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Dear Ian:

I am writing on behalf of the Climate, Ocean and Sea Ice Modeling group at Los Alamos National Laboratory (LANL) and the Land Ice Working Group (LIWG) of the Community Earth System Model (CESM). I currently manage LANL's ice sheet model development efforts, which are funded primarily by the Office of Science of the U.S. Department of Energy (DOE). I am a co-chair of the LIWG, which is responsible for developing and applying the ice-sheet component of CESM, one of the world's leading global climate models (GCMs). We at LANL, in collaboration with CESM software engineers and other members of the LIWG, have recently implemented the Glimmer Community Ice Sheet Model (Glimmer-CISM) in CESM. For the past several years we have been working to improve Glimmer-CISM (e.g., by developing a parallel, higher-order ice-flow model) and to extend the coupling (e.g., by linking Glimmer-CISM to the CESM ocean component).

Your NERC proposal, "Shared frameworks for next-generation ice sheet modelling," would greatly benefit our efforts. Our primary scientific goal is to provide accurate predictions of ice-sheet retreat and resulting sea-level rise in a changing climate. Meeting this goal requires an ice sheet model that not only simulates complex physical processes, but also contains robust, flexible interfaces to other climate model components. As our project has matured, the original Glimmer-CISM interface has proven to be useful but incomplete. More work is needed to support multiple modes of coupling to land and atmosphere models (e.g., using surface-energy-balance schemes as well as positive-degree-day methods) and new coupling to ocean models (to simulate dynamic interactions between oceans and ice shelves).

Your project would provide essential resources for this work. By developing standard interfaces that allow Glimmer-CISM to be coupled to multiple GCMs (including the Hadley Centre models as well as CESM), you will enable climate scientists to quantify ice-sheet modelling uncertainties associated with different land, atmosphere, and ocean physics. Glimmer-CISM will likely become the international model of choice for coupled ice-sheet/climate modeling.

We will actively collaborate with your project and will provide significant in-kind support. At LANL, two full-time staff (Stephen Price and I) have long-term DOE funding to develop higher-order dynamical cores and improved physics for Glimmer-CISM and to integrate the model in CESM. The two of us currently supervise three postdocs (with a fourth to arrive later this year) who are developing and validating improved models of surface and subglacial hydrology and ice-shelf/ocean interactions. Also, we are active participants in the DOE Ice Sheet Initiative for Climate Extremes (ISICLES), which is using advanced numerical methods and software to develop efficient, scalable ice sheet models on adaptive and unstructured grids and to quantify model uncertainties. Since 2009 ISICLES has funded multiple scientific staff and postdocs at several DOE laboratories (Los Alamos, Oak Ridge, Sandia, Berkeley, Argonne, and Pacific Northwest) and universities (including Columbia U., U. of Texas at Austin, New York U., Florida State U., and MIT). Many advances from ISICLES, such as higher-order ice-flow models based on the Trilinos and Chombo software packages, have already been added to Glimmer-CISM.

Following the conclusion of ISICLES in 2012, the DOE Office of Science plans to support a long-term, multi-institutional ice sheet modeling project through its Scientific Discovery for Advanced Computing (SciDAC) program, with LANL taking a leading role. DOE's annual investment in ice sheet modeling at LANL is currently about $1.5 million; we expect this figure to be steady or growing during the course of the NERC project. Including the ISICLES projects, the total DOE investment is approximately $4 million/year. The majority of this funding is being applied specifically to Glimmer-CISM model development and coupling.
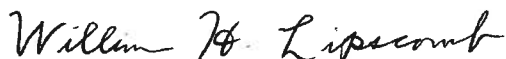
We also collaborate with scientists at the National Center for Atmospheric Research (NCAR), who are developing CESM with primary support from the U.S. National Science Foundation and DOE. We work closely with William Sacks, the software engineering liaison to the Land Ice Working Group, on the coupling of ice sheet models to CESM. Through this partnership, we will ensure that the new interfaces provided by the NERC project are fully incorporated in CESM.

These ongoing efforts will result in a more robust, realistic, and flexible ice sheet model. New versions of Glimmer-CISM will be publicly released on a regular basis and will be available not only for standalone ice sheet experiments, but also for coupled simulations using CESM and other GCMs. These improvements will lead to a growing community of model users and a substantial broadening of model applications. The work you propose is critical for supporting new users and applications. In particular, the development of interfacing standards will guide us as we implement full two-way coupling in CESM and will allow us to compare results with those from other GCMs. Also, the framework workshops and training events will be critical for building community consensus on the new standards and for recruiting and educating a new generation of ice sheet modelers.

We plan to take an active role in the planning and execution of the proposed workshops and trainings. We will complement the NERC-funded events by continuing to hold twice-a-year meetings of the LIWG in Boulder and Breckenridge, Colorado. These meetings have consistently drawn 50 to 100 participants, with significant involvement from scientists outside the U.S. We invite you and other NERC project participants to attend these workshops in order to publicize your efforts and facilitate the integration of Glimmer-CISM improvements in CESM. Also, we would welcome the opportunity to host U.K. scientists at LANL for periodic visits.

In summary, this project would provide much-needed support for making Glimmer-CISM more modular and flexible and for building a world-wide community of expert model users. The resulting ice-sheet model, coupled to multiple GCMs, will be an invaluable tool for international efforts to predict the evolution of ice sheets and sea level. We wish you every success and look forward to an active collaboration.

Sincerely,

William H. Lipscomb
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