Study of the increase in plasma pressure in the Earth's magnetosphere during geomagnetic storms

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Abstract:

Geomagnetic storms are a major disturbance of the Earth's magnetosphere that takes place when there is a very efficient exchange of solar wind energy in the space environment surrounding the Earth. These storms are the result of variations in the solar wind that produce important changes in the currents, plasmas, and fields of the Earth's magnetosphere. Solar wind conditions that are effective in creating geomagnetic storms are sustained periods (several to many hours) of southward orientation of the interplanetary magnetic field and of high-speed solar wind.

It is not yet fully understood how the magnetosphere reaches magnetostatic equilibrium and what specific conditions are necessary to maintain it. Unraveling these processes requires knowledge about the 2-D distribution of plasma pressure for different geomagnetic conditions. In this context, a particularly important article was studied in the analysis of the Earth's magnetic field in the presence of geomagnetic storms (Antonova & Vovchenko, 2010), in which the results of numerical modeling of variations in the magnetic field with increased pressure in the inner regions of the magnetosphere are presented, in the axisymmetric case with pressure isotropy.

In this work, we continue the study carried out in (Antonova & Vovchenko, 2010) in such a way that it is possible to understand how magnetic fields are affected when there are variations of pressure. In that regard, we have obtained an equation for the magnetic field, deduced from the magnetostatic equilibrium, which allows to calculate the perturbations produced to the dipole field given a certain 2D pressure profile.

These results can be complemented with the use of actual data measured by high-orbit satellite missions to recover the magnetic field in the presence of geomagnetic storms which will represent a breakthrough in the understanding of the Earth's magnetosphere.

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References: Antonova, E. E., & Vovchenko, V. V. (June 24, 2010). Nonlinear Disturbance of the Dipole Field. Geomagnetism and Aeronomy. doi:10.1134/S0016793210060058.

Vovchenko, V. V., & Antonova, E. E. (May 16, 2012). Dependence of Volumes of Magnetic Flux Tubes on Plasma Pressure. Geomagnetism and Aeronomy. doi:10.1134/S0016793212010161.

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