



RAPID-AMOC Research Programme Announcement of Opportunity – Call for Full Proposals

Closing date: 16:00 on 20 February 2014

Summary

Full proposals are invited for submission to the RAPID-AMOC research programme which builds upon the previous RAPID-WATCH and RAPID programmes and which will extend the delivery of the Atlantic Meridional Overturning Circulation (AMOC) time series until 2020.

This call is for standard type proposals to address three novel uses for the observational data arising from the 26.5°N RAPID array:

- 1) Novel approaches to ocean state estimation using 26.5°N data.
- 2) The role of the AMOC in climate variability and predictability.
- 3) Biogeochemical fluxes.

Proposals for this call are invited from eligible UK researchers (see [NERC Research Grants Handbook](#) for standard eligibility criteria).

The closing date for proposals is 16:00 on 20 February 2014.

Background

The Atlantic Meridional Overturning Circulation (AMOC) is a critical element in the energy balance of the global climate system¹. The AMOC consists of a near-surface, warm northward flow of ocean water, compensated by a colder southward return flow at depth. The AMOC transports ~1.3 PW of heat northwards at latitudes ~24°-26°N, accounting for ~25% of the global (atmospheric and oceanic) poleward heat transport at those latitudes. This heat is transferred from the ocean to the atmosphere at mid-latitudes, with a substantial impact on climate and, in particular, on that of the UK and northwest Europe.

Observing and understanding changes in the AMOC is critically important for identifying the mechanisms of interannual-to-decadal climate variability and change, and for interannual-to-decadal climate prediction. This includes predicting changes in the location, frequency and intensity of Atlantic hurricanes, storms in the North Atlantic and over Europe, shifts in tropical and European

¹Srokosz et al. 2012 Bull. American. Met. Soc, 2012, doi:10.1175/BAMS-D-11-00151.1

precipitation patterns, and the response of sea level to changing radiative forcing². Sustained observations are also critical for assessing the possibility of abrupt changes in the AMOC, such as are known to occur in palaeoclimatic records³.

Since 2004 the NERC RAPID and RAPID-WATCH programmes⁴, in partnership with NSF and NOAA, have supported a pioneering observing system to continuously measure the AMOC. The key component of RAPID is the 26.5°N observing system, based on a unique trans-basin array of moored instruments. This measures the basin-wide strength and vertical structure of the AMOC, and its components. Observations from the 26.5°N array have already revolutionised understanding of AMOC variability, and documented its variability on seasonal-to-interannual timescales. The first few years of observations, having demonstrated the feasibility of AMOC measurement⁵, provided new insights into the seasonal cycle⁶, allowing apparent trends in previous historical snapshots⁷ to be put into context. More recently, from autumn 2009 to spring 2010 the 26.5°N array revealed a substantial weakening of the AMOC, with a second weakening event in late 2010.⁸ These events coincided with record low states of the North Atlantic Oscillation, and cold winter conditions over Europe. Anomalies of this magnitude are not seen in state-of-the-art climate models, calling into question the reliability of these models to serve as guides for future behaviour of the AMOC and suggesting a hitherto unexpected role for the MOC in interannual climate variability.

The 26.5°N data are already spawning extensive international research activities, funded independently of the RAPID programme. This wide use of the observations is expected to continue, but in this programme, a targeted investment is planned in three key uses of the data. Targeted areas are: a) application of array data for improved ocean state estimation; b) use of array data to understand the role of the AMOC in climate variability and predictability; c) addition of biogeochemical sensors to the array to constrain biogeochemical flux estimates.

Strategic Context

The RAPID-AMOC research programme will build on previous NERC investment in continuous AMOC observations through RAPID (2001-2008) and RAPID-WATCH (2008-2015).

The 2012 International Review of the RAPID-WATCH programme recommended the continuation of the 26.5°N array for the next decade and beyond, subject to 5-yearly independent reviews. The RAPID-AMOC programme will extend the 26.5°N AMOC time series to 16 years and the next international review is planned for early 2018. An overarching issue for the 2018 review will be to evaluate the scientific and wider societal benefits of continuing the 26.5°N observations beyond 2020. The three key science questions identified in this announcement have been selected because they are critical issues for the 2018 review. Proposals must demonstrate clearly how they will contribute to the 2018 review and its key questions.

² E.g. Knight et al GRL 2006; Woollings T. et al. 2012 Nature Geosci., **5**, 313-317; Vellinga, M. & Wu P. 2004 J. Climate, **17**, 4498-4511; Sutton, R.T. and Dong, B. 2012 Nature Geosci. **5**, 788-792; Gregory et al. 2001, Clim. Dyn., **18**, 225-240; Pardaens et al. 2011, Clim. Dyn., **36**, 2015-2033.

³ E.g. Alley R.B. 2007 Ann. Rev. Earth Planetary Sci., **35**, 241-272.

⁴ Hereafter referred to simply as RAPID (see www.rapid.ac.uk).

⁵ Cunningham et al. 2007 Science, **317**, 935-938; Kanzow et al., 2007 Science, **317**, 938-941.

⁶ Kanzow et al. 2010 J Climate, **23**, 5678-5698; Chidichimo et al 2010 Ocean Sci., **6**, 475-490.

⁷ Bryden et al. 2005 Nature, **438**, 655-657.

⁸ McCarthy et al 2012 Geophys. Res. Lett 39, doi:10.1029/2012GL052933

Programme Objective

The overarching objective of the RAPID-AMOC research programme is:

To determine the variability of the Atlantic Meridional Overturning Circulation (AMOC), and its links to climate and to the ocean carbon sink, on interannual-to-decadal time scales.

This will be delivered through continuing operation of the 26.5°N array from 2015-2020, and through research on the three targeted questions that are the subject of this announcement.

Scope of the call

Up to £2.4m is available for this call to fund three research projects, one to address each of the research questions – this includes the associated NERC costs (i.e. cruise support and services and facilities) but excludes data management costs which will be covered by the programme.

Proposals should include costs for NERC cruise support (should it be required) and services and facilities (e.g. HPC).

Proposals may present a work plan for up to 4 years for Research Questions 1 & 2 and up to 7 years for Research Question 3.

The NERC funding contribution will be 80% of FEC.
Indexation at the prevailing rate will be applied at the time of award.

Project studentships are ineligible as part of this call.

Collaboration with the Met Office is strongly encouraged. However, NERC does not directly fund the Met Office, and their staff are not eligible to act as investigators; their normal status would be as project partners, not sub-contractors. NERC does in certain circumstances allow small sub-contracts to the Met Office within a research grant but this has to be very well justified. In general this is where the work is clearly outside the current strategic work programme of the Met Office, and the Met Office has critical expertise that cannot be found elsewhere.

Capital Equipment

For all items of equipment costing over £10,000 (including VAT), but excluding those used for instrument development, the applicants of the proposal will need to:

- confirm that the piece of equipment is not readily available for use within the host institution, or any other accessible location (for instance by making reference to any asset registers consulted);
- provide evidence that all other reasonable options have been considered;
- if the equipment requested will replace existing equipment, explain what will happen to the existing equipment;
- explain the dependence of the project on this capital as well as any contingency plans that would be invoked should it not be possible to fund the capital elements of the proposal.

Additional information will be required for capital equipment costing more than £25,000 (quotations and involvement of RCUK procurement services) or £121,588 (full business case required); both cost thresholds include VAT. For details of these requirements, see http://www.rcuk.ac.uk/RCUK-prod/assets/documents/publications/Equipment_Guidance.pdf.

NERC will make best endeavours, but does not expect to be able to fund more than a small fraction of any capital equipment. In most cases, the maximum NERC support will be 50%, thus applicants will need to provide evidence of co-support for at least half of capital costs. Only in exceptional circumstances will NERC fund more than this, and applicants should discuss in advance with NERC any cases requiring such commitment, to receive feedback on whether it is worth proceeding with a proposal.

Research Questions Requirements (funding levels outlined below are given at 80% FEC)

Research question 1: *Novel approaches to Ocean State Estimation using 26.5°N data* (available funding: up to £600K; duration up to 4 years)

Proposals should address **ALL** of the following points:

- develop techniques to optimally combine the 26.5°N AMOC observations (from RAPID, RAPID-WATCH and RAPID-AMOC programmes) with other data (e.g. from Argo) and ocean models to derive ocean state estimates and associated error estimates;
- refine estimates of the AMOC by combining data from the 26.5°N AMOC observing system and other sources (e.g. Argo) with ocean models;
- provide a dynamically consistent description of the evolving state of the Atlantic;
- determine the added value provided from the 26.5°N data, to estimates of the climate state of the Atlantic, using both current techniques and those that may be available 'in principle' given plausible future developments in modelling and data assimilation;
- contribute to the international review of the AMOC observing system in 2018.

Research question 2: *The role of the AMOC in climate variability and predictability* (available funding: up to £600K; duration up to 4 years)

Proposals should address **ALL** of the following points:

- use the 26.5°N AMOC observations (from RAPID, RAPID-WATCH and RAPID-AMOC programmes) to investigate the role of the AMOC in climate variability and predictability on seasonal to interannual to decadal timescales;
- investigate quantitatively the lead-lag relationships between changes in the AMOC and changes in climate, and the mechanisms responsible;
- investigate the degree of predictability in the AMOC and any consequent predictability of climate;
- determine the potential added value provided by the 26.5°N data for AMOC and climate prediction;
- contribute to the international review of the AMOC observing system in 2018.

Research Question 3: Biogeochemical fluxes (available funding: up to £1.2M; duration up to 7 years)

Proposals should address **ALL** of the following points:

- demonstrate the value of the existing RAPID 26.5°N AMOC data in constraining biogeochemical fluxes and budgets, particularly of carbon, in the North Atlantic;
- add field-tested biogeochemical sensors to the RAPID-AMOC array, taking advantage of the scheduled cruises (autumn 2015, spring 2017 and autumn 2018), without jeopardising the existing measurement programme;
- evaluate the usefulness of the additional data obtained from the biogeochemical sensors added to the array to constrain biogeochemical fluxes and budgets;
- determine the added value provided by the 26.5°N data (physical and biogeochemical) in analysis and prediction of North Atlantic biogeochemical budgets, using both current techniques and those that may be available 'in principle' given plausible future developments in modelling and data assimilation;
- contribute to the international review of the AMOC observing system in 2018.

Applicants submitting proposals to address Research Question 3 must contact the 26.5°N RAPID Array team to discuss their plans for additional sensors in advance of submission (see page 9 for contacts). All discussions will be held in strict confidence.

Implementation and Delivery

Proposals to deliver Research Questions 1 and 2 may be up to 4 years in duration and for Research Question 3 may be up to seven years in duration. The start and end dates for all grants should take into account the requirement for them to input into the 2018 review. The start date for proposals addressing Research Question 3 should also take into account preparation time required to enable biogeochemical sensors to be proven before being deployed during the planned RAPID cruises. Proposals addressing Research Question 3 should take into account that only instrumentation deployed during the Autumn 2015 cruise will be able to deliver data in time to contribute to the 2018 review.

All proposals must include milestones and deliverables to ensure that the RAPID-AMOC Programme Executive Board can monitor project progress and the delivery of the science outputs.

All proposals must clearly state how they will contribute to the 2018 International Review of the AMOC observing system.

Knowledge Exchange/Impact

Knowledge exchange (KE) is vital to ensure that environmental research has wide benefits for society, and should be an integral part of any research. All proposals are required to identify their KE plan through a '[Pathway to Impact](#)' section, with associated delivery costs. The KE plan will identify those who may benefit from or make use of the research, how they might benefit or make use of the research, and methods for disseminating data, knowledge and skills in the most effective appropriate manner.

Data Management

All full proposals will be required to include an appropriate outline Data Management Plan that complies with [NERC data policy](#).

The delivery of the overall programme objectives necessitates effective exchange of data between the teams involved and this will be facilitated by the British Oceanographic Data Centre. Well-defined protocols for the exchange of data will therefore be required, with agreement on data formats and timely delivery by Principal Investigators at the start of the programme. The cost of data management will be covered by the programme and should not be included in proposals.

Reporting, Governance and Programme Integration

In order for NERC to manage performance against its Strategic Objectives and Delivery Plan and report to the Department for Business, Innovation and Skills (BIS) and NERC Council, suppliers of strategic research are required to report regularly on the outputs and outcomes they have been commissioned to deliver. The Principal Investigator (PI) will therefore be required to:

- keep their outputs and outcomes updated through inputs to the RCUK Research Outcomes System (ROS)
- complete additional reporting requested by the RAPID-AMOC Programme Executive Board – for example, reports on progress against milestones and deliverables.

In order to facilitate overall coordination to deliver the programme goals, all funded projects will be required to work closely with the Programme Advisory Group and be responsive to their suggestions and input on progress.

Eligibility

This opportunity is open to individuals and organisations eligible for NERC research grant funding. Please refer to the [NERC Research Grants Handbook](#) and the list of Independent Research Organisations (for NERC managed mode: <http://www.rcuk.ac.uk/funding/eligibilityforrcs/>) for details.

Potential applicants should contact the NERC [Research Grants Team](#) 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 the RAPID-AMOC call; only one of these may be as lead Principal Investigator.

Application Process

Closing date: 16:00 on 20 February 2014

Full proposal will be Standard applications. Full proposals must be submitted using Je-S. Please select Proposal Type – ‘Standard Proposal’ and then select scheme – ‘Directed’ and the call – ‘RAPID AMOC FEB14’.

Applicants must ensure that NERC receives their proposal by 16:00 on the closing date. They 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 eligibility criteria of this call, will be returned to the applicant and will not be considered.

For all proposals for NERC research grants, the Principal Investigator must submit the relevant Je-S form, 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 11point, Arial font, with margins of at least 2cm. References can be presented in a smaller font size provided it is sufficiently clear to ensure good quality reproductions. Applicants referring to websites should note that referees may choose not to use them.

The **lead** component of each proposal should have the following documents attached:

1. The **Case for Support** which is comprised of **three** parts:

Part 1 – a common ***Previous Track Record*** (up to **2 sides of A4** in total to cover 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; 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 2 – A common **Description of the Proposed Research**. For **Research Questions 1 and 2** this must not exceed **8 sides of A4** (including all necessary tables, figures and references). For **Research Question 3** this must not exceed **10 sides of A4** (including all necessary tables, figures and references). The following points should be included:

- underlying rationale, scientific and technological issues to be addressed;
- relationship to programme objectives;
- description of the proposed research – please describe why the work is strategically important, the key research objectives and how these will be achieved;
- field programme requirements;
- the research's milestones and deliverables.

Part 3 – An **Outline Data Management Plan**. This must not exceed **1 side of A4**.

2. A common **Justification of Resources** of up to **2 sides of 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. If capital requests (i.e. individual items over £10k) are included, applicants are advised to explain the dependence of the project on this capital as well as any contingency plans that would be invoked should it not be possible to fund the capital elements of the proposal. Publication costs may no longer be included in grant proposals. For further information of what to include in the Justification of Resources, see sections F in the NERC Research Grants Handbook.
3. A **Pathways to Impact** Plan (up to **2 sides of A4**), detailing:
 - those who may benefit from or use the research;
 - how they might benefit and/or make use of the research;
 - methods for disseminating data/knowledge/skills in the most effective and appropriate manner.Full details of the requirement for Pathways to Impact, can be found on the NERC website: <http://www.nerc.ac.uk/funding/application/howtoapply/pathwaystoimpact/> . The costs of knowledge exchange activities in the plan should be fully integrated into the proposal costings and justified in the Justification of Resources section.
4. Price quotation for equipment costing more than £25k.
5. Letters of Support from named Project Partners only, to confirm that support and facilities will be made available for associated collaborations and co-funding (up to 2 sides A4 each).

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

- a **CV** of up to 2 sides A4 for each named PI, Co-I, researcher staff post and Visiting Researcher.
- **Application forms for access to NERC services and facilities**, if applicable.

Applicants for NERC grants may apply to NERC for access to any of the NERC services and facilities. Further information on NERC services and facilities can be found in the [NERC Research Grants Handbook](#) and on the NERC website at: <http://www.nerc.ac.uk/research/sites/facilities/>.

Prior to submitting the grant proposal, the applicants must first contact the facility to seek agreement that they could provide the service required and obtain the notional cost. For the facilities listed here, <http://www.nerc.ac.uk/research/sites/facilities/list/>, applicants will need to submit a quote for the facility work. The quote will be provided by the facility and will need to be uploaded to Je-S as the attachment type 'Technical Assessment'.

No research grant involving a ship-time application will be allowed to begin until ship time has been formally allocated, and contact should therefore be made with NERC Marine Planning if any preliminary work will need to be undertaken prior to the allocation of the cruise.

Assessment process

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.

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

- Research Excellence
- Fit to Programme Requirements

Pathways to Impact plans will be assessed by the moderating panel and graded as either 'Acceptable' or 'Unacceptable'. If the Pathway to Impact plan of a fundable proposal receives an 'unacceptable' grade the plan will have to be revised before any grant funding is released.

Feedback on unsuccessful proposals will be available on request.

Timetable

Closing date for proposal submission: 20 February 2014

Decision communicated to applicants: by the end of September 2014

Contacts

For general queries and further information about the application and assessment process please contact:

Nicky Lewis
nile@nerc.ac.uk
01793 411739

For information regarding possible collaboration with the Met Office please contact:

Richard Wood
richard.wood@metoffice.gov.uk

To discuss the addition of sensors to the RAPID array as part of Research Question 3 please contact:

Darren Rayner
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