Assimilation of SEVIRI infrared observations at ECMWF

Matthew Szyndel[1], Jean-Noël Thépaut and Graeme Kelly

Infrared data observed from geostationary orbit is assimilated into the ECMWF integrated forecast system (IFS) with positive impact in the form of Meteosat clear sky radiance data and GOES Imager clear sky brightness temperature data (Köpken *et al*, .2004). These data provide not only upper tropospheric humidity data, but also wind information through the use of a 4D-Var assimilation system (Courtier *et al*., 1994) and the temporally dense nature of geostationary observations. In January 2004 Meteosat-8 became the first operational Meteosat second generation (MSG) satellite. MSG satellites carry the spinning enhanced visible and infrared imager (SEVIRI) (Schmetz *et al*., 2000), an instrument with a range of visible and infrared channels including two channels sensitive to water vapour. We carried out assimilation experiments to assess the impact of assimilating Met-8 water vapour channel data in place of Met-7 data into the ECMWF IFS. Following these assimilation experiments Met-8 data from channels WV6.2 and WV7.3 were routinely assimilated into the IFS in place of Met-7 data from channel WV from 28th September 2004. Full details may be found in Szyndel *et al.*, 2004.

Our assimilation experiment was run for the period 2nd February 2004 to 2nd March 2004 and compared four streams of assimilation and forecast; these streams were:

1. 'Esuite' - operational test bed in use at the time of the experiment.
2. 'Control' - as esuite with Met-7 WV data blacklisted.
3. 'SEVIRI 1' - as 'Control' with Met-8 WV6.2 assimilated with 2K error and WV7.3 assimilated with 2K error.
4. 'SEVIRI 2'- as 'Control' with Met-8 WV6.2 assimilated with 2K error and WV7.3 assimilated with 1.5K error.

The assimilation of Met-8 data produced stronger increments than Met-7 data, with the increments over a wider area. This applies to increments in both relative humidity and vector winds. Relative humidity increments showed an increase in vertical structure, which is attributable to the use of two channels for each observation point where only one was used for Met-7. Relative humidity increments are shown in figure 1.

Over the period of the trial it was found that SEVIRI 1 and SEVIRI 2 both gave a small positive impact, with statistically significant impact on vector wind RMS error and geopotential height anomaly correlation at a number of pressure levels. Furthermore, studies of the impact on statistics for radiosonde observations show a reduction in bias of observation difference from model first guess for relative humidity observations in the area observed by Met-8. AMSU-B channel 3 observations and HIRS channel 12 observations show a reduced standard deviation of observation minus first guess in the Met-8 observed region. Figure 2 shows the impact of Met-8 assimilation on the standard deviation of (O-B) for HIRS-12 on NOAA-16.

Stream SEVIRI 1 was chosen for operational use as this stream showed marginally better impact.

[1] matthew.szyndel@ecmwf.int

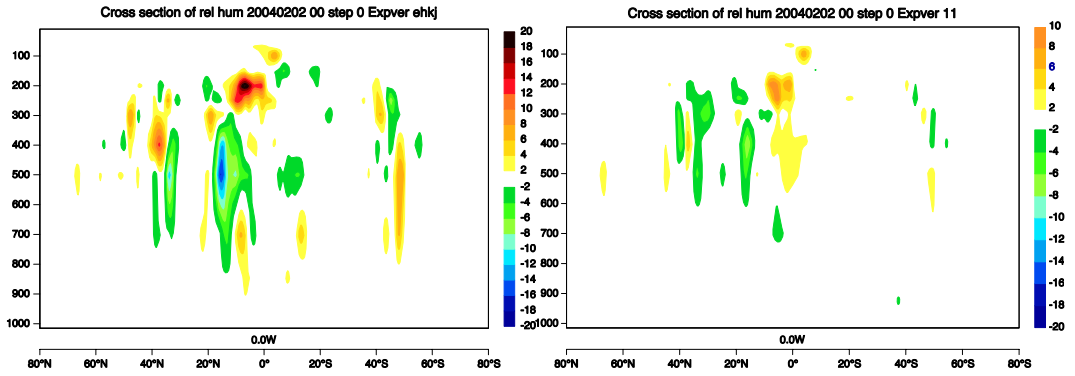

Figure 1: Relative humidity increment (in percent) for a cross section through the 0° meridian for the first cycle due to Met-8 in stream SEVIRI 1 (left panel) and Met-7 in stream esuite (right panel).

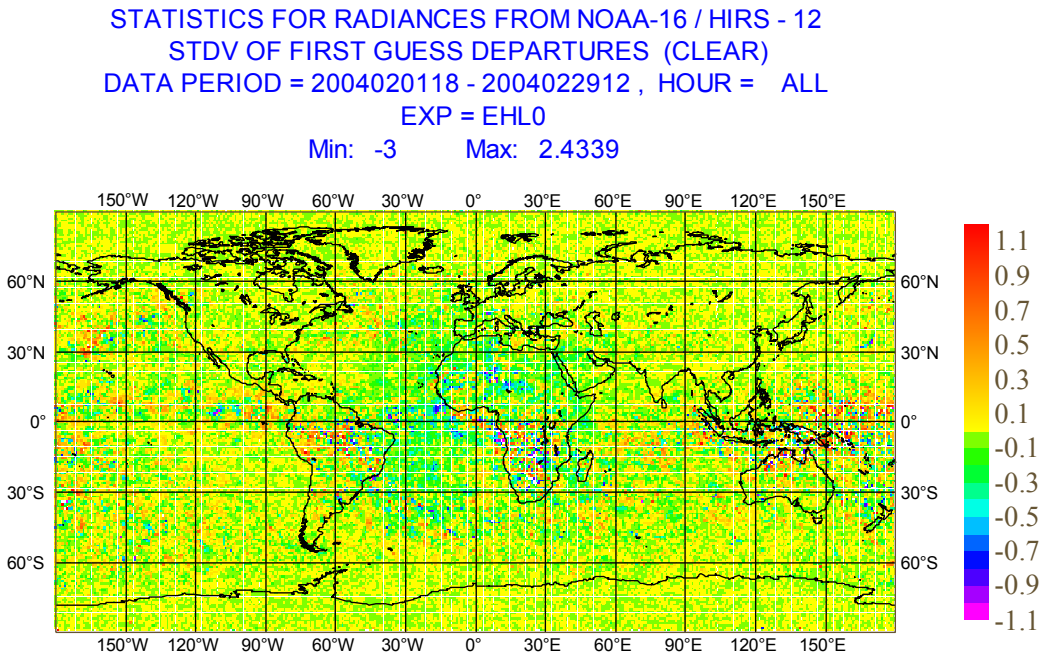

Figure 2: Change in standard deviation of (Observation - First Guess) for HIRS channel 12 on NOAA-16 as a result of Met-8 assimilation (stream SEVIRI 1)

Courtier, P., Thépaut, J.-N. and Hollingsworth, A., 1994: A strategy for operational implementation of 4D-Var, using an incremental approach, *Q. J. R. Meteorol. Soc.*, **120**, 1367-1387

Köpken, C., Kelly, G. and Thépaut, J.-N., 2004: Assimilation of Meteosat radiance data within the 4D-Var system at ECMWF: Assimilation experiments and forecast impact, *Q. J. R. Meteorol. Soc.*, **130**, 2277-2292

Schmetz, J., Pili, P. and Tjemkes, S., 2000: Meteosat Second Generation (MSG) Pp. 111-121 in proceedings of ECMWF seminar on exploitation of the new generation of satellite instruments for numerical weather prediction, 4-8 September 2000, ECMWF, Reading, UK

Szyndel, M.D.E., Kelly, G. and Thépaut, J.-N., 2004: Assimilation of Geostationary WV Radiances from GOES and Meteosat at ECMWF, EUMETSAT/ECMWF Fellowship Programme, Research Report No. 14