PhD Positions in urban futures under flood risk

We have openings for motivated students to undertake PhD research that will improve the flood resilience of New Zealand communities through developing innovative research. Two 3-year positions are available and will be supported by the New Zealand Government via the Ministry for Business, Innovation and Employment (MBIE) through a NIWA-led five-year Endeavour Programme called *Mā te haumaru ō nga puna wai ō Rākaihautū ka ora mo ake tonu: Increasing flood resilience across Aotearoa*.

The research will address aspects of planning for future flood risk, including issues surrounding climate change, and will feed into and work with the wider group of Endeavour Programme researchers. The PhDs are to focus on the following topics (see below for further details):

1. ***Implications of uncertainty in flood hazard assessments for planning under climate change***. This PhD will be co-hosted by the School of Earth and Environment and the Geospatial Research Institute at the University of Canterbury in Christchurch, New Zealand. Lead supervisor: Prof. Matt Wilson (University of Canterbury); co-supervisor Prof. Iain White (University of Waikato).
2. ***Building future urban development scenarios into assessments of future flood risk***. This PhD will be hosted by the School of Social Sciences at the University of Waikato in Hamilton, New Zealand. Lead supervisor: Prof. Iain White; co-supervisor Dr. Xinyu Fu (University of Waikato); co-supervisor Prof. Matt Wilson (University of Canterbury).

An annual scholarship of NZ$30,000 plus fees is available to successful applicants. For both PhD projects, good computer literacy (ideally with coding skills in Python, Matlab or similar), some knowledge and interest in flooding and flood risk assessment and/ or urban development, and skills in manipulating and analysing spatial data (e.g., using GIS) are needed. In addition, numeracy and excellent written and oral communication skills are essential. The candidates should expect to interact with a multidisciplinary team of researchers throughout Aotearoa/New Zealand and internationally. The research results will have global applications in improving the evidence base to avoid and manage future flooding and will be published in national and international peer-reviewed journals.

If you are interested in applying for one of the projects, please get in touch with one of the project supervisors: Prof. Matt Wilson (University of Canterbury, matthew.wilson@canterbury.ac.nz) and Prof. Iain White (University of Waikato, iain.white@waikato.ac.nz). Applications should be sent by email care of the Project Manager, Dr. Belinda Sleight (belinda.sleight@waikato.ac.nz). Review of applications will take place continuously; to ensure full consideration, you should submit your application no later than **30 September 2022**. Please submit the following documents:

1. A full curriculum vitae, including details of any prior publications;
2. A cover letter outlining your motivation and suitability for the selected project;
3. Contact details of at least two referees; and
4. A GPA report obtained from https://support.scholaro.com/portal/kb/articles/canterbury (those with New Zealand or United States qualifications are not required to use Scholaro).

PhD project details

PhD 1: Implications of uncertainty in flood hazard assessments for planning under climate change.

Flood risk assessments are a vital part of the planning process for the development of urban areas and the infrastructure which protects them from flooding. They are usually generated using computational modelling of flood inundation, combined with an analysis of its potential impacts. However, the output of this analysis contains uncertainty, which results from a complex interaction of the various sources of error contained in the input data, and from the methods used to transform these data into the risk assessments obtained. This uncertainty makes decision making in urban development challenging, particularly when we include the variability between different projections of climate change. This PhD project will explore the implications of uncertainty associated with the production and use of flood assessments in decision making for urban development and seek to develop methods for enabling adaptive planning approaches, such as through the use of decision trees. The PhD student will work with stakeholders to identify improved methods to account for uncertainty in the decision-making process.

PhD 2: Building future urban development scenarios into assessments of future flood risk.

Urban growth and development change flood risks which, when integrated with the effects of climate change, present large uncertainties regarding the potential impacts of future flood events. Projections of future flood risk in the near or medium often do not account for future changes in urban areas, meaning that our assessments are missing a key component of the changing characteristics of the flood hazard. This PhD project will explore and develop methods to project socioeconomic urban development and link these with assessments of future flood risk, alongside the implications of climate change. Methods may include multi-scenario agent-based simulations for exploring the linkages between current policy and future flood risk. The model developed will provide an understanding of future urban form and enable policy implications to be explored, through multi-scenario simulations in a Monte Carlo framework.

Each of these PhD projects will build on existing research within the programme, particularly a digital twin which has been created to enable rapid scenario assessments.

Research programme details

The PhD projects are part of the 5-year multi-stakeholder research programme, *Mā te haumaru ō nga puna wai ō Rākaihautū ka ora mo ake tonu: Increasing flood resilience across Aotearoa*[1], running from 2020 to 2025. Flooding is one of New Zealand's most damaging hazards. It is also the hazard that will change the most rapidly in intensity and nature as climate change impacts become realised. For instance, flash flooding caused by very heavy rainfall over a short period of time is expected to increase the most dramatically. At the same time our country is undergoing intense urban development that, if not linked to climate futures, will increase the risk to people's homes and wellbeing. These dual challenges make reducing flood risk extremely difficult for our current planning and response systems. There is a knowledge vacuum about the scale of these problems, the integration of different policy domains, and the details of how different parts of the country will be affected.

Our research programme will support the changes that are needed. We will produce New Zealand's first consistent national flood map, showing where flooding is likely to occur, but also identify how vulnerable our assets and taonga are. In partnership with local and central government agencies, iwi, communities and key financial organisations we will work collaboratively to design, test and establish novel decision-making practices that integrate different climate and socio-economic projections and promote proactive adaptation to changing flood risks.

Recent flooding events have demonstrated the ongoing impacts of flooding are not restricted to rescuing those inundated by water but are felt widely through society and the economy. We will work closely with communities to understand these cascading impacts and how we can be better prepared for them. This programme will generate information and guidance that is immediately relevant as local and central government form the regulations and policy that will drive our response to climate change.

[1] https://niwa.co.nz/natural-hazards/research-projects/m%C4%81-te-haumaru-%C5%8D-te-wai-increasing-flood-resilience-across-aotearoa-0