GNSS ZTD and ATOVS Data Assimilation AEMeT 2017

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NWP Dep. AEMeT

GNSS ZTD and ATOVS Data Assimilation.
AEMeT 2017

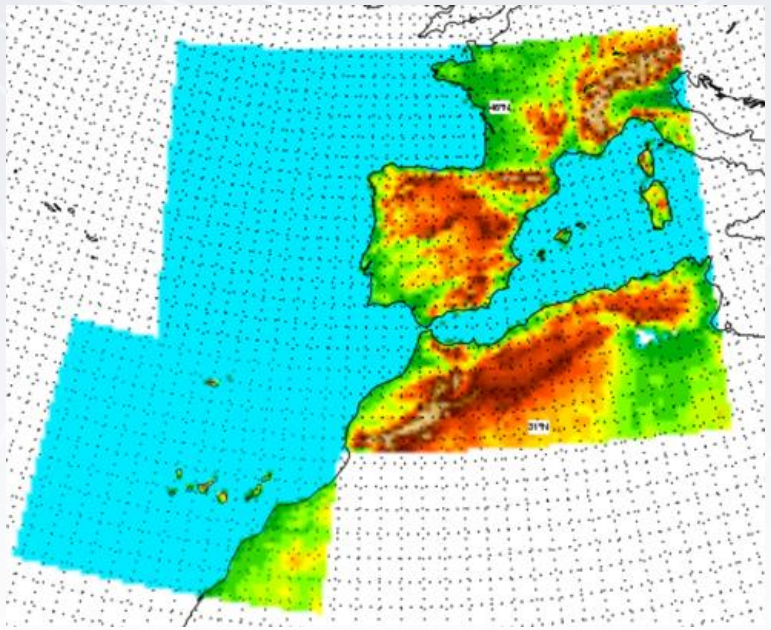
- OUTLINE

1) **Impact of assimilating GNSS ZTD or ATOVS obs.**
2) Impact of assimilating GNSS ZTD **+** ATOVS obs.
3) Canary Islands domain
4) Summary

1) Impact of assimilating GNSS ZTD or ATOVS obs.

Cy40h11b5 HARMONIE-AROME Operational Cycle on BULL supercomputer in AEMet:
3DVAr 3h Conv obs: TEMP, AIREP, AMDAR, SYNOP, BUOY and SHIP.

TWO domains
- Iberian Peninsula
- Canary Islands



Iberian Peninsula Domain:

Two Parallel runs:

1) Impact of assimilating GNSS ZTD +conv obs
2) Impact of assimilating ATOVS +conv obs

Canary Islands Domain:

One Parallel run:

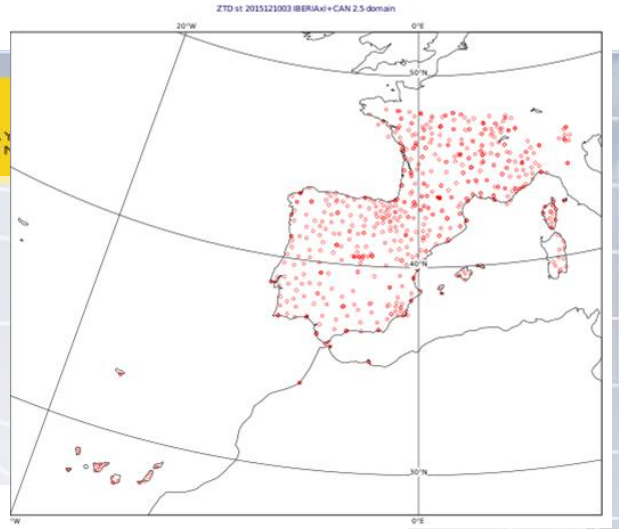
1)Impact of assimilating ATOVS + conv obs

Period of study: july - november 2016

(Aladin-Hirlam Newsletter num 8, January 2017; *J. Campins, J. Sánchez-Arriola, M. Díez, B. Navascués, J.Calvo , **AEMet***

1) Impact of assimilating GNSS ZTD or ATOVS obs.

GNSS ZTD obs HANDLING — Iberian Peninsula domain



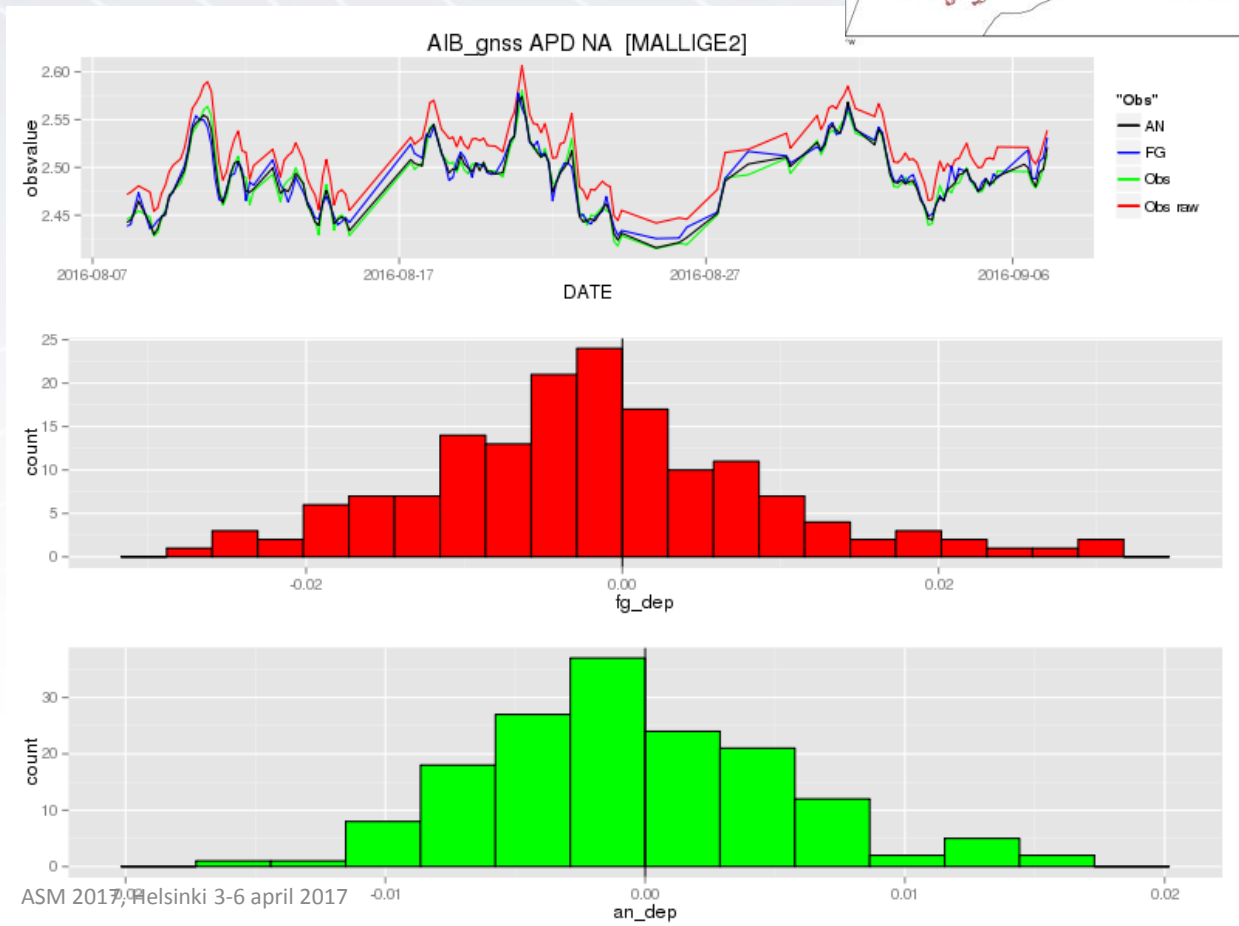
3DVar 3h cycle: conv obs + GNSS ZTD

- GNSS ZTD observations from E-GVAP Program (ASCII, via ftp).
  Files from: ASI_, ROBH, SGN_, IGE2 and METO.

- Cut-off time: at 0040 /0140 the files are taken

- Use White list (783 sites),
  - temporal thinning (obs closest to an time)
  - **no spatial thinning applied**
  - Quality Control
  - Redundancy check

- VarBC (cte offset).
  About one month to calibrate the coeff.



1) Impact of assimilating GNSS ZTD or ATOVS obs.

ATOVS obs HANDLING

Iberian Peninsula domain

3DVar 3h cycle: conv obs + AMSU-A, AMSU-B or MHS

- Data by EUMETCAST local dissemination.
  - No pre-processing.
  - Bufr 4.

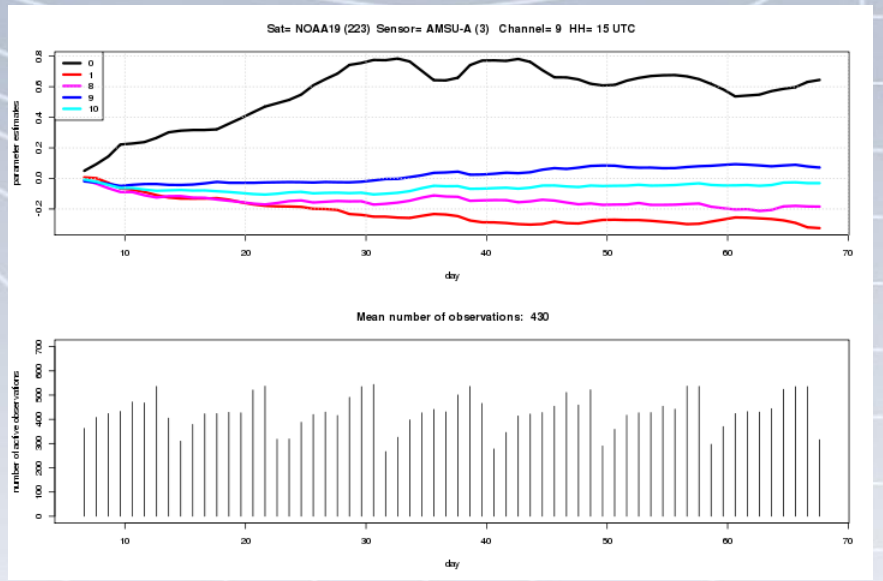
- Long period needed for calibration of the VarBC. (One month for Iberia Peninsula and *two months for the Canary Islands suite*).

- Used satellites and channels:
  - Noaa 18.
  - Noaa 19.
    - Ch 7,8 AMSU-A blacklisted.
    - Ch 3 MHS blacklisted.
  - METOP A.
    - Ch 7,8 AMSU-A blacklisted.
  - METOP B.

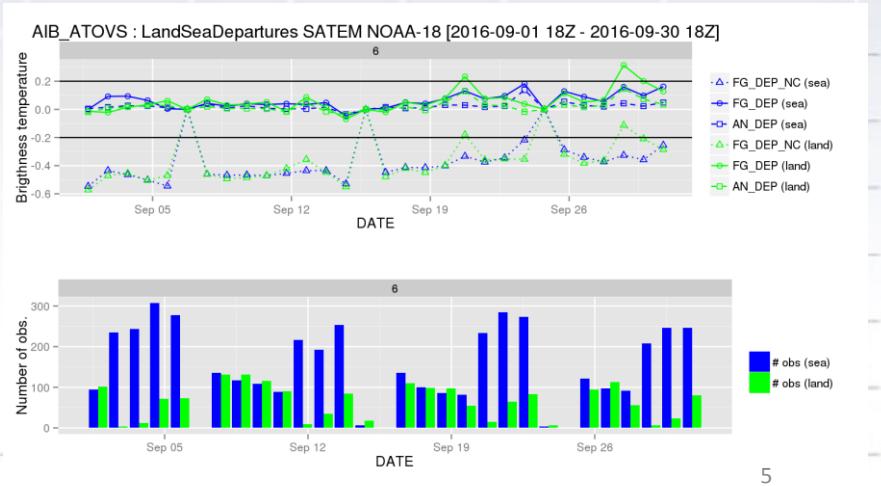
IBERIAN P. Spin up period
NOAA 19, AMSUA,Ch9

Predictors

0 constant
1 1000-300 hPa thickness
8 nadir view angle
9 nadir view angle2**
10 nadir view angle3**



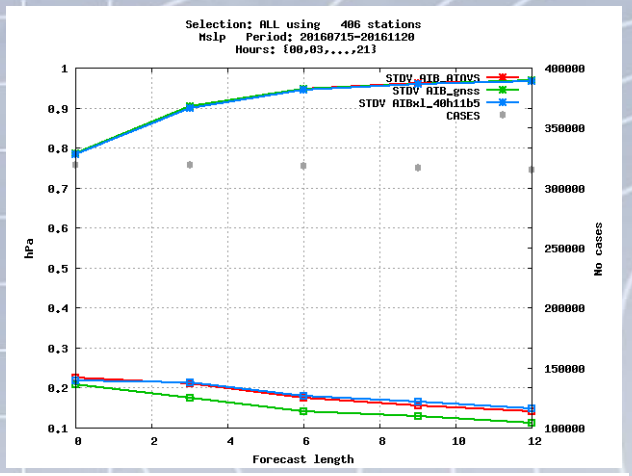
IBERIAN P. Period of study
NOAA 18



1) Impact of assimilating GNSS ZTD or ATOVS obs.

Results

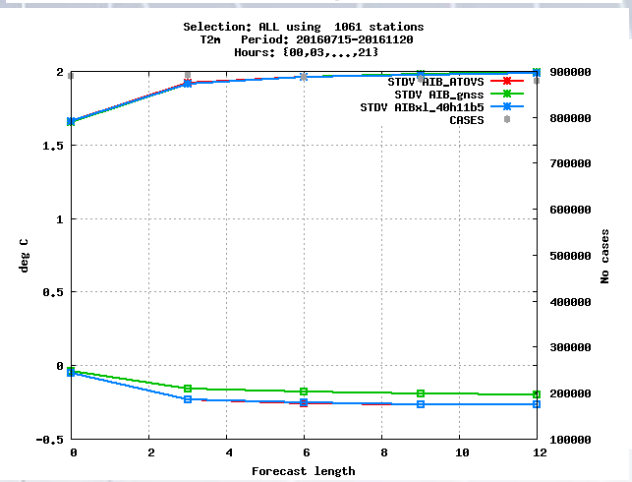
Iberian Peninsula domain

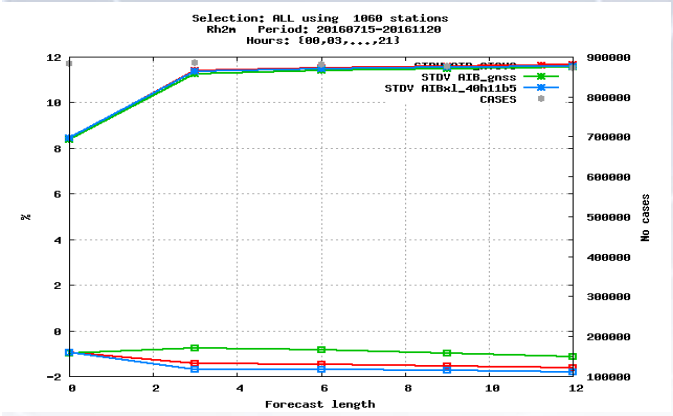


ATOVS, GNSS, CONTROL

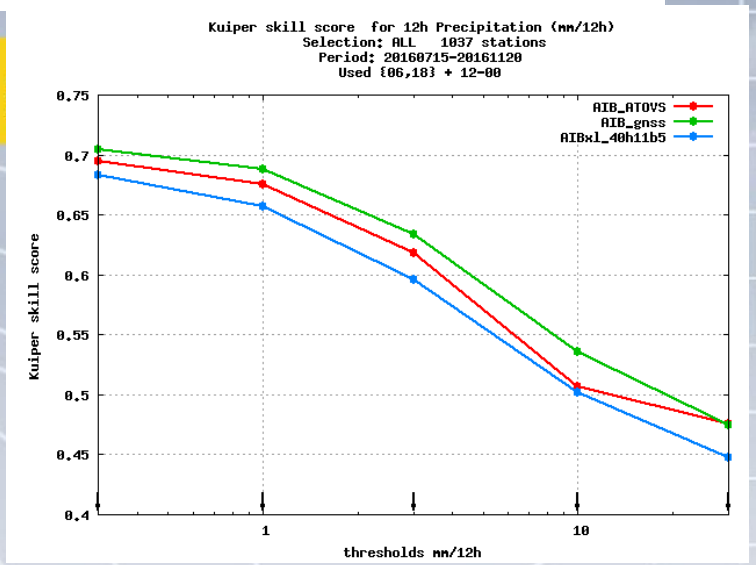
Surface parameters

The bias of mslp, T2m and RH2m is reduced when assimilating ZTD GNSS.

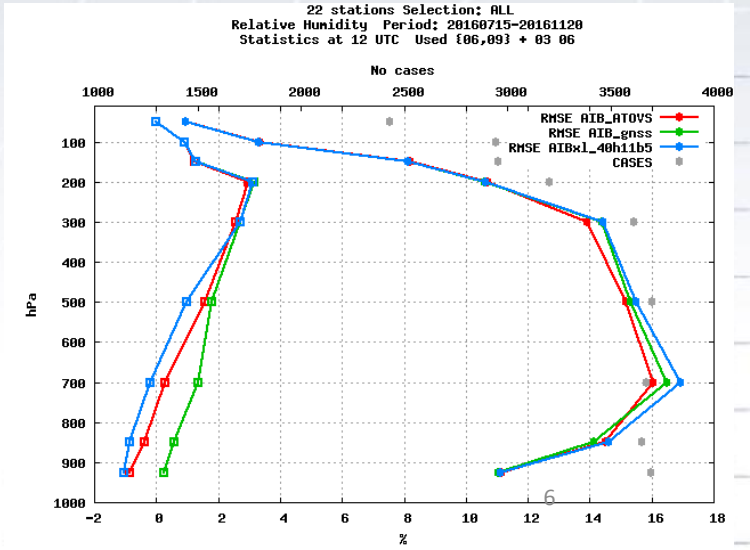




KSS score for 3h acc pcp: Positive impact when adding GNSS or ATOVS observations to conventional.



Vertical profiles Positive impact on RH both at 00h (not shown here) and 12 UTC below 300 hPa and also upper for ATOVS.



(Aladin-Hirlam Newsletter num 8, January 2017;
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GNSS ZTD and ATOVS Data Assimilation
AEMeT 2017

- OUTLINE

1) Impact of assimilating GNSS ZTD or ATOVS obs.

2) Impact of assimilating GNSS ZTD + ATOVS obs.

2.1 Impact of thinning and increasing the GNSS ZTD obs error

2.2 VarBC

3) Canary Islands domain

4) Summary

2) Impact of assimilating GNSS ZTD + ATOVS obs.

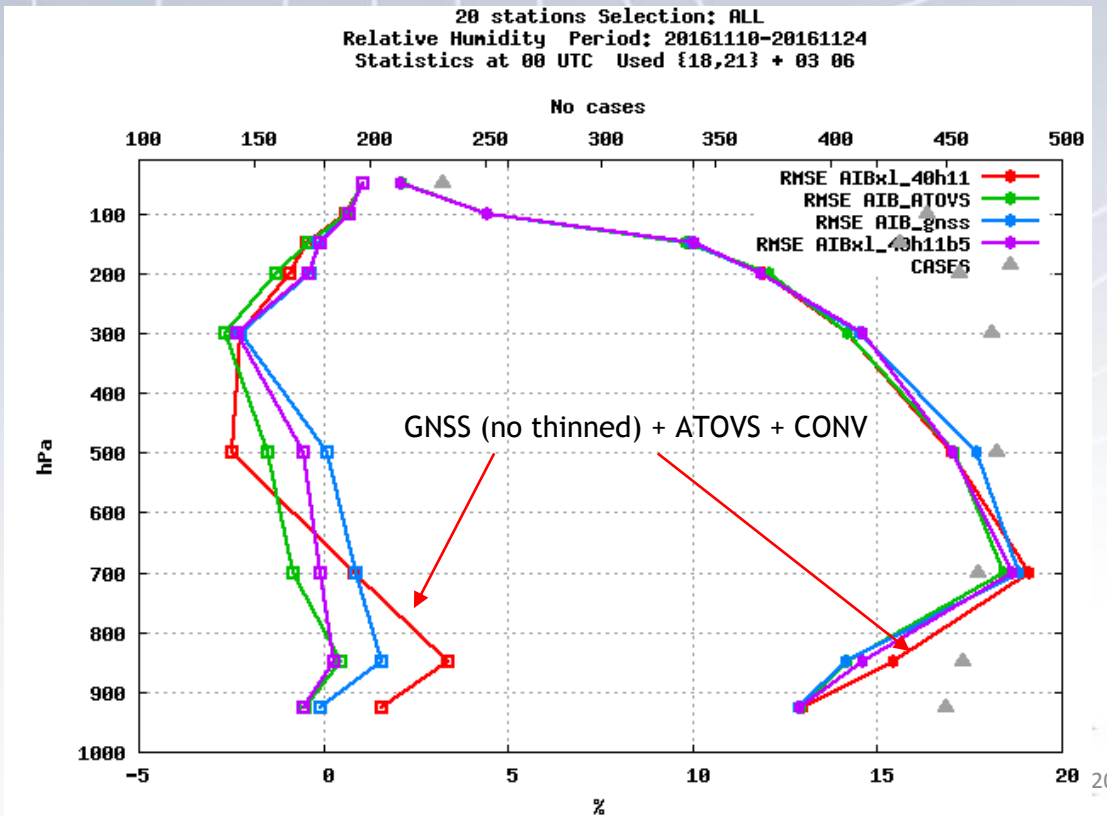
2.1 Impact of thinning and increasing the GNSS ZTD ob error

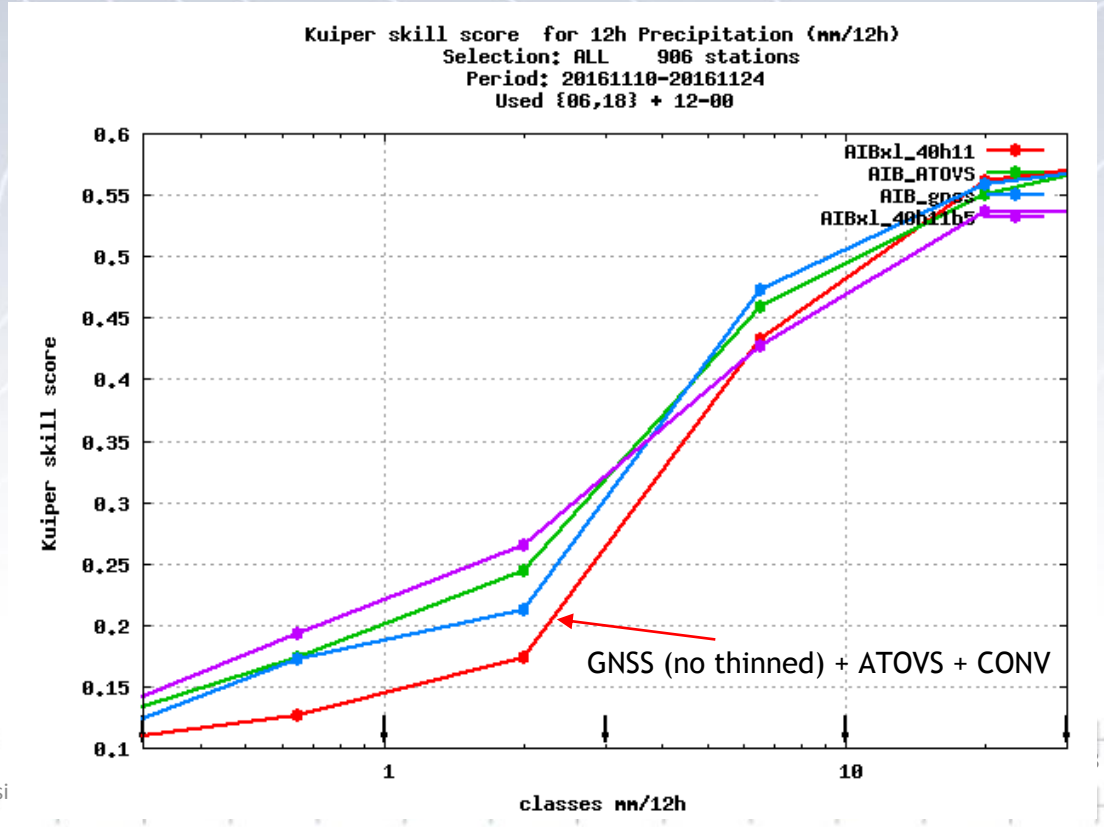
GOBIERNO DE ESPAÑA · MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE · AEMet Agencia Estatal de Meteorología

HARMONIE-AROME Cycle 3DVAr 3h

- Conv obs: TEMP, AIREP, AMDAR, SYNOP, BUOY and SHIP.
- ATOVS: AMSUa, AMSUB-MHS
- GNSS ZTD

AIBxl_40h11 No GNSS ZTD thinning





2) Impact of assimilating GNSS ZTD + ATOVS obs.

2.1 Impact of thinning and increasing the GNSS ZTD ob error

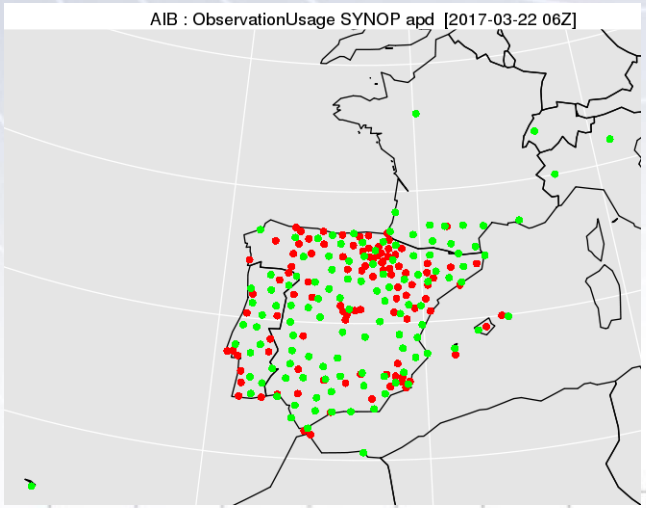
HARMONIE-AROME Cycle on BULL supercomputer in AEMet:

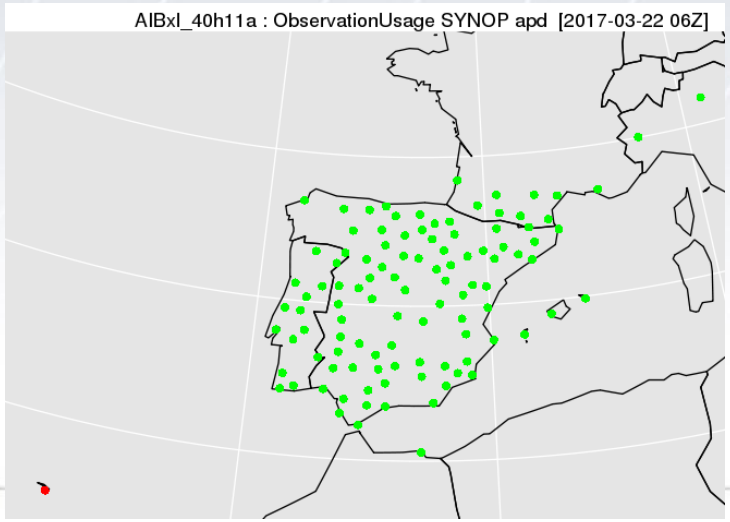
3DVAr 3h - Conv obs: TEMP, AIREP, AMDAR, SYNOP, BUOY and SHIP.
- ATOVS: AMSUa, AMSUB-MHS
- GNSS ZTD

➢ **GNSS ZTD thinning and increased sigmao tests**

50 km thinning

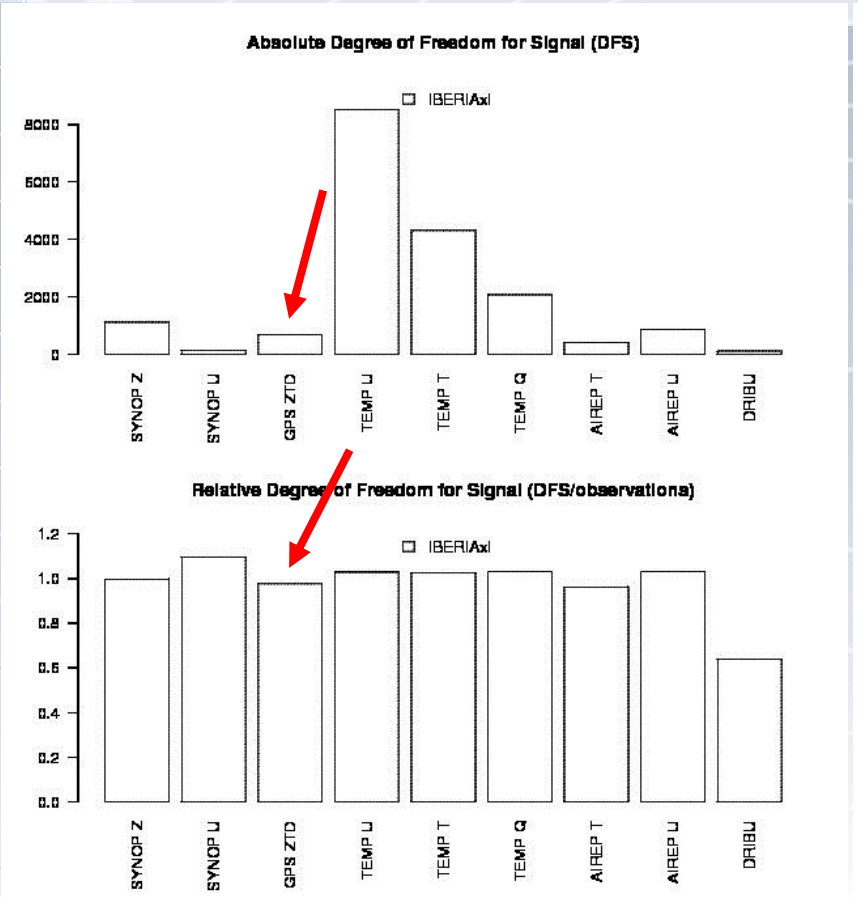
AIB (before mid-feb17) : conv + GNSS ztd no thinning, sigmao=12 mm
(after mid-feb17): conv + ATOVS+ GNSS ztd 50km thinning, sigmao=12 mm

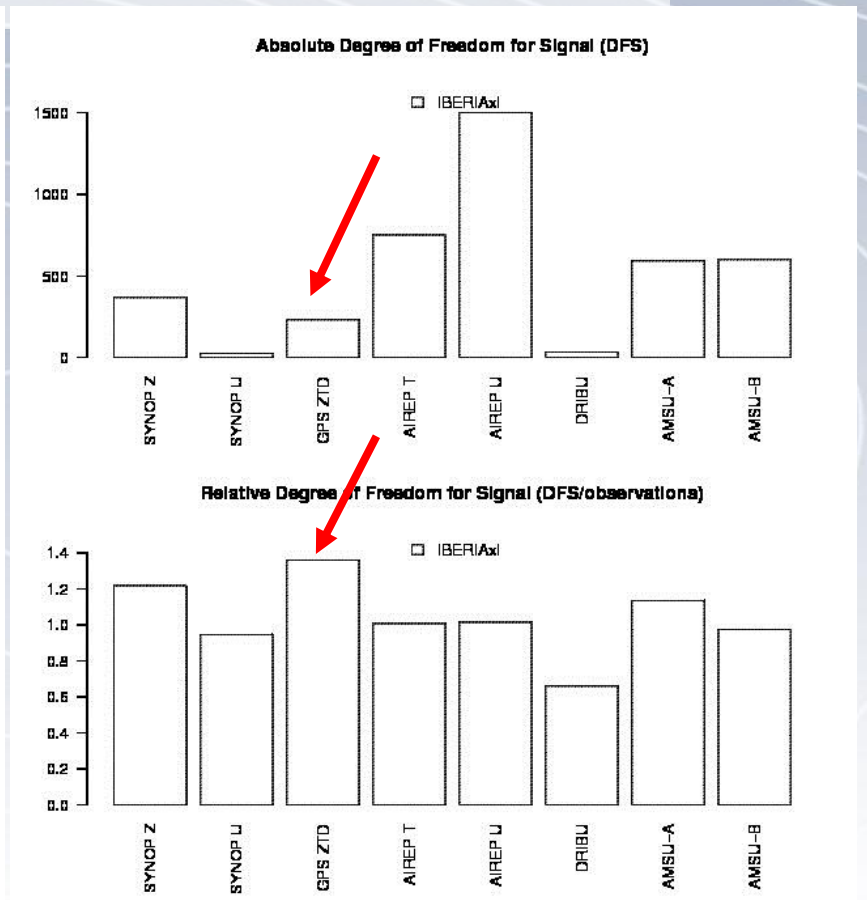


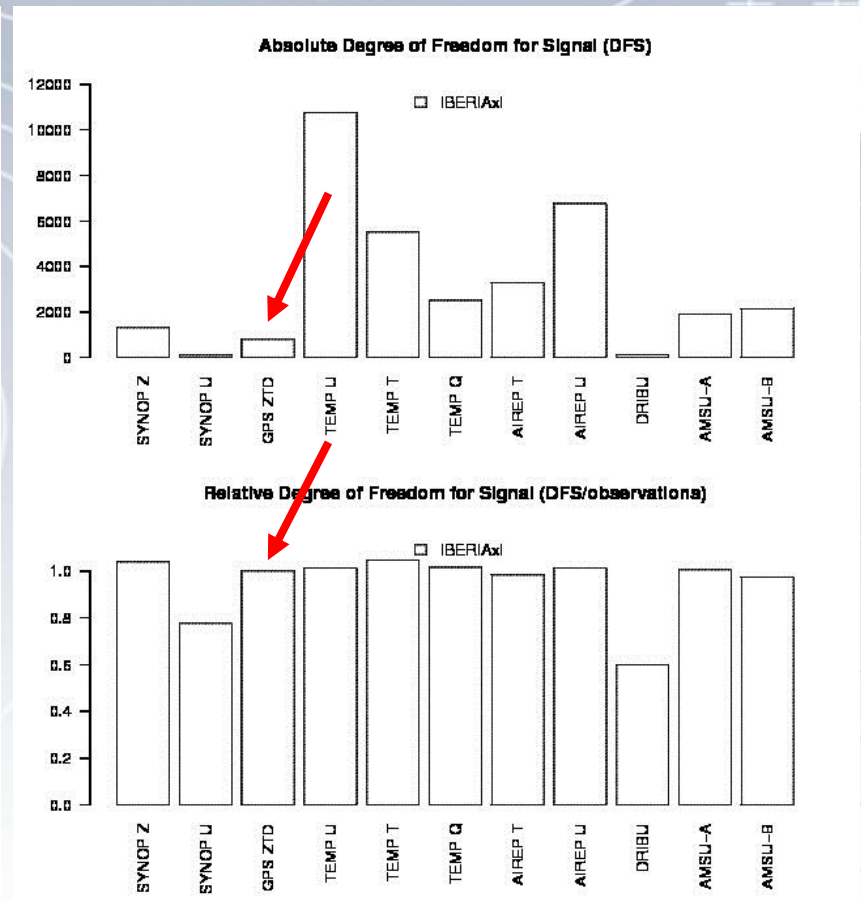


AIB: conv + ATOVS+ gnss ztd 50km thinning, sigmao=12 mm

Weight of GNSS ZTD higher than other obs at 06H… so decrease its weight seems needed







00H No ATOVS

06H No RS

12H

2) Impact of assimilating GNSS ZTD + ATOVS obs.

2.1 Impact of thinning and increasing the GNSS ZTD ob error

HARMONIE-AROME Cycle on BULL supercomputer in AEMet:

3DVAr 3h - Conv obs: TEMP, AIREP, AMDAR, SYNOP, BUOY and SHIP.
- ATOVS: AMSUa, AMSUB-MHS
- GNSS ZTD

➢ **GNSS ZTD thinning and increased sigmao**

50 km thinning

Increase sigmao value x2

3 experiments :

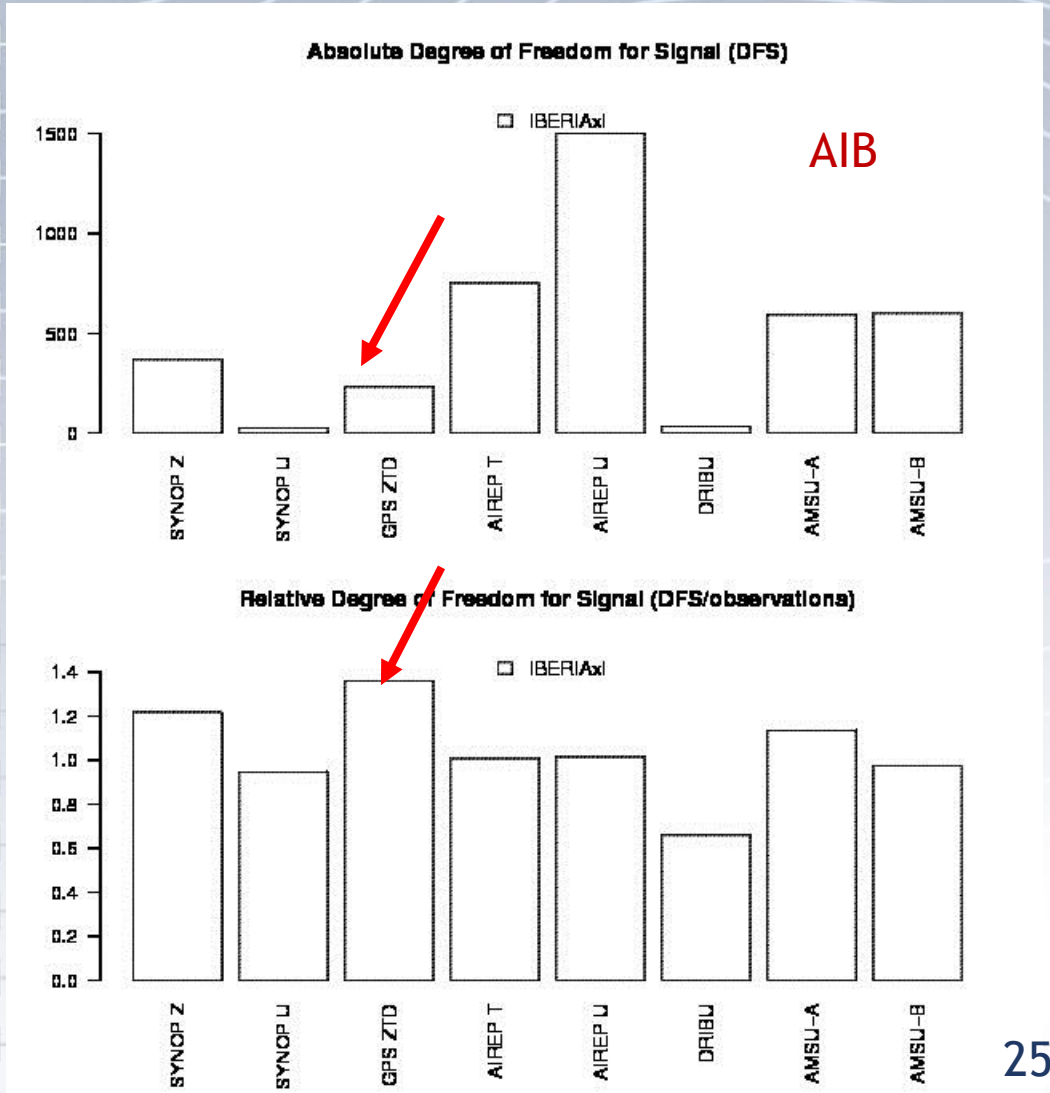
AIB (before mid-feb17) : conv + GNSS ztd no thinning, sigmao=12 mm
(after mid-feb17): conv + ATOVS+ GNSS ztd 50km thinning, sigmao=12 mm

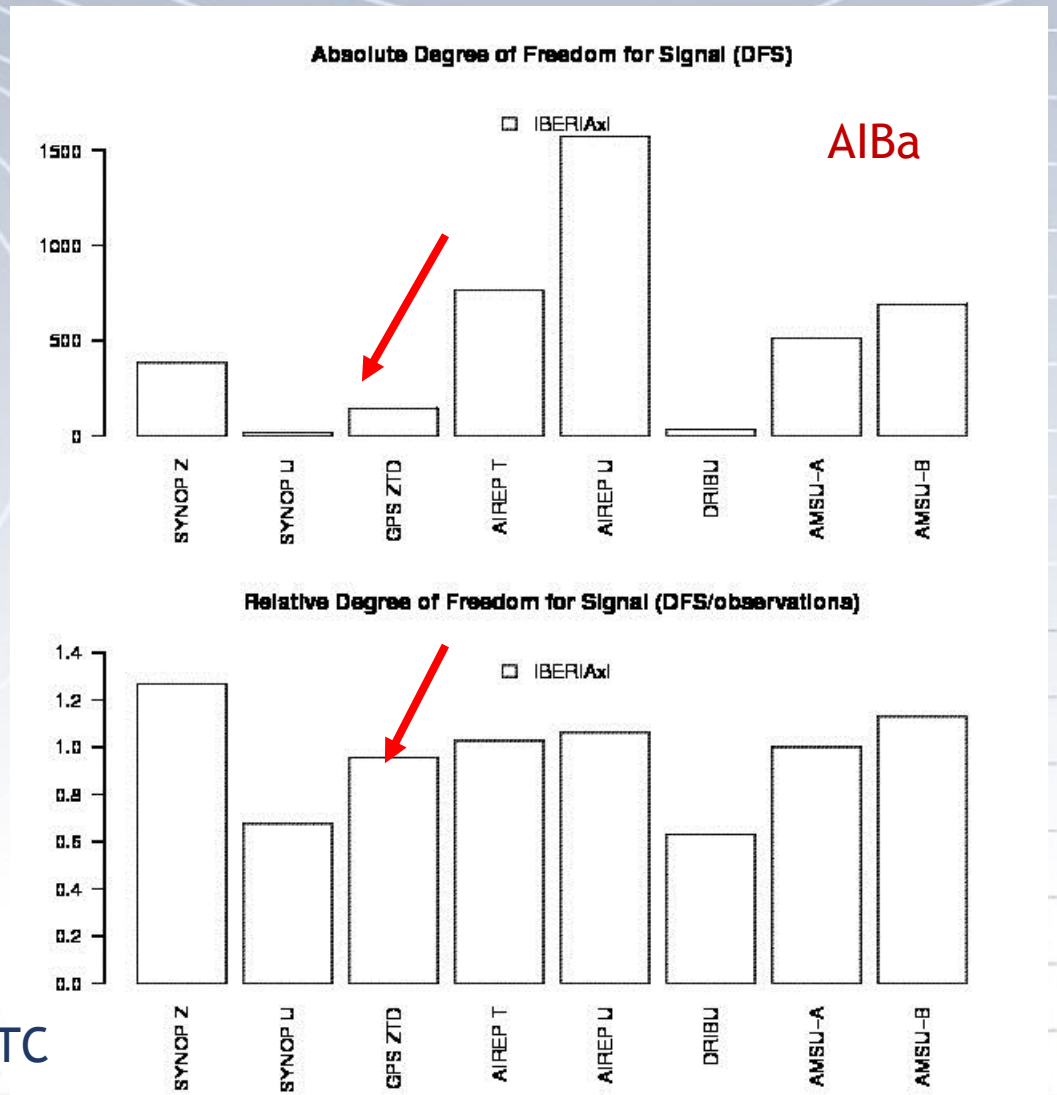
AIBp : conv + passive ATOVS+ passive gnss ztd 50km thinning, sigmao=20 mm (spin-up period)

AIBa : conv + ATOVS+ GNSS ztd 50km thinning, sigmao=20 mm, Varbc coeff from AIBp

AIB: sigmao=12 mm vs AIBa: sigmao=20 mm

Weight of GNSS ZTD lower at 06H if sigmao is increased.



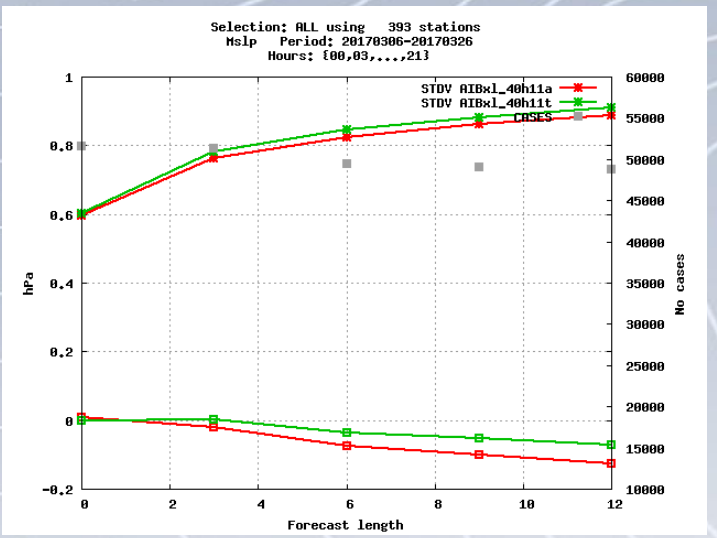


25 mar 2017, 06UTC

AIB (sigmao=12mm) vs AIBa: (sigmao=20mm)

(in both GNSS thinning distance=50km)

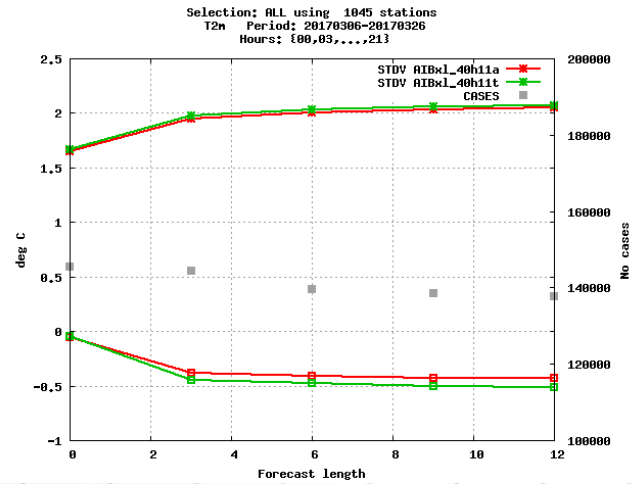
Verification plots

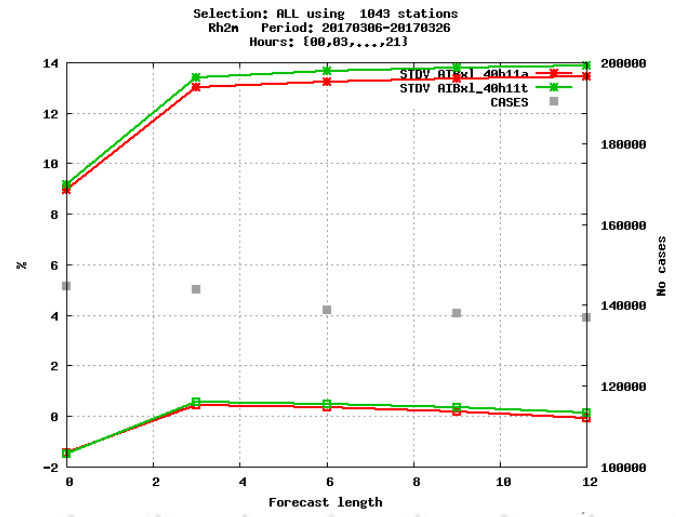


AIBa , AIB

Surface parameters

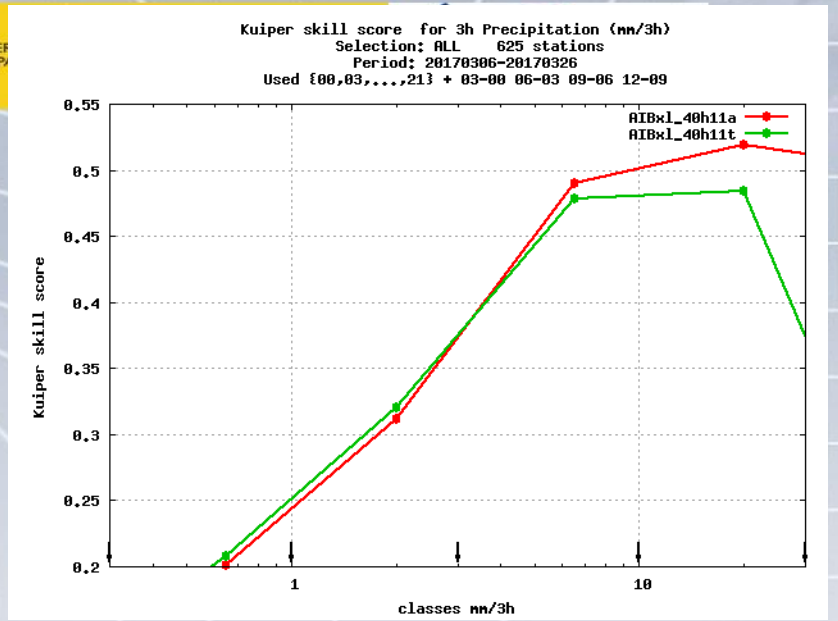
The stdv of mslp, T2m and RH2m is reduced when assimilating ZTD GNSS with LESS weight.





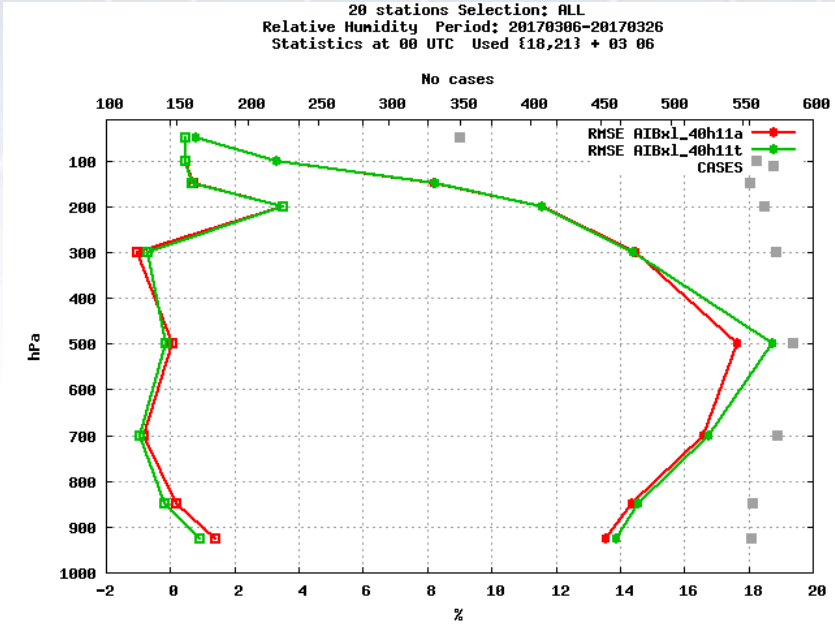
KSS score for 3h acc pcp

The less weithed gnss exp AIBa better for longer acc pcp clases.



Vertical profiles

Positive impact on RH, when reducing the weight of gnss.

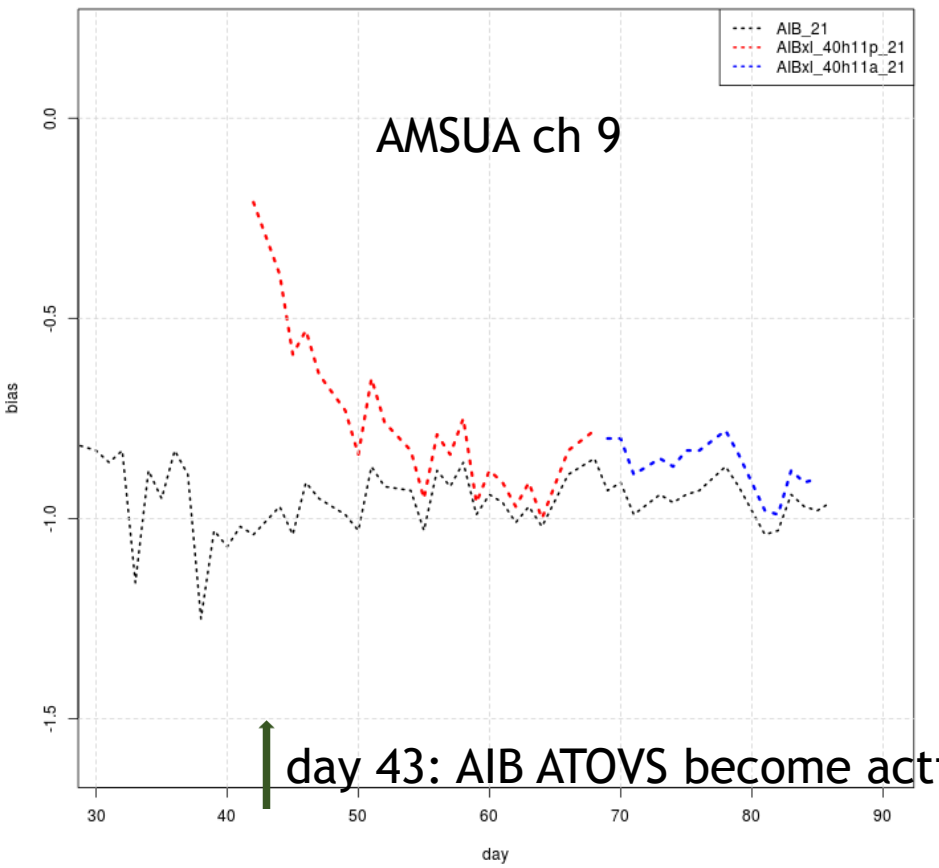


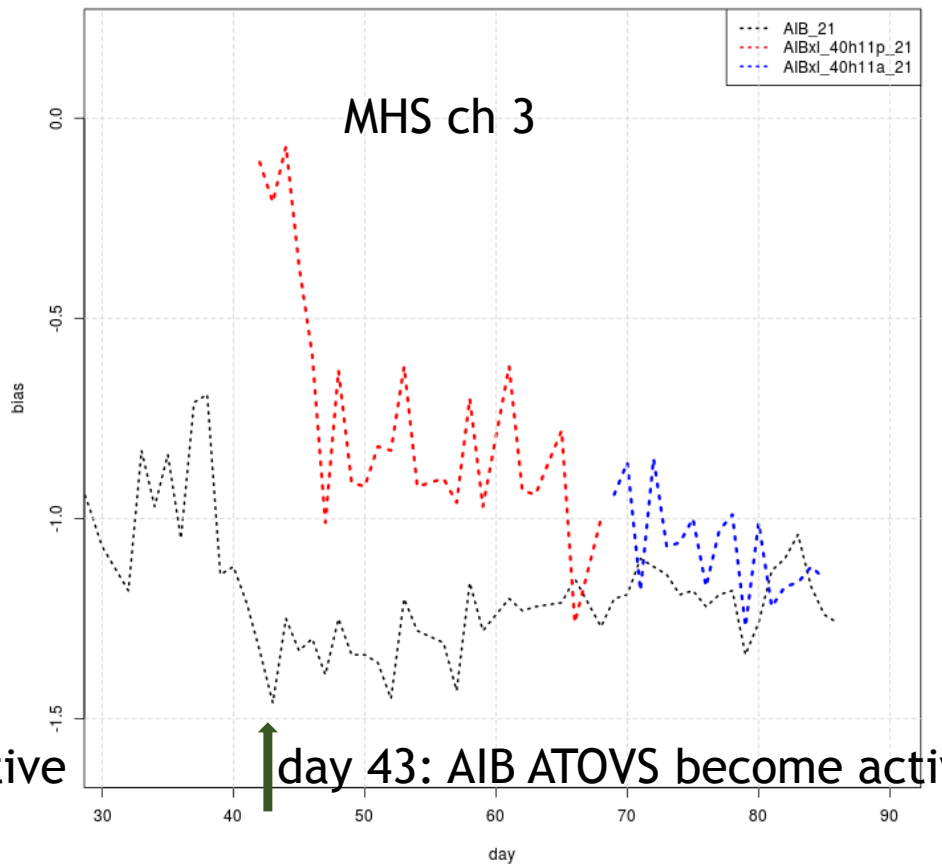
2) Impact of assimilating GNSS ZTD + ATOVS obs.

2.2 VarBC ATOVS

METOPA bias: no impact of starting first guess of VARBC coef

AIBp ATOVS& GNSS passive, **AIBa** ATOVS&GNSS active, **AIB** GNSS active& ATOVS active since day 43





The starting varbc coef for the Spin-up period is not crucial

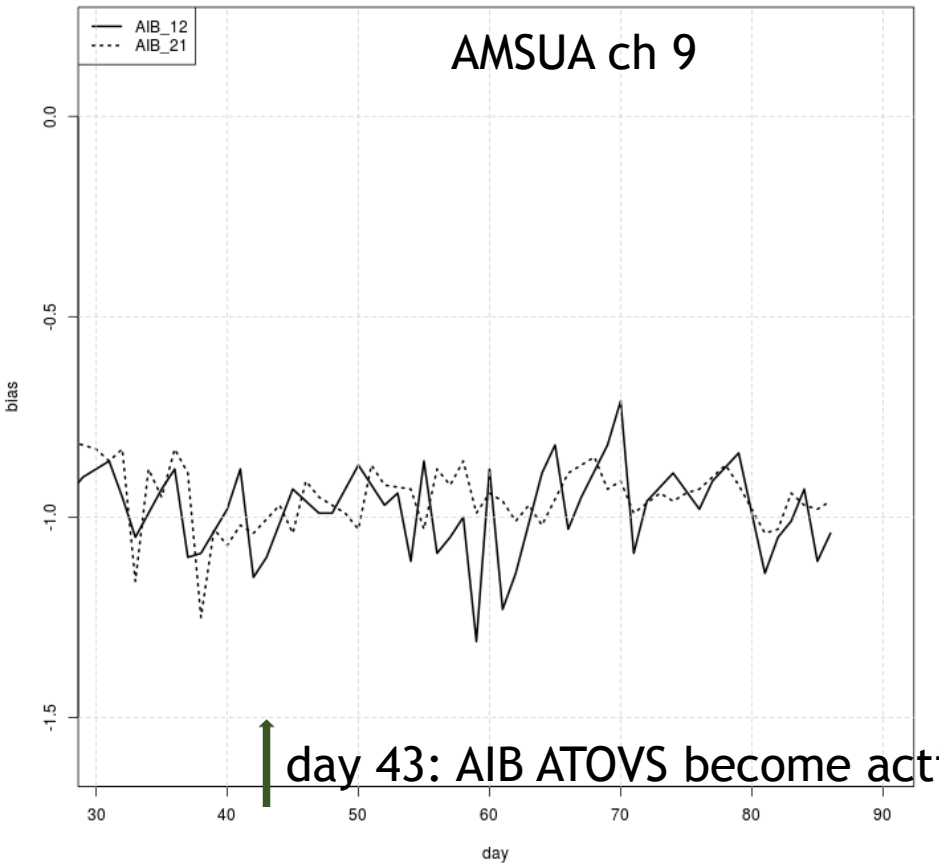
Convergence of the bias values

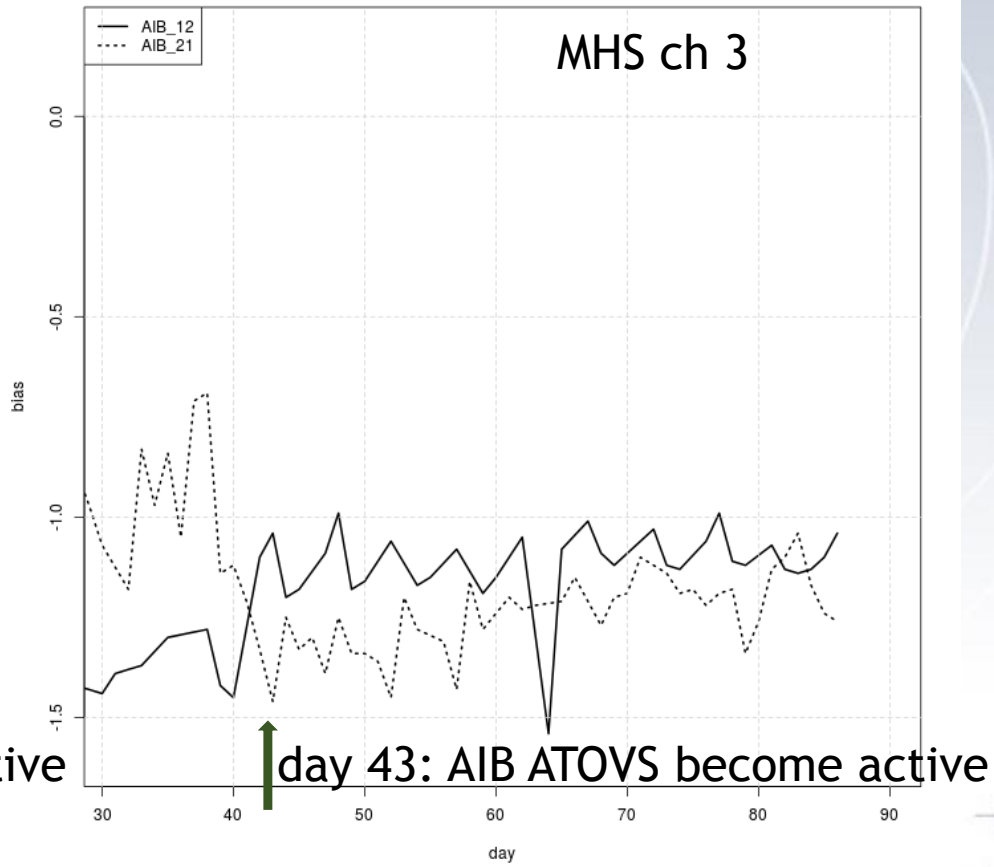
2) Impact of assimilating GNSS ZTD + ATOVS obs.

2.2 VarBC ATOVS

Impact on METOPA bias of assimilated obs (12UTC solid, 21UTC dashed)

AIB GNSS active (thinned since day 43) & ATOVS active only since day 43





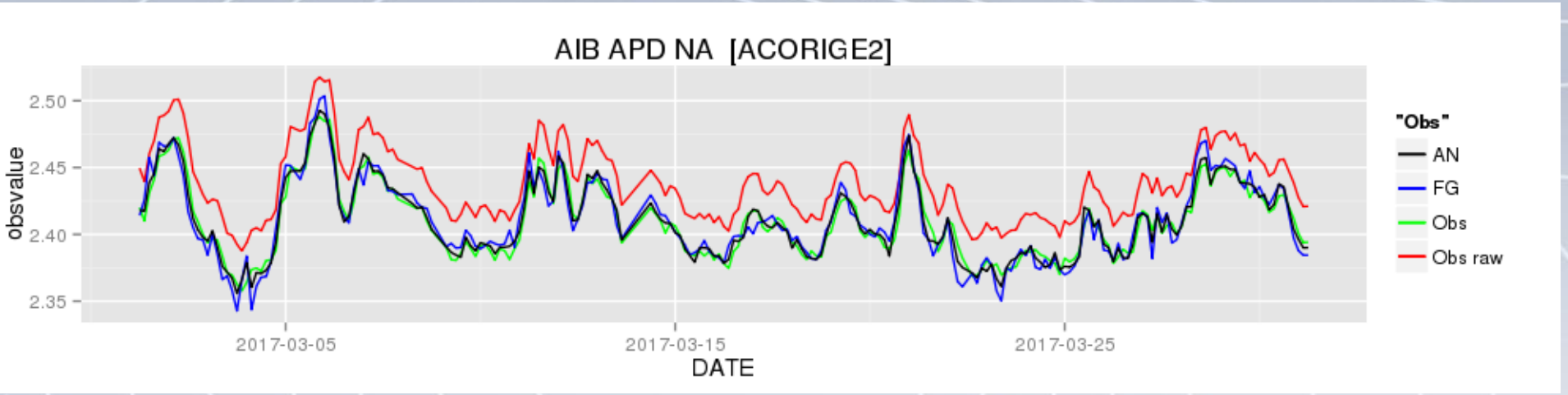
Bias value differences between 12 and 21 h:

-Insignificant for AMSUA ch9 due to aircraft data and also RS at 12 and 00UTC

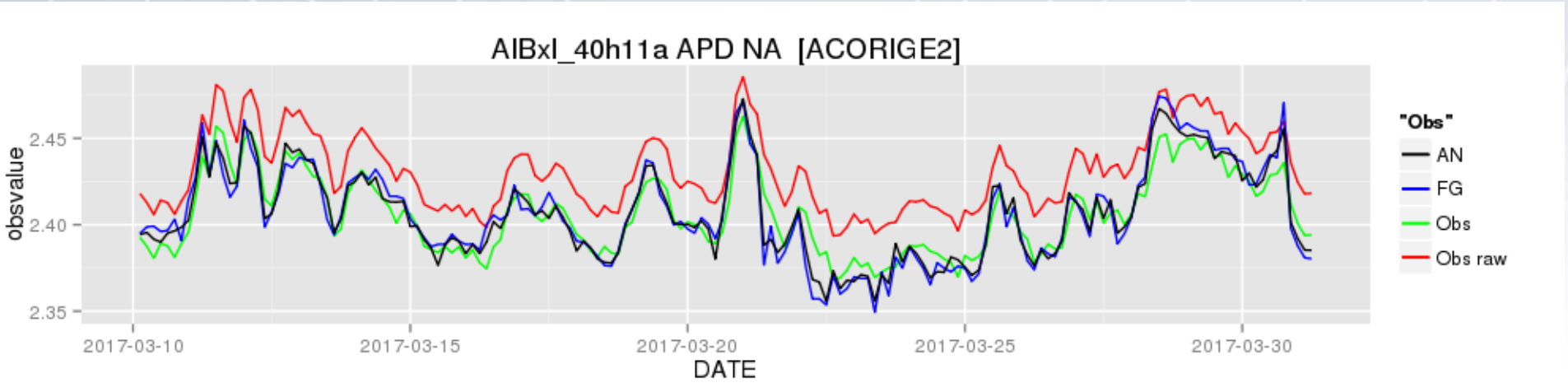
-Significant for MHS ch3.Just RS at 00 and 12 as anchor observations!

2) Impact of assimilating GNSS ZTD + ATOVS obs.

2.2 VarBC GNSS



AIB
Last 30 days



AIBa
Last 30 days

GNSS ZTD and ATOVS Data Assimilation.
AEMeT 2017

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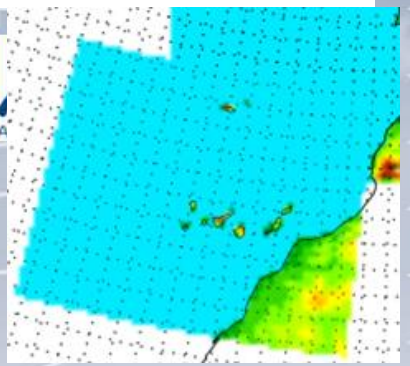
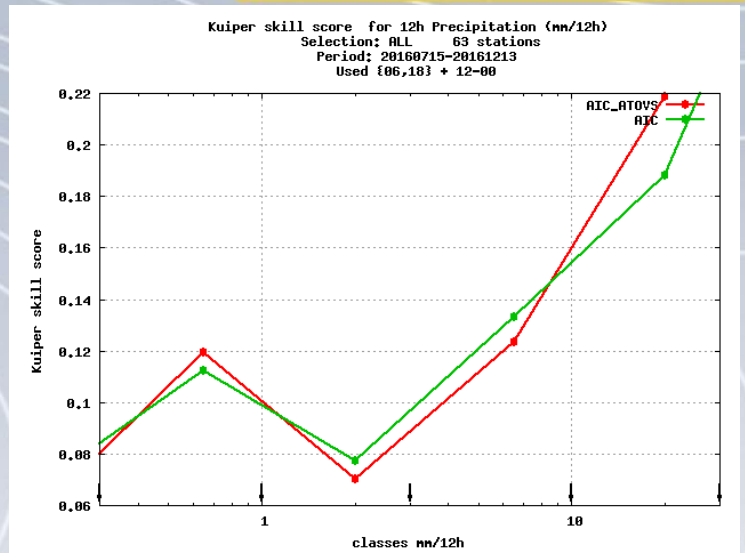
3) **Canary Islands domain**
4) Summary

3) Canary Islands domain

ATOVS assimilation

ATOVS, CONTROL





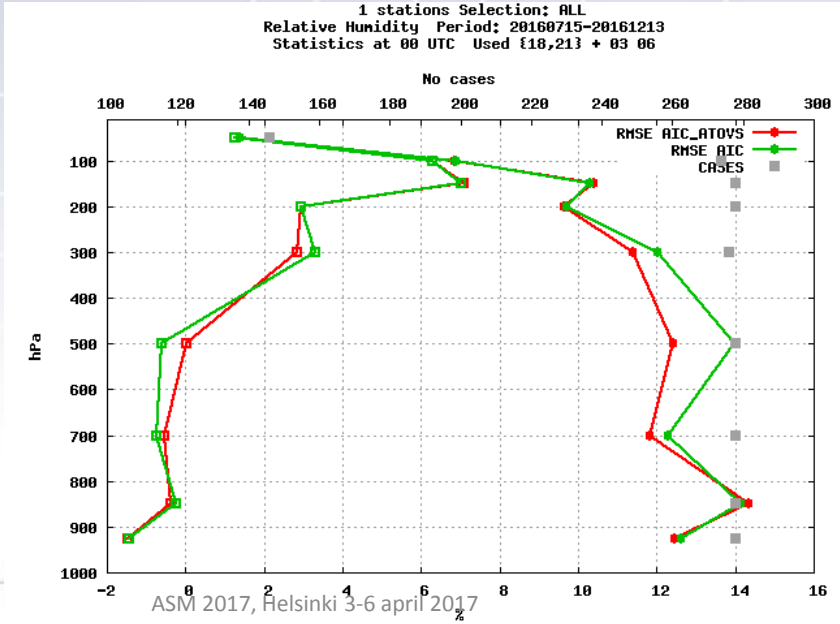
Surface parameters

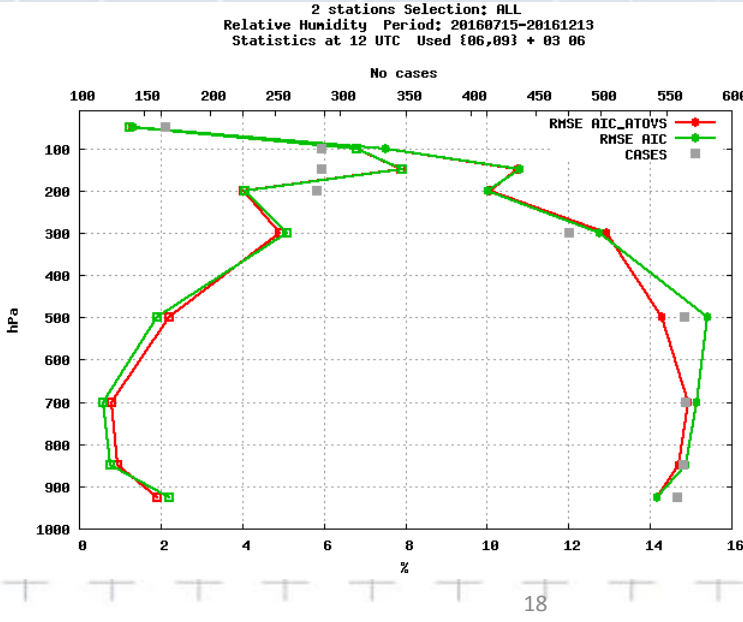
The impact is neutral for all parameters.

Pcp KSS: There aren't enough events.

Vertical profiles

Positive impact on RH both at 00h and 12 UTC between 300 and 700 hPa.





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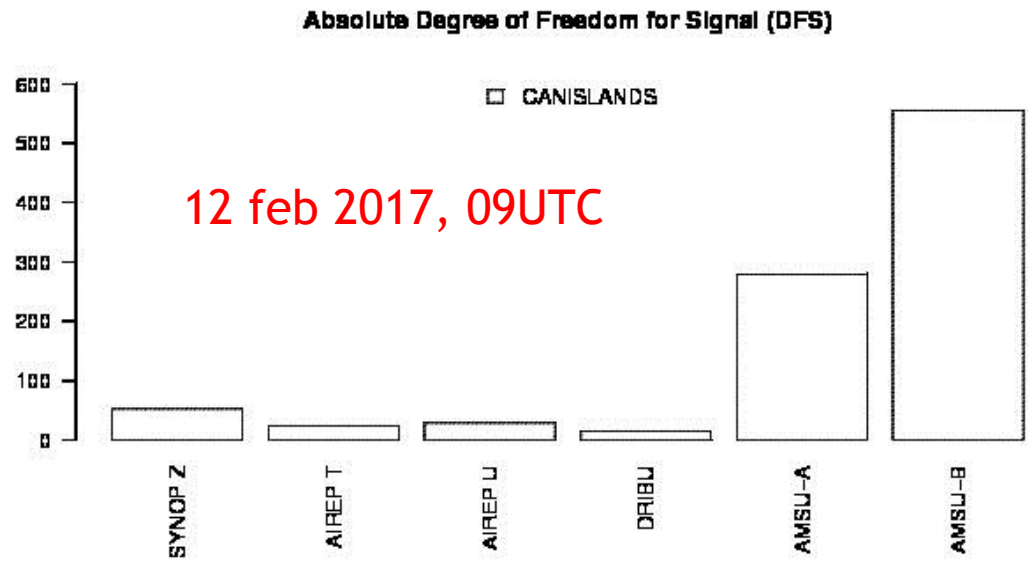
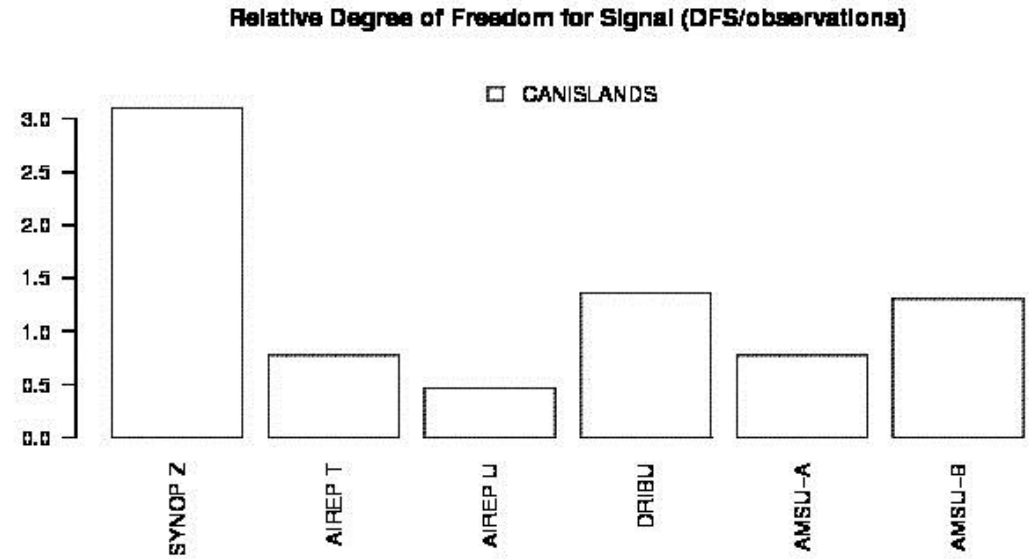
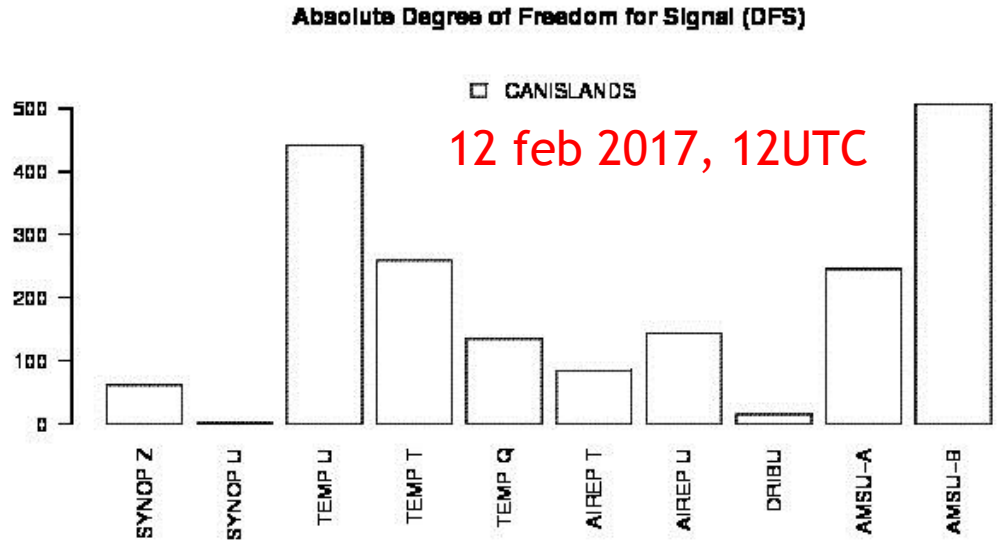
3) Canary Islands domain

ATOVS assimilation

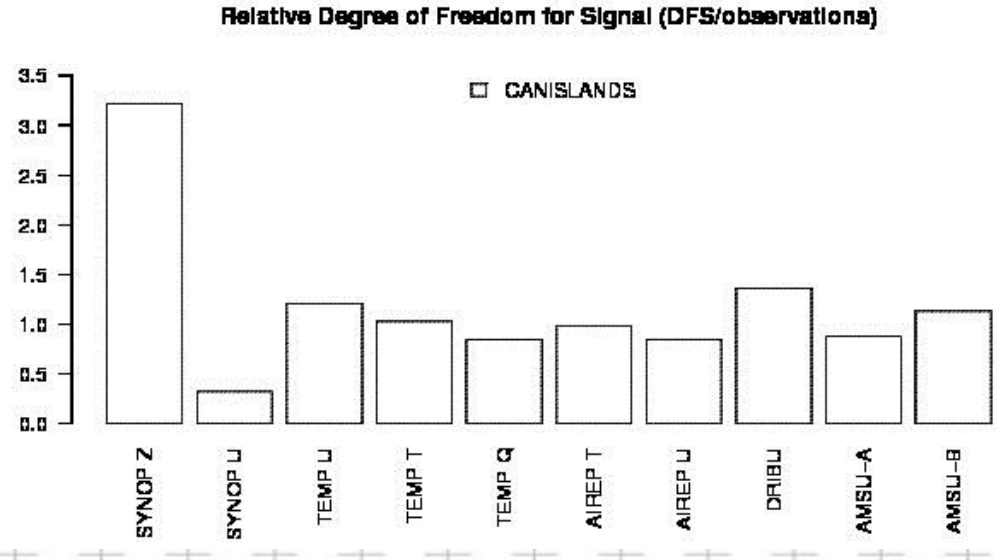


12 feb 2017, 09UTC





12 feb 2017, 12UTC



3) Canary Islands domain

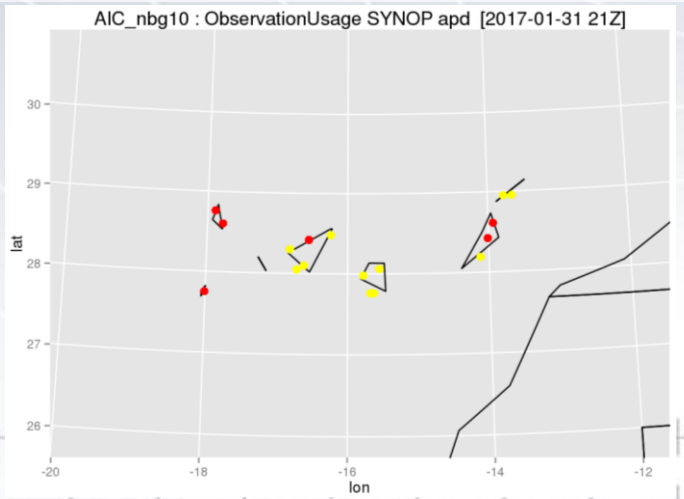
ATOVS + GNSS assimilation

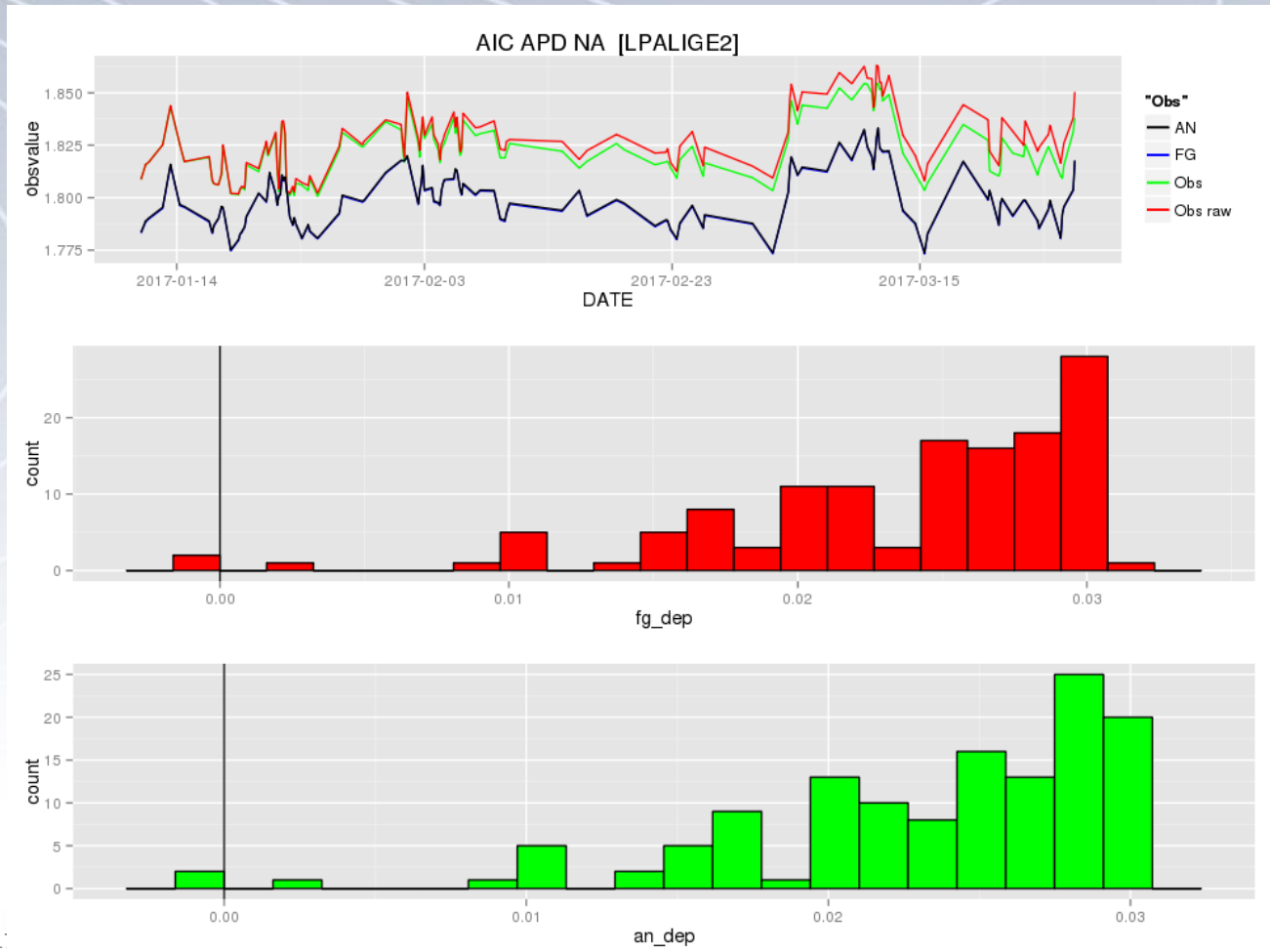
HARMONIE-AROME Cycle on BULL supercomputer in AEMet:

3DVAr 3h

- Conv obs: TEMP, AIREP, AMDAR, SYNOP, BUOY and SHIP.
- ATOVS: AMSUa, AMSUB-MHS
- GNSS ZTD passive

➢ GNSS ZTD: just 18 stations





GNSS ZTD and ATOVS Data Assimilation
AEMeT 2017

- OUTLINE

1) Impact of assimilating GNSS ZTD or ATOVS obs.
2) Impact of assimilating GNSS ZTD + ATOVS obs.
3) Canary Islands domain
4) **Summary**

4) Summary

1. **Parallel suites** of a **Cy40h11b5** HARMONIE-AROME system for IBERIAxl_2.5 and Canary Islands domains were prepared for assimilation of ZTD GNSS (no thinned) and ATOVS observations, and tested for a period from **July 2016 to November 2016 have shown** a **positive impact of all humidity related fields when assimilating GNSS ZTD observations OR ATOVS** together with conventional observations, GNSS influencing the lower troposphere that could be complementary with the impact seen for ATOVS observations for the upper troposphere.

2.However, assimilation of Conventional + no thinned GNSS ZTD + ATOVS has shown a negative impact.

3. Introducing thinning and increasing obs error for GNSS ZTD obs have been tested and then the joint assimilation of conventional + ZTD GNSS + ATOVS impact has shown to be positive.

4. VarBC coefficients are sensitive to which observations are assimilated actively/passively when no other anchor observations (aircraft and RS) are available. This is an issue for AMSUB/MHS/GNSS assimilation at intermediate an times between RS launches. In respect to the spin-up period to tune VarBC coef, no significant differences have been found for different initial coefficients values.

5. Over Canary Islands domain, assimilation of ATOVS has a clear positive impact in RH. DFS shows that these satellite obs are the most relevant observations. The reduced number of obs in this area leads to a slow convergence of VARBC coef.

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