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Latest results from the GreenHouse gas Observations of the Stratosphere and Troposphere (GHOST) airborne shortwave infrared spectrometer

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GHOST is a novel, compact shortwave infrared grating spectrometer, designed for remote sensing of tropospheric columns of greenhouse gases (GHGs) from an airborne platform. GHOST observes solar radiation at medium to high spectral resolution which has been reflected by the surface, using similar methods to those used by polar orbiting satellites such as the JAXA GOSAT mission, the NASA OCO-2 mission and the forthcoming Copernicus Sentinel 5-Precursor. By using an original design comprising optical fibre inputs along with a single diffraction grating and detector array, GHOST is able to observe CO_2 absorption bands centred around 1.61 μm and 2.06 μm (the same wavelength regions used by OCO-2 and GOSAT) whilst simultaneously measuring CH_4 absorption at 1.65 μm (also observed by GOSAT), and both CH_4 and CO at 2.30 μm (to be observed by Sentinel 5-P once launched later in 2017). The overlapping spectral ranges and comparable spectral resolutions mean that GHOST has unique potential for providing validation opportunities for these platforms, particularly over the ocean where ground-based validation measurements are not available.

Here we present the latest results from the spectral analysis, using an optimal estimation based retrieval method, of CO_2 and CH_4 from GHOST flight spectra for the 1.6 μm band which utilise recently updated laboratory calibration measurements. GHOST took part in two science flights on board the NASA Global Hawk unmanned aerial vehicle based at the Armstrong Flight Research Centre in Edwards, California, in March 2015. These flights involved long approximately north-south transects over the eastern Pacific Ocean. In addition to observing spatial trends in GHG column concentrations over a regional scale, the second of these flights (on 10th March) allows inter-comparisons of GHOST retrievals with observations from OCO-2 and GOSAT, which both passed directly over the Global Hawk during clear sky conditions. We will show results from these flights together with an analysis of measurements from the laboratory to assess the instrument performance, and demonstrate the suitability of GHOST for model evaluation and for the validation of column-averaged GHG concentrations measured from space.