Research experience placements at the University of Reading, summer 2021

The Natural Environment Research Council has a scheme aimed at encouraging undergraduate students who are doing a degree in a quantitative discipline to consider a career in environmental research.
http://www.nerc.ac.uk/funding/available/postgrad/advanced/experience/

The SCENARIO DTP http://research.reading.ac.uk/scenario/
has five placements in this scheme this year, based at the University of Reading. This scheme is therefore an excellent opportunity to get experience of working in a thriving research environment before considering applying for a PhD next year (whether with SCENARIO or elsewhere). SCENARIO will ensure that all research experience students are offered a PhD interview, where appropriate.

Students would receive £9.25/hr. We allow flexibility in working patterns ranging from 30 hours per week for 7 weeks to 20 hours per week for 10 weeks.

Projects will take place this summer. You will have a PhD student mentor to help with the practical aspects of the project and to discuss the experience of being a PhD student.

The eligibility criteria are:

- be undertaking their first undergraduate degree studies (or integrated Masters).
- be applying for a placement in a different department to their undergraduate degree.
- be eligible for subsequent NERC PhD funding (details of eligibility for PhD studentships).

Five possible areas of study are given on the following pages. Please note that all of these topics will require computing skills to perform, in terms of data handling and presenting your results. The projects may be run remotely. Supervision, including guidance in using software, will be provided by the supervisors, online if necessary.

If you are interested in applying for one of these placements, please email Dr Miguel Teixeira (m.a.teixeira@reading.ac.uk) by **Friday 18th June 2021**, providing a brief application (no more than 2 sides of A4) that should include information on:

(a) How you meet all of the above criteria,

(b) A-levels grades (or equivalent), and the marks you have received on your University course so far,

(c) Any experience with data processing software (Python, Matlab, R, etc.),

(d) The topics you would like to work on, in order of preference.

(e) Provide a short statement, of around 250 words, on the origin and nature of your interest in environmental science. Include any relevant work or project experience.

The University is committed to having a diverse and inclusive workforce, supports the gender equality Athena SWAN Charter and the Race Equality Charter, and is a Diversity Champion for Stonewall, the leading LGBT+ rights organisation.

NERC feedback is that some student groups are typically underrepresented within the Higher Education pathways including (but not limited to) students from ethnic minorities, those with a disability or from low-income backgrounds, and we welcome applications from these student groups**.**

SCENARIO is committed to widening the diversity of our student cohorts.

1. The impact of Hybrid Working on Carbon Footprint

Eugene Mohareb, Tim Dixon, Andrew Charlton-Perez, University of Reading

As the economy rebounds from COVID-19 and its associated restrictions, discussion is currently focused on how a “green” recovery can be realised that matches our global low-carbon (and zero carbon) ambitions. A key part of this would be to consider how the conventional workplace model of office work might be altered during this recovery, considering the investment that has been made to enable working from home (WFH) over the past 14 months, and how the evolution of ‘hybrid’ working, combining home and office working, could evolve to underpin a drive to a green business transition.

The proposed project will review the literature (academic and trade) to gain an understanding of what the carbon impacts of various modes of working would be and to scope out the range of tools currently used by organisations for measuring carbon footprints (e.g., WSP, 2020). Within this, changes in domestic, commercial and transportation energy and material demands will be considered; this will involve identifying key data for the development of scenarios to quantify domestic activity (heating, lighting, plugloads, equipment purchases, and potentially waste), transportation mode shifts (mode share, frequency) and commercial operations (space conditioning changes, lighting, and equipment), as well as the potential impact of seasonality on consumption (e.g., Turits, 2020) . A framework will be developed based on this literature review, enabling an exploration of the baseline demands, changes observed in the past year, and how various hybrid models might improve carbon performance.

Key outputs will include the literature review document and a preliminary framework for assessing the impacts of various modes of working. The student will benefit from the exploration of academic literature on a topical research area, engagement with a private-sector partner, and supervision of academics across Meteorology and Built Environment.

Turits, M, 2020. Why working from home might be less sustainable. [online] available: https://www.bbc.com/worklife/article/20200218-why-working-from-home-might-be-less-sustainable Accessed 04/05/2021

WSP, 2020. Office vs Home Working – How we can save our carbon footprint. [online] available: https://www.wsp.com/en-GB/insights/office-vs-home-working-how-we-can-save-our-carbon-footprint, Accessed 04/05/2021

2. What controls long-term variations in global mineral dust?

Alcide Zhao, Claire Ryder, Laura Wilcox, University of Reading

Introduction: mineral dust lifted by strong winds is a key component of our Earth's atmosphere. It has important impacts on global climate, ecosystems, and human wellbeing. As we endeavour to clean the air up by mitigating human activities produced aerosol particles, natural aerosols like desert dust may make up a greater proportion of atmospheric aerosols and hence shape future climate. It is therefore pressing to better understand how global dust emissions are changing in the long-term and what controls such changes. Of particular interests are North Africa, the Middle East and North China. These regions combined account for over 80% of global total dust emissions.

Objectives: The student will investigate long-term variations in dust emissions over the world's dustiest regions and link such variations to the natural rhythm (variability) of the climate system.

Methods: The student will analyse dust emissions in the state-of-the-art Earth climate system models such as those of the UK Met Office. The student will then investigate the links between dust emissions and climate variability indices such as the El Niño–Southern Oscillation (ENSO) and the Atlantic multidecadal variability (AMV).

Benefits: The student will benefit from (1) an exposure to climate modelling, atmospheric composition and circulations, (2) analysing and visualising data using various programming languages such as Python and bash scripting on which guidance and support will be provided, (3) working and collaborating within a climate focused research groups, and presenting findings at group meetings, and (4) writing report and potentially contributing to a publication.

3. Radar observations of turbulence in storms

Thorwald Stein, Chris Westbrook, University of Reading

Radar observations in frontal cloud and precipitation systems have been collected as part of the PICASSO programme to study ice cloud processes. Two scanning Doppler radar instruments were deployed, each sensitive to different-sized snow and ice particles. The Doppler measurements tell us about the mean wind in the radial direction, but the Doppler spectrum also informs us of the variation in the wind due to particles falling at different speeds, wind shear, and turbulence. We are interested in retrieving the turbulence in these frontal systems and comparing the results from the two radars. Differences in turbulence estimates may be explained by the radar configurations and we will explore different configuration parameters (scan speed, number of pulses). Weather permitting, there may be the opportunity to collect new data with these two radars for a case of deep convection (thunderstorms). Both radar instruments are world-renowned research tools to understand clouds and precipitation and storm dynamics and to help constrain and improve weather forecasts. It is important for us to understand how well each instrument performs under different weather conditions.

Working on this project, you will benefit from supervision from two leading scientists in radar meteorology and cloud physics from the University of Reading and you will get to present your work at our research group, meeting our current PhD students. You will be provided with code and scripts to read and visualise radar observations, learning to handle large data sets. The project is an opportunity for science undergraduates to learn about cloud physics and to apply their existing knowledge to a problem in weather forecasting.

4. Investigation of the urban surface-energy balance

Denise Hertwig, Sue Grimmond, University of Reading

Worldwide the levels of urbanisation and the number of people living in cities are rising. The volume and density of buildings and the thermal and radiative properties of urban materials affect the surface-energy balance in cities, for example, through augmentation of the heat storage capacity, enhanced radiative trapping and increased aerodynamic roughness. A well-studied manifestation of this is warmer cities compared to their rural surroundings (urban heat island). The prevalence of impervious surfaces also affects the water balance in cities, with increased surface runoff and strongly reduced potential for infiltration and evaporation. Additional anthropogenic emissions (heat, water, pollutants) further distinguish cities from rural environments.

Land-surface models used in numerical weather prediction or climate projections need to be able to capture the impact of such urban features and feedback mechanisms with the atmosphere. The objectives of this study are to explore the effect of anthropogenic heat and water emissions (irrigation) on the surface energy balance in Chinese cities. The aim is to identify model improvements needed to represent anthropogenic water and heat contributions. The student will learn about fundamental urban processes, their representation in models and will gain experience in the analysis of land-surface model output and evaluation against observations. This offers opportunities to extend their programming skills (Python) and knowledge of statistical analysis methods.

External collaborators: Junxia Dou, Institute of Urban Meteorology, CMA, Beijing

IT requirements: Own computer/laptop; Python; basic knowledge of Linux/Unix

5. How have the COVID-19 lockdowns influenced the atmospheric oxidising capacity?

Alcide Zhao (University of Reading), David S. Stevenson (University of Edinburgh)

Introduction: the hydroxyl radical (OH) is a highly reactive component of the Earth's atmosphere. Its abundance determines the atmospheric "oxidizing capacity" and controls the removal of many important trace gases such as methane (CH4). The COVID-19 pandemic has led to recessions in economic activities and hence reductions to emissions of greenhouse gases and air pollutants. It is very interesting to know how this has changed atmospheric OH concentrations. This may provide useful information for understanding future changes to many aspects of the climate system as we press to reduce human activities induced emissions.

Objectives: The student will investigate whether atmospheric OH concentrations have changed because of the COVID-19 pandemic and examine the drivers. If time allows, the student will also investigate how such changes have influenced other components of the atmosphere such as CH4.

Methods: The student will analyse several idealised scenario experiments from the state-of-the-art Earth System models that are participating in the COVIDMIP project. The student may also collate satellite and ground-based observations data to support their analysis.

Benefits: The student will benefit from (1) an exposure to atmospheric chemistry modelling and simulations, (2) collecting, analysing and visualising data using various programming languages such as Python and bash scripting on which guidance and support will be provided, (3) working and collaborating with research groups based at Reading and Edinburgh universities, and presenting findings at group meetings, and (4) writing a report and potentially contributing to a publication.