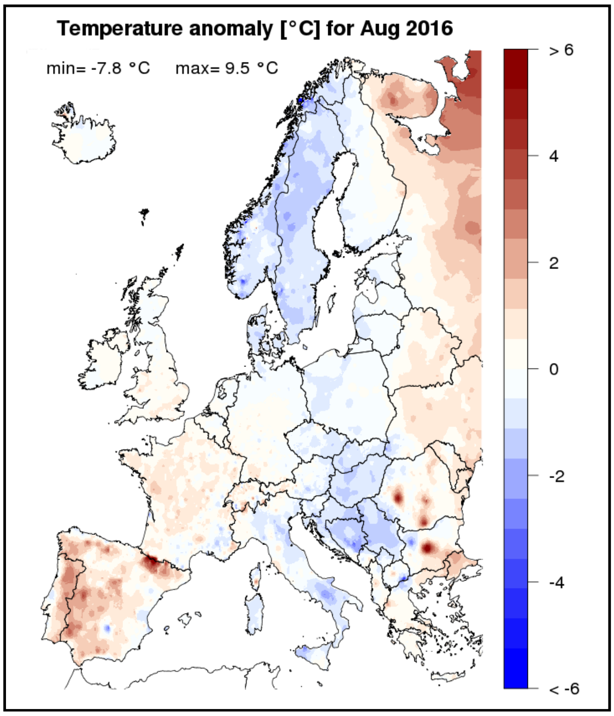


Figure 12: Temperature anomaly [°C] for August 2016, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

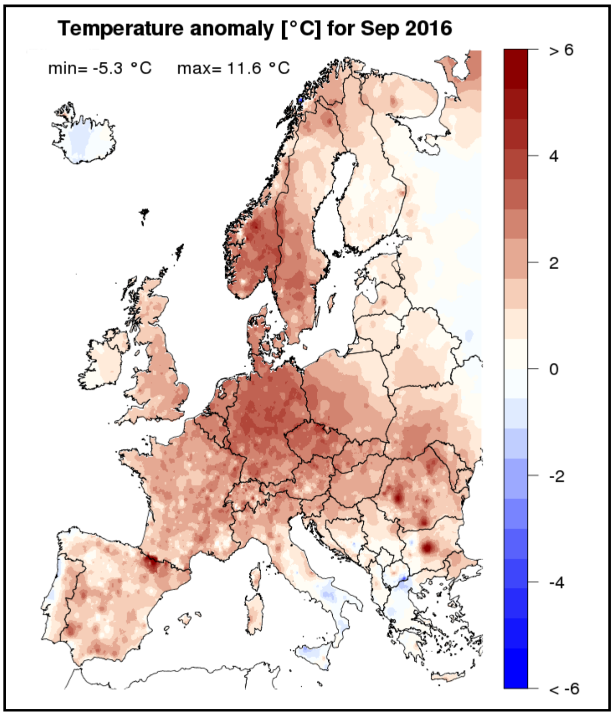


Figure 14: Temperature anomaly [°C] for Sept 2016, relative to a long-term average (1990-2013). Blue (red) denotes colder (warmer) temperatures than normal.

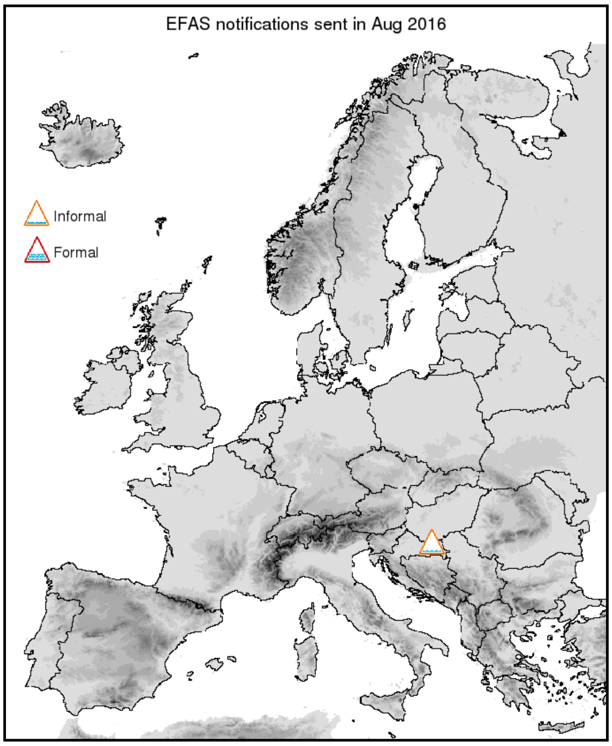


Figure 15: EFAS flood notifications sent for August 2016.

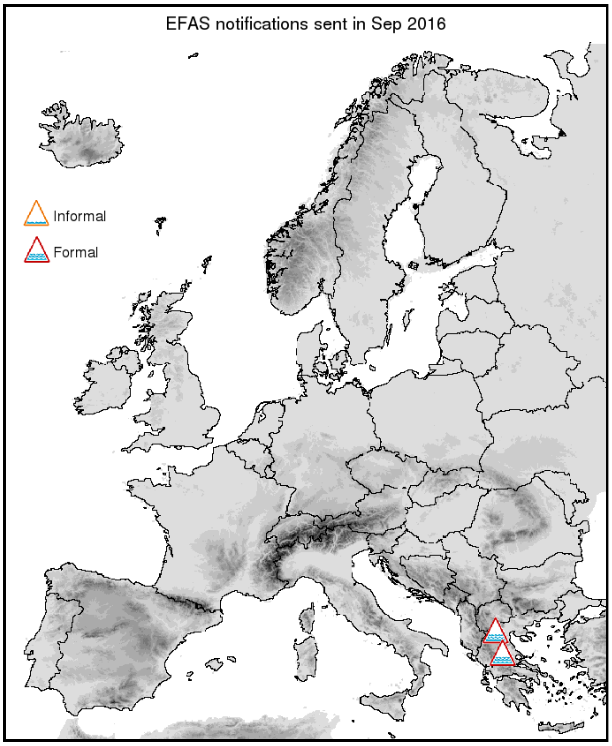


Figure 17: EFAS flood notifications sent for Sept 2016.

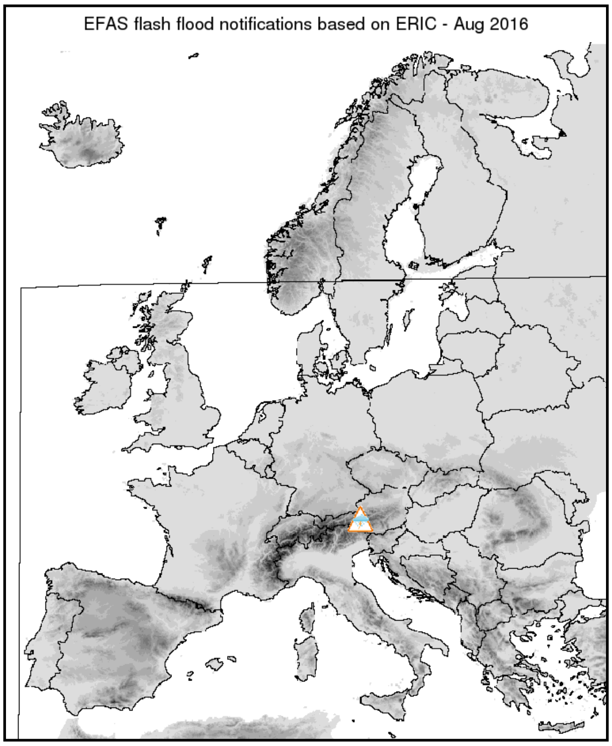


Figure 16: Flash flood notifications sent for August 2016.

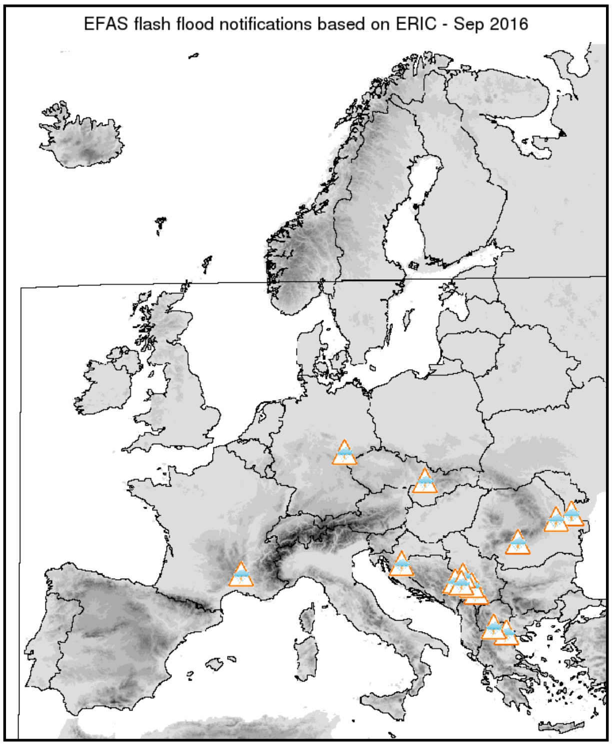


Figure 18. Flash flood notifications sent for Sept 2016.

## Appendix - tables

**Table 2: EFAS flood notifications sent in August - September 2016**

| Type | Forecast date | Issue date | Lead time* | River | Country |
|---|---|---|---|---|---|
| Informal | 12/08/2016 00 UTC | 12/08/2016 | 1 | Drava | Croatia |
| Formal | 05/09/2016 00 UTC | 05/09/2016 | 2 | Alikamonas sub-catchment | Greece |
| Formal | 05/09/2016 00 UTC | 05/09/2016 | 2 | Pinios | Greece |

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

**Table 3: EFAS flash flood notifications sent in August - September 2016**

| Type | Forecast date | Issue date | Lead time* | Country | Region |
|---|---|---|---|---|---|
| Flash flood | 09/08/2016 00 UTC | 09/08/2016 | 36 | Austria | Salzburg |
| Flash flood | 05/09/2016 00 UTC | 05/09/2016 | 36 | Serbia | Zlatibor |
| Flash flood | 04/09/2016 12 UTC | 05/09/2016 | 24 | Slovakia | Trenciansky kraj |
| Flash flood | 06/09/2016 00 UTC | 06/09/2016 | 36 | Macedonia | Pelagoniski |
| Flash flood | 05/09/2016 12 UTC | 06/09/2016 | 30 | Kosovo | Kosovo-Metohija |
| Flash flood | 05/09/2016 12 UTC | 06/09/2016 | 30 | Serbia | Moravica |
| Flash flood | 05/09/2016 12 UTC | 06/09/2016 | 24 | Serbia | Raska |
| Flash flood | 05/09/2016 12 UTC | 06/09/2016 | 24 | Bosnia and Herzegovina | Republika Srpska |
| Flash flood | 06/09/2016 12 UTC | 07/09/2016 | 24 | Greece | Kentriki Makedonia |
| Flash flood | 14/09/2016 12 UTC | 15/09/2016 | 6 | France | Ardeche |
| Flash flood | 16/09/2016 12 UTC | 17/09/2016 | 24 | Germany | Thuringen |
| Flash flood | 19/09/2016 00 UTC | 19/09/2016 | 36 | Romania | Valcea |
| Flash flood | 19/09/2016 00 UTC | 19/09/2016 | 12 | Romania | Galati |
| Flash flood | 19/09/2016 00 UTC | 19/09/2016 | 18 | Bosnia and Herzegovina | Federacija BiH |
| Flash flood | 19/09/2016 12 UTC | 20/09/2016 | 30 | Moldova | Cahul |

## Acknowledgements

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- Richard Wylde from SMHI
- Borivoj Terek from DHMZ