Explanation of global plasmapause characteristics in the frame of interchange instability mechanism

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Recent statistical studies based on CLUSTER, CRRES, and THEMIS satellite data have provided insight into global plasmapause characteristics: start of erosion between 21-07 MLT and eastward azimuthal propagation. The observed plasmapause behavior is found to agree with the theory of the interchange instability mechanism. We present the results of the plasmapause characteristics obtained with simulations based on this mechanism.

Here we aim to obtain the same plasmapause characteristics that we previously obtained with simulations using real values of geomagnetic Kp index (which are the proxies for the convection electric field), but using synthetic Kp changes. We show that for that, completely unexpected, instead of many combinations of Kp changes occurring at different UT times (generated for instance with Monte Carlo methods), only 3 Kp jumps occurring at one UT time, leads to the same plasmapause characteristics obtained with simulations using the real Kp values. Therefore, two plasmapause datasets are constructed by setting the following input in the simulations: (a) real values of the geomagnetic Kp index, (b) certain types of time-dependent changes in the Kp (Kp jumps). The Kp jumps include sharp Kp increase, sharp Kp decrease, short time burst enhancement (increase-decrease within 3 hours) in Kp and their combinations in order to obtain plumes, shoulders, and notches, the structures most often observed in nature. The modeled plasmapause is cross-correlated with the Kp index at different 1-hour MLT bins.

We have shown that the cross-correlation curves provide deep insight into the physical processes related to the plasmapause dynamic and evolution. In single events, plasmapause may undergo complex and different dynamics. Here, we show that global plasmapause motions and deformation in time may be simply explained, at least in the statistical sense. Accordingly, we will demonstrate and discuss that three plasmapause structures and their combinations statistically leave the same imprint in the passage through a specific MLT sector as a combination of the plasmapauses created with a large number of the real Kp changes.

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