Hybrid Machine Learning–Integrated Modelling of Global Agricultural Systems

Applications are invited for a fully funded PhD studentship as part of an international research consortium to enable local knowledge production for water security. The successful candidate will be based in the Water Systems Integration Group at the Department of Civil and Environmental Engineering, supervised by Professor Ana Mijic. The project will be co-supervised by Dr Jimmy O'Keeffe (Dublin City University). Further collaborations will involve work with Dr Rossella Arcucci (Imperial College London), Dr Barnaby Dobson (Trinity College Dublin) and Dr Seifu Tilahun (International Water Management Institute).

Project:

Agricultural systems are complex and dynamic, integrating biophysical processes such as soil, water, and crops with human decision-making and institutional frameworks. They are essential for human livelihoods but also exert significant pressures on the environment through water use and runoff of agrochemicals. Advanced integrated computational models that can capture key interactions across multiple spatial and temporal scales can shed new light on the role of agriculture within the broader human–water cycle. However, the representation of local farm practices and biophysical processes is a key challenge in these models, particularly when upscaling to the catchment, regional, and global scales.

To address the challenge, this interdisciplinary PhD project will focus on developing an improved representation of agricultural systems within flexible integrated water system models. Contrary to existing detailed modelling approaches, this project will develop a reduced complexity representation of agricultural systems embedded within integrated water system models and enhanced through machine learning (ML) enabled data assimilation. It will then test these simulations for consistency of agricultural impacts and policy relevance in a range of settings through a global network of collaborators.

You will leverage a state-of-the-art integrated water system model, WSIMOD. The project will extend and improve WSIMOD by developing a globally generalisable agricultural systems module capable of representing key global crops, including wheat, rice, maize, soybean, and potato. You will explore hybrid WSIMOD–ML approaches, where ML-based data assimilation techniques are used to support model parameterisation, evaluation, or uncertainty reduction.

We are looking for an exceptional candidate with a strong interest in ML and data assimilation approaches, together with experience in agricultural systems modelling and quantitative data analysis. The PhD is embedded a larger international consortium project for global water assessment. In addition to scientific advances, the results will support evidence-based decision-making on water security and agricultural productivity.

Requirements:

- A First Class Degree (or international equivalent) in water engineering, environmental engineering, or a closely related discipline with a strong quantitative or data-analysis component.
- A Masters level degree qualification.
- Experience with modelling and programming, ideally using Python, for water systems analysis.
- A genuine enthusiasm and ability for working in a highly collaborative and interdisciplinary research environment.
- Excellent English communication skills, including strong writing abilities and excellent presentation skills.

How to apply:

Applicants are recommended to contact Professor Ana Mijic (ana.mijic@imperial.ac.uk) for further details, informal discussions and information about the project.

Applicants wishing to be considered for this opportunity should send the following application documents to Professor Mijic by email, using the subject line “PhD Application: Hybrid Machine Learning–Integrated Modelling of Global Agricultural Systems”:

1. Current CV including details of their academic record, and if possible, class ranking (degree transcripts are not required at this stage)
2. Covering letter explaining their motivation, suitability, skills and/or experiences (1 page maximum)
3. Contact details of two academic referees

Application via the Imperial College Registry is not necessary at this stage. Applications will be regularly reviewed until the position is filled.

Administrative questions should be emailed to civilphdadmin@imperial.ac.uk.

Funding:
The studentship will provide funding for 4 years from the start date of the PhD (1 October 2026). The funding includes international tuition fees and a tax-free stipend at the standard UKRI London rate