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Early Flood Warning in the Elbe: Application of the European Flood Alert System (EFAS) in the Elbe

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DG-JRC
(*) detached from LUA Brandenburg
(**) detached from CHMI

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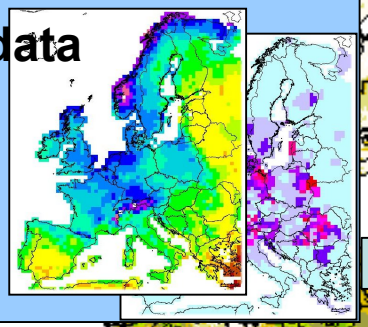
Why a European Flood Alert System?

- Early flood alert information to National Hydrological Services (> 48 hrs, max 10 days) to complement the systems in MS
- Catchment based: not depending on information from upstream catchments -> enabling longer leadtime by simulating entire catchment
- Probabilistic approach using different weather forecasts and ensemble weather forecasts (EPS)
- Overview and monitoring of flood situation in Europe (assist DG ENV MIC):
  - Sharing rescue resources during European crises
- Potential backup for national systems

EFAS: based on LISFLOOD system

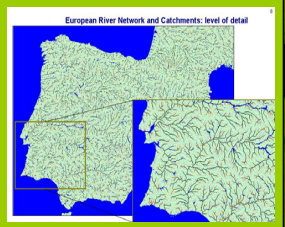
Meteo data

-ECMWF
-DWD
-DMI…



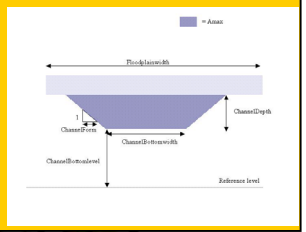
JRC European Data

- Soil, Surface, river catchment system, …

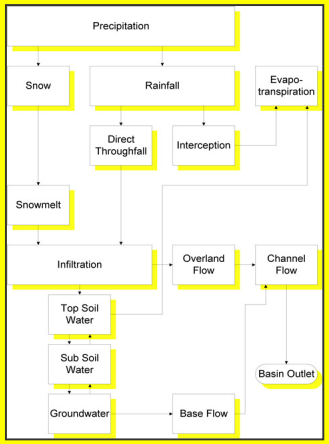


Member States data

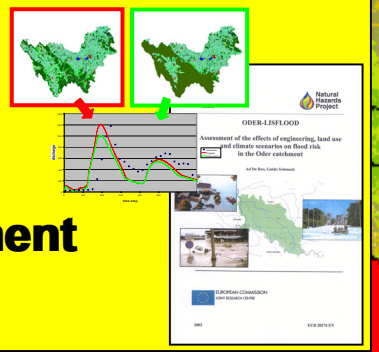
- River dimensions
- Alert levels



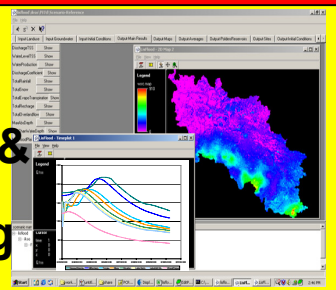
LISFLOOD



River Basin Management



Flood simulation & Forecasting (EFAS)



Special features:

- Early flood alert to Nat. Hydrological Services (48+ hours)
- Catchment based
- Probabilistic approach
- Input to the MIC (Monitoring and Information Centre of DGENV) during crises

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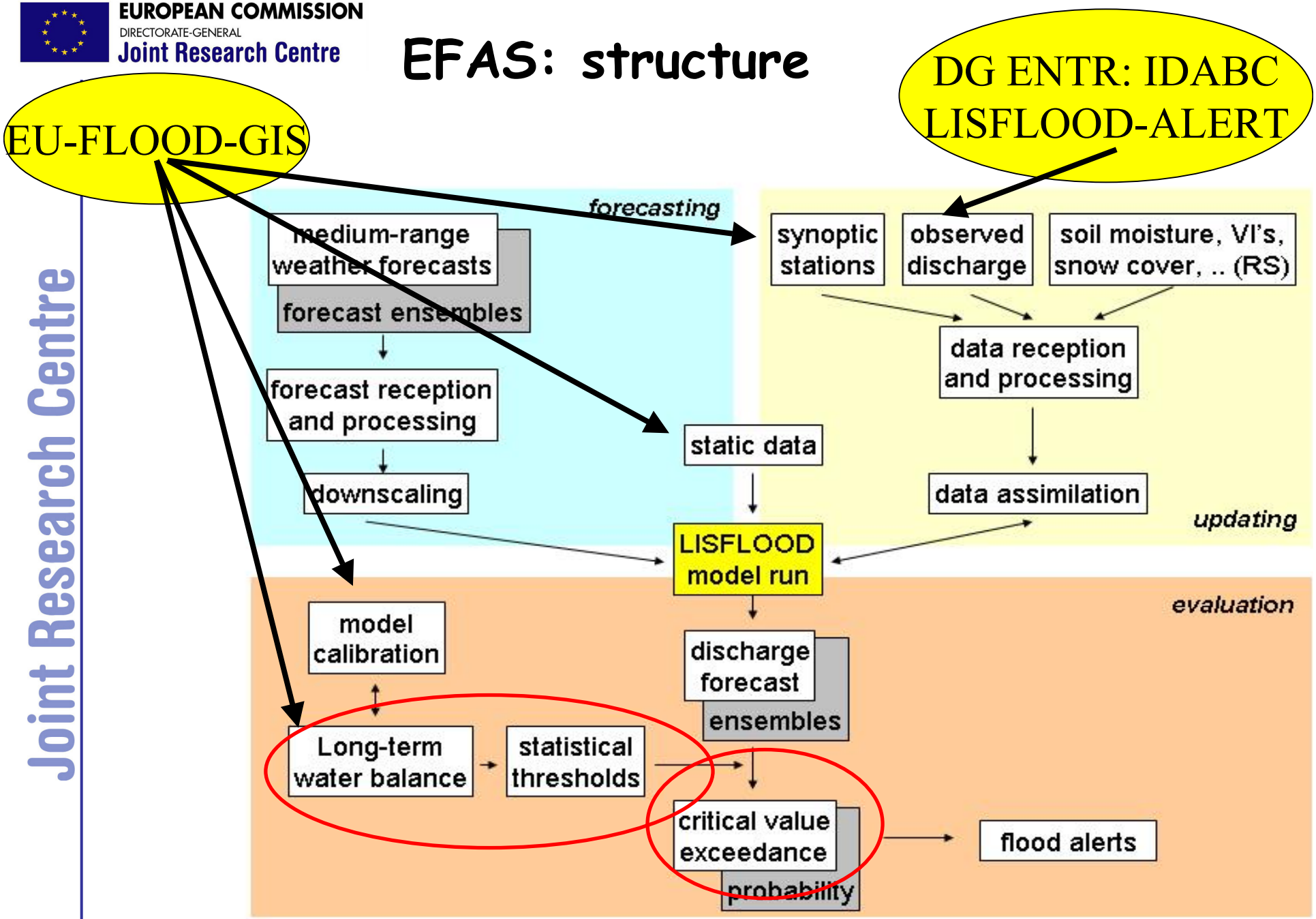
EFAS: structure



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EFAS

- 5x5km Europe
  - ECMWF deterministic
  - DWD LME-GME deterministic
  - ECMWF EPS ensembles
  - COSMO-LEPS ensembles (IP-PREVIEW)
- 1x1km Selected river basins
  - Danube upstream Iron Gate
    - ICPDR Flood Action Plan
  - Elbe
    - IKSE Flood Action Plan (scenarios)
  - Oder
    - 1km model setup available from IKSO scenario study
  - Maas
    - 1km model setup available

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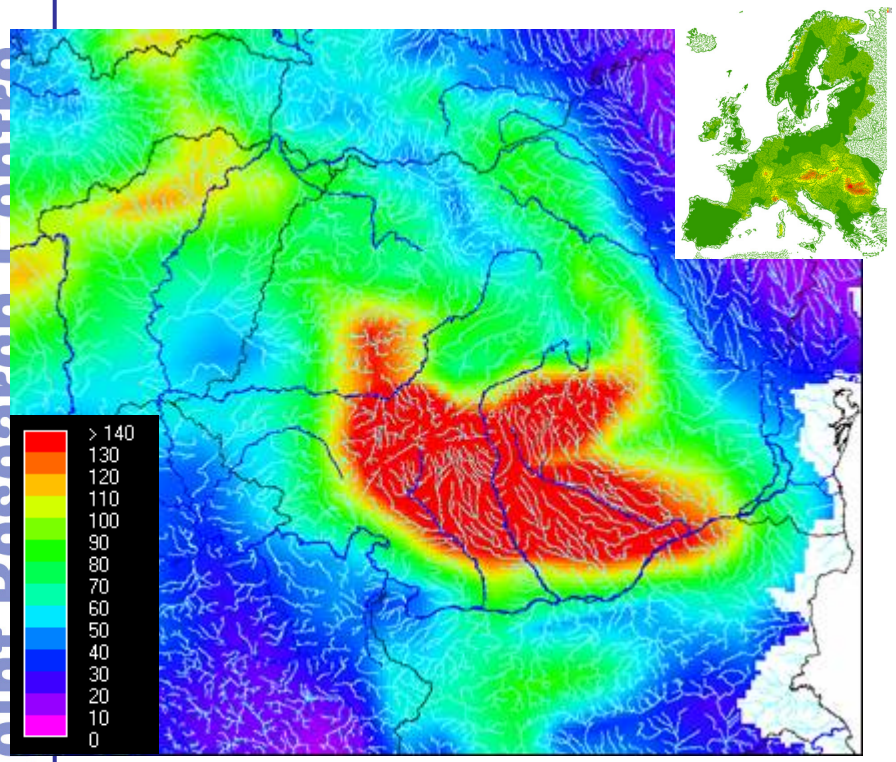
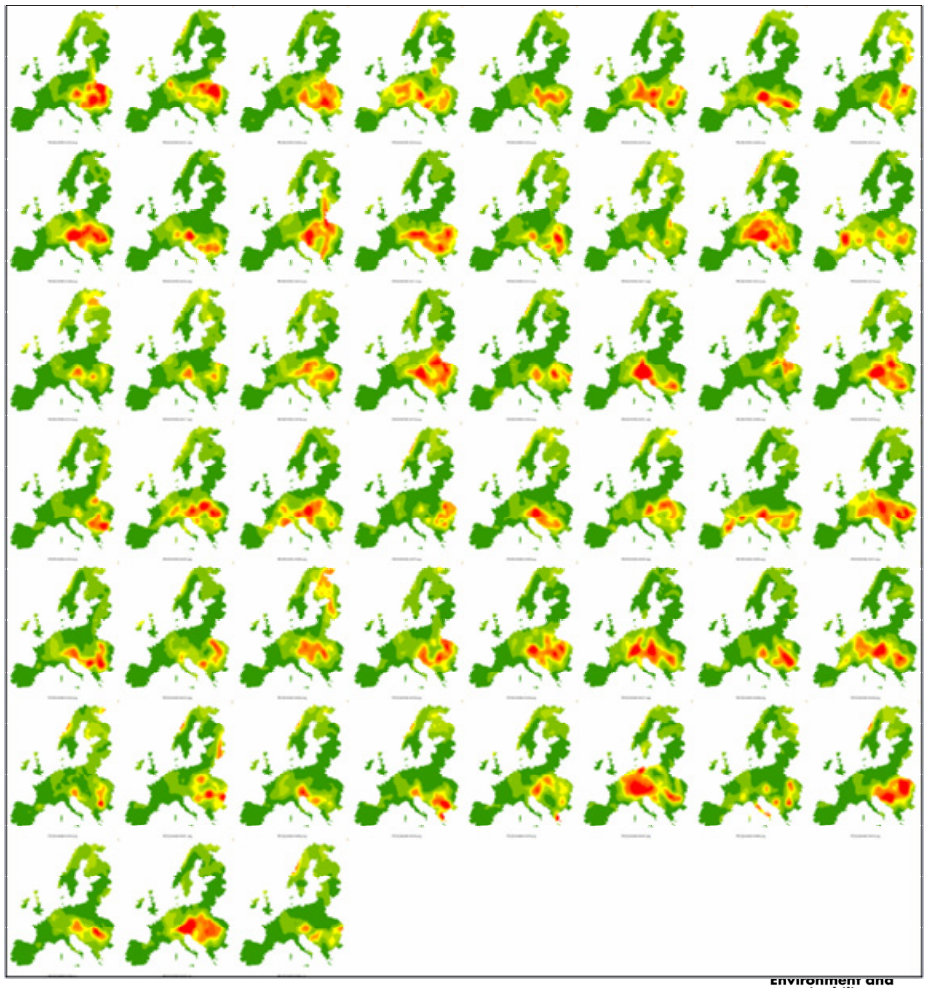
ECMWF weather forecasts



ECMWF Deterministic
Total amount of rainfall
forecast for the next 10 days

ECMWF- EPS (51 members)
Total amount of rainfall
Forecasts done for the next 10 days



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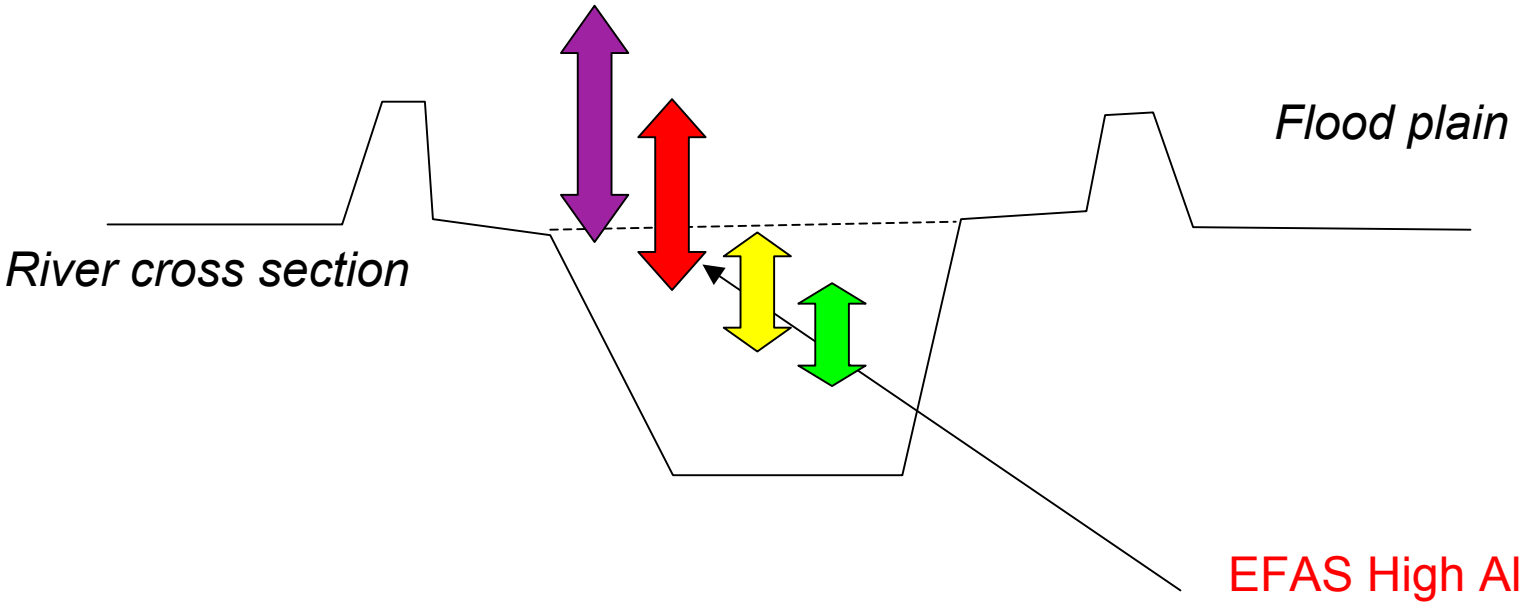
EFAS alert thresholds

EFAS Stufe	Farbe	Beschreibung
S (Sehr hoch)		Sehr hohe Hochwasserwahrscheinlichkeit
H (Hoch)		Ernsthaftes Ansteigen der Abflüsse mit hoher Hochwasserwahrscheinlichkeit (voraussichtliches Überschreiten des Freibord)
M (Mittel)		Signifikantes Ansteigen der Abflüsse; kein Hochwasser erwartet
L (Niedrig)		Steigende Abflüsse; kein Hochwasser erwartet

Tabelle 1: EFAS Alarmstufen

EFAS thresholds compared to the real river cross section



EFAS High Alert

~ 2-5 year return period

~ bankful conditions

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EFAS: 2x daily flood forecasting of Europe

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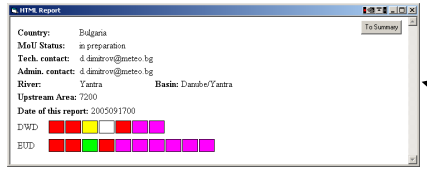
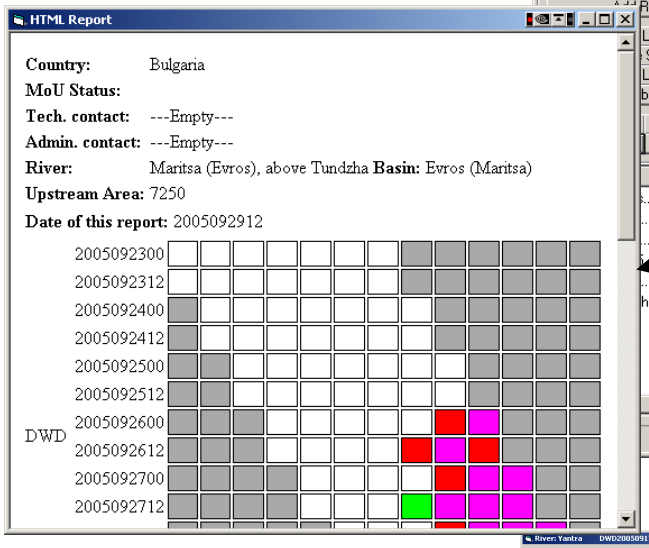
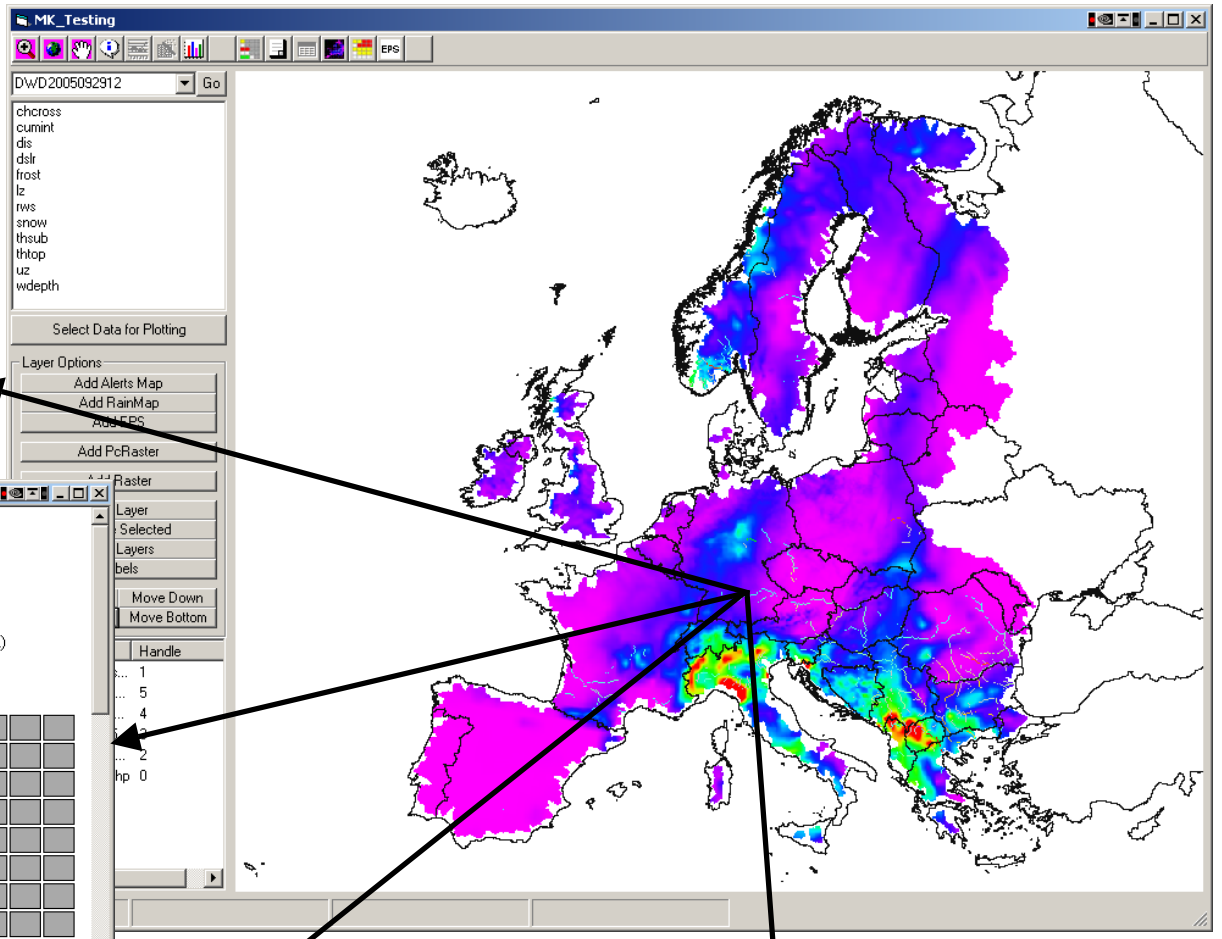
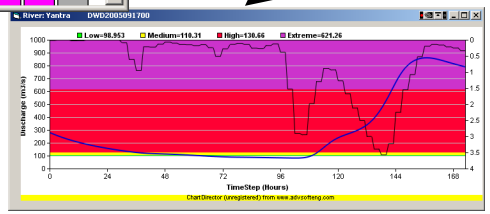
ECMWF
- Det
- 51 EPS

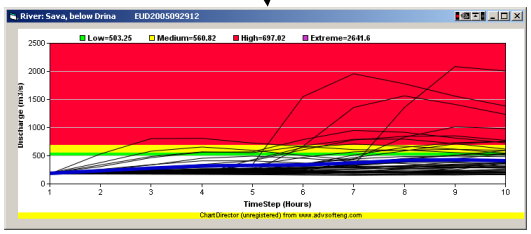
DWD:
- LME
- GME











- Interface for EFAS
  - Display spatial data
  - Display time series
  - Analyze results
  - Reports

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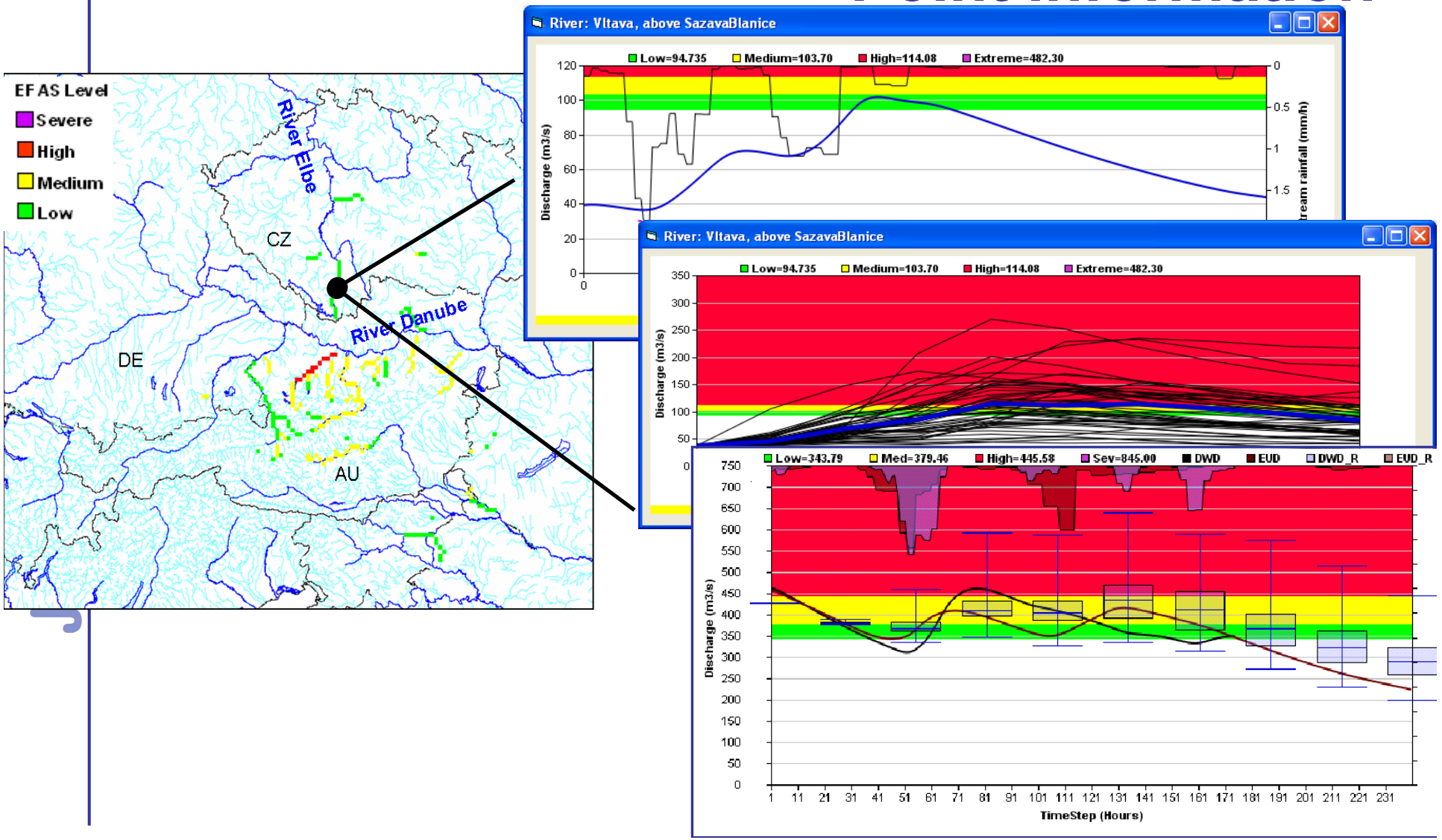
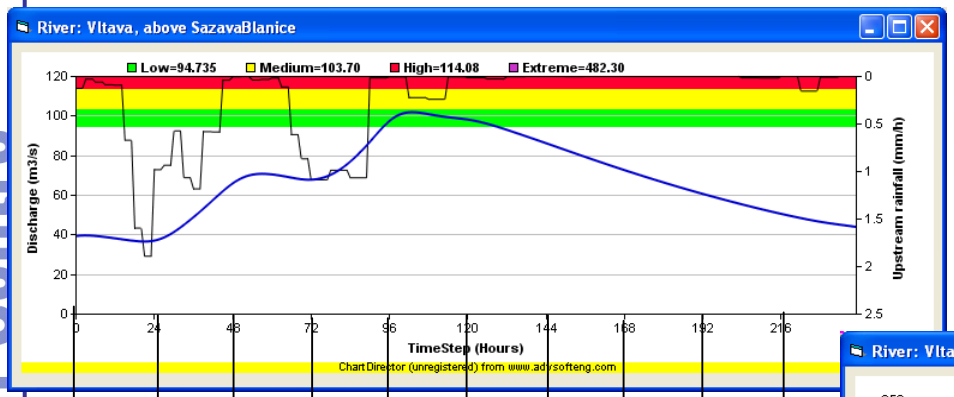
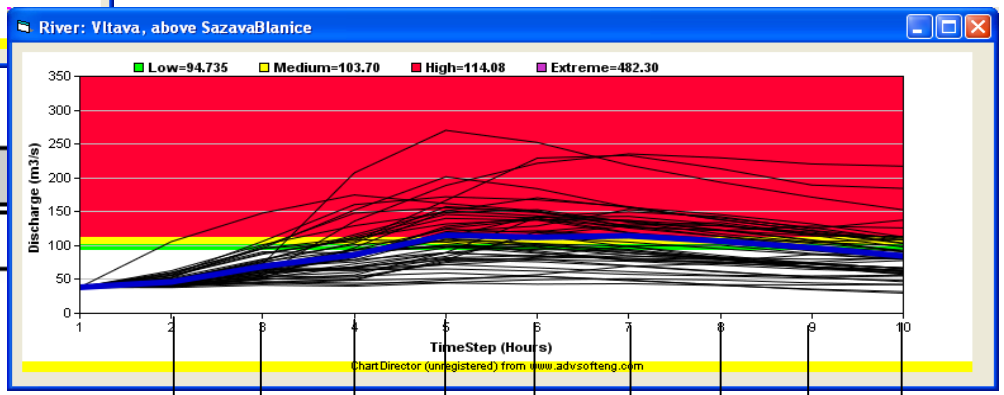
EFAS user interface:

Point information



EFAS: SIMPLIFYING INFORMATION

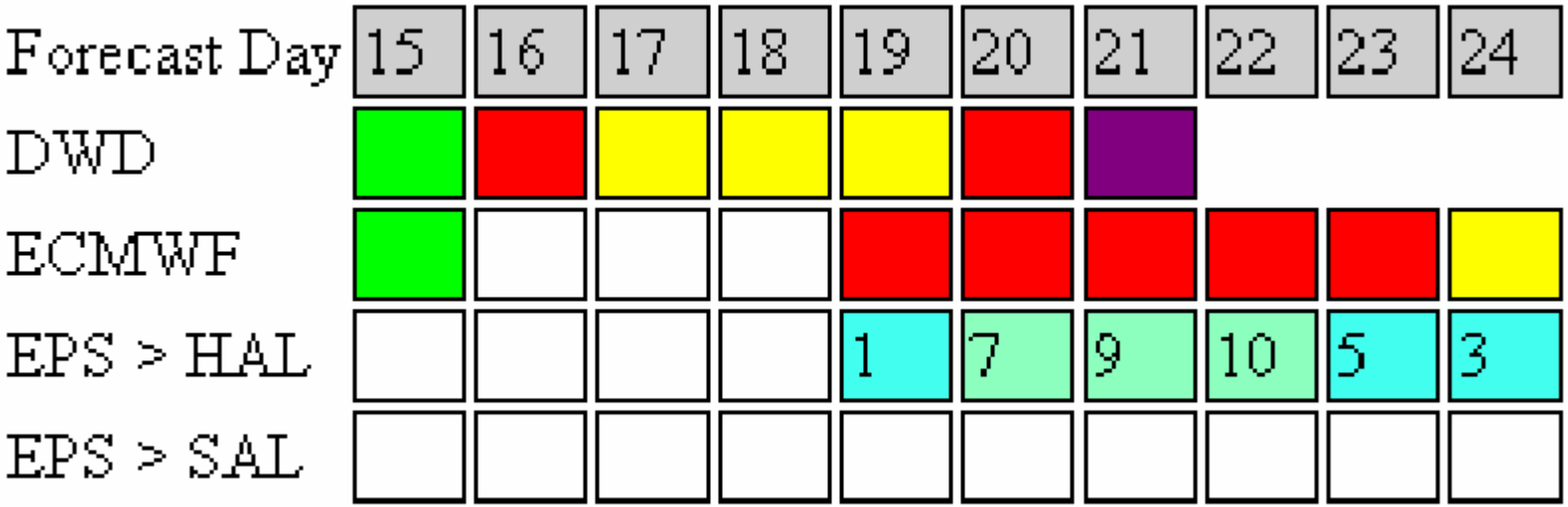




Forecast Day	8	9	10	11	12	13	14	15	16
EPS > HAL		1	8	22	24	22	17	14	5
EPS > SAL									

Communication to endusers

Date of this report: 2005101500



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An EFAS alert is send out:

- If a forecast is persistent
- If MoU exists (liability)
- If systems & data are checked
- Send daily until flood event is over

MoU's:

- signed: DE (BfG, Brandenburg, Saxony, Baden-Wuertenberg), HU, SK, BG, IT, LT, PL, MD, CZ, NL, ES
- In progress with: DE (Bavaria), SL, UK, FR, RO, AT, BE-Flanders 2x, SE
- No reply yet from: PR, BE-Wallonia, SB, BH, HR

European Flood Alert System

Information Report

Nr. 1

Subject:
Potential flooding in Upper-Danube Basin + tributaries Isar, Inn, Iller, Lech

Date of this report	20050821 15:30
Responsible Person EFAS team:	A. de Roo
EFAS forecaster:	A. de Roo

Date of next report	20050822 14:00

Cc:

Hydrological Service	**WeatherServices**	**EC**
A. Vogelbacher (Bayern)	W. Zwieflhofer (ECMWF)	G. Schmuck (JRC)
P. Krahe (BfG)	T. Kratsch (DWD)	M. Grasserbauer (JRC)

1. Summary

This report is for EFAS simulations based on meteorological forecasts from **2005082100**

EFAS simulates potentially hazardous situation in the Upper Danube from 23 to 27 August (tributaries already on 22 August)
Countries: Germany
River basin: Danube
Discharge expected to reach high values: 23 August
Peak flow expected: 24 August

Simulations are mainly based on DWD forecasts; ECMWF forecasts are in this case lower and do not result in extreme flood alerts

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Internal and external alerts during 2005

10 External reports for 7 events

Jul: Danube (SK, HU)

Aug: Rhine and Danube (HU, G, *Au*)

Sep: Po (It), Danube (2 BU, *RO*)

Oct: Danube (Hu, *SLO*)

1st EFAS report

(HU, 8th July)

Except for the Po event in September, flooding or close to bankful conditions were reported:

- 4 feedback questionnaires
- 2 emails, verbal confirmation

Internal and external alerts during 2005

27 Internal alerts

-No MoU exists

-Upstream area < 30000 km2

-Event within 48 h

-forecasts are not persistent

-irregularities in the forecasts

- 15 of the internal alerts were confirmed through media, webpage monitoring, verbal exchange
- in some cases no information could be found

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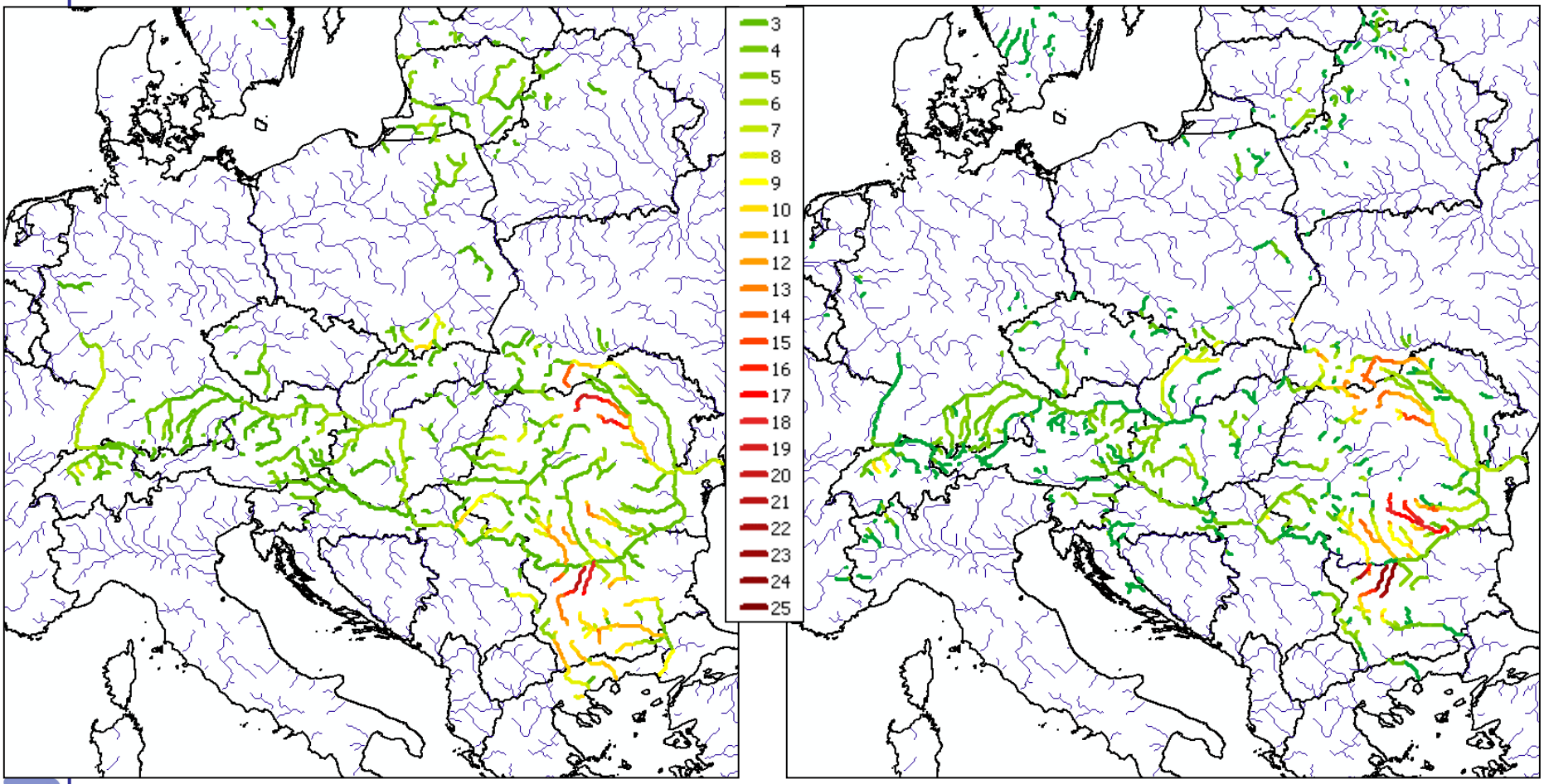
EFAS: research on forecast persistence: when to issue an alert?



EFAS threshold High exceedance 200508 (2 both or 2 EUD or 2 DWD persistent forecasts)

MARS threshold High exceedance (>2) 200508

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Example:

Northern Alps, August 2005

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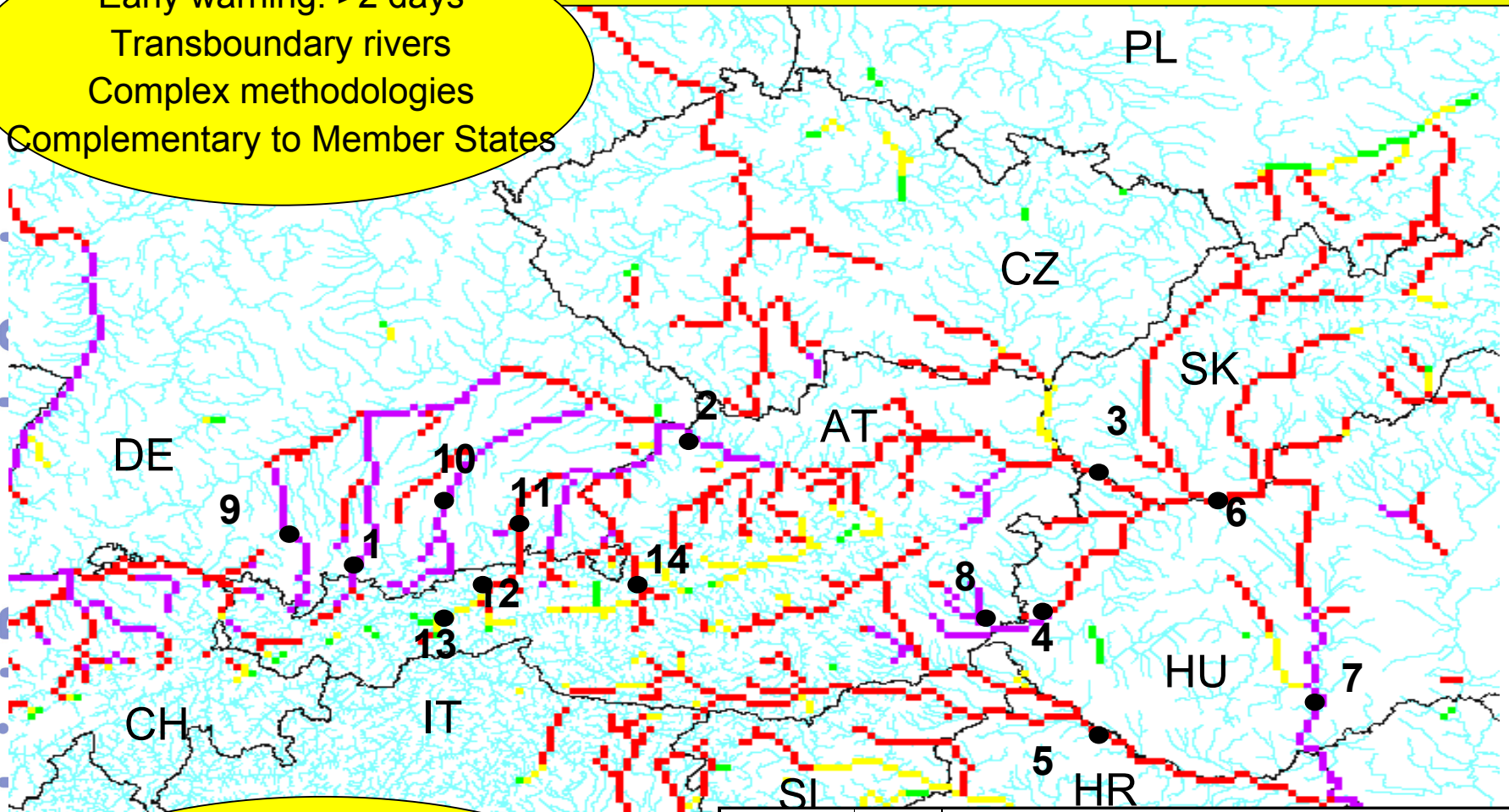
European Flood Alert System: Alert Map issued 21 August 2005 at noon, for the next 7 days

Early warning: >2 days
Transboundary rivers
Complex methodologies
Complementary to Member States



EFAS Level	Color	Description
S (Severe)		very high possibility of flooding, potentially severe
H (High)		seriously increased river discharges with high possibility of flooding (likely exceeding bankful conditions)
M (Medium)		significantly increased river discharges, no flooding expected
L (Low)		river discharges increased, no flooding expected

If we are confident,
EFAS sends early warning
out to MoU members

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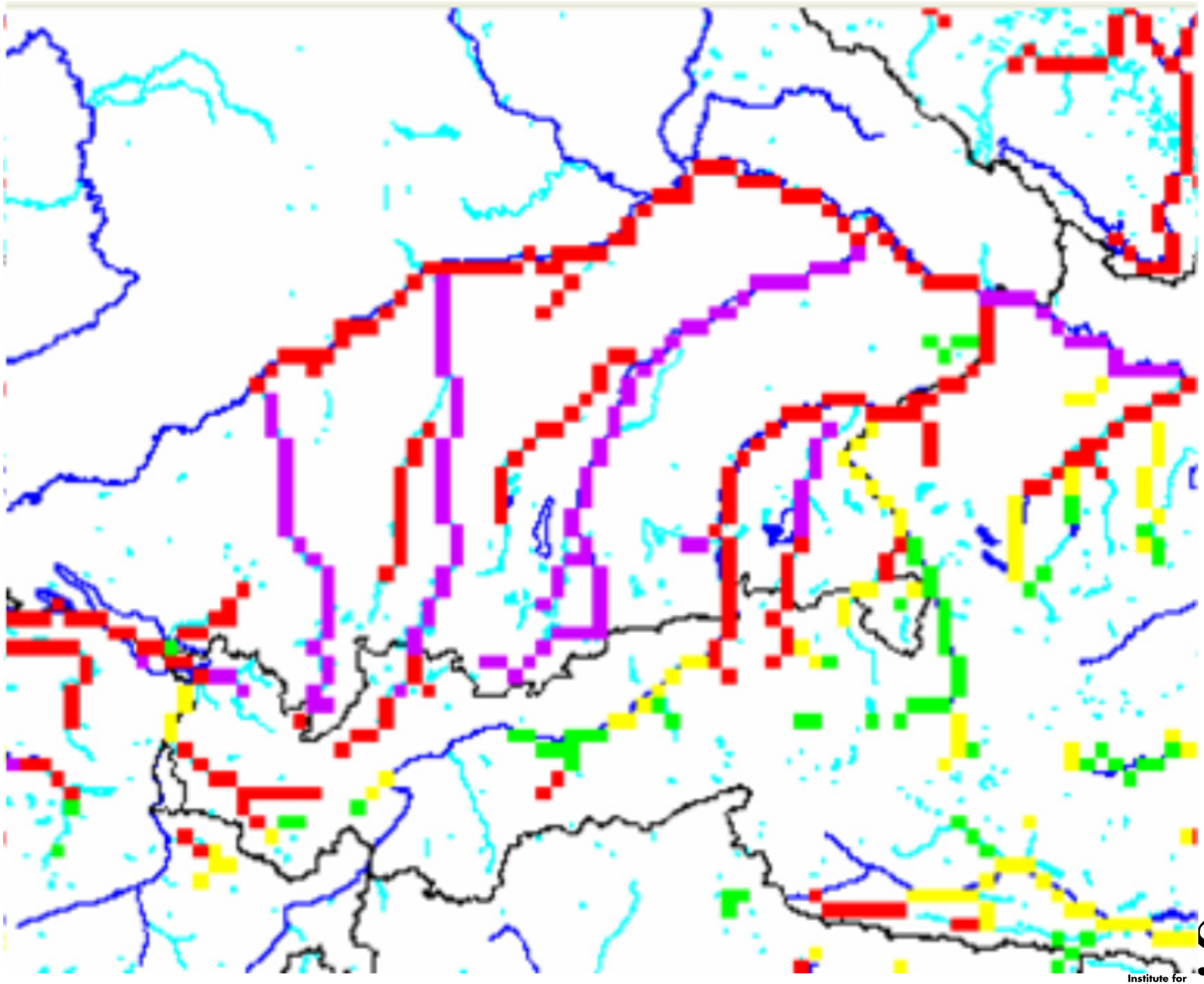

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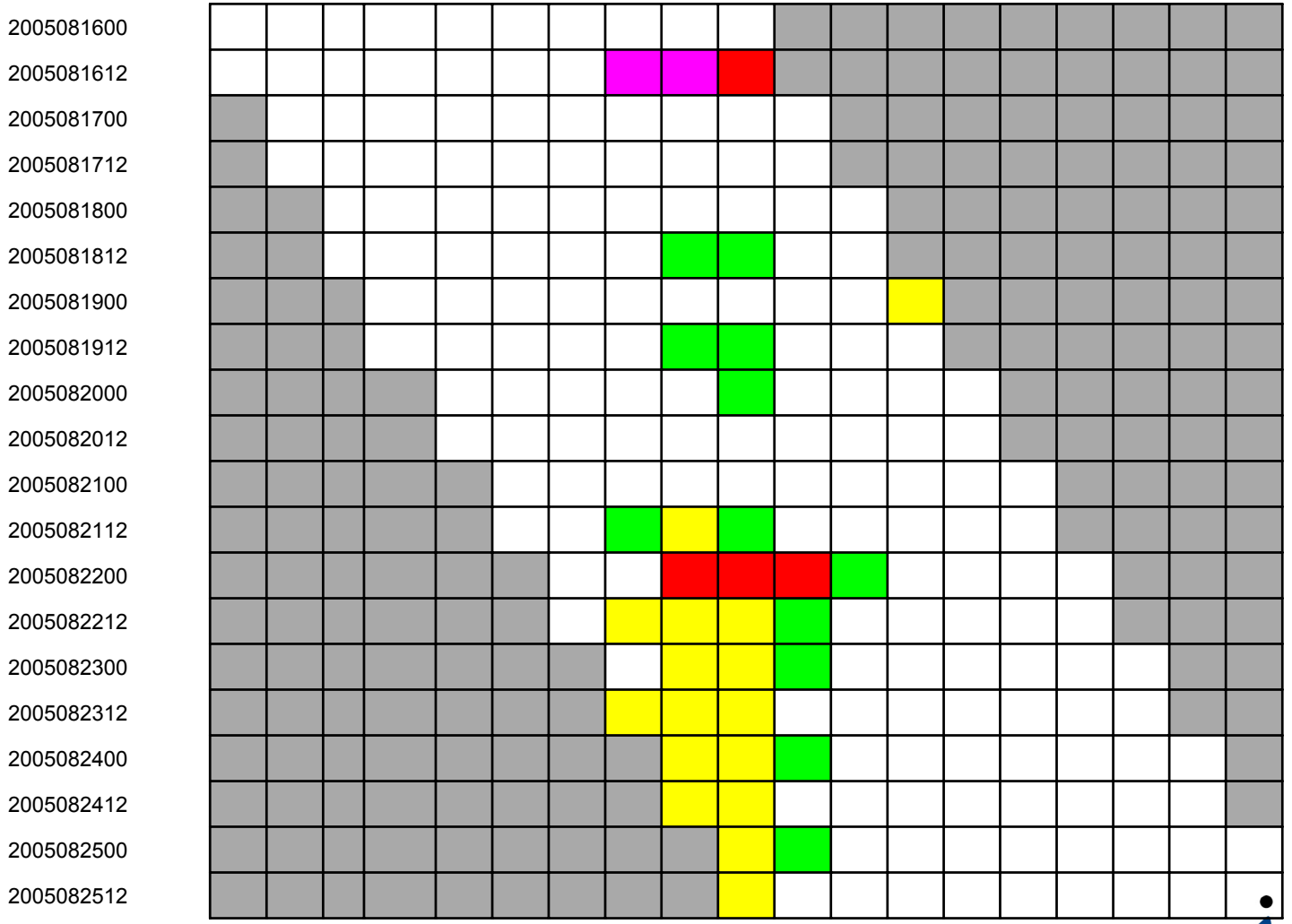
Passau (Danube, D): EFAS: forecast based on ECMWF



Critical discharge predicted for 23-26 August, with peak around 25 August

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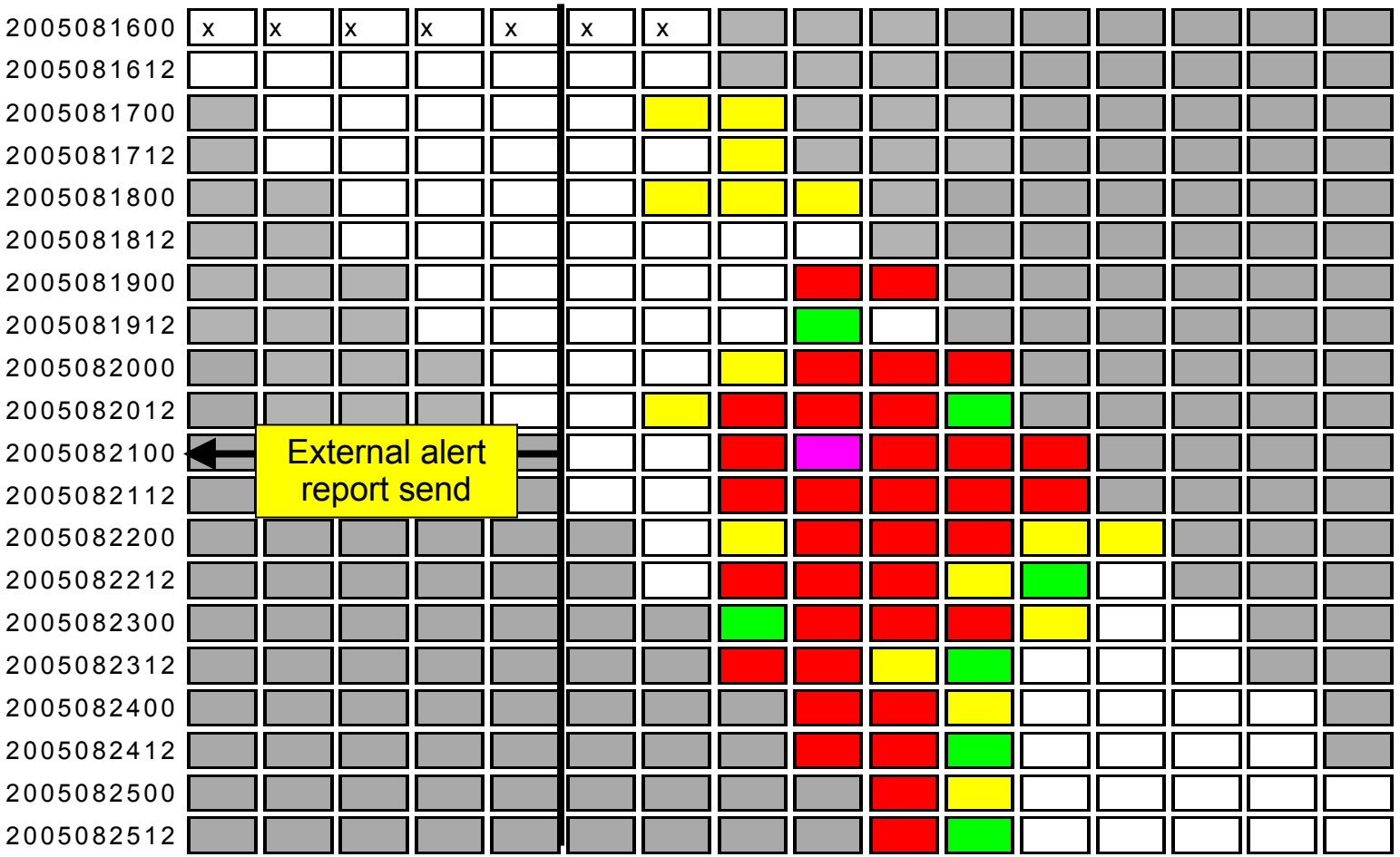
Passau (Danube, D): EFAS forecast based on DWD



Critical discharge predicted for 23-27 August, with peak/extreme at 24 August

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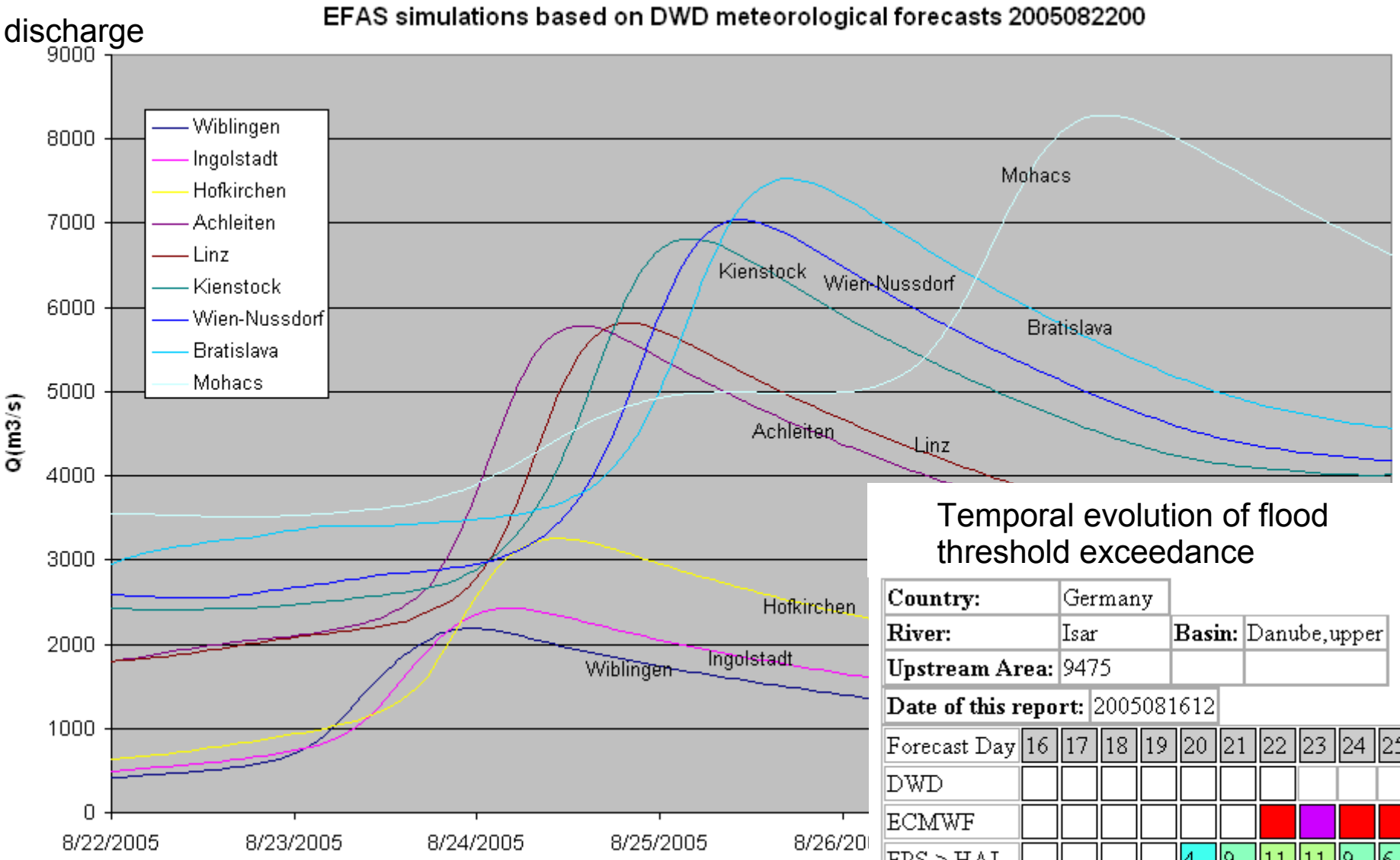
EFAS forecast Danube 22 Aug 2005, based on DWD weather forecasts

River discharge



Temporal evolution of flood threshold exceedance

Country:	Germany		
River:	Isar	**Basin:**	Danube,upper
Upstream Area:	9475		
Date of this report:	2005081612		

Forecast Day	16	17	18	19	20	21	22	23	24	25
DWD										
ECMWF										
EPS > HAL					4	9	11	11	9	6
EPS > SAL										

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Calibration of LISFLOOD 1km Elbe setup for EFAS

Results from the Czech part

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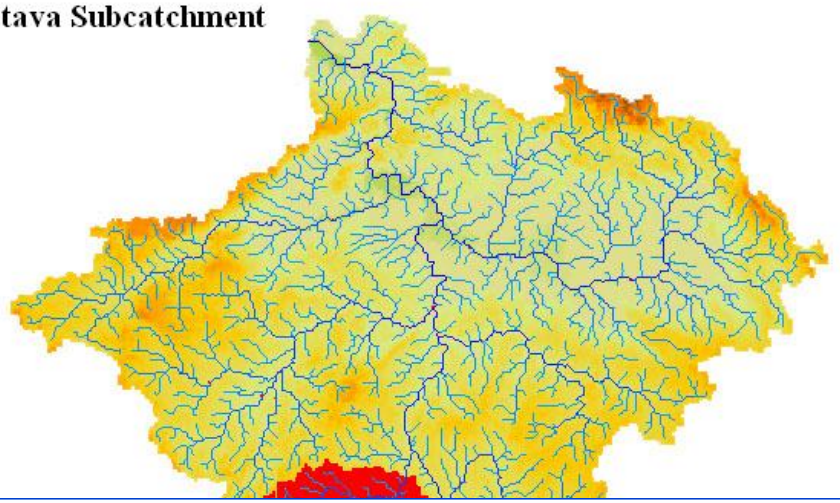
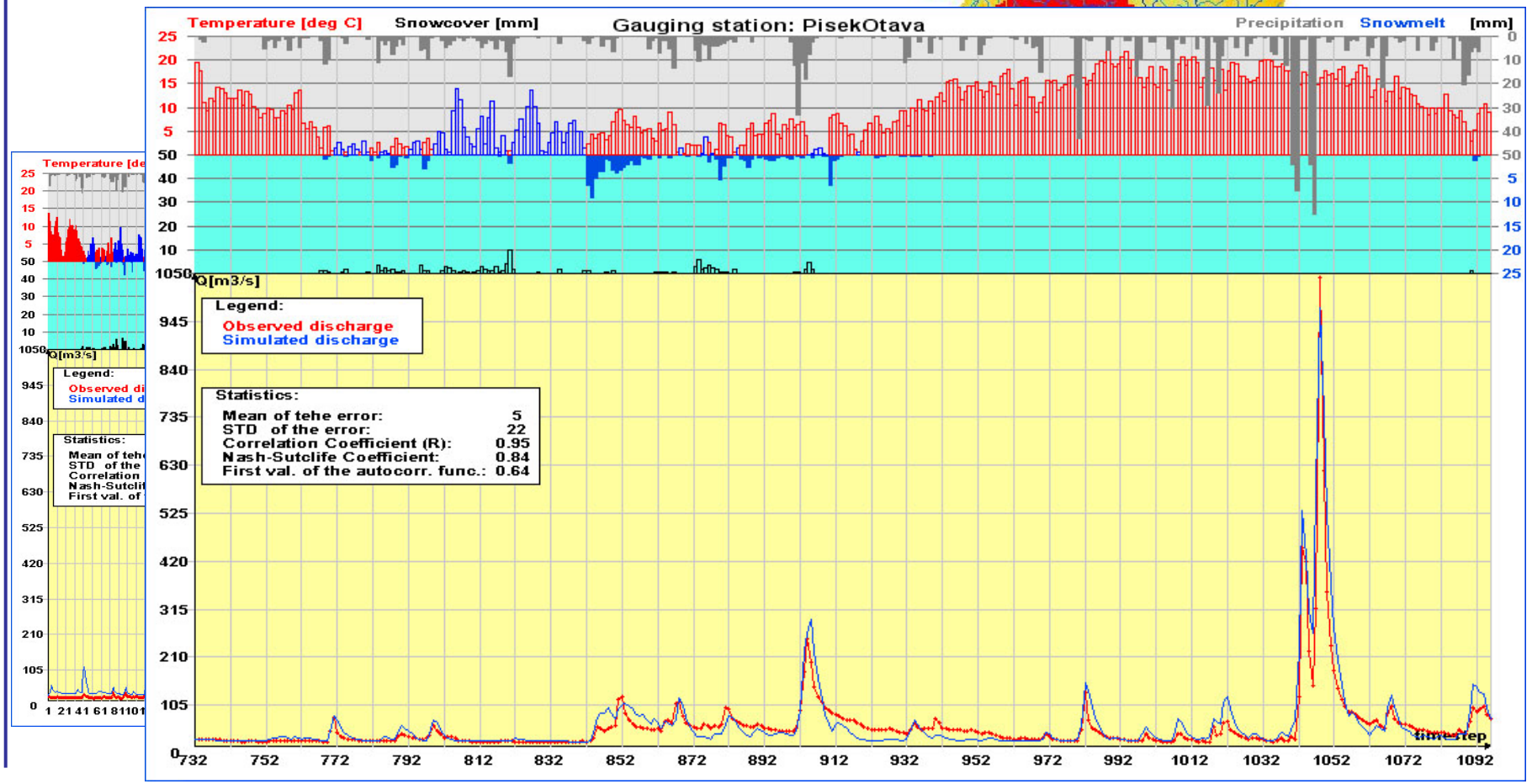
Otava





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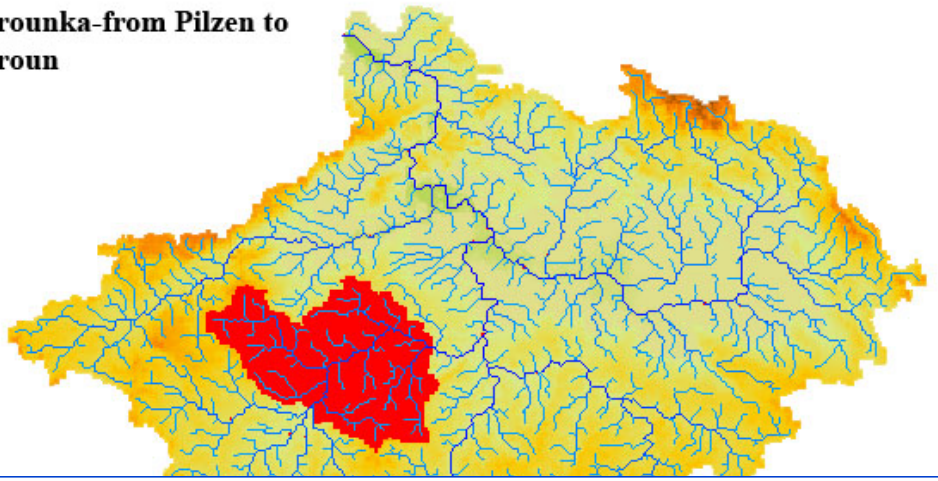
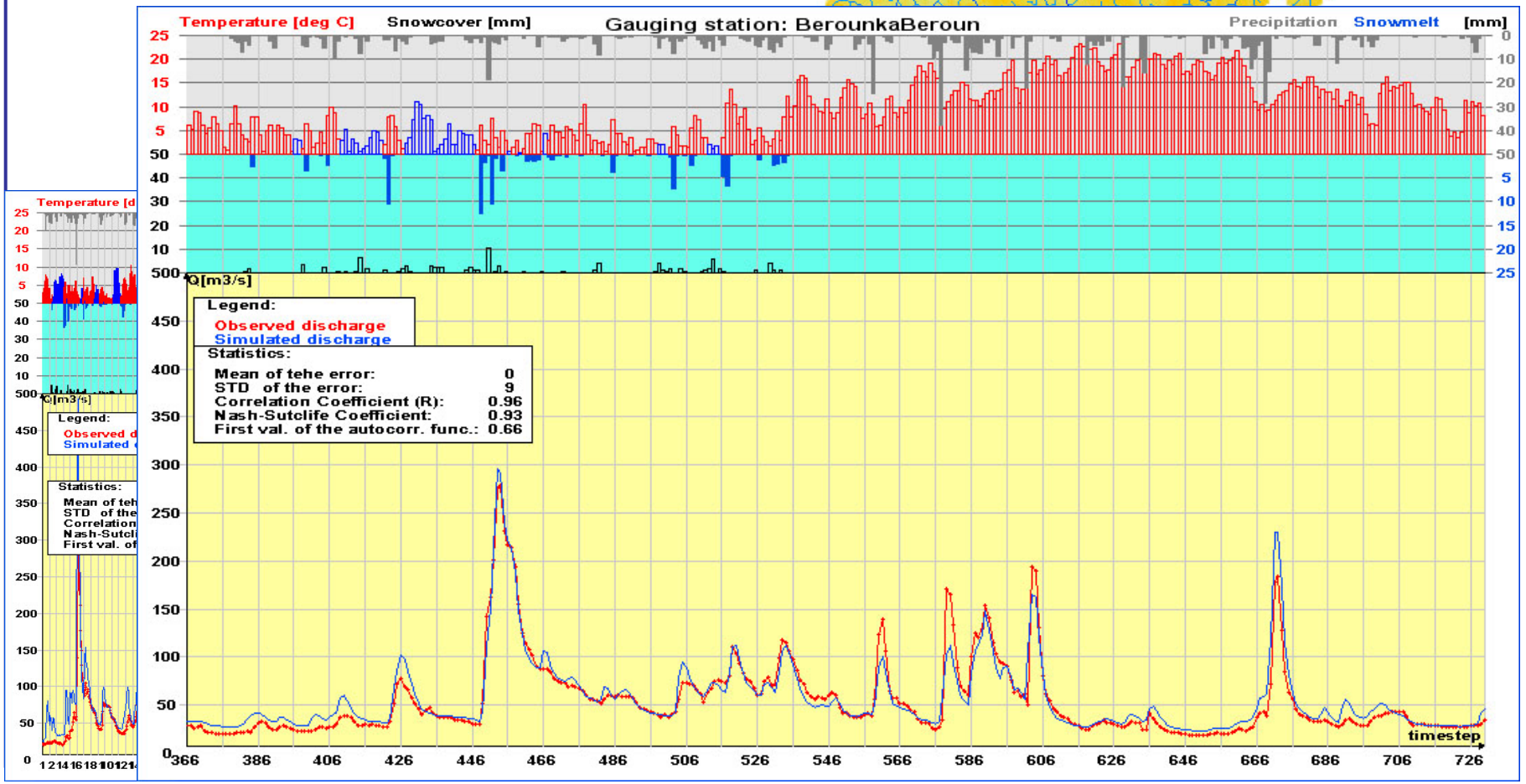
Berounka





EFAS-Elbe

- 2nd half of 2006:
  - 2x daily forecasts:
    - 5km European set-up, incl Elbe
    - 1km Elbe & Danube setup
  - Evaluate:
    - Added-value of resolution and improved data (cross sections)
    - Percentage accurate and false alerts

EFAS & Elbe

- **Advantages for Elbe**
  - **Increased leadtime by:**
    - **Simulations include Czech republic**
      - **Don't depend on measured discharge**
    - **Medium range weather forecast incl EPS potentially allow early warning**
  - **Knowledge sharing & transfer on EPS**

- **EFAS way forward**
  - **Until end 2006:**
    - **Pre-operational testing 5km + EPS**
    - Danube, Elbe 1km versions; linked to Flood Action Programs (FP6): end 2006
    - Light validation for other European river basins (FP6)
  - **2007-2009:**
    - Detailed validation for rest of Europe
    - Inclusion of FEWS
    - EU Flood GIS (Eur Parliament support + DG ENV)
      - Static and historic hydro-meteorological data+ realtime meteo data
    - IDABC Lisflood Alert (DG Enterprise support)
      - Real-time river levels (with WMO Global Run-off Data Centre)
  - **Continued R&D:**
    - JRC workprogramme FP6 & FP7
    - (EFFS), IP PREVIEW, IP FLOODSITE

- **Around 2010, transfer to ?? (to be discussed between DG ENV, Member States, WMO, ECMWF)**
    - Next internal meeting with DG ENV 6 April 2006