# Current developments in global and regional data assimilation at Météo-France

**Florence Rabier, Claudia Faccani, Nadia Fourrié, Elisabeth Gérard, Vincent Guidard, Fatima Karbou, Patrick Moll, Christophe Payan**

**CNRM/GAME, Météo-France and CNRS**
**42 av Coriolis**
**31057 Toulouse**
**France**
**Florence.Rabier@meteo.fr**

Variational assimilation is a good algorithmic framework for an efficient use of observational data of different kinds. In particular, data from the AMSU-A, AMSU-B/MHS, HIRS, AIRS and SSM/I satellite instruments are assimilated under the form of raw brightness temperatures and scatterometer wind observations are used over open sea. Developments in terms of data usage which took place in 2008 are summarized below.

Very recently, IASI data from the European MetOp satellite have been inserted (1 July 2008). IASI was launched in October 2006, onboard the polar orbiting European satellite MetOp. This new instrument is a Michelson interferometer which sounds a wide spectrum in the infrared region. Similarly to all satellite-based radiances, IASI data have to be bias corrected (e.g. from viewing geometry or air mass induced biases) before being assimilated. The variational bias correction is a method that continuously adapts to possible variations of the bias; it has been used in operations since February 2008 and satisfactorily handles biases in IASI and other satellite data. Since July 2008, 50 IASI channels are assimilated over open sea in operations, both in the global model ARPEGE and the regional model ALADIN; they bring information on atmospheric temperature. The subsequent impact on forecasts is largely positive up to 4-day range in extra-tropical regions, especially in the Southern Hemisphere.

Already used at high-resolution in the ALADIN model, the radiances observed by Meteosat Second Generation (MSG) are now assimilated into the global operational model ARPEGE as Clear Sky Radiances (CSR produced by EUMETSAT), with a horizontal sampling of 250km similarly to the other satellite data. The impact of these data is relatively small but always positive, especially over Europe, and these observations contribute to the observation network above our area of interest.

The ocean surface wind measured by scatterometry is retrieved with an ambiguity about the direction, resolved with the model background. Taking into account the 4-most likely directions of the SeaWinds scatterometer (instead of 2) improves the measurement quality (mainly in dynamically active areas), similar to that of the new data from ASCAT scatterometer, for which only two directions can be considered. The combination of these two instruments together with the AMI scatterometer (similar to ASCAT) is the best observing system for the ocean surface winds (1.2 $m.s^{-1}$ in terms of standard deviation vector), with an almost global coverage every 6 hours and therefore an improved monitoring of tropical cyclones.

Radiosondes are to date of prime importance for Numerical Weather Prediction. However, these observations are known to be biased and therefore need to be bias corrected. The additional data from the soundings recorded during the 2006 AMMA (African Monsoon Multidisciplinary Analysis) campaign have been assimilated into the ARPEGE system, with and without a bias correction for relative humidity. Other assimilation experiments have used soundings which were received operationally at the time, or from a degraded pre-AMMA radiosonde network. The impact of different scenarii on the analysis and forecast over western Africa has been evaluated. For the full experiment using all data together with a bias correction, the humidity analysis and the daily and monthly averaged precipitation are improved. The impact of additional radiosonde observations is found to propagate downstream with a positive impact on forecast performance over Europe at the two and three-day forecast range (see Figure).

Whereas radiosonde observations have then shown to be very relevant, an important additional source of information is provided by satellite microwave data. These are more easily used over sea than over land and in-house developments have been necessary to advance the use of these data over the continents. Data assimilation experiments using for the first time ever AMSU-B humidity observations over land have emphasized strong drying and moistening features over Western Africa consistent with results obtained with the enhanced radiosonde network. The drying or moistening of the atmosphere have been successfully evaluated using independent humidity measurements. As a consequence, the African Monsoon appears to be better organized with a stronger Inter-Tropical Convergence Zone.
Both series of data assimilation experiments have shown that additional data over the African continent, either in situ or satellite-based, if carefully processed, can help to improve the description and prediction of the monsoon. The positive impact can also propagate in time during the forecast and affect Europe after a few days.

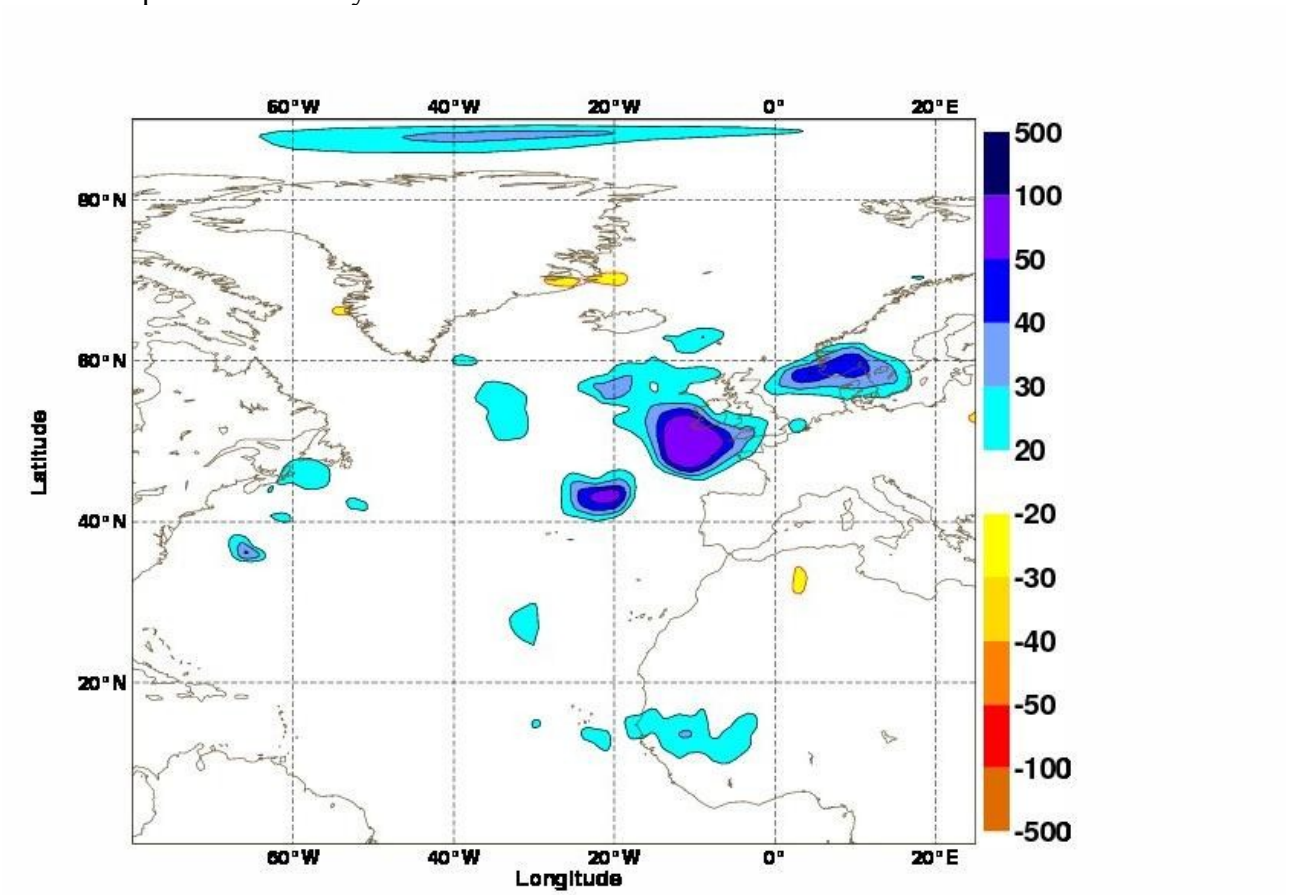


Figure caption: Differences in root-mean-square errors between the experiment using bias-corrected radiosonde AMMA data and the experiment using data from a network as in 2005. The errors are computed for the geopotential at 500 hPa at the 48h forecast range, over the period 1 August - 14 September 2006. Blue colours indicate that the AMMA data have contributed to improve the forecast.