



Copernicus Emergency Management Service (EMS)

European Flood Awareness System EFAS

Follow us on:

Background and history

- **The Elbe and Danube floods in 2002 were a wake-up call for the European Commission to start different activities on floods and disasters.**

1999-2002	<i>Research project: European Flood Forecasting System</i>
2002	<i>Elbe and Danube Floods</i> <ul style="list-style-type: none">❖ European Commission plans to develop EFFS into an operational system❖ JRC offered ICPDR to use Danube as their main pilot for the alert system
2003	<i>Launch of European Flood Alert System</i> <ul style="list-style-type: none">❖ Building a partner network – Start with Elbe and Danube partners❖ Meteorological and hydrological data collection❖ Development in collaboration with national authorities and scientific community
2004	<i>Collaboration agreement with ECMWF to use ECMWF ensemble prediction</i>
2005	<i>Start of pre-operational dissemination of results to NHS</i>
2007	<i>EFAS Web-interface for all partners</i>
2010	<i>Daily dissemination of results to European Civil Protection</i>
2011	<i>EFAS was adopted as part of Copernicus (ex-GMES) emergency management service.</i>
2012	<i>Start of operational EFAS</i>
2014	<i>Flash flood was introduced</i>

Partners Network, Condition of Access

- ❑ An EFAS partner is any national, regional or local authority that is legally obliged to provide flood forecasting services or has a national role in flood risk management within its country and the European Commission Services, i.e. DG ECHO-ERCC, DG ENTR-COPERNICUS and DG JRC.
- ❑ All EFAS partners sign a condition of access (CoA) agreement with the EFAS DC
- ❑ EFAS Partnership gives **REAL-TIME ACCESS TO THE EUROPEAN FLOOD AWARENESS SYSTEM (EFAS)** products through the EFAS Information System (EFAS-IS), as well as the right to attend and get one vote at the Annual EFAS Partners Meeting
- ❑ An EFAS Partner gains free of charge, password protected, web access to the EFAS Information System (EFAS-IS) from which the Partner can retrieve **early flood information** products for the river basins agreed upon.
- ❑ **Limited EFAS access for Third Party and Research Partners**
- ❑ **Archived EFAS forecasts (older than 1 month) are freely available**



Participants of EFAS annual meeting 2016.
Photo: Arnau Cangròs i Alonso

Operational Centres

JRC (Joint Research Centre) is responsible for contract management of the Operational EFAS and coordinates the scientific and technical development.



The operational EFAS organization consists of four centres:

EFAS Hydrological data collection centre

A Spanish consortium consisting of REDIAM and ELIMCO is responsible for collecting historic and real-time discharge and water level data.



EFAS Meteorological data collection centre

A consortium consisting of KISTERS AG and the German Weather Service (DWD) collecting historic and real-time meteorological data across Europe.



EFAS Computational centre

The Computational centre is located at European Centre for Medium-Range Weather Forecasts (ECMWF). The centre runs the forecasts and post-processing calculations as well as the web interface of the EFAS-Information System.



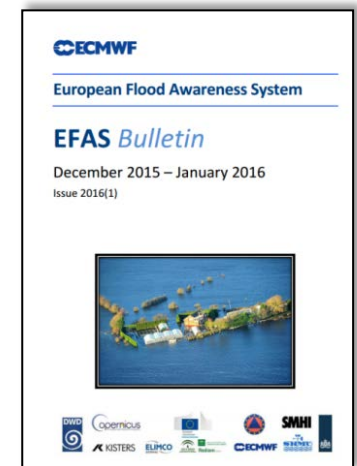
EFAS Dissemination centre

The Dissemination centre is a consortium of Swedish Meteorological and Hydrological Institute, Slovak Hydrometeorological Institute and Dutch Rijkswaterstaat. The centre analyses EFAS results on a daily basis, disseminates information to the EFAS partners, organizes user meetings and provides training.



Summary

- ❑ provides complementary, flood early warning information up to 10 days in advance to its partners: the National/Regional Hydrological Services and the European Response and Coordination Centre (ERCC).
 - ❑ Sends out notification to partners and ERCC
 - ❑ Sends out daily overview to ERCC and JRC
 - ❑ Daily overview available in EFAS-IS
- ❑ Collects feedback from EFAS partners
- ❑ Collects hydrological and meteorological data
- ❑ Runs the LISFLOOD model twice daily
- ❑ Manages and develop the model and EFAS- IS
- ❑ Arranges annual partner meetings
- ❑ EFAS Bulletin
- ❑ EFAS training, webinars and videos
- ❑ Currently has 51 national/regional authorities as EFAS partners including ERCC. Most partners are national meteorological/hydrological services, some include civil protection.

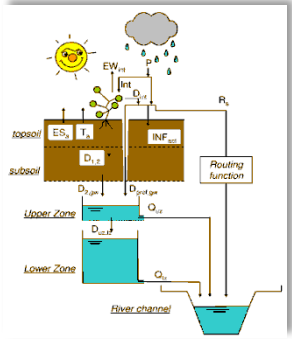


Processing chain

Static Input Data
Initial Conditions

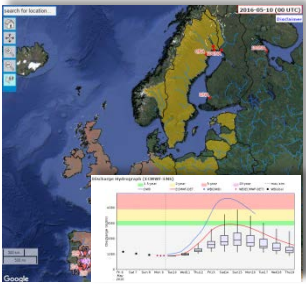
Input Data

Hydrological Model - LISFLOOD



Automatic processing & evaluation

EFAS user interface EFAS-IS



Analysis by forecaster

Notifications

EFAS Flood Notification for Albania - River: Moraca - Type: Formal

Written by: Michalis Misiulis
Sunday, 20 March 2016 08:27

EFAS Flood Notification - Type: Formal*

Countries: Albania
River(s): Moraca (Drina basin)
Predicted start of event: **Tuesday 8th of March 2016**
Earliest predicted peak: **Thursday 20th of March 2016**
Probability to exceed a 5-year return period magnitude: **78%**
Probability to exceed a 20-year return period magnitude: **8%**
Forecast date: **2016-03-20 12:00 UTC**
Comment: -

This is the only notification you will receive for this event! Please follow the evolution of the event on EFAS.

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e-mail: michalis.misiulis@meteo.gov.al
Slovak Hydrometeorological Institute (SHMI)

* Formal = previous EFAS Flood Alert, Informal = previous EFAS Flood Watch
The conditions for an EFAS Flood Notification of Type: Formal/alert can be found [here](#)

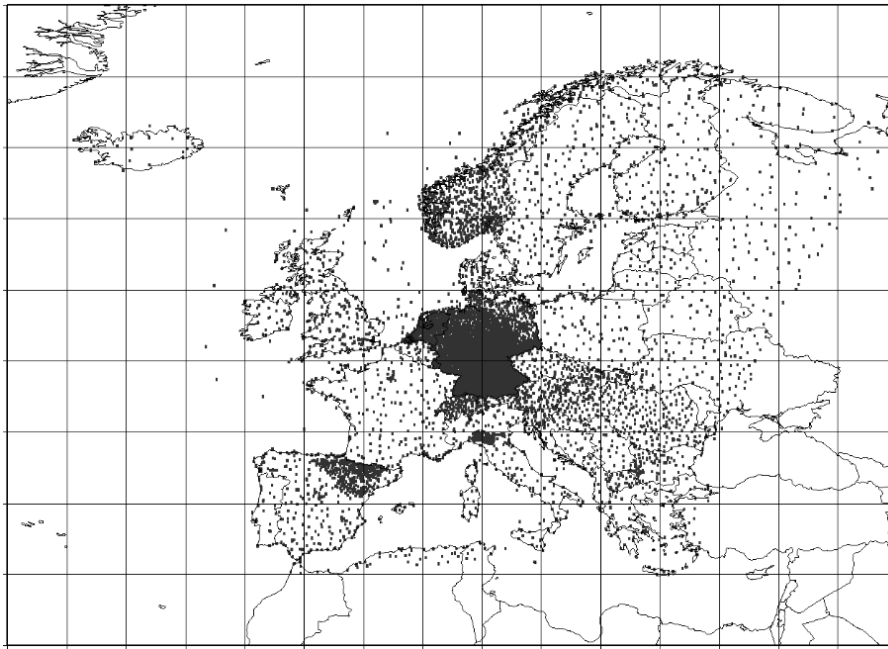
Expert Knowledge of Member States

EFAS Partners

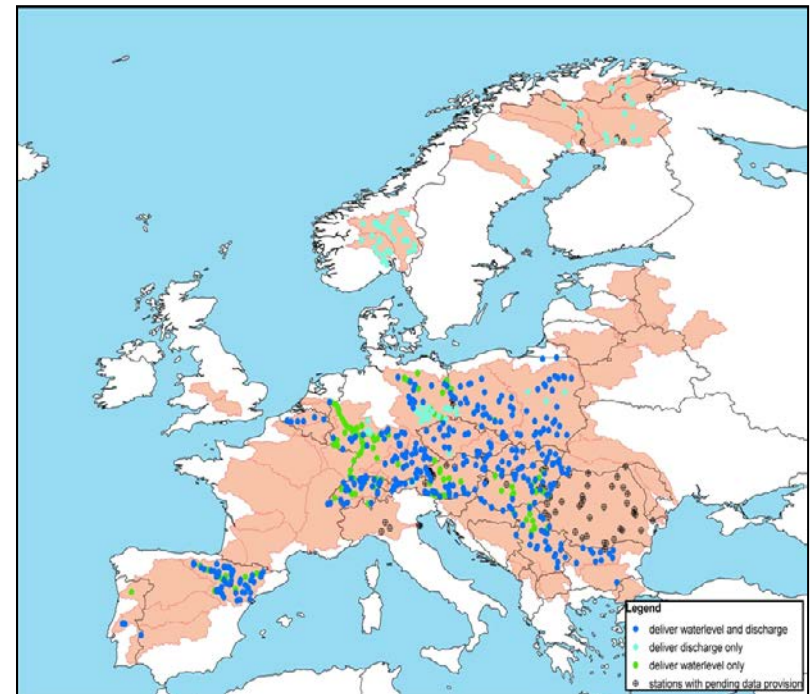


Real time data

5978 Meteorological data stations

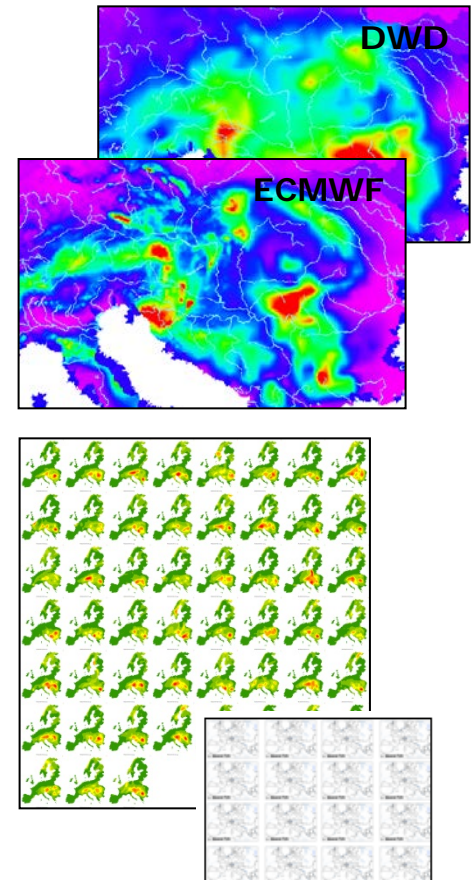


Discharge and water levels



Weather forecasts

- An EFAS forecast consists of
 - **Deterministic forecasts**
 - **DWD** (ICON & ICON-EU) – global model, 7 forecast days (~ 6.5 km, day 1-3 – ~ 13 km, day 4-7)
 - **ECMWF** – global model, 10 forecast days, ~ 9 km
 - **Ensemble forecasts**
 - **ECMWF VAREPS** – global model, 51 members, 10 forecast days, ~18 km
 - **COSMO-LEPS** – Europe, 16 members, 5 forecast days, ~ 7 km

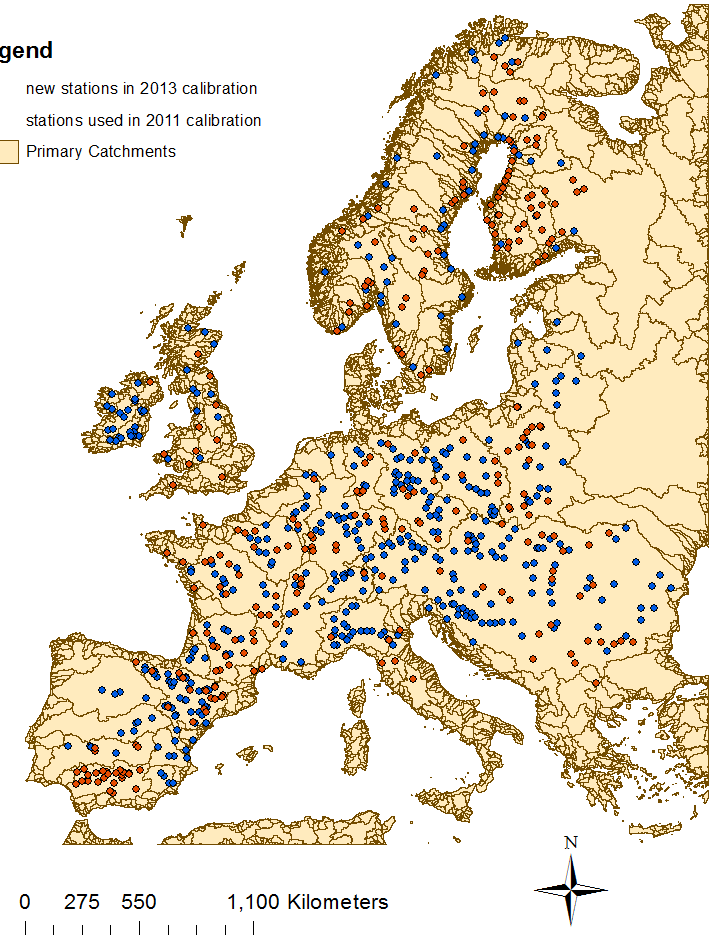


Lisflood model

- ❑ LISFLOOD is a distributed model developed for trans-national river basins
- ❑ Parameters physically based when possible
- ❑ Model optimised for flood forecasting
- ❑ Embedded in a dynamic GIS programming language PCRaster
- ❑ 693 calibration stations (incl. 34 reservoirs)
- ❑ Calibration period: 8 years (if sufficient data available)
- ❑ Validation period: 8 years (if sufficient data available)
- ❑ Calibration parameters: 9 (for sub-catchments with reservoirs 13)

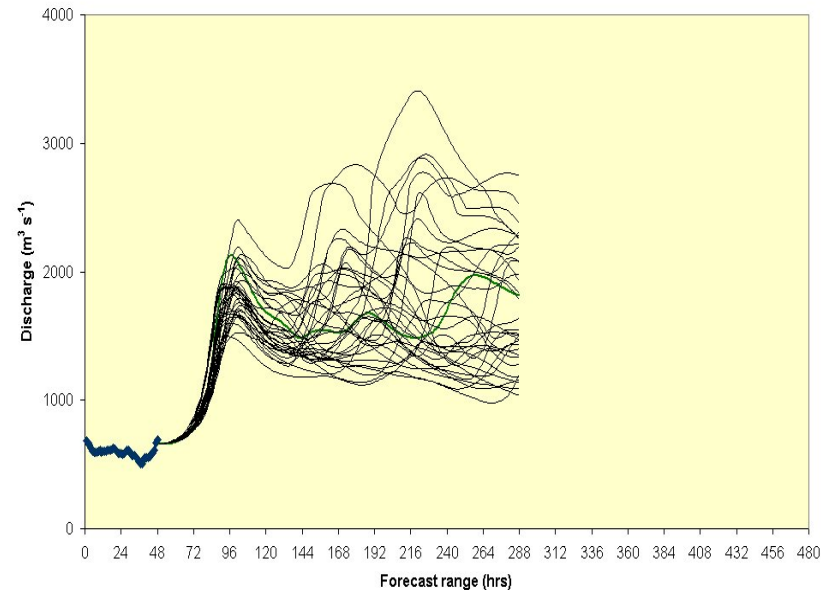
Legend

- new stations in 2013 calibration
- stations used in 2011 calibration
- Primary Catchments

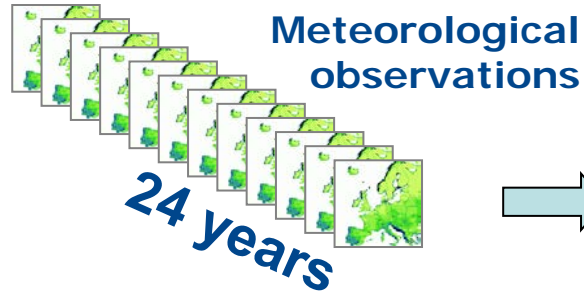


Ensemble Prediction System (EPS)

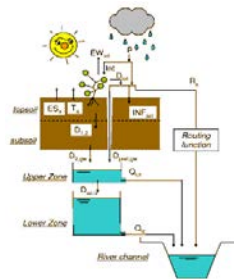
- ❑ EPS increases the robustness of the system through multiple inputs
- ❑ At the beginning the differences are small between the ensembles
- ❑ The longer the forecasting range, the bigger the differences



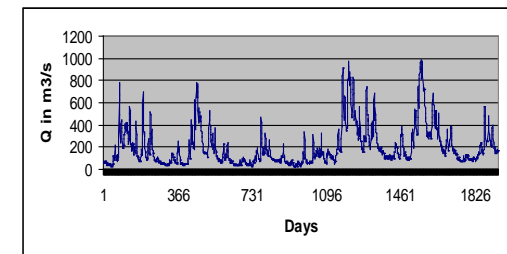
Thresholds



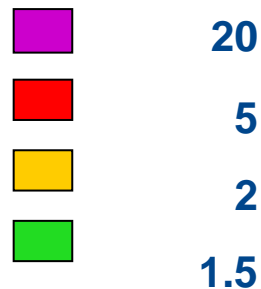
LISFLOOD



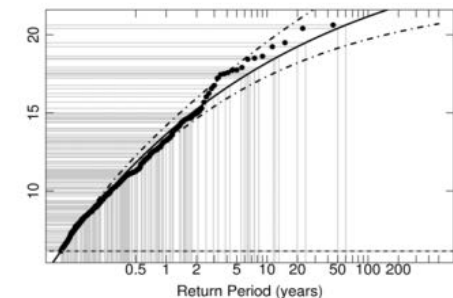
Discharge time series



Thresholds (return period)



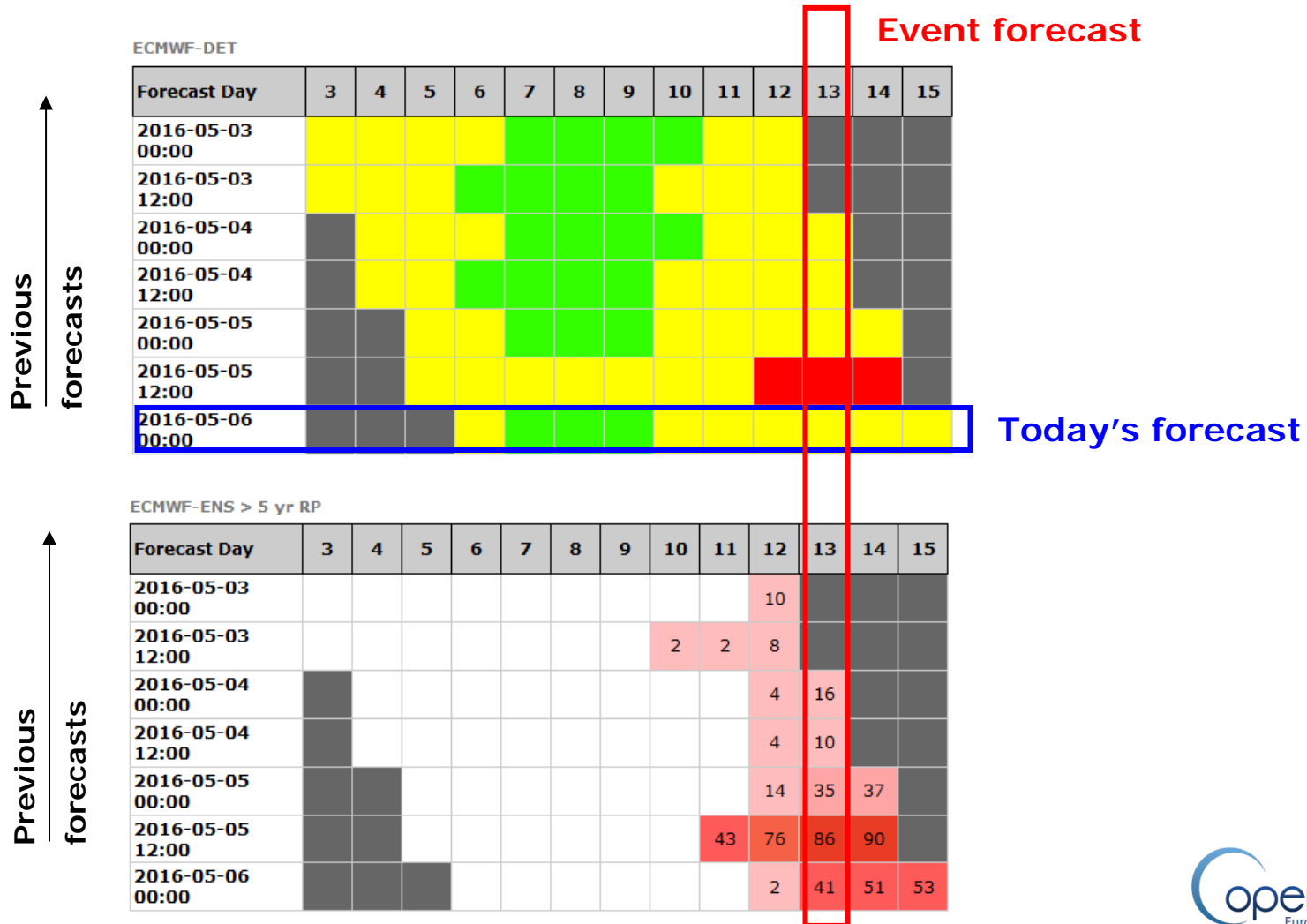
Return period statistics



- Thresholds are derived from simulated time series.
- The same model setup and parameterisations are used in the forecasts to remain model consistency

Visualization of the threshold exceedance. Evaluation of persistency in time and consistency between forecasts are important and provide a concise picture of the forecasts.

Threshold exceedance



Threshold exceedance

Overview of DWD, ECMWF-DET, ECMWF-ENS > 5 yr RP, ECMWF-ENS > 20 yr RP, COSMO-LEPS > 5 yr RP, COSMO-LEPS > 20 yr RP

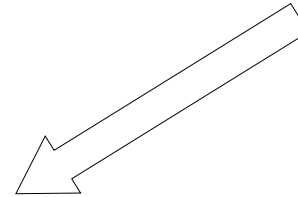
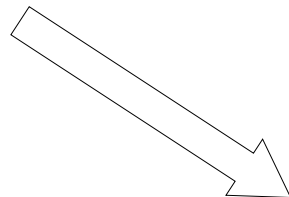
Forecast Type	6	7	8	9	10	11	12	13	14	15
DWD	↓	↓	↑	↑	↑	*				
ECMWF-DET	↓	↓	↑	↑	↑	↑	↑	↑	↑	*
ECMWF-ENS > 5 yr RP							2	41	51	53
ECMWF-ENS > 20 yr RP										
COSMO-LEPS > 5 yr RP										
COSMO-LEPS > 20 yr RP										

ECMWF-ENS > 5 yr RP

Forecast Day	3	4	5	6	7	8	9	10	11	12	13	14	15
2016-05-03 00:00										10			
2016-05-03 12:00								2	2	8			
2016-05-04 00:00										4	16		
2016-05-04 12:00										4	10		
2016-05-05 00:00										14	35	37	
2016-05-05 12:00									43	76	86	90	
2016-05-06 00:00										2	41	51	53

Consistency between forecasts

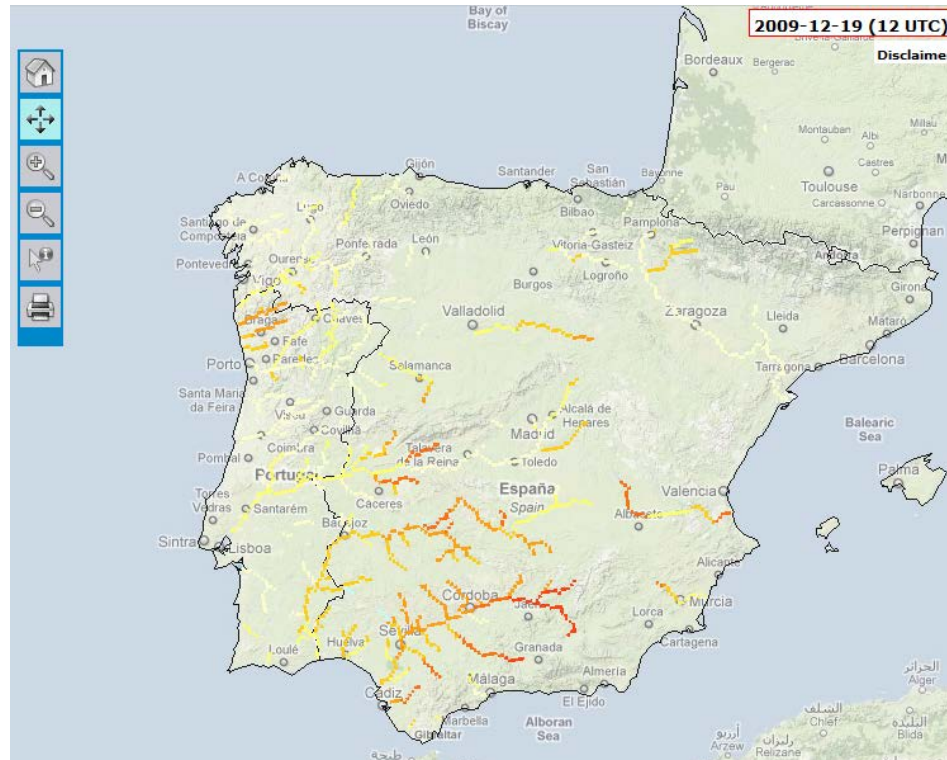
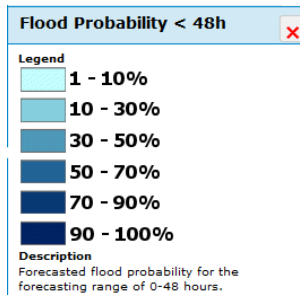
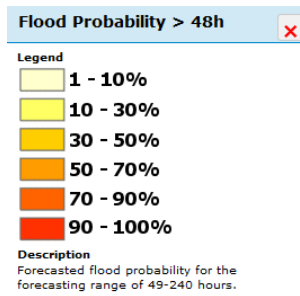
Persistency of results from forecast to forecast



Reduction of false alarms

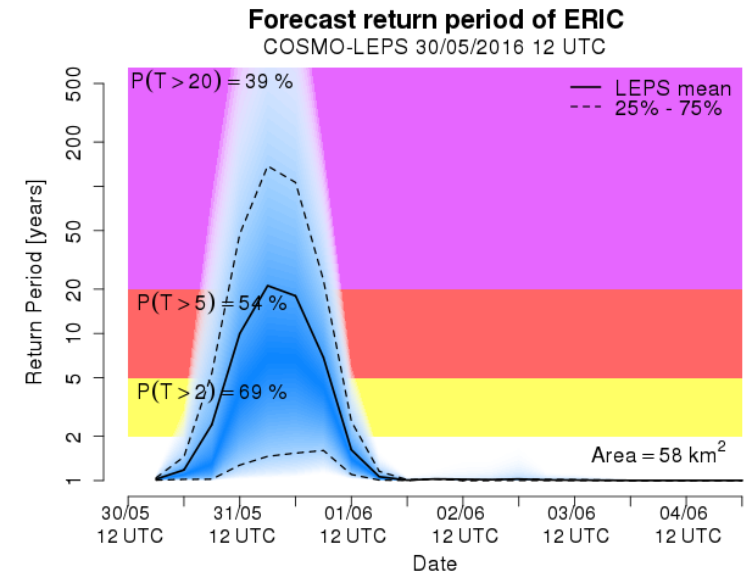
Total flood probability

Total flood probability takes into account all forecasts weighted (DWD=17 %, ECMWF=23%, each EPS=1.2 %) and persistency.



Flash flood

- ❑ Based on forecast accumulated upstream precipitation for durations up to 24 hours (no hydrological simulation)
- ❑ Accounts for soil moisture status, geomorphology and land-use through a soil moisture - runoff coefficient relation
- ❑ COSMO-LEPS forecasts
- ❑ River network at 1 km resolution
- ❑ Fit for catchments with area between 25 km² and 2000km²
- ❑ Probabilistic return period shown for lead time range 12-120 hours



Point Information

Country	CoA Status	Region	River	Upstream Area [km ²]
France	YES	Loire	France - Loire, above Allier	58

Landslide susceptibility of the affected areas

Very high	High	Moderate
0%	22%	33%

Notifications & Overview



- **EFAS Formal Notification (prev. EFAS Flood Alert)**

- Catchment part of CoA
- Catchment area > 2000 km²
- Event > 48 h in advance
- Persistent forecasts, 3 consecutive VARAPS forecasts with more than 30% of the members exceeding threshold corresponding to return period of 5 years
- At least one of the deterministic forecast also exceeds EFAS high threshold



- **EFAS Informal Notification (prev. EFAS Flood Watch)**

- Catchment part of CoA
- Any of the above criteria is not met (catchment size, lead time, forecast persistence) but the forecasters think the authorities should be informed
- Any other doubt



- **EFAS Flash Flood Notification (prev. EFAS Flash Flood Watch)**

- Catchment part of CoA
- The probability of exceeding a 20 year return period magnitude of the surface runoff index is forecasted to be greater than 35% and the forecasted start of the event is < 72 hours.

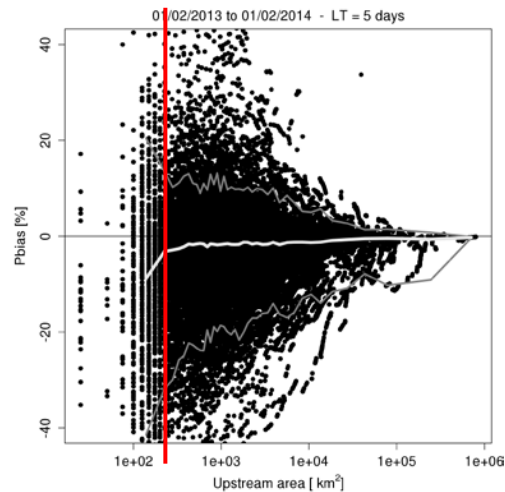


ERCC Overview

Catchment criterion

□ Why catchment size criterion?

- EFAS skill decreases significantly for catchments < approx. 600-700km²
- In addition small catchments are more prone to flash flooding
 - Thus, catchments > 2000km² are covered by EFAS hydrological forecasts and catchment < 2000km² are covered by the EFAS flash flood indicator



Significant drop in bias for upstream areas below approx. 600km²

Decision making

- ❑ **Early flood warning to EFAS partners aims to draw attention to an upcoming event so a country can make proper preparations regarding for example**
 - ❑ Equipment
 - ❑ Put team and responsible officers on standby
 - ❑ Consult local information regularly (MetService, observations, ...)

- ❑ **Provide a congregated picture on a larger scale to decision makers at EU level**

- ❑ **Misses are more harmful than false alarms**

Decision making



- ❑ Daily analysis of full information
- ❑ If high probability for flooding and EFAS partner exists, officer on duty sends a notification
- ❑ Only 1 notification to partner to draw attention to probability of flooding

- ❑ Can decide to analyze EFAS-IS daily or wait for EFAS notification
- ❑ Notification should trigger further investigation with local system, meteorological office, observations
- ❑ Partner free to use EFAS information or not

Contact Information

- ❑ To access the EFAS-IS go to www.efas.eu
- ❑ Personal login is required to access forecasts, notifications etc.
- ❑ To contact the EFAS team please email info@efas.eu