Scalable, Efficient, and Accurate Community Ice Sheet Model (SEACISM)

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SPONSOR: US DOE, Office of Science, Advanced Scientific Computing Research (ASCR)

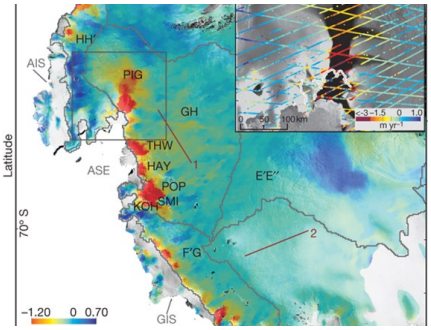
PARTNERS: Los Alamos National Laboratory, New York University, Sandia National Laboratory, Florida State University

PROJECT WEBSITE: http://www.csm.ornl.gov/SEACISM/

Glacier National Park, Alaska, July 2008

PROJECT DESCRIPTION

SEACISM is one of six projects launched from ASCR's Scientific Discovery through Advanced Computing (SciDAC)-funded ISICLES (Ice Sheet Initiative for Climate ExtremeS) initiative, which aims to yield high-fidelity, high-resolution ice sheet simulations. The goal of the SEACISM project is to develop a scalable, efficient, and accurate Community Ice Sheet Model (Glimmer-CISM). A state-of-the-art algorithms and tools framework has been developed within which climate model developers can create a predictive ice sheet modeling capability. A fully integrated parallel hierarchical blocking structure will allow maximum use of the latest high-performance computing architectures. An implicit solution algorithm with scalable preconditioning has been implemented using the Trilinos package of solvers to maintain efficiency with resolution and physical enhancements of ice representation. ASCR's Leadership Computing Challenge program granted SEACISM researchers 5 million processor hours on Jaguar at the Oak Ridge Leadership Computing Facility and another 1 million hours on Intrepid, Argonne National Laboratory's leadership computing facility system.



Rate of elevation change of Coastal West Antarctica

CISM has short-term requirements to provide accurate, quantitative estimates of ice sheet behavior, so the project will provide initial throughput gains for practical use. The model will be developed in extensible form such that ongoing code improvements will transfer to the climate model development effort with minimal structural modification. CISM has already been coupled as a component of the Community Earth System Model (CESM); the computationally-modern Glimmer-CISM could provide a template for the next generation of other climate model components in the CESM. At the completion of the project, the model will allow users to utilize demonstrably scalable solution algorithms and high-performance computing tools and allow for the incorporation of future improvements.

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SIGNIFICANCE

The need for research to provide simulation data about ice sheet dynamics arose from the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) which did not provide a prediction of ice sheet fate due to a lack of data. All six of the ISICLES projects, including SEACISM, respond to the national and international need to provide better ice sheet dynamics simulations in Earth system models to more accurately predict the behavior of ice sheets under a changing climate. SEACISM researchers hope their ice sheet model improvements will allow climate scientists to provide simulation data about ice sheet dynamics that will inform the Fifth Assessment Report of the IPCC, expected in 2013.

INTERESTING FINDINGS

SEACISM researchers recently incorporated a new solution method into Glimmer-CISM that provides nonlinearly converged solutions for improved accuracy and much faster (order of magnitude) solution speeds for a given problem. Current work involves the extension of an early version of a decomposed version of the code for highly parallel simulations and development of a preconditioner to the new solution method to allow even faster and more robust simulations.