

Use of satellite data in ALADIN/HARMONIE-Norway



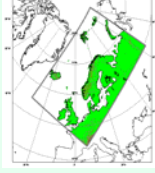
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Introduction

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AMSU-A	5 to 13	Air-mass and scan bias correction	80 Km horizontal
AMSU-B, MHS	3, 4, 5	Air-mass and scan bias correction	80 Km horizontal



The system takes also advantage of surface analysis by the use of RH and T measurements at 2 meters and wind measurements at 10 m from synoptic stations. The domain (shown above) has a resolution of 11 Km for a 400x270 computational grid centred over Norway.

Assessment of a strategy for assimilating MHS radiances is not shown here but presented in a separate poster (By R. Randriamampianina).

Degrees of Freedom for Signal

Degrees of freedom for signal (DFS) indicate the self-sensitivity of analysis to different observation types; they are given by the derivative of the analysis, in observation space, with respect to the observations, and are sensitive to the weight of the observations and to the observation operator formulation. DFS have been computed perturbing all the observations for 5 independent assimilation cycles. Results show that the most important observations in terms of information content carried into the analysis are the wind observations (AIREP, TEMP and PILOT, although the latter are only a few). AMSU-A radiances are very important as well, and also AMSU-B show to have a big information content. Humidity observations (from TEMP) have a great impact on the analysis but there are too little of them in the assimilation system. Addition of SEVIRI data in the system slightly reduced the contribution from all the other observations, especially from the "dominant" one, i.e. AIREP and AMSU-A. The use of variational bias correction technique to correct the bias of all radiances emphasizes the information content of all the observations since they are better assimilated. This is true not only for satellite data but also for conventional data.

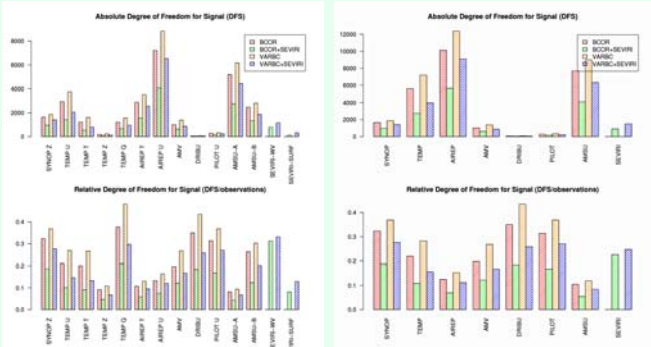


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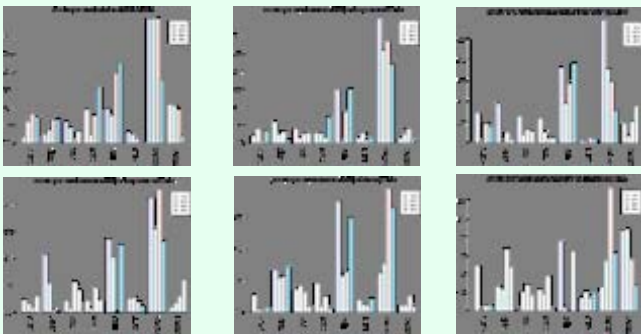


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According to our results, **AMSU-A data** have the most remarkable impact on forecasts, at all the forecast ranges.

A positive impact of **CloudSat data** - especially on the mass fields - was found against observations in a short period study.

Impact of **SEVIRI data** on humidity forecasts was found to be positive.

We concluded, that the use of background errors derived through **ensemble techniques** could contribute to the optimal assimilation of observations.

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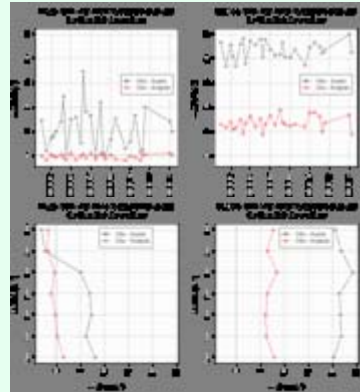


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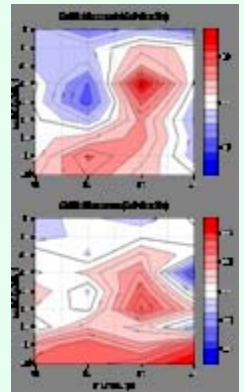


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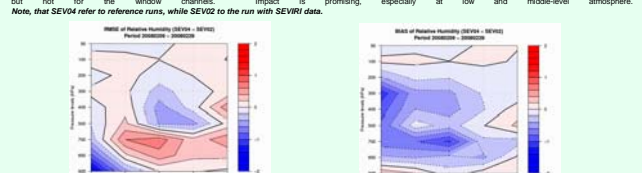


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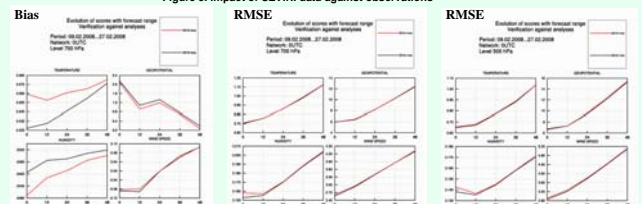


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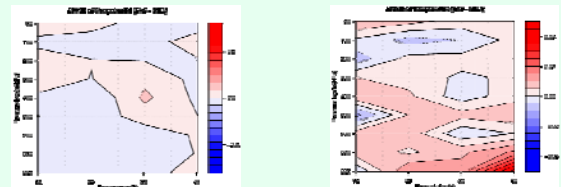


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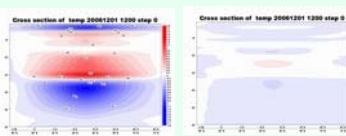


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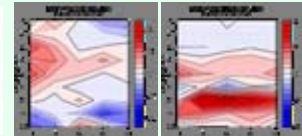


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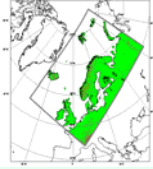
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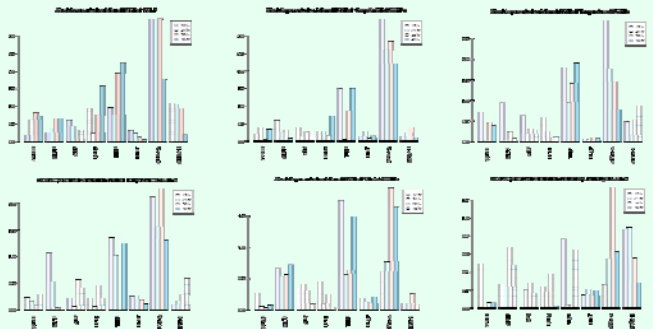


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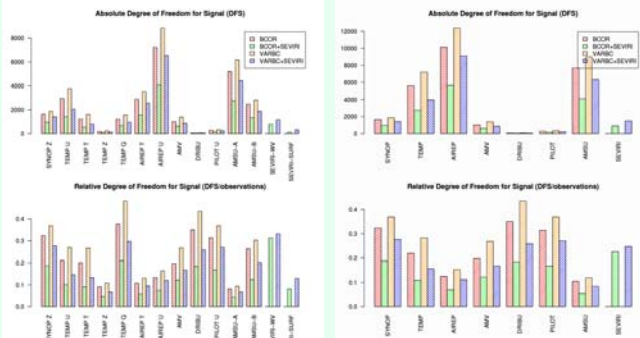


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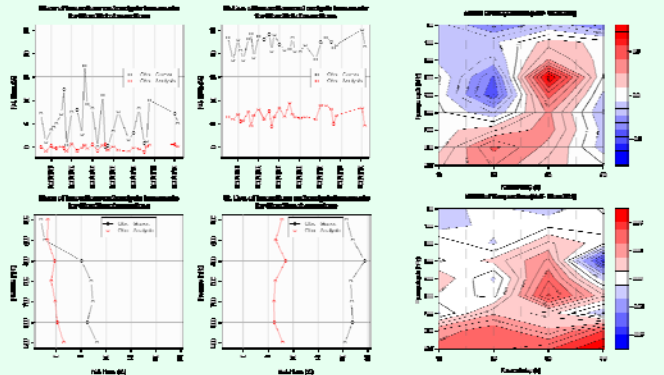


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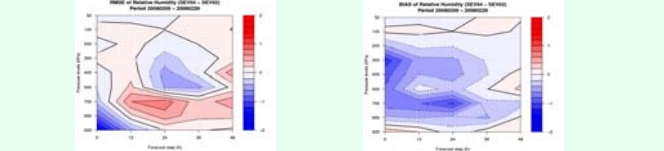


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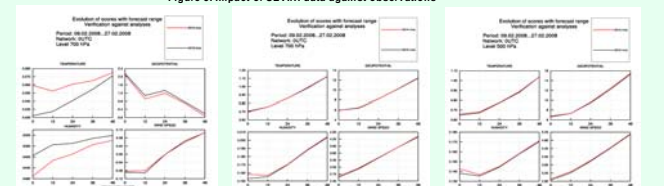


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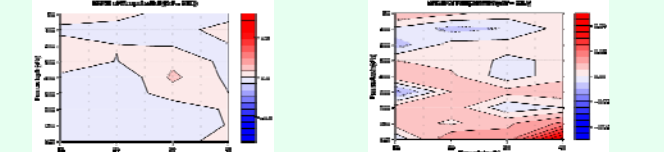


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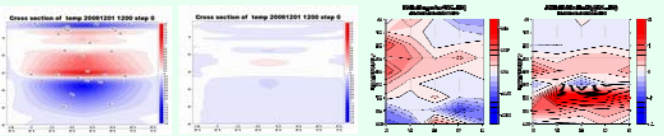


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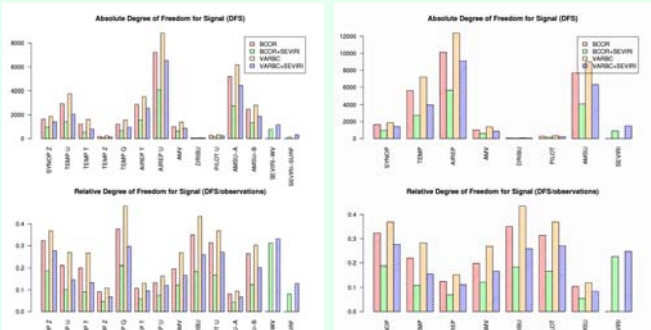


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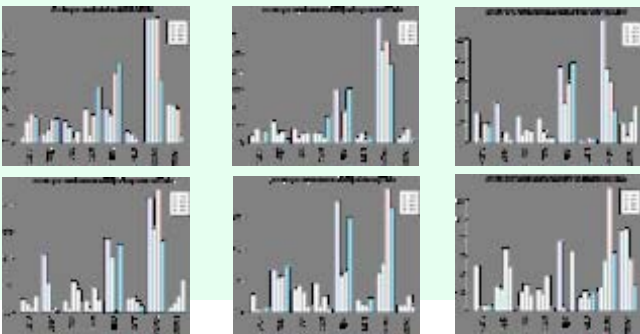


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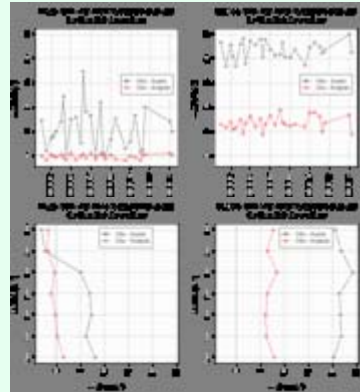


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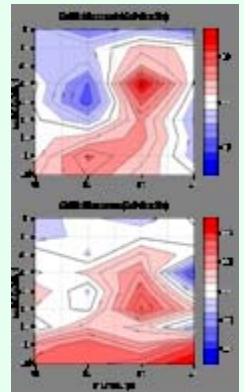


Figure 4. Radiosonde verification scores against experiment with all observations in Table 1 but without CloudSat assimilation.

SEVIRI data: First assimilation trials have also been run with SEVIRI Infrared radiances (channels 5, 6 in clear-sky or above mid-level clouds conditions, channels 7, 9 and 10 in clear-sky above sea). An air-mass bias correction scheme was used, not varying latitudinally, provides reasonable analysis increments for WV channels (5 and 6) but not for the window channels. The impact is promising, especially at low and middle-level atmosphere. Note, that SEV04 refer to reference runs, while SEV2 to the run with SEVIRI data.

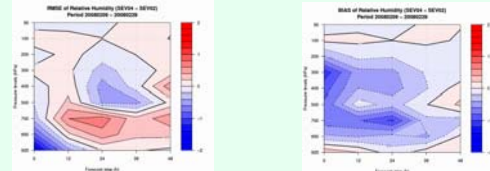


Figure 5. Impact of SEVIRI data against observations

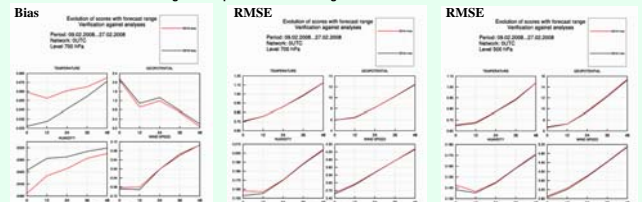


Figure 6. Impact of SEVIRI data against analyses

GPS ZTD data: A feasibility study for the assimilation of GPS Zenith Total Delay has been carried out through the creation of a dataset of reliable GPS stations and data processing centre. This approach led to 52 assimilable stations over the Norwegian domain. Trials experiment, that used an overestimation of the delay errors through the observations minus guess standard deviations have been performed over one month (Feb. 2008). A flat bias correction is used. Impact on verification against TEMP is small for all the parameters except for temperature, where it is positive in general. A more rigorous formulation of observations errors is under evaluation.

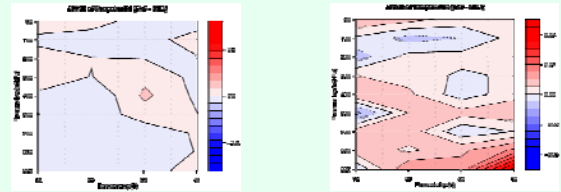


Figure 7. Impact of GPS ZTD data on forecast of geopotential and temperature

B covariances from downscaled ensemble analysis

In order to exit background covariances typical of small scales, ensemble analysis generated at ECMWF (kindly provided by Lars Isaksson) by perturbing observations in the assimilation, have been used after downscaling as initial and lateral boundary conditions for ALADIN/HARMONIE-Norway 6 hours forecasts. The experiment used all the original 10 members, for a period of 1 month (two daily runs), and differences between the true state of the atmosphere and the model forecasts have been simulated as differences between the ensemble mean and the forecasts coming from each of 10 members initial conditions. Background error covariances follow Lok Berre's formulation. Results have been extensively compared with background error covariances obtained through the "NMC" method, for a winter three-months dataset of differences between 48 and 24 hours forecasts. The use of ensemble analysis produced much shorter correlations, especially on the vertical covariances and at large horizontal scales. Variances and cross-covariances present a very similar structure in the two B statistics. Analysis initialized by 3DVAR using ensemble-derived statistics result closer to the background, and the forecasts show a better verification scores after day 1. The two cross-sections on the left show different analysis increments for a 2 K single-obs innovation (brightness temperature for the channel 9 from NOAA-18), NMC B (left) against Ensemble B (right). Differences in analysis increments are very big. Verification (right side) compare an NMC-based experiment against an Ensemble-B experiment.

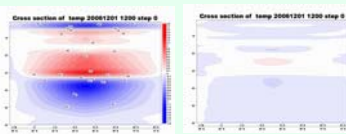


Figure 8. Analysis increments for a 2 K single-obs innovation (brightness temperature for the channel 9 from NOAA-18)

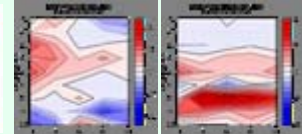


Figure 9. Comparison of an NMC-based experiment against an Ensemble-B experiment