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Long-term behavior of the magnetotail stretching and dependence on interplanetary and geomagnetic conditions

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It is known that the stretching of the magnetic field lines in the near-Earth magnetotail is characterized by the latitude of the precipitation boundary, on which the energy flux of ions with energy above 3 keV is maximum. This boundary, called b2i, is routinely determined from low-orbiting DMSP satellite particle data by the Auroral Particles and Imagery Group at JHU/APL. The lower b2i, the more stretched is the magnetic field. We used b2i values, which are publicly available at the JHU/APL website, along with interplanetary and geomagnetic activity data from the OMNI database for years 1984-2004 (the interval spanning solar cycle 22 and most of solar cycle 23) for investigation of the long-term evolution of the magnetotail stretching. It is found that annual average of b2i has pronounced variations during the two solar cycles. Maximal b2i values (more dipole-like magnetosphere) are found in 1987 (near the minimum of solar cycle 22) and in 1996 (near the minimum of solar cycle 23). Minimal b2i value (more stretched magnetosphere) is found in 1991near the maximum of solar cycle 22, but in 2000 (maximum of cycle 23) the b2i minimum is not distinct. In contrast to the behavior of b2i during the declining phase of the preceding cycle, a strong decrease of the latitude is observed in 2002-2003. Such variations of b2i are in agreement with the behavior of interplanetary parameters which also demonstrate an “anomalous” behavior in 2002-2003. The best correlation of the magnetotail stretching is found with annual average of the merging electric field. More stretched magnetotail means more intense cross-tail current in the near-Earth region and, consequently, higher level of geomagnetic activity. This explains a high correlation ($|r|>0.8$) between annual average of b2i and geomagnetic activity indices Kp, AE, and Dst. The correlation is higher than that between the indices and interplanetary parameters. It is also found that b2i

depends on season. Monthly averaged b2i values exhibit distinct minimum in March and October. This agrees with the well known equinox increase of geomagnetic activity.