Title
Modeling the Evolution of Polar Ice Sheets

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Ice Sheet System Model Workshop; Bergen, Norway, 2–4 June 2014

The Ice Sheet System Model (ISSM) team, which is funded primarily by NASA (Cryosphere and Modeling, Analysis and Prediction programs), as well as the Jet Propulsion Laboratory, University of California, Irvine, and National Science Foundation's Office of Polar Programs, organized a workshop in collaboration with the Bjerknes Centre for Climate Research (BCCR) at the University of Bergen in Norway, in June 2014.

This is the third in a series of ISSM workshops dedicated to teaching cryospheric scientists how to model the evolution of polar ice sheets in a changing climate. The workshops are based on ISSM, the open-source community-based ice sheet modeling software capable of simulating the evolution of large-scale polar ice sheets using a combination of higher-order physics and massive scalability, as well as data assimilation and adjoint-based inverse methods. This framework's goal is to improve predictions of the contribution of ice sheets to sea level rise, which requires ocean–ice sheet–atmosphere coupling capabilities and the integration of NASA data from missions such as Operation IceBridge; Ice, Cloud, and Land Elevation Satellite 1 (ICESat-1); and the Gravity Recovery and Climate Experiment (GRACE).

Over the span of 3 days, the ISSM team taught tutorials on ice sheet modeling, including (1) how to model the flow of outlet glaciers and ice sheets, (2) how to invert basal friction from remote sensing data, (3) how to project the evolution of an ice stream into the future, and (4) how to quantify the uncertainty of such projections. In addition, a lecture was given at BCCR focusing on the challenges of modeling the evolution of polar ice sheets with ISSM.

The participants included 24 cryospheric scientists from around the world whose interests varied from traditional ice sheet modeling and paleoreconstructions to interactions between the ice sheets and the ocean and atmosphere.

Strong links were created between ISSM and the participants, and new priorities were identified to answer some key scientific questions, such as (1) coupling ISSM with ocean and atmospheric circulation models to better capture the interaction between grounding line dynamics, subcavity melting, and ocean circulation under ice shelves, as well as the feedback between surface mass balance, atmospheric circulation, and ice sheet dynamics; (2) the development of moving boundaries to more accurately capture the dynamics of calving front and grounding line retreat of polar ice sheets over long time periods ranging from decades to thousands of years; and (3) better integration of existing data sets from in situ and satellite observations, in particular surface altimetry from ICESat-1, CryoSat-2, IceBridge, and the soon to be launched ICESat-2 mission and surface velocities from interferometric synthetic aperture radar sensors such as TerraSAR-X, Alos/Palsar, and the NASA–Indian Space Research Organization Synthetic Aperture Radar (NiSAR) mission starting in 2020.

The workshop was funded by BCCR and the World Climate Research Program Climate and Cryosphere working group, which also provided funding for early-career scientists from four different countries to attend the workshop.

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