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Atmospheric composition and thermodynamic retrievals from the ARIES airborne TIR-FTS system

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The role of airborne remote sensing instruments is important in building up an accurate quantitative and process-driven understanding of the atmospheric composition, where the benefit of a large spatial coverage and the potential for near surface measurements results in the characterization of possible localized emission sources. In the Thermal InfraRed (TIR), the opportunity to fly at relatively low altitudes allows for a greater sensitivity towards the surface than that provided by any current satellite measurements.
In this study we present an assessment of the retrieval capability of the Airborne Research Interferometer Evaluation System (ARIES); an airborne remote sensing Fourier Transform Spectrometer (FTS) operated on the UK Facility for Airborne Atmospheric Measurement (FAAM) BAe-146 aircraft. As exemplars of the capability of the ARIES retrieval system, retrievals of temperature, water vapour (H_2O), carbon monoxide (CO), ozone (O_3), and methane (CH4), and their corresponding sources of error and potential vertical sensitivity, are discussed.
This work also presents ARIES scenes that have been retrieved and validated throughout the troposphere and planetary boundary layer over a wide range of environmental variability, using data from aircraft campaigns over and around London, the US Gulf Coast, and the Arctic Circle.

Typically high DOFS for temperature and H_2O confirm that vertically resolved information could be obtained for these parameters, whilst only partial-column retrievals of CO, CH4, and O_3 can be usefully obtained. Partial-column mean biases averaged across all campaigns were less than 6% for all of the variables that were retrieved.

This work demonstrates that remote sensing measurements from the ARIES instrument can provide valuable additional information, to supplement the aircraft measurements and ground-based networks that are already in operation, whilst also serving as a useful tool for the calibration and validation of satellites operating in the TIR.