

Operational use of Satellite Radiances at Deutscher Wetterdienst

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The operational use of satellite radiances of the polar orbiting satellites has changed at DWD on 4 January 2005. Hitherto satellite products (SATEMS) were assimilated with the optimal interpolation scheme OI of DWD that provides the analysis for the operational global model GME. The SATEMS consist of profiles of temperature and humidity that are statistically derived by NOAA/NESDIS from the satellite radiances.

The new method applies a one dimensional variational analysis (1DVAR) in order to retrieve profiles that are assimilated at a second step in a similar way as the former SATEM data. Short term forecasts (3-hourly cycles) are used as background and first guess for the minimisation of 1DVAR.

During development of 1DVAR it was experienced that inconsistencies in vertical interpolations of the first guess profiles in OI and 1DVAR caused spurious biases. Being very small for one single assimilation step they accumulated to harmful sizes during several days. As a remedy only the analysis increments of 1DVAR (the differences to the first guess) are assimilated therefore and not the analysed values themselves.

Vertical background errors have been derived using the NMC-method with differences of 12 and 24 hourly forecasts valid for the same time. The sizes of background and observation errors have been tuned in order to provide best collocation of the 1DVAR retrievals compared to IFS analyses (Hess, 2005). As the top of the GME model is limited at 10 hPa, stratospheric fields are required for the radiative transfer simulation which is carried out using RTTOV-7. For that reason 12 to 33 hourly forecasts based on the previous 12 UTC analysis of IFS are received from ECMWF that are computed and arrive timely for the main forecasts runs at DWD. Bias correction is based on Eyre (1992) using scan angle and air mass correction, the latter with observed radiances of channels AMSU-A 4 and 9 as predictors.

Currently AMSU-A data of the satellites NOAA-15, NOAA-16 and AQUA are processed and assimilated. The use of NOAA-18 data is being prepared. Only temperature profiles are extracted for the time being, as the assimilation of humidity is deferred until HIRS and AMSU-B radiances are prepared for 1DVAR.

Figure 1 displays the observation coverage of a 3-hourly assimilation cycle. Data over land are removed during preprocessing, data with precipitation and sea ice are rejected during 1DVAR. The applied 1DVAR shows a significant improvement in forecast skill compared to the former use of SATEMS especially for the southern hemisphere where the data coverage of conventional observations is poor. Anomaly scores for 500 hPa geopotential height for a trial forecast run are given in Fig. 2.

Future plans are the assimilation of humidity and the assimilation of highly spectrally resolved infrared data from AIRS and IASI.

References:

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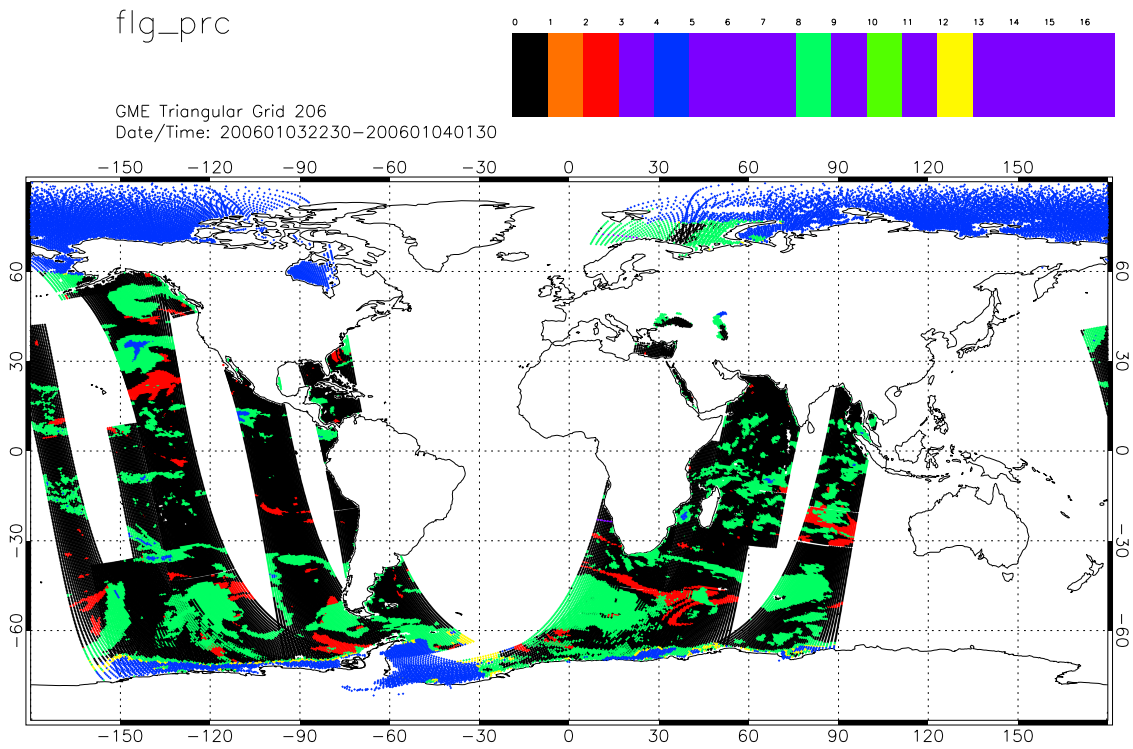


Figure 1: *Observation coverage of a 3-hourly assimilation cycle of satellites NOAA-15, NOAA-16 and AQUA. Displayed: processed data (black), rejected because of precipitation and of thick clouds (green), rejected because of sea ice (yellow and blue), rejected because minimisation of 1DVAR failed (red)*

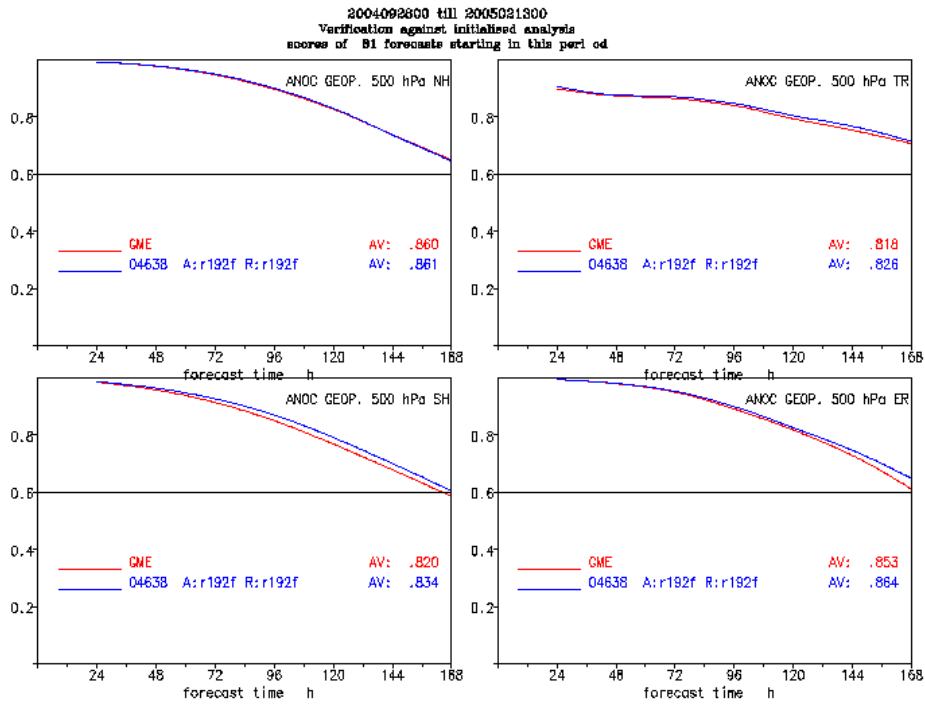


Figure 2: *Anomaly Scores for 500 hPa geopotential height for operational forecast with SATEMS (red) and trial run with 1DVAR (blue) for a trial period of 81 days. From left to right and top to bottom: northern hemisphere, tropics, southern hemisphere, Europe.*