VARIATIONAL DATA ASSIMILATION FOR MOSST: A PROGRESS REPORT

Gary D. Egbert[1], Lada Dimitrova[1], WEIJIA KUANG[2], Andrew Tangborn[3]

1. College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR, USA
2. Planetary Geodynamics Laboratory, Code 698, NASA GSFC, Greenbelt MD, USA
3. JCET, Univ. Maryland, Baltimore County, Baltimore, MD, USA

We describe our ongoing efforts to develop variational data assimilation (DA) methods for the MoSST (Modular Scalable Self-consistent Three-dimensional) geodynamo simulator. The project builds on previous work with sequential DA in geomagnetism, adapting recent developments of variational DA methods from oceanic and atmospheric sciences. In the variational approach model inputs (initial and boundary data, forcing) are adjusted to simultaneously fit dynamical equations and observational data. This approach to DA provides a natural way to use high quality data from recent years to improve magnetic field and core flow estimates for past epochs, allowing dynamically consistent simultaneous estimation of the time evolution of the core magnetic and fluid velocity fields. More generally, variational DA provides a common framework for comparing geodynamo model outputs to data, and will allow rigorous tests of dynamical hypotheses. The present focus of our efforts is to develop tangent linear (TL) and adjoint (ADJ) codes for the MoSST geodynamo simulator. Our general strategy is to develop the exact adjoint of the numerical time-stepping scheme, in terms of adjoints of the discrete spatial operators. Because the linear parts of these operators are explicitly formed matrices, adjoints of these spatial operators are essentially just matrix transposes. Non-linear terms (which must be linearized around a background state) require more care. The TL and ADJ codes will be used to implement a modern variational DA scheme, the so-called representer method, making use of a previously developed modular Inverse Ocean Modeling (IOM) system.

Data Assimilation, Geodynamo

Gary D. Egbert, COAS, COAS Admin Bldg 104, Oregon State University,
Corvallis OR, 97331-5503, USA, 1-541-737-2947,
egbert@coas.oregonstate.edu