AI4ER Undergraduate Research Experience Placements 2022

The UKRI Centre for Doctoral Training in the Application of Artificial Intelligence to the study of Environmental Risks (AI4ER) trains researchers to develop and apply leading edge computational approaches to address critical global environmental challenges by exploiting vast, diverse and often currently untapped environmental data sets. Embedded in the outstanding research environments of the University of Cambridge and the British Antarctic Survey (BAS), the AI4ER CDT addresses problems that are relevant to *building resilience to environmental hazards and managing environmental change*. The primary application areas are: Weather, Climate and Air Quality, Natural Hazards, Natural Resources (food, water & resource security and biodiversity).

The *AI4ER CDT Research Experience Placement (REP)* scheme aims to encourage suitably qualified undergraduate students to consider a career in artificial intelligence applied to environmental risk.

We encourage that placements are undertaken in person, however this can be flexible depending on student and supervisor's circumstances.

REP placements will be between 6-8 weeks and each student on a REP placement will be paid £332.5 per week. (Based on 35 hour week.)

A list of available projects is given here.

Eligibility of students

Students must meet all of the following criteria to be eligible for this placement:

(i) Be studying for an undergraduate degree (or integrated Masters degree) in one of the following subjects: natural sciences (e.g. physics, chemistry, earth sciences, biology), engineering, computer science, mathematics. (The degree course should continue beyond summer 2022, i.e. students should not currently be in their final year. Priority will be given to students who will complete their course in 2023.)
(ii) Be expected to obtain a first or upper second class UK honours degree.
(iii) Be eligible for subsequent UKRI PhD funding and have the right to work in the UK.
(iv) Meet the particular requirements (academic background/skills) associated with the project or projects of interest.

How to apply

Students should submit their application by email to the CDT administrator (ai4er@esc.cam.ac.uk).

(i) Single sheet giving: (a) Full Name, (b) DOB, (c) email, (d) Home address, (e) Nationality including confirmation of right to work in UK, (f) current academic course and expected graduation date, (g) List of projects for which you wish to apply, in priority order (most preferred first), (h) Name and contact details of referee (we will contact referee but applicants must have informed referee in advance of application).
(ii) CV (no more than 2 pages).
(iii) Brief covering letter giving motivation for application – maximum 1 page.

Closing Date: Sunday 1 May 2022

UNIVERSITY OF CAMBRIDGE

Application of AI to the Study of Environmental Risk

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

AI4ER Research Experience Placement Project 2022

PROJECT 1

Title	IceNet2 Operational Forecast refinement
Supervisor	Dr. Scott Hosking, James Byrne, Tom Andersson
Department/Institution	British Antarctic Survey Artificial Intelligence Lab

Brief description of background to project:

IceNet demonstrated improved accuracy for monthly-averaged sea-ice forecasting in the Northern hemisphere using deep learning-based CNNs, being published and communicated widely. A subsequent project has operationalised this work, moving to daily temporal resolution and both hemispheres. This project created an MLOps based framework and demonstrated integration to real-world use-cases, as well as increasing adoption potential for research.

We are currently working on improving the accuracy and demonstrations of the daily resolution system, IceNet2. There are many opportunities for keen researchers to leverage the forecasting framework and coordinate with our partners, utilising a novel deep-learning pipeline.

Current comparisons against operational physics models shows potential for improvement against the monthly forecasting. Model refinement is ongoing, as the recent project increasing temporal granularity and operational forecasts was concerned with building the technical infrastructure to facilitate future research activities.

Background introductory reading:

The following are key resources:

• The original IceNet research, which details the methods and results for monthly averaged predictions in the Northern Hemisphere

• Notebooks illustrating the usage of the revised codebase for training and utilising daily SIC forecasting networks:

Brief description of what the student will do, the skills they will gain and the outcome expected from the project:

The following objectives will be available for the student to build on. We aim to help students understand their work contextually within the fields of polar science, open research and artificial intelligence.

- Improve forecasting accuracy and functionality.
- Improve MLOps functionality for continuous improvement of pipelines.
- Quantify performance changes between reanalysis and real-time forecasting modes.
- Assess capacity to forecast the Weddel 2016 polynya.
- Assess coastal Arctic and Antarctic prediction capabilities.

- Explore alternative training methods IceNet2 to improve baseline performance.
- Explore alternative deep learning architectures for IceNet2.
- Explore coupling possibilities with physics and/or emulation based models.
- Explore strategies to increase the spatial resolution of the model.

Students will not be limited to a single topic. They may choose to undertake a composite project based on the above tasks. We expect the basic timeline to be (a) familiarisation and project planning, (b) baseline analysis/research, (c) implementation and (d) reporting and evaluation.

Required academic background/skills of student:

- Python and Linux systems experience is required.
- Basic knowledge of statistical analysis.
- Basic knowledge scientific data formats is useful.
- HPC experience will be useful.
- Basic level of knowledge modelling or weather/climate forecasting would be a plus.
- Ability/willingness to work independently to a plan created in collaboration with others.

Dates within which the project could be carried out and supervision could be offered:

- No current constraints are identified at this time.
- First line supervision will be primarily offered by the BAS AI Lab Research Software Engineer James Byrne with support from the IceNet PI Scott Hosking, and scientific/analysis from IceNet lead researcher Tom Andersson, as and when available.
- It's expected to have a weekly catchup with the RSE and one of the IceNet scientists, with additional support offered on request.

Logistic arrangements:

There is **no requirement** for visiting Cambridge and hence this project can be undertaken remotely, though a BAS visit at some point for context is always entertaining for the student and would be particular welcome at the start and end of the project.