Dst and IMF By as driving parameters for strongly disturbed dayside magnetopause

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Abstract

It is well known that solar wind dynamic pressure Pd and Bz- component of interplanetary magnetic field (IMF) are the key parameters controlling the magnetopause. However there are indication appeared that other interplanetary and geomagnetic parameters, such as IMF By and Dst might influence to the magnetopause (MP) size and shape. That influence is believed to be especially prominent under strongly disturbed conditions when the MP approaches the distance of 6.6 Re and passes the geosynchronous orbit.

In the present study we investigated an influence of storm-time geomagnetic index Dst and By component of the IMF to the MP at geosynchronous orbit. Several case events were studied and statistical analysis was performed. The case events have been selected for quasi-state solar wind conditions such that the geosynchronous magnetopause crossings (GMCs) are caused either by the motion of satellite at geosynchronous orbit or by small oscillations of the magnetopause. Such choice provides the most accurate determination of the solar wind conditions during the GMCs, because the MP is located near its equilibrium position. In the statistical analysis we used a data set of several hundreds time intervals with total duration of ~15000 min, which were accompanied by 560 GMCs. The data set was collected for period from 1997 to 2002 using geosynchronous satellites of GOES and LANL series.

The analysis is based on comparison of the observed MP location (outside or inside geosynchronous orbit) with a model prediction. We chose a model by *Shue et al.* [1998] and modified Chao model [*Yang et al.*, 2003], because they depend on Pd and Bz only. Hence an influence of other parameters should cause systematical displacement in the model predictions. That displacement can be revealed and analyzed by using such statistical number as overestimation/underestimation ratio (OUR). Both studies of quasi-state events and statistical investigation show a prominent influence of the Dst and By to the magnetopause.

Under strong negative Dst the models systematically overestimate the MP size at both low and middle latitudes for any IMF Bz. Due to the MP duskward skewing the overestimation is larger (achieves up to 1 Re) at prenoon sector. Hence during strong magnetic storms the size of dayside MP is smaller than the model predicted. The physical nature of the Dst effect can be explained as a storm-time depletion of the

dayside geomagnetic field due to the tail current intensification and approaching of its inner edge to the dayside magnetosphere.

The MP dependence on the IMF By is ambiguous. It was suggested that the By influences to the MP size through a cone angle. The latter controls the bow shock size such that for quasi-perpendicular IMF orientation the bow shock is located far from the earth than for quasi-parallel one. For negative cone angles the IMF orientation is quasi-parallel (quasi-perpendicular) at prenoon (postnoon) sector. Hence in the prenoon sector the size of bow shock and magnetopause is smaller and the models systematically overestimate the MP distance. For positive cone angles the MP size is smaller at posntoon sector. In this sense the effect of strong IMF By consists in changes of conditions for solar wind flowing around the magnetopause.