

Use of ground based GNSS data in NWP models at Météo-France

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Outline

1. The operational models at Météo-France
2. Implementation of ground based GNSS ZTD
3. Monitoring and use of ground based GNSS ZTD
4. Impact of the ground based GNSS ZTD in the operational models
5. Further work



1. The operational models at Météo-France



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The operational models at Météo-France

■ Global model and 4DVAR assimilation system **ARPEGE**

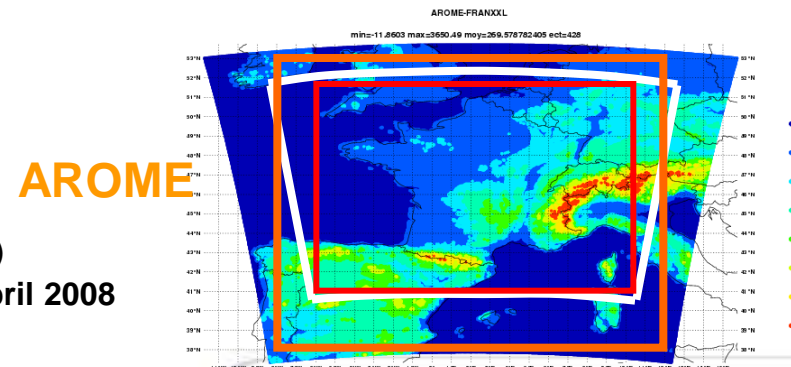
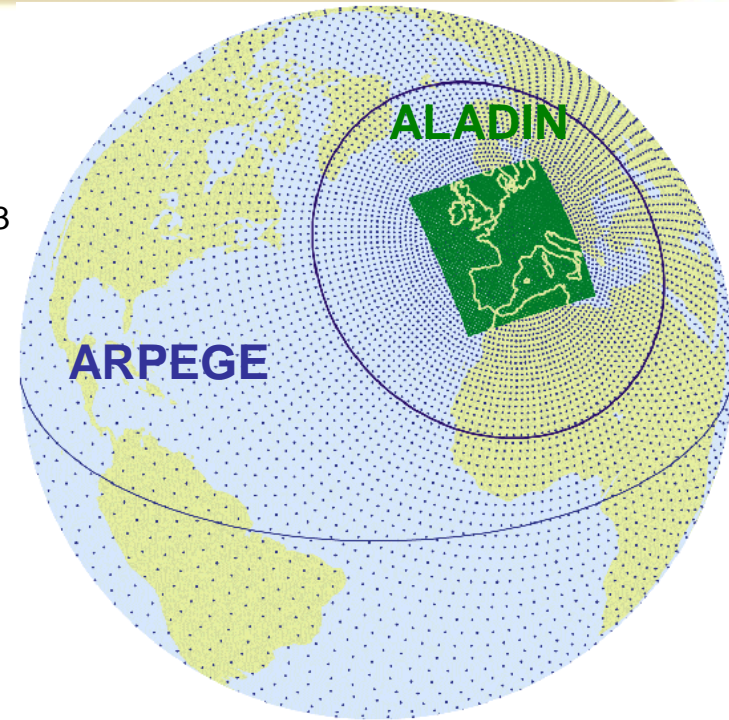
- Vertical: 70 levels, model top at 0.1 hPa (~65 km altitude)
- Horizontal: T798, stretched model : highest horizontal resolution over France (~10 km)
- 4DVAR assimilation (non-stretched) with two minimizations: T107 / T323
- Analysis horizontal resolution is about 60 km (globally)
- **Assimilates European GNSS ZTD data since 19 September 2006**
- Note: there are still operational runs of our non-stretched global model

■ European limited-area model and 3DVAR assimilation system **ALADIN**

- Horizontal resolution 7.5 km, same vertical levels as ARPEGE
- 3DVAR assimilation with 1 minimization at full resolution (6h period)
- One version running over France
- **Assimilates European GNSS ZTD data since 19 September 2006**

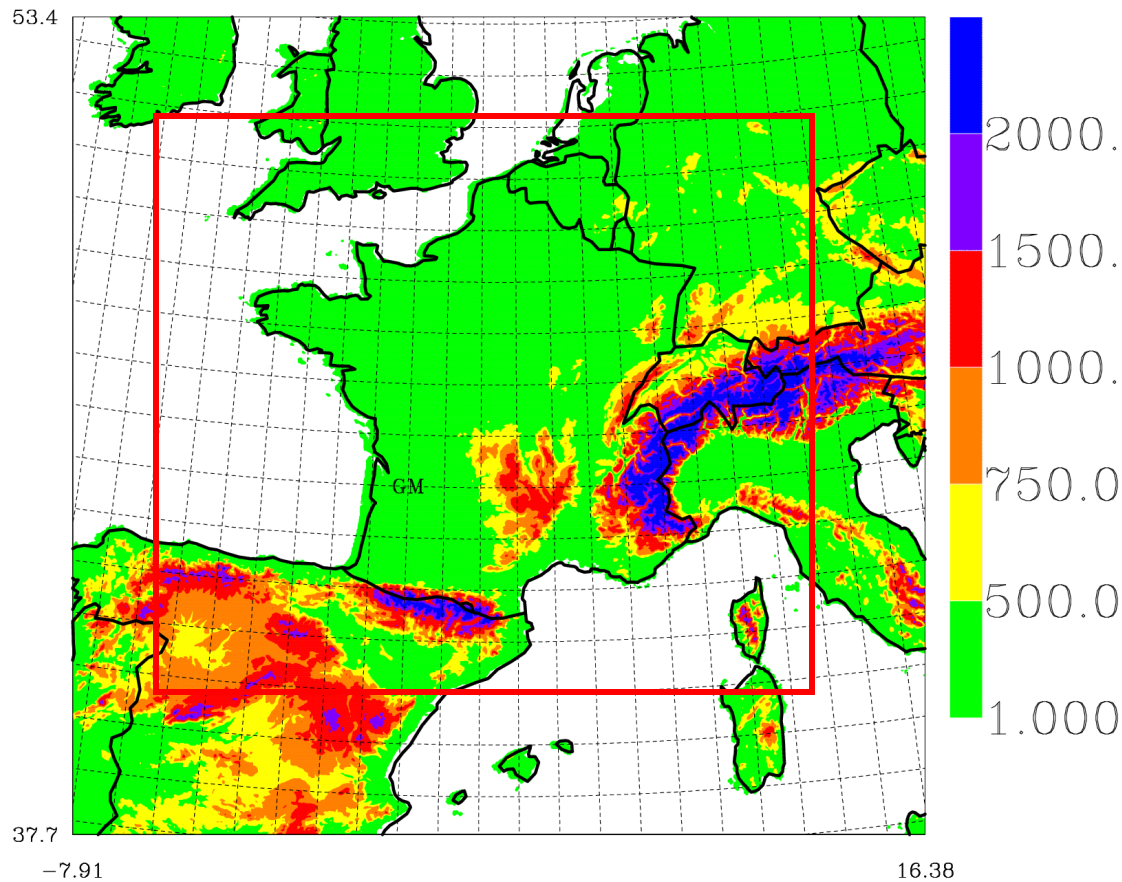
■ High-resolution mesoscale non-hydrostatic model and 3DVAR assimilation system **AROME** over France

- Horizontal resolution 2.5 km, 60 levels
- 3DVAR assimilation with 1 minimization at full resolution (3h period)
- **Assimilates European GNSS ZTD data over France since 22 April 2008**



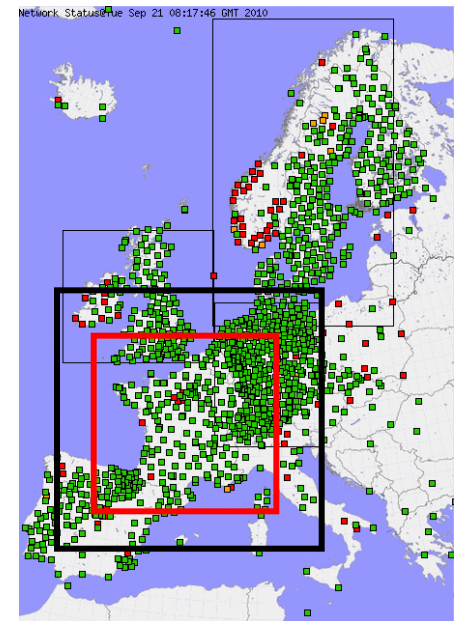
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AROME operational model



Domain 750x720 points

Boundary conditions : ARPEGE



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2. Implementation of ground-based GNSS ZTD assimilation



E-GVAP ZTD data in the M-F operational models

- **1st period : 2005 - 2006**
 - First experiments to evaluate the impact of GPS data in the operational models (Paul Poli)
- **2nd period : 2006 - 2008**
 - Implementation in the operational models : Arpege, Aladin (in 2006) and finally Arome (in 2008) using a white list approach
- **3rd period : 2008 - 2010**
 - No major changes for ZTD data in the operational models, except a new white list for Arome. Experiments in research mode.
- **4th period : 2010 - 2011**
 - After several experiments, big extension of the white list in the meso-scale model AROME : in pre-operational suite during several months and operational since September 2011.
 - New pre-operational suite starting in December 2011 with an extended white list and a direct BUFR decoding in all the M-F NWP models.
- **5th period : 2012 -**



GPS ZTD Pre-processing

Pre-processing input :

- GNSS ZTD data
- White list built monthly

Pre-processing steps :

1. Checks on the observations
 - ❖ Check all values within physical range
 - ❖ Verify that latitude, longitude, altitude, time significance have not changed
2. Time thinning:
 - ❖ In 4DVAR: average observations by time-slot (30 minutes or 1 hour)
 - ❖ In 3DVAR: retain only the 'most central' obs (closest to analysis time)
3. Observation minus background bias correction (from monitoring)
4. Observation standard deviation error assignment



GPS ZTD Pre-processing : extended white list

fic_list_monitor: Opening file list_monitor

Finished reading list_monitor, found : 1598 station/center

number of rejections for bad quality : 150

number of good quality but redundant station/center : 651

final number of station/center kept in the white list before thinning : 797

final number of station/center kept in the white list after thinning : 768

Summary of the choice by analysis center after thinning

IGE_: 125 over 176

METO: 91 over 133

ASI_: 2 over 54

ROB_: 14 over 112

SGN1: 114 over 277

SGN_: 101 over 275

NGAA: 1 over 16

LPTR: 3 over 48

KNM1: 4 over 21

KNMI: 20 over 39

LPT_: 62 over 98

GOP1: 17 over 28

GFZ_: 214 over 258

BKG_: 0 over 63

end of white list creation

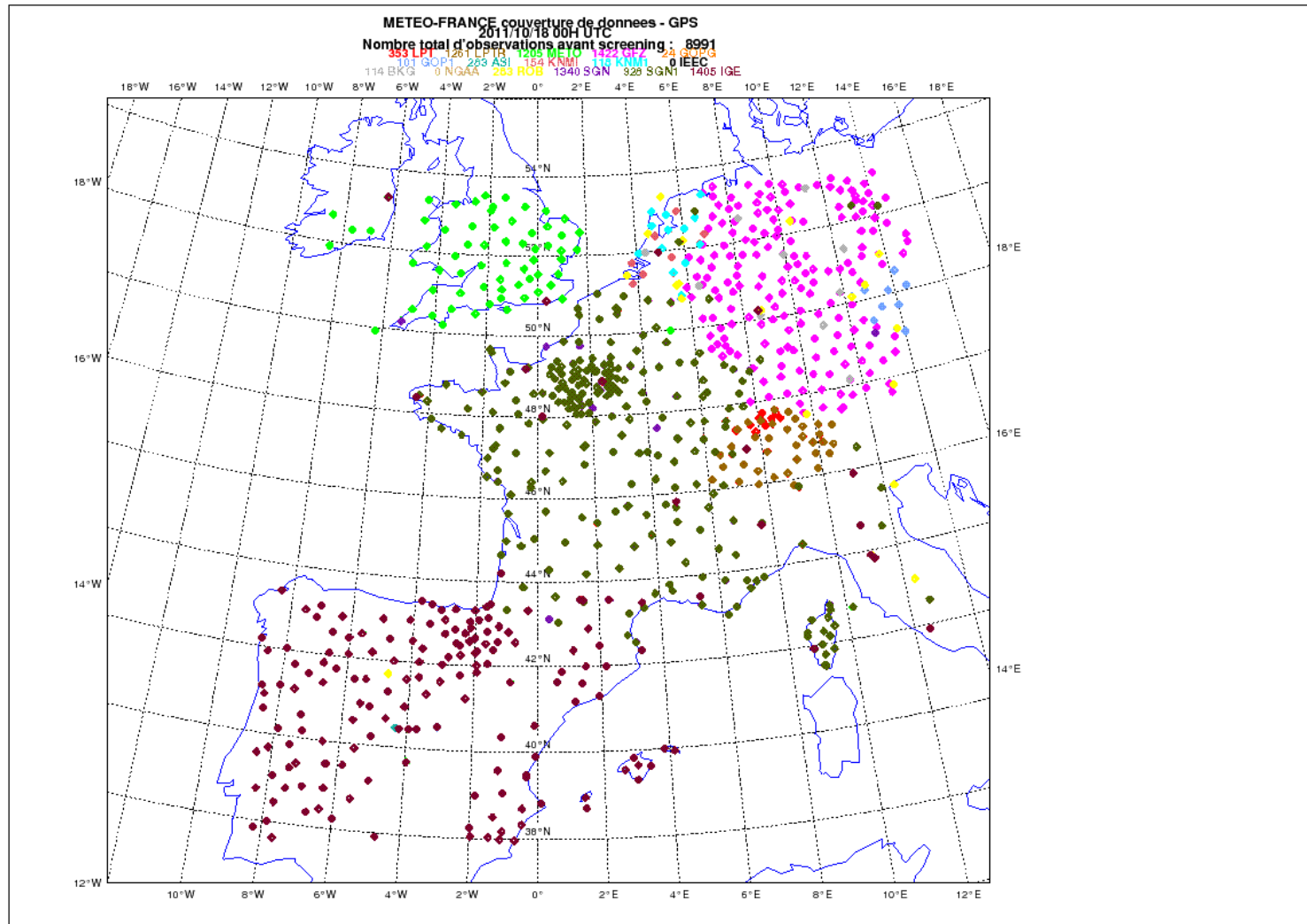


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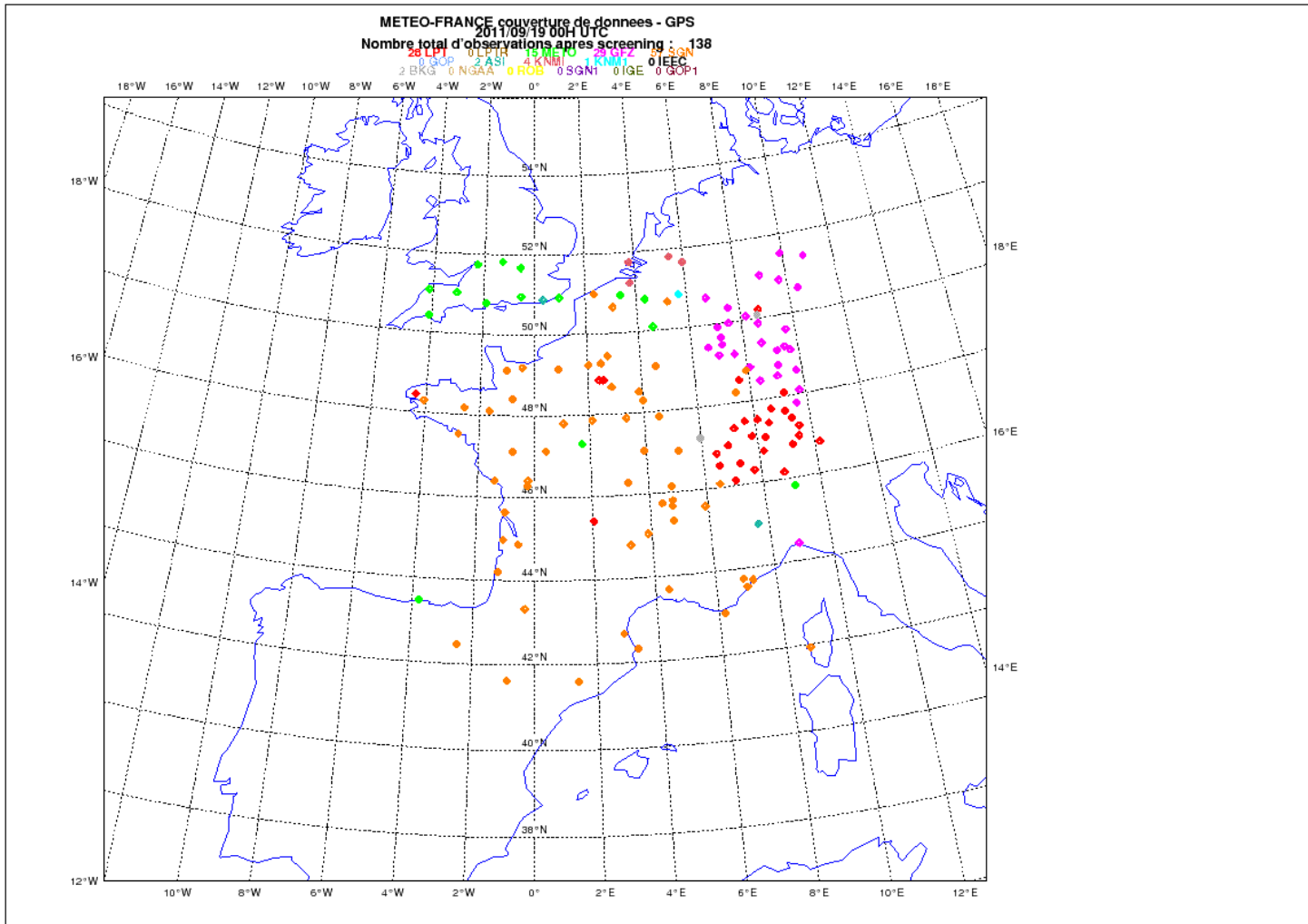
3. Monitoring and use of ground-based GNSS ZTD



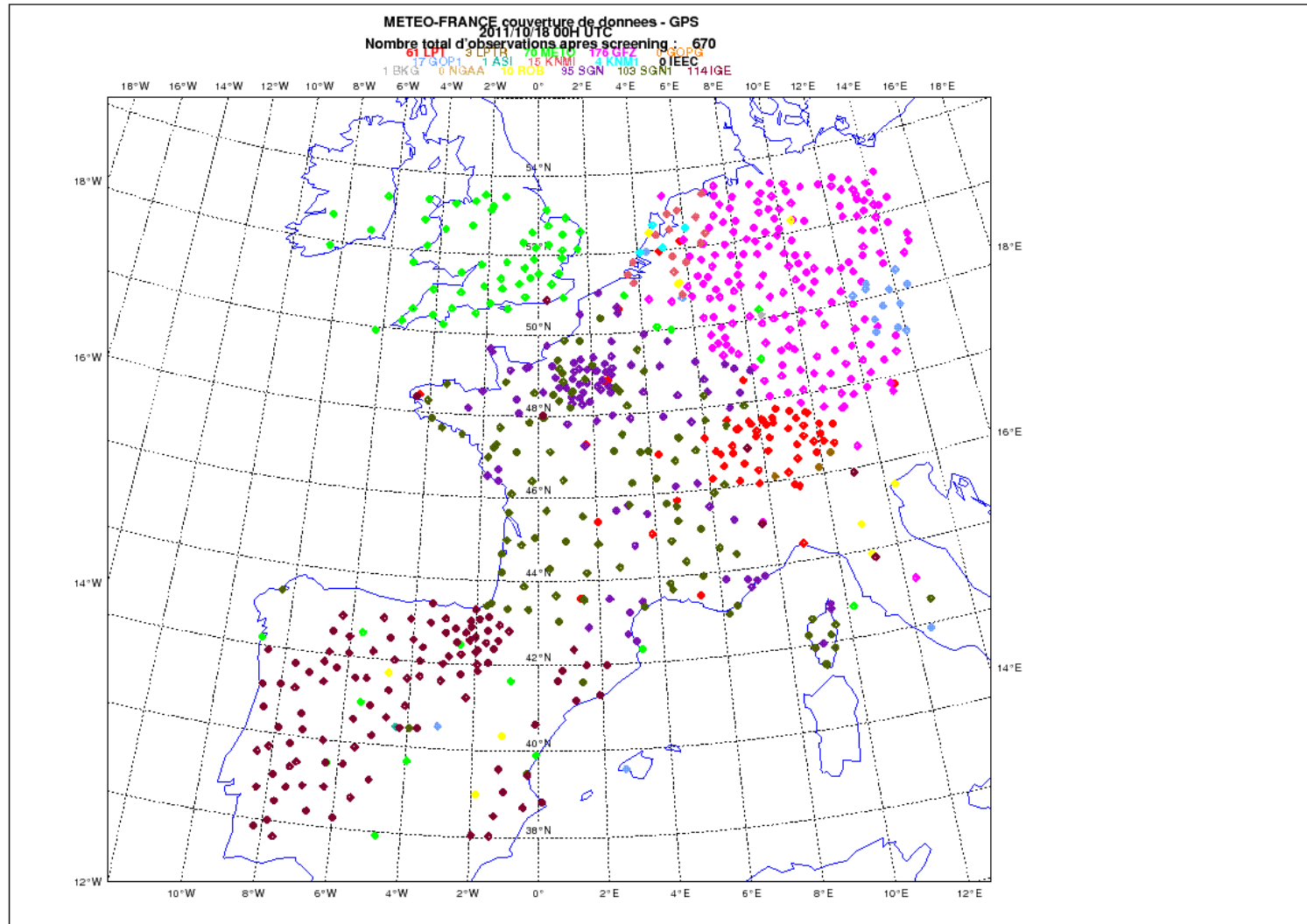
00 UTC long cut-off Arome



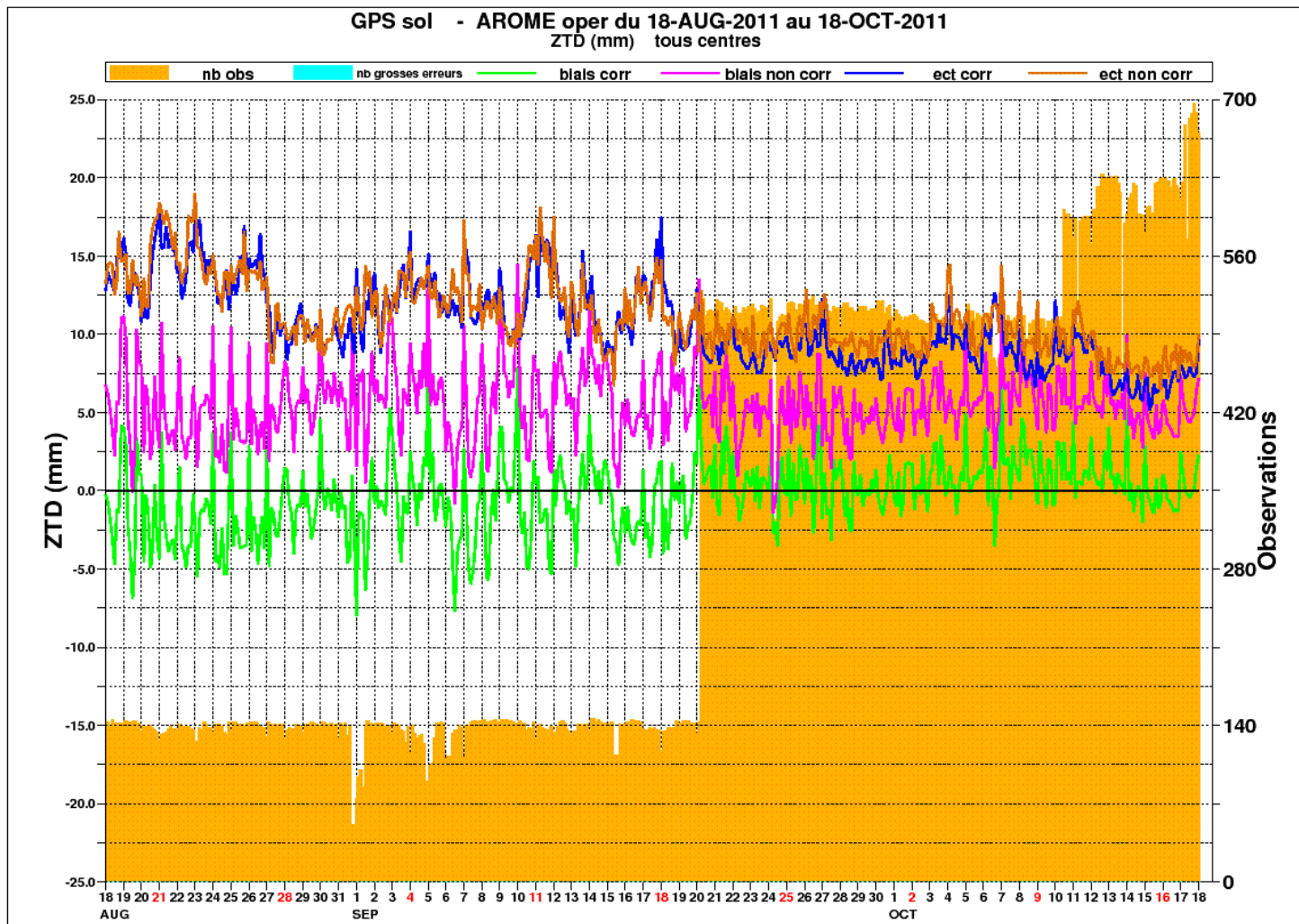
00 UTC long cut-off Arome



00 UTC long cut-off Arome



Monitoring example (time-series)

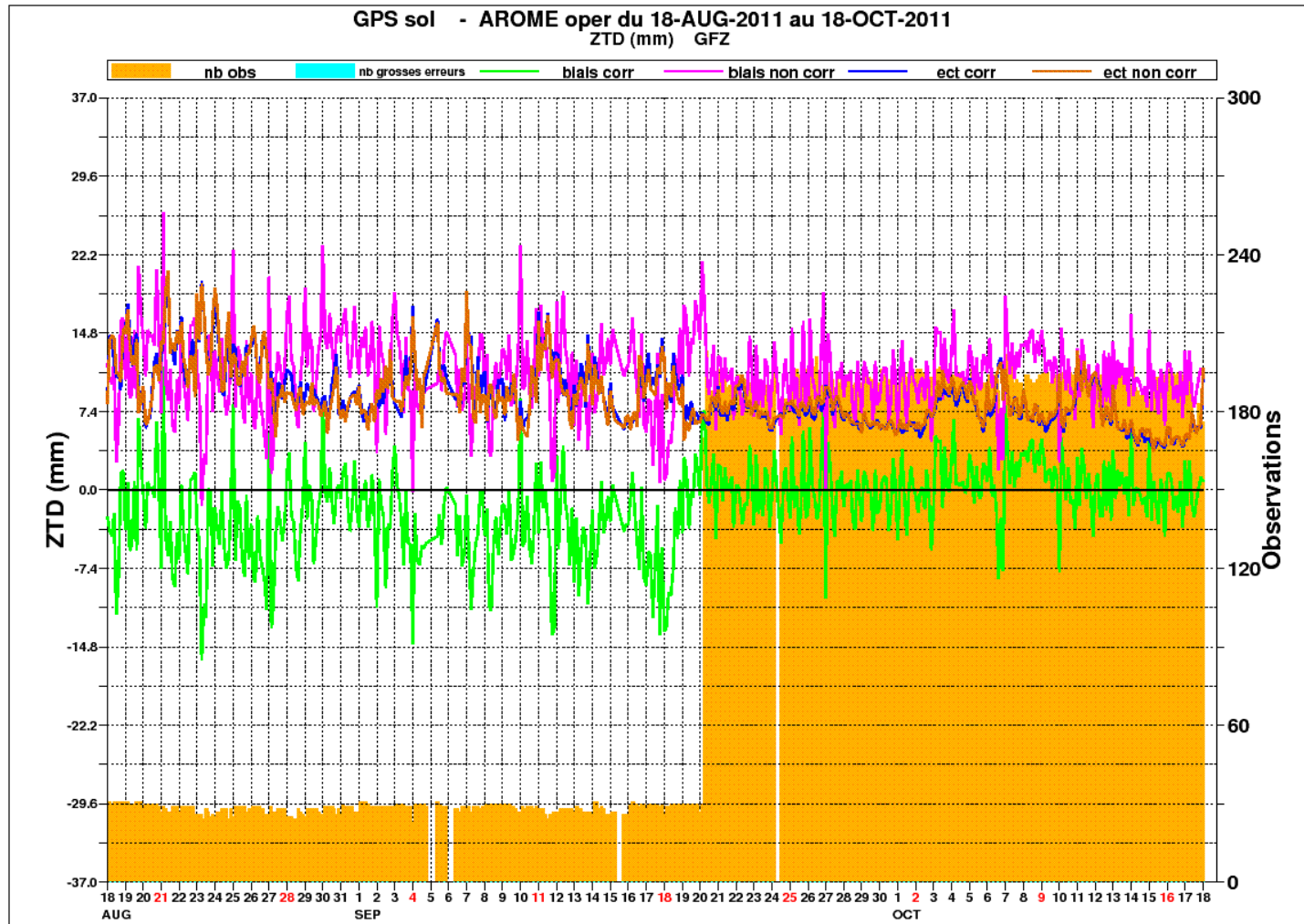


DPREVI/COMPAS



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Monitoring example (time-series)



DPREVI/COMPAS

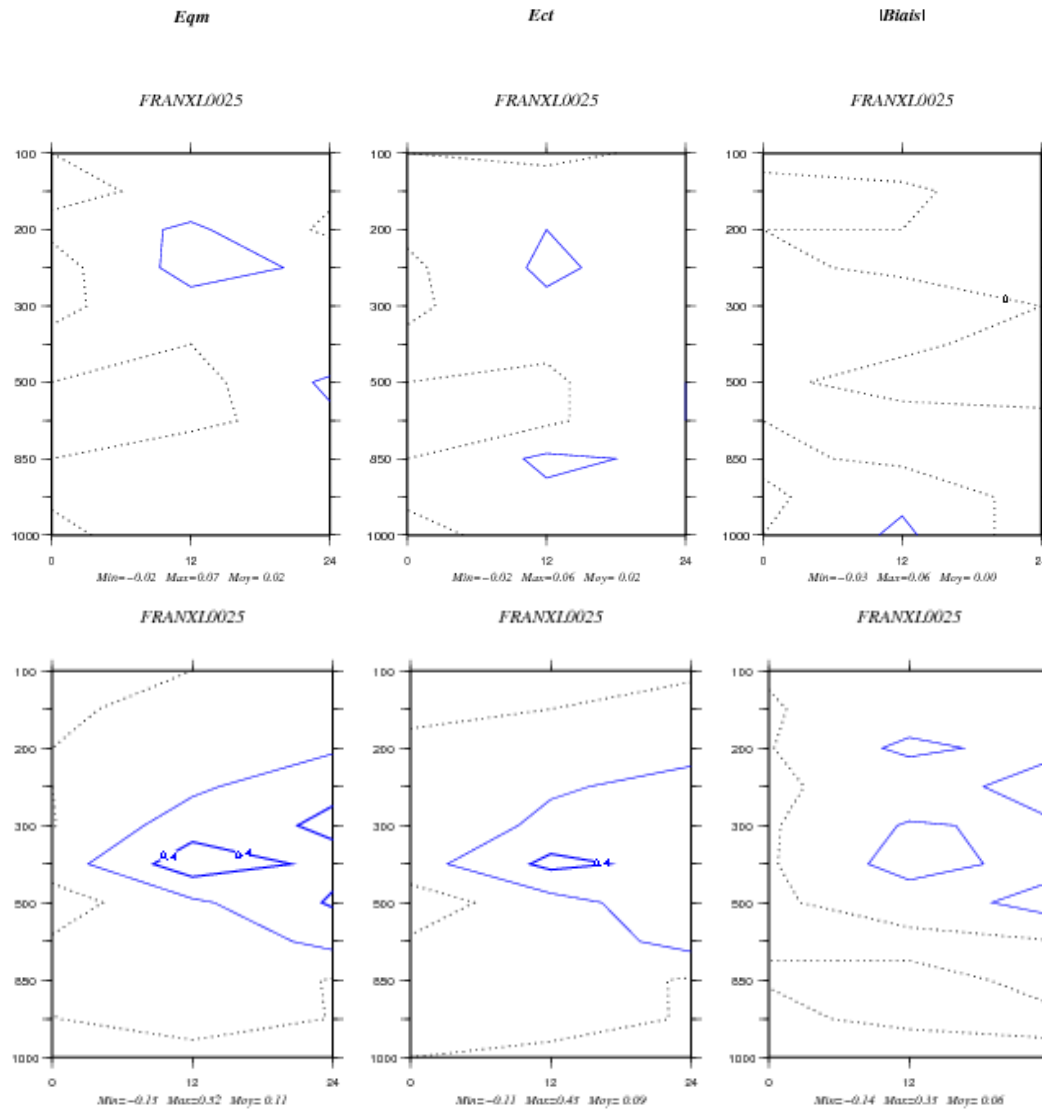


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4. Impact of the ground-based GNSS ZTD in the operational models

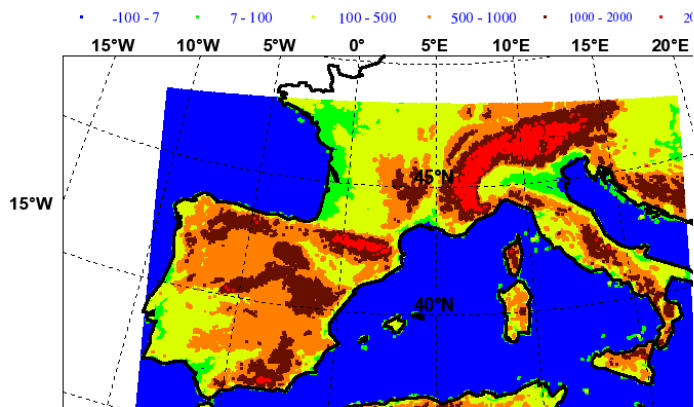


Pre-operational Arome (scores)

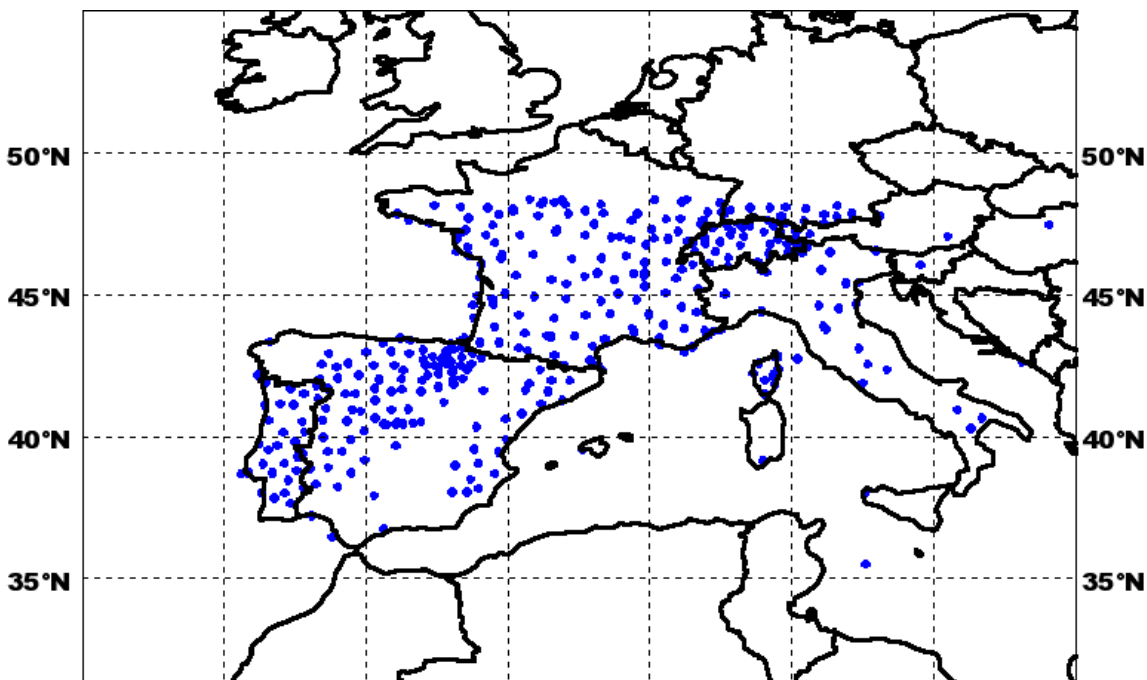


Validation of AROME-WMED

(Mathieu Nuret)



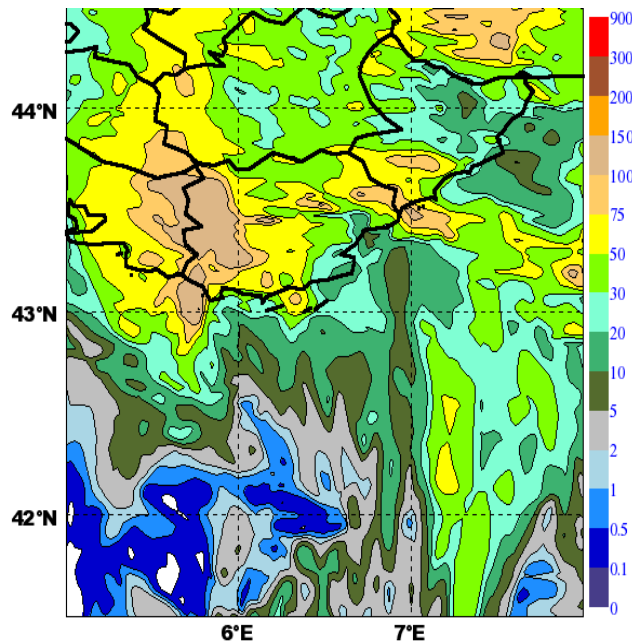
AROME WMED domain



GPS data used

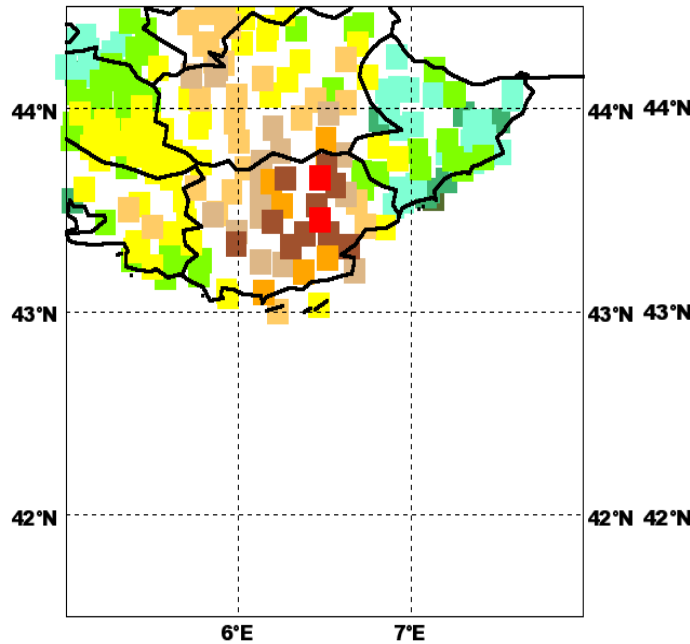
15/06/2010 – 06UTC

AROME_WMED (D031)



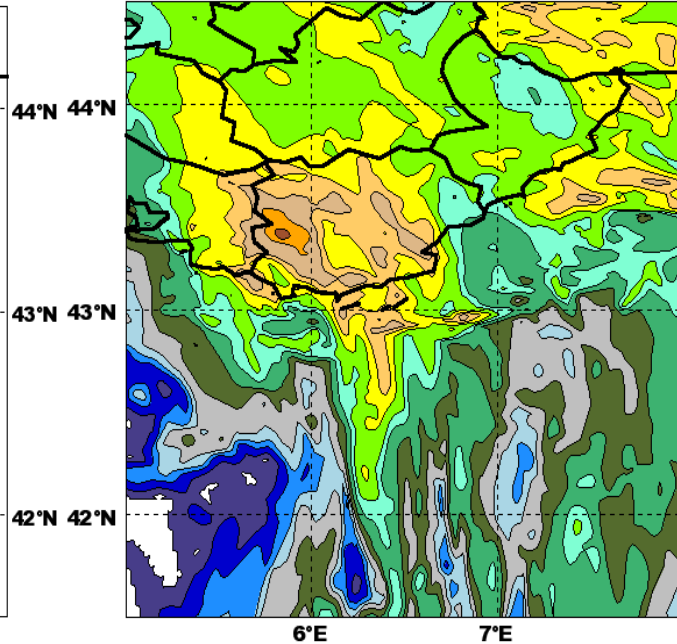
Old white list

OBS (24h accumul.)



Rain gauges obs

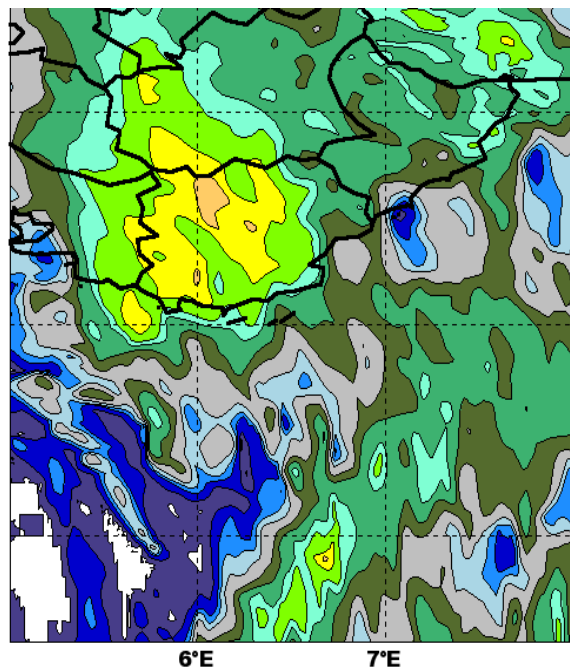
AROME_WMED (D03Q)



New white list

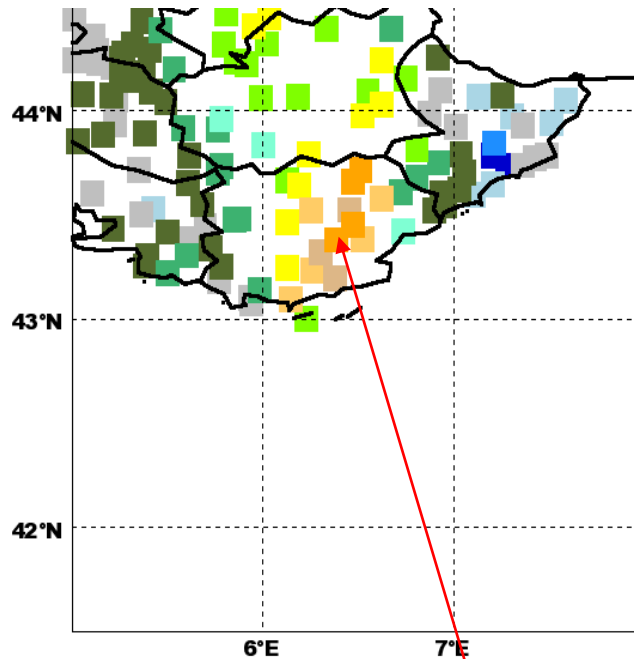
15/06/2010 – 09UTC

AROME_WMED (D031)



Old white list

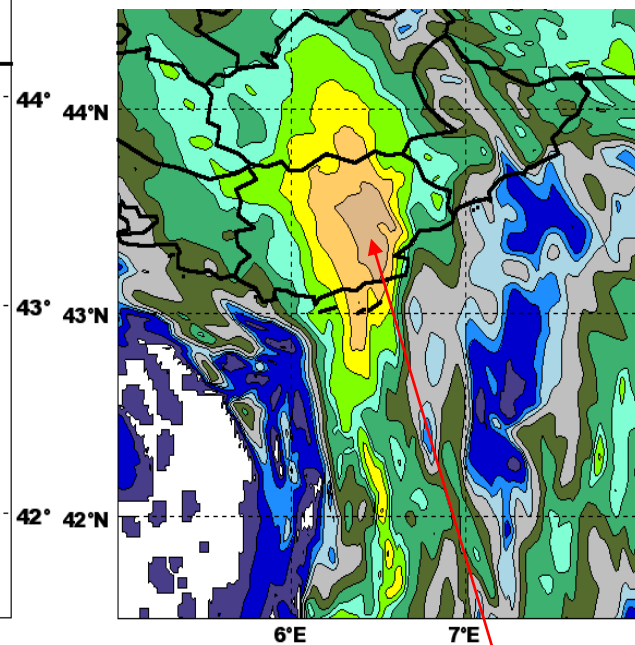
OBS (6h Accumul.)



195mm/6hr

Rain gauges obs

AROME_WMED (D03Q)



130mm/6hr

New white list

5. Further work



Further work

- Under development, planned to enter the spring 2012 pre-operational suite :
 - Replacement of the monthly pre-selection of the GNSS data by a dynamic selection inside the analysis.
 - Implementation of a variational bias correction.
- Classical black-list method ?
- Many experiments planned (case studies, HyMex, etc.)
- Big interest in the global sets of data (GOPG, METG, etc.)



Thank you for your attention

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