

Institution: Aberystwyth University
Unit of Assessment: 14: Geography and Environmental Studies
<p>1. Unit context and structure, research and impact strategy</p> <p><i>Our Ambitions and Principles</i> Researchers at Aberystwyth have been undertaking research at the forefront of Geography and Environmental Studies for over a hundred years and continue this tradition to advance knowledge and techniques, enhance public understanding, and deliver societal and environmental impacts, nationally and internationally. The centenary of the Department in 2018 presented an opportunity to celebrate our historical contribution to the discipline - including over 100 PhD alumni currently working in universities and research institutes in at least 15 countries - and to highlight the ongoing significance, relevance and impact of our research, as well as to re-affirm our commitment to supporting frontier research and training the next generation of research leaders.</p> <p>The Department of Geography and Earth Sciences (DGES), submitted wholly to UoA 14, provides a vibrant and supportive research environment, with practices, policies and structures embedded in a research strategy aligned with the Aberystwyth University (AU) Research and Innovation Strategy (see REF5a), that aims to develop research capacity and extend impact, emphasising increasing research income, promoting interdisciplinarity, and building academic and non-academic collaborations. The strategy has 15 priorities, detailed below (pp. 3-4), which have contributed to:</p> <ul style="list-style-type: none"> • Empowering the vitality of our research environment through policies to encourage solutions-oriented research, increase grant capture, develop interdisciplinary centres and projects, and support engagement of our staff in the subject community. • Enhancing the sustainability of our research environment by building on capacity-building and investment reported in REF 2014, with new large research projects, expanding our graduate school, upgrading facilities and equipment, and consolidating links with government bodies, industry and civil society. • Promoting inclusivity in our research with actions to remove barriers to equal participation, promote open research, expand public engagement and co-production, develop research and outreach activities that contribute to social, economic and environmental wellbeing in Wales, and ensure social and environmental responsibility in our research practice. <p>In the REF 2021 period these policies, practices and structures have enabled DGES to achieve a number of objectives including substantially increasing research income, leading major research projects, extending interdisciplinary collaborations, expanding graduate research numbers, consolidating our international profile, and realising impacts on policy, professional practice and public discourse.</p> <p><i>Delivering the Strategy: Structure and Organisation</i> DGES's research environment is underpinned by six research groups reflecting breadth across a spectrum of sub-fields in Human and Physical Geography and Environmental Studies (Figure 1). The structure and membership of the research groups is regularly reviewed, with a new Earth Surface Processes Research Group established during the assessment period, integrating the previous River Basin Dynamics and Hydrology Research Group with an expanding area of research on dryland environments. The research groups also house specialist research laboratories and link to interdisciplinary research centres and inter-institutional networks.</p>

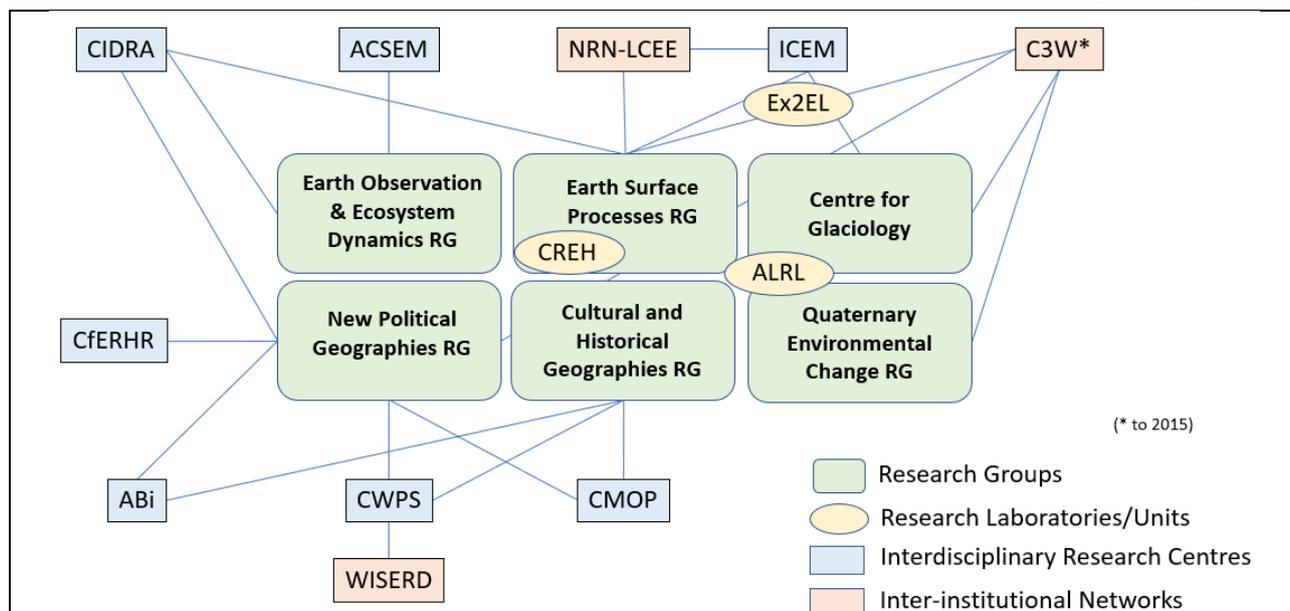


Figure 1: DGES Research Structure (see text for acronyms)

The research groups provide a locus for collaboration, mentoring, peer review, development of new research proposals and testing of results and findings, as well as internal and external seminars and postgraduate supervision. Many academic staff are affiliated to more than one research group and cross-working between groups is encouraged, including through a common Departmental guest seminar and public lecture series. Research group leaders sit on the DGES Research Committee, which is responsible for the management and delivery of the Research and Impact Strategy, chaired by the Director of Research. A Director of Impact and Engagement is responsible for developing, facilitating and monitoring public engagement, policy transfer and the impact of DGES research. Research activity in DGES is integrated with the AU Research and Innovation Strategy through the Faculty of Earth and Life Sciences Research Committee, chaired by the Associate Dean (Research, Knowledge Exchange and Innovation), on which the Department has two representatives (see REF5a).

A key strategic priority throughout this REF period has been the expansion of interdisciplinary engagement. DGES researchers have been proactive in establishing Interdisciplinary Research Centres (IRCs) within AU, leading or co-leading the Aberystwyth Behavioural Insights (ABi) centre, the Aberystwyth Centre for Space and Earth Modelling (ACSEM), and the Centre for Welsh Politics and Society (CWPS); and contributing to the Centre for Excellence in Rural Health Research (CERHR), the Centre for International Development Research at Aberystwyth (CIDRA), the Centre for the Movement of People (CMOP) and the Interdisciplinary Centre for Environmental Microbiology (ICEM). These IRCs complement DGES's research groups by stimulating interdisciplinary collaboration, supporting bids for research funding and facilities, and providing additional resource and opportunities for internal and guest seminars, peer review, postgraduate training, and outreach activities. Externally, interdisciplinary work has been advanced through competitively awarded, HEFCW-supported initiatives including the Climate Change Consortium for Wales (C3W) (to 2015), the Sêr Cymru National Research Network for Low Carbon Economy, Environment and Energy (NRN-LCEEE), Sêr Cymru Living Wales Chair, and continuation of the Wales Institute for Social and Economic Research, Data and Methods (WISERD) with ESRC Research Centre funding.

Achievements during the REF 2021 assessment period

Our REF 2014 Research Environment and Impact Statements outlined specific objectives for the assessment period. Delivery of these objectives has been supported by targets and mechanisms, including: policies for staff development, capacity-building and research leave (see Sections 2 and 3); investment in infrastructure detailed (Section 3); and initiatives for outreach,

public engagement, policy transfer and impact (Section 4). Performance against the strategy has been monitored through reporting in the AU research information system, PURE, and annual individual research plans and review meetings for all staff, with feedback through the Research Committee.

These Research Strategy priorities have been realised by:

- **Developing interdisciplinary collaboration** with biologists, environmental scientists, physicists and computer scientists through the ICEM and ACSEM, the new Extreme Experimental Environments Laboratory, the Sêr Cymru Living Wales project, and other externally-funded projects.
- **Strengthening interdisciplinary collaboration** with economists, historians, political scientists and psychologists through the establishment of CWPS and ABi, collaboration in the DGES-led IMAJINE project, and the award of a second consecutive ESRC Research Centre grant for WISERD/Civil Society.
- **Translating the legacy of capacity-building activities** in C3W into research grants including ACCLIMATIZE, Black and Bloom, BRITICE-CHRONO, CHERISH, and the Hominin Sites and Paleolakes Drilling Project.
- **Increasing research grant capture** per year by 46% on the 2008-2014 REF period, including prestigious awards of a European Research Council (ERC) Advanced Grant and ESRC Research Centre funding, and coordination of large Horizon 2020 projects.
- **Consolidating our international research profile and networks** by introducing a visiting researcher programme, with 46 international visitors during the REF 2021 period, as well as through the successful recruitment of eight Marie Skłodowska-Curie and Newton international fellows, and leading international collaborative research projects.
- **Expanding the graduate school**, with a 15% annualised increase in PhD completions on REF 2014, retention of ESRC Doctoral Training Partnership status, and diversification of postgraduate funding.
- **Supporting the leadership and service** of DGES researchers in the subject community by recognising contributions as journal editors, panel members, and association officers, in a new workload model.
- **Promoting open access publishing** through the AU Research Portal, publisher agreements and funding for publication fees through individual discretionary funds and UKRI open access APC funds, engagement in shaping open access policies as journal editors, and supporting open research by developing open-source software for luminescence dating analysis and for spatial analysis in GIS and remote sensing (disseminated through open access libraries including RSGISLib, SPDLib, KEALib and ARCSI).
- **Strengthening impact on public policy** in Wales and internationally, by consolidating links with the Welsh Government and public agencies, including serving on advisory groups, presenting at seminars and undertaking commissioned policy-related research; engagement with policymakers in Wales through Rural-Urban Outlooks: Unlocking Synergies (ROBUST), WISERD, and the Wales Centre for Public Policy (formerly the Public Policy Institute for Wales); and consolidating links with international organisations including the European Commission and World Health Organisation in fields such as bathing water quality (see Impact Case Study).

- **Consolidating connections with civil society, local communities and with the environmental sector** in Wales and internationally, through activities including the Living Wales project, participation in the Environment Platform Wales, working with the UNESCO Dyfi Biosphere on the Citizen Observatory Web project, and leading the Global Mangrove Watch programme (see Impact Case Study).
- **Expanding impact on commercial and organisational practice** through developing CPD, workshop and short-course provision and collaborative studentships in areas including GIS, remote sensing, luminescence dating, glacial hazards, Welsh language policy, behaviour change and mindfulness (see Impact Case Study).
- **Promoting DGES research through public engagement**, creative practice and media engagement on issues including climate change, extreme weather, environmental hazards, globalisation, migration and Brexit, with examples including exhibitions, theatre performances, film, art-science events, collaboration with the Whitechapel Gallery, and work leading the production of promotional material, for example, on 'Why Geomorphology is Important'.

Three further priorities have also been adopted in response to evolving staff interests, shifting societal and policy contexts, and new funding opportunities. These are:

- **The strategic development of solutions-oriented research** addressing key environmental and societal challenges and enhancing the applied impact of DGES research. New research has explored biogeochemical solutions in environmental engineering, including geological carbon capture and storage; applications of mindfulness and behaviour change techniques to enhance policy-making, promote sustainability and tackle social problems; hydrological approaches to eradicating malaria in Africa; and smart rural development. This work is aligned with UKRI's Global Challenges Research Fund and Sustainable Development Goals, and complements existing research on bathing water quality, flood alleviation and the application of Earth observation to monitoring biodiversity.
- **The consolidation of research and outreach activities contributing to the social, economic and environmental wellbeing of Wales**, reflecting the Welsh Government's emphasis on the civic mission of universities and the principles of the Wellbeing of Future Generations Act in Wales. The delivery of this objective has involved strategic targeting of European Regional Development Funds and collaboration with businesses and public agencies.
- **The practice of social and environmental responsibility in DGES research**. AU has introduced research ethics assessments for all research proposals prior to submission, and DGES has engaged in benefit sharing in international research, including working with local partners and communities and contributing to capacity-building, within the framework of AU research integrity procedures (see REF5a).

The delivery of DGES's Research Strategy has consolidated an environment in which excellent research has flourished. Academic and research staff and postgraduates in DGES have published three monographs, 17 edited books, over 600 papers in peer-reviewed journals and over 100 chapters during this REF period, with 69% of our articles in the top 10% of journals by CiteScore (SciVal analysis). The effective implementation of our approach to impact, and our targeting of solutions-oriented research, is demonstrated in our impact cases studies. 'Improving quality standards for recreation waters' highlights our impact on public policy through close working with international organisations; 'Global Mangrove Watch' illustrates outcomes from nurturing connections with the global environmental sector and a commitment to open research; and 'Transforming Behavioural Public Policy Delivery' documents impact achieved through

research-based training programmes and responding to the Wellbeing of Future Generations agenda in Wales.

Priorities for the next assessment period

Our strategic aims for the next REF assessment period are to balance blue-sky and critical research that advances our established areas of expertise with solutions-oriented research, applications and public engagement to achieve social, economic and environmental impacts at local, national and international scales. Confirmed grant awards will support research over the next 2-3 years on topics including coastal heritage (CHERISH extension; CUPHAT), ice sheet rift propagation (RIPFISH [NERC]), Quaternary timeline of human evolution (EQuaTe [ERC]), and volunteer responses to the COVID-19 pandemic (ESRC), as well as work in the ESRC WISERD Civil Society Centre on political polarisation, elites and patronage, and new repertoires of environmental social action and participation through two ESRC-funded UK-Ireland networks on civil society and on rural policy.

A new DGES Research Strategy has been developed for the next REF assessment period, foregrounding the following strategic priorities:

- Promoting solutions-oriented research that addresses major societal and environmental challenges and facilitates commercial, technological and social innovation, supported by the capture of targeted research funding, collaboration with non-academic partners and user communities, and the appropriate adoption of co-production and citizen science methods.
- Making ongoing contributions to conceptual and methodological development in Geography and Environmental Studies, valuing and supporting pure and inquisitive research through leave policies, inclusion of non-grant research time in workload allocations, and conference support, as well as through competitive external grant funding.
- Enhancing the reach and critical mass of the Department's research capacity through strategic collaborations with academic and non-academic partners in Wales, the UK and internationally, including leading pan-Wales initiatives in our specialist areas in response to the 2020 'Strength in Diversity' report on research collaboration in Wales.
- Further strengthening interdisciplinary collaboration with cognate subject areas in AU to produce novel and agenda-setting research, including in the AU strategic research priority areas of 'Rural Futures' and 'The Lives We Want'.
- Consolidating and diversifying research grant capture to enhance long-term sustainability of our research activity, including engaging with opportunities in the UK Shared Prosperity Fund and Horizon Europe.
- Continuing to contribute to AU's civic mission in delivering research that enriches the social, economic, cultural and environmental life of Wales, deepening our relationships with stakeholders including the Welsh Government through avenues including Environment Platform Wales, engaging with the regional agenda of the Growing Mid Wales Deal and opportunities for commercial partnerships through AberInnovation, and building on the resources and networks created by the Sêr Cymru Living Wales project.
- Extending the reach of our research impact by building networks with policymakers in Wales, the UK and internationally, strengthening collaboration with transnational companies, and connecting with wider audiences by using online public engagement, event and dissemination tools.

- Maintaining the excellence of our research infrastructure and facilities with over £450k already committed to future state of the art instrumentation (including e.g., digital and fibre-optic borehole sensors; spatially-resolved micro-XRF spectrometer), upgrading existing equipment to maintain the highest capabilities (including e.g., XRF core scanner, and EDX addition for Transmitted Electron Microscope), and developing custom-built novel instrumentation with industrial partners (e.g. with Kärcher Ltd UK on the development of robust, high pressure pumps for field use).
- Continuing to train and develop the next generation of researchers in Geography and Environmental Studies through a vibrant graduate school, hosting post-doctoral and visiting research fellows, and strengthening the capacity of early-career researchers (including by supporting applications for UKRI Future Leaders Fellowships and other research funding and encouraging participation in subject networks).
- Further strengthening the inclusive research environment in DGES, including identifying and dismantling barriers to equal and effective participation in research activities for all and by adopting specific policies and actions to support staff whose research capacity has been affected by the COVID-19 pandemic.
- Contributing to the development of inclusive practice and discourse within Geography and our specialist areas by facilitating and participating in discussions and workshops to promote inclusivity, following good practice in our involvement in subject associations and conferences, and adopting benefit-sharing principles in our collaboration with international and community partners.

2. People

In the REF 2021 assessment period we have:

- *Strengthened the **vitality** of our research environment by attracting emerging world-class researchers on international fellowships, expanding our graduate school and increasing our cohort of post-doctoral researchers.*
- *Enhanced the **sustainability** of our research environment by developing the capacity of our early- and mid-career researchers, as reflected by promotions and academic awards.*
- *Promoted **inclusivity** through equality and diversity policies, modification of practices to facilitate inclusive participation, targeted support and mentoring and the fostering of a bilingual research culture.*

Staffing Strategy

DGES aims to foster an inclusive research culture in which all eligible academic staff are active in research and able to fulfil their potential as researchers. We recognise that excellent research is produced by researchers at all career stages, from all backgrounds, and in all sub-fields of the discipline, and support and promote excellent work without prejudice.

In the reporting period, the DGES staffing strategy has focused on supporting the professional development of existing academic staff in the Department, including those initially appointed as post-doctoral or early-career researchers, with progression marked by individuals becoming first-time principal investigators for research grants and research team leaders, growing external profiles and invitations to positions of esteem, and recognition of achievements through academic promotions. Since 2014, 14 members of academic staff have received internal promotions, including five to personal chairs (Brewer, Merriman, Roberts, Thomas, Tooth), four to readerships (Bunting, Davies, Mitchell, Perkins), and five to senior lectureships (Gagen, Griffiths, Heley, Hoskins, Irvine-Fynn).

The research community has been strengthened by two early-career academic appointments (Busfield and O'Connor), the transfer of Holt to a permanent contract, and strategic recruitment through the competitive Welsh Government Sêr Cymru and Marie Skłodowska-Curie COFUND programmes to bring world-class researchers to Wales. Appointments have included the Sêr Cymru Chair in Earth Observation (Lucas), with associated research team, and fixed-term COFUND post-doctoral fellows in dryland soil-atmosphere exchanges (Lan), biomineralisation (Dhami; Sand), glaciology (Racoviteanu) and luminescence dating (Ou). Additionally, DGES has hosted international research fellows supported by competitively obtained Marie Skłodowska-Curie (Kreutzer; Zebre) and Newton (Srivastara) fellowships, enhancing research capacity in luminescence dating, glaciology and environmental bioremediation respectively.

Staff Development

Professional development of all academic staff in DGES is supported by annual research planning and review meetings within AU's Effective Contribution Scheme, which include identification of training and capacity building needs (see REF5a). Staff have been supported in undertaking training and professional development courses internally and externally, including on research grant writing, project management, research ethics and data management, media engagement, leadership skills, and pan-departmental techniques such as image analysis and the use of drones in research. Academic staff participate in university and departmental level seminars, workshops and 'cafés' enabling the sharing of good practice in research and public engagement, as well as informal discussions of research ideas, proposals and draft publications (in human geography the 'Social Research Lab'), reading groups and writing retreats. Targeted research mentoring has been provided to staff not returned in REF 2014 to facilitate eligible returns in REF 2021.

The introduction of a Workload Allocation and Management Model (WAMM) has provided a mechanism for assigning research time and recognising research and research-related activities. All academic staff are allocated 550 hours annually for research, with additional time allocations for commitments to externally funded research projects, PhD supervision and intensive activities such as journal editing. A research leave policy entitles academic staff on research and teaching contracts to apply for sabbatical research leave of six months every four years, subject to the approval of a research plan by the DGES Research Committee. During the 2014-2020 REF period, 29 periods of research leave have been awarded in DGES under this policy, totalling 14.5 years of dedicated research time. Academic staff in DGES receive a standing annual research fund allocation to support conference participation and other minor costs, with further funding available from DGES's Discretionary Research Fund and through the distribution of a proportion of indirect cost from external grants to individual research accounts.

Additional support for early-career researchers includes mentoring, fast-tracked research leave after 3 years, an annual sandpit event to develop projects, and access to seed-corn funding for small-scale and pilot research from ring-fenced pump-priming funds. Early-career researchers are encouraged to apply for external research funding, with guidance and support – including a formal process of internal appraisal and mentoring of grant applications – from experienced colleagues, as well as to develop initiatives in the Department and to take on active roles and leadership positions in external organisations and networks. These policies also apply to early-career researchers on fixed-term contracts providing cover for permanent staff with buy-outs for fellowships or research projects, with the aim of assisting them to develop research profiles and secure permanent employment. In the period since 2014, two early-career researchers have moved from fixed-term and/or associate lecturer to full lecturer contracts within DGES, and five have been appointed to permanent positions at other universities or research institutions.

Four early- or mid-career researchers in DGES have participated in the HEFCW Welsh Crucible (Griffiths, Heley, RD Jones and PDRA Goodwin-Hawkins), a competitive scheme to identify and develop future research leaders. This involves intensive residential workshops on themes including media engagement, networking with policy stakeholders, research impact and interdisciplinary working, as well as seed-corn funding for small-scale interdisciplinary projects

with participants from other Welsh HEIs. The achievements of early-career researchers have been recognised in the assessment period by awards including the Eilir Hedd Morgan Memorial Prize for Welsh-medium science research (Busfield [2019] and Griffiths [2015]), the Worshipful Livery Company of Wales Gold Award (Griffiths) and the AU Award for Excellent Research Impact (Hardy).

Experienced researchers in DGES are encouraged to apply for external research fellowships to facilitate innovative research and undertake significant writing projects to enhance their profiles – with awards obtained during the REF 2021 period including Leverhulme Research Fellowships (Irvine-Fynn; RA Jones), KCL Australia-UK Bicentennial Fellowship (Thomas) and the Independent Social Research Foundation Mid-Career Fellowship (Whitehead) – and to take on research leadership roles within AU and externally, with time commitments recognised in the WAMM. Experience of research leadership has been nurtured through the appointment of emerging mid-career researchers as leaders of research groups and centres (including Bunting, Merriman, Roberts, Thomas, Tooth, Whitehead); and Department members have been appointed to senior research-related leadership positions in AU, including: Pro Vice Chancellor and Dean of the Faculty of Earth and Life Sciences (Glasser); AU Director of Research Excellence and Impact (Roberts); Director of the Institute of Geography, History, Politics and Psychology (Glasser); Professor of Transformative Social Science (leading research capacity-building in the social sciences) (Woods); and Chair of the Research Ethics Panel (Roberts).

The research excellence of DGES staff has been recognised in elections to fellowships of the Academy of Social Sciences (Woods) and the Learned Society of Wales (Woods, joining Kay and Emeritus Professors Dodgshon and Hambrey as Fellows), and awards including the Polar Medal (B Hubbard), the NSF Antarctic Service Medal (Mitchell) and the Water Industry Forum Prize for Research Impact (Kay). Glasser's contribution to Antarctic science was recognised by the naming of the Glasser Glacier on James Ross Island by the Antarctic Place-names Committee in 2016, and Lamb's career contribution to Quaternary research was marked by a special issue of Quaternary Science Reviews in his honour in 2018.

Post-Doctoral Researchers

The DGES research community has benefited during the REF 2021 period from 24 post-doctoral research staff employed on grant-funded research projects. Post-doctoral research staff are affiliated to research groups, assigned independent mentors, and have access to internal and external professional development courses. They are encouraged to participate in research seminars and other Departmental activities, and to publish and present at conferences on their own research. Since 2014, post-doctoral research staff have published 97 outputs during their appointments at DGES, including 43 sole- or lead-authored publications. The research environment in DGES has assisted post-doctoral researchers in establishing their research careers and securing further employment. Since 2014, post-doctoral research staff in DGES have been appointed to lectureships or associate lectureships at Aberystwyth, Cambridge, Edinburgh, Edinburgh Napier, Keele, Liverpool, Royal Holloway and Salford universities; and to research posts in DGES and at Gloucestershire, Kent, Liverpool, Manchester and Sheffield universities and the Geological Survey of Ljubljana.

Research Students

The expansion of the graduate school has been a key objective for DGES in REF 2021, with 61 PhD completions compared with 38 completions in REF 2014, a 15% increase in the annualised rate. All awards have been for research-based doctorates.

Research students in DGES each have two formal supervisors, with 34 staff supervising research students during the assessment period. All staff supervising research students are required to have completed appropriate training. Staff in DGES have additionally externally supervised 21 PhD students at other UK and international institutions.

Fifty-two new PhD studentships were awarded in the assessment period. In Human Geography, DGES is an accredited pathway in the ESRC Wales Doctoral Training Partnership and is eligible

for funding from the AHRC South West and Wales Doctoral Training Partnership. During the assessment period, four PhD studentships have been competitively awarded directly from the ESRC Wales DTP, with a further five ESRC-funded PhD studentships linked to the WISERD/Civil Society research centre (four match-funded by AU). Other PhD studentships awarded include 14 EU-funded Knowledge Economy Skills Studentships (KESS) involving collaboration with industrial partners, 16 awards from the Aberystwyth University ABERDOC/DCDS competitions, and 13 studentships funded from other sources, including AHRC, NERC, ERC (linked to GLOBAL-RURAL project), Coleg Cymraeg Cenedlaethol, Commonwealth Scholarships and the UK Space Agency. DGES has hosted three long-term visiting PhD students from Brazil and China funded by the CAPES scheme and Chinese Scholarship Council respectively, as well as short-term visits by 18 PhD students from Australia, Belgium, China, Czechia, Finland, Germany, Japan, Netherlands, Switzerland and other UK universities.

All research students in DGES complete subject-specific training within the Department and generic training delivered through the University's Graduate School. They have access to further professional development activities within the Vitae Researcher Development Framework as well as to the monthly AU research cafés, as well as activities organised by IRCs and networks, including CWPS and WISERD. Human geography research students participate in an annual symposium run by the ESRC Wales DTP and linked residential 'theory school', which DGES staff contribute to organising, and DGES PhD students have participated in summer schools and training events run by the British Society for Geomorphology (BSG), EGU, European Society for Rural Sociology (ESRS), the Researchers in Development Network, and the RGS-IBG Postgraduate Forum.

Research students are assigned to research groups and encouraged to participate fully in the Department's research culture, including assisting with the organisation of guest research seminars, as well as in IRCs and networks. A DGES PhD student sits on the CWPS management committee and during the assessment period DGES PhD students have served as postgraduate representatives and committee members in the RGS-IBG Postgraduate Forum, Geographies of Health and Wellbeing Research Group, Rural Geography Research Group and Social and Cultural Geography Research Group, the BSG Postgraduate Forum, and as News Editor for the Geographical Directions blog. Research students are encouraged to participate in national and international conferences, with support available from a Postgraduate Discretionary Research Fund in addition to RTS allocations, and to publish in appropriate journals. Since 2014, DGES research students have published more than 110 papers in academic journals, organised seven workshops and conference sessions, and have presented more than 100 conference papers and posters.

PhD students have additionally contributed to public engagement and impact activities, including giving the annual E.G. Bowen Lecture at the National Eisteddfod; participating in the ESRC Festival of Social Science, British Science Week and the Far Old Line Art-Science Festival; organising events on behaviour change, volunteering, museums and civil society and land-grabbing; curating exhibitions at the National Library of Wales; giving talks to local and specialist associations; writing three articles for The Conversation and several blog-posts; meeting with Welsh Government officials and Welsh Assembly Members; and being interviewed for BBC Radio and other media outlets. DGES PhD students have been recognised during the assessment period in external competitions, including Maderson (finalist, ESRC Making Sense writing award), Riedesel (Best Student Oral Presentation, UK Luminescence & ESR Meeting 2018 and 2019), and Hepburn (Best Poster, BSG Conference 2019).

As an indication of the quality of graduate research training in DGES, 32 PhD students completing since 2014 have secured academic appointments, including lecturing or teaching posts at AU, Swansea, National Taipei University (Taiwan), National Tsing-Hua University (Taiwan), Thammasat University (Thailand) and the University of Swaziland; and research positions at AU, Brown University (USA), Cal-Tech (USA), Cambridge, Cologne, Leicester, Masaryk University (Czechia), National Taiwan University, Newcastle, Sheffield, Sheffield

Hallam, Swansea, UWE and the Max Planck Institute for Evolutionary Anthropology. Two ESRC-funded PhD students (Maderson and Saville) have competitively secured Post-Doctoral Fellowships from the ESRC Wales DTP, both held in DGES.

Equality, Diversity and Inclusion

DGES is committed to building an inclusive research environment with respect to equality and diversity in recruitment, promotion and staff development; opportunities and support for research; research mentoring and monitoring and REF selection; postgraduate recruitment and supervision; and impact and engagement activities. We are working towards a diverse research community in DGES that is representative of the society in which we work, including the target of achieving a gender balanced team. During the assessment period, women have comprised 60% of new REF-eligible academic appointments, 67% of post-doctoral and research fellow appointments in the department, and 50% of new PhD students.

The commitment of DGES and AU has been recognised by a Disability Confident Employer accreditation and inclusion in Stonewall's Top 100 UK Employers for a LGBT+ friendly workplace. All staff are required to complete Equality and Diversity Training and several networks promote equality issues and provide support for researchers, including the Women in Research Network, BAME Network, LGBT Network, and Disability and Wellbeing Network. Within DGES, equality and diversity issues are promoted by a designated Equality Champion. As well as AU policies on flexible working, the Department has enhanced the inclusivity of its research environment through actions such as moving research seminars from late afternoon to lunchtime to avoid conflicts with childcare, and introducing fast-tracked research leave and additional research fund allocations for staff returning from periods of parental leave.

Principles of equality and inclusion have been incorporated into the REF 2021 selection process, as outlined in AU's Code of Practice, with all members of the REF Reading Committee and supplementary reviewers required to have completed Unconscious Bias training. The Departmental REF Reading Committee has also included an independent member from a cognate department to monitor fair practice. Applications for output reductions for Individual Staff Circumstances have been assessed through an anonymous process, with decisions made outside the Department.

DGES researchers have also contributed to promoting equality and diversity within their subject communities, including organisation of a panel on disability and chronic illness in academic Geography at the 2019 RGS-IBG Conference (PhD student Kingsbury) and the online 'Girls into Geoscience' initiative (Busfield), and commentaries co-authored by Tooth on 'Equality, Diversity, Inclusion: Ensuring a Resilient Future for Geomorphology' (Earth Surface Processes and Landforms, 2020) and Woods on 'The Language of Rural: Reflections Towards an Inclusive Rural Studies' (Journal of Rural Studies, 2020). Roberts participated in the 'Girl Talk' project at the National Eisteddfod in 2017 showcasing the work of women scientists in Wales. Within AU, DGES researchers have contributed to initiatives to promote diversity, including co-organisation by O'Connor of a workshop on 'Is Our University Too White?' in 2019.

DGES supports a bilingual research environment in which English and Welsh languages have equal status. All research conducted in Wales follows AU's Welsh Language Policy with opportunities for research subjects to participate in Welsh and bilingual communication with research participants and the public. Staff and postgraduates are encouraged to present and publish research in Welsh where appropriate, and DGES academic Griffiths is Associate Editor of the Welsh language academic journal Gwerddon. Welsh-medium research is supported by the Coleg Cymraeg Cenedlaethol, to which five DGES staff are affiliated. Welsh language public engagement and impact activities include events at the National Eisteddfod and Urdd Eisteddfod, contributions to the Welsh language media, bilingual publication of research reports and newsletters, and simultaneous translation at public lectures and events.

3. Income, infrastructure and facilities

In the REF 2021 assessment period we have:

- Demonstrated the **vitality** of our research environment by securing over £18.3m in competitive external income and increasing our capture of large grants, supporting research in 65 countries, and methodological and theoretical innovation.
- Enhanced the **sustainability** of our research environment by investing in and maintaining world-class laboratory facilities and facilitating research development through workshops, networks and pilot funding.
- Strengthened **inclusivity** in research through training and mentoring to build the research capacity of all staff, enabling more staff members to obtain external research funding.

Research Income

DGES has received £19.6m in HESA-reported external research income (spend) during the assessment period, with average annual income up by 46% on the 2008-2014 REF period (Figure 2). We have secured £18.3m in new competitive research grant awards in the REF 2021 period, including UKRI awards from NERC (14 awards, £1.9m total value), ESRC (four awards, £1.44m), AHRC (two awards, £245k), and STFC (one award, £190k); and awards from the ERC (three awards, £2.85m), other Horizon 2020 (six awards, £1.19m), EU Structural Funds (eight awards, £5.37m), UK and Welsh government (19 awards, £1.03m), the Leverhulme Trust (two awards, £105k), and the British Council (five awards, £312k). This represents an increase in research grant capture per annum of 32% on REF 2014. External research funding has been secured by 33 academic staff during the assessment period, with five researchers each securing over £1 million in new grant awards as PIs, covering work in glaciology, Quaternary research, remote sensing, water quality, and human geography.

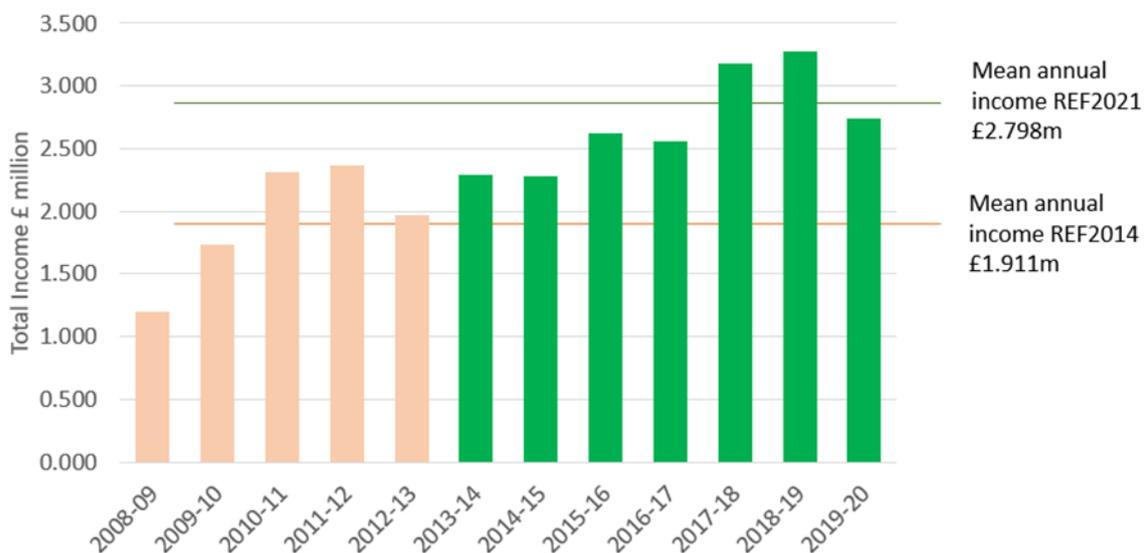


Figure 2: Annual total external research income in REF 2014 and REF 2021 periods

Strategic targeting of large grants has resulted in a doubling, to £12.7m, of total income from research grants worth more than £250,000 to DGES compared with the previous REF period (increasing to 19 awards from 13 awards). Notable large grants awarded during REF 2021 include:

- ERC Advanced Grant GLOBAL-RURAL (£1.76m [€2.25m]) and ERC Consolidator Grants RESPONDER (£594k to DGES) and EQuaTe (£498k to DGES);
- Horizon 2020 RIA projects IMAJINE (DGES coordinating, €5m total, £395k to DGES), MICROARCTIC (£186k to DGES) and ROBUST (£276k to DGES);
- European Space Agency CCI-Biomass project (DGES coordinating, €1.5m total, £200k to DGES);
- ESRC WISERD Civil Society centre award (£632k to DGES for 2014-19) and renewal (£708k to DGES for 2019-24);
- NERC projects MOMENTS (£455k) and RIPFISH (£270k [awarded, but start date delayed to 2021 by COVID-19]);
- Welsh Government Sêr Cymru Living Wales project (£864k) and NRN-LCEE award Geo-Carb-Cymru (£284k);
- Geoscience Australia project Landcover and Evidence-based Change Mapping (£507k)
- Projects funded through EU Structural Funds, including ACCLIMATIZE (£2.13m to DGES), GEOM (£924k to DGES), CHERISH (£739k to DGES) and Ports Past and Present (£579k to DGES).

These awards have complemented continuing large grants awarded prior to the assessment period, including the ESRC Transformative Social Science grant Negotiating Neuroliberalism (£167k), NERC Hominin Sites and Paleolake Drilling Project (HSPDP) (£440k) and AHRC 'Extreme Weather' project (£260k). DGES staff have also participated in more than 50 grants held at other institutions, receiving indirect support through travel, fieldwork logistics, laboratory time and equipment totalling more than £500k.

Research grant capture has been supported by initiatives to facilitate research planning and development, including: annual planning and review meetings with staff members; internal peer review of research proposals and sharing of expertise; building capacity of early-career researchers through collaboration in larger projects and research centres; and participation of DGES staff in research development activities organised by the AU Department of Research, Business and Innovation – including 'Grants Factory' workshops, research cafés and sandpit events – and external bodies, including pitch-to-peers sessions for social science organised by WISERD. Seed-corn funding for pilot studies has been provided to DGES researchers by the University Research Fund, the GCRF-supported Centre for International Development Research at Aberystwyth (CIDRA) and WISERD. DGES researchers also benefited from the university-wide ESRC-funded Transformative Social Science initiative (2014-2017), linked to Whitehead's ESRC Negotiating Neuroliberalism award and coordinated by Woods, which provided seed-corn funding for pilot research and facilitated research development through sandpits, workshops, mentoring and training. These activities led directly to the H2020 IMAJINE project and the development of the ABi centre.

External research income has supported research in 65 countries (Figure 3), employed 47 post-doctoral and graduate research staff, facilitated data analysis including the use of specialist facilities, and released staff time for research work, leading to high quality publications and other outputs.

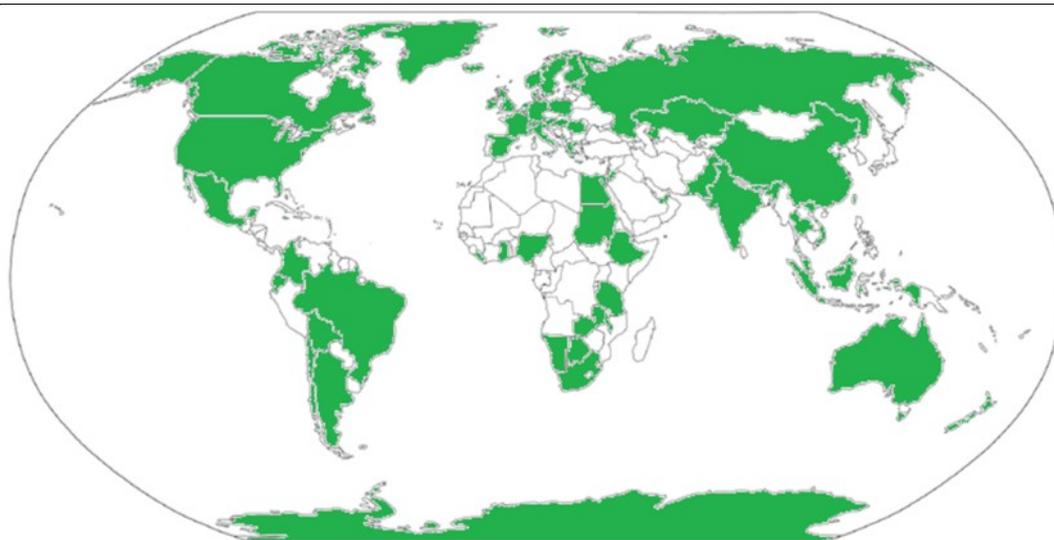


Figure 3: Countries and territories where DGES researchers have undertaken research in the REF 2021 assessment period.

Infrastructure and Facilities

Research in DGES is underpinned by world-class laboratory facilities and resources. Core research technicians (1.9 FTE) support laboratory intensive research, and design, build and maintain instrumentation. Key facilities and resources include:

- The Aberystwyth Luminescence Research Laboratory (ALRL), with instrumentation for Luminescence dating with unique UK capability (ALRL held NERC Recognised Facility status while that category operated until 2016);
- An Itrax XRF Core Scanner for high resolution elemental analysis of sediment cores with new high specification XRF detector and software installed February 2020;
- The Experimental Extreme Environments Laboratory (EX2EL), a state-of-the-art facility established in 2014 between DGES and the Institute of Biological, Environmental and Rural Sciences (IBERS) for studying mineral-fluid-gas-microbe interactions at extremes of temperature, pressure and aridity;
- Geochemistry laboratories including a laser ablation ICP-MS instrument for mass spectrometry;
- Palaeoecology laboratories, with pollen and diatom preparation and microscopy facilities and an extensive pollen reference collection;
- The Earth Observation Laboratory, equipped for the analysis of remotely-sensed imagery, LiDAR and SAR data, including a spectroradiometer;
- A 3DIce Research Facility, including a deep hot-water ice drill and suite of geophysical borehole probes with winches with up to 3km capacity;
- An extensive collection of field equipment for glaciological, palaeoenvironmental and hydrological research, including drilling and coring equipment, dinghies and pontoons; GPR and DGPS; fixed-wing UAVs and quadcopters, and a 10m Parker Cabin Rib equipped for coastal surveying;
- Social science research resources, including qualitative field equipment and access to coding and online survey tools.

In addition to £18.3m of research grant capture, more than £2m of capital funding has been invested in upgrading and enhancing research facilities, laboratory and field equipment since 2014. These include an Elementar isoprime stable isotope analyser (£180k); luminescence readers and unique imaging capability in ALRL (£550k); UAVs and ground penetrating radar for polar geophysical and cryosphere remote sensing research (£338k); fixed wing and rotary UAVs and UAV LiDAR capability (£185k), and upgrading of the XRF core scanner, complemented by a new portable XRF analyser (£60k).

Capital investment includes shared facilities with IBERS of £350k to establish EX2EL and £405k for two new electron microscopes with chemical analysis capabilities (SEM-EDX and TEM-EDX), led by DGES. An ongoing programme of estates investment has included refurbished office accommodation for research staff, a research computing suite, and a new flexible research seminar space for up to 65 people.

Research in DGES benefits from wider local resources, including the University library and extensive electronic information resources, and the adjacent National Library of Wales, a UK copyright library. The Earth Observation and Ecosystem Dynamics Group is a major user of the national Supercomputing Wales infrastructure, which provides access to data storage, research software engineers and supporting rapid processing of remote sensing data.

To support commitments to Open Access and good practice in research data management, each research project is allocated networked server space (including ~500TB storage for Earth Observation data), with back-up on a shadow server, and open access to research outputs is facilitated through the AU Research Portal and Data Catalogue. Data Management Plans are required for all research projects.

4. Collaboration and contribution to the research base, economy and society

In the REF 2021 assessment period we have:

- *Supported the **vitality** of our research environment by hosting international visitors and academic meetings and conferences, participating in the subject community, and engaging with local, national and international stakeholders to translate our research into contributions to social and economic wellbeing, environmental sustainability, policy and public culture.*
- *Consolidated the **sustainability** of our research environment by developing new collaborations with academic and non-academic partners, nationally and internationally that have strengthened our research capacity and extended the reach of our research impact.*
- *Strengthened **inclusivity** in research, within and beyond DGES, by recognising staff contributions to the subject community and to wider economy and society in a workload allocation model, and by practicing co-production of research with stakeholders and communities and benefit-sharing with international collaborators.*

Collaborations

DGES is committed to collaborative and interdisciplinary research, locally, nationally and internationally. Within AU, we collaborate with researchers from almost every other department, across the sciences, social sciences, arts and humanities, through research projects, co-authored publications and joint PhD supervision. These collaborations have been formalised and strengthened during the assessment period through the formation of Interdisciplinary Research Centres, including the Aberystwyth Behavioural Insights centre (led by RA Jones and Whitehead; with International Politics and Psychology); the Aberystwyth Centre for Space and Earth Modelling (co-led by Bunting; with Computer Science and Physics); the Centre for Excellence in Rural Health Research (with IBERS, Computer Science and Psychology); the

Centre for the Movement of People (with Modern Languages and International Politics); the Interdisciplinary Centre for Environmental Microbiology (with IBERS); and the Centre for Welsh Politics and Society (co-directed by Woods; with Business, International Politics, History & Welsh History and English). These IRCs receive core funding from the University Research Committee and benefit DGES by facilitating the development of interdisciplinary research projects and grant bids, enabling shared use of facilities and resources, and coordinating public engagement and research impact activities.

Within Wales, collaborations with researchers at Bangor, Cardiff, South Wales and Swansea universities extend our research capacity by providing critical mass for large grant bids, complementing our research expertise in interdisciplinary projects, and amplifying the efficacy of engagement and impact with stakeholders. Key collaborations include the Sêr Cymru NRN-LCEEE, which has supported fellowships and studentships in DGES; the Climate Change Consortium for Wales (C3W) and the Centre for Catchment and Coastal Research during the early part of the assessment period; and WISERD. As well as hosting an ESRC Research Centre, WISERD encompasses a wider range of projects, networks, training and capacity building courses and public engagement and knowledge transfer activities, and was commended in the Diamond Report on Student Finance and Higher Education Funding in Wales for its contribution to social research. DGES is the second most significant participating department in WISERD by people and research spend.

International collaborations

A strategic priority for DGES during REF 2021 has been the development of its international profile and networks, with supporting mechanisms and policies including research leave, a visiting scholar policy, an annual staff research allocation for travel and conferences, a strategic review of Memorandums of Understanding (MoUs) and partnership agreements, and support for applications to international research fellowship schemes (including COFUND, Mare Curie-Skłodowska and Newton). Funding for networking and scoping visits for international collaboration has been obtained from the GCRF, Newton Fund, Rutherford Fund, Welsh Government SCoRE programme, and WISERD.

These actions have enabled DGES researchers to lead and join major transnational research collaborations, including: coordinating the interdisciplinary Horizon 2020 IMAJINE project on territorial inequalities and spatial justice (with 15 partners in 13 countries) and the ESA CCI-Biomass project (with 11 partners); in Horizon 2020 projects CHANGE, CREDit and ROBUST, MCSA Initial Training Network MICROARCTIC, and the NERC-supported international HSPDP consortium; collaboration with Irish partners through the INTERREG programme in the ACCLIMATIZE, CHERISH, ECHOES and Ports Past and Present projects; and contributions to collaborative projects supported by international funding bodies, including the Belgian Science Foundation, DFG, Norwegian Funding Council, NSF, SSHRC and Swedish Research Council (Figure 4). International networking within specific areas of expertise has been facilitated by partnerships and MoUs, including the Trans-Atlantic Rural Research Network (TARRN) of leading rural social science centres in the UK and USA, and with the Universidad Nacional de la Patagonia. SciVal analysis shows that 62.3% of our journal articles in the REF 2021 period included international co-authors.

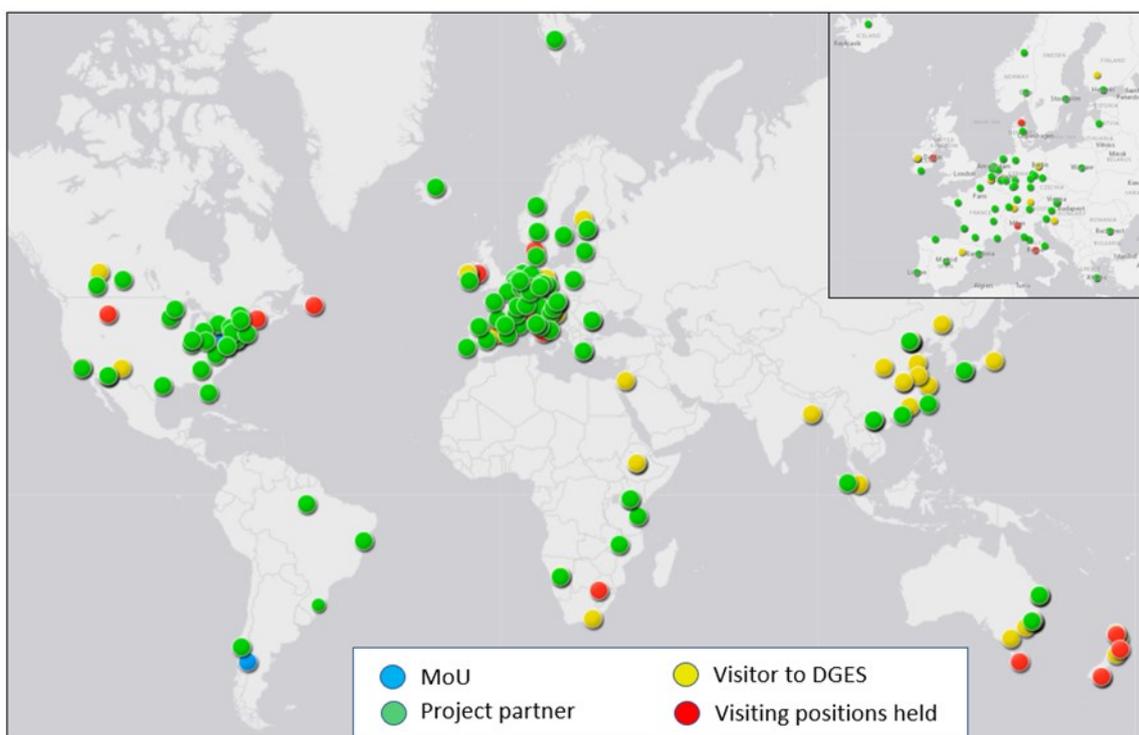


Figure 4: DGES international collaborations and networking in the REF 2021 period.

Collaboration with researchers in the global south, guided by benefit-sharing principles, has been a specific aim and has involved working with local partners, including in Ethiopia on the NERC HSPDP project; Zambia on the NERC FLOODMAL project; Indonesia and Vietnam on the NERC MOMENTS project; Nepal on the NERC EverDrill project, and Brazil, China and Malawi on the ERC GLOBAL-RURAL project (including a MoU with the Chinese Academy of Sciences). New initiatives have been developed with researchers in Argentina, Botswana, Brazil and Jordan through GCRF and British Council networking funds, and in Namibia in a Rutherford Fund SPG. Benefit-sharing activities have included co-authorship of papers, support for partners to participate in international conferences, graduate student workshops and mentoring, and facilitating the formation of a new network of rural development researchers in Brazil, as well as training in field geomorphology and GIS for local researchers and stakeholders in Bhutan and Nepal.

International exchanges and links have been further enhanced by eight in-coming fellowship awards through COFUND, Marie Curie-Skłodowska Individual Fellowship scheme, and the Newton Fund, and hosting 50 international visitors from 20 countries since 2014 through DGES's visiting scholar policy (including visitors funded by the Chinese Scholarship Council and a Rutherford Strategic Partnership Grant). In the same period, DGES researchers have held 23 visiting positions at institutions in 13 countries, including: the William Evans Fellowship at the University of Otago (B Hubbard), Moore Institute Visiting Fellowship at NUI Galway (held separately by Griffiths, RD Jones and Woods), as a Guest Professor at the Chinese Academy of Sciences (Woods), Honorary Professor at Witwatersrand University in South Africa (Tooth), Adjunct Professor at Trinity College Dublin (Lamb), and Adjunct Associate Professor at Montana State University (Mitchell).

Collaboration with social, policy and commercial partners

As part of DGES's impact strategy, collaborations have been developed with non-academic partners in the UK and internationally. In the assessment period, DGES researchers have worked with policy and civil society partners on several EU-funded projects including ACCLIMATIZE (Natural Resources Wales, EPA, Environmental Health Wales and local authorities), CHERISH (Royal Commission on Ancient and Historical Monuments in Wales, Geological Survey Ireland), Ports Past and Present (Wexford County Council) and ROBUST

(Welsh Local Government Association), as well as through the Environment Platform Wales (led by Natural Resources Wales, with Davies serving on the Board).

Commercial partners have been engaged through collaborative projects, notably QinetiQ in knowledge transfer projects on drone use and helping businesses to use remotely sensed data; and commercial, government and civil society partners were involved in more than 25 collaborative PhD and Masters projects, including Environment Systems, Ecodyfi, Cwmni Telesgop, Tata Steel and Robertson Geologging. Public engagement and communication have also been enhanced by collaborations with cultural partners including the Whitechapel Gallery on 'The Rural Assembly: Contemporary Art and the Rural' event and with the WOW Film Festival, and the strengthening of relationships through honorary appointments, including Honorary Professors Richard Bevins (formerly Keeper of Natural Sciences, National Museum of Wales) and John Reynolds (Reynolds International Ltd).

Contributions to the Discipline and Research Base

Contribution to the wider research base in Geography through active participation in subject conferences, associations and periodicals is a key objective of the DGES Research Strategy. Service in editorial and society positions and in peer review and significant conference organisation is recognised in the WAMM, and staff are encouraged to participate in major conferences, with travel support available through the annual departmental research allocation of £500 per staff member, DGES Discretionary Research Grants, and the distribution of research grant overheads. Since 2014, the Department has hosted and provided support for conferences and scientific meetings including the Remote Sensing and Photogrammetry Society 2014, Quadrennial UK-US-Canadian Rural Geography Conference 2015, TARRN 2017, British Society for Geomorphology 2018 and WISERD Annual Conference 2014 and 2019, and 26 symposia and workshops linked to research projects and externally-funded seminar series.

DGES staff have contributed to the scientific committees organising 14 further conferences (including ESRS 2015, ICHG 2015 and INQUA 2019), convened over 60 sessions at major conferences (including AAG:5, AGU:4, EGU:16, RGS-IBG:14), and presented over 275 conference papers (including AAG:14, AGU:38, EGU:48, RGS-IBG:29), including 38 invited plenary or keynote addresses, as well as more than 75 invited lectures or seminars to universities and institutions in the UK, Australia, Belgium, Brazil, Canada, China, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Spain, Switzerland and United States. More than 80 guest speakers from UK and international universities have presented seminars and lectures in DGES since 2014, including 21 distinguished DGES alumni and former staff members as part of the Centenary Lecture Series in 2017-2018.

Through editorial work, DGES staff have supported scholarly publishing and shaped disciplinary trajectories as editors of nine journals (Ancient TL (Duller), Environmental Values (Whitehead), Geo (Davies), Geomorphological Techniques (Holt), Journal of Geophysical Research: Earth Science (B Hubbard), Journal of Quaternary Science (Duller), Journal of Rural Studies (Woods), Quaternary Science Advances (Glasser) and Quaternary Science Reviews (Glasser)); as associate editors or review editors of a further 14 journals; and as members of editorial boards for 33 journals. DGES researchers are book series editors for Routledge (Whitehead) and Policy Press (Woods), and have guest edited eight journal special issues and two Geological Society Special Publications in the assessment period.

Staff have also contributed to the discipline as officers or committee members of subject associations, including: Glasser (President, Quaternary Research Association), Roberts (Vice President, INQUA Stratigraphy and Geochronology Commission), Tooth (Chair, BSG), Davies (Secretary, International Society for Diatom Research) and RD Jones (Secretary of the Social and Cultural Geography Research Group), as well as over 20 other positions in RGS-IBG research groups, AGU, IGS, IGU, IUGG, RSPSoc and groups and committees and other organisations. Duller is the UK representative on a working group to establish an International Society for Luminescence and ESR Dating.

DGES has actively supported networking and development for new and early-career researchers, hosting the 2016 HGRG Postgraduate Conference and 2016 ESRS Postgraduate Autumn School, and with staff contributing as guest speakers to the Warwick Political Geography Graduate Conference, SUSPLACE ITN Meeting, and Regional Studies Association Masterclass at the European Week of Cities and Regions, as well as a keynote address to the Geographical Association Conference. DGES researchers have promoted good research practice as invited speakers at an ERC Conference on Ethics in Social Science Research (Woods), a RGS-IBG panel on 'Ethics in/of Geographical Research' (Tooth), and a workshop on Researcher Wellbeing at Cambridge University (Gagen); and supported researcher professional development, notably through the internationally-recognised specialist luminescence dating course run by Duller and Roberts.

Contributions to the research base have additionally been made as members of grant award panels or peer review colleges, including for the AHRC (Griffiths, Hoskins, RA Jones, Merriman), NERC (Glasser, B Hubbard), NERC Environmental Isotope Facility (Davies), ERC (Woods), European Science Foundation (Merriman), UKRI Future Leaders Fellowships (Merriman), Commonwealth Scholarships (Woods), and research councils in Austria (Merriman), Australia (Woods), Ireland (Griffiths), Sweden (Thomas, Woods), and USA (B Hubbard). Woods has also contributed to the wider research base as a member of the Welsh Government Review of Student Finance and Higher Education Funding (Diamond Review) and as Chair of the External Science Review for the Social, Economic and Geographical Sciences Group at the James Hutton Institute.

Contributions to Economy and Society

DGES produces research that is relevant to a range of non-academic users and contributes to social and economic wellbeing, environmental sustainability, public policy development and governance practice and the public understanding of science and social science. These aims are pursued through strategic initiatives and activities including: working in partnership with commercial, public and civil society organisations; translating pure research into applied contracts and consultancy; engagement with policy stakeholders; participation in government advisory roles and contributions to public inquiries and consultations; provision of advice and training for businesses; dissemination of research through new and traditional media; and public engagement through talks and events. A primary focus in Wales reflects the civic mission of AU, but activities extend across the UK and internationally, giving DGES research global impact.

Mechanisms to facilitate engagement and impact include access to AU funds and short leave for impact-related activities; explicit recognition of impact- and engagement-related activities in WAMM; training and capacity building in media and policy engagement, including through the Welsh Crucible programme; inclusion of impact planning in annual research review meetings; training for postgraduate students on communicating science and policy engagement; and organisation of public engagement events.

In the assessment period, these policies and mechanisms have enabled DGES research to contribute to the economy by developing e.g., commercial uses of drones to create market-ready products (in collaboration with QinetiQ), providing support for applications of GIS and remote sensing technologies by businesses (through the GEOM and Living Wales projects), and exploring the potential of low carbon subsurface energy in Wales in the NRN-LCEEE Geo-Carb-Cymru project. Further contributions to economic development have been made through work with the Welsh Local Government Association (WLGA) on a post-COVID-19 Rural Vision as part of the ROBUST project, a Mid Wales regional skills assessment for the Welsh Government, advice to the National Lottery Charities Fund Wales's Rural Programme, and inputs into planning for Welsh Government post-Brexit Regional Investment Framework by RA Jones and Woods as members of the Monitoring and Evaluation Sub-Group.

More broadly, relationships with the Welsh Government have facilitated contributions to policy development and governance, including invited presentations and briefings on topics including Brexit, rural development, environmental change and language policy, as well as delivery of

workshops and training sessions with the Welsh Government and the WLGA on mindfulness in policy-making and delivery. DGES researchers have contributed to work by the Public Policy Institute for Wales / Wales Centre for Public Policy on rural poverty; provided evidence and analysis on the impacts of Brexit on agriculture and rural healthcare (as part of AU's Framework Agreement with the Welsh Senedd), and advised on humanities in the new Welsh curriculum. The ESRC WISERD Civil Society Centre has supported workshops for policy and civil society stakeholders on language policy, evaluation of youth work, integration of migrant workers, combating hatred and hostility in rural communities, and refugee support. Beyond Wales, DGES staff have given invited presentations to the UK Department of Transport, DEFRA and the Estonian Ministry of Rural Affairs, and to a USDA and National Academies expert workshop on rural-urban classifications in the USA.

Impacts on environmental sustainability have been achieved through the provision of data and evidence from our research to underpin EU and WHO bathing water standards, and for global monitoring of biomass (CCI-Biomass project) and changes in mangrove extent (Global Mangrove Watch). Data from DGES research has informed land use classifications in Australia and Wales and been applied in environmental monitoring and management in Wales and elsewhere, facilitated in part through the release of open-source software and data for use by public agencies, conservation organisations and other stakeholders. Our researchers have run workshops on water quality for the EU, WHO and German Länder governments (Kay), and on glacial hazard mitigation for communities in Nepal (Racoviteanu). DGES staff have also supported environmental policy development and delivery as members of the UK Government SAGE Volcanic Emergencies Sub-Committee (Grattan), Welsh Government Advisory Panel on Sustainable Development and Change Programme (Whitehead), Natural Resources Wales Evidence Advisory Committee (Whitehead), and UNESCO UK Man and Biosphere Programme Committee (Woods).

DGES's impact strategy emphasises public discourse and public understanding of science, which has been supported by public talks and the promotion of research findings through the Department's social media accounts, as well as encouragement for researchers to build innovative engagement activities into projects, with ideas shared through AU's engagement café series. During the assessment period, more than 20 public talks and events have been organised by DGES directly or through research centres and projects, including lectures and panels at the National Eisteddfod and Urdd Eisteddfod, events as part of the ESRC Festival of Social Science, and CWPS public lectures, including the 2020 Annual Lecture by First Minister of Wales Mark Drakeford. Additionally, over 80 talks have been given by DGES staff to TEDx, science cafés, festivals and local clubs and societies in England and Wales, as well as more than 160 talks to schools. Tooth's work on the 'Why Geomorphology is Important' brochures series has been significant in promoting the public profile of geomorphology in the UK and internationally.

DGES has encouraged innovation and creativity to disseminate research to diverse public audiences, including work with theatre groups on performances including 'The Storm Officer' exploring weather memories (AHRC TEMPEST project) and 'The Forecast Project' on climate change and community (funded by the Transformative Social Science programme); film, including the documentary 'En Route' on asylum seekers in rural Sardinia, which has been screened at a number of film festivals in the UK, Italy and Argentina; poetry, reflecting on water and weather; and collaborations with artists, including Antony Lyons, Julian Ruddock ('Strata: art and science collaborations in the Anthropocene' event), Caitlin Shepherd (part of GLOBAL-RURAL project) and Marie-Pierre Leroux and Perry Walker ('Voicing the Air' project). DGES researchers have organised or contributed to the 'Living Wales' permanent exhibition at the Centre for Alternative Technology and touring exhibition; '2A Earth Core: The Hominin Project' exhibition; 'Assembling Newtown' exhibition; 'Vanishing Glaciers' exhibit in the 2015 Royal Society Summer Science Exhibition; and an exhibition on the historical geographies of Cefn Coed hospital in Swansea.

New and traditional media have also been used, with contributions by DGES researchers to The Conversation and other websites, blogs and podcasts, including the RGS-IBS Ask a Geographer series and sharing of results, data and resources through project websites, such as the Living Wales project geoportal, multimedia 'Storymaps' on the GLOBAL-RURAL project website, and the Wetlands in Drylands website. During the REF 2021 assessment period, DGES researchers have made contributions to television and radio programmes, including Doomsday Volcanoes (Channel 5) and Timebomb Iceland (Discovery Science) drawing directly on Grattan's research, Extreme Wales (BBC, Sky News, Radio 3, Radio 4, and over 80 contributions to Welsh national broadcast media (BBC Wales, S4C, Radio Cymru, Radio Wales). DGES researchers have published articles in newspapers and magazines (including The Guardian, Science, and Welsh current affairs magazines Barn, Golwg and Planet) and DGES research has featured in the broadcast and print media of at least 14 countries (including CNN, NBC, National Geographic, Newsweek and USA Today in the USA), as well as in UK outlets including BBC News, ITV News, The Guardian, The Times, The Independent, The Daily Telegraph, The Daily Mail, New Scientist, The Economist and the Economist 1843 Magazine, and on numerous news and science websites.