Report on statistical analysis of the lower thermospheric wind velocity using EISCAT Svalbard radar data

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Of vital importance is to qualify significance of the magnetospheric forcing (such as the Joule heating and the ion drag) to the polar thermospheric wind dynamics, in order to obtain better understanding of the Magnetosphere-Ionosphere-Thermosphere (MIT) coupling process. During the last three decades, a number of studies based on observations have been made to investigate the thermospheric wind dynamics. The previous observations demonstrated that the thermospheric wind velocity tends to be higher during the geomagnetically disturbed periods and its speeds are sometimes much larger than the theoretical sound speeds (typically 300-400 m s^{-1} in the lower thermosphere, at 100-120 km height, and 700-900 m s^{-1} in the upper thermosphere, at 300-600 km height). Theoretical studies pointed out that the transonic neutral wind might induce important effects on the atmosphere. Therefore, it is important to investigate general characteristics of such high-speed neutral winds (with the sound speed or more). A study reported a statistics of the high-speed neutral winds (with speeds on more than 700-900 m s^{-1}) in the upper thermosphere using satellite data. The occurrence rate of the high-speed winds was 1%, and the winds were more frequently located in the polar cap. In the lower thermosphere (100-120 km), on the other hand, neutral winds with speeds exceeding 300 m s^{-1} were found during geomagnetically active intervals in several measurements by Incoherent Scatter (IS) radars and Fabry-Perot Interferometers (FPIs), while there are few statistical studies on the high-speed neutral wind.

In this study, based on data sets of more than 800 hours accumulated during 129 days from 1998 to 2005 by the European Incoherent SCATter (EISCAT) Svalbard Radar (ESR) located in Longyearbyen (78.2 deg N, 16.0 deg E in geographic coordinates, 75.2 deg in invariant latitude), we give an overview on the lower thermospheric wind velocity at 100-120 km height in the polar cap region. The wind speeds between 100 and 120 km tend to be larger at higher heights. We have applied a model fit to obtain a real velocity distribution excluding data fluctuations due to measurement uncertainties. Most of the real velocities at 110 km are less than 100 m s^{-1} and those at 120 km are less than 300 m s^{-1}. At 120 km height, 1% of the real velocities have speeds of more than 400 m s^{-1}. We here present these results and discuss relationship between the high-speed neutral wind with speeds more than 400 m s^{-1} and the magnetospheric energy inputs to the thermosphere (i.e. energy inputs by the Joule heating and the ion drag).