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Improving forecasts of the solar wind speed through the assimilation of near-Earth observations

Matthew Lang (1) and Mathew Owens (2)
(1) LSCE, Paris, France (matthew.lang@lsce.ipsl.fr), (2) University of Reading, Reading, UK (m.j.owens@reading.ac.uk)

Data assimilation (DA) is currently underused in the solar wind field to improve the modelled variables using observations. Data assimilation has been used in Numerical Weather Prediction (NWP) models with great success, and it can be seen that the improvement of DA methods in NWP modelling has led to improvements in forecasting skill over the past 20-30 years. The implementation of data assimilation for solar wind forecasting is still in its infancy. Hence, it is important to investigate the optimal implementation of these methods and what improvements in forecasting skill can be gained from these methods to improve our understanding of the solar wind.

The highly driven nature of the solar wind means that any improvements made by a data assimilation method to a solar wind component is swept radially out into deep-space. Therefore, if an observation is not downstream of the Earth, these improvements will not be noticed in near-Earth space.

In order to make the most of observations in near-Earth space, we propose that any data assimilation scheme should map information from the observation location to the model's inner boundary, such that the inner-boundary can be improved, improving the estimates of the solar wind throughout the domain.

To this effect, we present numerical experiments showing a variational data assimilation scheme being applied to a solar wind velocity propagation model using synthetic and real observations to evaluate the quality of our system.