

Study of gravity wave in middle atmosphere over Syowa using Rayleigh/Raman lidar from 2011 to 2015

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The gravity waves are generated in the lower atmosphere, propagate upward and transfer their momentum and energy to the middle atmosphere. It has been found that the gravity waves induce the large scale meridional circulation and drive the middle atmosphere away from radiative equilibrium [Lindzen, 1981; Holton, 1982; Matsuno, 1982]. However, we have not completely known the quantification of gravity wave roles in the middle atmospheric circulation. A Rayleigh/Raman (RR) lidar was installed in January 2011 at Syowa Station, Antarctica (69°S,40°E). The lidar has measured temperature profiles between 10 and 80 km since February 2011.

In this study, we investigated monthly mean gravity wave potential energy (Ep) in the height range of 15-70 km from May 2011 to October 2015 except for November, December and January. The number of nights used for this analysis is 360 nights in five years. Above 30km altitude, Ep was maximized during winter in each year. The seasonal dependence of Ep over Syowa was similar to Ep over Davis (69°S,79°E) [Alexander et al., 2011; Kaifler et al., 2014] and McMurdo (78°S, 167°E) [Lu et al., 2015]. Almost all Ep profiles had a roughly constant exponential slope between 30 and 70 km altitude. Between 35 and 64 km, the mean scale height was ~11 km in the 4 years except for 2014. The scale heights of winter (May to August) and spring (September and October) were quite similar and larger than those of autumn (March and April) in each year.

We compared our results with previous studies [Alexander et al., 2011; Kaifler et al., 2014; Lu et al. 2015]. Alexander et al. [2011] and Kaifler et al. [2014] showed the scale heights of winter over Davis where is relatively close to Syowa, and the scale heights were smaller than that over Syowa. Moreover, the scale heights over Davis increased with altitude between 30 and 60 km altitude. Lu et al. [2015] showed the scale heights of winter over McMurdo where is much further from Syowa than Davis, and the scale heights were roughly constant and quite similar to those over Syowa. It suggests that attenuation of gravity waves over Syowa is larger than that over Davis and close to that over McMurdo through the vertical propagation.

In this presentation, we will discuss the local variation and the annual variation of Ep .