

Institution: The Open University

Unit of Assessment: B7 Earth Systems and Environment Sciences

a. Context

The impact of research at The Open University in Earth Systems and Environment Sciences covers a wide range of science, operating within the established University Centre for Earth, Planetary, Space and Astronomical Research (CEPSAR). We pursue agenda-setting research that exploits the synergies between terrestrial and extra-terrestrial research challenges, and between past and future environmental change. Our impact agenda is significantly influenced by The Open University's mission to promote educational opportunity and social justice (such as citizen science and work related to the environment), and features impact in strategic areas in which we have invested to achieve a competitive advantage.

Here we seek to highlight our focus on achieving impact in the areas where we have deep experience and core competence. Our distinctive portfolio has impact at both UK and global level, as illustrated in the case studies (CS1–7). The case studies are not a complete account of all our research impact; rather, they illustrate excellent examples of the variety of our activities impacting across the range of different stakeholders and audiences:

1. Economic impacts, related to instrumentation development, detector technologies and translational research (CS 6, 7).
2. Impacts on public policy and services, where we have advised, informed or stimulated policy debate in the areas of climate change and environmental management (CS1, 2, 3, 4, 5).
3. Impacts on society, culture and creativity, through our work with partners in NGOs, and the charity sector (CS1, 2, 3), and also large-scale projects in public engagement and public participation in research (CS2, 3).
4. Impacts on practitioners and professional services, particularly in relation to planetary protection, environmental and ecosystem management (CS1, 4, 5, 6).
5. Impact on the environment, through conservation of biodiversity and changes to landfill practices (CS1, 5).

Our strong links with colleagues returned in the Education UoA (REF2014 UoA C25 impact case study 'Enabling publics to participate in science learning through technology') provide further evidence of enhanced impact arising indirectly from our expertise in developing digital tools and technologies that promote participation and engagement with the sciences. Professor Jonathan Silvertown leads iSpot, one of the largest UK citizen science projects. The prize-winning iSpot website for species identification has over 24,000 user registrations that have made, between them, 250,000 nature observations.

These initiatives complement the broader science reach, which include the University's contributions on iTunes U such as '60 second adventures in Astronomy', and BBC landmark co-productions such as 'Frozen Planet' (CS2). Through these channels, Open University researchers engage the public with social impact on a large scale.

b. Approach to impact

Our approach to impact is led by excellent research, often generated and applied through partnership with users, jointly developing a research focus that addresses current scientific challenges. Our work reshapes practices and policies, boosts UK industry, and promotes public engagement and debate in science.

The external stakeholder groups we consider are industry and commerce, statutory agencies, practitioners, policymakers, charitable foundations and NGOs, community groups and the public. We work with the RCUK-funded Public Engagement with Research (PER) Catalyst at The Open University which is implementing a process of culture change across the University. Working with this action research project, and with the University Champion, we are creating the conditions where public engagement with scientific research can flourish, e.g. by introducing support mechanisms for researchers, showcasing excellence, and embedding quality assurance within our systems of reward and recognition. Researcher skills in impact, enterprise and engagement are developed in workshops, including 'micro-production' workshops in which researchers and PhD students are mentored in producing video accounts of their research, and public engagement workshops where researchers consider how the dimensions of engagement apply to their research

with a view to planning more effective pathways to impact.

Industry and commerce

Investment by The Open University in the Centre for Electronic Imaging (CS7) was made to create a synergy with e2v, a company that designs, develops and manufactures technology for CCD (charge couple device) and CMOS (complementary metal oxide semiconductor) devices used for a range of applications including space missions. Further relationships with industry include academic-industry collaborations between the Planetary and Space Sciences group and the UK Space sector (CS6), and funded partnerships with UK industry including BAE systems, EADS Astrium, e2v, Magna Parva, Fluid Gravity Engineering, Systems Engineering and Assessment, and several other small or medium sized enterprises. We have also developed our capability in analytical services into an activity that attracts in excess of £200k per annum from diverse national and international industrial partners, and consultancies.

Since 2008, The Open University has won, or been instrumental in helping UK industry-based bidding partners win, R&D contracts from the European Space Agency (CS6) with a total value of approximately €2m. UK industry has directly benefited from contract income of ~€750k; however much larger benefits are likely to accrue downstream. It is widely acknowledged that winning strategically important R&D contracts can lead to the award of larger follow-on contracts; for example, the Centre for Electronic Imaging is helping to develop detectors for space missions, such as Euclid, and this has contributed to UK industry (e2v) securing a multi-million euro contract to supply flight hardware (CS7). Our commitment to undertake strategic R&D has generated both new knowledge and tangible financial outcomes for our UK industrial partners.

Practitioners

A key factor in the impact of our work has been the development of close relationships with collaborative partners across the whole spectrum of our research activity. For example, since 2007 The Open University has hosted and collaborated with a consortium of seven organisations including the Environment Agency and Natural England, all of which are involved in the conservation of an extremely diverse but threatened grassland habitat (CS1). We support practitioners within the member organisations, produce regular newsletters, run workshops and field visits, including some with volunteer citizen scientists, and also promote public engagement with a practitioner conference, public lectures and guided walks. We also work with communities outside the UK, particularly in areas of volcano risk; for example, the wardens in the Masaya volcano National Park in Nicaragua are now educated on which species of flora and fauna to monitor, and have been able to develop more systematic monitoring of long-term SO₂ release, to mitigate the environmental effects of persistent volcanism (CS3). Finally, a recent research contract of £370k continues our work measuring the performance and environmental impact of a Cambridgeshire MBT (mechanical biological treatment) plant, including testing biodegradability of municipal waste using the UK standard test developed by The Open University (CS6).

Policymakers

We have targeted impact on policymakers. Examples of our influence on policymakers are derived from direct engagement with the Environment Agency, Defra and Natural England regarding grassland management (CS1) and carbon dynamics in wetlands (CS4). The grassland work led to an Environment Agency publication entitled 'Ecohydrological guidelines for lowland wetland plant communities' in 2004, including a lead section on grasslands from Gowing (CS1). Carbon cycling in wetlands was identified in a recent government Natural Environment white paper: 'Natural Choice: Securing the value of nature' as research that will demonstrate "...how best to manage our lowland peatlands in a way that supports efforts to tackle climate change" (CS4). Indirect influence on policymakers has come from our work related to the IPCC 4th and 5th reports, in which Open University groups working on carbon dynamics and ocean models are referenced. The Open University modelling group has participated in an exercise for the IPCC that compared a number of Earth system models of intermediate complexity (EMICs), including the UK GENIE model. The OU work on deforestation, drainage and ensuing fires in Bornean peat swamps informs IPCC methodologies for carbon-balance calculations as set out in the recent IPCC Wetlands Supplement adopted in October 2013.(CS4)

We are expanding impact of our work on policy to expand into new areas. For example Professor Nuttall, who joined The Open University in 2012, is extending thinking on depletion of natural resources to a range of nuclear energy-related resources including helium, plutonium

and most recently thorium.

Digital media interests

Researchers at The Open University continue to achieve an outstanding profile of impact in digital media and iTunesU, Facebook and YouTube channels. In addition, CEPSAR academics have engaged with media professionals working for the BBC and independent production companies on several major projects including 'Bang Goes the Theory' and 'Frozen Planet'. Working with the OU Open Media Unit, CEPSAR academics have engaged directly with independent producers in science media creation, resulting in several high-profile projects. This includes the production of 14 STFC-funded '60 second adventures in Astronomy' videos. Available on YouTube, these assets promote aspects of cutting-edge research. Together, the videos have received over a quarter of a million views. Work with the new BBC Radio 4 series 'Inside Science' helps to promote the profile of UK science in the media. The 263,000 requests for poster-sized maps of Antarctica packed with high-level science from the 'Frozen Planet' series is evidence of the reach of our influence via this route (CS2).

Community groups and members of the public

While our international influence is reflected in digital media interests, CEPSAR scientists also work closely with local groups and communities. We work with partners in the Floodplain Meadows Partnership to organise volunteer-based annual fritillary and pollinator studies (CS1), attracting hundreds of members of the local public to work with scientists in monitoring grassland plant and insect communities. Our decade-long relationship with the charity Earthwatch has resulted in over 500 citizen scientists having the opportunity to participate in science research on volcanoes. Finally, face-to-face engagement work directly associated with iSpot has reached over 55,000 beneficiaries, over 10,000 from hard-to-reach groups. In the local area, we are contributing to the RCUK-funded School–University Partnership Initiative (SUPPI) project 'Engaging opportunities' where CEPSAR researchers are engaging directly with Key Stage 3, 4 and 5 students from the 12 schools that constitute the Denbigh Teaching School Alliance.

The Science Faculty has created an impact team with the professional skills to ensure that our approach to impact is structured around an analysis of stakeholder groups and an audit of the impact status and potential for each group. The science impact team provides a mechanism for ongoing audit of impact activities and acts a production resource. The team is led by the Associate Dean (Enterprise and External Affairs) and includes the Science Enterprise and Partnership Manager. The team also includes digital media specialists (video and interactive media), who are themselves trained postgraduate scientists with a research background. Interactions with industry are facilitated by enterprise champions and an STFC Innovations and Partnerships Scheme (IPS) Knowledge Exchange Fellow.

c. Strategy and plans

The impact strategy and plans of CEPSAR are an embedded part of its wider research strategy which acknowledges the need for a clear and strong strategic focus on impact. CEPSAR's research strategy highlights our role in producing innovative applied science for UK industry, shaping the future of public engagement and participation with scientific research, and influencing policymakers with robust science-based evidence.

Maintaining and developing our relationships with research users, deepening their engagement, and evidencing the impact of our work will continue to be a key task for CEPSAR. This will be achieved through the following key goals:

1. Maintain and develop relationships with key user groups in policy, practice and industry, drawing on professional and research networks;
2. Develop and implement clear plans for public engagement and impact, identify synergies with colleagues in Education from across the University and extend the visibility and recognition of researchers who are undertaking public engagement and impact work;
3. Support research teams in developing impact by assisting in the identification and elaboration of impact objectives in research planning, supporting translation activities and gathering and monitoring impact metrics;
4. Develop commitment to citizen science initiatives as a means of influencing and changing science practice and as a means of increasing active participation in science, combining digital media and face-to-face participation in science research forms of direct engagement;

5. Strengthen our focus on impact from applied and translational science research following the leadership of the Associate Dean for Enterprise and External Affairs, liaising both internally and externally and focusing on areas such as environmental monitoring, space mission instrumentation and satellite downstream applications.

We will achieve these goals with help from the Science Faculty impact team to ensure that our approach to impact is structured on an analysis of impact stakeholder groups and an audit of the impact status and potential for each group.

d. Relationship to case studies

Our work in developing long-term relationships with practitioners, and influencing policy and practice, is exemplified by the **'Enhancement of wetland biodiversity through improved water management'** case (CS1). This links long-term monitoring to key insights into the functioning of ecosystems and has brought together a partnership of seven organisations involved in the conservation of floodplain meadows, resulting in visits to 93 sites across the UK to gather data, and provision of advice and training to over 100 site managers, representing the majority of those managing this habitat. This project also involves citizen scientists in annual field surveys. Another of our case studies, **'Research and development of the UK standard biodegradability tests for treated and untreated municipal wastes'** (CS5), also involved long-term relationships with users and influenced government policy by designing the standard biodegradability test for municipal biological waste. This case study has also provided advice on economic benefits and services to partners in the waste sector such as AmeyCespa. Both these cases (CS1, 5) have a long-term influence on the environment.

Our contribution to policymaking and NGOs is further exemplified by **'Carbon and methane exchanges in wetlands'** (CS4), which has provided research input to the recent IPCC Wetlands supplement coinciding with the IPCC 5th assessment report.

Three of our case studies included public engagement with science: **'Public debate, engagement and participation associated with the BBC documentary series, Frozen Planet'** (CS2) stimulated public engagement in climate-change issues at a national level, and both **'Enhancement of wetland biodiversity through improved water management'** (CS1) and **'Citizen scientists and environmental volcanology'** (CS3) linked front-line research with citizen scientists, working in their local countryside to conserve ecosystem communities, and providing life-changing opportunities to undertake research and help communities living in the areas surrounding persistently active volcanoes respectively.

Industry-facing impact is exemplified by long-term relationships and applied research built on fundamentally important blue skies research outputs. The case **'Space instrumentation: An exemplar of academic-industry partnership'** (CS6) consists of a series of academic-industry partnerships with the UK Space Sector, influencing ESA practice, and helping enterprises in the UK Space Sector to attract significant funding, win contracts to supply ESA with goods and services, and move into new areas of business.. **'The Centre for Electronic Imaging – industrially sponsored research benefiting the UK economy'** (CS7) is acknowledged by e2v to have assisted in expanding the size of its potential markets from £2bn to £3.5bn a year.

In summary, the impact case studies demonstrate success in securing diverse funding sources for impact, for example STFC, ESA, the Esmée Fairburn Foundation, Earthwatch, Defra, and in-kind contributions from the Environment Agency and private companies including e2v and BAE Systems. All seven cases demonstrate that our approach to impact has generated significant change over the long term. We nurture strong local impacts while demonstrating our capacity to impact nationally and internationally. Our work has influenced UK government policy, enriched public debate, engagement and participation in science, and generated new opportunities for UK industry.