Project Details

ROSES ID: NNH15ZDA001N
Selection Year: 2015
Program Element: SCOSTEP/VarSITI

Project Title:
Geophysically Relevant Prediction of Solar Cycle 25

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Summary:
Solar cycle prediction has been traditionally limited to an estimation of the number of visible sunspots; a quantity that from a practical point of view is of little to no use. Part of the reason is a strong disconnection between the study of the dynamo mechanisms that cause the solar cycle, and studies of the impact of the solar cycle on the heliosphere. However, understanding the Sun-Earth connection and the impact of solar activity on the Earth's magnetosphere, atmosphere and climate requires much more than the compartmental study of heliospheric scientific domains.

The primary objective of this proposal is to couple 3D kinematic dynamo, solar wind, and cosmic ray transport models, with aims to predict solar wind conditions and cosmic ray flux inside the heliosphere for the oncoming solar cycle 25. This goal will be achieved by: 1. Carefully integrating the three models so that they match observations, 2. Assessing the sensitivity of the integrated system to degradation of the input data, and 3. Testing the viability of synthetic input data for predicting solar wind properties and cosmic ray flux at 1AU.

This proposal represents a clear effort to break traditional scientific boundaries by coupling 3D kinematic dynamo, MHD solar wind, and cosmic ray transport models; effectively creating a mega-computational domain spanning all the way from the tachocline into the outer edge of the heliosphere and laying down the foundation that will lead to a new generation of solar cycle predictions, which will not be limited to a simple number of sunspots in the photosphere. Instead, it builds the necessary framework to provide agencies and industry with geophysically relevant quantities such as solar wind properties and galactic cosmic ray flux at 1AU.

By developing the framework necessary to predict solar wind properties and GCR flux, the research in this proposal represents a directed effort at making solar cycle predictions accessible and useful to agency and industry planners. This is of critical importance for the planning and operation of long-term missions, especially manned missions such as long-term astronaut visits to the international space station and the intended visit of humans to an asteroid by 2025 and Mars in the 2030s -- goals outlined in the bipartisan NASA

Publication References:

no references