

DIRECTLY INCURRED***Framework Development Workshops***

A major aspect of this proposal is the need to bring different areas of expertise together to discuss and agree on the needs and specification of an Ice Sheet Model/Climate Model coupling Application Programming Interface (API). Very little collaborative work of this nature has so far been done by the communities who work directly with ice sheet models (ISMs), or on their coupling to global climate models (GCMs), although individual groups have developed their own solutions. For this project to succeed, it is essential that we can bring our collaborators together for focused discussions. Therefore, we request support for two Framework Development Workshops.

Workshop 1 will allow the wider partnership the opportunity to explore the nature of the ISM-GCM coupling problem, to share existing approaches, and to begin to determine a set of API requirements that will be adequate to tackling this problem. We need to make sure there is enough time to define and agree on the fundamentals of the API, encompassing both process/scientific (what and when ice sheet/climate systems need to exchange information about) and technical/software aspects (what are the data models used, what software tools will best permit coupling across a range of different models and platforms). To cover the necessary ground in enough depth, it will be necessary to devote *four days* to the first workshop.

Workshop 2 will also require four days if we are to report fully on the implementation of the API within Glimmer-CISM and Hadley Centre and CESM models as an instance of the working API, to resolve possible areas of difficulty, and to consider how best to extend and move the API forward on the basis of the initial experience. We also wish to allocate time at each workshop to discuss the best ways to further bring the community together in a longer-term network.

To each workshop we will invite our current list of 15 Project Partners and Supporters, with an additional 2 (flexible) spaces for research staff working with our Project Partners at Los Alamos and Montana. We request a further three unallocated spaces to allow us some latitude to invite further participants into the project given the rapid turnaround of this call. Including project investigators, this totals 24 participants in each workshop. We have budgeted a per-head allocation of £150 per day for all-inclusive accommodation, and for £500 each in respect of travel costs though we anticipate that some costs will be higher and others lower. In addition we request support for the rental of meeting rooms and equipment to run the workshop (£1000/day). The costs for one workshop are each allocated to Edinburgh and Swansea as the responsible investigator's organisation respectively. We appreciate that major costs are involved with these workshops but we believe this is the most effective way of making a step-advance in developing a community-shared API implementation. Additionally, we request funds for secretarial/administrative support for the workshops at both Swansea and Edinburgh (For internal administrative reasons this appears as a Directly Allocated cost in Edinburgh's case).

Training events

Our overall aim of widening awareness of the API, and increasing experience with Glimmer-CISM in particular, will be made possible to a large degree by the provision of the training events. We thus request support in the running of the training events, though we will request that participants support their own travel and accommodation requirements. We aim to seek additional funding from other sources in respect of graduate student travel. We will run three training events, one each at Swansea, Edinburgh and Bristol, and request support for the team's investigators (£500/tutor) to support travel and accommodation at these, and to provide for rooms in which the training can be held (£1000 per event). A sum of £6000 is requested (Bristol) to cover the cost of employing a suitable postgraduate student to write training materials and documentation.

Support for investigator team meetings

The investigator team needs to be able to meet frequently in order to ensure good communication and reporting in respect of the project's progress. We will meet in approximate rotation in Swansea, Bristol and Edinburgh with occasional visits to Project Partners Ridley (Exeter) and Gregory (Reading). We request for each institution moderate funds (£200/ head/ meeting) in

support of travel and subsistence for these visits. We also request support for two visits (£1000 each) by Rutt as PI to liaise with Lipscomb, Price and Johnson at CESM meetings in the US.

Conference Attendance

The nature of the project, and in particular the intended impact pathways, means it is best exposed at international inter-disciplinary conferences. In particular, we intend that in the final year of the project we will convene special sessions at each of EGU and AGU to report on our work, promote the API, and to further establishment of the longer term network proposed. We thus request funding to support conference attendance for project investigators to attend a total of ten international conferences. We have budgeted £1500 per head per meeting to support this.

Dedicated programmer to support GUI development (Swansea)

An important aspect of our proposed research is to ensure that we can widen accessibility and use of Glimmer-CISM to the international community. The training events are one aspect of this, but in addition we will develop a new Graphical User Interface (GUI) front-end to Glimmer-CISM that will make set-up and operation of the model far easier, and also support particular pre-compiled versions of the code. This is particularly targeted at providing good tools for student use, and in support of new users of the model, but it will also permit wider public access to the model. We request 4 months of a graduate programmer time (Swansea) to support this development. Considering the substantive current and future investment that is going into the development of Glimmer in the US, increasing its use and accessibility this way represents significant added value.

Other directly incurred costs:

We request funds (£800) to support a laptop for the project, principally for Co-I researcher Hagdorn specifically to develop core code, and to prepare the new GUI and other resources for preparation at workshops, training events and conferences. We request two portable drives to enable backup of large data sets in support of these events. In addition, we request dedicated funds to employ specialist IT support (Edinburgh). We request a sum for professional development of the project website: this is an essential public and community-facing portal for our impact activities.

We request page charges for two publications in peer-reviewed journals. These will contribute to the dissemination and profile of project outputs. It is anticipated that a publication in *Geoscientific Model Development* (or similar journal) will comprise the definitive technical reference for the model framework, and is therefore of crucial importance.

DIRECTLY ALLOCATED: INVESTIGATOR EFFORT

PI Rutt will spend 10% of his time on the project over its duration. In addition to managing the project as a whole, and in particular the liaison with our Project Partners, he will be primarily responsible (with Hagdorn) for developing the API specification, and overseeing its implementation in Glimmer-CISM in collaboration with Partners at Los Alamos (Lipscomb) and Montana (Johnson). He will manage Workshop 2. Co-I Payne will spend 6% of his time on the project. He will be primarily responsible for ensuring the implementation of the API in the Hadley centre models in collaboration with partners Ridley and Gregory. Co-I Hulton will also spend 6% of this time on the project. He will steer the initial API requirements specification and organise Workshop 1.

The success of this project depends on producing excellent software design, and being able to modify existing versions of Glimmer-CISM. We request a 50% Researcher Co-Investigator position for Magnus Hagdorn for the duration of the project. Hagdorn was responsible for many of the original major developments within Glimmer, particular in the software architecture and external API. Much of this work is still reflected in the code and Hagdorn is uniquely positioned to be able to work on the design interface. He currently has a specialist software support role in Edinburgh, in particular supporting the Centre for Earth System Modelling; he also serves on the Glimmer-CISM, steering committee. He will be released from 50% of his current role for dedicated work on this project. Hagdorn will be mainly responsible for the API specification and its implementation within Glimmer-CISM. He will take the lead in the preparation of API and Glimmer-CISM documentation.

All investigators will be involved in the preparation and delivery of training events, and require time for meetings, workshop and conference attendance relating to the project. In addition, all of the investigators will be involved in the preparation of academic publications and in the preparation of documentation for the API and Glimmer.