PhD Project Advertisement

Project title: ***Application of an optimality-based crop model to predict future cereal yields***
Project No: FBS25-39-Harrison-rc

Lead supervisor: Professor Sandy Harrison, Geography and Environmental Science, University of Reading
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Co-supervisors:
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Project description: Potential crop yield is determined by environmental factors, including solar radiation, daylength, temperature and CO_2. Information about potential crop yields under future climate change is useful to both farmers and policy makers as it describes the biophysical "ceiling" for crop production. Process-based crop models are used to predict potential yields under current and future climate conditions, including possible changes in growing seasons, but are extremely complex and require information about a large number of parameters. Projections of future crop yields differ between different crop models, reflecting the large uncertainties in their structure and parameterisation. Eco-evolutionary optimality (EEO) modelling provides a simpler approach by using universal constraints on plant and ecosystem processes, and accounting for physiological adjustments to climate conditions. EEO-based modelling has been widely applied to model natural ecosystems but has also been shown to be a promising approach for modelling crops, both in terms of the relationships between climate and crop yields and to determine the optimal management for maximising yields under specific climates.

The aim of this PhD is to develop an EEO-modelling approach to simulate the six cereal crops (wheat, barley, rice, millet, sorghum, maize) which are responsible for nearly two thirds of the total global crop production under current and future climate scenarios. This will involve using a simple light use efficiency model to predict the seasonal cycle of biomass production in response to environmental conditions, and calibrating this using field observations of the relationship between above-ground biomass and seed yield for each crop type. These calibrated models will then be used to explore how the yields of each crop might be expected to change under different future climate scenarios, including how short-lived temperature extremes and droughts might affect potential yields. The project will also investigate the impact of management strategies, such as shifting sowing dates or changing varieties, on potential crop yields.

The project will provide training in manipulating large data sets including climate model outputs, data analysis including working with data sets derived from experimental and field observations and from the agronomic literature, and EEO-based plant modelling and its application to crops. Project outcomes will contribute to a better understanding of climate change impacts on food production and food security across the world.

Training opportunities: The student will receive specialist training in eco-evolutionary optimality theory and model development, both as it is applied to natural ecosystems and to crops. There will also be training opportunities in advanced data analysis techniques and in programming and software development.

Project supervision style: The lead supervisor will have a 1:1 meeting with the student every week. Students will be expected to provide a weekly summary of progress and issues so that feedback on these can be given at these weekly meetings. There will be meetings with the whole supervisory team once a month. Additional meetings with specific supervisors will be arranged as needed during the project. The student will be based in Reading but will be expected to spend part of their time at Cranfield to benefit from the diverse range of expertise there. The student will be embedded in the SPECIAL research team at Reading; the major focus of this team is vegetation modelling but they are also working on land-atmosphere interactions and past and future climate changes. The student will be able to attend all research meetings and training courses of the SPECIAL team.

Student profile: The ideal candidate will have some previous modelling and programming experience, preferably in R and Python, as well as standard statistical analysis techniques.

Stipend (Salary):
FoodBioSystems DTP students receive an annual tax free stipend (salary) that is paid in instalments throughout the year. For 2024/25 this is £19,237 (£21,237 at Brunel University) and it will increase slightly each year at rate set by UKRI.

Equity Diversity and Inclusion:
The FoodBioSystems DTP is committed to equity, diversity and inclusion (EDI), to building a doctoral researcher(DR) and staff body that reflects the diversity of society, and to encourage applications from under-represented and disadvantaged groups. Our actions to promote diversity and inclusion are detailed on the FoodBioSystems DTP website and include:

- Offering reasonable adjustments at interview for shortlisted candidates who have disclosed a disability or specific learning difference.
- Guaranteed interview and applicant mentoring schemes for applicants, with UK home fees status, from eligible under-represented ethnic groups.

These are opt-in processes**.**

Our studentships are offered on a part time basis in addition to full time registration. The minimum registration is 50% FT and the studentship end date will be extended to reflect the part-time registration.

For up to date information on funding eligibility, studentship rates and part time registration, please visit the FoodBioSystems website.