



GOBIERNO
DE ESPAÑA

MINISTERIO
DE MEDIO AMBIENTE
Y MEDIO RURAL Y MARINO

Aemet
Agencia Estatal de Meteorología

ASSIMILATION of European GPS ZTD observations AEMET 2011

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OUTLINE

- 1) Status of assimilation of GPS ZTD observations in
HIRLAM at AEMET.
- 2) Status of assimilation of GPS ZTD. observations in
HARMONIE. First trials.
- 3) Conclusions and future work.



1) Status of assimilation of GPS ZTD observations in HIRLAM at AEMET.



1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

AEMET operational & parallel HIRLAM suites:

2005-2008: Passive GPS ZTD in AEMET operational run

HIRLAM 6.1.2. (16 km - 40 vl), STRACO, (Stat. bal. BG constraint (Berre 2000)).

- * 3DVar (6h assimilation cycle). Conventional obs apart of GPS ZTD.
- * GPS ZTD have been assimilated with:
 - + 6h assimilation cycle and redundancy check.
 - + No bias reduction scheme.
 - + Obserror sd for ZTD set to 18 mm

2010: HIRLAM 7.2 Passive GPS ZTD in AEMET operational run

1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

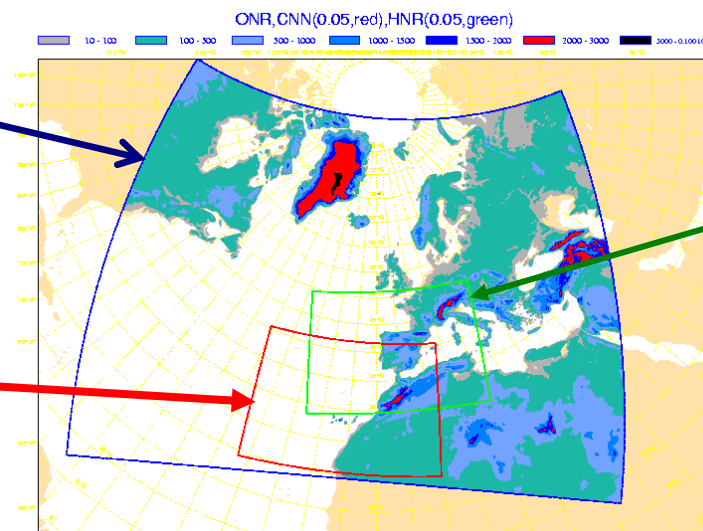
2011: ZTD GPS Data assimilation in AEMET: HIRLAM 7.2

Resolution	0.16°	0.05°	0.05°
OPERATIONAL runs	ONR NO GPS assim	HNR NO GPS assim	CNN (Canary Islands) NO GPS assim
PARALLEL runs	SK3 Active GPS assim (from july 2011)	HEC Active GPS assim (from july 2011)	

ONR/SK3

CNN

HNR/HEC



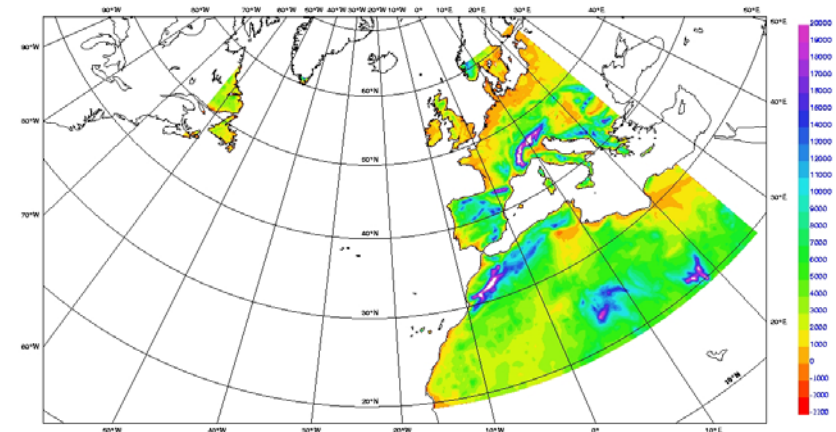
1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

2011: ZTD GPS Data assimilation in AEMET:

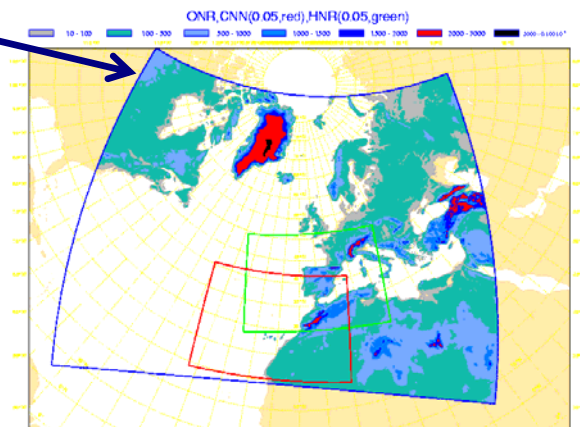
0.16° : **SK3** (0.16°) (ONR control)

HIRLAM 7.2. (0.16° - 40 vl), KF, H+72

- * Boundaries: ECMWF forecast fields
- * Blending with ECMWF analysis, 6h.
- * 3DVar 6h assimilation cycle
- * Stat. bal. BG constraint (Berre 2000).
- * Conventional observation types.
- * **Just in SK3**: GPS ZTD have been assimilated with:
 - + 6h assimilation cycle and Redundancy check.
 - + No bias reduction scheme.
 - + Obserror sd for ZTD set to 10 mm



SK3



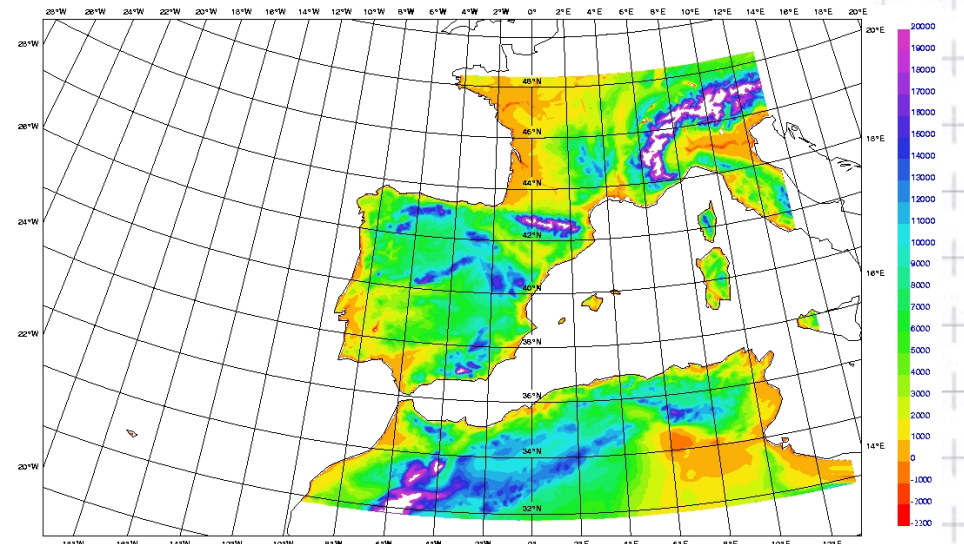
1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

2011: ZTD GPS Data assimilation in AEMET:

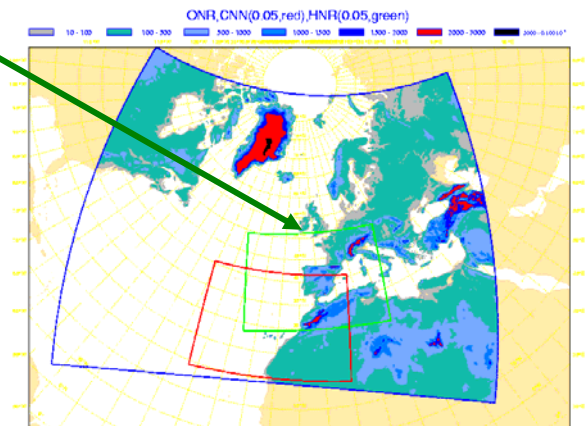
0.5°: **HEC** (0.05°) (HNR control)

HIRLAM 7.2. (0.05°- 40 vl), KF, H+36

- * Boundaries: ECMWF forecast fields
- * Blending with ECMWF analysis , 6h.
- * 3DVar 6h assimilation cycle.
- * Stat. bal. BG constraint (Berre 2000).
- * Conventional observation types.
- * **Just in HEC**: GPS ZTD have been assimilated with:
 - + 6h assimilation cycle and redundancy check.
 - + No bias reduction scheme.
 - + Obserror sd for ZTD set to 10 mm



HEC





1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

Parallel runs: SK3, HEC

GPS obs PRE-PROCESSING:

1) FILE EXTRACTION:

NRT-GPS ZTD obs fetched from 10 different processing centres (COST-716 V2) : ASI, BKG, GFZ, IGE, KNMI, LPT, METO, ROB, SGN, GOP1.

FTP 3h windows files , ascii files (cost format)

2) FILE READING:

+ Use of WHITE LISTS

+ Use of FILTERS

- Monthly updated
- "geographical" criteria (+ our own statistics).

Obs are NOT readed if:

- Lack of name, lat, lon, or ztd value.
- Name is not on the LIST.
- Irregular (cost-) format



1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

Parallel runs: SK3, HEC

GPS obs POST-PROCESSING:

Impact of ZTD GPS obs assimilation on the
ANALYSIS
FORECAST

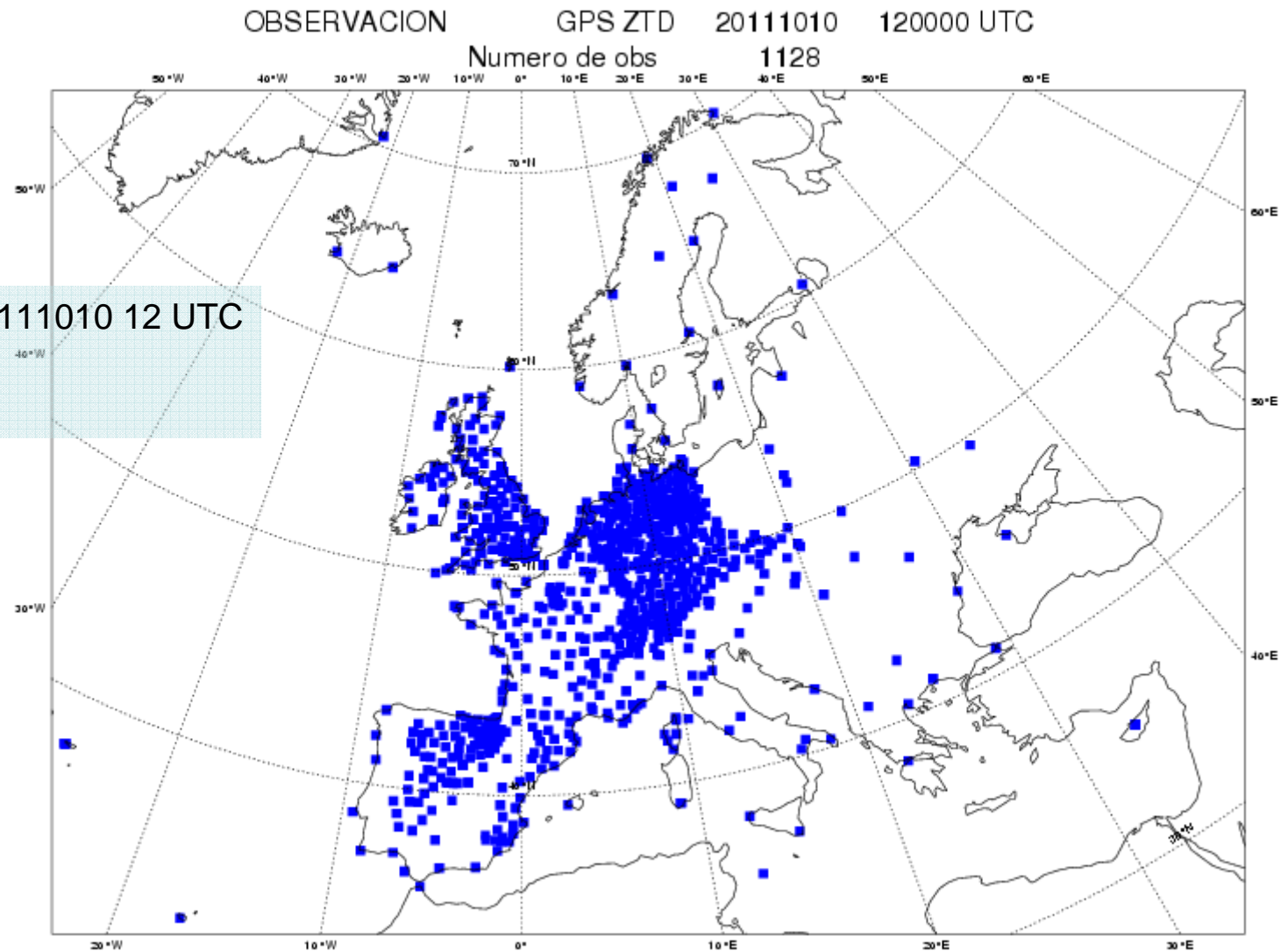
- 1.- Number obs maps and plots
- 2.- Innovations plots and Histograms
- 3.-- BIAS study.
- 4.- Experiments verification: HNR (no GPS) vs HEC (active GPS)



1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

1.- Number obs maps and plots

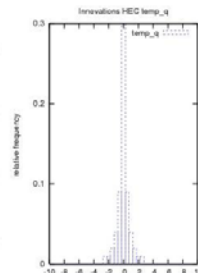
OBSERVATION GPS ZTD 20111010 12 UTC
Active obs number 1128



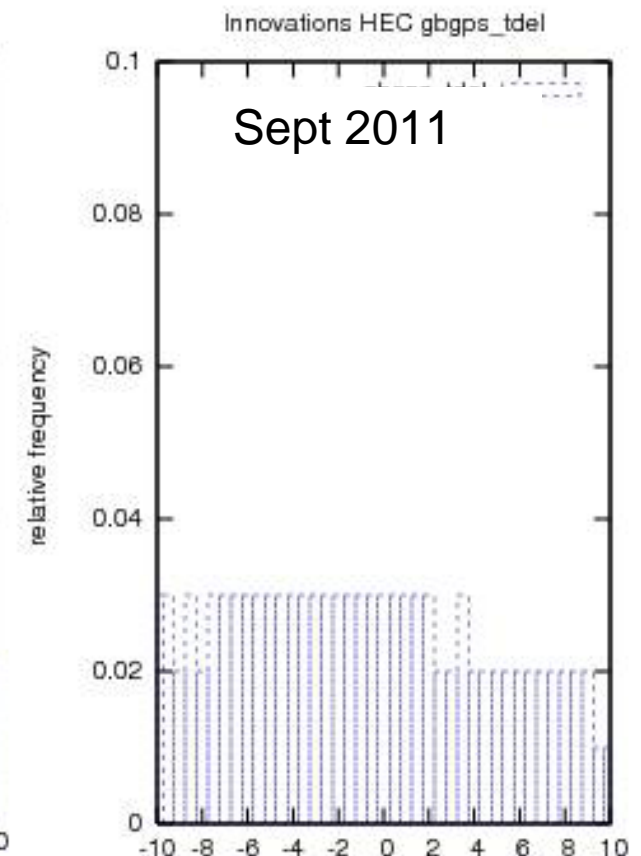
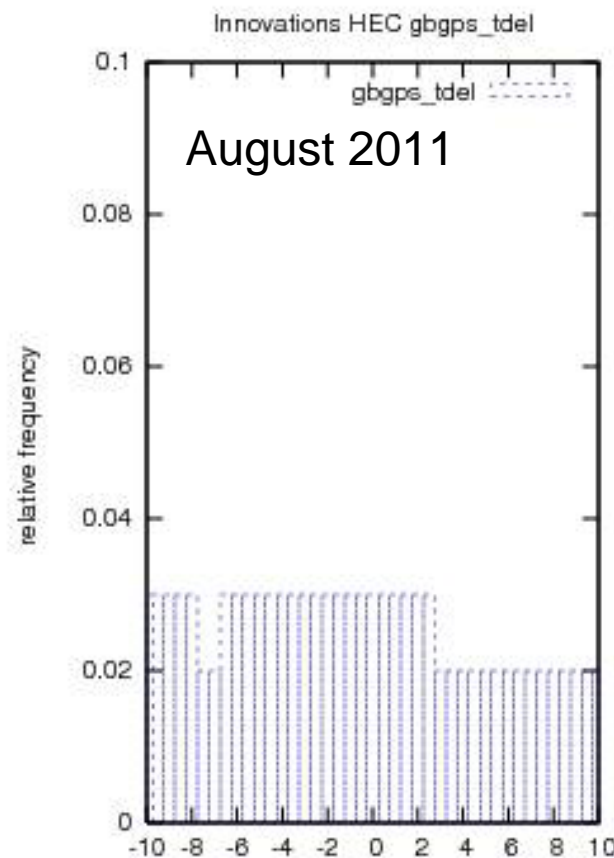
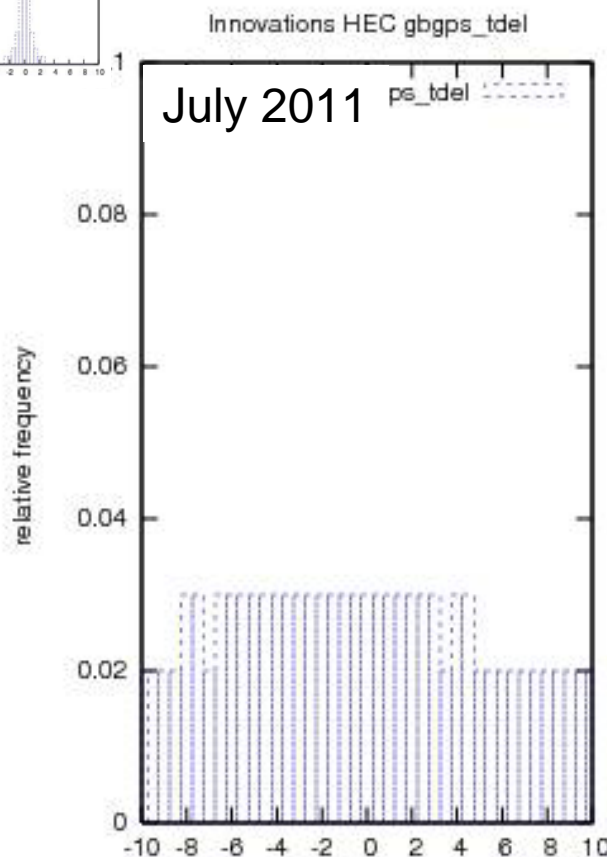
1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

2.- Innovations plots and Histograms of ZTD GPS obs INOVATIONS (ob-fg)

All ZTD GPS 07-09 2011

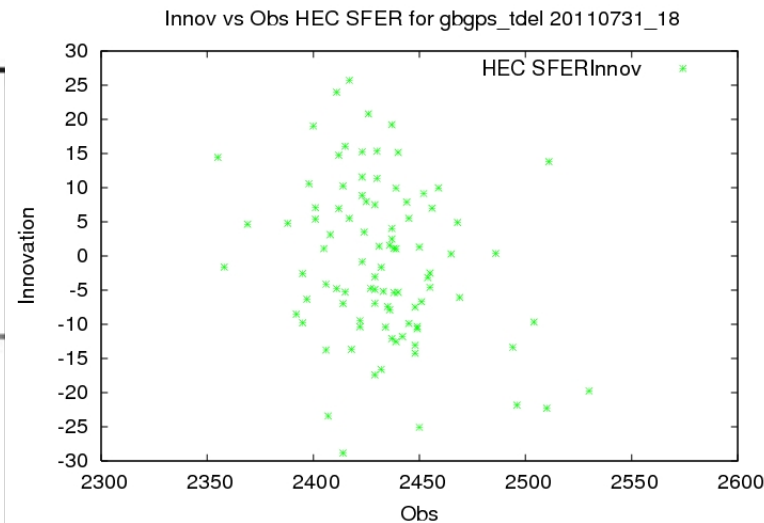
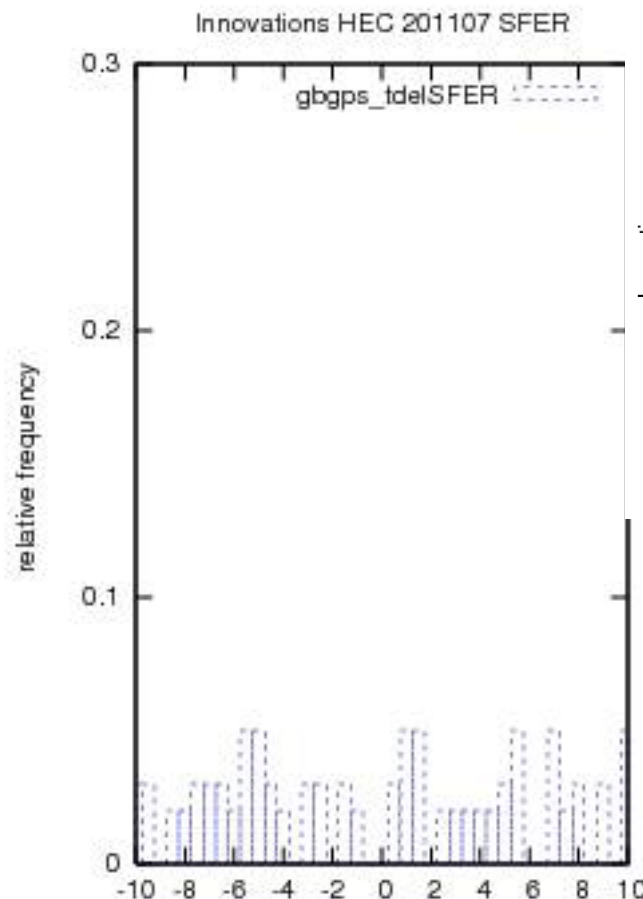


Gaussians?!?

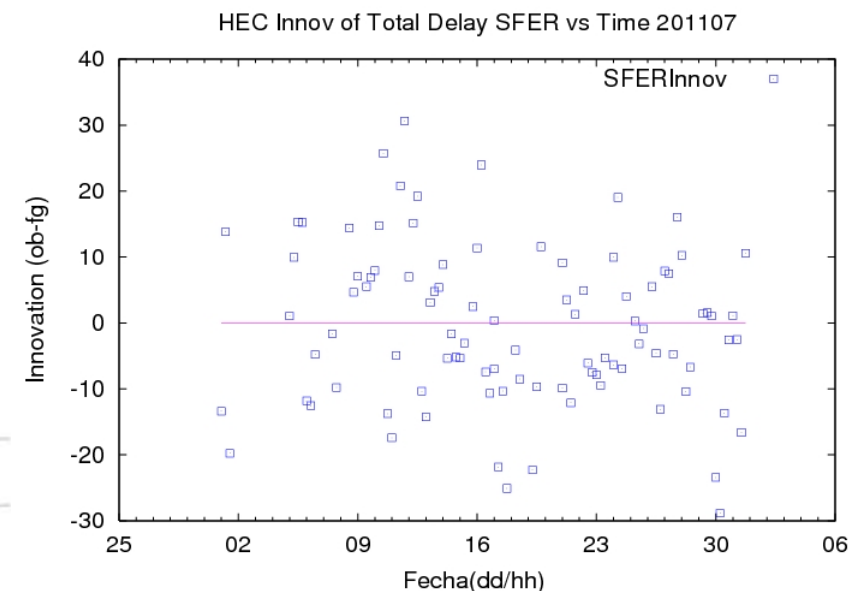


1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

2.- Innovations plots and Histograms of ZTD GPS obs. INOVATIONS (ob-fg)



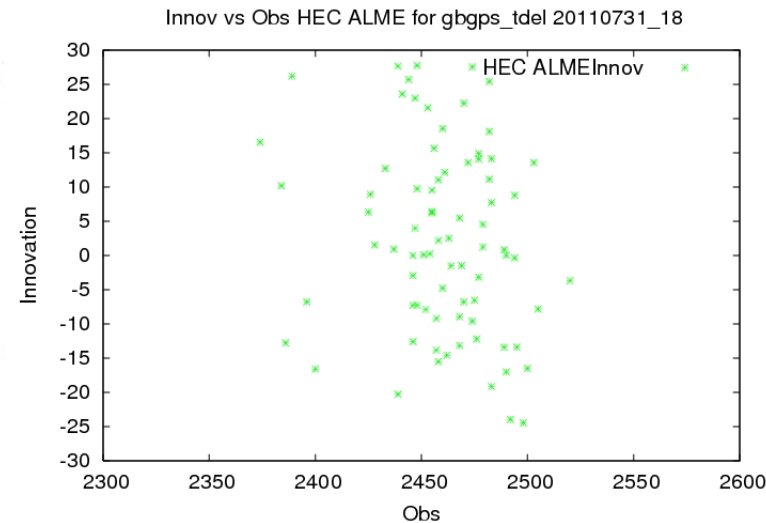
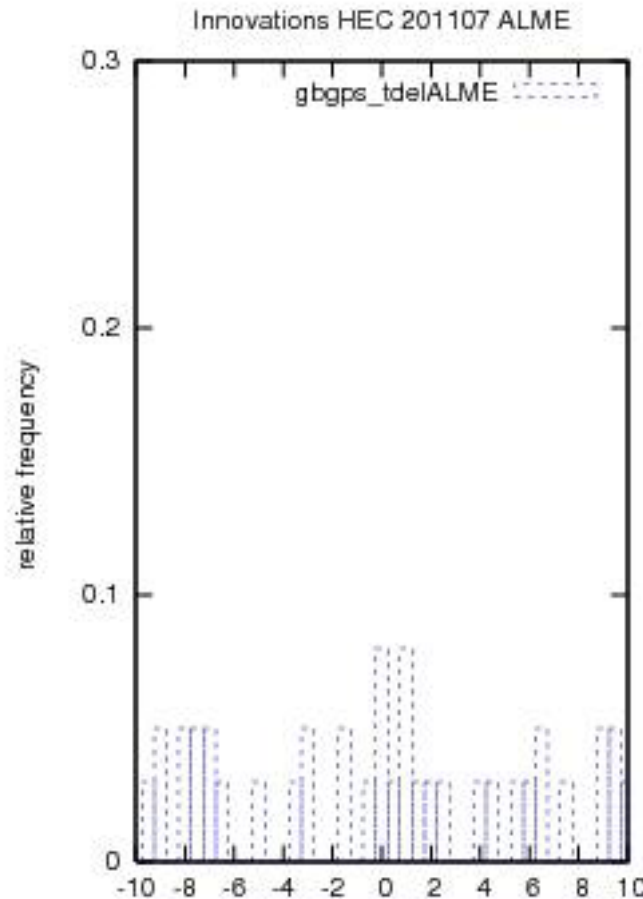
SFER (IGE)
July 2011



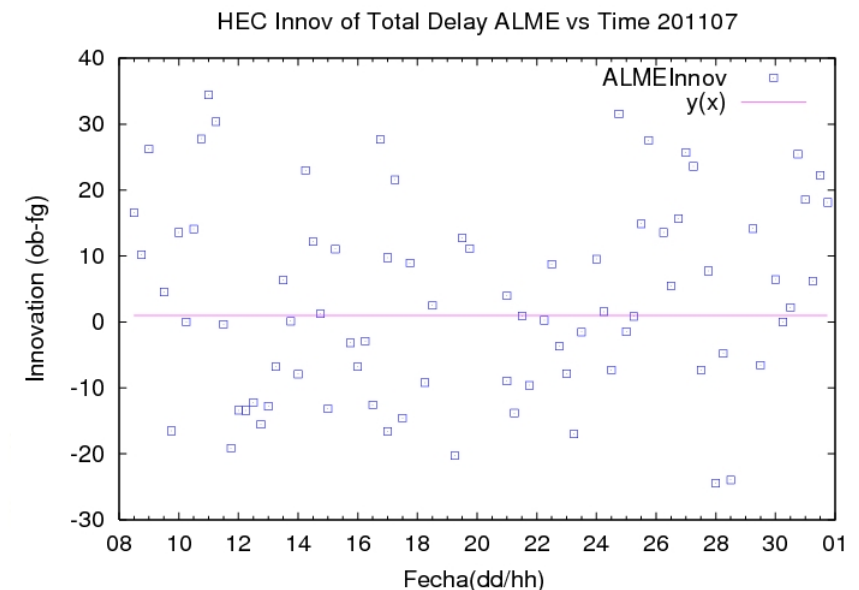
Inn , obs * 10³

1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

2.- Innovations plots and Histograms of ZTD GPS obs. INOVATIONS (ob-fg)



ALME (IGE)
July 2011



Inn, obs * 10³

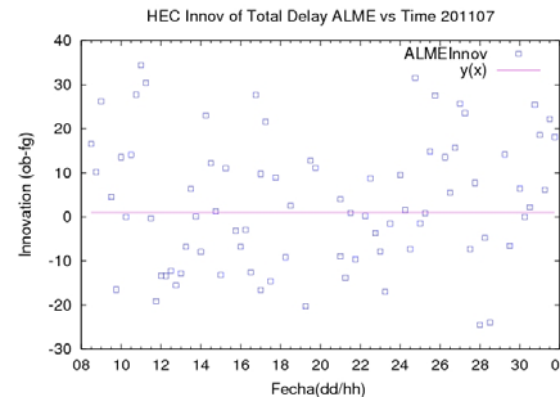
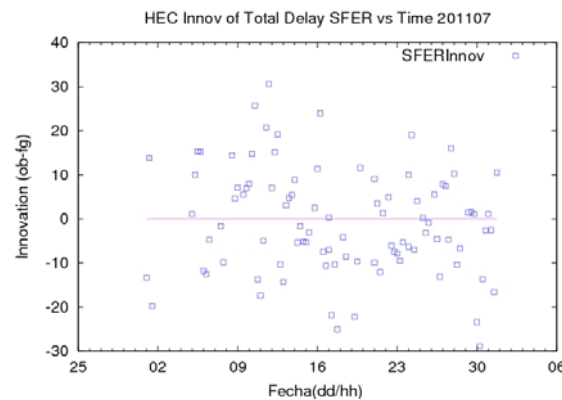
1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

2.- Innovations plots and Histograms of ZTD GPS obs. INOVATIONS (ob-fg)

It seems that BIAS values are

not constaat in time

SFER St

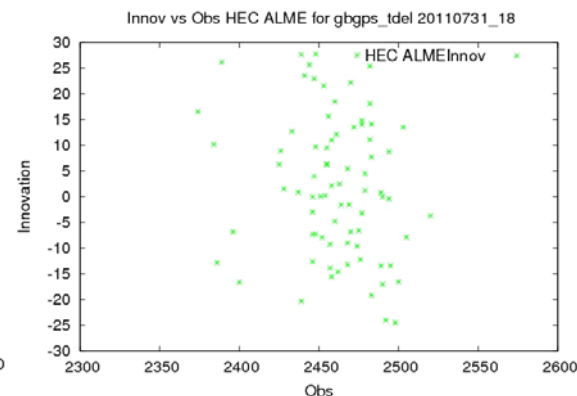
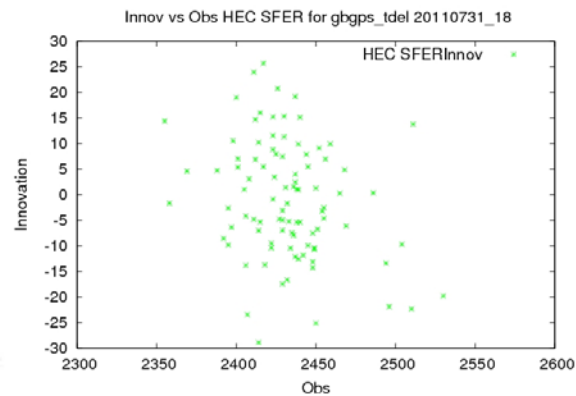


ALME St

It seems that BIAS values are

not ZTD obs value dependent.

SFER St



ALME St

1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

3.- BIAS study.

BIAS of ALL
Stations
over Iberian
Peninsula

July 2011

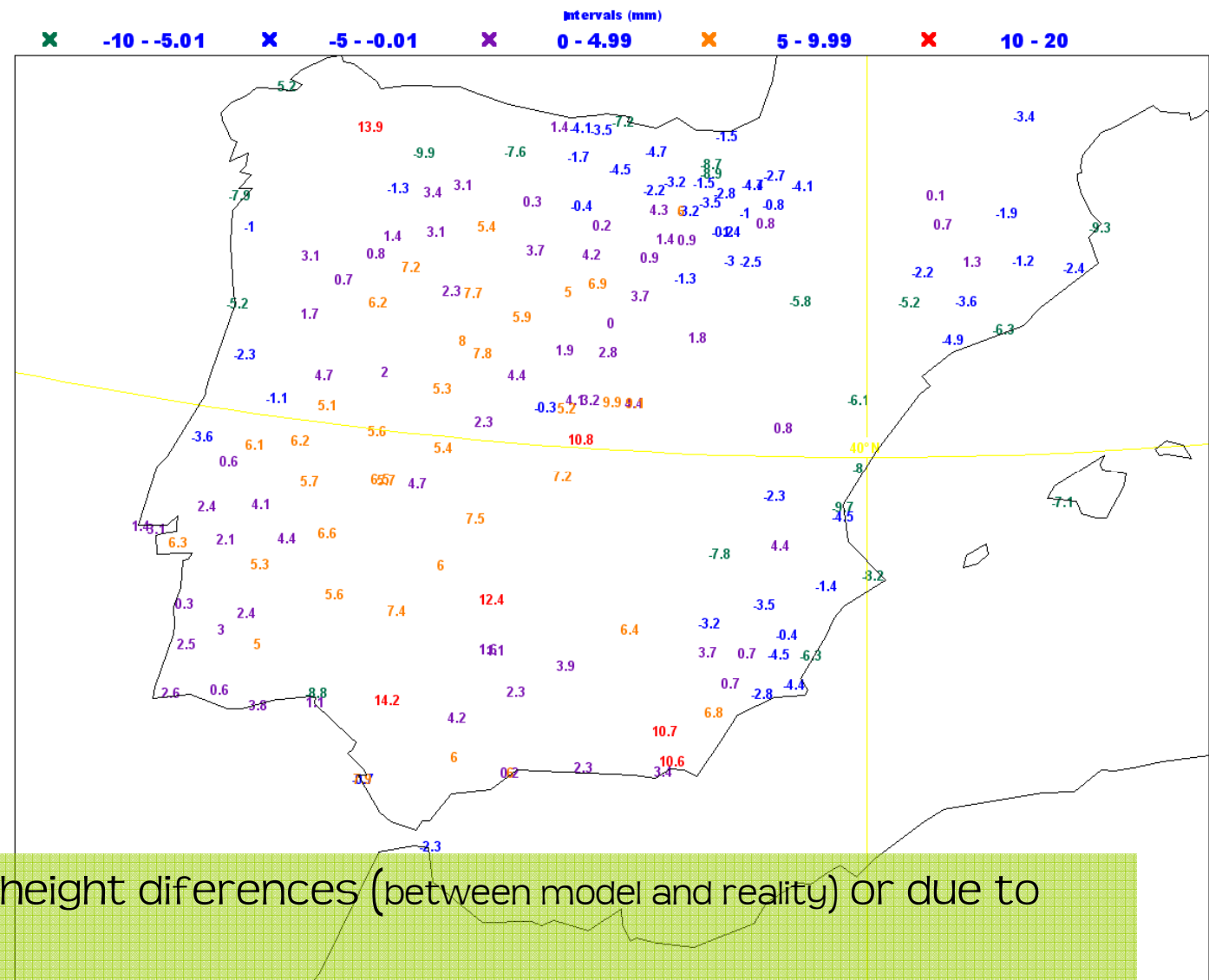
Ob-fg

BIAS > 0 : FG too dry

BIAS < 0 : FG too wet

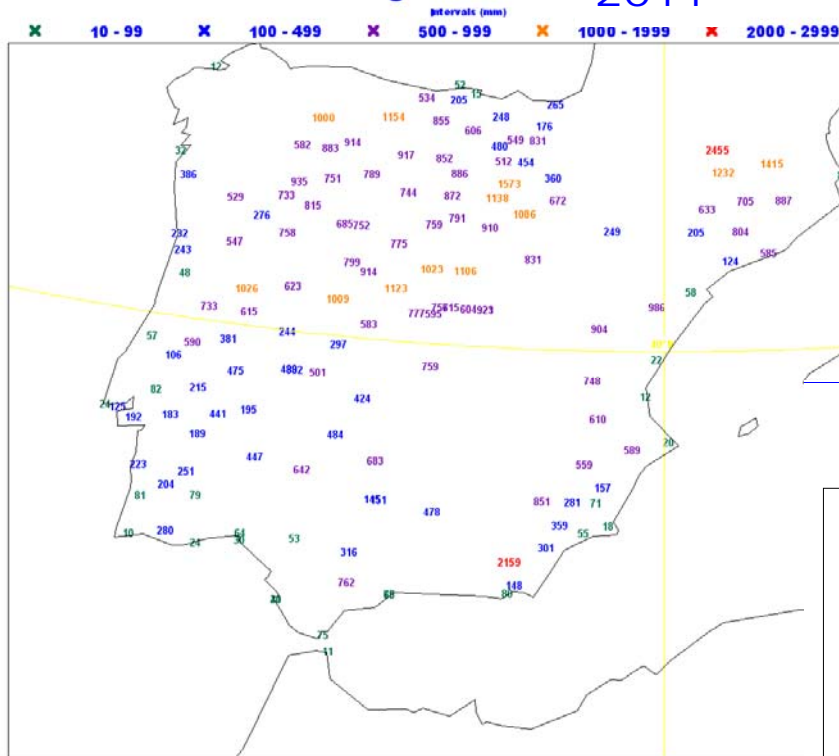
(compared with ZTD obs)

ZTD Bias values HEC 07 2011



So, are BIASES due to the height differences (between model and reality) or due to time or ZTD values ...?

ZTD height st HEC 07 2011



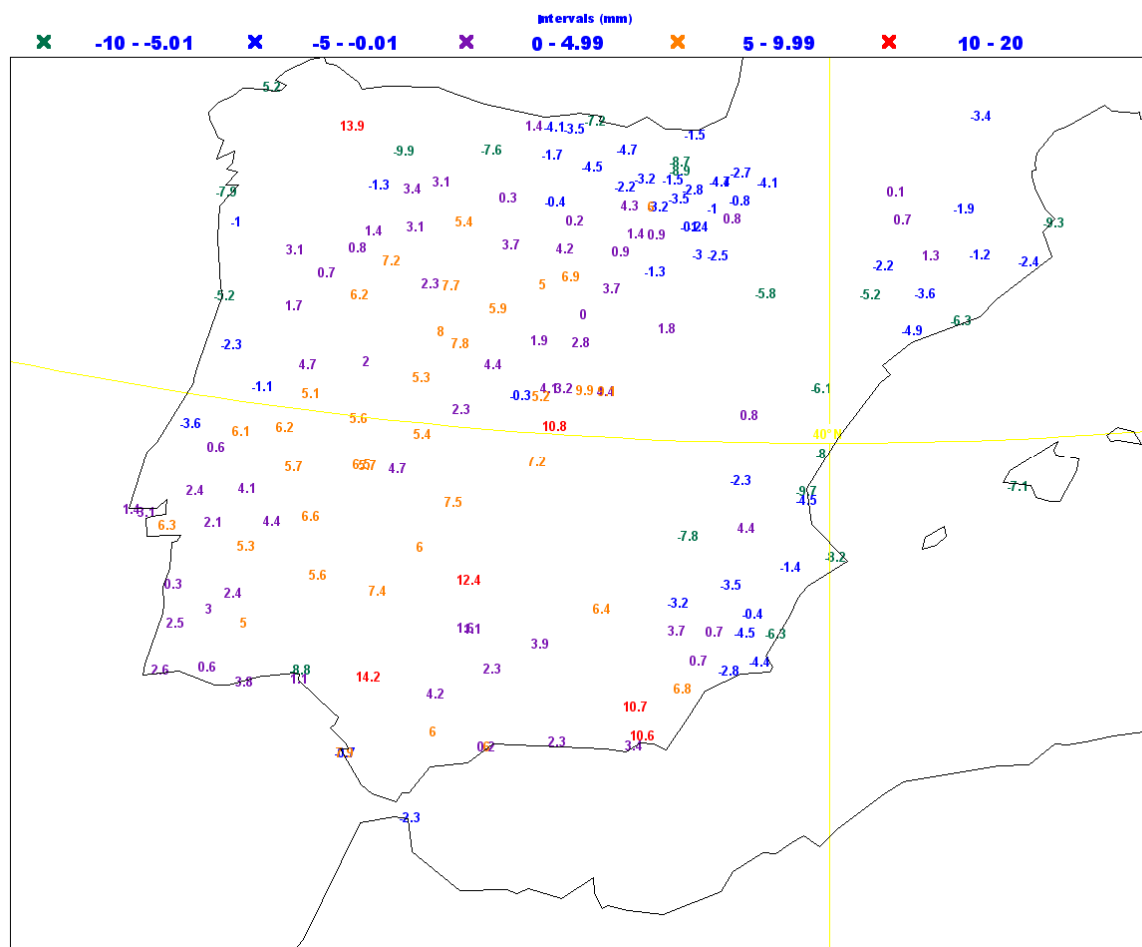
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HIRLAM at AEMET.

ZTD Bias values HEC 07 2011

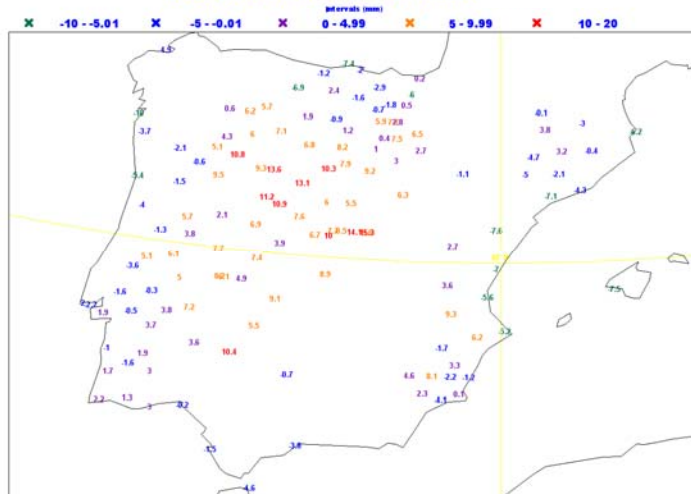


BIAS vary with st
HEIGHT...

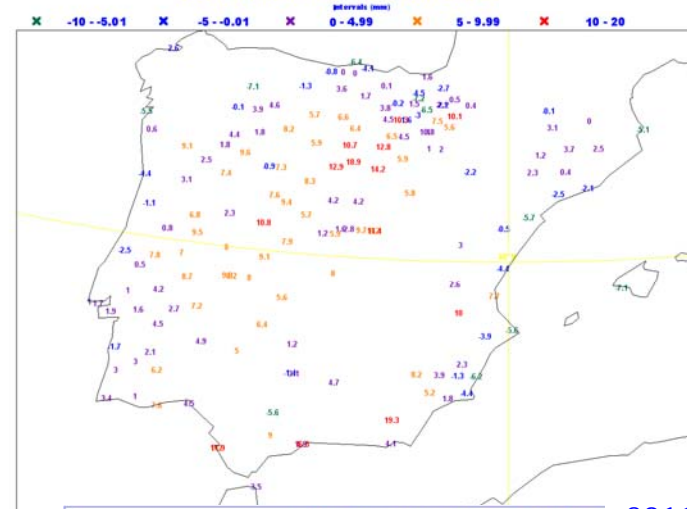
- Hight values at hight
sts???

1) Asimilation of GPS ZTD observations in HIRLAM at AEMET.

ZTD Bias values HEC 07week1 2011

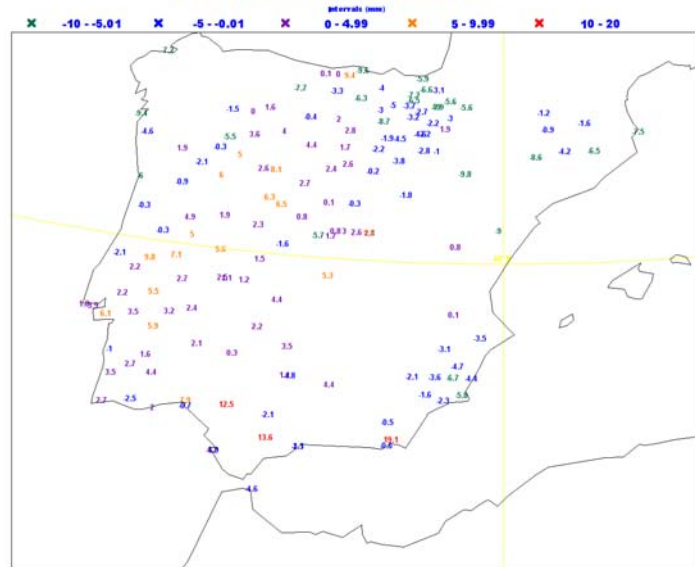


ZTD Bias values HEC 07week2 : 2011

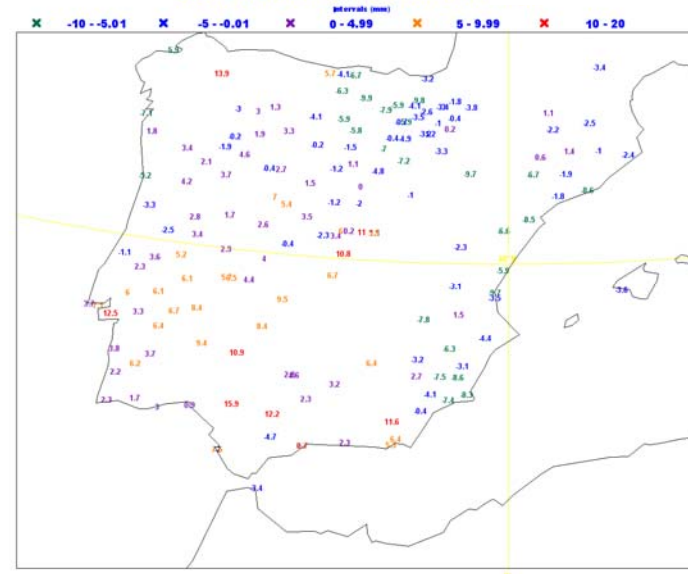


BIAS vary with
AREAS..???

ZTD Bias values HEC 07week3 : 2011



ZTD Bias values HEC 07week4 2011

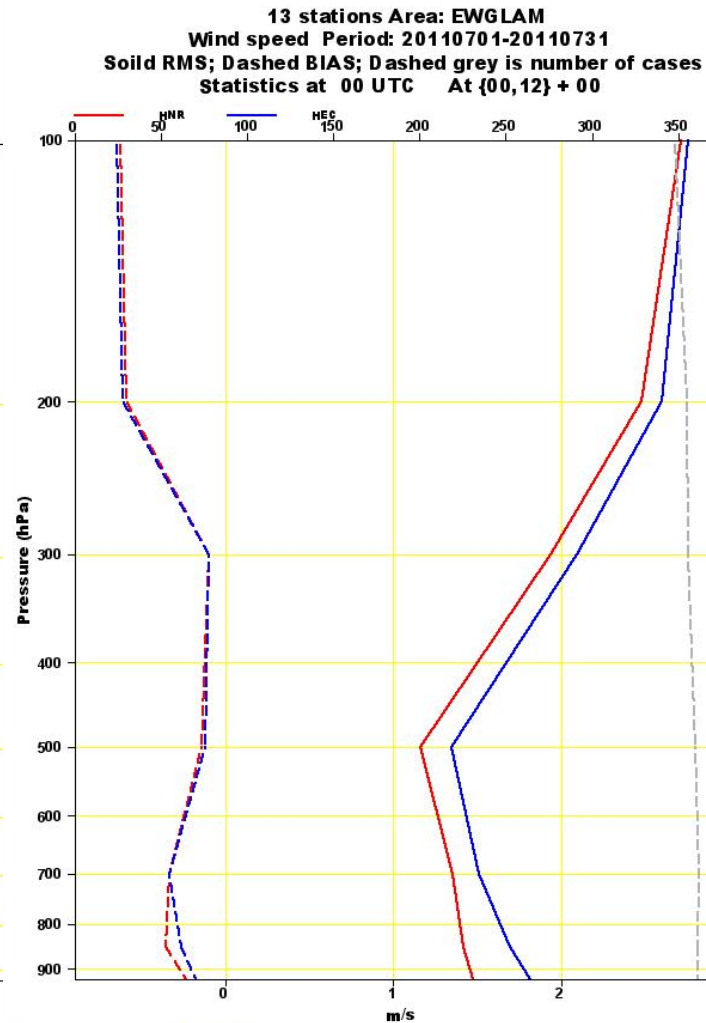
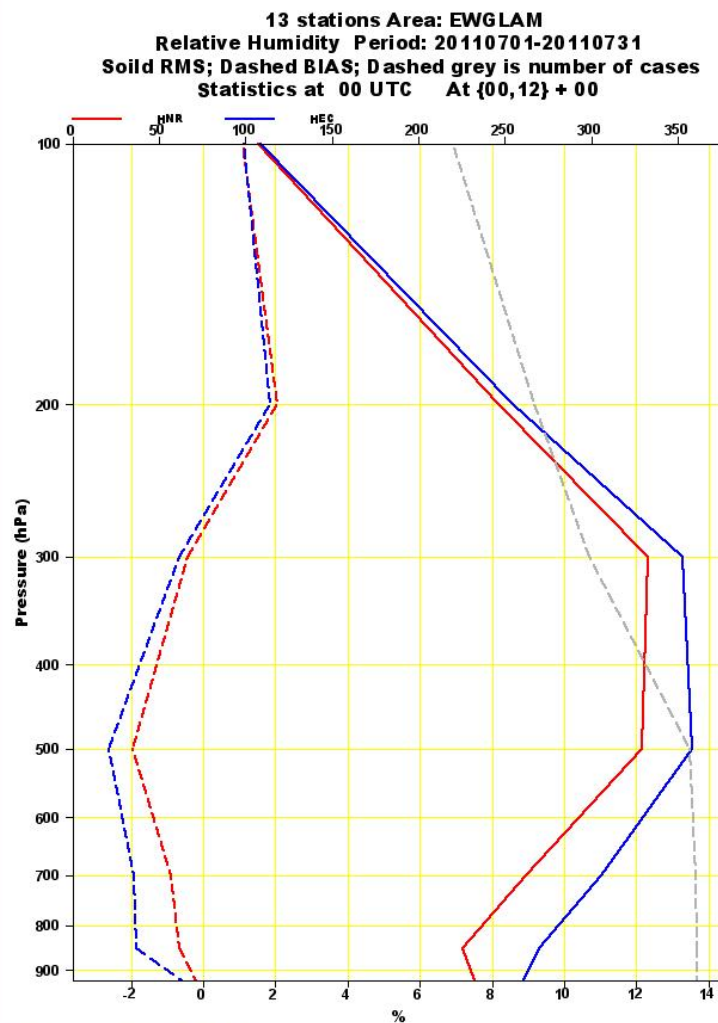


1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

4.- Experiment verification: HNR (control) vs HEC (GPS)

1 month : jul. 2011

IMPACT ON THE ANALYSIS



Inn=ob-fg

Impact on the
ANALYSIS:

- HEC an is more dry.
- Effect on RH and wind



1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

Parallel runs: SK3, HEC

GPS obs POST-PROCESSING:

Impact of ZTD GPS obs assimilation on the
FORECAST

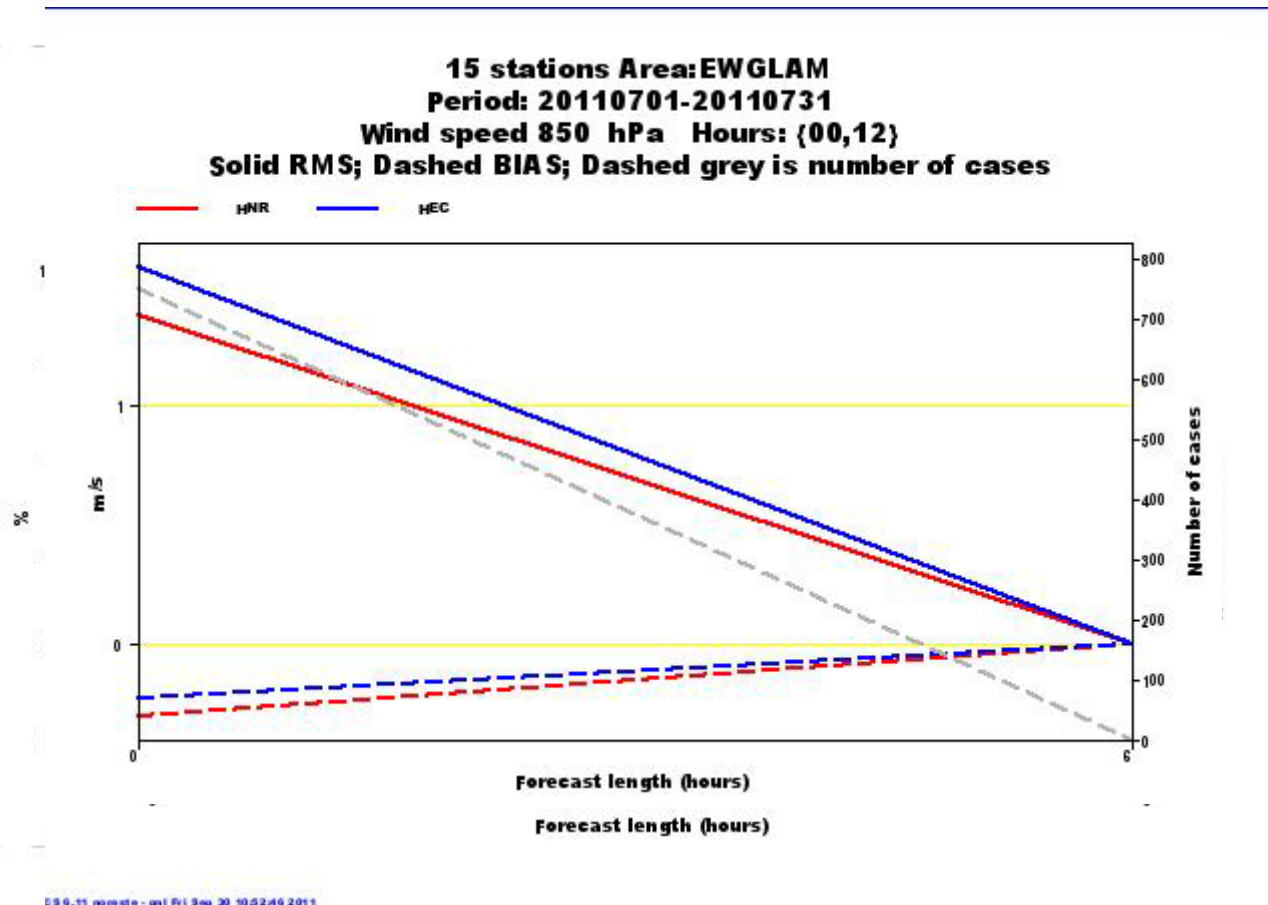
- 1.- Comparison between Histograms of innovations for TEMP obs.
- 2.- Experiments verification: HNR (no GPS) vs HEC (active GPS)

1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

3.- Experiment verification: HNR (control) vs HEC (GPS)

1 month : jul. 2011

IMPACT ON THE FORECAST : fc+06



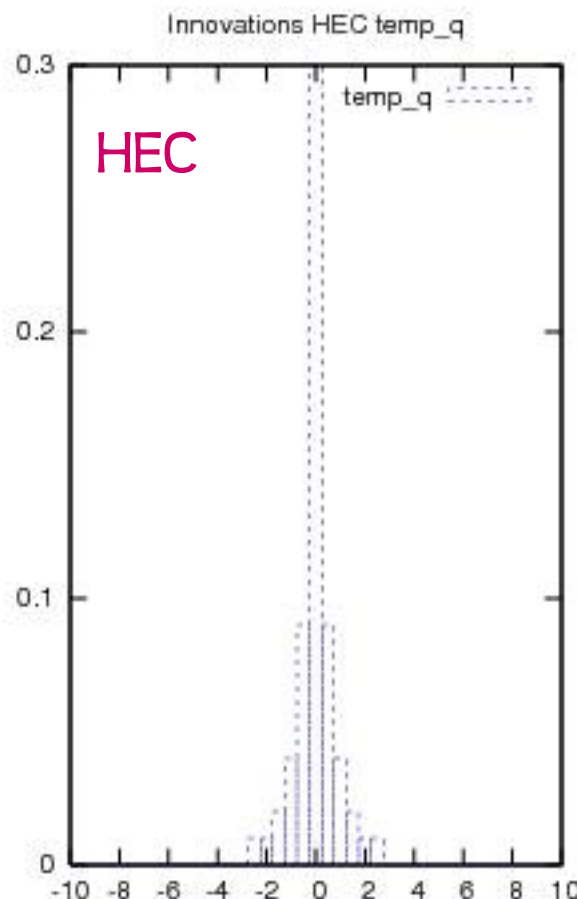
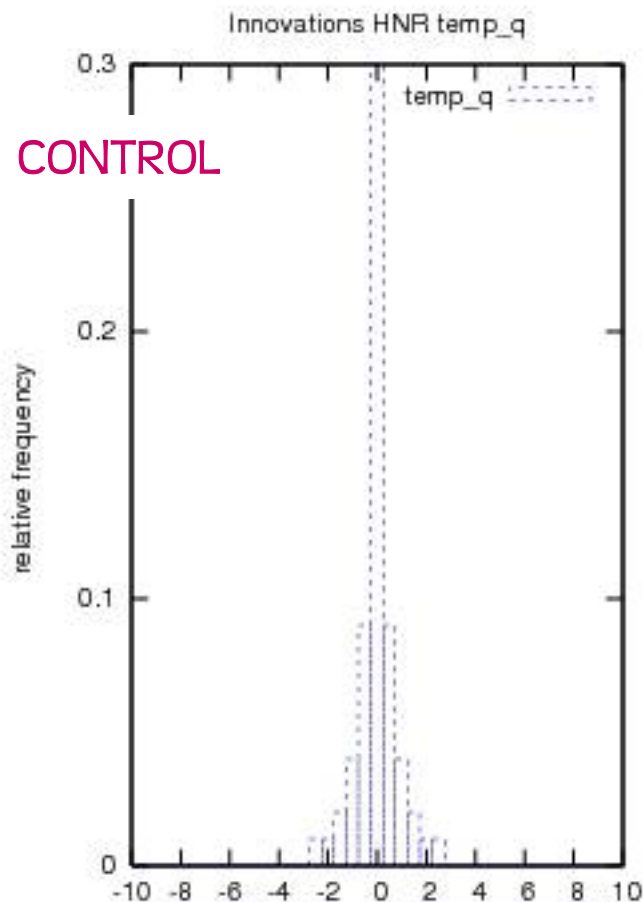
fc +06 differences:

The differences in RH Height and wind speed seen in the analysis, decrease after 6h...

1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

Comparison of Histograms : HNR (control) vs HEC (GPS)

Histograms of **TEMP q** obs INOVATIONS (ob-fg)



00, 12 UTC

July 2011

Inn=ob-fg

No differences
between CONTROL and
HEC TEMP-q
innovations:

HEC and HNR have
very similar fg

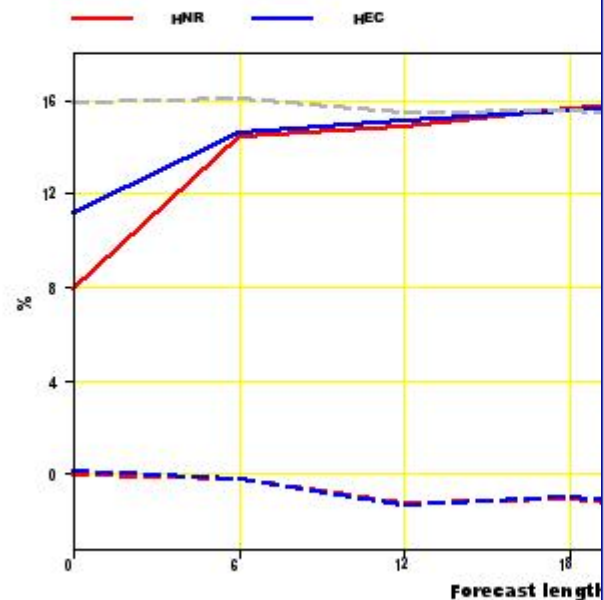
1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

3.- Experiment verification: HNR (control) vs HEC (GPS)

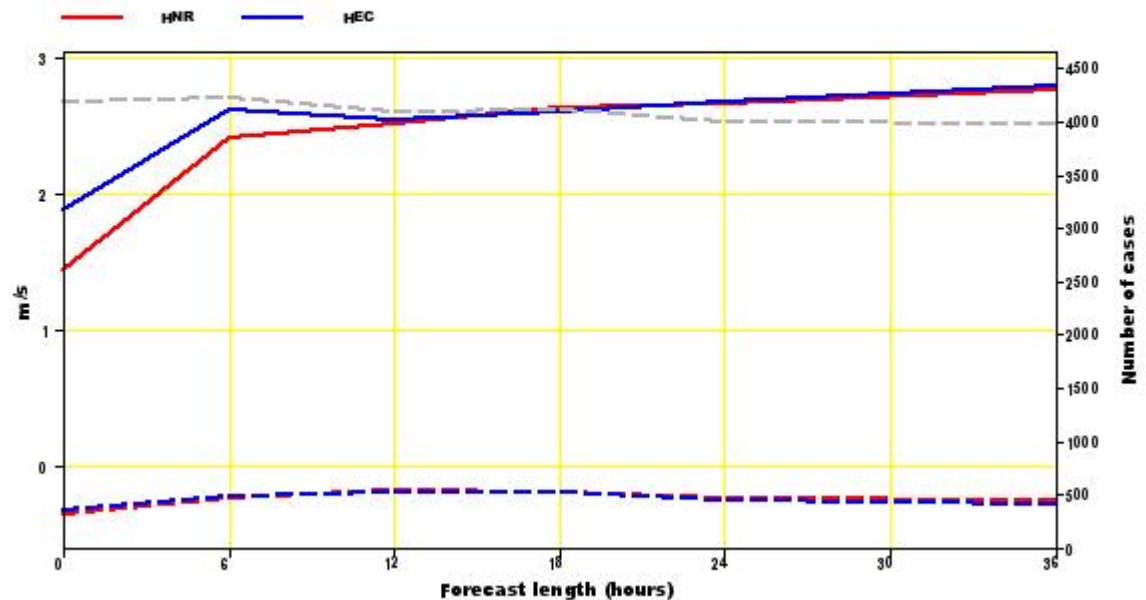
3 months : jul.-sep. 2011

IMPACT ON THE FORECAST : fc+36

34 stations Area:ALL
Period: 20110701-20110919
Relative Humidity 850 hPa Hours: {00,06,12,18}
Solid RMS; Dashed BIAS; Dashed grey is number of cases



34 stations Area:ALL
Period: 20110701-20110919
Wind speed 850 hPa Hours: {00,06,12,18}
Solid RMS; Dashed BIAS; Dashed grey is number of cases

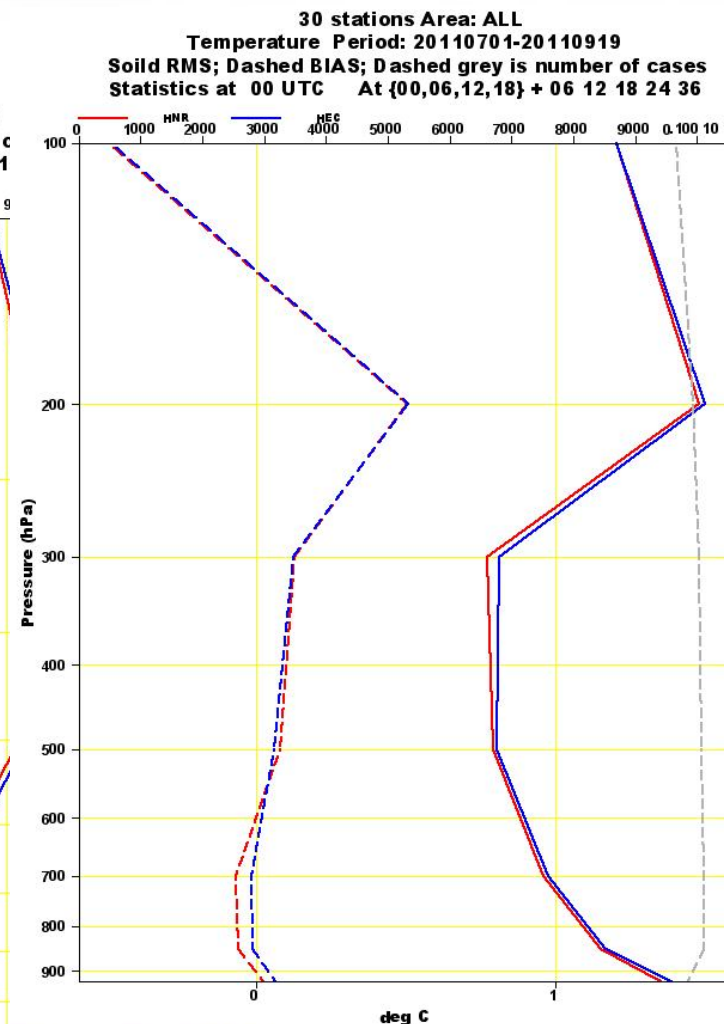
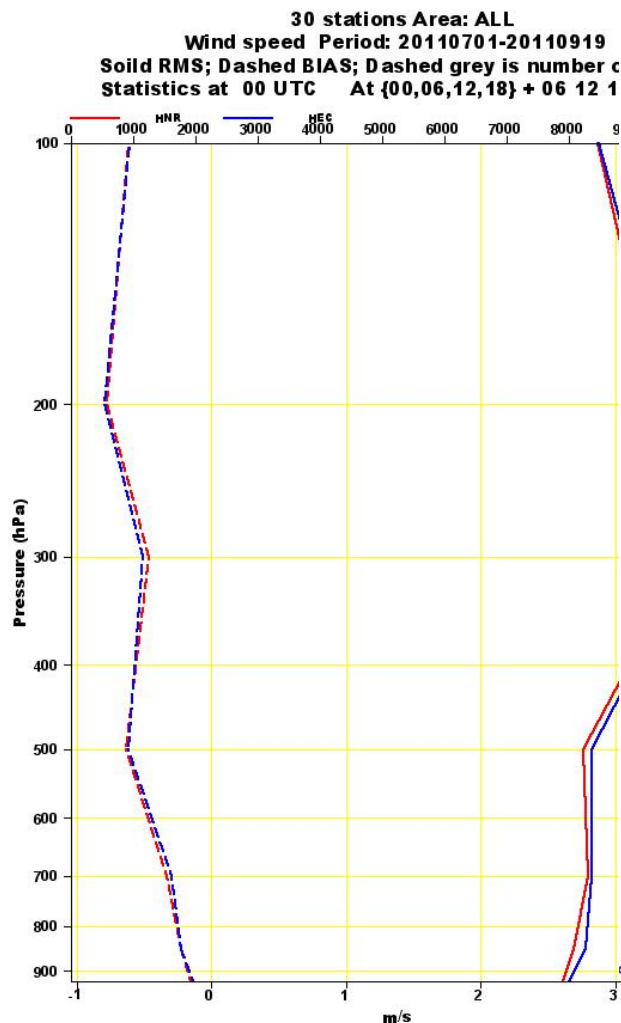
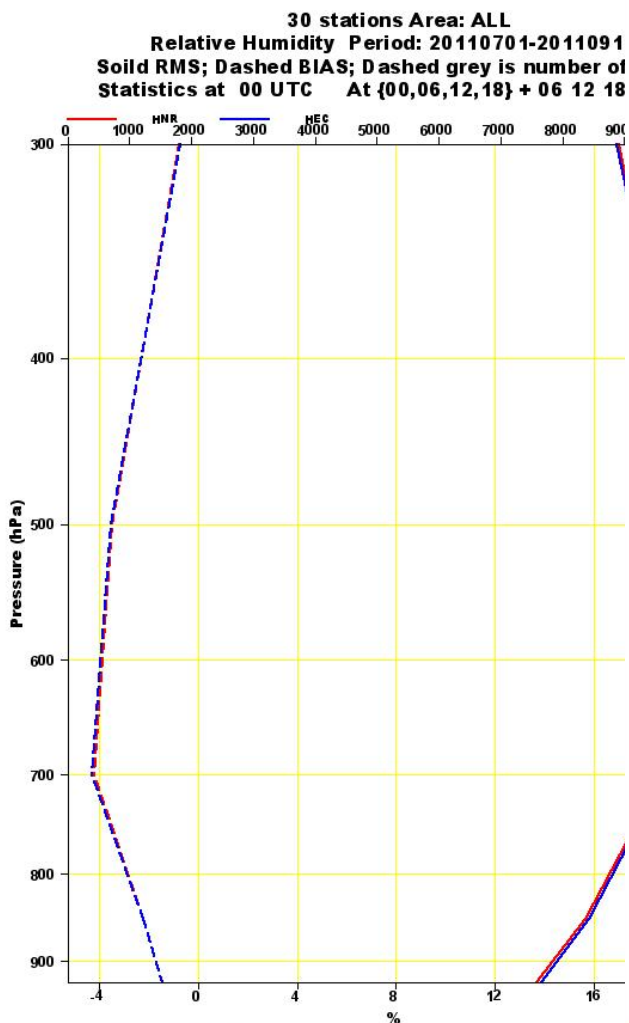


1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

3.- Experiment verification: HNR (control) vs HEC (GPS)

3 months : jul.-sep. 2011

IMPACT ON THE FORECAST : fc+36





1) Assimilation of GPS ZTD observations in HIRLAM at AEMET.

Assimilation of ZTD GPS obs in AEMET-Hirlam 7.2
for July 2011 period has:

*Impact on the analysis:

ZTD GPS obs make the FG to be more dry.

This affect not only the RH but also the wind.

*Impact on the forecast:

- After 6 h the Blending makes the ZTD GPS obs impact minimum.
- For longer forecast lengths the boundaries taken from ECMWF could also start to affect this impact.



2) Status of assimilation of GPS ZTD. observations in HARMONIE.

First trials.



PAS33/LL33

HARMONIE 36h1.3 nh

Period of study:

15 jan - 15 feb 2010

Resolution

2.5 km, 60 v.l.

Physics:

AROME

Initial state

Upper levels/Surface

3DVar (6h) (NOT BLENDING with ECMWF an!!) :

Conventional obs +GPS

GPS ZTD have been assimilated with:

- + 6h ass cycle and redundancy check.
- + No bias reduction scheme.
- + Obserror sd for ZTD set to 10 mm

SURFEX+ CANARI_OI_MAIN

Boundaries:

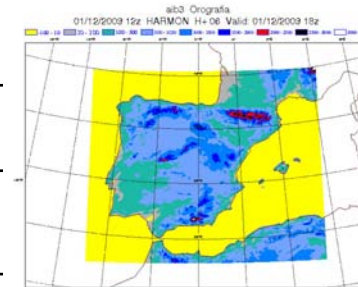
ECMWF T1279

ECMWF 3 hr frequency

Forecast lenght:

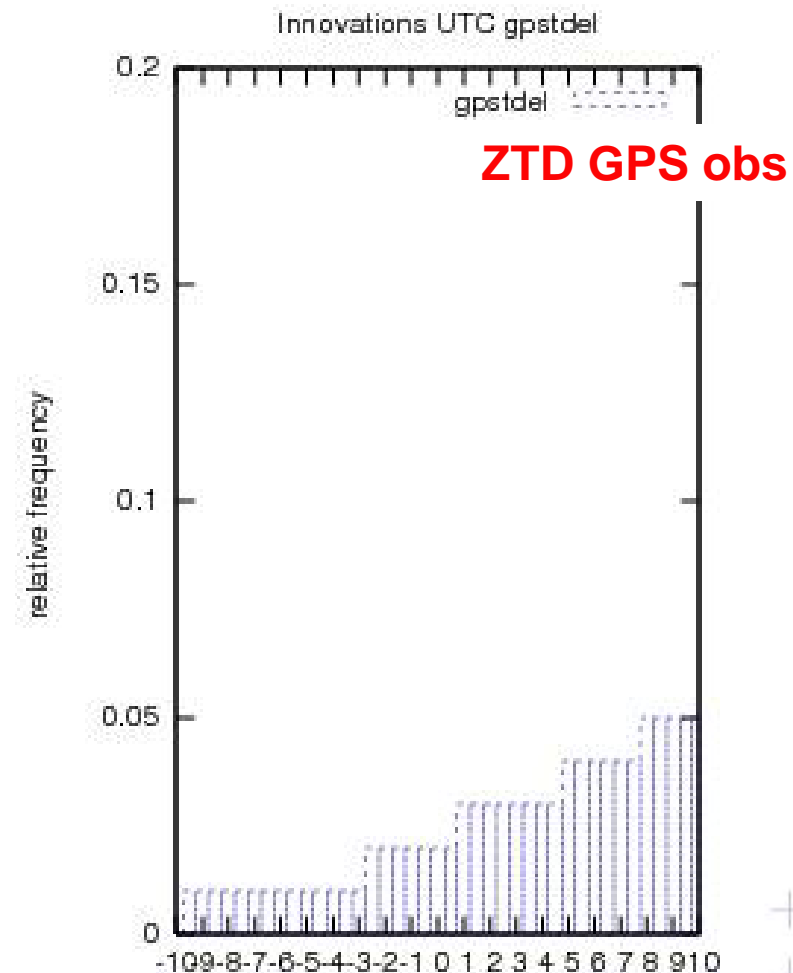
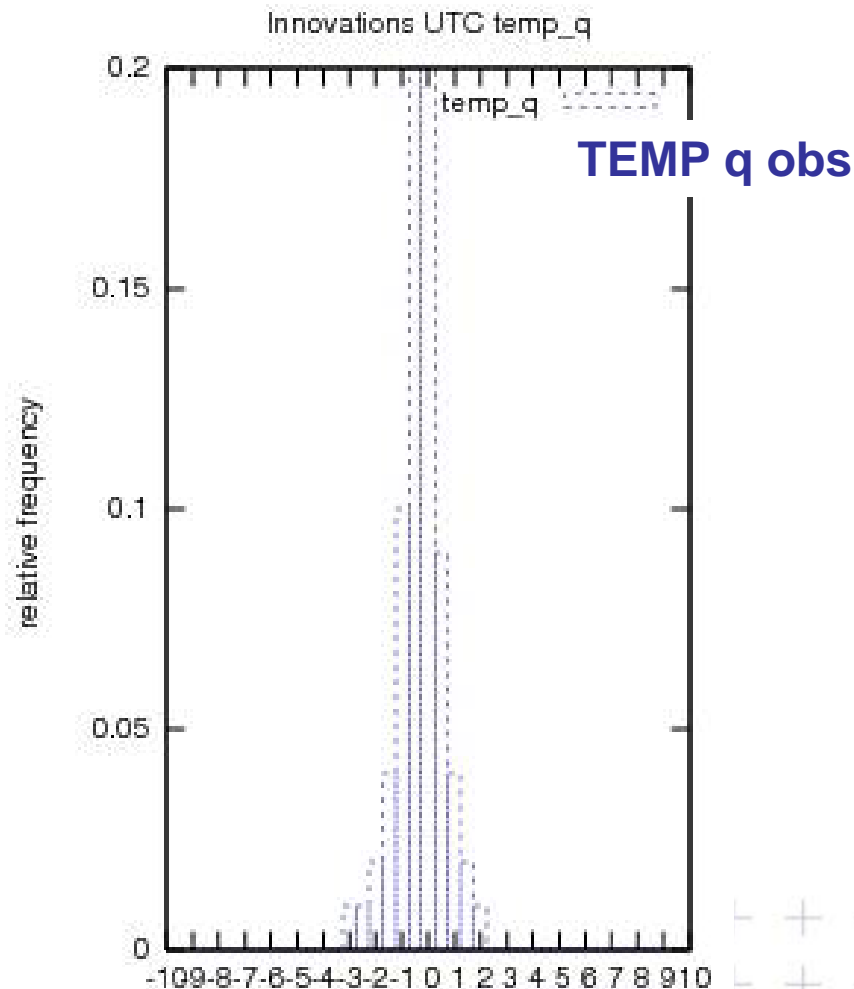
H+42 -> 00 y 12 UTC

H+06 -> 06 y 18 UTC



1) Assimilation of GPS ZTD observations in HARMONIE

Histogram of TEMP q and ZTD GPS Innovations (ob-fg) 15 jan-15 feb 2010





1) Assimilation of GPS ZTD observations in HARMONIE

BIAS of ZTD GPS obs.

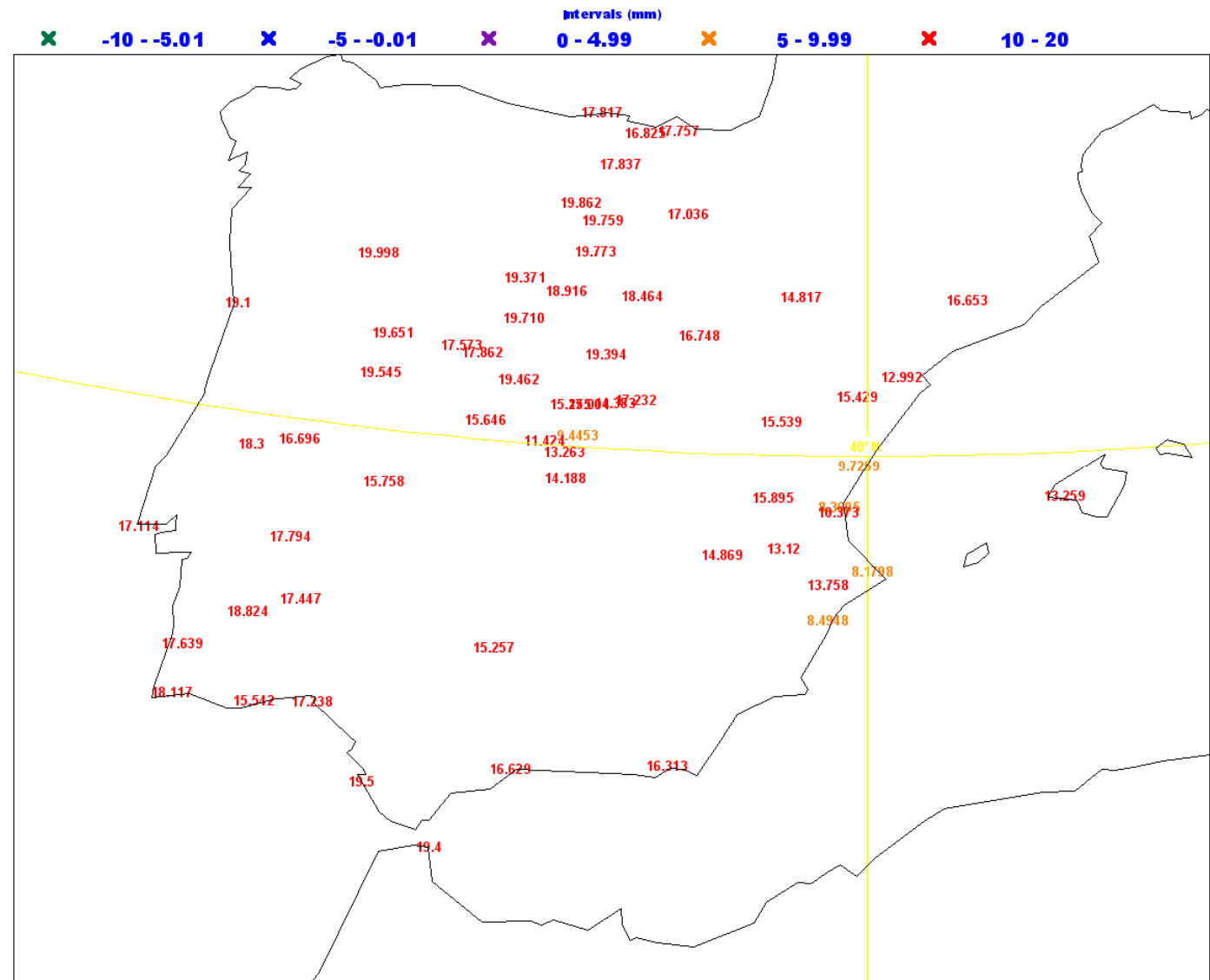
15 jan-15 feb 2010

BIAS of ZTD GPS obs for the
whole month...

*BIAS >0 for every
GPS place...

FG too dry (with
respect to the ZTD
obs)

ZTD Bias values 2010 01





1) Assimilation of GPS ZTD observations in HARMONIE

Experiments verification:

15 jan-15 feb 2010

IMPACT ON THE FORECAST : fc+24

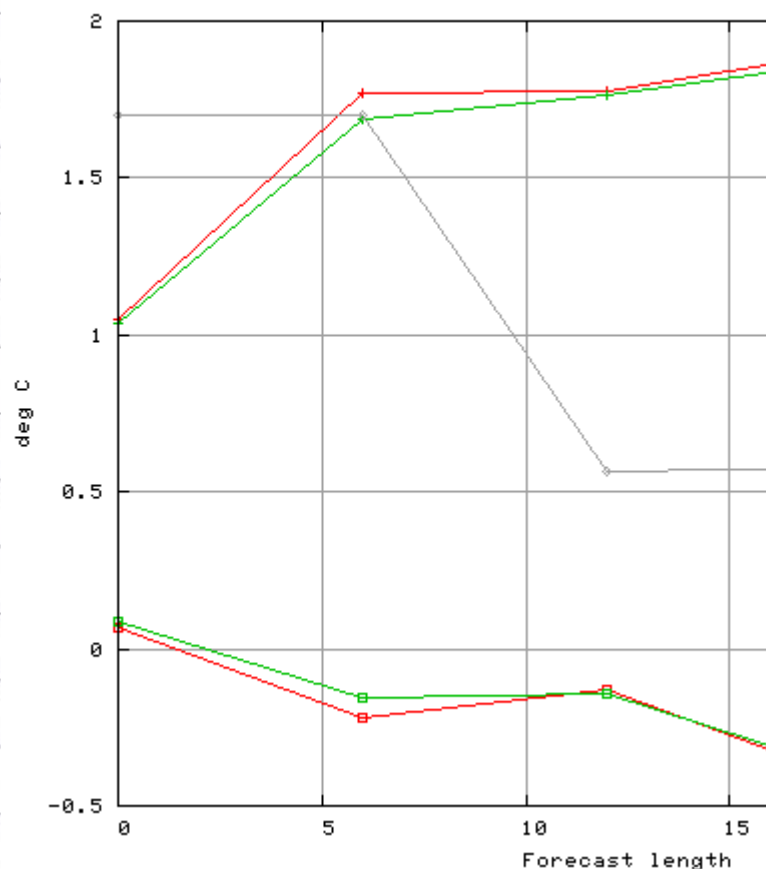
PAS33: pasive ZTD GPS assimilation (CONTROL)

LL33: active ZTD GPS assimilation (GPS)

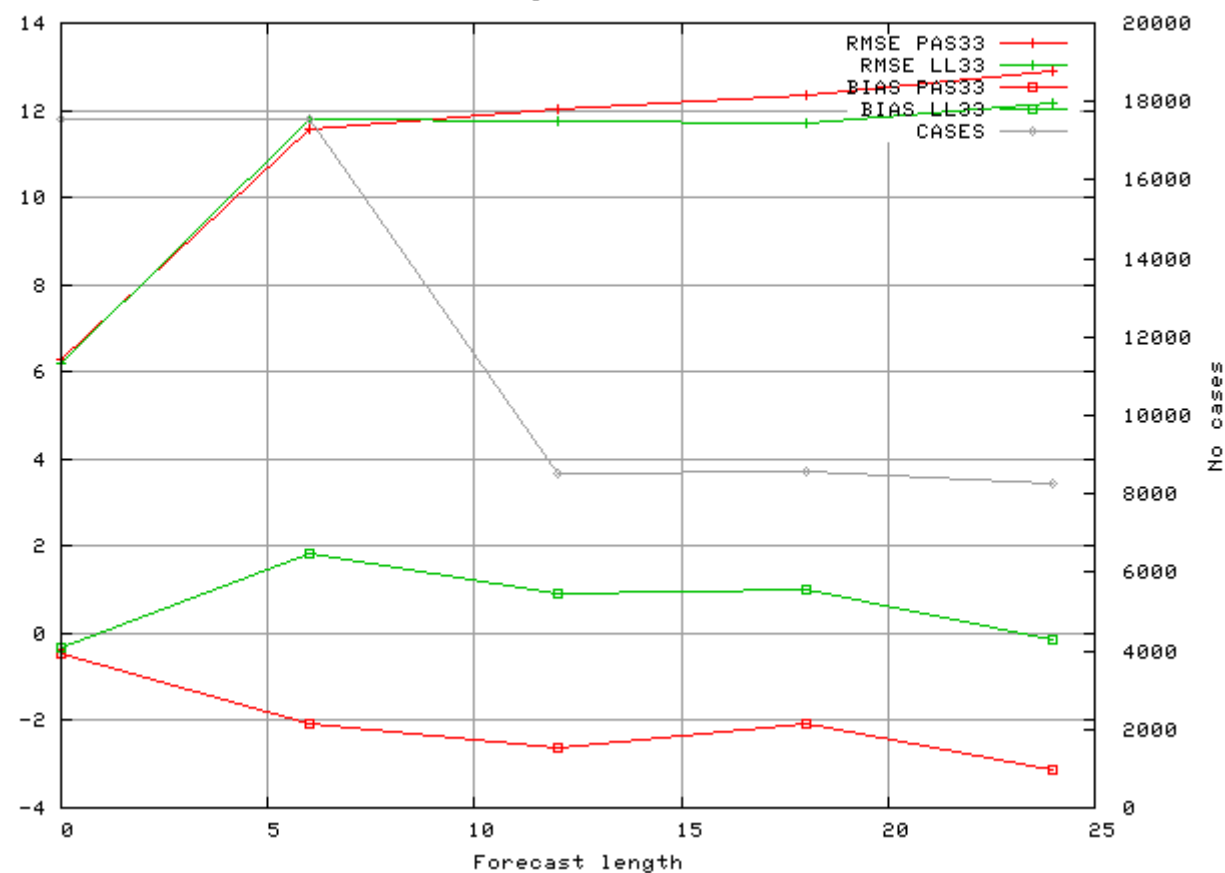
1) Assimilation of GPS ZTD observations in HARMONIE.

Surface (CONTROL)
(GPS)

Area: ALL using 156 stations
Period: 20100114-20100215
Temperature Hours: {00,06,12,18}



Area: ALL using 156 stations
Period: 20100114-20100215
Relative Humidity Hours: {00,06,12,18}





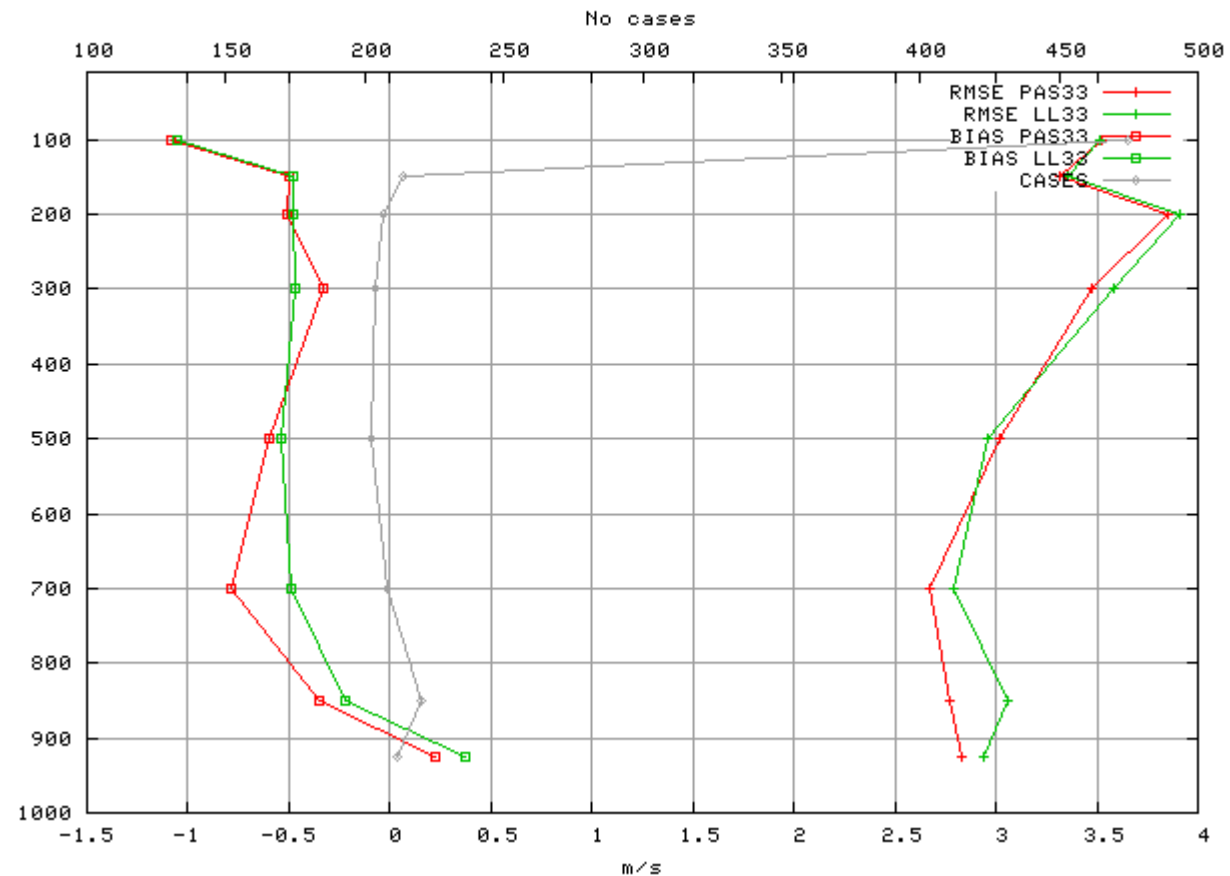
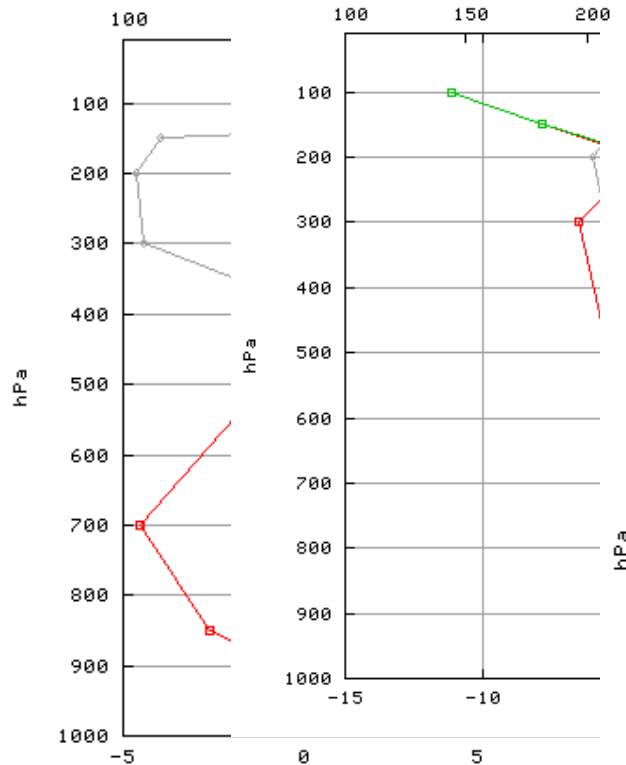
1) Assimilation of GPS ZTD observations in HARMONIE.

10 stations Area: ALL
Height Period: 20100114-20100215
Statistics at 00 UTC At (00,12) + 12 24

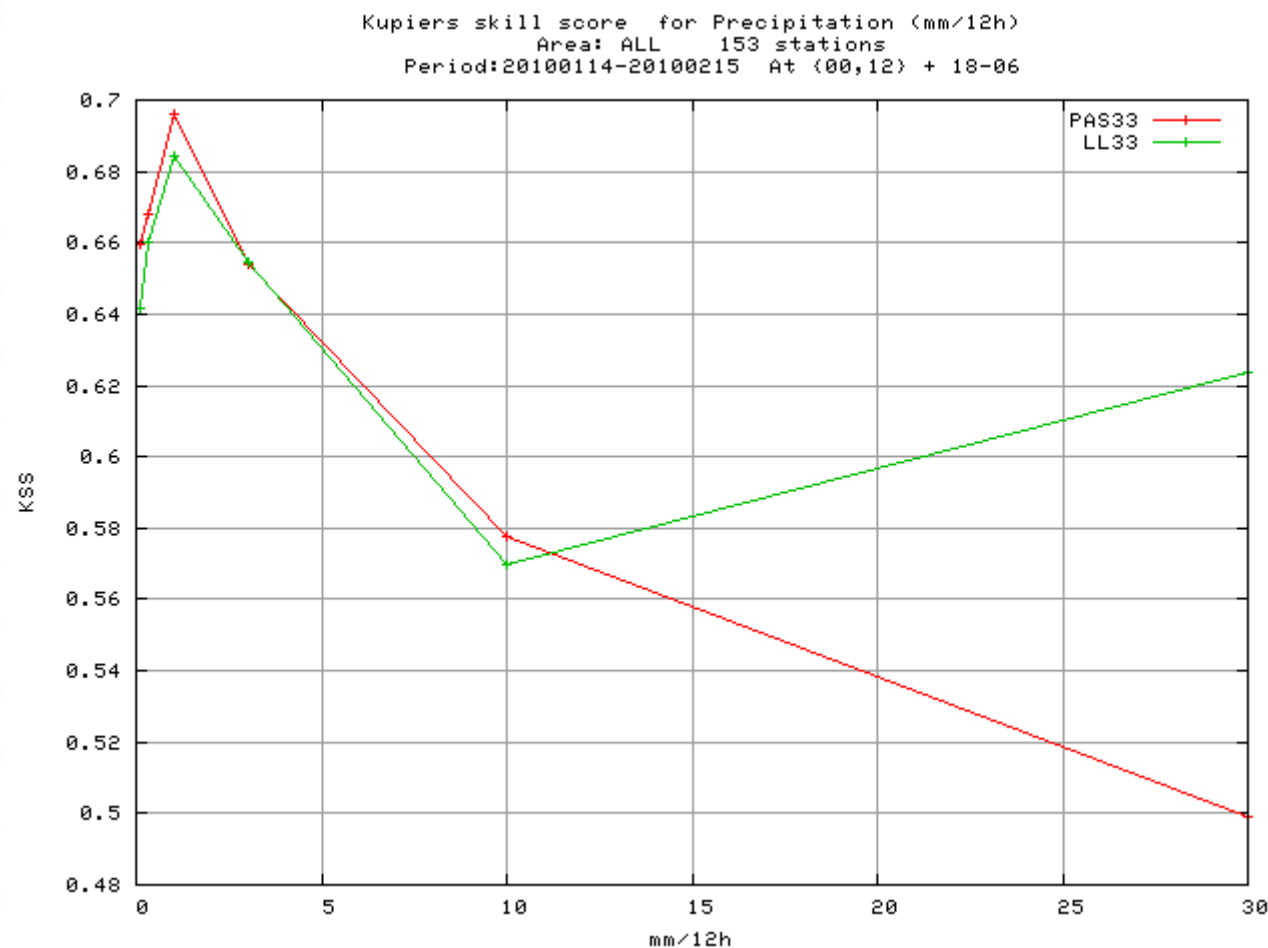
No cases

10 stations Area: ALL
Wind speed Period: 20100114-20100215
Statistics at 00 UTC At (00,12) + 12 24

Upper-air:
(CONTROL)
(GPS)



1) Assimilation of GPS ZTD observations in HARMONIE.



KSS pcp:
(CONTROL)
(GPS)



1) Assimilation of GPS ZTD observations in HARMONIE

Experiments verification: *15 jan-15 feb 2010*

Fist trials of Assimilation of ZTD GPS obs in Harmonie 36h1.3
for *15 jan-15 feb 2010* period show:

- *Positive impact on surface T and RH
- *Negative impact on upper-air variables.
- *Not clear positive impact on Precipitation forecast.



3) Conclusions and future work.



Conclusions and future work.

HIRLAM AEMET

Assimilation of ZTD GPS obs in AEMet-Hirlam 7.2 for July 2011 period has:

*Impact on the analysis, not only the RH but also the wind.

*Impact on the forecast: Effect of Blending after 6h.
Effect of bd for longer fc.

- 1) Next step: Bias correction scheme & Tuning
- 2) RUC cycles experiments.
- 3) Pairs PC_st innovation studies?



Conclusions and future work.

Harmonie

Fist trials of Assimilation of ZTD GPS obs in Harmonie 36h1.3 for *15 jan-15 feb 2010* period show:

- *Positive impact on surface T and RH
- *Negative impact on upper-air variables.
- *Not clear positive impact on Precipitation forecast.

Harmonie DA plans for 2012:

- Next step: Variational Bias correction scheme
- 2) More impact studies... & Tuning
 - + Choose the same period than for Hirlam parallel run: understand the BIAS



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Agencia Estatal de Meteorología

Thank you!

ASSIMILATION of European GPS ZTD observations
AEMET 2011

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