Numerical modeling of the vertical thermospheric wind behavior in the high-latitude ionospheric E-region during magnetic storms at high solar activity

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The behavior of the thermospheric wind velocity vector in the high-latitude ionospheric E-region during the strong magnetic storms at high solar activity has been investigated using the global numerical model of the Earth's upper atmosphere. The model calculations have been performed for the conditions of the magnetic storms of April 3-4, 1979 and March 31, 2001. The input model parameters (the electric potential drop across the polar cap and the precipitating electrons) were taken in dependence on magnetic activity. The extremely strong storm of March 31, 2001 was simulated by using E-region data, obtained from the incoherent scatter radar at Millstone Hill that was situated at the auroral zone when the magnetic activity was maximal. It was shown that the magnetospheric convection effects are clearly seen in the thermospheric circulation at E-region heights. The regions of generation of the intensive vertical wind disturbances in the high-latitude ionospheric E-region have been established. The vertical wind disturbances look like the internal gravity waves with amplitudes reaching 60-70 m/s at the top boundary of the E-region and their horizontal scales exceed 200 km. The results of the model calculations have been compared with the interferometer observations of vertical winds within the auroral zone (Lovozero observatory). Under disturbed conditions the observed vertical wind velocities were usually larger (up to 100 m/s) than the model values. The possible contribution of the diffusion movements to atomic oxygen vertical velocities measured at E-region heights and other possible causes of the disagreement between modeled and observed vertical wind data are discussed.

This work was supported by the Grant No.00-05-65132 of Russian Foundation for Basic Research