A new version of the magnetospheric block for the global numerical upper atmosphere model

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The new magnetospheric block of the global numerical model of the Earth's upper atmosphere [1] simulates the transport processes in the magnetospheric plasma sheet by solving the system of the magnetohydrodynamic equations for the plasma sheet ions. The geomagnetic field is considered as dipole at latitudes equatorwards to the polar cap boundary (Φ=75°) and having the field lines open inside the polar caps. The initial values of pressure and density in the plasma sheet are taken as 0,4 nPa and 0,4 cm^{-3}, correspondingly.
The present results are the following: the program produces more or less realistic pressure distribution and region 2 field-aligned currents. The problem is that the obtained solution is not stable and it falls apart after approximately one hour. The instability is caused by the fact that region 2 field-aligned currents depend on longitudinal pressure derivative. Therefore, even the slightest fluctuations in the longitudinal variation of the calculated plasma pressure result in a situation when there are several local extrema (more than needed two), and it at once results in occurrence of additional pairs of currents which subsequently amplify each other.
One of the methods to suppress similar effects is the smoothing. As region 2 field-aligned currents depend on longitudinal pressure derivative therefore to obtain one pair of currents, it is necessary that pressure at the fixed latitude should have one maximum and one minimum, what, in general, agrees with observations. At present the approximation of a longitudinal pressure variation by a cubic parabola based on least squares method is realized in the program.

Reference

1. Namgaladze A.A., O.V.Martynenko, M.A.Volkov, A.N.Namgaladze, R.Yu.Yurik. High-latitude version of the global numeric model of the Earth's upper atmosphere // Proceedings of MSTU. – 1998. – V.1, N.2. – P.23-84.

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