



Scenario
DOCTORAL TRAINING PARTNERSHIP

NERC
SCIENCE OF THE
ENVIRONMENT

Analysis of peatland carbon dynamics using combined optical and microwave satellite data

Lead Supervisor: Keith Morrison. Department of Meteorology, University of Reading.

Email: k.morrison@reading.ac.uk

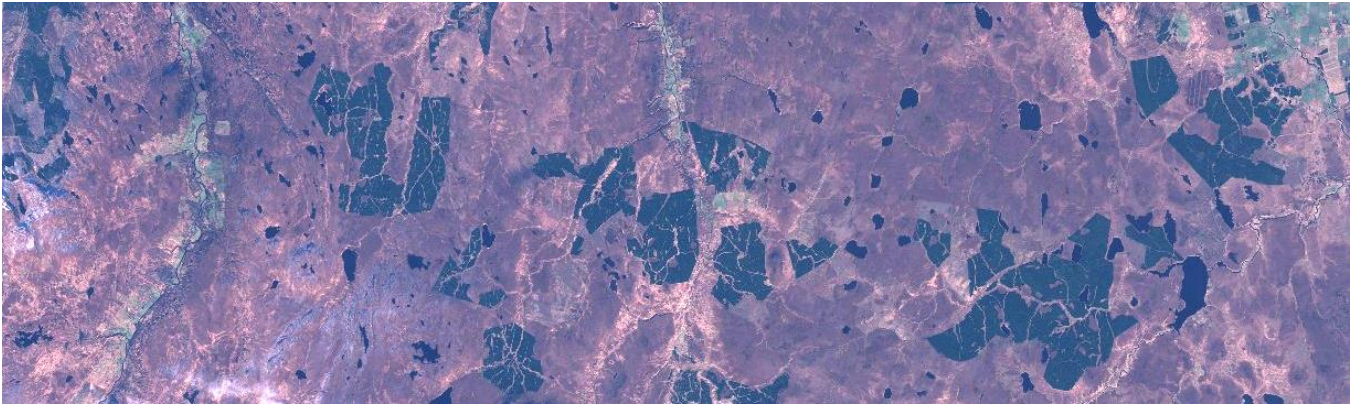
**Co-supervisors: Tristan Quaife - University of Reading
Rebekka Artz & Alessandro Gimona - James Hutton Institute**

Peatlands are a key component of the terrestrial carbon cycle and sequester large amounts of carbon from the atmosphere. Monitoring their health and state is therefore key to understanding carbon dynamics and the important role peatlands play in the climate, and in climate change. Within the British Isles, many peatlands have been subject to deleterious management schemes, including drainage, overgrazing, planting for commercial forestry, and burning. Although large-scale restoration efforts have now been implemented, it is often challenging to completely restore the hydrological characteristics of such sites. Peat-forming plants suffer disproportionately in dry conditions, and this leaves them vulnerable to drought periods during which markedly negative effects can occur to peatland landscapes, disturbing the carbon cycle and raising carbon emissions.

In the past few years, the number of satellites available to study peatlands has risen with the advent of the Sentinel-1 and Sentinel-2 missions, which are able to provide long time-series with short revisit times not previously available to the peatland community. Sentinel-2 carries instruments that are ideal for plant health monitoring. Unfortunately, these measurements can be severely impacted by cloud cover, greatly reducing the value of the data. Importantly, however, Sentinel-1 also provides coincident radar imaging which is not affected by cloud cover, guaranteeing imagery in any weather conditions, season, or time of day. In addition, beyond the lifetime of this project we will have direct observations of photosynthesis from the European Space Agency's FLEX Earth Explorer mission (planned launch 2022), which measures Solar Induced Fluorescence (SIF).

The student will investigate the novel synergistic exploitation of radar, visible/infrared and fluorescence imagery to test the feasibility of using remote, space-based monitoring of peatland resilience at the landscape scale. This will involve designing field and laboratory experiments that utilise hand-held instruments to measure the spectral responses to drying and rewetting cycles. In the field, the historical data from the 2018 drought also provides an exceptional opportunity to understand the remote sensing signals of peatland water stress.

The ultimate output of the project will be a new methodology for exploiting radar and optical measurements in a synergistic fashion for monitoring peatland health, as well as laying down the foundation for the exploitation of FLEX data.



Summer 2017 Sentinel-2 image for the long-term peatland (1998-present) restoration experiment at the Forsinard Flows, Northern Scotland. In this 20,000 ha reserve, former forestry plantations (in green) are slowly being restored back to blanket bog.

Training opportunities:

The student will be introduced to a wide range of remote sensing, data interpretation and analysis techniques. There is a strong experimental aspect to the work, and the student will gain experience in fieldwork and the use of field instruments. The student will join a group of researchers at both the James Hutton Institute and the University of Reading that have existing portfolios of research and expertise.

Student profile:

This project would be suitable for students with a degree in physics, engineering, mathematics, or a closely related environmental or physical science degree.

Funding particulars:

The project is supported through 50:50% funding with the James Hutton Institute and there is an expectation that the student will spend part of their degree programme with the partner institution. The student can also benefit from access to James Hutton Institute long-term peatland restoration monitoring sites, which include active observations of greenhouse gas exchange with eddy covariance techniques, to incorporate such data into their models.

More information on the doctoral training partnership:

<http://www.reading.ac.uk/nercdtp>