PROJECT TITLE: Quantifying the contribution of glaciers to water resources in mountain regions.

DTP Research Theme(s): Changing Planet

Lead Institution: University of Bristol

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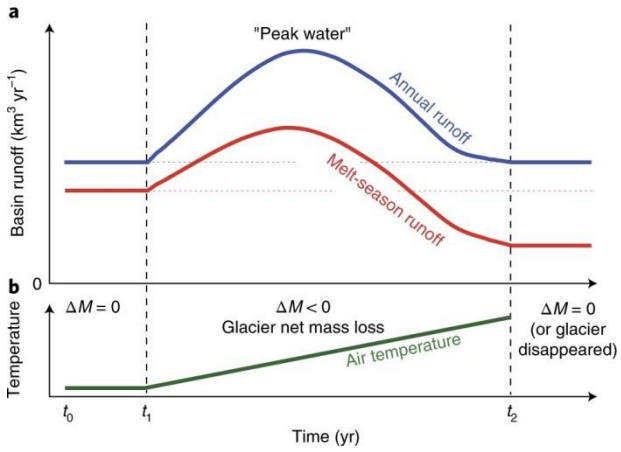
Project keywords: climate change, glaciers, water resources, modelling

Communities in mountain regions rely on water from snow and ice for irrigation, especially in the dry season (photo: F. Maussion)



Schematic illustration of the changes in runoff from a glacierized basin in response to continuous atmospheric warming. From Huss and Hock (2018).

Project Background

Mountain glaciers serve as natural water reservoirs, playing a crucial role in regulating freshwater resources in many mountain regions around the world. Glaciers collect and store precipitation in the form of snow and ice during cooler periods and release it as meltwater during warmer months. This seasonal melt provides a consistent supply of water, supporting agriculture, hydroelectric power, and daily human consumption, especially in periods of droughts where other water sources are limited. As climate change accelerates glacial melt, understanding the dynamics of mountain glaciers becomes increasingly vital, not only for the immediate communities that rely on them, but also for downstream regions that benefit from their sustained water release. Quantifying future glacier change is imperative for the sustainable management of freshwater resources in many regions. When using model predictions to inform long-term strategies for water management, decision-makers must deal with the deep uncertainties affecting these predictions. Glacier modelling is no exception. For instance, an overestimation of glacial melt could lead to unnecessary investments in water storage infrastructure, while an underestimation could result in water shortages and a lack of preparedness for related hazards such as floods.

Project Aims and Methods

The aim of this PhD project is to better estimate the uncertainty associated with hydrological projections of the Open Global Glacier Model (OGGM, http://oggm.org). OGGM is an open-source model dedicated to the study of global glacier evolution, supported by a dynamic community of users and developers worldwide. OGGM will be run through Sensitivity Analysis For Everyone toolbox (SAFE, https://safetoolbox.github.io) to help better understand what role the model parameters are playing in projected glacier runoff, and to support model-based decision-making. OGGM and SAFE will be applied in selected river basins where glaciers are known to play an important role: for example, in the Rio Santa watershed in Peru (where glacier contribution is expected to decline in the future), and in the Indus Basin in Pakistan (where glacier contribution is expected to increase). A particular emphasis will be put on making the OGGM projections useful to selected stakeholders in the selected regions, thanks to existing research partnerships.

Candidate requirements

This project would suit a candidate with a background in physical geography, Earth science, physics or mathematics, and a keen interest in numerical modelling and hydrology. We welcome and encourage student applications from under-represented groups and all abilities; we value a diverse research environment. Field work is not envisaged in this project, but opportunities exist within the research group if there is interest.

Project partners

The project will benefit from the involvement of the British Geological Survey, a world leading centre for water research. You will have the opportunity for extended research stays at the BGS, as well as our partner institutions in Peru (*Autoridad Nacional del Agua*) or Pakistan (*Water and Power Development Authority*).

Training

You will develop skills in glacier and hydrological modelling and the statistical analysis of large datasets, high-performance computing and programming. You will learn how to present complex ideas, both in written and verbal form, to a wide range of audiences. You will have the opportunity to attend relevant University taught units and training provided by the University as well as to workshops organized by the OGGM community. You will be encouraged to contribute to the OGGM and SAFE open-source initiatives, an opportunity that will equip you with valuable skills applicable in academic and non-academic careers alike.

Background reading and references

Maussion, F., et al.: The Open Global Glacier Model (OGGM) v1.1, https://doi.org/10.5194/gmd-12-909-2019, 2019.
Huss, M. and Hock, R.: Global-scale hydrological response to future glacier mass loss, https://doi.org/10.1038/s41558-017-0049-x, 2018.
Pianosi, F., et al: A Matlab toolbox for Global Sensitivity Analysis, https://doi.org/10.1016/j.envsoft.2015.04.009, 2015
Schuster, L., et al.: Glacier projections sensitivity to temperature-index model choices and calibration strategies, https://doi.org/10.1017/aog.2023.57, 2023.

Useful links

http://www.bristol.ac.uk/geography/courses/postgraduate/

Bristol NERC GW4+ DTP Prospectus:

http://www.bristol.ac.uk/study/postgraduate/2024/sci/phd-great-western-four-doctoral-training-partnership-nerc/

How to apply to the University of Bristol:

http://www.bristol.ac.uk/study/postgraduate/apply/

Please note: If you wish to apply for more than one project please contact the Bristol NERC GW4+ DTP Administrator to find out the process for doing this.

The application deadline is Tuesday 9 January 2024 at 2359 GMT. Interviews will take place from 26 February to 8 March 2024.

For more information about the NERC GW4+ Doctoral Training Partnership please visit https://www.nercgw4plus.ac.uk.

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