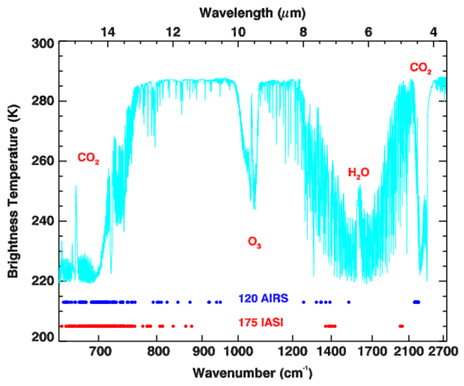
Prospects for the Assimilation of Advanced Infrared Sounder Radiances over Land

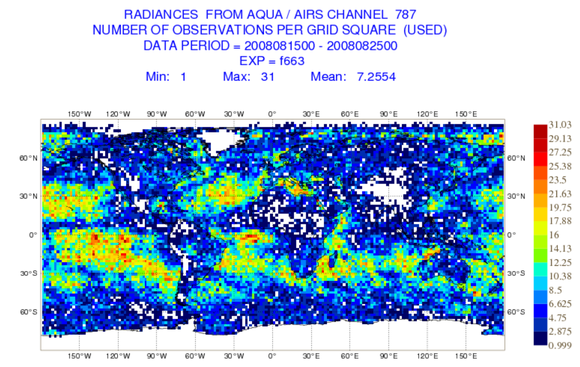
Andrew Collard
SAIC/EMC/NCEP (formerly ECMWF)

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.

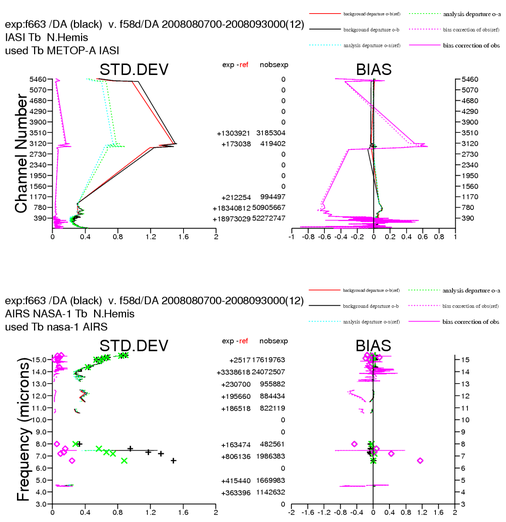
This poster documents the effect of using the fixed emissivity value of 0.98 used in RTTOV over land. The experiments are run between 7th August and 30th September 2008 at T511 using the ECMWF Integrated Forecasting System (IFS).



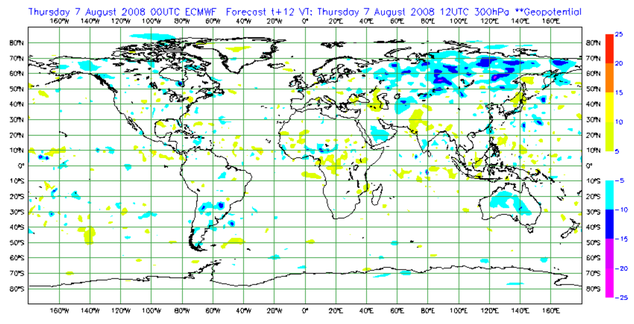
The current operational usage of AIRS and IASI channels at ECMWF. Only channels determined to be insensitive to cloud are assimilated. These channels are assimilated over sea and sea-ice. Over land only AIRS channels with wavenumbers below 707cm^{-1} are assimilated and no IASI channels are used.



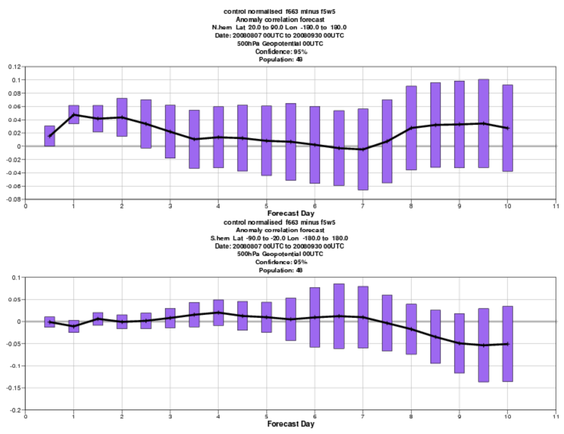
The number of observations passing the cloud detection tests for a typical AIRS channel in the longwave window region. Antarctica and land above 3000m are excluded. Typical land points have 10% of the number of observations passing quality control as the clearest regions over ocean.



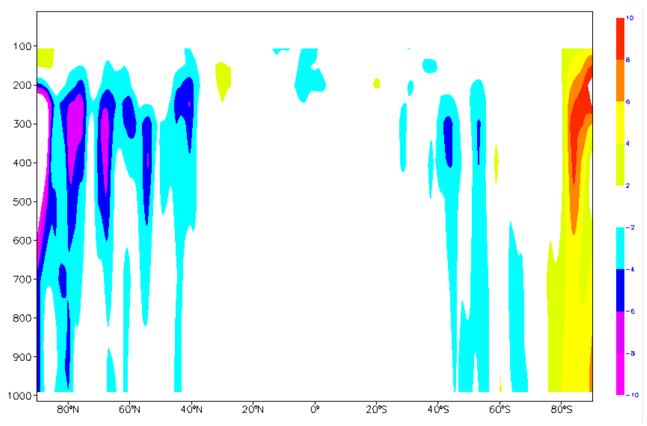
IASI and AIRS first guess and analysis departures for the northern hemisphere extratropics for the period of the experiment. The data counts, as expected, are greatly increased on adding the land surface points while the departure statistics are largely unchanged.



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.



The effect on the normalised 500hPa geopotential anomaly correlation forecast for northern (top) and southern hemisphere extra-tropics 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.



Zonally averaged difference in 48 hour RMS geopotential height forecast error on adding in IASI and AIRS observations over land. Blue areas indicate reduced RMS error on adding the extra observations. There are improvements throughout the vertical range of the troposphere in the northern extra-tropics. The area of degradation near the south pole is very localised and is not statistically significant.

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.

Acknowledgments

This work was performed at ECMWF, the Met Office and SAIC/EMC/NCEP and benefited from conversations with Graeme Kelly, Tony McNally and Eva Borbas.

Reference

McNally, A.P. and P.D. Watts, 2003. A cloud detection algorithm for high-spectral resolution infrared sounders. *Q. J. R. Meteorol. Soc.* **129:** 2411-2323.