Norwegian Meteorological Institute

Large scale mixing and data assimilation in HARMONIE

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outline

- Motivation;

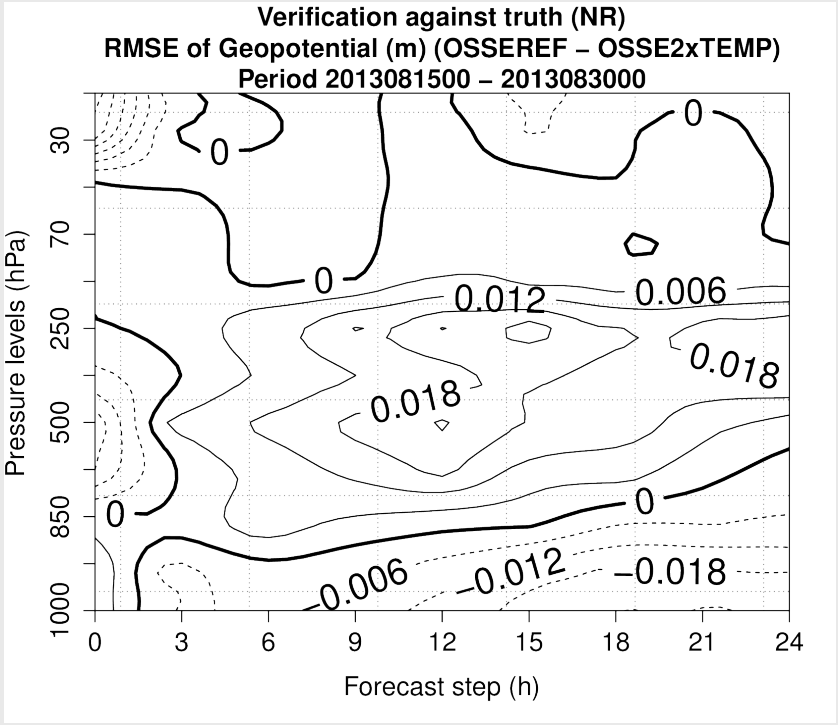
- The implemented large scale mixing (LSM) in HARMONIE;

- The HARMONIE system with and without LSM;

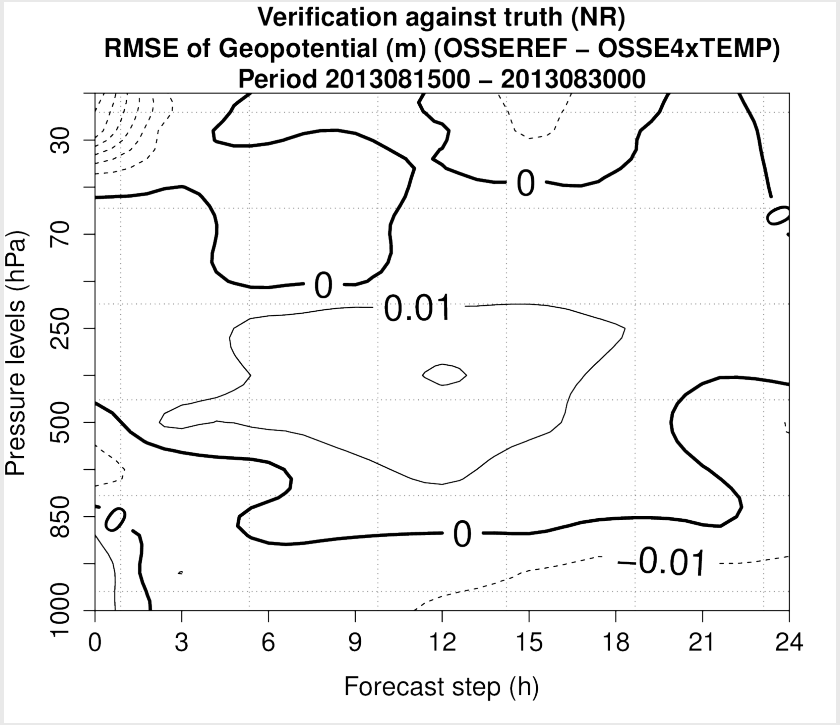
- Concluding remarks.

Motivation – OSSE study: using LSM

Using at least 2 radiosondes per day



Using 4 radiosondes per day



LSM in HARMONIE

Horizontal weighting

The horisontal weighting depends on a parameter R_{BC} (namelist) giving the resolution of the host model (in degrees). Based on this and the models own resolution in degrees (call it R_{OWN}) a "cutoff" wavenumber is computed:

$$k_C^* = \sqrt{M_{\max} N_{\max}}\, \frac{R_{\mathrm{OWN}}}{R_{\mathrm{BC}}}.$$

k^* is the equivalent 1D (isotropic) wavenumber of m, n:

$$k^* = \sqrt{M_{\max} N_{\max} \left[\left(\frac{m}{M_{\max}} \right)^2 + \left(\frac{n}{N_{\max}} \right)^2 \right]}$$

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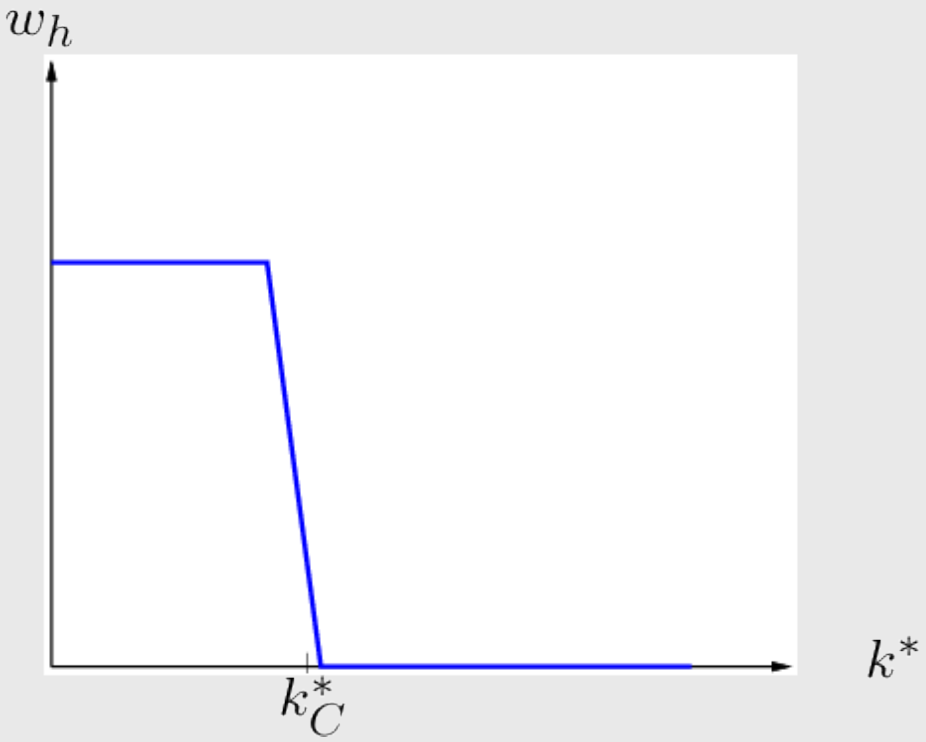
O. Vignes https://hirlam.org/trac/attachment/wiki/HarmonieSystemDocumentation/lsmixbc.ppt

LSM in HARMONIE

The horizontal weight $w_h(k^*)$ is then:

$$w_h = \begin{cases} 1, & k^* \leq 0.9k_C^*, \\ \frac{1.1k_C^* - k^*}{0.2k_C^*}, & 0.9k_C^* < k^* \leq 1.1k_C^*, \\ 0, & k^* > 1.1k_C^* \end{cases}$$



O. Vignes https://hirlam.org/trac/attachment/wiki/HarmonieSystemDocumentation/lsmixbc.ppt

LSM in HARMONIE

Vertical weighting

So far the vertical weight has been assumed to follow a simple exponential profile, with the exponent E_v given by namelist:

$$w_v = 1 - \eta^{E_v},$$

and where η is the usual hybrid coordinate

$$\eta(l) = A(l)/p_{ref} + B(l).$$

Since the host model usually has a much coarser orography, the weighting goes to zero near the ground. The surface pressure is not mixed. Mixing is applied only to temperature, humidity, and the wind variables (including the mean wind).

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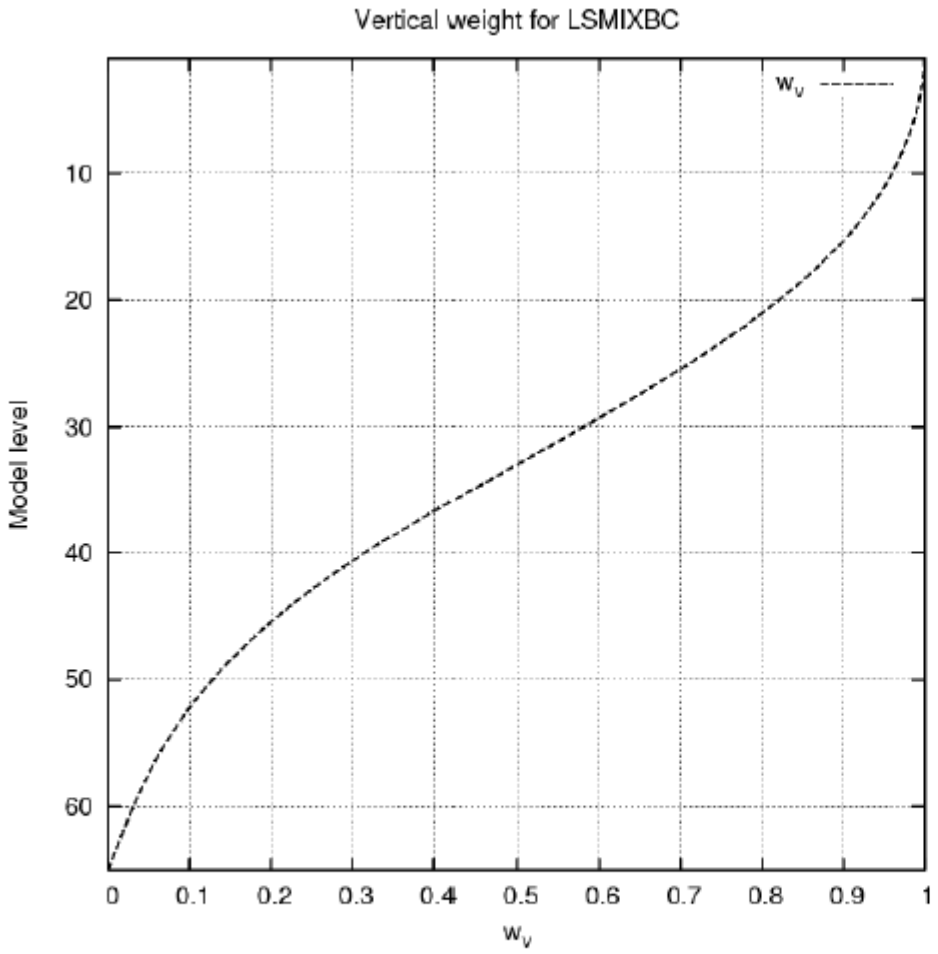
O. Vignes https://hirlam.org/trac/attachment/wiki/HarmonieSystemDocumentation/lsmixbc.ppt

LSM in HARMONIE



Switched on with LSMIXBC= .T.

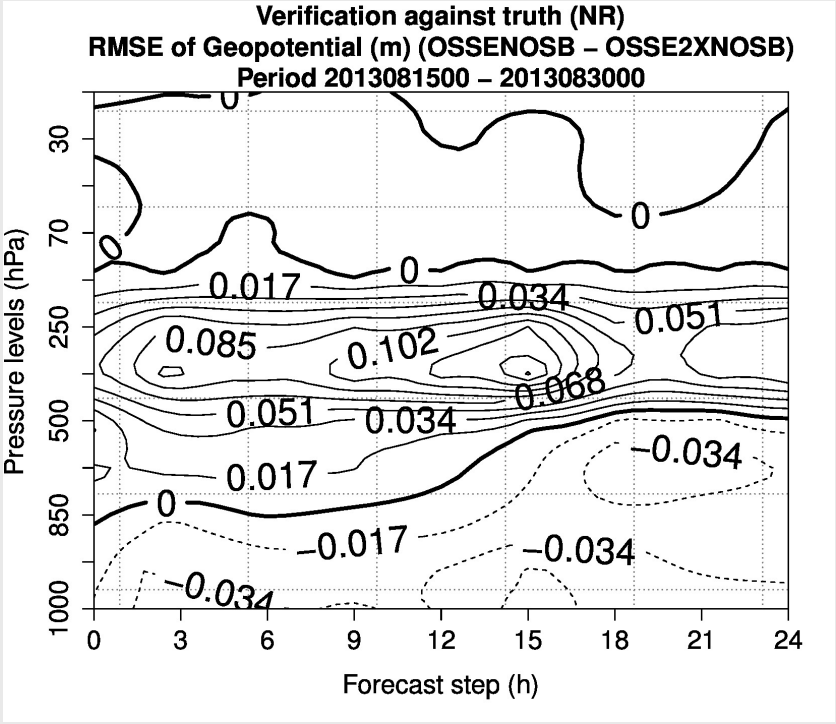
Today (18.06.2015) it's set to .T: when doing 3DVAR

Figure 2 The vertical weight used in LSMIXBC. Model level on y-axis and vertical weight on x-axis..

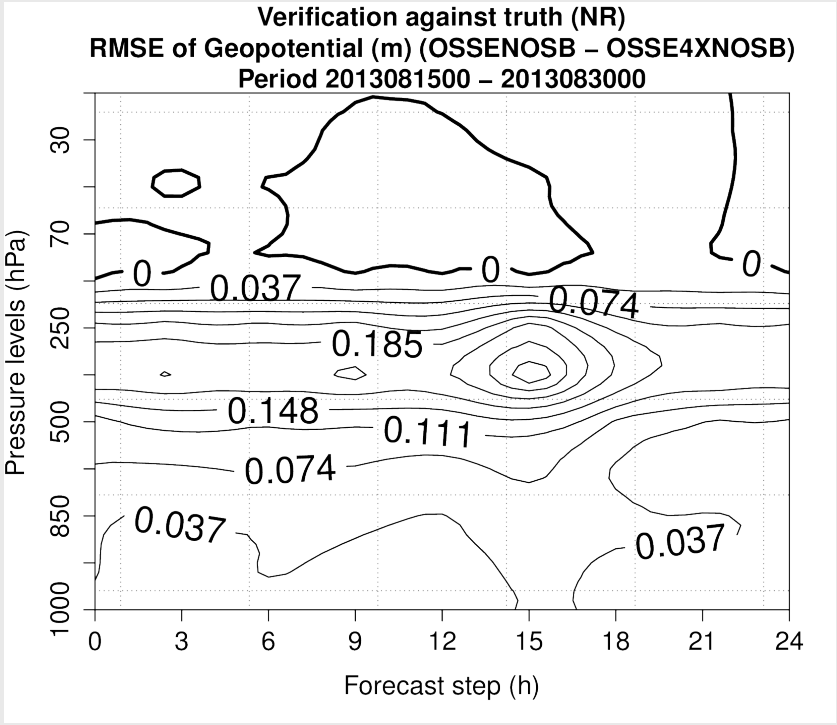
P. Dahlgren: http://metcoop.org/memo/2013/02-2013-METCOOP-MEMO.PDF

OSSE study: No LSM

Using at least 2 radiosondes per day

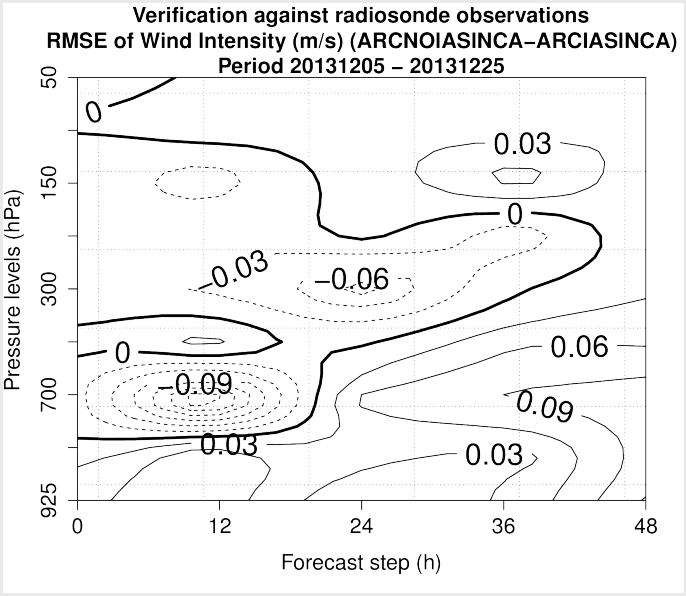


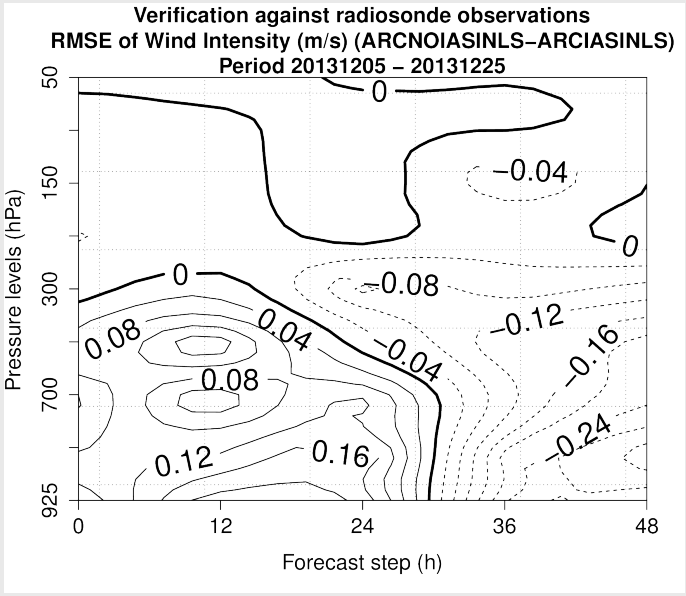
Using 4 radiosondes per day

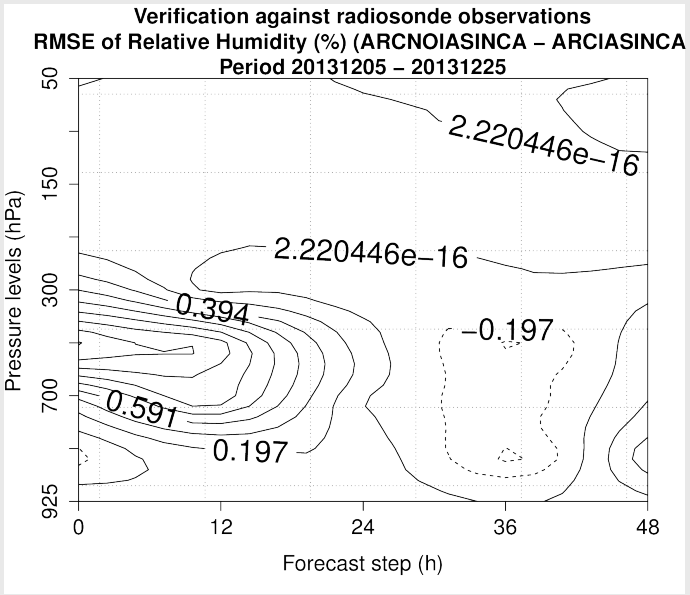


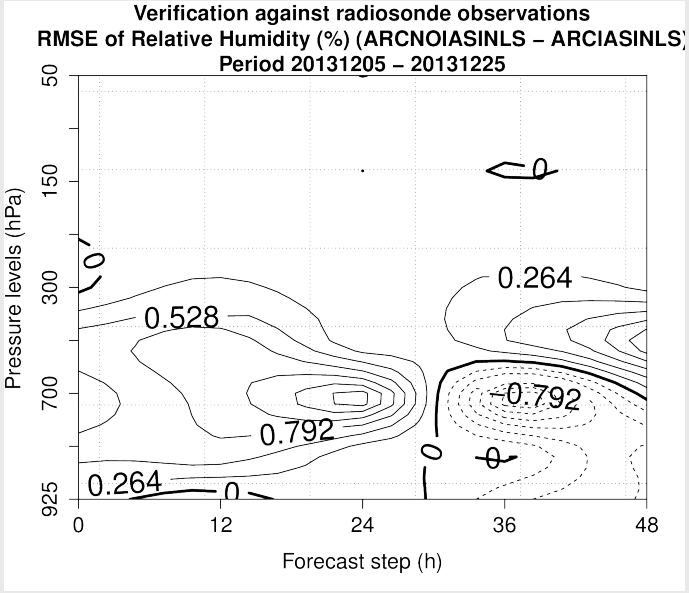
OSE study checking the impact of IASI

With LSM	00 UTC	Without LSM







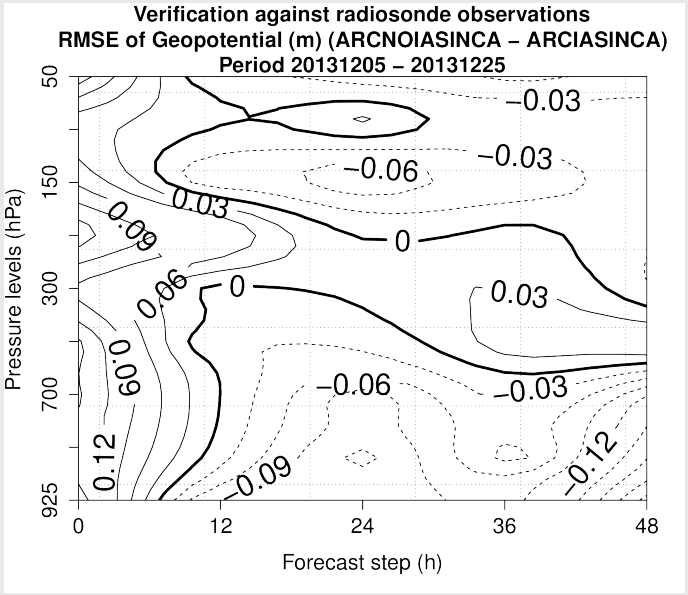


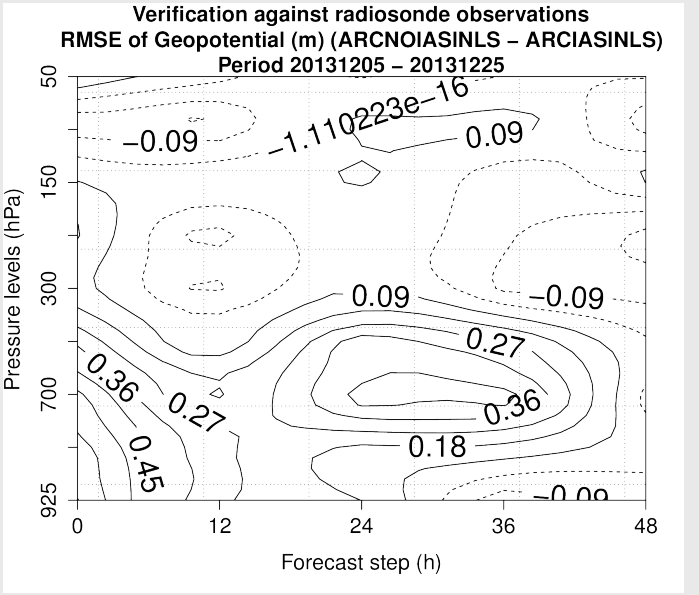
OSE study checking the impact of IASI

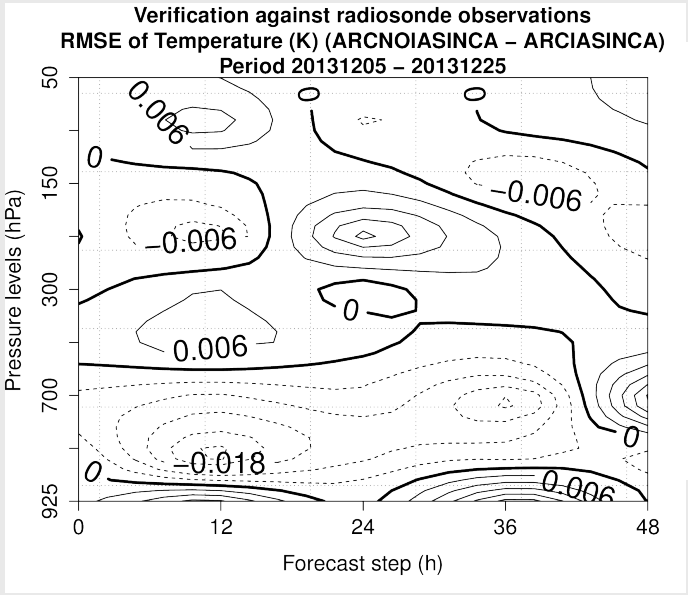
With LSM

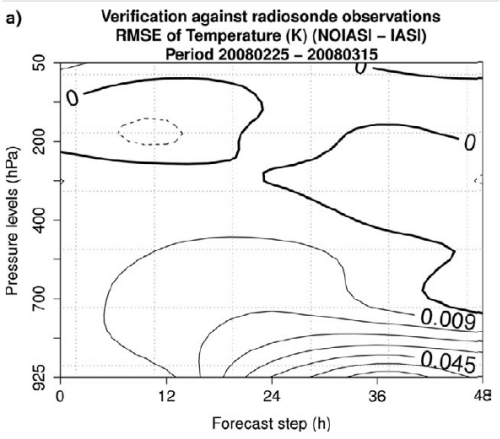
00 UTC

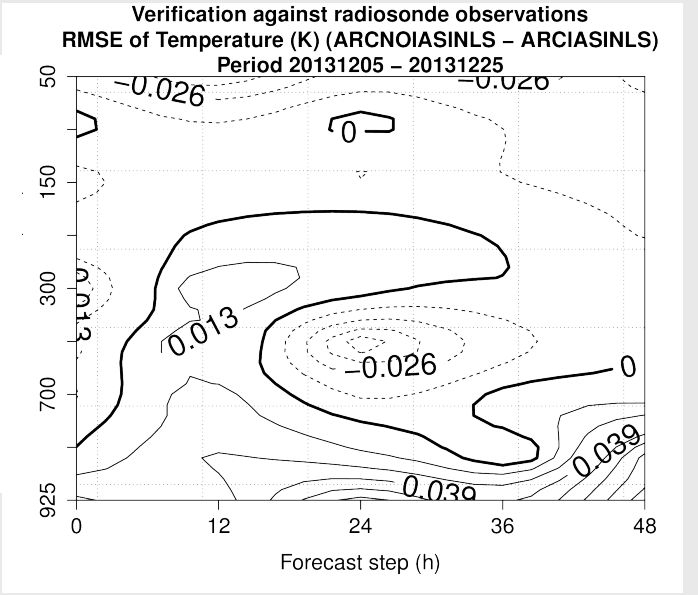
Without LSM





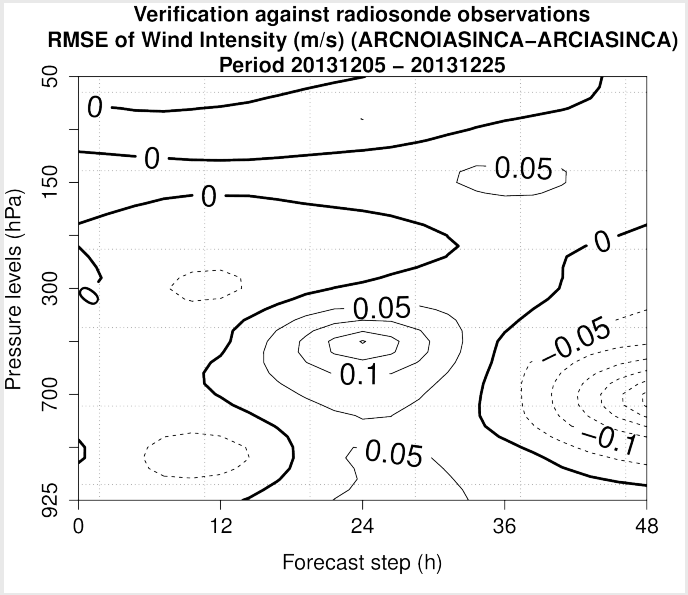


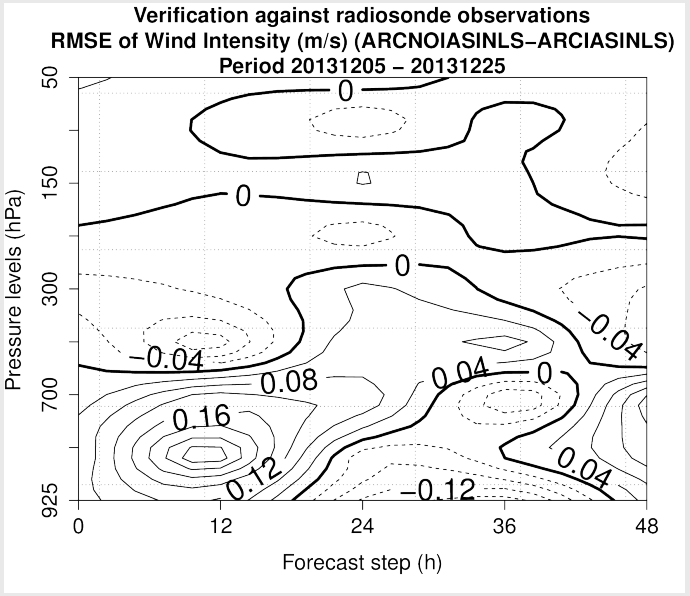


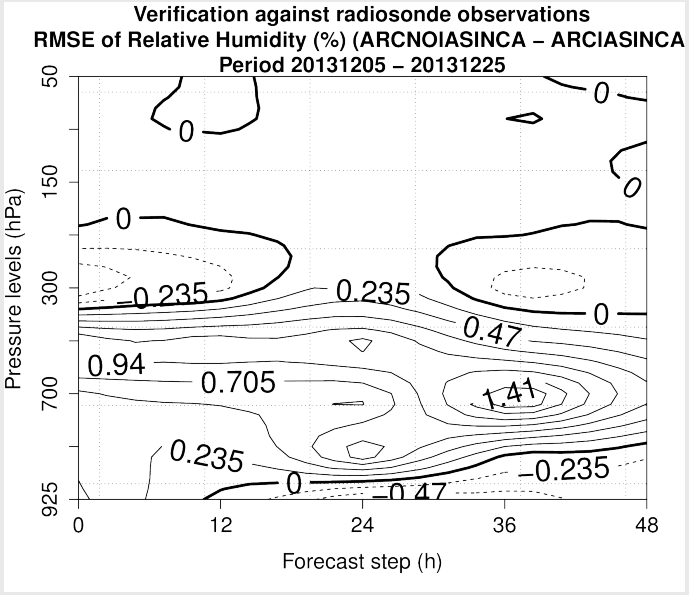


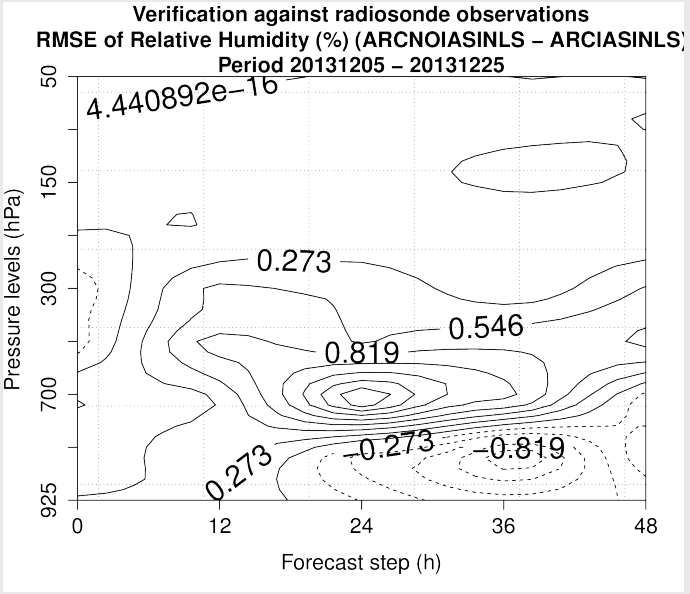
OSE study checking the impact of IASI

With LSM	12 UTC	Without LSM



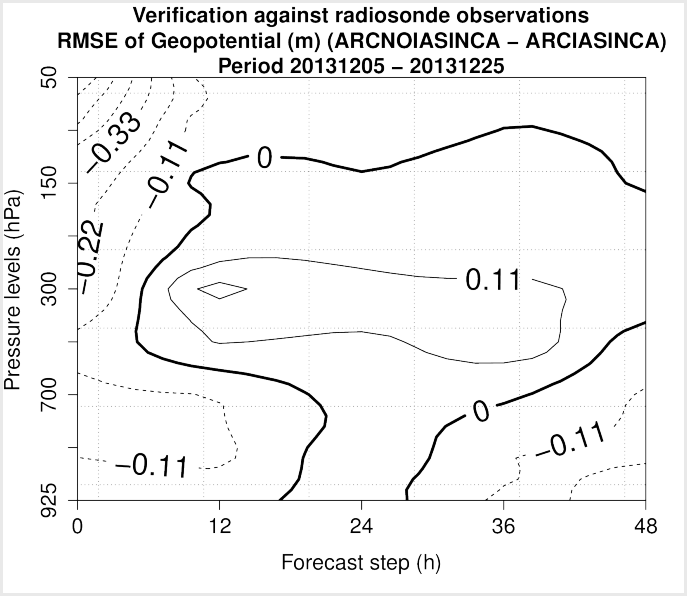


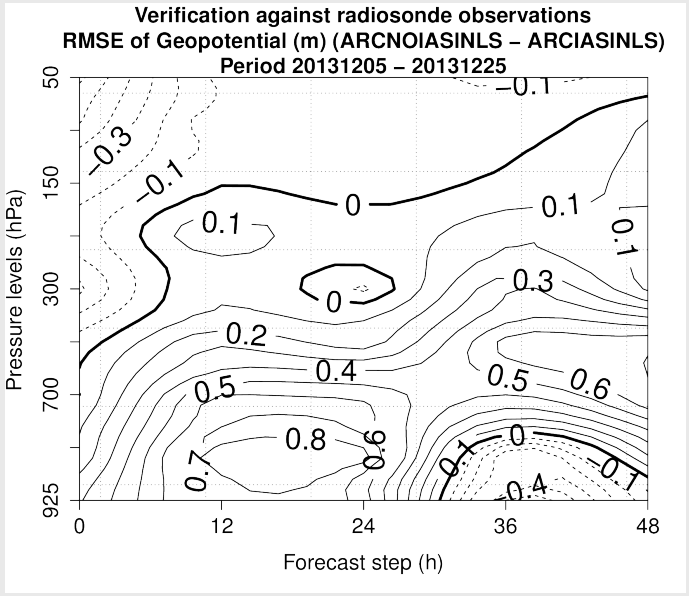


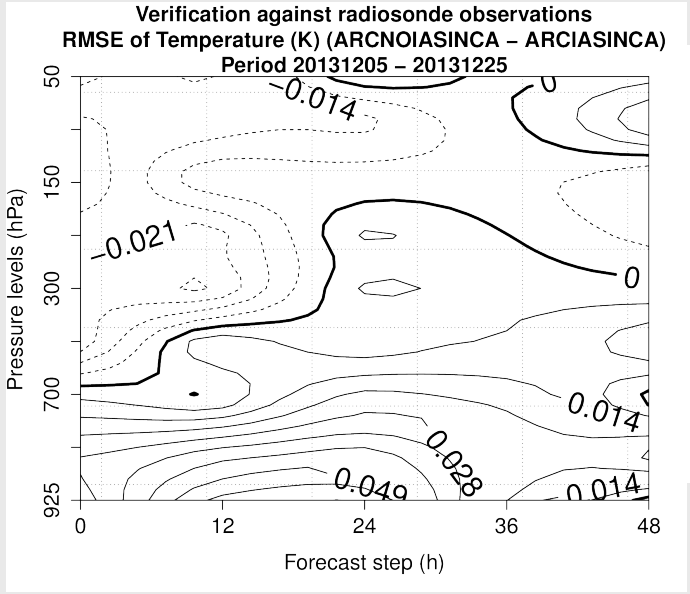


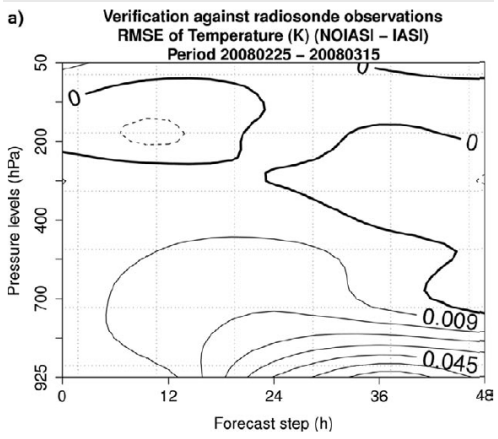
OSE study checking the impact of IASI

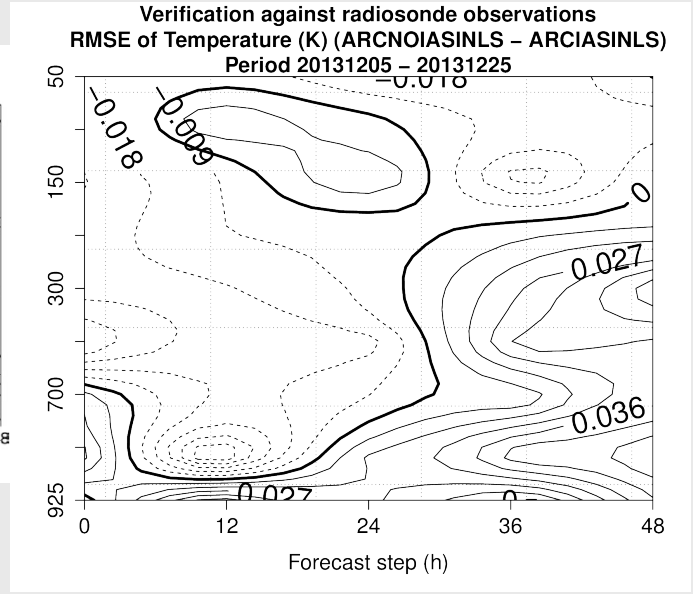
With LSM	12 UTC	Without LSM









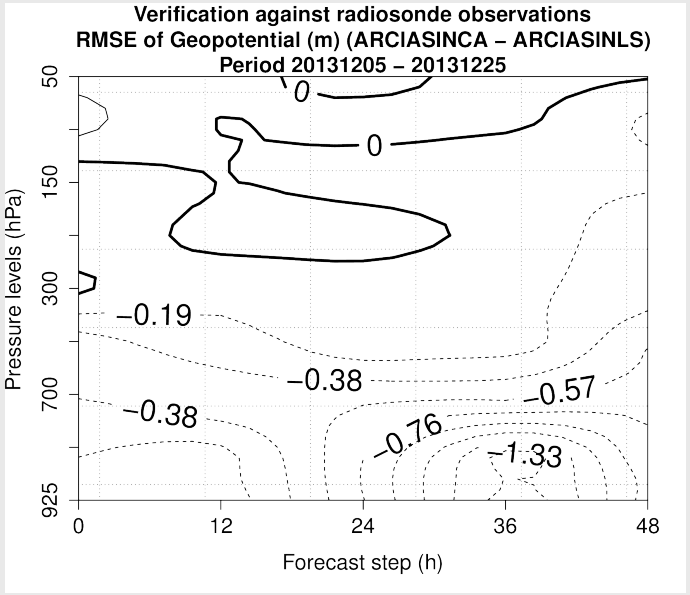


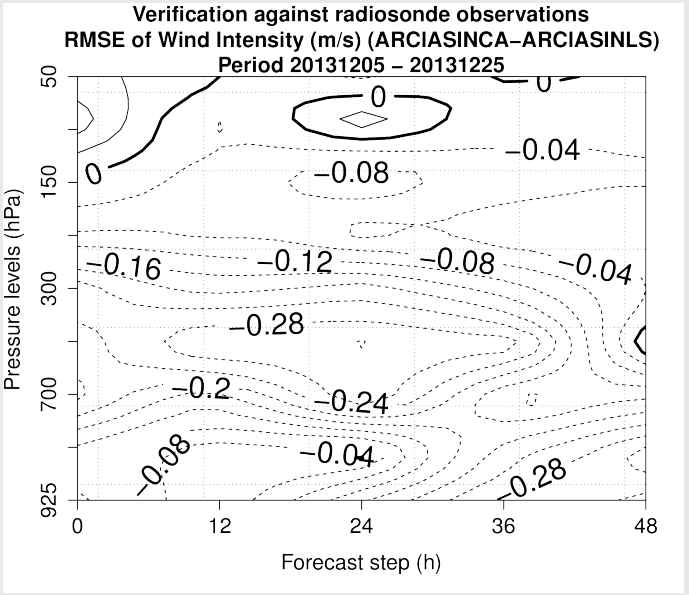
OSE study checking the impact of IASI

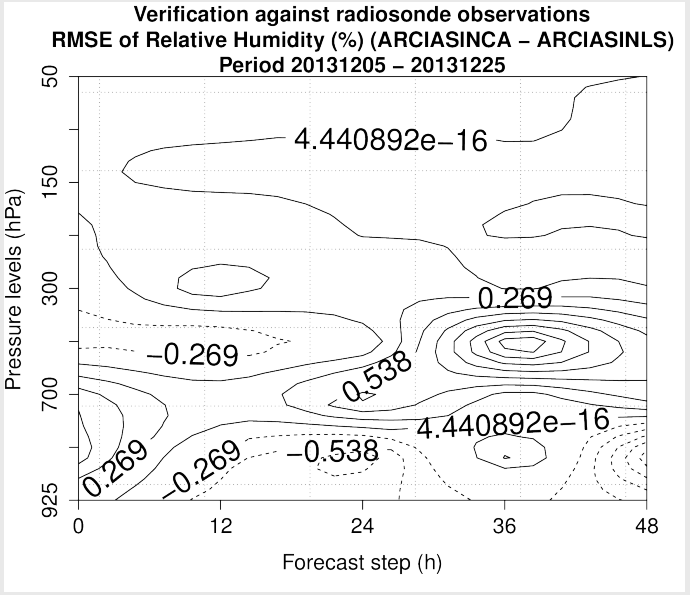
with -- without LSM

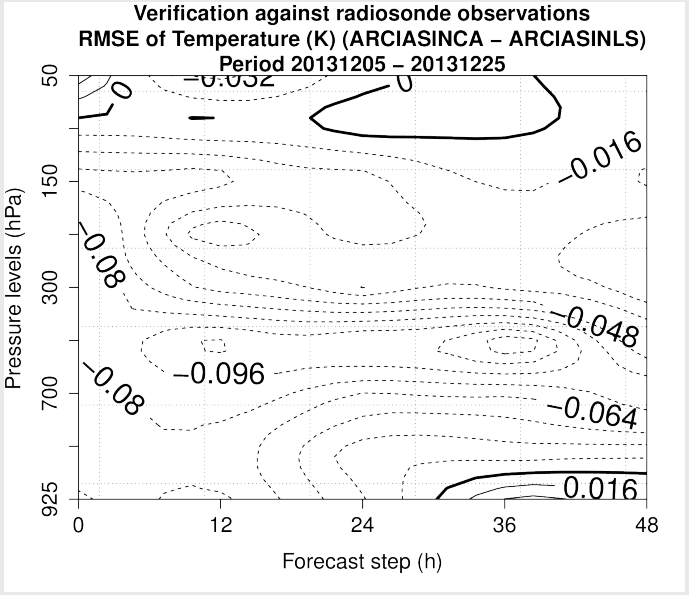
00 UTC

With – without LSM







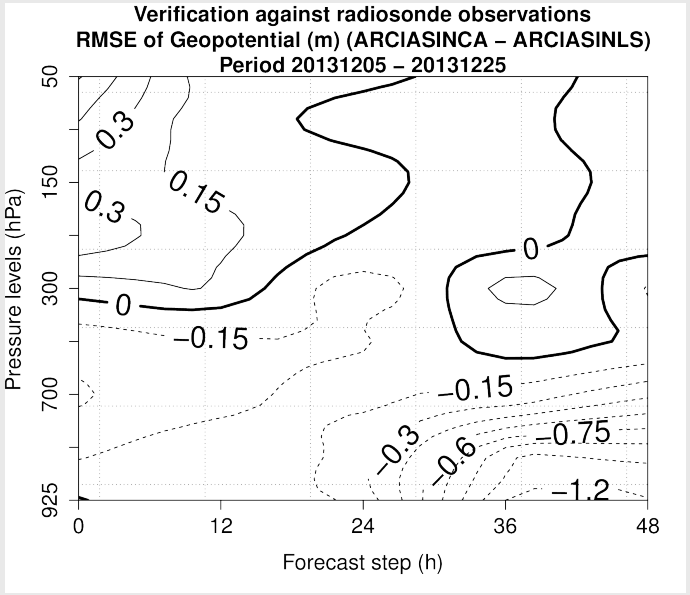


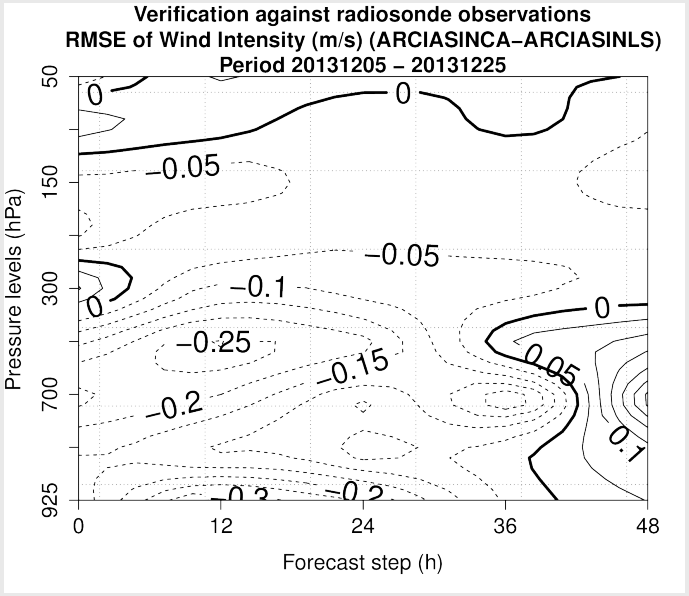
OSE study checking the impact of IASI

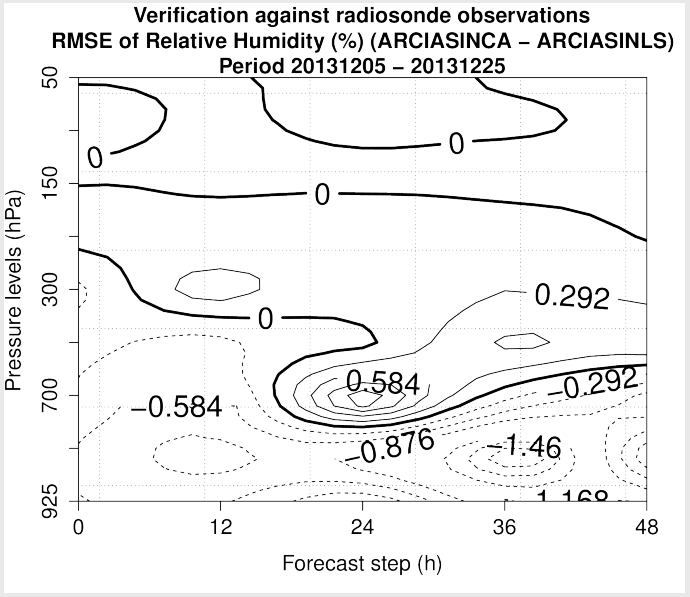
with -- without LSM

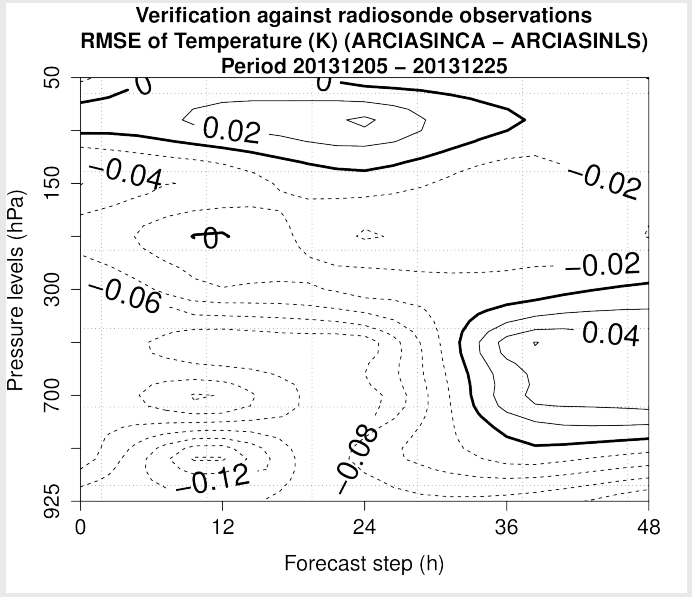
12 UTC

With – without LSM









Concluding remarks

- The impact on forecasts of humidity seems to be less influenced by LSM;

- Is the assimilation system with LSM optimal?
  (having LSM before screening – changing the guess before 3DVAR; it was not taken into account when computing the B matrix)
  → my answer is NO

- Do we need LSM? YES (see the last two slides)

- Can we improve the system? YES
  we need to compute a B matrix with EDA (explicitly will account for the LSM if switched on)

- Will we able to switch LSM off sometime? YES
  we need both tropospheric and stratospheric observations and B matrix that takes into account both large and meso scales
  (ex. obs. CrIS, ATMS, GPS-RO, etc...)