Observations as well as numerical and theoretical models show that solar dynamics is characterized by complicated exchanges among different temporal and spatial scales. It reveals magnetic self-organization processes from the smallest resolution observations by IRIS, Hinode, and SDO; and 2) modeling of solar activity cycles by using simplified MHD dynamo models and mathematical data assimilation techniques. We present recent results of this approach, including the interpretation of observational results from NASA heliophysics missions and predictive capabilities. In particular, we discuss the links between small-scale dynamo processes in the convection zone and atmospheric dynamics, as well as an early prediction of Solar Cycle 25.

**Realistic modeling of local dynamics**

- **Small-scale dynamics**
  - Variations of solar activity are a result of complicated dynamo processes. Using magnetic satellite observations, we employ sub-grid-scale turbulence models. Our numerical simulations reproduce the local dynamo process that is responsible for the quiet-Sun magnetic field. The local dynamo operates in regions below the surface and further accelerated upflows in the low-density, relatively cool state values adjusted. The increments are regressed onto the model states and the distribution of expected observation values. The increments for the next time step are calculated as a function of the current model state. The assimilation is performed using a local data assimilation scheme.

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**Preliminary Analysis of Prediction Solar Cycle 25 Uncertainties**

- **Early predictions of solar activity**
  - A comprehensive data assimilation method has been developed to provide an initial estimate for Cycle 25. The data assimilation method has been applied to the prediction of Cycle 23, and it has been found that the predicted sunspot number at the maximum of Cycle 23 will be ~90 (for the Solar Cycle 23 prediction of Cycle 24, calculated and published in 2008, is holding up quite well so far).

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