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Atmospheric Measurement Techniques
Discussions

Interactive comment on "GreenHouse gas Observations of the Stratosphere and Troposphere (GHOST): an airborne shortwave infrared spectrometer for remote sensing of greenhouse gases" *by* Neil Humpage et al.

Anonymous Referee #2

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The manuscript AMP 2017-274 "GreenHouse gas Observations of the Stratosphere and Troposphere (GHOST): an airborne shortwave infrared spectrometer for remote sensing of greenhouse gases" represents a substantial contribution to scientific progress within the scope of Atmospheric Measurement Techniques because it introduces a new instrument. The document is well written and properly structured. My comments and suggestions for improvement of the text and figures are given below. I recommend this paper for publication in AMT after consideration for the comments.

The paper address relevant scientific questions within the scope of AMT because it

introduces a new instrument "GHOST" that can be mounted in an airplane or UAV for spectroscopic measurement of greenhouse gases (GHG) in the portion of the Earth atmosphere underneath the flight track. A broad and well written introduction with a useful overview of relevant ground based, airborne and satellite GHG instrumentation is given. The GHOST instrument aims to fill the niche between existing ground observations on the local scale and satellite measurements on regional to global scale. Once mature enough, it could potentially be used for validation of satellite measurements.

The GHOST instrument is a fiber-fed spectrometer. Multiple orders of a single grating are used to combine high spectral resolution with compactness of the instrument. These methods are known from astronomy instrumentation. The GHOST instrument realization shows that airborne/AUV applications can be a valuable demonstration environment for remote sensing instruments, this is the substantial novelty in this work. There is a promise of useful data for validation of ground based or satellite. For this purpose the instrument, its calibration and data reduction would need to become more mature.

Scientific methods are clearly outlined and referenced. The GHOST instrument is introduced in a descriptive way. A more architectural description would be preferred to help the reader better understand the layout and working of the instrument.

The main result is the build-up of the instrument. A more detailed description of the optical layout supported by block diagrams or schematic of the optical path would largely improve the scientific value. A discussion of choices/trade-offs in the optical design and a description of the specifications and tolerances of the optical components is lacking.

Some minor point to be considered; the detector performance is characterized at 80 K but operated at a higher temperature, please discuss if the difference has an impact on the performance; The instrument employs two bands 2. A comparison of simultaneous measurements for the two bands could give insight in the instrument performance; The horizontal scale for bands 2A and 2B in figure 16 is different. Identical scales would be beneficial for comparison.

In conclusion, the presented instrument and its first application are a substantial and valuable contribution to the scientific field of atmospheric remote sensing. The innovation to combine multiple grating orders on a single detector is very interesting for its compactness. The paper could be significantly improved if the architectural design of the optical instrument would be given in view of the operational performance (design trade-offs, effect of stray light, separation of diffraction orders, suppression of spurious orders). Such treatment would be crucial to assess the wider applicability of the presented instrument and to assess future inter-comparison/validation studies.

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