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Open Research Case Studies: Faculty of Environment

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School of Earth and Environment

PlioMIP: The Pliocene Model Intercomparison project

What words and ideas come to your mind when you hear 'open research'?

"Collaboration, transparency, accessibility, broadening participation, recognition and reward for everyone who has contributed to the research at different levels, in different ways and at different times."

What is the PlioMIP?

My area of research looks at global change and seeks to understand how climate changes over time, and how sensitive the climate system is in the long-term to different types of forcing mechanisms such as greenhouse gases. I am focussed on what lessons we can learn about our climate system from studying how it has changed in the past, and what this may mean for the future.

Our planet has gone through quite extraordinary natural variations in climate during its long history. Earth is about four and a half billion years old. Over that time, the planet has experienced many different climate states (e.g. icehouse and greenhouse climate states) and we can reconstruct these variations by looking at the geological record and all of the rich climate and environmental information preserved within it. We can also use the same models that we use to simulate future climate to simulate past climates.

"Winston Churchill is quoted as saying "The longer you can look back, the farther you can look forward""

"PlioMIP is a network of paleoclimate modelers and geoscientists who, through the study of the mid-Pliocene Warm Period (mPWP ~3.3–3.0 million years ago), seek to understand the sensitivity of the climate system to forcings and examine how well models reproduce past climate change." (Alan M. Haywood1, H.J. Dowsett2, J.C. Tindall1, PlioMIP1 and PlioMIP2 participants, 2021).

PlioMIP is helping us understand how sensitive our climate system is to different forcing mechanisms as well as providing insights into how climate may change in the future.

How was this project conceived and what has been you role?

My PhD focussed on past climate modelling, in particular the Pliocene, so I have always been involved in this particular area of science. The project started through a collaboration with another climate scientist, Mark Chandler, who works at the Goddard Institute for Space Studies in New York. We wrote a paper in the late-2000s, which was an initial comparison of two climate models for the Pliocene.

We realised that there was huge scope to increase the scale of the project by including other climate modelling groups. So, we started work on the first phase of a full the model inter-comparison project. There was a workshop held in New York in 2008, which brought all parties together to discuss the scientific plan, the experimental design, and how we would go about disseminating the results and what papers we wished to write.

In about 2009/2010 I took over co-leadership of the project. It has notionally been led by me and another scientist from the US, Harry Dowsett, a palaeontologist who works at the United States Geological Survey. We established an advisory group for the project including scientists from different career stages from around the world. We have always found that the best outcomes are achieved when you take a consultative bottom-up approach, one which listens *and responds* to the aspirations and needs of a scientific community.

We have completed two iterations of the project so far. Phase 1 was from 2008 until 2015, and Phase 2 up until now. We have just started the process of planning the third phase for the project in collaboration with the international community. We held a conference at Leeds in August this year, bringing all of the interested parties together to look at the different options for the third phase of the project, and agree a way forward. We listen intently to what scientists would like, what they're interested in, where their curiosity is, where their ambitions are and we weave that into the science plan, whilst at the same time maintaining a coherent scientific strategy for the project.

How does the PlioMIP incorporate open research practices?

Open access

An overwhelming majority of publications based on data from the PlioMIP have been made open access at the point of publication. For example, PAGESmagazine_2021-2_92-93.pdf (pastglobalchanges.org).

Open data and software

We are now using a platform called Globus to share data and increasingly in future scripts and code. Globus enables all of the climate modelling groups involved to submit data from their own climate model, which are necessary for us as a community to do the science we want to do. Everyone involved in the project can go to the same place and have access to the same data.

It also enables us to open the datasets up to others who would like to have access to it as time goes on. Over the years this has helped to build a global community of scientists who are supported in their research through access to PlioMIP data and outputs, many of whom have been early career researchers.

We also have data stored data on the Earth System Grid Federation (ESGF). One of the nice things about ESGF is that it requires everyone who submits data to process their data in common file formats with common file names, which help in terms of making it easier for people to find specific things that they're looking for and use them more easily.

Reproducibility

Our future plans to increasingly share scripts and code will support reproducibility. We do have a challenge with the climate models themselves though. They are extraordinarily complex to run, so whilst simulations are technically reproducible, it requires people with a great deal of knowledge and experience in order to be able to perform the simulations successfully. The Globus platform conforms to FAIR principles (findable, accessible, interoperable, and reusable).

Collaboration across the globe

PlioMIP is a global scientific endeavour, the project has, since its inception, fostered the interaction and engagement of researchers from around the world. Crucially, this has involved direct engagement with key institutions and governmental bodies. The project necessitates geological information to be synthesised from across the world and has fostered the involvement of researchers and institutions in 'global south' countries.
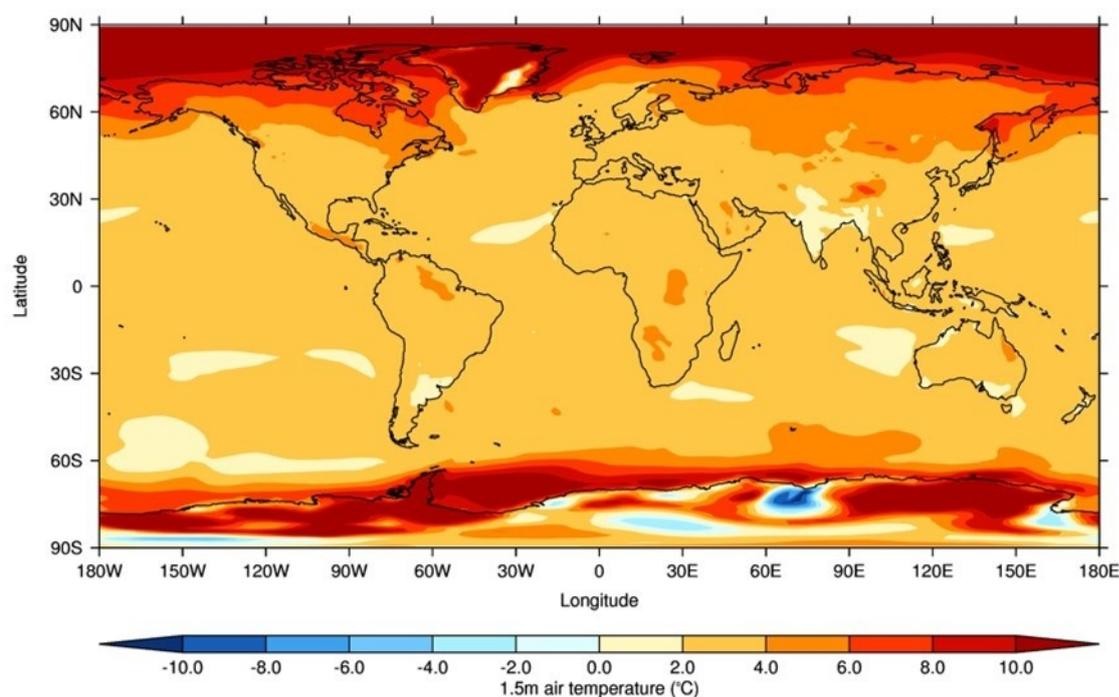
What kind of feedback have you received form researchers who have participated in the project?

We have received very positive feedback. We have conducted surveys and asked scientists their opinions of how things are going. I go to conferences where I am always talking to people about the project and how they view it. We try to listen to the feedback and do everything we can to respond to what people would like. There's always more we can do, but it's finding the time and resources to be able to do it. However, the success of the project is fundamentally built on the fact that we listen to what people say and what they would like us to do. If we do not feel we can respond to a particular request, then we try to always provide a clear reason.

Have you encountered any software licencing issues, especially if/when using platforms created by corporations?

Not particularly. As long as your organisation has got a license for specific programming languages and packages, then we do not tend to run into that sort of issue. One of the challenges can be having facilities to keep the model data in the long- term. It can cost money each year, so one of the ways that we have tried to mitigate this has been moving to Globus. That way, we're able to put the data somewhere safe, secure, and accessible for the long-term.

What challenges have you faced with the PlioMIP?

One of the challenges is that these type models are incredibly complicated. They include more than a million lines of code, and simulations can require large amount of computer time. So, as I mentioned above there's an important distinction to make between *technically* reproducible and *practically* reproducible. Over time you become an expert in using a particular climate model. Whilst it is possible to teach someone who has not had experience of using a particular model, it takes time and resources to do so. Maintaining the skills base and expertise in using these models is critical.

Has there been a policymaking and/or public engagement dynamic to PlioMIP?

PlioMIP has been connected into a broader initiative called 'CMIP', which is the 'Coupled Model Intercomparison Project'. CMIP co-ordinates the majority of climate simulations which feed into the Intergovernmental Panel on Climate Change Report. So, through CMIP, PlioMIP has informed the IPCC.

How has the Covid-19 pandemic impacted your research?

It slowed down the production of outputs. It has presented us with challenges in terms of communication, and it has been especially hard on early career scientists who do not have fully established mature, collaborative networks. We tried to compensate for that, specifically by organising online meetings and get-togethers to talk about how their science was going.

What are your future plans for the project?

We are putting plans in place for PlioMIP Phase 3 now. We would like to expand our scientific remit to look at different intervals of the Pliocene epoch, perhaps when conditions seem to have been even warmer than they were towards the latter part of the Pliocene that we have studied thus far. We also want to do more to understand the importance of uncertainty in some of the geological boundary conditions that we give to the climate models. Finally, we want to tighten the focus between the experiments that we do and the relevance to future climate studies.

Open Research in Earth and Environment Studies: Accessing and Using Third-Party Datasets

What is your research background?

[My research](#) is focussed on studying macroeconomic energy-economy interactions, through primarily the lens of exergy analysis. Exergy is considered as 'available energy', and enables the study of the energy conversion chain from primary to final to useful stages - where it is lost in exchange for energy services.

My work spans various energy-economy fields, including societal exergy analysis, energy rebound, the role of (thermodynamic) energy efficiency on economic growth; energy return on investment (EROI). I work within an network of international researchers in the field of exergy economics, and act as one of the conveners of this network, which has an outward facing website here: https://exergyeconomics.wordpress.com/

My current programme of work (2018-2023) follows the award of a 5 year Early Career Engineering and Physical Sciences Research Council (EPSRC) Fellowship entitled "Applying thermodynamic laws to the energy-GDP decoupling problem". My fellowship applies thermodynamic laws to examine a national and global problem: how can we decouple primary energy use from economic growth? - i.e reduce energy consumption to help mitigate greenhouse gas emissions, whilst allowing economies to grow to improve citizen well-being. However, despite wide-scale energy efficiency policies and investment, at the global level no absolute decoupling (energy down, GDP up) has occurred. The vision for the fellowship is a better understanding the role of energy efficiency and energy rebound in the energy-GDP relationship, thereby improving the evidence base for primary energy reduction policies. Studying exergy flows through an economy enables thermodynamic-based quantification of both aggregate energy (exergy) efficiency and energy rebound. The aim of my project is to build on momentum and insights from recent research – including my own – to complete world leading exergy-based research into the energy-GDP decoupling problem within an expanded international research network.

Three key research questions are studied:

- Q1. What is the relationship between energy efficiency and energy rebound?
- Q2. How much primary energy will we need in the future to meet our energy service demands?
- Q3. To what extent can we decouple primary energy use from GDP

What ideas and thoughts come to your mind when you hear 'open research'?

Reproducibility. Making sure that whatever results and findings or analysis you've done could be reproduced by somebody else, which helps academic robustness.

Public funding. Large amounts of our funding usually come from UK taxpayers, especially in my case where most of my research has been funded by the EPSRC. Therefore, we should ensure that whatever we produce is shared publicly.

Open access. making our publications/papers accessible without requiring a paid subscription. Usually, this involves gold and green open access. Part-and-parcel of this is us, the researchers, having access to funds that can help us in publishing open access.

What has been your personal experience with open research?

Open access

I have published around 30 papers where most have been made open access. My PhD and postdoc were funded by the EPSRC, which placed a strong emphasis on open access. However, usually, I would have to apply for additional funds to help facilitate this as many journals ironically require you, as the researcher, to pay for them to publish your paper and make it open access via their outlet. I would often do this through applying to Library services here at Leeds where they have a fund specifically for aiding in making content open access.

Open access is hugely beneficial for my field. There's around 40 researchers globally that study what I do, and before the pandemic we would meet every two years, and we meet online around every 2 months. Sharing our knowledge and exchanging ideas and findings is crucial. When I first came into this field there was not much of a community in my area of research, so it's been very informative and helpful that we have managed to build one over recent years. Open access both reflects this communal spirit and helps reinforce it, by allowing us to share our findings and data with others who may wish to contribute to our area. I would say I've been able to access 90 percent of materials I wanted to get a hold of.

"I feel that the more research is widely available, then the more good things are going to happen, because otherwise it's protected and then only a certain number of people can see the research. So that limits its impact."

Are there any negative perceptions/attitudes towards open access?

I would say there are more challenges that can dissuade away from open access publishing as opposed to researchers having a negative perception per se. In my field you have major high-impact journals like Elsevier and Springer, which have high fees. Over recent years they have adopted open access principles but the irony is you as the researcher sometimes have to foot the bill or pay extra to make your publication open access in that journal.

For these big ones it could be upwards of £4000 per article, and with others still a high fee of around £1000. 'Open access' arguably disrupted their original business model, so these additional fees can easily be perceived as them trying to claw back some of their reduced profits. The obvious impact on researchers is that we as researchers either have to factor these fees into grant applications or account for these costs by other means, which can be hard.

Open and FAIR data (findable, attainable, interoperable, reusable)

Making my findings and papers open access has gone hand-in-hand with making the underlying data available. For me, data is usually numerical where we typically might have a supplementary information folder that have some calculation files top help

interpret/understand the data. Usually, I deposit these datasets in the [University of Leeds data repository](#), where out of roughly 30 papers I've published over the last 5/6 years, 10-15 had associated datasets with their own DOI. So, others were able to access and download these datasets separately.

This is not always so clear-cut. I've got the International Energy Agency (IEA) data, other publicly accessible economic data, but if I use specific data from some people I will generally write to them to check with them directly. This can be because some may have data that is 5 years old, for example, where at the time of completion of that particular project or when the results were published the data was not made explicitly open for others to use. Most of the time there aren't any problems where they tend to agree, and you can reproduce it or reuse it as long as you give appropriate acknowledgement and citation when writing up a paper to be published.

Accessing and using third-party datasets

Data is split into three parts/types: 1) datasets under license, 2) freely available (open access and FAIR) and 3) datasets created by other/third-party organisations where you have to contact them directly if you want to access and use it. Restrictions can vary depending on who it is. For example, you can go to the World Bank and download world GDP data, and you'd be free to use it. With the IEA data we have to be really careful - sometimes it's not just the data we're trying to access/use, but also accompanying graphs, reports, extracts, etc.

So, in terms of my experience in trying to secure permissions, I'll generally get in touch with the Library, who have been very helpful in understanding the terms and conditions for the reuse of such datasets in publications I produce. They will help me get in touch with the relevant organisation, so the IEA for instance, with the correct processes to ask for these permissions.

The current project I'm working on, "Applying thermodynamic laws to the energy-GDP decoupling problem", relies on accessing third-party datasets. We work extensively with IEA-procured data, building a global database of energy consumption. Basically, different countries around the world consume varying levels of energy for numerous purposes, at different stages. These range from 'primary energies' like coal being dug out of the ground to be burned for energy consumption to 'final energies' like in the production of items you buy from a shop, for example.

We have world data for all countries going back at least 50 years for primary and final energy. But the work that I do extends that data from final to useful stage. So, from that we can get an understanding of the energy efficiency of whole countries. We can link that to economic growth, and essentially one of the two big things we've been doing in this project is building a large, sophisticated and robust primary and final useful database.

In terms of the IEA-supplied data we're using 4000 rows of data, with about 200,000 data points per country for over 150 countries. The process involves us pulling all that pre-existing data, then constructing a code to settle the data, do our calculations and then refine that data into our final useful dataset. We can then use that in our project to produce papers which we're going to write over the course of 2022-23. Because we are producing analysis off third-party datasets there's acknowledgements in our papers outlining that we have been using IEA data with rigorous referencing.

Challenges

Because our work here is based off third-party datasets there are challenges in other researchers, and those outside of academia, being able to access and use our data, and reproducing our analyses. All the data we use for this project has come from the IEA, which is under a licensed system, where you have to pay for access. Academic licensing means that we have an institution license, so I'm free to use it for my research. But I can't publish that as part of my results as long as people can then extract the individual source energy data.

In terms of the database we're constructing, our ultimate aim is for it to be openly available and accessible for all by the end of this project. However, a large part of this viability is down to whether the IEA data is made available. Unfortunately, it's completely out of our hands in this regard and we can't do anything; it's entirely down to them. We're hoping it will be available, but we're planning on the premise that whatever we do in terms of publications or sharing of data that a) we would not be able to share any original data from the IEA, and b) not be able to share sufficient information that people can trace back to that original data

Open software and coding

With one project I'm not the coder, but there are people who have been working with software and published the code on [GitHub](). Also, in some papers I've referenced the code and signposted it for readers to access. For example, I would provide the GitHub link.

More generally, what are attitudes towards open research like Earth and Environment?

I think everyone's quite clear on the benefits of publishing your paper open access; you get more citations and it simply feels it's the right thing to be doing anyway. Although I will say, on downside, if you're working as a lecturer (and not on a funded-project) and are working on publishing a paper you need to find those funds to make it open access. So, I think there's some discussions within the school that need to be had about how we would find funds for those in that position.

I am aware of the new UKRI policy that stipulates your paper has to be published if you are funded by them through the research councils stuff, which we have been doing anyway. Leeds University does have helpful mechanisms for facilitating open research, particularly open access. For instance, there is Sympletic, which is straightforward for uploading publications In terms of open and FAIR data, I think people are less aware and need more training in terms of the benefits of using the Leeds data repositories.

Open Peer Review: The Atmospheric Chemistry and Physics Journal (ACP)

What does 'open research' mean to you?

I immediately think of 'open research' entailing making data FAIR (findable, attainable, interoperable and reusable), and making publications open access. However for me it goes beyond that. It includes other aspects like transparency, opening up the peer review process, and inclusivity. Generally, it's all to do with 'opening up' the research process.

The Atmospheric Chemistry and Physics Journal (ACP)

Atmospheric Chemistry and Physics (ACP) is a not-for-profit international scientific journal dedicated to the publication and public discussion of high-quality studies investigating the Earth's atmosphere and the underlying chemical and physical processes. It covers the altitude range from the land and ocean surface up to the turbopause, including the troposphere, stratosphere, and mesosphere.

The main subject areas comprise atmospheric modelling, field measurements, remote sensing, and laboratory studies of gases, aerosols, clouds and precipitation, isotopes, radiation, dynamics, biosphere interactions, and hydrosphere interactions (for details see journal subject areas). The journal scope is focused on studies with important implications for our understanding of the state and behaviour of the atmosphere.

"Transparent peer review for 20 years: for 20 years, Atmospheric Chemistry and Physics has been a pioneer in transparent peer review. Submitted preprints, reviews, and author replies are posted and permanently archived on the journal website. This unique approach ensures the highest levels of scientific transparency and integrity, as well as fair peer review for authors."

The scope of ACP is to publish a wide range of studies that share commonality in important implications for understanding of Earth's atmosphere. For example, studies on gases and aerosol, and clouds and their role in the climate system, interactions with the biosphere, etc. So, everything related to the Earth and atmosphere.

ACP started in 2000, with the first papers being published in 2001. Concerning its origins, it was created by four postdoc junior scientists (including myself) working at the Max Planck Institute for Chemistry and Mines, along with a postdoc from University of East Anglia.

What is your role in ACP?

I was initially one of the founding executive editors. I'm now co-chief editor for the journal, the other is Barbara Ervens based in France.

How does the journal facilitate open research?

Open access

ACP incorporates two central open research practices. First, is open access, where you do not need a paid subscription to access the publications we have. At the time of its creation open access did not really exist, but it was something we were strongly in favour of facilitating through this journal, before it became widely-known as 'open access'.

We approached the European Geosciences Union (EGU), a huge organisation for research across the geoscience fields, which was called the European Geophysical Society at the time. Along with our 'open peer review' approach (discussed further on) they were very receptive to our idea for a 'disruptive', interactive journal. 'Disruptive' here can be taken to mean our stance in favour of open access and open peer review, given attitudes at the time and that pretty much all publications were closed, requiring subscriptions/paywalls to access papers.

I believe we have a had huge impact in this area, where there have been over 20 similar journals established by the EGU since. In many ways we were therefore the catalyst and influencer for open research in these areas, as these newer journals followed the same model we had pursued. We receive around 1000 paper submissions a year, so it's clear that our journal and model have been well-received given this popularity.

For a long time, authors pay article processing charges to make their publication open access, which either comes out of their grant budget, the library budget for open access, and/or from the government. Unfortunately, this has long been the case in academia, where individual researchers have to pay additional costs somehow to make papers open access, which is the funding model ACP originally adopted. However, we very recently signed a framework agreement with Jisc, so that when you submit to ACP from the UK funds will be paid up front, and the bill will be settled by them, not the individual researchers

We are very much in lock-step with the new UKRI open access policy. It helps ACP to some extent because it brings people to our journal because we have always been pure open access, we're not hybrid. With hybrid, you can no longer get funding for that from the UK research councils. So, we can always use those funds for ACP where we may get even more submissions in future.

Open peer review

A major motivation behind the journal was opening up the review process beyond the old, traditional peer reviewers 1 and 2 (and in some cases more) model. Indeed, part-and-parcel of this whole endeavour had been to 'open-up' the research process and be more transparent. We therefore devised the 'open peer review' as a major component to ACP.
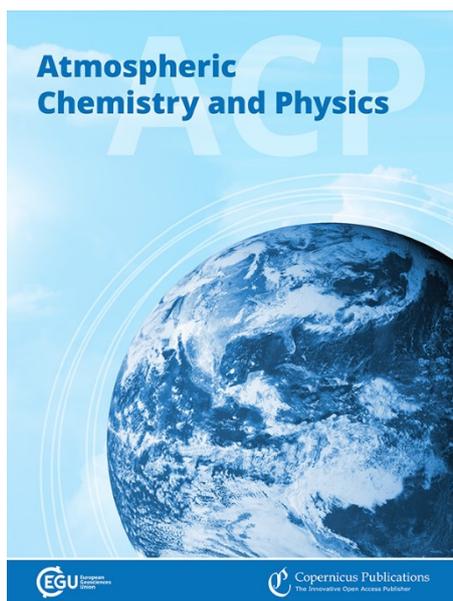
"In a normal journal: when you submit your paper, it is seen by an editor and then the editor sends out for peer review, and then the editor sees the reviews and makes the decision on acceptance or rejection. Nobody ever gets to see those reviews except the editor. So, we've made that entire thing completely open, so that an author will submit a paper. It then gets posted on our website as a preprint."

Like open access, 'preprinting' was very much a new practice back then and also not known widely under that name. After uploading we do a quick quality check from us to make sure that the paper isn't complete rubbish and/or full of errors. Then peer reviewers are called by the editor as normal, but their peer review is actually published immediately and alongside others' comments, so everyone can see all parts of the process and provide feedback.

Crucially, any member of the public can step in and write a review or make any kind of short comment on the paper. When we say 'public', we of course usually mean other scientists. You, as the author, get a full record of what people thought of the paper and what process it went through to reach publication. This model is still quite unique; no other journal in our discipline does it quite like we do, except the other journals in EGU.

What are the benefits of these practices to research?

For starters it helps facilitate transparency and therefore trust in the research process and dissemination of findings. It also helps in ensuring inclusivity, whereby anyone can access and comment (through the open review) on the works we publish. Last but not least, it helps in developing debate and dialogue on important issues related to atmospheric chemistry and physics, and research practices.

What have your experiences been like with the journal?

Outreach

We have had a really good outreach, where it is now one of the largest atmospheric journals. There are something like 60 or more journals in atmosphere and climate science, where we regularly pop up on indexes as one of the largest. We are therefore one of the most successful and popular, with one of the largest impact factors.

Our mentor at the time we set ACP up was Paul Crutzen, the 1990 Nobel Prize winner who got the prize for atmospheric chemistry. I don't think he was completely sure that the community would accept a completely new way of doing peer review. But it has proven very popular. We receive a lot of submissions from all over the world, with 119 countries now submitting to ACP from 4200 organisations, so it is right up there with all the big journals, with it being an incredibly popular publishing model and a very respected journal now.

Engagement in the open peer review process

Concerning the open peer review we haven't detected any kind of reticence amongst peer reviewers to actually making their review public. We don't name the reviewers unless they want to be named, so that's the same as a normal journal, because I think that would make them more reticent. We easily find reviewers just like other journals and authors seem very open to having their work reviewed in public. This is quite surprising as you would think they would be worried about public comments on their first draft, but they are still happy to submit to us.

In terms of engagement with the open peer review process it can be a mixed bag, depending on time and the subject/area(s) any given paper is exploring; some papers will always get more 'attention' than others. For instance, with some of the more 'contentious' papers we have had dozens of public comments and replies from the authors. When something is very contentious, we tend to send out some information to people who might have a view on it, and then we get a lot of public comments. Anyone can comment; all you need is an account with ACP which is completely cost-free.

We obviously get less submission and review engagement from global south countries compared to northern hemisphere countries due to greater technological access/availability, financial resources, and connectiveness of institutions. We are currently doing some work to try to understand whether there are other barriers to submission to journals like ACP with open access.

Potentially there is a barrier because you have to pay up front to publish your article and the funds may not be available. So, for many years we have had a fee waiver programme where basically we don't charge people from countries where they don't have the funds. We're doing more to make clear that we have that capacity, which I think a lot of people still don't know about.

Preprints

As I mentioned earlier preprints are very much part-and-parcel of the open peer review model of ACP, where the document uploaded prior to formal publication is a preprint, which anyone can review and comment on. I guess we were the pioneer of preprints, before they were widely called preprints because been posting papers along these lines for over 20 years is now called preprint. Originally, we referred to them as 'discussion papers'.

What you don't get with most preprints is the review and reply dynamic, and so we add to the preprint that context and make that public too. So, the way most current preprint servers work is they post a preprint on their server, and then they submit their paper elsewhere for formal publication, and then the review is still behind closed doors. So, you could say the reason they are posting the preprint is almost like self-advertisement. They want people to know: "hey guys, this is what I'm doing". What ACP does is to make the preprint available and the review of that preprint and the final version so you can track the whole process transparently, from preprint to final version. For me this is the benefit of preprints.

Before the term 'preprint' was used, other journals were very sceptical about our preprints because they were new and they thought that because they already had a DOI they could not be submitted anywhere else, so I think that was one of the reasons why the term was derived, to help overcome such misconceptions. However, I still think there are many researchers and journals out there that still perceive preprints negatively.

In terms of benefits, the advantage for preprints in ACP is people get to see your work earlier. It can take months to publish something, so it gets your work exposed earlier. Further it helps get feedback faster and can help incur dialogue and debate among researchers.

What are your present/future plans for ACP?

We're moving over to [EGUsphere](#), a preprint server, which will help remove any remaining barriers. We're going to also try to encourage more participation from the global south, so we're bringing on more editors from countries there and working with them to try to remove barriers to publication from developing countries.

There are also smaller things, like we're trying to expand the scope a little bit into subjects where we're not so strong, getting new editors, etc. So, there are quite a few evolutionary things going on for the journal.

School of Food Science and Nutrition

Open Research in Nutritional Science: The FIT Food online game

What does open research mean to you?

It is about ensuring research outputs like publications are open access, and not locked behind a paywall. That might mean seeking funding to pay for journal articles to become open access, which sometimes is more expensive, or being aware of university agreements with publishers. For example, I recently published an article on Wiley, where the university has an agreement with the publisher that all papers published there are immediately made open access.

Optimising the FIT Food online game app to promote the acquisition of skills and knowledge in nutrition and healthy food choice behaviours among users

Screenshot from FIT Food online game

[ESRC Impact Acceleration Funding](#) has been obtained to support a new Knowledge Exchange project which aims to build relationships between the University, the European app development company Fit Talent (https://www.fit-talent.com/) and several public health collaborators. The proposed knowledge exchange work will also enable University practitioners/academics to apply the current evidence base in the areas of nutrition/food labelling and game-based learning technologies whilst working in partnership with developers to optimise the game app 'FIT Food'.

The aim of the project is to help improve the learning power and impact of the 'FIT Food' app, which seeks to increase consumers' understanding of healthy foods and empower their use of nutrition label information on food packaging. The 'FIT Food' game app engages players (including children, families and consumers) in considering the actual 'healthiness' and nutrient content of foods, and actively compares real-life products. Such learning clearly supports recent UK policy to reduce obesity and the risks associated with COVID-19 infection, including initiatives to mandate food labelling and ban 'junk' food advertising seen by children (Department of Health and Social Care, 2020).

By encompassing other public health organisations as collaborators, including Leeds City Council and a major UK health care professional body (the UK British Dietetic Association), the project aims to improve the specific relevance of the game to two user groups: (1) UK families with children and (2) Health Care Professionals as patient educators. Furthermore, these collaborator relationships will help realise the potential and reach/dissemination of the game and support the undertaking of future primary research to assess the game's impact on public health and food choices.

I worked as the principal investigator for this project. I was approached a while ago by a company called Fit Talent, who operate in Germany. They were particularly interested in upskilling people with training and education, and they had developed an early version of the game called Fit Food, which was intended to help people learn about using nutrition label information on food products for the purposes of enhancing healthy eating. The game they developed involved you creating an avatar online and looking at products and picking up foods from the shelves in a virtual supermarket and participating in some competitions. My areas of research covers nutritional labelling on food products, so I looked into ways of making the game more realistic. I therefore looked into making the virtual labels look more the like food labels you see in real life stores, and educating people to eat healthier in line with dietary recommendations.

This was the first objective of the research project. The second was to make it a more fun and engaging game. I worked alongside Dr Arthur Lau, based in Medicine, and Dr Blayn Parkinson, a digital education manager. So, it was very much an interdisciplinary collaborative venture. We were successful in securing funding for this project, where we also had a project intern manager to oversee and drive the project from the ground-up, based in the Leeds Social Sciences Institute. Dr Blagovesta Tacheva played a major role in helping to manage the project, whilst also undertaking her PGR studies at Leeds.

There was two parts to the project. The first was to collaborate and share knowledge, and work on making the game more engaging. We worked online and with the game developers in Germany - this was done entirely remotely due to the Covid-19 lockdowns.

With the second element we explored avenues of using the game in future, broadening it out to healthcare centres and schools, and with communities and members of the public. As such, public engagement was a major means for doing this, where we organised a conference with several speakers from public health, nutrition, gamification, education and technology.

Link to the game: https://www.fit-talent.com/fit-food-app

External collaboration

Interacting with and working with external stakeholders was a major aspect of this project. After all, we are working to enhance a health-based platform for the public, where those engagements are needed to help facilitate such effectively. Logistically, having to do all these interactions online due to the pandemic actually worked out quite well. I think we got greater attendance and outreach online, as people did not have to travel. We were also able to look at the game itself simultaneously whilst meeting online, so they were quite practical too. We

were also able to easily convey our respective priorities and suggestions, and work together on them.

I think it would have been great to have held the conference in person, but I think we got more attendance online, and again people did not have obstacles regarding travelling given the online nature. We had to flesh out issues related to copyrights and property rights but we were able to do that under the guidance of the university Research Innovation Service. Overall, we have had positive and constructive relations with the collaborators.

Public engagement

This project has informed a new one where I talk to secondary schools in Leeds and Doncaster about health and nutritional matters. We had already done some engagement with school teachers, as well as our collaborators from the original project, on how we could test the game meaningfully with school students. We therefore have had some teachers come to the university to explore the game, provide feedback as well as what they think could be done to improve nutritional health in students. We also enquired how best to carry out this new project. For instance, should the data collection be a verbal collection or a written questionnaire, with 14-15 year old students. So, we are still very much in a phase of gathering evidence, where later on we hope our analysis and findings produced from such can help inform government policy.

This new project envisages using open education, where students will explore and discuss the subject more in-depth and help feed back to us.

On a more general note, a condition as part of this project was that this game would be freely available for everyone to access, so at a base level we can say the game itself is a form of public engagement. The benefits are that this is a tool that can be widely used and shared, and we hope it will shape people's eating and food choices because of the health crisis we're facing with the level of obesity and poor diets.

Have you made publications from the project open access?

All the outlets we have used to disseminate information from this project have been open access, including blogs, webpages, social media, etc. Of course, the game itself is also open access. We are also planning on making journal-level publications open access, even if that means paying a little more to do so and/or using specific publishers the university has open access agreements with.

Open Research in Food Science and Nutrition: the LubSat project

What does 'open research' mean to you?

Open research means that all the findings derived from research should be made accessible to everyone, irrespective of country/locality, type of university, or industry or sector they are in. It should essentially be about opening up research more to the wider public, beyond the strict confides of academia. It also helps greatly with transparency (with the research process) and allows others to validate your analysis and findings.

The LubSat project

LubSat is a European Research Council ERC) (Starting Grant) funded research project for 5 years (2017-22) with a value of €1.5 million to understand the role of oral lubricity on satiety. In particular, our quantitative multi-scale understanding of lubrication of the human salivary film when exposed to stimuli from food biomolecules, which in turn can have significant appetite suppression consequences, remains poorly understood.

The key limitation to accurately measure oral lubrication is the lack of availability of tribo-contact surfaces that effectively emulate the oral surfaces (i.e. the soft, slippery mucous-coated human tongue and the upper palate). The project will apply classical theories from Physics and tools from Mechanical Engineering to design novel soft lubricious surfaces emulating our saliva-coated human tongue. This will be then used to create fundamental understanding of how food molecules lubricate the oral surfaces and the implications this has on the satisfaction of the food and perceived satiety.

We know that obesity is a major, global problem, and is increasing. Obesity and overweightness can lead to multiple comorbidities, mortality diseases, etc. So, we have been working on lubricants, looking at how we can improve food design to influence obesity.

One of the things which we are looking at is satiety. Our hypothesis was: if people are satisfied and full for longer, they will not want to consume more calories. The research process involved us looking at a component in food textural manipulation which is lubricity. We were looking at changing the lubricity of food so they are adequately lubricious, they are nice in mouthfeel, people are satisfied and then they don't want to consume more.

The kind of data we generated was based on screening a wide variety of ingredients, where we also combine those ingredients into 'preforms' like gels, particles and different kinds of preformed structures, and we measured their instrumental properties. So, there was a lot of instrumental data and then there was a lot of human-based data because these food designs were also consumed by people. This data included collection of saliva, appetite ratings, their moods, the personal sensory properties of foods (e.g. likes and dislikes), and some blood trials. Of course, we went through a vigorous informed ethical approval process in order to conduct this. Afterwards, we used proper coding, made all the data anonymous so its origins could not be traced. Then we published the key finding that in some cases lubrication can impact short-term appetite sensation, and in some cases it cannot.

How has the project used open research practices?

Open access

The LubSat project placed a heavy emphasis on incorporating open research practices. For example, we have worked closely with the team from the Library to address open access in our data management plan for the project. This was also a provision from our funder, the ERC. So, there was a commitment from the very beginning to make the papers we would produce from it open access, which we have done.

The paper from the LubSat, where we talked about the key finding I mentioned earlier, is gold access with a JISC agreement. And people can also access the data that led to the finding to see for themselves. So, they can look at the means for standard deviation and the statistics behind it, which is accessible through the Leeds repository link in the paper.

Open and FAIR data (findable, attainable, interoperable, reusable)

Part-and-parcel of this open access approach was to also make the data collected open access, so open and FAIR for other researchers to use. This was done by us sending the data to the Library team via Excel spreadsheets. From this, a DOI was created for the data so others could cite and use it. With the paper, they can access the graphs and sets stored in the Leeds data repository. The data is easily findable and accessible via Google Scholar and Scopus.

What types of data have you collected for LubSat?

There was both instrumental data and human data, so they are all experimental data. 10% of the work is also theoretical data, so we did computational data collection, where we are also putting that into the public domain.
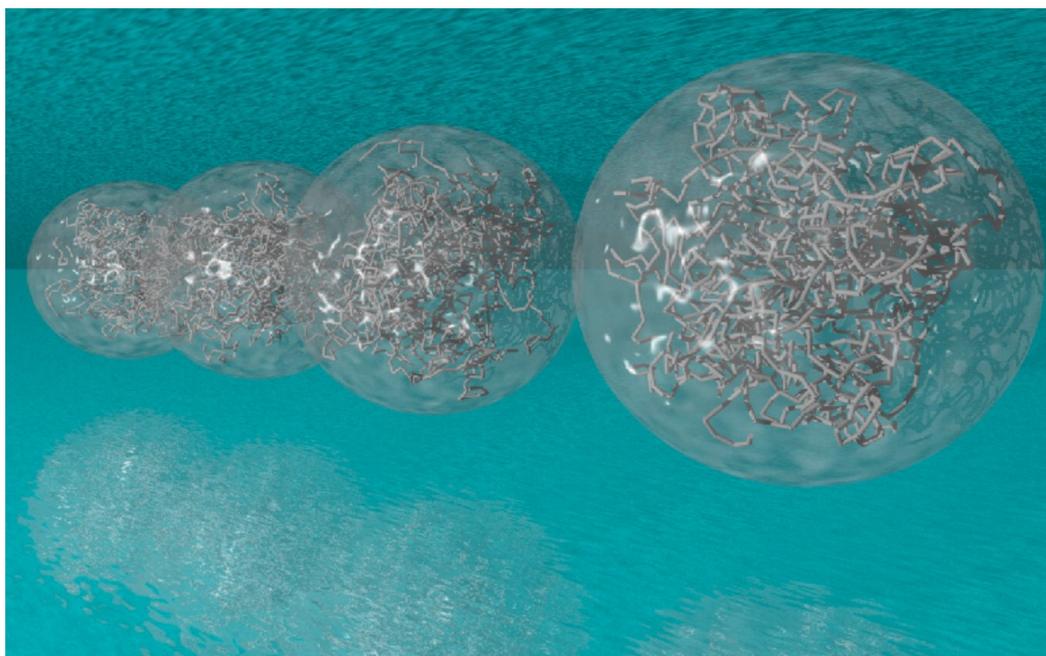
Have you encountered any challenges in carrying out the project?

The Covid-19 pandemic represented a major challenge for us as the labs were closed much of the time, so some necessary experiments were delayed. Concerning the human data collection dynamic this was also impacted by the pandemic as we struggled to recruit participants during this period.

Another issue we have encountered was data handing. Whilst everyone on the project was well-versed and experienced in handling data, we had significant quantities of it that were not used/published in the paper we produced. The data is still very much useful for other areas and analyses, so we need to think of a strategy of putting it into the Leeds repository and making it open and accessible for others. Not only that, but also structuring it in a way that others can easily identify and use, as opposed to just dumping a large chunk of data into the repository.

How do you disseminate the findings?

"We publish in peer reviewed journals first of all. We also do conferences, posters, workshops and present our findings on our website. Last but not least we use social media, particularly Twitter and LinkedIn."

Was there any external collaboration involved?

The project was principally based at Leeds with the team mainly made up of researchers based in Food Science & Nutrition. However, we did engage with some externally. For instance, we co-authored a paper with a researcher based at Wageningen University in the Netherlands. Even though the data collection was done here at Leeds they gave us valuable inputs on how to curate the data.

Are there any further (future) plans for the project?

Yes, we have two plans. One, is the results and findings from LubSat are helping to inform a proposal for a new project, where we will apply for funding from ERC and UKRI. The second thing is with the ERC PoC AquaLub project, there is a potential for the work to be used for creating a commercial entity, such as a University spin out, so we want to explore the viability of going down that route.

More generally, what are your attitudes towards open access?

This is something that has really picked up over the past few years, where people started talking about it more. I understood the concept and importance behind it, especially given I

am originally from India where in developing countries accessibility to research information, reports, data, etc. can be a big challenge.

I think its incorporation into the annual Research Excellence Framework (REF) a few years ago helped elevate its importance and centrality to how we disseminate our research. At first, it was hard to find routes and understand the know-how for making our work open access. However, the new UKRI policy, that explicitly states all funded research by the research councils in the UK be made open access, has really helped in easing and facilitating this.

In my opinion, open access benefits us massively, because it reaches out to a lot of researchers in sharing and ensuring accurate, effective research. So, it can help hugely in the kind of technology which we developed and the materials which we fabricate, for example. For instance, we fabricated a 3D biomimetic tongue surface, which can be used for understanding and screening food products. Now this is published online and we made the paper open access for anyone else to use.

What is the state of open access in food science?

Until quite recently it was relatively closed-off; open access is fairly new. So, it was very much a subscription-oriented field. I will say because our go-to journals, like Elsevier, American Chemical Society, Springer, Wiley, RSC journals, are all very much subscription-oriented, where we have to account for open-access publication costs in our grant applications, which was very difficult and complicated to cost within the budgets we have.

We therefore had to spend a lot of time and effort in thinking about how we could try to bypass these obstacles and make our works open access. However, the new UKRI guidelines and JISC agreement have made things much easier in this regard, where you can now make just about everything open access.

The green route open access was useful for working papers and preprints, but now it's even better that we have gold open access available. Before this, if we wanted to get a hold of a paper/data that was closed off to us we would have to appeal to the author(s) directly. However, this was not always a clear-cut or easy thing to do. For example, some had left and/or it's been 20 years since publication and the data is no longer findable or a struggle to get a hold of.

I think open access is overall perceived positively in my field. However, there are journals, which are from the beginning open access where you must pay £1000 or £2000 to get a paper published, in fact there is no option for subscription and also publication quality in those journals are not at par. This is seen extremely negatively in the field, because it seems like you pay to get your paper published even if it is not that great quality, rather than you pay to make it open access. Whereas if you publish in a regular journal which is subscription-based, but you pay the same amount or three times more and make it open access, this is seen positively as this is your choice – you do not have to pay to get it published.

What are your views and experiences with preregistration?

We did one for a systematic review and meta-analysis, where we used Prospero as the platform for that. In my view, preregistration can be quite beneficial, because principally it allows for the researcher to effectively copyright their research before they've actually done it, so to prevent others essentially copying or duplicating their study.

"I think the good side is nobody else can say they have done it before us."

Have you used and/or developed open software?

We have used MATLAB, RStudio, Origin and some drawing software like Adobe Illustrator, Autocad, and ChewDraw. We have used all of these to help with the LubSat project. It's been a mixed bag in terms of accessing software conducive towards our research. So, with all the aforementioned ones, we didn't have any issue. With RStudio we required some training to familiarise ourselves and we have got an in-house academic who is an expert in statistics and programming with RStudio, he also created training materials, so that was really helpful.

Is open research widely-known and practiced in food science?

"I think it will require some more training. There is public engagement, there are outreach activities, but I think more training will help."

School of Geography

Open Research and the PEATMAP project

# What do you think of when you hear 'open research'?

I think open research is very important, since it is not only for our study because we can get the available data for our research, and also we can make our own data public so that people can use it. I think not only from the academic sphere but also more the public audience, because currently not all of the data is openly available. I think only the researchers in the higher education, or the research institution which have subscribed to the license can use the data or papers. But it will be very nice to make the data more open so that all people which are interested in this data can use it.

What is the PEATMAP?

PEATMAP is a Geographic Information System (GIS) shapefile dataset that shows a distribution of peatlands that covers the entire world. It was produced by combining the most high-quality available peatland map from a wide variety of sources that describe peatland distributions at global, regional and national levels. The following sequence of comparisons to discriminate between overlapping data sources were used:

1) *Relevance*. The most important criterion was that source data are able to identify peatlands faithfully and to distinguish them from other land cover types, especially non-peat forming wetlands.

2) *Spatial resolution*. In areas where two or more overlapping data sources were indistinguishable in terms of their relevance to peatlands, the dataset with the finest spatial resolution was selected.

3) *Age*. In any areas where two or more overlapping datasets were indistinguishable based on both their apparent relevance to peatlands and their spatial resolution, the data product that had been most recently updated was selected. Recently updated products commonly contain much older source data, the period over which the latest revision source data were collected as the primary measure of the age of a dataset.

I developed the PEATMAP in my PhD a few years ago. Then, because my PhD was mainly focusing on the level of peatlands in global drinking water supplies, if we wanted to know the role of global peat levels in drinking water supply, I made the global PEATMAP as a base map. Unfortunately, during this period in 2015 there was no high-quality global peat map. So, I decided to develop the PEATMAP so that I can keep on working on my PhD project. So, this is very interesting because to be honest, at first, the main objective of this was to just develop stats for my PhD. But after this map was produced, I stored the collected data at the University of Leeds Library repository and it's open access. Others can use that, so immediately the map became very popular, which was a surprise for me.
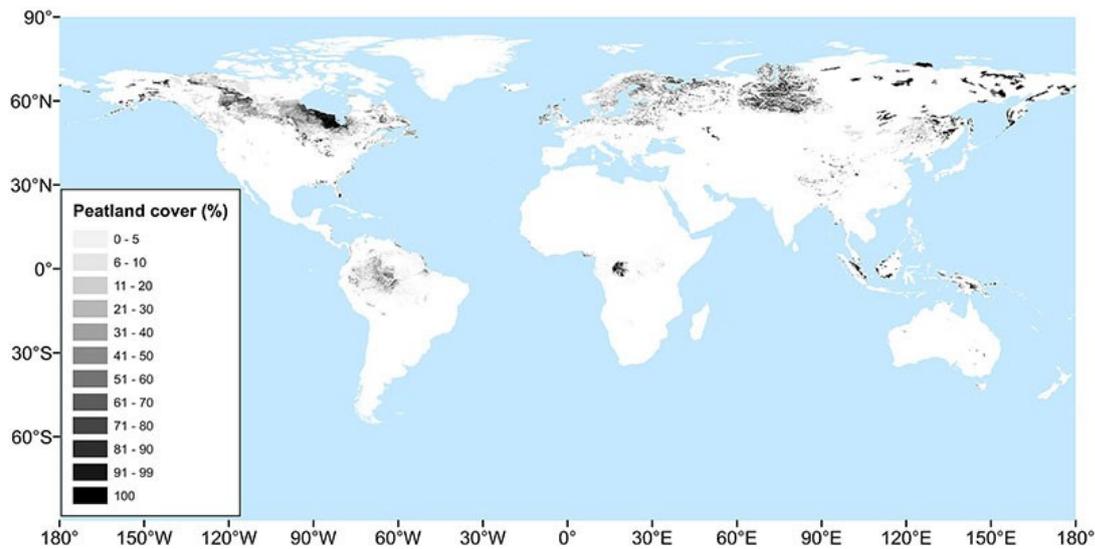
Has the PEATMAP benefitted a lot from open research practices?

Yeah, I think so. The PEATMAP is the highest-downloaded dataset in the University of Leeds research data centre. Also, the paper which described the PEATMAP has become the top one percent highly-cited paper on the website. So, I think it is all because it's open access and I have received so many emails from different audiences, not only just in the peat researcher field, but also like policymakers, the social sciences, even the arts and archaeologists. They are all very interested in PEATMAP because this is a global map(s) and they can always find the details of the area which they are interested in. So, basically, this is for the global audience and not just the scientists.

It therefore has an important reproducibility element, where the PEATMAP provides FAIR data (findable, attainable, interoperable, and reusable). So other researchers can access it for use in their own experiments, and test others' findings based on the map.

I have received so many emails from scientists from different countries who are interested in the PEATMAP. Some of them are not quite familiar with the GIS and some people ask "where can I download your PEATMAP?", and actually the links to the PEATMAP is in the paper. So, I send them the website of our university data centre, then they can download that, no problem. I was wondering if people can just Google 'PEATMAP' and they can just directly go through our universities, open datasets website rather than the paper. That would be better.

Some people just Google the 'PEATMAP' or 'global peat distribution' and the first search result is that paper. But actually, the paper is not open access, it is not golden access. 'Open access' is limited to the institution or the individuals who have subscribed to it, as well the publisher. So, this is the problem, but I will direct them to the university's dataset centre so they can download the data and they can reuse it, not only for the research but also to help inform other areas like policymaking.

I have received much feedback and it has all been good. Of course, there are some comments that suggest maybe I can improve the PEATMAP and we are very much looking towards developing a second version of the map, because it has been almost seven years so much of the relevant data has been updated. So maybe in our next steps we will develop the next version of the PEATMAP, a more up-to-date one.

Has open software been a major feature of the PEATMAP?

Actually, it's not quite open access because the final dataset was produced by the ArcGIS and the university have the license, but the company is a commercial business. The ArcGIS software, which is very popular, is not open access. But maybe if I work on this map again I can produce this map based on the QGIS, which is totally open access. When I developed the PEATMAP, I didn't use the open-access software, but this can also be produced based on open access. I used it (ArcGIS) actually just because our university has a licence for it.

Have you published any reports or findings that have been made open access?

Yeah. So many papers by others based on the PEATMAP have been published in journals like in Nature Climate Change and also I have done so for my own. I myself used this PEATMAP to calculate the value of the global drinking water supply from peatland, and the paper has been published in Nature Sustainability. That paper has been deposited in the White Rose online repository. Also the data which valued many drinking water from peatland in the UK has been cited and been used in the UK's National Statistical Office to present how important the problems are in growth in the UK and global ecosystem.

Currently the paper has been cited more than 300 times in just five or six years, so I can see that a lot more research has been developed based on the PEATMAP, because this can provide them with the basics and foundations for their own research. So, I am very grateful to know that.

What are the benefits of publishing open access in Geography?

I think it has quite a lot of benefits in physical geography. In physical geography, I think open access is more and more popular in recent years. Because people always need to repeat studies [reproducibility]. They need to make their data open access so that other people can repeat their experience. But some data or some research has been funded by industries, not just the government grants or so like in our field of geography. Some projects have been funded by the industrial sector and they provide us some data they have gathered themselves and provide it to us so that we can work based on this data, to use the simulation or the modelling, or computation. So, for this part I don't think the openness is there because you know they are commercial companies and they retain ownership of that data, so I think we need to separate it into two parts: results from public funding and those from commercial areas.

I believe the field has become more pro-open access and tried harder to facilitate such over recent years. If we look at the top journals, the top ones in our field, they all ask for the data to be made available to the public.

Have you heard of and used preprints?

We did a preprint for a paper for another project for Nature Climate Change last year. We did the preprint because the actual journal peer review process is quite time-consuming (it took over one year). So, it would be very useful to make a preprint at first so that we can get

comments from the public, and so at the same time we can revise the paper; not just wait for the very long, long period of review. We found the feedback helpful and informative.

Have you conducted any sort of public engagement with the PEATMAP?

I have conducted public engagement with other research projects but not directly with the PEATMAP. Before returning to Leeds, I worked as a postdoc in Glasgow and I have done some work in public engagement. It was very interesting and we engaged with the local farmers, the government, the government agencies and also the NGOs to discuss all of this data and all of the impacts.

I think public engagement in physical geography is important. We need to make our research more impactful, not just like we play the game by ourselves and we just publish some papers. But we really need our research to impact policy, and we can make the future better based on this.

I have done a workshop related to the PEATMAP, however. That was at COP26 UN Climate Conference in Glasgow last November. We even printed a very big poster to show the PEATMAP, and people attended the workshop and were quite interested in that. I also showed this in the international conferences or the invited talk. I have also used social media to try to disseminate the PEATMAP, mostly through Twitter.

What do you think could be done to enhance open research in physical geography?

I think it is important that people understand open access benefits our own research, and you don't need to 'hide' your data, like "this is my own data and it's not for others". I also think that the new UKRI policy on making work funded by them open access is important and will really help here. I'm currently working on a European project which has the same provision.

Open Research in Geography: The WaterLANDS project

What does open research mean to you?

For me, a key aspect of it is interdisciplinary collaboration and cooperation. So, working across different disciplines and with colleagues in different faculties, etc., where you see the differences in terms of how open people are with their data and how they use it. With that is also the broader idea of sharing data, and what you can class as open data, and how far you can go with it. We also talk about open access, and ensuring our publications are as widely and easily-accessible possible. Overall, the ideas are that we enhance academic discourse and exchanges to try to resolve problems.

WaterLANDS

WaterLANDS (Water-based solutions for carbon storage, people and wilderness) will restore wetland sites across Europe which have been decimated by human activity and lay the foundations for scalable protection across much wider areas.

Yorkshire Integrated Catchment Solutions Programme iCASP, part of Water@Leeds based at the University of Leeds, is one of the partners involved in WaterLANDS. The team will be supporting the UK action site using the range of stakeholders and knowledge exchange process they have developed. For more information email waterlandsUK@leeds.ac.uk

iCASP will be focussing on supporting The Great North Bog to deliver its landscape scale approach to upland peatland restoration and conservation. The Great North Bog is made up of six delivery partnerships: the North Pennines AONB Partnership, the Yorkshire Peat Partnership, the Moors for the Future Partnership, the Northumberland Peat Partnership, the Cumbria Peat Partnership and the Lancashire Peat Partnership.

We seek to determine how we can upscale wetland restoration across Europe. The project will be directed by the need to engage with multiple stakeholders to fully understand their needs and then to identify the ecological conditions, governance structures and financing

required to support this goal. The UK component of the project focuses on blanket peatlands in northern England.

For more information on the project visit www.waterlands.eu or follow on Twitter, and sign up to receive news and updates.

It is an EU Horizon 2020 project as part of the Green Deal call, which is looking at wetland restoration across Europe. The idea is we start off small, looking at more localised restoration examples and upscale them to larger cases, and how we can enhance existing measures and devise new ones.

The proposal has been led by University College Dublin and with some 36 partners across Europe, where we're working across six action sites (countries), across different wetland types in Ireland, the UK, Netherlands, Bulgaria, Estonia and Venice. We draw on past experience and knowledge from our 15 knowledge sites that represent different wetland types from across Europe. We are now two years in to the five year project.
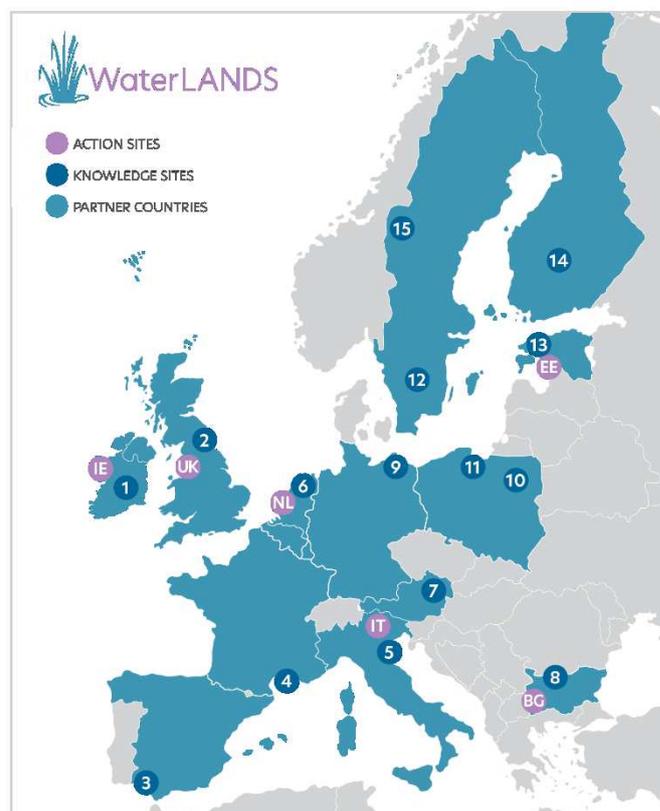

Concerning data collection, we have been using interviews, focus groups and surveys, where we have had quite a high degree of engagement. This information we have collected has helped in various ways. Aside from the obvious one being collecting subject-related data, it has helped shape our understandings of wetland restoration and conservation, and new perspectives, which in turn are helping to shape the activities we are undertaking throughout the project. We've also been running workshops and seminars to help increase engagement further and try to explore measures with the organisations we are working with.

What is your role?

I have been heading up our UK action site supporting the Great North Blog, based here at Leeds. So, I help coordinate the UK-based activities of the project and wider, overall project. We have teams and individuals across the UK working on this so I work to ensure everyone's working together, we're heading in the right directions, etc. It's quite complex so this coordination is vital. I've also got key responsibilities when it comes to the data, in terms of coordinating the collection processes, managing and storing that data, and securing ethical approval.

Interdisciplinary collaboration
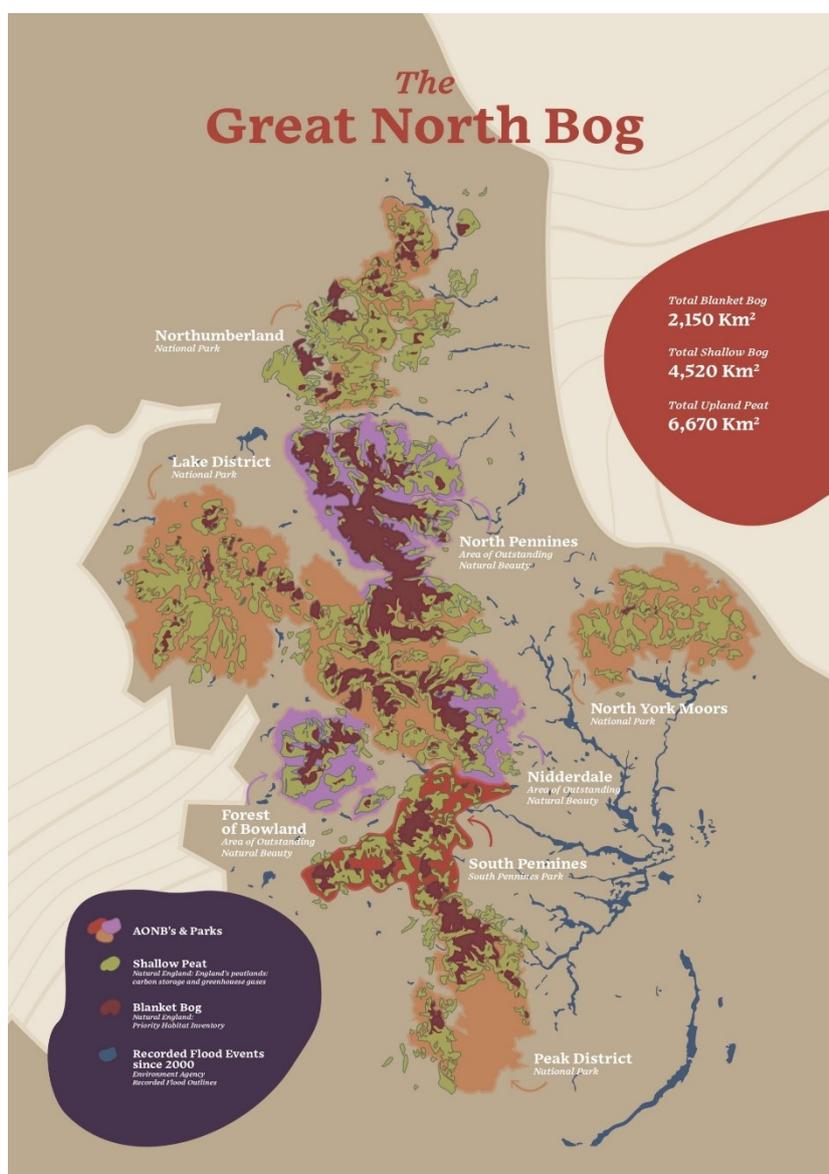
WaterLANDS is major a interdisciplinary endeavour, where here at Leeds we have researchers from across different disciplines in geography and environment working together on this project. We also host a finance coordinator role that is supporting the Great North Bog

We engage extensively with external stakeholders like NGOs, wildlife trusts, water companies, and local government agencies. Overall, the purpose of these collaborations is to bring different experiences to the table which help maximise our project outcomes.

This is really beneficial as it allows us to cover various angles of the subject. For example, finance experts help in understanding the financial implications for conservation and restoration, and how carbon credits could be used to entice companies to fund/engage with such efforts. Meanwhile, academics from across geography and environment help with understanding the multiple benefits associated with landscape scale restoration, including carbon, water resources and biodiversity.

Have you encountered any challenges?

Coordinating such a large, transnational project is challenging in itself, given the major logistical considerations, which has not be helped by the Covid-19 pandemic. Although it prevented in-person meeting at the start of the project we have now been able to have numerous face-to-face meetings. Generally speaking, most of the people working on this project are also working with others simultaneously, so it can be hard to communicate priorities and activities. Also, when you are starting out with such a project it can be hard envisage the best steps for going about it, which entails you abandoning steps, amending others and developing new ones altogether as you go along - it's a huge learning curve.

Open research practices being used

Open access and FAIR data

As part of the Horizon 2020 agreement we are signed up to the Open Research Data (ORD) pilot. So, anything that we published in terms of papers, the underlying datasets have to be made open access. We have therefore had to think carefully about what these underlying datasets will look like to both ensure they are easily accessible and understandable for others, but also don't cross any ethical lines, which can be tricky. However, we have done our best in outlining in our data management plan how are collected data will conform to FAIR (findable, attainable, interoperable, and reusable) principles. More broadly we are committed to public engagement, where our analysis and findings will be disseminated through non-academic means like reports to relevant agencies, webinars, etc.

Open software

We have been mainly using typical Microsoft software applications, and storage applications as well. For example, Excel spreadsheets, OneDrive, etc. Again, this is line with our aim to make data open and accessible, so by using easy-to-use formats where others can then interpret our data.

We are using PeatDataHub, which is an open repository for peat related data, to support our wark in WaterLANDS. To date this has focussed on water tables and is being used to support the IUCN UK Peatland Programmes Eyes on the Bog citizen science campaign. We aim to expand the types of data as part of this project.

Citizen science

We've been exploring how useful citizen science can be. As part of WaterLANDS we are running three pilot projects looking at how citizen science can be used to overcome barriers to restoration. In summer 2023 we held a series of four workshops across the Great North Bog. These workshops focused on looking at the historic peat record to help demonstrate how these systems have changed through time and to demonstrate the impacts of humans on the most recent record and how this can help guide efforts to manage and restore our peatlands. These workshops were attended by 60 stakeholders from a range of organisations involved in managing and restoring our peatlands.

Photo courtesy of Richard Grayson

Institute for Transport Studies

Open Research in the Institute for Transport Studies: the L3Pilot Driving Automation project

What does 'open research' mean to you?

I think it is around being open about what we do, showing the impact of our work. Also, talking about it with different audiences, different stakeholders. Hopefully also to then use it to understand what's going on and avoid the same mistakes that can lead to repetitive and inefficient research.

I've been doing research at the university as a postdoc since 2002. Most of my funding (approx. 80%) comes from the European Commission. They have been suggesting open research for maybe the last six or seven years. Then I think the research councils, UKRI, etc., have suggested that too in recent times.

It's got its pluses and minuses. Open access of publications is absolutely fine, but it's not straightforward in terms of the cash side of things. So, I think that's been the biggest headache: trying to balance what the funders want and what the journals want. I think we've got it sorted now, though, where journals have become more keen on open access and the funders have tried to fund/facilitate publishing along such lines.

The L3Pilot Driving Automation project

Automated driving technology has matured to a level motivating the next phase of road tests which can answer key questions before market introduction of the systems. The European research project *L3Pilot* tests the viability of automated driving as a safe and efficient means of transportation on public roads. It focused on large-scale piloting of SAE Level 3 functions, with additional assessment of some Level 4 functions. The functionality of the systems was exposed to variable conditions with around 1,000 drivers and 100 cars across ten European countries, including cross-border routes.

The technologies tested covered a wide range of driving situations, including parking, overtaking on highways and driving through urban intersections. The tests have provided valuable data for evaluating technical aspects, user acceptance, driving and travel behaviour, as well as impact on traffic and safety. With the comprehensive piloting of automated driving functions in test vehicles, *L3Pilot* has paved the way for large-scale field tests of series cars on public roads.

Basically, this project just finished last year, and we've started a new one called Hi-Drive and it's the same consortium of about 30 partners. It's normally the biggest consortium and sometimes the only project that's funded by the European Commission looking at automated vehicles. It's coordinated by Volkswagen, which has been leading these projects on-and-off for the last 15-or-so years. It involves all the vehicle manufacturers, so they basically work with the European Commission to push European expertise and knowledge in automated vehicles because, as you can imagine, there's a bit of competition with American and Chinese manufacturers.

So, there's a real push to make sure that automated vehicles are advancing within Europe by European manufacturers. Then, there's partnership with universities and research organisations, and also policymakers, road authorities, etc. as well. We're basically looking at what are the main research questions to be answered. I look at the human factors side of

things. So, what is it about the automation that drivers need to understand and vice-versa, what does the automation need to understand about what the driver knows and doesn't know, and how they behave, etc.

We basically spent about two years putting a proposal together to look at what's the next big thing that we need to investigate, and we work very closely together as part of a core group of partners, putting the proposal together. The large European projects (which are called Integrated Projects, or IPs) tend to have sub-projects. So, effectively, each sub-project is one big project in itself. I'm a sub-project leader now for Hi-Drive - leading the "User" sub-project, and looking at how Users in the vehicle (drivers), and pedestrians sharing the road with these vehicles interact with these future automated systems. In a nutshell, we work closely with other partners in the sub-project, and also collaborate with other sub-projects to answer a set of research question, using our facilities at Leeds, which include our driving simulator and our CAVE-based pedestrian simulator. So, it's a nice, controlled, environment, and we can get people to interact with a vehicle which is not currently on the market, and look at behaviours and interactions that are not possible to study in the real world.

How does the project use open research practices?

Open and FAIR data (findable, attainable, interoperable, reusable)

The questionnaire-based data conducted by the consortium is available and accessible to the public. I think there was a couple of them, one which is sort of a 'pilot site questionnaire', so a questionnaires at each "pilot site" i.e. the car manufacturers' site.

I also think the actual sort of data that I was talking about, in terms of the vehicle-based data is also made available by the L3Pilot project as a whole. I don't think we've had challenges in making the data FAIR in terms of licensing and copyright issues. I know there were a few questions, back-and -forth to make sure that it was OK to share it as a consortium, but I didn't

personally deal with it, but again we have good processes in place as a consortium and a good track record.

Public engagement and international research dissemination

Because these tend to be the European Commission's flagship projects, they're very engaged in making sure that the work is done to quite a high level and adequately disseminated. There is an advisory board as well. They tend to go to all the international meetings like the Intelligent Transport System (ITS) World Congress, where's there's also a European version of it, and there's a US version of it, and then there's other ones organised by Chinese, Japanese, etc. So, for each of those big meetings they have a whole day or session set aside for this project to be part of a panel, or special session.

We also have this trilateral group, with an agreement between the EU, US and Japan, where we look at all the aspects of automation. So, again I work on the human factors side and there's people looking at what infrastructure is needed, how we can assess the impact of automation and so on. We all get together virtually these days and exchange ideas and knowledge.

Has the project employed or created open software?

Personally, I have not been involved in the software side of the project. But there was a partner which worked on the database side. They developed a specific database for reduction of data, anonymisation, etc. Obviously with our driving simulator here at Leeds, we use our in-house development software. We've developed software to help with analysing eye tracking in driving simulation. But we haven't, as far as I know, released anything as open software.

However, I think it will be made available, it should be available on the website. Not everything is public but there are quite a few things that are public. One of the things that's of a lot of interest is how do today's traffic participants interact with each other? How do cars interact with each other? How close do they get to each other? How do they negotiate roundabouts? This information is then used to develop better machine learning algorithms and computer vision for future automated vehicles. So not software per se, but other sorts of data, but I think I'm pretty sure there will be others who may have even released some of that software.

More generally, how important is open software for transport studies?

I know that for the simulator guys it is very useful and there are lots of resources there available for them. It's lovely to be able to access it but then there are companies who do not want to share software they develop. Whereas academics do like to share, to have it open, so that helps them be out there and be known by companies and other academics. So, I think there's definitely two sides to the coin here when it comes to the software side of things.

What kind of feedback have you received?

Very good. The European Commission projects are very stringently monitored. We have deliverables that we promised to give over the course of the project that we've already written into the proposal. So, that's reviewed internally, reviewed externally by experts, and then reviewed by the Commission.

They're always super pleased, which is why we continue to get a 15-year track record with the same consortium. I mean one of the biggest advantages is that the manufacturers are involved and not many people can do the work that we do without a vehicle. So, it's quite useful to have the vehicle and the latest technology within the vehicle. It's very much kind of like a nice symbiotic relationship in that the Commission wants the research done and the manufacturers want to involved in these projects - it is good impact for them.

About halfway through a live project, we start talking about the next project -so L3Pilot was maybe live about two years, before we started talking about Hi-Drive. The way it works with European proposals is that you get to know about two years in advance what they're thinking about funding.

Understanding what we've done, what needs to be done, where the gaps are, etc., then that feeds back into what the Commission writes in terms of its next funding round. So, it's very much a collaborative way forward. Then obviously there are others, where this consortium is also supported by an organization called EUCAR, which is the European car manufacturers consortium. They again work together collaboratively to see how things are going, what the results are and what can be done better, etc. going forward.

What challenges have you faced with the L3Pilot project?

I guess data has been the biggest problem in L3Pilot, especially when it comes to the EU's General Data Protection Regulation (GDPR). The work involved looking at prototype vehicles, so they were not what you can get from your local car dealer. Some wouldn't be available on the market for another 5-10 years. So, it was very much like let's see what we can do by putting bits of kit in a particular Fiat, Renault or Volkswagen, because of untrialled (on the road) safety concerns, we could not use ordinary members of the public to carry out the tests. Instead, we had to rely on what the companies call 'safety drivers'. That was a problem, because obviously they have been trained so we could not collate completely accurate, impartial results from such tests.

For people like me who want to publish, these results are not 'real'; data based on real people. Unfortunately, that was a limitation we couldn't really do anything about and had to work with it. I am interested in looking at how do people behave? Do they manage to take over from the automation? etc., and I want to publish that. Well, that's like a no-no, because I'm saying, for example, "the driver in the Renault had to take over five times, where the driver in the Volkswagen had to take over 10 times", and that's not good for Volkswagen because people will say "oh, Volkswagen is not as safe as Renault" (as a hypothetical example).

I think we probably spent 18 months to 2 years discussing how we can make the data that's collected useful for us, and also not revealing which manufacturer we worked with. So that was one of the big issues around how do we manage the data to actually get something useful. I guess you could say that we were probably 50-60% satisfied, as open researchers that we could do that, but again, it is what it is. We would not ever have any data if we didn't have the manufacturers involved, so it's the best that could be done under the circumstances.

Impact of Brexit

A major concern we have for the future viability to engage with such research from here in the UK is what impact Brexit will have. Afterall, these projects are very much centre pieces funded and shaped by the EU Commission. We've been told to just get our heads down and get on with it. In terms of being involved in the consortium going forward at the moment I haven't been told otherwise. We are currently being funded by Horizon Europe, but looking further into the future I'm not so sure. I'm going to have a meeting with the core group in September, and that's going to be one of my questions to them.

What is the feeling? Some other partners and colleagues at Leeds have said they're get a feeling that people are not asking them to join European-based projects. But I think the other thing that's really affected me and my group is people's hesitancy to come to work here from Europe. So, there's far fewer applications, there's no certainty in terms of being able to settle, etc. My applications are basically now all completely from outside Europe. But aside from personnel issues it's the funding situation, what may or may not be, that has us deeply concerned.

Have you heard of and used preprints?

Yes, so I also see preprints as a major tool for making research open access too. ResearchGate is definitely my main go-to place. I know it's a commercial platform, but I find it is really useful and I know there's other ones, but I get an update every day about who's cited my work from ResearchGate. So, it's definitely the one place that we put everything on and it does seem to be quite useful in terms of giving access to people. Other colleagues use other kinds of social media to advertise their preprints. But ResearchGate seems to be a nice database to keep everything in. People do provide comments on my ResearchGate. They put comments on, where we do tend to get sort of recommendations and comments, but no one's ever been like "oh, this is the rubbish paper".

So far it's been good. I also believe it's very useful for researchers based in transport studies, where many have a positive outlook on them. For example, there is the group at the Technical University of Delft, which is high up, at least in terms of the Shanghai rankings. I know someone there who puts out like one preprint a day! It's nice to see what the general trend is of research in my area, so preprinting is absolutely useful.

Participatory Research in Transport Studies
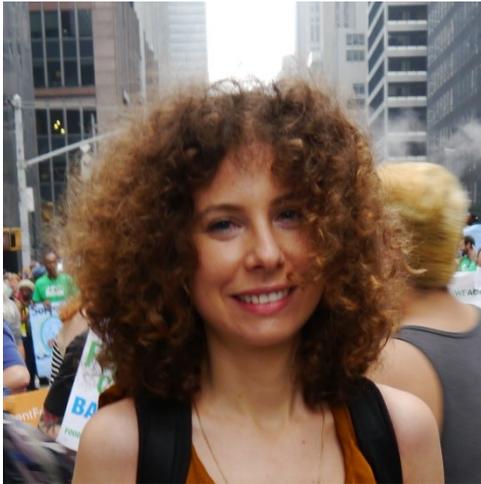
What is 'participatory research'?

"Participatory research (PR) encompasses research designs, methods, and frameworks that use systematic inquiry in direct collaboration with those affected by an issue being studied for the purpose of action or change. PR engages those who are not necessarily trained in research but belong to or represent the interests of the people who are the focus of the research. Researchers utilizing a PR approach often choose research methods and tools that can be conducted in a participatory democratic manner that values genuine and meaningful participation in the research process." (L. M. Vaughn & F. Jacquez, 2020)

What does 'open research' mean to you?

'Open research', in my lexicon is probably more along the lines of 'participatory research'. I think of participatory research more a methodological approach whereas open research, in my mind, is like the recent push to make sure that research findings, such as journal outputs, are open access. Most of my research has taken place in India, where many researchers and institutions can't afford certain subscriptions to journal publications. So, I guess that's how I see open research, but it seems like open research is also more about methodological approaches, and the overall research undertaking starting from the beginning. Overall, how can we make research open and transparent to everybody involved.

What have been your experiences with open research?

I transitioned into urban planning about a decade ago. I did my coursework at one of the first universities to advocate for participatory urban planning back in the 1960s, where the mindset was that planning was really detrimental to a lot of communities just because it was so closed and 'expert-led'.

At the time there was this idea that you plan for cities alongside the citizens and the residents, and so on. It just makes complete sense that you do not do research without giving agency to the people your effecting change upon. That informed the type of planning work I did in New York.

Example 1: Female bus conductors in India

For my doctoral work, I did an open research project with women bus conductors working for the Bengaluru Metropolitan Transport Corporation (BMTC) in south India to understand what it meant to be a woman bus conductor in the context of a very male dominated space and how women bus conductors claimed agency on board a bus to both do their job, but also to assert themselves as women. Much of that was done through participatory methods such as Augusto Boal's 'Theatre of the Oppressed', techniques, where we would do a lot of role-playing, acting out scenarios where again that agency is inserted.

Example 2: Inclusive Public Spaces project

Another project I have been working on is the [Inclusive Public Space](). This is led by Anna Lawson in the School of Law and is very transdisciplinary. It is very participant-led in terms of it raising awareness about issues of access and inclusivity of our public streets in five different countries.

Again, the idea is that it is participant-led with a multi-step processes involving participants who do everything from taking part in a one-to-one interview, to sharing a story of a difficult journey with both the researcher as well as other participants. Participants also have the option of working with a videographer who documents them making a journey they find difficult due to these barriers. So, it's not about coming in with an "expert-led" approach where we know what the problems are and finding some evidence to back it up. But instead let's first go to the participants and see what they see as the problems.

What are the benefits of participatory research?

It's very problematic to me that academic research is often very extractive. We go in, we get the 'knowledge' from participants, we get their lived experience and then we go away, and we publish in a closed publication. Maybe it helps our career and everything, but it does not feed back into the very issues and problems that we are trying to correct in the first place.

The benefit to participatory research is that if you are able to establish some kind of trust and accountability to the people that you are trying to learn from then there is a clear feedback mechanism. It can result in better impact for change, for meaningful change. Also, you have created a relationship of trust, which means you can continue to work with those people and maybe that community.

Then if you do publish something, you can triangulate your findings a bit better because again, you can go back to people and say: "this is what I heard, is this correct?". Obviously I'm kind of glossing over some of the problems of it and some of the challenges of making sure that it is genuinely participatory, e.g. you may just be getting access to incredibly vocal people, so there is a lot of factors and variables to account for. But I think if you design your research with that goal in mind, of giving back and having impact, you can ensure the long-term results are far more sustainable and impactful.

Photo courtesy of Morgan Campbell

How do you go about setting up this relationship with participants? How do you build interest and trust?

I think it always means going to where the participants are and not expecting them to take time out of their busy schedules to come to some venue, and not assuming that everybody is interested in your research. It is about taking the time to understand.

With the women bus conductors in India, for example, that had a lot of steps. First, was to approach the city bus agency and the HR department and make sure that they were on board with the work. One of the things that you struggle with when working with people in low paying jobs or precarious jobs is that there is always concern about losing your job if you speak out. So, having a researcher approach them, there is always a distrust/worry that you will report whatever they say and they will get fired. Establishing a clear channel of trust is therefore paramount.

With regards to the women bus conductors, it was about showing up at the bus depot at the start of shifts, riding the bus with them while they were on duty, hanging out at the bus depot when they were on breaks, making sure they understood what I was trying to learn and reiterating that it was about their personal experience and not the working conditions of the BMTC. It also involved finding a local research partner who was a woman, who took the public buses and for whom Kannada was her native language. Together we also deliberated over how qualities of caste, foreignness and so on would feed into how we might be perceived and received by the bus conductors. Lastly, it was about showing interest in who these women were/are beyond just their work and maintaining that relationship after the research ended.

What sort of ethical issues have you encountered through using participatory research and how have you tried to resolve them?

Photo courtesy of Morgan Campbell

There's a lot of ethical challenges. I do not know if this is the right direction or not, but you know you do your ethics review and you say you are going to do certain things. So, for example, sometimes ethics approval want you to have written consent forms, but then you find that actually people are very mistrustful of signing anything. So, then you have to figure out what to do, sometimes on the spot in order to not lose the opportunity.

In the case of the women bus conductors the involvement became very dominated by some of the women bus conductors who had been working for about 10 years and who had a certain level of confidence as opposed to some of the younger, newer bus conductors. Their experience could be entirely different, but because they were quite timid to talk to me again, coupled with some of that in-workplace and security issues, their voices were not heard as much.

The issue of who wields the 'power' in participatory research

Power dynamics are always an issue and challenge, and I think especially when it comes to publishing you do not want to feel like you are in command and exploiting participants. With the women bus conductors, that manifested in terms of being part of a public exhibition. From my own research perspective, I was interested in the question of embodied gender in public spaces. But that can be quite theoretical.

I was fortunate in that instance as the research was supported through a very experimental theatre collective called Sandbox Collective and the Goethe Institute. So, while my academic research was in something quite theoretical, the research was designed so that one output was a public exhibition that focused more on the important role the woman played as both conductors and public-facing women.

In addition to making a documentary and a small tactile exhibition it involved about five of the women bus conductors coming to the Goethe Institute and talking to people as they watched the documentary. There was a question of power, or maybe a rebalance of power in that

instance as bus conductors might find a space like the Goethe Institute intimidating or exclusionary and the people who frequent the Goethe Institute might be less likely to use the public buses on a regular basis. So, I think there was some interesting dynamics in that case.

Photo courtesy of Morgan Campbell

What methods of data collection have you used in your experiences with participatory research?

Predominantly interviews but also more creative approaches such as acting and role playing. It's been very fun and engaging to be working with video footage in the case of the Inclusive Public Space project.

What are the stances of major funders when it comes to participatory research?

Because I am an early career researcher my experience is going to be limited, but I think it entirely depends on the funding body. However, I think there is a real sort of disconnect between funders saying they want to see participatory methods but not actually allowing space for it. For example, there are very unrealistic time scales for a lot of research, and so if you wanted to do truly participatory research, you need more time. I am not saying we should be spending 10 years on one project to make these things happen. But you cannot pursue genuine participatory research and hope to organise it, conduct it, and deliver results and feedback to the community in a year.

What are your views on and experiences with open and FAIR data (findable, attainable, interoperable and reusable)?

Making data open and FAIR can be challenging when external stakeholders have been involved in that specific project. Our findings might expose something that could cause conflict with some of our stakeholders, so there can be a lot of conundrums.

There can be concerns that making collected data more readily available to others can make some stakeholders look bad, which can result in problems later down the line should you try to enact the desired changes or work on a new product. So, how we 'message' the data and findings is crucial too.

More generally, what are attitudes within your school towards open research like?

That is a good question. I've worked in three departments now and I think each one has its own unique approaches. Going back to my first point, I think the idea of open research in terms of making sure publications are freely accessible is clearly a priority of every department.

Within the Institute for Transport I'm embedded in the social and political science group. So, we clearly have that interest in engaging directly with participants. However, when you talk about 'transport studies', you're talking about this whole range of positionalities. You have civil engineers and then you have mobility, justice researchers, etc. Trying to say something definitively about the state of open research in this discipline is absolutely impossible.

I think that is also then reflected in transport planning or urban planning more generally; it really depends on what side of the discipline you are on. I can conclude by saying I think overall it is obvious that the university is very supportive of open research and wants to see it and that funders are addressing it too.

"There's a commitment to do it and there's acknowledgement that it needs to happen. But there's still a lot of ambiguity or uncertainty about how to do it, and I think that's both the blessing and the curse of open research."