Hydro-JULES

Project 4 - Quantifying water and carbon intensities of UK food and bioenergy production systems

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Project overview:

The global agricultural land area is under multiple and competing pressures. A large fraction of the terrestrial surface has been converted to cropland and is essential to meeting the nutritional, energy, and resource demands of a growing human population. At the same time, the expansion and intensification of cropland systems consumes large and increasing quantities of water and nutrients, represents a major historical cause of biodiversity loss, and is a significant source of greenhouse gases (GHG) emissions to the atmosphere. These impacts are projected to intensify under future environmental change.

This student project aims to estimate the carbon and water intensities of food and energy production for UK (and potentially global) croplands. New observational data will be analysed to assess potential trade-offs between carbon focused land management versus water use and agricultural output. The student will collate and analyse high-frequency observational data on water (evapotranspiration) and CO_2 exchanged between croplands and the atmosphere across UK-Flux, a state-of-the-art national network of flux towers operated by the UK Centre for Ecology & Hydrology. Flux tower data will be combined with crop yield and crop nutritional information (i.e., calories, proteins, vitamins, fibre) to estimate the water intensity (water use per nutrient content) and carbon intensity (CO_2 emission per nutrient content) of different cropping systems across a range of soil types, management practices and climatic regimes. By the end of this project, the student will create new metrics to rank food and bioenergy production systems based on their carbon emissions and water use per crop nutritional value.

A successful candidate will have:

Essential skills

- Passion, drive, and motivation to seek solutions to environmental challenges
- Experience using a high-level programming language for data analysis and visualisation, ideally R and/or Python
- Awareness of basic statistical concepts and ability to apply these to large observational datasets
- Experience in collating and managing large observational datasets
- Good oral/written communication skills and be willing to learn!

Interest in

- Climate change impacts on terrestrial carbon and water cycles
- Land use and land use change
- Land based climate mitigation
- Sustainable land management