<table>
<thead>
<tr>
<th>Project title:</th>
<th>Resilience to change in a fast-changing environment: vegetation productivity in the high Arctic</th>
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<tbody>
<tr>
<td>Project code:</td>
<td>OU13</td>
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<td>Host institution:</td>
<td>The Open University</td>
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<td>Theme:</td>
<td>Biogeochemistry</td>
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<td>Key words:</td>
<td>ecosystem productivity, warming experiment, carbon-climate feedbacks, solar induced fluorescence</td>
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<td>Supervisory team:</td>
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**Project Highlights:**

- Exciting field based project on carbon cycle processes in the high Arctic (Svalbard)
- Novel remote sensing technique of plant activity based on Solar Induced Fluorescence
- Strong international links

**Overview:**

The Arctic region is undergoing rapid change in response to the warming climate and other global change processes. Temperatures in the Arctic are increasing at twice the average global rate. The impact of these changes on ecosystem function, carbon balance and associated climate feedbacks remain uncertain. Warming has been stimulating growth and productivity in many Arctic ecosystems over recent decades, resulting in an apparent ‘greening’ trend across much of the region: an increase in satellite vegetation indices such as the Normalised Difference Vegetation Index (NDVI). However, greening is not observed everywhere, and in recent years some areas have started to show a ‘browning’ trend, associated with warmer and drier conditions or extreme events. Interestingly, vegetation of the High Arctic appears to display greater resistance to the warming trend, with less growth stimulation than at lower latitudes. The reasons for this resistance are not well understood, and will be the focus of this project.

Much of the High Arctic is considered a polar semi-desert; that is, it is dry as well as cold. The soils are also nutrient poor, and therefore the limited growth response to warming in these areas may be linked to water and/or nutrient limitation. However, climate change predictions strongly indicate that the region will get wetter as well as warmer in the future due to increased rainfall from the ongoing loss of sea ice and warming. Furthermore, our recent work has indicated that High Arctic systems are sensitive to combined changes in precipitation and warming, and that the limited growth responses in this region mask underlying changes in leaf photo- and bio-chemistry and carbon allocation.

This project will investigate the links between ecosystem productivity and hydroclimatic drivers in the High Arctic environment of Svalbard, to better understand recent trends and future trajectories of vegetation productivity in this region. Investigations will be focussed on both naturally varying areas of productivity, and at long-term warming and wetting experiment at Kvadehusken. It will employ a new proximal sensing technique, measuring Solar Induced Fluorescence (SIF) during photosynthesis, to investigate physiological activity across spatial and temporal domains. These measurements will be coupled to measurements of CO₂ and water exchange and biogeochemical parameters. In particular, it will explore the role of water and nutrient availability in

![Arctic tundra at Brøggerhalvøya, Svalbard. Credit: K. Newsham, BAS.](image-url)
mediating productivity and its response to climatic drivers.

**Methodology:**
Field measurements will be conducted at sites on the Svalbard Islands, located in the high Arctic (above 70°N). Sites are largely low productivity arctic polar deserts of moss, grasses, herbs and dwarf shrubs, although nutrient rich sites exist at the base of cliffs supporting large colonies of nesting birds. Research will be based out of the UK Arctic Research Station at Ny-Ålesund. Measurements of SIF from surface vegetation will be made using a lightweight, dual-field-of-view spectrometer system (Piccolo Doppio) designed for field-based SIF measurements. Simultaneous down-welling solar irradiance and up-welling surface radiance measurements will be made using both a broadband spectrum and high-resolution SIF-range spectrometer. Autonomous operation and data logging is controlled by a Raspberry Pi-based control board. In addition to surface SIF, measurements of leaf-level chlorophyll fluorescence parameters (PAM technique) will be made using a portable fluorimeter. Surface exchange of CO₂ and water will be made using surface chambers interfaced with a gas analyser, and samples will be collected for lab-based measurements of leaf optical properties.

Training and skills:
The student will receive full training in all necessary instrument use. The student will acquire specific skills in conducting field-based research for work in the Arctic; handling and processing of large data sets; plant ecophysiology; and scientific communication and networking with local and international partners. They will also be encouraged to undertake training in ecological statistics or modelling relevant to the data analysis that will be required.

NERC CENTA students are required to complete 45 days training throughout their PhD including a 10-day work placement. In the first year, students will be trained as a single cohort on environmental science, research methods and core skills. Throughout the PhD, training will progress from core skills to master classes specific to CENTA research themes.

**Partners and collaboration**
The British Antarctic Survey (BAS) are potential CASE partners on the project. The student will also benefit from strong links with the University of Edinburgh, for the development and use of the Piccolo system, the University of Helsinki, for SIF and leaf optical property measurements, and partnership with related projects in the Alaskan Arctic.

**Possible timeline:**

**Year 1:** Instrument training, data processing and analysis routines. Prepare literature review. First field campaign (summer).

**Year 2:** Data analysis and optical property measurements on collected samples. Manuscript from first campaign. Second field campaign (summer). Local conference presentation.

**Year 3:** Complete data analysis. Prepare second manuscript and present results at international conference. Write up thesis.

**Further reading:**

**Further details:**
We welcome applications from students with a strong background in plant, soil or ecosystem ecology or physiology, an interest in global change processes, and an enthusiasm for field work and independent work. Familiarity with micro-processor systems instrumentation is an advantage. The student will join a well-established team researching ecosystem processes at the Open University.

Please contact Kadmiel Maseyk for further information kadmiel.maseyk@open.ac.uk

Applications should include:
- a cover letter outlining why the project is of interest and how their skills match those required,
- an academic CV containing contact details of three academic references
- a CENTA application form, downloadable from: [http://www.centa.org.uk/media/1202/centa-studentship-application-form.docx](http://www.centa.org.uk/media/1202/centa-studentship-application-form.docx)
- and an Open University application form, downloadable from: [http://www.open.ac.uk/students/research/sites/www.open.ac.uk.students.research/files/documents/Application%20form.docx](http://www.open.ac.uk/students/research/sites/www.open.ac.uk.students.research/files/documents/Application%20form.docx)

Applications should be sent to [STEM-EEES-PhD-Student-Recruitment@open.ac.uk](mailto:STEM-EEES-PhD-Student-Recruitment@open.ac.uk) by 5 pm on Monday 22nd January 2018

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**Further reading:**