Geophysical Research Abstracts
Vol. 13, EGU2011-7349, 2011
EGU General Assembly 2011

Remote sounding of temperature and humidity in the presence of clouds

Cristina Prates (1), Stefano Migliorini (1), Stephen English (2), and Ed Pavelin (2)

(1) University of Reading, Reading, United Kingdom (C.P.F.M.Prates@pgr.reading.ac.uk), (2) Met Office, Exeter, United Kingdom

The new generation of vertical sounders such as the Infrared Atmospheric Sounding Interferometer (IASI) with its high spectral resolution provides the possibility to retrieve atmospheric temperature and humidity profiles at much higher resolution than that achieved by previous sounders. However, to make effective use of satellite measurements in the presence of cloud is still one of the major challenge faced by numerical weather prediction (NWP) community. In fact, the assimilation of satellite observations has been for a long time focused on clear-sky conditions and just recently some steps have been taken towards the operational assimilation of cloudy radiances. This is because cloudy retrievals present a more difficult problem than the assimilation of clear-sky radiances due to a number of issues, notably the nonlinearity of the relationship between observations and model state variables.

In the Met Office, IASI observed radiances are processed through a one dimensional variational (1D-Var) scheme before being assimilated in 4D-Var. The 1D-Var uses a radiative transfer model (RTTOV) where clouds are assumed to be single-layer grey bodies of negligible depth and therefore infrared effects are modelled by means of effective cloud fraction and cloud top pressure. The two cloud parameters are retrieved simultaneously with temperature and humidity profiles and then used as fixed parameters in 4D-Var assimilation to constrain the forward calculations.

Observations show that the majority of cloud formations found in the atmosphere are more complex than the single layer configuration assumed by 1D-Var. A new cloud scheme enabling an additional cloud layer (two-layer cloud representation) to be treated in the 1D-Var retrieval has been developed and tested using simulated IASI measurements.The importance that observation errors and background information have in this particular inverse problem is analysed, as well as the importance of having a good initial estimate of cloud quantities. Our results obtained with the new cloud model show how, in a highly non linear problem such as the minimization of the cost function in case of cloudy radiances, a first guess far from the true solution can prevent the convergence towards the right solution. It is demonstrated that by introducing a better estimate of cloud parameters based on the so-called "minimum residual method" applied to observations improves the first guess and leads to more accurate cloud retrievals.