Utilisation of IASI data in a cloudy atmosphere

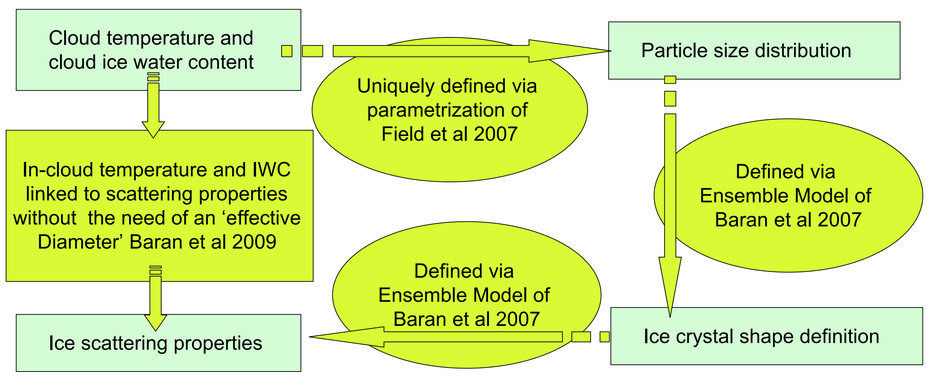
Stephan Havemann, Jean-Claude Thelen, Jonathan P Taylor, Anthony Baran

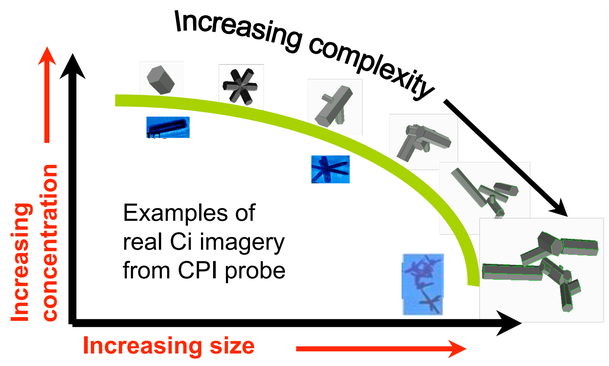
In addition to information on the temperature and water vapour structure of the atmosphere, IASI data also contain information on cloud properties and land surface emissivity. The use of Principal Component radiative transfer techniques allow the potential to compute the entire IASI spectrum quickly. This gives the opportunity to use the hyper-spectral information in IASI to its full extent – in theory allowing the retrieval of temperature and water vapour profiles in the presence of clouds. This poster presents the Havemann-Taylor Fast Radiative Transfer Code (HT-FRTC) which includes a complete treatment multiple scattering by clouds. The code is used within a 1d-Var environment to retrieve profile information in the presence of cirrus clouds. Results are presented where the Facility for Airborne Atmospheric Measurements BAe146-301 Atmospheric Research Aircraft under-flew an IASI overpass and characterised the structure of the atmosphere including the microphysics of the cirrus that was prevalent that day.

1. Cloud in the HT-FRTC

The HT-FRTC includes a full treatment of scattering using spherical harmonics. Within the 1d-Var retrieval the control vector is as follows:

• Temperature (z), LnQ (z), Ozone (z), T* (surface temperature), Surface Emissivity (represented as 15 Principal Components), Cloud top pressure(of ice and liquid water cloud), Cloud thickness (of ice and liquid water cloud), Cloud Ice Water Content (ln IWC), Cloud Liquid Water Content and Cloud fraction of ice and liquid water cloud.





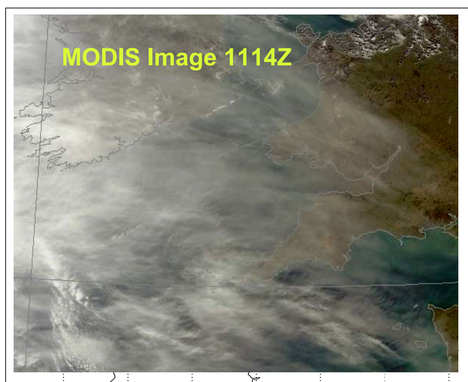
References

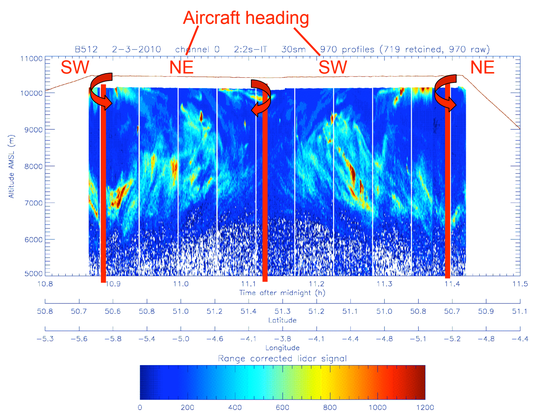
Baran, A.J. , P.J. Connolly, and C.Lee: Testing an ensemble model of cirrus ice crystals using midlatitude in situ estimates of ice water content, volume extinction coefficient and the total solar optical depth, Journal of Quantitative Spectroscopy & Radiative Transfer, 110, (2009), 1579-1588.

Baran A.J, and L.C. Labonnote, QJRMS, 2007.

Field, P. R., A. J., Heymsfield, and A. Bansemer: Snow size distribution parameterization for midlatitude and tropical ice cloud. J. Atmos. Sci. (2007);64; 4346-65.

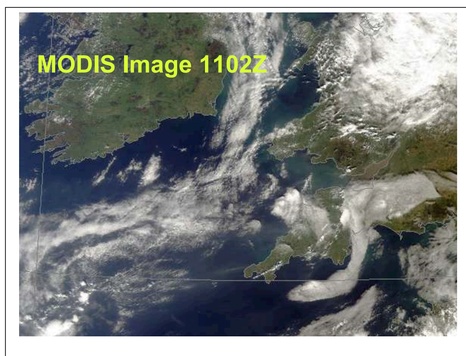
2. Case study ONE Flight B512, 2nd March 2010, IASI overpass 1102Z

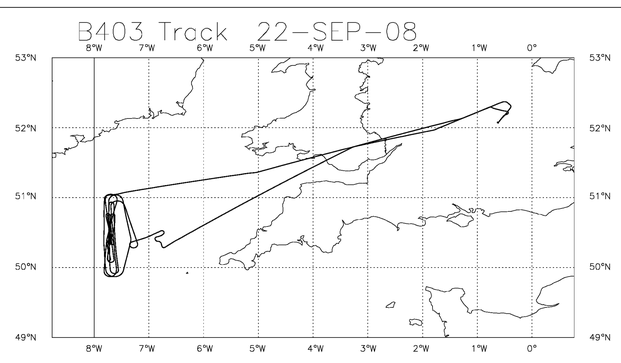




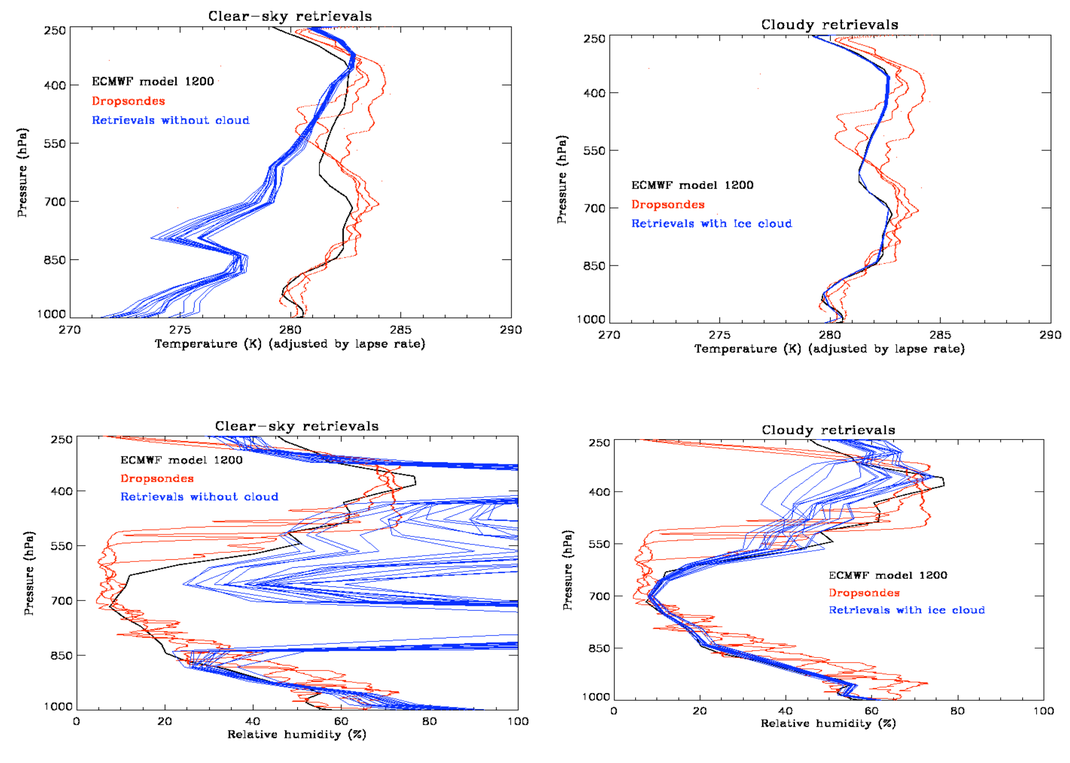
Lidar return on-board BAe146

2. Case Study TWO Flight B403, 22nd Sept 2008, IASI overpass 1045Z



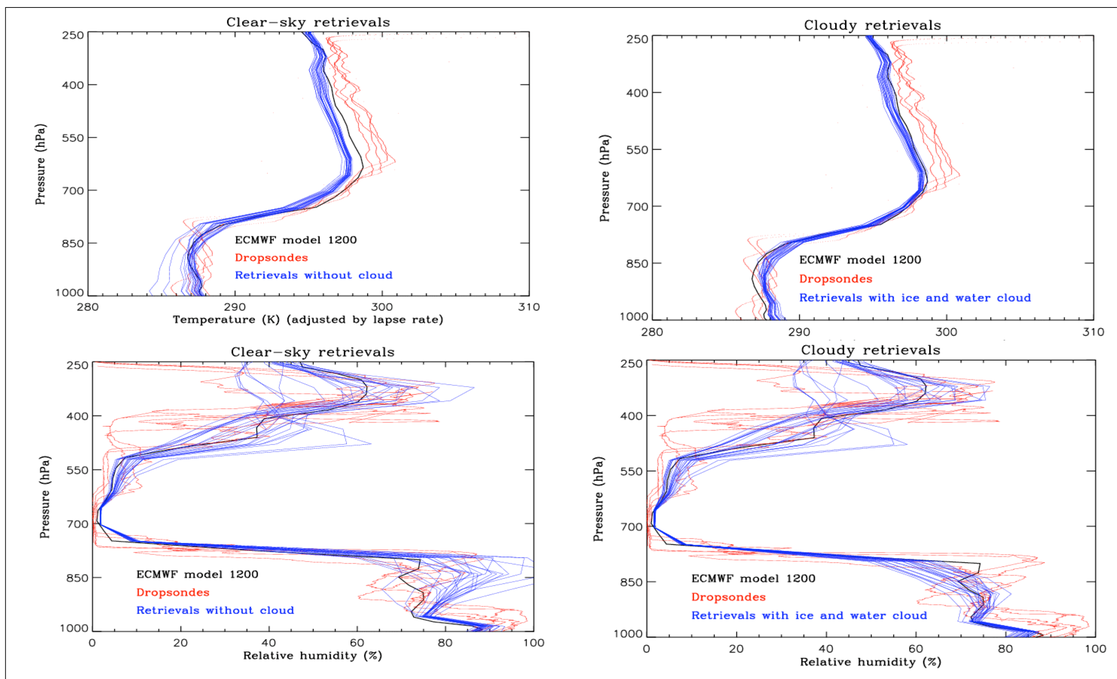


3. IASI 1d-Var Retrieval Results from Case Study ONE



Cirrus cloud (275 to 475 hPa): Retrieved ice water content is 171.0±64.4 mgm^{-3} and cloud fraction is 0.47±0.04.

4. IASI 1d-Var Retrieval Results from Case Study TWO



Cirrus cloud (275 to 325 hPa): Retrieved ice water content 34.4±19.3 mgm^{-3} and cloud fraction 0.72±0.22. Water cloud (850 to 900 hPa): Retrieved liquid water content 1.04±0.09 gm^{-3} and cloud fraction 0.17±0.13.

5. Conclusions and future work

The case studies demonstrate that the skill of temperature and humidity retrievals in the presence of cloud is increased if cloud parameters are part of the retrieval state vector. In the current retrievals, one (in case study ONE) or two (in case study TWO) homogeneous cloud layers were assumed. Future work will be directed towards the retrieval of vertical profiles of ice / liquid water content.

Met Office FitzRoy Road, Exeter, Devon, EX1 3PB United Kingdom
Tel: 01392 884647 Fax: 01392 885681
Email: jonathan.p.taylor@metoffice.gov.uk