PROJECT TITLE: Using deep learning to reconstruct past ocean warming and improve projections of future sea level rise.

DTP Research Theme(s): Changing Planet

Lead Institution: University of Bristol

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Project keywords: Climate change, sea level rise, ocean heat content, deep learning

Figure 1: Coastal flooding in Jakarta, Indonesia, February 2017. [Source: WMO / Flickr]

Figure 2: Global mean sea level change relative to 1900. [Source: IPCC, 2021. Summary for Policy Makers.]

Project Background

Sea level is rising at an accelerating rate. This is already being felt by coastal communities who are seeing more extreme sea level events and associated coastal flooding (Fig. 1). By the end of this century, many millions more will be at risk of permanent inundation or coastal flooding, leading to population displacements, eco-system degradation and huge economic and social costs. Although the broad picture of rising seas is clear, projections of future sea level rise are still quite uncertain (Fig. 2). This limits the ability of governments and coastal communities, which include a large fraction of the world’s poor, to take appropriate steps to prepare for rising seas. The primary goal of this project is to improve our understanding of how the ocean stores heat so that we can reduce the dynamical uncertainty associated with predictions of future sea level rise. Ultimately, this will strengthen the scientific base informing policies to enhance the resilience of coastal communities.

Project Aims and Methods

The project will focus on improving estimates of ocean heat content and sea level change. First, you will conduct a robust comparison of existing statistical techniques for reconstructing past ocean heat content. To do this, you will create synthetic observational datasets by sampling a large database of CMIP6 climate model simulations, produced as part of the latest IPCC assessment, as well as higher resolution ocean model simulations, and then applying the techniques to recover the known model signal. Next, the simulated datasets will be used to develop a novel reconstruction method, based on deep learning, to estimate past ocean heat content and associated sea level changes. Finally, we will use our improved reconstruction of ocean heat content to better understand the dynamics of the ocean’s response to warming and develop a reduced-physics model of the ocean’s response to warming that can account for the observed changes in ocean heat content. This model will then be used to project future changes in ocean heat content and sea level for given warming scenarios. There will be ample scope for the student to tailor the project to suit their own ideas and skills as the project develops.
Candidate requirements
You should have a strong quantitative background (e.g. maths, physics, computer science) and a desire to develop and apply your knowledge and skills to tackle a complex dynamic problem of enormous societal value using the latest high performance computing and machine learning techniques. As we value a diverse research environment, we welcome and encourage student applications from under-represented groups.

Project partners
The project will benefit from the involvement of the UK Met Office, a world leading centre for climate research, including sea level science and projections. You will have the opportunity to visit and present results at the Met Office and participate in international working groups on sea level reconstructions.

Training
You will develop skills in ocean modelling, machine learning and the statistical analysis of large datasets, high-performance computing and programming. You will learn how to present complex ideas, both in written and verbal form, to a wide range of audiences. You will have the opportunity to attend relevant University taught units and training provided by the University’s Advanced Computing Research Centre.

Background reading and references


Useful links
http://www.bristol.ac.uk/geography/courses/postgraduate/

Bristol NERC GW4+ DTP Prospectus:
http://www.bristol.ac.uk/study/postgraduate/2023/doctoral/phd-great-western-four-dtp/

How to apply to the University of Bristol:
http://www.bristol.ac.uk/study/postgraduate/apply/

Please note: If you wish to apply for more than one project, please contact the Bristol NERC GW4+ DTP Administrator to find out the process for doing this.

The application deadline is Monday 9 January 2023 at 2359 GMT. Interviews will take place during the period 22 February – 8 March 2023.

NERC GW4+ DTP Website:
For more information about the NERC GW4+ Doctoral Training Partnership please visit https://www.nercgw4plus.ac.uk.

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