DESDynI's Ability to Estimate Source Parameters for Solid Earth Science Applications

Paul A. Rosen
Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive, MS 300-227Q
Pasadena, CA 91109

Email: Paul.A.Rosen@jpl.nasa.gov
Tel: (818) 354-0023

Andrea Donnellan, Jet Propulsion Laboratory
Bradford Hager, Massachusetts Institute of Technology
Zhen Liu, Jet Propulsion Laboratory
Paul Lundgren, Jet Propulsion Laboratory
Mark Simons, California Institute of Technology
Frank Webb, Jet Propulsion Laboratory
Sang-Ho Yun, Jet Propulsion Laboratory

DESDynI is a mission specified in the National Research Council Decadal Survey of Earth Science and Applications completed in 2007 to address important scientific and societal questions in Deformation, Ecosystem Structure, and Dynamics of Ice. DESDynI exploits repeat-pass interferometric L-band synthetic aperture radar techniques to systematically measure deformation of solid Earth and ice surfaces globally, with rapid and comprehensive mapping to capture motion on time centers as short as two days and up to the duration of the mission, which is nominally five years. L-band radar polarimetry and vertical profiling lidar measurements are used determine ecosystem structure on unprecedentedly fine spatial scales across the globe to greatly improve biomass estimates and knowledge of biodiversity and habitats. These several observational techniques demand spacecraft resource sharing and competing modes of operation over the mission timeline. Thus, trade studies of instrument and mission capabilities are being conducted to optimize the science return from the mission.

This paper describes results of trade studies focused on solid Earth sciences. Progress in understanding the Earth's geophysical processes at depth is generally made through geophysical models. Measurements typically on or close to the surface are compared to modeled hypotheses, constraining possible mechanisms. Here, we examine the following questions: 1) Given a particular model, how does its fidelity improve under different DESDynI mission observation conditions, such as temporal and spatial sampling frequency, accuracy of the measurement, and number of vector measurement components? 2) Given two competing models describing processes at depth, how does our ability to discriminate between these models change under different mission scenarios? 3) What processes are currently poorly modeled due to lack of data, and how could DESDynI data lead to new models for these processes?

We approach the problem by selecting appropriate models and performing simulations of relevant processes of interest, and by creating suitable measurements and errors based on particular mission scenarios. From these simulated measurements, we invert for model parameters and examine sensitivities as we vary mission scenarios. Mechanisms of interest for solid Earth Science include coseismic, postseismic and volcano sources, as well as interseismic deformation geometry and slip rates, transient detection and imaging, and subsidence.

This paper was written at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.