Institution: University of St Andrews

Unit of Assessment: School and Department: School of Geography & Geosciences

UoA: 17 – Geography, Environmental Studies and Archaeology

a. Overview

The School of Geography and Geosciences at the University of St Andrews is committed to the pursuit and delivery of research at the highest international level. Our research is organised through two departments, the Departments of Geography & Sustainable Development (GSD) and Earth & Environmental Sciences (EES). Each has its own Director of Research. The Heads of Department with three colleagues comprise the School Management Group. Our research links the natural and social sciences across a range of spatial and temporal scales. It focuses on understanding population dynamics and new mobilities, developing methods for longitudinal data analysis, and evaluating the natural processes that drive and regulate environmental change from the Quaternary to the Archaean and those that form the continental crust. Common ground is provided by research on pro-environmental behaviour, environmental influences on health and development, Geoinformatics and isotope geochemistry. Staff share common laboratory and infrastructure support.

The success of our approach is highlighted by more than 800 publications since 2008, with over 550 of these in peer reviewed journals, and over 60% involving co-authors from across the globe. Over the REF period £20.6M in research funding was obtained from RCUK and other competitive national and international grant awarding agencies. In the 2013 Leiden Ranking, which analyses scholarly impact using metrics from the Web of Science, the University of St Andrews ranks 6th for the Life and Earth Sciences in the UK and is one of only seven UK Universities in the top 50 of 500 Universities worldwide. The ESRC (2013, p12) report on *International Benchmarking of Human Geography* placed UK first in the world, and cited research grant income in St Andrews as third highest in UK Geography as well as noting our leadership role in the *Centre for Population Change*.

Since 2008, academic FTEs have increased by 58% and the School now has 45.7 FTE academic staff, 27 Postdoctoral Researchers, 4 other Research Fellows, 6 technicians and 49 registered PhD students. The University has recently committed ~£3M to build state-of-the-art laboratories to underpin research in Earth and environmental sciences (operational by Summer 2014).

b. Research strategy

Our strategy is to produce internationally excellent research that:

(1) furthers analysis of ***demographic, societal and spatial interactions***, and provides research outcomes for use by government and public agencies in policy making;

(2) fosters understanding of ***Earth surface processes and environmental change*** with applications for utilisation of resources, their exploitation and management; and

(3) details ***Earth system evolution*** through deeper understanding of the processes that regulated our planet's development.

To achieve these aims, research is optimised and co-ordinated through Geography and Sustainable Development (GSD) and Earth and Environmental Sciences (EES) by (i) fostering synergies in key thematic areas, (ii) appointing world-calibre researchers to complement and extend existing research portfolios, and (iii) levering major funding to sustain current research foci and launch new research programmes.

Demographic, societal and spatial interactions.

In human geography our research is focused on analysing demographic processes, human wellbeing and environmental behaviour, and on the interdisciplinary boundaries spanning these areas. We lead three ESRC-funded research centres: the *Longitudinal Studies Centre - Scotland* (established 2005), the *Census and Administrative Data Longitudinal Studies* Hub (2012) and the *Administrative Data Liaison Service* (2008). We also host the *Scottish Cities Knowledge Centre* (2012) and the *Centre for Housing Research* (1990) and provide leadership for the ESRC-funded inter-university *Centre for Population Change* (2009). In 2012 we established the *Centre for Geoinformatics*, a major strategic investment that recognises the growing need for a facility devoted to analysis of complex spatial datasets. Success in winning peer-reviewed income for Research Council centres and programmes (£6M since 2008) has enabled appointment of over 20 Research Council-funded fellows. We now co-ordinate all ESRC-funded centres providing longitudinal census data throughout the UK, have a permanent presence in the National Records of Scotland in Edinburgh, and maintain the research tools and datasets that we have developed for use by Government and Civil Society.

Highlights of our achievements are: a) the development of new or extended *theorisations* of the impacts of globalisation and modernisation on aspects of population change which have drawn international attention to policy-related issues including, threats to the wellbeing of transnational families (Graham: REF2 outputs 1,2), long-distance labour migration and partnership (Reuschke: 3), the global differentiation of higher education institutions and international student mobility (Findlay: 2) and reconceptualization of international labour recruitment agencies in relation to employment regimes (McCollum: 1); b) the *reinterpretation* of the history of Geography providing new insights on militant tropicality (Clayton: 1,2); and c) the presentation of new and robust evidence *challenging injustices* relating to housing and labour market processes at city and neighbourhood levels (Houston: 1,3; McKee: 1,3). We have also contributed to *shaping future research agendas* through the innovative application of longitudinal methods to understanding the role of individual and household choices in influencing residential mobility and migration (Feng: 1; Findlay: 4; Reuschke: 1; Van Ham: 1,2), and promoted the green policy agenda by pioneering novel approaches to monitoring pro-environmental behaviour (Hunter: 2; Reid: 1). A wide range of research and policy applications continue to be enhanced by our cutting-edge *methodological developments* in GIS and geographically weighted regression, which have advanced analysis and visualisation of spatial data (Demsar: 2,4; Long 1) and raised new questions about the spatiality of the Irish famine in the 1840s (Fotheringham: 3,4).

Earth surface processes and environmental change

This research is concerned with characterising and modelling the interlinked physical, biological and chemical processes operating across Earth's surface. Sedimentology, geomorphology, stable isotope geochemistry, cosmogenic isotopes and geochronology are used to quantify rates of climate change, sediment and elemental fluxes and the physical and chemical parameters of fluvial, glacial and oceanic systems. Our biogeochemistry research investigates the influence of vital effects on isotope and trace element ratios of marine invertebrates and their use as proxies for estimating oceanic pH and sea-surface temperature. We also study the role of microorganisms in elemental cycling and the coupling between geochemical and biological processes. High-resolution geophysical survey methods and integrated remote-sensing platforms underpin research in geoarchaeology and near-surface environmental monitoring and assessment.

Research achievements by physical geographers and environmental scientists include new insights into the sulphur cycle, linkages between oceanic dimethylsulfoniopropionate

production and climate (Oduro: 1,2) and microbial phototrophic oxidation of sulphur (Zerkle: 2-4). We have enhanced understanding of isotopic fluxes and compositions of rivers and oceans to use in modelling the global carbon and magnesium cycles (Burke: 1; Robinson: 1,4; Tipper: 1,2). Modelling ice loss from marine-terminating glaciers has contributed to calibration of climate-warming driven sea-level rise (Benn, 2). We have employed datasets as diverse as C, O, B and cosmogenic isotopes, tephra layers and tree rings to refine understanding of Quaternary palaeoenvironments, including the dynamics of past ice sheets and their relation to atmospheric and oceanic circulation (Austin, 1; Ballantyne, 1,4; Benn, 1; Walden, 1) and retrodiction of climate change over the past millennium (Austin: 3; Rae: 1; Streeter 1; Wilson 1-4). Our aquatic culturing experiments are quantifying biomineralisation processes and how those influence proxy methodologies for assessing environmental change (Allison: 1-3; Burdett: 1).

Earth system evolution

Research is focused on documenting processes operating in the solid Earth across a range of time scales, with particular emphasis on the formation of orogenic belts and reconstructing ancient stratigraphic and depositional frameworks. A key motivator is to understand the cycling of natural materials, from nano- to global scales, to better evaluate geological models for the origin of continental crust, the mechanisms driving supercontinental cycles, and the nature of key redox reactions using stable and radiogenic isotopes and analytical geochemistry.

We have developed a new model for the development and preservation of continental crust over geological time and gained deeper understanding of supercontinental tectonics and mountain-forming processes (Cawood: 2-4; Hawkesworth: 1,2,4). Our research has added underpinning data to the understanding of the oxygenation and composition of Earth's atmosphere and oceans during our planet's early history through to the Snowball Earth episodes using methodologies ranging from molybdenum isotopic fractionations to high-precision Ca-Mg-B-C-O chemostratigraphy to document Earth system recovery from extreme environmental change (Prave: 1-3; Tosca: 2,3; Zerkle: 1). Our curiosity-driven science has reached beyond the terrestrial to model aqueous episodes and atmospheric composition on Mars to assess models of planetary habitability and evolution of life on the early Earth (Claire: 2,4; Tosca: 1).

Strategic planning

Strategic planning is driven by three main objectives: (i) to continue to attract and support outstanding researchers (see section 3a); (ii) to enhance and expand our Research Centres and infrastructure (see section 4); and (iii) to identify exciting research of societal, economic and environmental importance, and to address profound questions about the co-evolution of Earth and life. These underpin seven initiatives:

- The *Centre for Population Change* will deliver its next phase of research (2014-18) with St Andrews leadership of a range of ESRC-funded (~£1.0M) interlinked demographic studies. It will investigate, for example, how and why the dynamics of family formation and dissolution in the UK differ from other developed countries in key areas such as teenage parenthood, levels of un-partnered parenthood, social class polarisation in the timing of entry into parenthood, and levels of childbearing within re-partnered unions. The residential and transnational mobility of linked lives will also be studied in relation to the changing contexts of multiple and fluid lifecourse trajectories.

- Methodological advances in longitudinal analysis and geoinformatics will be led through the *Census and Administrative Data Longitudinal Studies* (CALLS) Hub (ESRC grant for £375k, 2012-2017) by building on the eDatashield and other methods refined by us in the *Longitudinal Studies Centre Scotland.* This will open a rich

spectrum of new research opportunities based on innovations such as simultaneous regression analyses of multiple longitudinal and spatial datasets. Researchers in the *Centre for Geoinformatics* (funded by a Nuffield/ESRC Q-step grant, £800k, 2013-7) will address substantive, integrative areas of interest from across the school including analysis of geo-referenced housing, health and social indicators, as well as developing new geo-visualisation methods.

- Sustainability research (building on funding from ESRC of £159k and NERC of ~£2.3M, see section 4) will focus on resolving links between human wellbeing and ecosystem services provision, coastal biodiversity and ecosystem services, and behavioural implications of low-carbon living. In concert with anthropologists we are developing theory on links between craft and well-being, and a collaborative programme on climate justice and its implications.

- Within the overlapping domains of physical geography and environmental science we will: (i) refine and retrodict high resolution key climatic events over a range of timescales (thermohaline circulation; D-O cycles; IRD events; ENSO; NAO), link these to changes in the global climate system and understand climate-driven changes in cryospheric systems and effects on terrestrial and marine resilience (ii) build on collaborative grants (Nordic and Norwegian Research Councils, ~£5.5M) to develop improved models of ice-sheet response to climate change as a contribution to IPCC AR5; and (iii) investigate anthropogenic influences on environmental change to address the "Grand Challenges" of the next 100 years (NERC £526k).

- Assessing the cycling and processing of matter across spatial and temporal scales through Earth's interior, surface and atmosphere: (i) to study the chemistry and physics of materials and the processes controlling their reactivity in natural and manmade systems; (ii) to examine the response of these processes to changing environmental parameters; and (iii) to evaluate and predict the outcomes of those interactions. Key is fingerprinting the processes that lead to isotopic fractionation and compound affinity of elements in solids and fluids (NERC and Marie Curie, £393k).

- Combining microbiology and geochemistry to define the pathways and pace of biological reactions to interrogate: (i) the cycling of carbon and other nutrients in regulating Earth's climate, weathering and redox state over short and geological timescales; and (ii) the influence of microbial activity in liberation, adsorption and/or precipitation of mineralised elements in the transport and sequestration of bioactive metals and pollutants in natural waters. Quantifying and numerical modelling these processes and their feedbacks in natural systems is a major goal (NERC £440k).

- Integrating field methods, isotope geochemistry and environmental modelling to understand better the genesis of continental crust as well as the conditions driving hallmark periods of major biogeochemical and climatic change in Earth system evolution (NERC £1.92M). We will reconstruct conditions of Earth system behaviour from Deep Time through to the contemporary.

Our vision is to develop closer links between the Social and Natural sciences, and between the Earth and Life sciences, initially through two multi-disciplinary centres, the Institute for Population, Wellbeing and Environmental Research (I-POWER) and the Centre for Earth, Life and Oceans (CELO). I-POWER, launched in 2012, is a trans-disciplinary nexus that highlights relationships between demographic change, human wellbeing and environmental change. CELO is dedicated to understanding the Earth, its biosphere and oceans, for the benefit of society and a sustainable future; a spin-out company, CERSA Ltd (Centre for Earth Resources St Andrews) offers expertise and

facilities to the hydrocarbon and mining industries. The remit of I-POWER and CELO is to provide mechanisms for (i) undertaking fundamental and applied, multidisciplinary research along the interfaces of the Natural and Social sciences; (ii) to facilitate global communication of that knowledge, and (iii) to enable us to employ our interdisciplinary expertise to target proposals for ESRC, EPSRC, NERC and BBSRC.

c. People, including:

i. Staffing strategy and staff development

The cornerstone of our staffing strategy is the appointment of outstanding researchers to augment and extend existing research strengths. Six new professorial appointments and 20 new lectureships, including 14 early-career appointments, have been made since 2008. We have created a youthful and strongly international research team with appointments from leading institutions in twelve countries, such as Caltech, Harvard, Cambridge, Edinburgh, Penn State, and Victoria BC.

Strategic professorial appointments were made to lead research teams in demography (Findlay), the *Centre for Housing Research* (Maclennan), sustainable development (Hunter), the *Centre for Geoinformatics* (Fotheringham) and geodynamics and isotope geochemistry (Hawkesworth, Cawood). Four human geography lectureship appointments were made to reinforce our research on demographic, social and housing systems, two appointments provide the nucleus of our geoinformatics team, and five new appointments support research in environmental change and sustainable development. Nine targeted appointments provide the foundation for solid Earth science, bringing further expertise in isotope geochemistry, biogeochemistry, biogeomagnetism, ecosystem modelling and palaeoceanography. We interpret the promotion during the REF period of four staff to chairs (Benn, Dibben, Graham and Van Ham) and of four others to senior lectureships/readerships as reflecting, in part, the value of a successful investment strategy in staff development.

Key to realising our research aims is to provide staff with the *time, training, resources* and *intellectual environment* to fulfil their potential. To enhance the research *time* available, we have restructured curricula to reduce teaching loads by ~20%, and appointed admissions and finance officers to assume duties formerly supported by academic staff. We also focus individual teaching commitments within a single semester to release blocks of uninterrupted research time. Staff are encouraged to apply for research leave (one semester in eight) encompassing funding capture, publications, research visits to other institutions and/or fieldwork.

Research *training* is a career-long endeavour and a key aspect for assuring continuing research leadership. New staff are assigned an experienced mentor who helps guide *inter alia* their research agendas, identification of appropriate training, involvement in research projects, and publication strategy. Staff meet annually with a research leader to discuss recent achievements and future research planning, and they are encouraged to exploit the professional and personal development training offered by the University's Centre for Academic, Professional and Organisational Development. In-house workshops are held that focus on honing research techniques, writing grant applications and refining on-going research. The School provides *research resources* (> £40k p.a.) allocated by Directors of Research to support attendance at conferences and workshops (run by, for example, ESRC, NERC and SAGES), fieldwork and research visits. All staff have personal research accounts to support research and are further rewarded by receiving 7% of PI salary and of total FEC salary costs on research grants. New staff are allocated start-up funds commensurate with their needs to establish an intensive and active research programme.

Our 37 postdoctoral, technical and other research staff are valued members of our community, with PDRAs being a vibrant and integral part of our research seminars, journal

clubs and research Away Days. The University meets all key principles of the Concordat regarding recruitment, selection and retention of researchers, gender equality, development of generic and flexible skills, encouragement of personal and career development, regular review of progress and promotion of equality and diversity. The University's excellence in this area has been recognised by an *Athena Swan Bronze Award* and a *European Commission HR Excellence Award.* The University actively promotes our Stonewall membership and LGBT charter mark, as well as Women in Science networking events.

We foster a stimulating *intellectual environment* through weekly research meetings within GSD and EES and in cross-school fora attended by academic and research staff and students. These are designed to share research experience, promote research synergies, drive research initiatives and widen research horizons. Agendas are wide-ranging, and meetings include (1) in-house research seminars, (2) 'journal clubs' designed to share new ideas emerging in the literature, (3) presentations by visiting researchers, (4) round-table discussions of work in progress on doctoral and postdoctoral research projects, (5) sharing of technical skills and experience in grant applications and research management, (6) brainstorming sessions to develop new research collaborations, (7) dissemination of information regarding opportunities for research funding, publication and impact, and (8) debate on research and appointment strategy, research infrastructure, succession planning and the award of Honorary positions and fellowships.

ii. Research students

Research students are an integral part of our research community, and during the REF period research student numbers have increased to 49 registered PhD students (an increase of 78% since RAE2008). Of the registered students 37% are from outside the UK, including 7 from the EU and 6 from the USA. Our students are members of the University's Research Graduate School, which has committed to co-funding 11 new PhD students in our School annually, including 11 new funded studentships that started in September 2013. Some 17 students hold RCUK or equivalent awards. RCUK studentships in human geography have been won through ESRC's Scottish Doctoral Training Centre, while in the environmental sciences we have won studentships from NERC. We are pleased to be part of NERC's new (2013) IAPETUS Doctoral Training Programme.

All research students are required to undertake generic and research-specific training. New postgraduates attend University and School induction days, completing a Development Needs Analysis to allow us to deliver appropriate skills training. Bespoke training models, for example on laboratory practice, IT, geoinformatics, cartography, are provided by the School, or through ESRC- or SAGES-supported residential training courses. Research students are required (~10 days/year) to participate in GRADskills, a portfolio of training programmes run by the University. GRADskills modules include study and presentation skills, maths and statistics, and generic professional skills such as fundraising, marketing, committee management, public speaking, staging events, interviews and time management. Research students are also required to develop teaching experience and to give research seminars to the appropriate research group.

All research students are encouraged to publish at least one paper before thesis submission (e.g. Coulter et al. 2011 Environment and Planning A 43, 2742-2760; Astell-Burt et al. 2011 Social Science and *Medicine* 72, 1472–1481; Spencer *et al.* 2013 *Geology* 41, 795-798; Small *et al.* 2013, *Geology* 41, 155-158) and to present research at international conferences. Our PhD graduates who have been appointed to lecturing and research posts across the world include Archibald (Aberdeen); Astell-Burt (West Sydney), Coulter (Cambridge), Foster (Bristol), Friis (Oslo), Hibbert (Southampton), King (Lausanne), Liu (Beijing), Ormond (Wageningen), Shakkour (Derby), Small (Glasgow).

Postgraduate training and administration are managed by the School Postgraduate Committee (SPC), which comprises elected postgraduate representatives and academic staff representatives. Our *Postgraduate Forum* is convened by research students and meets at least three times per year to discuss postgraduate issues, and to organise our annual postgraduate conference and social events. All research students have at least two supervisors responsible for overseeing research planning and progress, with fortnightly mentoring of first year research students. PhD students prepare a yearly progress report prior to their annual interview with the SPC, which provides written feedback and support. All research students are provided with desks and computers, arranged in research clusters to encourage interaction. The strong sense of community amongst our research students is manifest in their annual conference and dinner, participation in School activities, and involvement in training and social events.

d. Income, infrastructure and facilities

Income: During the REF assessment period we have won 308 external grants totalling £20.57M. The principal sources were the UK Research Councils (ESRC: 42 awards totalling £7.14M; NERC: 28 awards totalling £5.08M; EPSRC: 18 awards totalling £1.08M), government agencies (54 awards totalling £3.62M), charitable foundations, such as the Wellcome Trust, Leverhulme Trust, Joseph Rowntree Foundation and Carnegie Trust (68 awards totalling £1.35M), industry and commerce (35 grants totalling £0.40M) and EU grants (11 awards totalling £0.70M). 'In kind' awards for the use of NERC facilities totalled ~£1.2M.

Infrastructure: Staff are mostly located in two linked buildings that also house our secretarial, and computing facilities and many of the laboratories. Since 2008 the University made 17 new offices and other additional space available to the School to accommodate expansion in staff and laboratories. Most research students and postdoctoral researchers occupy the same buildings, although the School has satellite locations in St Andrews (*Centre for Housing Research*) and Edinburgh (*National Records Office*). Academic staff are supported by five secretaries, a cartographer, IT and finance officers and six technicians. Our main analytical clusters include:

- The *Longitudinal Studies Centre - Scotland* (established with £2.7M from ESRC, SFC, CSO and the Scottish Executive) and the associated *Census and Administrative Data Longitudinal Studies* (CALLS) hub provide an unrivalled platform for demographic, health and socio-economic research. To protect confidentially, the database is housed in the offices of the National Records of Scotland (Edinburgh), with St Andrews researchers based there permanently. The Scottish section of the ESRC-funded *Centre for Population Change* has been granted infrastructural support within the National Records Office for six Research Fellows to facilitate database access and to ensure effective exploitation of this unique resource.

- The *Centre for Geoinformatics* occupies a dedicated suite of rooms and represents a forum for all staff whose research involves the capture, processing, analysis and visualisation of spatial data.

- The *Facility for Earth and Environmental Analysis* (FEEA) was established in 2004 to support School-wide research. It houses a suite of analytical equipment to undertake inorganic and isotope geochemistry (LA and solution quad-ICP-MS, XRD, XRF, 514 nm Raman and LIB spectroscopy, IRMS with CF-peripherals for C,N,O,H, gas chromatography), aquatic bioculturing with CO_2 and DIC analysers, macro- and micro-imaging (W-D EPMA, SEM, 2D-3D digital

microscopy & scanning, reflected & transmitted-light microscopy), biogeomagnetism (< 5 nT shielded box, fluxgate magnetometers, magneto-optical microscope, ex situ magnetic susceptometers) and geochronology (radio-/cathodo-/thermo-/photo-luminescence, cosmogenic isotope preparation, automated-reader OSL/TL). Further, we have capability for surface and near-surface land and marine geophysics by ssSONAR, GPR, ER, EP, IR, laser, seismic and GPS sensors, as well as a comprehensive suite of sedimentology and micropalaeontology sample preparation and analysis facilities. The School underpins its field science with an array of survey, hydrological, GPS and soil sampling equipment, 21m-research vessel, eddy covariance towers and greenhouse gas analysers.

In 2012, the University invested ~£3M for new state-of-the-art laboratories including those to host two Nu Instruments MC-ICP-MS for radiogenic and stable isotopes and two Mat-253 mass spectrometers for complete S and Se analyses, including clean laboratories with ultra clean workstations. These laboratories will enable us to measure isotope ratios of almost every natural element and to process ng-level samples. A bespoke alumni donation has provided £50k to purchase a nonmagnetic shallow ("Winkie") drill rig.

Through the St Andrews Centre for Advanced Materials we access TEM, X-, W- and Q-band ESR, XP and NMR spectroscopy plus multi-laser Raman micro-mapping. We also extensively use national facilities (over 60 successful applications worth ~£1.2M since 2008) including synchrotrons at Argonne (USA) and Diamond (UK) and the NERC cosmogenic isotope, radiocarbon, isotope geoscience and ion microprobe facilities. We collaborate in marine research with the St Andrews-based Scottish Oceans Institute and the Marine Alliance for Science and Technology for Scotland oceanography community.

e. Collaboration and contribution to the discipline or research base

Our research outlook is *global*. During the REF period we have collaborated with researchers at over 500 institutions in the UK and abroad, as well as with representatives and stakeholders in government organisations and industry. Collectively, academic staff in the School produced more than 800 publications, including over 550 papers in peer-reviewed journals, and over 60% of our REF publication outputs are transnational. Our research collaborations during the REF period involved colleagues in 55 countries.

St Andrews Lead as PI	Collaborating Institution(s) (Co-Is)	Funder	Short Title
Austin	East Anglia, Wales	NERC	Hydrography of the subpolar North Atlantic during the interglacial
Benn	Edinburgh, Swansea, Helsinki, Oslo	Conoco Philips	Calving Rates and Impact on Sea Level
Claire & Zerkle	Leeds, Maryland, NASA, Tokyo	NERC	Did biogeochemical methane cycling regulate the Neoarchaean atmosphere?
Dibben	Belfast, UCL	ESRC	Census and Administrative Data Longitudinal Studies Hub
Graham	Edinburgh, Stirling, Strathclyde, So'ton	ESRC	Centre for Population Change (Scotland)
Tosca	Edinburgh, Heriot Watt, University of Illinois at Chicago	Petrobas & BG	The formation and diagenesis of Mg-silicates in non-marine carbonate reservoirs
Wilson	Aberdeen, Swansea	Leverhulme	Reconstructing 8000 years of Env. and Landscape Change in the Cairngorms

A selection of the 12 major inter-institutional projects (> £250k) that we have led are summarised in the Table above and exemplify the wide range of research areas in which we *lead* as PIs on national and international collaborations.

Other major collaborative projects on which staff were or are co-investigators include *Stability and Variations of Arctic Land Ice* (Nordic Research Council, £4M); *Dynamic response of arctic glaciers to climate change* (Norwegian Research Council, £1.5M); *Resilient futures* (ESRC/EPSRC £1.4M); *Lifelong health and wellbeing* (MRC, £1.4M); *Equity of Access to Cardiac and Mental Health Services in England* (NIHR, £236k); *New deal for communities and health inequalities* (DoH; £517k); and the *Scottish Health Informatics Programme* (Wellcome Trust, £3.6M).

Our wider disciplinary contributions since 2008 are manifold and include:

Visiting professorships: MIT (USA), UNIS (Svalbard, Norway) Wuhan University (PRC), National University of Singapore, Chinese Academy of Sciences; RFI Research Professorship; Science Foundation of Ireland Research Professorship.

Journal editorships: *Population, Space and Place; Transactions of GIS; Geographical Analysis; Journal of Housing Studies; Precambrian Research; Geology;* plus service on the editorial boards of 24 other journals.

Director, Chair or Vice-Chair: MRC-ESRC *Birth Cohort Study*; IGU Commissions on *Population Geography* and *Modelling Geographical Systems*; Strategic Research Cluster in Advanced Technologies; IGU Commissions on *Modelling Geographical Systems* and *Population Geography*; RGS *Coastal and Marine Research Group*; Geological Society *Marine Studies Group*; President, Geological Society of Australia; Vice-President, Mineralogical Association of Great Britain.

Committee membership: Housing Studies Association; Housing Statistic network management committee; RSE International and Fellowship Committees; Royal Irish Academy Geographical Sciences Committee; UNESCO International Geological Program; National Collaborative Research Infrastructure Strategy (Australia); Executive Committee of the Transportation Research Board; EU Joint Planning Initiative on Urban Europe.

Over the REF census period we have convened over 90 conferences, workshops or conference sessions within the annual conferences of AAG, AGU, EGU, IGC, RGS-IBG, and other major professional organisations. We have presented over 580 conference papers, of which over 130 were invited keynote or plenary presentations. Eight staff have served on Research Council peer review colleges or RCUK research programme boards.

A contribution beyond the higher education sector has been the GeoBus initiative, a NERC- and industry-funded mobile outreach programme that has brought research findings to more than 15,000 students in 120 schools across Scotland and parts of England since its inauguration in early 2012.

Our wider professional service during the assessment period has included, inter alia:

- Expert witnesses to UNICEF, House of Lords Select Committees, the Royal Commission on Environmental Pollution, Scottish Government, Department for Business Innovation and Skills and Chief Scientific Officer;
- Service on the Boundary Commission for Scotland and Government commissions including the National Data Linkage Oversight Group, Scottish Health Information Service Research Project Board, Population and Migration Statistics Committee (Scotland), ONS Longitudinal Study Steering Group, DoH Healthy Towns Research Commissioning Group, ESF working group Towards a revolution in education and

capacity building, and EU Joint Planning Committee on Urban Europe.

- Service on UKRC committees including the ESRC Commissioning Panels on Cross-National Research Methods and 'Transforming' Social Science, Scottish Doctoral Training Centre Foundation Steering Group, Understanding Society – Data Access Committee and National Centre for Research Methods, the NERC Isotope Geoscience Facilities Steering Committee, as well as the advisory committee for beamline design for the Diamond Synchrotron.

We are authors or co-authors of over 80 commissioned reports, including *High mountain glaciers and climate change: challenges to human livelihoods and adaptation* (UN Environment Programme); *The English Indices of Deprivation, 2007 and 2010* (Communities and Local Government); *Report on the First Periodic Review of Scottish Parliamentary Boundaries* (Boundary Commission for Scotland); *Annual Review of Demographic Trends, 2007 and 2010* (General Register Office for Scotland)*, Private Water Supplies (Scotland) Regulations 2006: understanding engagement of owners and users* (Scottish Government), *UK strategy for managing contaminated sediments* (DEFRA), *Understanding rural deprivation in Scotland* (Church of Scotland)*, Pluvial flood risk in urban areas* (Joseph Rowntree Foundation) and *The South African Index of Multiple Deprivation, 2007* (South Africa Department of Social Development).

Prestigious awards and fellowships since January 2008 include:

Fellowships: Royal Society of Edinburgh (Hawkesworth, 2012; Cawood, 2013); Geological Society of America (Prave, 2012); National Academy of Sciences (Fotheringham, 2013); Erskine Fellowship, New Zealand (Ballantyne, 2013); Marie Curie Fellowship (Reuschke, 2011); Norwegian Scientific Academy for Polar Research (Benn, 2008); NERC Research Fellowships (Tipper, 2010; Zerkle, 2010); Academy of the Social Sciences (Fotheringham, 2013).

Awards: Royal Society Wolfson Merit Award (Hawkesworth, 2008); Wollaston Medal of the Geological Society (Hawkesworth, 2012); Mawson Medal, Australian Academy of Sciences (Cawood, 2008); Clough Medal in Earth Sciences (Ballantyne, 2010); Max Hey Medal, Mineralogical Society (Tosca, 2012); Honorary Doctorate, University of Umea (Findlay, 2013).

Invited or keynote or plenary lectures at conferences have included the first Elsevier Lecture (QRA, 2008), the Annual Comeaux Lecture (Arizona State University), the 2010 Mawson Lecture of the Australian Academy of Sciences, 2012 Fermor Conference and 2011 Gordon Conference on Geobiology, and invited plenary or keynote addresses at EGU, INQUA, Annual Conference of Australian Geographers and Geocomputation 2011.

The University of St Andrews has prioritised our research through major investment in new staff and infrastructure across all sectors of the School. We have achieved our aims set out in RAE2008 and have attracted a stellar group of young researchers to further our strategy of focusing future research on major issues in the Social Sciences, big questions in the Earth and Environmental Sciences, and challenging research agendas at the interface between the two.