



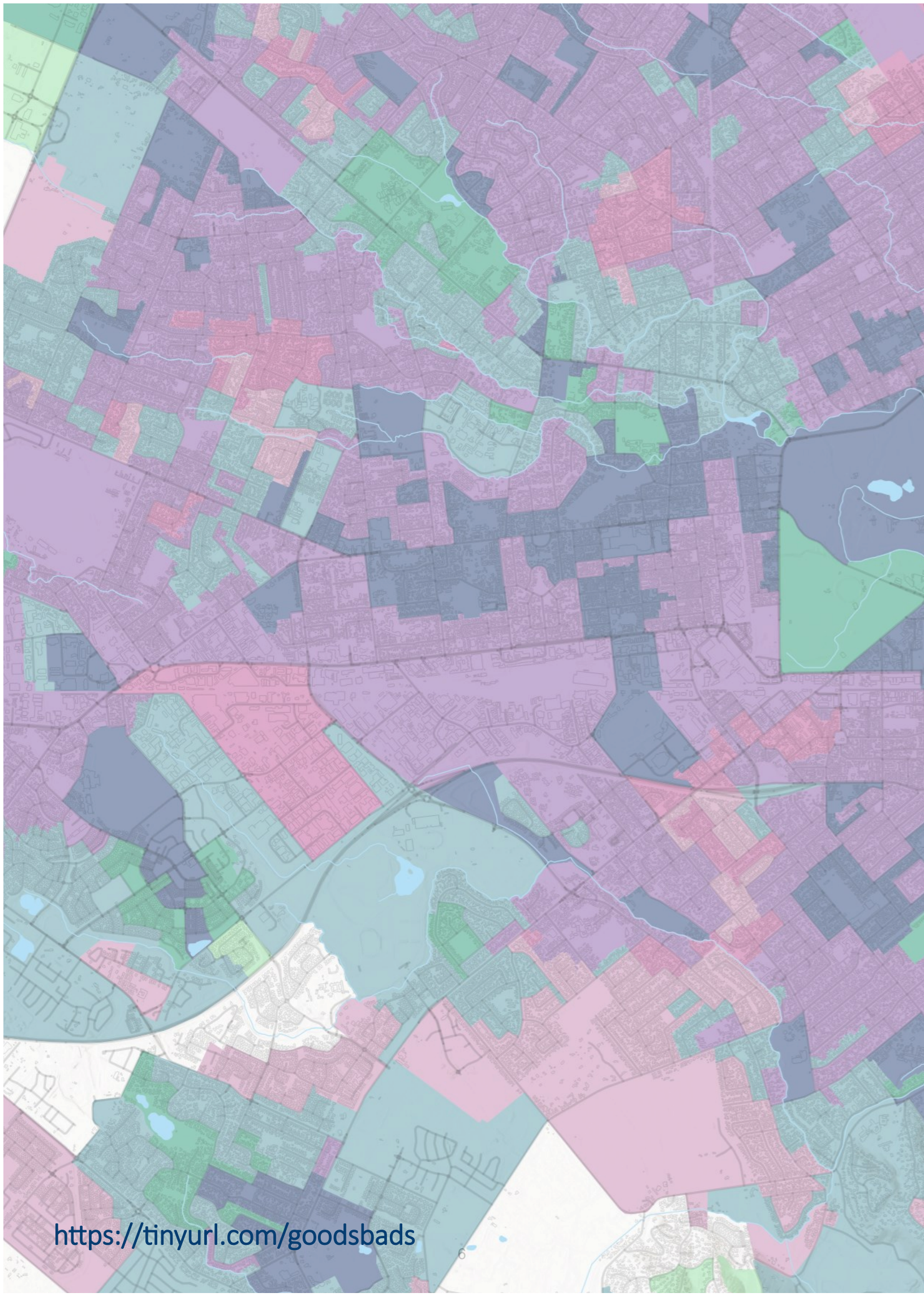
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GEOSPATIAL RESEARCH INSTITUTE *Toi Hangarau*



<https://tinyurl.com/goodsbads>

GRI Director's Statement

Tēnā koe e hoa, haere mai.

Welcome to our report for 2024. I hope you enjoy this issue as we reflect on some of the developments and achievements in the GRI Toi Hangarau. This year we celebrated the 20th anniversary of the establishment of the GeoHealth Laboratory, and wish them warm congratulations for all they have achieved over the years. The GeoHealth Lab is hosted within the GRI Toi Hangarau, but was established around ten years earlier within the (then) Department of Geography. Including them as part of the GRI has been valuable for enabling trans-disciplinary, impactful research across the physical and social sciences. Our celebrations included a public lecture with three former directors who reflected on why the lab was created, its work with the Ministry of Health, and its future directions. You can read much more about the GeoHealth Lab in a dedicated section between pages 24 and 33.

Our research continues to go from strength to strength, and the broad diversity of impactful research undertaken, each connected by geospatial methods, is a testament to the importance of location and spatial analysis across many disciplines. Bringing together researchers within the GRI enables the sharing of geospatial methods, data and research ideas, increasing our impact while making the institute a very interesting place to work! Some research highlights of the year included rapid flood scenario analysis using hybrid computational modelling and machine learning (pages 54-55), quantifying uncertainty in flood predictions (pages 56-57), assessments of urban trees and housing intensification (pages 48-49), development of methods for simulation oil spills during flood events (pages 50-51), and the development of deep learning methods for enhancement of digital elevation data

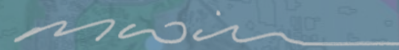
(pages 52-53).

Ongoing research in health includes the development of a Healthy Location Index (pages 36-37, and featured on the front cover), assessments of the health implications of the Canterbury earthquake sequence (pages 38-39), waterborne disease from community drinking water infrastructure (page 40), air pollution (page 41), vaping (page 42), as well as assessments of the relation between the environment and mental health (page 43), socioeconomic determinants of heart disease (page 44), and the impacts of chronic disease on families (page 45). GRI research also addresses rock glaciers (pages 58-59), implications of uncertainty on planning decisions under climate change (page 60), urban development scenarios for future flood risk (page 61), the spatial and temporal characteristics of digital language (pages 70-71), and visualisation of flood scenarios using virtual reality technology (pages 66-67).

The GRI team is also developing its own open-source software frameworks as an enabler to geospatial analysis and visualisation, with software components reutilised between projects. We have developed a dashboard for assessing urban carbon emissions (page 62), and are leading the development of environmental digital twins to enable automated geospatial processing and analysis, on demand. As part of this, we have developed the Flood Resilience Digital Twin (page 63), which enables automated flood scenario analysis and will underpin new research enabling community-led development of natural flood solutions, and the Ōtākaro Digital Twin (pages 64-65), which embeds a model of water contamination from roads and roof surfaces.

A particular highlight for me was participating in New Zealand's successful bid to host the IEEE International Geoscience and Remote Sensing Symposium (IGARSS) in Auckland in 2028 (page 82). Supported by Tourism New Zealand, this involved submitting a glossy bid document, then as one of the two finalists, giving a presentation to the Geoscience and Remote Sensing Society Administrative Committee (AdCom) at its annual meeting in Athens in August. IGARSS is a large conference of around 3000 participants, so it is a major achievement for New Zealand to win the conference for the first time, and represents an excellent opportunity to showcase the excellent research around the country.

Ngā mihi nui,



Prof. Matt Wilson
GRI Director

About us

We conduct interdisciplinary partnership-based geospatial research across the social and physical sciences.

Our objectives:



To conduct excellent, leading and novel geospatial research.

To enable innovative transdisciplinary geospatial solutions

To provide a hub for geospatial capability building

with positive impacts for Aotearoa's communities and the environment



Vision

Leading transdisciplinary geospatial research towards a just and sustainable society for our whānau and communities.



Mission

Our mission is to be a national centre of gravity for geospatial research to deliver transdisciplinary solutions that enables the benefits of spatial information technology to be fully realised.



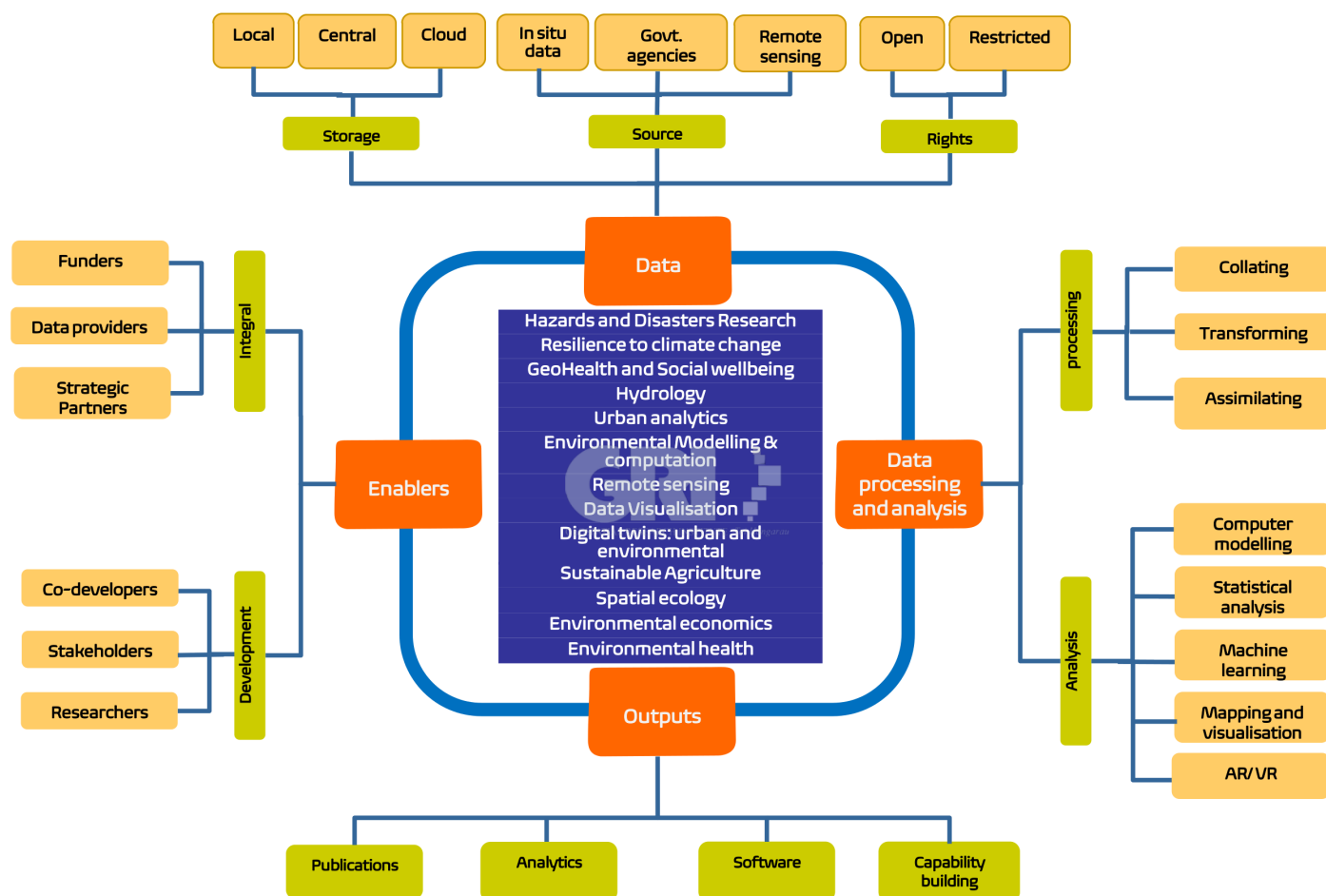
Core values

We are committed to develop research that is culturally appropriate, ethical, engaged and partnership-based. We promote diversity and inclusion and provide a supportive environment for everyone to thrive.

Research domains

Our research domains are aligned to the United Nations Sustainable Development Goals.

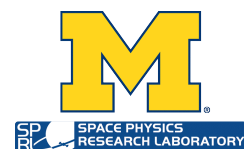




GRI domain map: contextualizing the GRI research domain areas. The GRI is a data driven institute. At present, one of our focus areas is in the development of integrated and automated data processing. We are developing comprehensive and detailed databases of remote sensing, statistics, demographics and environmental data, which can be shared with research partners. In the near future, we expect to be able to provide reliable databases that can be used for computing modelling, statistical analysis, machine learning, mapping and visualisation.

Supporting Funders and Partners



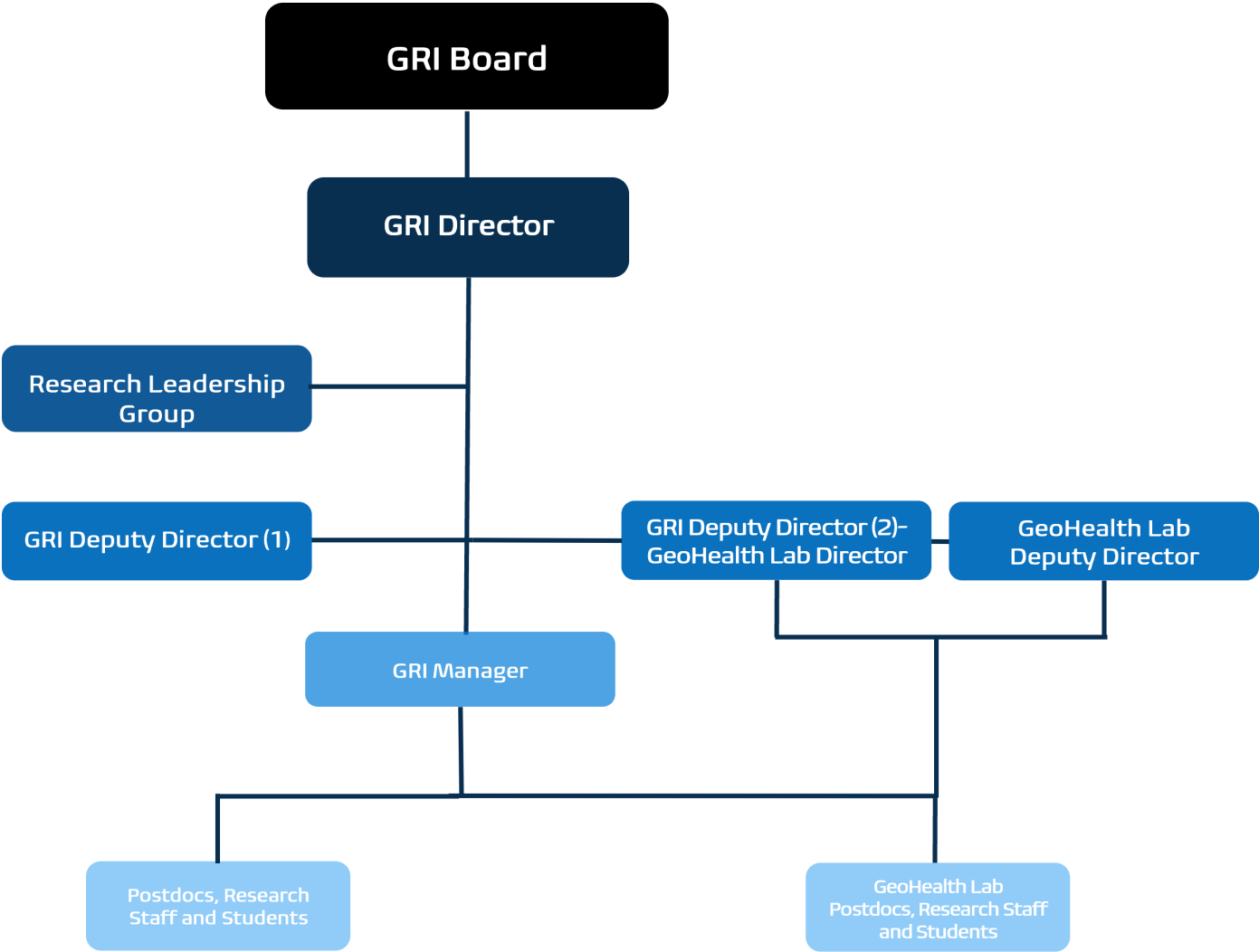




Governance



The Institute's Structure





Board Members



Jan Pierce (Chairperson)
Deputy Chief Executive,
Land Information NZ.



Lucy Johnston
Deputy Vice-Chancellor — Research
University of Canterbury



Peter Shaw
Engineering Director,
Trimble



Kat Salm
Consultant
Urbankind



Mike Taitoko
CEO Takiwa

Research Leadership Group



Professor Jennifer Brown
Head of Teaching - Data Science , UC.



Professor Rob Lindeman
Director, HIT Lab NZ



Dr. Graeme Woodward
Wireless Research Centre, UC



Dr. John Reid
Senior Research Fellow, UC.



Professor Malcolm Campbell
Director, GeoHealth Lab.



Professor Richard Green
Department of Computer Science
and Software Engineering, UC.

Management and staff



Matthew Wilson
Director



Simon Kingham
Deputy Director



Jennifer Brown
Deputy Director



Malcolm Campbell
Director
GeoHealth Lab.



Matthew Hobbs
Deputy Director
GeoHealth Lab.



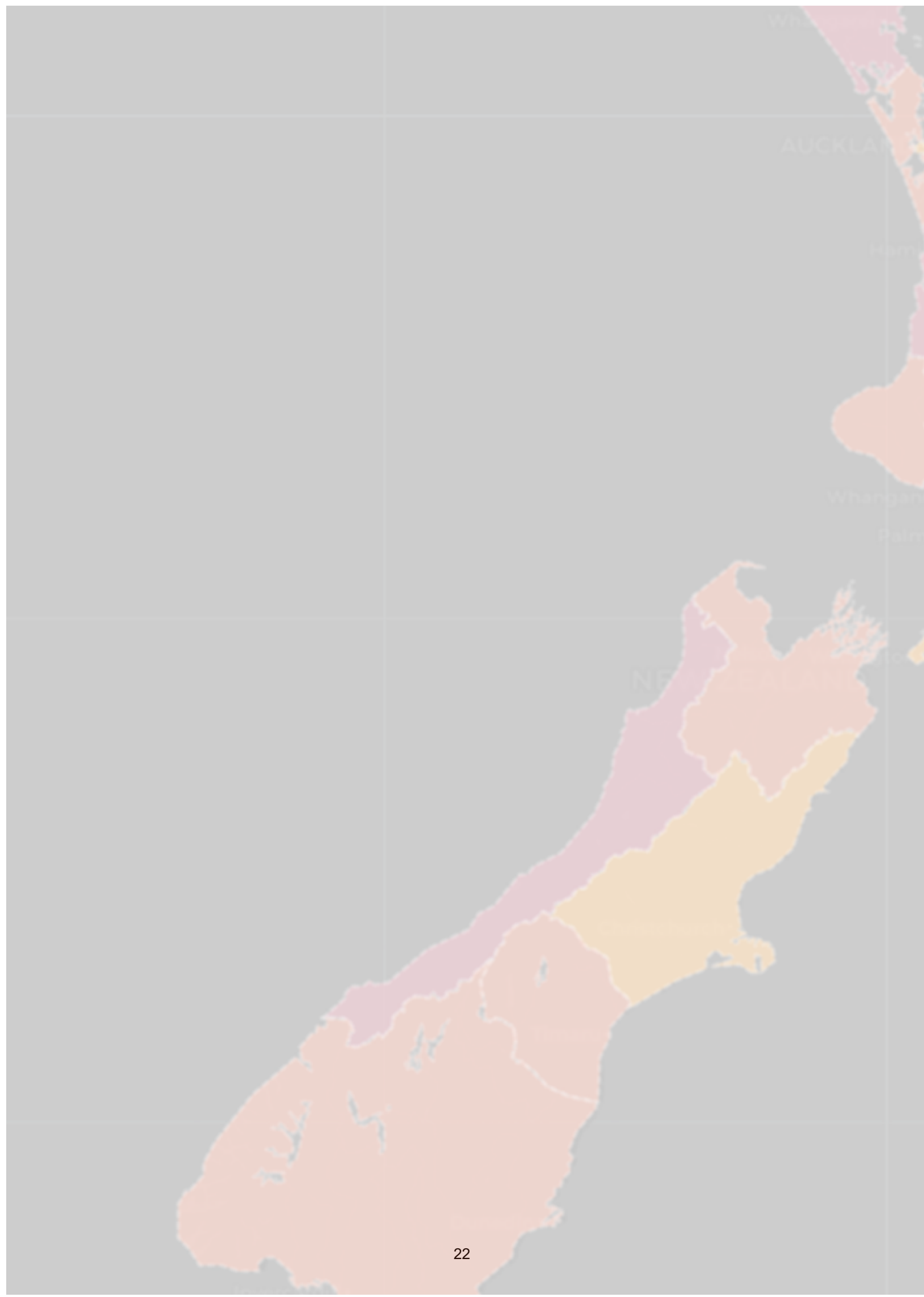
Maria Vega Corredor
Manager

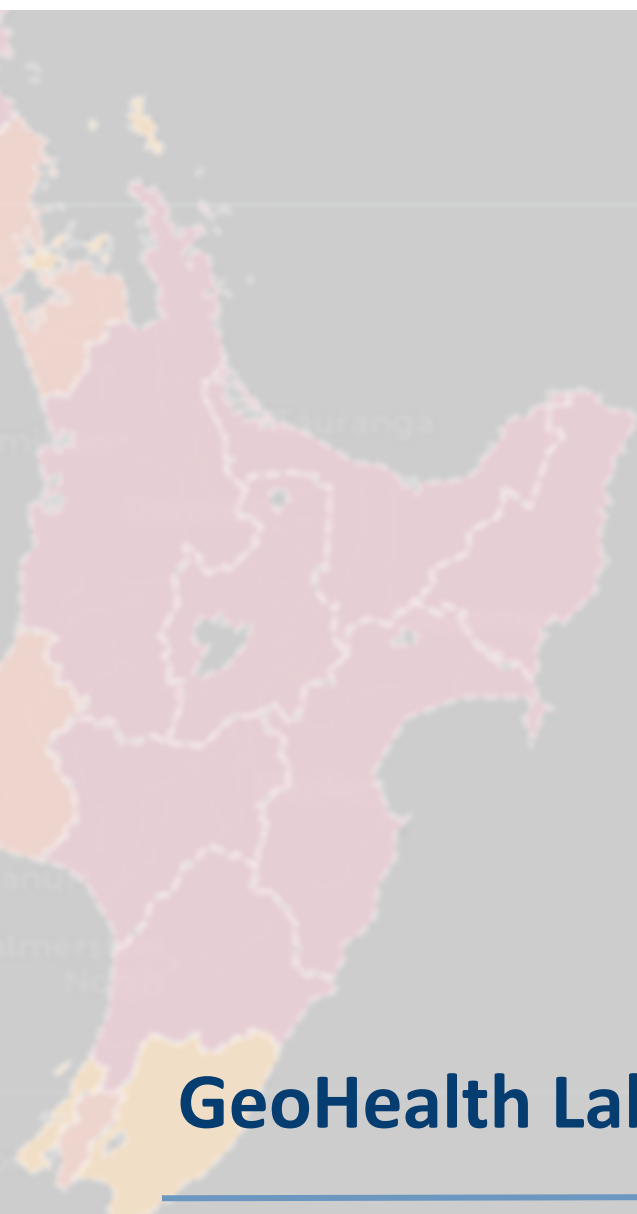


Luke Parkinson
Geospatial Software
Developer



Hannah Walker
Marketing
Administrator





Research Highlights GeoHealth Laboratory 20th Anniversary

GeoHealth Laboratory 20th anniversary

Director's statement

It is a real privilege and honour to lead and direct Te Taiwhenua o te Hauora | the GeoHealth Laboratory (GHL) as its current director. As you will be able to read in this annual report, the GHL has recently celebrated two decades of research. This is a significant milestone, and it is important to acknowledge all the hard work of the previous directors, Professor Jamie Pearce and Professor Simon Kingham, the many staff who have been employed, and those students and interns who have all contributed to quite an impressive portfolio of GeoHealth research, which we have tried to outline, albeit briefly, for this year's report. Space doesn't allow us to thank all of those GHL alumni individually. Every step forward in research has been a labour of love for one of the GHL team over the years past. The GHL has always been particularly focused on the intersection of research and policy, interested in making a difference to the health and wellbeing of all New Zealanders as we investigate a myriad of factors that relate to health and the environment. Our research can be found in policy documents worldwide, covering almost 30 countries according to a recent study on our impact. We have also made a significant contribution to building up the national and regional capacity in a skills shortage area, geospatial science, and in providing evidence-based research, whether through a simple map or a multi-year research program.

At this stage in the life of the GHL, we are excited by the opportunity to evolve our model of operation to weather the fiscally prudent environment that exists in this season. As such, we are looking for new opportunities to help build on the past 20 years of research and to continue the legacy of research for those who come after us. The GHL is an area of international research excellence and research specialisation for New Zealand. We also benefit from wider geospatial excellence that comes from being aligned with Toi Hangara | the Geospatial Research Institute (GRI). Arguably, the concentration of talented academic staff and researchers across the GHL and GRI means that we are a recognised world-class centre of interdisciplinary research excellence with a long-standing reputation in specific research areas, such as in GeoHealth.

Finally, a request from all our wonderful supporters and collaborators, we'd ask you to take time to consider. Producing many years of evidence-based research, making discoveries and creating insights has taken time, dedication and investment. **With your support - whether through donations, funding opportunities, or by fostering new collaborations - we can continue to grow this work and make an even greater impact in the decades ahead.** We'd ask you to consider partnering with us and supporting our work in the years ahead as we continue making contributions to improving the health, wellbeing and environments of all New Zealanders through applied research and evidence-based policy. Thanks to all those who have generously supported us over many years, you've helped us make a big difference!

Malcolm Campbell

Kaihautū Te Taiwhenua o te Hauora | Director of the GeoHealth Laboratory

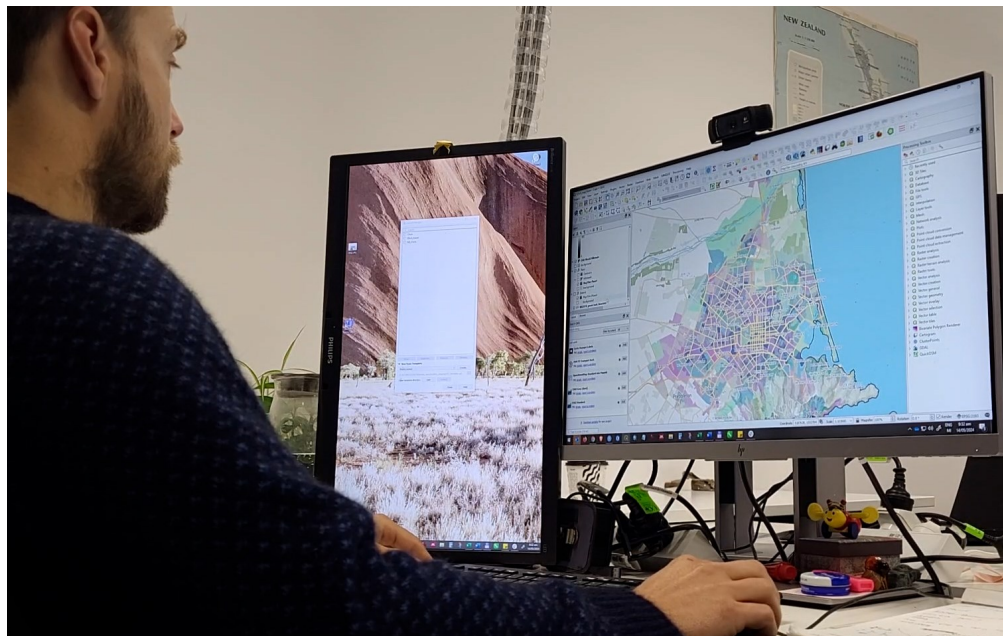
UC  **GEOHEALTH**



The GeoHealth Laboratory

In 2024, Te Taiwhenua o te Hauora | GeoHealth Laboratory (GHL) celebrated its 20th Anniversary. Two decades full of outstanding research, in collaboration with the health sector and colleagues both in New Zealand and internationally. Our research has led to a better understanding of the multiple factors that influence health and wellbeing, with a focus on Aotearoa New Zealand. In this section, we present some selected history and highlights of the GHL journey so far. If you are curious to know more, you can find the recorded talk that was a collaboration between all three directors over 20 years in the pages that follow.

What we do



Te Taiwhenua o te Hauora | GeoHealth Laboratory specializes in applied research in health geography, spatial epidemiology, and Geographical Information Science (GIS). Our research focuses on analysing the effects of local and national contexts that shape health outcomes and health inequalities in Aotearoa, New Zealand, and contributes to international evidence on the determinants of health.

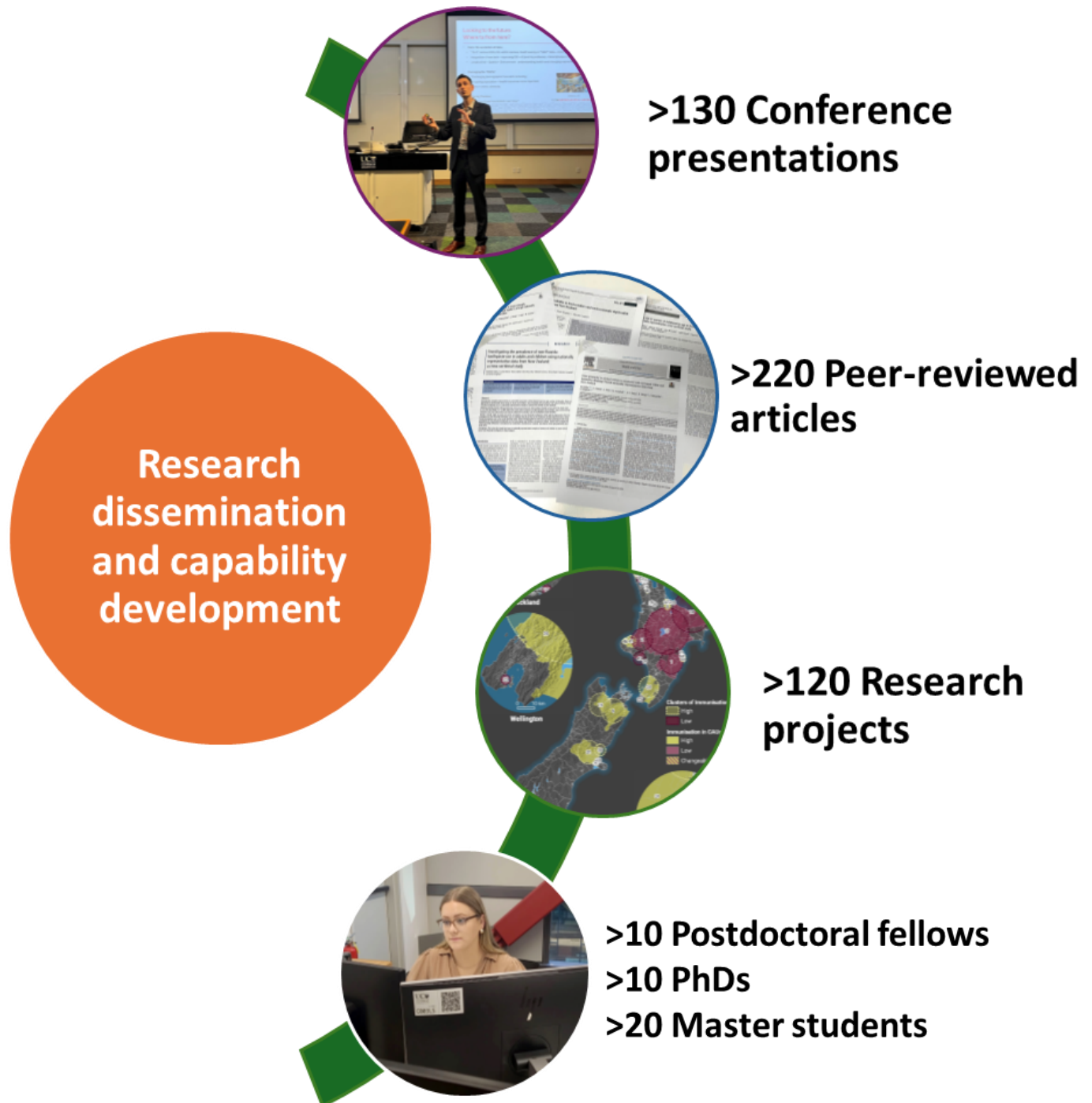
Some brief history

In 2004, the GeoHealth Laboratory (GHL) was launched as a joint enterprise between the University of Canterbury and the Ministry of Health. This collaboration provided a resource of research in health geography that was unique in the southern hemisphere and has been used as a model in other contexts worldwide. In 2005, the GeoHealth Laboratory was opened. Over two decades, we have contributed to a large body of policy-relevant evidence, mainly focused on New Zealand. You can find many of our outputs here <https://tinyurl.com/ghlpublicationsreportsanddata>. We have also trained many students who themselves have gone on to make significant contributions in the wider health and geospatial sectors.

Key aims

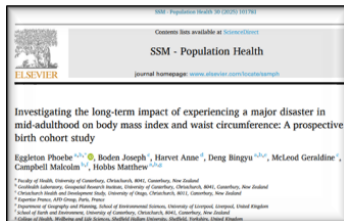
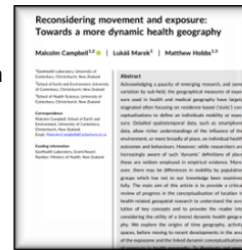
- To build strategic partnerships around health geography, spatial epidemiology, and GIS.
- To increase research capacity and research outputs in health and GIS.

GeoHealth Laboratory highlights



Research highlights

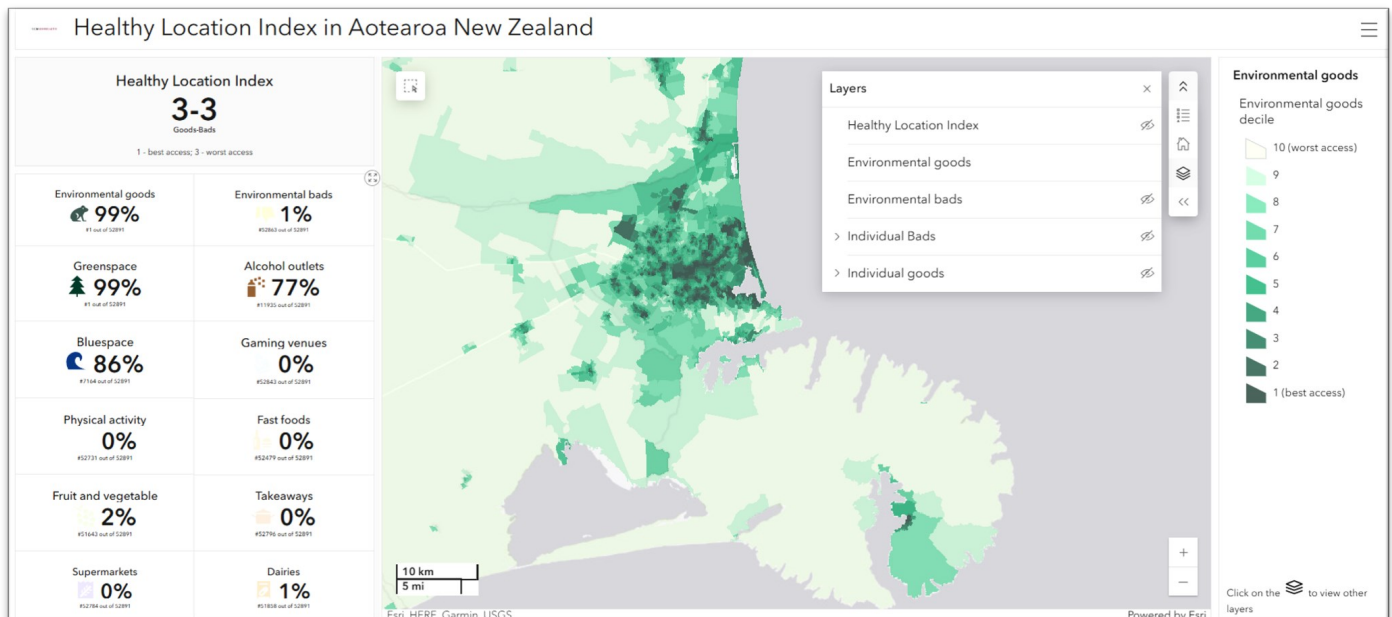
Publications: the GHL has an extensive record of publications that include peer reviewed articles, book chapters, reports and news articles. Our research has been published in some of the most prestigious peer-reviewed journals in the field, such as the Lancet, Health and Place, Social Science and Medicine among many others. Here are some examples of our peer-reviewed articles.



<https://doi.org/10.1111/gec3.12566>



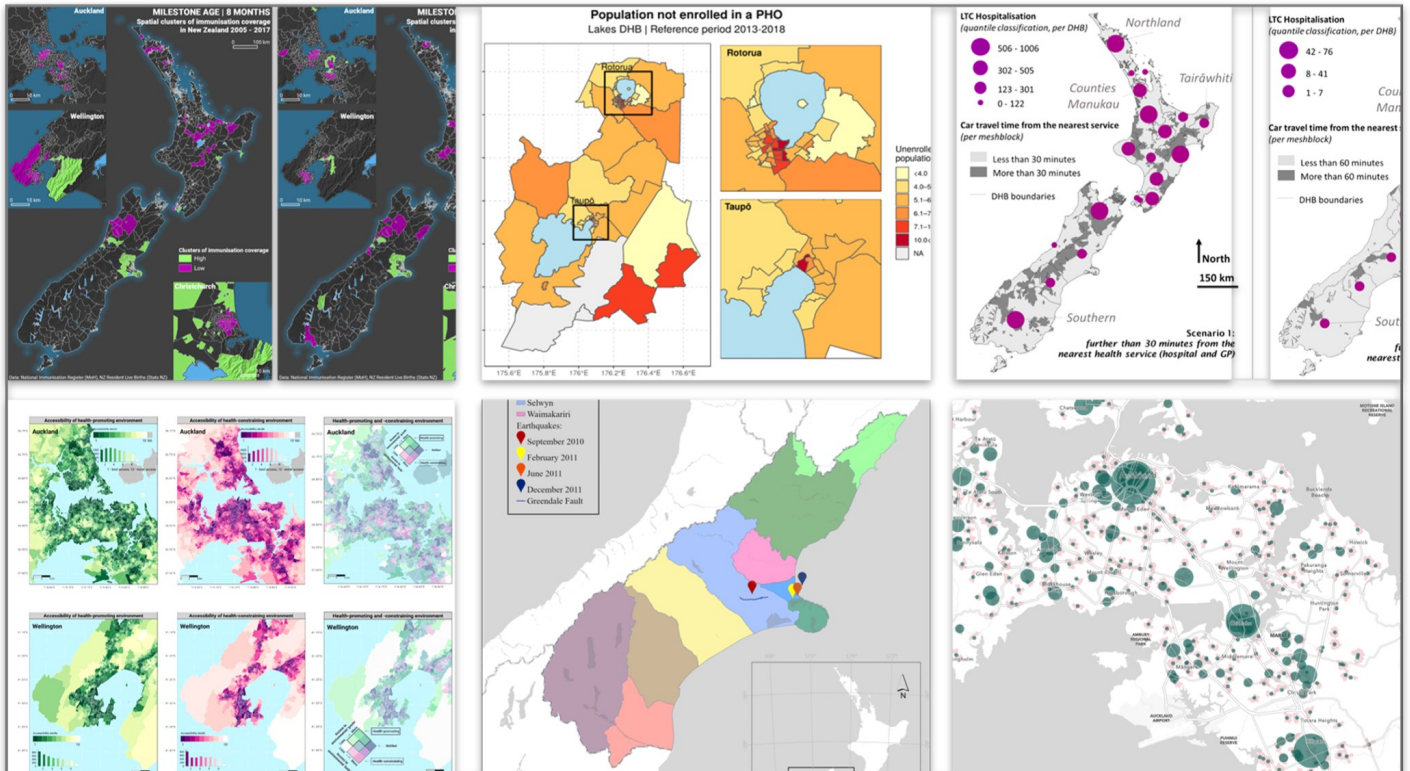
Projects: Healthy Location Index



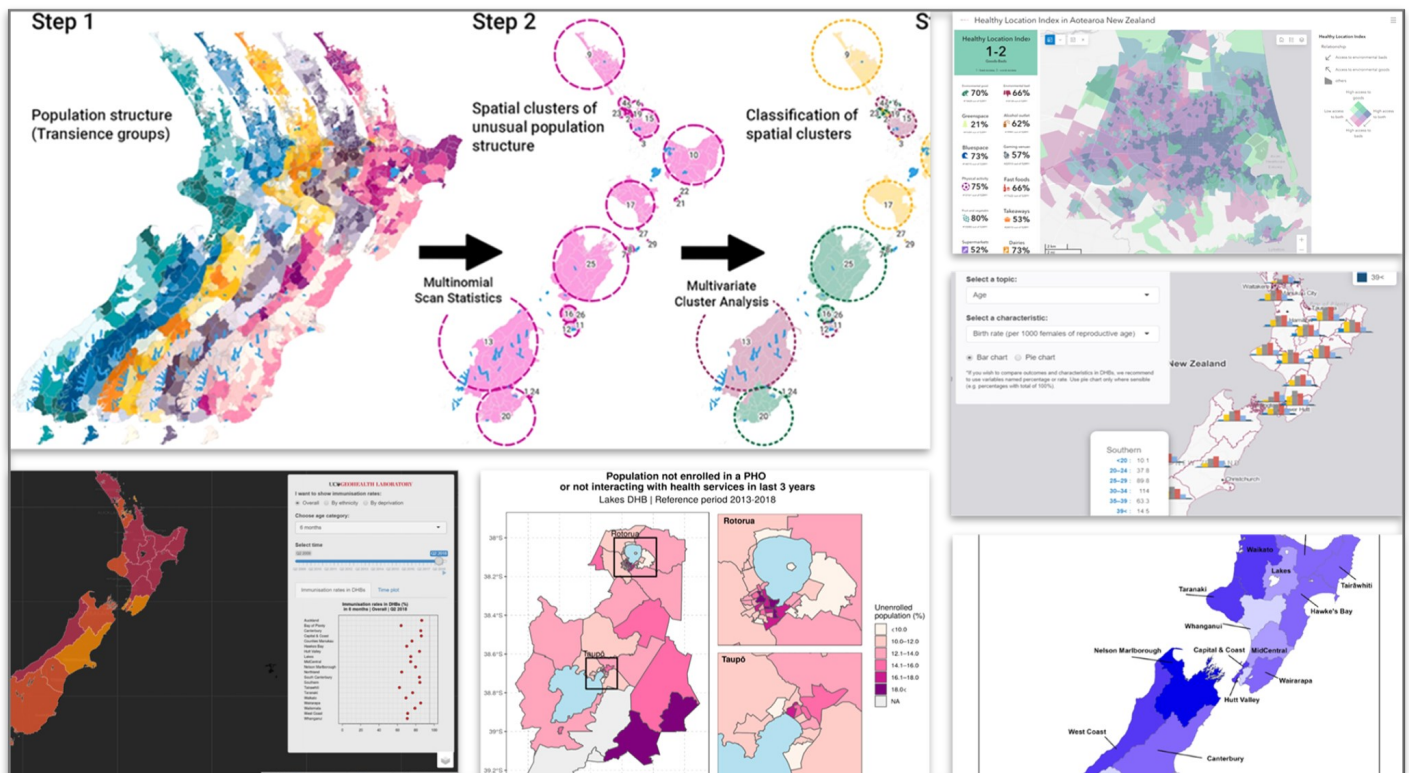
The Healthy Location Index (HLI) describes how environmental ‘goods’ such as green spaces and environmental ‘bads’ such as alcohol outlets co-occur in Aotearoa New Zealand. It accounts for the co-occurrence of multiple environmental influences and is a more accurate reflection of population exposure than considering isolated influences, aiding in understanding the complex interactions between environments, behaviour and health. The HLI was developed based on ranked access to environmental domains and can be used to investigate socio-spatial patterning by area-level deprivation and rural/urban classification.

Publicly available at: <https://tinyurl.com/goodsbads>

Research highlights: >120 projects



GeoHealth Laboratory 20 years of mapping the path to better health in Aotearoa New Zealand



All projects' information is available at:

<https://geospatial.ac.nz/> and

<https://www.canterbury.ac.nz/research/about-uc-research/research-groups-and-centres/te-taiwhenua-o-te-hauora-geohealth-laboratory>

The Laboratory's team over time

Over the past 20 years, many talented individuals have been part of the GHL team. Each of our wonderful GHL team members, whether interns, postgraduates or staff, contributed with their expertise, experience and hard work to establishing and positioning the Lab as an important centre of excellence in Health and Medical geography internationally. To all of the team,

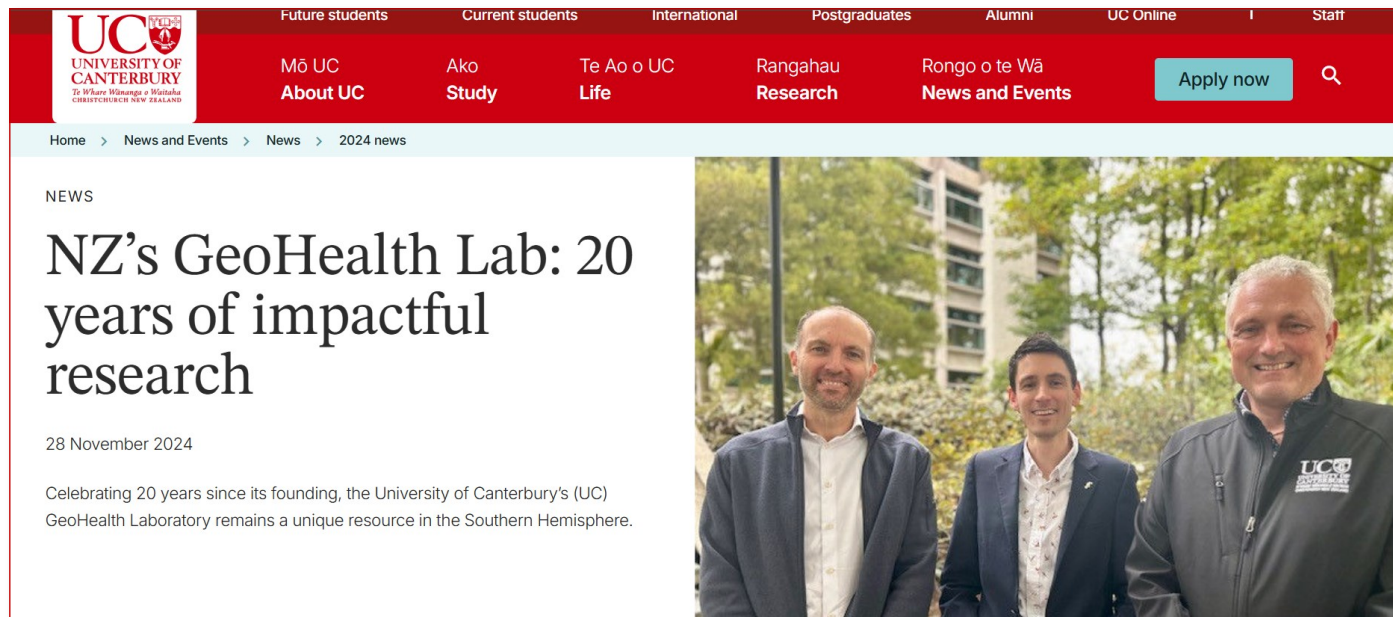
Thank you very much!

Ngā mihi nui!



Tauhere Connect UC Public Lecture Series

To commemorate the 20th Anniversary of the GeoHealth Laboratory, the University of Canterbury invited the former and current Laboratory Directors to give a public talk at the Tauhere Connect UC Public Lecture Series. Below is some information about the speakers and the talk.



Left: Prof Jamie Pearce, Founding Director of GeoHealth Lab. Middle: Prof Malcolm Campbell, current Director. Right: Prof Simon Kingham, former Director.

The presenters:

Prof Jamie Pearce Former Director Professor of Health Geography University of Edinburgh

Prof Jamie Pearce, the founding Director of the GeoHealth Lab (2004 -2009). Now he is at the University of Edinburgh where he is Prof of Health Geography. His work considers social, political and environmental processes affecting social and spatial inequalities in health. With colleagues at Edinburgh and Glasgow he has established the Centre for Research on Environment, Society & Health (CRESH).

We are grateful with the UoC Erskine office for supporting the visit of Prof. Pearce.

Prof Malcolm Campbell Director GeoHealth Laboratory University of Canterbury

Prof Malcolm Campbell, the Director from 2024, is a quantitative human geographer with expertise in Health and Medical Geography. He applies quantitative methods and spatial data science to understand and address social and spatial inequalities in health and wellbeing. He leads projects on understanding how poverty, wealth and inequality impact on a myriad of social, economic and health outcomes.

Prof Simon Kingham Former Director GeoHealth Laboratory University of Canterbury

Prof Simon Kingham is a Professor of Geography at Te Whare Wānanga o Waitaha | University of Canterbury, Ōtautahi | Christchurch, Aotearoa. He was the Chief Science Advisor to the New Zealand *Te Manatu Waka* | Ministry of Transport (2018-24). From 2009 to 2024 he was the Director of the GeoHealth Lab, and is now the Deputy Director.



Mapping the path to better health: Unleash the superpower of geohealth



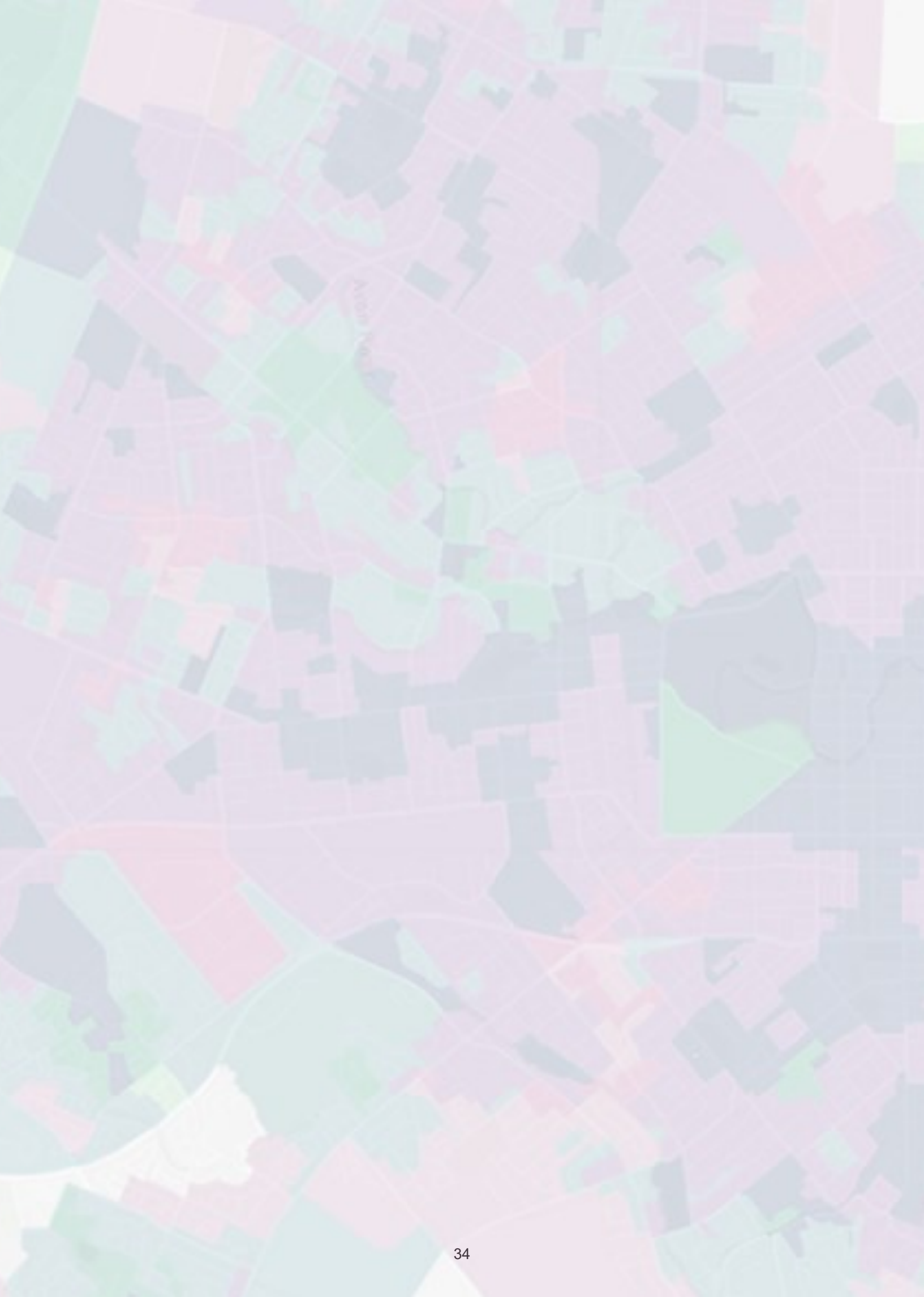
Summary:

What if maps could lead to better health and well-being for you and your community? Imagine using maps and data to improve our lives, helping us live longer and healthier lives. Join us on a journey as we show you how we make this happen!

A talk to learn how cutting-edge research has revealed the ways our environment can alter our health. Explore how our research has significantly impacted and influenced policy, advocating for meaningful, positive change in our world. Through fascinating case studies spanning two decades, we reveal how maps, stats and data have shaped positive changes in health across communities.



The video of the talk is available at: https://www.youtube.com/watch?v=B5D52_wX1Rg



Research Highlights GeoHealth Projects

Healthy Location Index

Research Team

Lukáš Marek (GRI GeoHealth Lab - UoC)
Matthew Hobbs (GRI GeoHealth Lab - UoC)
Jesse Wiki (GRI GeoHealth Lab - UoC)
Malcolm Campbell (GRI GeoHealth Lab - UoC)
Simon Kingham (GRI GeoHealth Lab - UoC)

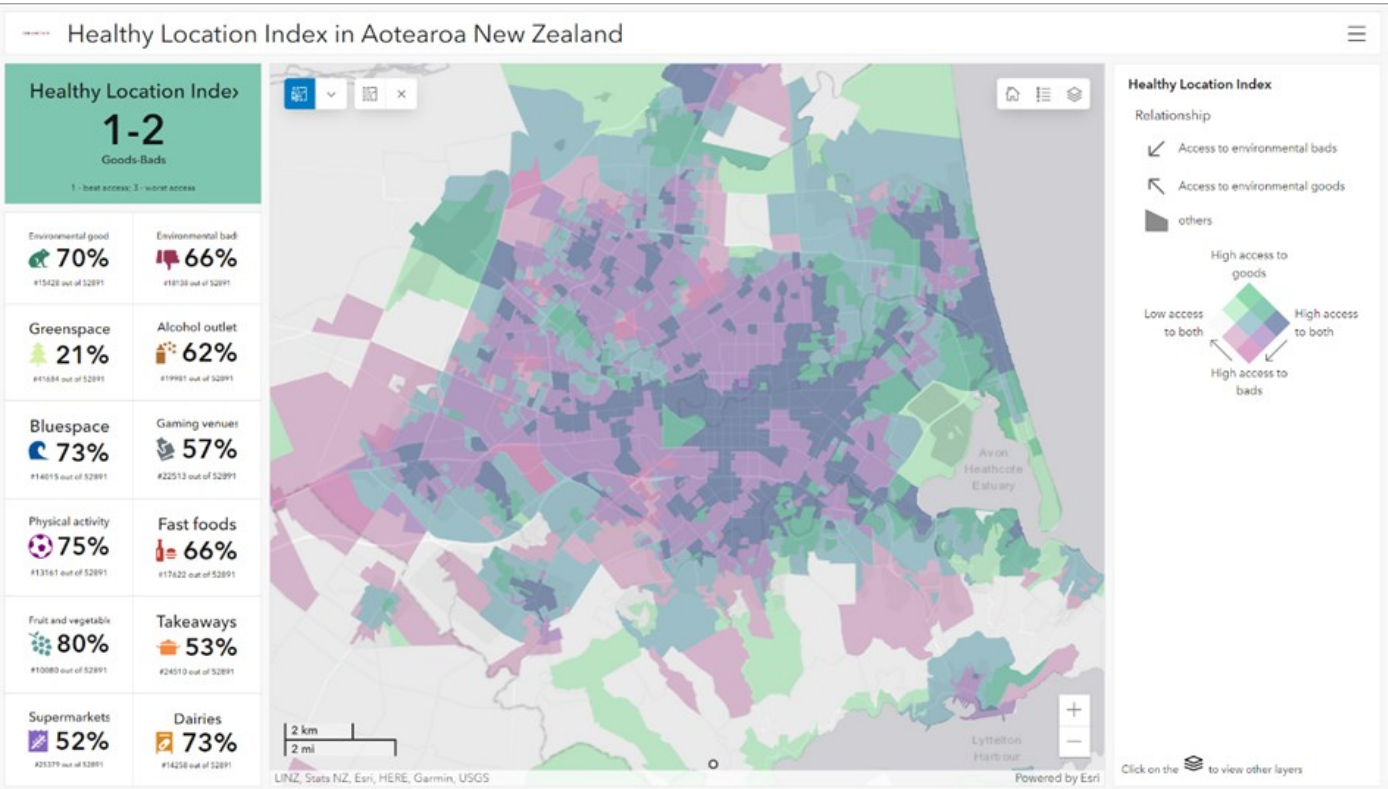
Duration

Ongoing from 2021

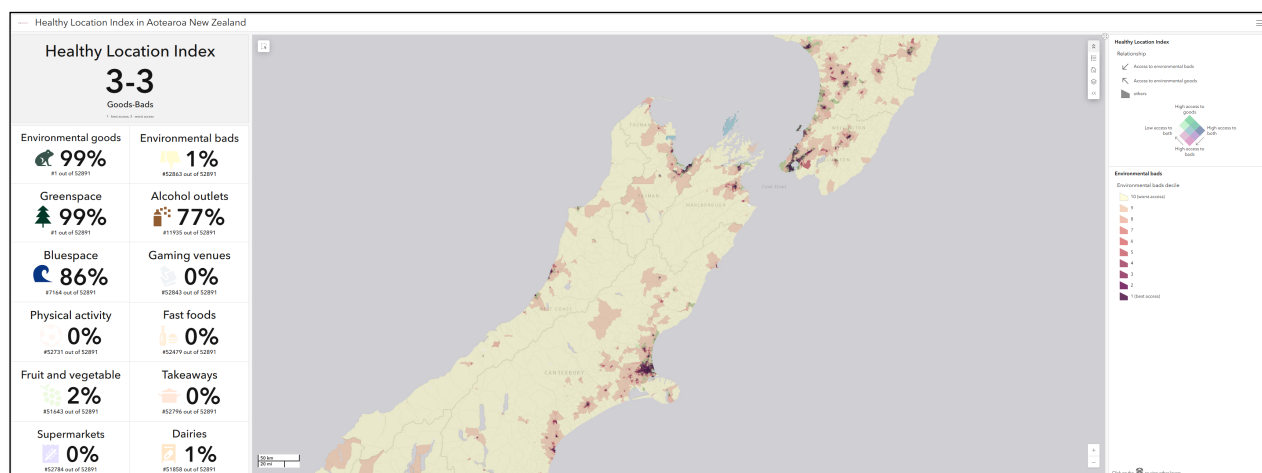
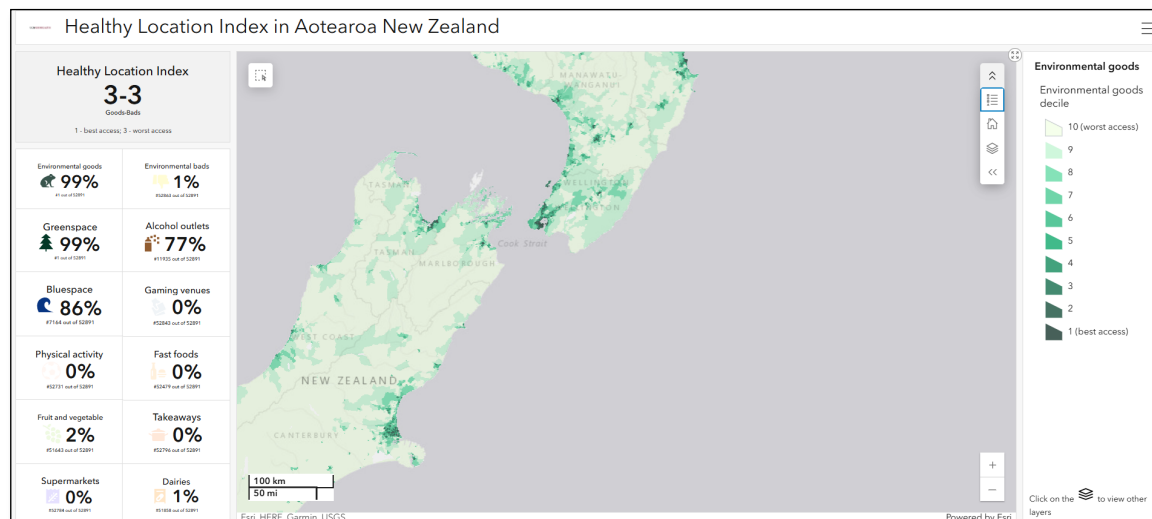
Project summary

Accounting for the co-occurrence of multiple environmental influences is a more accurate reflection of population exposure than considering isolated influences, aiding in understanding the complex interactions between environments, behaviour and health. Healthy Location Index describes how environmental ‘goods’ such as green spaces and environmental ‘bads’ such as alcohol outlets co-occur in Aotearoa New Zealand.

We collected, processed, and geocoded on a comprehensive range of environmental exposures. Health-constraining ‘bads’ were represented by: (i) fast-food outlets, (ii) takeaway outlets, (iii) dairy outlets and convenience stores, (iv) alcohol outlets and (v) gaming venues. Health-promoting ‘goods’ were represented by: (i) green spaces, (ii) blue spaces, (iii) physical activity facilities, (iv) fruit and vegetable outlets, and (v) supermarkets.



The healthy location index



Healthy Location Index: Environmental goods and bads

The HLI was developed based on ranked access to environmental domains and can be used to investigate socio-spatial patterning by area-level deprivation and rural/urban classification.

Results showed environmental 'goods' and 'bads' co-occurred together and were patterned by area-level deprivation. The novel HLI shows that the most deprived areas of New Zealand often have the most environmental 'bads' and less access to environmental 'goods'. These results further reinforce the need to embrace the multidimensional nature of neighbourhood and place not only when designing health-promoting places, but also when studying the effect of existing built environments on population health.

The index, now publicly available (tinyurl.com/goodsbads), is able to capture both inter-regional and local variations in accessibility to health-promoting and health-constraining environments and their combination.

2024 Research Update:

In 2024, we started updating HLI thanks to our intern Zoe Raines. The second version of HLI is expected to be available in 2025.

An investigation into how exposure to the Canterbury Earthquake Sequence (2010-11) is associated with physical health: a spatio-temporal birth-cohort study

Research team

Phoebe Eggleton (PhD Candidate)

Malcolm Campbell (Main supervisor - UoC)

Matt Hobbs (Secondary supervisor - UoC)

Joseph Boden (Supervisor - Christchurch Health and Development Study)

Funding

UC Aho Hīnātore | UC Accelerator Scholarship

Duration of Project

3 years

Project summary

This project is a Ph.D. thesis by publication which investigates exposure to the Canterbury Earthquake Sequence (2010-11) and the associated physical health outcomes. The project uses data from the Christchurch Health and Development Study, a birth-cohort which started in mid-1977 with 1,265 individuals born in the Christchurch urban area. This cohort has been studied over the course of 40 years on a number of topics such as health, education and life progress.

The Canterbury earthquake sequence began in 2010 with a major earthquake situated in Darfield, Canterbury. A series of aftershocks struck Canterbury the following year in 2011, with the most notable event on the 22nd February. Just over half of the Christchurch Health and Development Study cohort members were in Canterbury at the time of one or more of the major earthquakes. The thesis provides a distinct opportunity to use longitudinal data to assess the impact of the earthquake sequence.

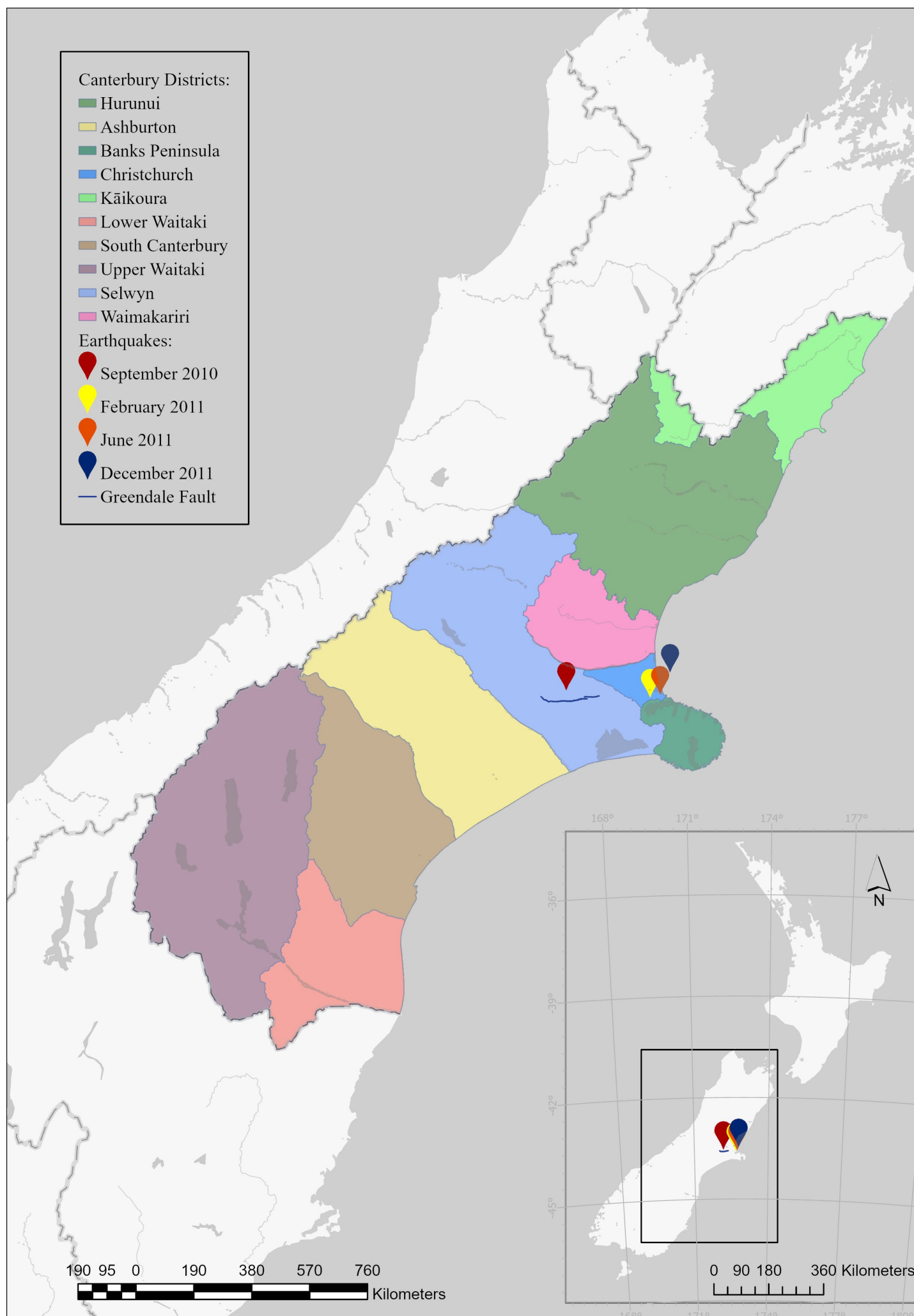
The thesis is split into three key ideas. The first published article investigates the spatial location of people during the time of the February 2011 major earthquake. This article shows that by using a residential address as a measure of exposure alone, important information about exact exposures at the time of the event are missing.

The second topic investigates exposure to the earthquake sequence and cardiovascular disease at age 40. Findings from this study show no significant association between exposure and cardiovascular disease six years after the event.

The third topic investigates severity of exposure to the earthquake sequence and long-term body weight changes. Specifically focused on body mass index and waist circumference, this article found a dose-response relationship evident by severity of exposure for increases in waist circumference.

Figure in the right: the Canterbury Region split into the 10 districts. Any cohort members who stated they were in Canterbury at the time were included as 'exposed' to the earthquake sequence.

The epicentre of the four major earthquakes which made up the Canterbury earthquake sequence (2010-11) located on the map. The Greendale Fault line which previously went unknown is shown.



A national assessment of the drinking water infrastructure deficit in New Zealand

Research Team

Tim Chambers (UoC)
Matthew Hobbs (FoH - UoC)
Lukáš Marek (GRI GeoHealth Lab - UoC)
Mario Puente Sierra (GRI GeoHealth Lab - UoC)

Funding

Te Niwha

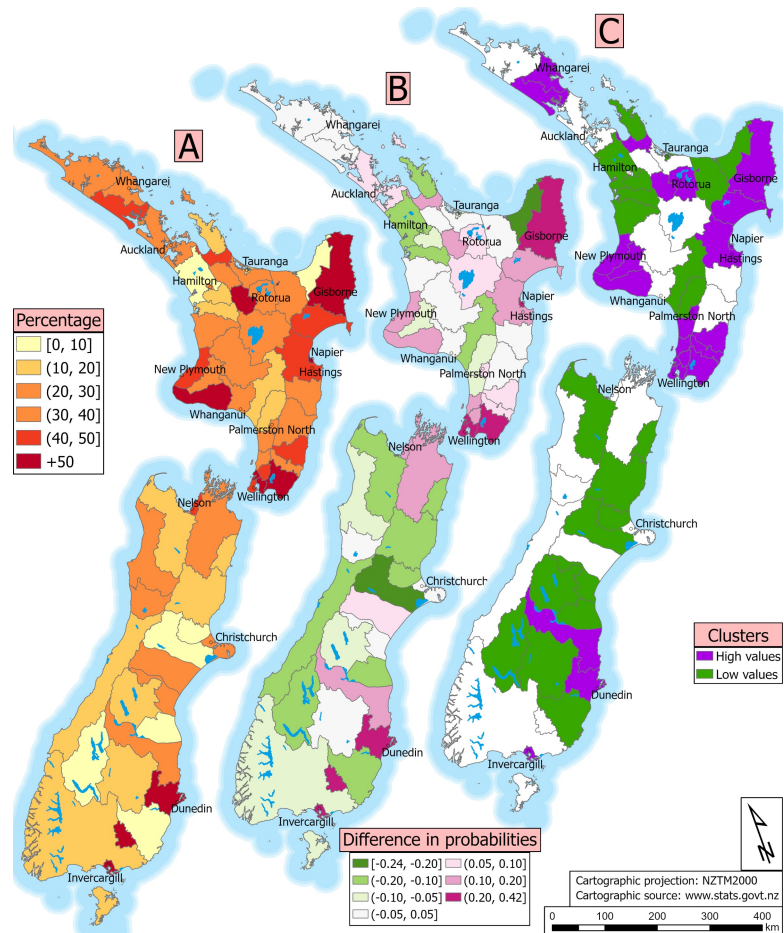
Duration

2024–2025

Project summary

This study and consequent ones look into the quality of drinking water reticulation networks, central to ensuring the provision of safe water. Here we conducted a national assessment of public drinking water reticulation condition in New Zealand derived from information on pipe material and age and investigated regional and sociodemographic variations in the reticulation network.

In total, 30.7% of the 57,174 km of drinking water pipes in NZ were in poor or very poor condition, while 18.5% were past their life expectancy. We identified wide variation in the proportion of pipes in poor or very poor condition amongst Territorial Authorities (TAs) and between areas of varying socioeconomic deprivation within TA. Using nationally consistent data, our findings suggest that the current drinking water infrastructure deficit in New Zealand may be larger than previously estimated. Our results also highlight potential challenges to TA-based amalgamation of water services under the new legislation.



Spatial patterns in territorial authorities by percentage of pipes in poor or very poor condition (midpoint LE boundary).

Cumulative impacts of air pollution exposure on adult physical and mental health

Research Team

Matt Hobbs (FoH - UoC)
Lukas Marek (GRI - UoC)
Susie Deng (GRI - UoC)
Lianne Woodward (UoC)
Annabel Ahuriri-Driscoll (UoC)

Funding

HRC Emerging Researcher First Grant

Duration

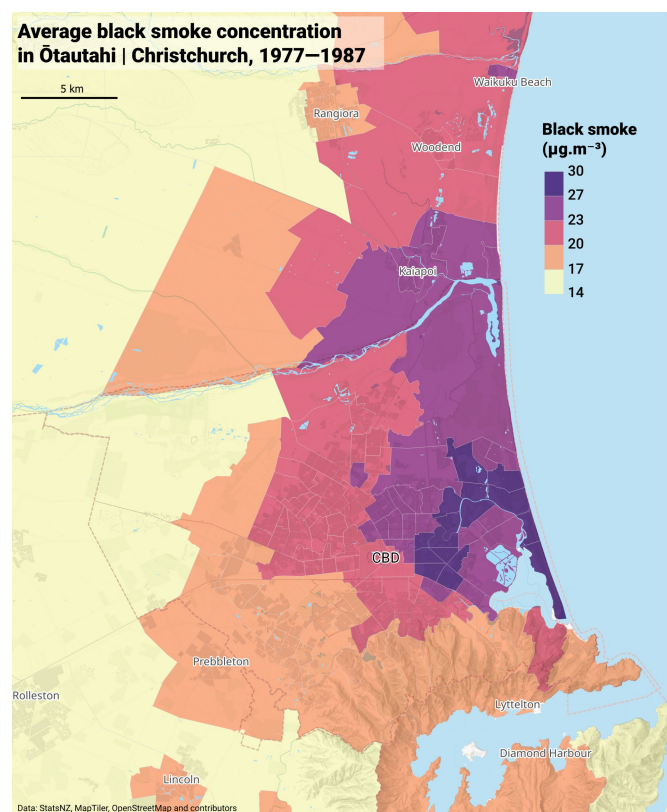
2023-2024

Project summary

Air pollution is recognised as a cause of morbidity but its longer-term and cumulative effects on health are less established. In New Zealand, persistent health inequities exist for Māori who are exposed to poorer environments than non-Māori. Using prospective longitudinal data from a large birth cohort of New Zealanders ($n=1,265$) we examined relations between the extent of air pollution exposure from conception to age 40 years and a range of physical (e.g. respiratory disease) and mental health (e.g. depression) and socioeconomic (e.g. education) outcomes. We hypothesised that higher levels of exposure were associated with poorer outcomes. Exposure was assessed at: conception (1975/76); early-childhood (1981/82); early-adulthood (2001 and 2006); and mid-adulthood (2016). This research advances scientific and public health understanding of the health and socioeconomic impacts of air pollution exposure over the lifecourse. It also informs cross-sectoral policies on the environmental determinants of health and historical causes of inequity.

2024 Research Update:

This was the final (funded) year of the project. The team published and prepared several publications, and a few more are expected to be submitted/published in 2025.



Vaping in Aotearoa New Zealand

Research Team

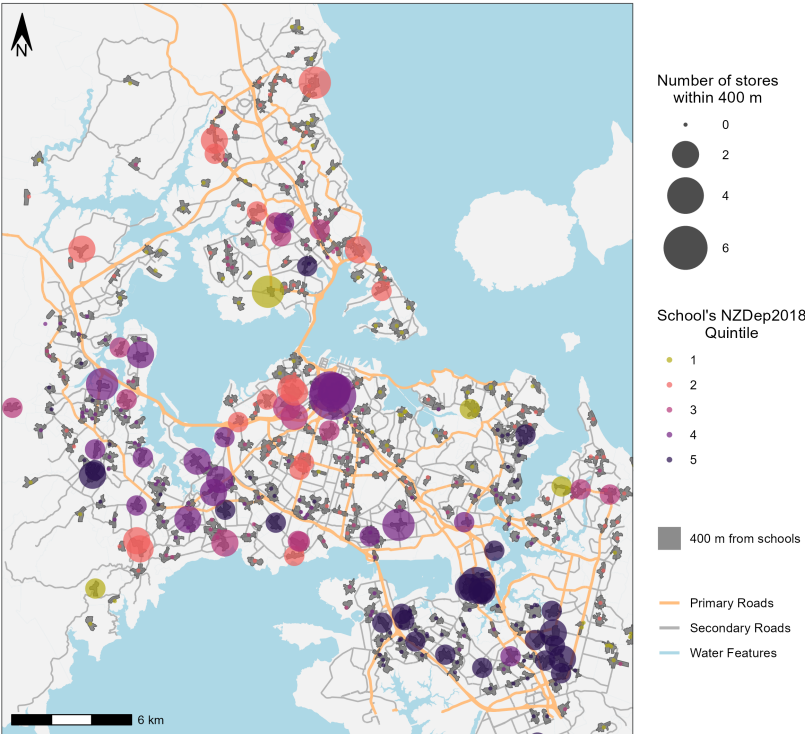
Isaac Waterman (GeoHealth Lab intern - UoC)
Matt Hobbs (FoH - UoC)
Lukáš Marek (GRI - UoC)

Funding

UC Summer Scholarship

Duration

2024



Number of vape stores around schools in Auckland. The size of the dot represents the number of vape stores within 400m of the school.

Project summary

Smoking rates have decreased in Aotearoa New Zealand in recent years however, vaping has shown a dramatic upward trend especially among young people; up to 10% of young New Zealanders are now regular vapers. Importantly, the long-term health consequences for their future life are largely unknown. The accessibility of vape retailers is important, particularly in relation to the youths’ daily activities and places such as schools where they spend a considerable amount of time and socialise. Despite this, we know little about the spatial patterning of vape retailers and even less of their socio-spatial patterning around schools. This ecological study utilised data from the New Zealand Specialist Vape Retailers register on nationwide vape retailer locations and combined them with whole-population sociodemographic characteristics and primary and secondary school data.

We identified the prevalence of vape retailers and their spatial distribution by area-level deprivation, ethnicity and urban-rural classification by using descriptive statistics and (spatial) statistical modelling on the area-, school- and individual students-level (using disaggregated data on students). We found that almost 97% of all vape retailers are located within 1,600m (~20-min walk) and 29% within 400m (~5-min walk) of schools. Our research also identified increasing inequities by deprivation and ethnicity both for the overall population and particularly for students in the most deprived areas who experience a disproportionate presence and increase of new vape store retailers that disadvantage schools and students in these areas. This difference was particularly prominent for Pasifika populations in major urban environments.

Do the environment young people grow up in promote or obstruct mental health? A nationwide geospatial study

Research team

Lukáš Marek (GRI, - UoC)
Matthew Hobbs (FoH - UoC)
Jesse Wiki (GRI GeoHealth Lab - UoC)

Funding

Cure Kids

Duration

2022-2024

Project summary

Mental health is one of the biggest health challenges facing New Zealand. One in four NZ young people will experience a mental health issue before they turn 18 years old. Inequities in mental health issues and care are persistent and worsening, with Māori and Pasifika over-represented.

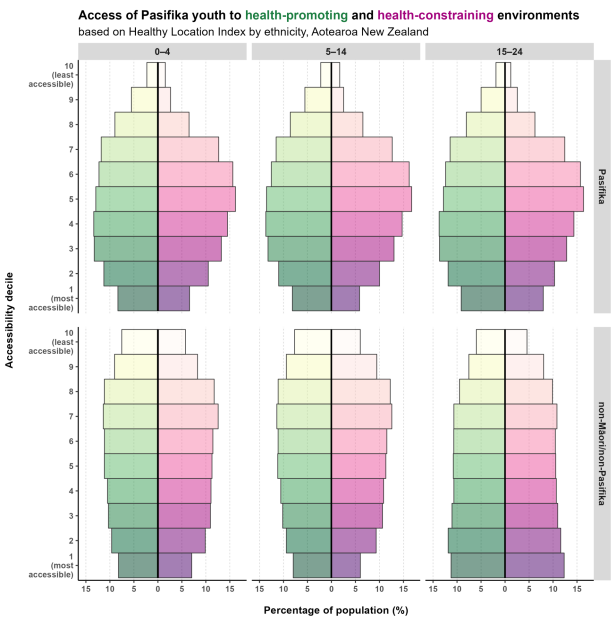
The determinants of mental health are multiple and complex, and increasingly the influence of the environment in which young people grow up is the subject of research to better understand mental health. This study aimed to understand the interplay between mental health and the environments in which NZ young people grow up. More specifically, it sought to determine whether young people have better mental health if they grow up in areas with more ready access to healthy environmental features such as green and blue spaces (e.g. parks and rivers), compared to unhealthy environmental features such as gaming venues, takeaway shops, and liquor outlets.

The study aimed to empower communities to advocate for change (e.g. support positions concerning liquor licence submissions and preservation of natural spaces), informed policy processes and interventions to improve health-enhancing environments, and informed subsequent research to develop culturally specific environmental measures to reflect health-enhancing environments for Māori and Pasifika.

The diverse and dynamic group of researchers undertaking this research has wide-ranging relationships with policy makers, health providers, and community groups that will be crucial to ensure the research has its intended impact of improving the mental health of young people in New Zealand.

2024 Research Update:

This was the final (funded) year of the project. The team published three publications and several more are expected to be submitted/published in 2025.



Socioeconomic determinants of Abdominal Aortic Aneurysm Mortality

PhD Research project:

Andrew Kindon (PhD candidate - GHL)

Supervisors:

Matthew Hobbs (FoH - UoC)

Simon Kingham (GRI - UoC)

Justin Roake (UoO)

Funding

HRC clinical research training fellowship

Duration of Project

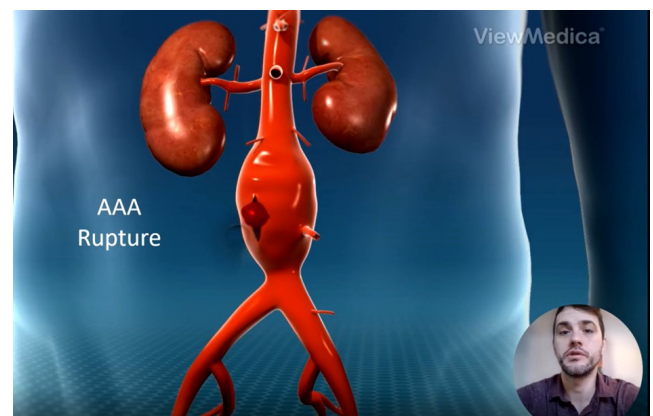
4.5 years

Project Summary:

This research uses geospatial technology to spatially identify areas across New Zealand that have excess risk of Abdominal Aortic Aneurysm (AAA) death in New Zealand, and the associated environmental risk factors, including socioeconomic deprivation, accessibility to health services and ethnicity; These factors are known to influence cardiovascular health outcomes but seldom considered in AAA research.

Some key findings show that deprivation is a strong predictor of relative risk of AAA rupture with a 56.5% increase in relative risk between the least vs most deprived areas of New Zealand. And for every 10% increase in the population of smokers in each area, there was a 31% increase in relative risk of aneurysm rupture for that area. As part of the PhD work, an interactive map has been developed (paper under review) to investigate geographic variations in AAA risk in the region.

The findings of this research will inform resource allocation in AAA screening. International evidence suggests that communities at high risk of AAA death are also likely to be communities that endure inequitable access to health services (rural, Māori, deprived). The result obtained from this research could be used to guide future policies related to ensure equitable access to AAA screening.



Interactive map developed (paper under review) to investigate geographic variations in AAA risk in the region.

Life-course impact of chronic health conditions: A family and whānau perspective. The impact of chronic disease of elders on the wider family and whānau

Research team

Lukáš Marek (GRI GeoHealth Lab - UoC)
Simon Kingham (GRI GeoHealth Lab - UoC)

Funding

A Better Start - National Science Challenge

Duration

2022-2024

Project summary

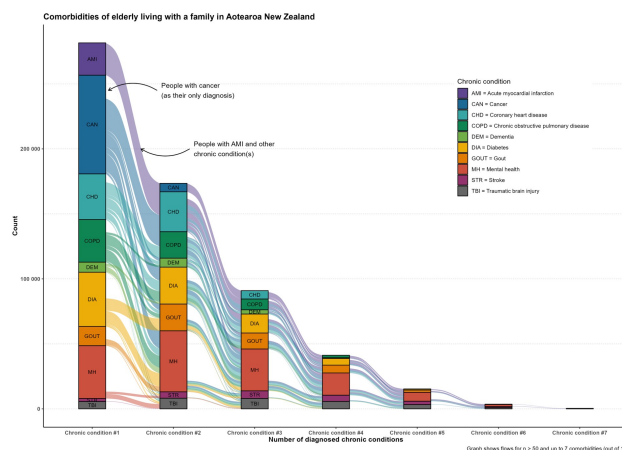
A life-course approach is essential to inform health and wellbeing policies and programmes that make a difference for children, youth, adults and later in life. An understanding of the factors that impact individuals at different stages of their life courses is crucial for designing such policies and programmes. Chronic diseases such as cancer, cardiovascular disease, diabetes, mental health and obesity have a direct effect mainly on the middle and later life-course (slightly younger for mental health). However, the indirect effect of chronic diseases on whānau and families has been less well-studied, and is likely to have impacts across the entire life-course.

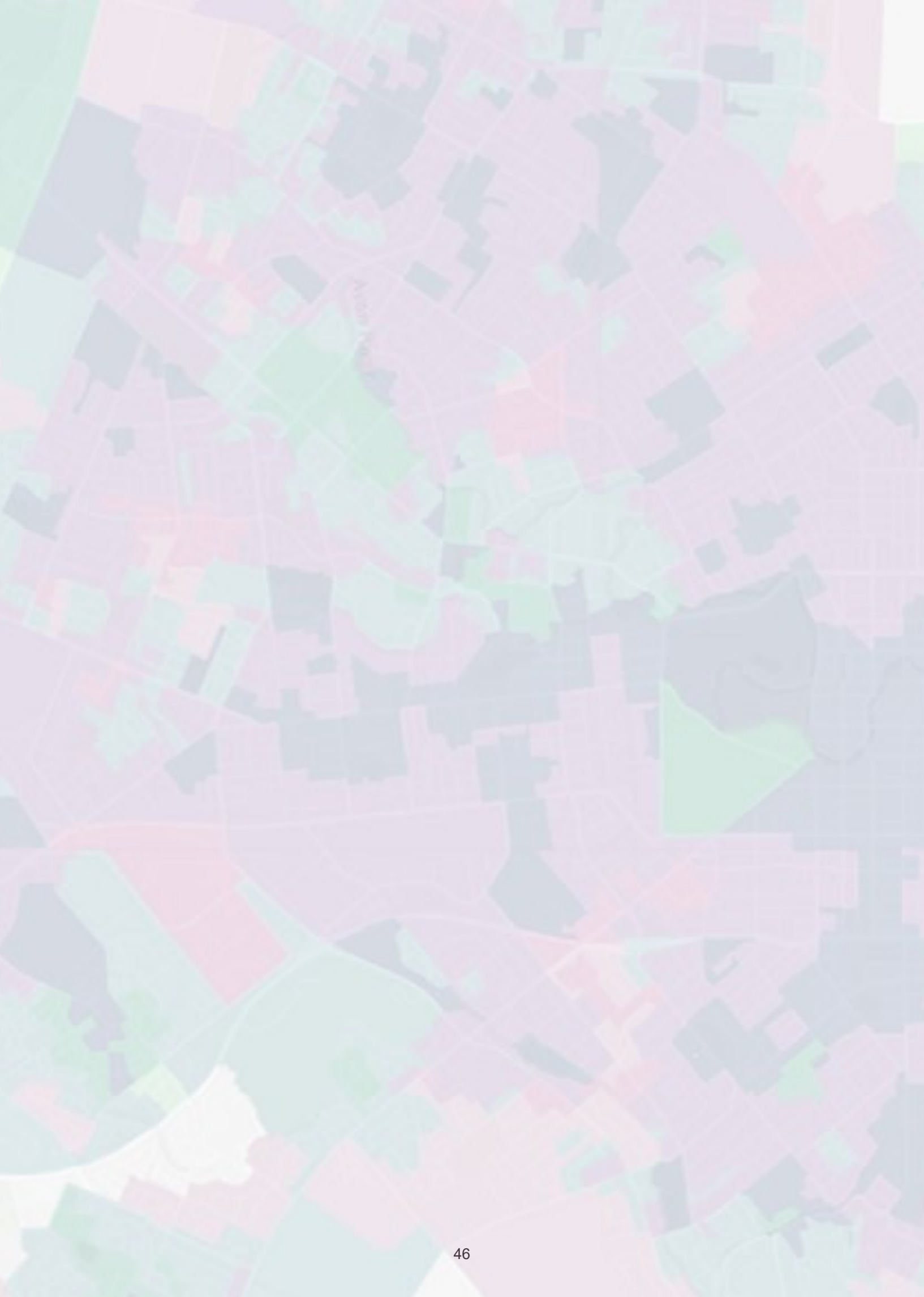
While the general focus of the wider project is to investigate the influence of chronic disease on the wider family and whānau at different life stages with four groups of interest: children, households, partners and carers, and elders. This particular part of the research focused on the elders experiencing chronic disease and how they impacted on the wider family and whānau. The study (i) identified older people with prevalent chronic conditions; then it (ii) evaluated household circumstances for such people; and (iii) quantified the health and social wellbeing of other whānau members. This is an administrative cohort study that followed individuals and families over time. We compared results for individuals within families containing a chronic disease sufferer, with individuals within families not containing a chronic disease sufferer. This study built on our pioneering research on the impact of loneliness (Jamieson et al. 2019), frailty (Burn et al., 2018), incontinence (Jamieson et al., 2017), dementia (Jamieson et al., submitted), and polypharmacy (Jamieson et al. 2018; 2019) on older people.

To answer the research questions, we used mostly administrative data from the Integrated Data Infrastructure (IDI) that is a longitudinal dataset which holds linked individual and household level microdata from a range of Government agencies (e.g. housing, health, policing), Stats NZ surveys, and non-governmental organisations (Statistics New Zealand, 2013). However, to provide a broader context, we included additional data sets such as derived residential mobility and transience (Marek et al., 2021b), New Zealand index of socioeconomic deprivation (Atkinson et al., 2014) or Healthy Location Index (Marek et al., 2021a) that provided area-based measures of locally varying environmental and socioeconomic determinants.

2024 Research Update:

This was the final (funded) year of the project. The team published and prepared several publications, and a few more are expected to be submitted/published in 2025.





New and Ongoing Research

Urban Trees and Housing Intensification: A Spatial Conflict?

PhD Student:

David Pedley (PhD student, SoF - GRI)

Supervisors

Dr Justin Morgenroth (UoC)

Dr Grant Pearse (Flinders University)

Dr Mijam Schindler (Victoria University)

Funding

GRI Scholarship and UC Doctoral Scholarship

Duration of project:

September 2022 to December 2025

Project summary

Many cities have simultaneous goals to increase the provision of housing through intensification, whilst also increasing urban tree canopy. These dual objectives create an inherent potential for conflict. Although intensification of residential land can create more compact cities, it may also result in the loss of existing trees, undermining their critical role in creating healthy and liveable environments. The overall objective of this research project is to explore this potential conflict and evaluate the relationship between residential housing intensification and changes in urban tree cover over time.

The first stage of the research utilised convolutional neural network deep learning models to detect and quantify the city-wide loss of urban tree canopy (UTC) at the scale of individual properties using high resolution aerial imagery and LiDAR data. The study was based in Christchurch, New Zealand, with a focus on UTC loss that occurred between 2016 and 2021. The output of this stage was city-wide polygons of UTC loss, which could be allocated to individual property titles to quantify the extent of loss for each property within the study area.

The property-scale identification of UTC loss creates the opportunity for detailed evaluation of the drivers of UTC loss on private properties to enable better management of existing urban forests. This is the focus of the second research stage, which utilises geospatial building consent data to investigate the relationship between resi-

dential housing intensification and UTC loss during the study period. The final stages of the research project will assess the extent to which UTC loss has been offset by new planting and evaluate the potential role of incentives for protecting existing urban trees.

Latest developments

During 2024, the mapping of UTC loss was completed and a manuscript was submitted for journal publication. The method achieved a high level of accuracy at the property scale and addressed the challenges of change detection using remote sensing data with imperfect alignment. The work was presented at ForestSAT, an international conference focussed on the application of spatial technologies for forest observation and analysis. In addition, the analysis has been completed to evaluate the relationship between housing intensification and UTC loss, including an evaluation of different forms and densities of redevelopment. This has provided insights into the variable impacts of development on urban trees and its contribution to overall changes in the Christchurch urban forest.

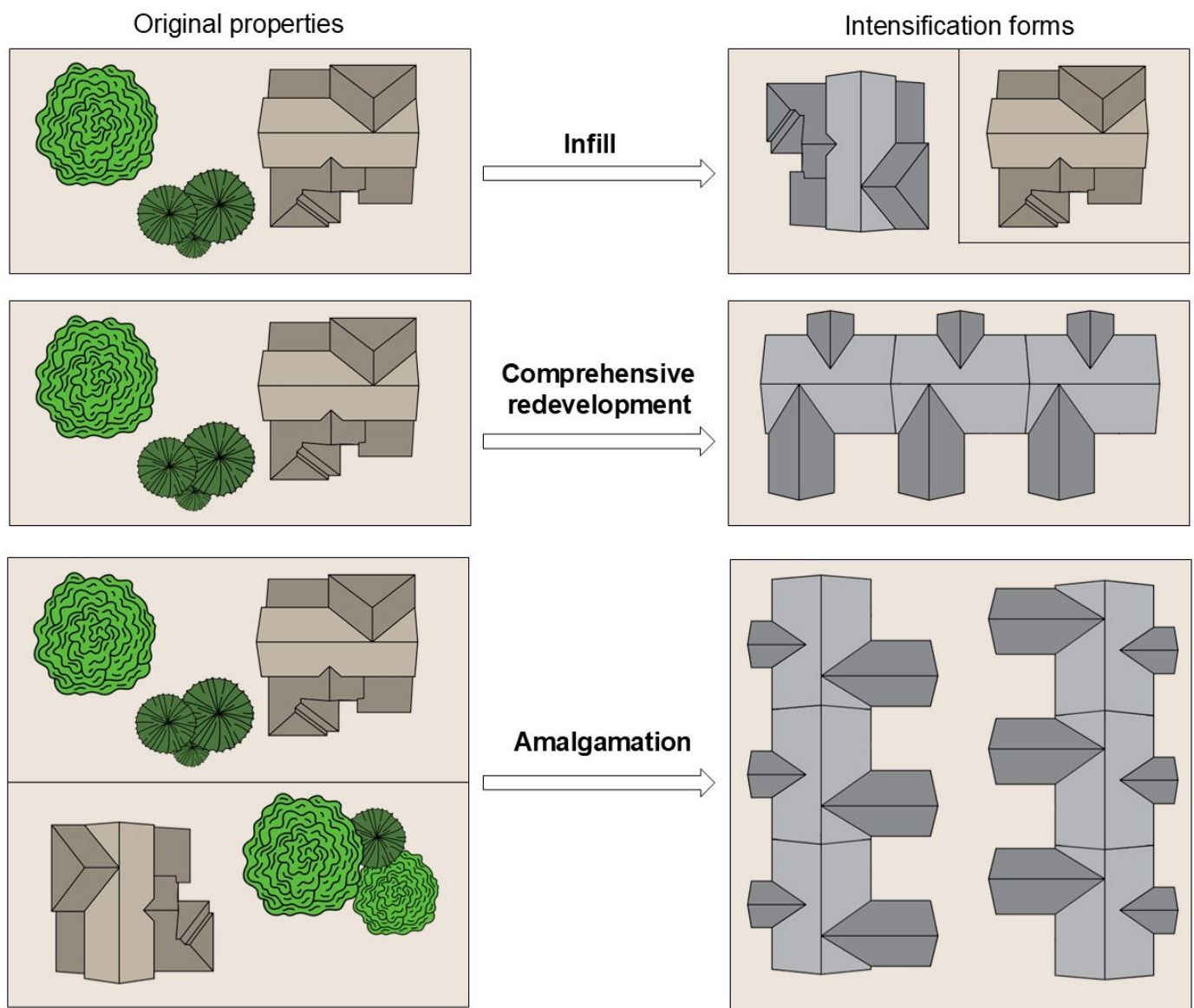


Illustration of Urban Tree Canopy (UTC) at the scale of individual properties using high resolution imagery and LiDAR data.



A new physically–based numerical model to simulate flood triggered oil spill scenarios in river systems

Research Team:

Paola Di Fluri (University of Bologna) Research fellow at UC-GRI
Alessio Domeneghetti (University of Bologna)
Matthew Wilson (UoC)

Funding:

The Phd project is funded by the University of Bologna

Duration of Project:

3 years

Project Summary:

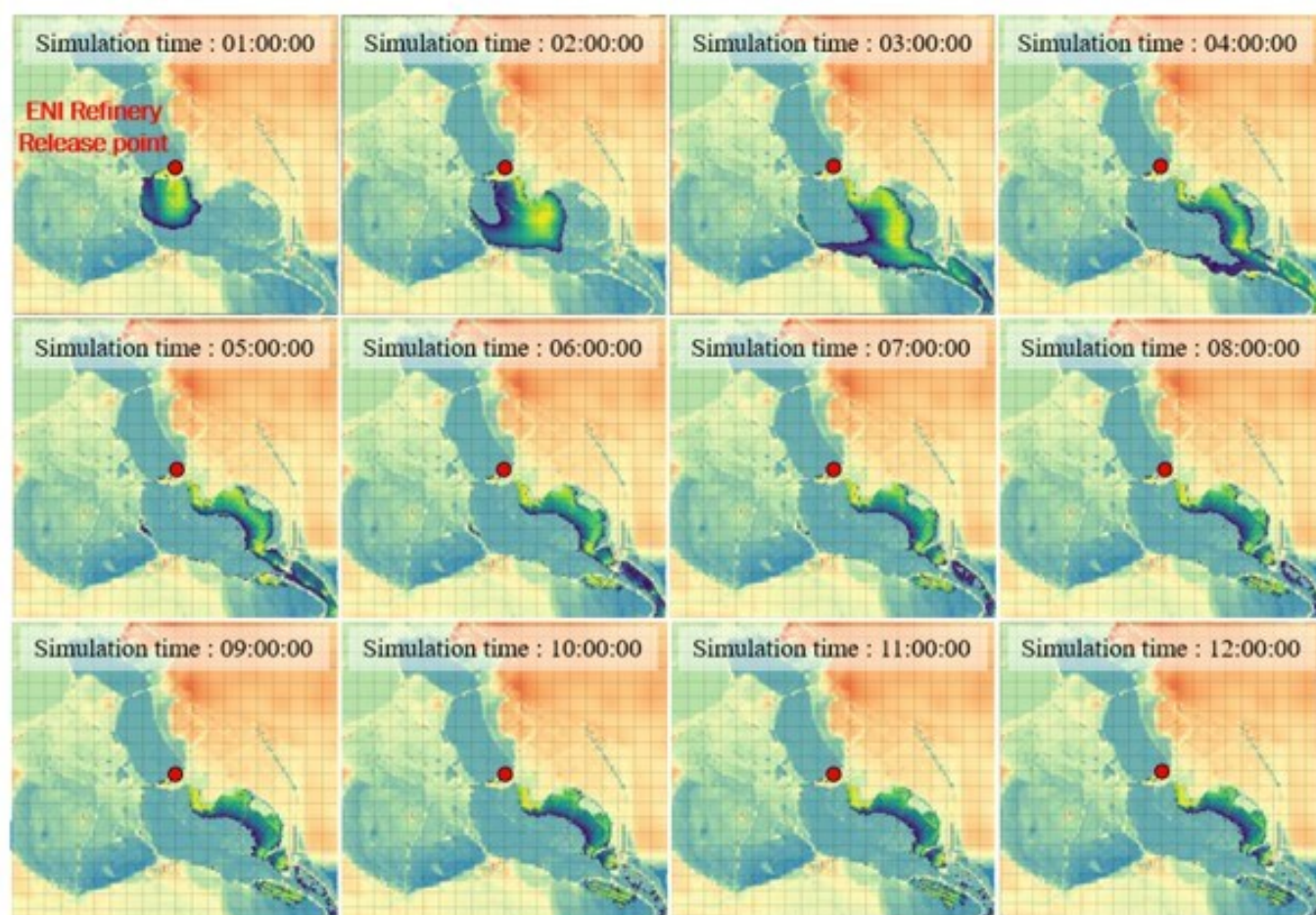
Floods represent the most frequent natural hazard worldwide, producing extensive impacts on buildings, infrastructures, and essential service systems. These events are particularly critical for industrial facilities located in flood-prone areas, where inundation can trigger complex industrial accidents classified as Natech (Natural Hazard Triggering Technological Accidents) events. The combination of natural and technological hazards generates synergistic effects, amplifying environmental impacts.

Within this context, petroleum products are of particular concern, as they rank among the most environmentally persistent and hazardous contaminants, posing severe risks to ecosystems and human health due to their toxicity and long-term degradation times. Modelling their fate and transport in floodwaters is therefore a priority in risk assessment frameworks.

The analysis of such scenarios requires a multi-risk approach, integrating hydrodynamic modelling with fate and transport modelling and technological risk assessment. Existing flood models generally do not consider,

except in limited cases, the simulation of pollutant spills and transport in floodwaters. Although numerous tools have been developed in the marine environment to describe oil dynamics, the fluvial context remains largely unexplored, where high flow velocities can exacerbate adverse effects by transporting oil over long distances and contaminating water, soil, and air.

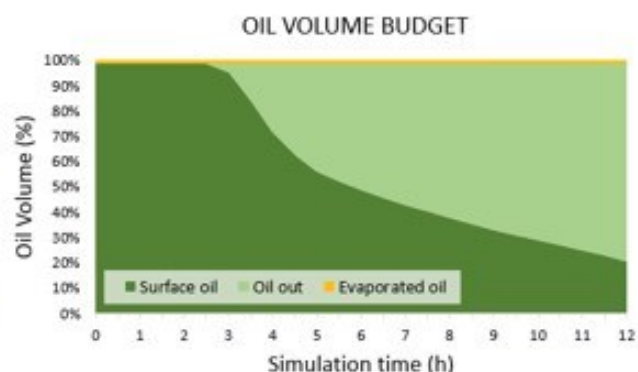
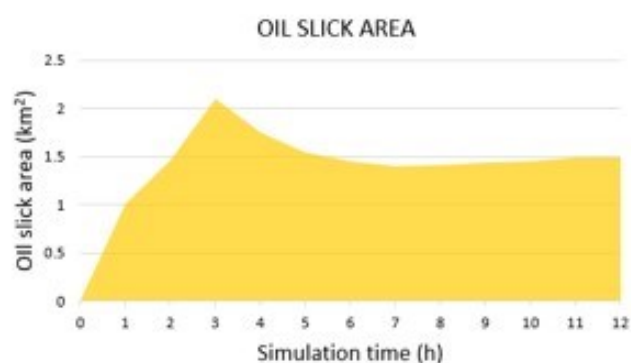
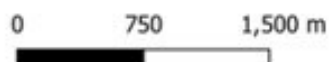
The present project aims to address this gap by developing a reduced-complexity method tracking crude oil released during flood-triggered Natech accidents. The proposed approach integrates, within the physically-based CAESAR–Lisflood hydrodynamic model, an oil spill module capable of estimating the extent of the contaminated area, the thickness of the oil slick and producing risk maps for multiple scenarios. Compared to existing models, the implementation will feature a lightweight computational structure, making it suitable for emergency contexts where fast processing is essential for decision-making support and impact mitigation.



Oil concentration (g/l)



DTM (m)



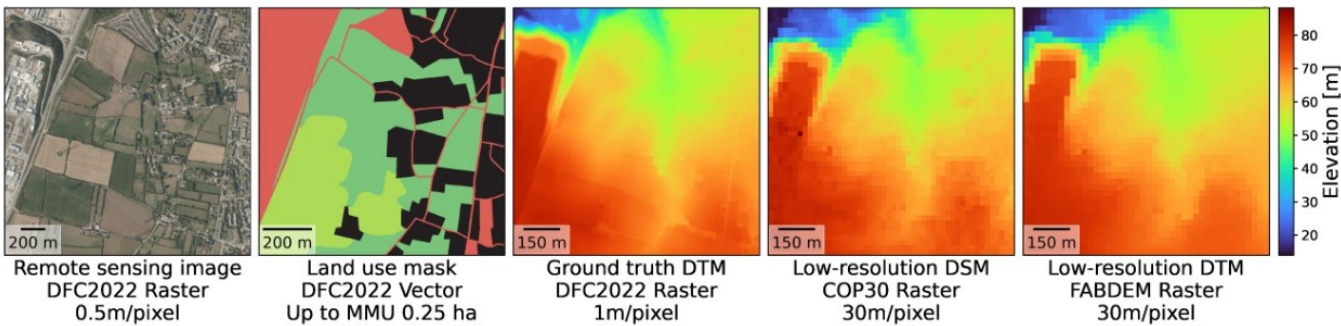
Temporal evolution of crude oil concentration following a spill caused by the damage of a storage tank (represented by the red dot in figure above).

Enhancement of bare-earth digital elevation model from global data

Research Team:
Xander Cai (GRI-UoC)
Matthew Wilson (GRI-UoC)

Funding
GRI funds

Duration of the Project
2024



Process of data training

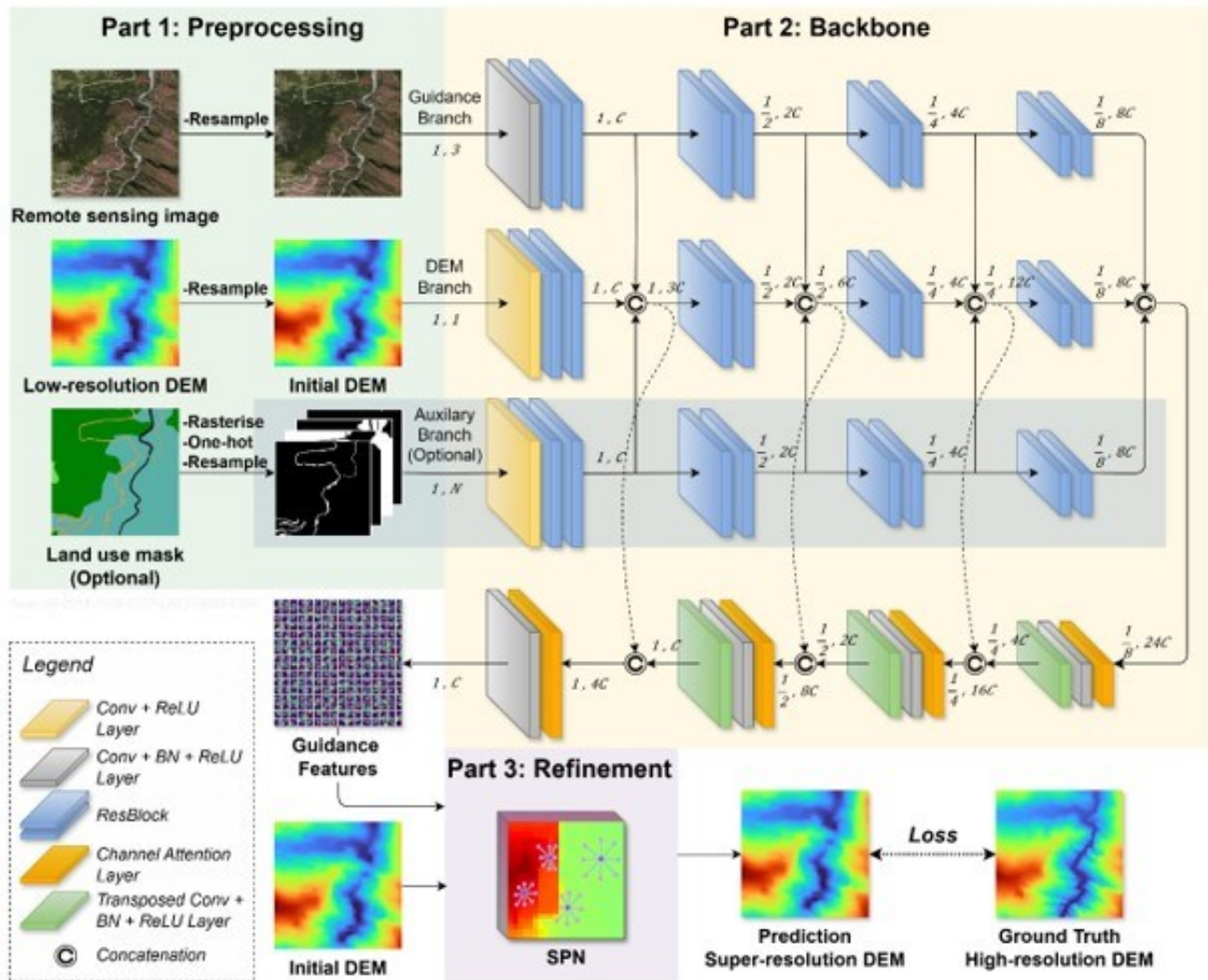
Summary

Acquiring high spatial resolution ($\sim 1\text{--}10\text{ m}$) bare-earth Digital Elevation Models (DEMs) is essential for various land surface applications, such as hydrological studies. However, such DEMs often suffer from limited coverage or accessibility. Moreover, widely available global DEMs have lower spatial resolutions ($\sim 30\text{--}90\text{ m}$) and contain errors introduced by surface features.

Applying super-resolution approaches to low spatial resolution global DEMs could generate higher spatial resolution bare-earth DEMs to address this gap. However, single-image super-resolution (SISR) methods underperform when processing real-world DEMs. This work investigates sparse-to-dense depth completion approaches to enhance the spatial resolution and vertical accuracy of DEMs. We propose the Joint Spatial Propagation Super-Resolution network (JSPSR), which integrates joint image filtering and non-local Spatial Propagation Network (SPN) to improve the vertical accuracy of super-resolution DEMs from open-accessible global DEMs by leveraging guidance features extracted from remote sensing images, with or without optional auxiliary spatial data. Additionally, we

developed a dataset for real-world DEM super-resolution problems in low-relief areas using open-access data for validating the proposed method.

Experiments on this dataset evaluated our method by reconstructing 3 m and 8 m spatial resolution DEMs from 30 m spatial resolution Copernicus GLO-30 DEMs. Results report that JSPSR improves prediction accuracy by 70.3% on RMSE (root mean squared error) and reconstruction quality by 22% on PSNR (peak signal-to-noise ratio) compared to bicubic interpolation, and achieves 54.5% and 13.2% improvement on the same items against the baseline single-image SR method, demonstrating that JSPSR outperforms comparison methods in bare-earth DEM super-resolution tasks.



The architecture of JSPSR and the training workflow. The preprocessing (Part 1) upsamples the low-resolution DSM to the target resolution as the initial DEM and sends the initial DEM with guidance image and optional auxiliary guidance data (land use mask in this case) to the corresponding branch of the backbone (Part 2) for multi-modal feature extraction and fusion. The SPN-based refinement model (Part 3) utilises a non-local spatial propagation network, which tunes the initial DEM based on guidance features extracted from the backbone, and outputs the predicted super-resolution DEM.

Advancing methods of rapid flood scenario and long-term assessment using hybrid approaches of hydrodynamic modelling, statistical methods and machine learning

PhD Student:

Andrea Pozo Estivariz

Supervisors:

Emily Lane (NIWA)

Matthew Wilson (UoC)

Marwan Katurji (UoC)

Fernando Méndez (Universidad de Cantabria)

Funding

This work has been funded by the research programme “Reducing flood inundation hazard and risk across Aotearoa/New Zealand”, supported by the New Zealand Government via the Ministry for Business, Innovation and Employment (MBIE).

Duration of the Project

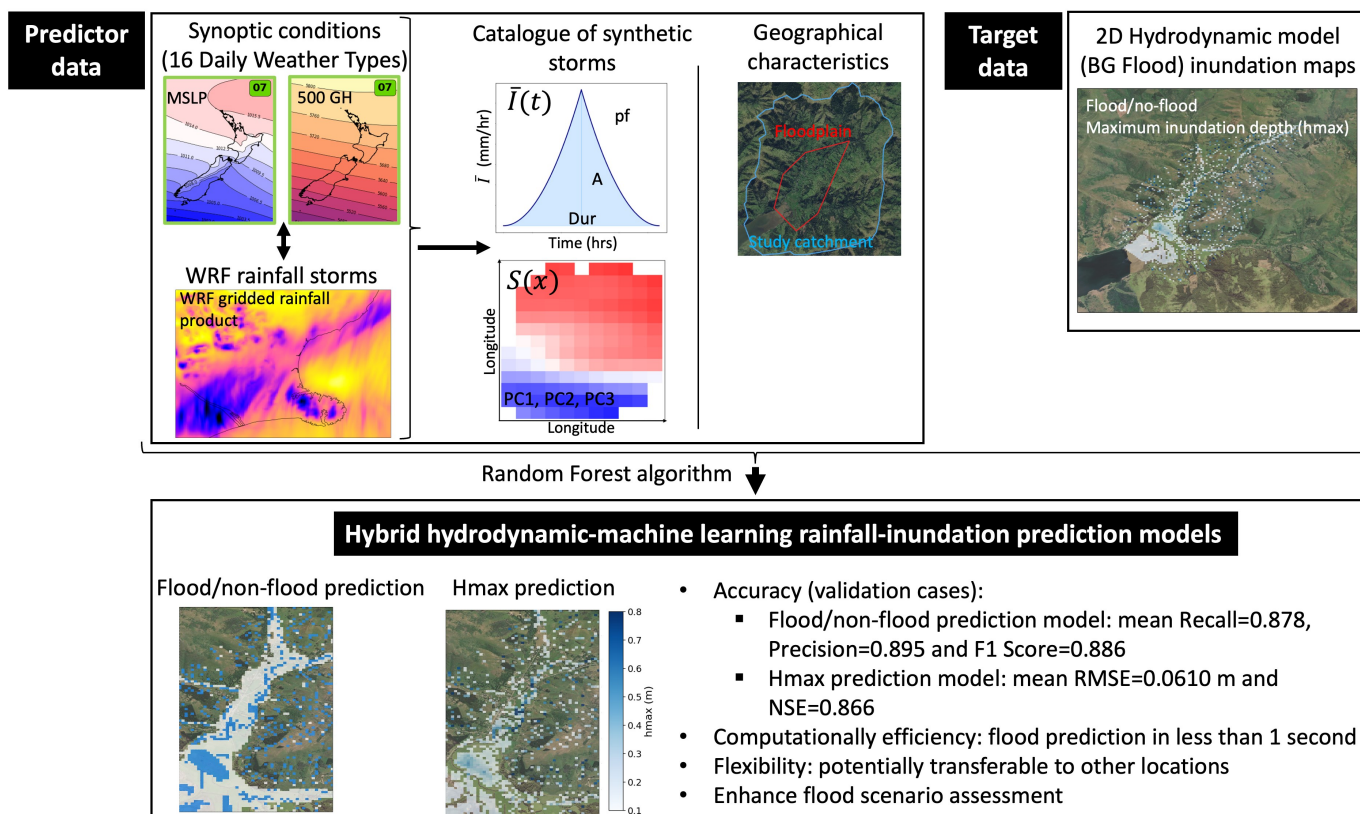
November 2021-October 2025

Project summary

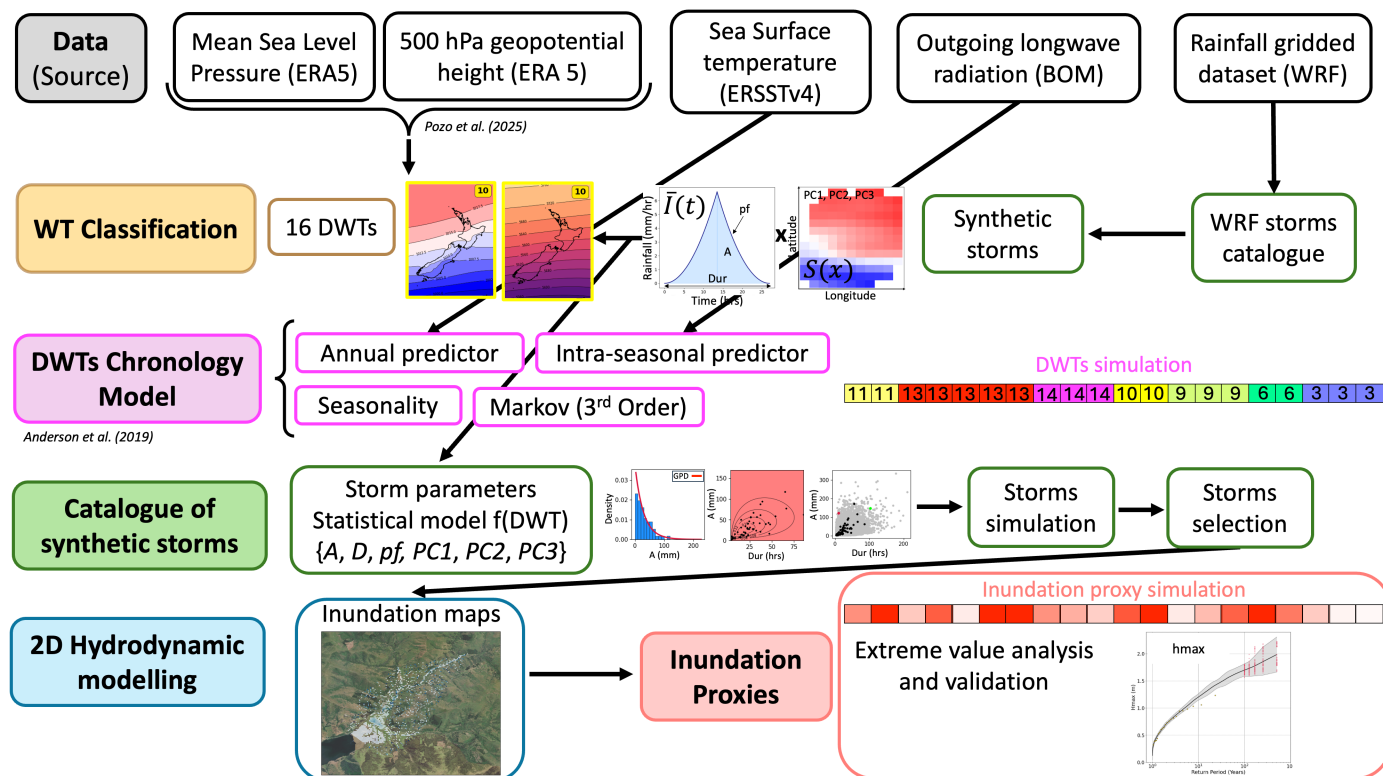
Flooding is one of the most devastating natural disasters worldwide. It is also expected to become more severe as climate change impacts are realised. Traditional physics-based 2D hydrodynamic models provide reliable flood hazard information but are computationally and time expensive, limiting their use in flood scenario and long-term probabilistic flood assessments. This work proposes an innovative framework for flood assessment, combining synoptic climatology, synthetic storm generation, 2D hydrodynamic modelling, statistical methods and machine learning techniques.

The proposed framework is applied to the Wairewa catchment in Aotearoa New Zealand. The first part of the project focuses on the main inundation driver, heavy rainfall, characterising local heavy rainfall events using synoptic climatology and large-scale climate patterns. Building on this, two hybrid hydrodynamic-machine learning rainfall-inundation prediction models are developed: one to predict flood/non-flood and another to predict maximum inundation depth.

These hybrid models can accurately and efficiently predict flooding, providing valuable flood hazard information for flood scenario assessment. Lastly, the last part of this project extends into long-term probabilistic flood assessment by proposing a climate-based emulator that simulates realistic storm time series. These time series are used to generate inundation proxies time series, enabling long-term flood frequency analysis. Together, these three studies form a comprehensive framework: from understanding the main inundation driver and generating storm events, to rapid flood scenario prediction and long-term hazard assessment, offering robust tools for flood risk management stakeholders.



Conceptual framework for hybrid hydrodynamic-machine learning model for flood hazard scenario assessment.



Conceptual diagram for climate-based emulator framework for flood risk assessment.

Quantifying uncertainty in flood predictions due to river bathymetry estimation

PhD student:

Martin Nguyen (PhD student, UoC)

Supervisors:

Prof. Matthew Wilson (Main Supervisor, UoC)

Dr. Emily Lane (Supervisor, NIWA)

Prof. James Brasington (UoC)

Dr. Rose Pearson (NIWA)

Funding:

MBIE Endeavour Research Programme – Increasing flood resilience across Aotearoa, New Zealand.

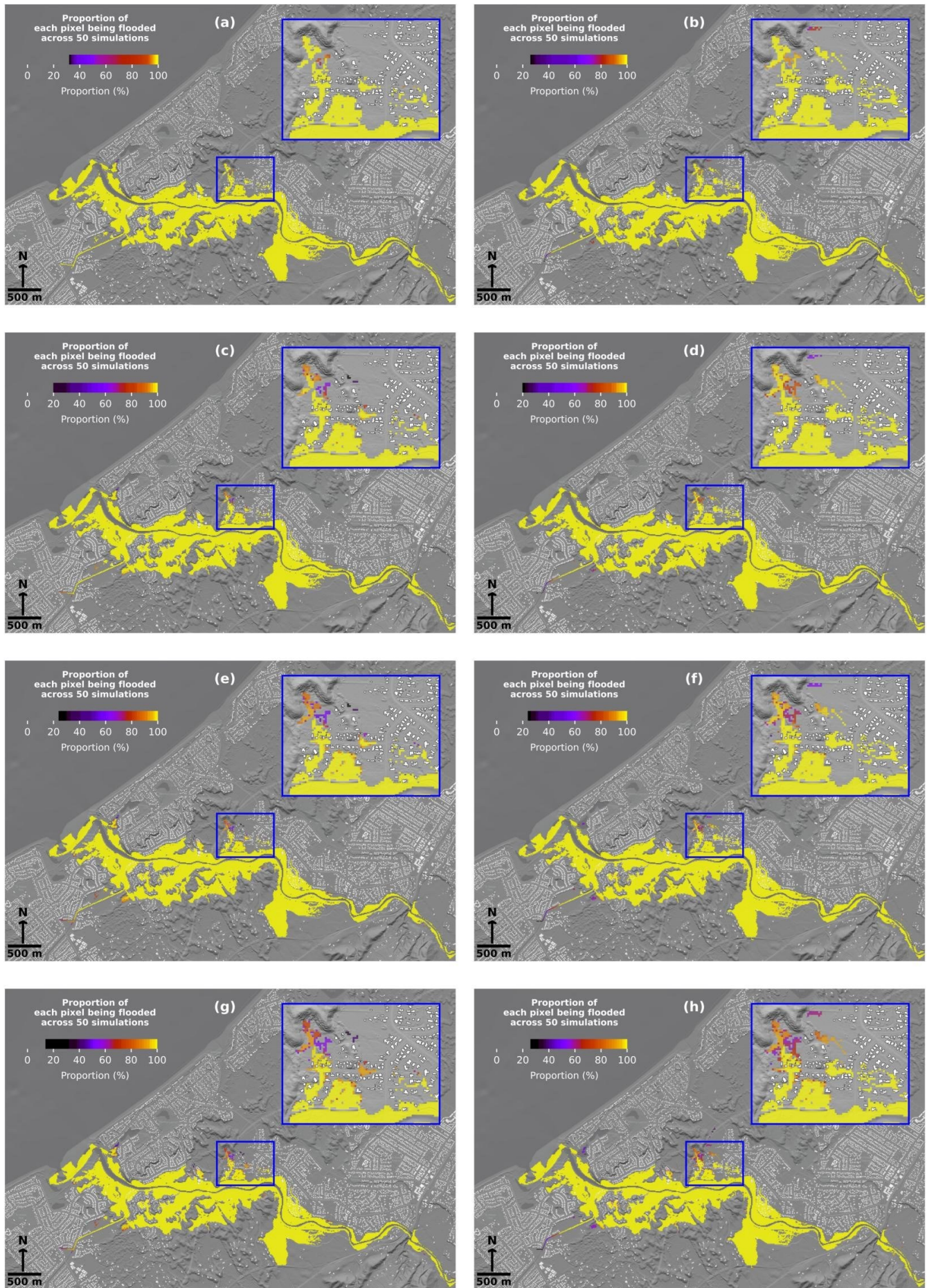
Duration of Project:

2021-2025

Project Summary:

River bathymetry is important for accurate flood inundation modelling but is often unavailable due to the time-intensive and expensive nature of its acquisition. This leads to several proposed and implemented approaches for its estimation. However, the errors in estimations inherent in these methods and how they affect the accuracy of the flood inundation modelling outputs, has not been extensively researched. Hence, to contribute, we investigate the sensitivity of flood predictions to the errors in river slope, width, and bank-full flow used in two formulas - the Uniform Flow and the Conceptual Multivariate Regression - for estimating river bathymetry. In this study, we employed a Monte Carlo framework to introduce random errors into these parameters drawn from a normal distribution with zero mean and a standard deviation set to 10\% of their best estimates. Using this process, we generated 50 simulated river bathymetries for each parameter along with an additional 50 where the errors were applied to all parameters simultaneously. The riverbeds generated from these bathymetries were combined with topographic LiDAR

data to create model grids. Each grid was used in the hydrodynamic model LISFLOOD-FP to simulate the 2005 flood event in the Waikanae River area of New Zealand. We assessed the resulting flood inundation predictions for their variability and sensitivity. The results indicate that between two methods, the errors in the parameters in the Uniform Flow formula are associated with greater uncertainty in flood inundation depths and extents compared to the Conceptual Multivariate Regression. Among the parameters, the width errors correspond to the highest uncertainty, while the slope errors correspond to the lowest.



Variations in January-2005 flood extents based on simulated Waikanae River bathymetrics estimated by parameters with associated error distributions: the Conceptual Multivariate Regression formula – (a) slope, (b) bank-full flow, (c) width, and (g) combined; the Uniform Flow formula – (b) slope, (d) bank-full flow, (f) width, and (h) combined.

Machine Learning Approach for Regional Scale Rock Glaciers Mapping

Research Team:

Sunil Tamang (PhD student, UoC)
Shelley MacDonnell (UoC)
James Brasington (UoC)
James Shulmeister (UoC)
Benjamin Aubrey Robson (University of Bergen)

Funding

GRI PhD Scholarship

Duration of the Project

1 February 2024 to 31 January 2027

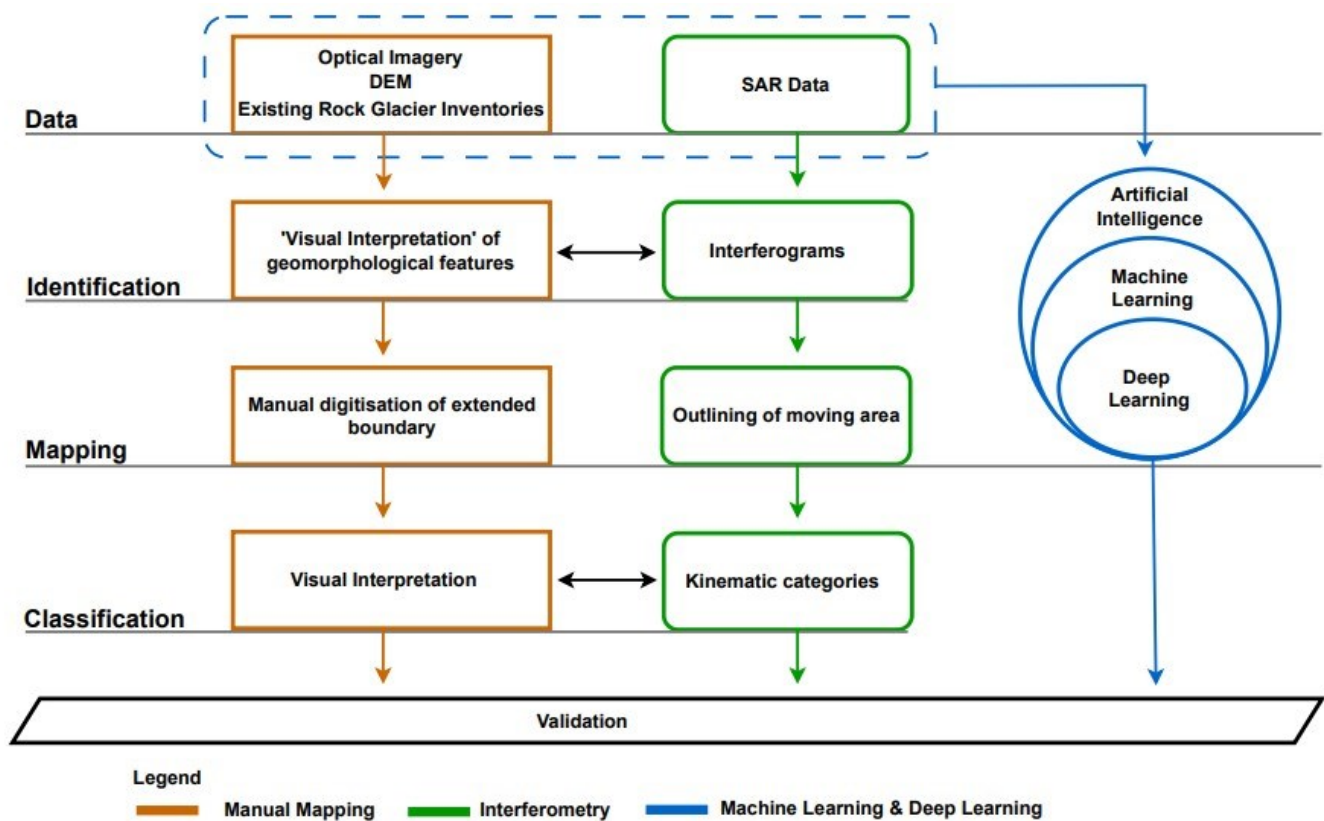
Project Summary:

Rock glaciers are the most visible expressions of permafrost and are found in mountain regions worldwide. Accurate and consistent mapping of rock glaciers is essential for various scientific and applied studies, including geomorphological analysis, hydrological dynamics, and geohazard assessment.

Mountainous landscapes consist of a variety of landforms, such as landslide deposits, rock avalanches, debris-covered glaciers, solifluction lobes, and rock glaciers. Despite their distinct formation processes, these landforms often exhibit similar geomorphological expressions, making their differentiation complex. Even when a rock glacier is identified, accurately mapping its extent presents another challenge.



Surface of rock glaciers [photo credit: Bob Wester for NSIDC]



Scheme of the stages of the PhD research project: Machine Learning Approach for Regional Scale Rock Glaciers Mapping

Rock glaciers lack distinct boundaries and shift over time due to changing topography and climatic conditions. Their movement is influenced by multiple factors, including slope gradient, debris supply, and internal ice creep, causing their boundaries to continuously evolve.

Within this context, my PhD research contributes to the broader field of geomorphology by addressing a fundamental question: How do we accurately map landforms that have no distinct boundaries and are continuously evolving? The research is structured around four objectives:

1. To conduct a comprehensive literature review of remote sensing and automated techniques in rock glacier mapping
2. To develop and evaluate different machine learning models for rock glaciers detection and extent mapping in different mountain regions.
3. To quantify uncertainty in rock glacier extent mapping using machine learning models.
4. To assess changes in the spatiotemporal distribution of rock glaciers.

Implications of uncertainty in flood hazard assessments for planning under climate change

PhD student:
Clevon Ash (PhD student, GRI - UoC)

Supervisors:
Matthew Wilson (GRI - UoC)
Iain White (UoW)
Carolynne Hultquist (SEE - UoC)

Funding
Ministry of Business and the Environment funded Endeavour Project

Duration of project
4 years

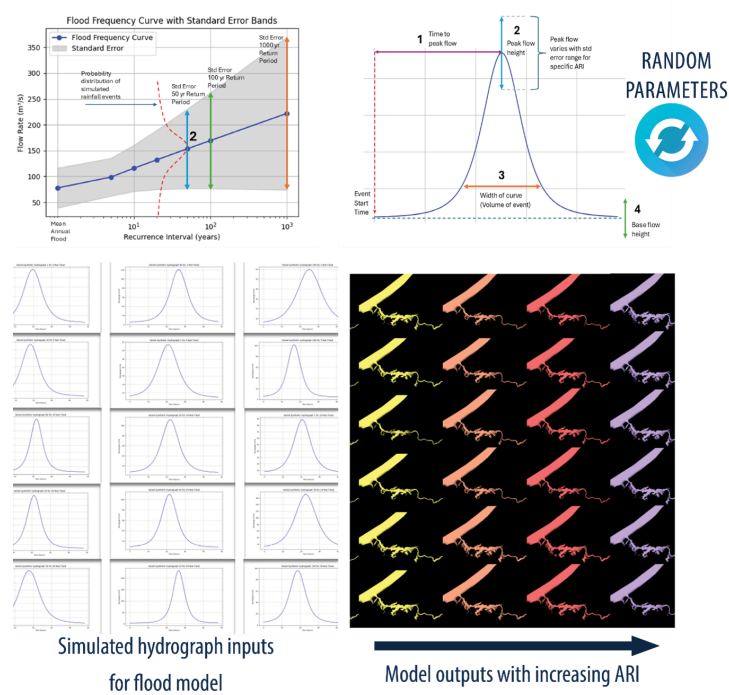
Project Summary

This research aims to develop a better understanding of uncertainty representation in flood risk management and to determine the impact that it has on decision making. As the uncertainty associated with flood risk grows due to climate change and other factors it becomes imperative that decision makers can make the decisions needed within acceptable margins of error to protect the people of Aotearoa and its assets.

2024 Research Update:

Using river flow projection data from Earth Sciences NZ (NIWA) for several annual exceedance probabilities (AEPs) a Monte Carlo method (MCM) (image 1) was set up and tested for Waikanae NZ, a small town on the Kāpiti Coast, 60 km north of Wellington. The outputs produced from the MCM highlighted the types of uncertainties that result both from modelling flood hazards and from future climate change. Several different visuals were generated from these outputs and sent to practitioners across the regional councils and stakeholders for feedback. Focus groups were also held at Otago University in November as part of the Endeavour Flood Project Science-Practice Roadshow where flood risk experts and other disaster management practitioners provided additional feedback.

CONVERTING RAINFALL UNCERTAINTY TO MODEL INPUTS



Building urban development scenarios into assessments of future flood risk

PhD student:

Katherine Booker (PhD student, UoW)

Supervisors:

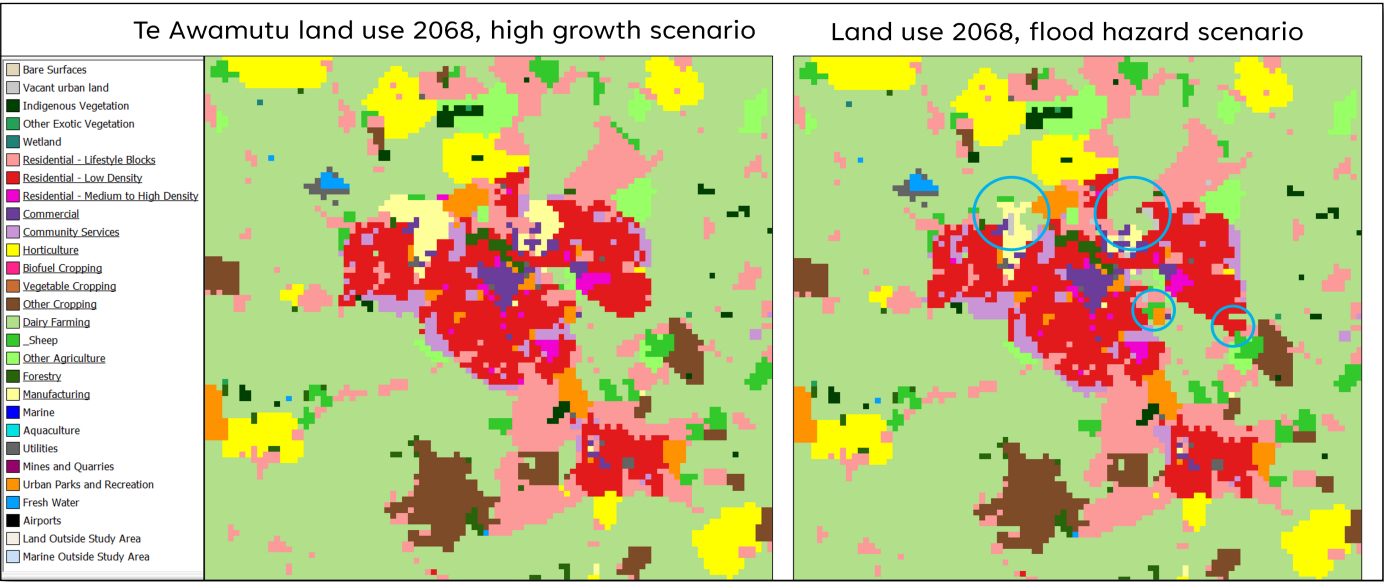
Iain White (UoW)
Matthew Wilson (GRI - UoC)
Dr. Xinyu Fu (UoW)

Funding

MBIE-Endeavour fund (2020-2025) *Institute of Water and Atmospheric Research (NIWA)*, running from 2020 to 2025.

Duration of Project

PhD May 2023 - May 2026 (3 years)



Project Summary:

Flooding is one of the costliest natural hazards in Aotearoa-New Zealand, and with a warming climate is expected to become more frequent and more severe in the future. The dynamic and uncertain nature of flood hazards creates a fundamental challenge for urban planners, who are also facing intense pressure to fast-track urban development to fix problems of housing affordability. Projections of *future* flood hazards under alternative climate scenarios are available, but pairing those with *current* urban form fails to consider how future urban growth will change exposure, whether by new development, intensification, infrastructure investment, or greenspace strategies. In this research we explore how long-term changes in urban morphologies might be envisioned under alternative future climate and flood scenarios, particularly if different paths for adaptation and mitigation are followed. The goal is to create a robust methodology for generating and then integrating urban futures with flood futures to provide a more comprehensive assessment of the uncertainties and inequalities of future flood risk.

2024 Research Update

A review of recent literature confirmed that urban growth modelling (UGM) can generate long-term climate-related urban development scenarios if a specific set of methodological choices are selected. Application of an existing model to a study area in Aotearoa-NZ (see Figure above) illustrates how UGM produces urban projections consistent with a plurality of economic, climate, and policy scenarios. However, the technical promise of UGM does not necessarily indicate its utility for urban planning. Results from our survey and interviews with NZ urban practitioners reveal that a lack of funding, data, skilled resources, and confidence in model functionality are significant barriers to uptake of UGM within local government. We conclude that stronger direction from central government is required to create a robust methodology for integrating urban and climate futures. Decision-makers need fit-for-purpose tools and a mandate for longer-term risk-based spatial planning that balances development needs with sustainability and resilience to a changing climate.

Carbon Neutral Neighbourhoods dashboard development

Project team

Malcolm Campbell (GeoHealth Lab - UoC)
Lindsey Conrow (SEE - UoC)
Tom Logan (Civil and Natural Resources Engineering - UoC)
Simon Kingham (SEE - UoC)

Dashboard development:

Malcolm Campbell (GeoHealth Lab - UoC)
Luke Parkinson (GRI - UoC)
Matthew Wilson (GRI - UoC)

Funding

BRANZ – Funded from the Building Research Levy

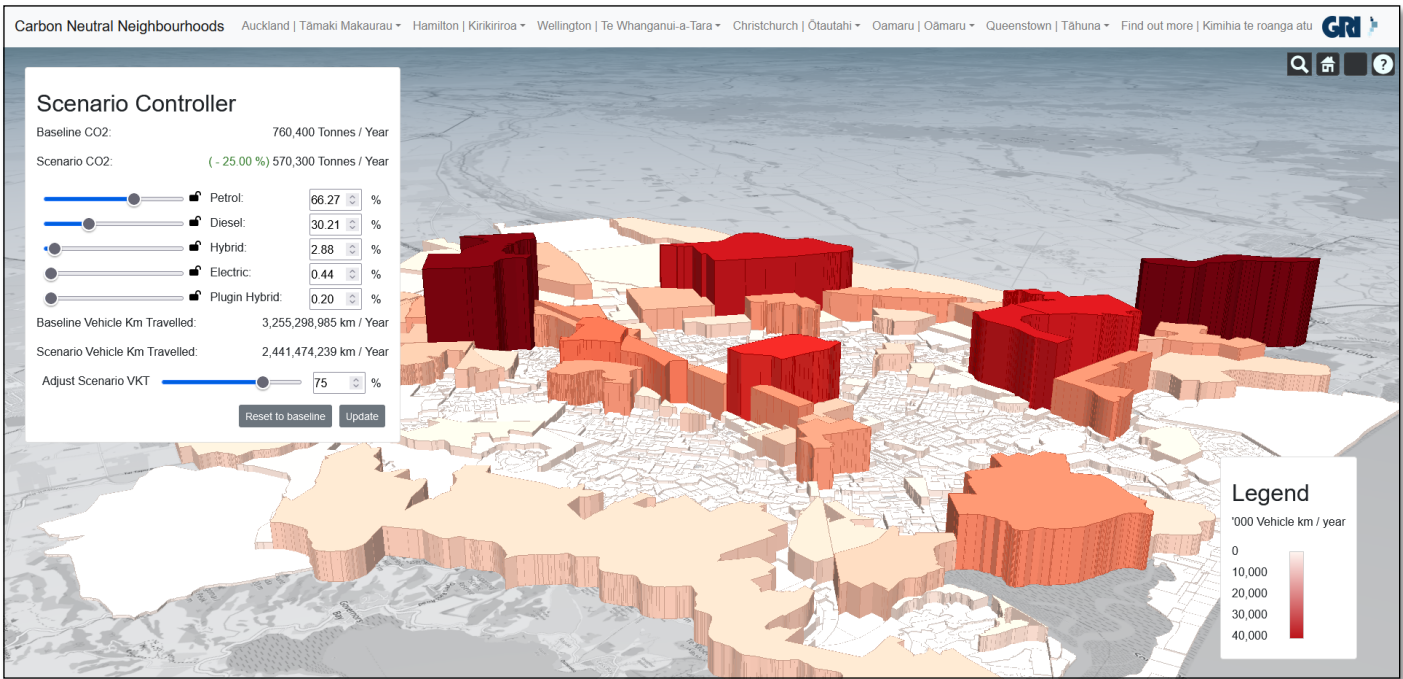
Duration:

2023-2025

Project summary

What if neighbourhoods were designed so that people could live sustainability with minimal effort? What can Aotearoa New Zealand learn from successful models both here and worldwide? To increase understanding of the relationship between urban form and emissions, this online mapping tool helps with visualisation of transport patterns and emissions.

The Geospatial Research Institute was brought onto this project to bring the geospatial patterns to life. We created a web application that processes data from the research team and produces interactive dashboards. These dashboards allow people to explore the emissions and transport patterns for six New Zealand cities using data from the most recent census. This project used the Open-Source library geo-visualization-components, which was developed at the GRI to assist researchers in displaying their data effectively on the web.



Flood Resilience Digital Twin version 1.0 Release

Research Team

Luke Parkinson (GRI - UoC)
Casey Li (GRI - UoC)
Matthew Wilson (GRI - UoC)

Funding

FrontierSI and
Building Innovation Partnership

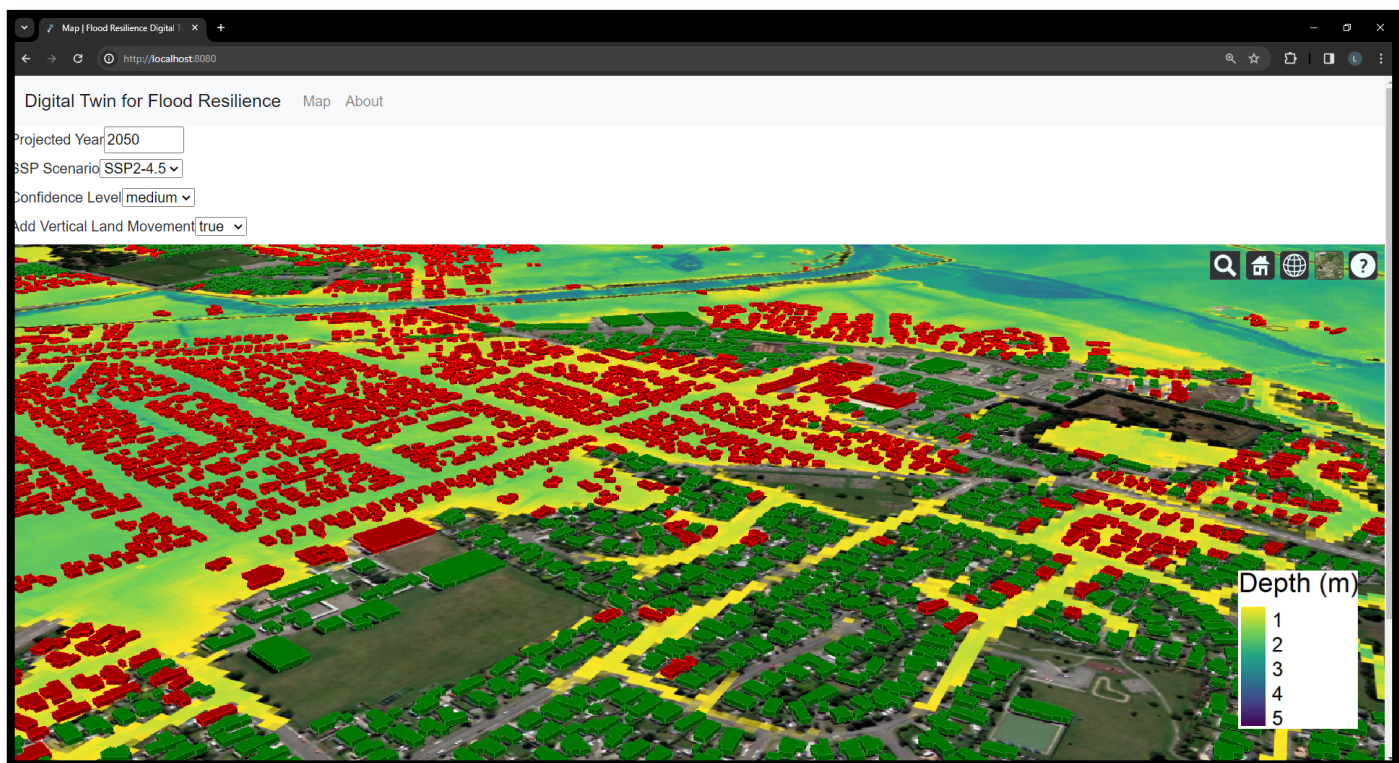
Duration

2021-2024

Project Summary

The Flood Resilience Digital Twin reached an initial release in April 2024. This coincided with the submission of a paper detailing the software to the Journal of Open Source Software. Following on from the release, development has been centred around user experience improvements and refinements.

The core software for handling the large amounts of data has been adapted for use in other domains such as the Ōtākaro Digital Twin. Development is underway to prepare this core for standalone release, so that plugin modules can be developed for many geospatial domains.



Ōtākaro Digital Twin Phase 1

Research team

Luke Parkinson (UoC)
Xander Cai (UoC)
Martin Nguyen (UoC)
Casey Li (UoC)
Rory Clifford (UoC)
Sam Thompson (University of Auckland)
Aporini Deer (UoC)
Alistair McIntyre (Open Plan)
Marcos Gabriel Merlo
Michael Healey (Christchurch City Council)
Frances Charters (UoC)
Kerri Gray (CreateBig)
Matthew Wilson (UoC)
John Reid (UoC)
Greg Preston (UoC)

Funding

Christchurch City Council and
Building Innovation Partnership

Duration

May 2024 – December 2024

Project Summary:

The aim of this project was to establish an accessible and innovative platform to collect and communicate knowledge about the Ōtākaro River (Avon River), serving as a tool to give voice to the Ōtākaro and its importance to the community.

Aims

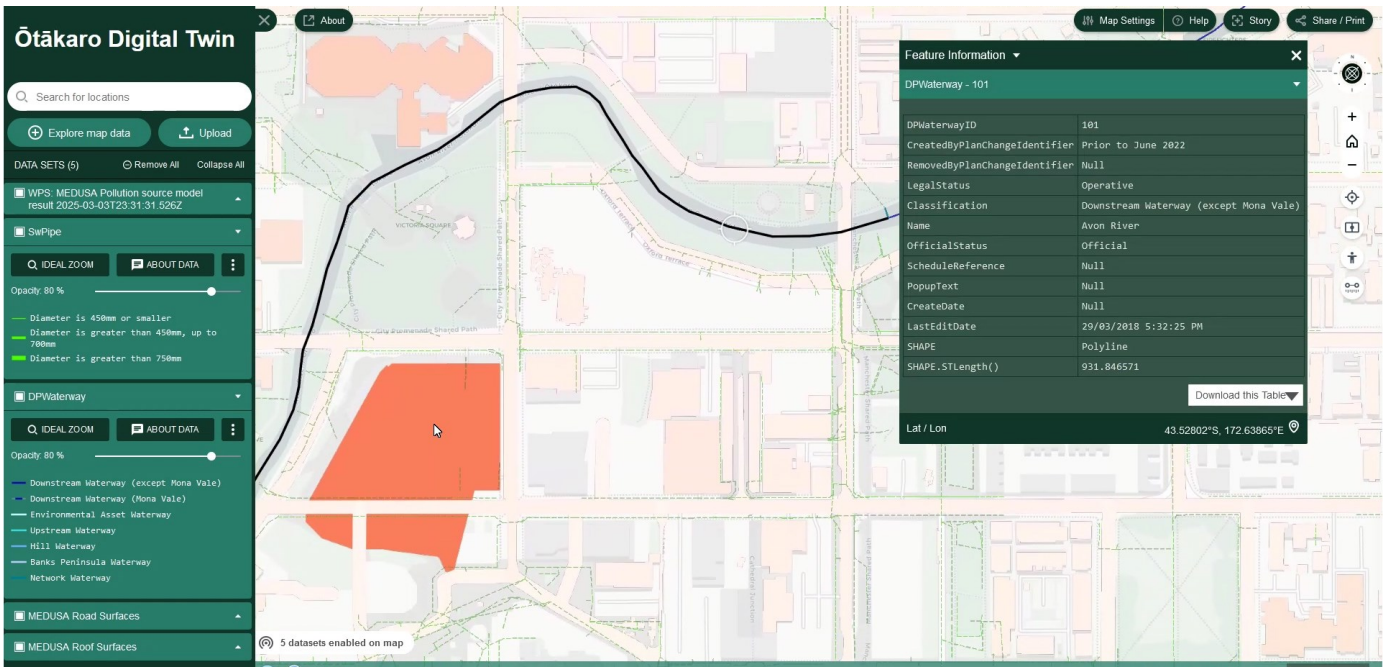
The platform aims to foster collaboration to support and encourage:

- Holistic decision making & governance, to restore te mauri o te awa,
- Environmental health and resilience outcomes,
- Representation of the mauri of the Ōtākaro and;
- Amplify the significance of the Ōtākaro to the region and people by allowing users to model potential future narratives and tell stories of the Ōtākaro's past & present.

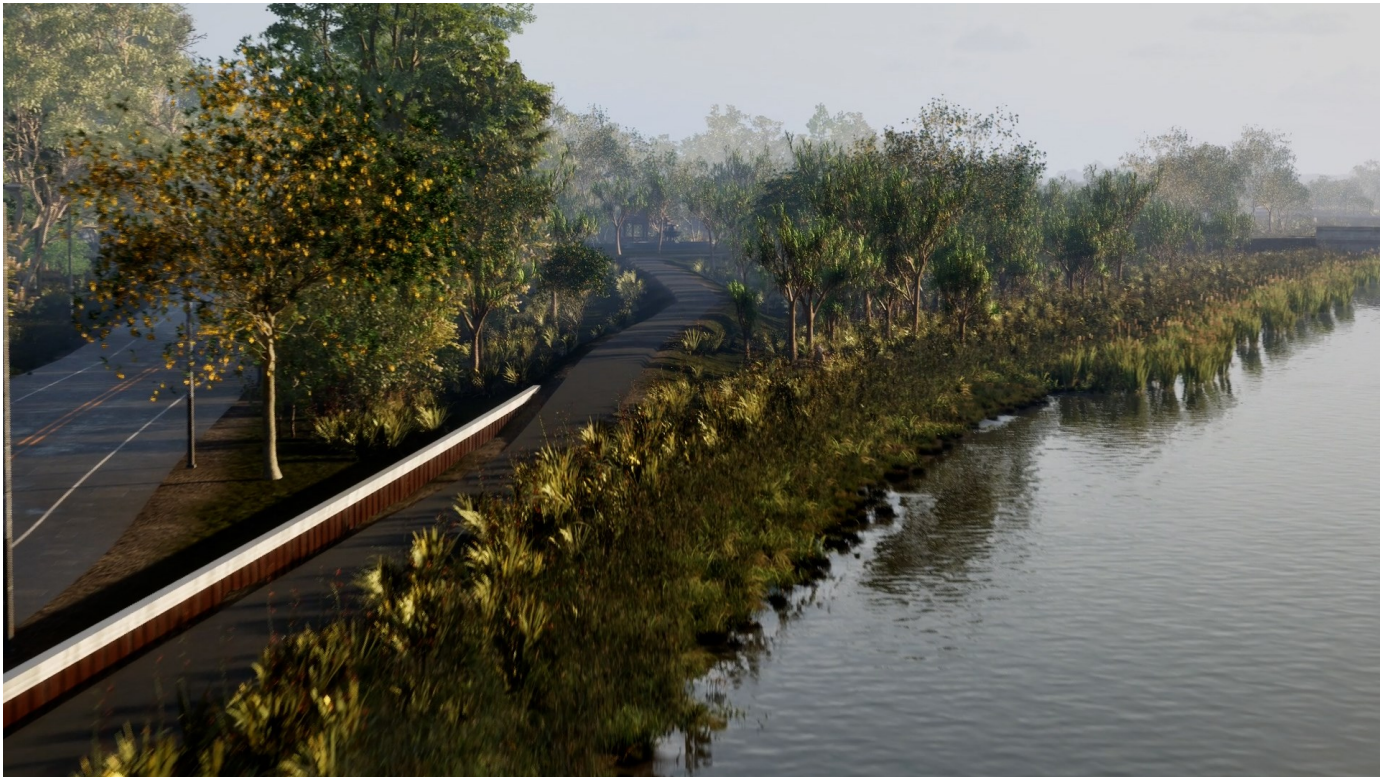
The Ōtākaro Digital Twin purpose is guided by the Te Mana o te Wai framework and is expected to be adaptable to other locations and environments.

The GRI led the software development of this first phase of the Ōtākaro Digital Twin. We created a web application based on the GRI's open-source Digital Twin platform. This platform can pull data from many sources, including Christchurch City Council (CCC)'s Open Data Portal. We use this data to run the MEDUSA2.0 stormwater pollutant model with user rainfall inputs, which allows users to identify sources of contaminants.

We also created a 3D Unreal Engine CGI fly-through of a short section of the Ōtākaro River, combining current geospatial data with future projects that the Christchurch City Council has planned along the corridor, such as wetland restoration, flood walls, new multi-use pathways, and stormwater pumping stations.



The Ōtākaro Digital Twin, displaying CCC's waterway and stormwater pipe datasets and contaminant contributions from roads and buildings.



Unreal Engine visualisation generated from geospatial plans of work on the Ōtākaro Avon River Corridor and Ōtākaro Digital Twin data.

Virtually flooded: Improved risk communication through immersive virtual reality

Research Team

Xander Cai (GRI - UoC)

Luke Parkinson (GRI - UoC)

Matthew Wilson (GRI - UoC)

Ian Grover (Te Rūnanga o Ngāi Tahu)

Funding

Natural Hazards Commission

Duration

2024-2025

Project Summary

Flood inundation is a frequent, widespread, and impactful hazard, which regularly causes damage to housing and infrastructure along with disruption to whanau, communities, and businesses. Flood risk is expected to increase in future because of climate change through increased storminess coupled with rapid growth of urban areas. To manage flood risk efficiently and effectively, now and in future, communication of risk assessments for multiple scenarios needs to be targeted with the right method for the right audience. However, there is limited information on what works best, why, and for whom. This has been particularly highlighted following Cyclone Gabrielle in February 2023, with its unprecedented impacts which were not well understood beforehand.

Flood risks are generally poorly understood by the public, with flood events taking communities by surprise even if risk assessments have been completed. Further, traditional two-dimensional risk maps are limited by interpretability challenges. Three-dimension AI visualisations and immersive Virtual Reality (VR) technology have been found to be more intuitive due to their increased realism. This research will design and test advanced visualisations of flood risk using VR, with the aim to improve awareness of flood risk in Aotearoa.

Building from our existing prototype system for the automated generation of flood scenarios, we will co-design and develop advanced visualisations of future flood scenarios with Te Ngāi Tūāhuriri Rūnanga and the Te Rūnanga o Ngai Tahu (TRONT) geospatial and transformation teams, and facilitated by the Ngāi Tahu Centre, University of Canterbury. The primary focus of this project is to develop and test high resolution, dynamic visualisations which are needed to improve the communication of the potential impacts of flooding under various scenarios, enabling communities and decision-makers with the information they need to adapt to their changing flood risks.

We will work with the Te Ngāi Tūāhuriri Rūnanga to test the improvements made to the communications process for flood risk, and the associated decision-making processes at multiple levels. The scenarios developed will situate people in communities with what the flood risk was like, is like, and might be like in future. Our work will lead to an increased understanding of flooding, particularly when accounting for climate change and potential strategies for mitigation, and the provision of the tools needed to communicate and address the complex nuances of changing risks. The flood visualisation have been developed using Unreal Engine. Immersive VR environments are created by integrating LiDAR, aerial imagery, and other geospatial data.



The system enables the modelling of realistic disaster scenarios for urban planning, emergency training, and public awareness, surpassing traditional 2D mapping through interactive 3D simulations that accurately represent water flow dynamics and the impacts on infrastructure.

The workflow begins with processing LiDAR point clouds for terrain modelling, complemented by orthorectified aerial imagery and GIS vector data for spatial classification and segmentation. Hydrological datasets are incorporated to establish realistic water behaviour models, with all data undergoing rigorous quality control and format standardisation for seamless integration with Unreal Engine.

The development process transforms processed geospatial data into interactive VR environments using

Unreal Engine's landscape tools, with custom shaders and procedural foliage systems enhancing realism. For flood simulation, specialised water dynamics systems account for terrain elevation, surface permeability, and infrastructure placement. At the same time, optimised rendering techniques maintain real-time performance without sacrificing visual fidelity during complex fluid simulations.

The project successfully demonstrates VR's potential for geospatial visualisation, particularly in flood prediction, with future development focusing on enhanced automatic modelling, real-time sensor integration, and AI-assisted scenario generation. This versatile platform lays the groundwork for ongoing innovation in disaster preparedness and environmental planning through immersive technology.



Water source analysis for Porirua Harbour, Wellington, New Zealand: Development and testing of a hydraulic model with water tracing capability

Research team
Matthew Wilson (GRI)

Funding
ESR

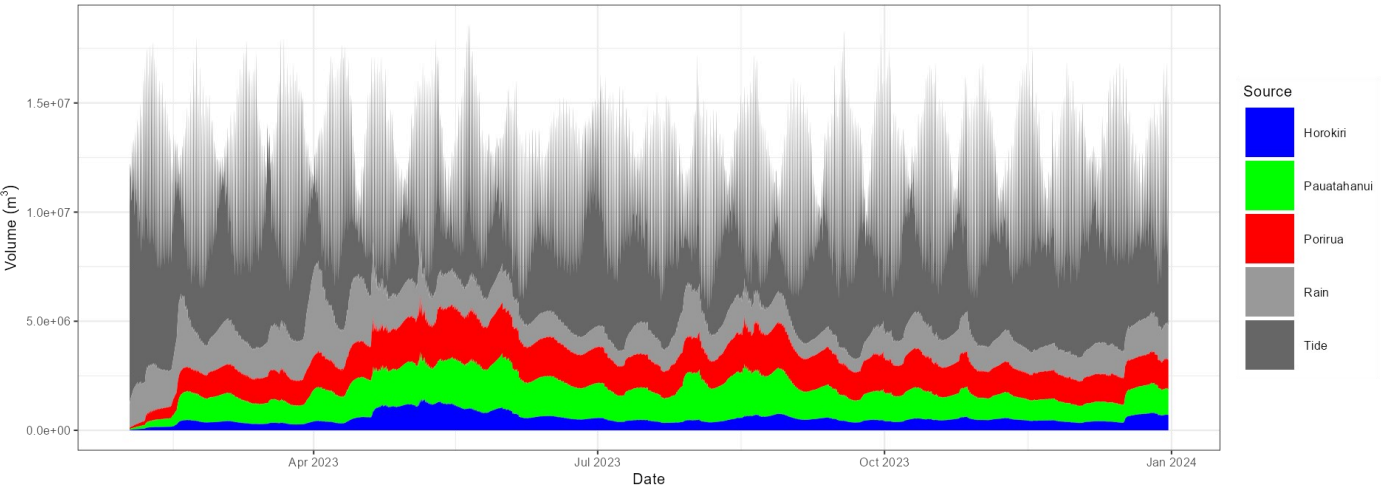
Duration
2023-2024

Project summary

A flow model of the Porirua Harbour with water source tracing capability was developed to enable an assessment of where is likely to be most affected by fluvial pollutants and assess the tidal flushing of the harbour. The model was developed and is available under open-source licensing. By using the model to assess where in the harbour is affected by which contributing water source, and by how much, results from the model can be used to infer where fluvial pollutants are likely to be within the harbour. As part of the model developments and analysis, a seamless topography-bathymetry grid suitable for hydraulic modelling was developed, observations of river flow, tide level and rainfall were obtained and processed, and the flow tracing model was constructed using open-source CAESAR-Lisflood 2.0 software. The model was run for a one-year period (2023) and, in addition, two scenarios

representing the potential impacts of sea level rise on water source mixing in the harbour were assessed.

Model results indicate that the proportion of river water in the harbour increases at low tide and after rainfall events in the river catchments, and that water from each non-tidal source tends to accumulate in the harbour, particularly in the upper harbour inlets and along the shorelines, as it is pushed back by the incoming tide. Since the river water carries with it pollutants from the catchments, results indicate that the locations within the harbour most likely to be affected by this are the shorelines along the upper harbour inlets. The sea level rise scenarios suggest an increase in fluvial source depths in the upper reaches at both low and high tides, with higher source depths for higher increases in sea level, which would likely worsen the situation regarding pollutants.



Total volume of water in Porirua Harbour during 2023, and the volume of each source of water assessed (three rivers, rainfall and tide).

Modelling the Spatial and Temporal Characteristics of Digital Language

PhD research project:

Sydney Wong (PhD candidate—UoC)

Supervisors:

Benjamin Adams (UoC)
Jonathan Dunn
Kong Meng Liew (UI-Urbana Champaign)
Jennifer Hay (UoC)

Funding

GRI PhD Scholarship

Duration of the Project

October 2021-September 2025

Project Summary:

The focus of this PhD research is on language, place and identity on social media. Through the work of social linguists and dialectologist, we are aware there is a relationship between language and geography. With this in mind, I'm interested in how users and the absence of physical barriers might construct a sense of place through language and in turn, their social identity on social media platforms. Therefore, my overarching research question is how do users reproduce a sense of place on social media (X/twitter and Reddit) through language use?

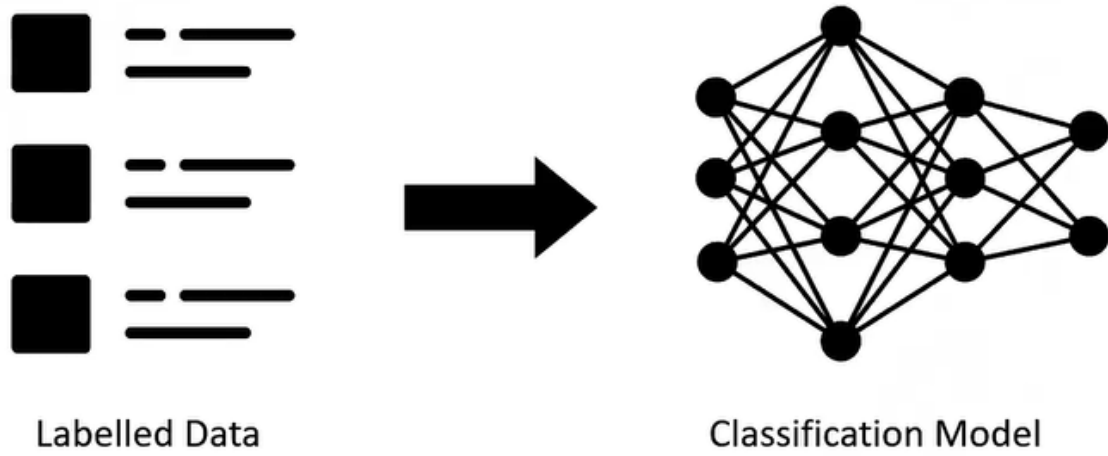
I have taken an integrationist approach in my research design by addressing each of the three social theoretical perspectives: social structure, social action, and social behaviour. By synthesising these three contrasting yet complementary theoretical perspectives, we can determine the interaction between space and place with linguistic variation. Using the same foundational principles as large language models such as Chat GPT, we can train a dialect classification model to identify where a sample of language is from, assuming there is an underlying structural relationship between language and geography. As an example, by comparing country level subreddits you can show that the way people use language in New Zealand and other English speaking countries are distinct. Similarly, we can predict the language used by users across the country with high accuracy. However this is not universal across all social media platforms. As we can see from X/Twitter, the predictive accuracy is only slightly above chance. What then makes one platform like Reddit more place like then X/Twitter, which we might describe as being more placeless?



Social Action

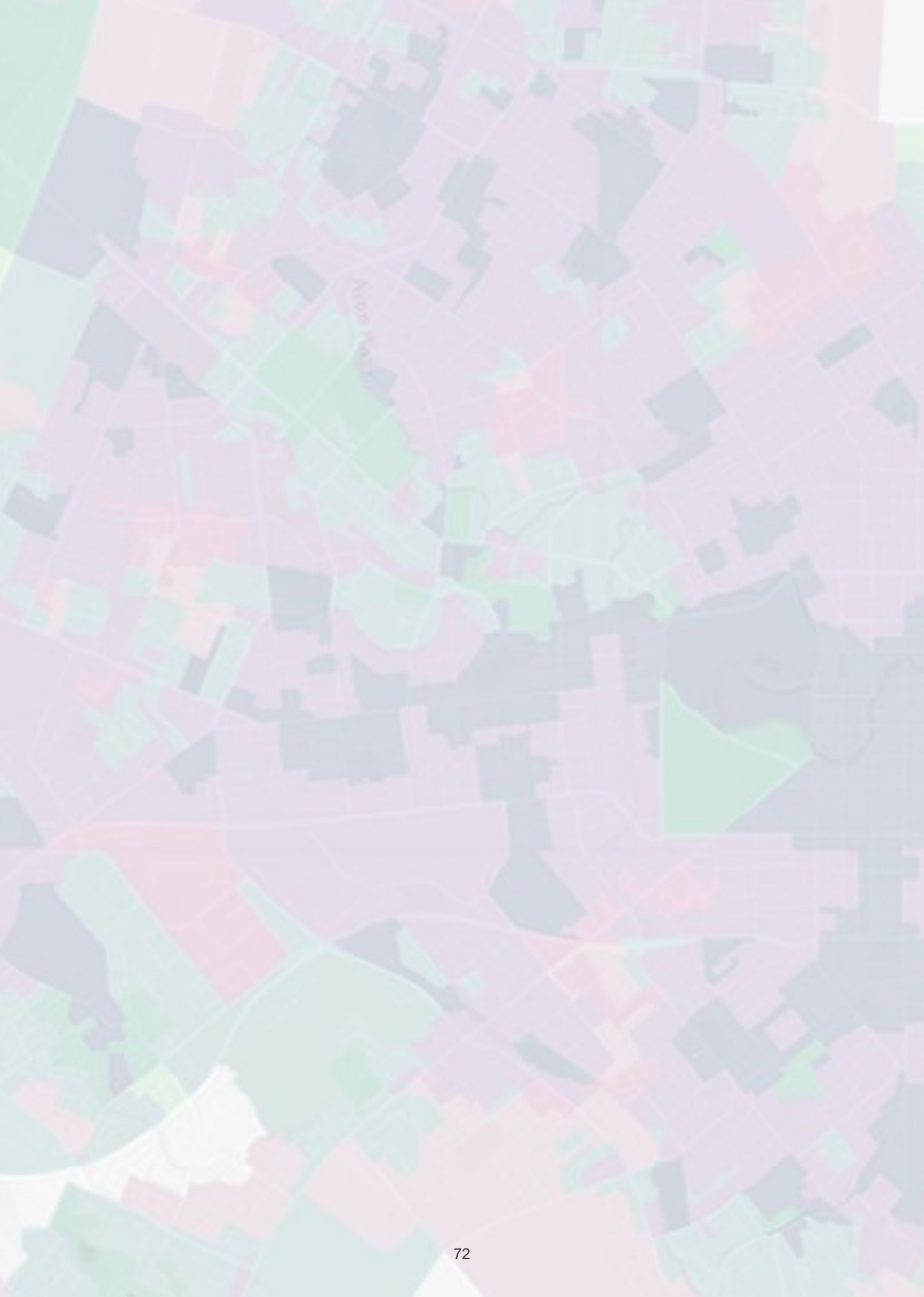
How do users construct a sense of place on social media through language-use?

I have made steady progress on my PhD research with the hope to submit my thesis by September 2025. In addition to my PhD research, I was fortunate enough to receive a Fullbright Science and Innovation Graduate Award in 2024 to test some of the theoretical assumptions from my PhD research in the area of automatic hate speech detection on social media. With the support of UC and the GRI, I've been able to spend the last 12 months as a visiting student researcher at the University of Illinois at Urbana Champaign to advance my research in this area and publishing my work at different venues, as well as being invited to share my research at the University of California, Santa Barbara and at Virginia Tech.



Dialect Classification

The same foundational principles used by large language models such as ChatGPT can be used to train a dialect classification model to identify where a sample of language is from, assuming an underlying structural relationship between language and geography.



Engagement and Research Dissemination

Geospatial Research Institute Seminar Series



March 2024

Dr Graeme Woodward UoC Wireless Research Centre. *Radio localisation: Understanding insect behaviour, busting sport cheats and studying climate change.* In this seminar, Dr Graeme Woodward introduced some of the work at UC's Wireless Research Centre.



April 2024

Dr Cristina Banks-Leite, Reader, Dept of Life Sciences, Imperial College London. *How much habitat is enough?* This presentation talked about ecological thresholds as a way to estimate the minimum amount of habitat required to preserve biodiversity, and how the position of thresholds changes across biomes world-wide.



September 2024

Dr John Reid, Senior Research Fellow, Ngāi Tahu Research Centre, UoC. *The Kaitiaki Intelligence Platform: Integrating mātauranga Māori, artificial intelligence, and sensing technologies in the design of an environmental sensing network.* This seminar outlined how mātauranga Māori can play a powerful role in ESN design through guiding data gathering and modelling processes.



November 2024

Dr Malcolm Campbell, Dr Simon Kingham, and Dr Jamie Pearce.

Mapping the path to better health: Unleash the superpower of geohealth. This seminar was led by Associate Professor Malcolm Campbell and features guests including the previous GeoHealth Laboratory Directors Professor Simon Kingham and Professor Jamie Pearce.

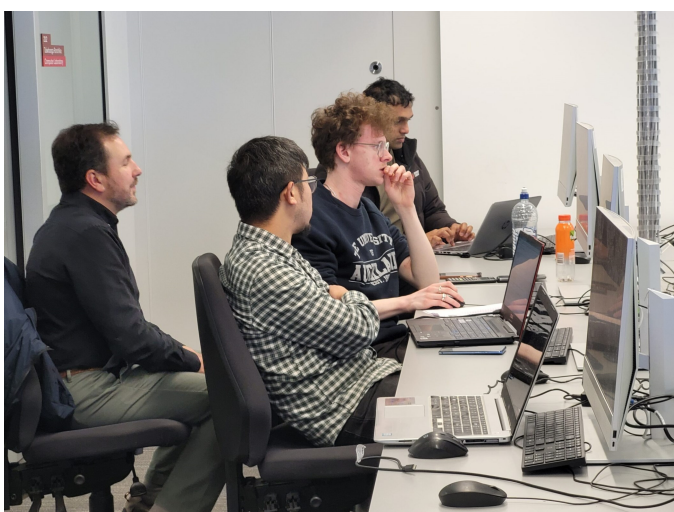


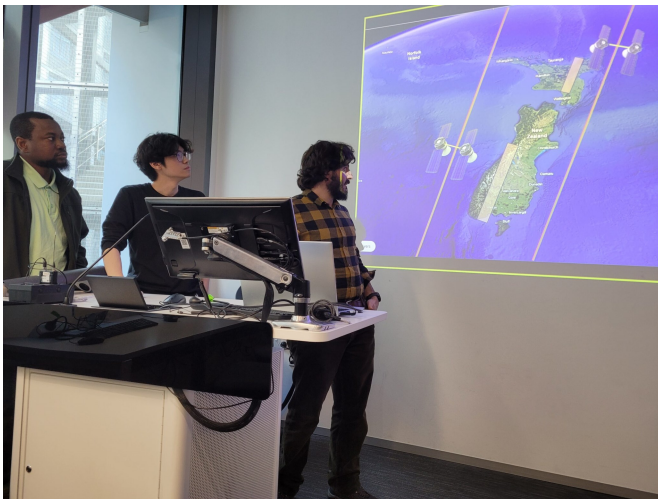
The 2024 NZ Synthetic Aperture Radar Workshop and Hackathon was funded by the New Zealand Space Agency, which worked in collaboration with the University of Canterbury and the Geoscience and Remote Sensing Society (GRSS) New Zealand chapter. The two day event was held in September 2024. It was split in two sessions: a workshop and a hackathon.

To incentivise students' participation, the New Zealand Space Agency sponsored eight students from Auckland University and the University of Waikato to attend the event.

Workshop:

Over 30 radar experts and stakeholders from academia, industry, and government attended a workshop at the University of Canterbury. The focus of the discussion was on the strengths, weaknesses, and opportunities within New Zealand's synthetic aperture radar (SAR) ecosystem. Participants also envisioned how a dedicated, sovereign NZ SAR mission could benefit the nation articulating the key characteristics of a national SAR mission.





Hackathon

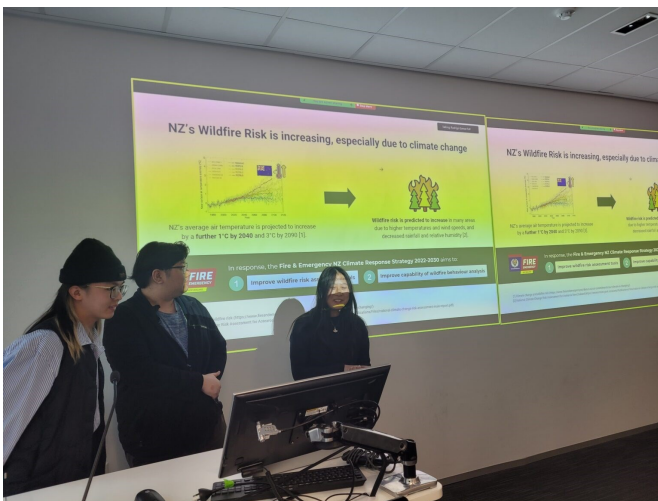
Open to undergraduate and postgraduate students who had an interest to increase their knowledge and expertise in radar technology through mission design. The aim of the hackathon was to propose a mission/instrument concept that advanced the state of the art in radar remote sensing. To achieve, three main objectives were established: to enhance the participant's understanding of mission design, demonstrate radar system synergy, and foster innovative solutions in radar remote sensing relevant to New Zealand.

Prior to the hackathon, attendees received the necessary learning experience in remote sensing, sensor design, and development to successfully complete the hackathon. They were introduced to:

- Integrated mission design and requirements flow.
- Demonstrate the synergy and complementarity between different SAR missions.

The participants were guided to develop a mission/instrument concept that advanced the state of the art in radar remote sensing. Identify observable gaps in existing missions/systems and propose solutions to address these gaps.

The prize for the winner team was round trip and registration (cost covered) to attend the Aerospace Summit to be held in Christchurch, between 23 and 24 September 2024.



Oliver Kim, Changjin He, and Lucy Zhu won the hackathon with a mission proposal for Wildfire Monitoring with SAR Technology.



Academics and students taking part of the 2024 NZ Synthetic Aperture Radar Workshop and Hackathon. University of Canterbury 4-5 September 2024.

Writing Retreat at Cass Field Station



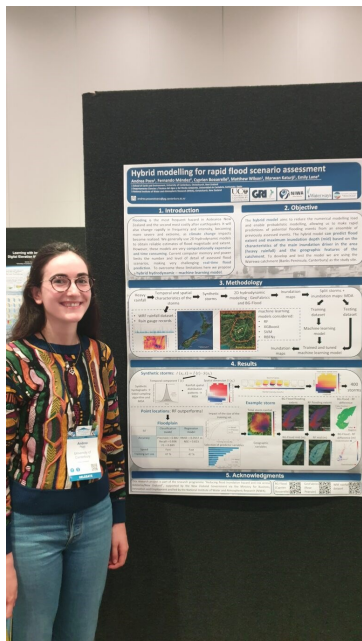
The GRI—GHL staff and students participated in an overnight writing retreat at University of Canterbury, Cass Field Station. Stunning views and a refreshing hike kept minds sharp for the writing workshop.

Professor Matthew Wilson (Director of the GRI), Dr Matt Hobbs (Co-director GeoHealth Lab), and Dr Gemma Bridge (University of Leeds, Erskine Fellow at UC) gave talks on different topics relevant to academic writing and ran sessions dedicated to time management, focus, structure and methodologies.

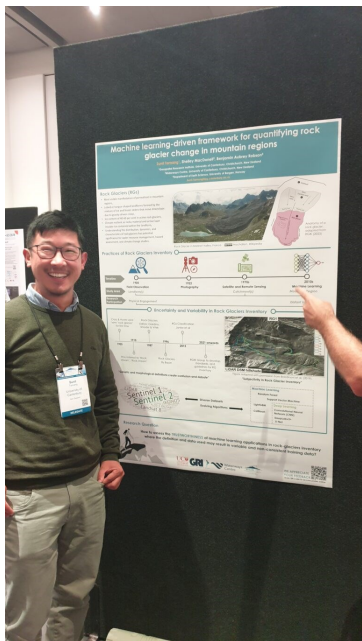




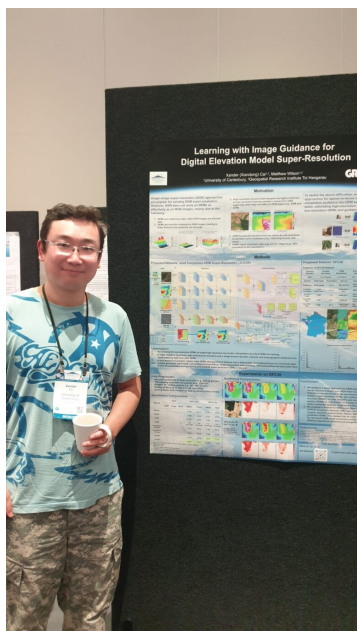
GRI presented at MIGARS Conference 2024



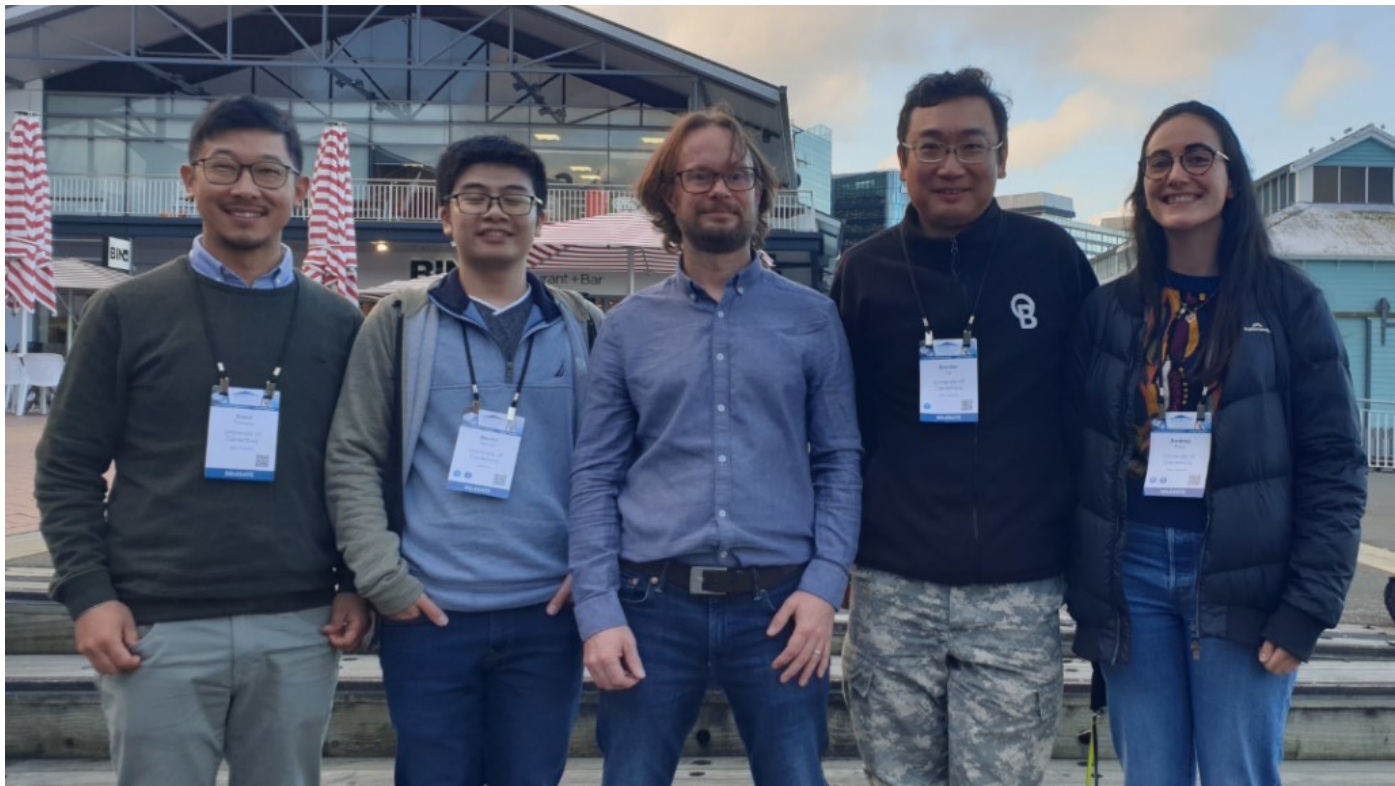
PhD student **Andrea Pozo Estivariz** presenting her work: Hybrid Modelling for Rapid Flood Scenario Assessment.



GRI PhD student **Sunil Tamang** presenting his poster: Machine learning-driven frameworks for quantifying rock glacier change in mountain regions.



Xander Cai, presenting his work: Learning with Image Guidance for Digital Elevation Model Super-Resolution.



GRI team members attending and presenting their research at MIGARS conference 2024, held in Wellington, NZ.



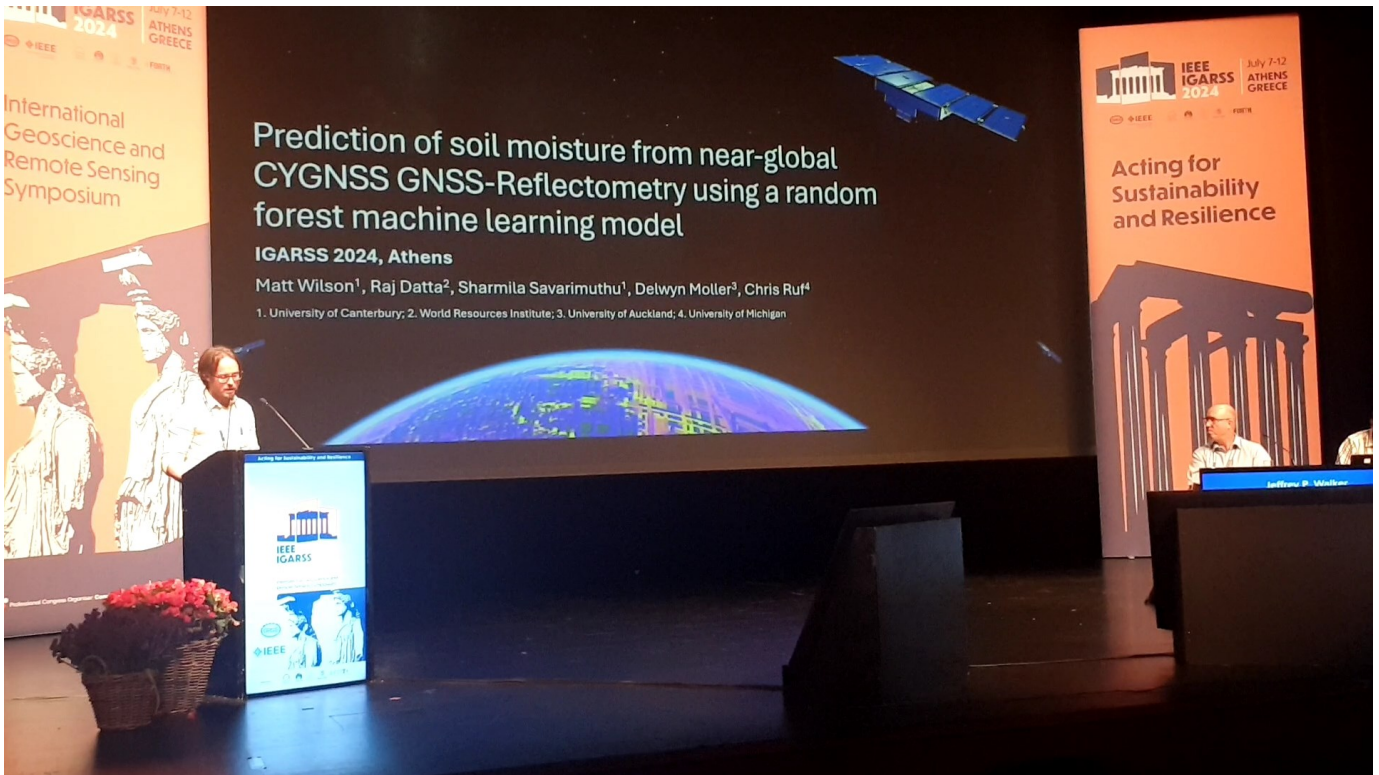
Martin Nguyen presenting his research: *Estimating uncertainty in flood model outputs using machine learning.*



Saif Khan presenting research related to detection of vegetated Wetlands of NZ through Satellite Imagery and Machine Learning.



Other conferences and events in 2024



Geospatial Research Institute Director, **Prof. Matthew Wilson** is in Greece presenting at the 44th annual International Geoscience and Remote Sensing Symposium, IGARSS 2024, In Athens, Greece.



The New Zealand IGARSS 2028 bid presentation team in Athens. In the image on the left, from left to right: A/Prof. Gabor Kereszturi (Massey University), Prof. Avik Bhattacharya (IIT Bombay, India), GRI Director Prof. Matthew Wilson, Prof. Nirmal Nair (Auckland University), and Loryn Blaikie (New Zealand International Convention Centre).



Faculty of Health Professor and Deputy Director of Geohealth Laboratory, University of Canterbury **Matt Hobbs** to be Keynote Speaker at The New Zealand Dental Association in Christchurch, August 2024.



GRI PhD Scholarship recipient and current PhD Candidate, **David Pedley** was invited to present “Detecting and measuring urban tree canopy loss at the property scale with remote sensing data” at the ForestSAT conference in Rotorua Sept 2024.



Dr Lukas Marek was invited as an expert to Geospatial Summer School 2024 focusing on geohealth and spatial analysis in health. The event took place at the Department of Geoinformatics, Palacky University in Olomouc, Czech Republic.

Other conferences and events in 2024



*The Geospatial Research Institute Director **Matthew Wilson** meeting with the Ngati Toa team in Porirua to present the results of the Porirua Harbour flow model.*



The GRI team in Rotorua for a workshop with members of the Ōhinemutu community.



*GRI PhD student, **Clevon Ash** presented at Roadshow 7 his research work "Increasing flood resilience in Aotearoa in Dalmore, Dunedin. His presentation was titled "Implications of uncertainty representation in flood hazard assessments for decision-making."*



Mario Puente Sierra presented his work at the Te Niwha Infectious Disease Summit 2024, in Wellington, Aotearoa NZ.



The GRI team and stakeholders involved in the Ōtākaro Digital Twin project went out on a waka trip on the Ōtākaro/Avon River to learn about the cultural narratives and the wetland ecosystem.



Phoebe Egleton presented at the Regional Studies Association Winter Conference in London at The Cumberland 7-8th Nov 2024.

Publications

Campbell, M. Working paper: "Up" vs "Out". Carbon emission scenario planning in Aotearoa New Zealand's urban centres (March 29, 2024). Available at SSRN: <https://ssrn.com/abstract=4887672> or <http://dx.doi.org/10.2139/ssrn.4887672>.

Campbell, M. Working paper: Scenarios for carbon-neutral neighbourhoods in Aotearoa New Zealand's urban centres. Sprawl or Densify? (November 11, 2024). Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5067893.

Campbell, M. (2024). New Data, New Directions: A Commentary on Emerging Big Geospatial Data for Population Research. *New Zealand Population Review*. <https://doi.org/10.31219/osf.io/x6c2z>.

Campbell, M., Hobbs, M. (2024). Up in smoke. The unravelling of world-leading policy changes in Smokefree legislation in Aotearoa New Zealand. *Australian and New Zealand Journal of Public Health*, 48(6). <https://doi.org/10.1016/j.anzjph.2024.100209>.

Deng, B., Campbell, M., Boden, J., Ye, N., Morgenroth, J., Eggleton, P., McLeod, G., and Hobbs, M. (2024). Life in green: Associations between greenspace availability and mental health over the lifecourse - a 40-year prospective birth cohort study. *Environment International*. <https://doi.org/10.1016/j.envint.2024.109223>.

Deng, B., McLeod, G., Dhakal, B., Mackenbach, J.D., Eggleton, P., Marek, L., Campbell, M., Boden, J., and Hobbs, M. (2024). Typologies of residential mobility in childhood in a prospective birth cohort study in New Zealand. *Child Indicators Research*. <https://doi.org/10.1007/s12187-024-10175-w>.

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Deng, B., Campbell, M., McLeod, G., Boden, J., Marek, L., Sabel, E.C., Norman, P. D., and Hobbs, M. (2024). Construction of a consistent historic time-series area-level

deprivation metric for Aotearoa New Zealand. *New Zealand Population Review*. https://population.org.nz/wp-content/uploads/2024/10/NZPR-VOL-50_Deng-et-al_.pdf.

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Hetrick, S.E., **Hobbs, M.**, Fortune, S., **Marek, L., Wiki, J., Boden, J.M., Theodore, R., Ruhe, T., Kokaua, J.J., Thabrew, H., Milne, B. and Bowden, N.** (2024). Proximity of alcohol outlets and presentation to hospital by young people after self-harm: A retrospective geospatial study using the integrated data infrastructure. *Australian and New Zealand Journal of Psychiatry*, 58(2):152-161. <https://doi.org/10.1177/00048674231203909>.

Hobbs, M., Marek, L., McLeod, G.F.H., Woodward, L.J., Sturman, A., Kingham, S., Ahuriri-Driscoll, A., Epton, M., Eggleton, P., Deng, B., Campbell, M., and Boden, J. (2024). Exploring the feasibility of linking historical air pollution data to the Christchurch Health and Development study: A birth cohort study in Aotearoa, New Zealand. *Spatial and Spatio Temporal Epidemiology*, 50. <https://doi.org/10.1016/j.sste.2024.100675>.

Hobbs, M., Puente-Sierra, M., Marek, L., Broadbent, J.M. and Chambers, T. (2024). Examining the Structural Inequities in the Quality of Nationwide Drinking Water Data in Aotearoa New Zealand: A Geospatial Cross-Sectional Study. *Applied Spatial Analysis and Policy*, 17 (3):951-962. <https://doi.org/10.1007/s12061-024-09571-0>.

Ruhe, T., **Marek, L., Bowden, N., Wiki, J., Theodore, R., Hobbs, M., Thabrew, H., Richards, R., Milne, B., Hetrick, S., Boden, J. and Kokaua, J.** (2024). Describing the natural and built environments Pasifika children and young people live in Aotearoa New Zealand: a nationwide geospatial study. *New Zealand Population Review*, 50:99-124.

Serrao-Neumann, S., White, I., Dean, S.M., Paulik, R., Sleight, B., Stori, F.T., **Wilson, M.D., and Lane, E. M.** (2024). The need to reconfigure consistency and variability to best manage changing flood risks in Aotearoa-New Zealand. *Journal of the Royal Society of New Zealand*, 54(4): 473-490. <https://doi.org/10.1080/03036758.2023.2211777>.

Underwood, L., Bowden, N., Teng, A., Dewes, O., **Marek, L.** and Milne, B. (2024) New Zealanders living with a family member who has a long-term health condition: cross sectional analysis of integrated Census and administrative data. *International Journal of Population Data Science*, 9 (5). <https://doi.org/10.23889/ijpds.v9i5.2764>.

Underwood, L., Teng, A., Bowden, N., Dewes, O., **Marek, L.** and Milne, B. (2024) Long-term health conditions among household families in Aotearoa New Zealand: cross-sectional analysis of integrated Census and administrative data. *New Zealand Medical Journal*, 137(1596):20-34. <https://doi.org/10.26635/6965.6370>.

Wallace, T., Crawford-Flett, K., **Wilson, M.**, Logan, T. (2024). A framework for modelling the probability of flooding under levee breaching. *Journal of Flood Risk Management*, 17(3). <https://doi.org/10.1111/jfr3.12988>.

Waterman, I., Marek, L., Ahuriri-Driscoll, A., Mohammed, J., Epton, M. and **Hobbs, M.** (2024) Investigating the spatial and temporal variation of vape retailer provision in New Zealand: A cross-sectional and nationwide study. *Social Science and Medicine*, 349. <https://doi.org/10.1016/j.socscimed.2024.116848>.

Wiki, J., Theodore, R., **Marek, L., Hobbs, M.**, Ruhe, T., Kokaua, J., Boden, J., Thabrew, H., Hetrick, S., Milne, B. and Bowden, N. (2024). How healthy are the environments of tamariki and rangatahi Māori in Aotearoa New Zealand? A nationwide cross-sectional geospatial study. *New Zealand Population Review*, 50, 71-98.

Wong, S. G.-J. (2024). What is the social benefit of hate speech detection research? A Systematic Review. In D. Dementieva, O. Ignat, Z. Jin, R. Mihalcea, G. Piatti, J. Tetreault, S. Wilson, & J. Zhao (Eds.), *Proceedings of the Third Workshop on NLP for Positive Impact* (pp. 1–12). Association for Computational Linguistics. <https://doi.org/10.18653/v1/2024.nlp4pi-1.1>.

Wong, S. (2024). Sociocultural Considerations in Monitoring Anti-LGBTQ+ Content on Social Media. In V. Prabhakaran, S. Dev, L. Benotti, D. Hershcovich, L. Cabello, Y. Cao, I. Adebara, & L. Zhou (Eds.), *Proceedings of the 2nd Workshop on Cross-Cultural Considerations in NLP* (pp. 84–97). Association for Computational Linguistics. <https://aclanthology.org/2024.c3nlp-1.7>.

Wong, S., & Durward, M. (2024). cantNlp@LT-EDI-2024: Automatic Detection of Anti-LGBTQ+ Hate Speech in Under-resourced Languages. In B. R. Chakravarthi, B. B. P. Buitelaar, T. Durairaj, G. Kovács, & M. Á. García Cumberras (Eds.), *Proceedings of the Fourth Workshop on Language Technology for Equality, Diversity, Inclusion* (pp. 177–183).

Association for Computational Linguistics. <https://aclanthology.org/2024.ltedi-1.19>.

Conference papers and presentations:

Ash, C., Wilson, M., White, I. and Hultquist, C – Implications of Uncertainty Representation in Flood Hazard Assessments for Decision-making. Roadshow 7, Otago, November 19, 2024.

Ash, C., Wilson, M., White, I. and Hultquist, C. A Monte Carlo Approach to Representing Flood Risk Uncertainty. Waterways Postgraduate Student Conference, Christchurch, November 12, 2024.

Booker, K., White, I., Fu, X., and **Wilson, M.** Building Urban Development Scenarios into Assessments of Future Flood Risk. Waterways Centre Postgraduate Conference. Canterbury, November 12, 2024.

Wong, S. G.-J. The Interaction of Space, Place, and Linguistic Variation in Social Media. Poster presented at the 52 New Ways of Analyzing Variation (NWAV), Miami Beach. November 7-9, 2024. <https://doi.org/10.6084/m9.figshare.27642444.v2>.

Eggleton, P., Hobbs, M., Deng, B., Boden, J., McLeod, GFH, **Kindon, A., Campbell M.** (2024, November 7-8). Investigating the association between exposure to a major earthquake and cardiovascular disease at six-year follow up: a prospective birth cohort study. Regional Studies Association Winter Conference, London, United Kingdom, November 7-8, 2024.

Pozo, A., Wilson, M., Katurji, M., L., Méndez, F. J., Bosserelle, C., & Lane, E. Hybrid modelling for flood scenario assessment. Waterways Postgraduate Student Conference. Christchurch, November 2024.

Pozo, A., Wilson, M., Katurji, M., L., Méndez, F. J., Bosserelle, C., & Lane, E. Hybrid modelling for flood scenario assessment. Rivers Group Conference. Napier, November 2024.

Tamang, S., MacDonell, S., Brasington, J., Shulmeister, J., and Robson, B.A. Evolving Practices in Mapping Rock Glaciers: A 65-Year Review. School of Earth and Environment Postgraduate Conference. University of Canterbury, Christchurch. 30-31 October 2024.

Wong, S. G.-J. End of a Golden Era: The Uncertain Future of Social Media Research. Poster presented at the Academic Data Science Alliance (ADSA) Annual Meeting, University of Michigan Ann Arbor. October 29-31, 2024. <https://doi.org/10.6084/m9.figshare.27365991.v1>.

- Pedley, D.** Detecting and measuring fine-scale urban tree canopy loss with deep learning and remote sensing, ForestSAT. Rotorua, September 9-13, 2024.
- Wong, S. G.-J.** Empowering Our Communities through Data-informed and Technology-informed Decision Making. Invited speaker at the Aotearoa Migration Research Network Seminar Series, September 6, 2024, Online.
- Marek, L.** Healthy Location Index of Aotearoa NZ. Christchurch City Council, September 2024.
- Pozo, A., Wilson, M., Katurji, M., L., Méndez, F. J., Bosserelle, C., & Lane, E.** Hybrid modelling for flood scenario assessment. Water New Zealand Conference and Expo. Hamilton, September 2024.
- Eggleton, P., Hobbs, M., Deng, B., Boden, J., McLeod GFH, Kindon, A, Campbell, M.** Investigating the Association Between Exposure to a Major Earthquake and Cardiovascular Disease at Six-Year Follow-Up: A Prospective Birth Cohort Study. Canterbury Waitaha Symposium of Health and Research. Christchurch, August 27, 2024.
- Eggleton, P., Hobbs, M., Deng, B., Boden, J., McLeod GFH, Kindon, A, Campbell, M.** The Relationship Between Earthquake Exposure and Cardiovascular Disease at Six-Year Follow-Up: A Birth Cohort Study. Health Research Society of Canterbury Annual Poster Evening. Christchurch, August 8, 2024.
- Deng, B.** The associations between greenspace exposure and mental health outcomes in adolescence and adulthood: a prospective birth cohort study [Oral Presentation]. Canterbury Waitaha Symposium of Health & Wellbeing Research. Christchurch, New Zealand. August, 2024.
- Pozo, A., Wilson, M., Katurji, M., L., Méndez, F. J., Bosserelle, C., & Lane, E.** Hybrid modelling for flood scenario assessment. Seminar for the Resilient River Communities group. Online, August 8-10, 2024.
- Deng, B.** The associations between greenspace exposure and mental health outcomes in adolescence and adulthood: a prospective birth cohort study [Poster Presentation]. Health Research Society of Canterbury Poster Evening. Christchurch, New Zealand. August 2024.
- Moller, D., Orzel, K., Andreadis, K., and **Wilson, M.** An Airborne GNSS-R Driven Low-Latency Flood Assessment Development. IEEE International Geoscience and Remote Sensing Symposium IGARSS, 1370-1373. July 7-12, 2024. <https://doi.org/10.1109/IGARSS53475.2024.10641457>.
- Wilson, M.D.,** Datta, R., Savarimuthu, S., Moller, D. and Ruf, C. PREDICTION OF SOIL MOISTURE FROM NEAR-GLOBAL CYGNSS GNSS-REFLECTOMETRY USING A RANDOM FOREST MACHINE LEARNING MODEL. IEEE International Geoscience and Remote Sensing Symposium (IGARSS). Athens Greece. July 7-12, 2024. <https://doi.org/10.1109/IGARSS53475.2024.10642723>.
- Marek, L.** Healthy Location Index of Aotearoa NZ. Greater Christchurch Analytical Network, July 2024.
- Pedley, D.** Urban Trees and Housing Intensification: A Spatial Conflict? Visualise Your Thesis Competition. Christchurch, July 2024. Youtube: <https://tinyurl.com/DavidPedley>.
- Wong, S. G.-J.** Geographic Dialect Bias in Multiclass Classification Models. Paper presented at the Sociolinguistics Symposium 25 (SS25), Curtin University Perth. Jun 24-27, 2024. <https://doi.org/10.6084/m9.figshare.26087992.v1>.
- Wong She, C., Wong, C., Sew Hoy, D., Tang, E., Chan, S., & **Wong, S. G.-J.** Revitalisation of Cantonese Culture and Language in Aotearoa New Zealand. Paper presented at 81st New Zealand Chinese Association Conference/Annual General Meeting, Wellington. Jun 22-23, 2024. <https://doi.org/10.6084/m9.figshare.26083561.v1>.
- Wong, S. G.-J.** 身份·歷程 Identity | History. Invited speaker at the 81st New Zealand Chinese Association Conference/Annual General Meeting, Wellington. Jun 22-23, 2024. <https://doi.org/10.6084/m9.figshare.26085622.v1>.
- Campbell, M.** Te Taiwhenua o te Hauora | The GeoHealth Laboratory. What is the Geohealth Lab? MoH - GHL meeting. Wellington, New Zealand. 29 May 2024. Oral Presentation.
- Pozo, A., Wilson, M., Katurji, M., L., Méndez, F. J., Bosserelle, C., & Lane, E.** Advancing methods of rapid flood scenario assessment using hybrid approaches of hydrodynamic modelling and machine learning. Seminar at Universidad de Cantabria. Santander, May 2024.
- Campbell, M.** Greenspace, Health and Policy. Te Aka Tāngaengae | Urban Forest Futures. Christchurch, New Zealand. 10 April 2024. Oral Presentation.
- Frery, A.C., Haywood, J., Kereszturi, G., Hitendra, S. T., Whitehead, M. and **Wilson, M.** International Conference on Machine Intelligence for Geoanalytics and Remote Sensing (MIGARS), Wellington, New Zealand. April 8-10, 2024. <https://doi.org/10.1109/MIGARS61408.2024.10544417>.

Khan, M.S.I., Wilson, M., and Corredor, M.C.V. Detecting vegetated wetlands of New Zealand through satellite imagery and machine learning. International Conference on Machine Intelligence for Geoanalytics and Remote Sensing (MIGARS), Wellington, New Zealand. April 8-10, 2024. <https://doi.org/10.1109/MIGARS61408.2024.10544418>.

Nguyen, M., Wilson, M., Lane, E., Brasington, J. and Pearson, R. Estimating uncertainty in flood model outputs using machine learning informed by Monte Carlo analysis. International Conference on Machine Intelligence for Geoanalytics and Remote Sensing (MIGARS), Wellington, New Zealand. April 8-10, 2024. <https://doi.org/10.1109/MIGARS61408.2024.10544837>.

Tamang, S., MacDonell, S., and Robson, B.A. Machine Learning-driven Framework for Quantifying Rock Glacier Change in Mountain Regions. International Conference on Machine Intelligence for GeoAnalytics and Remote Sensing (MIGARS). Wellington, New Zealand. April 8-10, 2024.

Wilson, M., Savarimuthu, S., Moller, D., Cai, X. and Ruf, C. Estimation of soil moisture from Rongowai GNSS-R using machine learning. International Conference on Machine Intelligence for Geoanalytics and Remote Sensing (MIGARS), Wellington, New Zealand. April 8-10, 2024. <https://doi.org/10.1109/MIGARS61408.2024.10544715>.

Pozo, A., Wilson, M., Katurji, M., L., Méndez, F. J., Bosserelle, C., & Lane, E. Advancing methods of rapid flood scenario assessment using hybrid approaches of hydrodynamic modelling and machine learning. Water New Zealand Water Modelling Symposium. Christchurch, March 2024.

Deng, B. Examining the long-term impact of childhood area-level socioeconomic status on adolescent and adult mental health: a birth cohort study in Aotearoa New Zealand [Oral Presentation]. American Association of Geographers Conference, Hawaii, USA. April 2024.

Waterman, I. Breaking through the cloud: Vaping in Aotearoa New Zealand. Interactive Story Map. 2024. <https://storymaps.arcgis.com/stories/9057d723efc34800b06dbcae06ca278a>.

Team building activity highlights



Fun at the bowls pitch



Farewell to Matt Hobbs

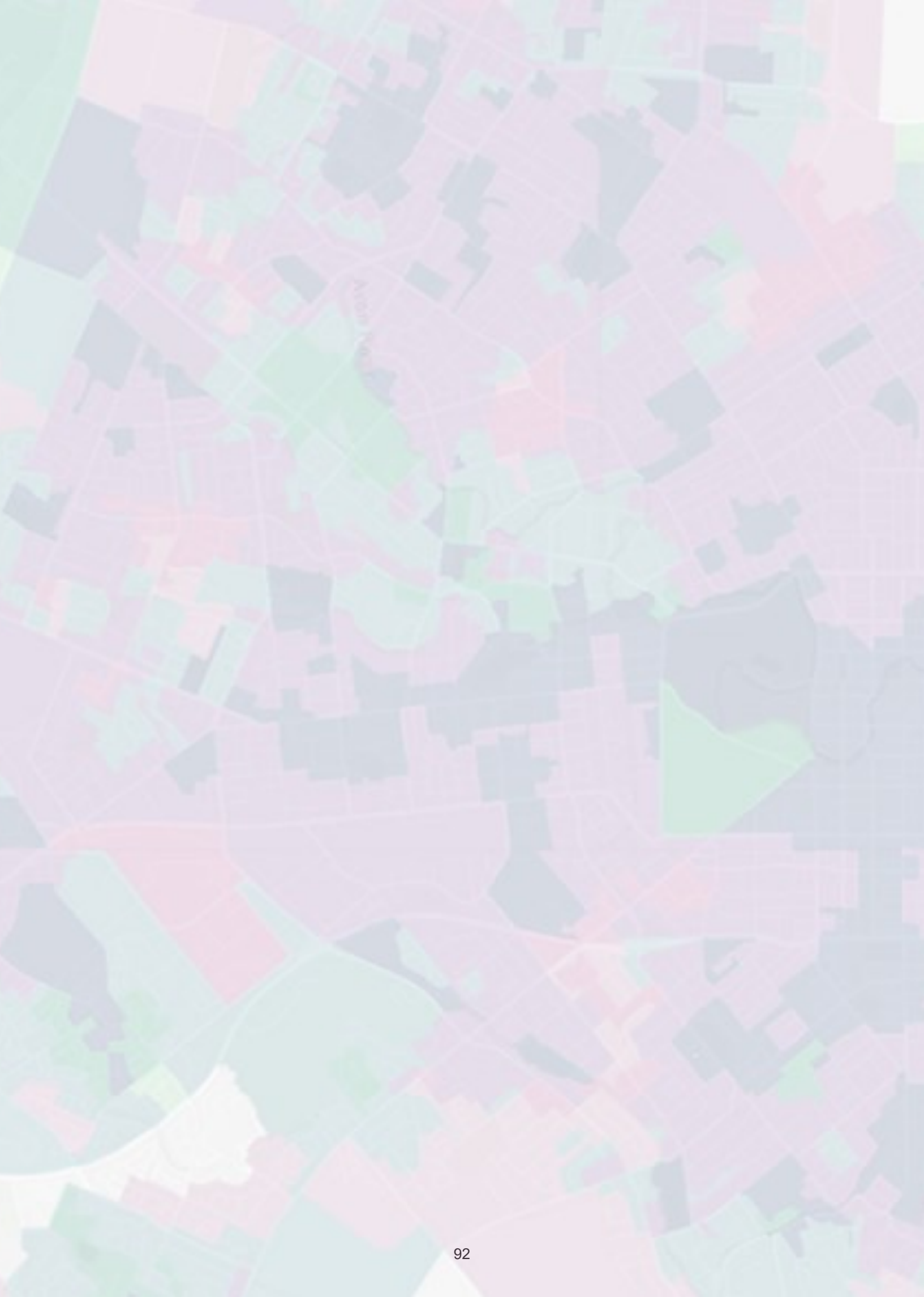




GRI Annual Ski Trip 2024



End of the year family gathering 2024

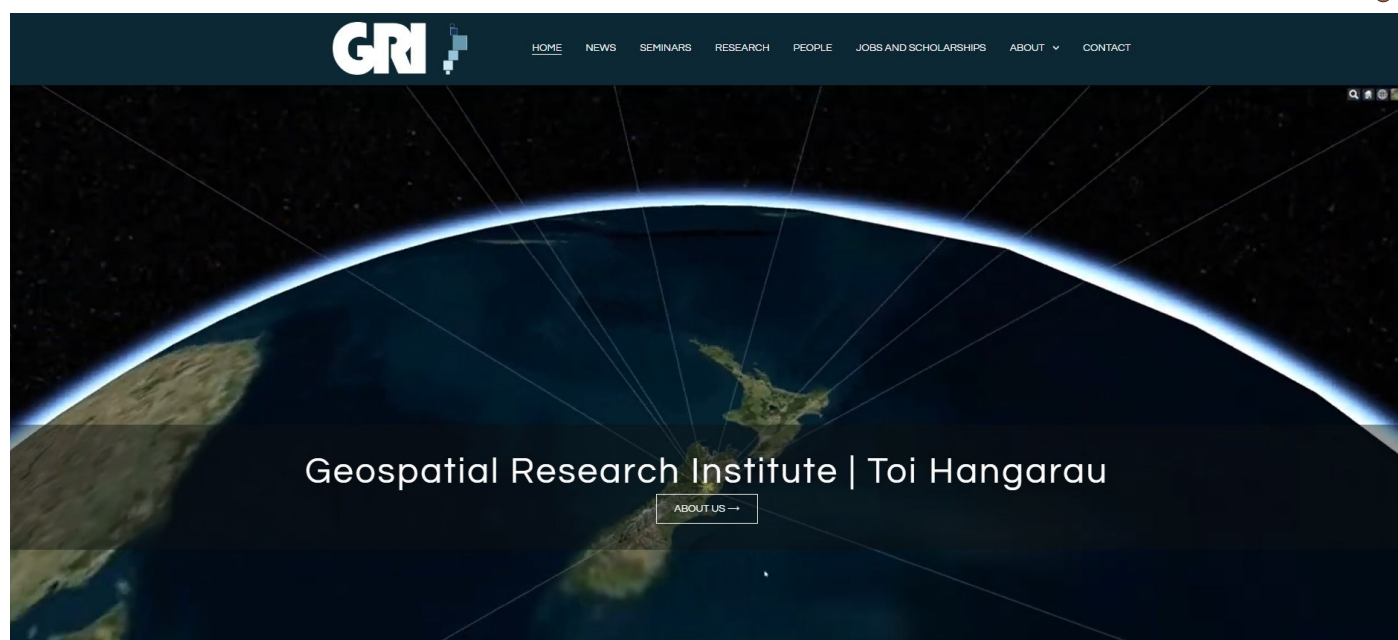


Financial Report and Contact

Financial report

Accounts	FY2024
Operating Income	
Government Grants	231,941
Student Tuition Fees	0
Other Income	637,154
Total	905,095
Operating Expenditure	
Personnel Expenses	581,087
Site and Property Expenses	
General Expenses	89,233
Depreciation	8,114
Overheads	35,258
Total	713,692
Net Income	191,403
Net Income %	21.1%
EBITDA	199,517

Contact us



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<https://www.linkedin.com/company/geospatial-research-institute>

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