HAREN

Hazard Assessment based on Rainfall European Nowcasts

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Genova (Italy) on 4th of November 2011

after > 300 mm of accumulated rain

Why precipitation nowcasting is crucial in hydrology?

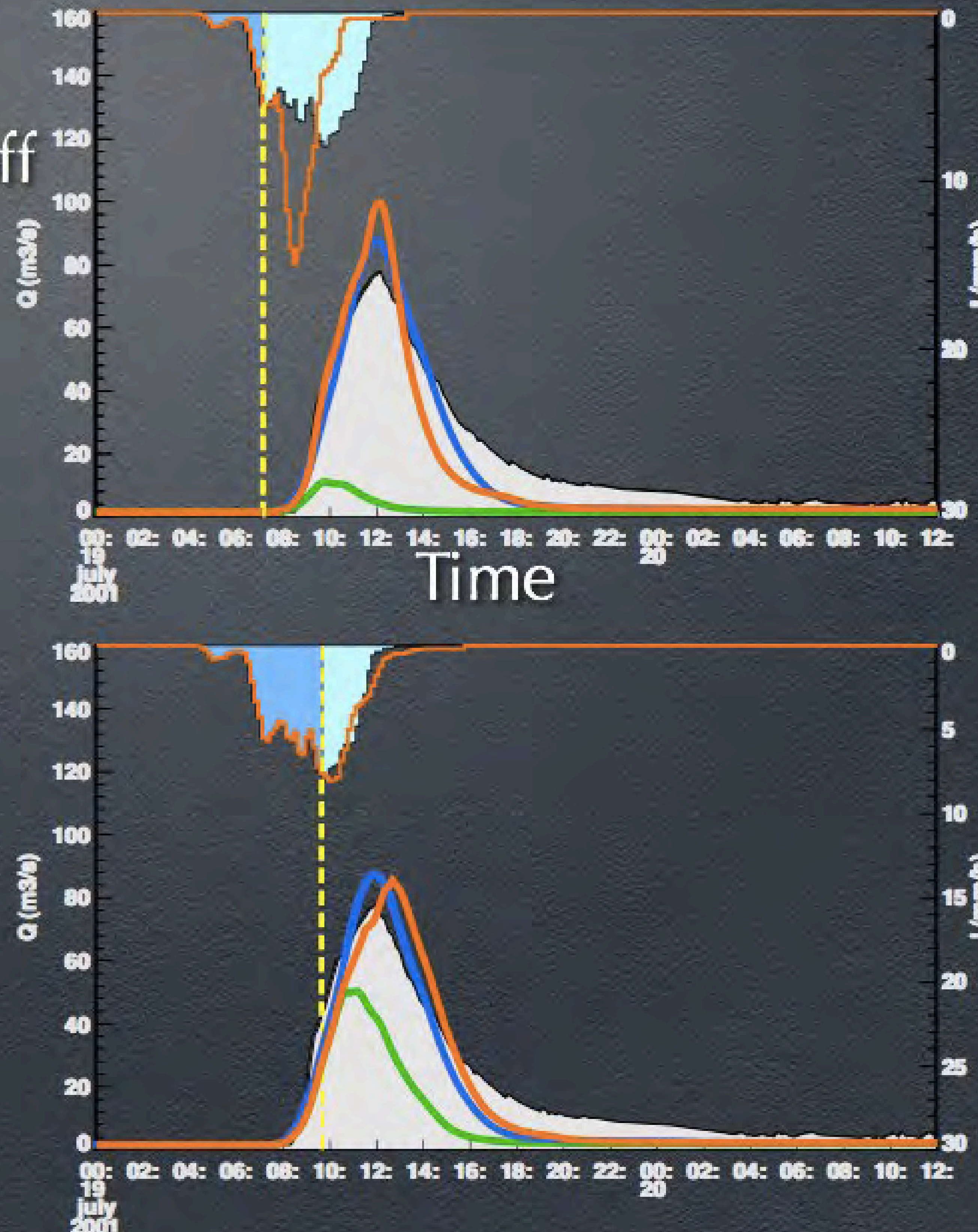
forecasting example using radar
(Besòs river at Montcada, July 2001)

observed runoff

model

model (without QPF)

model (with radar based nowcasting)



Heavy Rainfall Warnings

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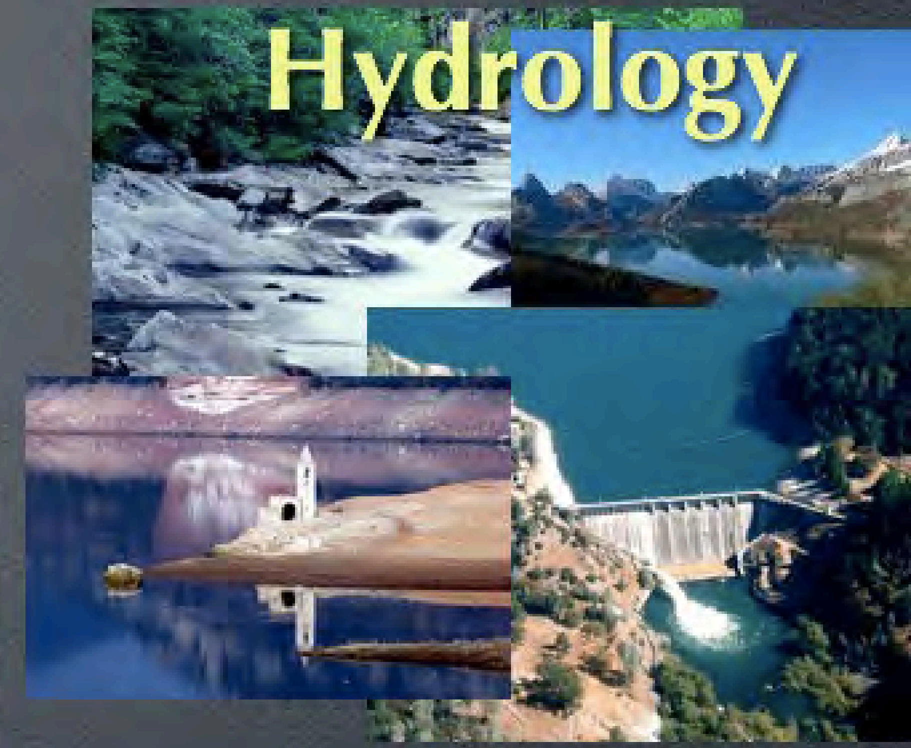
Sports

Transportation

Hydrology



Outdoor Activities

European
Civil Protection

Civil Protection Prevention & Preparedness Projects

Hazard Assessment based on Rainfall European Nowcasts (HAREN)

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meteoalarm
alerting europe for extreme weather

JRC
EUROPEAN COMMISSION

ies
Institute for Environment and Sustainability

PROTECCION CIVIL ESPAÑA
DIRECCIÓN GENERAL
DE PROTECCIÓN CIVIL
Y EMERGENCIAS

NÖZSV

OPERA

Objective

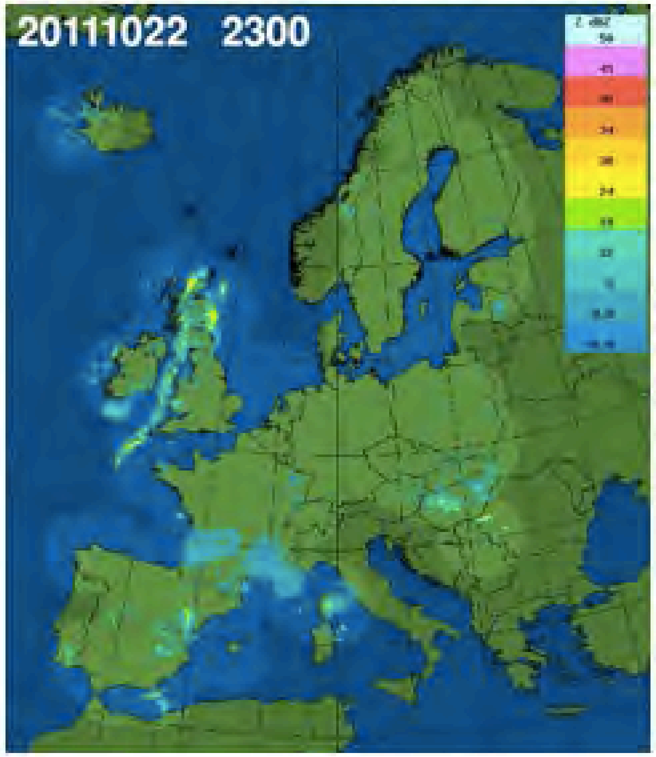
Heavy precipitation is one of the agents leading to major natural hazards in EU

THE CHALLENGE

Forecast the precipitation field at very high-resolution to produce better warnings for hazards induced by precipitation

Using the EU continental precipitation maps generated from the National radar networks provided by OPERA

From observations



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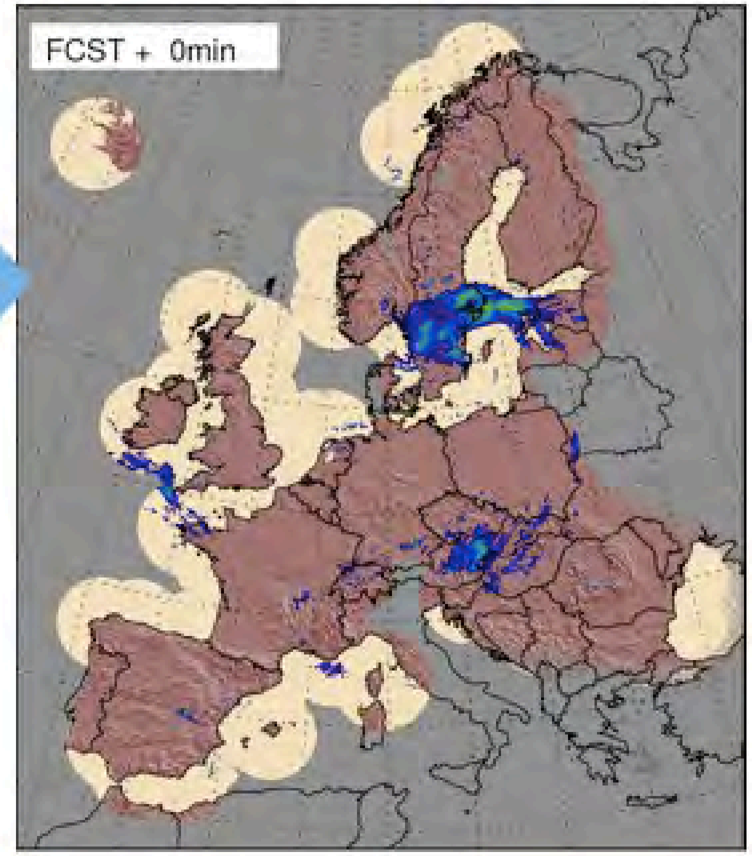
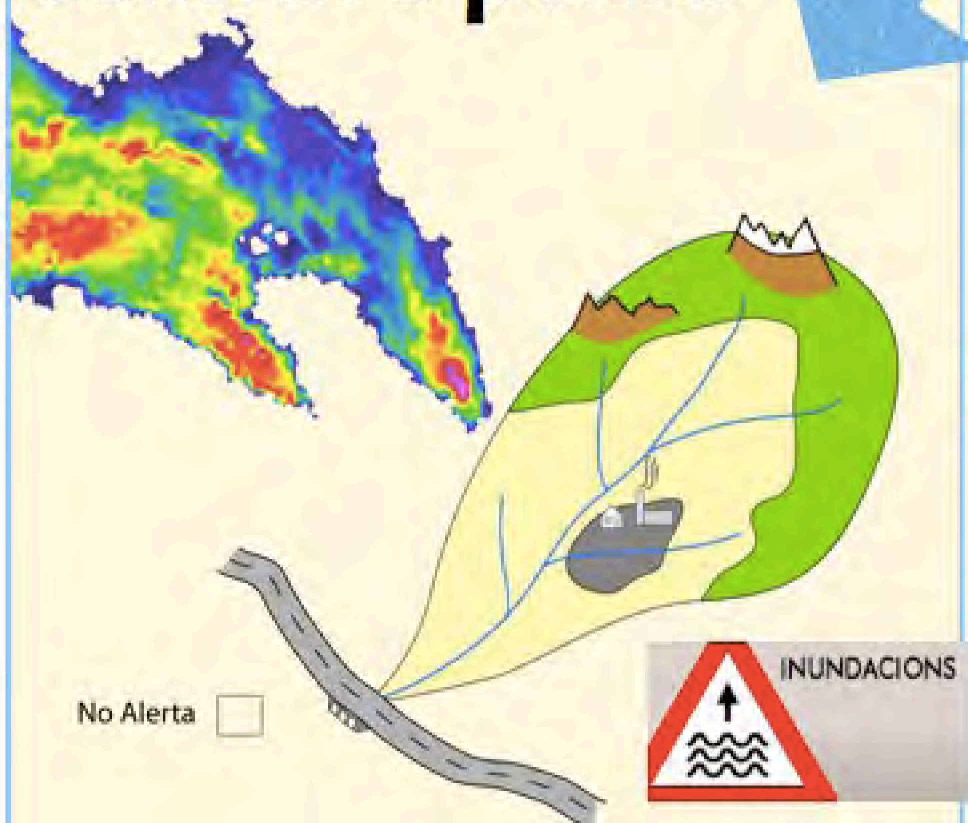
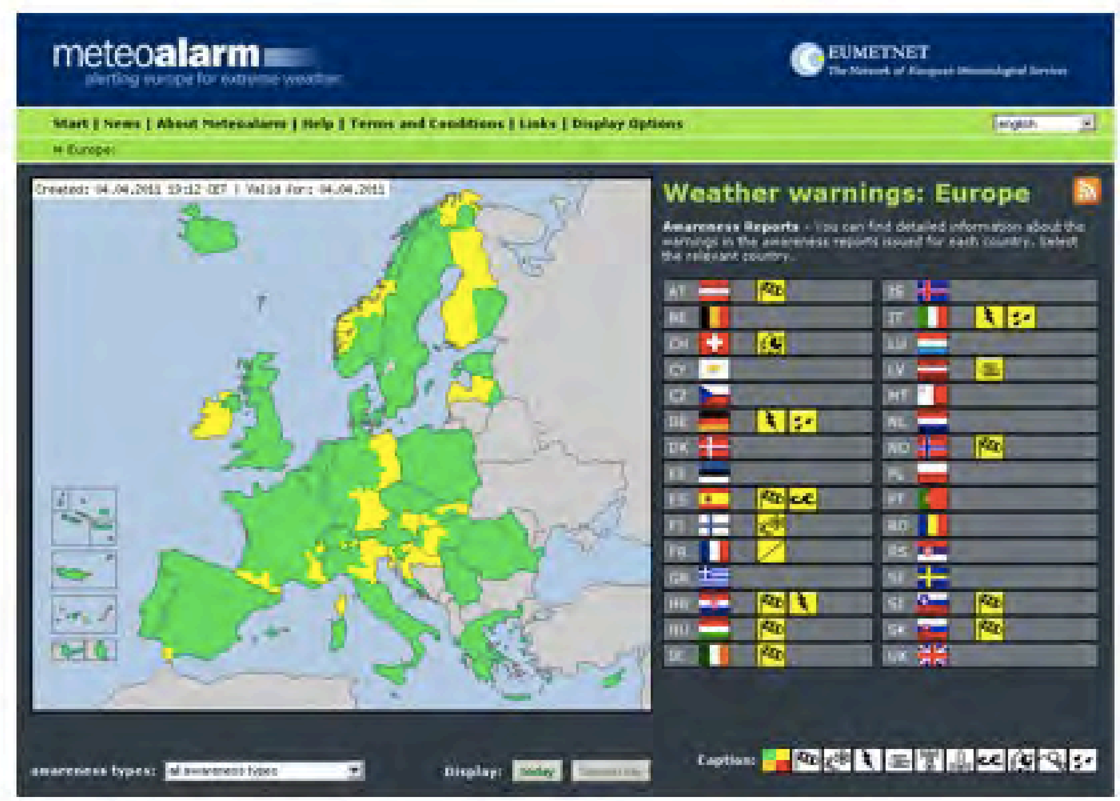


High resolution rainfall nowcastings over Europe @2km every 15 minutes

Warnings at sensitive points





Disseminate them

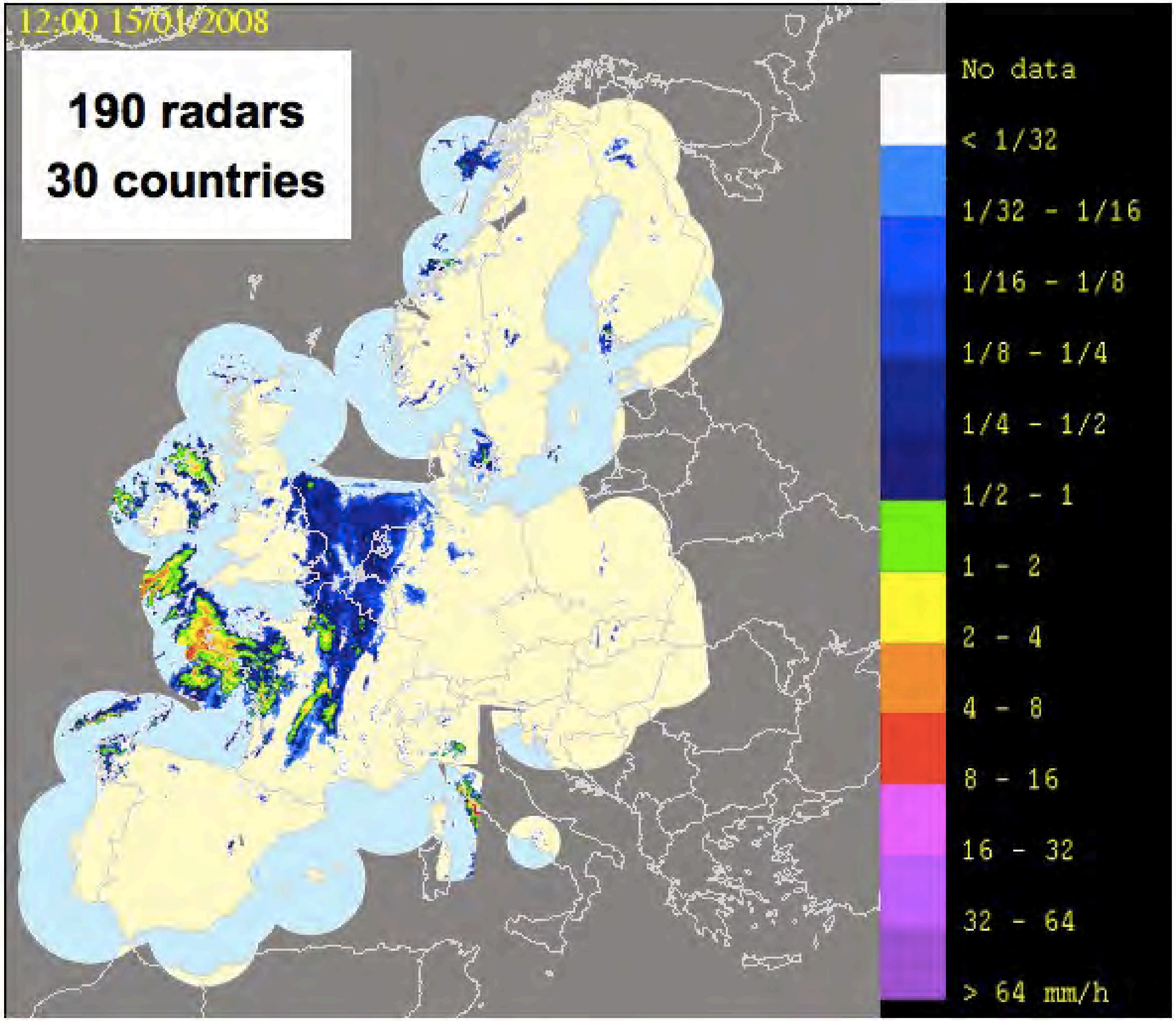
BASIC PRODUCT:

A radar-based rainfall nowcasting at European Scale

Radar-based rainfall nowcasting using OPERA European composites

OPERA radar mosaic:

precipitation observations over Europe @2 km and every 15 minutes.



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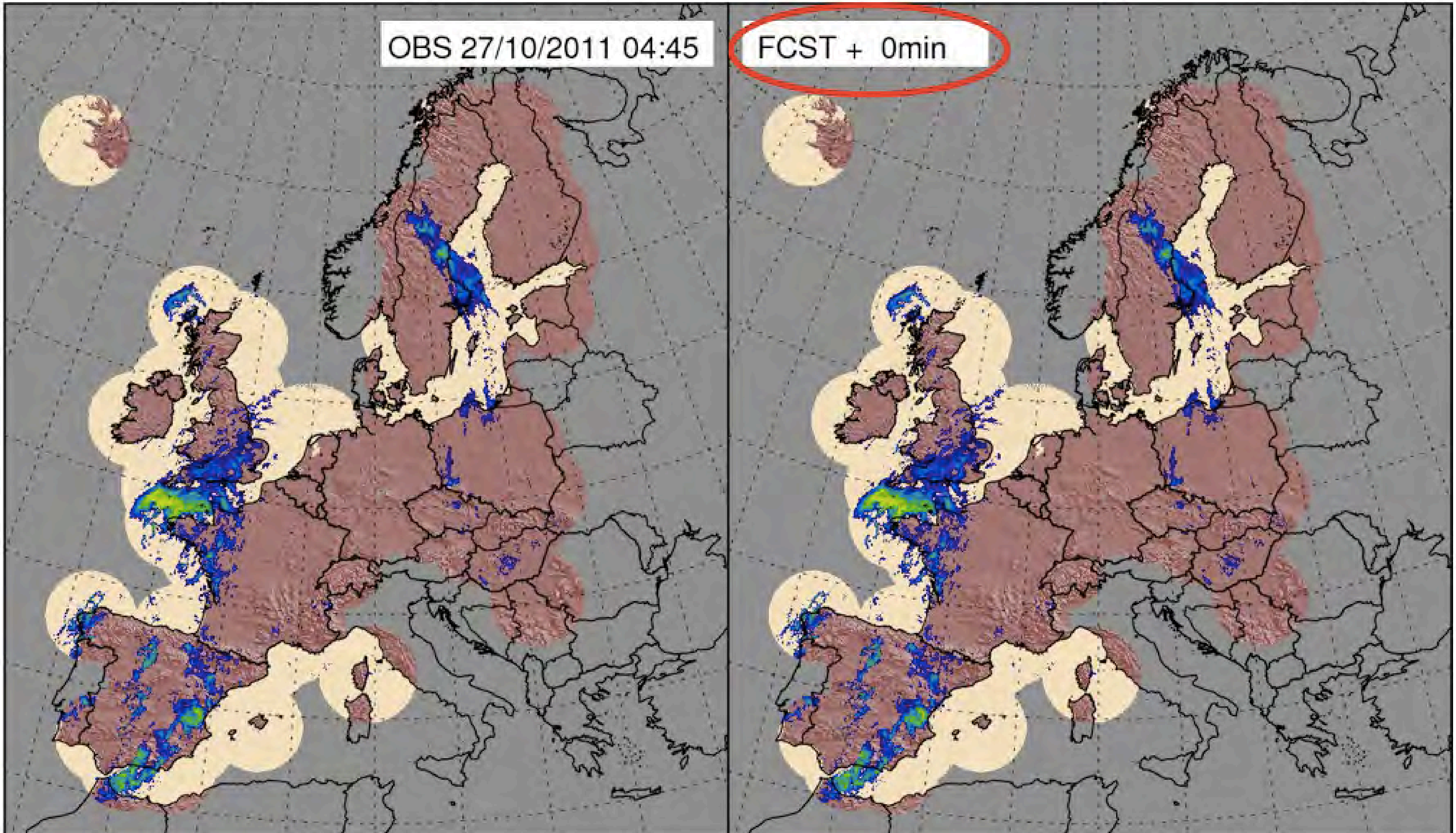
Radar based rainfall nowcasts

Nowcasts @ 27 October 2011 04:45 UTC up to 6 h

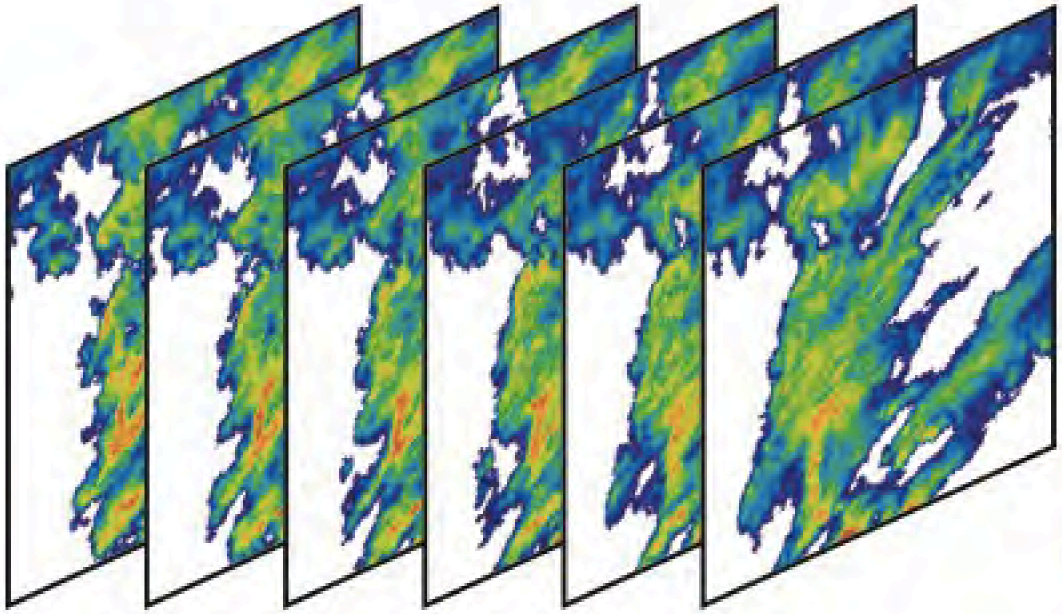


Basic Rainfall Nowcasting based on OPERA COMPOSITES

- Already operational inside the project
- OPERATIONAL at the EU Civil Protection Emergency Monitoring Center (MIC) in OCTOBER 2012
- Verification by the associated stakeholders during next 9 months

ADVANCED PRODUCT: Probabilistic Nowcasting

Can you imagine an HAREN of rainfall nowcasts?



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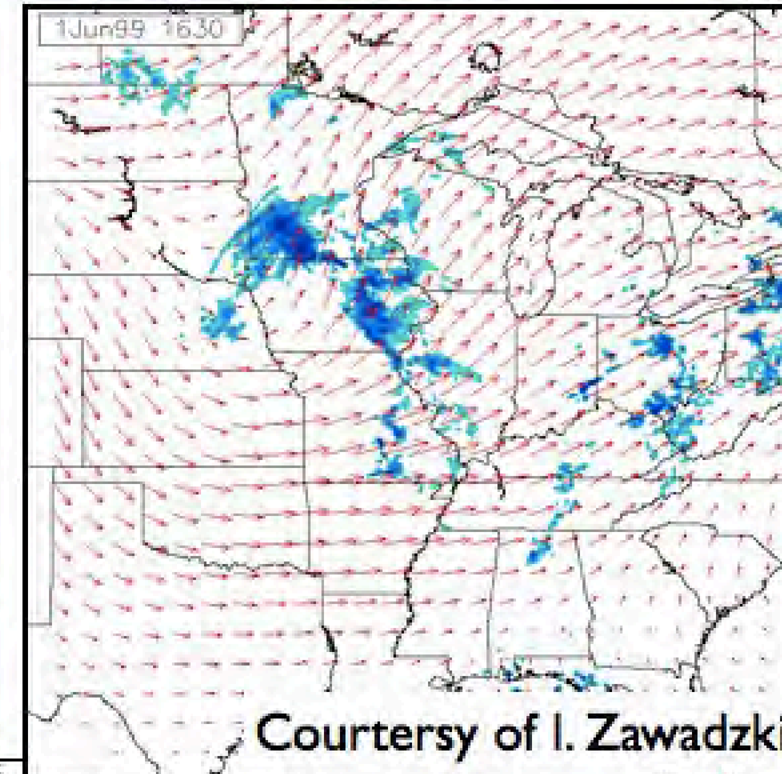
Errors affecting radar-based nowcasting

Main sources of errors in Lagrangian Persistence forecasts[1]

1) Errors affecting radar-based QPE (clutter, VPR, Z-R,...).

2) Estimation and evolution of the motion field

3) Growth and decay (evolution of rainfall intensities)



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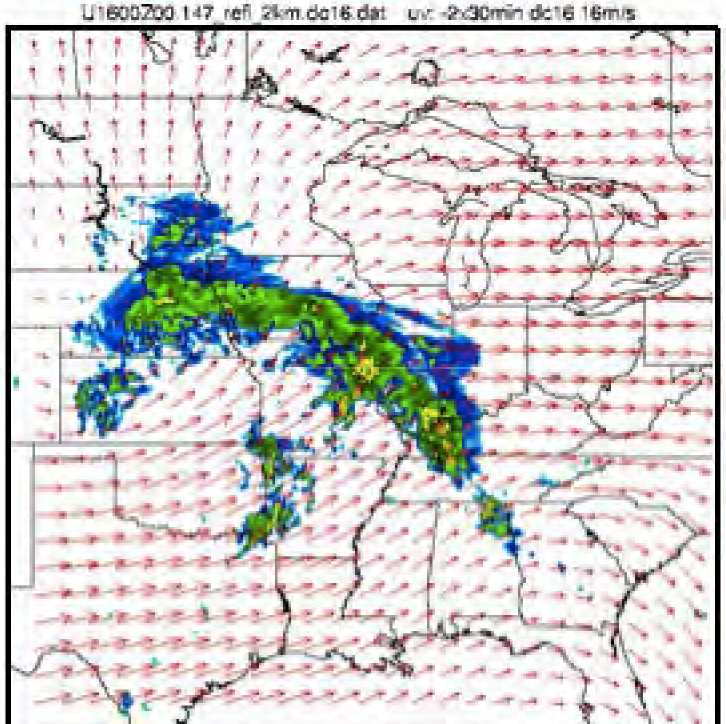
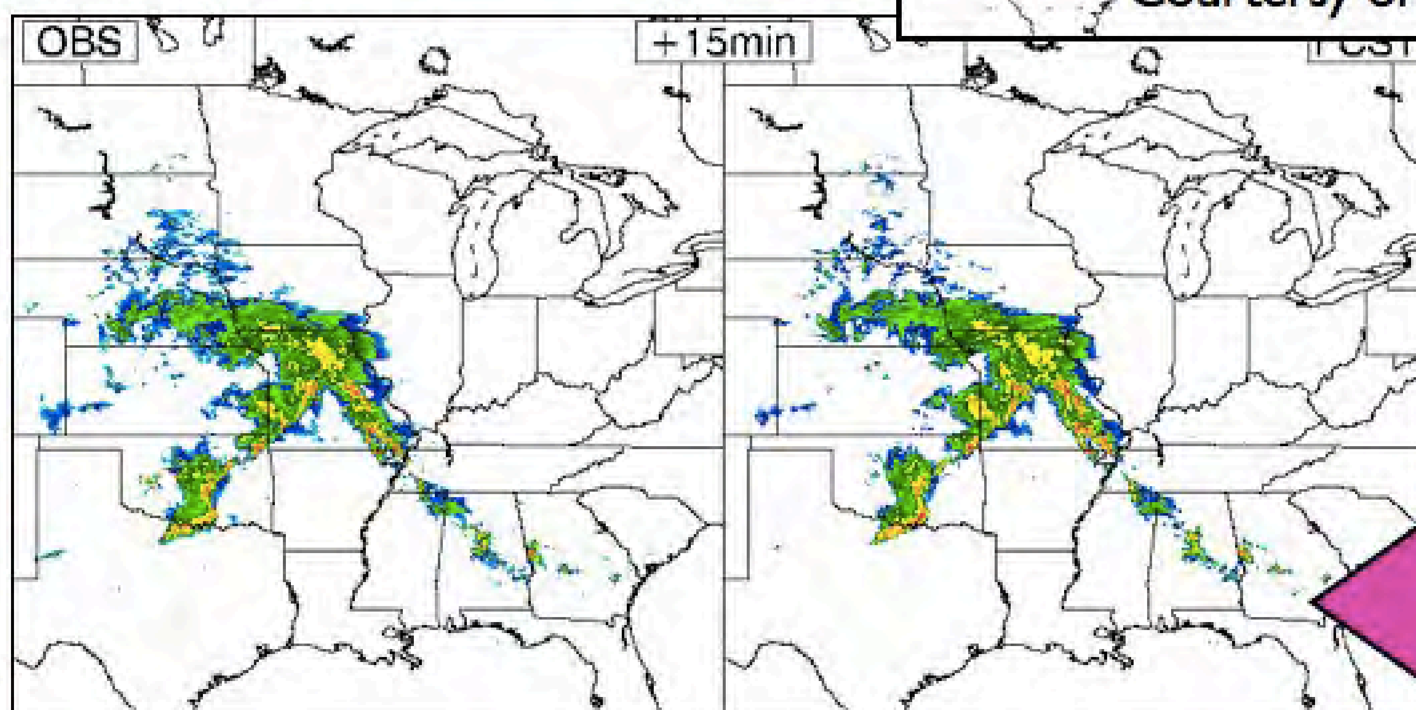
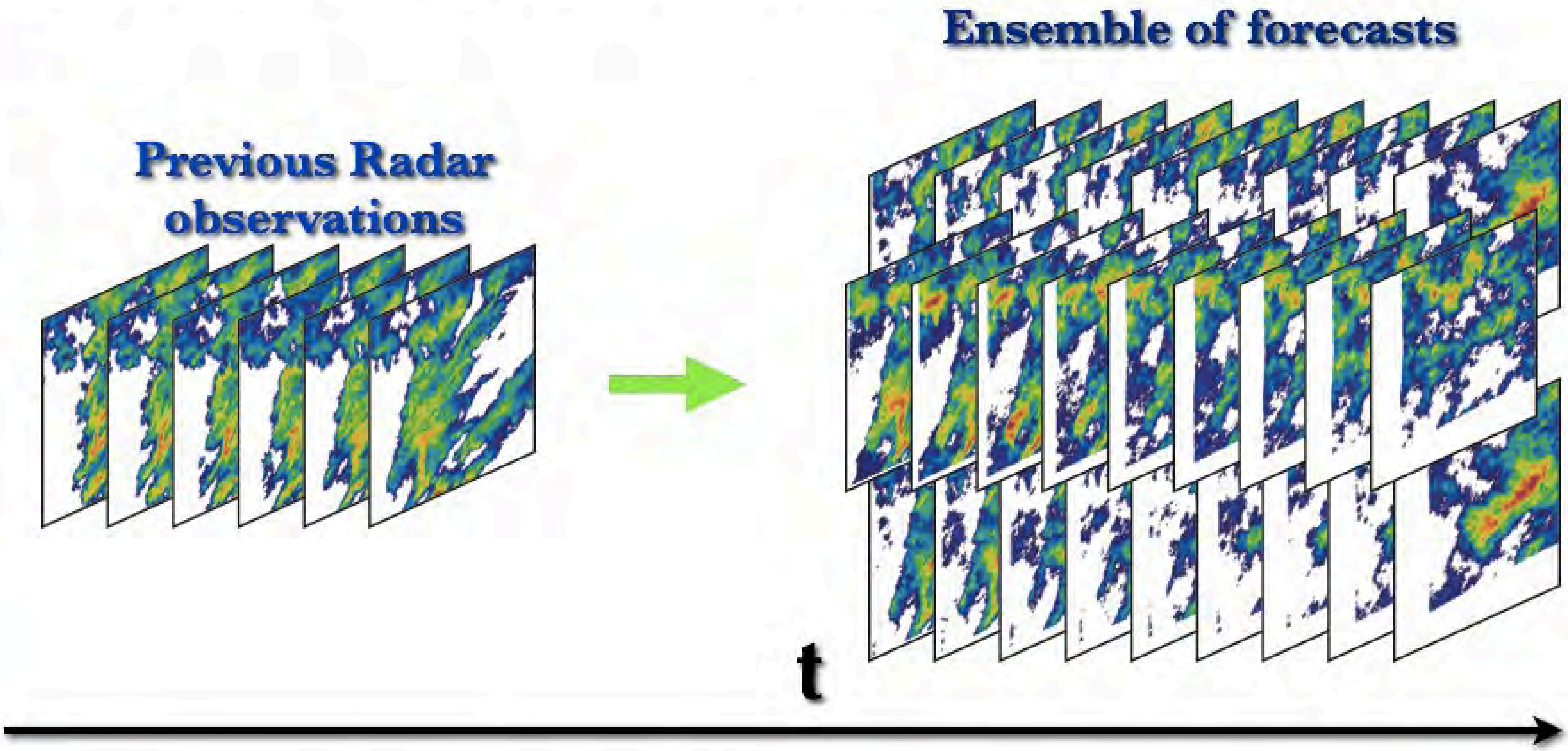




(1) Germann et al. (MWR2006)

Aim

Apply a **stochastic nowcasting technique to describe the uncertainty in rainfall nowcasts** trough the generation of an **ensemble of radar-based forecasts**



Adapted to be used in

probabilistic rainfall-runoff modelling

The technique - SBMcast[1]

An **ensemble approach** based on the hypotheses of the *String of Beads*[2] model for the evolution of the rainfall field:

- Simulation at 2 levels: global and pixel scale.
- Model for spatial and temporal correlation.
- Moving coordinates.

At present, implemented in Catalonia.

To be implemented at European scale during the project

(1) Berenguer et al. (**J. of Hydrology 2011**)

(2) Pegram & Clothier (J. of Hydrology 2001).

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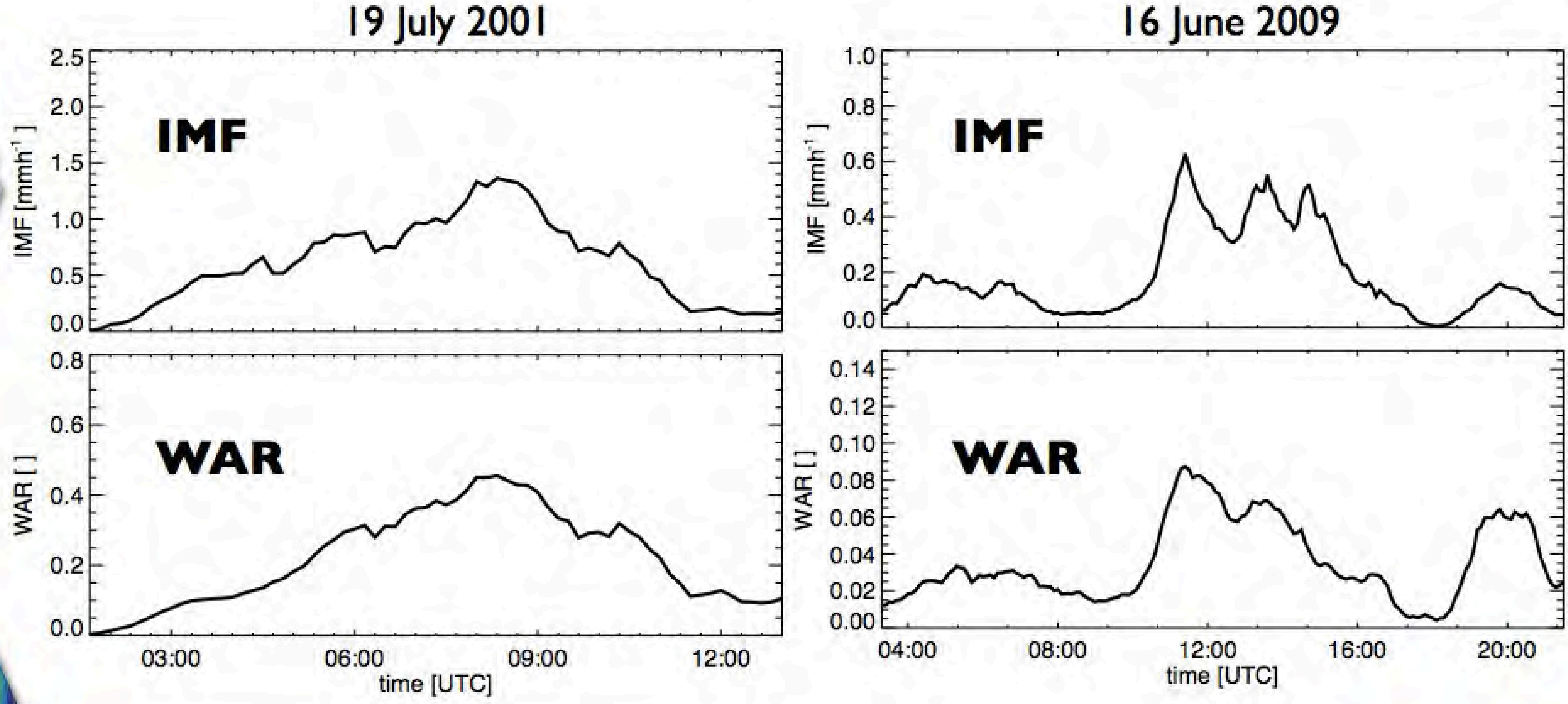
SBMcast

Global variables:

WAR: wet area ratio (**% of the domain covered by rain**)

IMF: image mean flux (**average rainfall intensity over the domain**)



solid line correspond to the variables measured over the observations

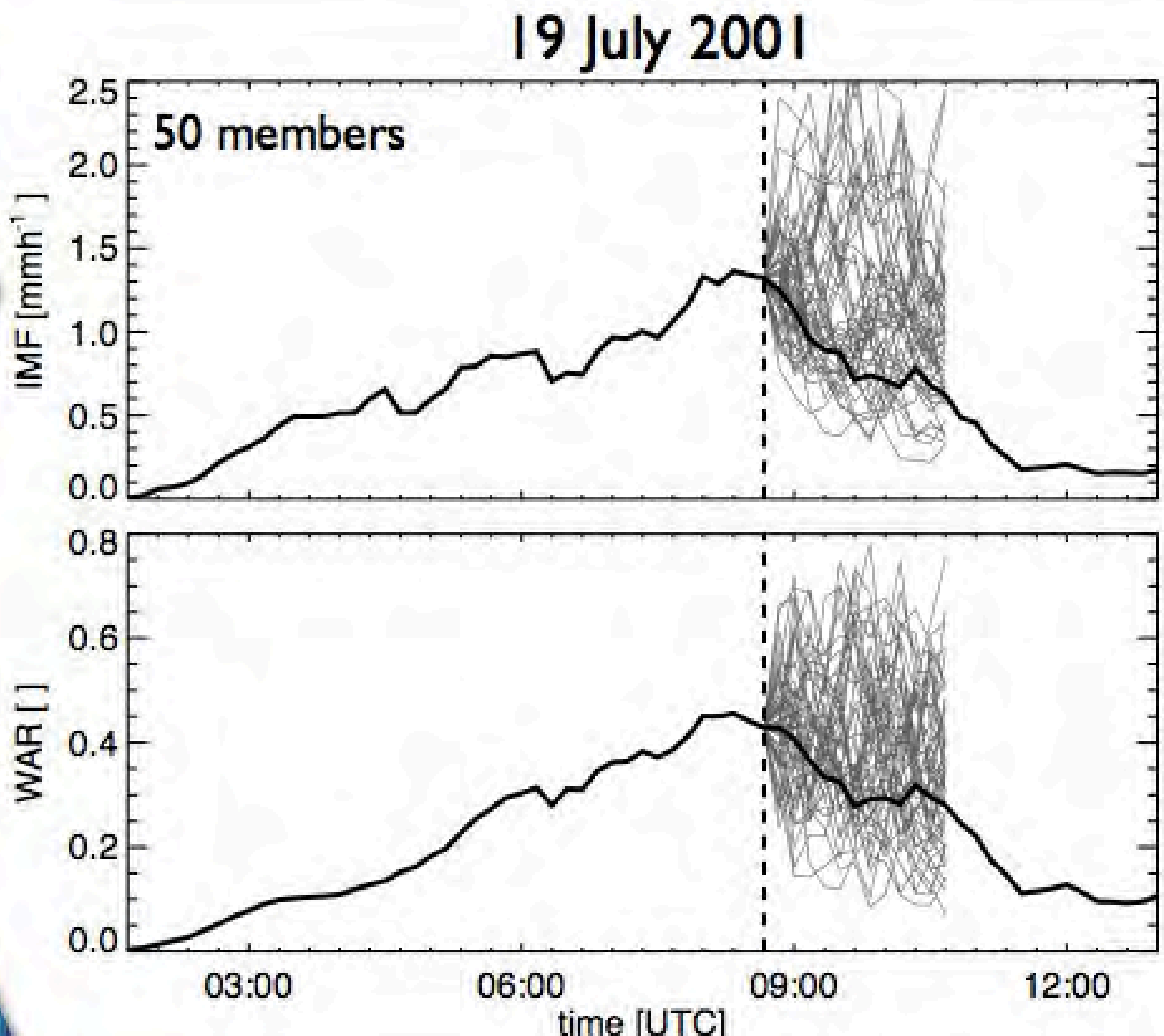
SBMcast

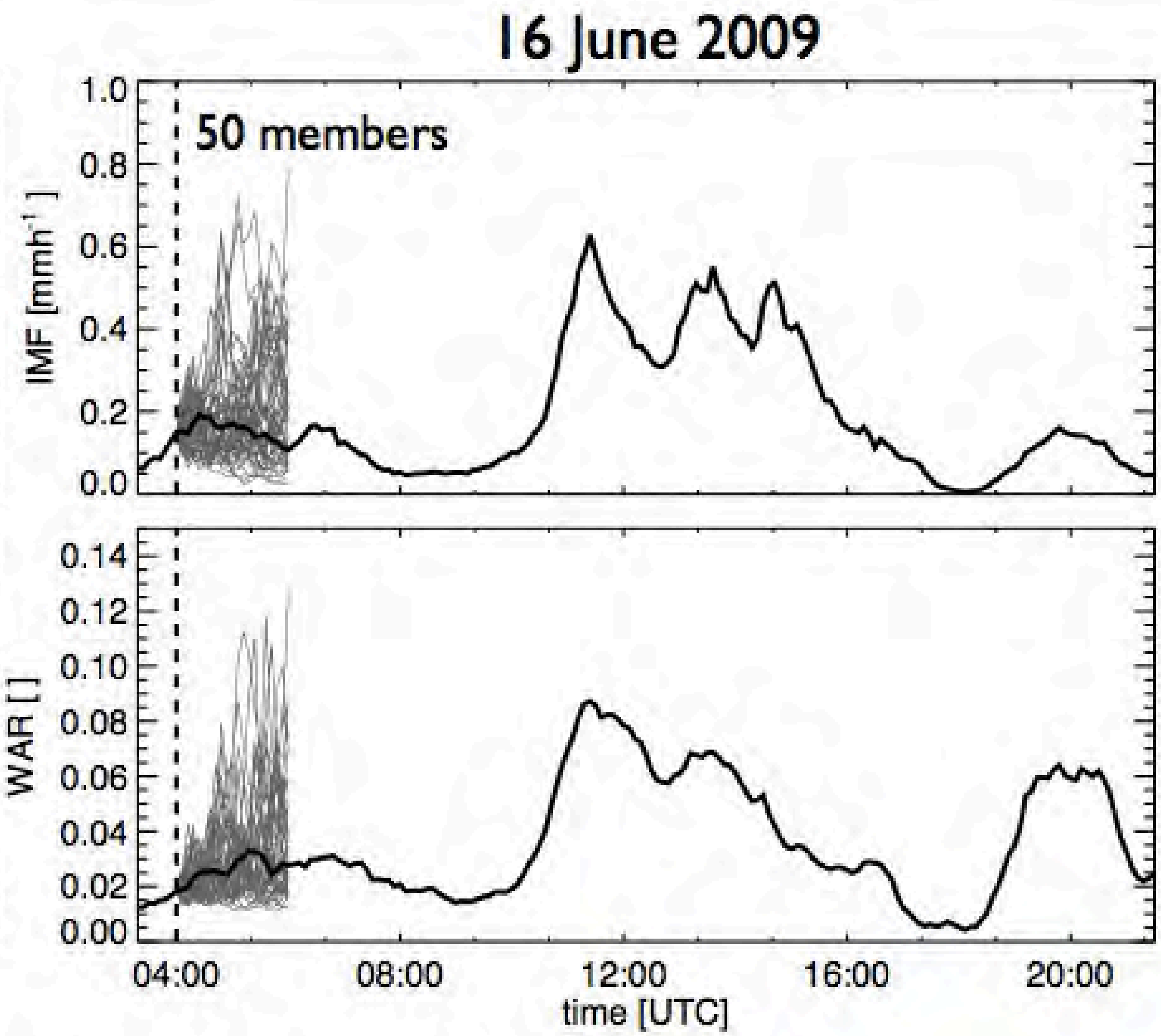
Global variables: **IMF*, WAR*** modeled as a bivariate AR(5) process:

WAR: wet area ratio

IMF: image mean flux

$$\begin{bmatrix} WAR'^{*}[t, n\cdot\Delta t] \\ IMF'^{*}[t, n\cdot\Delta t] \end{bmatrix} = \sum_{i=1}^{5} \Phi_i \begin{bmatrix} WAR'^{*}[t, (n-1)\cdot\Delta t] \\ IMF'^{*}[t, (n-1)\cdot\Delta t] \end{bmatrix} + Z[t, n\cdot\Delta t]$$





grey lines correspond to the variables forecasted
(ensemble of 50 members)

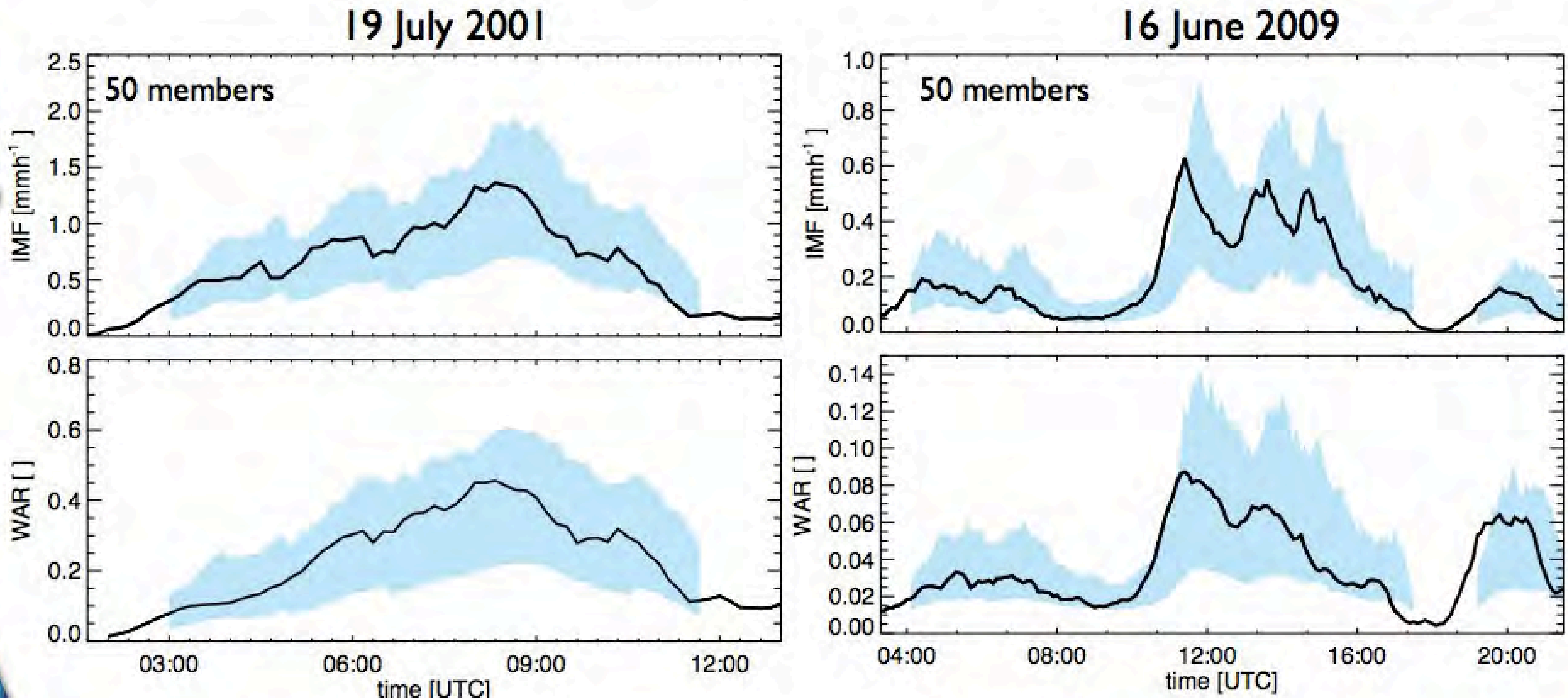
SBMcast

Global variables: **IMF*, WAR*** modeled as a bivariate AR(5) process:

WAR: wet area ratio

IMF: image mean flux

$$\begin{bmatrix} WAR'^{*}[t,n\cdot\Delta t] \\ IMF'^{*}[t,n\cdot\Delta t] \end{bmatrix} = \sum_{i=1}^{5} \Phi_i \begin{bmatrix} WAR'^{*}[t,(n-1)\cdot\Delta t] \\ IMF'^{*}[t,(n-1)\cdot\Delta t] \end{bmatrix} + Z[t,n\cdot\Delta t]$$



shaded areas correspond to the 10% and 90% percentiles for the 30 min forecasts

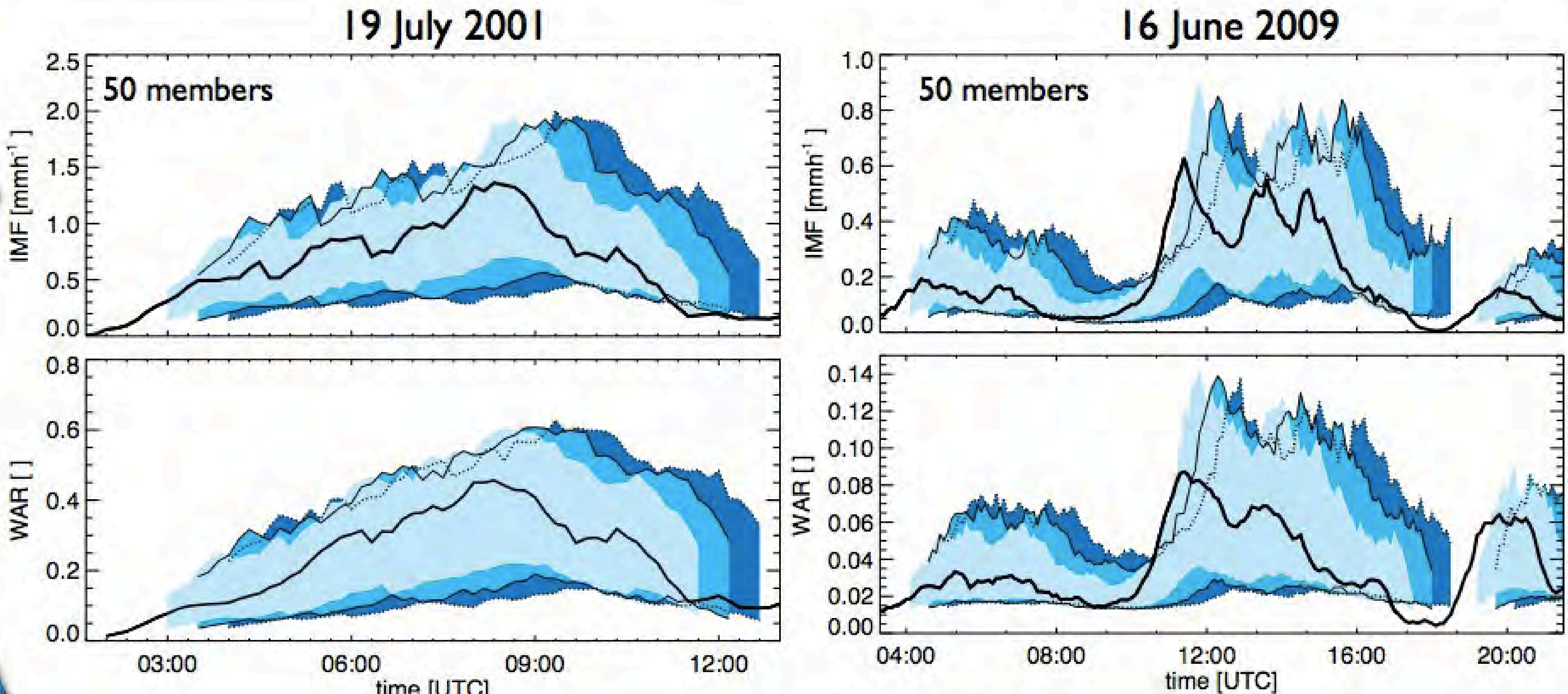
SBMcast

Global variables: **IMF*, WAR*** modeled as a bivariate AR(5) process:

WAR: wet area ratio

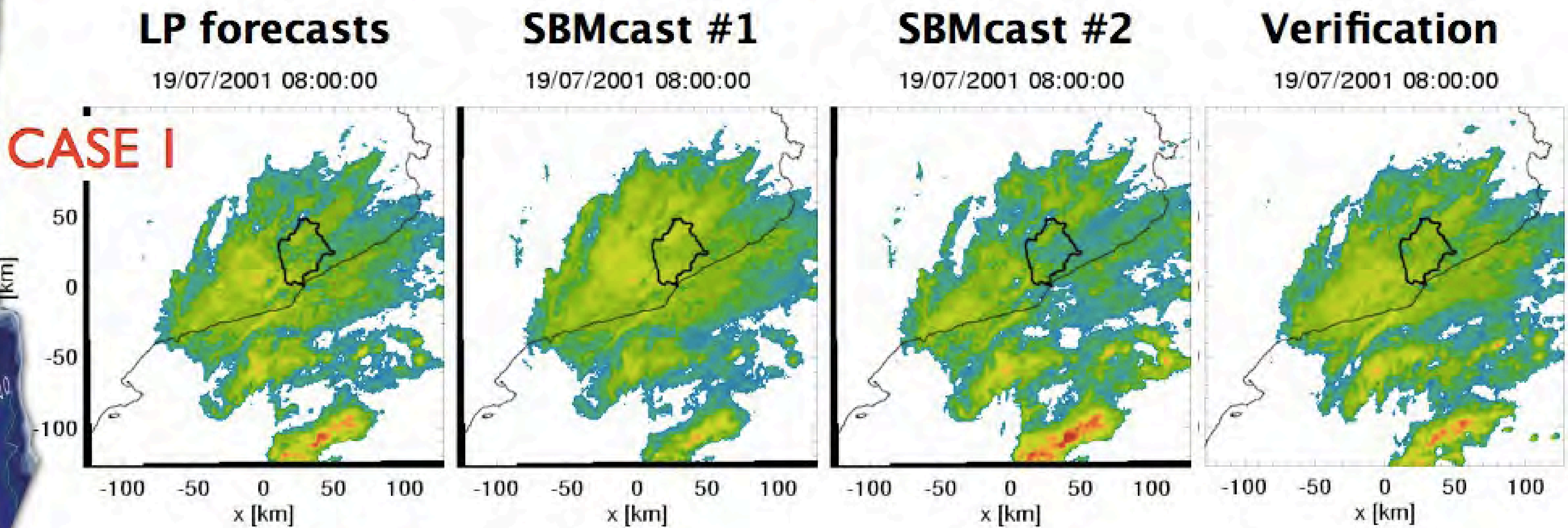
IMF: image mean flux

$$\begin{bmatrix} WAR'^{*}[t,n\cdot\Delta t] \\ IMF'^{*}[t,n\cdot\Delta t] \end{bmatrix} = \sum_{i=1}^{5} \Phi_i \begin{bmatrix} WAR'^{*}[t,(n-1)\cdot\Delta t] \\ IMF'^{*}[t,(n-1)\cdot\Delta t] \end{bmatrix} + Z[t,n\cdot\Delta t]$$

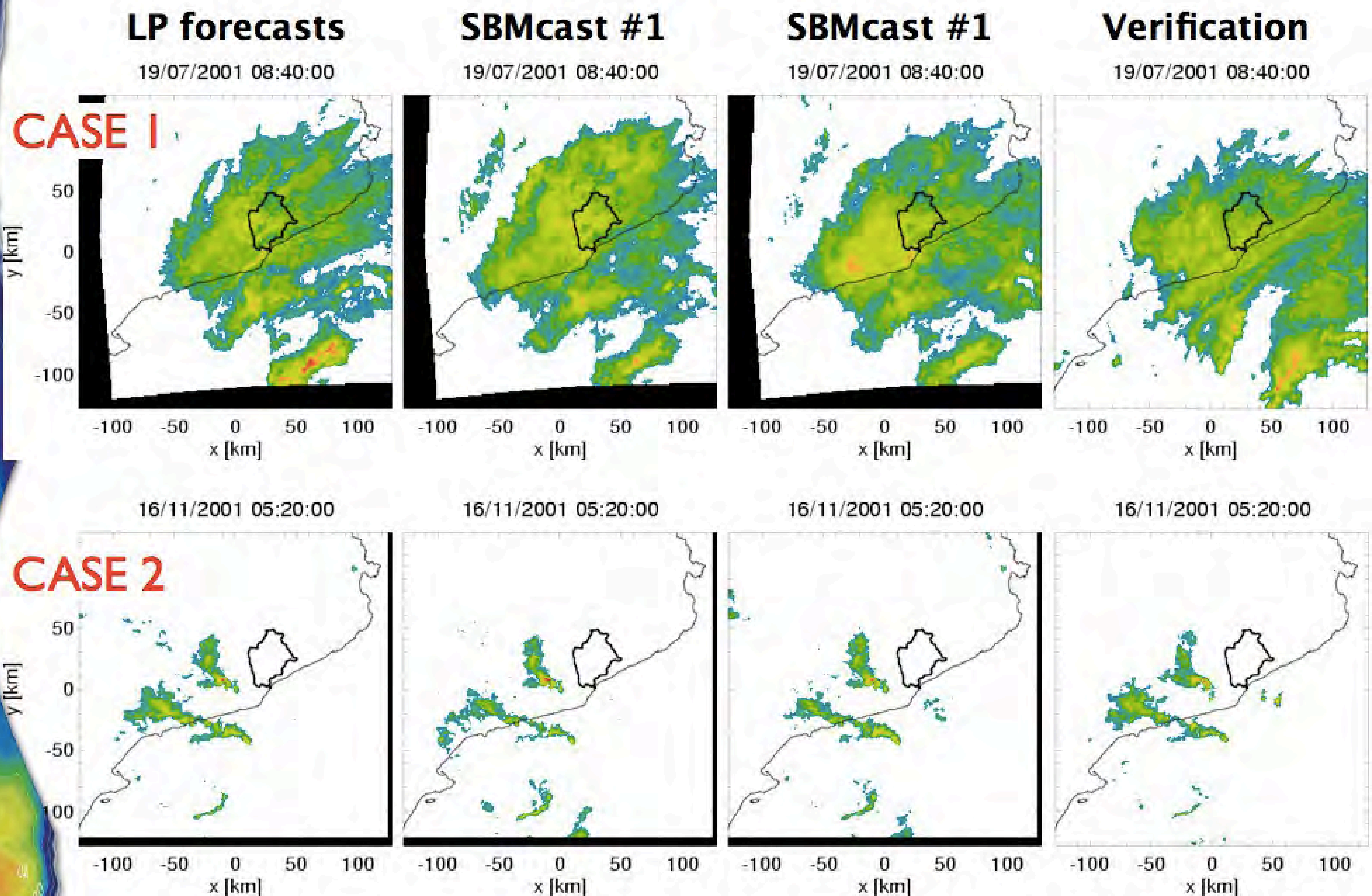


shaded areas correspond to the 10% and 90% percentiles for the 30, 60 and 90 min forecasts

Examples


LP forecasts
SBMcast #1
SBMcast #2
Verification
19/07/2001 08:00:00
19/07/2001 08:00:00
19/07/2001 08:00:00
19/07/2001 08:00:00
CASE 1
[km]
50
0
-50
-100
-100 -50 0 50 100
x [km]
-100 -50 0 50 100
x [km]
-100 -50 0 50 100
x [km]
-100 -50 0 50 100
x [km]

Examples

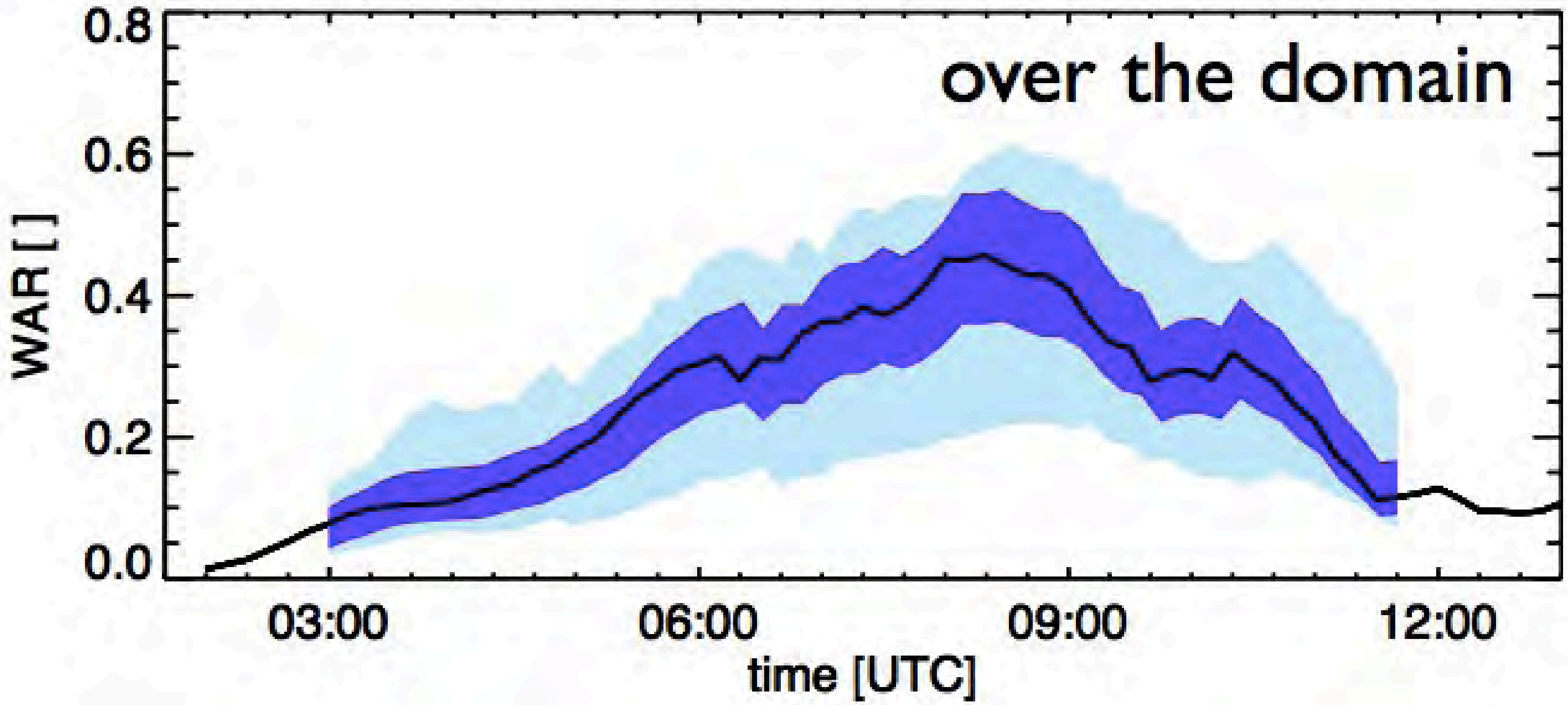

LP forecasts
SBMcast #1
SBMcast #1
Verification
CASE 1
19/07/2001 08:40:00
19/07/2001 08:40:00
19/07/2001 08:40:00
19/07/2001 08:40:00
CASE 2
16/11/2001 05:20:00
16/11/2001 05:20:00
16/11/2001 05:20:00
16/11/2001 05:20:00
y [km]
50
0
-50
-100
x [km]
-100
-50
0
50
100

Uncertainty in LP nowcasts

SBMcast takes into account the uncertainty in LP nowcasts.

The goal is to **improve SBMcast's skill** by **driving the global variables WAR and IMF from NWP.**

- NWP used to constraint the ensemble.



Uncertainty in LP nowcasts

SBMcast takes into account the uncertainty in LP nowcasts.

The goal is to **improve SBMcast's skill** by **driving the global variables WAR and IMF from NWP.**

- NWP used to constraint the ensemble.
- Systematic factors such as the diurnal cycle of precipitation

ADVANCED PRODUCT: Probabilistic Warnings

Can you imagine an HAREN of associated warnings?

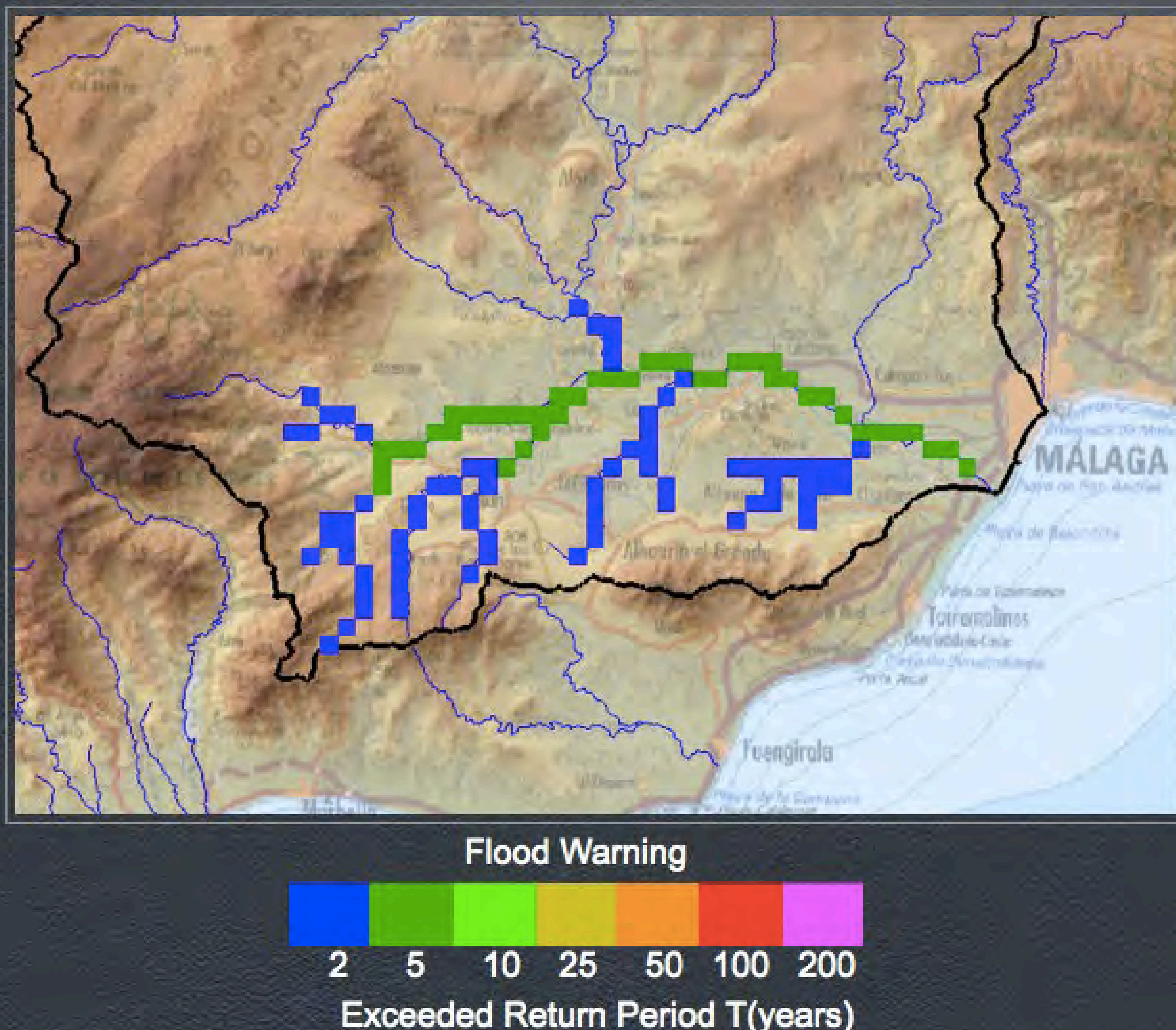
Based on the developments of

IMPRINTS

FF & DF early warning systems

IMPRINTS

- Probabilistic Early Warning System **based on the probability of basin-aggregated rainfall excedences**



Guadalhorce basin (Malaga) 16/02/2010

Example of PFFGS 1 km
Source: CRAHI

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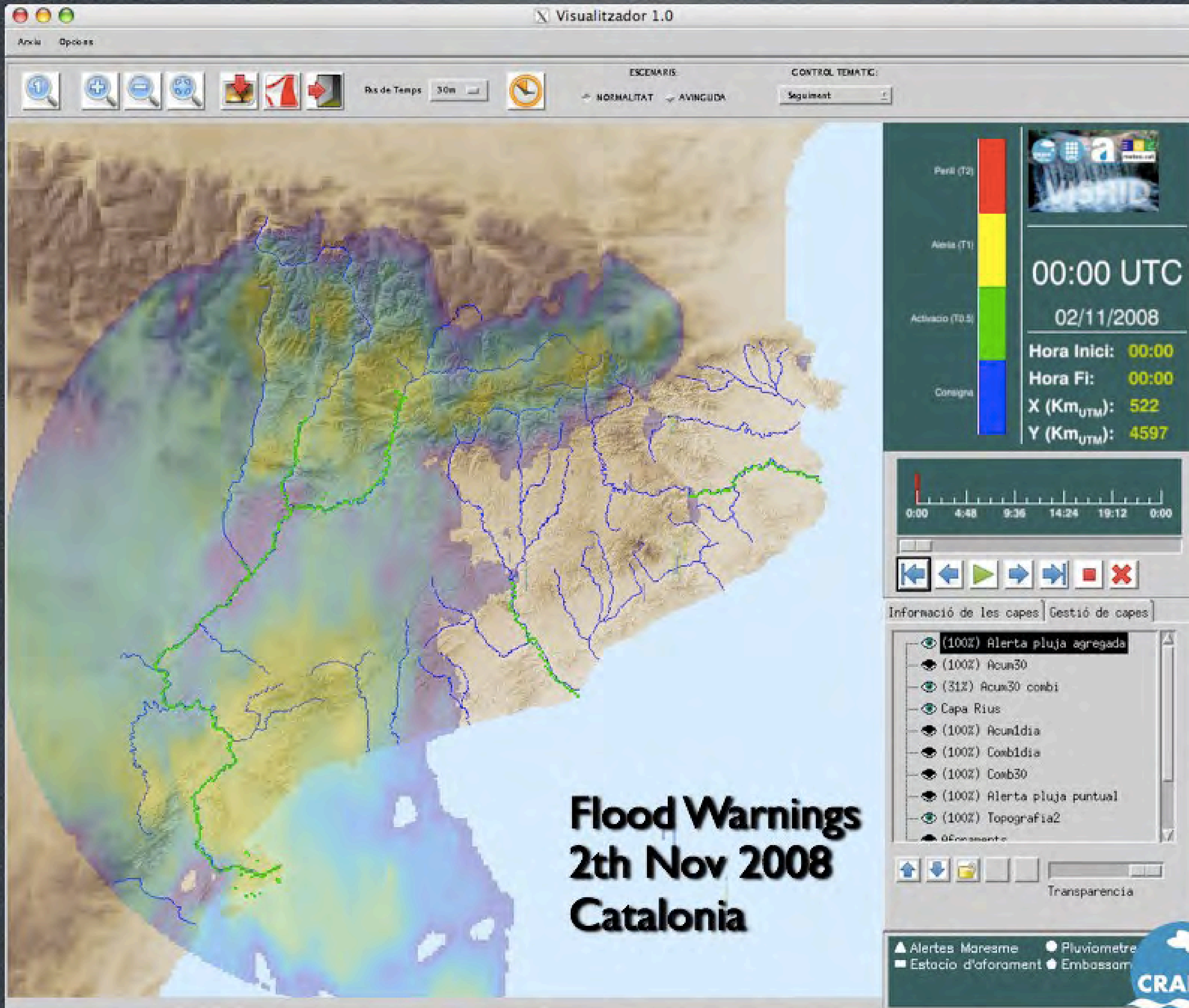
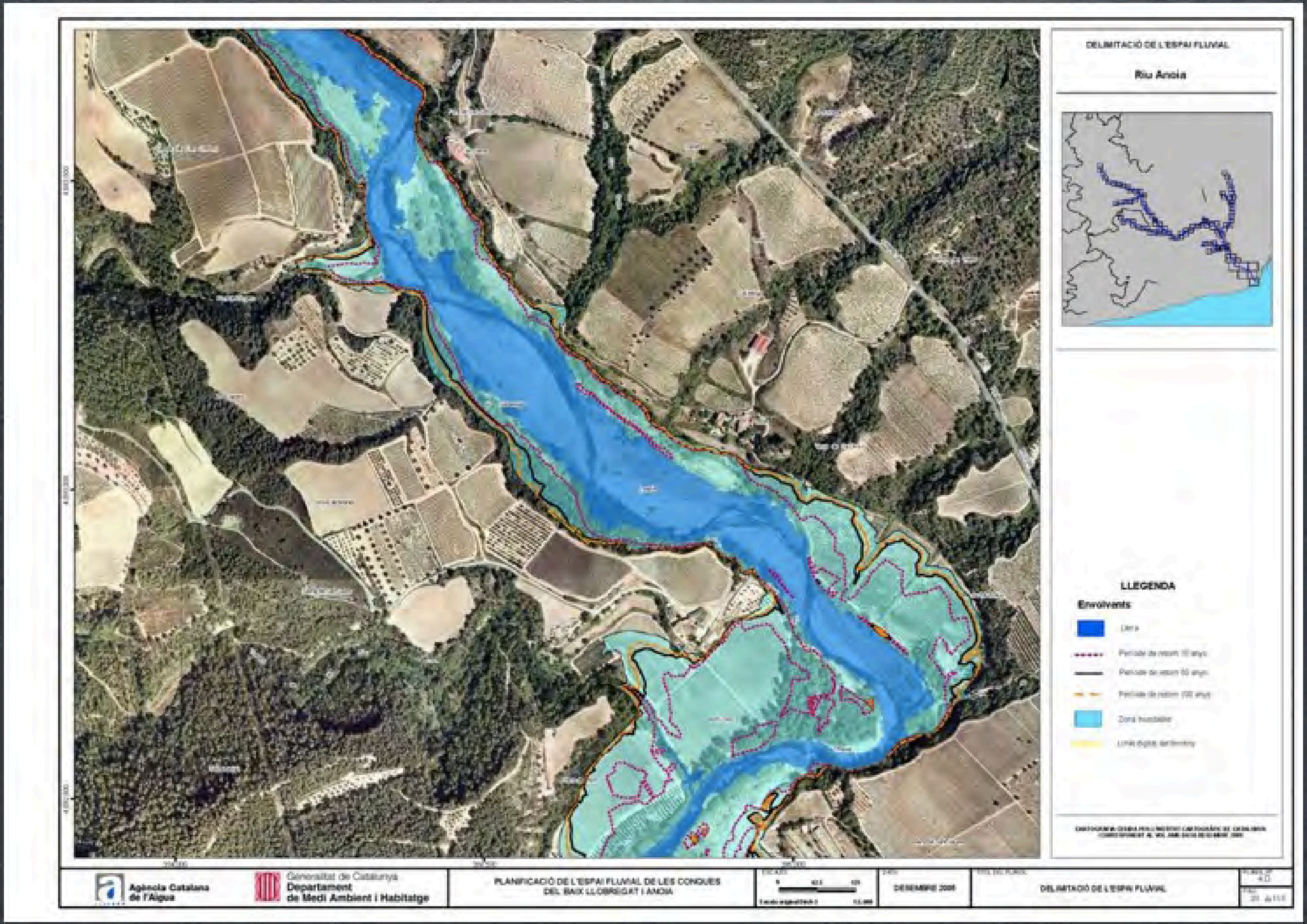
IMPRINTS

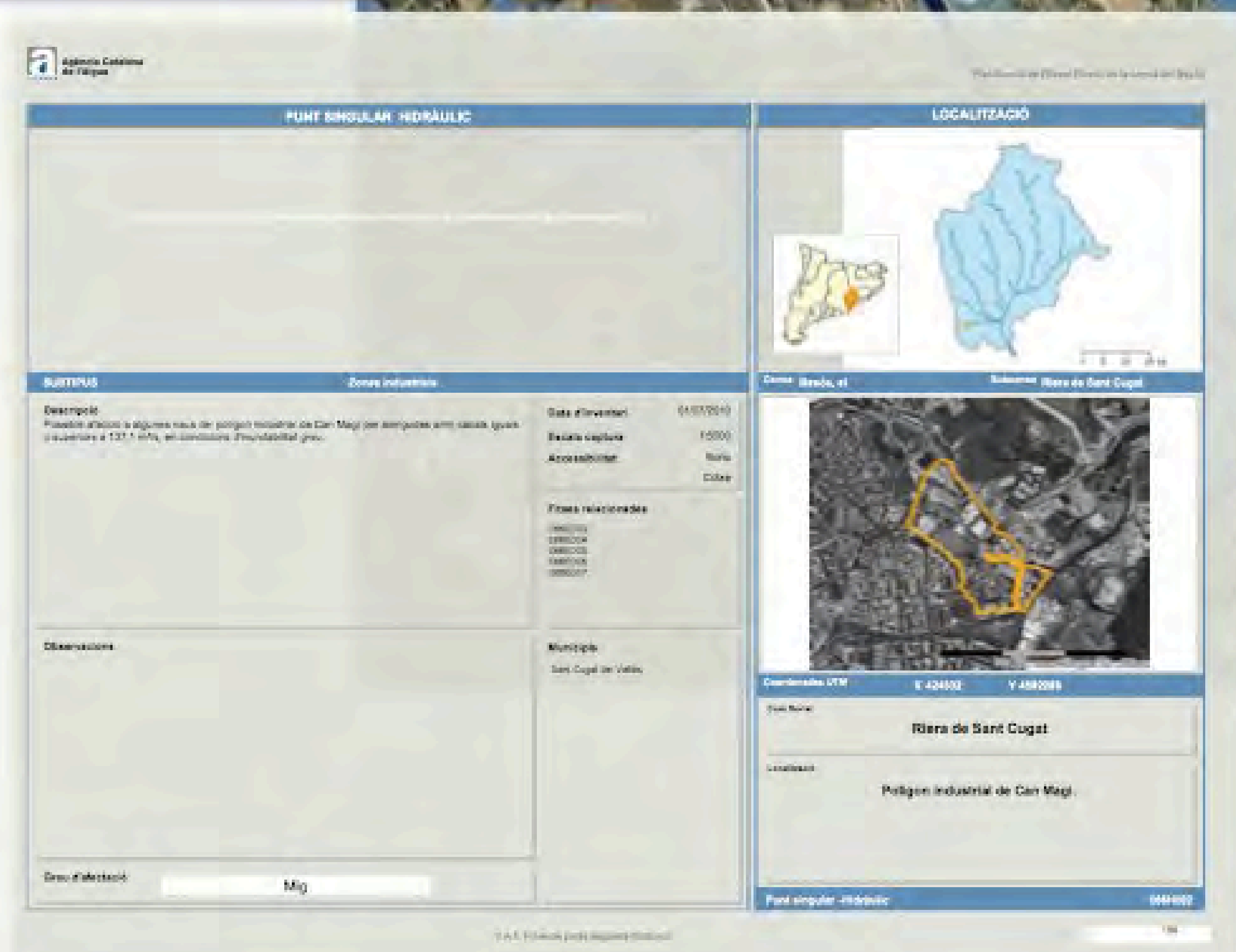


Flood Warnings
2th Nov 2008
Catalonia

Integrated with the local Flood Hazard and Risk Maps (EU Flood Directive)



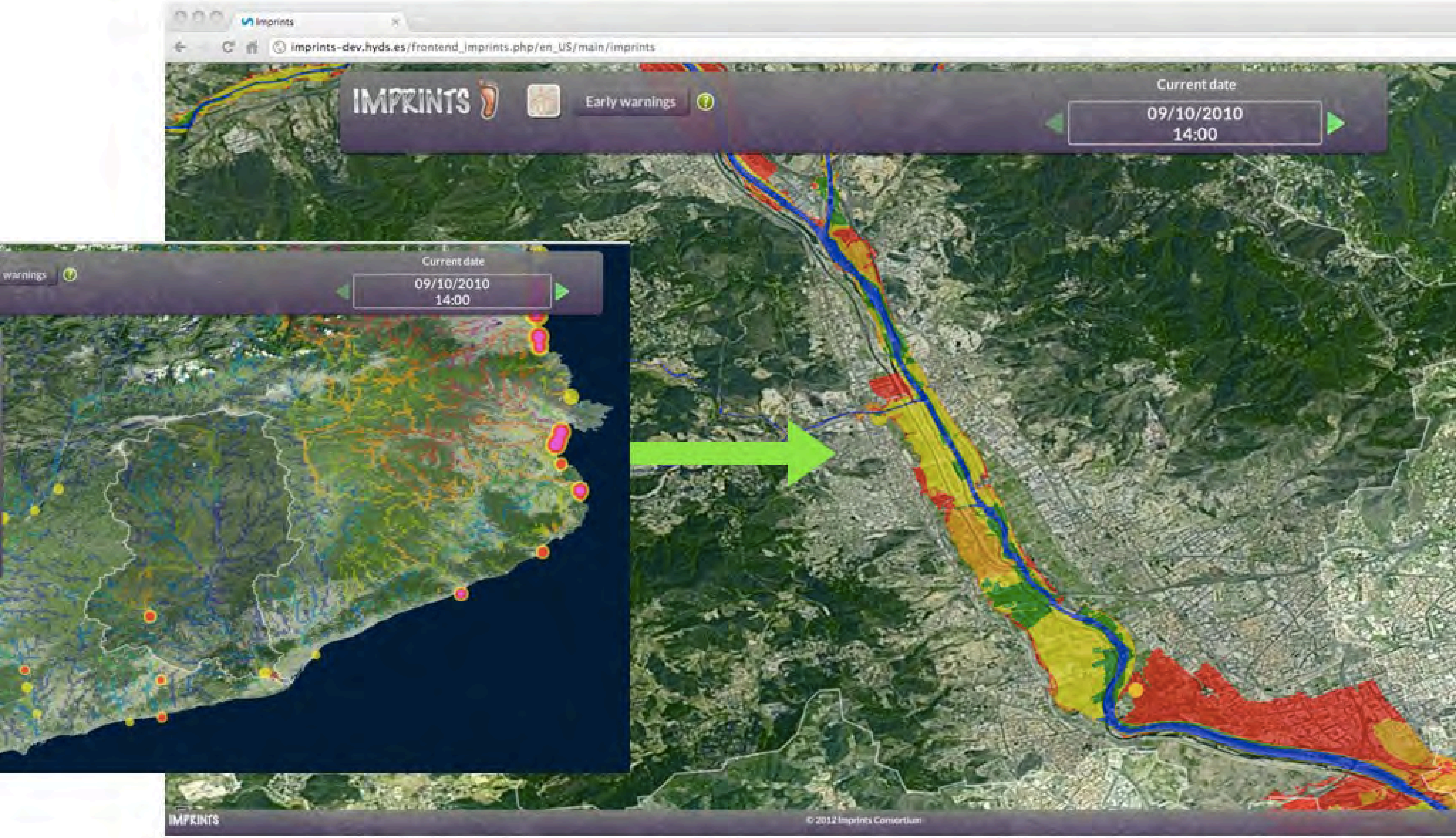
- Detailed information about flooded areas for different return periods
- Detailed information about critical points and impact of flooding



IMPRINTS

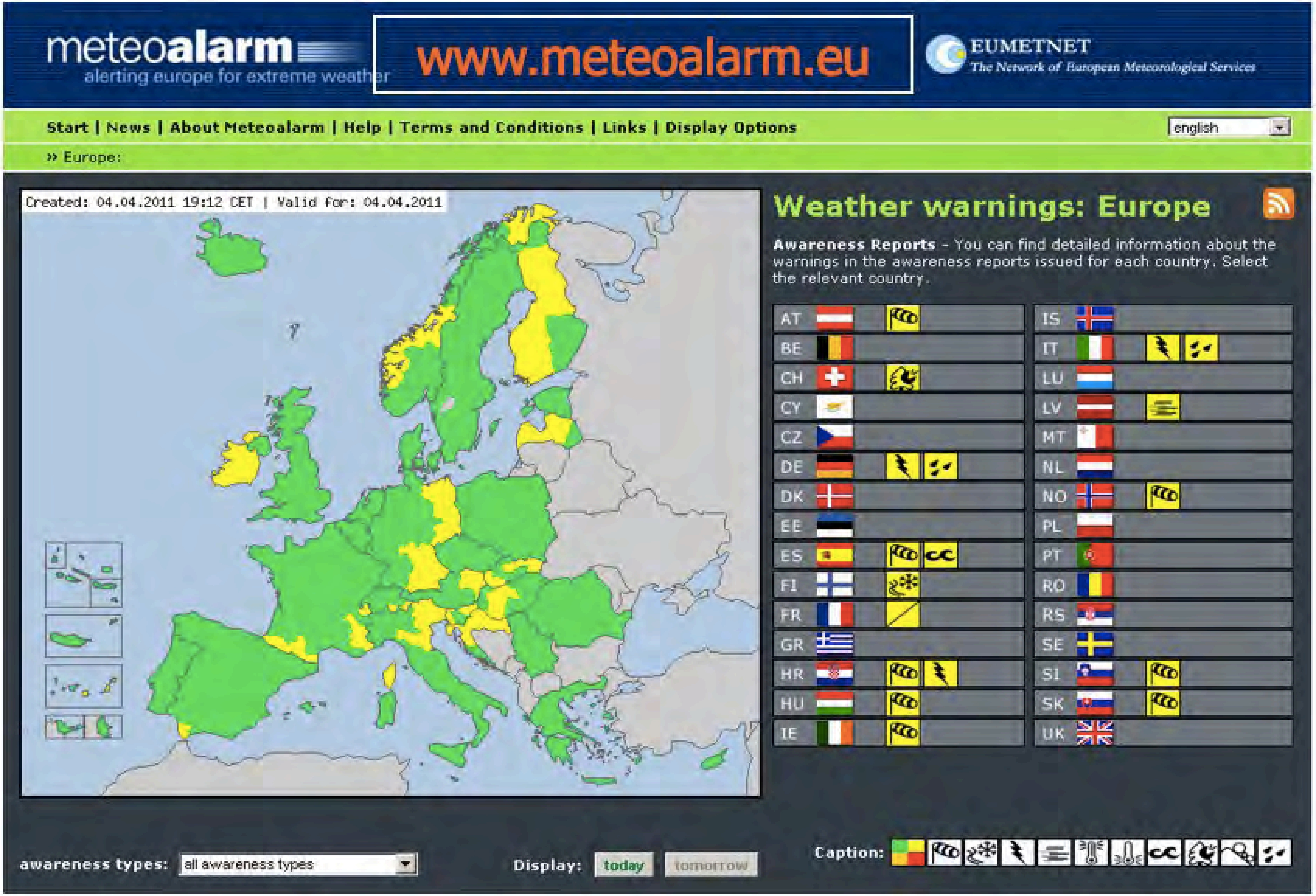
Basin warnings   10/10/2010

Basin warnings   10/10/2010



IMPRINTS

Dissemination at Civil Protection Level and through Meteoalarm




HAREN PROJECT PAGE
http://www.haren-project.eu/
Google
Maps analisis Google Ac SESAM ECAS Facebook FP7 Negotiation simyo Gmail Vuelos baratos "la Caixa" Amex SMC Radar-AEMET
HAREN PROJECT PAGE
HAREN
Overview
WorkPlan
Objectives
Project Coordinator
Project Team
Data Sheet
Contact us
Precipitation is one of the agents leading to natural hazards that have very serious impacts on people's life and goods: i.e. floods, debris flows, landslides...
The challenge faced by this Project is monitoring and forecasting the precipitation field at very high-resolution to produce better warnings for hazards induced by precipitation at local scale all over Europe.
With this aim, the Project will focus on the use of the Continental precipitation maps generated from the National radar networks in Europe within the EUMETNET programme OPERA (Matthews et al. 2011). OPERA has succeeded in generating a European precipitation field in real time with the resolution of
www.haren-project.eu
means of different approaches to provide probabilistic ensemble nowcasting (e.g. Berenguer et al. 2011; Koistinen et al. 2011).
The goal of the Project is thus to develop a system for precipitation monitoring and forecasting to be used in the anticipation of hazards induced by precipitation at local scale and over Europe. The Project will capitalize on the OPERA mosaics and on the recent improvements on nowcasting techniques, some of which developed and tested within several FP6 and FP7 EC projects (among others FLOODSITE, HYDRATE, and IMPRINTS (www.imprints-fp7.eu), to generate high-resolution precipitation forecasts and warnings over Europe, as well as the associated uncertainty of these products.
European Civil Protection
Hazard Assessment based on Rainfall European Nowcasts
-HAREN-
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Training course and Workshop:

Implementing the EU Flood directive in Flash Flood prone areas

Brussels 26 and 27 of September 2012

www.imprints-fp7.eu/finalworkshop

IMPRINTS

SEVENTH FRAMEWORK PROGRAMME

UNISDR
The United Nations Office for Disaster Risk Reduction

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Royal Flemish Academy of Belgium for Science and the Arts

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