Evaluation of the 1st AROME-WMED reanalysis of HYMEX-SOP1, plans for the 2nd AROME-WMED reanalysis

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Outline:

- Introduction: Characteristics of AROME WMED
- Evaluation of 1st AROME-WMED reanalysis
- 2nd AROME-WMED reanalysis
- Conclusions and perspectives

cnrs advancing the frontiers

METEO FRANCE
Toujours un temps d'avance

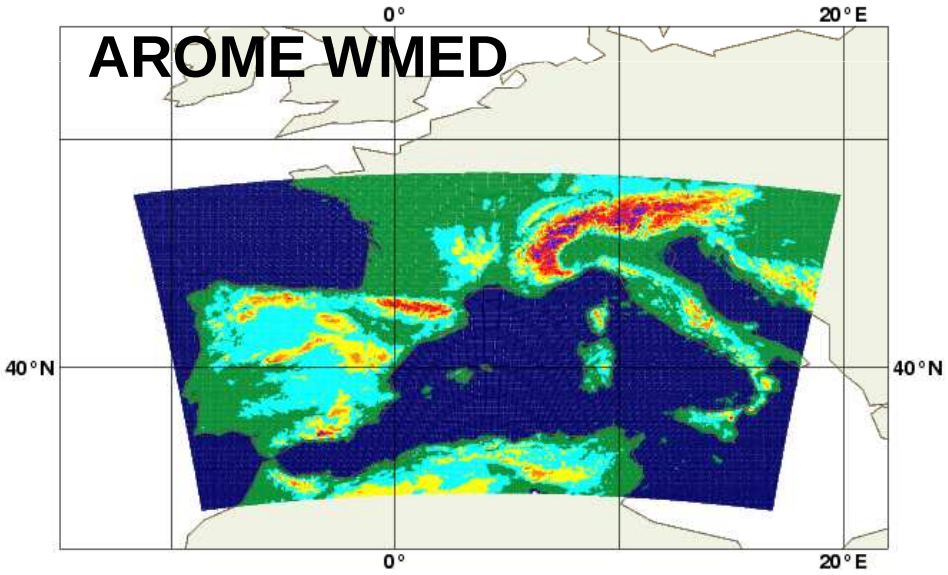
Introduction

- AROME-WMED (west mediterranean) developped for the real-time analyses and forecasts during the SOPs (1&2) of HyMeX ,and delivered to the Hymex Operational Centre (HOC) each day a 48-hour forecast
- Operational mode from September 2012 to March 2013

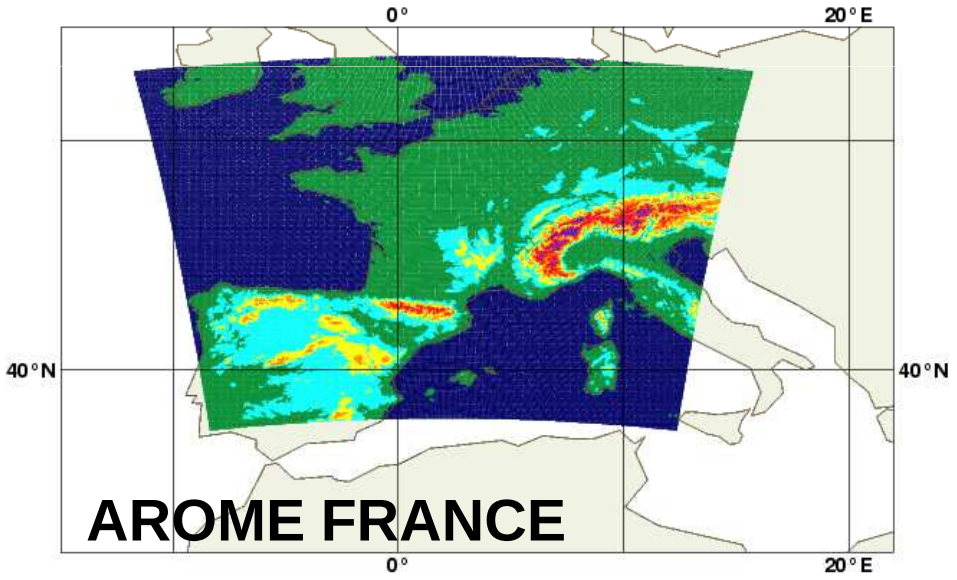
  ➔Tool for some studies of atmospheric data assimilation HyMeX
- Based on the operational AROME-FRANCE model, horiz. resolution **2.5 km**, 60 vertical levels from 10m to 1 hPa, time step 60s
- Domain: 34° N -9° W/ 48° N-20° E

AROME_WMED = **+11%** points vs AROME_FRANCE

sea=47%, land=53%
(nx:960,ny:640)



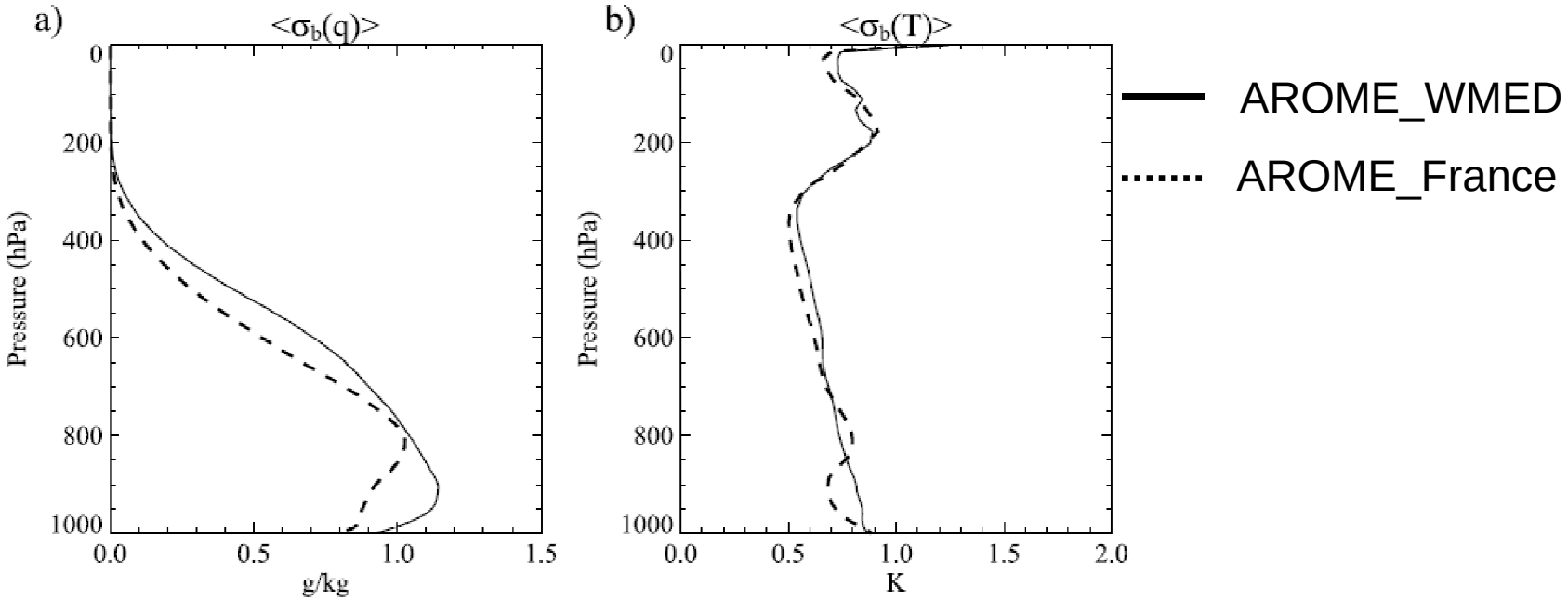
sea=41%, land=59%
(nx:750, ny:720)



AROME-WMED: Description

•**Atmospheric initial conditions**: 3D-Var with an assimilation window of 3h

•Background error covariance matrix computed with DA ensemble (Brousseau et al, 2011) over the rainy period **from 2010-09-10 to 2010-10-14** (analysis times 00 and 12UTC)



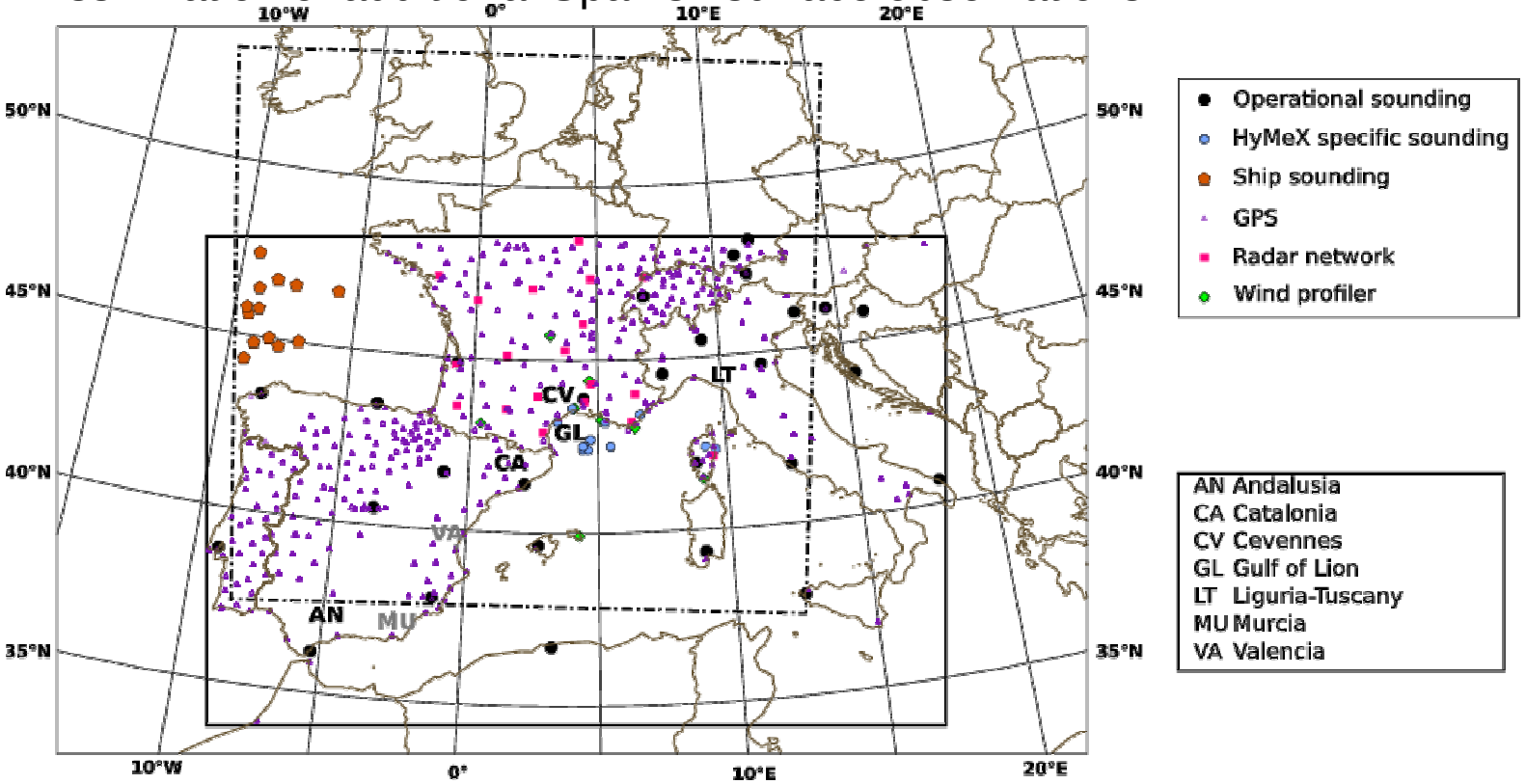
•Lateral boundary conditions provided by the French global model ARPEGE

•48h forecast range on 00UTC

AROME-WMED: Data usage

Assimilated observations

- Conventional data: surface data, wind profilers,radiosondes
- Ground-based GPS stations
- Satellite radiances from geostationnary and polar-orbiting satellites
- Wind derived from satellite imagery, Ascat winds
- Radar doppler winds and reflectivities
- Assimilation of additional Spanish surface observations

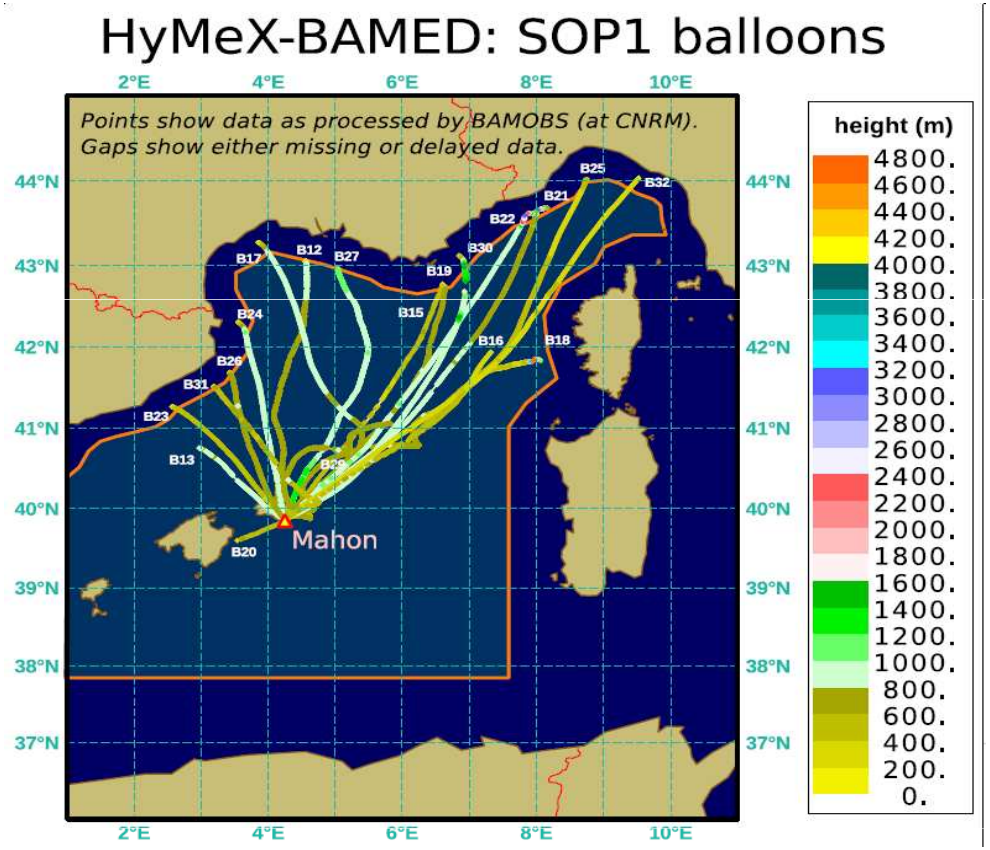


•**Surface initial conditions**: surface analysis (T and water content of the 2 reservoirs of the surface scheme) with optimal interpolation every 3h from T2m and Hu2m. SST: OSTIA analysis from UKMO

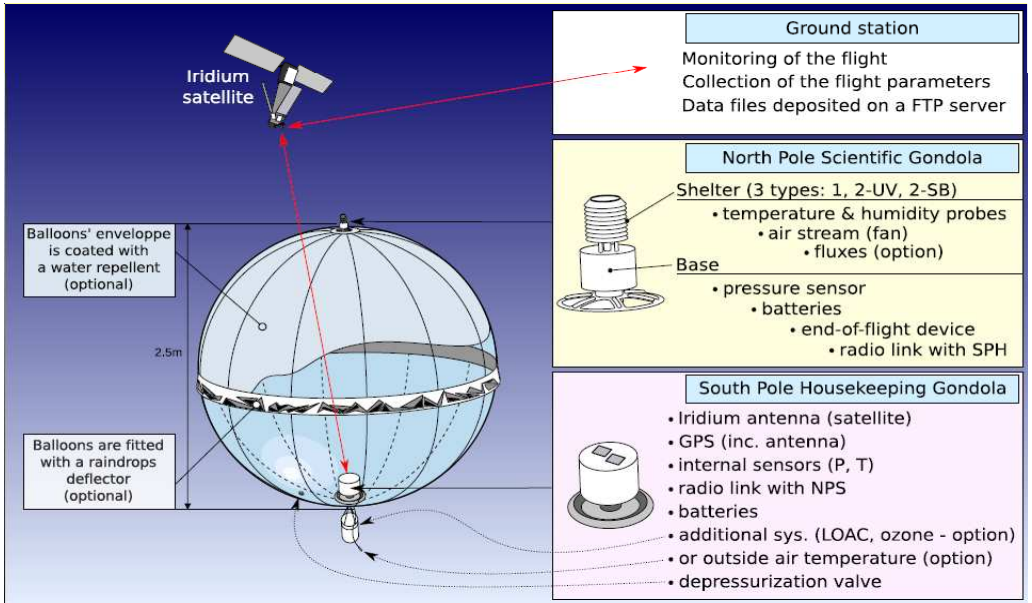
1st AROME-WMED reanalysis

- **Period**: SOP1 (05/09/2012 ➔ 05/11/2013) = 2 months
- **Forecast range: +54hr range** (+48 h for « oper » version) on 00UTC
- Unique software version
- **Run on the previous NEC supercomputer**
- **Observations new-extraction** (cut-off) implies more data available
- **Coupling:** ARPEGE « long » cut-off (instead of ARPEGE « short » version ➔ more observations in the coupling flux)
- Assimilation of some experimental mobile soundings not assimilated in real-time (not assimilated before 10/10 in « oper »)
- Activation of several **wind profilers**
- **Boundary Layer Pressurized Balloons** (BLPB, Alex Dorenbecher et al.), humidity data (Q) assimilated, (wind and T already used in « oper »)

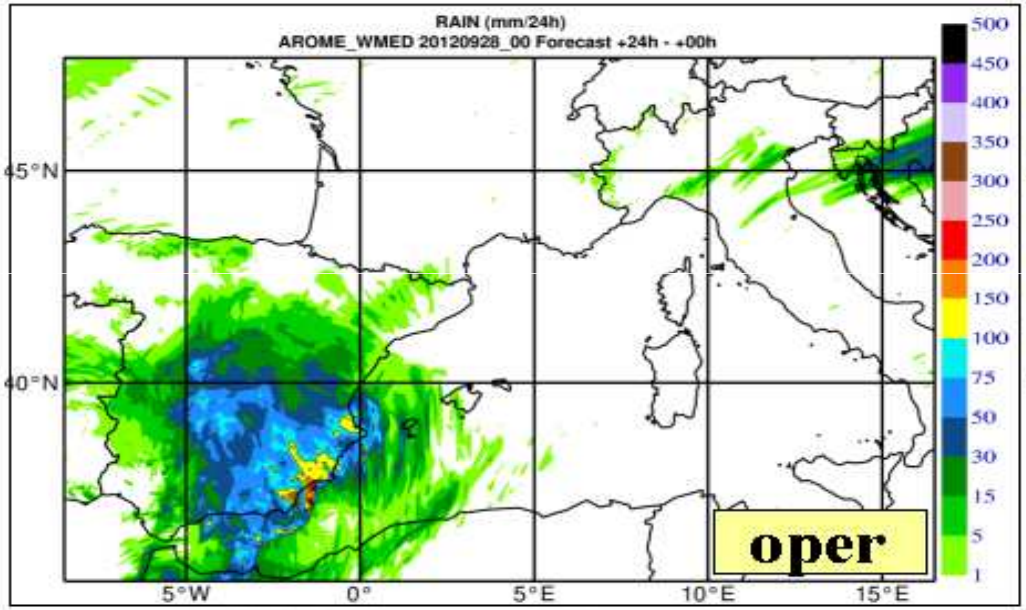
1st AROME-WMED reanalysis

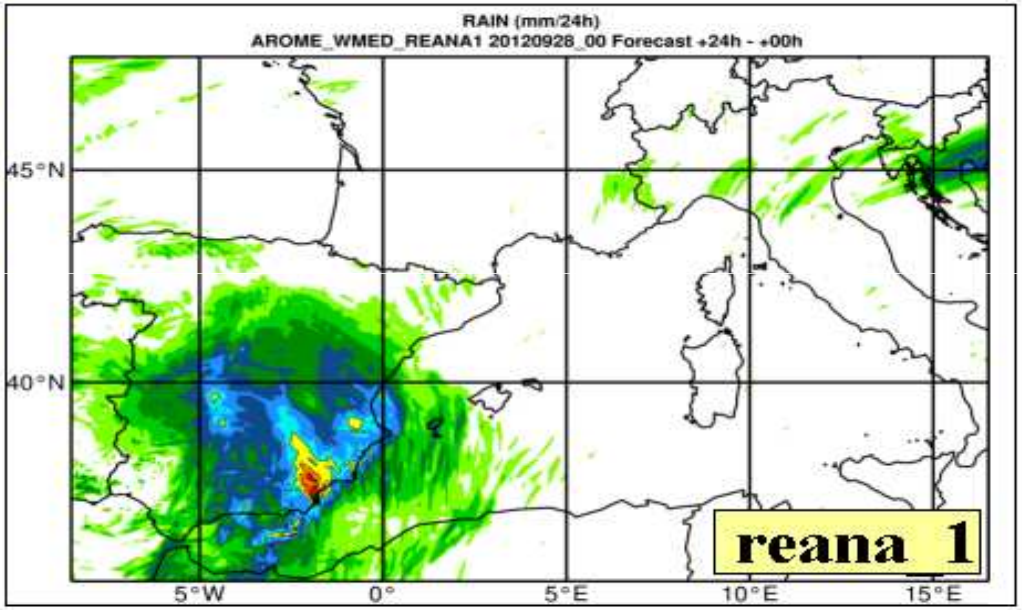


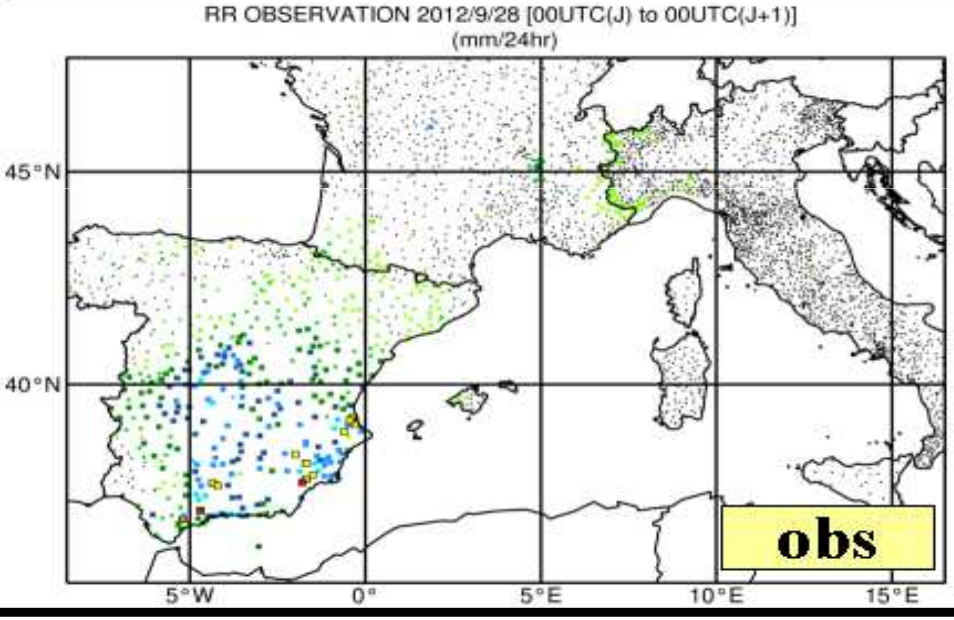
Launch of B47 and B48 on 2013/03/14 at 09h16 (courtesy BAMED website - Ph. Cocquerez)



1st AROME-WMED reanalysis







Qualitative impact hard to detect

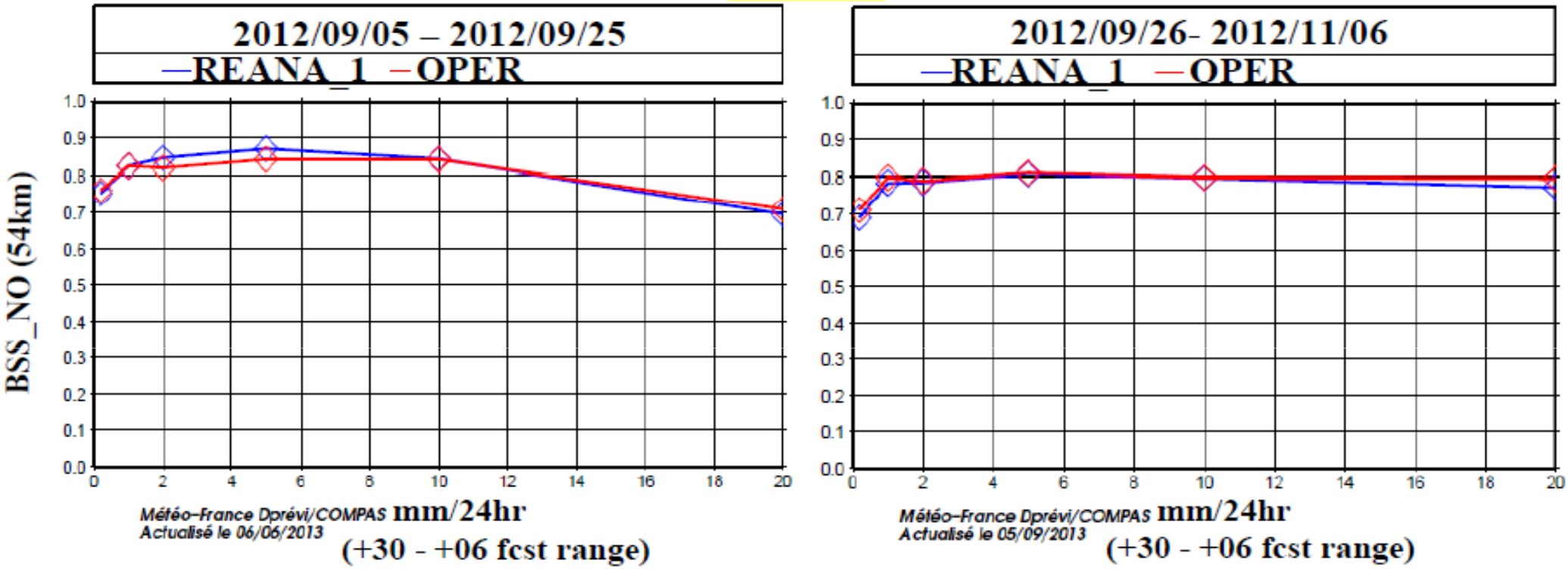
28/09/2012 case (Spain):
24h cumulated rainfall amounts (00-24)

Spanish « golden case » : IOP8

1st AROME-WMED reanalysis wrt AROME-WMED oper.

- Boundary pressurised balloons BAMED: ~ 400 observations (Hu)
- Wind Profiler: +64%
- Radiosonde: +4%
- Synop: +2%

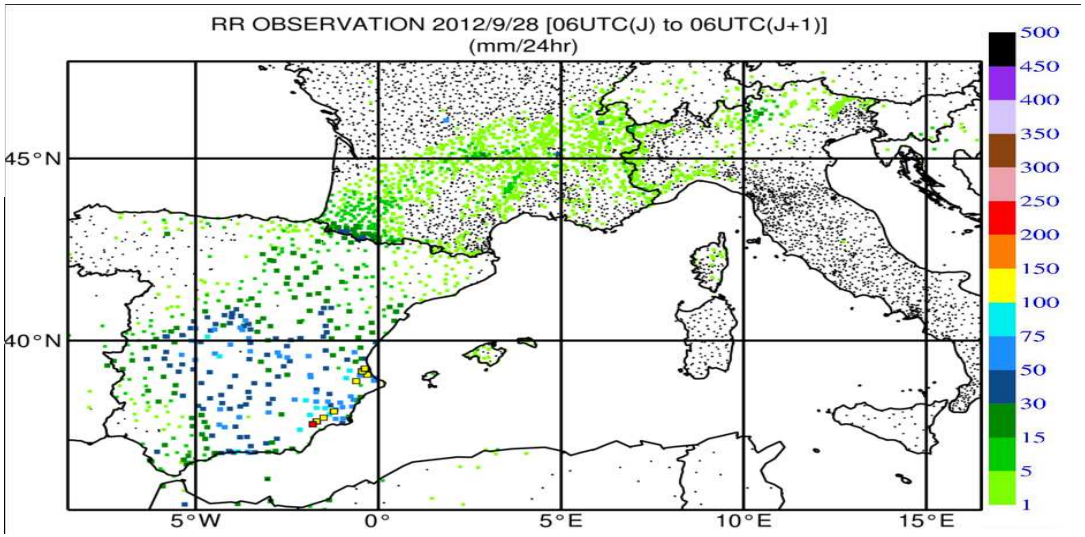
SOP1

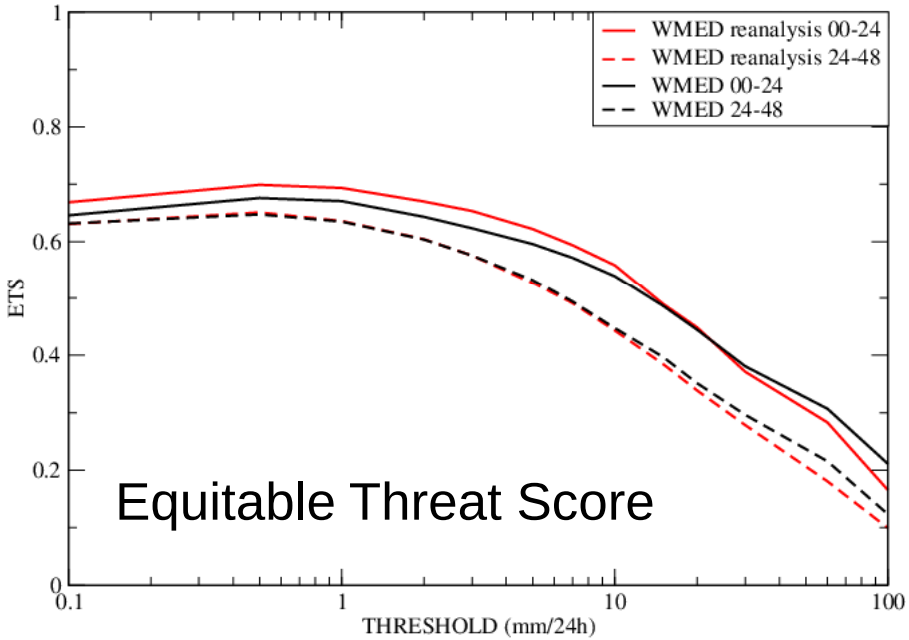


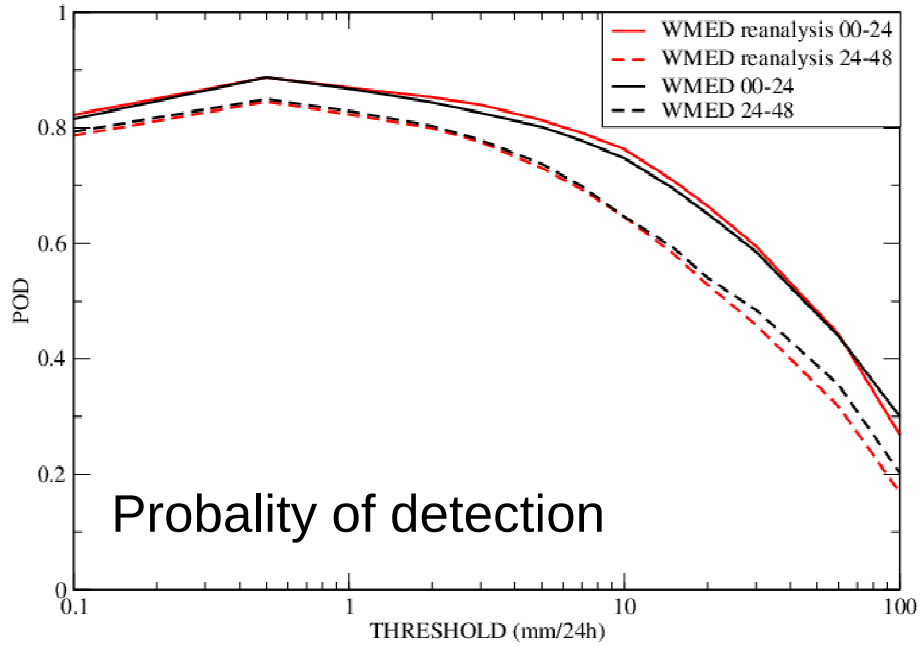
QPF: impact > 0 first period (cycle change)

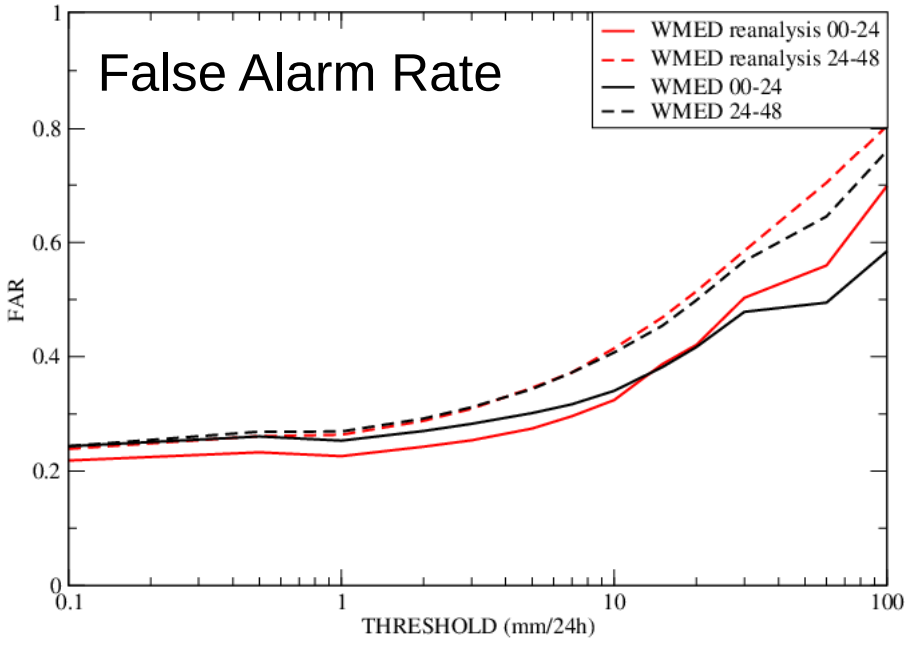
Comparison to observations: 24-h accumulated precipitation scores

24-h accumulated precipitation from raingauges data available for the 2 month period of SOP1.









1st reanalysis evaluation : conclusions

- Computed on the previous NEC computer, replaced by BULL
- More data assimilated, some improvement (e.g. QPF, geopotential and wind at 24-h range), neutral for temperature and humidity.
- but overall ~ ***neutral impact on the forecast quality***
- available in the HyMeX database

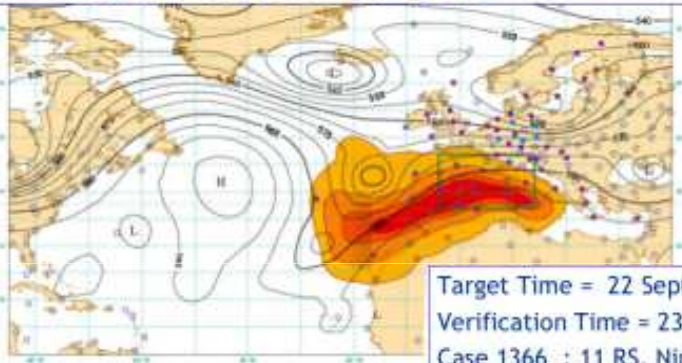
1st reanalysis :DTS experiment

About 850 radiosoundings (research and oper. stations), most sent as TEMP BUFR messages to GTS:

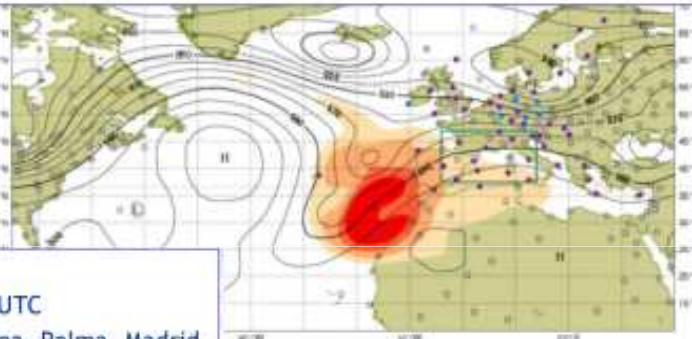
⇨ **447 from HyMeX sites**: ~ 250 RS in Corsica (San Giulano, Corte), ~160 RS along the French coast (Vias, Candillargues, Marseille, Fréjus), ~15 RS in Bologna, L'Aquila, Campoformido, ~ 30 RS from ship

⇨ **403 additional oper soundings at 06 & 18UTC (EUCOS funding), using the DTS system**

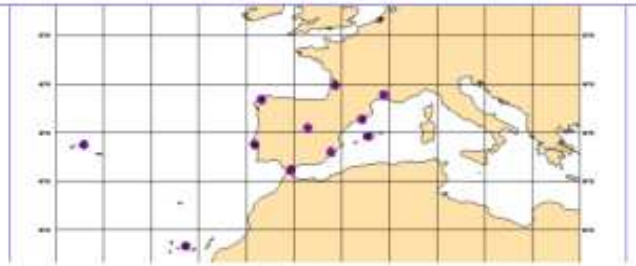
Target Time = 22 September 2012 at 18 UTC
Verification Time = 23 September 2012 at 18 UTC
IOP 6: 23-24 September 2012 - HPE in CV, LT and NEI
ECMWF-SAP based on TE-SVs



Target Time = 22 September 2012 at 18 UTC
Verification Time = 23 September 2012 at 18 UTC
IOP 6: 23-24 September 2012 - HPE in CV, LT and NEI
Météo-France-SAP based on EKS



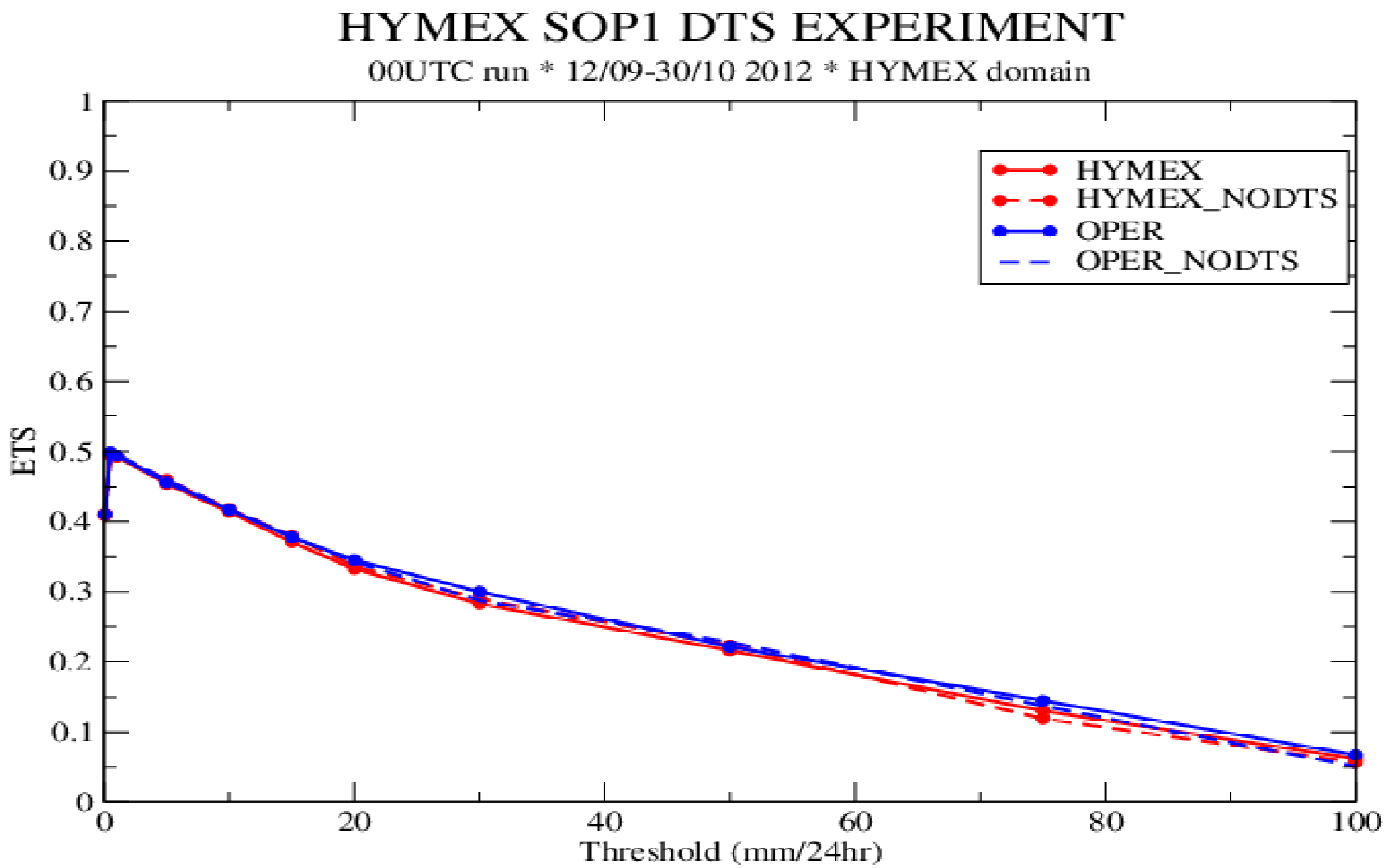
Target Time = 22 September 2012 at 18 UTC
Verification Time = 23 September 2012 at 18 UTC
Case 1366 : 11 RS, Nimes, Bordeaux, Barcelona, Palma, Madrid, La Coruña, Murcia, Gibraltar, Lisbon, Açores and Tenerife



⇨**Convective scale data assimilation impact studies**

SAP=Sensitive Area Prediction

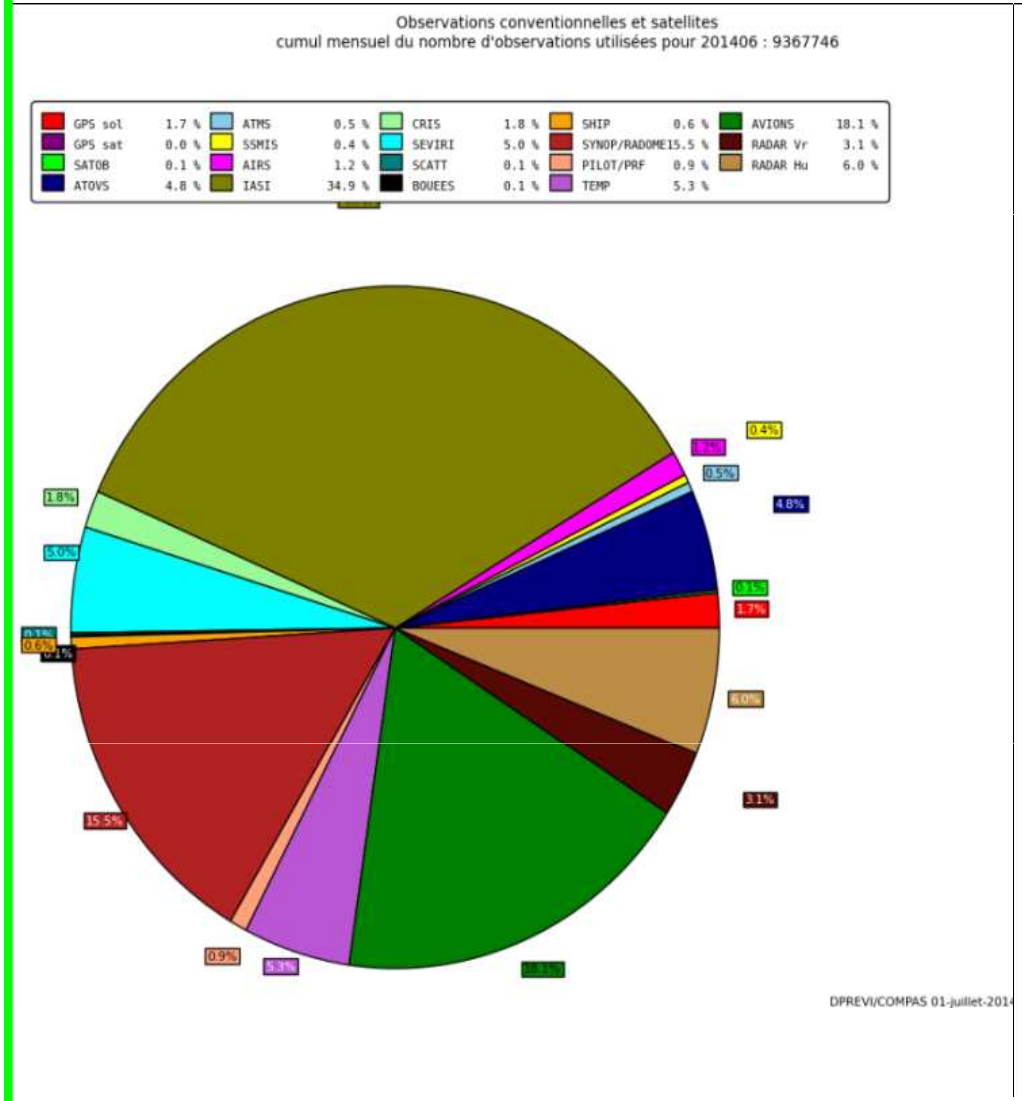
1st reanalysis :DTS experiment

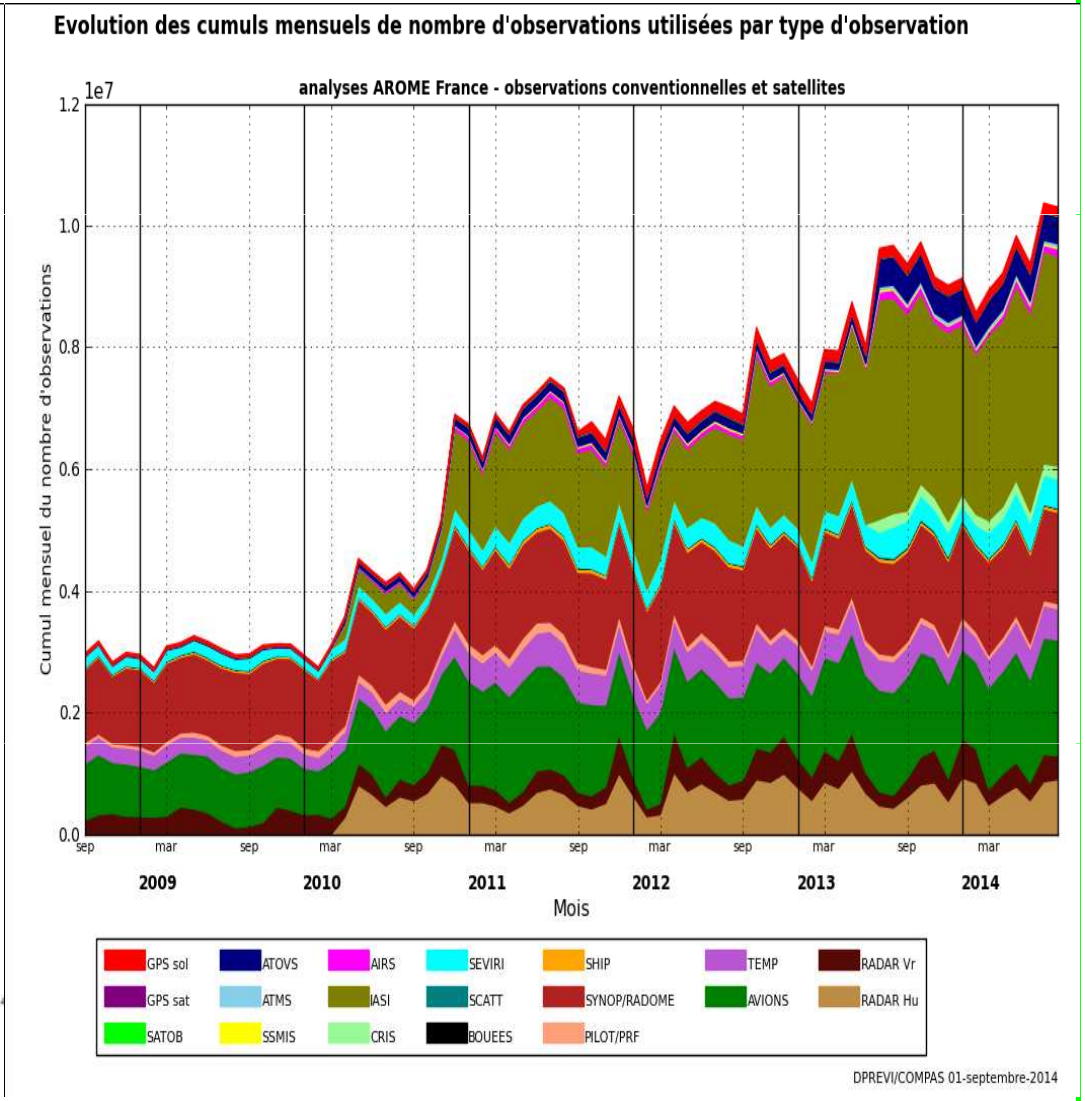


Extra (DTS) soundings have a **neutral impact** on short term forecast

Validation: 06UTC(J)-06UTC(J+1) ie forecast +30hr - +06hr
Sample size ~ 6000 comparisons/day x 50days

1st reanalysis :DTS experiment





DTS Temp ~0.5% data

Towards a new AROME-WMED (2nd) reanalysis of the HyMeX SOP1 (5 September 2012 - 5 November 2012)

- New BULL computer + new version of AROME

- New background error matrix, computed over a 2 week period of October 2012 from an ensemble data assimilation of 6 members

- New orography (same as AROME_France oper.)

- Enhanced observations flux vs the first reanalysis AROME-WMED:

More observations from the HyMeX will be assimilated

➔ *high resolution radiosounding* (France, Espagne, RS/4M, KIT, L'Aquilla, Biscarosse, italian?…)

➔ *dropsondes F20*

➔ *reprocessed GPS* and bias correction scheme adapted

➔ *reprocessed wind profilers*

➔ ground-based *lidar* (Candillargues, Minorque) + airborne

➔ *research aircraft measurements* (F20, ATR, Dornier)

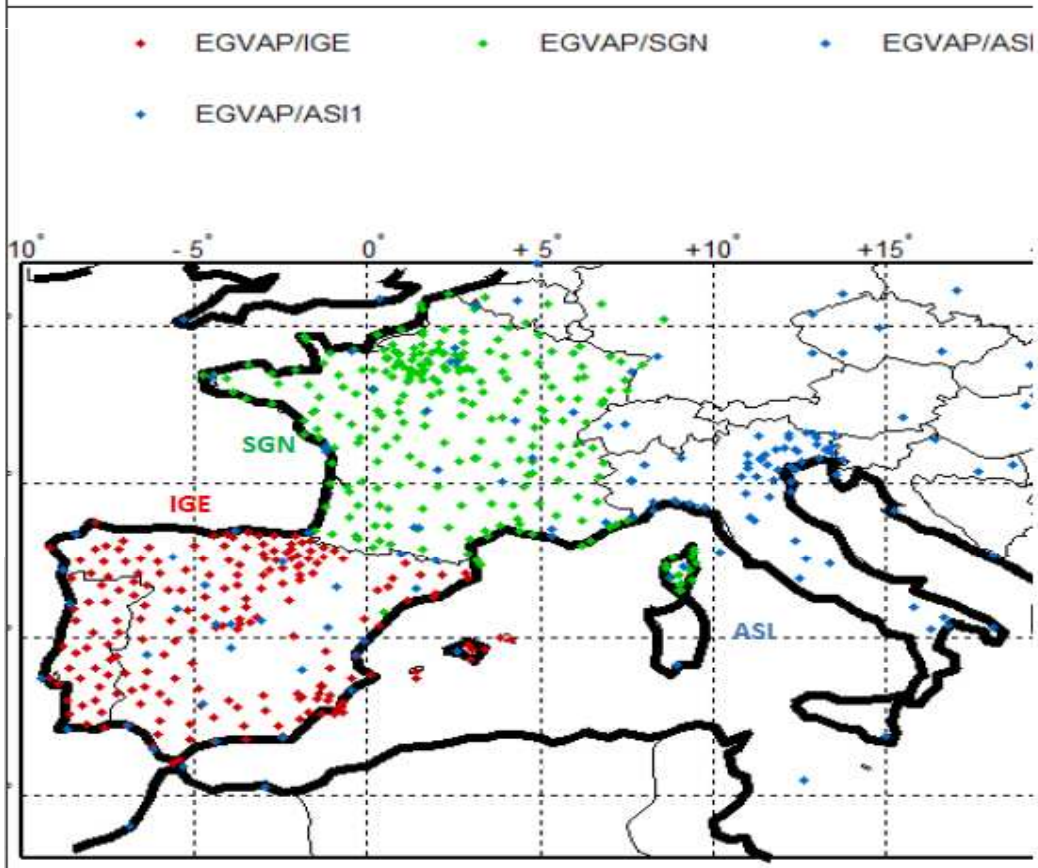
➔ *surface stations* (Candillargues, …)

➔ *last but not least … Spanish doppler radars*

GPS
(2nd AROME_WMED reanalysis)

Reprocessed network

EGVAP

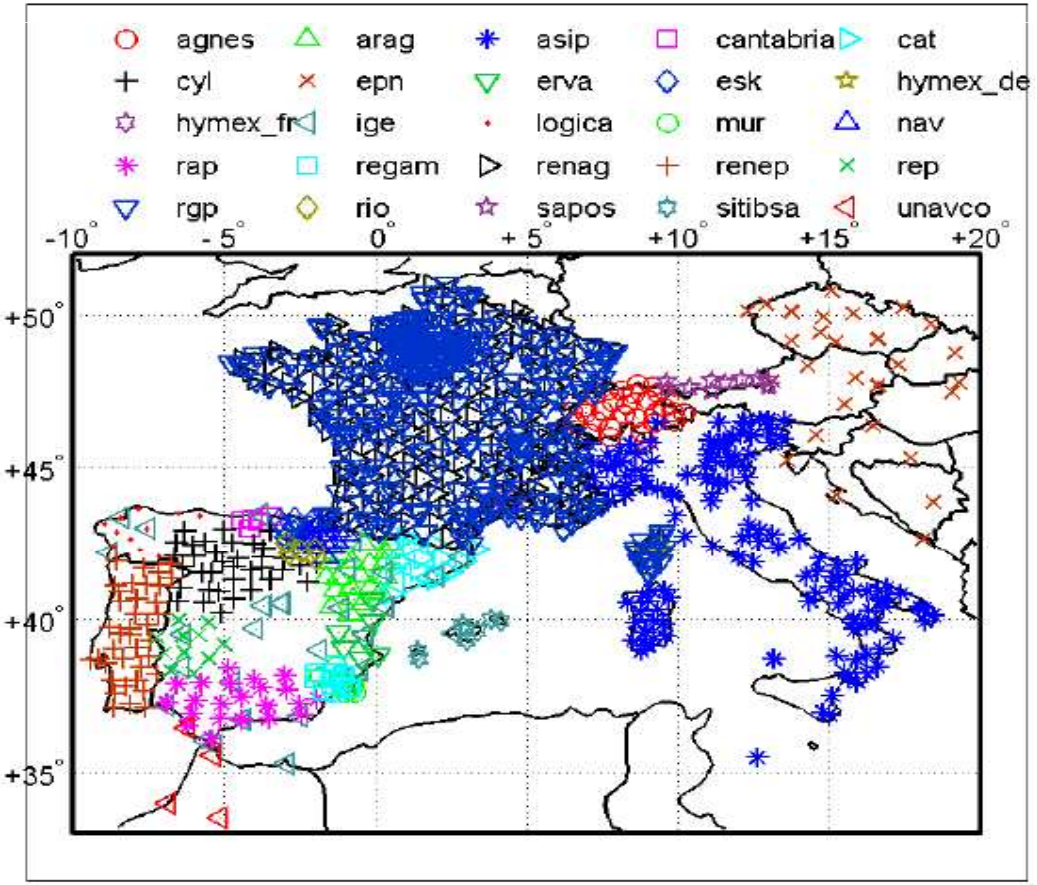


773 stations

(3 Analysis Centres)

ZTD data on HYMEX db

REPRO – final



1046 stations (25 networks)

GIPSY s/w LAREG & ASI proc.

Period 1 Sep 2012 – 31 Mar 2013

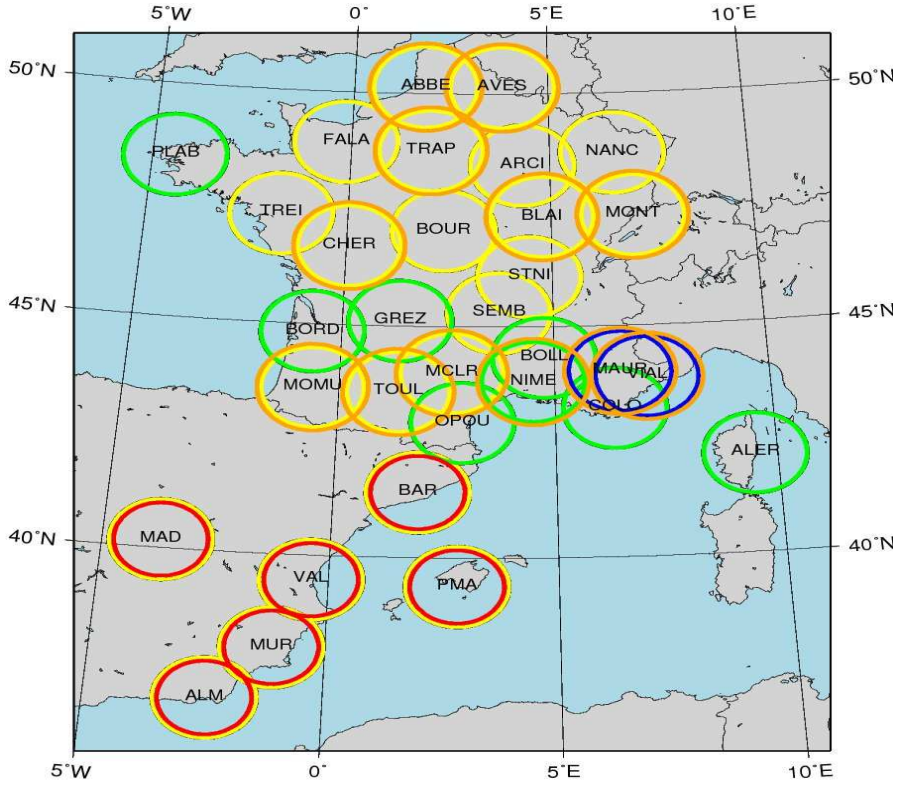
Assimilation of 6 AEMET radars

Courtesy, T. Montmerle

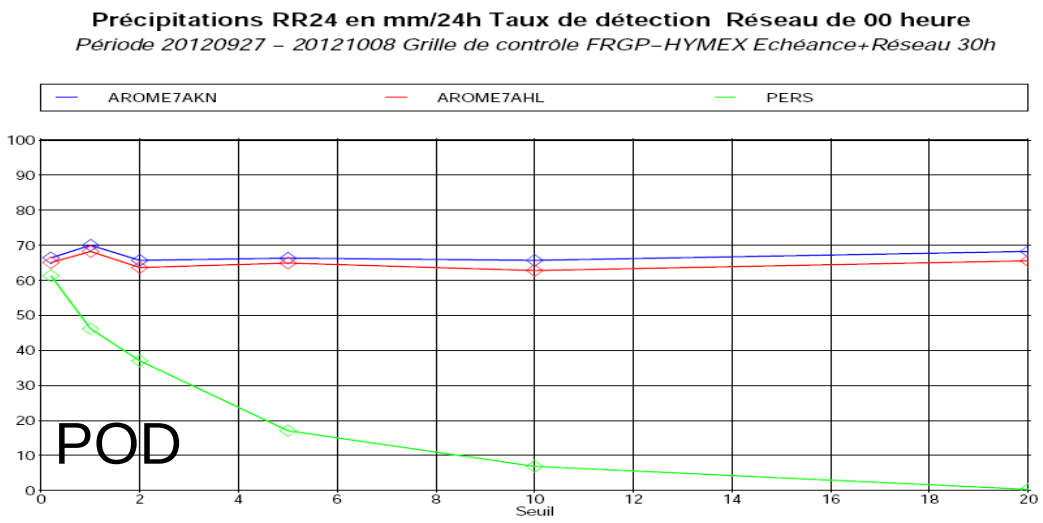
Period end of sept/oct 2012 :
26 sept r21 -> 8 oct r0

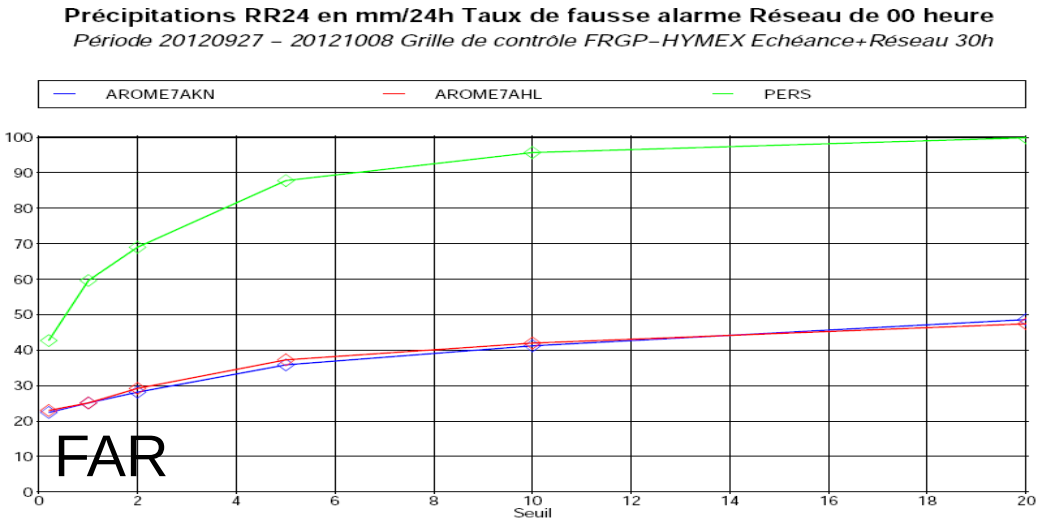
6 radars of Palma de Mallorca,
Madrid, Barcelona,
Almeria, Murcia and Valencia
Assimilation of doppler wind and reflectivity

Improvement of the probality of detection and
decrease of the false alarm rate over this period



Radar noradar





Conclusions and further developments

$\rightarrow$ Similar performance of AROME WMED oper and 1st reanalysis

2nd reanalysis in progress.

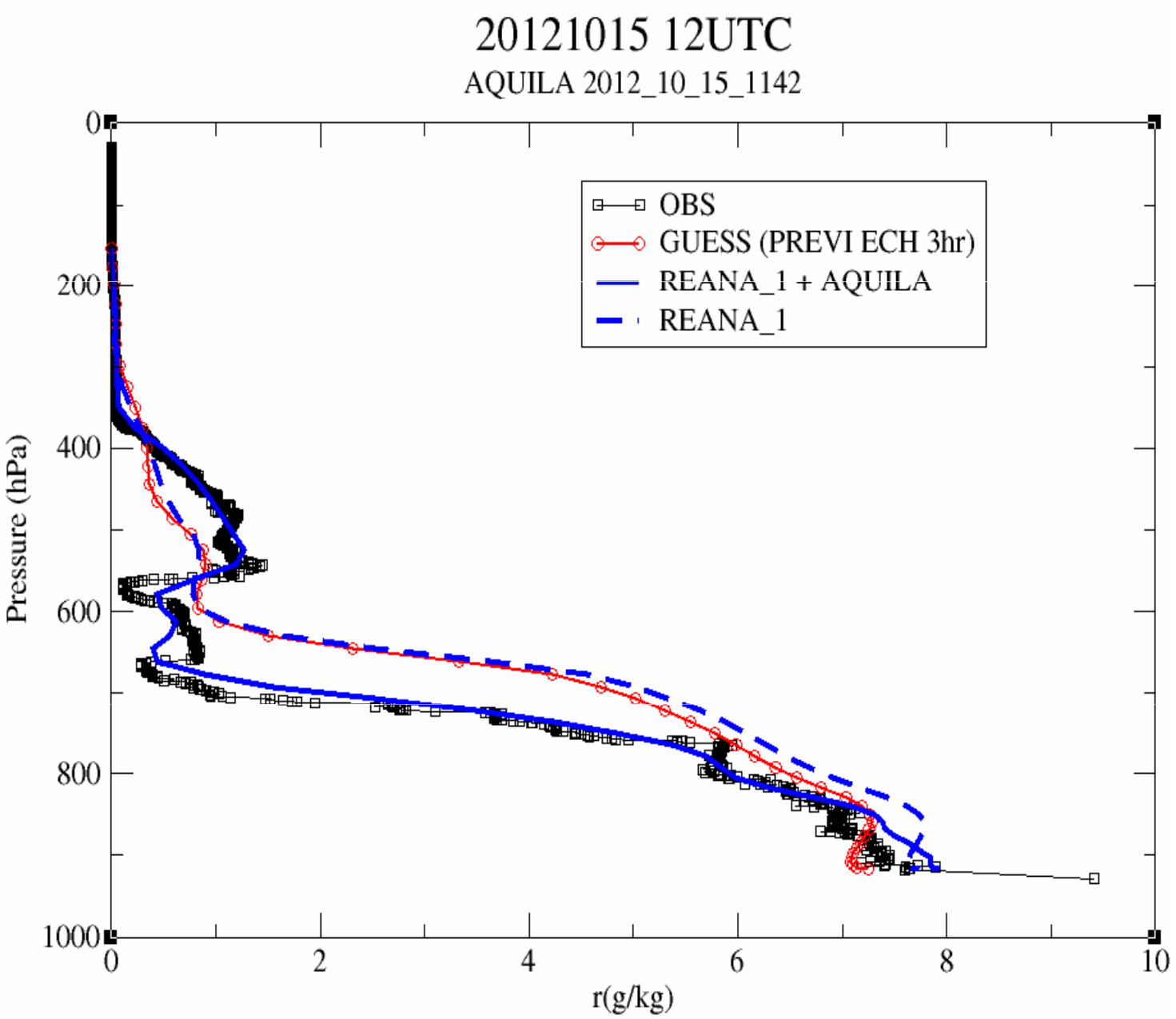
- Evaluation of the new background error matrix
- Test of experimental observations assimilation
- Availability in HyMeX database by mid-2015

Improved quality is expected …

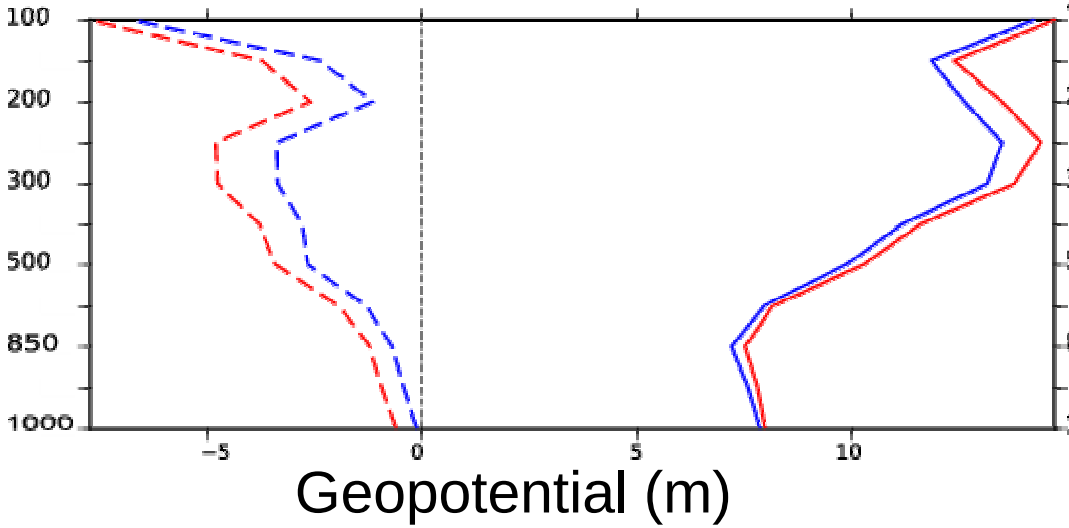
Use of L’Aquila radiosonde

Example of increased resolution radiosonde assimilation

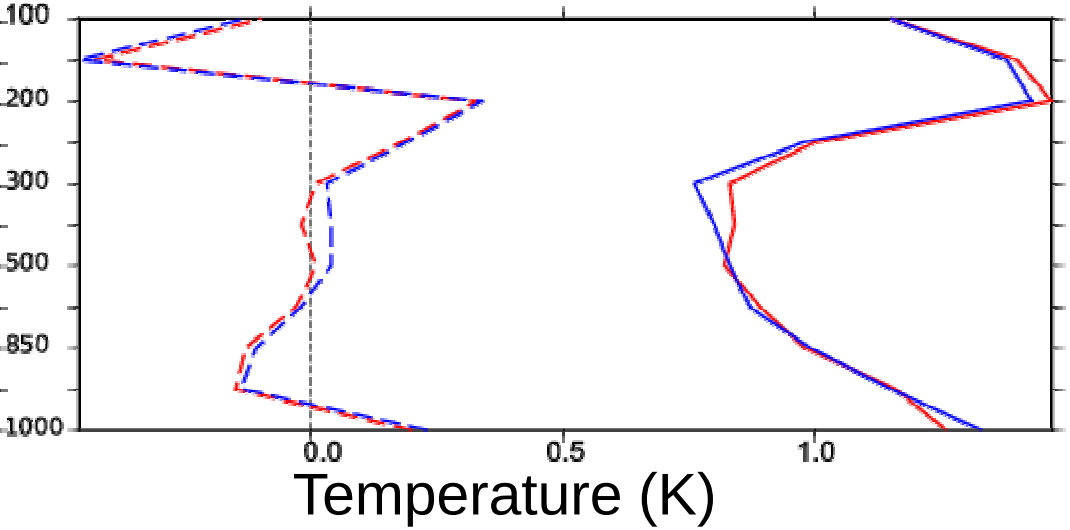
Finer vertical structures found in the analysis.



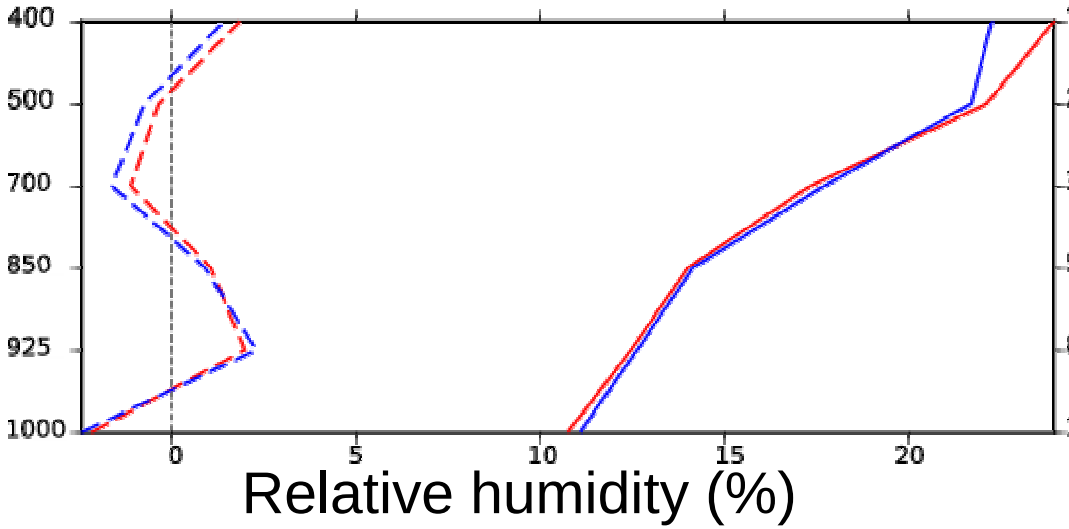
Comparison to observations:
24-h forecast wrt radiosondes
SOP1



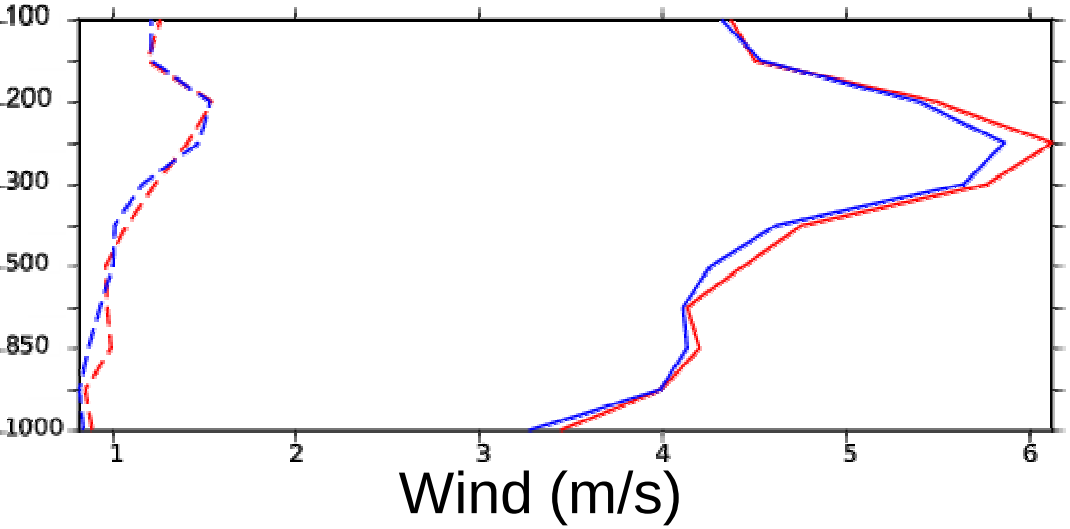
Geopotential (m)



Temperature (K)



Relative humidity (%)



Wind (m/s)

Legend : WMED oper - WMED reanalysis

----- Bias ——— RMSE