Tuning of HIRLAM screening and variational quality control

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Structure

- Overview observation quality control in HIRLAM data assimilation
- A first step of background check improvement
- On-going tuning of observation quality control
- Conclusions

Overview HIRLAM variational data assimilation observation quality control

- Screening Background check (BgQC)
- Variational Quality Control (VarQC)

Screening background check (BgQC)

$$\frac{(y_i - [Hx^b]_i)^2}{\sigma_b^2 + \sigma_o^2} \leq L^2$$

where

y_i - observation

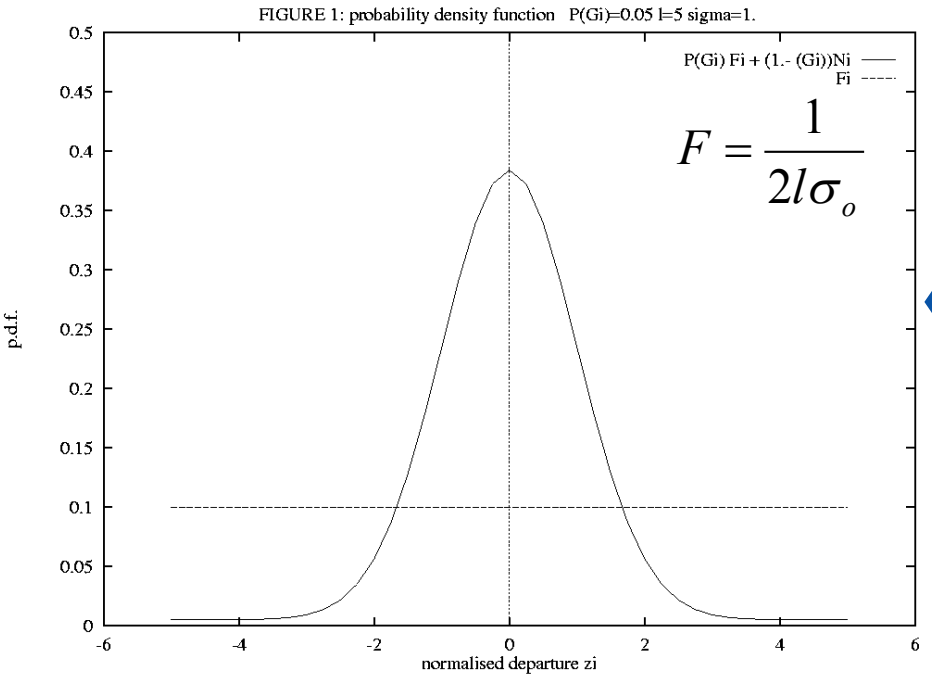
$[Hx^b]_i$ - background state equivalent

$\sigma_b^2 + \sigma_o^2$ - sum of error variances

L - rejection limit

L needs to be specified for different types of observations

Variational Quality Control (VarQC)

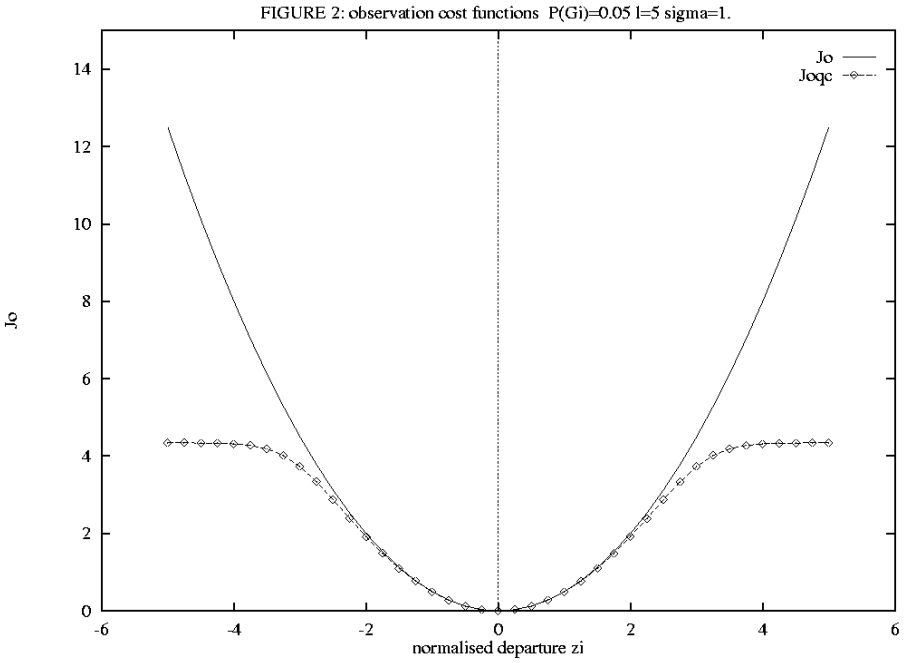


Probability density function (p_i) for single observation defined as a sum of natural errors (N_i) and Gross errors (F_i):

$p_i=P(G_i)F_i+(1-P(G_i))N_i$

($P(G_i)$-probability of Gross errors)

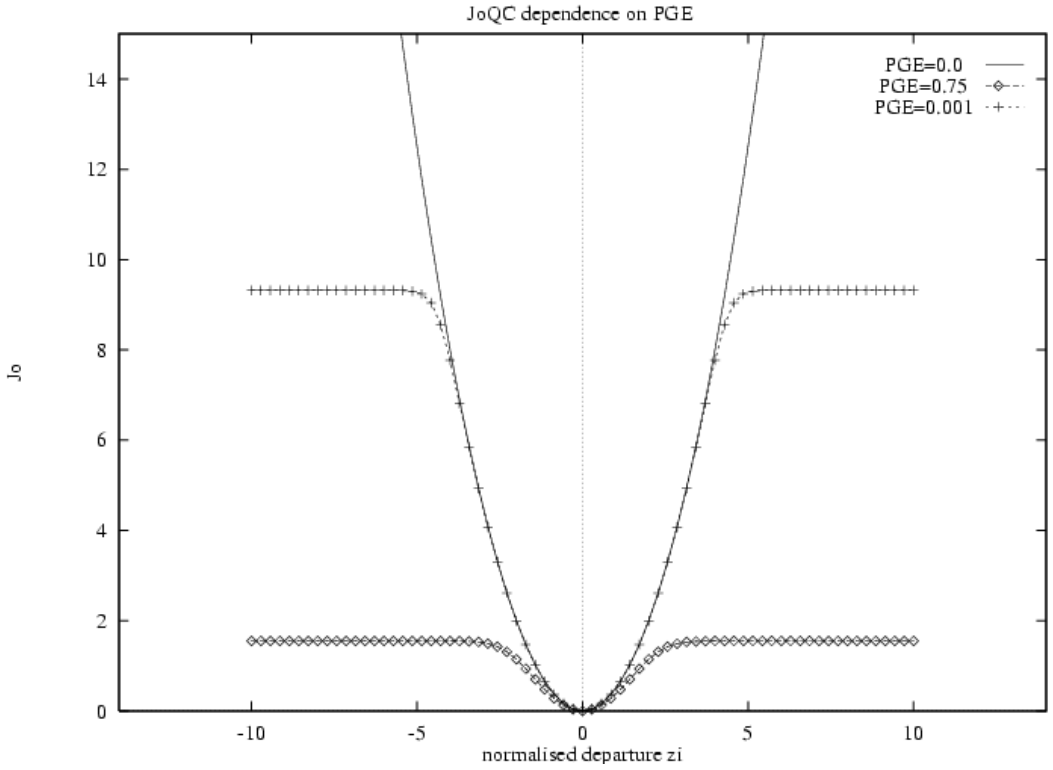
Cost of one single observation without (full) and with (dotted) variational quality control, as function of normalized observation minus model state departure.



P and l need to be specified

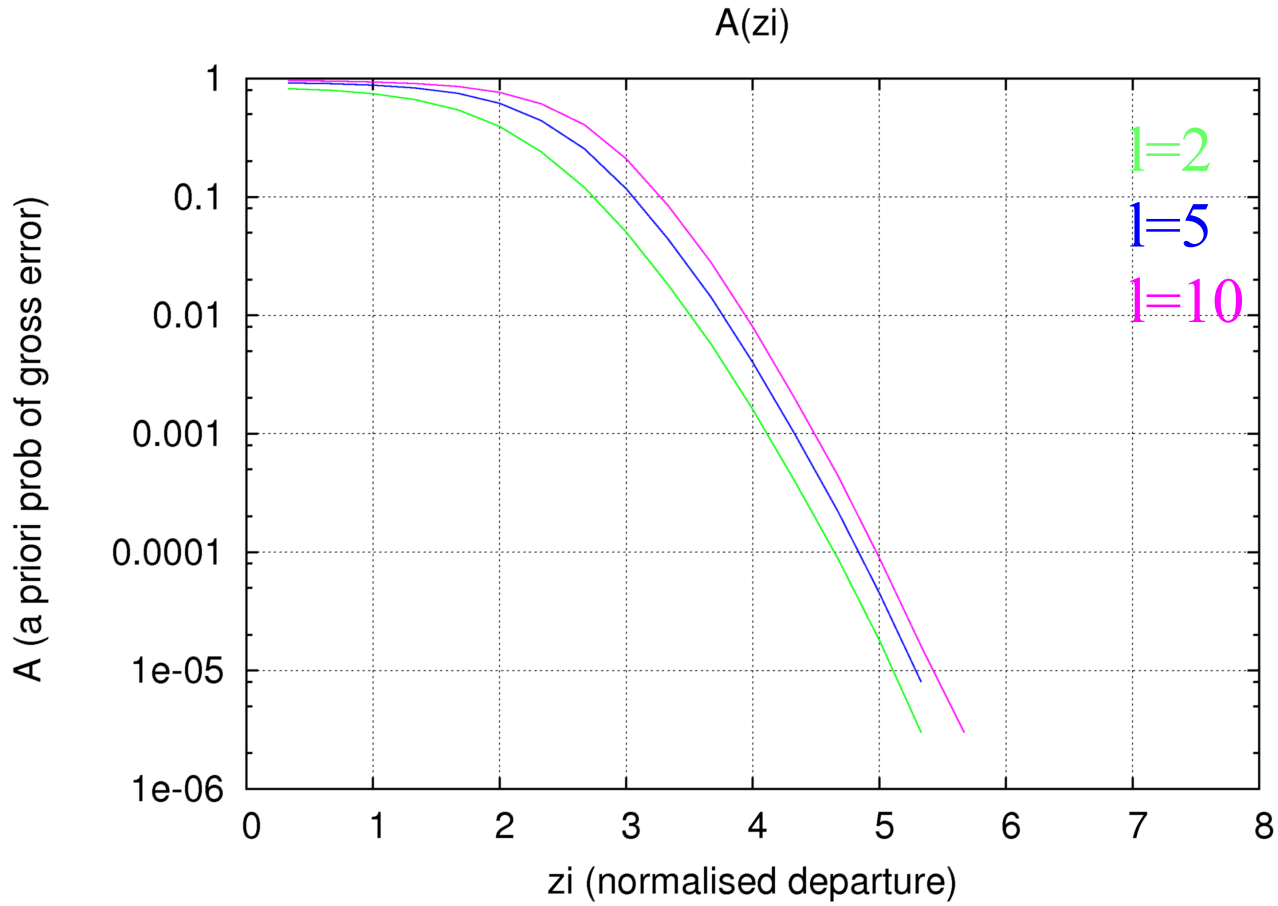
VarQC

Probability of Gross errors (for l=5)



VarQC

Probability of Gross errors (P) and range of possible values (l)

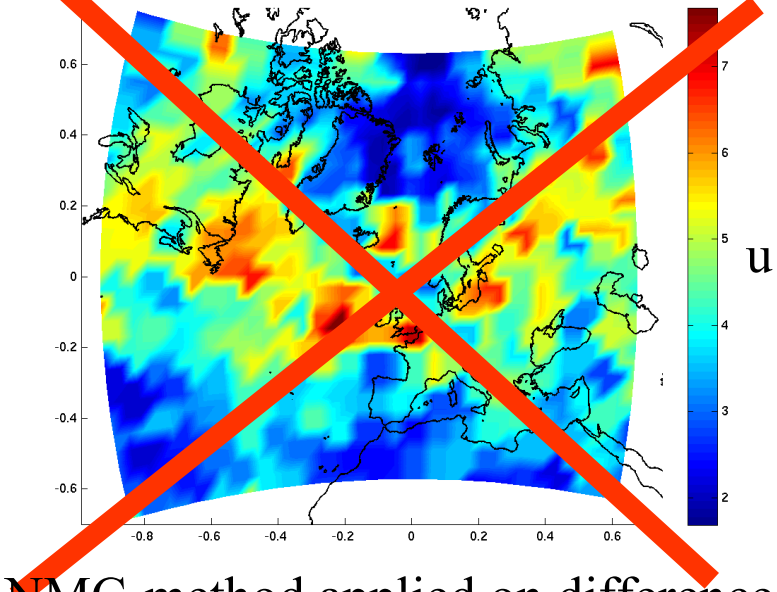


A first step of BgQC improvement

$$\frac{(y - [Hx^b]_i)^2}{\sigma_b^2 + \sigma_o^2} \leq L^2$$

OLD

REF



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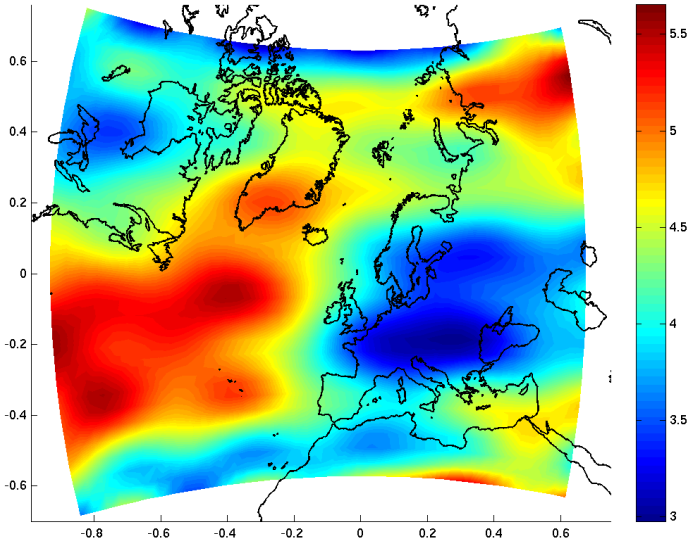
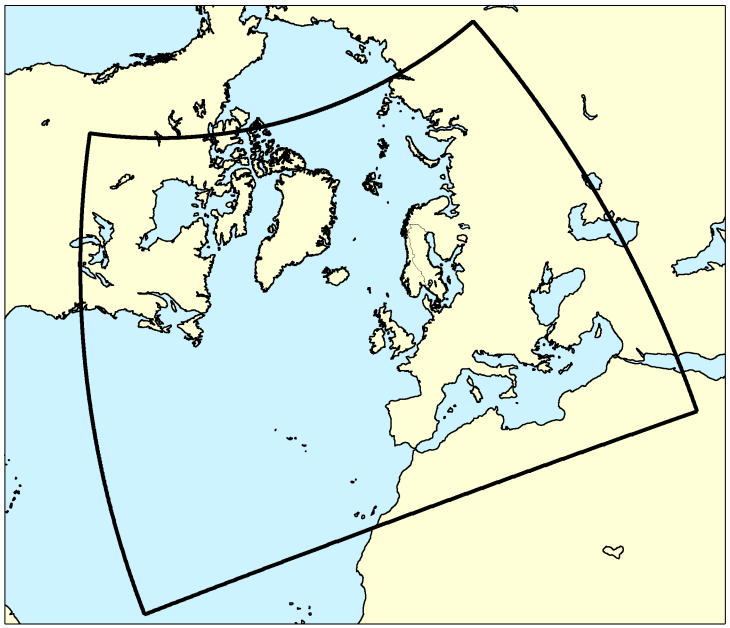


NMC-method applied on differences of ECMWF +24 and +48 h forecasts.

Based on σ_b-values used in minimi-zation. Randomization method and climatological index field.

As a first step, L set to 5 for all observation types

Parallel data assimilation and forecast experiment



Period: 20070201-20070228

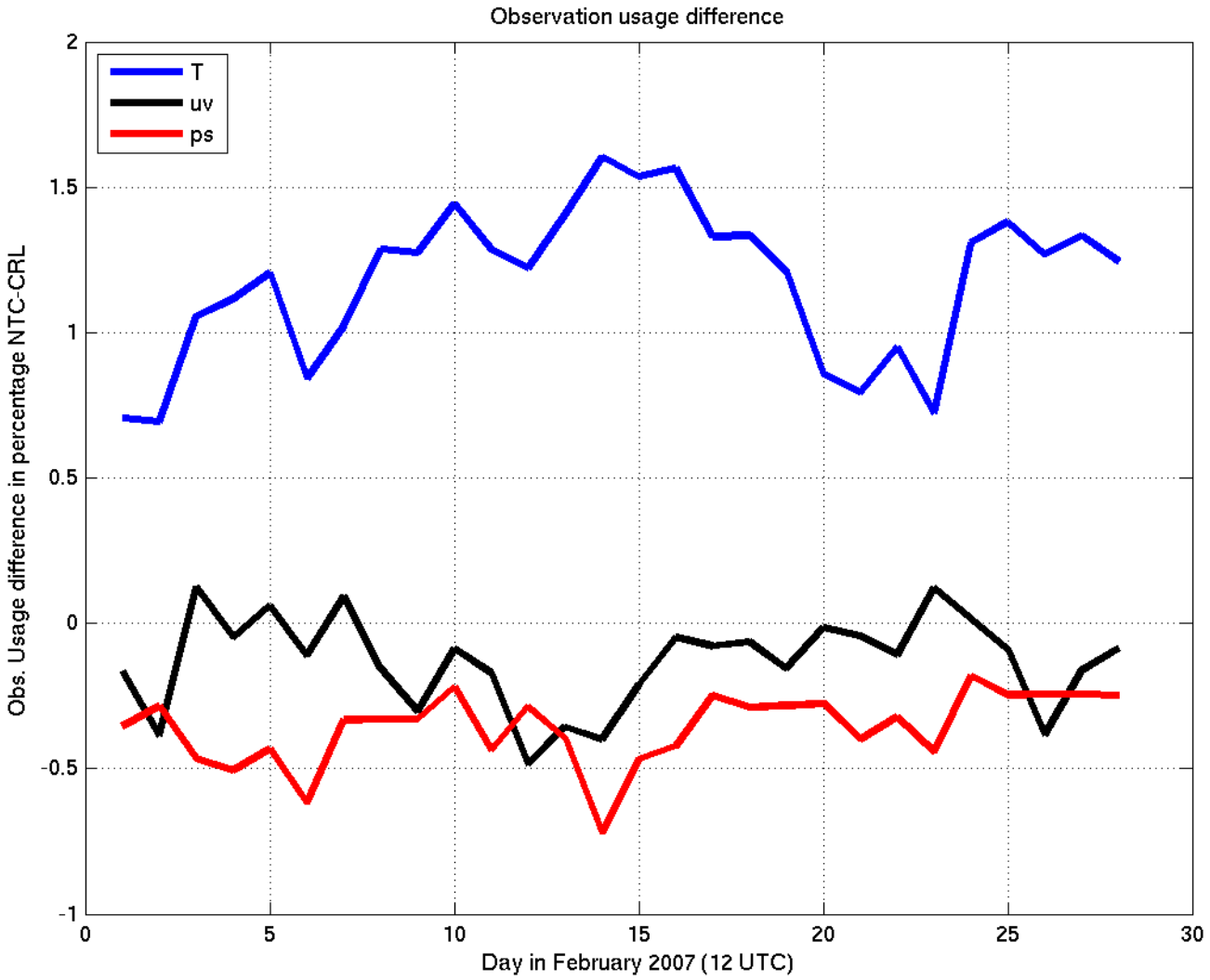
Area: HIRLAM reference

Version: HIRLAM 7.1.2

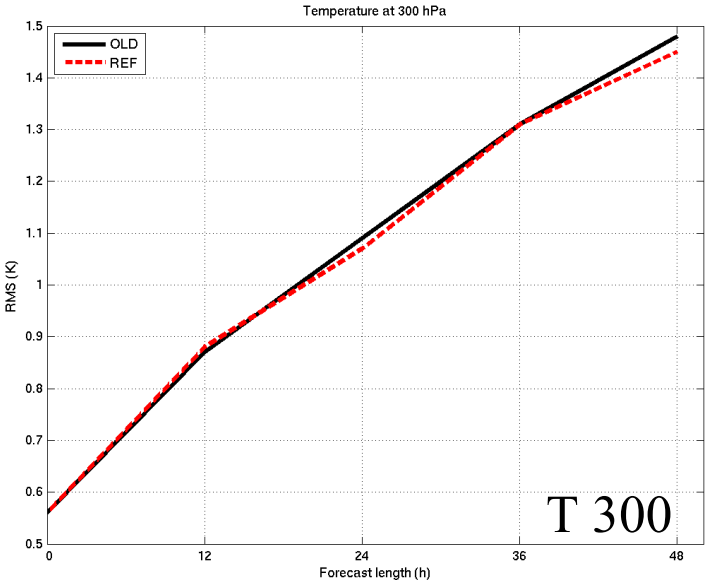
Experiments:

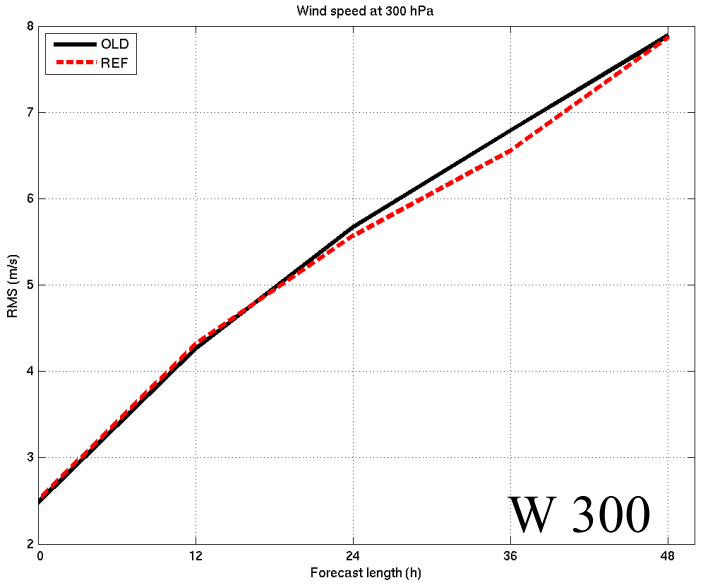
OLD: Old background check
REF: New reference background check

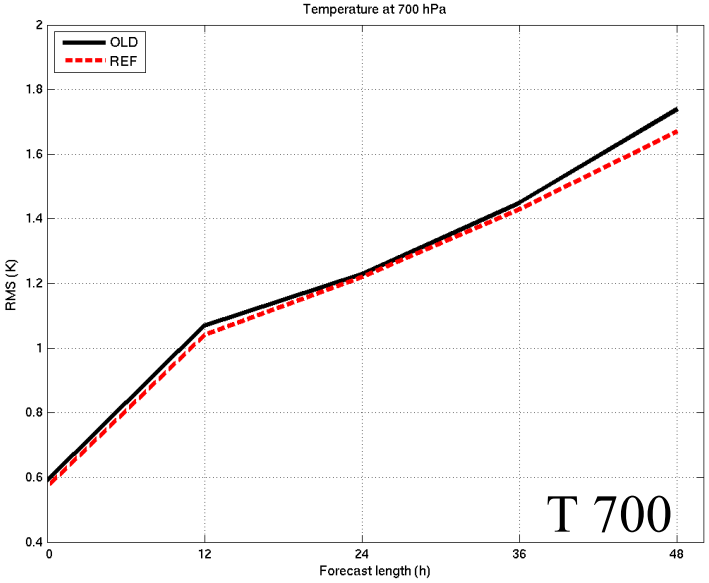
Difference in observation usage (REF-OLD)

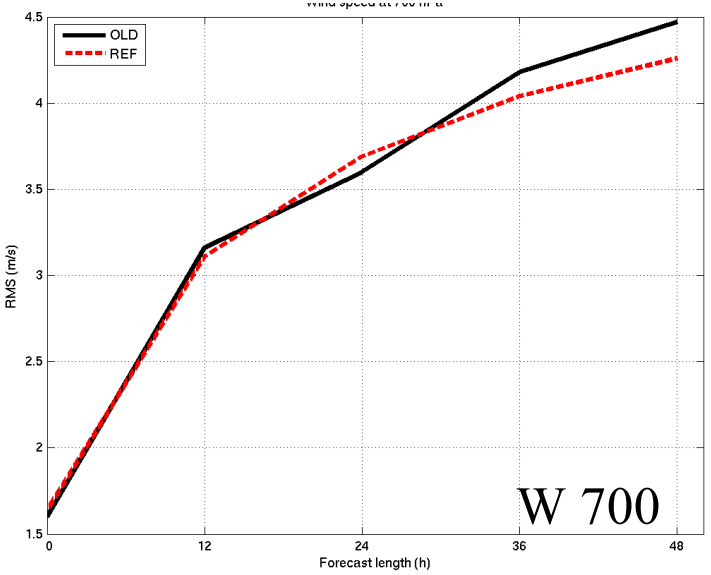


SCORES FOR VERIFICATION OF FORECASTS AGAINST OBSERVATIONS (REF, OLD)

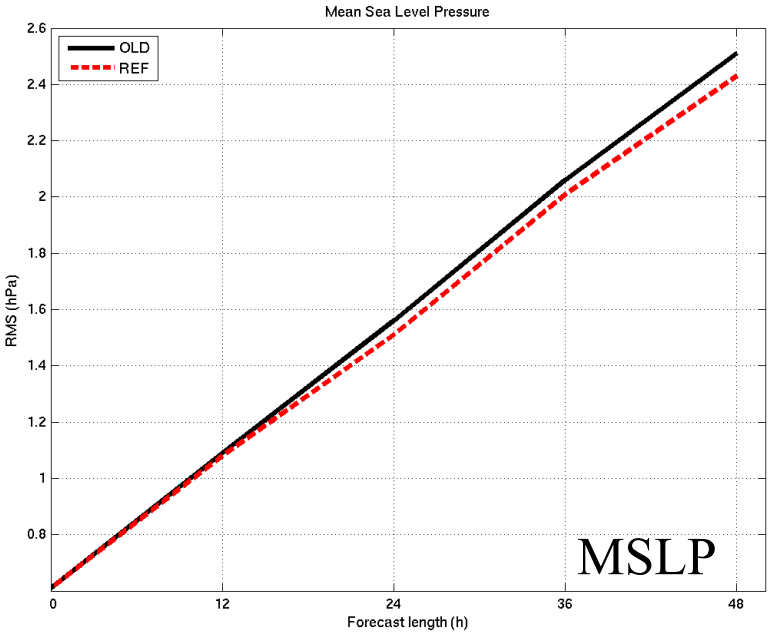


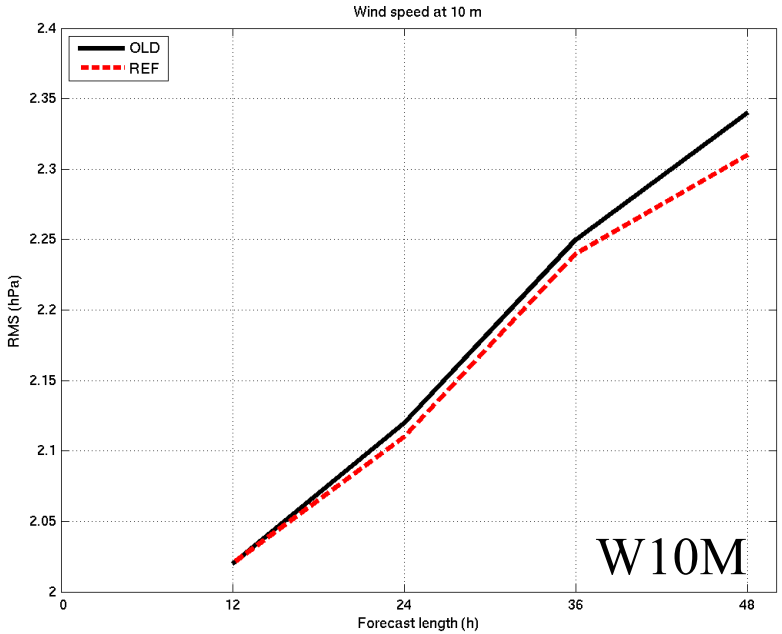






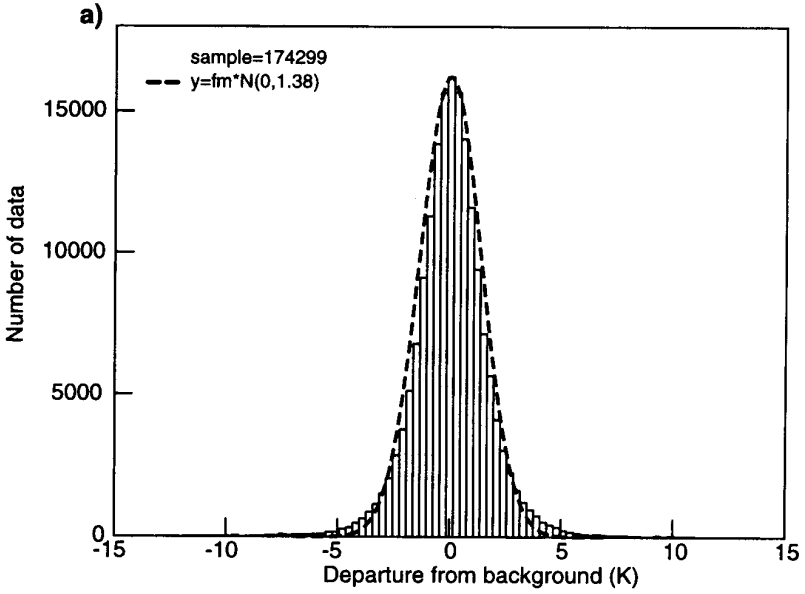
SCORES FOR VERIFICATION OF FORECASTS AGAINST OBSERVATIONS (REF-OLD)



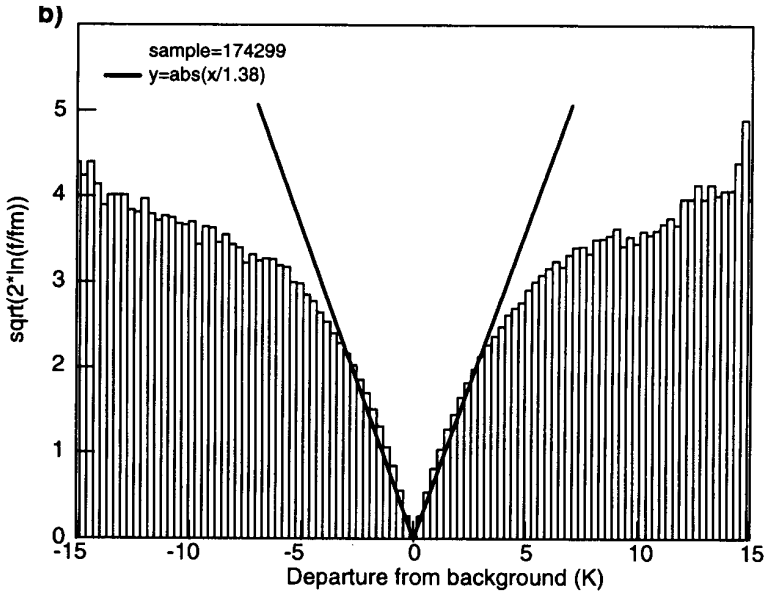


"Objective" Tuning of BgQC and VarQC

(following Andersson and Järvinen, *QJR*, 1999)



Derive histograms (*f*) of ob-bg and ob-an

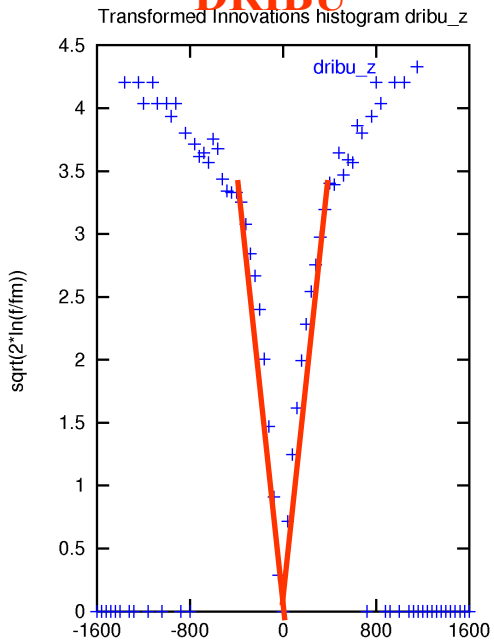


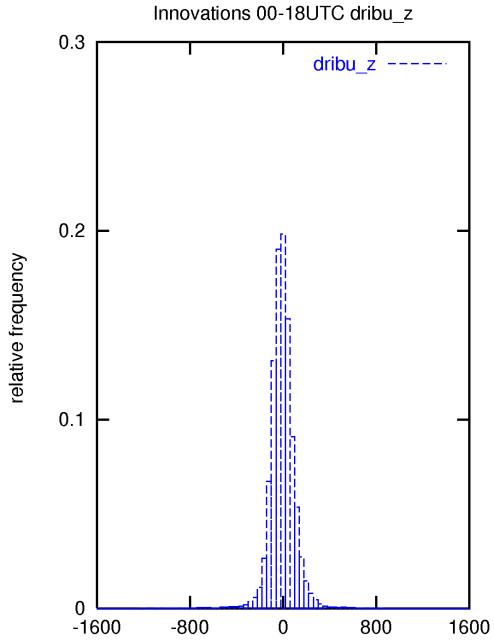
Transform histograms according to:

$$\hat{f} = \sqrt{-2\ln[f / \max(f)]}$$

Surface pressure innovation histograms (Pa)

DRIBU





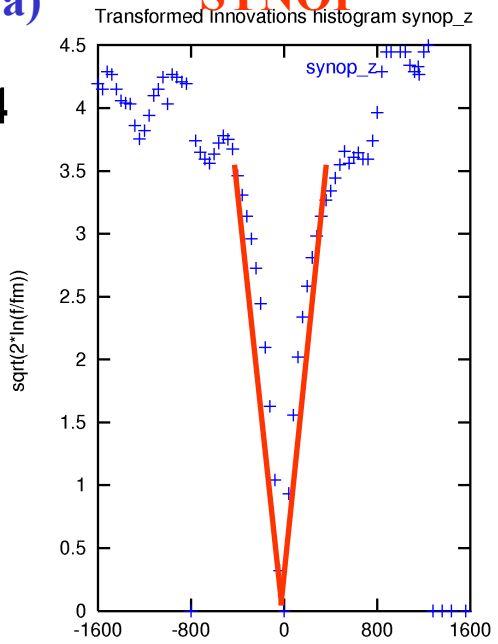
(Pa)

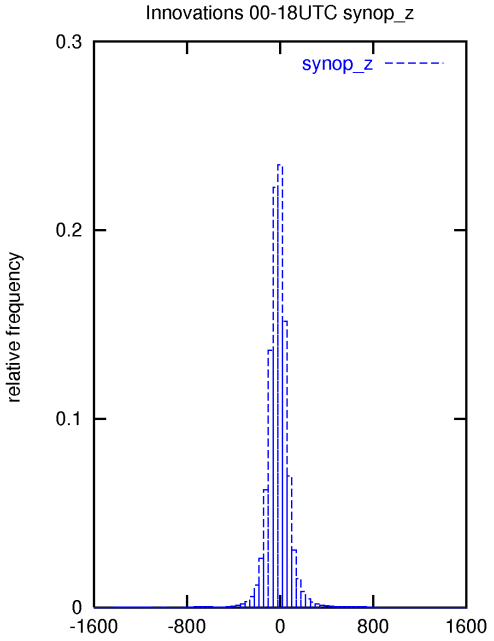
Data from 14 days of REF experiment

Transformed Histogram

Histogram

SYNOP

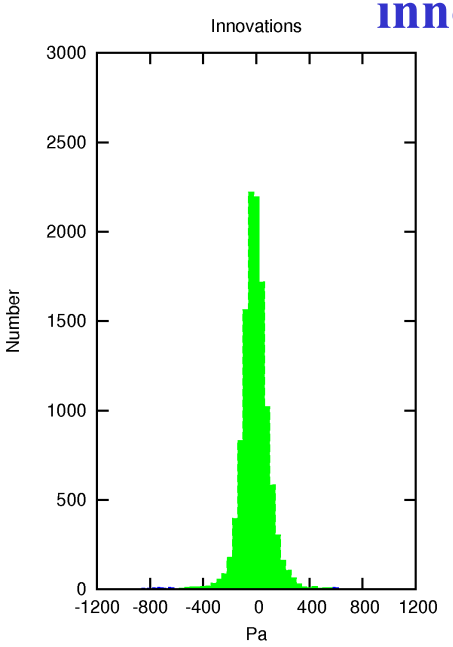


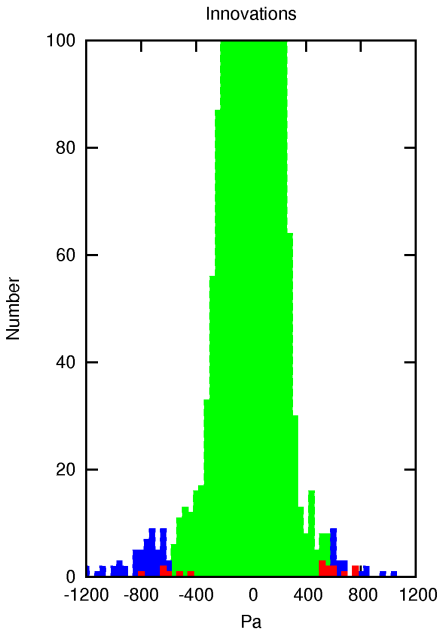


(Pa)

Surface pressure innovation histograms (Pa)

DRIBU





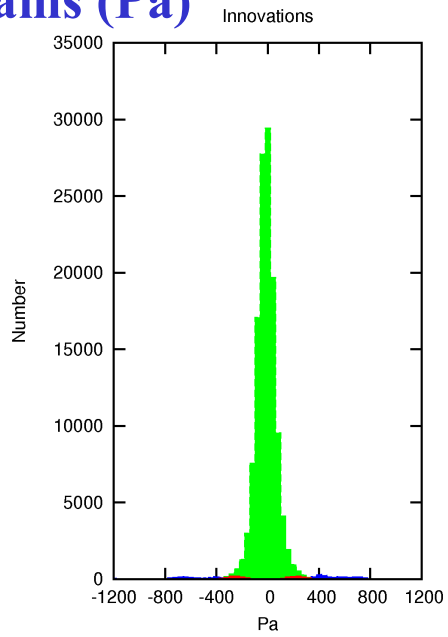
Data from 14 days of REF experiment

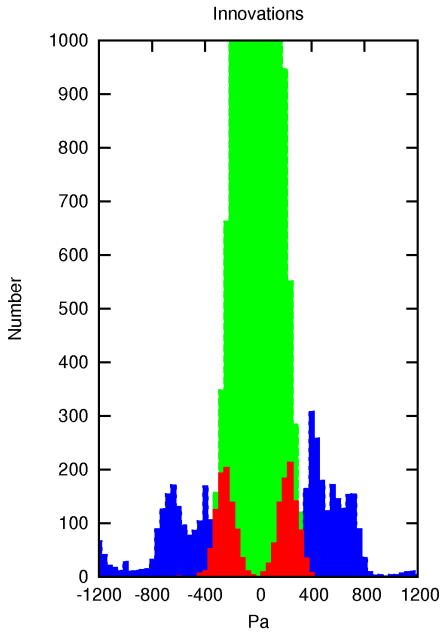
Accepted

VarQC rej

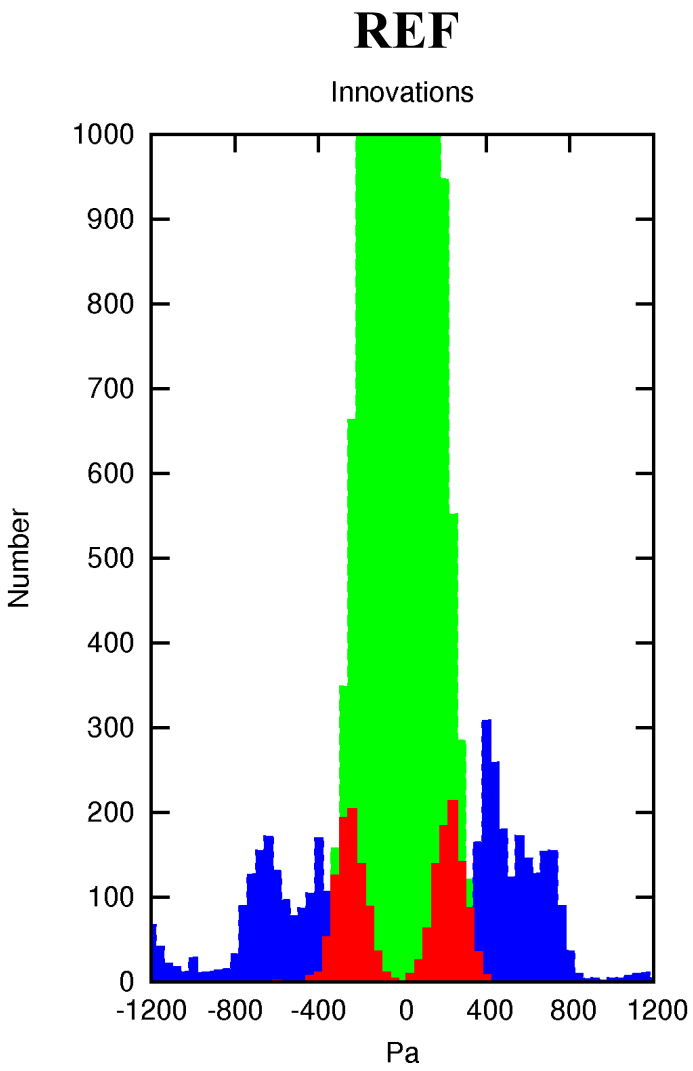
BgQC rej

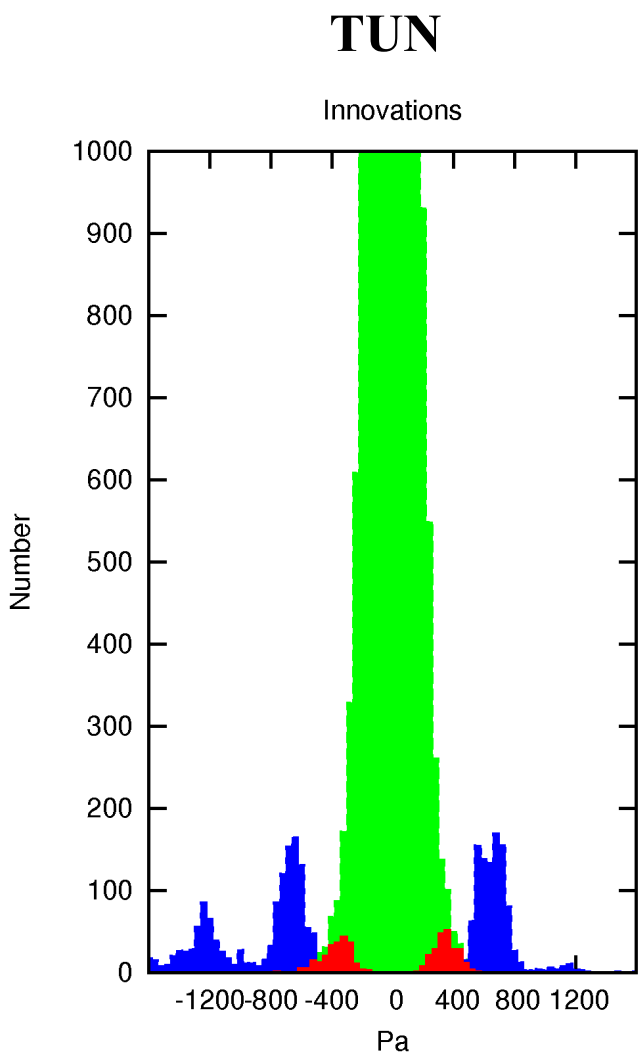
SYNOP





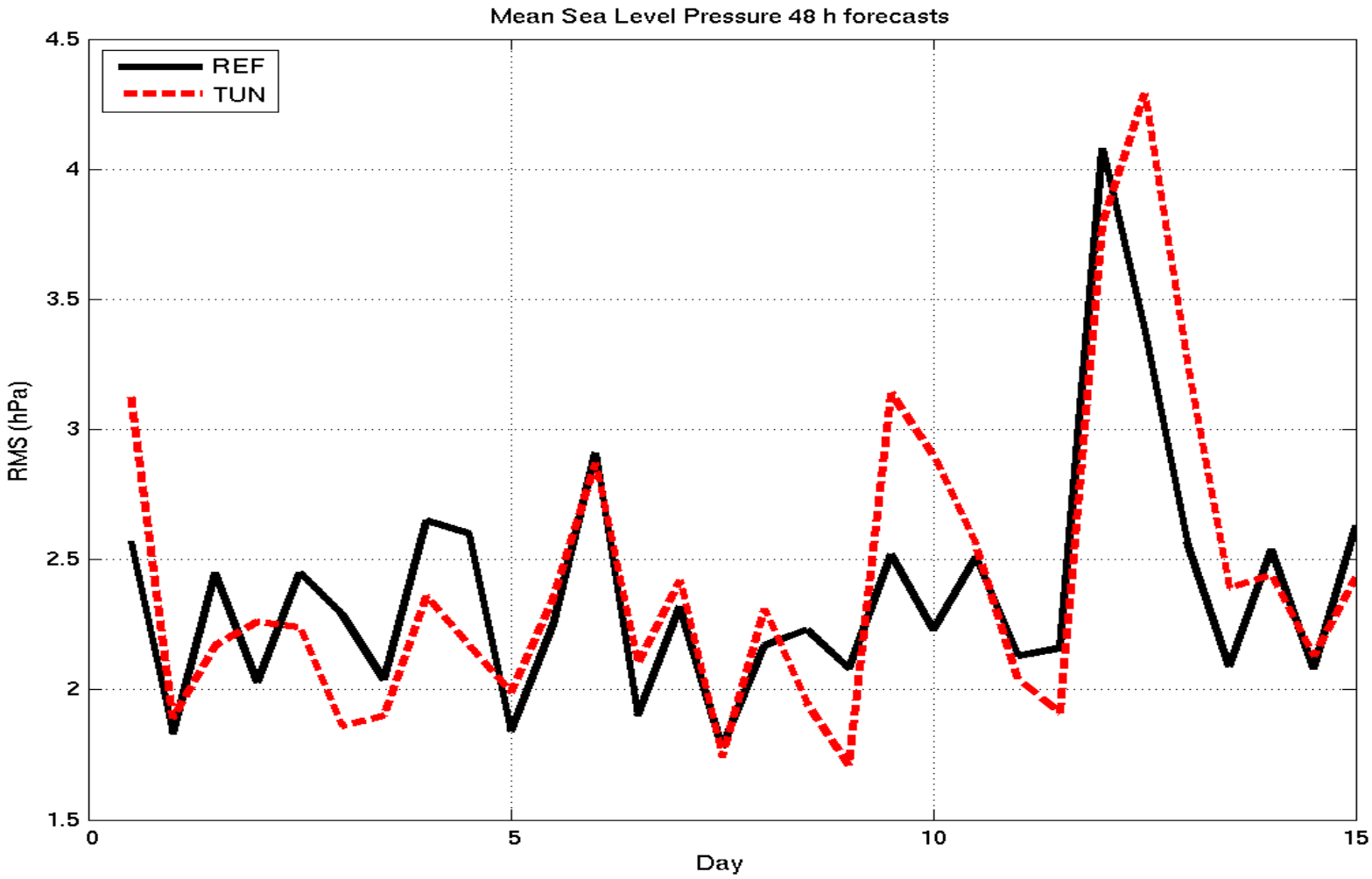
SYNOP Surface Pressure innovation histograms (Pa)





Accepted VarQC rej BgQC rej

TIME-SERIES OF SCORES FOR 48 H MSLP FORECASTS



Conclusions

- New background error standard deviations used in background check consistent with the ones used in the minimization.
- First improvement of BgQC had positive impact on forecast quality and was introduced into the HIRLAM reference system.
- Further tuning of BgQC and VarQC parameters is ongoing.
- Extended experiments as well as studies of individual cases needed.