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Markovian features of the Super-MAG Auroral Electrojet Index

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Earth's magnetospheric dynamics displays dynamical complexity during magnetic substorms and storms. This complex dynamics includes both stochastic and deterministic features, which manifest at different timescales. In this work, we investigate the stochastic properties of the magnetospheric substorm dynamics by analysing the Markovian character of the SuperMAG SME time series, which is used as a proxy of the energy deposition rate in the auroral regions. In detail, performing the Chapman-Kolmogorov test, the SME dynamics appears to satisfy the Markov condition below 100 minutes. Moreover, the Kramer-Moyal analysis allows to highlight that a purely diffusive process is not representative of the magnetospheric dynamics, as the fourth order Kramers-Moyal coefficient does not vanish. As a consequence, we show that a model comprising both diffusion and Poisson-jump processes is more suitable to reproduce the SME dynamical features at small scales. A discussion of the similarities and differences between this model and the actual SME properties is provided with a special emphasis on the metastability of the Earth's magnetospheric dynamics. Finally, the relevance of our results in the framework of Space Weather is also addressed.