Vertical motion of the neutral atmosphere in the polar MLT region

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We will present results of vertical motion above Tromsoe (69.6 deg. N, 19.2 deg. E) in the polar Mesosphere-Lower Thermosphere (MLT), mainly based on sodium LIDAR data. Vertical motion of the neutral gases in the polar MLT is a peculiar issue, and its understanding is important in terms of substance transport as well as thermal structures. Observations of the vertical wind in the MLT region are rather difficult, because vertical velocities are generally thought to be about two orders smaller than horizontal wind velocities. It is believed that the cold summer mesopause is set up by upward motion of the air with strength of a few cm/s in the mesosphere. During high auroral activity intervals, some observations conducted by Fabry-Perot Interferometer (FPI) reported about 10 m/s or larger vertical wind velocity in the polar lower thermosphere. FPI measurements, however, suffer from an unavoidable weakness of passive measurements: no information on the height observed. On the other hand, observations of vertical winds by radars (IS, MF and meteor radar) are also difficult. Thus, our understanding of the vertical motion in the polar MLT region is still limited. The sodium LIDAR operated at Tromsoe is capable of simultaneous measurements of wind velocities with five directions with a good accuracy (1-2 m/s). By using the LIDAR data (about 2100 hr data) obtained from October 2012 to March 2016 together with EISCAT, MF, and meteor radar data as well as auroral image data, we will discuss the characteristics of the vertical motion in the polar MLT.

We have found several events where the vertical wind blew with strength of about 10 m/s. In the case of January 14, 2015, the upward vertical wind with an amplitude of 10 m/s was found between 92 and 101 km lasting for a few hours. During the night, the semidiurnal tide was strong with an amplitude of 100 m/s. This would confirm that strong vertical motion exists when such waves pass by the MLT region. In another event found in February 8, 2013, upward flows were observed between 94 and 96 km at the same time for 15 min, while no vertical flows were found at and above 97 km and at and below 93 km. Of particular interest in the both cases is that a sporadic sodium layer (SSL) appeared nearby the height region where the upward vertical wind was observed at the same time (in the case of January 14, 2015) or 15 min later (in the case of February 8, 2013). In this presentation, we will address what conditions are needed for the vertical motion occurrence, and also discuss possible relationship with the advent of SSLs.