



# ASSIMILATION of european **GNSS** observations **AEMET 2013**

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# ASSIMILATION of european GNSS observations AEMET 2013

## OUTLINE

- 1) *Status of assimilation of GNSS data in HARMONIE*
- 2) Status of assimilation of GNSS observations in HIRLAM at AEMET.
- 3) Current/Coming work related to gnss obs assimilation

- Assimilation of GNSS observation in Harmonie cy37h12 with extended Danish domain. (Period: august 2010)
  - Impact of using a **White List** of GNSS observations.
  - Impact of using a **Static Bias Correction** for GNSS observations.
  - Impact of a **new Observation Operator** for GNSS ZTD.

**Area:** DK extended area :lat (50,70), lon (-10,30)

**Period:** july and august 2010

## 1.1 Impact of using a **White List** of GNSS observations.

### White List

242 places in total from 7 AC:

176 from GFZ\_

28 from METO

16 from GOP1

3 from SGN\_

3 from IGE\_

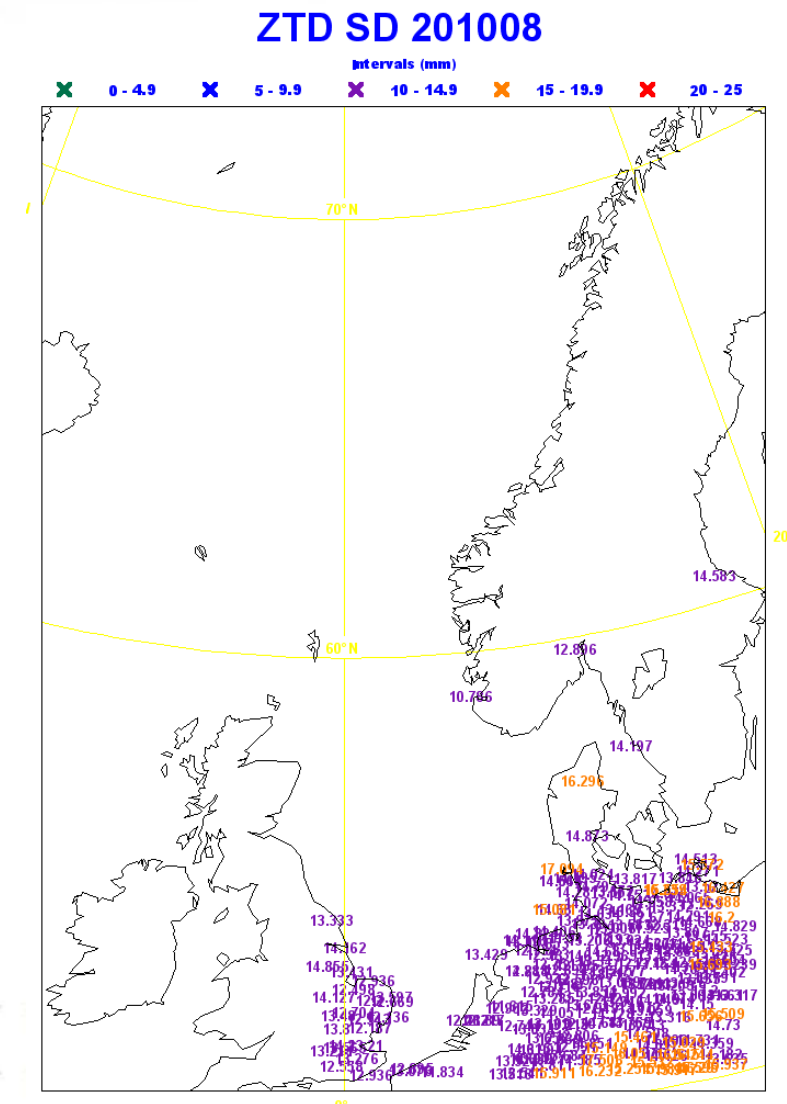
2 from LPT\_

14 from BKG\_

No data from NGAA

**Area:** DK extended area  
lat (50,70), lon (-10,30)

**Period:** july 2010



## 1.1 Impact of using a **White List** for GNSS observations (II).

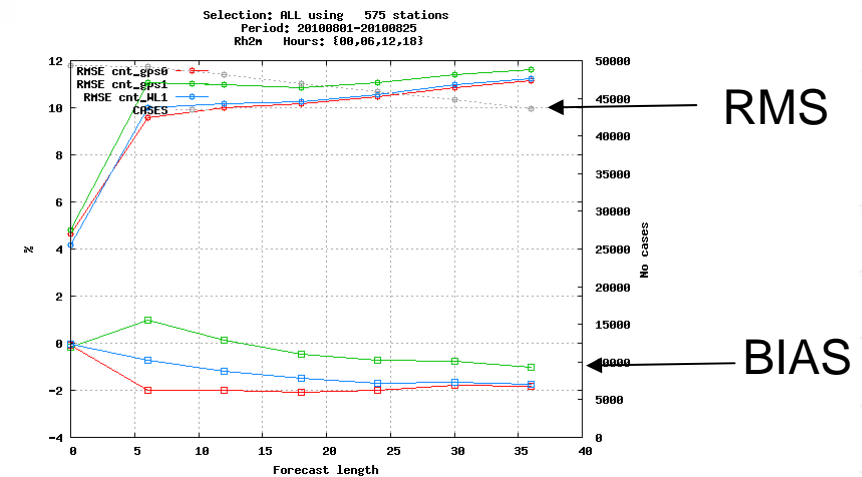
### RESULTS:

Mslp:

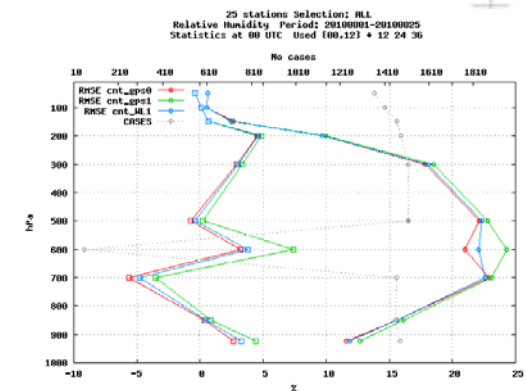
CONTROL

No white List

White List



The assimilation of gnss observations by Harmonie Cy37h12 together with conventional and atovs observations (with its varbc) in a 3 hour assimilation cycle, doesn't improve the control experiment, although it has been seen that in case of doing it, it is better to use **White List** that not using it.





## 1.2 Impact of using **Static Bias Correction** for GNSS observations

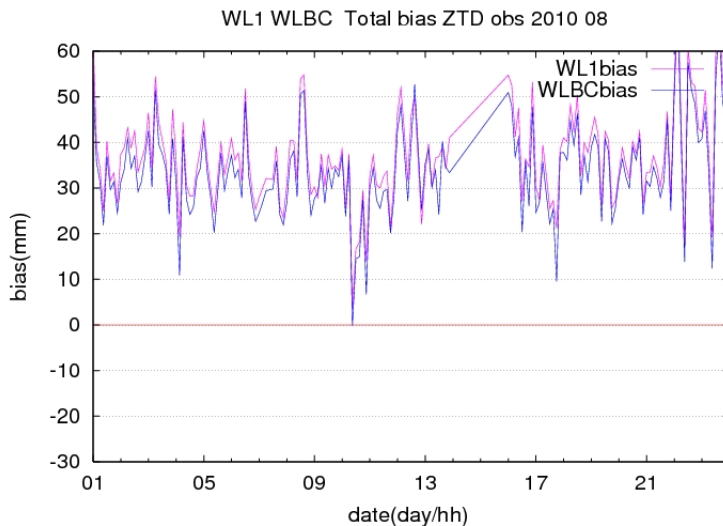
*This means that from each observation, the bias has been subtracted.*  
(bias values are provided by the White List obtained by the passive run for the previous month)

### RESULTS:

#### Bias of innovations:

**PINK:**No bias corrected obs

**BLUE:**Bias corrected obs



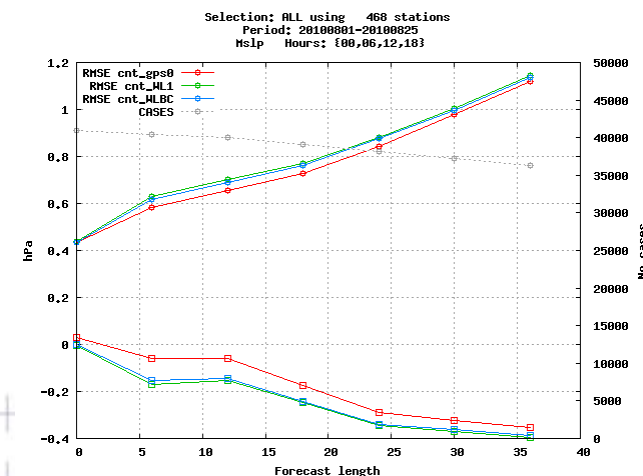
The assimilation of gnss observations by Harmonie Cy37h12 together with conventional and atovs observations (with its varbc) in a 3 hour assimilation cycle, **with a static bias correction** hasn't shown a remarkable impact for this experiment configuration, and it is not capable to improve the control experiment.

#### Mslp:

**CONTROL**

**No Bias Corrected**

**Bias corrected**



## 1.3 Impact of a new Observation Operator for GNSS ZTD.

- Current model configuration tends to under-estimate the first guess value of the ZTD observations compared with the real ZTD observation value.
- The reason of this systematic error calculating the ZTD first guess value is that ,as we are using the 65 vertical level configuration, we are currently missing the upper part of the real atmosphere (above 20hPa) and so we are missing a mass of air that is important for the ZTD value calculations.
- According to Henrik's last paper, a rough estimate of the top contribution that we might be missing is :

$$\text{ZTD}_{\text{top}} = 10^{-6} a \cdot R_d \cdot P_{\text{top}} / g$$

where  $a = 77.6 \text{ K/hPa}$

$R_d$  is the gas constant for dry air

$g$  is the gravitational acceleration.

$p_{\text{top}}$  is the pressure at the top of the model.

## 1.3 Impact of a **new Observation Operator** for GNSS ZTD.

For our model configuration, as  $P_{top}=20hPa$ , means that  $ZTD_{top}$  is around 45 mm, Two trials have been done then:

**OP1:**  $ZTD_{fg}=ZTD_{fg}+ ZTD_{top}$ , that is adding about 45 mm to the current  $ZTD_{fg}$ .

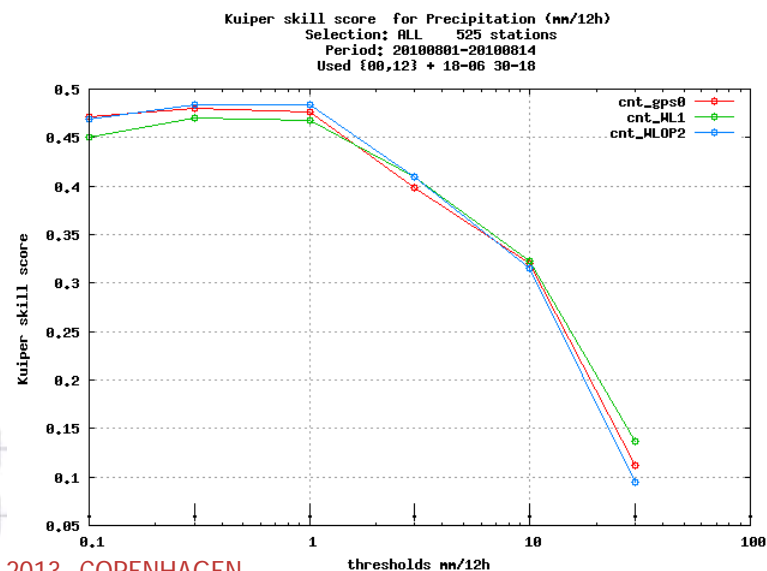
**OP2:**  $ZTD_{fg}=ZTD_{top}$ , that is adding about 25 mm to the current  $ZTD_{fg}$ .

### RESULTS:

Negative impact for **OP1** (corrected too much!) but neutral to positive for **OP2** ZTD observation operator can be seen, better than any other configuration tried here (filtered gnss data with a White List or doing Static Bias Correction with the default observation operator, tried for this area and period).

### Kuiper Skill Score for precipitation:

**OP2(blue)** is better for some pcp thresholds.





## SUMMARY:

- Impact of using a *White List* of GNSS observations.
- Impact of using a *Static Bias Correction* for GNSS observations.
- Impact of a *new Observation Operator* for GNSS ZT

- Among the different configurations tested to assimilate gnss observations by a 3h assimilation cycle of Cy37h12 for august 2010 period and over DKCOEXT domain, **the one where the observation operator has been changed by adding an amount of ztd on the top layer seems to be the only one that may improve control some times.**

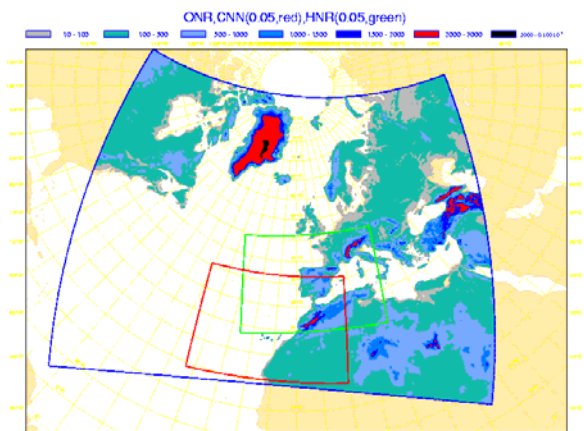
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## 2) Status of assimilation of GNSS observations in HIRLAM at AEMET.

### 2013: ZTD GNSS DA 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 PASIVE GPS assim (from july 2011): 8 cha ID from july 2012	SH3 PASIVE GPS assim (8 cha ID, from oct 2012)	

- ✓ No changes from 2012.
- ✓ **White Lists** made monthly for all the stations over the Iberian Peninsula received, compared with 0.16 Aemet Hirlam suite.
- ✓ Monthly statistics.

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### 3) Current/Coming work related to gnss obs assimilation

#### Cy38 Harmonie with DKCOEXP area:

- Coordinated Impact studies: (conventional +atovs) adding:  
**radar** + **iasi** + **gnss**
- July and August 2010 period.
- Cy38 Harmonie VarBC scheme...

$$b^{air} = \beta_0 + \sum_{i=1}^N \beta_i P_i$$

It seems to work finally!!

So we are starting with it first with a constant offset

$$b^{air} = \beta_0$$

- Calculating the coefficients,...
- Doing impact studies...

**RESULTS in 2014!**

### 3) Current/Coming work related to gnss obs assimilation

#### Cy38 Harmonie with **IBERIA** area:

- 'cuasi-operational' cy 38 **Harmonie** model over Iberian Peninsula: inclusion of gnss observations.
- Collaboration in **HyMex project** (Joan Campins, Jana Sánchez and Beatriz Navascués)
  - \* Some HIRLAM exp have already been performed using Data targeting of RS (403 additional radio soundings) on September 2012 over Mediterranean area.
  - \* NEW cy38 HARMONIE experiments assimilating: **extra RS obs**, **ATOVS (normal and double density)** and **gnss observations** will be performed along 2014 to study the impact in some case studies over the Mediterranean area (severe convective cases).



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## Summary:

### HIRLAM AEMET suite

Monitoring /White List are being done monthly with 0.16 Aemet Hirlam suite.

### HARMONIE Cy37h12

- ✓ The only positive impact has been seen when the Harmonie fg ZTD observation operator has been changed (fgZTD value slightly increased), although the impact is very little.
- ✓ Static Bias corrections doesn't seem to be very effective in this model configuration over the area/period tested.

### HARMONIE Cy38

- ✓ VarBC is finally going on
- ✓ Coordinated impact studies (radar+ias+gnss) over DKCOEXP area are going on.
- ✓ Harmonie over Iberian Peninsula runs may also include gnss obs.
- ✓ gnss obs will be used in HYMEX project.



**Thank you  
and have a fruitful  
meeting!**

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