Project Title: Modelling and mapping social vulnerability & flood risk in cities in low-income countries

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Summary

Operationalization of a global Loss and Damage (L&D) fund was agreed at COP28. However, operationalizing the fund will require the development of robust methods for estimating L&D in the aftermath of climate-related hazard events and predicting future L&D. Cities, as geographic concentrations of people and assets1, are particularly important for L&D calculations, and floods are likely to represent the greatest hazard in cities in coming decades. Yet cities are poorly modelled in low- and middle-income countries (LMICs), in terms of both (a) hydrophysical dynamics, and (b) socioeconomic geography, which jointly determine the spatial distribution of loss and damage (including welfare losses). In short, we need better flood risk maps in cities in LMICs. The objectives of this project are therefore to develop models that leverage freely available ancillary data (e.g. Open Street Map, new satellite stereo-photogrammetric terrain data sources2 such as GoogleDEM, Sentinel-2 imagery, SWOT-derived water elevations, nightlights, etc.) to (i) improve inundation models in urban areas of LMICs, and (ii) improve small area estimates of income, assets, and social vulnerability, in order to (iii) model L&D in LMICs under a range of scenarios3. The project will be grounded in select case study cities supported through a CASE studentship sponsored by the Red Cross/Red Crescent Climate Centre.

Methods

There are three modelling objectives:

(1) Using data collected in case study cities, construct “best possible” (i.e. benchmark) run-off models for case study cities and develop alternative models that can replicate outputs from these benchmarks utilizing only publicly available ancillary data and machine learning techniques (e.g. convolutional neural networks);
(2) Using data collected in case study cities, construct social vulnerability maps and develop models for social vulnerability mapping that can replicate these benchmarks utilizing only publicly available ancillary data and machine learning techniques;

Develop loss and damage estimation models that use outputs from (1) and (2) to quantify asset, income and welfare losses in monetary terms at local (i.e. ward or neighbourhood) and city scale.

Background reading and references

1. Andreadis, K., Wing, O., Colven, E., Gleason, C., Bates, P. and Brown, C. (2022). Urbanizing the floodplain: global changes of imperviousness in flood-prone areas.

Environmental Research Letters, **17** (10), paper 104024. (10.1088/1748-9326/ac9197).

2. Liu, Y., Bates, P., Neal, J. And Yamazaki, D. (2021). Bare-earth DEM generation in urban areas for flood inundation models using global DEM data. *Water Resources Research*, **57**, e2020WR028516. (10.1029/2020WR028516).

3. U.C. Nkwunonwo, M. Whitworth, B. Baily. (2020). A review of the current status of flood modelling for urban flood risk management in the developing countries. *Scientific African*, **7**, e00269, https://doi.org/10.1016/j.sciaf.2020.e00269 .

How to Apply: The deadline for this position is 8th April 2024. The studentship will begin in September 2024. Please apply to the "PhD in Geographical Sciences (Physical Geography)" at https://www.bristol.ac.uk/study/postgraduate/apply/