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Magnetospheric current systems as inferred from SYM and ASY mid-latitude indices

Natalia Ganushkina (1,2) and Stepan Dubyagin (1)

(1) Finnish Meteorological Institute, Earth Observations, Helsinki, Finland (natalia.ganushkina@fmi.fi), (2) University of Michigan, Ann Arbor, MI, USA

Separating the contributions from different current systems from point magnetic field measurements and interpreting them as belonging to one system or another is very difficult, and caution must be used when deciphering near-Earth currents from either data or modeling results. At the same time, there are other continuously measured quantities, which can provide, though indirectly, information about the dynamics of the magnetospheric current systems. The SYM-H and ASY-H indices, computed from the observations of magnetic field at low latitude ground-based stations, contain contributions from major magnetospheric current systems, such as the symmetric and asymmetric ring current, tail current, magnetopause currents and field-aligned currents. Highly distorted magnetospheric magnetic field during storm times due to disturbances in the current systems is reflected in the SYM-H and ASY-H observed variations. Using empirical magnetospheric models we study the relative contribution from different current systems to the SYM and ASY mid-latitude indices. It was found that the models can reproduce ground based mid-latitude indices rather well. The good agreement between the indices computed using magnetospheric models and real ones indicates that purely ionospheric current systems, on average, give modest contribution to these indices. The superposed epoch analysis of the indices computed using the models shows that the cross-tail current gives dominant contribution to SYM-H index during the main phase though this contribution can not be separated from FAC region 2 and partial ring current contributions since these systems are overlapped. The relative contribution from symmetric ring current to SYM-H starts to increase a bit prior or just after SYM-H minimum and attains its maximum during recovery phase. The ASY-H and ASY-D indices are controlled by interplay between three current systems which close via the ionosphere. The region 1 FAC gives the largest contribution to ASY-H and ASY-D indices during the main phase, though, region 2 FAC and partial ring current contributions are also prominent. The partial ring current is the main contributor to the ASY indices during the recovery phase. In addition, we discuss the application of these results to resolving the long-debated inconsistencies of the substorm-controlled geomagnetic storm scenario.