Observation of secondary gravity waves over the Southern Andes during an intense mountain wave event.

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Gravity waves (GWs) are an important atmospheric phenomenon with horizontal scales ranging from several kilometers to several thousand kilometers. GWs propagate vertically from their sources in the troposphere to upper altitudes, and they deposit their momentum into the background flow when they break. This deposition of momentum influences the global atmospheric circulation and temperature structure of the atmosphere [Lindzen, 1981; Holton, 1983].

The Southern Andes are well known as one of the mountain wave hot spots [e.g., Ern et al., 2004; Alexander et al., 2008; Hoffmann et al., 2013]. Recently, Vadas and Becker [2019] demonstrated with numerical modeling that the breaking of mountain waves over the Andes can create secondary GWs at about 50-80 km of altitude, yielding concentric ring structures. Vadas and Becker [2019] also pointed out that secondary (and higher-order) GWs could create medium- and large-scale ionospheric disturbances. Some observational studies support this hypothesis [Vargas et al., 2016; de Wit et al., 2017; Liu et al., 2019], but the observational evidence is still limited and indirect, and the characteristics of the secondary GWs (e.g., occurrence rate, horizontal distribution, and wave parameters) are not well understood. The purpose of this study is to look for signatures of secondary GW generation in observations from a space-based instrument (VIIRS/Suomi-NPP) and compare their characteristics in the real atmosphere with model simulations.

This study focuses on a mountain wave event with significant amplitudes (>3 K) and ~500 km horizontal wavelengths over the Southern Andes, observed on 24 and 25 July 2017 with AIRS/Aqua satellite data [Hoffman et al., 2017]. The AIRS/Aqua satellite instrument can measure GWs with >30 km horizontal wavelengths in a range of ~20-50 km of altitude. In the MERRA-2 reanalysis wind data, a mesoscale vortex-like pattern appeared to the west of the Andes, and the wind flowed over the Andes. Thus, the GWs observed by AIRS/Aqua were probably mountain waves. VIIRS/Suomi-NPP (can resolve GWs with > several km horizontal wavelengths at ~85 km) did not detect mountain waves but instead observed concentric ring-like GWs with a few hundred km wavelengths at 4.5 UT on the same night (25 July 2017) over the Southern Andes and its east side (leeward).

In this presentation, we will show the observational results and discuss the relationship between the mountain waves observed by the AIRS/Aqua satellite and the concentric GWs observed by VIIRS/Suomi-NPP. In particular, we will focus on what altitude the observed mountain waves broke and why the observed concentric ring-like GWs extended leeward.

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