Institution: UCL

Unit of Assessment: C17B Geography

a. Overview

UCL Geography aims to produce world-leading research and to translate this into impact in all its forms (scholarly, pedagogical, enterprise, public engagement, policy). We support a diversity of styles and scales of research, nurturing the very best of individual scholarship, concentrating strategically in areas where we can make a distinctive contribution, and exploiting cross-disciplinarity to generate critical mass and conceptually innovative and significant research.

Research within the Department is organised around six clusters that reflect intellectual agendas rather than infrastructural groupings: (1) Past Climates; (2) Recent Environmental Change and Biodiversity; (3) Environmental Modelling and Observation; (4) Comparative Urbanism; (5) Transnational Spaces; and (6) Science, Politics and Government. Clusters 1 and 2 are associated with the Environmental Change Research Centre (ECRC, founded 1991). Cluster 5 is linked to the Migration Research Unit (MRU, founded 1988) and the Equiano Centre (founded 2007 to undertake historical research on the black presence in Britain). The Department has led cross-disciplinary UCL initiatives, including founding and directing the UCL Environment Institute and the UCL Urban Laboratory, and has strong links with the Centre for Advanced Spatial Analysis and the Institutes of Sustainable Resources, Risk and Disaster Reduction, Energy, and Global Health.

Departmental structures supporting research are co-ordinated by the Deputy Head (Research) and a Research Committee, supported by a Faculty Vice-Dean (Research) and the UCL Office of the Vice-Provost (Research) (OVPR). Our doctoral programme is overseen by the Graduate Tutor, and supported by the UCL Graduate School. A Laboratory Committee manages our state-of-the-art facilities. Within the UCL Faculty of Social & Historical Sciences, Geography and Archaeology are distinct in their research, staffing and facilities, and are thus returning separate submissions.

b. Research strategy

Departmental goals are framed by UCL's Research Strategy, with its commitment to leadership, cross-disciplinarity and the beneficial application of knowledge. We fully exploit this context by taking advantage of institutional support for research excellence and cross-disciplinary initiatives. The quality of individual researchers in Geography, allied with our institutional strengths, provides an outstanding research environment that is stimulating and inclusive: this is reflected in the Department's long history of comprehensive staff returns in research assessment exercises (more than 97% of eligible staff returned in REF2014).

b1. Evaluation of the strategy outlined as part of RAE2008

As part of our future plans in RAE2008, we set out a strategy guided by a commitment to empirically grounded and theoretically innovative research that contributes significantly and rigorously to major societal issues. The following substantive themes were identified for further development: (1) Climate change; (2) Earth system science; (3) Dynamics of complex environmental systems; (4) Landscape, nature and environmental politics; (5) Cities and urbanisation; and (6) Geopolitics and security. These themes have been vigorously pursued over the current census period, leading to important research contributions (section b3). Staff changes (section c) led to a strategic review of our research environment. A key initiative has been to expand palaeoclimate research, while maintaining a world-leading position in the field of recent environmental change. Accordingly, the RAE2008 'Global Environmental Change' group has been recast as 2 clusters, 'Past Climates' and 'Recent Environmental Change and Biodiversity'. At the same time, the 'Environmental Modelling and Observation' cluster has been strengthened, while the RAE2008 groups of 'Mobility, Identity and Security'; and 'Cities and Urbanisation' have been re-focused on the themes of 'Transnational Spaces' and 'Comparative Urbanism' to reflect significant conceptual contributions and growing critical mass in these fields. Consolidation of a discipline-wide analytical interest in materiality and biopolitics, has widened the scope of the 'Environment, Landscape and Society' group to encompass 'Science, Politics and Government'.

b2. Mechanisms and practices for promoting research, and sustaining and developing an active and vital research culture

Our research environment is underpinned by the individual talents of the academic staff; our strategy seeks to cultivate these talents through embedded formal and informal mechanisms:

- Incentives and support (e.g. competitive salaries, promotions, state-of-the-art equipment,

space, support staff, excellent students) to attract, retain and cultivate intellectual leaders.
- Reviews of teaching and administrative commitments under a transparent workload model, in conjunction with a study leave entitlement (1 term after every 3 years), to allow all staff to develop their research agendas and mesh their teaching responsibilities with research.
- A mentoring and appraisal system to guide individuals in their career development.
- An output review system to advise on the wider significance of work and publication outlets.

We sustain and build our research income in a competitive environment through:
- A systematic internal peer review process of proposals.
- Employment of a dedicated person to provide administrative support for grant applications.
- Full use of Faculty and University expertise, including OVPR Research Facilitators, who offer funding intelligence and outstanding support in sourcing and managing external income.
- An incentive from overheads for PI activities (5% of overhead returned to PIs).

Attracting excellent research students is central to our strategy and considerable effort has gone into establishing mechanisms that contribute to this:
- 12 MSc courses are aligned with research cluster agendas and provide an excellent source of well-qualified PhD students in the Department (20 in the census period).
- The Department has been a leading participant in UCL's Impact PhD Studentship scheme, which provides match funding for projects intended to generate significant economic or societal impact, winning 50% or greater external funding for 5 Impact PhDs.
- We have a central role in the new (2011) UCL ESRC and EPSRC SECReT and Urban Sustainability Doctoral Training Centres (DTCs). In 2013, Geography secured 4 ESRC/NERC and 4 ESRC/EPSRC interdisciplinary studentships.
- UCL's and the Department's international standing ensures high quality students from home and overseas, leading to considerable success in competitive studentships (section c2).

We value and nurture individual curiosity-driven research, but also actively encourage and support collaboration and partnerships that expand cross-disciplinary research by:
- Engaging with a range of cross-disciplinary initiatives within and beyond UCL (section e1).
- Fostering an environment where openness to cross-disciplinary interaction is considered a significant aspect of leadership.

A pervasive culture of seminars adds to the vitality of our research community. We host two weekly seminars in Physical and Human Geography, and inter-departmental seminar series in 'Migration', 'Urban Studies' (the Urban Salon), 'Geospatial Science', 'Remote Sensing', 'Water', and 'Palaeoclimate' (with UCL Earth Sciences, weekly; Imperial and Natural History Museum, monthly).

b3. Evidence of the achievement of strategic aims for research

Over the reporting period, we have outstanding individual and collaborative research outcomes:
- Publication of 29 books, 149 book chapters and 705 papers, including 35 publications in *Annals/Transactions/Progress/E&P:A-D*, and 30 in *Science/Nature/Nature Geoscience/Nature Climate Change/PNAS*.
- Contribution to major societal issues through milestone papers on groundwater and climate change in the tropics (Taylor), the carbon sink for the world's forests (S. Lewis), HIV/Aids and Security issues (Ingram/Dittmer), and on Managing the Health Effects of Climate Change by the UCL-Lancet Commission (Maslin). Scholars in Transnational Spaces have pioneered the use of historical GIS to visualise and analyse migration, exemplified by Mateos's work on the geography of names (featured in *National Geographic*) and Bressey's mapping of the pre-1945 black presence in London.

Specific achievements, by cluster, relating to the themes identified in RAE2008 include:

(1) Past Climates. Over the census period, the cluster has become one of the UK's most diverse palaeoclimate groups, employing palaeoecological, geochemical and climate modelling approaches to the study of marine and terrestrial environments, and theoretical frameworks of climate variability. Its work has been published in *Science* (5) and *Nature* journals (11), cited by the IPCC in its 5th Assessment Report [AR5] (10) and attracted considerable media attention.
- **Long-term climate change**: data and modelling results have contributed to our understanding of the maintenance of minimal tropical temperature gradients in the Pliocene (Brierley), the natural length of the current interglacial (Tzedakis), the coupling of low- and mid-latitude

hydrological changes (Maslin, Tzedakis) and the role of tropical coastal shelves and caves as contributors to atmospheric methane (Maslin, Atkinson).

- **Abrupt climate change**: state-of-the-art datasets have improved our understanding of the influence of background climate on millennial-scale variability (Tzedakis), revealed unexpected North Atlantic variability in both surface and deep circulations (Thornalley), and established the impact of Atlantic circulation changes on central Asia (Mackay).
- **Spatial patterns**: data syntheses have led to evaluations of Holocene climatic gradients across Europe recorded by speleothems (Atkinson), the effects of the 8.2 ka event across the North Atlantic (Holmes) and distribution of glacial tree refugia in Europe (Tzedakis).
- **Climate and ecosystems**: novel transfer functions and multiproxy analyses have highlighted the influence of climate and catchment drivers on millennial-scale variability in Boreal lake functioning (V. Jones, Mackay).
- **Climate and humans**: new data and data syntheses have led to the development of new hypotheses linking East African lake variability to early human evolution (Maslin) and palaeoenvironmental reconstruction of critical hominin sites (Holmes).

(***2) Recent Environmental Change and Biodiversity*** has combined neo- and palaeo-ecological approaches, biogeochemical cycling and environmental modelling to explore the nature and pace of freshwater and terrestrial ecosystem changes, their structure and functioning, and to inform national and international legislation and policy. Work has appeared in major journals, including *Science* (3) and *Nature* journals (5) and cited by IPCC AR5 (4).

- **Biodiversity and Conservation**: extensive collection and analysis of field and environmental data have challenged plant-based approaches to biodiversity conservation in mountain (Axmacher) and shallow lake ecosystems (Sayer), and have deepened our understanding into the hydrological and chemical controls on aquatic communities in lakes (Flower, Sayer) and flood-pulse wetlands (Mackay).
- **Freshwater contamination and recovery**: novel proxy (V. Jones) and rigorous statistical methods (Mackay) provided insights into chemical and biological recovery pathways following surface water acidification including confounding climatic factors (Flower). Establishment of reference conditions for European lakes impacted by eutrophication (Bennion) and assessment of pollutant deposition, transport and sources in circumpolar and other remote regions (Rose).
- **Impact of recent climate change on freshwater ecosystems**: determining the complexity of ecosystem responses to synchronous changes in climate and other stressors has revealed how nutrients dominate control of lowland lake ecology (Bennion) and the role of climate change in the remobilisation of legacy trace metals through upland soil erosion (Rose).
- **Forest ecosystem dynamics**: quantifying changes in tropical forest structure and function has led to substantial gains in knowledge of carbon stocks, estimation of total forest carbon sinks worldwide and the sensitivity of tropical forest carbon fluxes to drought events (S. Lewis).

(3) Environmental Modelling and Observation has brought a unique range of methods to bear on aspects of global change and its impacts that must necessarily be investigated by modelling. Our work is cited by IPCC AR5 (5), has won an international prize (French), improved the accuracy of the Met Office's weather forecasts (P. Lewis) and received widespread media coverage (Taylor).

- **New frontiers in understanding observations**: we have produced the first quantitative maps of groundwater resources in Africa and the longest record of tropical groundwater response to climate (Taylor); the first evidence for centennial-scale persistence and superimposed oscillatory behaviour of submarine landforms in the North Sea (Burningham); the first 3D radiative transfer model for savannah fire impacts (Disney); new methods to exploit observations of fluorescence from space, and a more fundamental understanding of the coupling of canopy structure and biochemistry (P. Lewis).
- **Understanding uncertainty in model-data frameworks**: we have highlighted new sources of model uncertainty in projections of global climate (Brierley); quantified relative GCM and hydrological model uncertainty for climate change projections for major basins on five continents (Thompson, Taylor); shown convincingly that the North Atlantic Oscillation is a weaker proxy for storminess than hitherto supposed (Burningham); devised better methods to locate error in coastal hydrodynamic models (French); built a community framework for combining EO data and models using data assimilation (P. Lewis); and released methods to simulate new LiDAR measurements to quantify information content and uncertainty (Disney).

- **Understanding responses to global change**: we have shown tropical groundwater systems to depend critically on replenishment by intensive rainfall (Taylor); challenged managed realignment as the preferred adaptive response to sea-level rise, revealing incompatibilities between flood defence and ecosystem restoration goals (French); and proposed a new tropical cyclone-climate feedback for the Tropical Pacific (Brierley).

(4) Comparative Urbanism. The outputs of urban researchers in UCL Geography have defined new directions and methods for global urban studies, and include some of the most widely read papers in urban studies (2 in the top 20 most downloaded in *IJURR* 2011 and 2012):

- **Intellectual and methodological foundations of comparative urbanism**: researchers have established new methodological approaches to advance global urban studies, notably through comparative urbanism (Robinson, Harris, Dennis); theorising cities from the global South (Gandy, Arabindoo, Lemanski, Varley); and conceptualising and thinking with the complex spatialities of policy mobilities (Acuto, Robinson).
- **Extending urban theory through global urban studies**: key topics in urban studies have been reformulated through empirically grounded theorisations in cities around the world: urban public space has been refigured as a site of communal identification and action in Indian cities (Arabindoo); seminal contributions to global analyses of gentrification have been made through a comparison of Mumbai and London, emphasising state-led gentrification and collective politics (Harris); dominant analyses of neoliberalisation have been shown to be limited in their relevance for cities beyond the west with different state forms, policy histories and significant extra-neoliberal processes (Robinson); the concept of informality has been extended through comparing the divergent experiences of Latin American and African cities (Varley); the importance of inter-sectoral relationality for economic clusters has been demonstrated through quantitative analysis (Essletzbichler); and the concept of urban modernity has been subject to rigorous reassessment in relation to the complex techno-politics of urban modernity in India (Gandy) and the globally interconnected histories of the US, Canada and the UK (Dennis).
- **Novel theoretical approaches to urban materialities**: detailed ethnographic and case study research sets out a materialities approach to the production of urban public space (Latham), and establishes the interconnections amongst popular and professional cultural practices, urban ecologies and socio-natures (Gandy).

(5) Transnational Spaces has produced new insights into the politics surrounding the circulation of people, ideas and objects within and across borders. This work has resulted in 5 research monographs and 2 art exhibitions, as well as receiving national and international media attention.

- **Shaping analyses of transnational circulations**: researchers have advanced understandings of diasporic politics from the impact of African diaspora associations on international development (Page) to the historical black presence in the English countryside (Bressey). Empirical analyses have identified the role of transnational circulations of art, architecture, landscape design, and popular culture in the production of nationalist and/or cosmopolitan identities (Dittmer, Ingram).
- **Reconceptualising geographies of states, borders, and the globe**: innovative internet-based research has identified how 'extrazens' obtain multiple citizenships by mobilizing ethnic identities (Mateos). Other scholars have detailed the emergence of multi-scalar governance regimes around HIV/AIDS and climate change (Ingram, Acuto) and re-theorised transnational governance through the lenses of materiality and transparency (Barry, Dittmer).
- **Challenging implications of immigration**: analyses have undercut simplistic accounts of the implications of immigration by constructing alternative statistical measures of ethnicity and residential segregation (Mateos), and tracing the significance of multiple transnational faith traditions in changing suburban geographies (Dwyer). Work in this area has led to policy inputs on ethnic migration (Dwyer, Latham), and has challenged assumed network geographies of transnational civil society, drawing on new diasporic approaches (Page).

(6) **Science, Politics and Government** has generated methodological innovation in archival research, studies of visualisation and analysis of big data, and has engaged broadly with the politics of environment, population and health. Highlights include advances in geo-temporal demographics (funded by EPSRC, £1.27M) and widely-cited research on interdisciplinarity.

- **Political events and materials**: extending the insights of theories of governmentality, biopolitics, complexity and materiality, researchers have interrogated the politics and

government of materials, bodies and spaces (Barry, Dittmer, Gandy, Ingram), and have developed novel approaches to the analysis of the multiplicity and contingency of political controversies and events (Barry, Dittmer, Kneale).

- **Environment, politics and expertise**: researchers have advanced critical readings of the relation between expert knowledge and policy, highlighting tensions between the aesthetic and scientific significance of 'waste spaces' and utilitarian approaches to landscape design (Gandy) and challenging received accounts of interdisciplinary research (Barry). Work has also addressed problems with long-term temperature targets in climate policy (Randalls); the calculation of life insurance (Kneale) and weather derivatives (Randalls); as well as evaluating the possibility of energy transitions (Essletzbichler) and the complex governance arrangements of marine reserve policies (P. Jones).
- **The practice of everyday life**: new understandings of the embodied practices of everyday life have informed original ethnographic research and policy analysis on temperature (Hitchings), alcohol consumption (Kneale) and exercise, including a seminal history of jogging (Latham).
- **Geodemographics**: development of novel public service applications of geodemographics in policing, health and educational opportunity (Mateos, Longley); investigations of the geographic link between family names and genetic profiles (Longley); use of social media and open data to link systematic representations of virtual and observable worlds for the first time (Longley).

b4. Research strategy 2014-2019

Our future strategy is framed by a commitment to: (1) foster new talent within the discipline and enhance the profile of our researchers; (2) develop areas of research strength and pursue cross-disciplinary research in a wider UCL context; (3) increase the impact of our research and its range of beneficiaries. To these ends, we will continue and enhance proven practices and mechanisms (see b2), while actively pursuing new initiatives:

1. **Funding**: (i) promote applications for individual scholarship awards (fellowships, visiting positions); (ii) increase research student recruitment via expanded research council funding. The Department (Maslin) has led the successful bid for a London NERC DTP, a consortium of 9 institutions; (iii) pursue targeted funding. (section d2)

2. **Infrastructure**: (i) maintain and expand our state-of-the-art laboratories, scientific computing facilities and technical support staff (section d3); and (ii) unite all Departmental activities on the main UCL site (section c1)**.**

3. **Facilitation**: (i) maintain our mentoring and administrative support structures; (ii) maximise use of UCL facilitators.

4. **Key research areas**: consolidate and expand centres of excellence in (i) palaeoclimate research by increased collaboration and pooling of resources with Earth Sciences and the Institute of Archaeology; (ii) political geography research by working with UCL's new Institute of Global Governance and Department of Science, Technology, Engineering and Public Policy; (iii) comparative urbanism, by exploiting the critical mass of the Urban Laboratory and London-wide collaborators; and (iv) 'Big Data' by developing partnerships with business and government organisations responsible for creation of hitherto under-exploited Big Data sources. (The last two areas reflect priorities identified by the 2012 ESRC UK Human Geography Benchmarking Review)

5. **Collaborations**: expand our cross-disciplinary research by assuming key roles in a number of new UCL initiatives (Institute of the Americas, Amazonas, Carbon and Climate Governance).

6. **Impact**: (i) continue to encourage and support staff and group impact activities; (ii) expand our engagement with UCL-wide initiatives and with industry, Government and communities; and (iii) develop new knowledge exchange opportunities. (REF 3A)

Cluster leaders and a newly appointed Impact Co-ordinator will oversee and facilitate the collaborative initiatives. Management and Research Committees will monitor progress.

c. People, including:

i. Staffing strategy and staff development

Strategy In keeping with UCL's Research Strategy of Leadership, our aim is to attract, develop and retain scholars of outstanding distinction or potential with an appetite for engagement with cross-disciplinary research of high impact. Guided by our strategic review (section b1), we have invested heavily in new staff and in world-class laboratory and computing facilities (section d3).

Our commitment to excellence requires an international recruitment policy: 25% of those appointed since 2008 have international backgrounds, while 2 UK-nationals have been recruited from the US (Yale and Woods Hole). Our 16 Emeriti are an important resource and we encourage them to remain active in research by providing office space and administrative support. At present, physical geographers and all Postgraduate Research (PGR) students and their facilities are housed in the refurbished Pearson Building in the main UCL Quadrangle; most human geographers are in Bedford Way. A key objective for the next five years is to locate all activity on the main UCL site.

Sustainability: In the last five years, we have experienced a healthy staff turnover and recruitment has attracted applicants of the highest calibre. Five senior staff retired, two relocated abroad, three moved to Chairs within UK HE and one is now in UCL UoA13. The Department has been successful in acquiring senior posts for the strategic appointments of Barry, Robinson and Tzedakis (Chairs) and S. Lewis and Jazeel (Readerships). Staff previously holding research posts have been appointed to fully-supported academic posts (Rose [Chair]); V. Jones, Bennion [Readers]). As part of the strategy to expand palaeoclimate research, we have made three appointments (Brierley, Thornalley, Tzedakis), while S. Lewis has joined the Recent Environmental Change and Biodiversity cluster. Further strategic investment in Comparative Urbanism is reflected in the appointments of Acuto, Arabindoo, Harris and Robinson, and in new positions to strengthen the Transnational Spaces (Jazeel) and Science, Politics and Government clusters (Barry).

In 2007, the demographic profile of the Department included eight ECR staff and the median age of the Category A staff was 40. Their progression and a strategy of appointing staff across the full career range has raised the median to 45.3 in 2013. All staff have full-time contracts except for three who work part-time, and all contracts are permanent. Four appointed staff are ECR.

UCL has a strong commitment to interweaving teaching and research. Teaching is concentrated in two of the three terms. Staff are eligible to apply for one term's study leave after three years in post; this is increased to two terms on completion of a major administrative duty. In the census period, 32 staff have received a sabbatical term and 49 terms of leave have been taken.

Equal opportunities: Institutional and Departmental policies and practices manifest a commitment to an inclusive and hospitable working environment that allows staff to achieve their full potential. UCL holds a Bronze Athena Swann designation, and we comply fully with UCL's equal opportunities policy. The Department ensures that adjustments are made so that career progression is not disadvantaged by absence or disruption to research caused by factors such as ill health, care and family commitments, maternity/paternity, disability, religious commitments, part-time status. An example is the additional term of research leave on return after maternity leave (Bennion, Lemanski). Our selection panels are inclusive and representative in terms of seniority, gender and ethnicity. UCL requires at least 25% of panel membership to be female.

Career progression: We aim to develop research leaders and are committed to fair and transparent appraisals and promotions. Appraisals are an opportunity to recognise achievements formally, provide feedback, review research objectives, and identify development needs. Appraisers are trained and appraisal is carried out regularly in accordance with UCL procedures (annually for probationary staff, biennially for non-probationary staff). Our annual promotion process is rigorous, but recognises and rewards talent at all levels. 55% of staff were promoted during the census period: Burningham, Disney, Hitchings, P. Jones, Kneale, Latham, Lemanksi, Sayer, Thompson to Senior Lectureships; Bennion, Dittmer, V. Jones, Mackay, Page, Taylor, Thompson to Readerships; and Dennis, Flower, French, Mackay, Rose, Taylor, Varley to Chairs.

ECR development: UCL provides a wide range of skills-enhancing programmes for ECRs and funding is available to attend external courses. The Department provides in-house training in Numerical Analysis and the Faculty offers innovative ECR training in grant proposal writing including a mock review panel. Each new staff member has a mentor to advise on research, and career planning. Research clusters also provide a strong support framework. Departmentally, we reduce ECR teaching loads in the first year of appointment (<75% of the median load), with no significant administrative responsibility. New lecturers are usually probationary for three years and, unless previously qualified, take the *Postgraduate Certificate in Teaching and Learning*.

Researchers: Over the census period, we have employed 29 PDRAs and 12 PGRAs. They have benefited from high-quality facilities, co-location with related research clusters and full access to UCL support systems including conference funds. In line with UCL HR policy, they have regular

career development meetings and take a range of UCL training and development courses.

Fellowships: Prestigious fellowships have enhanced individual and Departmental research profiles. The Philip Leverhulme Prize enabled Bressey to visit archives in the United States and Australia and to build new international collaborations. Dittmer's AHRC fellowship funds work on posthuman approaches to diplomacy and foreign policy. Gandy's two prestigious fellowships from the Alexander von Humboldt and the Gerda Henkel Foundations develop radical interdisciplinary approaches to urban environmental research and foster international connections between UCL and Germany. The British Academy Mid-Career Research Fellowship enabled Ingram to devote time to a new field of research and to develop new pathways to impact beyond academia. It also strengthened the Department's growing profile in the field of experimental and creative practices and methods at the interface between geographical inquiry and art. Maslin's Royal Society Industrial Fellowship has enabled him to work with industry on estimates of land carbon stock and flux as a basis for carbon trading and compliance.

Visiting scholars: The Department's research culture benefits from a constant flow of visiting scholars, 34 in the current assessment period, including 5 invited distinguished visitors, and 6 visiting professors and honorary appointments.

Research governance: Any issues relating to ethics are identified at the mentoring stage. The Departmental arrangements are through the UCL Research Ethics Framework and the UCL Research Ethics Committee. Approval operates as two-stage process first through Departmental endorsement and then application to a UCL panel of expertise that meets 10 times a year.

ii. Research students

Postgraduate research students are central to our research environment and benefit from the considerable resources of the UCL Graduate School. Our PGR students (91 commencing their doctoral programme in the census period) have been funded by Research Council studentships – 24 ESRC, including 8 from the UCL ESRC DTC, 12 NERC, 2 NERC CASE and one AHRC collaborative. 14 internally- funded studentships have been awarded in this period, including 4 from the highly competitive UCL Graduate School competition and 5 UCL Impact awards. At least 30 of 56 awarded a doctorate since 1 January 2008 have gone on to postdoctoral research or permanent university posts.

Equal opportunities: We have equitable policies on funding, study leave and skills training; all PGR students, including those studying part-time, have equal access to space, facilities and Graduate Conference Funding. PGR students can take unpaid study leave and those in receipt of any UCL administered studentship are also entitled to full maternity leave.

Training, monitoring and support mechanisms: PGRs have two supervisors, including some from other UCL departments or affiliated bodies if appropriate. Progress of doctoral students is carefully monitored via an on-line Research Student Log and annual reports. Formal procedures govern upgrading from MPhil to PhD status. The Department and Graduate School fund fieldwork and conference attendance via open competition. Training needs, covering both generic and specific skills, are considered on arrival and agreed by supervisor and student.

Skills development: We support the career development of doctoral students with skills training and relevant experience. The Department provides varied teaching opportunities supported by training. The UCL Graduate School skills development programme provides a wide range of modules (e.g. devising and managing research projects, preparing for viva, languages, teaching and publishing, coping with writer's block). Over the census period, our PGRs accrued a total of 1898 attendances of these modules. PGR students are fully integrated into the Departmental research environment through participation in the research seminars and by organising their own reading groups and internal workshops. Conference presentations are a vital part of PGR training and our students present papers at international meetings and also run conferences, such as the annual Stadtcolloquium international seminar series and the Student Migration Conference, and workshops (Financial crisis and architecture, 2009; London's alternative economy, 2012).

Evidence of third stream/knowledge exchange: 12 Government/Charity funded-studentships, 6 industrial/commercial studentships and 5 Impact studentships with Office for National Statistics, Cambodia Foundation, BHP Billiton Foundation, Scottish Natural Heritage, OTT Hydrometry Ltd. PGR research has also involved collaboration and exchange with government (London Borough of Camden) and community-based groups (Just Space, Occupy).

d. Income, infrastructure and facilities

d1. Research funding

Over the census period, we have been successful in increasing our research income in a competitive environment from £1.21M/year in RAE2008 to £1.33M/year in REF2014. We have achieved this through a range of funding sources, from Research Councils and EU, UK Government bodies and local authorities to small grants from charities and learned societies (119 grants, contracts and studentships). In addition to standard research grants and fellowships, we have provided research leadership in several major awards:

- Coordination of two large EU Projects (Euro-limpacs, REFRESH) by the ECRC on the impact and mitigation of projected climate change on the ecology of lakes, streams and wetlands.
- Leading the Open Air Laboratories Network (OPAL) - Aquatic Bio-monitoring Project, funded by The Big Lottery Fund Changing Spaces Programme.
- Core funding from the NERC National Centre for Earth Observation and the European Space Agency (ESA), has led to a new albedo product (GlobAlbedo), a prototype EO land data assimilation system for ESA, and new physical methods for interpreting EO signals.
- Leading a major EPSRC interdisciplinary project (WhoDoYouThinkYouAre), involving GIS, Information Security Systems and Computer Science, to manage uncertainties in establishing human identity and linking it to geographic locations.

External funds from sources not reported in HESA returns, include data provision (£1.1M for over 70,000km^2 of LiDAR and aerial imagery from the Environment Agency [EA] via the NERC iCOASST project) and £264K raised through consultancies.

d2. Strategies for generating grant income

As outlined in section b2, we have instituted a series of mechanisms to encourage and support research grant applications. While standard research grant proposals remain a core activity, a major component of our strategy is targeted funding, which builds on our research strengths to provide leadership and co-ordination of large research consortia and core funding (EU and NERC/NCEO 'National Capability'). Such efforts leverage UCL's institutional commitment and funding success (European Office and ERC grants [e.g. Gandy's 2013 Advanced Grant]). Opportunities are also envisaged in initiatives to access new sources (Wellcome Trust, Technology Strategy Board [TSB], Department of Energy and Climate Change [DECC], UK Space Agency) and to support individual research excellence via major fellowships.

d3. Infrastructure and facilities

We sustain our research excellence by providing state-of-the-art facilities, which have benefited from over £350K of institutional investment in the census period, and maintaining a strong cohort of 17 professional technical and administrative support staff.

Laboratories and field equipment: UCL's investment in laboratory facilities in RAE2008 has established the Department as a world-leading centre for laboratory-based science. This has continued through lab infrastructure enhancements and the appointment of 2 technical staff to support pollen and isotope work, in line with our strategy to expand palaeoclimate research.

Laboratory facilities include: an ultra-clean prep room with laminar flow bench for trace element analysis and biomarkers; two HF-grade laboratories for pollen sample preparations; a research microscope room for microfossil analyses; a water chemistry laboratory for cation, anion and nutrient analysis; an ICP laboratory (joint with Earth Sciences); XRF laboratory and a Millennium Merlin 1631 for low level mercury determination; a gamma spectrometry lab with four Ametek gamma spectrometers for radioisotope analyses, including ^{210}Pb/^{137}Cs dating; Malvern and Sedigraph instruments. We share with Earth Sciences an Avaa Tech XRF Core Scanner and Geotek MSCL-S Multi-sensor imaging track for non-destructive profiling of sediment cores.

The Bloomsbury Environmental Isotope Facility (BEIF) is a central UCL laboratory founded in 2002 by Geography, Earth Sciences and Chemistry. It is equipped to measure stable isotopes (three Finnigan mass spectrometers for O, C and N isotopes in water and sediments).

The Department has an extensive range of field equipment, including five research boats, Livingstone, Russian, Hiller, Mini Mackereth gravity and percussion corers, hydrographic and coastal oceanographic instrumentation, dGPS survey, sounding and side-scan sonar equipment.

Computing: Staff have wired and wireless internet and access to a new 'smart print' system. The

EMO cluster runs 50 high-end linux workstations on a 1Gbit network and a 60 cpu linux cluster with >100Tb storage for complex simulations and 'big data' processing. We are lead user of a further 80 cpu linux cluster, within the co-located UCL Chorley Institute. Geography also has direct access to the 5728cpu UCL Legion cluster and Emerald (one of the largest GPU clusters in Europe).

Space/facilities for PGR students: The Department provides a PGR common room and dedicated space with individual networked desks (65 spaces), printing and copying. Students undertaking computationally-intensive work are provided with dedicated high-spec workstations.

e. Collaboration or contribution to the discipline or research base

The Department continues to make a significant contribution to the wider research community both nationally and internationally. Collaborations and cross-disciplinary work have increased substantially in the reporting period, and the standing of the Department is evidenced by the extensive role played by its staff within the academic community and in the public sector.

e1. Collaboration

UCL initiatives: Over the census period, we have led major cross-disciplinary research initiatives within UCL, including founding the Environment Institute (directed by Maslin, 2008-2011) and the Urban Laboratory (directed by Gandy, 2005-2011). We have played executive roles in UCL Grand Challenges, aimed at addressing major societal challenges: *Global Health* (Maslin), *Intercultural Interaction* (Dwyer) and *Sustainable Cities* (Gandy).

National/international academic collaborations and networks: 38+ staff members are involved in collaborative research projects, networks or partnerships with other institutions. Among these, 36+ are involved in cross-disciplinary collaborations. Notable examples and indicators of their success include: (1) Dittmer leads the AHRC-funded Diplomatic Cultures Research Network of practitioners and scholars of diplomacy as a collaboration with the Foreign and Commonwealth Office, contributing a Green Paper to their First Class Foreign Policy programme. (2) Harris has led the AHRC-funded network on *Creative city limits: urban cultural economy in a new era of austerity*, bringing together artists, policy makers, and academics, including international links with Argentina, Canada, South Africa and the USA. (3) P. Jones instigated and led a UNEP funded project on governing marine protected areas from around the world (10 academic, 6 NGO and 5 state authority collaborators). Its findings have challenged conventional theories on the role of the state in community-led decisions. (4) S. Lewis founded and co-ordinates the only African Tropical Rainforest Observatory Network (AfriTRON) of on-the-ground forest monitoring plots, spanning 12 countries across tropical Africa. (5) Taylor heads a global network of leading researchers under the allied IAH Commission and UNESCO GRAPHIC programme, which has made substantial scientific and policy-relevant outputs and impacts on groundwater and climate change. (6) Tzedakis leads an international collaborative network on 'Past Interglacials', under the auspices of PAGES, involving over 50 palaeoclimate scientists from the ice-core, marine, terrestrial and modelling communities (2008-present); its findings have been included in the IPCC AR5.

Collaborations with industry, commerce, third sector and other users of research: Maslin and Disney have a £1.2M TSB award with DMC International Imaging company to develop a new global land carbon stock model. Maslin, members of the UCL Institute for Sustainable Resources and KMatrix Limited design metrics for low carbon technology development in the UK economy in a DECC project. Knowledge Transfer Partnerships have been developed with Camden and Southwark PCTs and Local Futures Group Ltd. ESRC's Retail Research Data Initiative is coordinated by Longley and links 15 of the UK's major retailers in a national retail industry engagement scheme. The ECRC has managed the Acid Waters Monitoring Network with strong links with Defra, Welsh Government, Scottish Government (via Marine Scotland), EA, Forestry Commission, Natural England, Scottish Natural Heritage, Scottish Environmental Protection Agency and Natural Resources Wales. The UCL OPAL Water Centre (Rose) has linked public participation in aquatic science with Defra and the EA as associate partners. Gandy collaborated with the Hackney Environment Network and the Hackney Biodiversity Partnership.

PGR Training: ECRC short courses (diatoms, ostracods, pollen, plant macros, isotopes, chironomids, numerical analysis) with external collaborators from 10 institutions have continued to provide a significant service to the discipline, with 203 UK and international PhD students and researchers outside UCL attending them over the census period.

Departmental support for research collaboration: The Department actively encourages and

supports collaboration and partnerships that expand cross-disciplinary research. The Department has a long-standing commitment to provide space, resources, laboratory use and technician time to research groups with strong collaboration profiles and has hosted cross-disciplinary institutional and third-sector initiatives (Environment Institute; Urban Laboratory, Thames Estuary Partnership).

Contribution to the Departmental research environment and strategy: Research collaborations range from the long-term and institutionally-supported to those arising on an *ad hoc* basis, reflecting our aim to maintain a diversity of styles and scales of research, contributing to the vitality of the research environment. Ultimately, the extent and depth of such collaborations inform the Departmental research strategy, in terms of long-term investment in the development of particular groups and directions of research.

e2. Contribution to the discipline

Peer-review: 17 of our staff served on AHRC, BBSRC, EPSRC, ESRC, NERC Peer Review Colleges; 3 are members of NERC Committees. In addition to Research Council grants, staff have reviewed applications for the Royal Society, RGS, The Leverhulme Trust, Nuffield Foundation, Wellcome Trust, British Council, ERC, and 11 overseas funding bodies. Further participation in peer-review includes 13 journal editorships, co-editorships and associate editorships, 39 editorial board memberships and 4 book-series editorships. Staff have examined 98 external doctorates.

Advisory/Strategy/Review Bodies: Our research expertise is reflected in staff participation in 12 boards/committees, including: Advisory Board British Film Institute *Inview* (Barry); IPPR 'Condition of Britain' group (Barry); IPPR Migration Advisory Committee (Dwyer); Gabon Government and National Parks Programme for Resource Mapping and Monitoring (Disney; S. Lewis); Canadian Ministry of National Defence on UK-Canadian Arctic policy (Dittmer); Selection panel for the ESA Earth Explorer missions (P. Lewis, Disney); RGS/ESRC benchmarking review of UK human geography (Dwyer, Dittmer); Advisory Board for the ONS Centre for Demography (Salt).

Conferences and meetings: Organisation (39); conference chairs (15); keynote lectures (207).

Membership of Learned Societies: 75, including Royal Society (1), RGS (21), AAG (8) AGU (7).

Leadership: P. Lewis chairs the Steering Committee for the NERC Field Spectroscopy Facility; Taylor chairs the International Association of Hydrogeologists' Commission on Groundwater and Climate Change. Ingram was secretary of the RGS-IBG Political Geography Research Group and Dittmer was the president of the AAG Political Geography Specialty Group.

Fellowships and Awards: Outstanding research has led to 13 fellowships and 5 prizes. Notable examples include: Philip Leverhulme Prize (Bressey); Alexander von Humboldt Foundation and Gerda Henkel Foundation Fellowships (Gandy); British Academy Mid-Career Fellowship (Ingram); AHRC Fellowship (Dittmer); Royal Society Industrial Fellowship and Wolfson Research Merit Award (Maslin); RGS Victoria Medal (Longley); RGS Busk Medal (Varley); RGS Murchison Award (Robinson); Coastal and Estuarine Research Federation Pritchard Award in Physical Oceanography (French); Richard Morrill Public Outreach Award, AAG Political Geography Specialty Group (Dittmer).

Responsiveness to national and international priorities and initiatives: MRU staff advised the Home Office, the OECD and the Equality and Human Rights Commission on migration policy. The ECRC has provided the evidence base informing UK Government response to its EU and UNECE obligations to combat acid rain and the EU Water Framework Directive requirement to establish reference conditions for lakes. Kneale testified on historical geographies of alcohol regulation before the Parliamentary Health Select Committee. Salt testified before the House of Commons Public Administration Select Committee on migration statistics. Hitchings produced a policy report on older people and their winter warmth behaviours for Nuffield Foundation. Lemanski contributed to DFID deliberations on their international urban development focus. Dittmer was invited for consultations with the Canadian Minister of National Defence on UK-Canadian Arctic policy. Varley advised the Instituto Mora and Delegación Magdalena Contreras, Mexico City on recuperation of Rio Magdalena, Los Dinámos, Mexico City; Robinson contributed to public and council events reviewing Johannesburg City Council's Growth and Development Strategy. S. Lewis co-drafted the Inter-Academies Panel statement on tropical forests released at the Copenhagen UN conference on climate change, contributed to the development of the Government of Gabon's national climate change and tropical forests monitoring program, and acted as an advisor at the UNFCC negotiations on forests and climate. Four staff were Expert Reviewers for IPCC AR5.