Effects of horizontal wind structure on the gravity wave activity in the upper stratosphere over Syowa

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Gravity waves (GWs) transport their momentum and energy from the lower atmosphere to the upper atmosphere and drive the general circulation, which significantly changes the temperature in the middle atmosphere [Fritts and Alexander, 2003]. To understand this role quantitatively will improve the modern general circulation models. Typical GW activities and its seasonal variations have been studied at various places around the world. Some studies have shown global maps of the typical activities from satellite observations lately. However, what causes a shorter temporal and local variations of the activities are poorly understood, especially above the upper stratosphere.

To understand this cause, we estimated the potential energy of GW (Ep) over Syowa Station (69˚S, 40˚E) from a Rayleigh/Raman (RR) lidar observation between 2011 and 2015. We found a clear enhancement of the Ep during 8th-21st August 2014. The Ep in this period was about two and five times as large as the winter mean in the other years at 50 and 60 km, while the one between 20 and 40 km was as small as the winter mean. One of possibility is that some source would exist around 45 km, but there seemed no specific source within the Modern-Era Retrospective analysis for Research and Applications (MERRA) [Rienecker et al., 2011]. The second one is that the GWs would converge from the lower atmosphere at various latitudes due to the meridional gradient of the westerly wind [Dunkerton, 1984]. The polar night jet around 40˚E during the enhancement period slanted to ~70˚S from ~50˚S and the gradient was larger. In such condition, the GWs with west-ward wavenumber can converge to Syowa. We estimated paths of GWs in order to examine whether the GWs could converge to Syowa. We found that the large-scale GWs could converge to 50-55 km altitudes over Syowa in that period. This result suggests that the enhancement could be caused by the convergence of the GWs.

In this presentation, we will show the potential energy, the wind field and estimated paths of the GWs during the enhancement period, and discuss the cause of the enhancement.

Keywords: Gravity wave, Antarctic, Polar night jet, Lidar, Intermittency, middle atmosphere

