

NATURAL ENVIRONMENT RESEARCH COUNCIL

EVALUATION PANEL REPORT

**Evaluation of progress with delivering NERC's
Earth System Science (ESS) Theme**

January 2012

*This document reports the conclusions of a Panel of experts.
The views expressed are entirely those of the Panel.*

INTRODUCTION

1. This evaluation was commissioned by NERC's Director, Science (DS), to meet a high priority need for evidence on progress with implementing the science themes set out in NERC's strategy. The Earth System Science (ESS) theme is the seventh, and therefore last, theme to be evaluated in this first round of evaluations of NERC's science themes. The intention is to evaluate each theme every two-to-three years via a rolling programme.
2. ESS is one of seven science themes set out in NERC's strategy *Next Generation Science for Planet Earth*¹. The key drivers of the theme are '*...to provide the underpinning science to understand the Earth system, and how the components affect each other at present and over geological time. This understanding will inform all the other themes, as well as providing key scientific understanding to help manage the environment in the face of current global change pressures*²'. To achieve this, NERC has set the theme two challenges:

1. Understanding the biogeochemical forces and feedbacks that drive the Earth system
2. Understanding the long-term development of the Earth and its habitability

3. The evaluation was designed to meet the evidence needs of DS (the main customer for the evaluation) and other key stakeholders, including the Science and Innovation Strategy Board (SISB) and the Head of Strategic Management. The design incorporated lessons learned from the preceding theme evaluations.
4. The customer and stakeholders requested evidence that will:
 - Provide information to SISB and Council on progress with delivering the ESS theme;
 - Inform strategy and investment planning, including future Theme Action Plans (TAPs) and refreshes of NERC strategy, and decisions on management of current investments;
 - Provide evidence of achievements and highlights for publicising to external audiences, including government, the research community, and research users.
5. The evaluation was conducted by a Panel comprising representatives from key stakeholder groups (**Annex A**) and met for one day, in January 2012. The Theme Leader (TL) and NERC lead on the ESS theme attended *ex officio*. The Panel's objective was:

To undertake a high-level overview of progress with delivering the ESS theme at this stage, three years into implementing the strategy.

6. The Panel's Terms of Reference are attached as **Annex B**. They covered:
 - Inputs: the extent to which each challenge, and the whole theme, is being addressed;
 - Outputs: the extent to which each challenge and the whole theme has been achieved; and
 - Performance: the extent to which investments are being effective in meeting theme challenges and delivering outcomes.

¹ <http://www.nerc.ac.uk/publications/strategicplan/nextgeneration.asp>

² Earth System Science Revised Theme Report, June 2010 (<http://www.nerc.ac.uk/about/strategy/documents/theme-report-earth-system.pdf>)

7. The evaluation concentrated on investments current at, or planned since, July 2008, when implementation of the strategy commenced, with the approval of the first TAPs. However, the Panel was provided with additional information relevant to the theme³, listed in **Annex C**. Key facts about the major investments contributing to this theme are included at **Annex D**.

³ Including Research Programmes managed by Swindon Office, Research Programmes managed by NERC Research Centres, and Responsive Mode grants.

8. The current NERC strategy *Next Generation Science for Planet Earth* is intended to be dynamic and is periodically refreshed, enabling NERC to respond more rapidly to new opportunities and priorities. An outcome of the 2010 Strategy Refresh was a revision of the ESS theme (including its scope and challenges), and theme report. The implemented changes were primarily based on the conclusion that the scope of the theme, as originally envisaged, was too broad, encompassing all timescales and all parts of the Earth system. The aims were to: i) define the boundaries between ESS and other strategy themes, particularly Climate System, and ii) more clearly define the focus of the theme.
9. Following the 2010 Strategy Refresh, the ESS theme's challenges were reduced in number, from eleven to two.
- 10. Pre-refresh theme challenges:**
 - Providing forewarning of abrupt climate change:
 - Changes in ecosystems in response to increasing ocean acidity (1)
 - Destabilisation of methane hydrates under global warming (2)
 - Forewarning of abrupt climate change (3)
 - Improve knowledge of the interaction between the evolution of life and the Earth (4)
 - Quantify forces and feedbacks that drive the Earth System:
 - Global biogeochemical cycles (5)
 - Dynamics of the Earth's interior and their manifestation at the surface (6)
 - Terrestrial processes and their interaction within the Earth system (7)
 - Ocean processes and their interaction with the Earth system (8)
 - Cryospheric change and its interaction with the Earth system (9)
 - Atmospheric composition (10)
 - What do records of past environments reveal about the operation of the Earth system? (11)
- 11. Post-refresh theme challenges:**
 1. Understanding the biogeochemical forces and feedbacks that drive the Earth system, and
 2. Understanding the long-term development of the Earth and its habitability
12. The revised theme now focuses on biogeochemical cycles and the interactions between the surface and deeper parts of the Earth System on all timescales. The physical components of the Earth System were moved to the Climate System theme.

INTRODUCTORY NOTE

13. This report summarises the Panel’s findings against their ToR, with proposals for ways in which delivery of the theme might be strengthened. The report will be considered by SISB, and copied to Council along with a management response setting out any actions in response to the Panel’s proposals. Both report and response will be published on NERC's website.

TOR 1: INPUTS

14. The Panel was asked to evaluate the extent to which the theme is being covered by current and planned investments, in the three ways presented below (1a - 1c). The Panel concluded that investments are addressing the challenges well, but there is a risk that the aspirations of the theme as a whole cannot be met with the current two challenges, which are narrower in scope than the full remit of the theme. The revision of the theme’s challenges, as a result of the 2010 NERC strategy refresh, has had a significant effect on the theme’s delivery.
15. The ESS strategy refresh was intended to create a clear boundary between themes, and was motivated partly by the recognition that there was a need for greater focus on deep Earth processes. The Panel concluded that this improved focus has been achieved, together with clarification of the boundaries between ESS and Climate Systems, but some elements of Earth system science are now unaddressed by the theme’s new challenges, for example palaeoclimatology, and atmospheric physics.
16. The radical changes to the theme’s challenges have complicated attempts to evaluate the theme’s progress. In particular, some TAP actions which predate the refresh and were closely mapped to the original theme challenges now have a weak relevance to the two new challenges. This change to the strategic landscape makes it difficult to judge their success. This is particularly true for investments such as Ice Sheet Stability & Sea Level Rise, which when developed addressed challenges that are no longer in the ESS remit. This is the case to such an extent that few of the investments now mapped to Challenge 2, for want of a better home, really contribute well to delivery against it.

1.a The extent to which each challenge is being addressed by relevant investments

Challenge	Panel comments (<i>acronyms – Annex E</i>)
1. Understanding the biogeochemical forces and feedbacks that drive the Earth system	<p><i>Challenge 1 is being well addressed by a very wide portfolio of investments, some contributing specifically to research into biogeochemical cycles, others more broadly. There are no significant gaps in delivery against this challenge.</i></p> <p>The majority of the investments mapped to Challenge 1 are contributing well to the understanding of global biogeochemical cycles. Some, e.g. Shelf Sea Biogeochemistry, Macronutrient Cycles, and Ocean Acidification, were developed to address the challenges, whereas others are contributing research in this challenge area more generally. Some of the many programmes mapped against this challenge are of limited relevance to biogeochemical processes, but have been mapped to this challenge as it is marginally more relevant than Challenge 2.</p>

Challenge	Panel comments (<i>acronyms – Annex E</i>)
	<p>The Research Centres' programmes are more difficult to map to the theme's challenges than the research programmes.</p>
<p>2. Understanding the long-term development of the Earth and its habitability</p>	<p><i>The Panel did not identify any significant gaps in the delivery of Challenge 2. Like Challenge 1, however, the re-mapping of investments to Challenge 2 from the pre-refresh challenges has led to a large number of research programmes nominally allocated to this challenge but which are not delivering towards it in any substantive way.</i></p> <p>Fewer programmes are mapped to Challenge 2 than to Challenge 1, although the level of investment is adequate and, for a typical theme challenge, relatively high. Three of the four actions being prepared for inclusion in ESS's TAP4 are targeted to Challenge 2, which will help to balance the investment between the challenges.</p> <p>As for Challenge 1, although several of the mapped programmes squarely address this challenge, the majority contribute more obliquely (e.g. Ice Sheet Stability).</p> <p>ESM Strategy Implementation is exploiting the high value collaboration developed between NERC researchers and the Met Office through the ESM programme, which itself is built on the QUEST programme. This is an example of successful follow-through activity, the results of which are highly anticipated by the user community.</p> <p>The TAP4 deep Earth action scoping studies, if authorised, will directly address two of Challenge 2's desired deliverables: <i>The controls on subduction and mantle convection, melting and volcanism, and how deep-Earth processes influence the surface environment, such as by the generation of the magnetic field and volcanic degassing leading to global change.</i></p>

1.b The extent to which the whole theme (sum of challenges) is being addressed

17. The theme's investments to date have concentrated on studies of observable systems and cycles, rather than on future projections and modelling. The ESM Strategy TAP action should go some way to addressing this, benefiting from the very welcome NERC/Met Office Hadley Centre collaboration. Proper validation of complex models is widely recognised as essential, and necessary to ensure their reliability. It is vital that the validation process for NERC models must remain thorough, adequately resourced, and visible to users.
18. The Theme Leader does not have authority or direct influence over the ongoing pre-theme investments, e.g. QUEST and RAPID-WATCH, but has done a very effective job engaging with, and helping to integrate, these programmes with the ESS theme. On the whole, where required the ESS community have cooperated enthusiastically and helpfully in the development and review of actions.
19. ESS is central to NERC's mission and science remit, and more programmes are mapped to this theme than any other. ESS is also a theme with one of the largest overall spends. The ESS theme's broad science remit has made it, in many cases, the default theme for the mapping of pre-theme programmes. Although much of the RM

and Centres' work mapped to the theme isn't contributing to delivery against either of the theme's two challenges, a few programmes map well to, and are delivering towards, both of the theme's challenges, e.g. UKIODP.

20. Certain research topics are not explicitly part of the ESS theme remit, but remain important on-going challenges. One example is palaeoclimate.

1.c The extent to which new investments are on track

21. The Panel were satisfied that there are no major threats to delivery of the ongoing investments relevant to the theme. The commissioning process has become more streamlined following changes to the process adopted through experience and via recommendations from the Commissioning Evaluation. The Panel welcomes the new AO-workshop model of community preparation which, early indications suggest, is helping to improve the quality of subsequent programme grant applications, as well as showcasing the NERC National Capability that can contribute to the delivery of the actions.
22. The Ice Sheet Stability programme was delayed for a year. The Panel recognised that this was an informed decision taken by the DS, responding to significant risks to delivery had the programme adhered to the intended schedule.

TOR 2: OUTPUTS

23. The Panel was asked to evaluate the extent to which the outputs of the relevant investments have contributed to the theme's strategic objectives. Because the theme is still relatively immature, there are few research outputs from its commissioned investments. Nevertheless, some programmes' achievements are already clear. Many of the SO-managed programmes would not have happened without the theme; this itself is one of the theme's a major achievements.
24. Overall, the ESS research agenda in the UK is clear and advanced, by international standards, but there are opportunities for the currently less mature programmes to improve the influence of the UK's ESS outcomes on the international research and policy agenda.

Proposal: In order to further improve the impact of the UK's ESS research, NERC should consider means by which the outputs of NERC-funded ESS research can be applied more influentially on the national and international policy stage, for example through IGBP, Belmont Forum, and continued participation in CARBOCEAN.

2.a The extent to which each challenge has been achieved

Challenge(s)	Achievements (<i>acronyms – Annex E</i>)
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Challenge(s)	Achievements (<i>acronyms – Annex E</i>)
1. Understanding the biogeochemical forces and feedbacks that drive the Earth system	<p>The UK Ocean Acidification and Shelf Sea Biogeochemistry programmes have been well received by users and partners, and have attracted substantial co-investment (Defra, DECC). UK Ocean Acidification is working well and beginning to deliver outputs. It has established good links with European, domestic and international policy drivers, and industry.</p> <p>ARP and MC are strong examples of cross-theme and cross-discipline actions, illustrating a success of the theme model in tackling integrated science.</p> <p>ESM Strategy and JCWRP have produced highly regarded outputs and built ongoing collaborations between the NERC research community and the Hadley Centre. ESM Strategy outputs [more detail required here] expected to be a significant evidence input to the upcoming IPCC report.</p> <p>The ESS Summer Schools have been popular, and are fostering an interdisciplinary approach to ESS in students. This action is also delivering towards Challenge 2.</p> <p>The Methane Network is performing well, and the community it is fostering is already participating in research projects, e.g. the methane hydrates component of the ARP.</p>
2. Understanding the long-term development of the Earth and its habitability	<p>Long Term Co-evolution of Life and the Planet is primarily contributing to Challenge 2, and is concerned with fostering interdisciplinary partnerships and capacity-building to help address this challenge.</p>

2.b The extent to which the whole theme (sum of challenges) has been achieved

25. Assessing the success of the ESS theme as a whole is complicated by the fact that the theme's ultimate deliverables are synthesis of knowledge at the Earth system scale. The strength of the pre-theme, Directed, programmes' outputs is being well exploited by TAP investments, particularly for the development of novel Earth system models.

2.c The extent to which larger investments have been effective in delivering outcomes

26. The larger investments which have delivered the majority of their anticipated outcomes all predate the theme. An unusually high number of large NERC programmes are mapped to the ESS theme. The most significant of these are:
- i. QUEST has generated very high-profile outputs, especially publications. QUEST-FISH integrated the human aspect well. The research communities established through QUEST (including the early NERC/Met Office collaborations) have carried through to deliver research for more recent programmes. QUEST could have been more successful at adding to and synthesising understanding of Earth system-level activities.
 - ii. IODP can be regarded as a great success, fundamental to the establishment of the now world-leading UK palaeo-ocean research community. Generated a

remarkable number of high-impact papers, and leveraged an extremely high amount of international co-investment.

- iii. The Ocean Acidification programme, co-funded by DECC and Defra, is an excellent example of a more mature ESS programme. UKOA has played a major role in bringing the issue of ocean acidification to intergovernmental organisations, through participation in expert reports (e.g. CBD, OSPAR, IPCC 5th AR), exhibition stands and side events (e.g. at UNFCCC COPs and SBSTAs), and international conferences (e.g. Planet Under Pressure). In order to make effective use of resources to ensure maximum possible impact UKOA has collaborated with other national programmes and institutes in this outreach. Receiving endorsement of the message from international and intergovernmental organisations was a simple and effective way of ensuring message uptake by the organisations. UKOA was also a member of the International Ocean Acidification Reference User Group, another effective method of outreach via its stakeholder members and publications. A film, *Ocean Acidification: connecting science, industry, policy and public*, also helped ensure a widespread uptake, with subtitled versions developed in Korean (for the World Expo) and Portuguese Brazilian (for the Rio+20 Earth Summit). UKOA's successful impact has been achieved through creating networks, collaboration, trust and targeting key outreach events and doing these professionally. UKOA's KE activities and impact have been used as examples of good KE practice by NERC and LWEC.

27. Before the 2010 ESS theme refresh, RAPID-WATCH was highly relevant to the ESS theme, but is now more relevant to Climate Systems.

3. Overall Progress

28. The ESS theme has taken an admirably holistic approach to the various elements of Earth system research, and the communities that deliver it. The continued breaking down of barriers to cross-disciplinary working is leading to exciting research opportunities and outcomes, but it is too early to conclude that the barriers have been removed.
29. The theme has concentrated on the more accessible research targets, largely policy-driven and shared priorities with partners. This utilised the current skills base, is efficient, and will continue to produce products which are of high value to the ESS stakeholder community. However, the theme has made less progress in the development of a holistic new vision for ESS, and a fully coupled Earth System Model, as had been part of the theme's original strategy.
30. The theme has made progress in some areas with integrating a human element into ESS research, but more focus in this area should be considered in future TAPs.
31. The theme's collaborations with partners are largely highly successful, but some issues remain between NERC and other RCs with coordination of research activities where remits are shared.

Proposal: Although progress has been made, the co-ordination of cross-Council research activities and equipment-sharing in and for the Earth sciences can be improved. This is a particular issue where research is funded through other councils' Responsive Mode funding streams, but also applies to the use of

facilities such as the Diamond Light Source, which is currently under-utilised by the Earth sciences community. The Theme Leader-type role is well positioned to influence in these areas, and the development and facilitation of multi-agency partnerships should be a more formal aspect of the position.

Future Opportunities

32. The Panel discussed the potential for the theme to add value to the ESS research portfolio through synthesis activities. There is an opportunity, if not a role, for the ESS theme to enable conceptual synthesis activity, assimilating ongoing RM and RP work and to communicate advances to the entire stakeholder community. Similar work is supported at the RP-level as “synthesis activities”.

Proposal: In order to add value to its wide variety of investments, NERC should consider options for support of ‘big picture’ syntheses of ESS research outcomes. This could include Marie Curie-type fellowships combining synthesis and communication activities. This is a Knowledge Exchange issue, and will be better addressed once NERC’s KE role is finalised; the Panel recommend that NERC consider the issue of these fellowships within the KE strategy.

33. The Panel advise NERC to use the opportunity provided by the upcoming strategy refresh to review the ESS theme challenges, and consider whether they are delivering the aspirations for ESS.

PANEL MEMBERSHIP

Position	Name	Organisation
Chair (recent SISB member)	Prof Harry Elderfield	University of Cambridge
Member of the original Strategy Development Panel	Prof Philip England	University of Oxford
NERC Centre representative	Prof David Vaughan	BAS
HEI representative	Prof Manuel Barange	PML
HEI representative	Dr Greg Cowie	University of Edinburgh
User representative	Dr Cathy Johnson	DECC

Attending *ex officio*

Prof Tim Jickells, ESS Theme Leader

Dr Mike Webb, NERC SIM with responsibility for delivering aspects of the theme

NERC Evaluation Team

Dr Liz Fellman, Evaluation Team Leader

Will Thomas, Evaluation Project Manager

PANEL TERMS OF REFERENCE

Purpose

Based on the evidence presented, the Panel is asked to undertake a high-level overview of progress in delivering NERC's Earth System Science (ESS) theme at this stage, three years into implementing the strategy.

Objectives

1. Inputs: Evaluate the extent to which the theme is being covered by current and planned investments

- a) The extent to which each **challenge** is being addressed
- b) The extent to which the **whole theme** (sum of challenges) is being addressed
- c) The extent to which new investments are on track

2. Outputs: Evaluate the extent to which the outputs of the above investments have contributed to the theme objective

- a) Progress made with each theme **challenge**
- b) Progress made with the **whole theme** (sum of challenges)
- c) The extent to which larger investments have been effective in delivering outcomes

EVIDENCE PROVIDED TO THE PANEL**Strategic Material**

- Next Generation Science for Planet Earth (NERC Strategy 2007 – 2012)
- ESS Theme Action Plan 1 (2008)
- ESS Theme Action Plan 2 (2009)
- ESS Theme Action Plan 3 (2011)

Investments Information

Summary-level information (dates, % relevance to the theme, £ associated with theme, mapping to challenges) for the following, where relevant to the theme:

- TAP Actions (RPs)
- Directed Programmes active in July 2008 and onwards
- Research & collaborative centre programmes
- Consortium grants

Detailed information for the above, comprising

- PI (or equivalent) questionnaire response submissions to the evaluation process, including details of progress to date, and outputs
- Relevant programme publications, AOs, business cases etc. as appropriate (one or two supporting documents per programme)

Number, and value of contribution towards theme, of non-Consortium RM grants active at July 2008 and onwards

Spend per challenge for RP, centres & Consortia

LWEC response to the following two questions: To what extent is the theme delivering LWEC's needs?; Could the delivery of the theme be improved in terms of contributing to LWEC's challenges?

SMT commentaries for progress with the ESS theme, 08/09 to present

ESS theme highlights from NERC Annual Reports, 08/09 and 09/10

ESS THEME: MAJOR CURRENT INVESTMENTS

Tables 1-4 summarise the investments listed at Paragraph 2, which total £188.3m, plus £11.8m in '09/'10 Research Programme spend at Centres, which would equate to £54.2m over five years (for broad comparison). Paper 5 contains more detailed information about each of these investments.

Table 1: TAP actions (RPs) relevant to the theme, and Directed Programmes, managed by Swindon Office where led by the theme and/or >£0.5m investment relevant to theme

Action	Start date	End date	% ESS ⁴	£m ESS
Shelf Sea Biogeochemistry	2011	2016	100	9.60
Greenhouse Gas Emissions & Feedbacks	2011	2016	50	4.05
DBPR: Ocean Shelf Edge Exchange	2011	2016	40	1.52
ESM Strategy Implementation	2011	2016	43	1.29
Macronutrient Cycles	2011	2015	24	2.26
Mantle Control on a Habitable Planet	2011	2013	100	0.30
Long Term Co-Evolution of Life and the Planet	2010	2015	100	4.00
Ice Sheet Stability and Sea Level Rise	2010	2015	68	5.03
DBPR: Ocean Surface Boundary Layer	2010	2015	20	0.76
Arctic Research Programme	2010	2015	29	4.36
DBPR: Aerosols & Clouds	2010	2014	20	0.60
ESS Summer Schools	2010	2013	100	0.20
Ocean Acidification	2009	2014	78	6.02
Methane Network	2009	2012	100	0.30
Earth System Modelling (ESM) Strategy	2009	2011	50	0.50
Rapid Climate Change – Watch (RAPID – WATCH)	2007	2014	35	5.25
Rural Economy & Land Use (RELU)	2004	2011	10	1.10
UK Integrated Ocean Drilling Project (UKIODP)	2003	2013	65	4.55
Surface Ocean / Lower Atmosphere Study (SOLAS)	2003	2010	60	6.00
Quantifying & Understanding the Earth System (QUEST)	2003	2009	65	14.95
Post-Genomics & Proteomics (PGP)	2003	2009	10	1.10
Rapid Climate Change (RAPID)	2000	2008	35	7.00
Total				80.75

Table 2: Research Programmes managed by Centres

34. These programmes are mostly five years in duration, ending in 2012 or 2013.

Centre	£m ESS '09 / '10	Major programmes (where 0910 spend >£0.1m) ⁵	% ESS	£m ESS '09 / '10
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⁴ As mapped by NERC's Portfolio Planning team in consultation with the Theme Leader or amended by programme managers.

⁵ Equating to £0.5m over 5 years, to allow broad comparison with other funding modes.

Centre	£m ESS '09 / '10	Major programmes (where 0910 spend >£0.1m) ⁷	% ESS	£m ESS '09 / '10
Marine Centres ⁸	6.68	1. Climate, circulation & sea level	32	0.75
		2. Marine biogeochemical cycles	65	1.44
		3. Shelf & coastal processes	64	1.88
		5. Continental margins & deep ocean	48	1.24
		8. Ocean prediction	34	0.75
		9. Sustained Observations	31	0.48
		National Facilities: BODC, PSMSL & CCAP	5	0.13
British Antarctic Survey (BAS)	1.91	Icesheets	82	0.76
		Environmental Change & Evolution	50	0.50
		Chemistry & Past Climate	30	0.27
		Climate	12	0.18
		Ecosystems	5	0.12
National Centre for Atmospheric Science (NCAS)	0.96	Challenge 3 - Improving prediction for human exposure to air pollution	30	0.55
		Challenge 1 - Decadal & Regional Climate Change	10	0.22
		Challenge 2 - Global change on centennial and longer time-scales	20	0.19
British Geological Survey (BGS)	0.70	Science Resources & Infrastructure	26	0.56
National Centre for Earth Observation (NCEO)	0.38	Theme 2: Carbon	50	0.14
		Theme 1: Climate	50	0.11
Centre for Ecology and Hydrology (CEH)	0.21	BGC-01 Monitoring and interpretation of biogeochemical and climate changes	30	0.15
Total	10.84			

Table 3: Responsive Mode: summary of non-Consortium grants current at, or started since, July 08, with ≥50% relevance to the ESS theme

Grant scheme ⁹	No. grants ¹⁰ (%)	ESS spend £m (%)
Standard grants	302 (54%)	73.78 (77%)
Small grants	110 (20%)	3.11 (3%)
Postdoctoral fellowships	61 (11%)	9.87 (10%)
New Investigators	45 (8%)	1.89 (2%)
Masters training grants	29 (3%)	3.20 (3%)
Advanced fellowships	17 (2%)	4.51 (5%)
Total	564	£96.36m

Figure 1 presents the investments divided by challenge (for the 58% of spend that has been mapped by challenge; this does not include the majority of Responsive Mode grants).

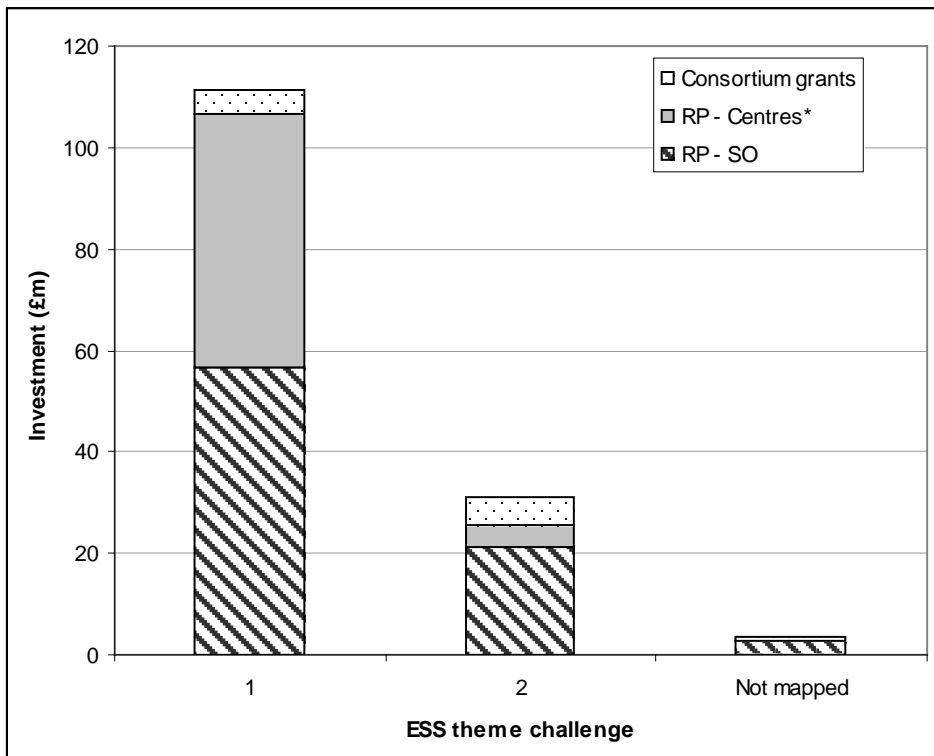
⁷ Equating to £0.5m over 5 years, to allow broad comparison with other funding modes.

⁸ National Oceanography Centre, Southampton (NOCS), Proudman Oceanographic Laboratory (POL), Plymouth Marine Laboratory (PML), Scottish Association for Marine Science (SAMS), Sea Mammal Research Unit (SMRU), Marine Biological Association (MBA) and Sir Alister Hardy Foundation for Ocean Sciences (SAHFOS)

⁹ Description of the schemes available at www.nerc.ac.uk/funding/available. Doctoral training grants are not included as they are not classified by topic. Grants not relevant to the EPHH theme were excluded.

¹⁰ Split grants are combined and treated as one.

Figure 1: Distribution of investments that have been mapped by challenge



** 0910 spend by Research Centres multiplied by 5, to be broadly comparable with the other investment categories*

LIST OF ABBREVIATIONS

AO	Announcement of Opportunity
ARP	Arctic Research Programme
BAS	British Antarctic Survey
CARBOCEAN	CarbOcean Integrated Project
DECC	Department for Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DS	Director, Science
ESM	Earth System Modelling Strategy programme
ESS	Earth System Science theme
IGBP	International Geosphere-Biosphere Programme
IPCC	Intergovernmental Panel on Climate Change
JCWRP	Joint Climate and Weather Research Programme
MC	Macronutrient Cycles programme
NERC	Natural Environment Research Council
PML	Plymouth Marine Laboratory
QUEST	Quantifying and Understanding the Earth System Model programme
QUEST-Fish	QUEST-Fish consortium project
RAPID	Rapid Climate Change programme
RAPID-WATCH	RAPID-WATCH programme
RC	Research Council
SIM	Science and Innovation Manager
SISB	Science and Innovation Strategy Board
TAP	Theme Action Plan
TL	Theme Leader
ToR	Terms of Reference
UKIODP	UK Integrated Drilling Programme

For further information on Research Programmes listed above, see www.nerc.ac.uk/research/programmes