

## *QUEST Announcement of Opportunity*

### **EARTH SYSTEM PROCESSES AND PREDICTION**

The Natural Environment Research Council (NERC) hereby announces a research opportunity under the auspices of the NERC programme Quantifying and Understanding the Earth System (QUEST), led by Professor I. Colin Prentice (QUEST, University of Bristol). Funding applications are sought under six headings which have been chosen as a result of a “gaps and opportunities” consultation involving a broad cross-section of stakeholders and the UK Earth System Science community. We anticipate funding one project under each heading. Each project will be expected to build on existing research efforts, both within and beyond QUEST, in order to maximize the added value for the programme as a whole. All proposals must include explicit plans to maximize synergies with relevant international projects and programmes, as well as with ongoing UK research. Expected outputs will include at least one high-profile scientific synthesis paper and/or policy briefing paper per project, to be developed in consultation with the QUEST Integration Team.

The maximum total funding available under this round is approximately £2.75 million (this being NERC’s 80% contribution to full economic costs, and including indexation). Indicative upper funding limits are provided for each heading. Projects should be planned to start on or after 1 July 2007 and to be completed on or before 31 March 2010.

**Assessing and Facilitating QUEST** (£150k). Action-oriented, social science-based research is needed to evaluate in real time, and thereby assist and facilitate, QUEST’s activities in interdisciplinary community building and engagement with decision makers. This work must take into account other ongoing activities to analyse and promote stakeholder engagement such as the science-to-policy studies conducted by the Environment Research Funders' Forum and by NERC. It should include a strong comparative element, considering QUEST’s performance in relation to existing case studies in and outside the UK. The proposal must demonstrate a strong international perspective, and awareness of and linkage to relevant assessment activities such as those carried out within the framework of the International Human Dimensions Programme (IHDP).

**Biogeochemical Cycles and Feedbacks** (£450k). QUEST aims to develop Earth System models including an expanded range of interactions among physical, chemical and biological subsystems so as to allow better quantification of the full set of biogeochemical feedbacks influencing natural and anthropogenic climate change. Work in this area funded by QUEST has focused on new model development (Theme 1 projects and the QUEST Earth System Modelling contract) and applications of models with specific added components (e.g. dust, fire) to palaeoclimate problems (Theme 2 projects and the QUEST-INSU Earth System Dynamics project). Building on this work, the new project will seek to determine and quantify the most important biogeochemical feedbacks for climate change. The proposal must include a preliminary assessment of the Earth System models planned for use or under development by QUEST projects with regard to completeness, in terms of the biogeochemical exchanges that could be important for climate change on time scales from one to a million years. This assessment should include “GENIE class” models of

intermediate complexity as well as models based on the Hadley Centre general circulation models (GCMs). The project will (1) add representations of key missing processes, drawing on the most relevant expertise and existing modelling work, and (2) design and perform model “experiments” to quantify the potential strength of biogeochemical feedbacks and to assess their significance for past and future climate. The project must be planned and executed in close collaboration with the modelling groups concerned, in a manner consistent with QUEST’s Earth System Modelling strategy and that of the Earth System Science Partnership (ESSP). The proposal must demonstrate awareness of the international state of the art in Earth System modelling and seek to establish a leading position in this field. The project plan must include sufficient allocation of resources for strong co-ordination and liaison among different modelling groups. It should demonstrate linkages as appropriate to the IGBP “interactions” projects (iLEAPS, LOICZ, SOLAS) and to the UKSOLAS and APPRAISE programmes of NERC.

**Climate-Carbon Modelling, Assimilation and Prediction (CCMAP) (£700k).** C<sub>4</sub>MIP (the Coupled Climate-Carbon Cycle Model Intercomparison Project, jointly sponsored by the International Geosphere-Biosphere Programme, IGBP and World Climate Research Programme, WCRP) has found large differences in the strength of carbon-cycle feedbacks as simulated by different coupled climate-carbon models, amounting to a major “new” uncertainty in the relationship between CO<sub>2</sub> emissions and climate. CCMAP will develop: (1) a toolbox of data-model comparisons using observations (including but not limited to atmospheric CO<sub>2</sub> and O<sub>2</sub> concentration measurements, “flux tower” CO<sub>2</sub> and latent heat fluxes, ocean anthropogenic carbon inventories, and remotely sensed land and ocean “greenness”) to critically evaluate the modelling of processes involved in carbon-climate feedbacks. This element must engage the most relevant expertise on the terrestrial, marine and atmospheric data, and must exploit the potential synergy with the C-LAMP (Oak Ridge National Laboratory, USA) project; (2) a data assimilation framework to provide optimal parameter estimates and their uncertainties, based on these data; (3) a probabilistic estimate of the carbon-climate feedback based on scenario runs of the optimized model; and (4) a demonstration study to evaluate the potential for a similar data assimilation system to optimize the predictive skill of a coupled climate-carbon cycle GCM. The choice of model(s) used for each component of the project must be well thought-out and consistent with QUEST’s strategy for Earth System Modelling. The modelling and data-model comparison protocols must be designed so as to facilitate potential collaboration with other modelling groups, especially those who have been involved with C<sub>4</sub>MIP. The project should actively seek to engage non-UK modelling groups’ participation through contacts with the relevant international programmes, specifically the WCRP Working Group on Coupled Modelling (WGCM), the IGBP Analysis, Integration and Modelling of the Earth System (AIMES) project, and the ESSP Global Carbon Project (GCP).

**Dynamics of the Palaeocene-Eocene Thermal Maximum (£550k).** The Palaeocene-Eocene Thermal Maximum (PETM) has become recognized as an interval of major significance to the contemporary climate change problem, for two reasons. First, the possible origin of the PETM in major releases of carbon in the form of methane from submarine hydrates offers the possibility of evaluating and improving models of clathrate destabilization and re-evaluating the risk of such events in the future. Second, the total release of carbon to the atmosphere associated with the PETM is

estimated to be have been of the same order of magnitude as would occur if conventional fossil fuel reserves were to be fully exploited without sequestration of the resulting CO<sub>2</sub>. The PETM can thus be regarded as a “model system” signalling the potential consequences of business-as-usual fossil fuel combustion for climate and ecosystems, including ocean acidification and its consequences for marine biodiversity. The QUEST PETM project should aim (1) to test one or more existing models of submarine methane hydrate accumulation and destabilization under the global climate boundary conditions of the Palaeocene, (2) to use an existing carbon cycle model together with observations from the PETM to quantify the associated total carbon release and its uncertainty, (3) to evaluate the consequences of the PETM for species and ecosystems, including a quantification of the associated drop in ocean pH. The proposal must demonstrate awareness of existing efforts in Cenozoic research in Europe and North America and must seek to build on these efforts through a combination of modelling, data synthesis and critical assessment. Explicit links should be made with the IGBP Fast Track Initiative on ocean acidification, which is co-ordinated by the IGBP Past Global Changes (PAGES) project, and to research activities supported by the RAPID programme of NERC.

**Environmental Change and Fisheries** (£500k). Global climate change will impose stresses on fisheries in addition to those created by overexploitation. Effects of recent changes in sea-surface temperatures and climate variability modes on the distribution and diversity of plankton and fish have already been identified, yet little work has been done to explore the potential implications of climate change for marine ecosystems and fisheries in the future. A QUEST project in this field should assess the vulnerability of one or more of the major world fisheries, and consider what adaptive measures might increase their overall sustainability and resilience in the face of a changing climate. The project should explicitly consider the risks associated with changes in ocean temperatures, climate variability modes and ocean circulation patterns, as simulated by state-of-the-art coupled atmosphere-ocean GCMs, as well as socio-economic drivers such as rising fuel prices and projected population-driven increases in the demand for fisheries products in developing countries. The project should fully exploit existing research being carried out internationally within the framework of the IGBP Global Ocean Ecosystems (GLOBEC) and Land-Ocean Interactions in the Coastal Zone (LOICZ) projects, and in EU-funded fisheries projects. Links should also be established with other climate vulnerability research funded under QUEST’s Theme 3.

**Fire data assimilation and prediction** (£400k). Fire is an insufficiently understood process that is nevertheless of fundamental importance both to terrestrial ecosystems and to the composition of the atmosphere. The development of globally consistent models and observational data sets of fire has been identified as a top-level research priority by IGBP through its Fast Track Initiative on fire. The QUEST consultation also revealed that although several major activities on fire in the UK have started or are proposed, they are not well consolidated. The QUEST fire project will have two complementary aims. (1) It will develop a methodology allowing current or next-generation remotely sensed observations (e.g. ignitions, radiative power, burned area, and abundances of pyrogenic species such as carbon monoxide) to be used to evaluate, improve and constrain state-of-the-art models of the interactions among vegetation, climate and fire. (2) It will build on recent advances in seasonal forecasting, fire observation and fire modelling to develop and evaluate a globally

consistent forecast system for fire risk over a time horizon from one to six months. The project should have close ties to activities of the National Centre for Earth Observation and the NERC e-science programme. It must explicitly build on and exploit synergies with the full set of fire-related research projects funded by NERC and the EU as well as with parallel activities elsewhere co-ordinated through the GCP and/or the IGBP Global Land Project (GLP).

**Outline Proposals and Full Proposals must be submitted electronically using the Research Councils Joint Electronic Submission (Je-S) system.** The closing date for receipt of Outline Proposals is **4 pm Thursday, 14 December 2006**. Further information for submitting the Outline Proposals is provided below.

The Outline Proposals will be reviewed by a small panel who, in addition to evaluating outlines according to NERC assessment criteria, will also examine potential for synergies and overlap and may therefore request additions, deletions, mergers, or any other appropriate measures as part of any invitation to submit full proposals. The closing date for receipt of full proposals will be **4 pm Wednesday, 14 March 2007**. Further information for submitting Full Proposals is also provided below.

Outline Proposals should include a **clear programme of work indicating interactions and interdependencies with QUEST projects and/or Working Groups**. Applicants are strongly recommended to consult with Prof. Prentice concerning these linkages, before submitting outline proposals. Funds are available if needed for meetings to plan outline and/or full proposals. Interested people should consult Prof. Prentice via e-mail ([colin.prentice@bris.ac.uk](mailto:colin.prentice@bris.ac.uk)) in advance of any such meeting.

### **Further information for submitting proposals**

NERC rules for institutional and investigator eligibility will apply. For example, submissions must be made via UK universities or NERC-recognised bodies. For full proposals, an individual may only be lead Principal Investigator on one proposal, plus be involved on one further proposal as Co-Investigator (or be involved in two proposals as Co-Investigator). However, at the outline proposal stage, there will be no limit to the number of times an individual can be identified as a Co-Investigator, Recognised Researcher, or Project Partner. Linkages with research users and other non-academic organisations (as Project Partners) are encouraged.

The outcome of the assessment of full proposals should be known in June 2007; 1 July 2007 is therefore the earliest start-date for projects (later if appointment processes are involved). The awards should plan to be completed no later than 31 March 2010.

Prospective applicants wishing to informally discuss their ideas for involvement in the programme should contact the QUEST Leader, Prof. I. Colin Prentice ([colin.prentice@bristol.ac.uk](mailto:colin.prentice@bristol.ac.uk)) (tel. 0117 331 5019).

For administrative queries regarding the submission of outline or full proposals, contact the Programme Administrator, Dr. Caroline Culshaw ([ccul@nerc.ac.uk](mailto:ccul@nerc.ac.uk)) (tel. 01793 442597).

### **Outline Proposals:**

**Researchers intending to bid for funding under this Announcement of Opportunity must submit an Outline Proposal using the Research Councils Joint Electronic Submission (Je-S) system by 4pm Thursday 14 December 2006.** The FEC Outline Proposal Form (Je-SOP1 (NERC)) should be used. At the Outline Proposal stage, only the lead institution should submit a form, which should summarise the applicants and resources required for all institutions in the collaborative proposal. A case for support of no more than 3 pages and a CV for the Principal Investigator (PI) must be attached.

See <https://je-s.rcuk.ac.uk/eforms/secure/Login.asp> for information on the Je-S process. Further information, including details on Full Economic Costing, is also available in the [NERC Research Grants Handbook for Full Economic Cost Grants](http://www.nerc.ac.uk/funding/application/researchgrants/), (<http://www.nerc.ac.uk/funding/application/researchgrants/>). *Potential applicants are reminded that they and their institution must be registered with Je-S, in order to submit applications. As the registration process takes several weeks, applicants and institutions that are not registered should register with Je-S as soon as possible.*

NERC will inform individuals whether outlines are suitable for development as full proposals by late January 2007.

Potential applicants should note that information provided on the Outline Proposal form may be made available by NERC to other applicants to this QUEST Round, where the Outline Proposal review panel request that full bids involve mergers or other collaborations involving more than one bid. Information may also be provided to Principal Investigators of previous rounds, where the panel suggest that this will help to maximise synergies with funded projects.

### **Full Proposals:**

All Full Proposals must be in response to an invitation from the QUEST Leader.

**Full Proposals must be submitted via the Research Councils Joint Electronic Submission (Je-S) system by 4 pm Wednesday 14 March 2007.** The FEC Research Grant Application form Je-SRP1(NERC) must be used. (See Outline Bid section above, for details of further information available on the Je-S and NERC research grant application process).

For collaborative, multi-institutional proposals each organisation requesting funds must submit a separate Je-SRP1(NERC) form. This should be accompanied by a common case for support. Applicants should identify a lead organisation for the purposes of submitting the joint proposals. The other partners must use the common Je-S reference provided by the Lead. Only the lead organisation should include details of project partners and nominated referees. There is no limit to the number of institutions that can be involved in a proposal.

The project description must include a clear outline of project management planning, including managing interdependencies with other projects, which must include an element for co-ordination commensurate with the scope and complexity of the project.

The page limit for the project description within the Case for Support is dependent on the number of institutions involved in the application: For proposals that involve investigators from one or two institutions, the page limit is 8 pages. For each additional institution involved in a proposal (at a Co-Investigator level), an additional 2 pages may be used, up to a maximum project description length of 16 pages (3 institutions = 10 Pages, 4 Institutions = 12 pages, etc.).

Proposals requesting funds for more than one institution must also attach an additional page to the case for support, summarizing for all institutions in the application, the individuals involved and the resources requested. This is to help reviewers of collaborative proposals identify precisely which institutions and individuals will be performing which functions and the respective resources requested. This summary should be no more than 1 page long.

Applicants may provide up to 2 pages per institution for the track record section of the Case for Support.

The justification of resources should be completed as a separate section. Up to an additional 1 side of A4 may be used for this purpose.