Further tuning of the variational bias correction scheme in the HARMONIE Model (Lindskog et al., 2012) (having a spin up of predictor parameters within reasonable time)

- How to start new experiment without (bias) information from global Models? → Do passive assimilation or independent analysis.

- How to aggregate the bias coefficients for new experiment?
  → In case of variational scheme, Randriamampianina et al. (2011) recommended to estimate the bias coefficients with 24 hour cycling. So, each assimilation time will have its own aggregated coefficients. Note also Lindskog et al. (2012) and Benacek (2013). For off-line (Harriss and Kelly, 2001) case at MetOffice Fiona Smith have got a very promising results when checking few days statistics with daily (24 hour cycling) aggregates:
  - Can coefficients from global model help in doing warm start?
  - No clear answer yet on this question. Benacek (2013) have got promising (better convergence to the nominal bias) results when using operational forecasts from ECMWF model. But can HARMONIE/Hungary use the ECMWF forecasts as lateral boundary condition. Do you have experience on this issue, please share it with us. Give your e-mail address with short comment in the box below.

- How can we use high peaking channels (around or above the model top), when having high top coupling model available?
  → Do you have answer on this? Please share it with us. Use the box below.

Further tuning of the variational bias correction scheme with the ALADIN/Hungary Model (Benacek, 2013) (Improving the use of low peaking channels)

Bias correction

Satellite bias was corrected using VarBC method. This method is based on multivariate linear regression implemented into the variational 3D-Var scheme. The set of predictors are described in the Tab. 1. The stratrophic predictors 5 and 6 were not used due to the sparse model levels in the stratosphere.

Regression coefficients have been initialized from global model ECMWF (warm start) and updated in each assimilation time (24h cycling). Satellite data have been assimilated passively.

A problem with IASIS data re-rejection (in quality control) was found due to the cloud contamination. This problem is related with cloud detection scheme used for high-spectral satellite instrument like IASI, AIRS and OIS. This algorithm is based on the assumption that observation departures are unbiased. However, the satellite data have relatively larger bias in the beginning of the passive assimilation experiment, which leads to a data rejection (this phenomenon occurs over middle tropospheric areas).

One evident feature of Figure 1 is that there appears to be a strong correlation between predictors 0 and 2. It might be that they should not be used together. To investigate that, an additional experiment was carried out. The additional experiment was identical to the one with NBG value of 2500, except for that predictor 2 was removed. As result, the predictor 0 is almost doubled (Fig. 2). as was expected from the parallel evolution of predictors 0 and 2. The conclusion is that it is sufficient to use predictor 0 and not both 0 and 2, as the default for the HARMONIE system.

On the use of satellite radiances in regional models

Applying Lindskog et al. (2012) solution in the implementation of the IASI humidity sensitive radiances in the AROME-Norway data assimilation system

The AROME-Norway and RT model:

- The overall results are shown in the Figure 3; The model top is at 10 hPa;
- Use of full FOVs both for ATOVS and IASI.

Radiance bias correction coefficients update:

- Coefficients for VarBC estimated for August 2011.
- Coefficients for VarBC estimated for August 2011.
- RT model use RTTOV version 9; The model top is 10 hPa;
- The AROME-Norway and RT model:
  - Channels selection:
    - For ATOVS-A, channels 5-10: All channels peaking above 10 hPa are blacklisted for both ATOVS and IASI with more emphasis on humidity sensitive channels (38 of overall 73).
    - Avoiding humidity channels that are sensitive to relatively thin tropospheric layers, we ended up to 22 active humidity sensitive channels.
  - For IASI4, both for ATOVS and IASI.

Experiments design:

- METAT0 - reference run with conventional and ATOSV data;
- METIASI - run with reference data and all 73 IASI channels;
- METASISU - run with reference data and 38 humidity channels;
- METASISLY - run with reference data and 22 humidity channels.

Period: September 1-30, 2011, with the first 4 days a warming period

Case study: Case of September 12 at 00 UTC

Figure 9.

Figure 8.

Further icing to the cloud detection scheme.

Improved use of low peaking channels

A selection of clear-sky radiance was validated for random day to check the functionality of the cloud detection scheme. We compared a clear-sky pixel selection with cloud-type (CT) from SAF-NWC for selected IASI channels. The validation is shown for the “middle-peaking” channel 246 in the Fig 6. It is obvious that the pixels (red points) are selected from the clear-sky conditions, whereas data contaminated by high/middle cloud types (pink/white colour) are rejected. Note that clear-sky radiation for middle-peaking channels are also selected over very-low clouds (the orange points over the North Sea).

Figure 10.

Experiments design:

- ATOVS - Operational setting using conventional and ATOSV data;
- NIHPR - Operational setting using the newly estimated bcor coefficients;
- IASIS - Run with IASI radiances using data from C10 band and window channels.

The IASI data has slightly positive impact on temperature for a lower troposphere temperature (700 hPa) and wind speed in a middle troposphere (300 hPa). Slightly degradation was detected for wind speed in 200 hPa. The main impact of IASI data was evaluated for precipitation. We found clear improvement in the forecast of heavy precipitating area above 300 hPa and slight degradation for the low precipitating area (between 1.11 mm/12h).

References