Prospects for the Assimilation of Advanced Infrared Sounder Radiances over Land

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To use IASI data properly over land we need to know the surface emissivity. We can either use an emissivity atlas or analyse the emissivity from the observations. To analyse the surface emissivity we need to have a robust cloud detection scheme – which in turn needs to have a good a priori emissivity. Therefore the first step is to investigate the use of emissivity atlases. But to do so we need a control.

This poster documents the effect of using the fixed emissivity value of 0.98 used in RTTOV over land. The experiments are run between 7th August and 30th September 2008 at T511 using the ECMWF Integrated Forecasting System (IFS).

The current operational usage of AIRS and IASI channels at ECMWF. Only channels determined to be insensitive to cloud are assimilated. These channels are assimilated over sea and sea-ice. Over land only AIRS channels with wavenumbers below 707 cm⁻¹ are assimilated and no IASI channels are used.

The number of observations passing the cloud detection tests for a typical AIRS channel in the longwave window region. Antarctica and land above 3000m are excluded. Typical land points have 10% of the number of observations passing quality control as the clearest regions over ocean.

The effect on the normalized 500hPa geopotential anomaly correlation forecast for northern (top) and southern hemisphere extratropics on using AIRS and IASI observations in the same manner over land as is used over sea. Positive values indicate an improvement in the forecast skill. There is significant positive impact in the first two days in the northern hemisphere. The statistics were generated for 46 cases and were verified versus the operational (T799) analysis.

The change in RMS 300hPa geopotential height forecast error for the 12hour forecast verified against own analysis. Blue values indicate improvement on assimilating land observations. The largest impact appears over Siberia.

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Discussion

This very simple test of the use of advanced infrared sounder radiances over land (intended as a control for future investigation of more sophisticated emissivity schemes) indicates that there is useful information to be gained from using these observations over land and that this information may be obtained with relatively simple methods.

The key to using these data is in quality control. Firstly, the most difficult terrain is blacklisted: Antarctica and mountainous terrain. It was found (not shown) that significant errors to short-range forecast fields originate from these regions if they are not removed.

Secondly, the cloud detection scheme employed at ECMWF (McNally and Watts, 2003) ensures that only spectra that are relatively flat across the long-wave infrared window and which have absolute first-guess departures in the window below 0.5K are accepted. Therefore scenes which have large a priori skin temperature or surface emissivity errors, and which have the potential to degrade the analysis, are rejected. The result is a relatively small number of accepted observations, but enough to still provide positive impact.

It is suggested that on testing emissivity atlases or retrieval schemes in an NWP context a simple fixed emissivity system such as this is used as a control.

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Reference