Geophysical Research Abstracts
Vol. 20, EGU2018-6308, 2018
EGU General Assembly 2018

Are vertical velocities from PMSE a good representation of vertical winds?

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Radar measurements of the vertical velocities from Polar Mesospheric Summer Echoes (PMSE) have been considered not to represent the vertical wind over the last couple of decades. The importance of the vertical wind in dynamical processes motivated us to analyze data obtained with the Middle Atmosphere Alomar Radar System (MAARSY) over Andoya, Norway during summers of 2016 and 2017. We obtain neutral wind vector components based on the Doppler beam swinging (DBS) technique using PMSE as a tracer. The mean vertical component shows a downward value of $\sim$ -0.17m/sec for the summer seasons and altitudes between 80-90 km-s. The vertical profile of the vertical component starts on its minimum value $\sim$ -0.4m/sec and increases with altitude to positive (upward) values at a transition altitude close to the mesopause heights (approx. 86 km). We show that the obtained mean vertical component does not depend on the PMSE brightness, local time or measurement uncertainties. The influence of ice-particle sedimentation on the measurements is considered. A possible bias due to tilted layers of PMSE is also discussed and eliminated. Our results are statistically sound over two summer seasons.
In addition, we propose a possible mechanism of the local forcing due to vertical shear in the total horizontal wind, which is dominated by the zonal wind component, to explain the observed vertical component and its connection to the vertical wind. Westward gravity wave drag on the zonal wind is partially responsible for the vertical shear in the horizontal wind during the summer season. Stratified horizontal wind, in turn, changes the pressure profile deviating from the hydrostatic balance. In result, the vertical downward advected wind is corresponding to the decreasing profile of the total horizontal wind and vice versa. The up-and-downward motion should exhaust(decrease) the atmospheric density on the mesopause altitudes and lead to an additional local cooling in the narrow layer around the transition altitude of the west-eastward zonal wind.