More accurate topography data would enable more reliable flood risk modelling

Natural Hazards Research Australia

Michael Meadows,[1] Prof Simon Jones,[1] Assoc Prof Karin Reinke[1] and Dr Serene Ho[1]

[1] Faculty of Geospatial Science, School of Science, RMIT University, VIC

Correcting vertical errors in a global Digital Elevation Model, to derive a "bare earth" terrain surface for flood modelling in data-scarce regions

Flood modelling relies on accurate topography data, but in much of the world the only options are the free global Digital Elevation Models (DEMs), known to suffer from significant vertical errors. My research explores ways to correct these errors, to enable more reliable flood hazard and risk modelling where it's needed most.

Modelling flood risk is increasingly important

The impacts of floods continue to rise, driven by increasing human exposure (especially development in floodplains) and the higher hydro-meteorological variability associated with climate change. Especially in light of this non-stationarity in the meteorological drivers, flood modelling is an important tool in understanding and reducing this flood risk, enabling emergency managers and city planners to predict and prepare for possible future flood events.

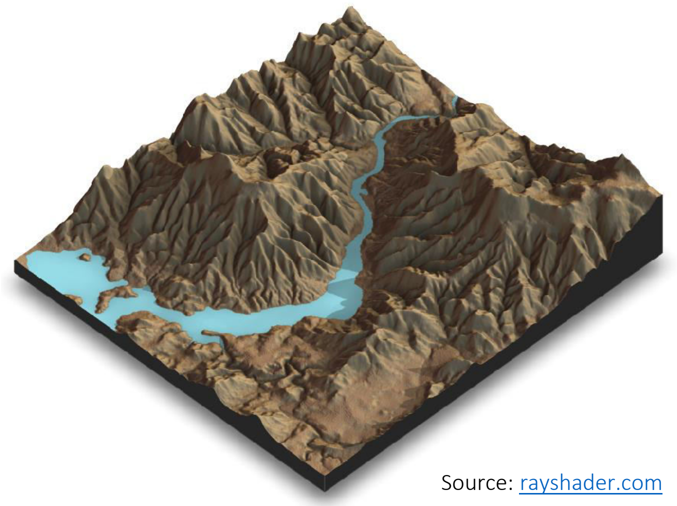
Importance of using accurate topography data in flood models

Accurate topography data is a critical requirement for these flood models, given their sensitivity to even minor vertical errors. Ideally, these data are derived from airborne LiDAR surveys, which can penetrate vegetation canopies and filter out buildings to provide "bare earth" Digital Terrain Models (DTMs). These are increasingly available in high-income countries but remain rare in low-income countries, where the risk to lives and livelihoods is greatest.

For this reason, many flood models rely instead on free global DEMs, despite well-known vertical errors associated with the inability of spaceborne sensors to fully penetrate vegetation canopies to record the ground surface beneath. When used in a flood model, these vertical errors act as artificial obstructions that block or divert simulated flows, often resulting in misleading flood assessments.

Developing a correction model to reduce vertical errors in a DEM

However, since these errors are at least partially due to vegetation and buildings, it is possible to reduce them by using complementary remote-sensing data products (such as canopy height maps).



Source: rayshader.com

Machine learning (ML) algorithms are well suited to predicting the corrections required, given their capacity to handle large input datasets and complex, non-linear relationships. My research explores the predictor variables and ML models/architectures most relevant to predicting these vertical errors, with a focus on global applications that use only free, open-access datasets and tools.

Accounting for model uncertainty & data dependencies

Past studies on DEM correction have focused on performance rather than model uncertainty or data dependencies. However, these are essential considerations if the outputs of such models are to be used in real-world applications potentially affecting people's lives and livelihoods, and will be explored as part of my research programme.

Further information

For additional information scan the QR code or contact:
Michael Meadows, PhD Candidate, RMIT University
michael.meadows@student.rmit.edu.au

Australian Government

RMIT UNIVERSITY