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The polar cap magnetic activity (PC) index as an indicator of the solar wind energy incoming into the magnetosphere

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Abstract

The polar cap (PC) magnetic activity index was approved by the International Association of Geomagnetism and Aeronomy (IAGA) in 2013 as a new international index assigned to monitor the energy that enters into the magnetosphere under the solar wind-magnetosphere coupling. The following experimental data form the basis for this statement: (1) the *PC* index strongly follows the time evolution of interplanetary electric field (E_{KL}) reduced to the magnetopause, (2) delay time ΔT in response of *PC* index to E_{KL} variations is controlled by the E_{KL} field growth rate (dE_{KL}/dt), (3) magnetic storms and substorms are always preceded and accompanied by a growth in *PC* index, (4) substorms and magnetic storms start to develop as soon as the *PC* index exceeds the threshold level of 1.5 mV/m, (5) the substorm sudden onsets are commonly associated with a sharp increase in the *PC* (and E_{KL}) growth rate, (6) the solar wind drivers (ICMEs or SIRs) determine the type of magnetic storm, such as "classic" storm, related to ICME impact, with well-defined PC maximum and clearly expressed one maximum of depression, "pulsed" storm, related to SIR impact, with periodically repeating oscillations in *PC* and geomagnetic field depression, and "combined storms", which are regarded as effect of simultaneous ICME and SIR action, (7) maximal depression of magnetic field responds to maximal PC value with a delay of ~1 hour, the storm intensity (*Dstmin*) being linearly depending on *PCmax* value. In ~10% of the substorm events the correlation between E_{KL} and *PC* was practically absent, in spite of the *PC* index rise before the substorm onset, which means that solar wind, measured in the Lagrange point, passes by the magnetosphere in these cases. Therefore the PC index can be used also to verify whether or not the solar wind measured in Lagrange point L1 is in contact with the magnetosphere.

All these statistically justified relationships testify that the *PC* index is an indicator of the solar wind energy incoming into the magnetosphere. In this context, the *PC* index can be successfully used as a new reliable ground-based technique for exploration of short-term changes in space weather and magnetosphere state.

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