inventWater

ESR Project 4

Incorporating water management in an Earth System Model for improved climate, impact and adaptation modelling

Host institution: Vrije Universiteit Brussel (VUB), Brussels, Belgium.

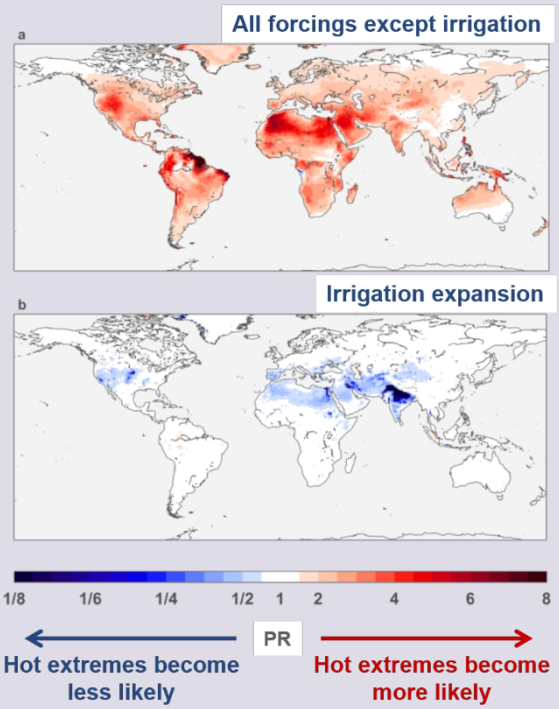
Supervisor: Prof. Dr. Wim Thiery

Co-Supervisor: Dr. Yoshihide Wada, International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria.

The ESR will be enrolled in the 4-year PhD program of the Vrije Universiteit Brussel, Brussels, Belgium. The Host institution guarantees funding for the 4th year beyond the duration of the 3-year invenWater project.

Project description

In the future, irrigation activities are expected to expand and intensify to meet growing demands for food, fibre and energy. However, projected climate change caused by both anthropogenic greenhouse gas emissions and land-use activities is likely to constrain this evolution. The aim of this research will be to implement climate change adaptation techniques in an earth system model to assess the effects of climate-smart water management (e.g. irrigation, flow regulation) on regional impact projections across the globe. Different from previous research with hydrological models, this approach explicitly accounts for atmospheric feedbacks. The proposed research will be conducted within the Community Earth System Model version 2 (CESM2), a fully coupled, state-of-the-art earth system model whose simulations have contributed to the Intergovernmental Panel on Climate Change's (IPCC) sixth assessment report (exp. 2021). CESM is tested and developed by an international research community of more than 5000 scientists and CESM1 is considered to be the best performing model of its generation. However, water management is poorly parameterised (e.g., no reservoir operation), routed water is decoupled from landscape processes (e.g., river water is not



available for irrigation), and adaptation options in the water sector are absent (e.g. no climate-smart irrigation). In this project, we will improve CESM to include (i) a two-way coupling between landscape processes and routing; (ii) crop irrigation, industrial and domestic water use from routed freshwater

and reservoirs [Secondment to IIASA]; (iii) scenarios of climate change adaptation options for irrigation [Secondment to Climate Analytics]. By explicitly considering climate change adaptation in a subset of global-scale simulations, we will be able to forecast the added value of adaptation in alleviating impacts projected under no-policy scenarios.

Expected Results:

1. An improved earth system model (CESM-ADAPT), the first earth system model that explicitly represents atmospheric feedback and climate change adaptation techniques for the water sector.

2. The Community Land Model (CLM) contribution to ISIMIP3. Prof. Thiery (VUB) is a key player in ISIMIP and is currently its largest data provider, with public-domain output from CLM version 4.5 amounting up to 47% of all ISIMIP2b output.

3. Uncover how climate change adaptation measures in the water sector may help alleviate regional impacts from projected climate change using global-scale impact simulations with CLM.

The outcomes of this research are expected to make a substantial contribution to upcoming assessments by the Intergovernmental Panel on Climate Change (IPCC). The information generated within this project will be particularly useful for Working Group II, and its results are expected to be included in the seventh assessment report (exp. 2027).

Host laboratory

Research in the BCLIMATE group at VUB focuses on (i) how surface waters interact with other components of the climate system, and (ii) how these interactions will change towards the future. Hereto the group employs global climate modelling, land surface modelling, field observations and data analysis. This combined expertise is unique within the Belgian research context and key to the success of the proposed research.

The Vrije Universiteit Brussel is an internationally oriented university in Brussels, the heart of Europe. Through tailor-made high-quality research and education, VUB wants to contribute in an active and committed way to a better society for tomorrow.

Secondments

This project is carried out in strong collaboration with the following groups, and visits to their laboratories is expected during the project. A willingness to travel and spend time abroad is therefore essential:

- Dr. Yoshihide Wada and Dr. Ting Tang, International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria. 3 months
- Dr. Carl-Friedrich Schleussner and Dr. Quentin Lejeune, Climate Analytics, Berlin. 4 months

Specific requirements

- The candidate must hold an MSc degree from or equivalent to a Master degree awarded in the European Higher Education Area.
- Master's degree must be in Atmospheric or Climate science, Environmental Sciences, Geography, Environmental Engineering, Water resources engineering, Mathematics, Physics, or similar.
- Technical Skills required: Good programming skills in typical scientific programming languages (e.g. Python, R, Matlab). Prior experience with Linux, high-performance computing and NetCDF data handling (e.g. CDO, NCL, Ncview, Xarray) and are a clear asset. Willingness to face complex modelling problems. Ability with mathematics and statistics are essential.
- Proficiency in the English language is required, as well as good communication skills, both oral and written.

HOW TO APPLY

Download the application form from this link: http://u.pc.cd/LP8ctalK and fill it. The application form, together with an official copy of degree(s) (if applicable, an official English translation), course transcripts (if applicable, an official English translation), and English proficiency test results cited in the form, must be sent as a **SINGLE** pdf in a **SINGLE** email to *inventWater-jobs@icra.cat.*

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For additional information on this project, please contact Wim Thiery (wim.thiery@vub.be)

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