Nonlinear Processes
in Geophysics
Discussions

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Interactive comment on "Compacting the Description of a Time-Dependent Multivariable System and Its Time-Dependent Multivariable Driver by Reducing the System and Driver State Vectors to Aggregate Scalars: The Earth's Solar-Wind-Driven Magnetosphere" *by* Joseph E. Borovsky and Adnane Osmane

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General comments

This is an interesting paper demonstrating an application of the canonical correlation analysis technique to magnetospheric state variables. The canonical correlation analysis produces three leading canonical variables representing different physical processes in the magnetosphere. In addition to the CCA method the authors use Jensen-

Shannon complexity and permutation entropy analysis methods. In my opinion, the results and implications of canonical correlation analysis are clearly presented, but the manuscript lacks a proper discussion on the implications of Jensen-Shannon complexity and permutation entropy analysis results. I think that the main purpose of this paper is to demonstrate the combined CCA / complexity analysis methodology to a wide audience of geophysicists. Thus, the paper would be much stronger if the authors could explain in detail what value does the complexity analysis add on top of the CCA analysis. I suggest that the authors add a concise review on the complexity analysis methods and explain their implications better.

Specific comments

The authors state on line 25 of page 7 that "the system variable S1, based on various magnetospheric indices, preserves the stochastic and correlational structures of its individual components". I do not understand the significance of this result. Is the preservation of the correlational structures in linear combinations (S1-S3) surprising? Would the opposite result be even possible? The CCA analysis reveals that geomagnetic indices (such as PC and Kp) respond to differently to different solar wind parameters which gives rise to the third canonical variable, verifying earlier results by Borovsky et al. (2014) and Holappa et al. (2014). Interestingly, the analysis also reveals a new independent mode arising from the difference in the electron and ion precipitation power. The physics behind this result is (understandably) not discussed in this paper as it will require more detailed data analysis. However, I suggest that the authors highlight this result in the abstract. Line 8: What would be the correlation coefficient between S1 and the best fitting solar wind coupling function? Is it significantly worse than the correlation between S1 and D1?