

Interactive comment on “3-D tomographic reconstruction of atmospheric gravity waves in the mesosphere and lower thermosphere (MLT)”

by Rui Song et al.

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This paper by Rui Song et al outlines a technique for retrieving 3D gravity wave structure in the MLT measuring O2 A-band airglow using an observation strategy that sweeps the line of sight of the limb sounder horizontally across the orbital track during flight from a nano-satellite (cubesat) platform. I find the paper well written, the literature review comprehensive, the sections are being logically organised and the simulations and retrievals presented compelling to illustrate the technique. I recommend I paper be accepted and only offer the following suggestions for consideration by the authors.

C1

We thank the reviewer for providing a thorough review and offering valuable suggestions.

The literature review can be strengthened by adding some references of gravity wave detection from SABER instrument onboard TIMED satellite, 2) GW detection from the SOFIE instrument onboard the AIM satellite and GW detection from the CIPS instrument which images gravity waves in PMC's with horizontal wavelengths not detected by any other instrument in the MLT.

The work on SABER and relevant references have been added:

“...The Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) measures temperature between 20 and 110 km. The observations are sensitive to GWs with horizontal and vertical wavelengths longer than ~100-200 km and ~4 km (Preusse et al., 2002; Schroeder et al., 2009; John and Kumar, 2012; Liu et al., 2017)...”

Reference of the SOFIE instrument was added:

“The Solar Occultation for Ice Experiment (SOFIE) onboard the Aeronomy of Ice in the Mesosphere (AIM) satellite measures temperature profiles in the height range of 10-102 km in the Arctic and Antarctic. The SOFIE measurements can be used to study seasonal and annual variations of GWs in the entire polar stratosphere and mesosphere in both hemispheres (Liu et al., 2014). Compared to limb sounding or occultation measurements, ...”

Reference of the CIPS instrument was added:

“The Cloud Imaging and Particle Size(CIPS) instrument onboard the AIM satellite measures polar mesospheric cloud (PMC) morphology and particle properties. GWs derived from nadir viewing of CIPS have horizontal wavelengths mainly in the range of 250-300 km (Chandran et al., 2010).”

C2

Figure 1 is confusing and can use a better figure to illustrate the sweep mechanism along the line of sight strategy.

Thanks for the suggestion. The other referee also thinks this figure is confusing, and suggests to not include this figure as it's not entirely necessary given Fig. 2. Therefore, we removed Fig. 1 from the updated manuscript.

This consideration is probably beside the scope of the paper, but the paper can be improved by a discussion on stray light considerations for the instrument and stray light effects on retrievals. A discussion on the radiances required for accurate estimation of GW parameters from the O2 airglow emission may be included. How do errors in slew rate, positioning accuracy and jitter affect the retrievals?

In this work, we assumed the stray light can be suppressed very well by the instrument. Here, we added a sentence in Sect. 3.3:

“... and other sources of light (i.e. stray light, scattered sunlight) are ignored in this case.”

In our method, the GW parameter and temperature retrieval relies on the relative intensity of the emission lines, not the absolute airglow emissions. In Sect.4.3, we obtained a temperature retrieval precision of 2 K at altitudes between 87 and 110 km.

A sentence was added in Sect.4.1 to explain the errors in the slew rate:

“Considering a L of ~ 2600 km, an 1° error in the turning angle can result in a ~ 45 km offset of the tangent points in the horizontal plane.”

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C3