Gravity wave radiation from the shear instability induced by tides in the mesosphere and lower thermosphere

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Gravity waves (GWs) play a significant role in the mesosphere and lower thermosphere (MLT) in which they cause strong wave forcing to drive the summer-to-winter-pole circulation in the upper mesosphere. The GWs are mainly generated in the troposphere and propagate into the MLT region. However, the importance of GW generation in-situ in the MLT region is pointed out in recent studies. GWs are secondarily generated in the MLT region directly by the forcing given by GWs originating from the lower atmosphere and indirectly through the shear instability in the strong vertical shear formed by the GW forcing. In this study, one of the other mechanisms of in-situ GW generation in the MLT region is shown.

Tides have large amplitudes in the MLT region. Thus, the shear instability associated with the tides may also occur in the low and middle latitude MLT region. In this study, relation between tides and the shear instability is examined using simulation data from the whole atmosphere model GAIA. As a result, it is shown that the Richardson number sometimes becomes less than a quarter in the low (middle) latitudes of the summer (winter) MLT region where the vertical shear of the mean wind is not strong. In addition, it is seen that the occurrence frequency of shear instability has strong diurnal (semi-diurnal) variability. The region with high occurrence frequency of the shear instability follows phase movement of DW1 and SW2. The percentage of downward GWs is enhanced below the regions with the high occurrence frequencies for each local time. These results indicate that large-amplitude DW1 and SW2 significantly and respectively contribute to the formations of the shear instability radiating GWs in the low latitudes of MLT region and the middle latitudes of the winter hemisphere in the lower thermosphere.

Keywords: Middle atmosphere, Gravity waves, Tides

