Institution: University of Hull

Unit of Assessment: C17: Geography, Environmental Studies and Archaeology

a. Overview

Our research focuses on natural and human environments and has developed in range, depth and scope since 2008. We make original and agenda-setting contributions of outstanding international significance to key environmental debates in academic, policy and practical realms. We have evolved strong, interdisciplinary collaboration across geography, biological sciences, earth sciences and environmental studies. In particular, we aim to transcend the traditional remits of inherited disciplines like Geography and Biology, to engage natural and human environments and their interactions, with rigorous, interdisciplinary approaches appropriate to these multi-scale, trans-disciplinary phenomena.

Our research structure draws together researchers from the Department of Geography, Environment and Earth Sciences (GEES), the School of Biological, Biomedical and Environmental Sciences (SBBES) who include the Centre for Environmental and Marine Sciences (CEMS) and the Hull International Fisheries Institute (HIFI), and the Institute of Estuarine and Coastal Studies (ICES). Our research environment is thus interdisciplinary and broad based, and our UoAC17 submission comprises 34.5 FTE staff, including 4 early career researchers.

Our vibrant research environment is demonstrated by the quality of our research outputs, our significantly increased levels of both pure and applied research funding, by our range of collaborative and integrated research and postgraduate supervision, and by our intellectual leadership in environmental research areas. This is evidenced by:

- a markedly increased quality of our research outputs.
- a greatly increased (>50%) research income to £10.07m, from £6.7m (RAE2008).
- a ~110% increase in Research Council Funding spend to £2.01m, from £957k (RAE2008).
- a significantly increased PhD completion rate per annum: to 11 per year, from 6.9 (RAE2008).
- an increase in our Post Doctoral researchers to 36, from 22 (RAE2008).
- appointments to a range of new posts across the unit, including 4 Chairs and 12 Lectureships. These sustain our traditional staffing levels, but are targeted strategically at research agendas.

Our interdisciplinary strengths are based on sustained collaboration that has emerged over two decades. In RAE2008 the research of the Departments of Geography and Biological Sciences (now GEES and SBBES) were linked closely enough for two research institutes from Biology (IECS and HIFI) to be returned with Geography. Since 2008 collaboration has progressed further in response to broader scientific agendas and the increased significance of the environment in our changing world. Our collaboration is particularly evident in:

- large collaborative projects funded through the Higher Education Investment Fund (HEIF5);
- 15 interdisciplinary PhD studentships.

b. Research strategy

The University of Hull's Strategic Plan 2011-15 has 'Energy and Environment' as one of its six key interdisciplinary research themes - primarily in response to our successful interdisciplinary work in this area. Due to the strategic plan, our collaboration has developed still further. We now offer an inter- and multi-disciplinary focus on natural environments and the way societies understand and use them: this constitutes our sustainable, productive and successful research environment.

To this end we have re-oriented our Departments' names and elements of our research to face and address these issues. The Department of Geography became 'Geography, Environment and Earth Sciences' (GEES) in 2012. The Department of Biological Sciences became the School of Biological, Biomedical and Environment Sciences (SBBES) in 2013. The Centre for Environmental and Marine Sciences (CEMS) was merged into the research and administrative structure of SBBES in 2011. We have evolved to address an increasingly interdisciplinary age and to respond to the pressing, multidisciplinary environmental challenges that face our contemporary world.

Our key research agendas have also developed since RAE2008. We aim to sustain our established strengths while nurturing productive new research directions. These new research foci are informed by key research questions and debates in, and between, our disciplines; by Research Council and European Framework strategies and priorities; and by the University's strategic

themes and investment. These new initiatives also reflect our growth as a unit as we respond to new academic challenges and opportunities. We have seven academic 'agendas' that were established in our RAE2008 documents (UoA32 Geography; UoA15 Biological Sciences). We have strengthened and developed each agenda subsequently. Our activities within, and across, these agendas are outlined below, as are our plans to develop the agendas further:

1) Living with environmental change: In response to urgent global environmental agendas plus the NERC-led *Living with Environmental Change* partnership (2007-17), we have enhanced our focus on how environmental systems respond to shifting climates. Bond's recently awarded NERC Advanced Fellowship investigates and models the evolution of the Earth System through its histories of global mass extinctions. We address questions of conservation and ecosystem functioning in these shifting contexts (Bunting, Evans), and the spread and impact of invasive species as environments change (see agenda 5). We explore methodologies for assessing environmental systems, including how to better understand environmental contaminants (Mayes, Rotchell), and we continue work on translating palaeo signals into ecologically meaningful data (Bunting, Reed, Rogerson). The grouping of Blackford, Bond, Bunting, Lillie, Reed and Rogerson form an emerging research cluster in 'Long term environmental change', which is set to become a major theme in the forthcoming REF period.

We also address environmental issues from the intersection of the natural and social sciences – as integrated, interdisciplinary approaches are the best guarantee of understanding these complex systems adequately. Cowx and Elliott continue to explore how policy regimes like the Water Framework Directives impact upon aquatic and estuarine ecosystems. They ask how we can preserve biodiversity given changing environments, alien species and shifting consumer demands. Echoing the Energy and Environment theme, plus the Humber's emerging status as a UK centre for renewable energy, we have also developed a clear and growing focus on renewable energy. Work on tidal and wave power has found application in industrial patents and start-up companies (Hardisty, Elliott). We also interrogate the impact of renewables on the environment (McClelland and Parsons, EPSRC 2011-2015) and we will grow this focus in the future in tandem with the region's engagement with this sector.

2) Modelling complex environmental systems: We have an internationally renowned group interrogating the processes of water flow and sediment transport, with 17 researchers active in this area. We undertake both field-based investigations and numerical and physical modelling that together synergise a range of approaches that interrogate key areas of global environmental systems. Examples of leading computational modelling include Coulthard's research on the impact of flash floods (NERC 2013-2016) and the evolution of African river networks through the Pleistocene. Bellerby's work on precipitation modelling extends this expertise. Much complex modelling research also uses the Total Environment Simulator (TES, our state-of-the-art Flume Laboratory modelling suite). Parsons' studies of flood response in large rivers (NERC 2010-2013) and on the influence of biological and physical cohesion on sediment transport (NERC 2011-2014) both used the TES. This laboratory also underpins research on shoaling waves and bedform for hydraulic engineering guidelines (Frostick, McLelland: EU-HYDRALAB-III 2006-09, EU-HYDRALAB-IV 2010-2014). Together this work is world-leading and results in high-quality international outputs and a series of other RCUK and EU awards. We will sustain this focus but also encourage new research directions such as Parsons' NERC award to investigate the impact of riparian vegetation on river channel roughness and, therefore, flooding. A further project will investigate the interplay between monsoonal floods and large floodplains on a mega-river. These new projects will enhance this strong research theme still further.

3) Geobiology and geochemistry: We have developed a new research area in biosphere-lithosphere interaction to develop our growing reputation in this emerging field. We have worked on carbonate precipitation rates and how these change under different conditions to record past climates, plus the interaction between climatic variability and rainfall distributions over long timescales (Rogerson, Leverhulme 2013-16). We examine the implications for waste management of contaminants, changing environments and the bacterial degradation of organic remains (Frostick). Elsewhere we create new solutions to understand and deal with post-industrial water pollution (Mayes: NERC 2010-11), the in-situ preservation of archaeological artefacts in wetland

contexts, and the stable isotope analysis of Prehistoric Populations' genetic records buried within western-Asian graveyards (Lillie)**.** Geochemical characteristics of igneous rocks are being used to understand volcanic and mantle dynamics (Williams), and to explore volcanic impacts (Blackford). We assess biogeochemical methods to modelling climate influence on fresh water cycles (Reed). Geochemistry and Rock Sciences laboratories have been created in the REF period to add impetus to this theme, and recent NERC and Leverhulme funding demonstrates our progress.

4) The **Evolutionary Biology** agenda encompasses a range of contemporary biological questions. We have built on our strengths in behavioural ecology and phenotypic evolution with the appointments of two new staff working alongside established colleagues (Breithaupt, Hardege, Joyce, Morrell). Similarly, we have reinforced our interests in phylogenetics, population genetics and molecular evolution with new colleagues (Capellini, Gomez, Haenfling, Humphries, Joyce, Lunt) and we will continue to develop agenda-setting research in this field.

In addition, a new research grouping around **Evolutionary and Environmental Genomics** has emerged (Evans, Gomez, Haenfling, Johnson, Joyce, Lunt). This links biodiversity and population structure to ecological networks and functional ecology. This interdisciplinary group has earned significant University support in the form of HEIF5 funds (Evans, Lunt), which complements strong external funding from NERC, Forest Research, CEFAS, FSBI, and the Spanish Government. Hull is one of the few places integrating genomic approaches with modern biodiversity and ecological network statistics. Lunt and Evans work with Forest Research, for example, to quantify and understand network robustness to the challenge of invasive forest pest species. Haenfling, working with CEFAS and FSBI, is using environmental genomics to understand the flow of genetic material between invasive fish species and endangered native species. This incorporates modern ideas of species as semi-permeable units - which greatly extends debates surrounding invasive species. Joyce is investigating the origins of the dramatic adaptive radiations of cichlid fish in Lake Malawi. Supported by NERC (2013-15) she uses environmental genomics to quantify and understand the contribution of hybrid species formation to this globally important biodiversity hotspot.

5) The **Ecology and Environment** agenda has developed strongly since 2008 and is a major research focus linking staff across the unit. This focus reflects our interests in natural resources and the organisms that inhabit them. It also signals the growing environmental orientation of much of our work. Sustained recruitment in this area, including two Chairs (Capellini, Ennos, Evans, Humphries, Morrell, Rotchell) has introduced new, interlinked themes including the adaptation to, and implications of, climate change. These interests are supported by a NERC Advanced fellowship, the Royal Society and the Leverhulme Trust (Humphries 2004-09, 2009-10, 2013-18), HEIF5 (Evans 2012-14), and the Faroese government (Morrell 2009-13).

The group is also developing a strategy to enhance and strengthen the 'invasion biology' theme that links the research of Breithaupt, Capellini, Cowx, Elliott, Evans, Gomez, Haenfling, Hardege, Johnson, Joyce. This theme also connects to the management of invasives in fresh and salt-water environments via research developed by IECS and HIFI. Impressive progress in this new area is evident through a recent NERC grant to Capellini (2013-16), plus Evans' innovative use of smartphone apps for his successful citizen science project about invasive moths. A second growth area lies in interdisciplinary studies of biological processes using knowledge from physics and engineering (Ennos, Humphries). Humphries' works on the role a microorganism's shape plays in its biology and interactions with humans; Ennos' focus is on improvement of urban environments delivered by planting trees. Both speak directly to human wellbeing through understanding the environment. Humphries' work is driven by a highly prestigious Leverhulme Trust Research Leadership Award (and attendant University-level support, 2013-2018) and includes significant input from Engineering, Physics and the Hull-York Medical School. Both of these growth areas will develop our presence in key debates related to our changing environments and human well-being.

6) Emergent spaces of governance: This agenda responded to the challenges of appropriate governance and regulation in the changing contexts of the early 21st century. How can neo-liberal, globalising economies incorporate environmental and sustainable agendas? How do city-regions, and more traditional models of state and territory, develop in this changing world order? How do

sustainability debates and environmental concerns influence business and the economy? Much work in this group builds upon these issues and in particular, uses international comparative research to explore these global processes in regional contexts. Jonas continued his work on alternative economies and, with Gibbs, explored the growth dynamics of emerging new economic spaces of various cities around Europe, India and the United States (Jonas, Gibbs, British Academy and Nuffield, 2008). Jonas also developed his longstanding work on regional governance and conservation planning in Southern California (NSF). Deutz continued her research into the development of industrial symbiosis networks and the circular economy as part of wider interests in the embedding of sustainability into local economies. In turn, Gibbs has worked on how the low carbon agenda in the maritime sector is impacting upon port operations (EPSRC, 2010-12), and a comparative study of the negotiation of genetically-modified crops in the UK and Australia (Australian Research Council, 2008-2010). More recently, Gibbs has begun to explore the relationship between China and the EU, with regard to climate change policy and the mutual benefits this may bring to both parties (British Academy/Sino-British Friendship Trust, 2012-14), as well as cross-national research between Germany and the UK into the motivations of entrepreneurs in the green building sector (University of Hull, 2011-14, British Academy, 2012-14). We also developed research on green and low-carbon economies in collaboration with CASS funding and the 'White Rose' consortium's Centre for Low Carbon Futures, focusing upon low carbon cities and the development of low carbon supply chains for business.

7) Interrogating diverse knowledge practices: This research developed our established reputation for work on the production of knowledge and the various contexts and actors that inflect how we know, understand and engage with our world. We have pushed forward debates in nature-culture and post-human research by interrogating geographies of science, technology and nature, and their political implications for humans and non-humans. This research entails studies of food, consumption and alternative agricultures (Holloway, Leverhulme 2007-09). Current work with Eden (EPSRC 2012-13) explores how smartphone apps connect consumers with food. Holloway's research also encompasses robotic milking (ESRC 2010-12), plus (with Gibbs) the knowledges and connected practices of farming and genetics (ESRC 2007-10). Eden also works on the various roles of knowledge and field experience as ways of knowing natural environments. She does this through angling (ESRC-NERC-BBSRC RELU Programme, 2006-9). Over the period we also developed our reputation for research into how geographical knowledge is produced in historical contexts and then embodied in landscape. Atkinson's work on Italian Partisans in the forests of World War II Italy (AHRC 2010-13) also sustains Hull's reputation for pushing forwards debates about landscape. In the coming years we will develop these themes of human-landscape knowledge and the socio-technical assemblages that constitute our modern world. A new direction in this agenda is provided by Robson who researches youth, living with disease, and mobile phone technologies in Southern Africa. Her work extends our interests in knowledge to their negotiation in the Global South.

In addition, the integration of environmental research at Hull is also demonstrated by two internationally renowned environmental research institutes, plus centres and institutes designed to enable interdisciplinary research and research with impact.
1) The **Institute for Estuarine and Coastal Studies** (IECS) has thrived since 1983. It employs 22 staff and generated almost 100 research articles and research income of over £1m per annum (and around £4.8m in the REF period). It is directed by Elliott and undertakes integrated, interdisciplinary research and consultancy on marine environmental science, coastal management, conservation and coastal regulation. It attracts very significant funding from governments and their agencies in the UK and Europe (like the Environment Agency and DEFRA).

2) The **Hull International Fisheries Institute** (HIFI) is directed by Cowx and it has undertaken research on freshwater fisheries since 1989. HIFI has six full time staff and their research ranges across the conservation, management, regulation and governance of fresh water resources and fisheries. HIFI has published 49 research articles in the REF period, and earned 68 grants and contracts totalling around £973k. It collaborates regularly with the United National Food and Agriculture Organisation, the European Commission and other international research-users.
3) From 2003 onwards the University developed interdisciplinary centres for the environmental

research that was strengthening on campus. The **Hull Environmental Research Institute** (HERI, 2003-2010) connected environmental researchers and explicitly encouraged interdisciplinary approaches via seminars, workshops and conferences, and pump-priming projects. The applied aspects of this research were articulated through the **Environmental Technologies Centre for Industrial Collaboration** (ETCIC, from 2006) which provided an industry-facing outlet for Hull's Environmental research (a role that saw it funded by the Yorkshire Forward Regional Development Agency). Given the accelerating environmental and sustainability agendas within the UK, HERI and ETCIC were merged into the **Centre for Adaptive Science and Sustainability** (CASS, from 2010). This centre was created using £1.87m of HEIF funding and coordinates research on sustainability, renewable energy and low carbon economies. Biologists, Geographers, and Environmental Scientists are central to its remit as it melds their pure and applied research and continues our interdisciplinary tradition in these fields.

The University's 'Energy and Environment' Research theme also catalyses collaborative, interdisciplinary environmental research through two funding streams:
1) Higher Education Investment Fund (HEIF5) is directed at industry- and public- facing research. The University has £1.96m HEIF5 income per annum and, via CASS, distributes a good proportion to our unit. HEIF5 funded projects in our unit currently amount to £314,105. They include :

- The 'Dynamic Humber' (Coulthard, Elliott, Gibbs, McLelland, Parsons, £205,000) explores how the physical, social and economic aspects of the Humber will be changed by climate change.
- 'Climate Change, Farms and Ecosystem services' (Evans, Lunt, £109,105) addresses how natural insect parasitoids can be used to tackle pests on farmland crops.

2) Sustained University investment in PhD studentships is also directed at the 'Energy and Environment' theme. Studentships are awarded to projects that ensure interdisciplinary foci and links with partners beyond Universities. As noted, we have won 15 studentships in the REF period.

c. People, including:

i. Staffing strategy and staff development

Our staff cohort is ideally suited to the research agendas outlined above. We have strong leadership and an age profile with research-active staff at all career-stages. This structure will sustain our progress for the foreseeable future.

- **Developing research leadership:** The REF period has seen additional Chairs appointed across the unit (Blackford, Ennos, Parsons, Rotchell), with a promotion to personal Chair (Atkinson) and to readerships (Eden, Hardege, Holloway, Lillie). Senior staff now total twelve professors and four readers: they will push the unit forwards. In addition, the promotion of Johnson and Mayes to Senior Lectureships brings greater leadership to CEMS.
- We have a balanced and sustainable age profile for our unit: our average age is 45.86, with 7 staff under 40 and just 2 over 60. This profile offers resilience and stability for the future.
- All staff returned in this submission have permanent contracts, except for one 3-year contract and one emeritus Professor. This stability will allow us to develop our strengths in the forthcoming REF period.
- **Developing emerging research strengths:** In addition, we have also appointed staff in strategic areas to evolve our research strengths and develop new foci. Three lecturers have strengthened both the *Evolutionary Biology* and *Ecology and Environment* themes by adding strengths in Environmental Genomics and Behavioural areas (Capellini, Joyce, Morrell), with two further appointments in the Ecology and Environment agenda (Evans, Humphries).
- Three appointments (including two Chairs) have strengthened our two main physical geography clusters (Blackford, Milan, Parsons). Our Advanced NERC Fellow (Bond) transfers to lecturer in Earth Science after his 5-year project. With a Lecturer in Geology (Williams) and the re-orientation of GEES to include Earth Sciences, Hull becomes one of only two centres for Earth Sciences in Yorkshire. This is as an opportunity for strategic growth in research and strong undergraduate recruitment in 2013 supports our plan to further develop this provision.
- **Developing greater interdisciplinary research capacity:** Virtually all our staff work across traditional disciplinary boundaries, but we have reinforced these strengths explicitly through Chair appointments (Blackford, Ennos, Parsons**,** Rotchell) who address the environment via interdisciplinary frames. Other appointments (Evans, Robson), and our expansion into Earth

Sciences (Bond, Williams) also bolster our interdisciplinary scope.

We provide an intellectually stimulating, well-resourced and supportive research environment for all our staff at all career-stages.

- Early career lecturing staff have experienced mentors and are also supported with a Faculty-funded PhD student (worth ~£65,000), appropriate start-up funds, protected research time for three years (with a minimum 50% of time in year 1) and lighter administrative and teaching loads. The Staff Development Unit inducts new staff.
- Early career researchers enjoy structures that enable their longer-term development. PDRAs join research groups and can access the mentoring, training opportunities, and other research support open to lecturers. In addition, researchers have a small fund each year to present and publish their doctoral research. They can also access larger funds to develop new research proposals. PDRAs are represented on the Research Committees and Departmental Boards.
- To enhance the career development of post-doctoral research scientists the University has established a steering group (including post-doctoral representation) to implement the *Concordat to support the Career Development of Researchers*. The plan highlights achievements to date (www2.hull.ac.uk/theuniversity/research/theconcordat.aspx) and details future actions. In January 2012 the University won the European Union's HR Excellence in Research badge for its work supporting vital and sustainable research environments.
- We also strive to guarantee equal opportunities. The University has applied for Athena SWAN Bronze status to mark progress towards better gender equality in STEM subjects. Equal opportunities and diversity training is mandatory for staff (with additional training for those managing colleagues and making appointments). Colleagues on fractional contracts enjoy equivalent support to full-time staff. We also try to schedule events and meetings at times friendly to those with family or caring responsibilities, and we are flexible about when study leave can be taken by colleagues returning from maternity and sickness leave.

Research management is provided through various routes.

- Strategic direction is overseen by Research Committees that oversee annual research monitoring and reporting. They also facilitate our research environment by: i) facilitating supportive, pre-submission, peer-review of funding applications, ii) funding pilot projects and conference attendance (prioritised for PhD students and early career researchers); iii) organisation of weekly seminar programmes and showpiece public lectures. The research committees report to the Faculty Research and Enterprise Committee (which reports to a University Research & Enterprise Committee). In parallel, all research projects by staff, researchers and postgraduates are overseen by departmental ethics committees which also report to Faculty and University committees. Departmental Annual Plans, including research plans, must connect proposed new initiatives and investment to the University Strategic Plan. In response, the centre and Faculty make strategic investments to strengthen our research.
- Individual research support and guidance is provided through individual annual research reviews with the Research Director and Head of Department. The Departments' appraisal process has a research component and we report our outputs in annual research reports to the Faculty. The University's 'Academic Investment Initiative' (2013) asks staff to outline attainable research goals that will aid their career progression. To this end, continuing professional development is available to all colleagues. Support also comes from the University and Faculty, including workshops on improving grant proposals and courses such as "getting published".
- Workload models are weighted to encourage research, with enhanced support for those running large projects. Typical research weightings are at or above 40%. Study leave is granted to research active staff (with viable research plans) after seven teaching semesters; these criteria make leave virtually automatic for colleagues. All staff receive basic research support funds and can bid for additional conference or research costs to pump-prime projects and initiatives.

Our various research clusters and groups also facilitate research support and collaboration. Their meetings provide mutual support for developing research, identifying funding, and discussing draft proposals and publications. All staff can access the seminar series, reading groups and a weekly writing group – all of which sustain research cultures in and across departments. We also encourage creative, imaginative new initiatives. Members of one weekly writing group, for example,

developed a blog to communicate their research to other academics and the public (gees-talk.blogspot.co.uk). Other staff also benefited from a day-long Research Visualisation and facilitation workshop in 2013, which made us debate our collective research goals, what we perceived as barriers, and how we might overcome obstacles.

ii. Research students

Postgraduate researchers are central to our research environment, including seminars, reading groups and writing groups. Many of them work within research groups and most publish with supervisors. In consultation with postgraduates we have further strengthened our supervisory cover; we also redrafted our progression processes with improved completion rates as a result.

- Formal postgraduate research training works through the University's Postgraduate Training Scheme. Students accrue 60 credits from a choice of over 70 modules ranging from specialist methodological training, to transferable, professional skills that aid employability. Students enjoy a high-quality, bespoke training programme that evolves their skills alongside their research.
- Supervision is undertaken by teams of two or three. University policy requires all early career lecturers to have supervisor training (established staff also undertake annual professional development in postgraduate issues). We have monthly recorded supervisory meetings and six-monthly and annual progress reports. We augment these reports with upgrade and 'progression' processes (including independent assessors who examine student progress).
- We hold annual postgraduate poster days and run postgraduate seminar series. The Faculty of Science and Engineering also holds an annual 'Science Showcase' that highlights academic and postgraduate research to potential external users and the public.
- Since 2008 we have further improved our material support for postgraduates. They can access excellent field support plus high quality IT, laboratories and research equipment.
- All PhD students are guaranteed dedicated office space, laboratory space, and a desktop computer. They receive at least £250 base support annually, plus £1000-1500 further research costs over their degree. They can access professional and skills development opportunities.
- The University also makes postgraduate provision via the Graduate School: a centre of postgraduate administration, advice and progress monitoring. This centre also supports PhD research via conference funding, workspaces, IT facilities and a seminar series. The Graduate School also runs an annual PhD Experience conference where postgraduates share experiences and good practice. An innovative online Graduate Virtual Research Environment extends this through 200+ video accounts from Hull students about postgraduate research.

Our postgraduate strategy has been to expand numbers while diversifying funding sources. We have more students and we attract good levels of RCUK postgraduate funding (the REF period saw AHRC, EPSRC, ESRC and NERC completions), but we are also developing new funding streams, notably from industry and government co-sponsorships. Our tradition of policy-relevant, outward-facing research (reflected by eight ESRC, EPSRC and NERC CASE awards in the period) has helped this shift. Further, as noted above, University studentships are allocated through a competition which emphasises the 'Energy and Environment' theme and potential impact.

Our postgraduates engage with the unit formally. They are active in Departmental governance via Postgraduate and Research Committees and other relevant committees. We also encourage activities on the national stage through conferences and service on national bodies.

d. Income, infrastructure and facilities

Research income strategy

Research income in the Unit has grown very substantially since RAE2008 from £6.7m to £10.07m, including far greater success with relevant research councils (up by ~110%). It far exceeds the significant sums raised in the longer RAE period.

- Our strategy is to target RCUK funds to produce excellent research that will grow our reputation. We respond to Research Council and HEFCE agendas and target new calls.
- We also encourage staff to access RCUK facilities and have received £442k (research income-in-kind) from STFC and NERC in the period (Ferrier, Bunting, Lawson-Handley, Lillie, Lunt, Gomez and Rogerson).
- Our Key Performance Indicators require staff to be involved with one RCUK bid each year and to earn feasible income levels (depending on career stage). We have supportive peer review

processes for all applications. The central Research Funding Office supports the writing of grant bids and the Post-Award Office assist with project management. Full Economic Costs and grant success are accommodated in workload models.

- In tandem with grant-writing workshops and mandatory peer review, our success rates have risen and 72% of submitted staff earned a blue-chip award in the period, with some earning four or more (Gibbs, Holloway, Parsons). In addition, our unit contains half of the top ten earners in the Faculty of Science and Engineering over 2010-13, including Elliot (£1.83m), Parsons (£1.37m), and Cowx (£884k).

Research infrastructure and facilities

Our research infrastructure has seen continued investment and focused strategic investment in areas of research expansion. Our tradition of sharing equipment across Departments has been augmented by a University strategy of centralising research facilities. This strategy, plus bequests and NERC and Royal Society funding, has seen investments that provide state of the art facilities.

- The Total Environment Simulator (TES) at the Millennium Project 'The Deep' is a virtually unique resource. As a world-class research facility it is booked solidly for 24 months in advance by a combination of EU based funding, inter-university NERC- and RCUK- funded research, visiting international scholars, and commercial work for the DTI and UK industry. It is a 16m x 6m x 2m flume with recirculating flow, rainfall simulators and wave generators. The measurement facilities have been upgraded substantially with over £200k investment in the REF period, including the purchase of the only submersible 3D laser PIV system in the UK, plus 3D laser Doppler anemometry (LDA), laser bed scanners, and an array of acoustic Doppler velocimeters (ADVs) and pressure transducers.

New laboratories in this REF period include:

- the Genome Analysis Suite (offering state-of-the-art sequencing, genotyping, mutation detection and robotics facilities); the Bioinformatics Laboratory (for population genetic analysis and modelling, genomic project analyses and phylogenetic studies); and the Ancient DNA Laboratory (for recovering DNA from contemporary, archived and archaeological samples).
- Royal Society funding has helped to refurbish our sector-leading marine aquaria and facilities. The Faculty invested SRIF funds to add a postgraduate wet-lab area and renovate more marine aquaria. Faculty also invested £30k (via Humphries) in a tropical coral culture facility in collaboration with The Deep (and which includes five years of technical collaboration).
- A new Geochemistry laboratory (£64k investment) connects the research interests of colleagues from across our remit (Mayes, Rogerson). An experimental flowing-water mesocosm laboratory for biofilm studies has been created (Rogerson), as has a Rock Preparation Laboratory (£30k investment) with a state-of-the-art thin sectioning system. All this investment supports the new Earth Science programme.
- significant investment in the Hull Microscopy Suite: a faculty-wide facility offering fluorescence, confocal, transmission electron, scanning electron and atomic force microscopes. We have also invested in high quality optical microscopes for diatom, pollen and petrological analysis..

New field equipment includes upgraded research vessels for coastal, river and estuarine work; new field vehicles; a suite of state-of-the-art shallow geophysics instruments; a field spectroradiometer; differential global positioning systems; Acoustic Doppler profilers; continuously recording sondes; a laser granulometer; and a recent (~£200k) investment in a state-of-the-art RESON multibeam swathe bathymetric sonar facility (Parsons). New coring equipment allows the retrieval of undisturbed, high resolution sediment sequences from lacustrine, bog and marine environments.

e. Collaboration or contribution to the discipline or research base

Our unit has extensive, sustained links with researchers and institutions worldwide and we make sizeable contributions to our disciplines. We take a strategic approach to this and provide staff with time and support to make these contributions and foster external collaborations.

- We organised symposia and conferences at Hull, including seven international events including the International Sustainable Development Research Conference 2012 and the British Sedimentological Research Group AGM, 2013. We ran international conferences elsewhere, like the 10th International Conference of Fluvial Sedimentology, Leeds, 2013, and events on Aquatic Environments at Les Houches, France (Humphries) and on Countourite (Rogerson).

- We also support academic bodies and Learned Societies in the UK. Major contributions include Frostick's C17 REF service and membership of the Equality and Diversity Advisory Panel. She was also President of the Geological Society 2008-10; recipient of UKRC Outstanding Women of Achievement Award for SET Leadership and Inspiration; a member of the Government's Science Careers Expert Group; Chair, British Society for Geomorphology; and Yorkshire Post Environmental Champion.
- Cowx was awarded the 2008 American Fisheries Society Award (2008); and Honorary Doctor of Science, Michigan State University, USA (2012); Cowx also delivers the Rachael Carson Memorial Lecture, Michigan State, and the International Fisheries Science Prize (2012).
- Elliott was Visiting Professor, Palermo, Italy; Gdansk, Poland; Klaipeda, Lithuania; Walter Murdoch Distinguished Adjunct Professor, Murdoch University, Australia; Honorary Research Associate of the South African Institute for Aquatic Biodiversity (Grahamstown, RSA). He was: Chair, Expert Panel, British EDF Estuarine and Marine Studies, for New Build Nuclear power plants (from 2007); Chair BONUS ERA-NET research application evaluation and selection, Helsinki, 2008, and member of evaluation panel 2012; Member, Wadden Sea Research programme, research evaluation exercise (2007-08); Research recruitment panel, University of Lisbon, Faculty of Sciences, November 2008 and Oceanographic Institute Evaluation Panel 2011-12; President of the international Estuarine and Coastal Sciences Association (2005-09); Ministerial Appointee of the Scientific Advisory Panel for Defra Marine Conservation Zones project (2009-12); Independent Expert Review Group, for Marine Conservation Zones, Defra (2011-12); Ministerial appointee, independent review for Rame Head inquiry (2010-11); Member, Baltic STERN Science Advisory Committee, Stockholm (2010-13).
- Gibbs was elected to the Academy of Social Sciences, 2013.
- Atkinson served on the Italian REF equivalent sub-panel for Geography and Anthropology (2012-13); he also sits on the Italian RCUK equivalent peer-review panel (2008 - ongoing).
- Rotchell won a 'High End Scholar' Award, China, 2012.
- Parsons is on the NERC core panel; other NERC peer review College members include Bunting, Coulthard, Ferrier, Reed, Rogerson. Ferrier also served on a NERC Service Review Group panel (2011), the NERC Airborne Remote Sensing Facility Steering Committee (2005-09) and the NERC Field Spectroscopy Facility Steering Committee (2007–11). He was an Expert Evaluator on the EU FP7-SPACE-2013-1 CALL (2013).
- Editorial roles with international journals in the period include: Blackford, *Geoarchaeology*; Breithaupt, *Behavioural Ecology and Sociobiology*; Coulthard, *Earth Surface Dynamics* ; Elliott, *Estuarine Coastal and Shelf Science*; Ennos, *American Journal of Botany*; Evans, *Journal Animal Conservation (Zoological Society of London)* and PLoS ONE; Haenfling, *Journal of Fish Biology*; Hardege, *Helgoland Marine Research, Sexuality* and *Early Development in Aquatic Organisms*; Humphries, *PloS ONE*; Johnson, *Journal of Crustacean Biology* and *PeerJ*; Lawson-Handley, *Heredity*; Scott, *Bioscience Education*; Robson, *Childrens Geographies*; Rotchell, *Ecotoxicology*; Scott, *Bioscience Education*.
- Seven colleagues are officers of Scholarly Societies.
- We engage with overseas universities via fellowships, visiting positions and international research programmes (seven colleagues).
- Our international total of Plenary lectures is over 60 in the REF period on five continents.
- We work with the White-Rose Consortium's inter-University 'Centre for Low Carbon Futures' (with Birmingham, Leeds, Sheffield and York and funding from the Regional Development Agency). Projects starting in 2010 totalled £438,000 and included the 'Balanced Green Supply Chain System' (Gibbs, Eden: £197,926) and 'Towards a low carbon, climate resilient economy' (Bellerby, Coulthard: £240,074).
- Parsons is Director of the Centre for Adaptive Science and Sustainability (CASS, from 2013). Set up with HEIF funds, this is an innovative, interdisciplinary research centre for Hull's environmental research - enabling excellent, collaborative research that delivers impact.
- We work nationally and internationally on postgraduate training, for example, we hosted the RGS-IBG Historical Geography Postgraduate Conference 2012. Staff are involved in national and international postgraduate research training collaborations (Bunting, Elliott, McLelland, Parsons and Reed) and have all trained postgraduates across Europe.