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Sawtooth substorms generated under conditions of the steadily high solar wind energy input into the magnetosphere: reasons for periodicity

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Periodicity in occurrence of magnetic disturbances in polar cap and auroral zone under conditions of steady and powerful solar wind influence on the magnetosphere is analyzed on the example of 9 storm events with distinctly expressed sawtooth substorms (N=48). Relationships between the polar cap magnetic activity (PC-index), magnetic disturbances in the auroral zone (AL-index) and value of the ring current asymmetry (ASYM index) were examined within the intervals of the PC growth phase and the PC decline phase inherent to each substorm. It is shown that the substorm sudden onsets are always preceded by the PC growth and that the substorm development does not affect the PC growth rate. On achieving the disturbance maximum, the PC and AL indices are simultaneously fall down to the level preceding the substorm, so that the higher the substorm intensity, the larger is the AL and PC drop in the decline phase. The ASYM index increases and decreases in conformity with the PC and AL behavior, the correlation between ASYM and PC being better than between ASYM and AL. Level of the solar wind energy input into the magnetosphere determines periodicity and intensity of disturbances: the higher the coupling function EKL, the higher is substorm intensity and shorter is substorm length. Taking into account the permanently high level of auroral activity and inconsistency of aurora behavior and magnetic onsets during sawtooth substorms, the conclusion is made that auroral ionosphere conductivity is typically high and ensures an extremely high intensity of field-aligned currents in R1 FAC system. The periodicity of sawtooth substorms is determined by recurrent depletions and restorations of R1 currents, which are responsible for coordinated variations of magnetic activity in the polar cap and auroral zone.