Monitoring and assimilation of ATOVS data at Météo-France

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1. INTRODUCTION

Since 1997, Météo-France has switched its operational assimilation system to a three-dimensional variational analysis (3D-Var). This assimilation system is a convenient framework for the assimilation of radiances which are non-linearly related to the model variables (temperature and humidity mainly). This change has allowed the direct assimilation of pre-processed radiances from the NOAA satellites. The co-located data from the HIRS, MSU and SSU instruments from the NOAA14 satellite have been assimilated since 1999. Since then, the new satellite NOAA15 provided new data, including radiances from the AMSU instruments. The operational assimilation of HIRS and AMSU-A radiances from NOAA15 has taken place in 2000.

2. RESULTS

The method used is similar to the one which was operational at ECMWF from 1996 to 1999, after the introduction of 3D-Var and before the use of raw radiances (McNally et Kelly, 1999). Its first step consists in applying 1D-Var to the pre-processed radiances from NESDIS. This 1D-Var produces quality control flags and provides vertical profiles of temperature and humidity. The radiance data are then introduced into 3D-Var at a degraded 250km resolution, together with the surface temperature and the profiles above the top of the model (5hPa) coming from 1D-Var. This method has also been used for the introduction of the new ATOVS data. A first experiment was run in December 1999 during the week of the Christmas storms hitting Europe. The performance of the models having used or not the ATOVS data in the analysis is shown in figure 1. The RMS scores are shown for the geopotential at 500 hPa for the Northern and Southern hemispheres. Forecasts are significantly improved when ATOVS data are used in the analysis, with a larger impact in the Southern hemisphere as expected. Following the monitoring of the data (Rabier et al., 1999), the operational assimilation took place in June 2000 together with the implementation of a four-dimensional variational assimilation system (4D-Var), after pre-operational trials. Results from monitoring and experiments performed in summer 2000 are shown in figures 2 and 3. Figure 3 shows score differences for
Figure 1: Forecast performance in December 1999 for the operational model using only TOVS data (dashed blue line) and the test model using both TOVS and ATOVS data in the analysis (solid red line). The 500hPa geopotential RMS error is plotted with respect to forecast range. Top panel: results for the Northern hemisphere. Bottom panel: results for the Southern hemisphere.
Figure 2: Operational monitoring plots for AMSUA-10 radiance data in summer 2000. The number of observations is shown as bars. The blue bars represent the number of observations not used in the system (thinned or rejected), and the yellow bars represent the number of observations actually used in the system. Standard-deviations (thick lines) and biases (thin lines) of differences (observations – background) and (observations – analysis) are shown as green and red curves respectively. Those are computed using the full sample of observations (excluding gross errors).
Figure 3: RMS error score differences for geopotential between the experiment using TOVS+ATOVS and the experiment using only TOVS. The ordinate is pressure in hPa and the abscissa the forecast range in hours. Dashed red isolines indicate negative values: they show a positive impact of ATOVS data (less forecast error). The left column shows RMS, the middle one STD, and the right one Bias. Forecasts are compared to their own analyses.
geopotential for two experiments, one using TOVS and ATOVS data and another one using only TOVS data from NOAA14. Scores are shown as a function of pressure and forecast range. Negative differences shown by red dashed lines indicate a reduction of forecast error brought by the new ATOVS data. The positive impact of ATOVS data is clear, and particularly large in the stratosphere and the Southern hemisphere.

3. CONCLUSIONS

ATOVS pre-processed radiance data from NESDIS have been assimilated in operations at Météo-France since June 2000. Forecasts show an improvement, particularly large in the stratosphere and the Southern hemisphere. Perspectives are now to use raw radiances where radiances have not undertaken pre-processing. This will allow to use new satellite products quicker and will place us in a better position to use locally received data.

4. REFERENCES

