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A study of the intermittency of momentum fluxes associated with gravity waves in the Antarctic lower stratosphere and troposphere based on the PANSY radar observation

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It is known that the momentum fluxes associated with gravity waves (GWs) significantly vary both in time and space. It is important to qualify the intermittency, because mean momentum flux values are not sufficient to determine momentum deposition by GWs. Sporadic GWs with large amplitudes tend to decay and/or break, and deposit momentum at lower altitudes compared to continuous GWs with small amplitudes, even though both GWs associate the same amount of momentum fluxes as an average. Thus, the intermittency can largely affect the vertical profile of momentum flux convergences (i.e., wave forcing to the mean wind) in the middle atmosphere. Recent observations with high time resolution enable us to make an analysis of momentum flux characteristics in term of the intermittency (e.g. Herzog et al., 2012). In this study, the long-duration observation with high resolution and accuracy based on the PANSY radar, which is the largest MST (Mesosphere-Stratosphere-Troposphere) radar in the Antarctic, are used to study the intermittency of GWs in the lower stratosphere and troposphere above Syowa Station.

One method to describe the intermittency quantitatively is the use of Gini coefficient (e.g., Plougonven et al., 2013; Alexander et al., 2016). In any season, Gini-coefficient is large (0.6–0.7) in the troposphere, while it is small (0.3–0.5) in the stratosphere. This means that the intermittency in the stratosphere is smaller than in the lower troposphere. Alexander et al. (2016) estimated the Gini coefficient in the lowest stratosphere over the coastal Antarctica as 0.5–0.6 using simulation data from a GW-permitting GCM which contains no GW parameterizations (Watanabe et al., 2008). The mean value of Gini-coefficient estimated in this study roughly accord with but slightly smaller than the value by Alexander et al. (2016). The seasonal variation of the intermittency is found. The region with quite small Gini coefficient (0.3–0.4) in the stratosphere extends to the upper troposphere, whose usual Gini coefficient is 0.4–0.5, from Jun to July 2016. It is also worth noting that the intermittency of GWs is quite sensitive to the strong disturbances occurring several times a year, which means that the intermittency of GWs varies greatly year to year.