

European & Global Flood Awareness Systems



Emergency
Management

Overview & new developments

WMO RAVI Hydrological Forum, 2-4 April in Bratislava



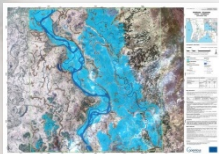
Copernicus Emergency Management Service

Emergency Management



On-demand Mapping

Rapid Mapping



24/7 on-demand and fast provision of geospatial information

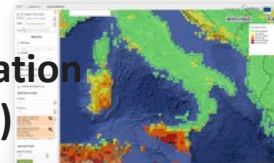
Risk & Recovery Mapping



supporting prevention, preparedness, disaster risk reduction, reconstruction, recovery

Early Warning & Monitoring Systems

European Forest Fire & Global Wildfire Information Systems (EFFIS & GWIS)



European & Global Drought Observatory



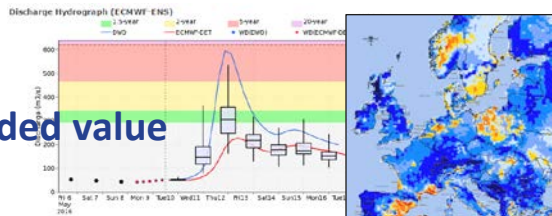
European & Global Flood Awareness Systems (EFAS & GloFAS)



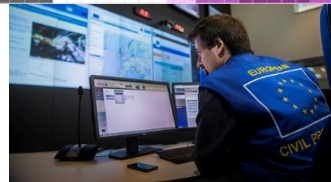


Objectives

- Provide users with **complementary, added value flood forecasts**
 - Probabilistic
 - Medium-range
 - River basin wide
- Support **preparedness for floods at EU and global level** by providing the ERCC with an overview of ongoing and forecasted floods
- **Knowledge exchange platform** for operational flood forecasting
- **Foster collaboration and co-operation** between the different users



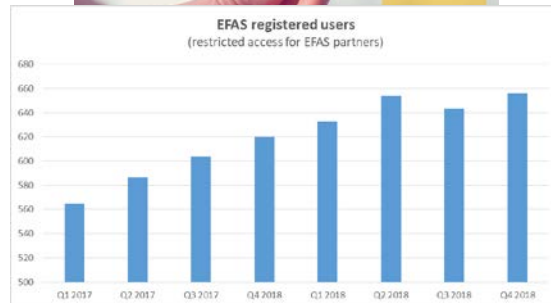
Forecast Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
201405017																
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201405022																





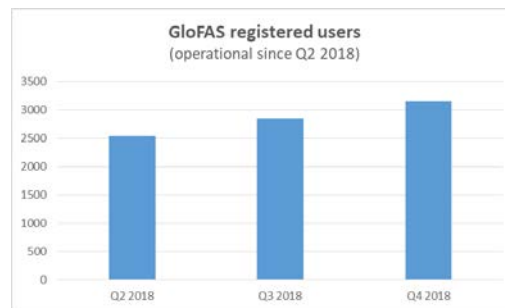
Who are the users of EFAS?

- ★ Mostly national/regional hydro-met authorities covering almost all WMO Region VI countries
- ★ ...but also increasingly civil protection authorities
- ★ Currently: **more than 70 EFAS partner institutions**



Who are the users of GloFAS?

- ★ national/regional hydro-met authorities, development agencies, NGO (e.g. Red Cross), civil protection, intergovernmental organizations (UN-WFP, OCHA), insurance
- ★ Currently: more than 3000 registered, active users





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User feedback & uptake

EFAS collects:

- ★ User feedback after notifications & at the annual meeting

EFAS offers:

- ★ twice yearly webinars
- ★ Individual partner training
- ★ EFAS bulletins with monthly summaries, news and latest developments
- ★ EFAS performance evaluation reports for specific events
- ★ Annual user workshops



GloFAS offers:

- ★ Trainings
- ★ Specific GloFAS workshops



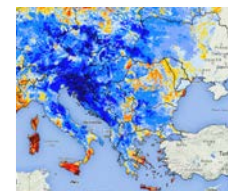
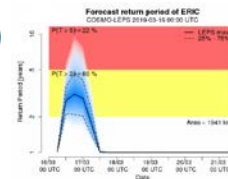
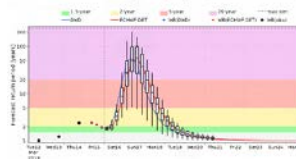


EFAS Set-up & Products

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- ★ Hydrological model: LISFLOOD
- ★ Updated twice daily
- ★ Spatial resolution 5km
- ★ Medium range, probabilistic, European wide flood forecasts (up to 10 day lead time)
 - ★ Multiple weather forecasts (ECMWF, DWD, COSMO-LEPS)
 - ★ Persistence graphs – return period hydrographs – etc.
- ★ Post-processed, bias correct forecasts
- ★ Flash flood indicators with a lead time up to 3 days & radar-based flash flood now-casting
- ★ EFAS Flood & Flash Flood Notifications to all partners at river basin level
- ★ Monitoring of national flood alert exceedances
- ★ Soil moisture, snow maps, anomalies
- ★ Hydrological seasonal outlook
- ★ Impact forecasts and pre-tasking of Copernicus EMS rapid mapping

Return Period Hydrograph (COSMO-LEPS)



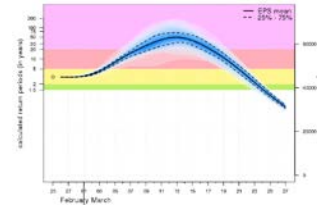
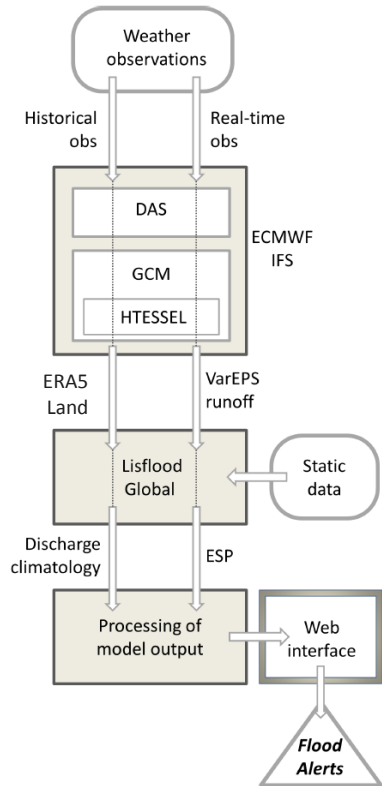
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GloFAS Set-up & Products

Emergency Management



- Updated daily
- Output resolution of 0.1° (~10 km)
- Ensemble prediction (ECMWF-ENS) 50+1 members
- Forecast lead time of up to 30 days (medium range plus extended range)
- Model cascade: IFS + HTESSSEL + Lisflood
- Discharge threshold exceedance based on 2, 5, and 20 year flood return periods
- Persistence diagrams to identify “jumpiness” over consecutive forecasts
- Daily runs since 2011 in pre-operational mode – since 2018 operational

Forecast Day	21	22	23	24	25	26	27	28	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
21/02/2017												4	24	43	57	65	69	67	67	53						
22/02/2017												4	16	27	59	71	73	76	80	76	69	69				
23/02/2017												4	24	33	47	65	75	80	80	75	69	47				
24/02/2017													10	27	43	59	71	75	79	82	78	63	49			
25/02/2017													4	20	49	59	78	86	92	92	90	76	55			



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Constant increase in meteorological & hydrological data collection!

EFAS collects in-situ data for **calibration, validation, monitoring, post-processing** and **model initial conditions**

Hydrological data:

- ★ More than 1300 stations (historic & NRT)
- ★ More than 37 data providers

Meteorological data:

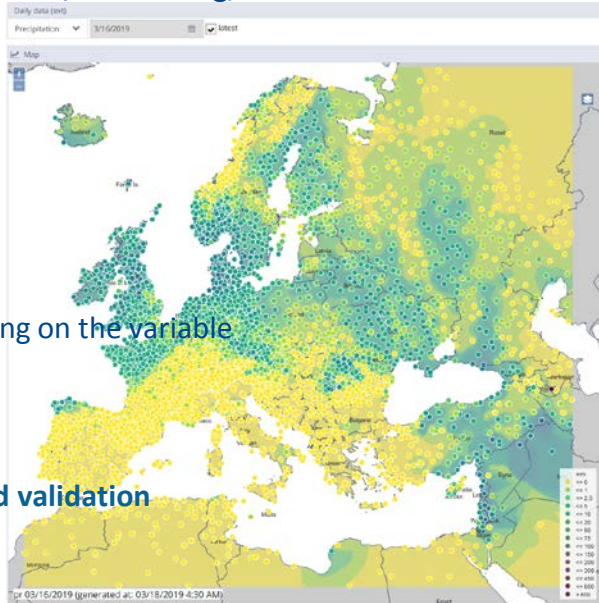
- ★ Between 4.000 and 10.000 stations depending on the variable
- ★ includes gridded datasets
- ★ 21 different data providers

GloFAS collects in-situ data for **calibration and validation**

Only Hydrological data:

- More than 2000 stations (historic)
- More than 37 data providers

GloFAS uses ERA-Interim/ERA5 as meteorological input



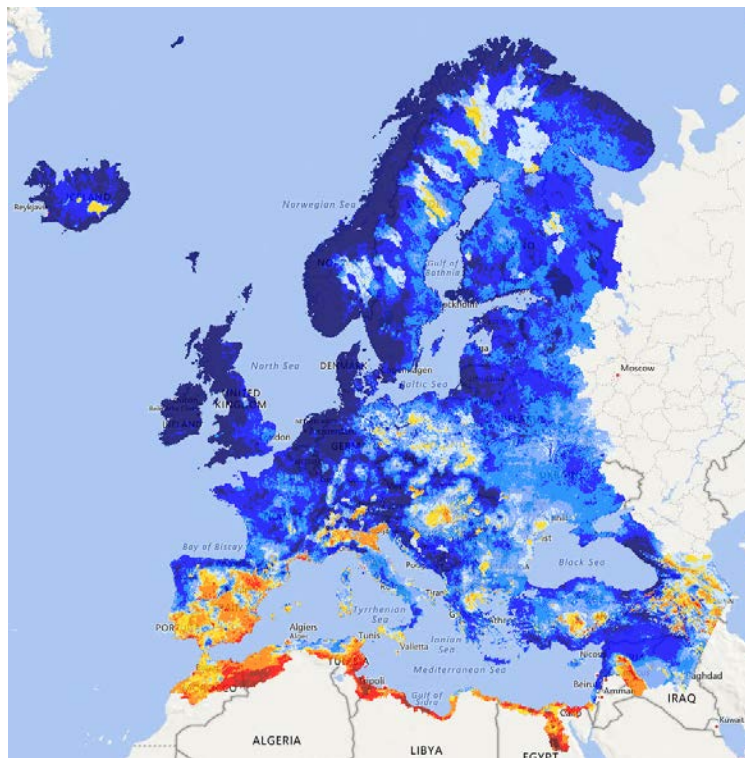


New developments – EFAS extended domain

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EFAS extended model domain

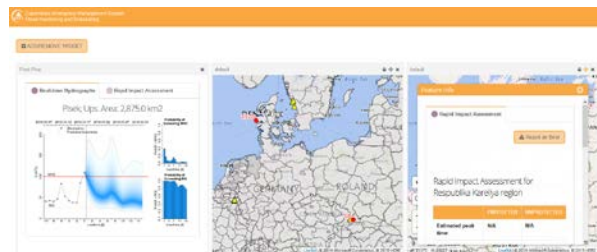
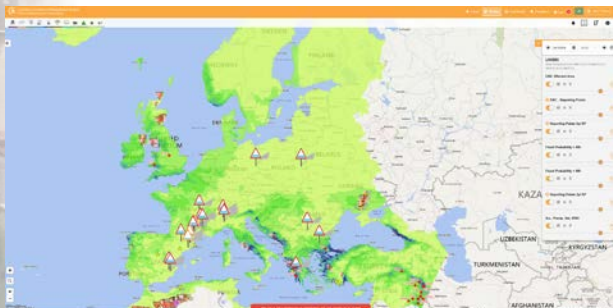
- Released May 2018
- Bigger model extent & INSPIRE compliant projection system
- re-done static input maps for LISFLOOD
- LISFLOOD model updates
- Improved meteorological data
- Improved calibration (704 stations for calibration used)





New developments – EFAS web interface

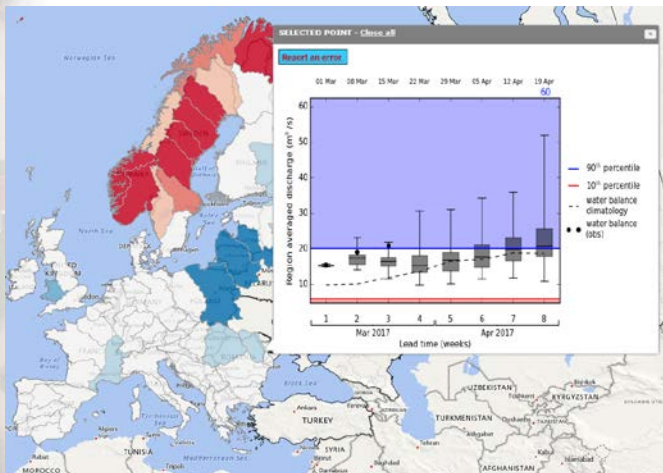
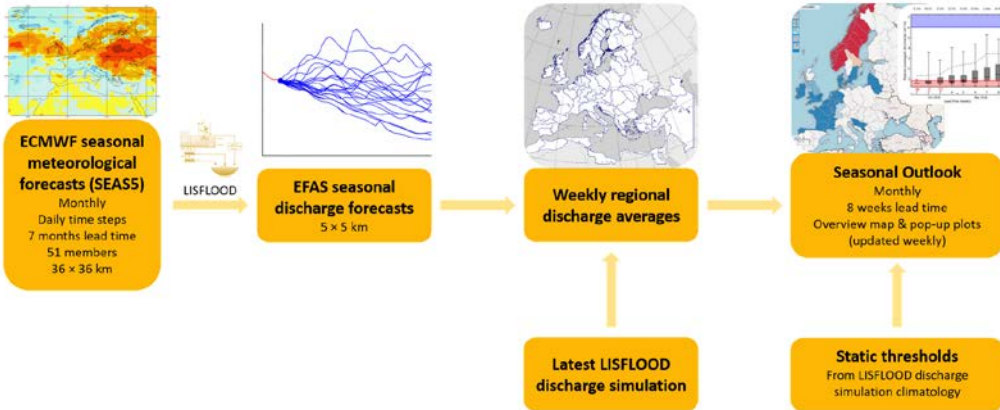
- ★ New EFAS web interface released February 2019
- ★ Modern design
- ★ Customizable
- ★ Adapted for mobile devices
- ★ Possibility to add external WMS
- ★ Dashboard
- ★ Notification feedback integrated + possibility to report a missed event





New developments – seasonal outlook

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- river flow anomaly and its probability of occurrence for the next 8 weeks for Europe
- To provide a very early outlook of possible high and low flows



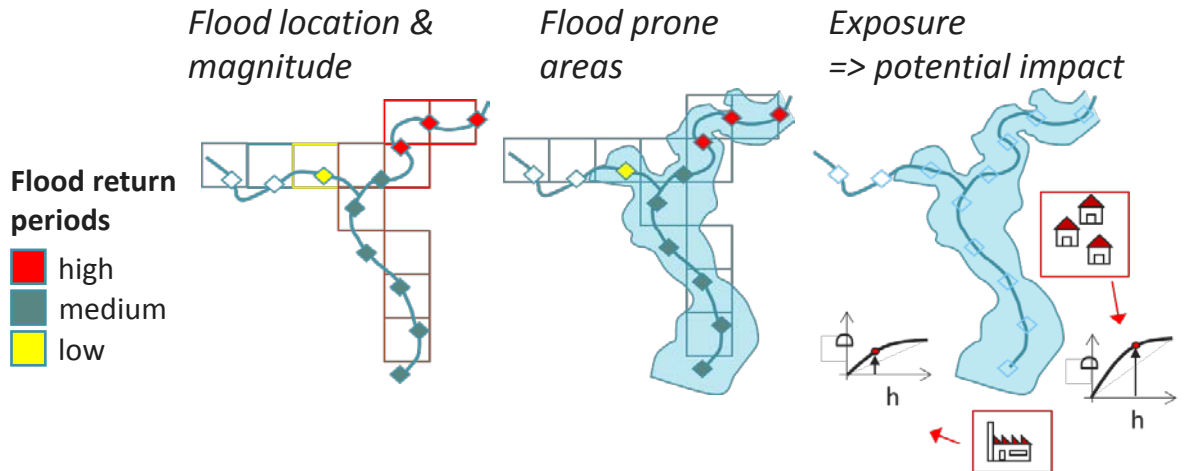
Impact based forecasting in EFAS

Motivation:

- Provide an estimate on affected people, cities, infrastructure & economic damages based on EFAS forecasts

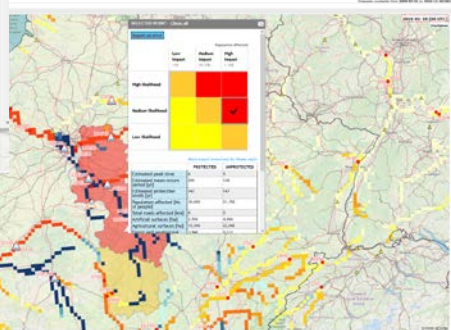
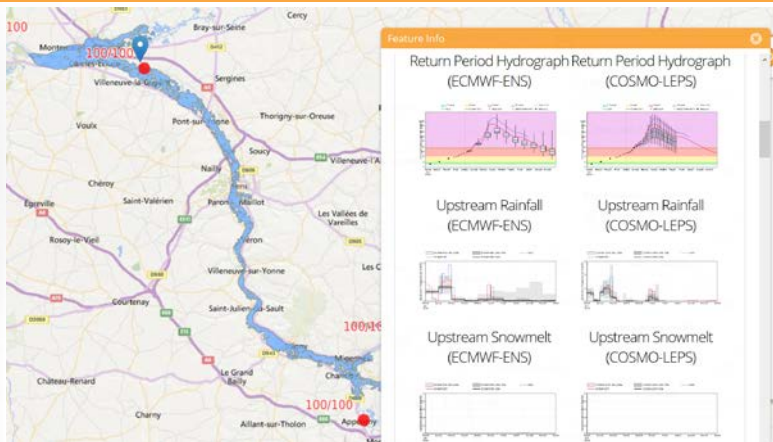
Approach:

- Linking coarse-scale EFAS flood forecasts with high-res flood hazard maps
- Test using national/regional flood hazard maps instead of EFAS 100m resolution maps





Impact based forecasting in EFAS



Combination of the forecasted flooded area with exposure information to assess the potential impact

- (forecasted) flooded area
- affected population / major cities / economic damage / major infrastructures (under dev.)
- Not for detailed emergency planning but for having a forecast based estimate of where the highest impacts are to be expected!



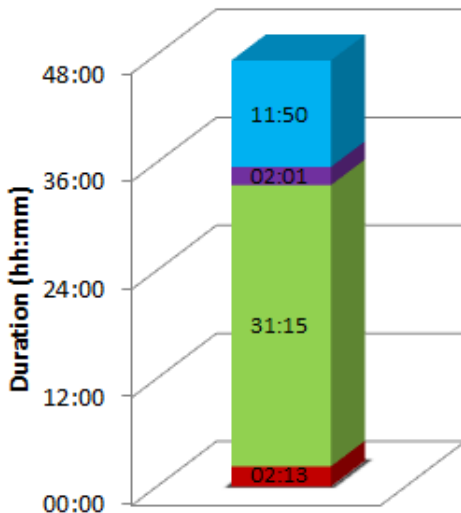
Linking early warning & rapid mapping

Motivation:

- Reduce time for image acquisition (66% of RM workflow)
- Optimise acquisition time with respect to event time

Approach:

- Use EFAS impact forecasts for provision of AOI with high potential impact to pre-task satellite image acquisition (NO RM activation!)



Map production & delivery (25%)

Satellite data reception & validation (4%)

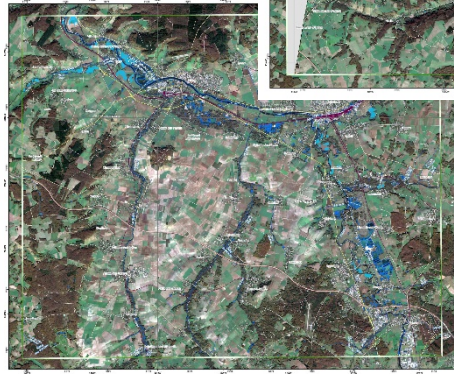
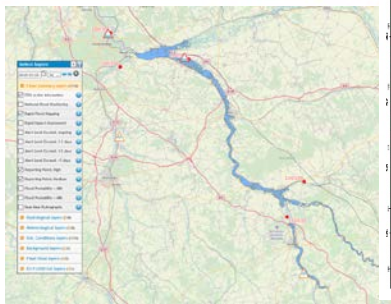
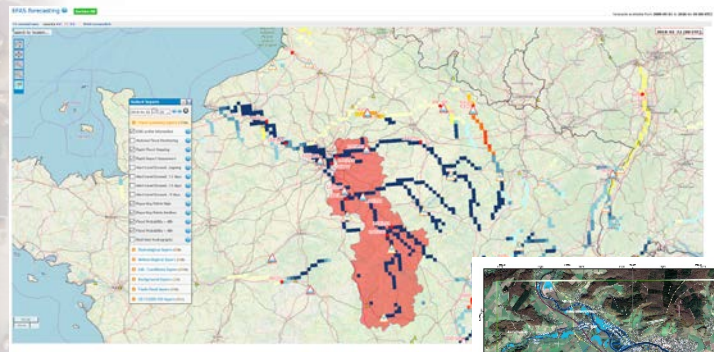
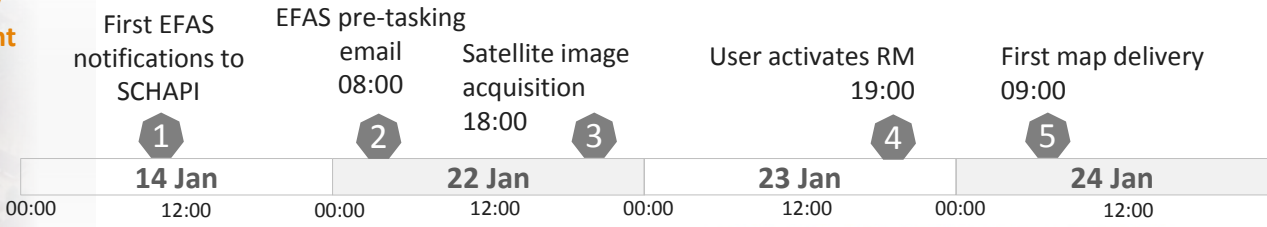
Satellite tasking & acquisition (66%) ←

Request handling (5%)



France Floods January 2018

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New developments – GloFAS v2.0

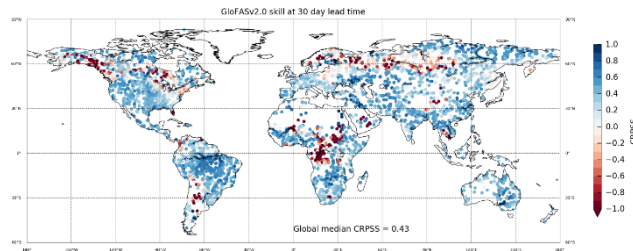
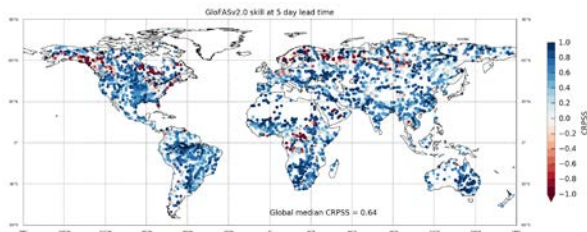
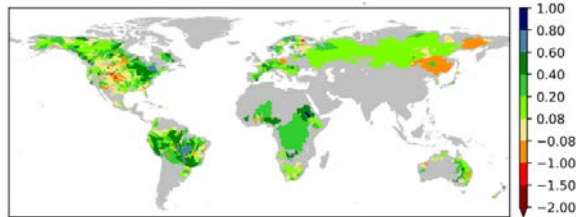
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New model version

- Implementation on 14 November 2018
- Calibrated Lisflood parameters at 1287 river sections
- ERA5 based climatological baseline run and thresholds

Hydrological verification suite

- Comprehensive probabilistic verification suite (under dev)
- Verification against discharge observations and water balance (modelled discharge at initialisation)

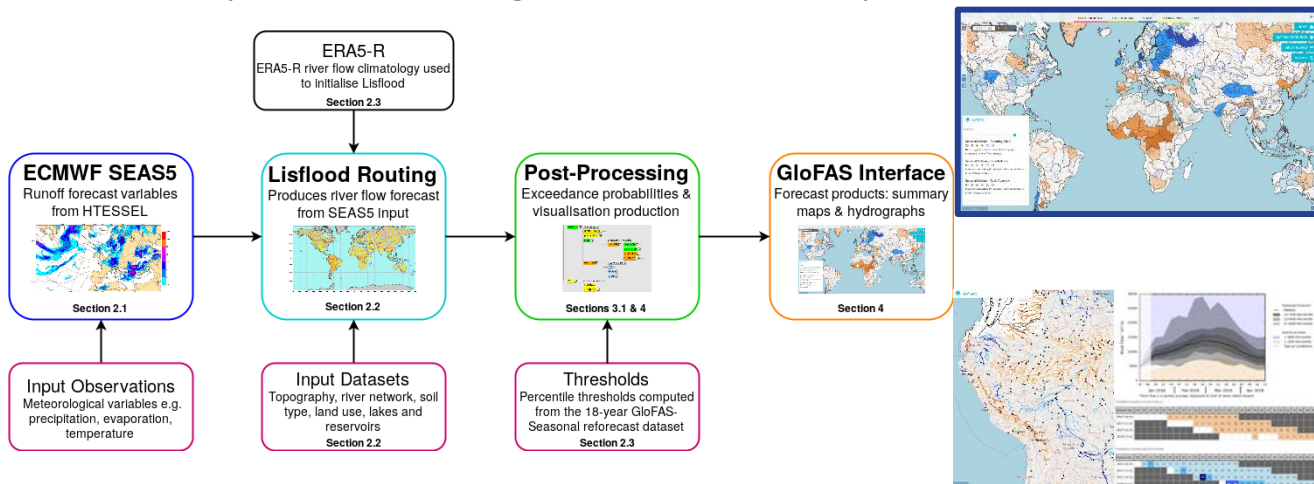




New developments – GloFAS seasonal

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- Developed by University of Reading and ECMWF
- Provides openly available, hydrologically relevant seasonal forecasts for the global river network
- Early indications of high or low river flow, up to 4 months ahead



Emerton et al., 2018, **Geoscientific Model Development**: GloFAS-Seasonal v1.0



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Data access – EFAS & GloFAS

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- Currently: forecast visualization in the EFAS & GloFAS web interfaces or through web map service (WMS)
- Ongoing development:

Archived forecasts and climatology for EFAS & GloFAS available in the Copernicus Climate Change Climate Data Store and ECMWF MARS – under development

Raw forecast data available in NRT through an ftp service (EFAS partners only) – under development

Raw forecasts data at gauging locations available through SOS (EFAS) or individual ftp transfer (GloFAS)

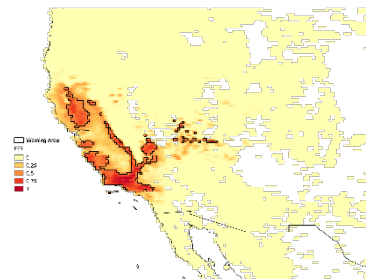




Future developments – EFAS & GloFAS

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- Next major update EFAS: Q1/Q2 2020 – includes improved Lisflood, more calibration stations, 6-hourly temporal resolution for all forecasts and climatology
- Next major update GloFAS: Q4 2019 – includes switch to full Lisflood, more calibration stations, ERA5 for model climatology
- Global flash flood indicator: ECMWF Ensemble 24h Total Precipitation Extreme Forecast Index (EFI)
- Impact based forecasting for GloFAS: Q3 2019 – same concept as in EFAS
- Lisflood open source: Q2/Q3 2019 – turning Lisflood and its associated tools into a full open-source code model



The screenshot displays a web interface with several sections:

- Lisflood**: A section with a map and text describing Lisflood as a physics distributed urban inundation model.
- Lisflood**: A section with a map and text describing Lisflood as a spin process that simulates urban inundation.
- Calibration**: A section with two line graphs showing precipitation and discharge over time, and text describing calibration and development.
- Test Catchments**: A section with two maps of Europe and text describing the catchments used for testing.
- Tools**: A section with a bar chart and text describing the tools available for data collection and analysis.

How To collaborate

Thank you!



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Copernicus Emergency Management Service
Annual Meeting
21-22 May 2019
Stresa, Italy

