

School of Environmental Sciences

Newsletter • No1 • 2019/20



Sampling in Maldivian waters

Photograph by **Edward Doherty**

Fieldwork Winner - SoES student photographic competition 2018-19

Nitrogen fixation in the
Arctic Ocean

Geophysical Probing of
Liverpool History

Magnetic to the Core
at the Royal Society
Summer Science Exhibition

Earth, Ocean and Ecological Sciences • Geography and Planning

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Any news you would like to share with the School, of work being done, grants awarded, fieldwork, new staff, retirements, facilities, social events or anything else, please submit an article along with any images for the next edition to **SoES Marketing & Communications team** soesweb@liverpool.ac.uk

Introduction from Dean

Dear all,
Public discourse around climate change and environmental impacts of modern life has intensified. The next generation is more engaged than ever. Concerns over plastics and recycling are increasingly seen as an international scandal. The UK Government has responded by making a commitment to net zero carbon emissions by 2050. The UK started the transition to the fossil fuel economy; there is a growing urgency to the case that the UK should therefore be leaders in transition to a carbon free future.

School strikes this year have been symbolic and effective at putting Climate Change at the top of public discourse once again but disengagement from education is surely an uncomfortable approach for us, as academics, to wholeheartedly support. On the contrary, engagement with education and aspiration to change the world through new social and scientific knowledge is the answer. I believe the voice of academics has not been loud enough. Most people in our towns and cities have no idea of the kinds of work that so many of us are engaged with every day that is directly relevant to researching the problems, challenges and solutions posed by Climate Change and more broadly through environmental degradation. The role of universities as key agents of debate and change is not prominent enough.

Colleagues with interests in areas of Environmental research that span health, engineering, biological sciences, big data, social sciences and humanities are coming together

across the University to once again raise the profile of this work. We are uniting around the theme of "Climate Crisis: The Science, Society and Solutions". There are obvious benefits for us in acting collectively and with our wider local community. By strengthening our Civic engagement we can raise our profile in the public conscience and once again impress upon politicians and policy makers the real long-term value and benefits of investing in higher education. Our School is taking a leading role in pushing forward this agenda so please look out for ways to strengthen our contributions to research and educational initiatives that will be related to this.

Best wishes
Doug

Congratulations and celebrations on funding successes

PI	Investigator	Funder	Project Title	Dept	Total Cost	Funder Contribution	Investigator Contribution
PI	Mahaffey C (Professor)	Natural Environment Research Council (NERC)	Nitrogen fixation in the Arctic Ocean	EOES	£587,409.05	£469,927.24	£469,927.24
PI	Lord AD (Professor)	Economic And Social Research Council ESRC	The potential of Land Value Capture to secure sustainable urban development supporting air quality enhancement	G&P	£370,948.00	£296,758.40	£118,703.36
PI	Lea JM (Dr)	UK Research and Innovation (UKRI) (UK)	Ice sheet and glacier stability in a warming world: using innovative modelling and satellite image analysis for the first comprehensive estimates of sea level rise and iceberg rise	G&P	£1,006,240.00	£804,992.00	£804,992.00
PI	Lavallee Y (Professor)	Leverhulme Trust (UK)	Explore the magma frontier to unlock the full potential of geothermal energy	EOES	£55,141.30	£54,996.00	£54,996.00
PI	Mahaffey C (Professor)	Natural Environment Research Council (NERC)	Can we detect changes in Arctic ecosystems?	EOES	£16,986.00	£13,588.80	£4,076.64
PI	Mahaffey C (Professor)	Natural Environment Research Council (NERC)	An Alternative Framework to Assess Marine Ecosystem Function in Shelf Seas (AlterEco)	EOES	£64,770.93	£51,816.74	£25,908.37
PI	Rietbrock A (Professor)	European Commission	The European Open Science Cloud for Research Pilot Project (EOSC) - European Plate Observing System (EPOS)	EOES	£32,347.00	£20,668.55	£14,467.98
PI	Mahaffey C (Professor)	Natural Environment Research Council (NERC)	Can we detect changes in Arctic ecosystems?	EOES	£22,131.00	£17,704.80	£5,311.44
PI	Moore TE (Dr)	University Of Glasgow (UK)	UK Collaborative Centre for Housing Evidence (CaCHE)	G&P	£5,435.00	£4,348.00	£4,348.00
PI	Dunning RJ (Dr)	Scottish Federation Of Housing Associations (UK)	Building the case for social housing investment post 2021	G&P	£17,774.00	£24,600.00	£14,760.00
PI	Faulkner DR (Prof)	Natural Environment Research Council (NERC)	The physical properties of an active subduction megathrust	EOES	£87,734.00	£70,187.20	£70,187.20
PI	Singleton AD (Professor)	Economic And Social Research Council (ESRC)	Business and Local Government Data Research Centres (Big Data)	G&P	£399,139.99	£319,311.99	£127,724.80

Nitrogen fixation in the Arctic Ocean

PI Professor Claire Mahaffey

Dept EOES

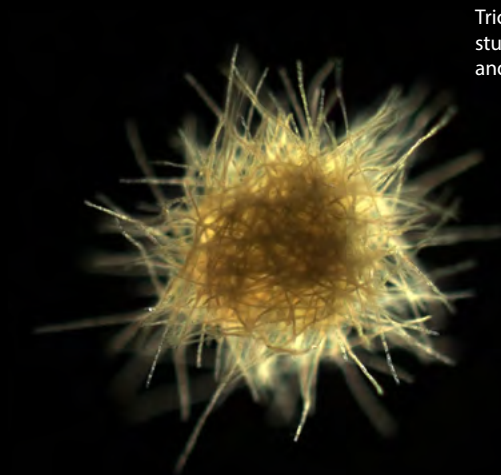
Funder NERC

Total Cost £587,409

Marine nitrogen fixing organisms, known as diazotrophs, biologically transform inert nitrogen gas dissolved in seawater into fixed nitrogen forms, such as ammonium, which can be used by other phytoplankton. These tiny marine microbes provide the global ocean with nitrogen and without this process, the ocean would be devoid of marine life as we know it.

Having studied nitrogen fixation for over 10 years, I was quite comfortable with the assumptions made about marine diazotrophs. Thousands of papers and textbooks tell us that diazotrophs are restricted to tropical waters warmer than 20°C, that they have diverse phosphorus acquisition strategies and they flourish under iron enrichment.

In 2012, a study reported the existence of diazotrophs in the cold western Arctic Ocean (Blais et al 2012). While diazotroph activity was relatively low, this odd result raised eyebrows. In 2017 and 2018, two independent studies reported the presence and activity of diazotrophs also in the western Arctic Ocean (Sipler et al 2017, Harding et al 2018). Curiously, they found a common unicellular diazotroph called UCYN-A, actively fixing nitrogen in waters colder than 10°C. When a few sparse measurements were extrapolated



Trichodesmium, the most well-studied nitrogen fixing organism and my favourite diazotroph

to the entire Arctic ocean, the contribution of nitrogen fixation to the Arctic ocean nutrient budget was significant.

Why is this important? Global models predict that as the Arctic ocean warms and sea ice declines, phytoplankton productivity will increase causing the nitrogen demand to also increase. The consequence - the Arctic Ocean will lose fixed nitrogen. Worst case scenario would be the collapse of an entire ecosystem. So this begs the question, what role do nitrogen fixers have to play in the contemporary and future Arctic Ocean? Will nitrogen fixation stop the Arctic from running out of nutrients?

We saw an opportunity to address this problem on the eastern Arctic, specifically in the Barents Sea and Fram Strait where there were no measurements of nitrogen fixation. The motivation for the study was clear but we needed a proof of concept – some evidence that we were going to find diazotrophs in the eastern Arctic and we were not just going on a fishing expedition.

Through the Liverpool-led NERC-funded Changing Arctic Ocean project (ARISE: <https://www.changing-arctic-ocean.ac.uk/project/arise/>), Dr. Louisa Norman collected samples for the analysis of nifH, a gene present in all diazotrophs, during a summer cruise to the Barents Sea. These precious samples were sent to the University of California, Santa Cruz, a world-renowned laboratory for nifH analysis.

The proposal was written, the motivation was strong, and the objectives were clear. Constructive feedback from colleagues and the local peer review panel sharpened the proposal. We just needed the evidence that diazotrophs existed in this part of the Arctic ocean.

Three days before Christmas Eve and the results were in. The nifH genes were present, but for a very odd variety of diazotroph, the gamma-proteobacterial group, which acquire carbon from organic sources rather than photosynthesis. We don't know what makes these diazotrophs tick in any part of the ocean, never mind the Arctic.

We designed our ship-based activities to investigate the environmental controls on Arctic nitrogen fixation through high resolution measurements and experiments. In previous proposals, we would have leaned on global ocean models to extrapolate our results and run thought experiments. However, nitrogen fixation is currently restricted to warm waters in ocean models and so doesn't exist in the Arctic. After a fun discussion with Dani Arribas Bel in the Data Analytics group, we discovered that we could disentangle the environmental drivers of Arctic diazotrophs using

machine learning techniques, and so added this to the proposal.

This was a fun proposal to write as it brought together my old love of nitrogen fixation with my new love for the Arctic Ocean. The outcome was surprising. The proposal was awarded a 9 and recommended for funding. Together with colleagues in Liverpool (Dr. Daniel Arribas-Bel and Dr. Louisa Norman), NOC (Dr. Jo Hopkins) and Southampton (Professor Maeve Lohan), alongside international partners in UC Santa Cruz (Professor Jon Zehr) and Duke University (Professor Nicolas Cassar), we now get to find out

where, how and why nitrogen fixation exists in the cold waters of the Arctic Ocean.

Blais et al 2012. Nitrogen fixation and identification of potential diazotrophs in the Canadian Arctic. *Global Biogeochem. Cycles*, 26, GB3022.
Sipler et al 2017. Preliminary estimates of the contribution of Arctic nitrogen fixation to the global nitrogen budget *Limnol. Oceanogr. Lett.*, 10.1002/lol2.10046
Harding et al 2018. Symbiotic unicellular cyanobacteria fix nitrogen in the Arctic Ocean. *PNAS*, 10.1073/pnas.1813658115

Tackling the UK's housing problems

PI Dr Thomas Moore
Dept G&P
Funder University Of Glasgow (UK)
Total Cost £916,421

The UK Collaborative Centre for Housing Evidence (CaCHE) is a multidisciplinary partnership between academia, housing policy experts, and practitioners. The funding of £7.5m over five years is used to produce evidence and new research aimed at tackling the UK's housing problems. Dr Tom Moore, a Lecturer in the Department of Geography & Planning, has been allocated funding to undertake two qualitative research projects. The first looks at resident voice in housing governance, exploring the processes and practice through which residents exert

influence over the management and governance of their housing. There has been limited attention to comparative analysis of resident voice in housing governance across tenures or organisational forms. While there are arguments in principle about the advantages and disadvantages of different organisational structures, including various types of resident participation in social, co-operative, and community-owned housing, this project will offer consistent assessment of their different processes and practices.

The second project looks at the development of community-led housing in England. Community-led housing groups are formed by local community members to

develop and manage housing in ways perceived to be more holistic and sensitive to community needs. This project specifically looks at the relationship between groups and local government. It seeks to provide a greater understanding not only of the ways in which local government enables and understands community-led housing, but also of the key benefits that justify this support and that evidence or challenge core assumptions underpinning alternative forms of housing provision. The project will be based on qualitative research conducted with case studies around England and key stakeholders at a national level.

Geophysical Probing of Liverpool History

Richard Holme EOES

In December 2018, the school Geophysics group took part in a field campaign at St. George's Hall to investigate a piece of Liverpool history. In the past, there was a direct underground connection from St. George's Hall and the County Sessions building close by. The Civil and Crown courts were located in St. George's Hall up until 1984, and the County Sessions buildings had cells in the basement. An underground tunnel existed to allow below-ground transfer of prisoners from the cells to the court, although this was abandoned and perhaps filled

in over 100 years ago. The aim of the survey was to determine whether there is geophysical evidence of this tunnel.

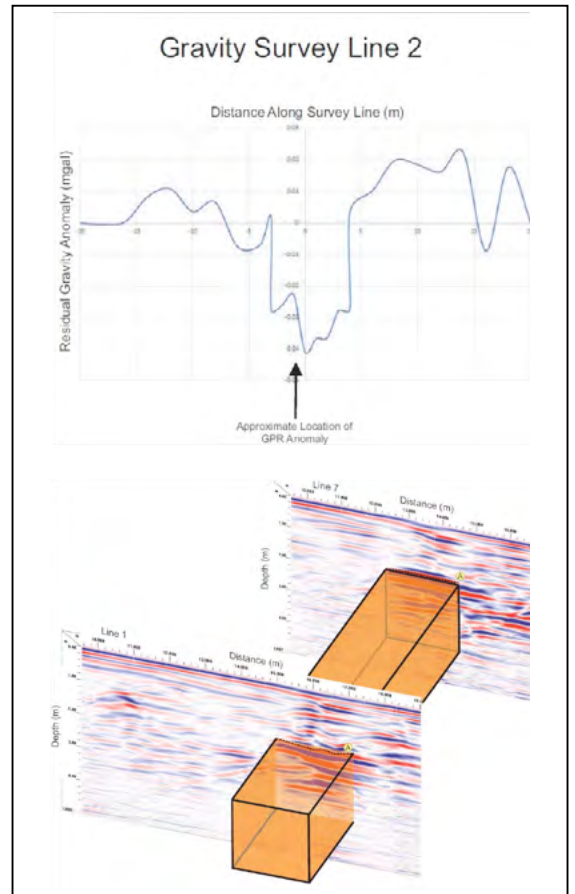
The survey was led by the near-surface geophysics group from RSK based in Helsby, but carried out using University of Liverpool radar and microgravity equipment by two current second year geophysics students, Lottie Cooper and Harry Ashenden. Both the RSK team leader Steve Owen and site manager Make Garnett are Liverpool Geophysics alumni. Results show a signal which could result from a tunnel, with the GPR

giving possible depth and width, and the gravity the height, all of around 2m. The gravity values (the magnitude of the negative gravity anomaly) are consistent with an open, unfilled, structure. However, these estimates can only be confirmed by direct investigation – digging!

If it proves that we have located a tunnel, the Hall management may investigate developing it as a visitor attraction. Our survey was recorded by a documentary-film maker, to be part of a series on tunnels – if successful, you may yet see us on TV!



The team (past and present Liverpool Geophysics students)



Gravity and GPR survey results

Liverpool scientist co-authors IPCC climate change and oceans report

Liverpool ocean scientist, Professor Alessandro Tagliabue, is one of the lead authors of a new Intergovernmental Panel on Climate Change (IPCC) report published on 25 September 2019 which warns on the impact of climate change on oceans and frozen areas.

The IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) provides a detailed assessment from more than 100 scientists from across the world of the latest scientific knowledge about the physical science basis and impacts of climate change on ocean, coastal, polar and mountain ecosystems, and the human communities that depend on them. The report tracks the flow of water from the frozen tops of mountains to the bottom of the seas over a three year period, and shows how this is changing as the world gets warmer. It demonstrates the role oceans play in mitigating rising temperatures but issues a stark warning that global warming is turning the seas into a huge potential threat to humanity. However, the report also presents different options for achieving climate-resilient development pathways.

An ocean scientist with particular expertise in the processes that shape ocean biogeochemical cycling and the impacts at the base of the ocean ecosystems, Professor Alessandro Tagliabue from the University's School

of Environmental Sciences contributed as an author to the chapter entitled 'Changing Oceans, Marine Ecosystems, and Dependent Communities'.

In addition he was selected as one of around 50 authors across all six chapters who synthesised the findings into the Summary for Policy Makers that aims to communicate major findings of the report as a whole. This was approved during a four day governmental approval session at the Grimaldi Forum in Monaco where the report findings are considered line-by-line in response to government interventions.

Professor Alessandro Tagliabue, said: "This report is a landmark in that it focusses specifically across ocean and ice systems and seeks to link physical sciences with policymakers throughout. We have highlighted unambiguous observed trends demonstrating ocean warming, sea level, ocean acidity, sea ice and oxygen contents and the fact that the ocean is undergoing a transition towards unprecedented conditions, raising risks for key marine ecosystems like coral reefs, seagrasses, mangroves and fisheries. Most importantly, we found that many of these emerging threats may be strongly diminished by rapid cuts in fossil fuel emissions."

Professor Tagliabue holds a European Research Council fellowship to better understand how environmental change



Professor Alessandro Tagliabue (right) at the 51st IPCC Session

affects ocean ecosystems, is UK Chair of the Scientific Commission on Ocean Research, is a member of the governing council of the UK Challenger Society for Marine Science.

He is part of the GEOTRACES international research programme which aims to improve the understanding of biogeochemical cycles and large-scale distribution of trace elements and their isotopes in the marine environment.

SROCC follows the Special Report on Climate Change and Land (SRCCL) released in August 2019 and the Special Report on Global Warming of 1.5°C released in October 2018.

Using the Past as a guide for management

Knowledge of how present vegetation communities have developed from earlier conditions and what likely future compositions may develop, is of value to managers in planning pragmatic and successful forest conservation measures. The county of Halland, Sweden, commissioned Liverpool palaeoecologist Dr. Gina Hannon to contribute to the management plans of a nature reserve. Gina Hannon and Em. Professor Richard Bradshaw presented results of the investigations from Sällstörpsjön in June 2019. The reconstructed vegetation and fire histories based on pollen and charcoal data revealed a dynamic history of largely unbroken forest continuity over the last c.13,500 years, but with shifting species combinations and complex mixtures of natural and anthropogenic disturbance. The present-day large forest areas dominated by near monocultures of Beech or Spruce are very unusual in a longer time perspective and potentially lack resilience in a period of rapid climatic change.

Restoration of former mixed deciduous forest would increase biodiversity and trees such as Lime, Oak, Elm, and Alder should be able to build sustainable populations in the present climate. Their success would depend on the management of the browsing regime and control of deer populations. Fire risk is likely to increase under current climatic trends, but past mixed deciduous forest tolerated a mild regime of



Sällstörpsjön, the studied lake whose sediments contained over 13,500 years of forest history.
Photo: Mikael Stenström.

Gina Hannon and Richard Bradshaw presenting research results to forest managers and conservation officials from Swedish government agencies.



ground fires that disadvantage Spruce and Beech. Research agendas need to move beyond the protected reserves concept and consider novel ecosystems adapted to future climates that may prove to become major threats to biodiversity.

The study has been published in the *Holocene* (Hannon, G.E., Halsall, K., Molinari, C., Boyle, J. & Bradshaw, R.H.W. (2018) The reconstruction of past forest dynamics over the last 13,500 years in SW Sweden. *The Holocene* 28: 1791-1800) and highlighted in *Science trends*.

Scientific controversy taken on tour in Germany

John Wheeler EOES

How is scientific controversy to be resolved? Argument? Debate? Experimental tests? For some years I have been involved in a controversy about some basic ideas that are relevant for rocks as well as other crystalline materials like metals

My own version is that stress can have important effects on chemical processes, such as new mineral growth, in rocks. In a recent invited talk at the Geomünster conference (in Münster) I outlined the existing experimental evidence in favour of my version. The audience had scientists with opposing views (the convenors had arranged this) who duly leapt up at the end of my talk to question my position. One pointed out that the interpretations of existing experimental results were ambiguous. Naturally they would say this – so is there one decisive experiment, yet to be undertaken, to resolve this? Another asserted that assumptions behind my fundamental maths was incorrect. How is that to be decided, when it depends on mathematical subtleties which are not in mainstream Earth science thinking? What happened next: we all drank beer and debated. In terms of the “maths” side of things, I later worked on some “building block” ideas with the scientist involved. Maybe we can reach a foundation of agreed ideas to build upon.



Fired up by these debates, I went straight to the Max-Planck-Institut für Eisenforschung (iron and steel research) in Düsseldorf to discuss the same topic. Rocks and steel are both made of interlocking crystals: the same science should describe them both. I said this at the start of my invited talk, and I pointed out that there was controversy in Earth science so I wanted input from beyond that subject. No-one asserted that my version was wrong, and instead a number of stimulating conversations span out. What is notable about the debate in Earth science is the psychology of it – as academics we love our subject and of course want to be recognised as right, which means our positions are hard to shift.

As another and less controversial strand, I discussed ongoing collaboration on magnesium

alloys (the institute studies more than just iron and steel) with MPIE scientists and postgraduate researchers. The techniques I have developed to use electron microscopy to analyse distorted crystals work just as well on alloys as on minerals. Routinely, electron microscopy examines a two dimensional surface through a 3D object. These days, we want 3D information and that can be obtained laboriously by removing thin layers one at a time and mapping each 2D section. At MPIE they have a robot to do this. Apparently the robot arm (pictured) carries the lump of metal between the electron microscope (on the left) and the machine to remove thin layers (on the right). It's got to be on youtube one day.

UKRI Future Leaders Fellowships

Liverpool researchers are part of a new generation of rising stars supported by the UK Research and Innovation's (UKRI) Future Leaders Fellowships scheme to tackle pressing global challenges.

Liverpool volcanologist, Dr Janine Kavanagh, is part of the latest wave of researchers supported by the UKRI scheme which provides funding, flexibility and time to take forward challenging questions. Janine specialises in understanding the development and evolution of volcanic plumbing systems.

The overall goal of her Fellowship is to develop new methodologies to help forecast and assess the danger posed by volcanic

eruptions in order to significantly minimise their human and economic cost.

Existing models of magma sub-surface flow struggle to resolve important information which would allow for rapid and reliable decision making in the lead up to and during volcanic crises.

Janine will build on her track record of developing novel methodologies and use her multidisciplinary expertise in volcanic plumbing systems to integrate analogue modelling, mathematical modelling, geophysical observations and geological analyses of volcanic systems to build the next generation of



magma-filled fracture models.

She will work with academic and government partners to develop new models and use recent data from volcano and space observatories to test and develop them so they can be integrated into volcanic warning systems.

100 years of oceanography at UoL

The study of oceanography is celebrating its 100th year anniversary with a series of events which commenced on 20th October with the Inaugural Lecture of the new Professor of Oceanography, Claire Mahaffey. More than 100 guests including alumni, students, current and former staff attended Professor Mahaffey's Inaugural lecture which explored how the oceans have transformed over the past century and gave an insight into the work scientists are undertaking to better understand the impact of climate change on our oceans.

Professor Mahaffey's Inaugural lecture kicked off a year-long celebration of oceanography culminating with a dinner preceded by lecture given by alumnus Professor Eric Achterberg taking place on Saturday 19 September 2020 at the Maritime Museum in Liverpool. Other events will include Centenary lectures by alumnus Professor Alberto Naveira Garabato (11/2/2020) and Professor Mick Follows (25/3/2020).

For more information about the history of Oceanography at Liverpool and current activities, please go to:



<https://www.liverpool.ac.uk/media/livacuk/schoolofenvironmentalsciences/events/OCEANS,BROCHURE>.

Postgraduate research across Environmental Sciences



Madeleine Moyle
Environmental Change, G&P

'Phosphorus budgets and monitoring for the Midland Meres'

Supervisors John Boyle, Richard Chiverrell, Mark Riley, Mags Cousins (Natural England) and Ken Downward (Natural England)

My research is focused on the impact of human activity on catchment phosphorus (P) flux at Crose Mere, a SSSI in north Shropshire. Increased P input to a water body can result in eutrophic conditions which can have detrimental impacts on biodiversity. National targets for total P are in place for these environments however many sites, including Crose Mere, have P levels well above the desired nutrient status. The aim of the project is to work towards understanding what mitigation practices would need to be in place to achieve good ecological status at Crose Mere. This will involve a programme of fieldwork and labwork to examine past conditions and monitor the current nutrient status which will inform the production of scenario-based projections for future catchment P flux at Crose Mere.



Stephanie Harris - Ecology and Marine Biology , EOES

'Does personality drive plastic responses to the changing polar ecosystems?'

Supervisors Dr Samantha Patrick, Dr Sebastien Descamps, Dr Lynne Sneddon

My research interests are in understanding drivers of individual success in animals. My PhD looks at consistent individual behavioural differences, or personalities, in seabirds, and how personality may influence responses of individuals, and ultimately populations, to environmental change. Working on declining seabird populations in the Arctic and the Antarctic, I hope to combine personality data with information on foraging movements, reproductive success and environmental data, to improve understanding of how behaviour and environment interact to determine individual success.



Simon Lloyd - Geomagnetism, EOES

'After the inner Core? Palaeomagnetic field behaviour in the Neoproterozoic'

Supervisors Prof A. Biggin and Dr M. Hill, Dr Phil McCausland (Brock University), Dr Nick Swanson-Hysell (UC Berkeley)

When did Earth's inner core form? This is one of the most hotly contested questions in deep Earth Science at the moment; it is also a question that links directly to the thermal evolution of the whole planet and the energy budget available to drive global geodynamic processes. My project investigates the claim that Earth's inner core is 1,300 million year old. If the hypothesis is correct, we would expect Earth's magnetic field to have remained strong, on average, since this time. By focussing on the late-Proterozoic to earliest Cambrian (500-720 million years ago), my aim is to establish if Earth's magnetic field was indeed strong during this interval by measuring new palaeomagnetic field intensities from numerous sites across the world.

Postgraduate research



Arthur Gourain- Oceans and Climate, EOES

'Copper speciation: from Estuary to Open Ocean'

Supervisors Dr. Pascal Salaun (UoL), Dr. Alessandro Tagliabue (UoL), Prof. Stan VandenBerg (UoL), Dr. Cedric Garnier (Université de Toulon)

The PhD project I am currently doing in the Ocean, Earth and Ecological Science department at the University of Liverpool is focusing on the speciation of copper at the estuarine interfaces. Copper is an essential micronutrient for the biology. It is involved in several protein structures as Iron transport but it could be toxic. Copper toxicity and bioavailability is a function of its concentration and its speciation. That is why understanding the speciation is essential to understanding the key role of copper in the ecosystem.

I will determine the speciation of copper using electrochemistry techniques including the Gold Microwire Electrode. This electrode was developed at Liverpool opening new perspectives in metal determination.



Theresa Jones - Ecology and Marine Biology, EOES

'Social dynamics in foraging behaviour of colonial breeding seabirds'

Supervisors Dr. Jonathan Green and Dr. Samantha Patrick

My research interests are focused on sociality in seabirds as well as the effects of individual variation in social interactions. Using bio-logging technology, my PhD work will track the individual foraging movements of a small colony of Australasian gannets. Using a social network approach, I will assess variation in social foraging behaviours and use this data to help understand the potential for seabirds to utilise social information while foraging.



Ahmad Tareemi - Power, Space and Cultural Change , G&P

'Sustainable Water Demand Management Strategies In Saudi Arabia'

Supervisors Dr Mark Riley and Dr Neil Macdonald

As the largest country of the Arabian Peninsula and second largest of the Arab world, the Kingdom of Saudi Arabia (KSA) develops with great acceleration. Saudi Arabia faces a potential water crisis, with limited water availability comparative to need. The fundamental cause of this is increased consumption per capita rising population and constant exhaustion of available water resources and potential reduction of water quality. The study seeks to critically examine the challenges of water resource availability and use. The first stage of the research is to develop a holistic framing to recognise the interplay between technical issues, economic imperatives and public awareness in Saudi Arabia's water problems. The research intends to take a case study approach, focusing on the city of Jeddah, and will utilise pre-existing data sources alongside stakeholder interviews to determine effectiveness of current water demand management strategies in KSA and potential improvements.

Dates for your diary

DECEMBER

2nd: SoES Graduation, Ceremony @ 3pm.
School reception @ 4.30pm,
GIC Roxby Building

JANUARY 2020

22nd: Grant writing workshop @12pm-1pm,
Herdman map library

22nd: New Staff Member Research Sharing Event @1pm-2pm

MARCH

3rd: Raising the Level 2 @ 12pm-1pm,
Herdman map library

APRIL

22nd: NERC (Standard grant) Pitching Event – July round (Subject to Peer review dates being released) @ 1pm-3pm,
Herdman map library

UK and Ireland

The Planning, Environmental Assessment and Management Research Group successfully organised and hosted the 2019 UK and Ireland Planning Research Conference, 2-4 September 2019 in the Foresight Centre (1). It was organised partly in collaboration with the Liverpool City Region (LCR) and the opening plenary was given by Metro Mayor Steve Rotherham. This was a high profile event and having this level representation from the LCR is a good indicator of the level of links that exist.

The conference brought together over 100 delegates from the UK and overseas across 12 tracks and included an introduction from the Dean of SOES and keynotes from speakers including Bruce Stiftel of Georgia Tech School of City and Regional Planning on the UN's Urban Agenda. The programme also included field visits across the Liverpool City Region, a roundtable organised in conjunction with the Royal Town Planning Institute, and a public session attended by 40 people in the Quaker Meeting house in Liverpool City Centre. One of the conference tracks focused on housing, with sponsorship from the Housing Studies Association supporting two sessions composed of eight papers (2).

(1) <https://www.liverpool.ac.uk/geography-and-planning/events/planningresearchconference/>

(2) <https://housing-studies-association.org/2019/10/blog-make-planning-great-again-housing-debates-at-the-uk-ireland-planning-research-conference-2019/>

Conferences & workshops



There was also a PhD Workshop held on the day before the main conference programme started. This attracted 17 PGRs from the rest of the UK and overseas, many from other leading institutions, giving a chance to showcase Liverpool as a centre of activity and excellence in PGR training in planning and related disciplines. The feedback on this was very good. Similarly, the feedback on the PRC overall was very positive both from external attendees and from within the school.

The conference was an excellent example of how to stage a major knowledge exchange event between research and practice and contribute strongly to the impact agenda - notably the 'Planning, participation and localism' and 'Shaping the reform of British planning policy' impact case studies. Building on the links to the LCR many planning staff continue to be involved in different capacities in the production of the Spatial Development Strategy (SDS) for the LCR. Shortly after the conference another event was hosted on campus about the Liverpool Sustainable Development Strategy (SDS) in conjunction with Planning Aid with and with a presentation from Mark Dickens the Lead Officer - Spatial Planning for the LCR Combined Authority.

The School welcomes new members of staff



Sophie Almond – Student Experience Assistant (Roxby)

I joined the Student Experience Team as a Student Experience Assistant in the first week of July. I graduated from the School of the Arts in 2016 with an MA in Modern and Contemporary Literature - so whilst I know the University of Liverpool well, I haven't had much experience within the School of Environmental Sciences. For the past few years I have worked as an Event Manager at the Liverpool

Philharmonic Hall, where I line-managed a large team and took responsibility for the running of events taking place at various venues across the city. I felt that it was time to make a change, and moving into such a different, predominantly administrative role has been a positive challenge that I look forward to continuing. I have enjoyed my first few weeks here, and am glad to be a part of the SoES team.

Stephen Brough – Postdoctoral Research Associate, G&P

Following a PhD at the Centre for Glaciology, Aberystwyth University and a postdoctoral position at Newcastle University, I joined SoES in September 2019.

I am a glaciologist whose research focuses on understanding how ice masses on Earth (principally the Greenland Ice Sheet) and other planetary bodies (principally Mars) respond to climate change.

At present, I use a combination of remote sensing, GIS and numerical modelling to instigate the dynamics of Greenland's marine-terminating glaciers, so that we can better understand their potential as agents for future sea level change.

At Liverpool, I am part of the UKRI funded 'Ice Sheet and Glacier Stability in a Warming World' project (PI James Lea).



Emma Goult – Student Experience Assistant (Roxby)

I recently joined the Student Experience Team following a three-month internship supporting Janine Kavanagh from the School of Environmental Sciences with Outreach and Public Engagement work.

Prior to this, I carried out my undergraduate degree at UoL

studying BA Geography, so I have lots of experience of the School from a student's perspective. I'm looking forward to the challenge of this new role being the first port of contact for students and visitors. I see this as a great opportunity to gain an insight into student administration and an exciting way to use my customer service skills within a Higher Education setting.

David McNamara – Lecturer, EOES

Hello! I joined the School in July 2019. My research explores the role of geomechanics, structural geology, and mineralogy in natural resources and hazards.

Currently I am working on research into slow slip earthquakes in New Zealand, geothermal resources in a number of locations globally, and how

mineralogical processes create concentrations of elements vital to green technology manufacturing.

I am excited to return to the University of Liverpool, ten years after completing my PhD research here, and I am looking forward to engaging with everyone and rediscovering the wonderful city of Liverpool.



Encari Montoya – Lecturer, G&P

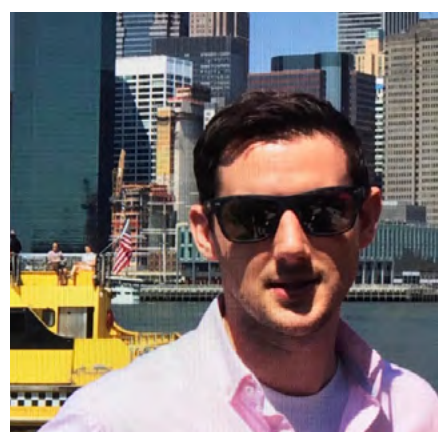
I am a new lecturer in Physical Geography and my research background is in neotropical palaeoecology. I study the interactions between the vegetation and environmental drivers such as climate, humans or volcanoes, during the last 50 thousands years, with a special

emphasis on northern South America. To do this, I use a wide range of proxies preserved in sedimentary archives including pollen, non-pollen palynomorphs and charcoal particles. I am originally from Murcia (SE Spain), and was previously based at the Institute of Earth Sciences Jaume Almera (Barcelona).

Leo Uieda – Lecturer, EOES

I am a geophysicist researching methods for determining the inner structure of the Earth from disturbances in the Earth's gravity and magnetic fields.

I am an advocate for openness in the scientific process and I develop a range of open-source software for processing, modelling, and visualizing geophysical data.



Pete Westmoreland – Student Experience Administrator (Herdman)

After working for Bangor University for six years, I decided to relocate to Liverpool.

I originally joined the University of Liverpool Engineering School but took advantage of a secondment within the SoES Student Experience Team in April, which I am thoroughly enjoying.

Magnetic to the Core at the Royal Society Summer Science Exhibition

Annique van der Boon, Geomagnetism Laboratory

Last year in September, we at the Geomagnetism research group decided to apply for a stand at the Royal Society Summer Science Exhibition during the first week of July 2019. With 2.5 weeks to go before the deadline, and very little experience in outreach or public engagement, this sounded like a great plan.

We came up with plenty of hands-on activity ideas to demonstrate paleomagnetism to anyone who was interested. We decided to make an animation that would explain our research, and got creative with whiteboard markers and a camera (the result of which you can see here: <https://vimeo.com/337541435>).



Our 'Magnetic to the Core' stand



The custom-made magnetometer

Our stand revolved around four activities that allowed visitors to explore the range of tasks that a real paleomagnetist does. Of course we had to start with collecting samples, so we took our visitors on a 'fieldtrip' which involved getting them into a high-visibility vest and a hardhat (safety first!). They could then pose for a picture in front of a backdrop with a picture of the Canadian high Arctic (courtesy of Dr. Bono) while holding the drill that we use in the field, or 'pumping water' to cool the drill.

was Normal or Reversed. If the sample was reversed, this meant that the sample was at least 780,000 years old, which is the last time that Earth's magnetic field was reversed. For geologists, 780,000 years old is not very old, but a lot of non-geologists were astonished by how old the rocks were.



Dr. Annique van der Boon (UoL) and Dr. Anouk Beniest (VU Amsterdam)

After the samples were 'collected', visitors could measure samples on our custom-built magnetometer (developed in collaboration with Magnetic Measurements) designed especially for outreach. We had samples of Icelandic lavas, and people could measure if the polarity of these samples



The magnetic globe of the University of Bremen

The next bit was understanding more about the Earth's magnetic field. For this, we had a huge magnetic globe that the paleomagnetism lab of the University of Bremen (Germany) had kindly lent to us. This globe shows a scale model of the Earth, with the solid inner core as an iron ball, the outer core (which generates the field) as a coil, and compasses on the surface to show what happens during a reversal, which was controlled by flipping a switch.

The final experiment was 'Rock or Choc', where visitors could determine whether pebbles were real rocks, or made of chocolate. The chocolate pebbles looked so real that even for geologists it

was nearly impossible to tell them apart. By measuring the magnetic susceptibility, visitors could find out if they had guessed correctly which were rocks and which were chocolates. As a reward (or consolation), they got a chocolate pebble that they could eat. This was a huge success, and many people came back to guess again and eat more chocolate.

For people who were really interested, we made a little booklet with '10 things you might not know about Earth's magnetic field' which you can download here: [https://www.researchgate.net/publication/335715337Ten things you might not know about the Earth's magnetic field](https://www.researchgate.net/publication/335715337Ten_things_you_might_not_know_about_the_Earth's_magnetic_field)

Overall, we had rave reviews from visitors, we handed out lots of chocolates, stickers and magnets and had a great time ourselves too. We are grateful to the university for supporting our stand!

For more information, see www.geomagnetism.org, <https://twitter.com/LivUniGeomag>, <https://www.instagram.com/magnetictothecore/>



Team Geomag

Halloween Outreach at the VG&M

By Louisa Brotherson, PhD Student

This Halloween, scientists from across the University came together to bring families an afternoon packed full of gory science activities during the Spooky Science event at the Victoria Gallery & Museum on campus! A team of undergraduate and graduate earth scientists took part in running the “Spooky Fossils and Mysterious Minerals” activity where we showed off our scariest pieces from the geological collections found in the Herdman Building. Fossils included Jurassic “snake stone” Ammonites (folklore tells the tale of St. Hilda who was said to have decapitated snakes and turned them into stones), Devonian sharks’ teeth, a mammoth’s tooth and opals (thought to bring bad

luck). We even had a stuffed Eurypterid handmade by John Kavanagh to match our real Eurypterid cast, probably from the Silurian! Keeping in with the Halloween theme, we told tales of Ichthyosaurs which could grow to over 15m long and told of the origins of the myths behind Devil’s toenails (Gryphea), haematite “bloodstones” and pyrite “Fool’s Gold”.

The event was a success - the team shared their collective knowledge to children who were keen to learn about the history behind these items and had plenty of questions to keep us on our toes!



Many thanks to Megan Davies, Olivia Flatman, Sam King, Domenico Meduri, Charlotte Jeffery and John Kavanagh for their help in designing and running the stand!

50th Anniversary of Earth Day approaching...

The School of Environmental Sciences will be taking part in a nationwide initiative to make the voices of academia heard loud and clear amidst the strengthening of calls to action on societal response to Climate and Environmental Change. We are taking the lead in organising a coordinated simultaneous national event that sees universities across the whole UK hosting and organising outreach at the same time on the same theme to create a national and international impact on society.



When? - Wed 22nd April 2020 - the 50th anniversary of Earth Day.

The theme? - “The Environment: it’s all about us – Collective Solutions for Climate Change”

We will be working with colleagues across the University, students and with Civic authorities to arrange events on campus, in our public spaces and in our schools, engaging with industry, commerce, charities and faith groups. Our message is that Climate Change is a health issue, an engineering and scientific challenge, a social sciences debate, and an ethical conundrum as well as a central focus for environmental scientists. We will bring together a steering group to organise our School’s activities on this so watch this space for further information in the weeks ahead. Please contact Alison Barkley (Alison.Barkley@liverpool.ac.uk) if you are keen to contribute to our efforts.

New recycling initiatives

Jenny Bradley

According to a recent study on plastics, it is estimated that only 31% of plastic waste is currently recycled in the UK. Walkers alone produce 11 million packets of crisps a day in its factory in Leicester; none of these packets are conventionally recyclable, meaning that countless crisp packets end up in landfill sites across the UK every year. It is currently estimated that around 8 million tonnes of plastics end up in the world's oceans every year, and in every square mile there around 46,000 pieces of plastic. To quote David Attenborough – “Surely we have a responsibility to care for our blue planet”.

TerraCycle is an innovative recycling company that has become a global leader in recycling typically hard to recycle waste. They offer a range of free programmes that are funded by conscientious companies, as well as recycling solutions available for almost every form of waste. So far over 202 million people are collecting in 21 countries; they've collected billions of pieces of waste and have raised 44 million dollars for charities around the world. Their website gives more details about the many recycling schemes that you can personally become involved in by dropping off your waste at many various drop off points. You might be surprised by what you currently put in the bin that could actually be recycled!



The School of Environmental Sciences will be launching two new recycling initiatives across all three of our buildings; empty crisp packets and used stationery! You'll notice our colourful posters across the Roxby, Herdman and Nicholson buildings which will let you know where you can find the bins.

All bins will be regularly emptied by our collection leaders and taken to the designated drop off locations in the Guild and School of Engineering. These will then be sent to TerraCycle; weights of the packages result in TerraCycle points, which are converted into money for local schools and charities!

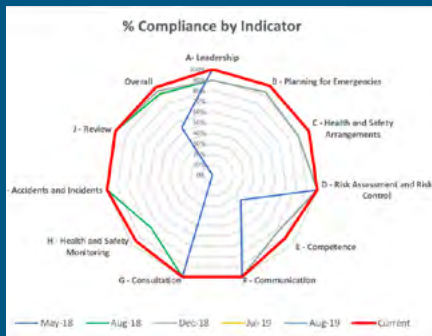
It would be great for everyone to get involved with these bins – the more emptying our collection leaders have to do the better!

We hope these bins will inspire you to think about other ways you can reduce your own environmental footprint and become a conscious consumer, because the small changes we make as individuals add up to something much bigger.

Please feel free to get in touch if you have any questions at jmobbs@liverpool.ac.uk or check out <https://www.terracycle.com/en-GB> for more information on recycling.

South Campus Collection Leaders: *Jenny Bradley & Maddy Moyle*

North Campus Collection Leaders: *James Utley & Richie Clark*



HASMAP: from 'substantial' to 'higher' level - what do we need to do next?

SOES performance for H&S under the HASMAP standard is rated as 98% compliant (July 2019) providing actions the School put forward for the substantial level plan are met.

This includes:

- Meeting KPIs:
 - Completion of Laboratory checklists and tours with individual research groups in higher risk areas
 - Accidents and incidents recorded and investigated as appropriate
 - Staff online obligatory training complete
 - Safety inductions completed for staff, PGR, PGT and UG project students.
- School Safety Code of Practice reviewed and updated regularly
- Risk assessment of SOES activities reviewed and updated regularly
- H&S website reviewed and updated regularly

- Provision of a training matrix for members of SOES

Areas we need to improve are related to measuring competency in our activities and auditing H&S performance and knowledge across staff and students. Achieving the 'higher' level by July 2021 will mean major investment and changes to safety processing and recording systems, training programs and the involvement of all staff.

The 'higher' standard objectives have recently become available to the School and over the coming weeks what needs to be put in place will be assessed. Regular progress reports will be provided.



EVAC chair training

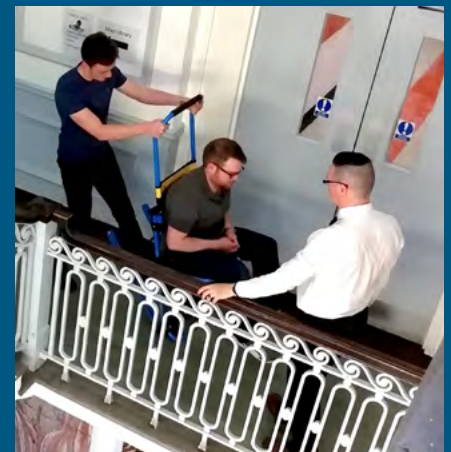
Two EVAC chairs have been installed in Herdman building.

These enable a trained team to assist recognised staff and students with reduced mobility to vacate the building in an emergency in line with their personal emergency evacuation plan (PEEP).



A number of staff took part in a training session delivered by Steve Dunkley in how to use the chairs and understand their duties in an emergency situation.

All visitors with decreased mobility should make themselves known to the Safety Coordinators so the assistance team can be made



aware of their need of support in an emergency. Many thanks to Steve Dunkley for the training.

Participants were: Alejandro Diaz-Moreno, Andy Gilroy, John Kavanagh, Carmel Pinnington, Amy Sinclair, James Utley.