

Drivers of Variability in Atmospheric Circulation: European Climate



Announcement of Opportunity

Issued on 14 November 2013

Outline Proposals deadline: 16.00 GMT on 23 January 2014

Full Proposals deadline: 16.00 BST on 24 April 2014

1 Summary

Outline proposals are invited for a new Research Programme on drivers of variability in atmospheric circulation affecting European climate.

The outcome of this Research Programme will be better predictions of European climate on seasonal to decadal timescales. This will be achieved through studying the underlying processes and mechanisms that underpin climate variability, assessing the representation of these processes in climate models, and developing improvements to regional climate predictions. Recent developments in observation, modelling and reanalyses provide an exceptional scientific opportunity to move forward understanding and prediction by improving the representation of mechanisms that link potential climate drivers to climate variability in all seasons, and particularly summer. £2.2M (80% FEC) is available to fund two projects of up to four years duration.

This Research Programme has been developed in response to the challenges of the Climate Systems theme in the 2007-2012 NERC strategy *Next Generation Science for Planet Earth*.

The UK Met Office is a strategic partner for this call. Their aim is to develop climate prediction systems initialised with current information on the state of the climate system. This approach can provide more information than traditional “climate projections” and allows prediction of some classes of impending climate extremes. Understanding and improved climate modelling of the mechanisms of regional climate variability is key for improving these operational climate prediction systems. Collaboration around the UK Unified Model framework will allow pull through of research into operations.

2 Background

While climate is often described in terms of time mean variables, it is experienced primarily as the statistics of weather. For example a cold winter in the UK might be characterised not by ‘normal’ winter conditions with a cooling superimposed throughout the season, but by longer than usual periods of cold, blocked flow interspersed with warmer, cyclonic periods. These changes of circulation dominate seasonal to decadal climate and it has even been proposed that the regional effects of greenhouse gas-induced warming may be experienced primarily through a change in circulation regimes. Thus changes in the statistics of regional atmospheric circulation are an important element in climate prediction on all timescales. This Research Programme will deliver

focused research aimed at improved understanding, modelling and prediction of variability in atmospheric circulation.

Substantial recent research has established connections between climate drivers and regional circulation anomalies, leading to the prospect of increased climate predictability. Drivers include anthropogenic climate forcings (greenhouse gases, aerosols), natural climate forcings (solar variability, volcanic aerosols), slowly varying internal variability (e.g. El Niño-Southern Oscillation) and teleconnections (i.e. dynamical links with climate events in remote regions). In many cases the links between the drivers and the regional climate anomaly of interest are mediated through remote parts of the climate system (e.g. the ocean or the stratosphere), and may involve dynamical, thermodynamical or biogeochemical processes.

To realise the potential of these connections for regional climate prediction, the underlying mechanisms must first be understood, and reproduced with good fidelity in climate models. In some cases competing hypotheses exist for operating mechanisms, in which case more detailed diagnostic work using observations, reanalyses and high resolution modelling are required. This goes beyond the simple establishment of empirical relationships between large scale variables or purely 'bottom up' development of parametrization schemes. The approach in this programme is to establish the underlying processes and mechanisms that underpin regional climate variability and change, to assess the representation of those processes in climate models, and to develop improvements to the models and hence regional climate predictions from months to years ahead.

NERC is currently commissioning a related £3.5M programme 'Drivers of Variability in the Asian Monsoon' in partnership with The Earth System Science Organization of the Ministry of Earth Sciences, India, and the UK Met Office. The two programmes share a common goal: to characterise at a process level the drivers of variability in atmospheric circulation and use this knowledge to improve climate models and predictions.

3 Scope of Call

The research supported by this programme will lead to improved prediction of European climate, which is critical for the UK. It could help to explain the recent cold winters (e.g. 2009-10 and 2010-11), and anomalous summers (e.g. 2003 heatwave, wet 2012 summer), the impacts of which were felt across society and the economy.

The research will build on recent substantial progress in identifying relationships between multiple potential drivers of seasonal climate anomalies. Drivers that the research projects may consider include (but are not limited to): teleconnections from El Niño-Southern Oscillation (ENSO), Atlantic sea surface temperature (SST) and Arctic sea ice anomalies, snow cover, volcanic aerosol, solar variability, persistence of subsurface ocean heat anomalies, variations in the Atlantic meridional overturning circulation (AMOC), as well as anthropogenic forcing from greenhouse gases and aerosols.

In some cases mechanisms have been proposed for these links and demonstrated in climate models, leading to the potential for improved predictability of climate. However the links and mechanisms are subtle, for example sometimes having different effects in early and late winter;

because of this, realising potential predictability has sometimes been hampered by modelling issues such as sensitivity to biases in the baseline model state. The research programme will attempt to develop model improvements to overcome such issues.

The programme will include an element investigating summer climate variability, which has been much less studied than winter variability. Drivers of summer variability may be more complex as evidenced for example by the fact that the leading order North Atlantic Oscillation (NAO) pattern, linked to the path of the upper tropospheric jet stream, explains less of the variance in summer circulation than in winter. It could also be that summers are less predictable than winters. Nevertheless, a number of possible drivers of interannual variability in summer climate have been proposed, which projects may consider, including (but not limited to): La Nina teleconnections, soil moisture memory, Arctic sea ice variability, Atlantic Multidecadal Oscillation (possibly linked to the AMOC), movement of the Gulf Stream path near Newfoundland, as well as anthropogenic forcings.

Similarly, climate variability in Spring and Autumn has received less research attention than other seasons and there is additional scope for improved understanding in these seasons.

The programme will take advantage of recent developments in observation, modelling and reanalyses, which provide an exceptional scientific opportunity to move forward understanding and prediction by improving the process-level description of the above links and identifying new ones.

These developments include:

- new observations of the AMOC (RAPID), ocean heat content (Argo) and sea ice thickness (Cryosat2);
- higher resolution climate models with improved Atlantic blocking statistics and improved stratospheric resolution, thought to be crucial for some mechanisms;
- full 20th century atmospheric and ocean reanalyses (e.g. ACRE, C20C, SODA).

4 Programme Requirements

4.1 Scientific

The objective of the Research Programme is to characterise at a process and mechanistic level the drivers of variability in atmospheric circulation and use this knowledge to improve models and predictions of European climate.

Proposals are invited for projects that aim to establish the underlying processes and mechanisms that underpin robust climate responses, to assess the representation of those processes in climate models, and to develop improvements to the models and hence to their representation of regional climate variability.

Projects will improve understanding and modelling of European climate variability on seasonal to decadal timescales, through a combination of studies of large scale observational links, climate modelling and theoretical work. Work to undertake new observations will not be supported through this research programme.

Research on variability in all seasons is in scope. However, recognising the opportunities, importance and relatively under-researched status of summer variability, there will be an emphasis on studies of summer variability.

4.2 Knowledge Exchange and Impact

Insights from this programme will deliver improved climate models and forecasting capability for Europe. This capability underpins the development of climate services for a wide range of stakeholders. A key requirement is that projects feed new understanding through into improved models and prediction systems.

Partnerships with operational prediction agencies are crucial to delivering the required impact, through implementation of developments into models and prediction systems. Projects will be expected to show engagement with the UK Met Office, and potentially other operational agencies, in order to facilitate this.

The Met Office will make available output from its seasonal and decadal forecast systems to projects in this programme, and engage with projects to facilitate pull-through to improved prediction. Successful projects must contain elements that are complementary to the Met Office research strategy. An outline of Met Office research strategy for near term climate prediction and details for further discussion are available in Annex A.

NERC and the Met Office have a joint strategy for Earth System Modelling, in which the UK Unified Model (UM) system provides the atmospheric component and climate prediction capability. While it is expected that new insights and parametrizations from this programme will be applicable generically to large scale models, there will be a strong incentive to test these initially in the UM, with consequent benefits for the UK's wider Earth System Modelling capability. This does not preclude the use of other models in the projects.

Post-award, NERC and the Met Office will make available additional resource to enable the funding of joint working and impact activities. Applicants must be willing to engage with the programme to design and undertake these joint activities.

4.3 Data Management

The NERC Data Policy must be adhered to, and an outline data management plan produced as part of the proposal. Applicants are advised to contact the relevant data centre to discuss their requirements. NERC will pay the data centre directly on behalf of the programme for archival and curation services, but applicants should ensure they request sufficient resource to cover preparation of data for archiving by the research team.

4.4 NERC Facilities

Significant access to HPC is expected to be required for much of the work in this programme. HPC is free at the point of use for NERC-funded researchers, but requests for large amounts of resource should be discussed with the relevant HPC consortia leader prior to application. Contact details and

full guidance can be found on the following webpage:
<http://www.nerc.ac.uk/research/sites/facilities/apply/>

4.5 Management and Governance

Successful project teams will be expected to work with NERC Swindon Office and the Met Office in forming the programme governance, management and advisory structures. Additional funds will be made available to facilitate this post-award, but applicants should be aware that modest additional staff time will be required.

Projects funded as part of this programme will need to follow the Joint Weather and Climate Research Programme (JWCRP) Agreement between NERC and the Met Office. This provides the basis for research carried out as part of this partnership. It provides a mechanism for sharing Intellectual Property (IP) generated from jointly funded research. NERC funded HEIs that invest 1 FTE or more in the Programme are entitled to use a commercial licence for the Unified Model.

5 Eligibility and Funding

This opportunity is open to individuals and organisations eligible for NERC research grant funding, i.e. applicants based in UK Higher Education Institutions (HEIs), NERC Research & Collaborative Centres, and Independent Research Organisations (IROs) approved by NERC. Please refer to the NERC Research Grants Handbook for details. Potential applicants should contact NERC well in advance of the submission deadline if they have any queries concerning their eligibility. Individuals are limited to involvement in no more than two proposals submitted to this call; only one of these may be as the lead Principal Investigator.

The total proposed NERC investment for this announcement of opportunity is £2.2M (80% FEC). It is intended to fund two projects, at least one of which will have a focus on summer variability. It is anticipated that the investment will be split equally between the two projects. Projects are expected to be up to four years in duration. The Met Office will provide in-kind contributions of model output and resource to facilitate joint working.

6 Application Process

This call has a two-stage application process.

6.1 Outline Proposals **Closing date: 23rd January 2014**

The outline proposal stage will be used to identify projects that will be invited to submit a full proposal. Any sift of proposals will be made on the basis of the likely fit of proposals to requirements of the call.

Outline proposals must be submitted using the 'Drivers of Variability in Atmospheric Circulation Outline Proforma', which may be downloaded from the NERC website, and emailed to atmospheric@nerc.ac.uk.

Applicants must ensure that their outline proposal is received by NERC by 4pm on the closing date. Any proposal that is received after the closing date, is incomplete, or does not meet the eligibility criteria of this call for proposals, will be returned to the applicant and will not be considered.

For all proposals, the Principal Investigator must submit a completed outline proposal form together with a Case for Support.

The outline proposal form should include the expected Co-Investigators and their Research Organisations. If successful, some of the Co-Investigators would then become the Principal or Co-Investigators on the component grant proposals and not be named on the lead grant proposal.

The outline proposal form should be accompanied by a Case for Support, which must not exceed 4 sides of A4 in total and should be completed in single-spaced typescript of minimum font size 11 point (Arial or equivalent), with margins of at least 2cm..

The Case for Support should include the following summary information:

- Outline of research proposed and its international context.
- Composition and experience of the research team.
- Proposed collaboration with the Met Office and other partnerships likely to be involved (proposed and secured).
- Outline of project management plan and data management plan.
- Proposed use of any NERC facilities (initial discussions should be held with the relevant facilities on feasibility at this stage).
- Equipment to be requested and the expected NERC % contribution required.
- Proposed Pathways to Impact.
- References.

A Justification of Resources attachment is not required, but it is the responsibility of applicants to undertake sufficient planning at the outline proposal stage to determine that the full costs of research proposed (including any facility costs) can be accommodated within the fixed financial limits of the scheme. The Resources indicated at the outline proposal stage are considered as estimates only and may be amended in a subsequent full proposal, within the financial limits of the scheme. No CVs or project partner letters should be submitted at the outline proposal stage.

Proposers should be informed in February 2014 if they are to be invited to proceed to the full proposal stage.

6.2 Full Proposals

Closing date: 24th April 2014

You must previously have submitted an outline proposal that has been invited to proceed to the full proposal stage in order to submit a full proposal. We would expect proposals to evolve between

submitting the outline proposal and the full proposal (including personnel), but major aspects are expected broadly to remain the same.

Full proposal applications must be submitted using the Research Councils' Joint Electronic Submission system (Je-S). Applicants should select Proposal Type - 'Standard Proposal' and then select the Scheme – 'Directed' and the Call – 'Drivers of Variability in Atmospheric Circulation APR14'.

Applicants must ensure that their proposal is received by NERC by 4pm on the closing date. Applicants should leave enough time for their proposal to pass through their organisation's Je-S submission route before this date. Any proposal that is received after the closing date, is incomplete, or does not meet NERC's eligibility criteria, will be returned to the applicant and will not be considered.

For all proposals for NERC research grants, the Principal Investigator must submit form Je-SRP1 (NERC), together with a Case for Support. All attachments submitted through the Je-S system, including the Case for Support, must be completed in single-spaced typescript of minimum font size 11 point (Arial or equivalent), with margins of at least 2cm. Applicants referring to websites should note that referees may choose not to use them.

The **lead** component of each proposal should include the documents detailed below.

i. **Case for Support**, which is comprised of four parts:

Part A – a common **Previous Track Record** (up to **3 sides of A4** in total for all Research Organisations)

The Previous Track Record should:

- provide a summary of the results and conclusions of recent work in the technological/scientific area that is covered by the research proposal, including reference to both NERC and non-NERC funded work and details of any relevant past collaborative work with other beneficiaries should also be given;
- indicate where your previous work has contributed to the UK's competitiveness or to improving the quality of life;
- outline the specific expertise available for the research at the host organisation and that of any associated organisations and beneficiaries.

Part B – a common **Description of the Proposed Research**.

This must not exceed **16 sides A4** (including all necessary tables, figures and references) and should address the following points:

- underlying rationale, scientific and technological issues to be addressed;
- relationship to programme objectives;
- relationship to other NERC and LWEC partner research programmes;
- description of the proposed research – please describe why the work is strategically important, the key research objectives and how these will be achieved; and

- description of the proposed collaboration with the Met Office and other operational prediction agencies.

Part C - an outline Data Management Plan (up to **1 side A4**)

Part D - a description of the Proposed Management Structure and plans, participant responsibilities, and scheduling chart (up to **2 sides A4**).

- ii. A common **Justification of Resources** of up to **4 sides A4** for all Research Organisations involved, for all Directly Incurred Costs, Investigator effort, use of pool staff resources, any access to shared facilities and equipment and requests for capital costs between £10,000 and the OJEU threshold, being sought. For further information of what to include in the Justification of Resources, see section F in the NERC Research Grants Handbook.
- iii. A **Pathways to Impact** Plan (up to **2 sides A4**), detailing:
 - those who may benefit or make use of the research;
 - how they might benefit and/or make use of the research;
 - what will be done during and after the project to increase the likelihood of the research reaching the identified beneficiaries and maximise the likelihood of the identified benefits being achieved
 - suggestions for impact activities that could be undertaken with the Met Office and other partners and delivered at a programme level. These will be further refined at a closed workshop post-award.

Any costs associated with project-level activities in the Pathways to Impact plan should be integrated into the proposal costings within the £2.2M total budget available for this call and justified in the Justification of Resources section. The suggestions for programme-level activities should be accompanied by cost estimates, if appropriate, but not integrated into the proposal as they will be further refined and funded separately.

- iv. **Letters of Support** from named Project Partners to confirm that support and facilities will be made available for associated collaborations and co-funding (up to **2 sides A4** each). The Met Office will be a strategic partner co-operating with all complementary projects funded under this opportunity, therefore letters of support from the Met Office for individual projects are not required.

Each **component** proposal (including the lead) will additionally require the following attachments:

- v. A CV of up to 2 sides of A4 for each named PI, Co-I, research staff post and Visiting Researcher.
- vi. Application forms for access to NERC Services and Facilities, if applicable.
- vii. Price quotations for equipment costing more than £25k, if applicable
- viii. A Business Case of up to 2 sides A4 per item, for items of equipment above the OJEU threshold, if applicable. Further guidance regarding capital equipment costs may be found in the NERC Grants Handbook.

Where support is requested for Associated Studentships (formerly Project Studentships), these must be justified fully in the case for support. All costs for the student's travel and subsistence, consumables etc. must be itemised on the grant proposal form. Further information on Associated (Project) Studentships is found in the NERC Grants Handbook.

7 Assessment Process

All outline proposals received will be assessed by an assessment panel to shortlist those that will be invited to submit full proposals. The assessment criteria to be used for the outline proposal stage will be as follows:

- Research Excellence
- Fit to Programme Requirements

Feedback will be provided to both successful and unsuccessful outline bids.

Full proposals will be internationally peer-reviewed and final funding recommendations made by a moderating panel consisting of independent experts and members of the NERC Peer Review College. Applicants will be given the opportunity to provide a written response to peer review comments prior to the moderating panel. Applicants may be invited to give a presentation at the moderating panel.

The assessment criteria to be used for the full proposal stage will be as follows:

- Research Excellence
- Fit to Programme Requirements

Feedback will be provided on proposals unsuccessful at the full proposal stage.

NERC will use the recommendations of the moderating panel to fund the projects that best meet the aims of the programme.

8 Timetable

Closing date for outline proposals: 23 January 2014

Successful outline proposals invited to proceed: February 2014

Closing date for full proposals: 24 April 2014

Decision communicated to applicants: July 2014

Post-award, successful applicants will be expected to attend a closed workshop with NERC and the Met Office to agree a joint work plan for collaboration and impact activities, and joint governance and management structures. Additional funds will be available to resource these joint plans.

Projects are expected to commence by October 2014.

9 Contact

For all enquiries, please contact Simon Howe atmospheric@nerc.ac.uk

Annex A

Outline of Met Office near term prediction strategy

It is now becoming widely recognised that the impacts of climate change emerge when natural climate fluctuations are exacerbated by additional anthropogenic climate change. The recent global climate record is littered with examples of extreme events where anthropogenic and natural fluctuations may have combined to create impacts of great societal and economic importance such as the European and Russian Heatwaves of 2003 and 2010 or the East African drought of 2011. However, it is not yet clear to what extent such events can be predicted in advance to allow forewarning of increased risk. Furthermore, climate variability may temporarily reverse or offset the long term climate trend as occurred for example in the cold winters of 2010 and 2011 in the UK and Europe and the extreme flooding in north east Australia in 2011. These equally extreme events need prediction where possible to allow effective adaptation measures. These activities are now at the forefront of providing world leading operational information on the effects of climate variability and anthropogenic climate change.

The Met Office Hadley Centre is developing climate predictions systems jointly with NERC researchers to provide the best possible advice on the likelihood of impending climate extremes out to years ahead. While groundbreaking work has already been carried out, there is much left to do to maximise the accuracy and reliability of current near term climate predictions. It is widely acknowledged that the major source of error in near term predictions is likely to occur in climate models themselves but there are also limitations from real time observing networks and from the methods used to combine observations to create starting conditions for climate model predictions. All of these efforts are based around the latest high resolution version of the UK Unified Model to provide the best possible real time forecasts of worldwide climate events.

Met Office Hadley Centre research and development plans are to further develop ensemble predictions for extreme climate events worldwide. Initialisation of climate models from our best estimates of the current state of the atmosphere, ocean, cryosphere, land surface and other elements of the climate system will be carried out while also accounting for future changes in anthropogenic climate forcing. Of course some extreme climate events will inevitably occur through internal chaotic processes and therefore turn out to be unpredictable. Even these cases will be dealt with by the systems being developed which aim to reliably capture both the natural and anthropogenic effects on future near term climate.

Contact for further information:

Prof. Adam Scaife
Head Monthly to Decadal Prediction
Met Office Hadley Centre
(adam.scaife@metoffice.gov.uk)