

<p>Institution: The University of Leeds</p>
<p>Unit of Assessment: C17- GEOGRAPHY, ARCHAEOLOGY AND ENVIRONMENTAL STUDIES</p>
<p>a. Overview</p> <p>The mission of the School of Geography (SoG) is to provide international leadership on major social, political and environmental challenges associated with global change. Our strategy emphasises the production of top-quality scholarly outputs, the submission of innovative funding applications, and the maximisation of opportunities for impact. Major achievements include:</p> <ul style="list-style-type: none"> • Since January 2008 we have more than doubled our annual research income, developing a diversified portfolio of over 50 separate funders (total research income: £16.6 million). • We have published regularly in top international journals (e.g. <i>Science</i>, <i>Nature</i> group, <i>PNAS</i>, <i>Transactions of the IAGLR</i>, <i>Antipode</i>) and other leading outlets. • We have increased the number of research-active staff by 30% since RAE2008. • We have provided leadership to <i>major international research networks</i>, including the Amazon Forest Inventory Network (RAINFOR) and the African Tropical Forest Observation Network (AFRITRON), and to <i>major RCUK projects and programmes</i>, including the Amazon Integrated Carbon Analysis Consortium (AMAZONICA, NERC), Understanding Population Trends and Processes (UPTAP, ESRC), the ESRC Centre for Interaction Data Estimation and Research (CIDER), and an <i>ESRC National Research Methods Node</i> on Geospatial Data Analysis and Simulation (TALISMAN). • We have been at the forefront of creating, and currently lead, the UK's largest university-based water research centre, <i>water@leeds</i>. • Our doctoral programme thrives with diversified funding sources and a robust culture of student publication (100+ Scopus articles authored/co-authored by PhD students). Our average number of annual PhD completions has increased by 40% compared to RAE2008. <p>SoG is located in the Faculty of Environment. Our research is organised around five research clusters: 1) Ecology and Global Change; 2) River Basins Processes and Management; 3) Centre for Spatial Analysis and Policy; 4) Cities and Social Justice; and 5) Citizenship and Belonging. Our Research Committee is chaired by the Director of Research and includes Cluster Leaders and the Director of External Relations, reporting to the Head of School.</p>
<p>b. Research strategy</p> <p>i. <u>STRATEGIC DIRECTION AND PROGRESS SINCE RAE 2008</u></p> <p>SoG conducted a strategic review after RAE2008 to develop future research priorities and objectives. The result was a refreshed approach that built upon the successful strategy of RAE2008 (which had produced substantial growth in external grant income, a threefold increase in ISI papers by staff, high profile engagements with external stakeholders, and an enhanced role in disciplinary/interdisciplinary leadership) while also adapting to emerging global research challenges and the changing funding landscape. The strategic review affirmed three core research aims, which are consistent with the plans that we outlined in RAE2008:</p> <ol style="list-style-type: none"> 1) <i>The production of excellent scholarly outputs:</i> As evidenced in REF2, SoG staff regularly publish in influential disciplinary/interdisciplinary outlets. The production of excellent outputs underpins other elements of our strategy, providing the basis on which our extensive record of impact is built and enhancing the scholarly reputations necessary for successful funding bids. 2) <i>Increased submission of innovative research grant applications and the confident pursuit of large and high-profile projects:</i> The substantial growth in our annual research income (more than doubled since 2008) and the diversification of our funding sources reflects the success of strategies originating in the previous assessment period to protect staff research time, provide continued research leadership by experienced scholars, and develop the capacities of early/mid-career staff. Our success has been underpinned by investments in the institutional support available to staff, including the employment since 2010 of a Research Development Manager to assist with complex bids. We have further embedded internal peer review, ensuring good success rates while responding to demand management. In RAE2008, we identified the pursuit of larger grants/programmes as a priority, and this has led to a number of successes (see Section d.i). 3) <i>Maximising research impact:</i> We have successfully extended and built knowledge exchange relationships with governmental, corporate, and other partners, and deployed our substantial expertise in participatory approaches to citizen engagement (REF3a provides a full discussion).

Our research clusters focus our strategy and integrate academic staff, postdocs, postgraduates, and visiting scholars. RAE2008 panel feedback noted that ‘internationally outstanding work is to be found in all the research clusters’. Our strategic review affirmed the continued value of the cluster model. Four of the five clusters continued in shapes analogous to RAE2008, although updating their aims to reflect new research challenges. Members of one cluster (Urban Cultures and Consumption) adopted the new title Cities and Social Justice, absorbing key strengths of the previous group while adapting to reflect emerging research priorities. All staff are ‘core’ members of one cluster, but many staff are jointly involved with the activities of multiple clusters.

ii. **CLUSTER RESEARCH MISSIONS GUIDING OUR FIVE YEAR POST-REF STRATEGY**

To guide our post-REF strategy, our clusters have developed the following *cluster research missions* for the five years following REF (major cluster achievements during the assessment period are detailed in Section e.viii).

(1) **Ecology and Global Change (EGC)**: EGC’s mission is to provide international leadership in determining the response of the global carbon cycle—and particularly global vegetation—to a warming world and increasing levels of CO₂. EGC’s work is based on ongoing contemporary large-scale observations focused on the tropics, analysis of palaeo records, and genetic methods to elucidate responses on evolutionary time-scales. EGC also develops new quantitative models of complex systems to assist decision makers in understanding the interplay between land management decisions and the impacts of land use change on ecosystem services. *Leaders*: Gloor and Baker. *Core members*: Bacon, Brienen, Galbraith, Grainger, Lawson, Lewis, Lovett, O.Phillips, Roucoux, Swindles, Ziv.

(2) **River Basin Processes and Management (RBPM)**: RBPM provides international leadership in understanding and managing the environmental processes and feedbacks that control and link water, sediment, solute and biotic dynamics in river basins, estuaries and marine systems. RBPM’s post-REF priorities include advancing fundamental understanding of peatland hydrology and biogeochemical cycling; glacial system mass balance and ice-marginal geomorphology, hydrology and ecology; water and sediment fluxes through hillslopes; and water resource management. *Leaders*: Holden and Brown. *Core members*: Baird, Blundell, Carrivick, Chapman, Kay, Kirkby, McDonald, Palmer, Quincey, Smith, Woulds.

(3) **Centre for Spatial Analysis and Policy (CSAP)**: CSAP are international leaders in developing and applying advanced spatial modelling methods for the analysis of human geographical systems. Core areas of interest include retail analysis and planning, health-care, education, crime, ethnicity and population change. CSAP works closely with a wide variety of corporate partners, national and local government agencies, police forces and health trusts. A key post-REF priority involves the analysis and dissemination of ‘Big Data’ sources such as retail data, mobile device data and data from social media sources. *Leaders*: G.Clarke and M.Clarke. *Core members*: Birkin, Carver, Evans, Gould, Heppenstall, Malleon, Mitchell, Norman, Rees, Stillwell.

(4) **Citizenship and Belonging (CAB)**: CAB’s mission is to understand contemporary/historical geographies of exclusion, to shape key international debates on citizenship and belonging, and to explore possibilities for more inclusive futures. Key future priorities involve understanding forced labour in Europe; intergenerational justice and sustainability in international comparative perspective; changing regimes of border control and immigrant detention; the changing gender politics of urban renewal in postcolonial contexts; and new legal geographies of sexuality. *Leaders*: Datta and Vanderbeck. *Core members*: Butlin, Conlon, D.Phillips, Waite, Wilkinson, Zebracki.

(5) **Cities and Social Justice (CSJ)**: CSJ’s mission is to articulate and promote more socially just and ecologically sustainable ways of living in cities. CSJ will provide international leadership in debates over post-carbon cities and alternative urban futures; the impact of austerity on urban politics and policies internationally; the development of transnational urban social movements in response to post-crisis urban restructuring; retail gentrification and other new gentrification frontiers; and participatory/action research methodologies. *Leader*: Chatterton. *Core members*: Bell, Fritsch, González, Hodkinson, Routledge, Schafran, Waley.

iii. **STRUCTURES PROMOTING RESEARCH EXCELLENCE, INNOVATION AND COLLABORATION**

We strategically utilise the distinctive opportunities afforded at Leeds (a research intensive Russell Group university) for inter-institutional collaboration. Leeds is a member of the *White Rose University Consortium*. This long-standing strategic partnership links Leeds, Sheffield and York and

provided a basis for the *ESRC White Rose Doctoral Training Centre* (DTC). Leeds is a member of the *Worldwide Universities Network* (WUN), an international network comprising 19 research-intensive institutions spanning 6 continents (<http://www.wun.ac.uk>). WUN creates multilateral opportunities for collaboration in research and training. Through WUN, we have received 1) support for significant new international collaborations (detailed in Section e.ii); 2) start-up funding for the Wildland Research Institute (Section e.ii); and 3) support for international seminar series (e.g. Horizons in Human Geography; Global GIS Academy seminar).

In RAE2008, we identified the promotion of cross-cluster engagement on environmental and other themes as a priority. New cross-fertilisations have emerged supported by strategic investment. We host a University 'Peat Club' involving members of RBPM and EGC which provides a forum for informal exchanges and training, resulting in new projects including circa £1M to SoG for three Defra-funded peat projects and 12 cross-cluster papers. Interfaces between human/physical geography are promoted, for example, by cross-cluster PhD studentships (e.g. ESRC/NERC Interdisciplinary Studentship on 'Carbon Contestation and Communities', co-supervised by RBPM and CSJ). New appointments promoting cross-cluster engagement on environmental themes include Lovett (Chair in Global Challenges), Datta (environment/urbanisation in India), Fritsch (environmental governance) and Ziv (ecosystem services). The new Chair in Social and Urban Change (Routledge) promotes linkages between CAB and CSJ. CAB and CSJ developed a shared agenda on forced labour (Waite/Hodkinson, ESRC).

iv. SPECIFIC OBJECTIVES FOR FIVE YEARS FOLLOWING REF SUBMISSION

Our objectives are designed to promote our cluster research missions (Section b.ii) while facilitating sustainable adaptation to a changing funding landscape, new teaching demands, and emerging global challenges. Substantial groundwork for realising our objectives has been laid through strategic hires (see Section c.i) and major infrastructural investments (Section d.ii). We employ performance indicators monitored by Research Committee concerning publication quality, income, diversity of funders, partnerships, and other measures. Specific objectives include:

1. **Develop new international partnerships:** SoG staff have diverse regional links/expertise, language skills, and experience in non-UK HEIs. Continued success will involve enhancing this diversity, including expanding existing linkages with the global South. Latin American linkages for urban research are being substantially extended through our on-going (2012-16) partnership in the *EU-IRSES Contested Cities Exchange* with Autonomous University of Madrid, which involves spending 60 months of Leeds staff/PhD student time in universities in Argentina, Brazil, Chile, and Mexico (González Co-I, SoG share €200K). Gloor is using a Royal Society International Exchange to build networks in Russia (Siberian Federal University) on broad scale vegetation change in Siberia. Recent hires Datta and Routledge are significantly building our research linkages in South Asia, and the WUN (see b.iii above) will be used strategically to further East Asian collaborations and opportunities. African partnerships are being strengthened via AFRITRON (see Section e.ii).

2. **Deliver and support new projects/initiatives in priority research areas:** New projects in priority areas that will realise their outcomes in the next cycle include: T-FORCES: Tropical Forests in the Changing World System (ERC Advanced Investigator Award, O. Phillips PI); The Amazon Hydrological Cycle: Past, Present and Future (NERC, Gloor PI, Brien Co-I, SoG share £671k); Greenhouse Gas UK and Global Emissions (NERC, Gloor Co-I, SoG share £220k); Biodiversity and Ecosystem Functioning in Degraded and Recovering Amazonian and Atlantic Forests (Gloor PI, NERC, SoG share £327K); Intergenerational Justice, Sustainability, and Consumption (AHRC, Vanderbeck Co-I with Sheffield, SoG share £170k); Geospatial Restructuring of Industrial Trade (ESRC, Heppenstall PI, SoG share £124K); and Energy Gardens for Small Scale Farmers in Nepal (ESRC-DFID, Lovett PI, SoG share £79K). SoG has a number of developing initiatives that it plans to support. These include (a) *World Forest Observatory*, coordinated by Grainger, which plans to map the world's forests every year by 2020 and make its digital maps available to scientists globally, and which has received a two year grant from the Science & Technologies Facilities Council for the next phase of its development (www.astrotrop.org); and (b) *Structural Reinforcement of Inequality*, a new WUN network led by Lovett with Penn State, York, Western Australia, and Engineering without Borders to explore the systematic reinforcement of inequalities by planning and development of fixed infrastructures.

3. **Further growth/diversification of non-RCUK funding streams:** We have multiple

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examples of successful European funding bids and are promoting further participation in large European projects. We have developed a more systematic strategy for recruiting European fellows. We have close relationships with Leeds' experienced European Office and are educating early career staff on the complexities of these bids. Facilitated by the Director of External Relations, we aim to increase the number of industrial Strategic Partnerships. *Further diversification of PhD funding sources* is planned via our engagement with Horizon 2020 including Marie Skłodowska-Curie Actions, industrial linkages, and other mechanisms.

4. **Continued efficiency gains to protect research time:** Changing expectations related to teaching as a result of increased tuition fees (e.g. greater contact time) are being met with efficiency gains (e.g. new approaches to team teaching) to protect staff time.

c. People, including:

i. Staffing strategy and staff development

Our staffing strategy has involved consolidating and expanding existing areas of internationally-recognised strength, developing future leadership capacity, and promoting cross-cluster linkages in priority research areas. While retaining many staff from RAE2008, we have made dynamic new hires at various career stages, ensuring a balanced demographic profile amongst academic staff: 41% Lecturer, 31% SL/Reader/Associate Professor (new grade introduced in 2012 replacing SL/Reader), 29% Professor. Our policy of valuing the leadership and contributions of our existing staff has resulted in the promotion of Birkin and Gloor to Chairs; Chatterton, Chapman, and D. Phillips to Readerships; and Brown, Carrivick, and Waite to SL/Associate Professor. New appointments include Chairs (Baird, Lovett, Routledge), lecturers (Bacon, Conlon, Galbraith, Quincey, Swindles, Schafran, Smith, Woulds, Zebracki), and an Associate Professor (Datta). We are committed to career development for research staff. Since 2008 five staff in research posts have earned permanent academic posts (Baker, Heppenstall, Hodkinson, Kay, Malleson). Although several senior scholars have departed due to retirement (Sibley) or appointments elsewhere (Bailey, Lloyd, Tzedakis, Valentine), in 2012 the University awarded SoG with two centrally-funded Leadership Chairs aligning with School strategy: the Chair in Global Challenges and Chair in Social and Urban Change (see b.iii). When employing fixed-term lecturers, these contracts are typically for at least two years to allow some stability and career development, with an entitlement to research time. We make provision for staff seeking to remain research active beyond normal retirement age, providing office space and part-time contracts. Emeritus staff mentor current staff/students while also leading projects and producing significant outputs.

Promoting staff development and leadership capacity: We provide all staff with opportunities and support to further their research agendas and become research leaders. At the heart of this is the Staff Review and Development Scheme, which provides two-way review of progress, identifying objectives, recognising success, providing feedback, and planning developmental opportunities. Our approach to staff development embraces the principles of the *Concordant to Support the Career Development of Researchers*. School leaders who manage staff (e.g. Head of School, Director of Research, Cluster Leaders, and Grant PIs) are guided by Leeds' *Leadership and Management Standard*, which provides a framework for promoting excellence within the context of values of professionalism, integrity, inclusiveness, and community. Staff with new management responsibilities are guided by the training programme *Tomorrow's Leaders*. The participation of multiple mid-career staff in this programme has enabled succession management for roles including Head of School, Director of Research and research cluster leadership.

Early career researchers (ECRs): In their first two years, ECRs are granted a reduction in their workload of 20% to ensure research development. We operate a mentoring system for ECRs and promote research leadership in several ways. Leeds operates the *Next Generation Researcher* programme, which has been developed in line with the *Concordant to Support the Career Development of Researchers* and the national Researcher Development Framework (RDF). The programme allows early career researchers, postdocs, and others to enhance skills related to the funding applications, project management, media skills, research governance, enterprise activity, effective dissemination, and other skills. In December 2010, Leeds University was awarded the *HR Excellence in Research Award* by the European Commission to recognise its commitment to good working conditions and career development for researchers. As discussed above, we have a strong record of developing staff on research contracts into academic posts.

Prestigious fellowships: We support staff at different career stages to win fellowships to support their research, as well as to attract top-quality applicants and holders of prestigious fellowships. Fellowship holders during the assessment period have included Lewis (Leverhulme Prize, Royal Society), Baker (EPSRC), Brienen (NERC), Gloor (Intra-European Fellow), Hodgkinson (British Academy), and Wilkinson (British Academy). We were awarded a NERC Knowledge Exchange Fellowship: the holder comes from 25 years in the end-user sector, using this understanding to help shape our research/support impact. We hosted philosopher/sociologist John Holloway from Autonomous University-Puebla (2011-12) as *Leverhulme Visiting Professor*, who delivered workshops and postgraduate teaching. We also hosted *two Leverhulme Artists in Residence* who have engaged in creative collaborations with staff: Jai Redman (2009), on built environment and social justice, and Trudi Entwistle, who collaborates with water@leeds on landscape themes.

Equality of opportunity: SoG promotes equality for all staff/students, ensuring fairness in HR processes (e.g. hiring, probation, promotion, staff review) and providing a welcoming workplace environment for members regardless of status based on protected equalities characteristics. This is underpinned by the *University Policy on Dignity and Mutual Respect*. Our ethos is supported by the presence of CAB staff who are internationally recognized on equality/diversity issues who designed bespoke equalities training. We recognise that our academic staff are disproportionately male (circa 3/4), with this imbalance wider amongst physical compared to human geographers, and at the senior level. We are using the Athena Swan process to address this imbalance. Leeds has received a Bronze award, and our Faculty is currently applying for an award, a process that involves a detailed investigation of faculty culture and protocols, and a long term plan for tackling identified issues. We operate a post-maternity programme and have a carefully monitored part-time workload modelling system. Support for disabled students and their supervisors is provided by the Leeds Disability Team on issues such as supervision and viva accessibility.

Research leave: Our research leave system offers academic staff seven months of release from all teaching/administration in every five year period. Extra periods of leave are available for those with major leadership responsibilities. Staff develop clear plans that are overseen by Research Committee. Full and part-time academic staff are eligible on an equal basis. All academic staff in post on 1/1/2009 who requested it have had leave in this assessment period.

Maintaining quality and integrity: Consistent with University practice, we promote a values-based ethical review process. All research by staff/students involving human subjects or substantial environmental impacts is reviewed by the Research Ethics Committee. Our strategy is supported by policies including the Policy Statement on Professional Integrity in Research, Data Protection Policy, Whistle-blowing Policy, and Research Misconduct Policy, as well as protocols on informed consent and paying participants (<http://researchsupport.leeds.ac.uk/>). All PGRs undergo ethics training. We operate a policy that all authors be named on research to which they have significantly contributed, and ghost-writing is deemed unethical.

ii. Research students

We provide a stimulating and rigorous environment for research postgraduates (PGRs). We actively seek the best applicants and routinely have a surfeit of excellent applications for competitive funding schemes. Over the assessment period, we achieved 64.74 completions, which represents a 40% annual increase compared to RAE2008. The rate of increase in completions becomes marked from AY 2010-11, reflecting (and exceeding) growth in our staff numbers.

Doctoral funding: We have a sustained record of winning competitive studentships from research councils, external sources, and internal competitions. Reflecting our strong external linkages, we have held 16 CASE studentships in the assessment period: 7 NERC, 8 ESRC, and 1 EPSRC. We have also received studentships through industrial partnerships (e.g. the *Yorkshire Water/North Pennines Area of Outstanding Natural Beauty Partnership*). Prior to 2011, we received on average two annual ESRC 1+3 quotas, plus success with open competition awards. Since the 2011 launch of the ESRC DTC (see below), we have offered 2-3 studentships annually (allocated by quota and competitive mechanisms), including two awards for Advanced Quantitative Methods training. Since 2008 we have annually received two NERC quotas (allocated via the Faculty).

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Training and supervision: All PGRs have two supervisors with whom they meet at least monthly, while reporting twice annually to a wider Research Support Group that reviews progress/offers advice. Pastoral care is overseen by the Postgraduate Research Tutor. PGRs undergo a training needs analysis to identify specific needs while attending to the national RDF. We utilise a central Postgraduate Development Record System that facilitates the tracking of training progress. We offer both generic and subject-specific training. Generic training occurs within the framework of Leeds' *Next Generation Researcher* programme, including academic integrity; writing and publishing; effective presentations; enterprise, innovation, and impact; safety; and public engagement. For social science PGRs, the White Rose DTC—one of the largest in England—combines expertise from Sheffield, Leeds and York, delivering first-class training. Sheffield and Leeds jointly developed the Human Geography pathway. In SoG, the pathway includes core training for +1 students via the MSc-GIS, MA-Social & Cultural Geography, or MA-Activism & Social Change. At +3 level, PGRs choose from advanced training drawn from in-house provision and other linked pathways (see also Section e.vii on our national training contributions). Physical geography PGRs undertake training through the EME (Environment, Mathematics and Physical Sciences, and Engineering) Training Hub, which offers workshops on intellectual, analytical and professional skills. Core training includes project management and scientific writing, and more specialised training includes statistical techniques and programming languages that enable quantitative and qualitative data to be managed, analysed, mapped and visually represented (e.g. ARC1, Digimap, Excel, FORTRAN, LabVIEW, LaTeX, R, and SPSS). Year 1 PGRs are encouraged to take taught modules that support their training needs. Leeds has put in a unified bid (with Chemistry at York) for a NERC Doctoral Training Centre (successful November 2013).

Research postgraduate culture: PGRs are fully integrated into our research clusters, with each having a cluster 'home' (although cross-cluster engagement is encouraged). PGRs attend all cluster meetings, where they participate in decision-making and present emerging ideas. Clusters manage budgets to which PGRs can apply to support conference attendance or organise events (e.g. workshops). The cluster model has not precluded the formation of a wider 'PhD community'. PGRs participate in departmental/university initiatives to support their development (e.g. Peat Club; water@leeds postgrad forum; Leeds Social Science Institute postgrad seminar series). Our PGRs also take leaderships roles in wider scholarly networks (e.g. Wilkinson as 2011-13 Secretary of the RGS Space, Sexualities and Queer Research Group; Andrucki as 2008-10 Treasurer of the AAG Sexuality and Space Specialty Group) and through the organisation of conference sessions/events (e.g. organisation by Vis in 2012 of the Assembly for Comparative Urbanisation and the Material Environment, competitively funded by the National Centre for e-Social Sciences). PGRs have a robust culture of publication, authoring/co-authoring 100+ Scopus papers.

Quality of graduates: Our programme's excellence is reflected in the range of posts offered to our graduates. Students graduating since 2008 have obtained *postdoctoral positions* at Cambridge (Peh), Cornell (Heck), McMaster (Worth), UCL (Milner), OU/East Anglia (Wallage), Lancaster (Jones), Southampton (Wilcock), Leeds (Fauset, Johnson, MasGiralt, Wilkinson), Ulster (Banin), Corinthia (Tomintz), Max Plank-Biogeochemistry (Schrodt), Taiwan (Chao), and Smithsonian Tropical Research Institute (van der Heijden). Graduates have obtained *lectureships* at institutions including UCL (Dennett), Cardiff-Social Sciences (Hemming), Nottingham-Clinical Sciences (Edwards), Liverpool (Morrisey, Russell), Leeds (Malleeson), Northumbria (Wanjiru), Nottingham-Ningbo (Chan), Sheffield Hallam (Savage), West Indies (Jordan), Srinakharinwirot (Meksangsouy), Teknologi MARA (Sadek), Utara Malaysia (Jali), and Chulalongkorn (Karcharnubarn).

d. Income, infrastructure and facilities

i. RESEARCH INCOME

The pursuit of external income is central to achieving our research mission. Our average annual research income has more than doubled since RAE 2008 (total: **£16.6M**). We have already secured more than **£6.3M** of research income for the post-REF period.

Funding strategies: Our staff have pursued and been awarded funding from a diversified portfolio of over fifty different funders, including UK Research Councils (AHRC, ESRC, ESRC, NERC, and MRC), UK government, charities (Gordon and Betty Moore Foundation, Leverhulme, Joseph Rowntree, others), EC, ERC, and private sector funders. Significant RCUK grants have

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been held by staff in all five research clusters. Our funding successes have enabled the publication of excellent research outputs (evidence of these is provided in e.ii, e.vii, and REF2). Consistent with RAE2008 plans, we have increased the proportion of our income (circa 52%) from non-RCUK sources. Efforts to 'scale up' aspects of our research—a key objective in RAE 2008—through large grants and programme have proven successful. This is evident in projects including the following, for which we act as PIs and/or Co-Is (*figures represent value to Leeds*): AMAZONICA (NERC, £1.3M), RAINFOR (Gordon and Betty Moore Foundation, £1.44M), T-FORCES (Tropical Forests in the Changing World System, ERC Advanced Investigator Award, £1.4M), TALISMAN: ESRC National Research Methods Node on Geospatial Data Analysis and Simulation (Birkin PI, with UCL, £617K), EMBER (Effects of Moorland Burning on the Ecohydrology of River Basins, NERC, £643K), National E-Infrastructure for Social Simulation (JISC, £391K), and the UK Data Service-Census Support (£293K). Although larger grants/programmes have received concerted effort, we recognise that smaller grants (e.g. from the British Academy/Royal Society) also facilitate the production of outstanding research. Consultancy is used selectively to enhance our research excellence, impact, and staff career development. We hosted a Knowledge Transfer Partnership funded by TSB, NERC and Dinsdale Moorland Services (DMS) to support DMS to grow its business through the appointment of a postdoc based in the company and supervised by SoG. The School and Faculty provide resources for promising new initiatives, and research clusters also have budgets to provide seedcorn funds.

Water@leeds: We have been at the forefront of developing *water@leeds*, the UK's largest university-based water research centre, producing a step change in research income. Holden leads the centre, an initiative launched in 2009 supported by the University Transformation Fund. *Water@leeds* builds on our research partnership with Yorkshire Water. The Fund supports new posts with potential to produce leading research, generate substantial funds and enable new interdisciplinary to develop. *Water@leeds* links experts from across the University (150+ personnel, including many RBPM staff) and outside organisations, to foster collaboration to solve major global/regional water problems. With the support of £1M from the University, matching funds from the Faculty, and specialist co-ordinators who support grant writing, impact and internationalization, *water@leeds* has generated circa £17.1M in new awards (SoG share circa £5M). *Water@leeds* employs a Director of Industrial Research (Martin Tillotson) with substantial experience of facilitating research partnership with the water industry. Additionally, the University has supported the creation of a *Sector Innovation Hub on the theme of water* which is embedded within *water@leeds* through the allocation of £600k of HEIF funds. The Hub is building on existing strengths, with the goal of further industrial relationship building, attracting new investment, and maximising impact. The sector hub enabled two new fixed-term research appointments in SoG.

Research support: We provide a high level of support at both pre-award and post-award stages of the funding process. To facilitate the submission of the highest quality applications, the School, Faculty, and University provide a co-ordinated system of support. The Leeds Research and Innovation Service (RIS) works closely with Schools/Faculties to co-ordinate support and strategy. RIS, for example, provides a specialist team to support European funding bids both pre- and post-award, facilitating the success of 2 ERC Advanced Investigator Awards won by SoG staff Valentine (now at Sheffield) and O.Phillips. In 2010, we made the decision, partially supported with HEIF funds, to employ a *full time Research Development Manager* (RDM). The RDM has considerable experience of complex funding bids and provides support in identifying and building relationships with external partners in the UK and internationally. The RDM also attends meetings hosted by the European Commission, research councils, and other bodies to make linkages and gather information about new opportunities. Our research clusters are serviced by support staff in contrast to models that restrict clerical support based on seniority. This inclusive model reduces barriers to effective support associated with seniority, non-work obligations, and contractual standing.

ii. INFRASTRUCTURE AND FACILITIES

We are located in two adjacent, self-contained buildings. Our infrastructure includes a regularly updated GIS lab, SharePoint technology and virtualising technologies used for simulation/modelling. SQL database development coupled with modern Terminal Servers facilitate work offsite supporting computer intensive modelling, micro-simulation work, and a virtual seminar

series. The University commits strategic capital investments of £1M biennially to *High Performance Computing*, and hosts the £2.6M regional facility of the N8 universities (Durham, Lancaster, Liverpool, Manchester, Newcastle, Sheffield, York), providing SoG researchers with access to more than 12,000 cores and up to 110 Tflop/s for intensive data processing and simulation. We have *high quality laboratory facilities* including elemental, laser particle size, total carbon and nitrogen analysers, GC-MSD, ICP-OES, high performance liquid chromatographs, atomic adsorption spectrophotometers, benchtop gas chromatograph-mass spectrometer, environmental gas analyser, and a palaeoecology and microscopy laboratory. We own 3 research vehicles and an extensive range of off-the-shelf field equipment including ground-penetrating radar, real time kinematic GPS systems, a cutting-edge terrestrial lidar system, in-stream water quality monitoring probes, fluorometers, spectrophotometers, a suite of data loggers, weather stations and >200 of the latest automatic water level and soil moisture recorders, including telemetry networks, and percussion coring equipment. Research is supported by a *skilled technical team of 10*. We have a philosophy of shared activity-based lab space, creating efficiencies in equipment purchase and maintenance and facilitating excellent technical support. We participate in the Leeds equipment database, which allows searches for all equipment costing more than £25,000. Leeds has worked with other N8 universities to develop a searchable website to promote efficiencies/collaborations through equipment sharing. We benefit from the extensive collections of the University's libraries, with a dedicated funding stream.

In 2012, **the University approved new capital expenditure of £9.9M** (90% from central funds) to relocate SoG to completely refurbished facilities (move planned for late 2014). In addition to providing cutting edge facilities and space to grow, the move will produce significant savings by utilising the latest technologies for water/energy efficiency. With dedicated research labs, our space will include a specialist climate controlled room and temperature controlled storage facilities. FERA licenced activity will occur in dedicated areas with air filtration technology to ensure containment of contaminants. State of the art seminar/interview rooms with video-conferencing and web interlinks will ensure efficient and effective international collaboration. Co-location of SoG with colleagues from Biology and Faculty of Environment will facilitate collaboration and produce efficiencies. Specialist IT facilities will be provided for doctoral students.

e. Collaboration or contribution to the discipline or research base

i. INTERDISCIPLINARITY

All five of our research clusters have interdisciplinary outlooks. Physical geography staff publish in leading journals from disciplines including biology, ecology, geology, geochemistry, and physics, as well as interdisciplinary outlets. Human geographers have published in top journals of sociology, urban studies, area studies, computer science, demography, criminology, and beyond. The networks described in Section e.ii (below) all involve scholars from multiple disciplines.

ii. SIGNIFICANT INTERNATIONAL RESEARCH NETWORKS/COLLABORATIONS

International collaborations that we have led or in which we serve as significant partners include:

1. **AMAZONICA**: Led by Gloor, this NERC-funded UK/Brazil consortium on the carbon balance of the Amazon and its global significance has produced 25+ peer reviewed articles, with partners from Oxford, Edinburgh, Glasgow, Universidade de São Paulo, National Oceanic and Atmospheric Administration (USA), and other HEI/non-HEI partners. (<http://tinyurl.com/m8vlpps>)

2. **Towards a New Urban Deal? Uneven Responses to the Global Recession**: Leverhulme Network (González PI, 2010-12) with partners from Spain, Italy, and Belgium. Publications in *International Journal of Urban and Regional Research*, joint monograph under contract with Routledge. <http://tinyurl.com/py44rh2>

3. **RAINFOR**: Led by SoG, RAINFOR brings together researchers throughout Amazonia who maintain permanent forest sample plots. Since 2008, it has been supported by the Gordon and Betty Moore Foundation, plus UK funders (NERC), the EU, and South American governments. Project partners span HEIs, government actors, and NGOs from North America, Central America, South America, and Europe. Major collaborative publications at: <http://www.rainfor.org/en>.

4. **AFRITRON**: an international network of researchers engaged in on-the-ground long-term monitoring of tropical forests, with partners in HEIs, NGOs, and governments in Africa (Cameroon, Democratic Republic of Congo, Gabon, Ghana, Liberia, Nigeria, Tanzania, Uganda); the Americas (Canada, Panama, USA); Asia (Indonesia); and Europe (Austria, Belgium, France, Ireland,

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Netherlands, UK). Major collaborative publications are viewable at: <http://tinyurl.com/oltzusq>

5. *Wildland Research Institute (WRI)*: Led by Carver, WRI elucidates the requirements, strategies and policies needed to promote greater presence of wild landscapes. Partners from Aldo Leopold Wilderness Institute (USA), IIASA (Austria), Pan Parks Foundation (Hungary), and UK institutions. Multiple collaborative articles, viewable at: <http://tinyurl.com/oh3k655> (see also Section b.iii on WUN funding).

6. *ACCWA (Approaching Climate Change for Water Resource Adaptation)*: WUN-funded (see Section b.iii). Led by SoG with partners from Australia, China, UK and USA. To date ACCWA has led to co-authored articles, 2 major international water conferences (Leeds 2010 and Hangzhou 2012), and new funding bids under review. <http://www.wun.ac.uk/research/accwa>

7. *AEVO (Arctic Environments: Vulnerabilities and Opportunities)*: WUN-funded (see Section b.iii). Led by SoG with partners including Alberta and Wisconsin-Madison. Arctic field school and collaborative publications in preparation and under review at *Quaternary Sciences Review*.

8. *Sun, Sea, Sand, and Silicone: Aesthetic Surgery Tourism*: ESRC funded, Bell co-I, with Leeds Sociology, Sydney, and UT-Sydney. Case studies in Thailand, Korea, Malaysia, Spain, Poland and Tunisia. Multiple collaborative publications: <http://www.ssss.leeds.ac.uk/publications>

9. *IMAGE (Internal Migration Around the Globe)*: Stillwell Co-I, funded by Australian Research Council, with Queensland, Fujian Normal University, and Central European partners. Outputs at: <http://www.gpem.uq.edu.au/image>, plus more forthcoming journal papers.

10. *DEMIFER (Demographic and migratory flows affecting European regions and cities)*: EU funded, 2008-10, Rees and Stillwell, Co-Is, led by NIDI Netherlands with European partners.

11. *EU-IRSES Contested Cities Exchange* (discussed in Section b.iv).

iii. LEADERSHIP AND SERVICE TO JOURNALS AND KEY PUBLISHING INITIATIVES

We have led and served many internationally-recognised journals/publication outlets. CSAP founded Applied Spatial Analysis and Policy in 2008. We edit 3 *significant book series*: Ashgate Environmental Policy and Practice Series (McDonald), Springer Understanding Population Trends and Processes (Stillwell), and Ashgate International Population Studies Series (Rees). *Journal leadership* has included Co-editors of Antipode (Chatterton), Acme (Datta and González), and City (Chatterton); Associate Editor, WIREs Water (Brown 2013-Present); book review editor of Gender, Place and Culture (Datta); and *editorial boards* of journals including Acme; African Journal of Ecology; Biogeosciences; Children's Geographies; City; Computers, Environment and Urban Systems; Ecoscience; Ecohydrology; Hospitality & Society; Migration Letters; Open House International; Regional Science Policy and Practice; Riparian Ecology and Conservation; Social & Cultural Geography; Social Movement Studies; Spatial Economic Analysis; and Spatial Justice. Chatterton led the creation of the Antipode foundation, promoting critical and radical geography.

iv. LEADERSHIP AND SERVICE TO LEARNED SOCIETIES AND FUNDING BODIES

Key leadership positions held within the assessment period include: President-IGU Commission on Applied Geography (G.Clarke); Executive Director-Regional Science Association (G.Clarke); Chair-RGS Space, Sexualities and Queer Research Group (Vanderbeck); Co-Chair-RGS GIS Research Group (Heppenstall); Co-chair-AAG Sexuality and Space Specialty Group (Vanderbeck); Secretary-RGS Participatory Geographies Research Group (Waite); treasurer-RGS Population Geography Research Group (Norman); British Society for Population Studies council (Norman); ESRC National Centre for Research Methods Steering Group (Stillwell); Members of Peer Review Colleges of ESRC (Heppenstall, Hodkinson, Waite), NERC (Holden, Baird, Woulds) and AHRC (Bell); NERC Changing Water Cycle advisory panel (Holden); NERC Flood Risk from Extreme Events Programme Steering Group (Holden); NERC Life Sciences Mass Spectrometry Facility steering committee (Woulds); Executive Committee-British Society for Geomorphology (Holden); Regional co-ordinator-RGS-IBG (Holden); Executive Committee-Irish Quaternary Association (Swindles); panel member-International Benchmarking Review of Human Geography-Quantitative (Heppenstall); and Member of the Reviewers College-Canada Research Chairs (McDonald).

v. COLLABORATION, LEADERSHIP AND PROFESSIONAL SERVICE BEYOND ACADEMIA

REF3a provides extensive evidence of our research relationships with non-HEIs including water sector partners, Office of National Statistics (ONS), global corporations, NGOs, and social movements. *Examples of leadership positions* held outside academia within the assessment period

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have included: Department of Health Advisory Committee on Resource Allocation (Rees); UK Census Design and Methodology Advisory Committee (Rees); National Population Projections Expert Advisory Group (Rees); ONS Academic Advisory Group (Rees); ONS Migration Statistics Improvement Programme Analysis and Indicators Working Group (Stillwell); Director-Yorkshire Dales Landscape Research Trust (Swindles); Census Academic Advisory Group (Norman); Leeds/NHS Health & Social Care Information Centre steering group (Norman); UN Convention to Combat Desertification expert panel on desertification impact indicator refinement (Grainger); Contributor, Govt Office for Science *Migration and Global Environmental Change* report (Datta); Scottish Government Steering Group-Centre of Expertise for Water (McDonald); Director, Water Industry Forum (McDonald); Industry science and application lead, Environmental Virtual Observatory Pilot (McDonald); and Natural England Science Advisory Committee (Lovett).

vi. ORGANISATION, CONVENING AND HOSTING OF SIGNIFICANT EVENTS

We have both organised and convened significant national/international conferences, workshops and events. *Key examples include:* International Geographical Union Conference on Applied GIS and Spatial Modelling (2013, hosted by CSAP); 23rd Meeting-British Organic Geochemical Society (2012, hosted by RBPM); Water Quality 2010 (organised by RBPM/water@leeds) and 2012 (co-organised in Hangzhou, China); Intergenerational Geographies (2012, CAB); Housing Privatisation 30 Years On (2009, Hodkinson); Journeys and Justice: Forced Migration, Seeking Asylum and Human Rights (2010, Waite with Sociology and asylum NGOs); Vulnerable Workers, Forced Labour, Migration and Ethical Trading (2013, Waite/Hodkinson); Smart Cities: Bridging Physical and Digital (CSAP/UCL, 2012); Dynamics of Populations Large and Small (2009, organised by CSAP); Methane Emissions from Restored Peatlands (2009, Defra-funded workshop organised by RBPM); and Integrating Forest Dynamics in Vegetation Models (organised by Baker, EU funded).

vii. CONTRIBUTIONS TO NATIONAL TRAINING AND PROFESSIONAL DEVELOPMENT

Through the ESRC National Research Methods node TALISMAN (Birkin PI, with UCL), we developed a national series of training workshops for users interested in enhancing GIS skills. In 2013 we offered TALISMAN Summer School: Programming for Social Scientists. The 2012 Colloquium on Spatial Analysis (with Copenhagen) was open to applications from all ESRC PhD students. Norman and Rees organised a Summer School (2009, ESF) and Workshop (2011, ESRC, BPS, and RGS) on ethnic population projections for academic/non-academic users.

viii. NOTABLE CONTRIBUTIONS TO THE DISCIPLINARY/INTERDISCIPLINARY RESEARCH BASE

Ecology and Global Change: Notable contributions of EGC have included the discovery of a major carbon sink in intact African tropical forests (Lewis, Phillips, Baker); quantification of the drought sensitivity of Amazonian tropical forests (Phillips, Lewis); first quantification of the risk that climate change poses to the success of carbon-based ecosystem service projects in the tropics (Baker); advanced understanding of the causes of climate-induced 'die-back' of the Amazon forest in vegetation models (Galbraith); discovery of methods to elucidate past climate patterns across Amazonia based on isotope records in tree rings (Brienen, Gloor); first assessment of the magnitude of biases in growth rate reconstruction using tree rings (Brienen, Gloor); first quantification of the return times of Icelandic volcanic eruptions (Swindles, Lawson); analyses of the great uncertainty in estimates of pan-tropical forest area trends (Grainger); measurement of ecosystem services in an eastern African biodiversity hotspot (Lovett); and a new analysis of the trade-offs between hydropower dam construction and fish biodiversity and productivity (Ziv). Bacon and collaborators won the 2011 *Palaios* Best Paper award for research on Triassic-Jurassic boundary carbon-isotope excursions expressed in taxonomically identified leaf cuticles. Swindles was awarded the Quaternary Research Association's 2012 *Lewis Penny Medal*. O.Phillips received a 2013 *Royal Society Wolfson Research Merit Award*.

River Basins Processes and Managements: RBPM has made key advances in understanding *hydrological and geomorphological process linkages* by developing a new peatland development and growth model (Baird); creating influential new models for erosion and soil risk assessment applied at a pan-European scale and used for global applications (Kirkby); producing the first fully-validated measurements and fluid dynamics-based understanding of sediment erosion and

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deposition by dam break outburst floods (Carrivick); providing novel insights for modelling overland flow hydraulics and sediment transport (Smith); and pioneering the use of satellite radar interferometry and feature tracking techniques to quantify glacier flow (Quincey). RBPM has contributed to major *ecological* advances through studies of glacier retreat and drought influences on aquatic biodiversity (Brown); provided the first published evidence for damage to stream ecosystems from vegetation burning and land drainage in blanket peatlands and new data demonstrating that peatland restoration results in rapid recovery of stream biodiversity (Brown, Holden); and advanced understanding of marine benthic biological cycling patterns/processes (Woulds). Major discoveries in *biogeochemistry* include the large role of natural pipes in peatlands on the C cycle and as hotspots for fluvial/gaseous C loss (Holden, Chapman, Baird); and demonstrating that government-funded agricultural land management schemes have been unsuccessful in improving catchment level water quality (Kay). Interdisciplinary contributions are evident in peatland science (Baird, Brown, Chapman, Holden, Palmer), glacial/ice marginal system research (Brown, Carrivick, Quincey), and hillslope processes (Holden, Kirkby, Smith).

Centre for Spatial Analysis and Policy: CSAP is a leader in modelling techniques for application in diverse settings (e.g. ESRC-funded Modelling and Simulation for e-Social Science, Birkin PI; Generative Social Science, with UCL; Retail Industry Business Engagement Network, M.Clarke and G.Clarke, with Oxford and Southampton). CSAP has pioneered new spatial agent-based models for crime (Malleson, Evans) and retail (Heppenstall, Birkin), and microsimulation models for health policy on obesity, smoking, and nutrition (G.Clarke). Advances in retail dynamics (Birkin, G.Clarke, M.Clarke) include highly disaggregated spatial interaction models to solve difficult location problems in diverse retail environments, and new optimisation models for locating hub and spoke distribution systems to reduce food retailer carbon footprints. Advances in population dynamics/projection include a new model for ethnic group population projections in English LEAs (Rees), new contributions to understanding/disseminating census outputs (Stillwell, Rees), and new analysis of the relationship between internal migration and social segregation (Gould). CSAP conducted the first national small-area empirical analysis of environmental justice in the UK (Norman, Mitchell) and partnered in SOLUTIONS (EPSRC, Mitchell Co-I), the most rigorous study to date of the impact of widely-debated urban spatial strategies on future sustainability.

Citizenship and Belonging: CAB has made significant interventions in debates over international human rights agendas, including new perspectives on illegality in Indian informal settlements (Datta's *The Illegal City*) and the politics of homosexuality in Uganda (Vanderbeck). Butlin's *Geographies of Empire* provides a groundbreaking comparative account, unique in its scope, of European colonialism. CAB has consolidated its strength in migration and transnationality with innovative contributions on migrant precarity (Waite), migrant integration and 'encounters' (Phillips; Waite), transnational religious movements (Vanderbeck), translocal geographies (Datta), intergenerational relations amongst African migrants (Waite), and the theorisation of governmentality and asylum (Conlon). CAB's reputation for cutting-edge sexualities research has advanced through new work on the state promotion of coupledness (Wilkinson), surveillance (Bell, joint CSJ), public art (Zebracki), and new intersections of religion and sexual orientation (Waite; Vanderbeck, Co-I AHRC/ESRC Religion & Society Programme, *graded 'outstanding'*).

Cities and Social Justice: CSJ has collectively advanced understandings of how cities can become more socially/ecologically just in an era of neoliberalism and austerity. This has included a new agenda for research on housing and post-carbon cities (Chatterton), a major study of housing privatisation and private finance initiatives (Hodkinson), new insights into 'policy tourism' and the global flow of urban regeneration models (González), and important contributions to understanding cultural economies (Bell). CSJ has significantly contributed to understanding the spatialities of social movements through new contributions on global justice networks (Routledge), the role of emotion in producing activist solidarities (Routledge), and social movements related to climate change (Chatterton), as well as making internationally-recognised interventions on participatory methodologies (Fritsch) and scholar activism (Chatterton, Hodkinson). Waley has made significant new contributions to East Asian comparative urbanism, and Schafran's collaborative research on urban displacement shared a *2010 Ashby Prize* for innovation in *Environment and Planning A*.