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Geomagnetic Reconstruction in Gaps of Solar Wind Parameters by Singular Spectrum Analysis

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The main historical — i.e. pre-1994 — solar-wind and interplanetary magnetic field (IMF) observations come from measurements taken on board of the IMP-8 spacecraft. While the spacecraft crossed the magnetosheath and magnetosphere, it was not immersed in the solar wind at all times, and so large continuous gaps exist in the collected data. Even after 1994 there have been many data gaps in the solar wind data, though they are not as frequent and are usually shorter.

The behavior of Earth's magnetosphere is strongly influenced by the solar wind. Various geomagnetic indices — such as Kp, Dst or AE —are inferred from ground-measured, and hence time-lagged magnetic disturbances that are caused by the magnetosphere's interaction with the solar wind and the embedded IMF; these indices are inferred from the ground and are typically available continuously in time, even when solar-wind data are not. Broadly speaking, these indices can be considered as a proxy for the overall time-lagged magnetospheric response to the solar driver, i.e. to the solar wind and IMF.
We will demonstrate how to reconstruct data in the gaps of the solar driver by using smooth spatio-temporal modes of co-variability inferred by singular spectrum analysis (SSA) from time-lagged correlations in multivariate data consisting of gappy-driver (solar wind and IMF) and continuous-response records (various geomagnetic indices),— while discarding the noise. Application of the reconstructed data to radiation belts modeling will be presented.