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# Comments on "Dependence of the cusp latitude on various parameters" by A.A.Ostapenko and Yu.P.Maltsev (pages 45-46, this issue)

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The paper deserves publication because its gives sufficiently simple formulas for the cusp position which are in agreement with observations, and, as the beginning of such important investigations, it is of a great interest.

The principal objection is connected with the set of parameters used by the authors for studying the magnetospheric structure. That concerns not only the given paper, but the previous papers of the same authors (for instance [1] which is the base for the given paper).

The cause and effect are actually mixed here. As the first-order approximation the general scheme of the geophysical processes is simple. The Earth's dipole field is influenced by the solar wind, i.e. by the charged particle flow bringing the interplanetary magnetic field. It is just the solar wind which does create the terrestrial magnetosphere, hence all variations of the solar wind parameters must be manifested in the magnetospheric structure. The magnetosphere, in its turn, being magnetically connected with the Earth, crucially affects geophysical processes near the Earth, such as auroras, geomagnetic disturbances, riometer absorption, etc.

Thus the magnetosphere presents a transmission link from the solar wind to the ground geophysical phenomena. Search of simultaneous dependence of the magnetospheric structure on the solar wind parameters and their ground manifestations (on *Dst* and *Kp* in the given paper) is a kind of hotchpotch which is pleasant as a dinner dish, but is hardly eatable in geophysics. It is more reasonable to divide the problem in two independent parts. The first problem is the dependence of the magnetospheric structure variations on the solar wind parameters. In this case, we can try to understand the physical nature of any empirical relationships. The second problem, being not less important, is relation of the magnetospheric structure to its ground manifestation. Here the magnetosphere plays a role of a source. The obtained dependencies can be interpreted in terms of physical processes, for instance, in the framework of variations of the magnetospheric electric fields.

In this sense, the Tsyganenko 89 model [2] is more logical, although being the first-order approximation, is rather crude because only *Kp* index was used for characterizing the ground magnetic disturbances. This index is available for practically any time interval but seems to be the least informative one among all geomagnetic indices.

The brightest manifestation of the magnetospheric activity is a substorm whose explosive stage is connected with release of the energy accumulated in the magnetosphere. The whole substorm lasts for ~1 hour, the explosive stage lasting for 10-20 minutes. Kp index presents averaged characteristics of magnetic variations at a small net of subauroral observatories in relative nonlinear-scale units for three hour interval during which several substorms can occur.

N.A.Tsyganenko understanding the disadvantages of *Kp* has worked up recently a new model. Unfortunately, one can express the same dissatisfactions to this model as to the paper by A.A.Ostapenko and Yu.P.Maltsev. Both models use both the solar wind data and ground magnetic perturbations as input parameters.

For further studying the magnetospheric structure one should not mix heterogeneous data, but instead separately search for the dependence of the magnetospheric structure on the solar wind parameters and then the ground manifestations of the magnetospheric processes. Instead of *Kp* index leveling the really occurring disturbances it would be better to use *AL* or *AE* indices which tables are also available. These indices expressed in nanoteslas give information about the maximum value of the global magnetic perturbation, although their 1 hour averaging interval is also excessively large.

## *References*

1. Ostapenko, A. A., Yu. P. Maltsev, and M. V. Malkov, Relation of magnetic field in the inner magnetosphere to geomagnetic indices and solar wind parameters. Submitted to *J. Geophys. Res.*, 1996.

2. Tsyganenko, N. A., A magnetospheric magnetic field model with a warped tail current sheet, *Planet. Space Sci.*, *37*, 5-20, 1989.

## Authors reply

The G.V.Starkov's comments anticipate the future development of magnetospheric modelling. The magnetosphere is known to be formed by the solar wind, hence the final aim of modeling is to obtain the magnetic field at any point of the magnetosphere as a function of the solar wind parameters. Today, however, nobody knows how to find this function because simple linear relation is not valid. Two parameters are believed to be of the most importance: the solar wind dynamic pressure and the IMF southward component. Perhaps, the pressure affects the magnetosphere with a rather small time delay (a few minutes). For a one-hour resolution model it is sufficient to find the spatial distribution of the part of the external magnetospheric field which is related to the wind pressure. As for the southward IMF, its influence on the magnetospheric field is much more complicated, the time delay being very long (several hours) and dependent on the magnetospheric region. Today, at the first stage of modelling, investigators try to find any quantitative relationships between the magnetospheric field and another available parameters. *Ostapenko et al.* [1996] obtain that the magnetospheric field depends mainly on *Dst* index which in turn is a result of prolonged action of the southward IMF [*Burton et al.*, 1975; *Feldstein*, 1992]. One can proceed to the second stage of modelling by expressing *Dst* in terms of the southward IMF.

### *References*


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