Preconditioning effects on magnetospheric magnetohydrodynamic models

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Abstract. (Type abstract here)

1. Introduction

Forecasting the Sun-Earth domain is difficult. The guidance provided by physics based models are inherently error prone. The predictions made of future solar events have errors. The predictions made of the heliosphere are based on the predictions made from the solar models and have errors. The predictions made of the magnetosphere and ionosphere/thermosphere are based on the predictions made from the heliospheric models. These errors grow as information propagates towards the Earth. This issue is addressed in terrestrial weather models with dense ground based measurements for model input. The cost of adding more satellites to the Sun-Earth domain is expensive thus limiting available data points.

The magnetosphere is the region surrounding the Earth consisting of the Earth's magnetic field. The data available for this region is sparse. Forecasting this region is completed today using physics-based models. These models use equations representing the physics of the region which are solved to calculate values for space weather variables in many different locations across the modeled domain.

There are multiple models of the magnetosphere and each differ greatly. Some differ by their grid choice, some differ in the assumptions made in simplifying the MHD equations. These differences are chosen with goals of comparing best to in-situ data versus other models of the same domain, thus this is the most utilized validation method.

Models are always improving as technology improvements are made yet their predictive ability is still far from high accuracy and precision. Through analysis of all aspects of the modeling process, a stronger confidence can be gained in the results from these models.

In magnetospheric models, a physical system relevant to the inputs to the model can not be initialized as there is a risk of large instabilities. Preconditioning is a process in which the equations are solved during a predetermined time period to allow the physical system it is representing to reach a steady state before input data are used. A stable set of input conditions are used in preconditioning.

This paper aims to show the effects that this preconditioning time has on the errors of the differences between two model outputs from the same model. In the next section, we explain our method of testing preconditioning of multiple models through a model run web interface at the Community Coordinated Modeling Center at NASA Goddard. In section 3 we show the different errors produced when comparing two models through a difference validation method.

2. Methodology

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3. Results

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4. Discussion and Conclusions

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References