

ASSIMILATION of european **GNSS** observations **AEMET 2014**

Jana Sánchez Arriola

NWP Dep. AEMET

jsancheza @aemet.es



GOBIERNO
DE ESPAÑA

MINISTERIO
DE MEDIO AMBIENTE
Y MEDIO RURAL Y MARINO

AEMet
Agencia Estatal de Meteorología

Currently AEMET is involved..

- 1) Assimilation of GNSS observations in operational **HIRLAM** model at AEMET.
- 2) Assimilation of GNSS observations in **HARMONIE** high resolution model.
- 3) Contributing to **HyMEX Project** with the assimilation of GNSS observations



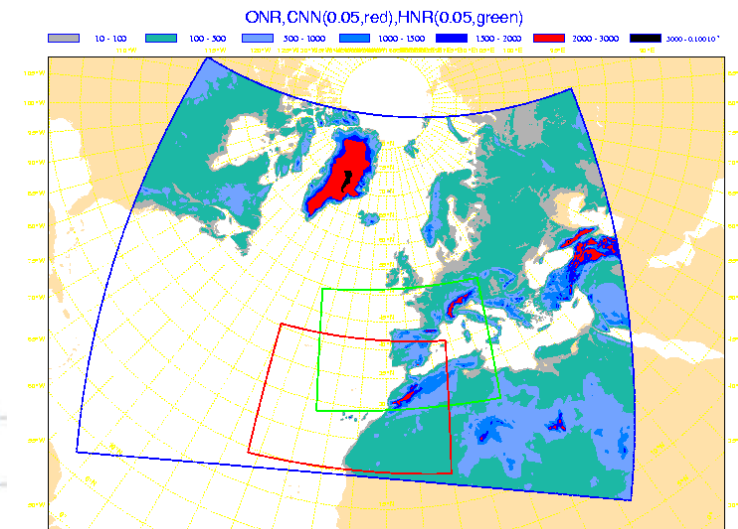
GOBIERNO
DE ESPAÑA

MINISTERIO
DE MEDIO AMBIENTE
Y MEDIO RURAL Y MARINO

AEMet
Agencia Estatal de Meteorología

1) GNSS ZTD in HIRLAM model at AEMET.

- GNSS ZTD passive assimilation in AEMET HIRLAM parallel runs since 2012:
 - SK3 (0.16 resolution, **big blue area**)
 - SH3 (0.05 resolution, **green area**)
- Monthly statistics to study the quality of the observations and Analysis Centres.



1) GNSS ZTD in HIRLAM model at AEMET.

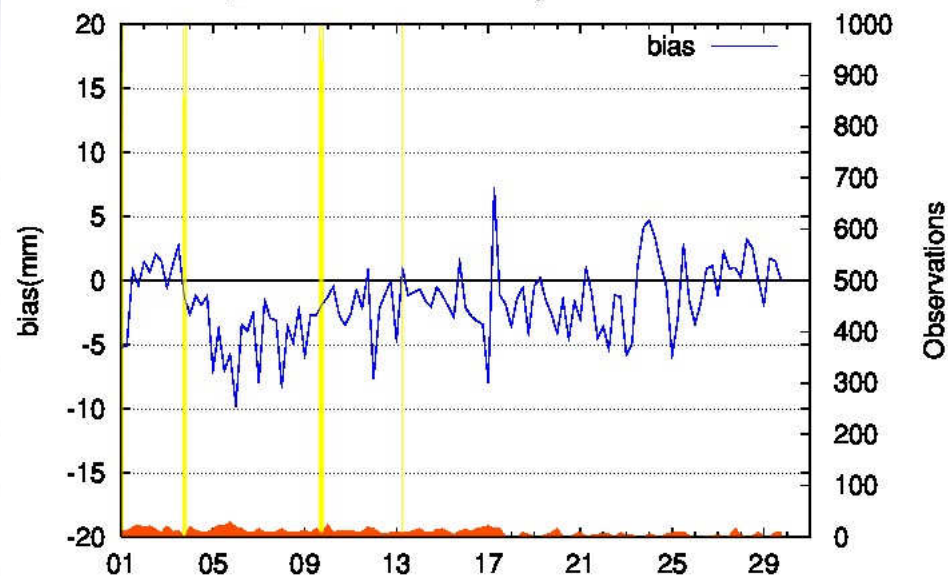


GOBIERNO
DE ESPAÑA

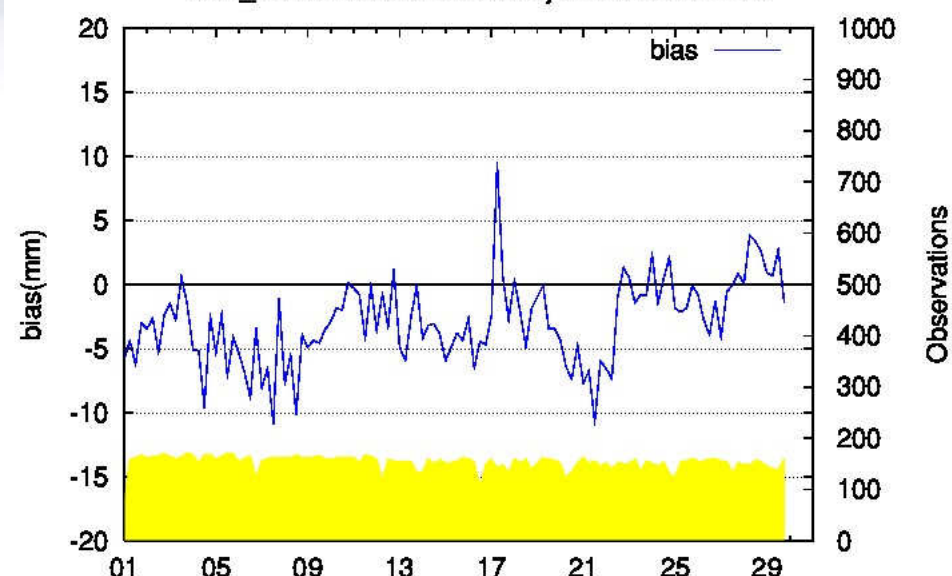
MINISTERIO
DE MEDIO AMBIENTE
Y MEDIO RURAL Y MARINO

AEMET
Agencia Estatal de Meteorología

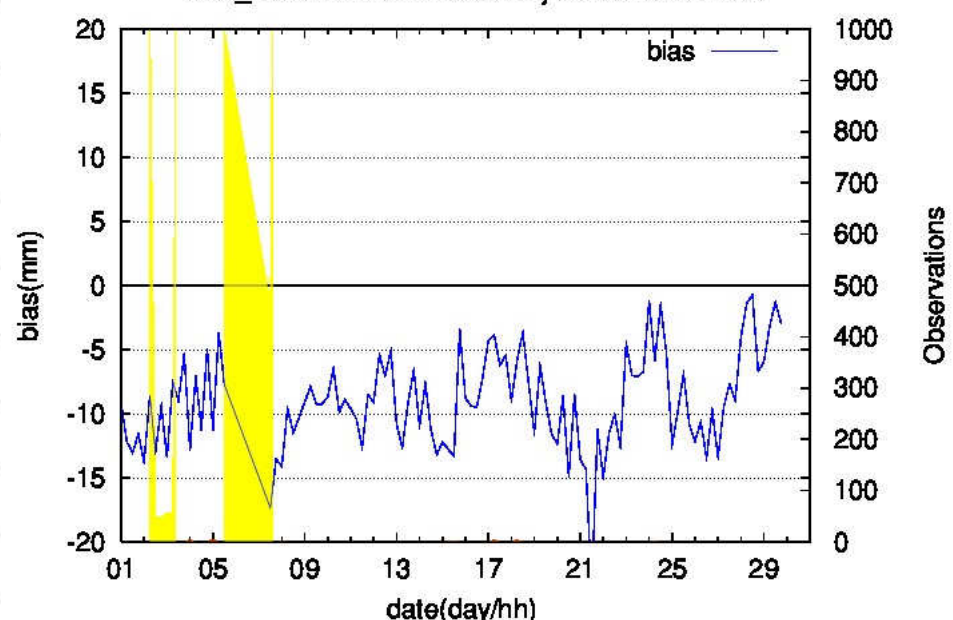
ASI_ Total bias and bias of rej ZTD obs 2014 09



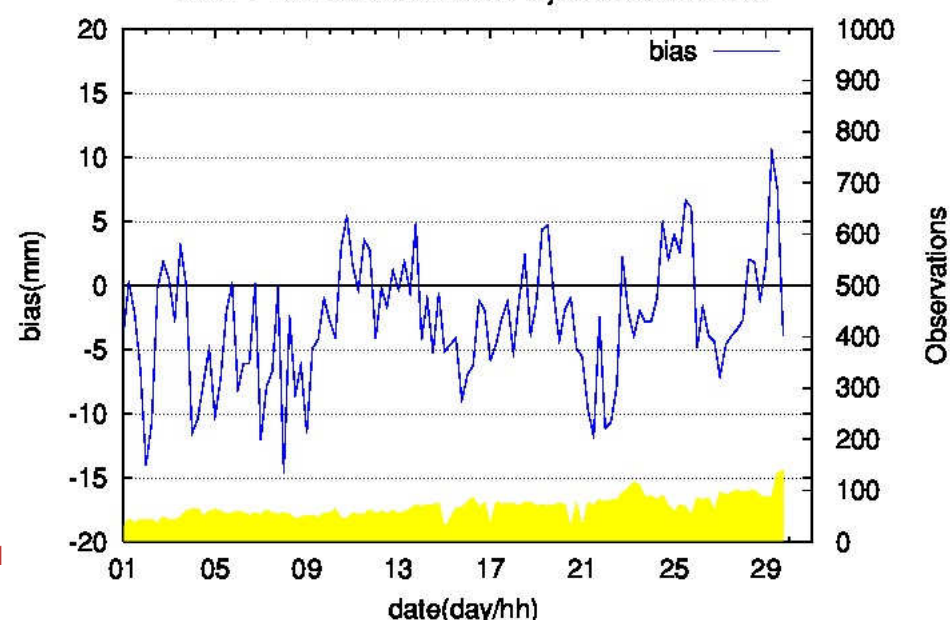
BKG_ Total bias and bias of rej ZTD obs 2014 09



GFZ_ Total bias and bias of rej ZTD obs 2014 09

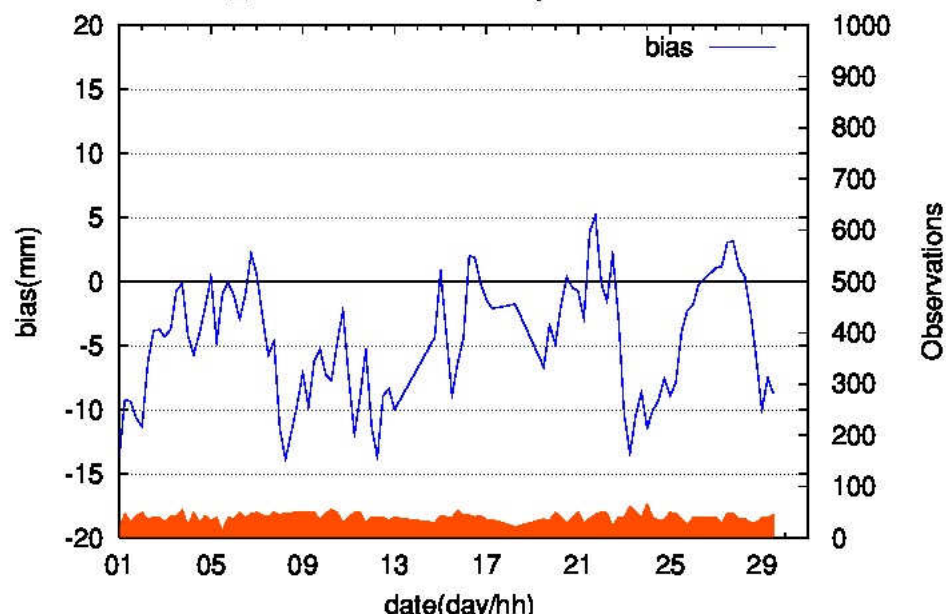


GOP1 Total bias and bias of rej ZTD obs 2014 09

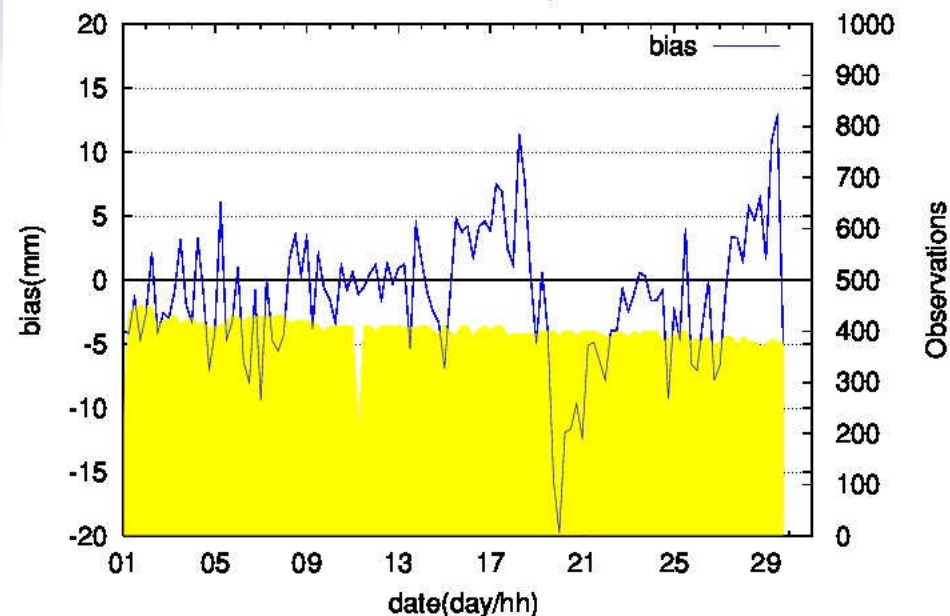


1) GNSS ZTD in HIRLAM model at AEMET.

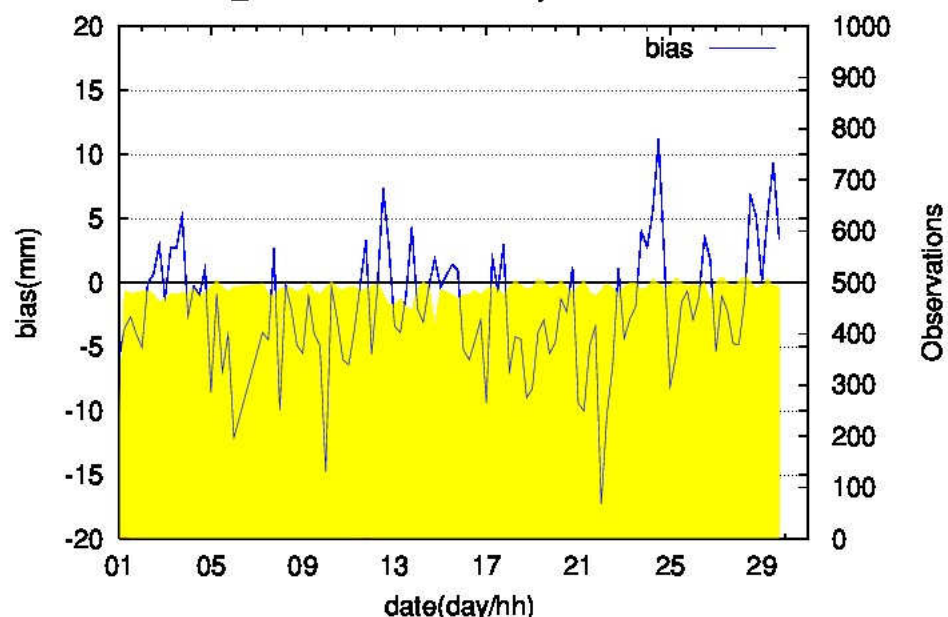
IGE_ Total bias and bias of rej ZTD obs 2014 09



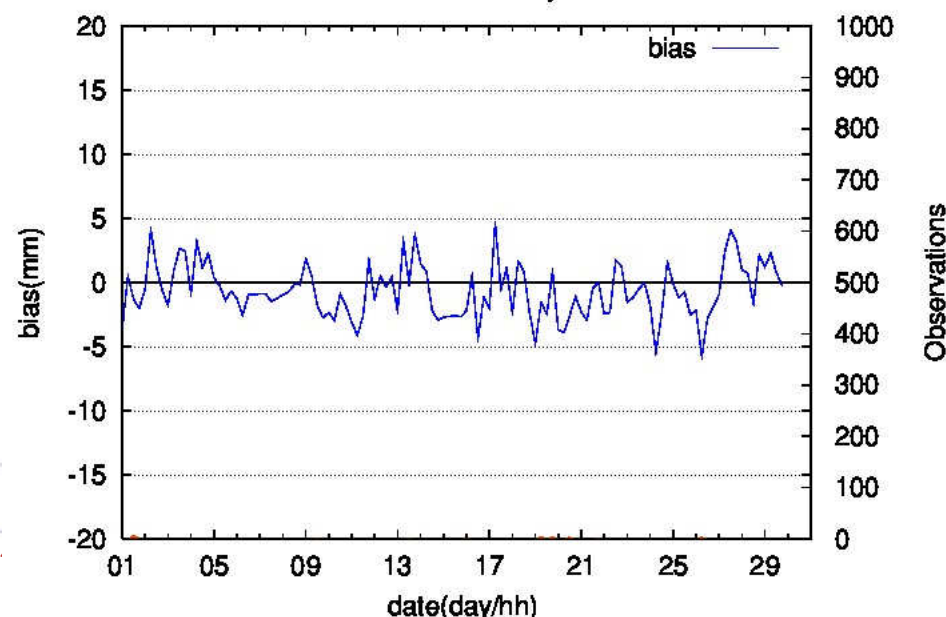
KNM3 Total bias and bias of rej ZTD obs 2014 09



LPT_ Total bias and bias of rej ZTD obs 2014 09



METO Total bias and bias of rej ZTD obs 2014 09



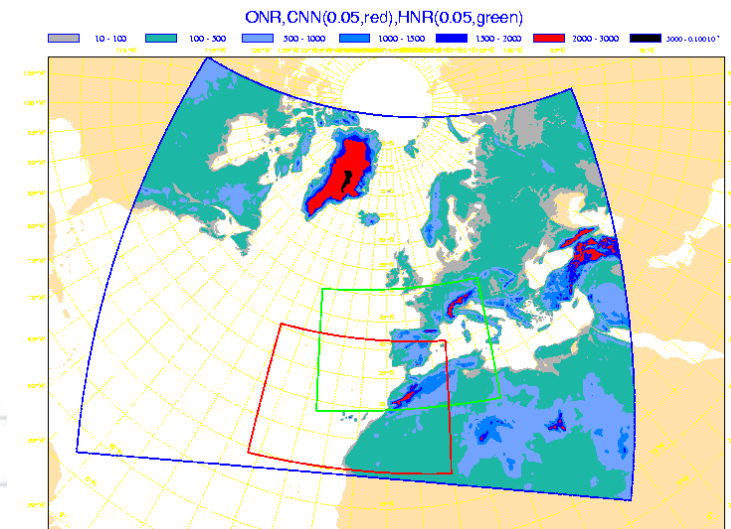
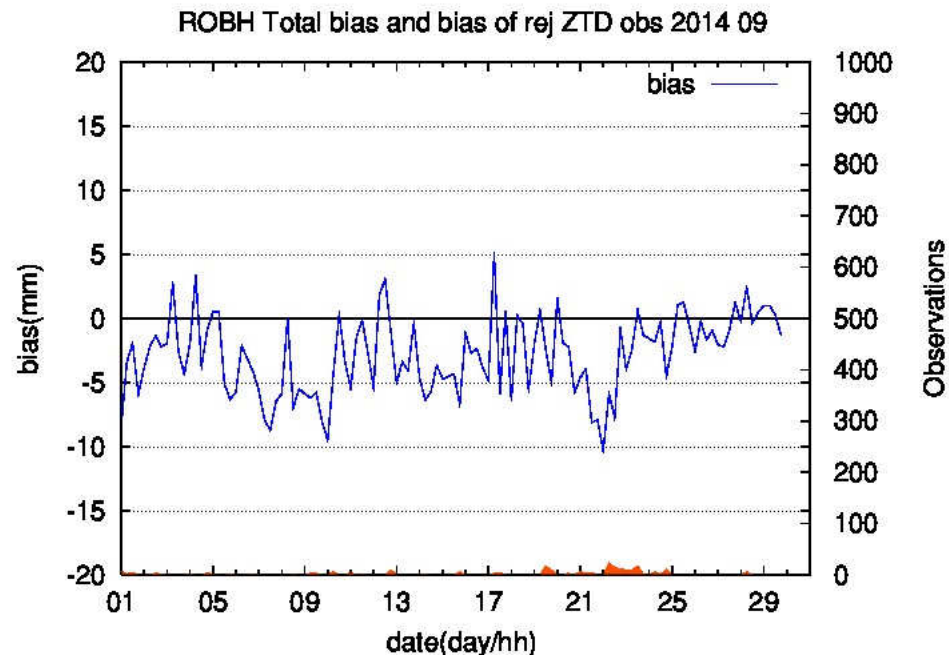


GOBIERNO
DE ESPAÑA

MINISTERIO
DE MEDIO AMBIENTE
Y MEDIO RURAL Y MARINO

Aemet
Agencia Estatal de Meteorología

1) GNSS ZTD in HIRLAM model at AEMET.





GOBIERNO
DE ESPAÑA

MINISTERIO
DE MEDIO AMBIENTE
Y MEDIO RURAL Y MARINO

AEMet
Agencia Estatal de Meteorología

Currently AEMET is involved..

2) Assimilation of GNSS observations in HARMONIE high resolution model.



GOBIERNO
DE ESPAÑA

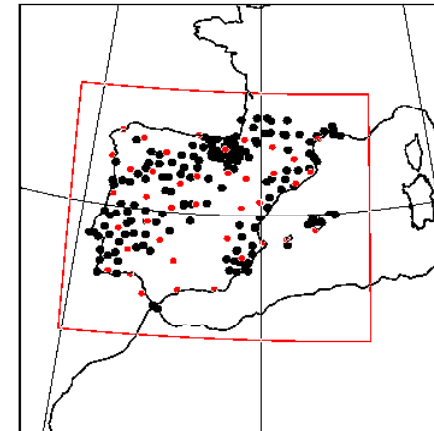
MINISTERIO
DE MEDIO AMBIENTE
Y MEDIO RURAL Y MARINO

AEMet
Agencia Estatal de Meteorología

2) GNSS ZTD in HARMONIE.

Status

- Improving of the code related to assimilation of gnzss ZTD observations in HARMONIE model.
- Impact studies (neutral to good impact!)
- Variational Bias correction development.
- Paper in progress





GOBIERNO
DE ESPAÑA

MINISTERIO
DE MEDIO AMBIENTE
Y MEDIO RURAL Y MARINO

AEMet
Agencia Estatal de Meteorología

2) GNSS ZTD in HARMONIE.

Assimilation of GNSS ZTD with HARMONIE

M. Lindskog (SMHI), J. Sánchez (AEMET), S. Thorsteinsson (IMO), J. Bojarova (Met.No)

SMHI

AEMet
Agencia Estatal de Meteorología

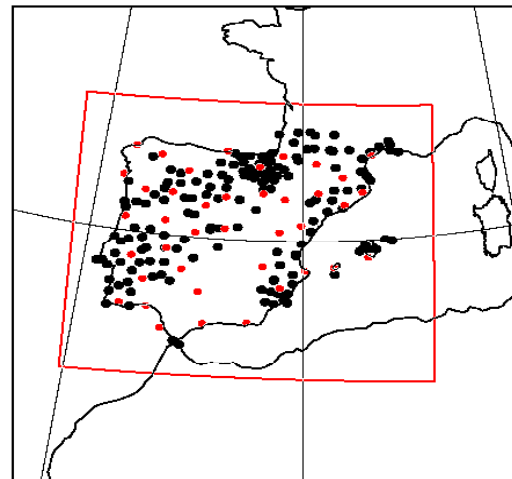
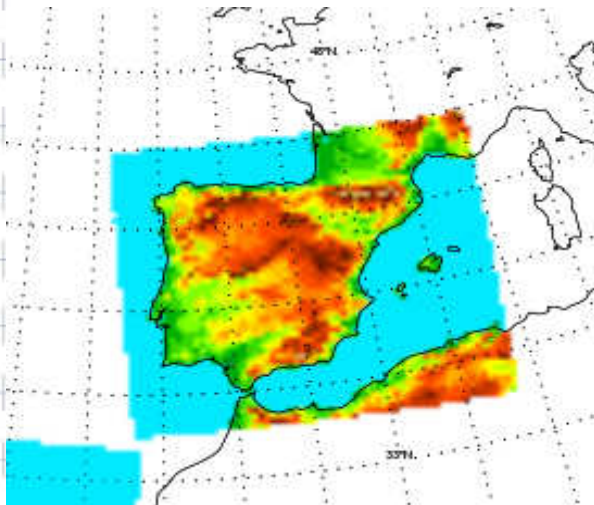
**Icelandic Met
Office**

**Norwegian
Meteorological
Institute**

Assimilation of GNSS ZTD with HARMONIE

Design of Parallel Experiment

- Cy38h1beta3, LSMIX=yes, 3DVar, with 3h cycle: conventional obs
- Period of study: 1-30 September 2012
- Domain: **IBERIA_2.5**, 2.5 km horizontal resolution and 65 vertical levels.



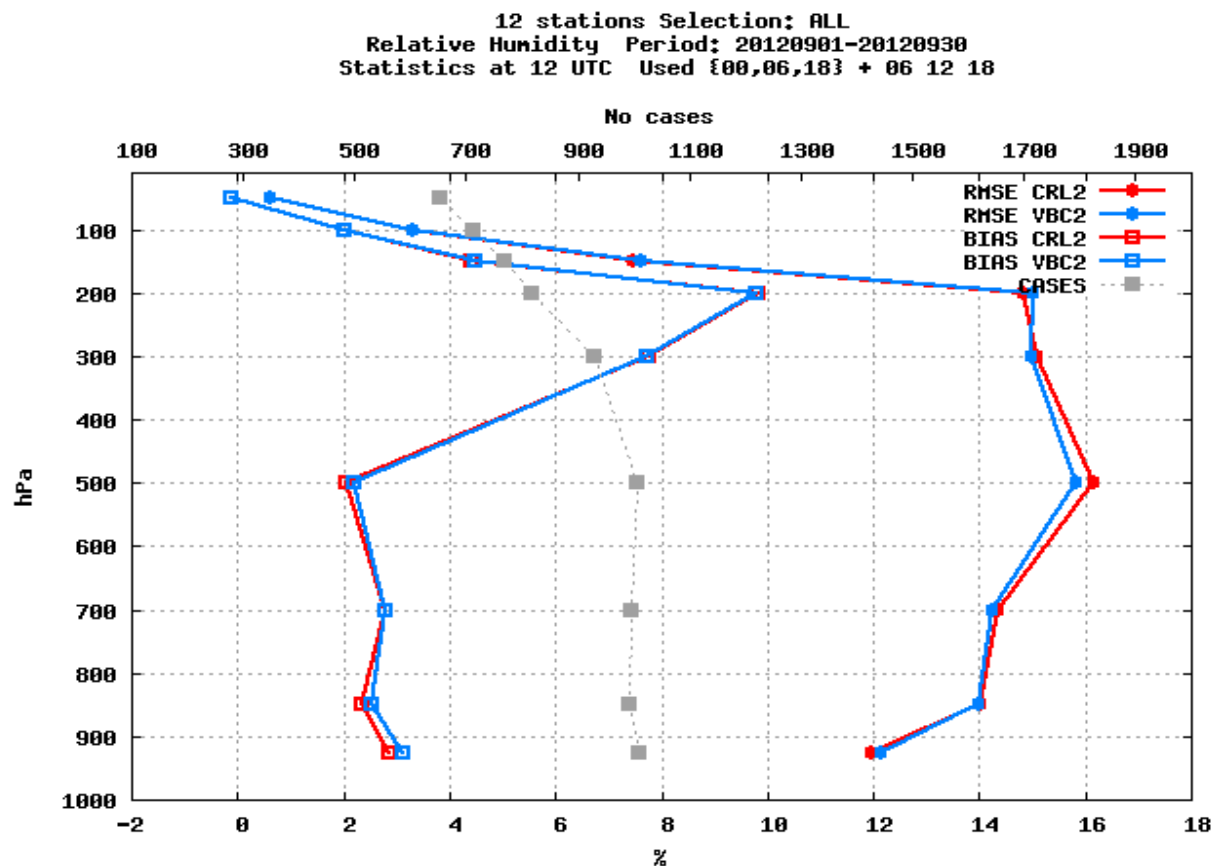
IBERIA_2.5
SEPTEMBER 2012

Model domain (red frame) and GNSS observations before (213 black dots) and after (46 red dots) thinning of data.

Assimilation of GNSS ZTD with HARMONIE

Verification scores against observations: Relative Humidity

BIAS and RMSE of +6,+12 and +18 h [Period: Sept 2012](#) [Valid Time: 12UTC](#)



Good impact, mainly on humidity, under 500hPa.

CRL2- Only conv. obs.
VBC2-Conv. obs. and GNSS obs.

Assimilation of GNSS ZTD with HARMONIE



GOBIERNO
DE ESPAÑA

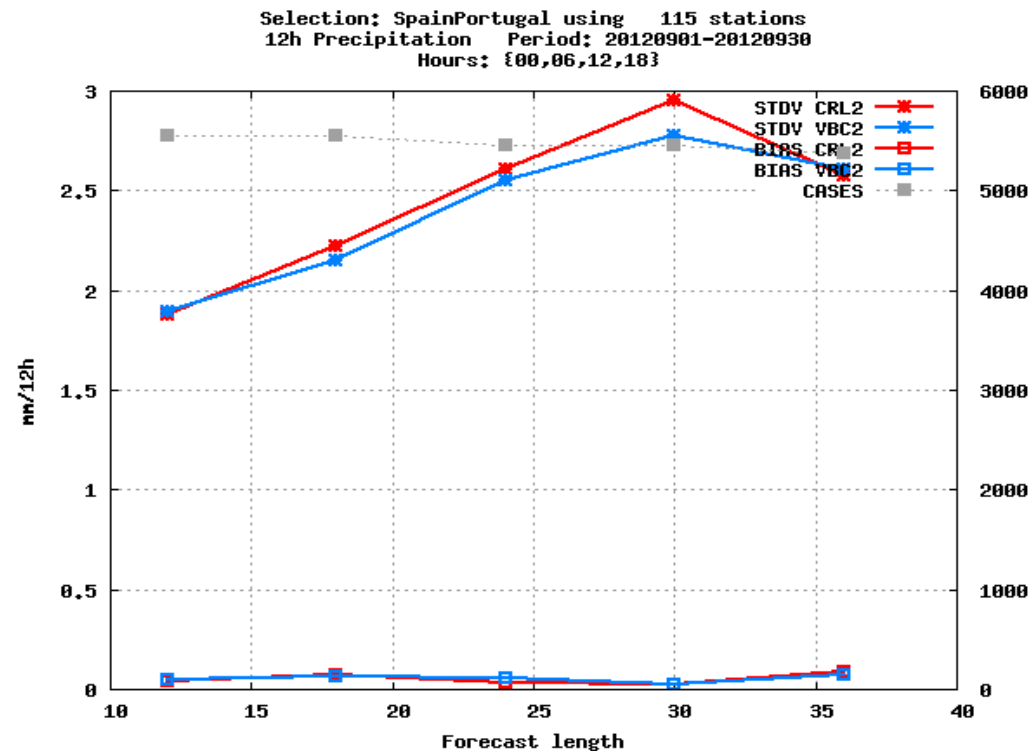
MINISTERIO
DE MEDIO AMBIENTE
Y MEDIO RURAL Y MARINO



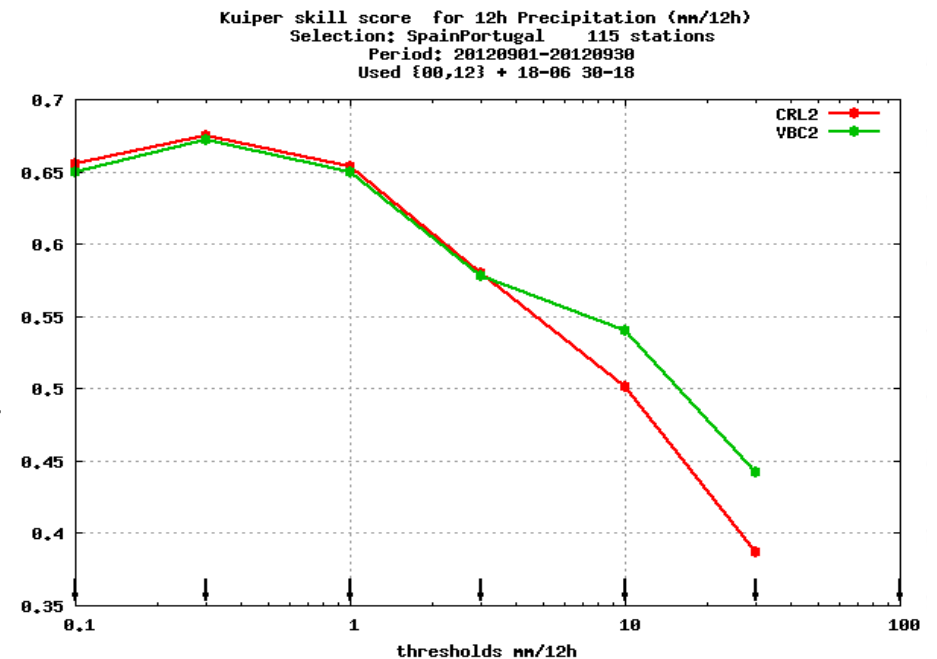
Verification scores against observations: 12h precipitation

Improvement of the forecast skill of 12h accum. precipitation when assimilating ZTD GNSS observations with VarBC scheme, mainly for high precipitation rates.

BIAS and RMSE of +6,+12 and +18 h



Kuiper Skill Score



Assimilation of GNSS ZTD with HARMONIE

Conclusions & Future work

- Encouraging results from parallel experiments assimilating ZTD GNSS observations with VarBC scheme have been found.
- Further evaluation and optimization planned, both over IBERIA and other domains.
- A scientific paper is being prepared.

2) GNSS ZTD in HARMONIE.

Assimilation of GNSS ZTD with HARMONIE over big IBERIA domain. First steps.

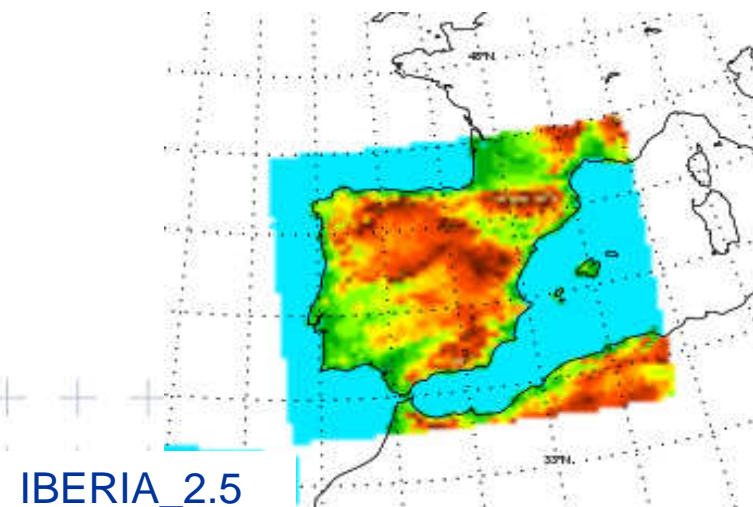
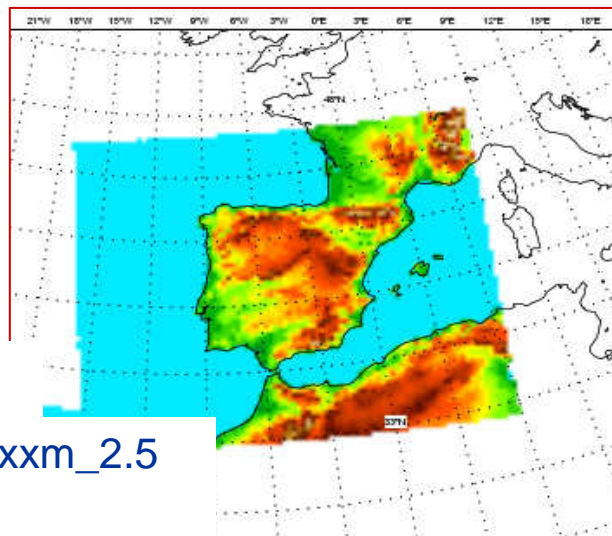
J. Sánchez (AEMET)



Assimilation of GNSS ZTD with HARMONIE over big IBERIA domain

Design of Parallel Experiment

- Cy38h11, LSMIX=NO, 3DVar, with 3h cycle: conventional obs.
- Period of study: 15-30 September 2012
- Domain: **IBERIAxm_2.5**, 2.5 km horizontal resolution and 65 vertical levels.
- NEW structure functions were calculated for this domain.





GOBIERNO
DE ESPAÑA

MINISTERIO
DE MEDIO AMBIENTE
Y MEDIO RURAL Y MARINO

Aemet
Agencia Estatal de Meteorología

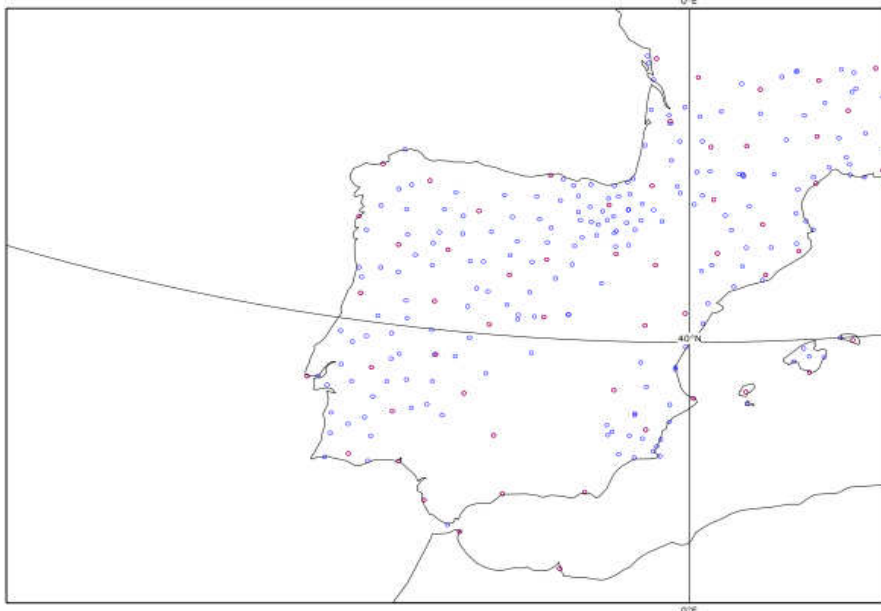
Assimilation of GNSS ZTD with HARMONIE over big IBERIA domain

Description of First Parallel Experiments

- iberiaB_pas**: control run assimilating conventional observations
- iberiaB_STA**: conventional + gnss with STATIC BC (white listed)
- iberiaB_STAthinn**: conventional + gnss with STATIC BC (white listed + thinned)

The GNSS run has been optimized with respect to bias correction (just static) , error statistics and thinning distances (80 km).

ZTD station locations IBERIAxxm_2.5 domain



IBERIAxxm_2.5
SEPTEMBER 2012

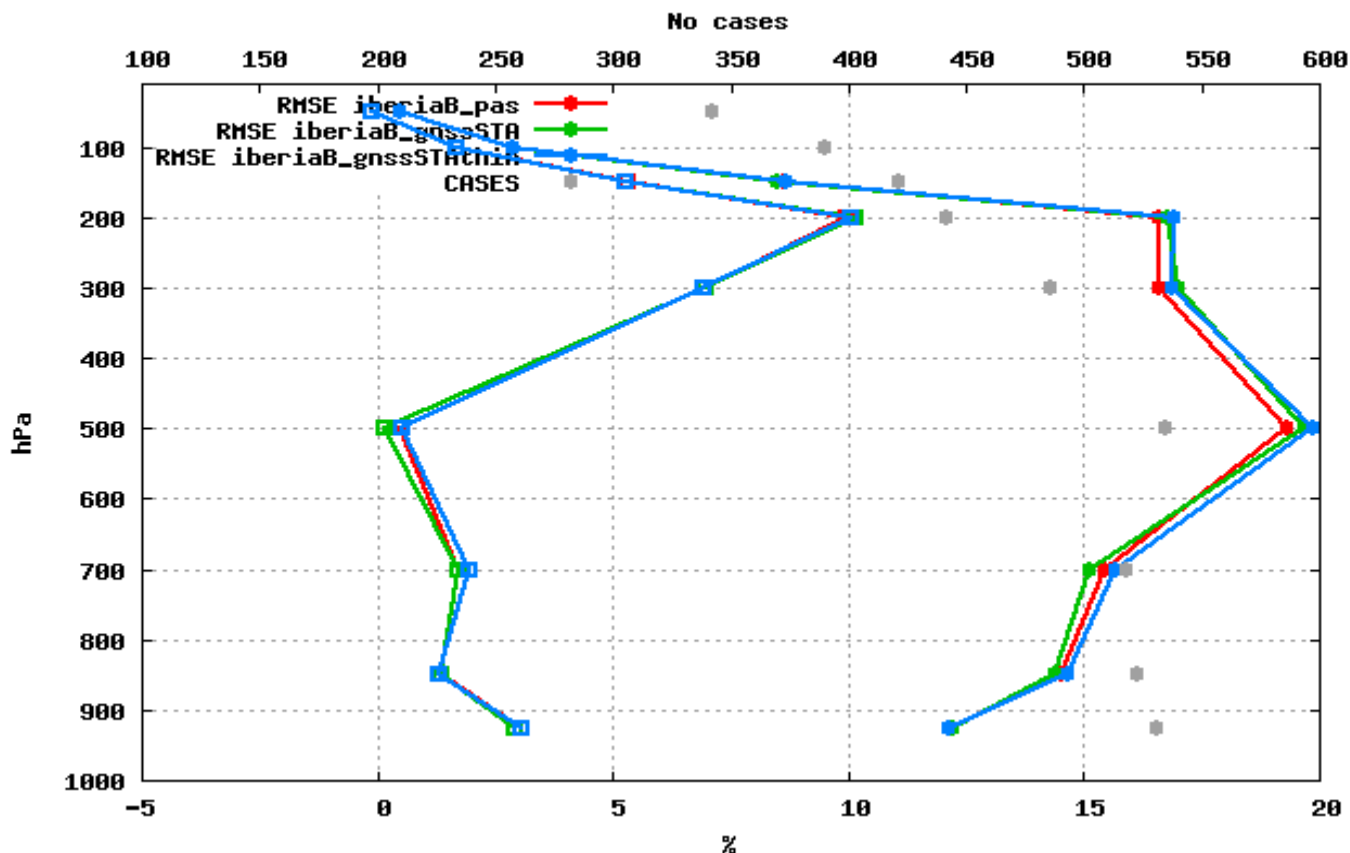
GNSS observations before (**266** blue dots)
and after (**58** red dots) thinning of data.

Assimilation of GNSS ZTD with HARMONIE over big IBERIA domain

Verification scores against observations: Relative Humidity

BIAS and RMSE ALL Period: 15-30Sept 2012 Valid Time: 12UTC

13 stations Selection: ALL
Relative Humidity Period: 20120915-20120930
Statistics at 12 UTC Used {00,12} + 12 24 36



- Good impact of gnss assimilation, mainly on humidity, around 700hPa.

- Better STA than STAthinn (more gnss sites)

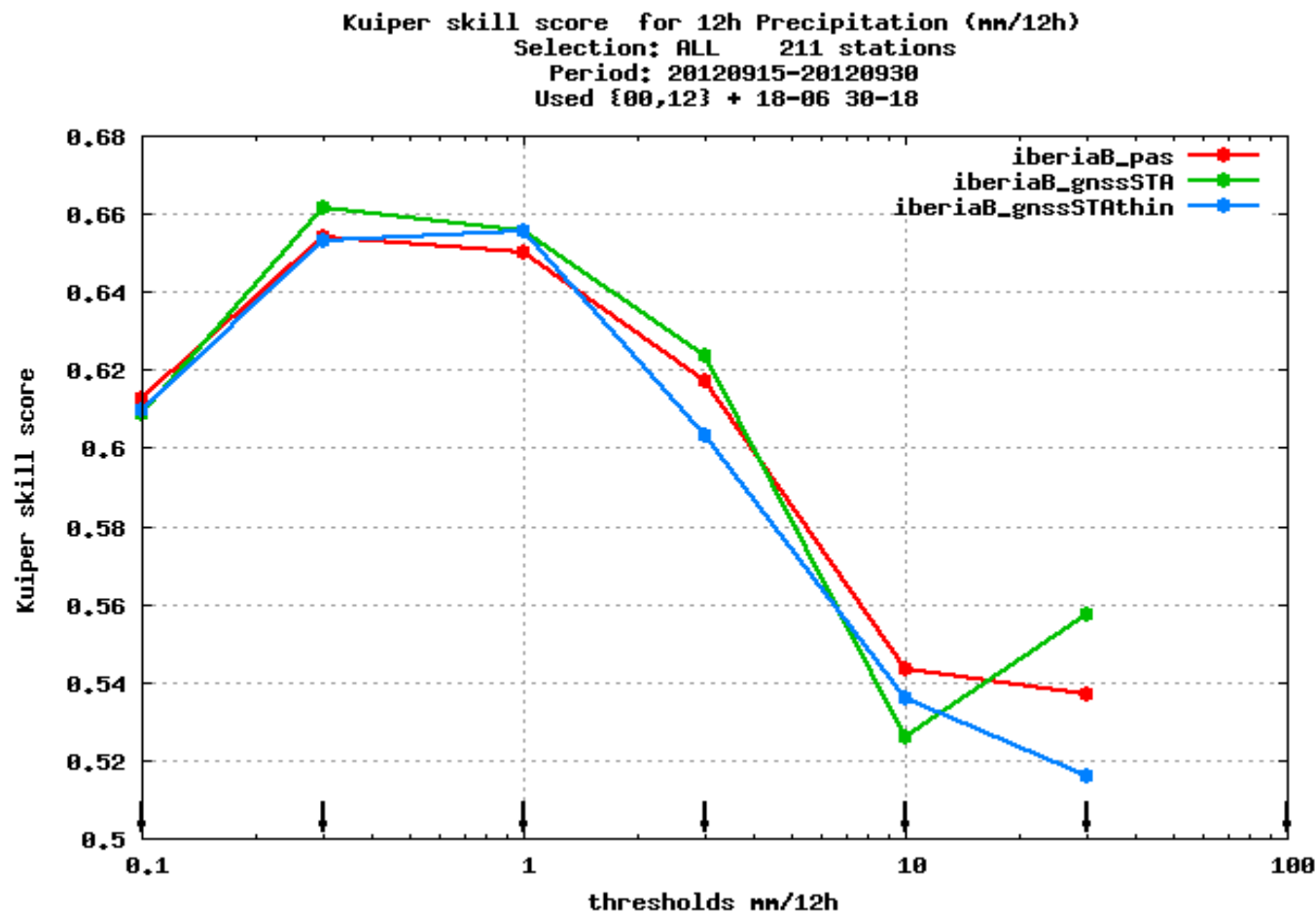
Pas- CONTROL, conv. obs.
STA- gnss static BC
STAthinn - gnss static BC thinned

Assimilation of GNSS ZTD with HARMONIE over big IBERIA domain



Verification scores against observations: 12h precipitation

Improvement of the forecast skill of 12h accum. precipitation when assimilating ZTD GNSS observations with STATIC BC and the list hasn't been thinned.



Kuiper Skill Score

Pas- CONTROL, conv. obs.
STA- gnss+static BC
STAthinn – gnss+static BC+
thinned

Assimilation of GNSS ZTD with HARMONIE over big IBERIA domain. FIRST trials.

Conclusions & Future work

- Neutral to positive impact found on the first experiments assimilating gnss over big iberian domain.
- **thinning distance** is an issue..
- Next step: VARBC experiments with BIG iberian domain.



GOBIERNO
DE ESPAÑA

MINISTERIO
DE MEDIO AMBIENTE
Y MEDIO RURAL Y MARINO

AEMet
Agencia Estatal de Meteorología

Currently AEMET is involved..

- 1) *Assimilation of GNSS observations in **HIRLAM** model at AEMET.*
- 2) *Assimilation of GNSS observations in **HARMONIE** high resolution model.*
- 3) **Contributing to HyMEX Project with the assimilation of GNSS observations**

3) HyMex project: GNSS ZTD assimilation.

Some impact studies are going to be performed in the framework of **HyMex project** assimilating in **HARMONIE model**:

- GNSS ZTD re-processed observations
- Data Targeting of radiosondes

on a serie of experiments over the Mediterranean area.





Thank you

Jana Sánchez Arriola

NWP Dep. AEMET

jsancheza @aemet.es