# Météo-France report

METEO FRANCE
Toujours un temps d'avance

# Outline

- Operational changes in 2012
- The HyMeX field experiment and associated research
- Planned changes for 2013
- Preparation for new configurations and applications

# Operational changes in 2012

Observations: (more channels for IASI, high latitudes for Ascat, additional ground-based GPS stations), and tuning of observation errors

Global model:

- Assimilation: Model error with inflation in the Ensemble of Data Assimilation (AEARP)
- Large-scale physics: Tuning of convection and wind gusts

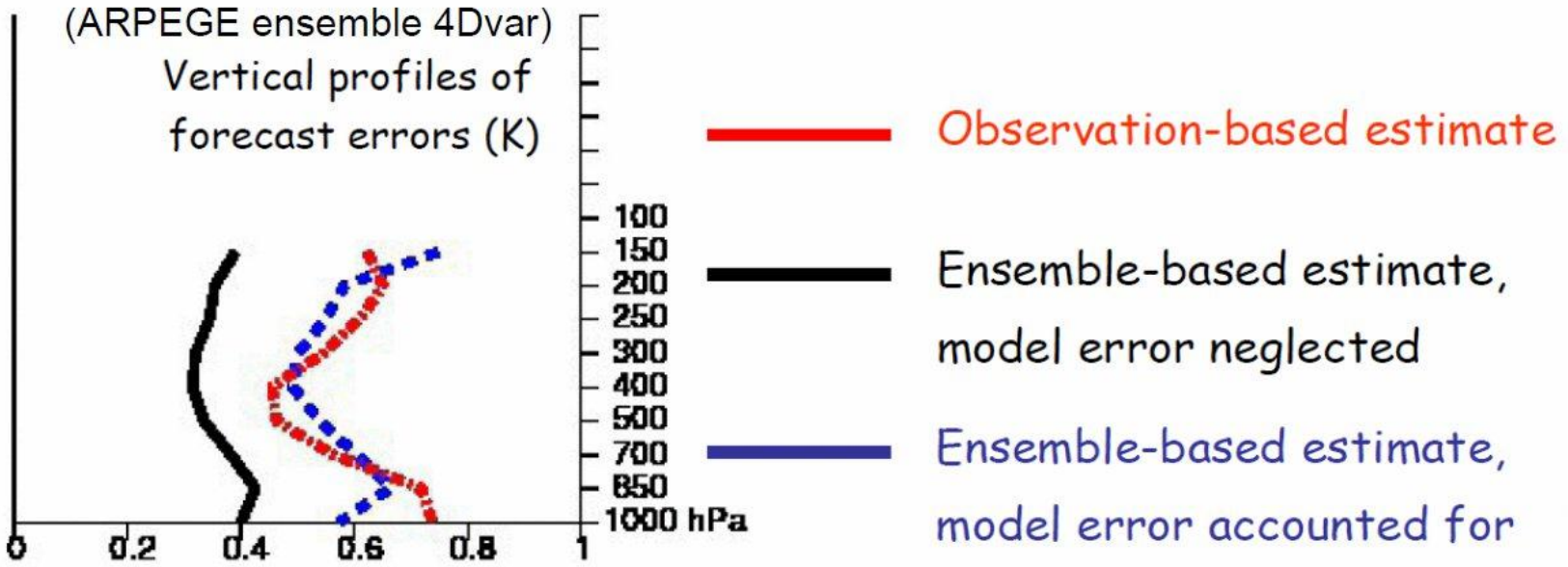
Meso-scale:

- Changes in EDKF and cloud scheme in Arome
- Finer climatolgy and orography inputs in Arome

# Model error in Ensemble Data Assimilation (used for errors of the day in deterministic 4D-Var)

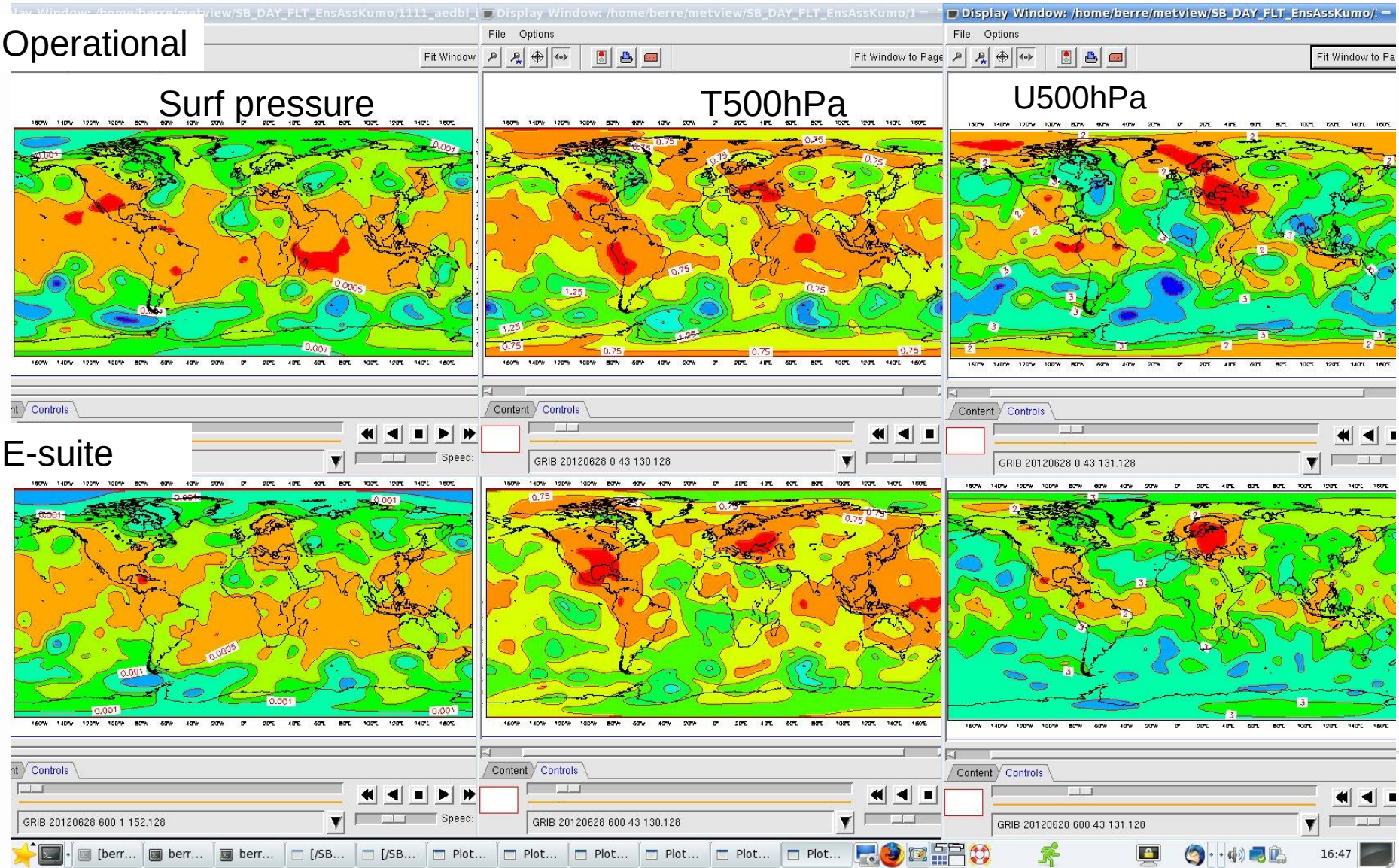
Methodology:

- total forecast error covariances estimated by innovations: $cov(y-Hx_b)=cov(Me_a + e_m)$ using a posteriori variational diagnostics (Jbmin)
- compare with EDA-predicted variances $cov(Me_a)$
- inflation of forecast perturbations: $e_i' = e_i + \alpha\,(e_i - e_i)$, $\alpha>1$
- $\alpha$~1.15 is applied every 3 hours
- more realistic initial spread for ensemble prediction

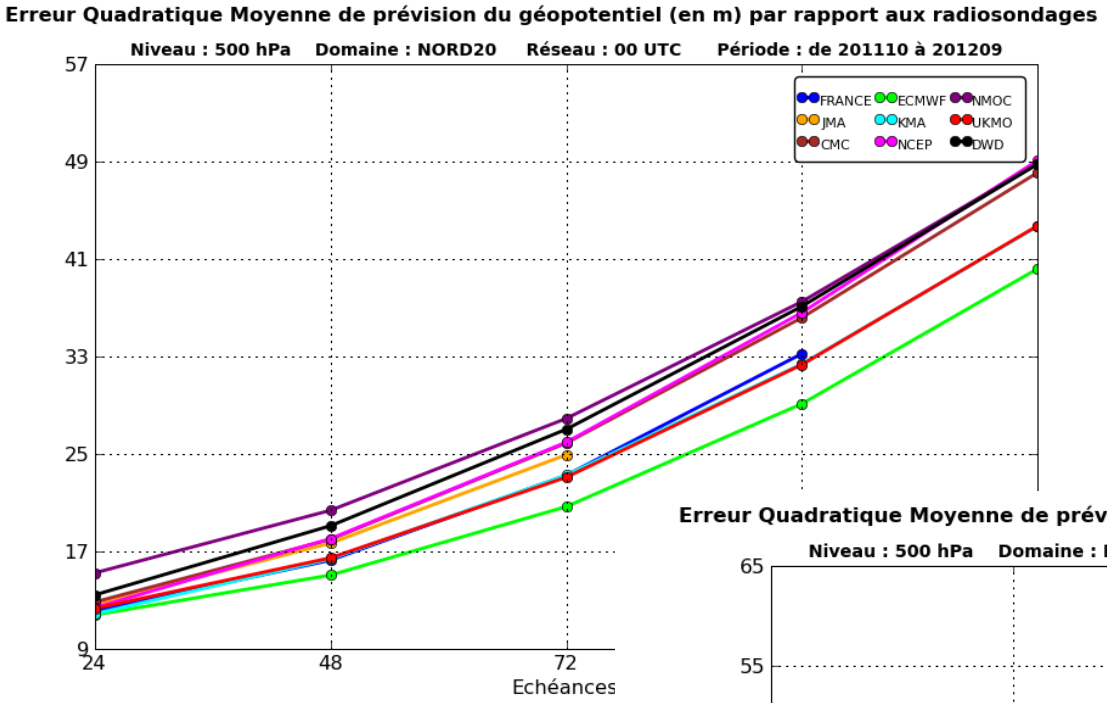


# Influence on errors of the day

Horizontal smoothing of variations in errors: less contrast between high and low values

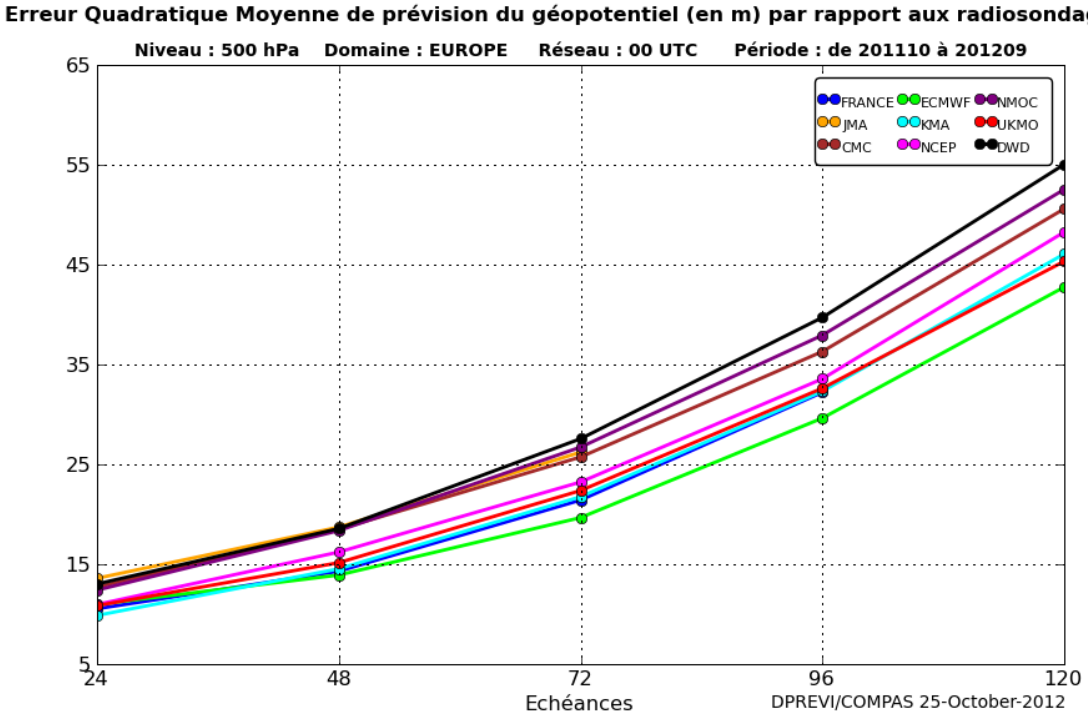


# Scores 2011-2012




Scores wrt radiosondes

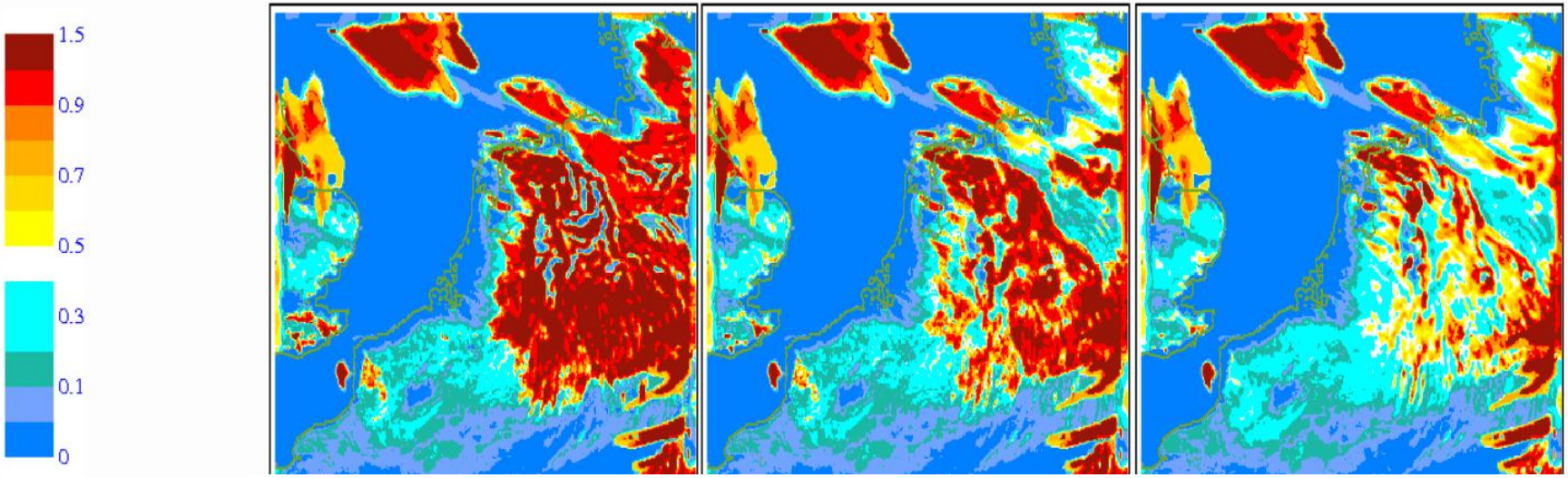
Z500, NH and Europe



# Changes in EDKF in Arome

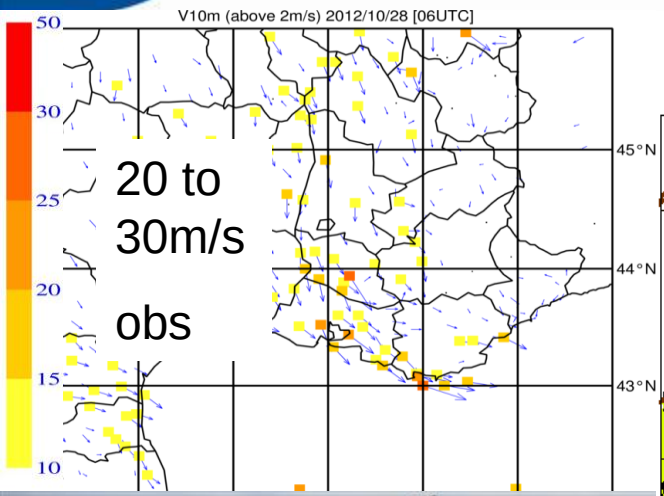

The solid phase is now correctly taken into account in the scheme, together with algorithmic changes.

This improves the cloud simulation.

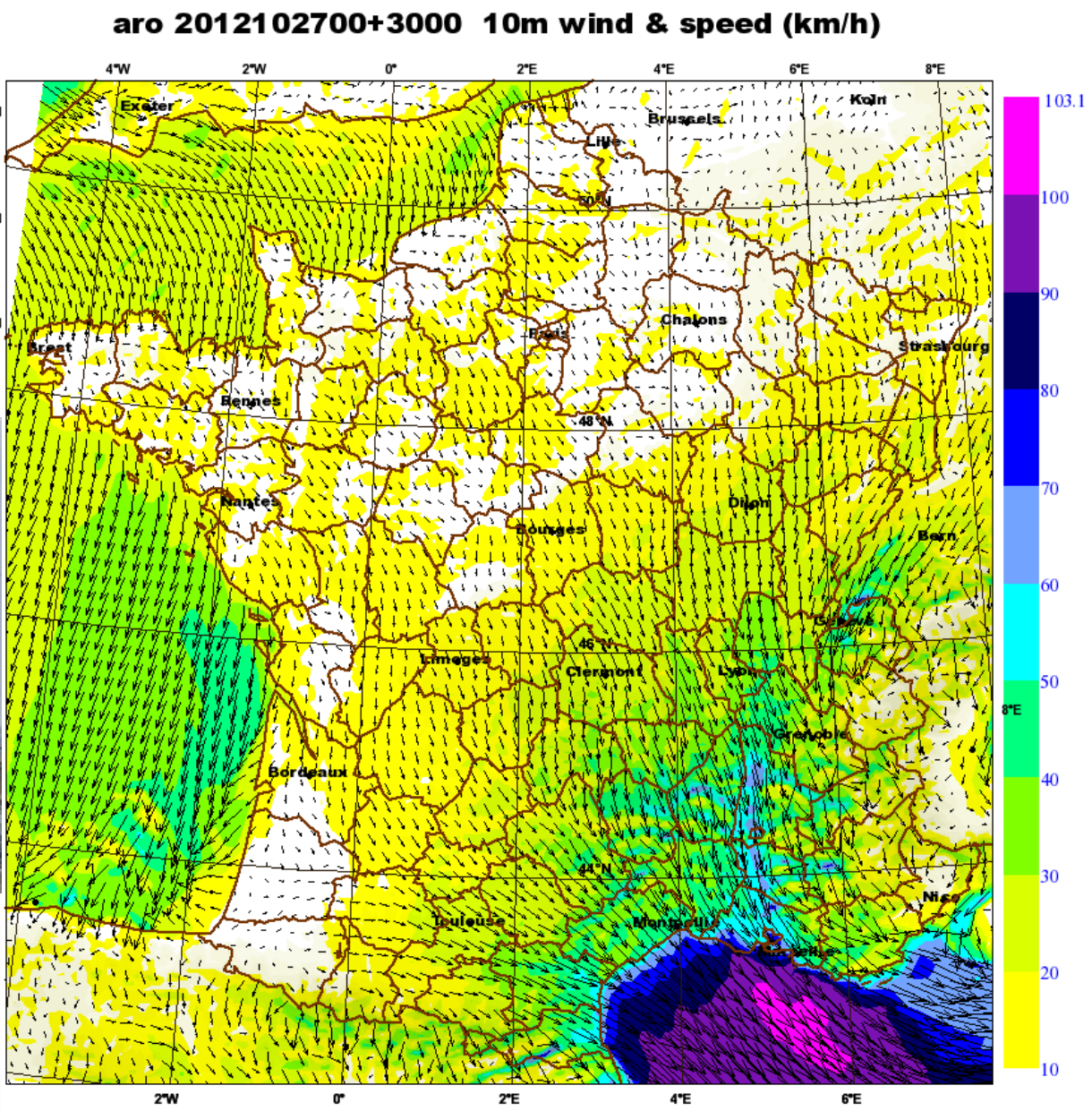



Operational model  Solid phase changes  + algorithmic changes

# 30-hr forecast with Arome on 27/10/2012




Due to the high winds, the Napoleon Bonaparte ferry broke loose and hit the quay in Marseille!



# Additional Arome run at 03UTC

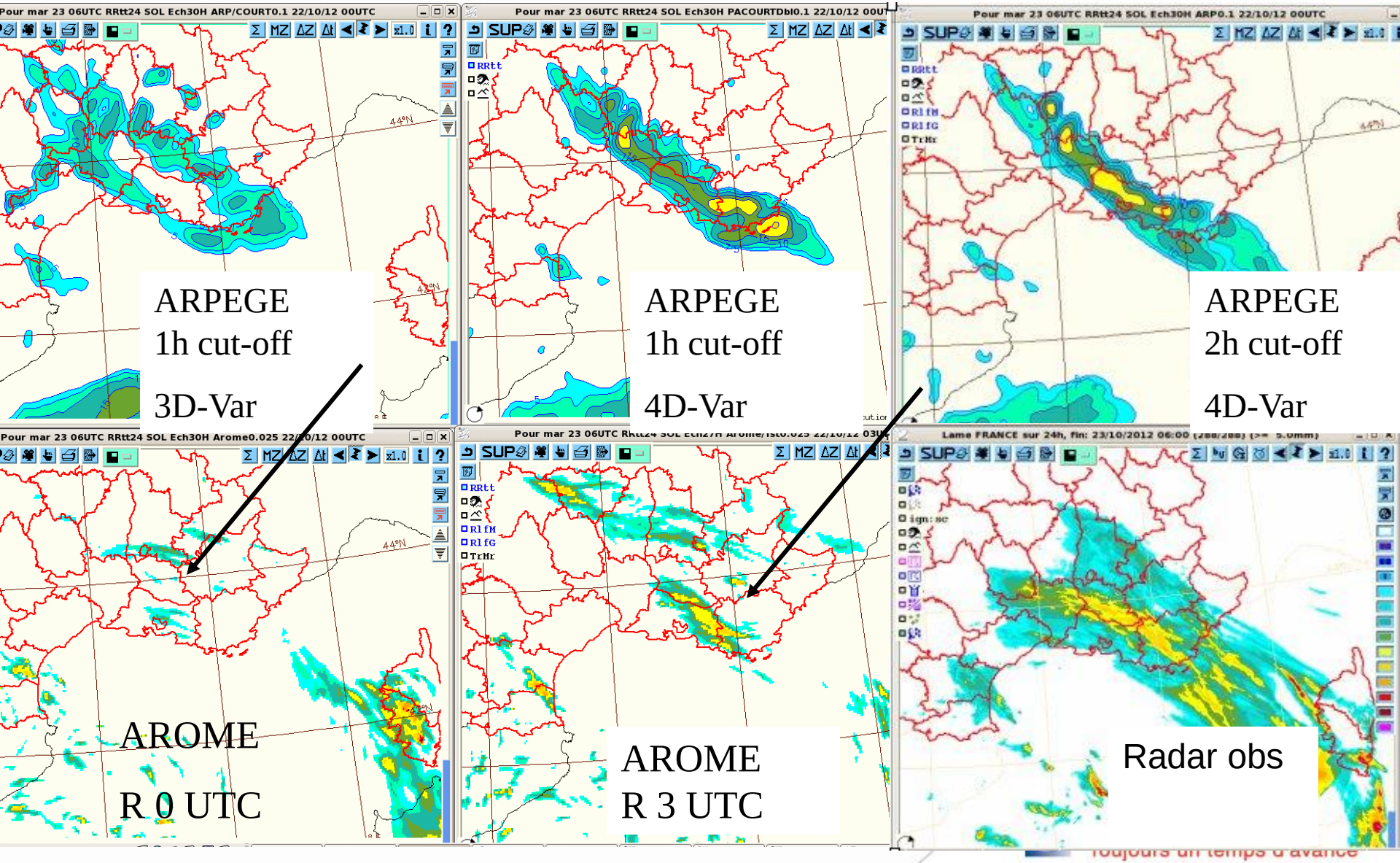
Currently, changes around 0UTC:

- The very short cut-off global Arpege model (1h10min): from a 3D to a 4D-Var analysis. The 0UTC Arome forecast is coupled with this global model and benefits from a better coupling run.

- Additional forecast from Arome at 03UTC coupled to the short cut-off (2h10min)

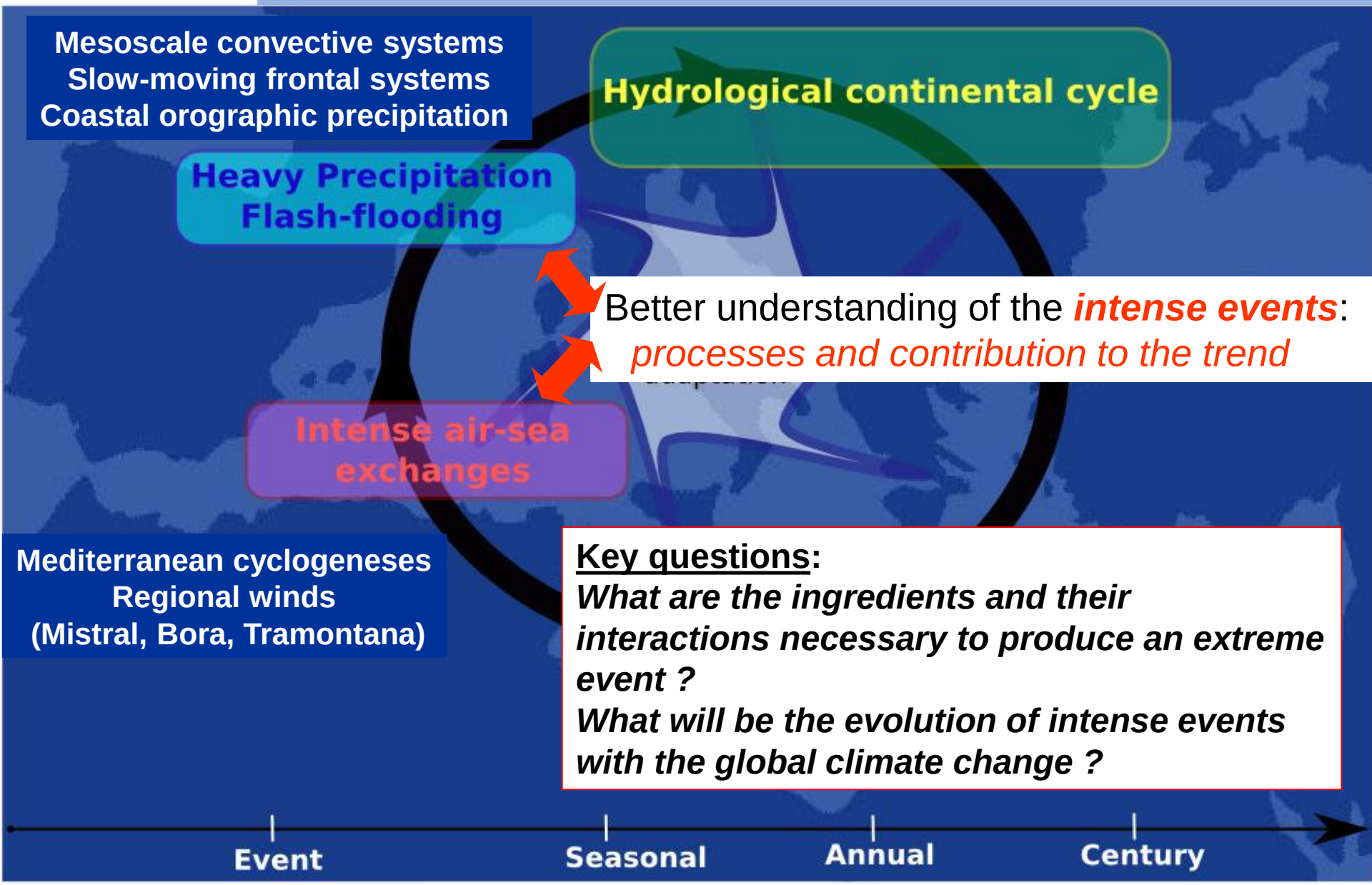
- Provides a new Arome run in the early morning, with refreshed initial conditions and better coupling model

## Precipitations over 24 hours from 22/10/2012, 06 UTC to 23/10/2012, 06 UTC (from 5 mm)



# HyMeX objectives

*Scientific topics*



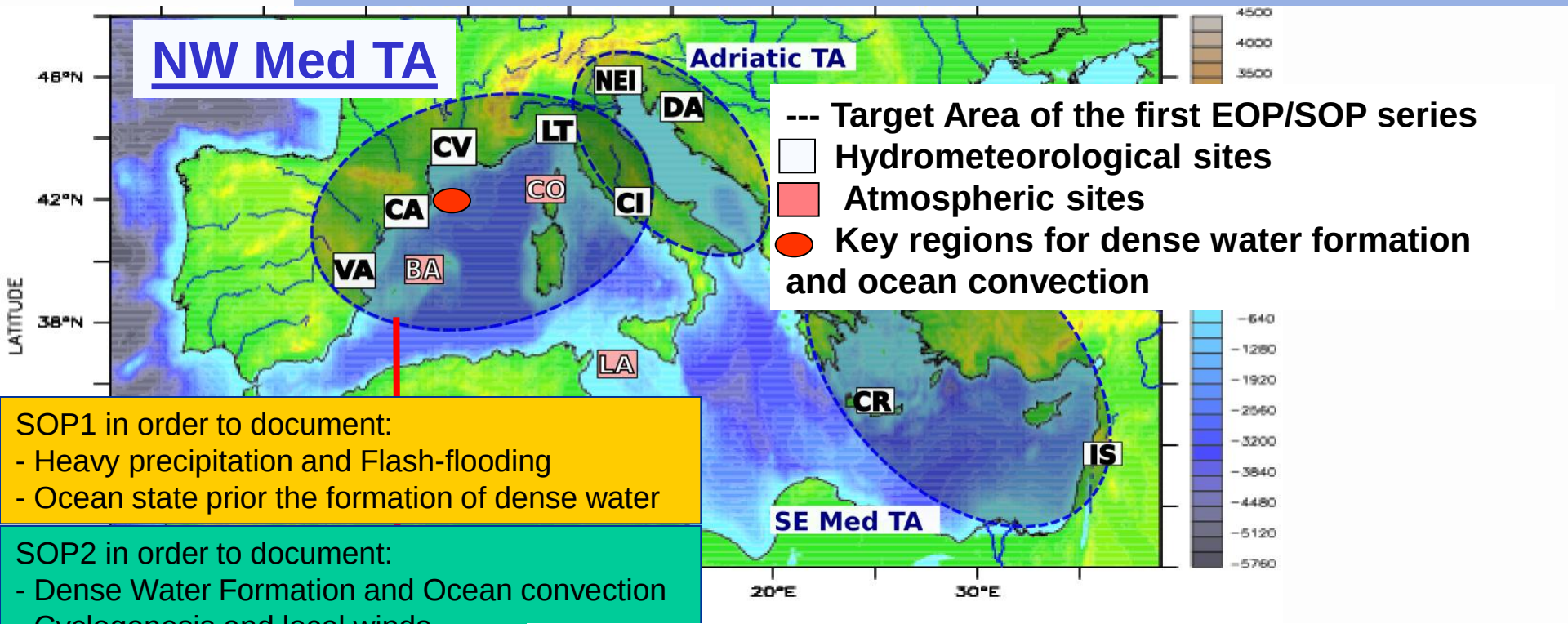

Better understanding of the ***intense events***:
*processes and contribution to the trend*

**Key questions**:

***What are the ingredients and their interactions necessary to produce an extreme event ?***

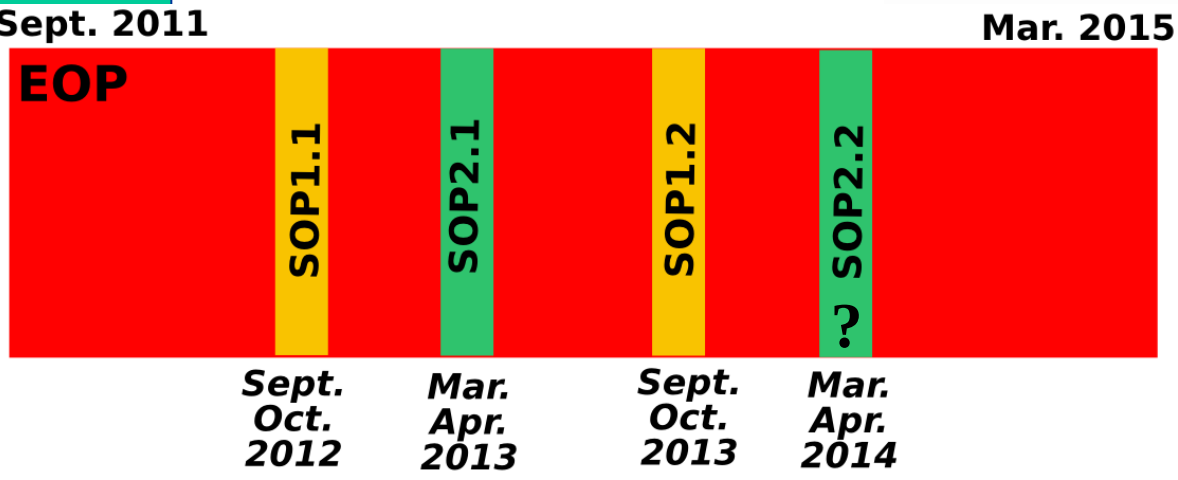
***What will be the evolution of intense events with the global climate change ?***

# Observation Strategy (Focus on NW Med TA)



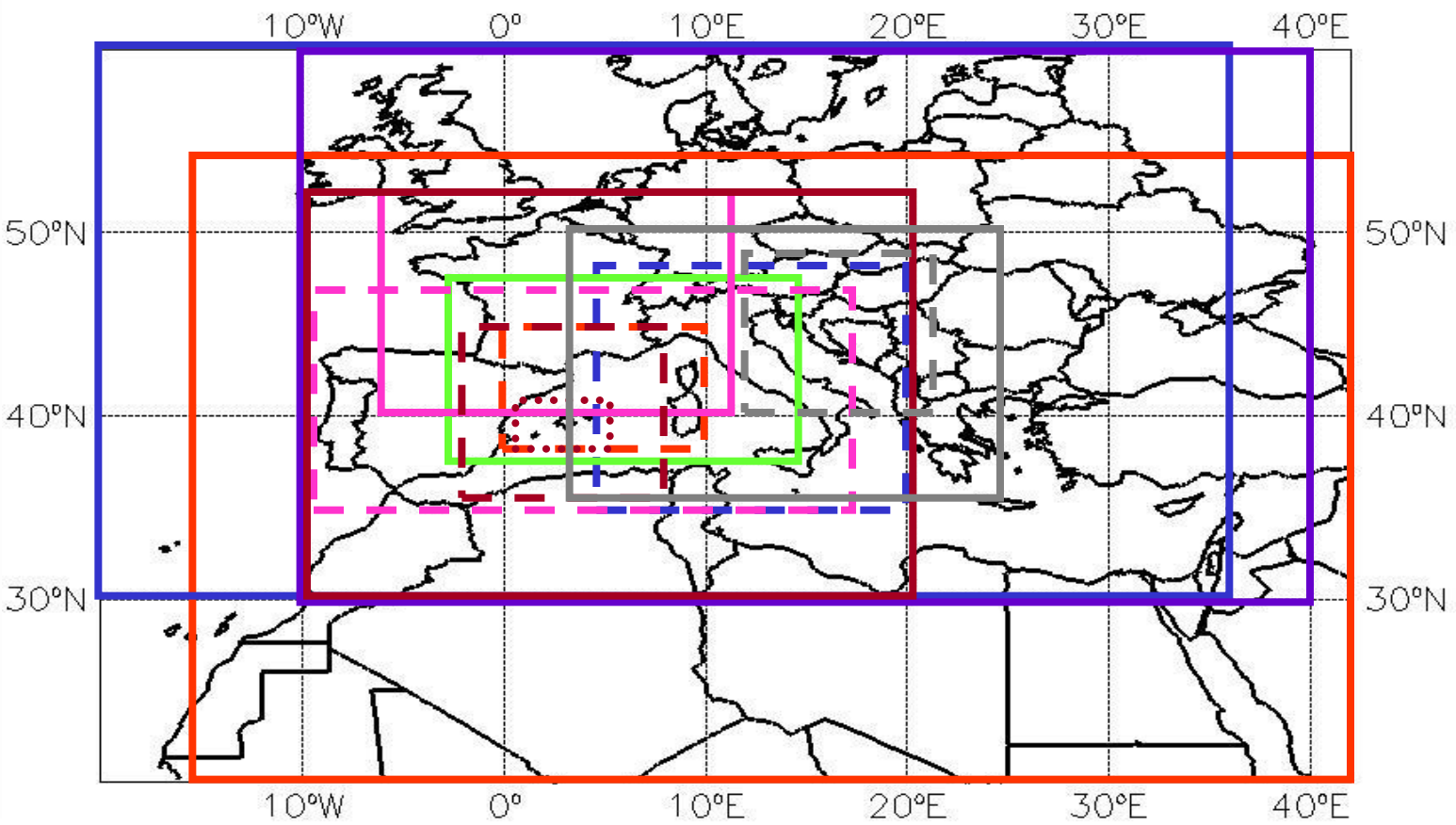

SOP1 in order to document:
- Heavy precipitation and Flash-flooding
- Ocean state prior the formation of dense water

SOP2 in order to document:
- Dense Water Formation and Ocean convection
- Cyclogenesis and local winds



# Real-time modelling forecast during SOP/EOP

**Real-time atmospheric models to guide observation deployement (available at the HOC)**




**AROME_FRANCE** (2.5km)
**AROME_WMED** (2.5km)
BOLAM (15km)
(**BOLD**, with assimilation cycle)

WRF-MED1 (50km)
WRF-MED2 (7km)
BOLAM (11km)
MOLOCH (2.7km)
MESO-NH (2.5km)

MM5-D1 (22.5km)
MM5-D2 (7.5km)
MM5-D3 (2.5km)
**ALADIN-HR** (8km)

Assimilation scheme:

3D-Var at 2.5km, assimilation window 3h, 48H forecast range

Assimilated observations:

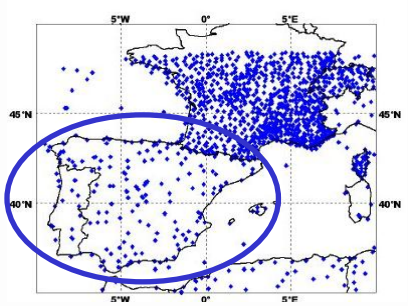
Conventional data : surface data, wind profilers, radiosondes

Ground-based GPS stations

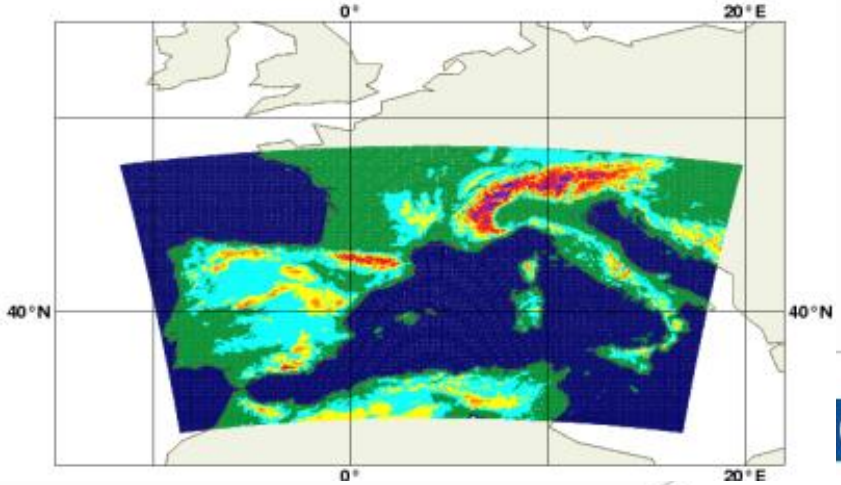
Satellite radiances from geostationnary and polar-orbiting satellites

Radar doppler winds and reflectivities (1D+3D-Var of RH profiles)

Wind derived from satellite imagery




Additional SYNOP provided by Spain



# Characteristics of IOP 8

***Short description / Objectives***

This IOP, which key pattern is a cut-off low, with heavy precipitation in its north-easterly flank, affected more to Spanish zones out of the SOP target areas (Andalusia, Murcia), with casualties and damage, than to HyMeX target areas, although in Valencia and Catalonia, less in the Balearics, was also important. The amounts of precipitation locally overpass 200 mm in 24 hours.

The IOP was selected, according the forecasts, as a typical situation of HPE in the Spanish Mediterranean. The objectives were to better document the warm and wet feeding of the HPE systems as well as other details of the meteorological environment of these systems.

# IOP 8: Social impact

RR24 > 200mm/24 hr southern Spain (Malaga, Murcia)

***Eleven casualties and 2 missing persons (Andalusia and Murcia)***

***-Hundreds of evacuated persons (Andalusia & Murcia)***

***-Around 120 M€ of material losses, including infrastructure, houses, cars, agriculture***

***-Air and terrestrial traffic affected***

litros por metro cuadrado

28/09/2012 10:20 CET

## Diez muertos en Murcia, Almería y Málaga por las lluvias torrenciales

FERNANDO J. PÉREZ / DIEGO NARVÁEZ / JAVIER RUIZ | Málaga / Murcia

Las trombas de agua han afectado sobre todo a Málaga, Granada, Almería, Murcia y Alicante. Varias carreteras permanecen cortadas, así como el tráfico aéreo y el ferroviario en varios puntos

28/09/2012 08:53 CET

01/10/2012 02:15 CET

## Los equipos de rescate buscan a tres desaparecidos por las lluvias

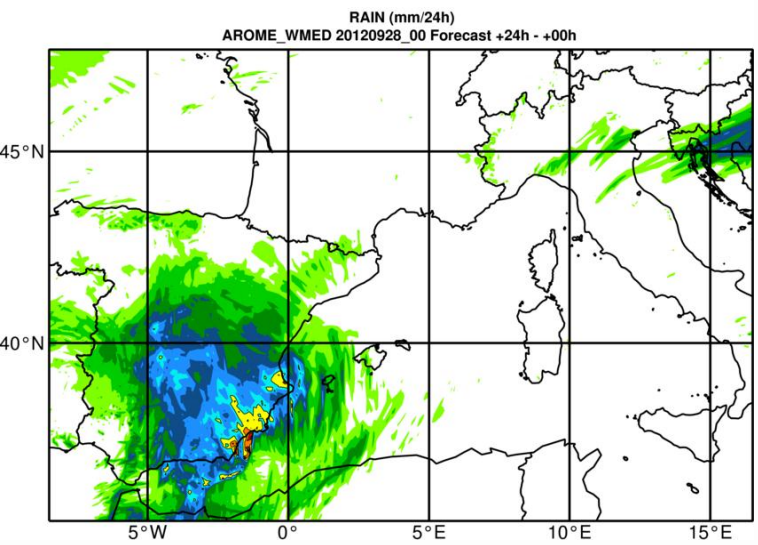
FERNANDO J. PÉREZ | Málaga

El temporal llega a Cataluña con abundantes precipitaciones

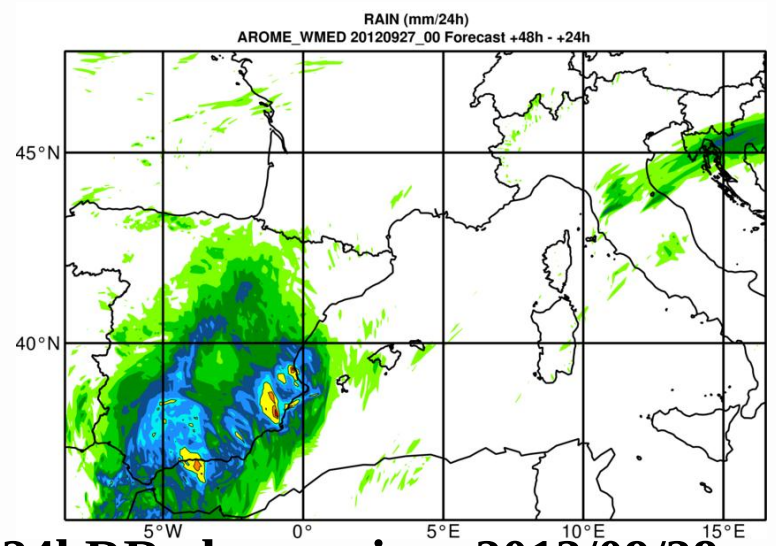
30/09/2012 02:12 CET

Treatment of spanish, catalan and italian SYNOPS
(a few for assimilation, most of them for validation)

## 24h forecast

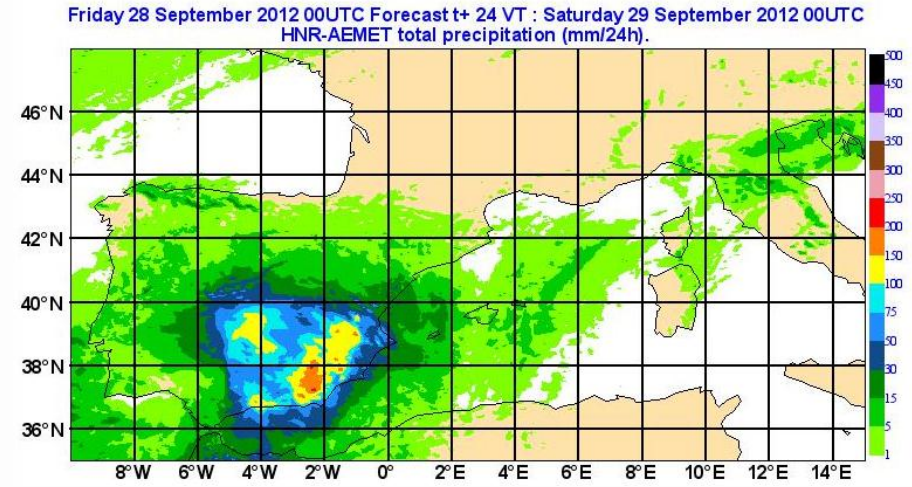



## 48h forecast

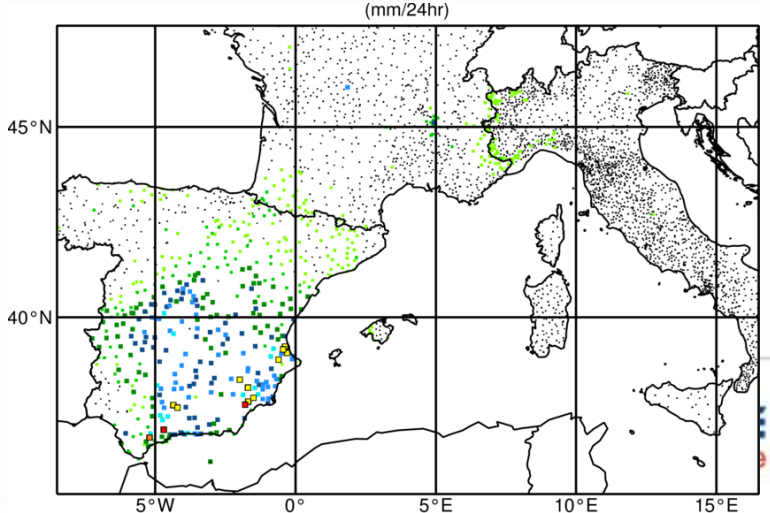



IOP 8

## HNR-AEMET



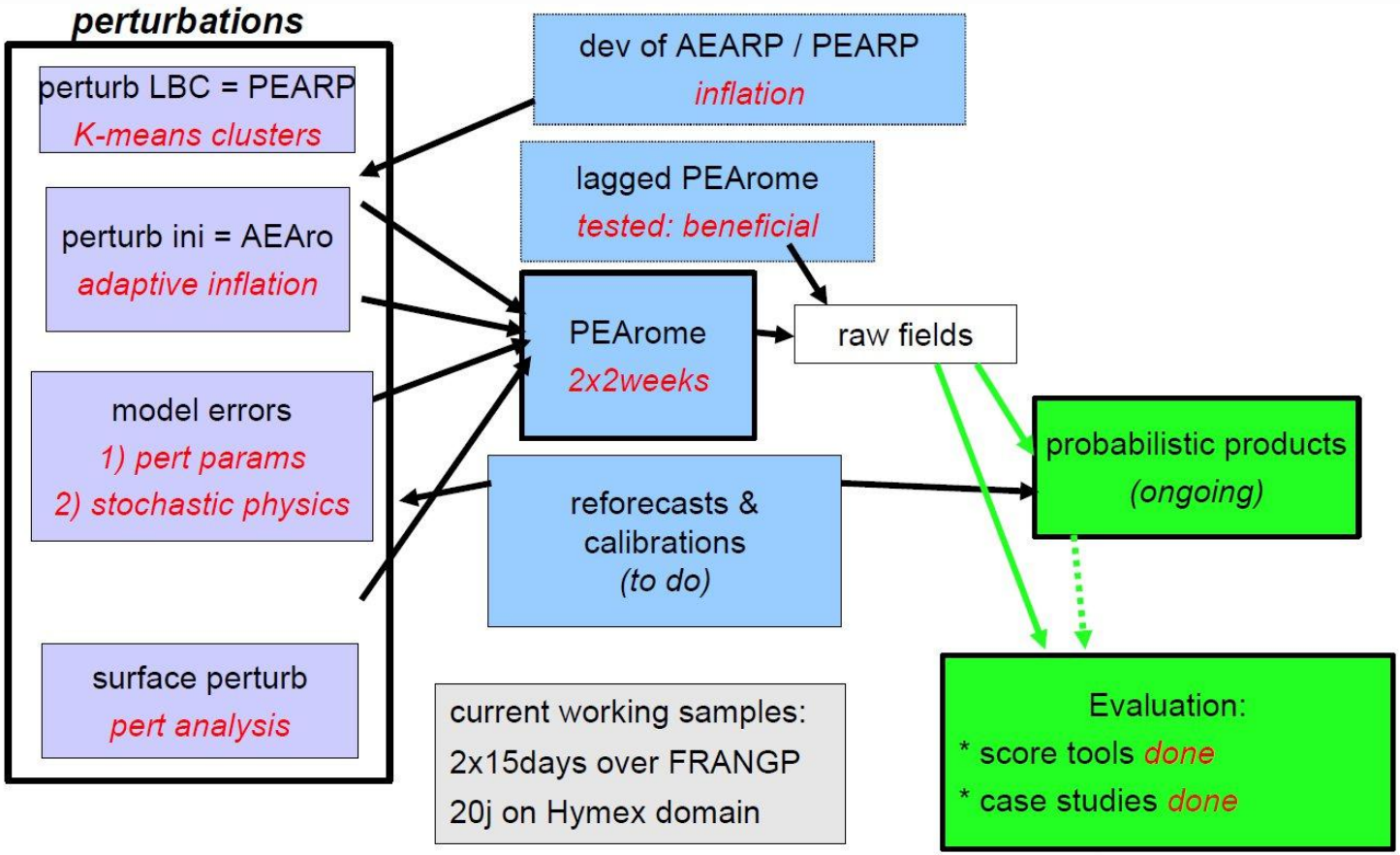

## 24hRR observations 2012/09/28 00UTC to 2012/09/29 00UTC



# PEARO: Ensemble Prediction at the convective scale, associated with the AROME model

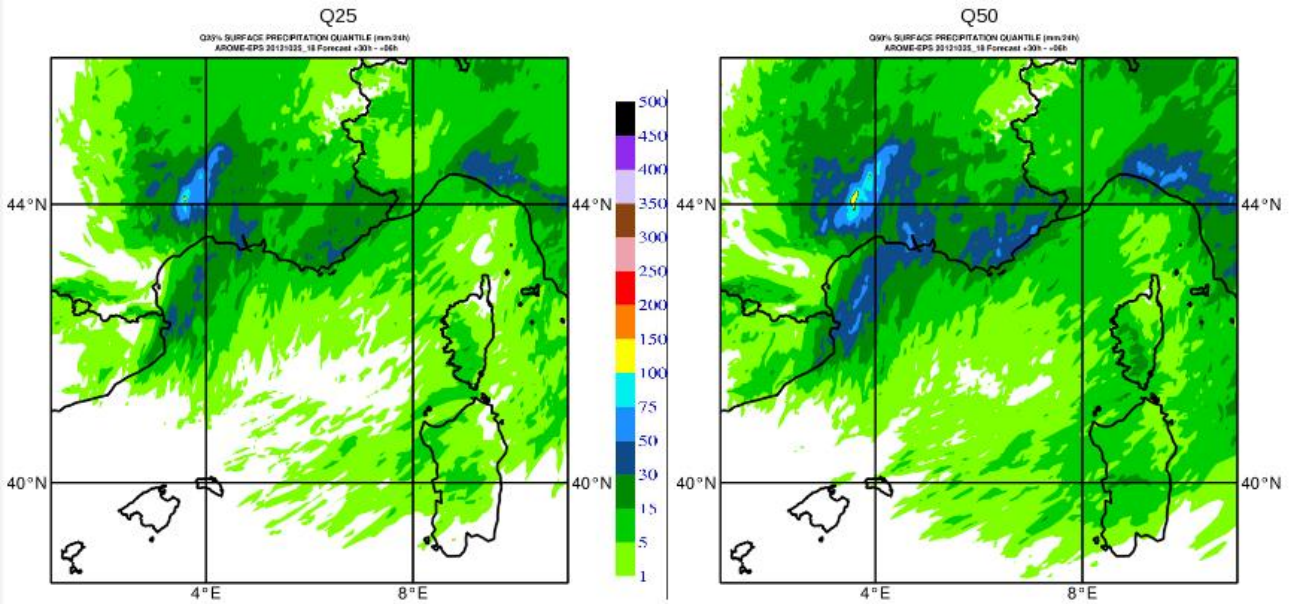
**Global Ensemble prediction**

**Local Ensemble of assimilation**



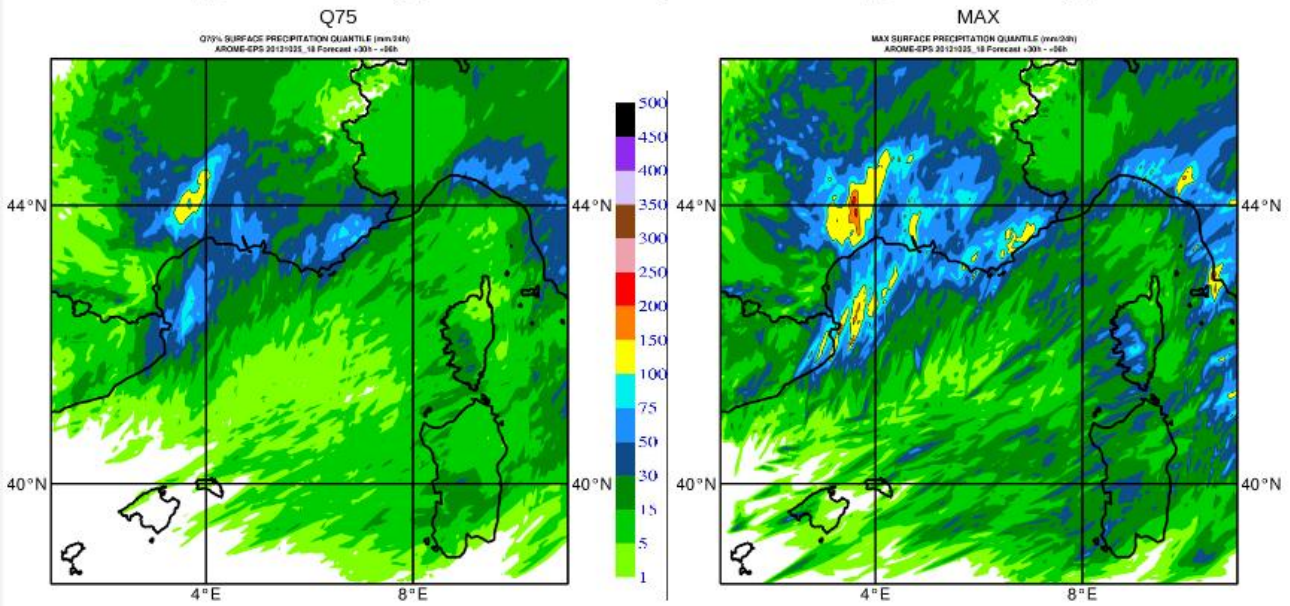

**In test: 8 members**

# Daily update on web site http://sop.hymex.org



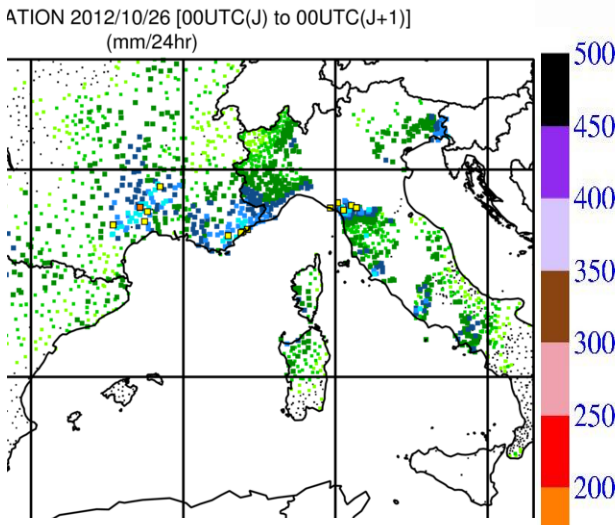


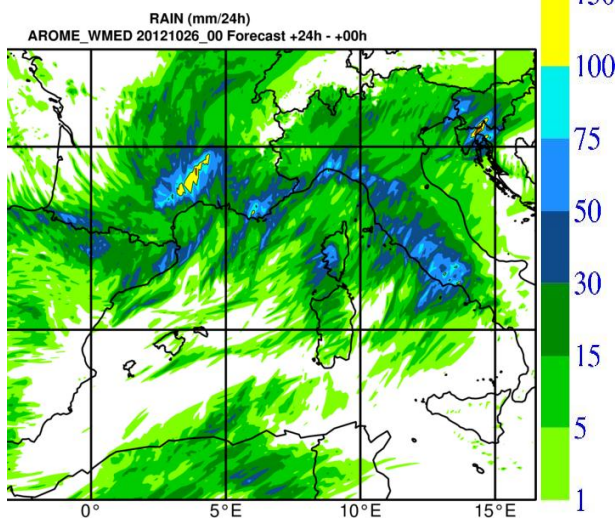








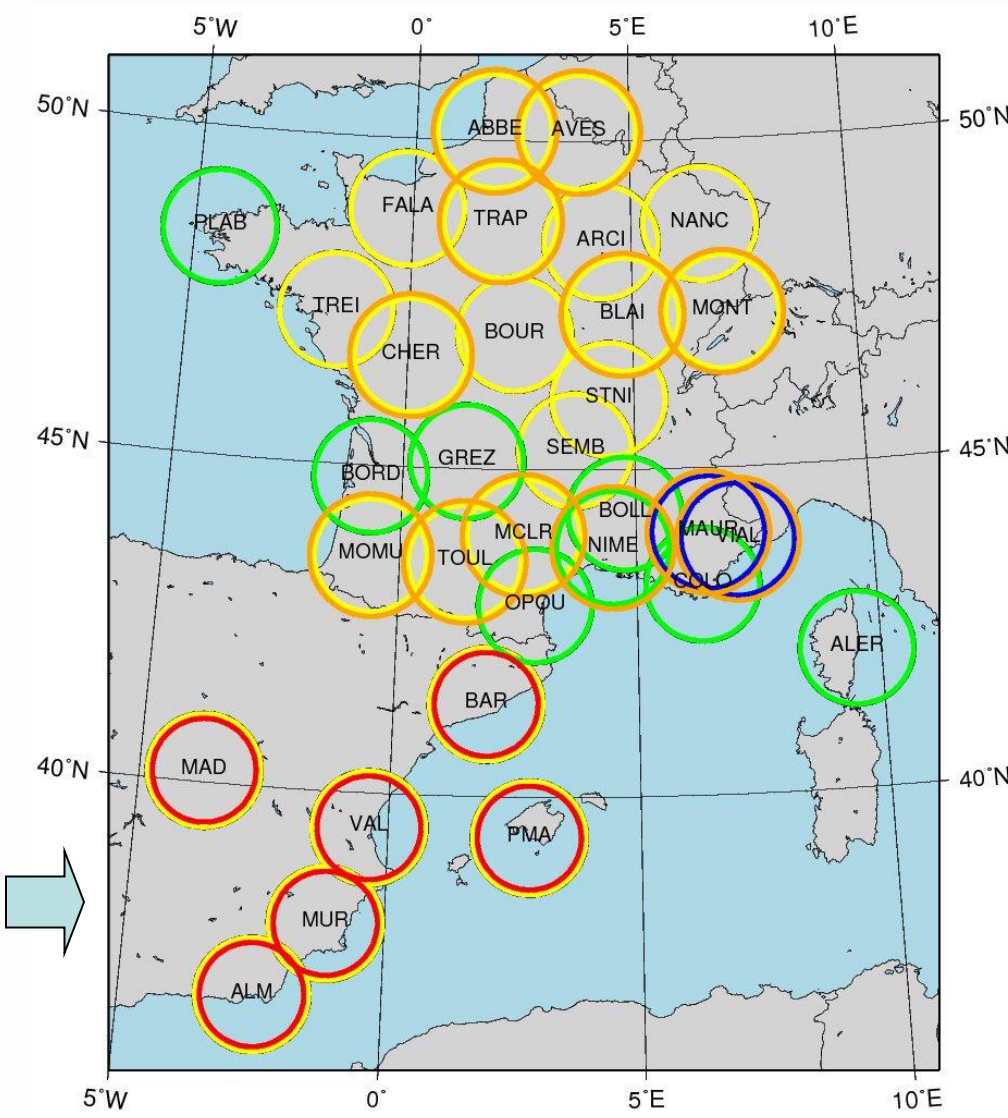


# European Collaborations

**Many ongoing studies using CONRAD in different NWP systems:**

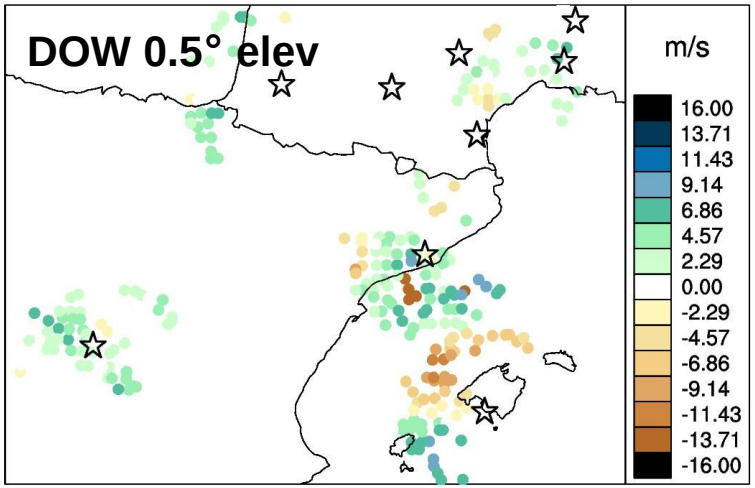
- **MetNo** is evaluating the assimilation of both Z and DOW
- **KNMI** is assimilating successfully DOW of 2 radars and has tested the inclusion of some French radars
- works are ongoing in Austria, Croatia, Hungary…
- **Assimilation of Z and DOW from spanish radars** is currently evaluated in AROME-France in the HyMex framework

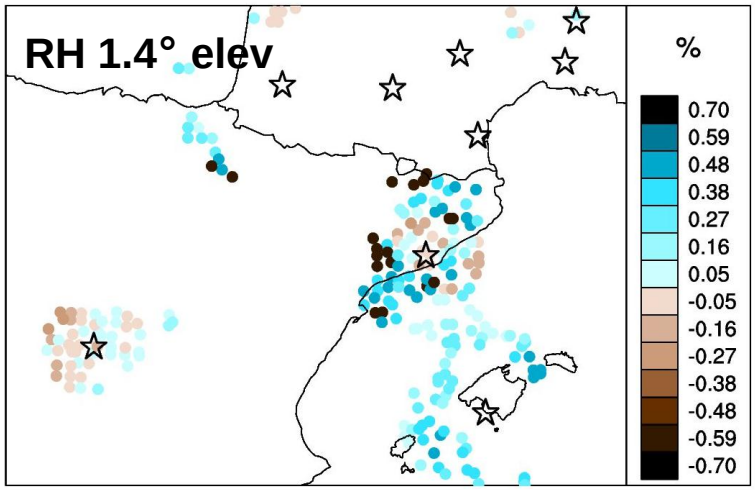


# European Collaborations

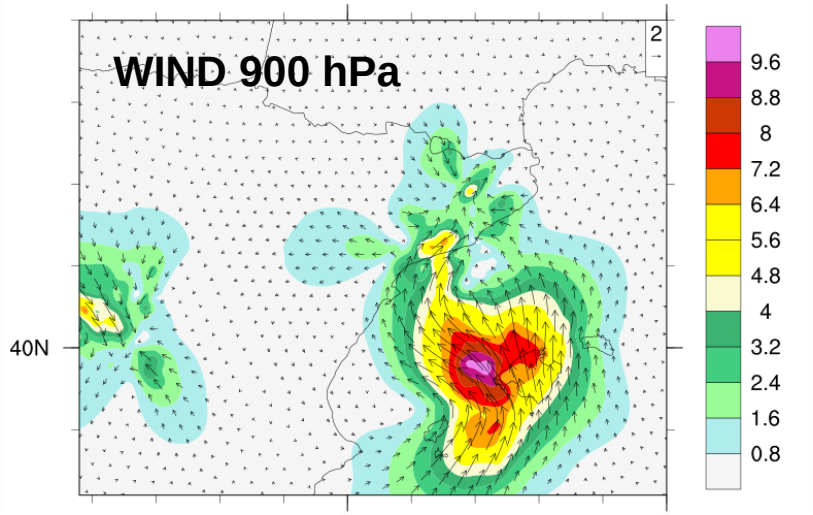
## Assimilation of AEMET's radars in AROME

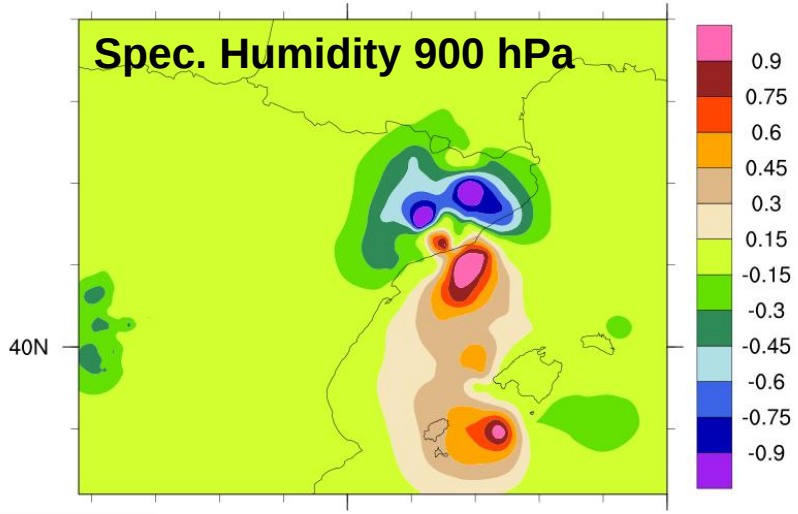
*(obs-guess) in observation space*
*(DOW positive towards the radar)*



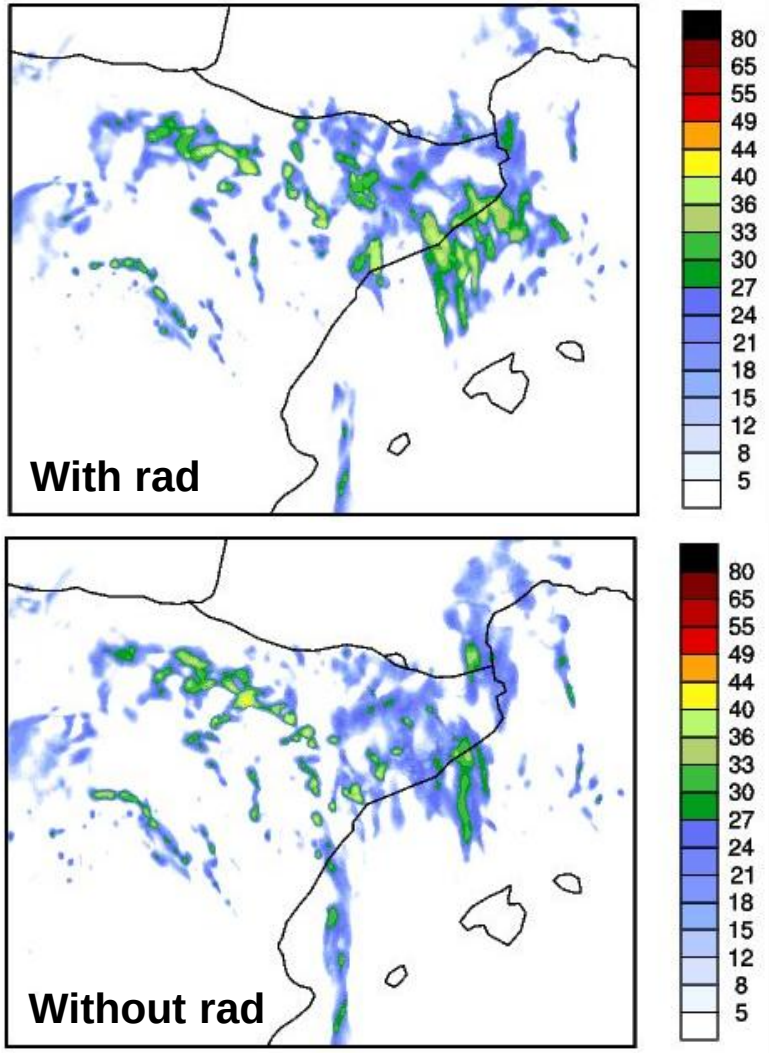

*Analysis differences with/without AEMET radars at 9 UTC*



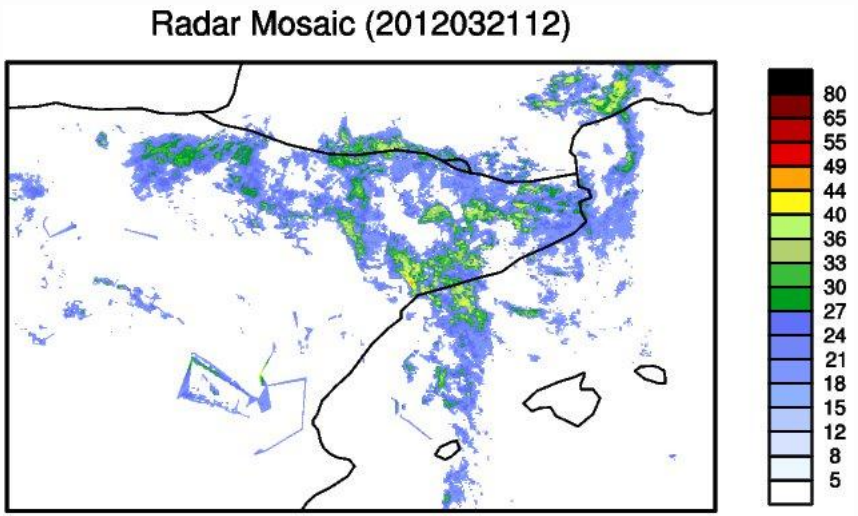
# European Collaborations

## Assimilation of AEMET's radars in AROME: precip. forecast




*3h Forecasts of Z (1500m)*

⇒ Realistic enhancement of the southerly humid flux, bringing more precipitations over Catalonia




- Technically OK, but more validation is needed
- 6 radars currently tested in quasi real time in AROME-WMED

# Research work on mesoscale Ensemble Data Assimilation

Can a large-scale ensemble data assimilation benefit to mesoscale data assimilation?

Questions about number of members and resolution needed to correctly reproduce the errors of the day at large and small scales.

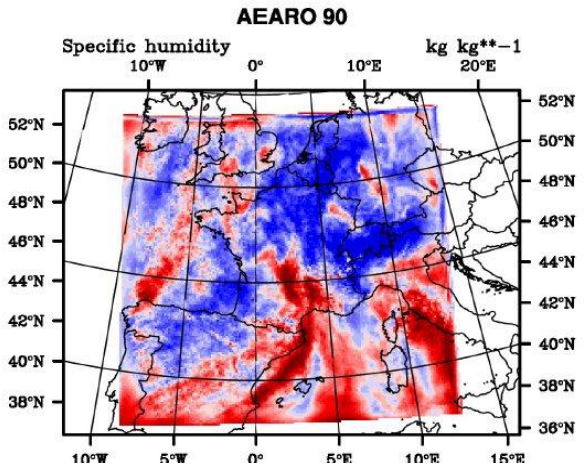
Several ensemble data assimilation systems were run:

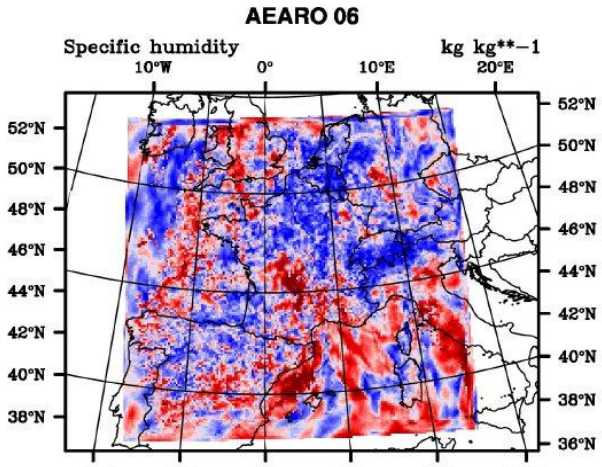
AEARP: global, large scales

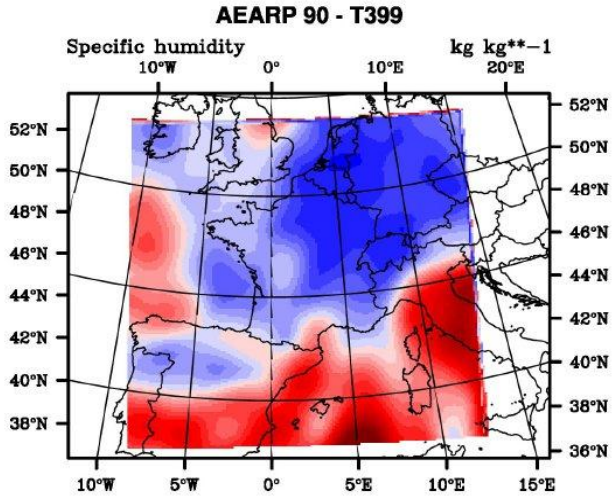
AEARO: small-scales

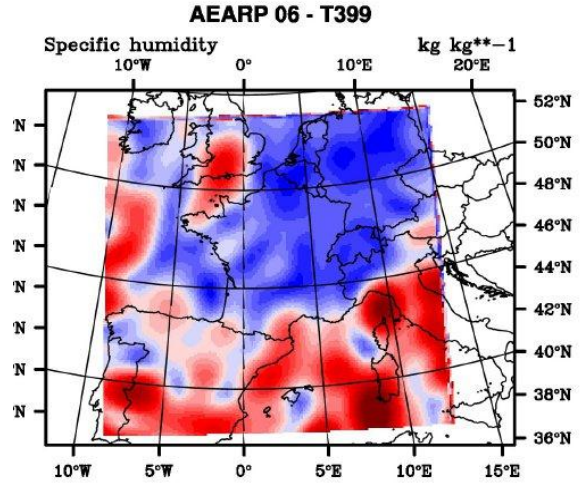
With variable numbers of members from 6 to 90

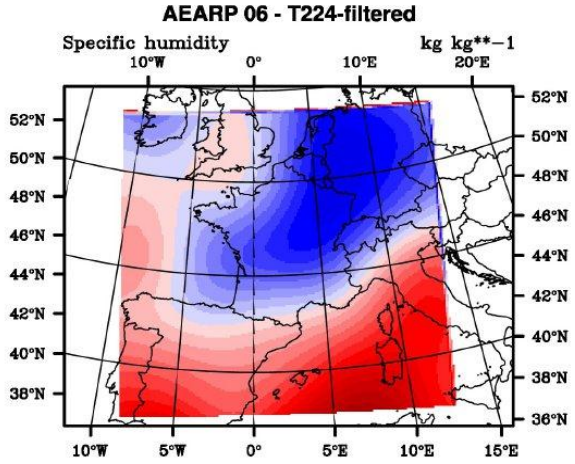
# Research work on mesoscale Ensemble Data Assimilation



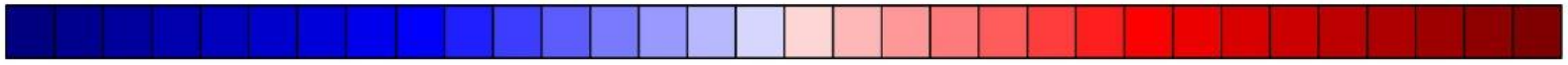




6 members: need for filtering

Large-scale info in the large-scale ensemble

Additional small-scale features from mesoscale ensemble



# The future

In 2013, mainly more observations from Suomi-NPP, MetOp-B, SSMIS sounding channels and use of flow-dependent correlations from the ensemble data assimilation in 4D-Var

Choice of new Bull super-computer. In 2013, 2 computers will be installed with a peak performance of 475 Tflops each (990 nodes with 20 cores). End 2015 / beginning 2016 they will be replaced by 2 computers of 2,85 Pflops each (1800 nodes). Intel processors (Ivybridge then Broadwell).

Preparations for 2014-2015:

- Resolution upgrades for global and local models
- New applications: Arome for nowcasting, ensemble prediction for Arome