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Application of information theoretical measures for improved machine learning modelling of the outer radiation belt

Constantinos Papadimitriou[1,2], Georgios Balasis[1], Ioannis A. Daglis[2,3], and Simon Wing[4]
[1]National Observatory of Athens, IAASARS, Athens, Greece (constantinos@noa.gr)
[2]National and Kapodistrian University of Athens, Department of Physics, Athens, Greece
[3]Hellenic Space Center, Athens, Greece
[4]Johns Hopkins University, Applied Physics Laboratory, MD, USA

In the past ten years Artificial Neural Networks (ANN) and other machine learning methods have been used in a wide range of models and predictive systems, to capture and even predict the onset and evolution of various types of phenomena. These applications typically require large datasets, composed of many variables and parameters, the number of which can often make the analysis cumbersome and prohibitively time consuming, especially when the interplay of all these parameters is taken into consideration. Thankfully, Information-Theoretical measures can be used to not only reduce the dimensionality of the input space of such a system, but also improve its efficiency. In this work, we present such a case, where differential electron fluxes from the Magnetic Electron Ion Spectrometer (MagEIS) on board the Van Allen Probes satellites are modelled by a simple ANN, using solar wind parameters and geomagnetic activity indices as inputs, and illustrate how the proper use of Information Theory measures can improve the efficiency of the model by minimizing the number of input parameters and shifting them with respect to time, to their proper time-lagged versions.