PC index as an indicator of the magnetospheric substorm and magnetic storm development

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The PC index as a characteristic of the solar wind energy that entered into the magnetosphere is used to monitor and nowcast the magnetospheric substorm development. It is shown that the PC index always begins to grow ahead the substorm sudden onset. Length of substorm growth phase is determined by the PC growth rate: the higher the rate, the shorter is growth phase duration. The substorms start when the PC index exceeds the definite threshold level (from ~ 1.5 mV/m to >3 mV/m under different conditions). The substorm intensity, expressed by the auroral AL index, is determined by difference between the initial PC value in moment of the growth phase beginning and final PC value in moment of the substorm onset: the larger the PC gradient during the growth phase, the more powerful is magnetospheric substorm. Under condition of high PC index (PC > 3 mV/m) the substorm intensifications can occur in any time. It means that energy available in the magnetosphere in these cases occurs to be enough for the substorm intensifications irrespective of the PC behavior. Substorms are stopped as soon as PC index falls below 1 mV/m.

The magnetic storms, identified by the world geomagnetic field depression (Dst index), start to develop when the PC value persistently exceeds the threshold level ~ 2mV/m. The storm intensity is linearly related to the greatest PC value preceding (~ 1 hour) the maximal depression. The storm recovery phase is observed when the PC index persistently declines below the threshold level.

The statistically justified relationships between the PC index and AL and Dst indices were derived for various trends of the PC index behavior and under the quite different conditions. The obtained relationships were testified while examining the concrete storm and substorm events. The checking results demonstrate that the PC index provides the reliable basis for the space weather monitoring and nowcasting.