**Title: Tropical flooded forests: their role in the dynamics of the Amazon biome**

**Supervisors**: Mathew Williams, Kyle Dexter (University of Edinburgh)

International Partners: INPA, Manaus, Brazil.

**Summary**
This project will determine patterns of carbon cycling across the Amazon basin with a particular focus on comparing wetland forests, that cover >1 million square kilometres, with the better studied *terra firme* forests. The project will link field data to satellite observations and process modelling.

**Project Background**
Tropical rainforests cover vast areas, and are the most productive biome on earth (Figure 1). Rainforest ecosystems are a key part of the earth system, highly productive and diverse. This biodiversity complicates our understanding of their global significance, and sensitivity to climate change. For example, there are important differences between wetland forests and *terra firme* forests of the Amazon Basin. Wetland forests are inundated for months of the year by river flooding. There are unique wetland species, and so there are important biodiversity differences between flooded and drier forests. Plant diversity is linked to differences in plant traits, related to photosynthesis, adaptation to drought stress, and plant architecture, phenology and root:shoot ratios. *How these plant trait differences in flooded forests affect carbon cycling* is a critical issue, needed for understanding the response of this biome to global change, and to quantify the role of the Amazon as a carbon source or sink. At the University of Edinburgh, we have developed numerical tools and models that allow advanced interpretation of field data with satellite observations. The goal of this project is to identify the critical ecosystem process differences between wet/flooded and *terra firme* forests, and link these to plant trait variation and climate sensitivity.

**Figure 1. Tropical rainforests are highly diverse and productive environments. However, flooded forests are important but understudied components of the Amazon basin.**

Project Description
This project will use a range of ecosystem observations from Brazilian partners, field data collection by the student, plant trait databases, and a simple model of plant growth, ecosystem processes and hydrological feedbacks. There will be close collaboration with Brazilian researchers in the Amazon and opportunities to visit and sample plant traits in key wetland forest areas. After appropriate training, the student will undertake the following:
(i) Accumulate data from regional studies including satellite products of biomass and leaf area, wetland forest data, meta analyses of plant traits, and species distribution maps (year 1).
(ii) Field work in Brazil to collect plant trait data in wetlands (years 1 and 2).
(iii) Develop and apply skills in model calibration, evaluation and testing, using independent datasets (year 1).
(iv) Develop skills in model-data fusion methods, and apply these to evaluate model efficiency and quantify uncertainty in model analysis of regional carbon cycling and forest dynamics (year 2).
(v) Generate complete analyses of carbon and water cycling for selected regions; determine sensitivity of photosynthesis to variation in plant traits and climate, and evaluate correlations with known variations in species distributions (year 3).

A series of scientific papers will result from these activities and form the basis of the thesis.

**Figure 2. Canopy towers provide researchers with a capacity to sample leaf traits.**

## Training and Facilities

A comprehensive training programme will be provided comprising both specialist scientific training and generic transferable and professional skills. The student will receive advanced training in plant trait measurement and analysis, ecosystem biogeochemistry, simulation modelling, statistics for model evaluation, and model optimisation approaches. Williams' group of post-doctoral researchers and PhD students provide a supporting environment for model-data fusion activities linked to global change ecology. Dexter's group provides further expertise in tropical rain forest ecology and field methods.

## Requirements

A background in ecological and/or environmental science, or related biological discipline is favoured, but transfers from physical sciences are possible. Strong quantitative skills are vital, and experience or interest in simulation modelling would be helpful.

## Future Opportunities

Williams has been primary supervisor for 17 PhD students,13 of whom have so far completed their studies. The current careers of these past-students include Research Scientist at NCAR, Boulder; Research Scientist at JPL, NASA, California; Lecturers at the Universities of Edinburgh, Exeter, Leeds, Umea (Sweden) and Costa Rica; Civil Service (Defra); Researcher at UK Food Security Programme; Researcher at German Weather Service; NERC Independent Research Fellow; Researcher at UK Forest Research; Post-doctoral Researchers at the University of Edinburgh (x4); Developer at Cambridge University Press. All graduates were employed straight from PhD, with strong career development.