Will tomorrow's climate grow tomorrow's food? Modelling crop resilience across the UK

Project ID: 3554

Supervisory team

Main supervisor: Prof Martin De Kauwe (University of Bristol)
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Collaborators: Dr Andrew Hartley, Met Office; Dr Katty Hung Met Office; Dr Duncan Harding, DEFRA

Host institution: University of Bristol

Project description: The exceptionally hot and dry summer of 2026 brought the risks of climate change into sharp focus across the UK. For crops, the challenge is rarely a single stress in isolation: high temperatures and water scarcity often co-occur, amplifying impacts on growth and yield. Understanding how crops respond to these compound stresses, and why some are more resilient than others, is increasingly important for forecasting agricultural productivity, strengthening food security, and guiding climate adaptation.This PhD will advance the Joint UK Land Environment Simulator (JULES), the land surface model used by the UK Met Office and the wider Earth system modelling community, to improve predictions of how crops respond to drought and heatwaves. JULES provides a powerful framework for understanding interactions between climate, vegetation and the carbon cycle, but key uncertainties remain in how crop stress and yield losses are represented under extreme conditions. Reducing these uncertainties is essential for predicting agricultural risks in a warmer and more variable climate.The student will combine field experiments, satellite observations and crop-yield datasets to develop new insights into how crop responses to heat and drought accumulate over time, and translate these insights into JULES. They will investigate how emerging stomatal optimality theory can provide a more mechanistic description of plant responses to water limitation. A central challenge will be to capture how stress accumulates across growing seasons, altering photosynthesis, growth and ultimately yield, rather than treating droughts and heatwaves as isolated events. In parallel, the student will evaluate JULES against emerging statistical and machine-learning approaches for crop-yield prediction, testing whether greater biological realism translates into improved predictive skill.The research will focus on wheat and maize while also considering globally important crops that contribute substantially to UK food imports. Improved model predictions could be used to explore adaptation options, including altered sowing dates, more resilient crop varieties, and water-management strategies.Working closely with researchers at the University of Bristol and the Met Office, the student will gain training in plant physiology, crop and land-surface modelling, climate science, data analysis, computational methods and scientific communication. The student will also have opportunities to contribute to the UK National Climate Crop Capability (UKNCCC), helping to improve assessments of climate risks and resilience for UK food production.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.