Implementation of IASI data in ALADIN-HARMONIE/Norway

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Introduction

Assimilation and impact assessment of the Infrared Atmospheric Sounding Interferometer (IASI) data at the Norwegian Meteorological Institute (Met.no) is defined in one of the working packages of the Norwegian international Polar Year project (THORPEX-IPY/Norway). ALADIN-HARMONIE assimilation and forecasting system have been chosen for this study. Since at Met.no the operational model is the HIRLAM, the ALADIN-HARMONIE system had to be implemented first. The implementation process of the assimilation and forecasting systems are described in poster by Storto and Randriamampianina and will be presented in oral presentation given by Randriamampianina.

This poster describes the implementation of the IASI data in the ALADIN-HARMONIE/Norway assimilation system. The importance of the bias correction in the assimilation of satellite radiances is well known. In the IFS/ARPEGE/ALADIN codes, the correction of radiance biases can be done in two different ways: Bias can be estimated in off-line regime (**off-line bcor**) or adaptively using variational technique (**VarBC**). The power of both techniques will be discussed in this poster to approve our decision on using the variational bias correction technique to correct the bias of the IASI data.

IASI senses from 15.5 μm (645 cm^{-1}) to 3.62 μm (2760 cm^{-1}) with spectral resolution of 0.5 cm^{-1} (see Fig.1). The total number of IASI channels is 8461. For each view, the instrument analyses an atmospheric cell of about 50km x 50km at nadir. Each cell (filed-of-regard - FOR) is analysed simultaneously by a 2x2 array of detector (see Fig. 1) (field-of-view - FOV). The horizontal resolution varies from 12km (at nadir) to 20 km (in the edge) along the scan direction and 39 km along the track direction.
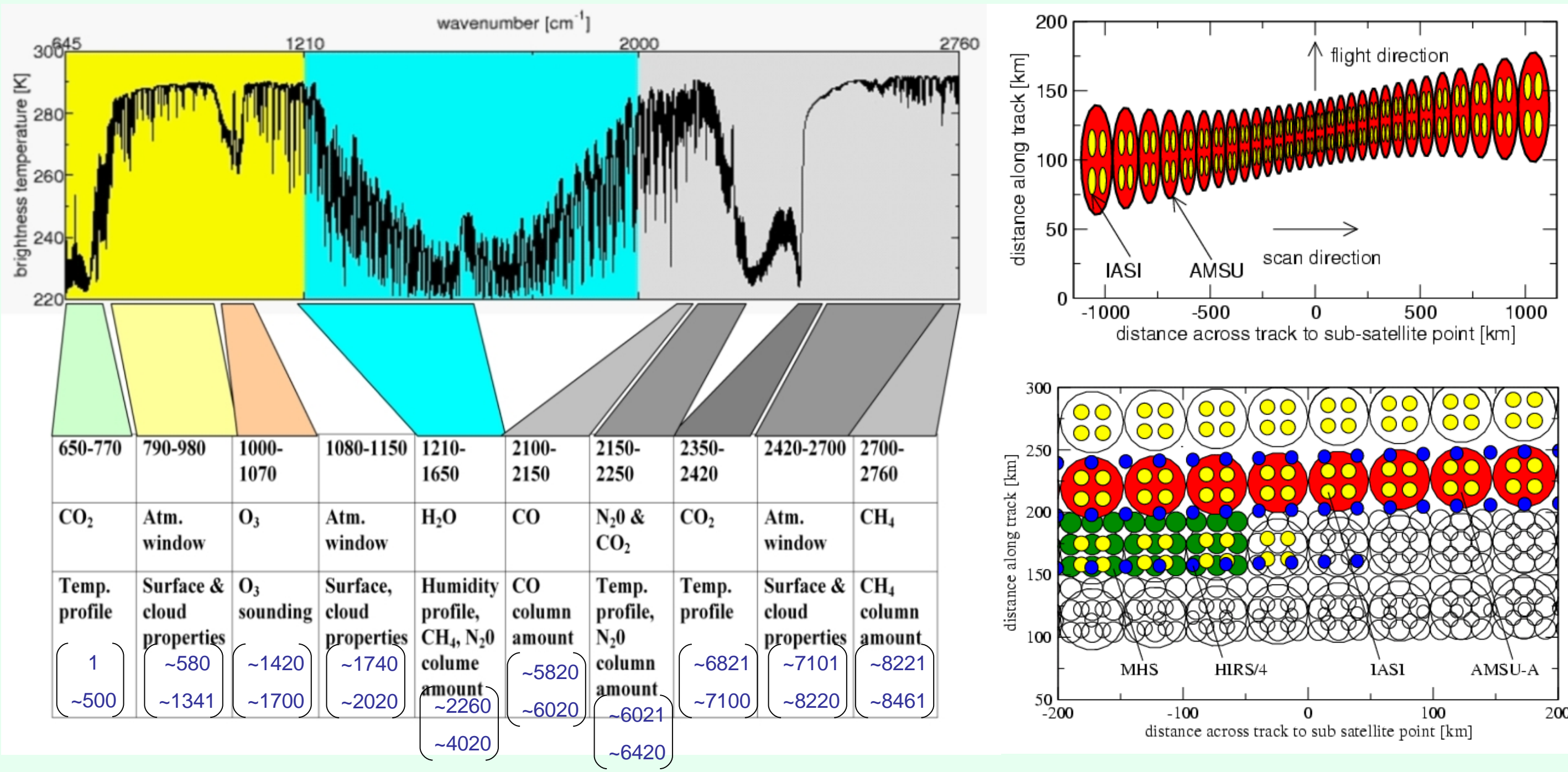

Fig.1. Different spectral bands of the IASI spectrometer (left) (approximate channel numbers are in brackets); the IASI and AMSU-A collocation (upper right) and overview of different instruments field-of-view (FOV) distribution along track and scan directions (lower right). (graphs from Collard and IASI doc files)

Main characteristics of the ALADIN-HARMONIE/Norway

→ Implemented observations

- **Conventional data**
  - SYNOP
  - BUOY
  - DRIBU
  - aircraft
  - radiosonde
  - PILOT
  - Wind-profilers
  - AMV

- **Satellite data**
  - L1C radiances from NOAA-15/16/17/18 and METOP
    - AMSU-A
    - AMSU-B
    - MHS

→ Observations under implementation
  - L1C IASI
  - L1D Seviri (See Storto and Randriamampianina, poster)
  - GPS Zenith Total Delay (See Storto and Randriamampianina, poster)

Small domain: rotated Lambert pr.
Dx=dy= 11 km, 60 vertical levels up to 0.2 hPa

Big domain: polar stereographic pr.
Dx=dy= 16 km, 60 vertical levels up to 0.2 hPa

Fig.2. The chosen two domains

Fig.3. Comparison of the statistics (left for vorticity and right for humidity) specific to both domains. Red refers to big domain and black to small one.

Monitoring of the IASI data

A set of 366 channels, provided by Andrew Collard from the ECMWF was used in this study. One FOV of four of each FOR's is extracted guaranteeing one IASI FOV for each AMSU-A FOV. FOVs corresponding to 3 AMSU-A FOVs (FOV with number less than 12 and bigger than 109) on both edges of the satellite track are rejected to avoid large bias.
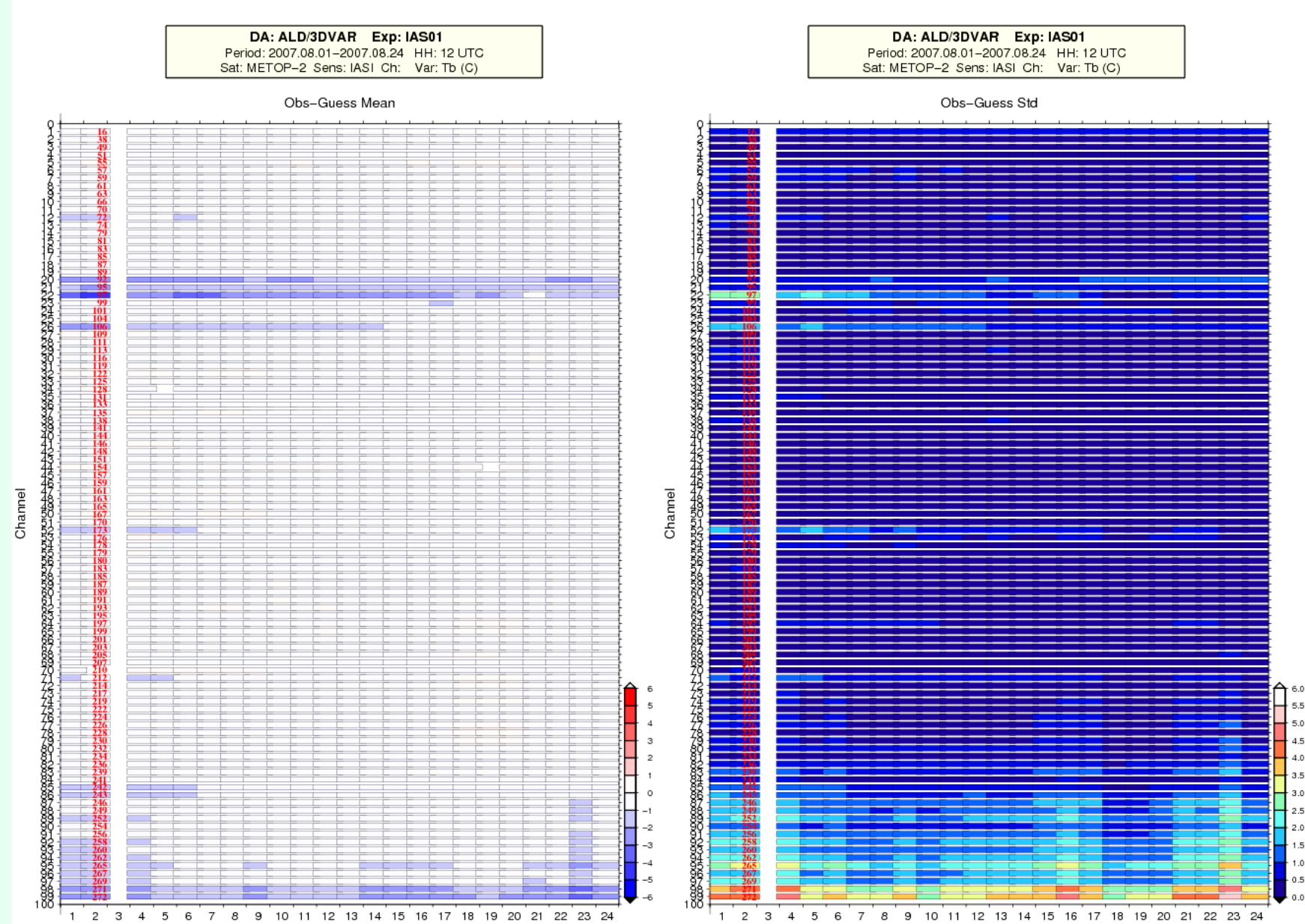

Fig. 8. Channels "obeying" the variational bias correction were privileged during the selection of channels to be used.
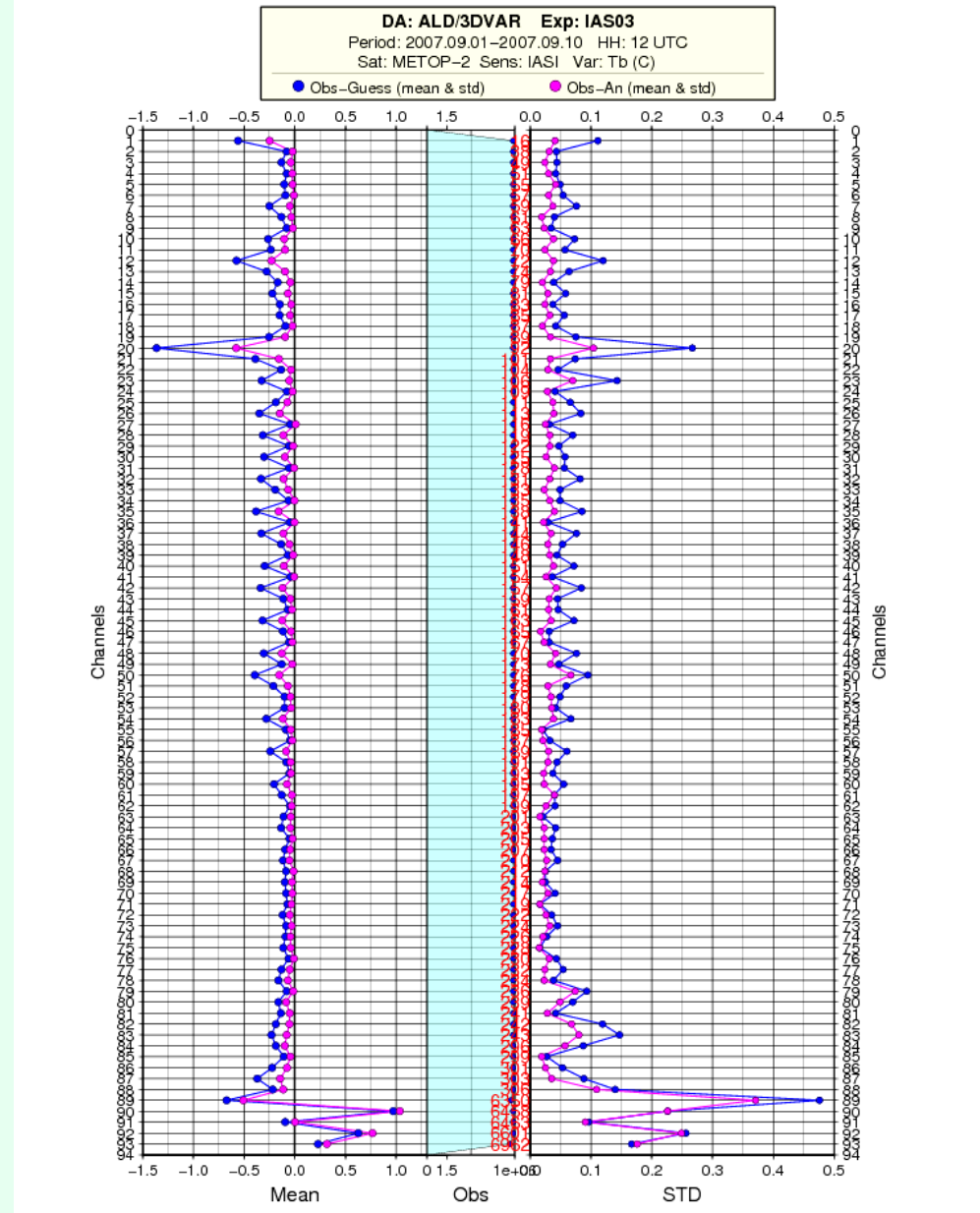
Fig. 9. Bias and standard deviation of the chosen 93 channels.

The preliminary assimilation trails

IAS01 – analysis using IASI data without cycling for updating the VarBC tables

IAS02 – run without IASI data

IAS03 – first trial of IASI data assimilation using temperature channels without using humidity surface or column channels over sea only. The observation errors were set as follows: 0.2K for CO2 band, 1K for window channels, 2K for water vapour channels

IAS04 – run without IASI data where bias correction for radiances is corrected using off-line bcor

IAS05 – as IAS03, but observation error for CO2 band, water vapour channels were set as 0.5K and 4K, respectively. The cloud detection scheme was improved. Stratospheric channels were used over sea and land.
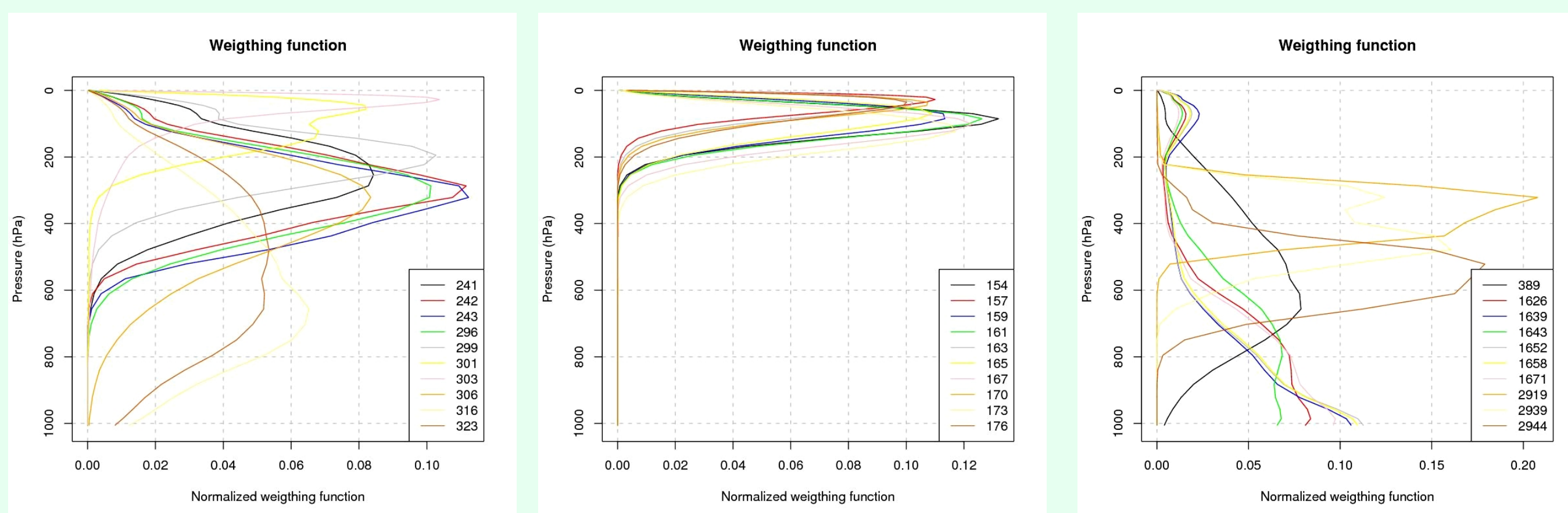

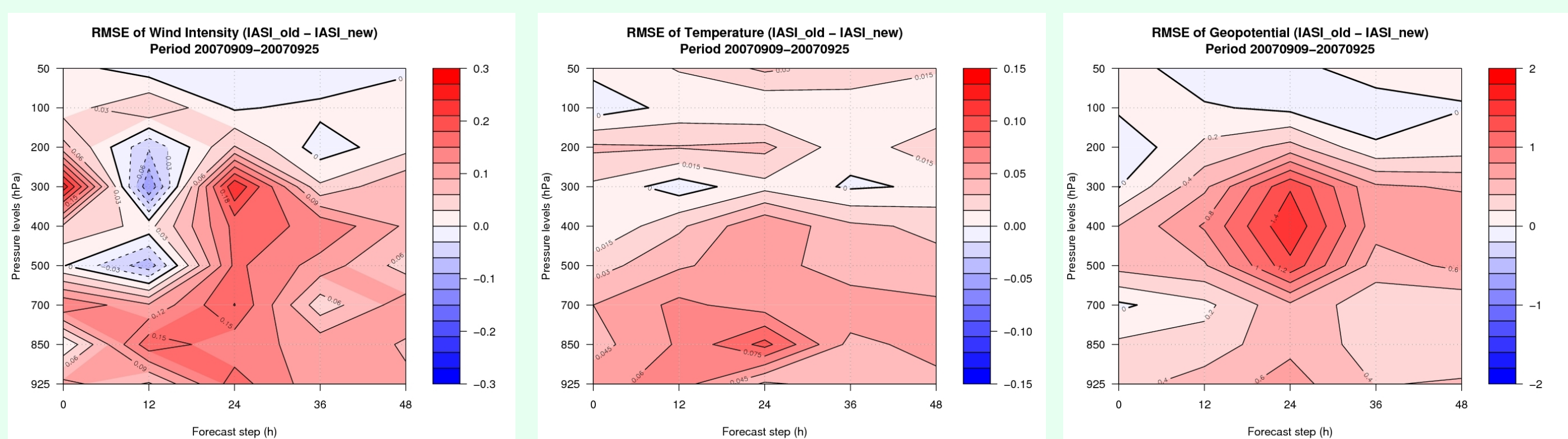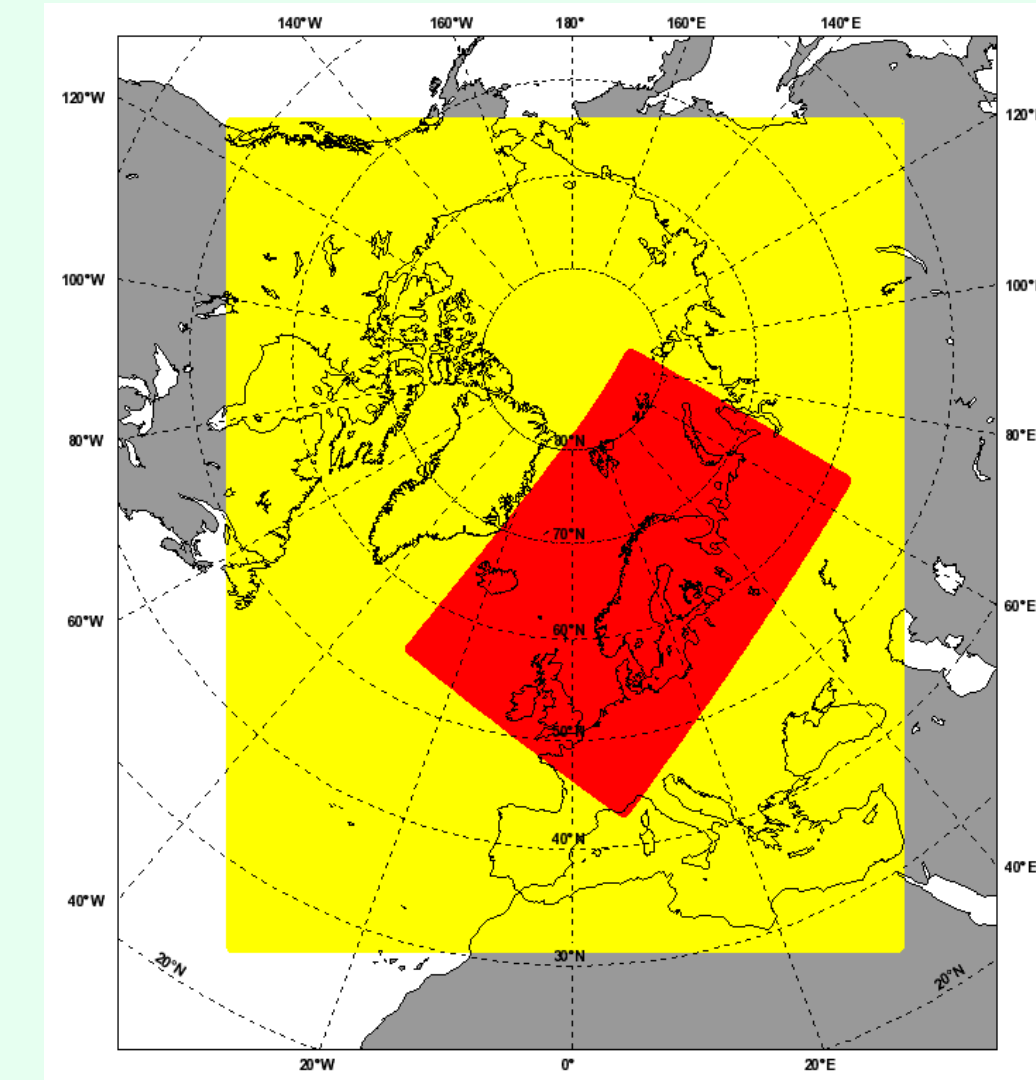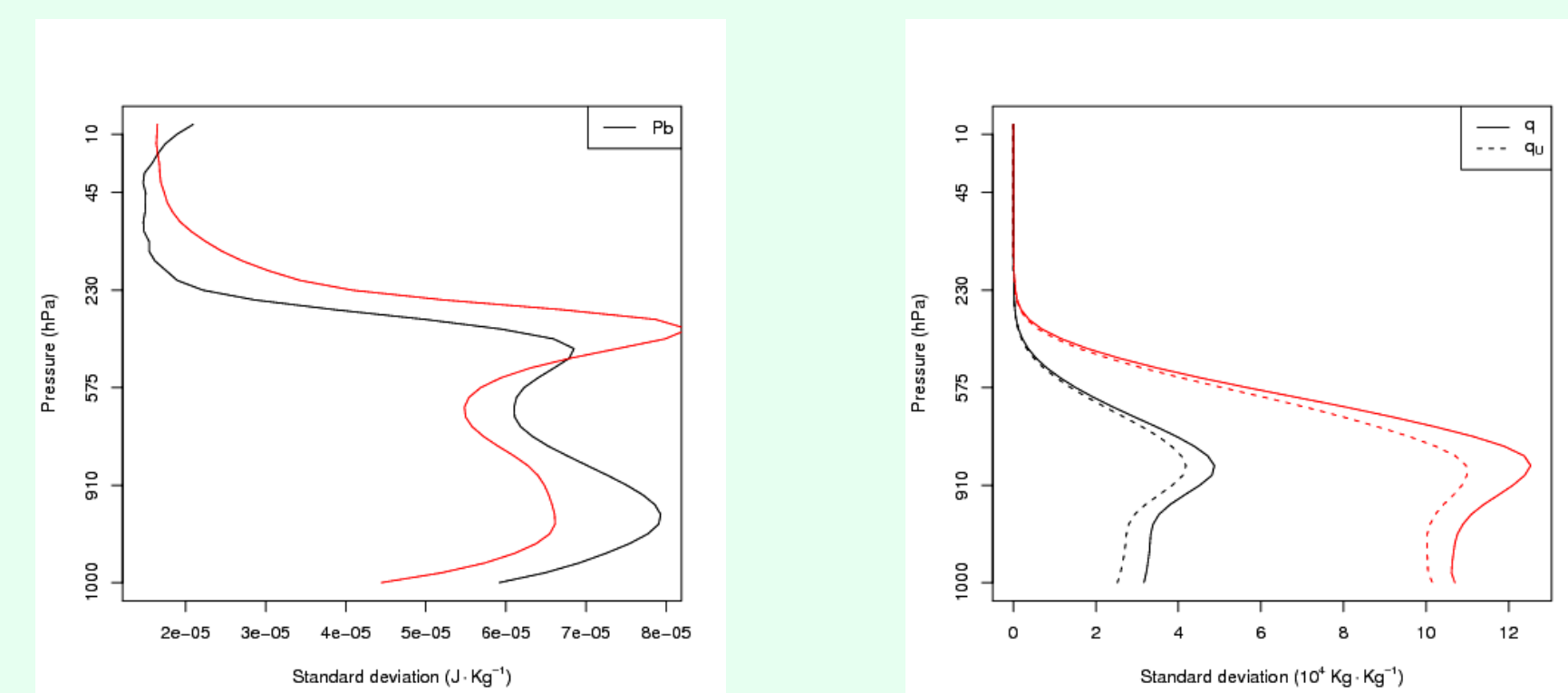**Fig. 10.** Examples of weighting functions of IASI channels.

Fig. 11. RMSE difference between IAS03 (IASI_old) and IAS05 (IASI_new) runs

Variational bias correction setup

We use the CY33T0 for the implementation of the IASI data. After small modification in the code, we could set up the VaBC tables doing 2-months (from 01.07.2007 till 31.08.2007) analysis (screening and minimisation) using on top of all conventional data, the AMSU-A, AMSU-B/MHS and IASI radiances. The setup started with coldstart and zero coefficients.
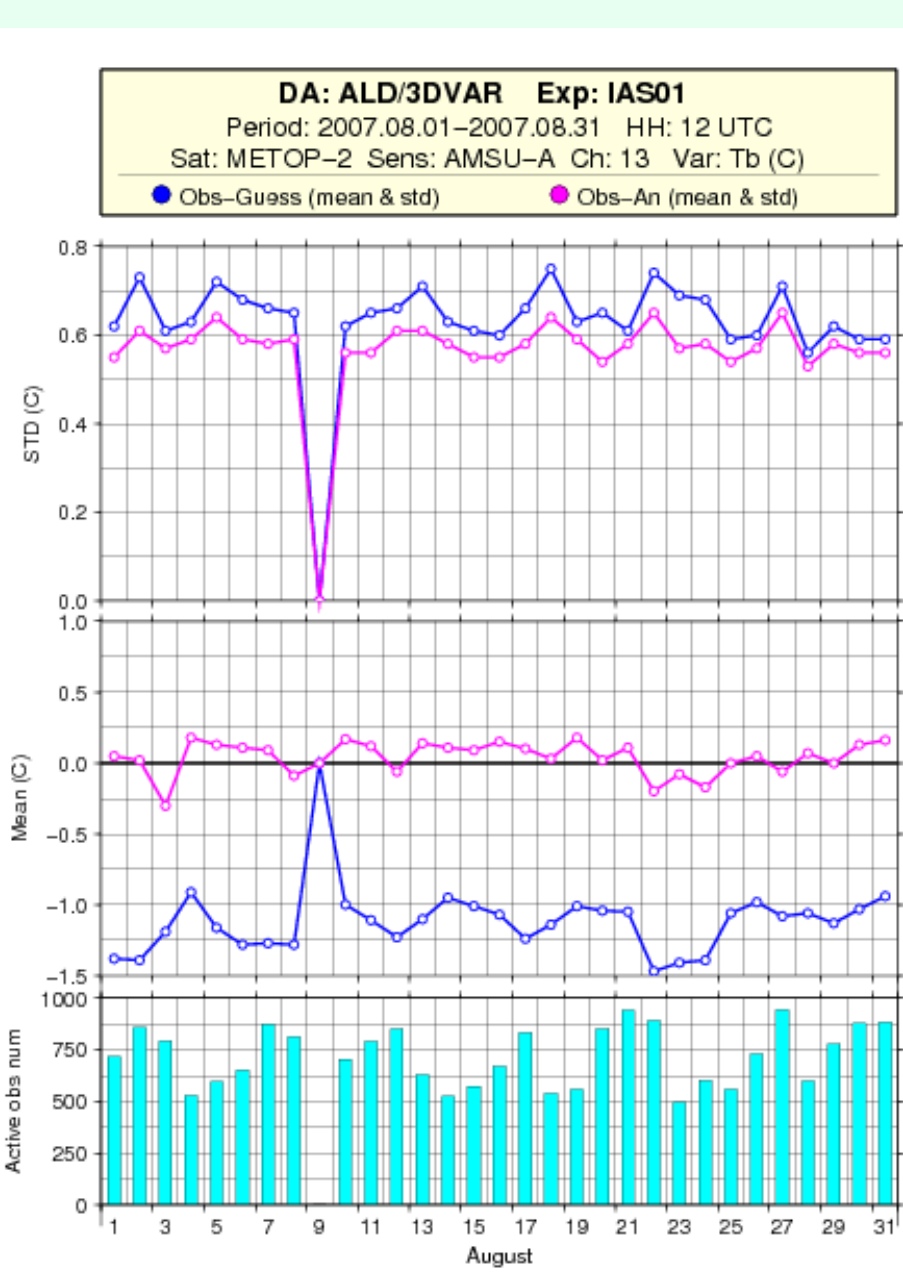

Fig. 4. Monitoring the channel 13 of the AMSU-A from METOP-2 satellite during the last month of set up time.
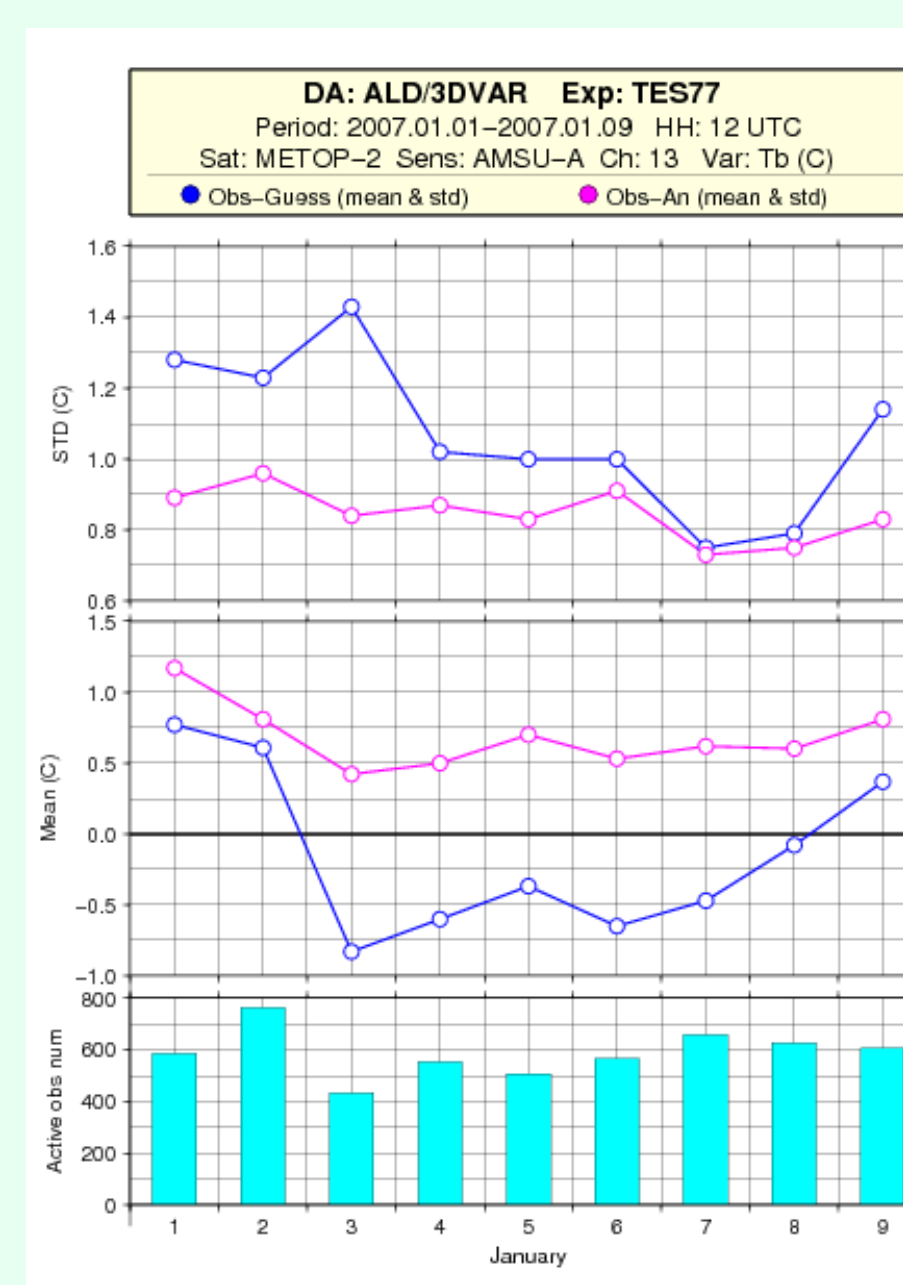
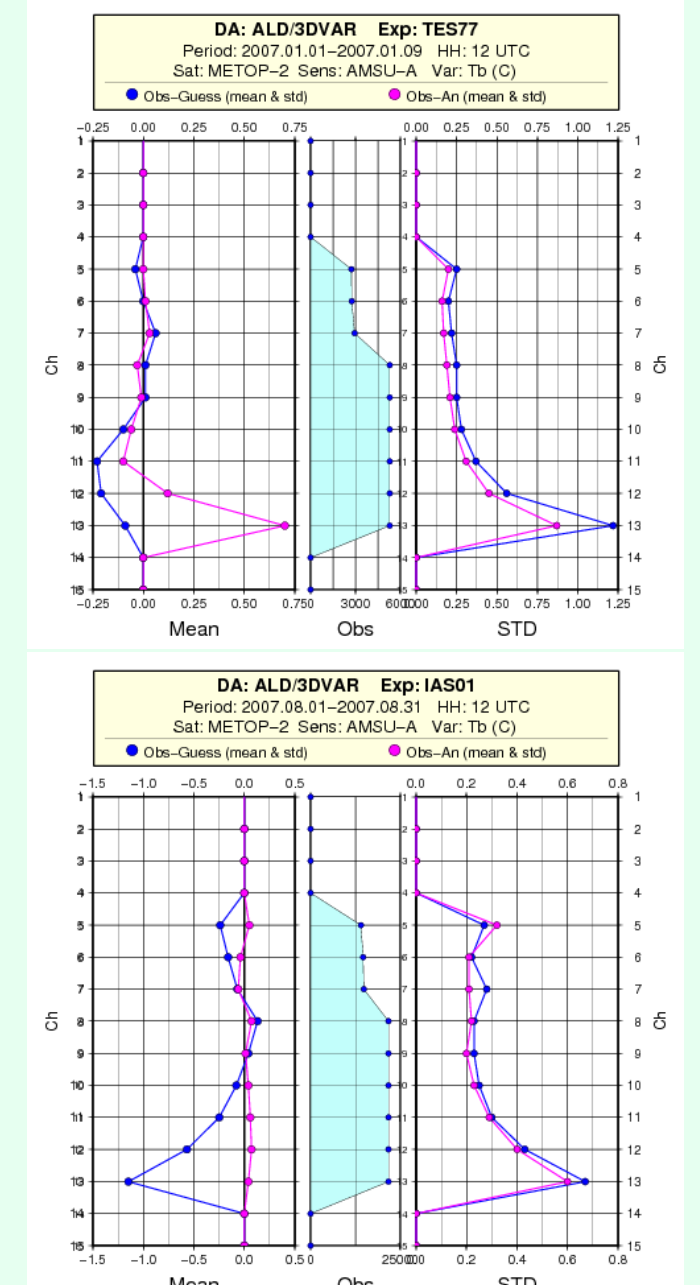**Fig. 5.** Monitoring the channel 13 of the AMSU-A from METOP-2 satellite using off-line bcor.

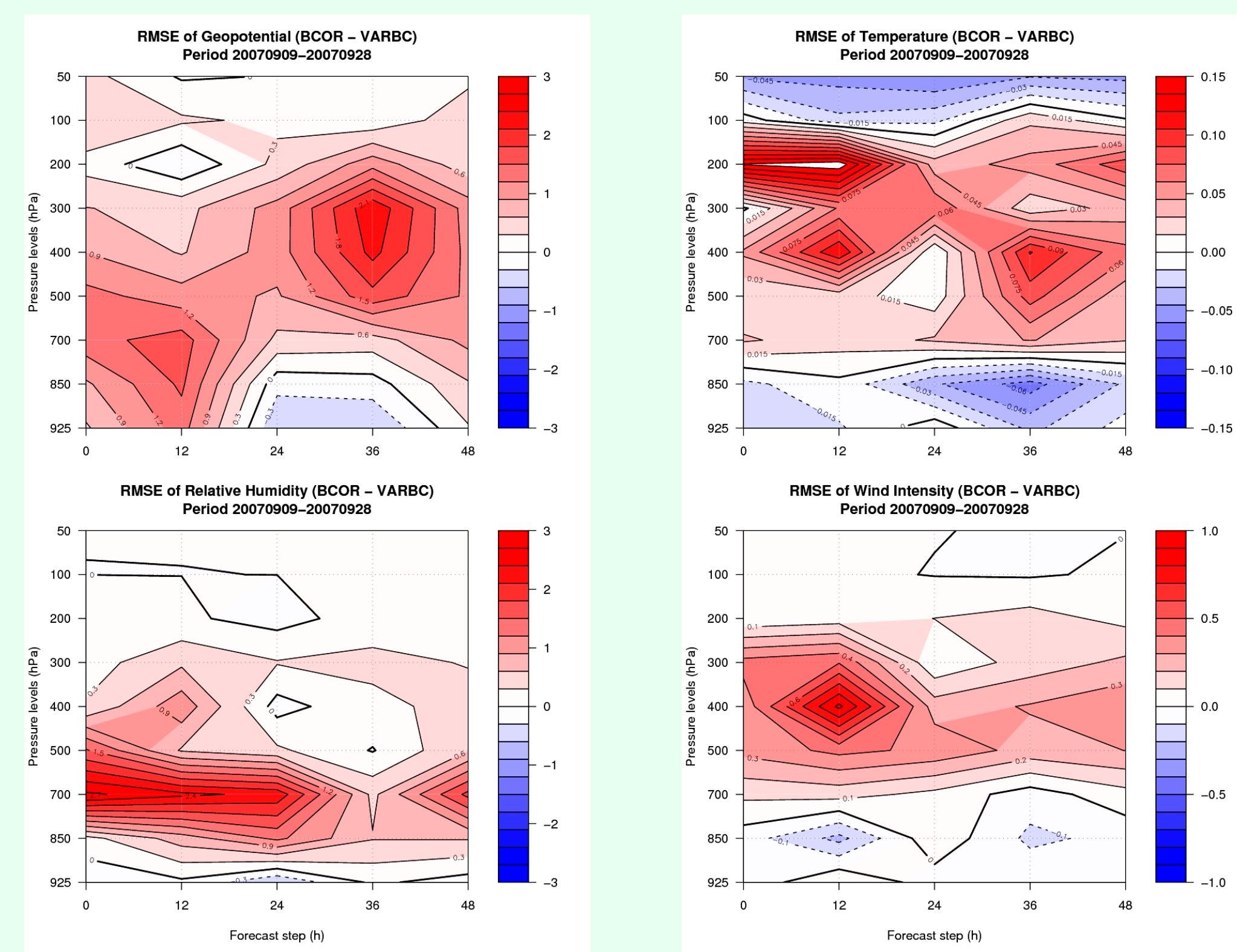**Fig. 6.** The power of off-line bcor (upper case) and VarBC (lower case).

Fig. 7. RMSE differences between runs with off-line bcor and variational bias corrections

Conclusions

Variational bias correction was found to be very efficient in reducing the analysis bias. Compared to the off-line bcor, the variational technique had large positive impact on the analysis and forecast. VarBC tables for satellite radiance assimilation were estimated and tested. Use of stratospheric channels over land and tuning of the cloud detection scheme improved the outcomes of the assimilation of IASI data, even thought the overall impact of the IASI data remained slightly negative.