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MARS: A New Retrieval Scheme for Aircraft Remote Sensing Measurements

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The importance of aircraft in-situ measurements of GreenHouse Gases (GHG) and trace gases is well understood, providing not only spatially resolved and accurate concentration data for these gases, but also essential validation for many other types of measurement, the most common being that from ground-based and satellite remote sensing instrumentation. The role of airborne remote sensing instruments is equally important in building up an accurate understanding of the composition of the atmosphere, providing far greater spatial coverage than their ground-based equivalents, whilst in the thermal infrared, the opportunity to fly at relatively low altitudes allows for a greater sensitivity towards the surface than that provided by any current satellite measurements.

The UK Met Office Airborne Research Interferometer Evaluation System (ARIES) is a Fourier transform spectrometer that is mounted on the NERC Facility for Airborne Atmospheric Measurements (FAAM) aircraft, and which measures incoming radiation over a large wavenumber range (550-3000 cm^{-1}), at high spectral resolution ($\sim$0.7 cm^{-1} unapodised). This level of precision, combined with a low NEDT (0.2 K for 1-minute averaged spectra) allows for the detection of a wide variety of important GHG and trace gases, the concentrations of which can be derived from the measured spectra by use of retrieval theory.

This work presents a new Optimal Estimation Method (OEM) retrieval of GHG and trace gas vertically resolved profiles in the mid-troposphere and planetary boundary layer, from observations of the ARIES instrument. The Manchester ARIES Retrieval Scheme (MARS) utilizes a large subset of high-accuracy and high-precision auxiliary datasets to produce a well-characterized retrieval product. First retrieval results, as well as a validation of these results with in-situ measurements are to be presented, with error characterization suggesting that the retrieval bias is of the order of 1-2%.

As well as presenting the results from this particular study, we shall also discuss the issue of vertical sensitivity of nadir IR sensors in the troposphere for various trace gases, as well as the importance that the selection of auxiliary data sets, in particular the influence of the a priori, play in the retrieval process.