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Comparison and Validation Studies related to the Modeling Ionospheric Convection and the EISCAT Observations in the Polar Cap

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We use the ionospheric velocity measurements obtained by The European incoherent scatter (EISCAT) Svalbard radar (ESR) for comparison with the electric field distribution predicted by new ionospheric convection model based on realistic maps of field-aligned currents [Lukianova and Christiansen, 2006].

We got the data from the MADRIGAL database, which contains analyzed ESR data starting from the beginning of the radar operation in 1996. Mostly, the radar measured along a fixed direction to the north or south. The velocity vector at high latitudes (above 75 deg. MLAT) can be obtained only in the cases when the antenna is pointed northward and swings between two directions. Altogether, there was 110 hours of such observation during 2000-2002. These data have been selected for the present study. Recently, in January and December 2004, two campaigns have been performed to observe the azimuthal plasma flow. During these campaigns the ESR steerable antenna was directed to the east or west along the corrected geomagnetic (CGM) latitude (i.e., at an azimuth angle of 70 or 250 deg from the geographic north) at an elevation angle of 45. The measurements were made in the dayside (6-16 MLT) during 60 hours, altogether. These data which include only the east-west flow component measured at 75.3 MLAT are also used in the present study.

Thus, the comparative analysis of model' output and observations is based on the data contained both the north-south and east-west components of the ionospheric electric field. First, such a comparison provides an independent check of the model. It is shown that the model represents accurately the large-scale features of statistical electric field

inferred from the ion velocity measured by the ESR. Also, from observations and modeling we quantitatively determine the dependence of the ionospheric electric field strength on the IMF conditions and how this varies with MLT. Such dependence are clearly seen by contrasting the results for two magnitudes of the IMF strength (BT=1 and 5 nT), for two opposite directions of the IMF BZ component, and for BY+, BY-. For specification of the dependence we derive average convection patterns for sorting by the magnitude and direction of the IMF. The magnitude of the IMF has the main impact on the average flows under southward IMF conditions. We calculated coefficients characterizing a linear increase of the electric field strength with BT (up to 8 nT) and obtained a very good consistency between simulation and actual observations with regard of this parameter. The sign of IMF BY is the most important factor influenced the convection system under the IMF northward. For BY- the northward component is negative during ¾ part of the day indicating clockwise plasma flow around the pole. For BY+, the situation is opposite, the electric field is directed poleward and the plasma rotate anticlockwise. These are confirmed nicely by the ESR observations.

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