

Multi-factor fitting of the convection reversal boundary position to solar wind parameters and geomagnetic indices

I.V.Golovchanskaya, Yu.P.Maltsev
(Polar Geophysical Institute, Apatity)

For many geophysical tasks it is important to know with good accuracy position of the convection reversal boundaries in the ionosphere. We performed multi-factor LST fitting of the boundary latitude to the solar wind parameters and geomagnetic indices for the dusk and dawn MLT sector by Dynamic Explorer 2 electric field measurements over the observational period of 540 days. Having tried a lot of linear combinations of the parameters, among which there were Bx, By, Bz IMF, RMS, n, V, nV, nV², Kp, Dst, AE, AL, we found that the evening convection reversal boundary (ECRB) invariant latitude can be most satisfactorily described by the relations

$$\text{LAT}_{\text{ev}} = 0.27B_y + 0.26B_z - 0.24nV^2 \quad \text{RES} = 0.82 \quad (1)$$

$$\text{LAT}_{\text{ev}} = 0.23B_y + 0.39\text{Dst} - 0.23nV^2 \quad \text{RES} = 0.73 \quad (1a)$$

where all the parameters are normalized and RES is the residual error.

To distinguish between the Dst and Bz effects on the ECRB position we performed its fitting to the four parameters: B_y, B_z, Dst and nV² and immediately found that the Dst effect is nearly three times greater:

$$\text{LAT}_{\text{ev}} = 0.25B_y + 0.12B_z + 0.34\text{Dst} - 0.25nV^2 \quad \text{RES} = 0.72 \quad (1b)$$

As for the morning convection reversal boundary (MCRB), we nearly failed to fit satisfactorily its position to the chosen set of parameters, i.e. in all our attempts the coefficients by all the terms appeared to be smaller than in (1) and residual error greater. The best fitting was the following

$$\text{LAT}_{\text{m}} = -0.14B_y - 0.08B_z + 0.08\text{Dst} - 0.11nV^2, \quad \text{RES} = 0.95 \quad (2)$$

Quite an unexpected feature in relation (2) is a negative coefficient by the B_z IMF term, which means that the MCRB shifts equatorward with B_z IMF increasing. Moreover, having performed the fitting with only northern B_z IMF preserved in the initial data set, we found the same effect for the ECRB.

In general, the results of the fitting indicate irregular behaviour of both ECRB and MCRB and dependence of their position on some other factors not considered here, one of which can be striation and destroying of the boundaries reported in the accompanying paper by Golovchanskaya [2001].