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Developing a new magnetospheric current index characterising hourly to decadal variations

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Geomagnetic field observations are a superposition of contributions from the geodynamo in the core, remanent or induced magnetic fields in the lithosphere, and the magnetic signals produced by current systems in the ionosphere and magnetosphere. Disentangling all of them remains a challenge. Geomagnetic activity indices like the widely used disturbed storm time index Dst, developed to characterize the magnetospheric ring current signal, are mainly aimed at describing relatively short-term field variations. On multi-annual to decadal timescales, however, internal field secular variation is intermingled with external field variations modulated by the solar activity cycle. The method to eliminate the core field contribution in the derivation of the Dst index does not take this into account.
We have developed an annual magnetospheric currents index (AMC) that robustly describes the long-term magnetospheric variations. It includes error estimates reflecting the uncertainty in our knowledge about main field strength and its secular variation by a Bayesian inversion. Moreover, the AMC is the first magnetospheric index aiming at giving the correct background level of the ring current. The index spans the interval 1900 to 2010 and its final version is based on the annual mean results from six geomagnetic observatories. The index has been validated by a comparison to magnetospheric field variations estimated in global geomagnetic field models of the Ørsted and CHAMP satellite era (2000 to 2010).
The AMC is the first step towards a new hourly magnetospheric currents index (HMC) with the same long-term properties. Work in progress towards this aim includes the determination of the best method to subtract the daily solar quiet ionospheric variation, that could be neglected for the AMC. It is not straightforward how to parameterize this signal, which is influenced by the extreme utraviolet radiation from the sun. Moreover, the ring current intensity becomes strongly asymmetric in magnetic local time (MLT) during the main phase of geomagnetic storms. We aim to find a parameterization that approximates this MLT dependence for the whole HMC time series.