GEOSPATIAL RESEARCH INSTITUTE *Toi Hangarau*
University of Canterbury | Te Whare Wananga o Waitaha
Private Bag 4800, Christchurch 8140, New Zealand Aotearoa
Website: https://geospatial.ac.nz/

Geospatial Research Institute (GRI) Toi Hangarau

PhD scholarship

Information sheet for applicants -2026

Aim

The Geospatial Research Institute (GRI) scholarship has been implemented with the aim to increase the amount of novel geospatial research in all areas across the University of Canterbury.

The scholarship

Name:	The Geospatial Research Institute PhD scholarship.
Funds awarded:	Total **NZ$35,650/year**, over 3 years full-time. This scholarship consists of: • One UC PhD scholarship ($32,650 per annum), plus • A GRI top-up scholarship ($3,000 per annum). Up to an additional $4,000 per year is available from the GRI for travel or other research related expenses (over three years full-time, or pro-rata for part-time study, subject to support from the senior PhD supervisor and approval of the GRI Director).
Funding period:	The scholarship is tenable for the period necessary to complete up to 360 points of enrolment
Scholarships available:	One
Closing date for applications	**29 May 2026, 17:00 pm NZ Time.**

Selection of PhD candidates

The scholarship is open to national and international applicants and is awarded in a competitive selection process.

From all applicants, a selected group will be shortlisted and invited for an interview. The scholarship will be awarded to the best applicant.

In their application prospective students should identify which of the approved projects advertised they would like to complete for their PhD.

The funding will be awarded to one PhD candidate under the following conditions:

- The candidate meets all UC criteria for enrolment in the PhD program (Doctor of Philosophy, Domestic/International Students).
- The candidate applies for one of the geospatial projects advertised **(all projects can be found at the end of this file)**
- The candidate demonstrates prior geospatial training (e.g. GIS, remote sensing, spatial data analysis) and research experience, ideally demonstrated by at least one publication in a peer-reviewed journal, with publication of geospatial research highly regarded.
- The candidate demonstrates a clear interest, knowledge and aptitude for geospatial research.
- The candidate is selected based on application and interview performance.
- The candidate is approved by the Senior (main) Supervisor of their selected project at UC (this happens as part of the shortlisting and interview process). Prospective PhD candidates interested in one of the advertised projects are encouraged to contact the project main supervisor to discuss the topic, and their suitability for it.

Prospective PhD student applications must include the following five items:

- Cover letter explaining motivation for doing a PhD outlining interest and experience in geospatial methods and analysis.
- Application form: https://geospatial.ac.nz/wp-content/uploads/2026/04/04_GRIscholarship-ApplicationForm-2026.pdf
- Curriculum Vitae, including a list of any prior publications.
- Contact details of at least two academic or professional referees.
- A GPA report obtained from https://support.scholaro.com/portal/kb/articles/canterbury (those with New Zealand or United States qualifications are not required to use Scholaro).

Please send your completed application to:

Geospatial Research Institute: gri-enquiries@canterbury.ac.nz

The deadline for submission of applications is 29 May 2026, at: 17:00 pm, NZ Time.

FAQ

Can I apply/select multiple projects in my application?

Answer: No. Candidates should select one project only and are encouraged to contact the main supervisor to find out about it and discuss their suitability.

Please see the GRI PhD Scholarship Projects selected for 2026 below.

GRI PhD Scholarship approved projects – 2026

<table>
<tr><td colspan="2">Project 1

Title: Water & Ice: Exploring impact of terminal lakes on glacier recession</td></tr>
<tr><td>UC senior supervisor project leader
Dr Heather Purdie

heather.purdie@canterbury.ac.nz</td><td>Department/School

School of Earth & Environment</td></tr>
<tr><td>Other members of the supervision team

Dr Rodrigo Gomez-Fell (ECR)</td><td>Department/School

School of Earth and Environment</td></tr>
<tr><td colspan="2">Links with organisations outside the University of Canterbury

Dr Mohammed Dabboor - Environment Canada – RADARSAT Constellation Mission (RCM) data collaboration

Dr Brian Anderson – Victoria University of Wellington,

Pancho Saucedo - Glacier Explorers – Aoraki Mount Cook</td></tr>
<tr><td colspan="2">Project outline

Glaciers have a crucial role in the natural environment and in human society, as key components of freshwater storage, and glacial lakes store water used to drive economies through hydroelectric power generation and agricultural irrigation [1]. The number of glaciers terminating into freshwater lakes is increasing meaning that iceberg calving becomes a dominant process of ice loss [2]. Predicting iceberg calving, lake growth, and subsequent impacts on water resources and sea-level rise remain critical knowledge gaps. Lake-ice interactions create additional and differing drivers of rapid terminus recession compared to land-terminating glaciers [3]. Model simulations indicate the presence of an ice-contact lake causes acceleration of ice flow and glacier recession [4]. However, foundational process understanding is derived from marine-terminating glaciers, and while some processes are universal, others (e.g. currents, turbidity, thermal structure) can differ significantly [3, 5], along with glacier geometry and dynamics [6]. While uncommon in a marine setting, submerged ice ramps have often been documented in lacustrine settings [7, 8], but little is still known about how these underwater features influence the rate and magnitude of ice loss. This PhD project will ask “Does the submerged portion of the glacier terminus influence the rate of ice retreat by affecting terminus buoyancy and ice dynamics?” Supported by the supervisory teams previous and ongoing research mapping terminus evolution and dynamics at Haupapa/Tasman Glacier [8,9] this PhD project will combine new and existing geospatial data sets with newly evolving analytical techniques [10] to progress process understanding at the lake-ice interface.</td></tr>
</table>

While it is expected that the successful PhD candidate will utilise their skills experience to refine methods and workflow, there are number of unique geospatial data sets and associated research objectives, specifically they will:

- Apply newly developing automated CNN framework techniques [11] to analyse available remote camera imagery to identify discrete calving events and explore the interplay between ice flow, buoyancy, and iceberg calving.
- Develop 3D visualisation and analysis tools to utilise existing and ongoing bathymetric and limnological survey data to progress understanding of the interconnections and cyclic evolution of subaqueous ice morphology.
- Utilise and fuse state-of-the-art remotely sensed SAR data and oblique camera images to characterise ice flow patterns before and after calving events – targeting the long-standing and persistent causality dilemma of whether ice velocity drives iceberg calving or iceberg calving drives velocity [4].

References:

1. *Huss, M., B. Brookhagen, C. Huggel, D. Jacobsen, R.S. Bradley, J.J. Clague, M. Vuille, W. Buytaert, D.R. Cayan, G. Greenwood, B.G. Mark, A.M. Milner, R. Weingartner, and M. Winder, (2017), Toward mountains without permanent snow and ice. Earth's Future, 5: 418-435.*
2. *Shugar, D.H., A. Burr, U.K. Haritashya, J.S. Kargel, C.S. Watson, M.C. Kennedy, A. Bevington, R, R.A. Betts, S. Harrison, and K. Strattman, (2020), Rapid worldwide growth of glacial lakes since 1990. Nature Climate Change, 10: 939-945.*
3. *Benn, D., C. Warren, and R. Mottram, (2007), Calving processes and the dynamics of calving glaciers. Earth-Science Reviews, 82: 143-179.*
4. *Sutherland, J.L., J.L. Carrivick, N. Gandy, J. Shulmeister, D.J. Quincey, and S.L. Cornford, (2020), Proglacial lakes control glacier geometry and behaviour during recession. Geophysical Research Letters, 47(e2020GL088865).*
5. *Sugiyama, S., M. Minowa, Y. Fukamachi, S. Hata, Y. Yamamoto, T. Sauter, C. Schneider, and M. Schaefer, (2021), Subglacial discharge control seasonal variations in the thermal structure of a glacial lake in Patagonia. Nature Communications, 12(630): 1-9.*
6. *Pronk, J.B., T. Bolch, O. King, B. Wouters, and D.I. Benn, (2021), Contrasting surface velocities between lake- and land-terminating glaciers in the Himalayan region. The Cryosphere, 15: 5577-5599.*
7. *Dykes, R., M. Brook, C. Robertson, and I. Fuller, (2011), Twenty-first century calving retreat of Tasman Glacier, Southern Alps, New Zealand. Arctic, Antarctic and Alpine Research, 43(1): 1-10.*
8. *Purdie, H., P. Bealing, E. Tidey, C. Gomez, and J. Harrison, (2016), Bathymetric evolution of Tasman Glacier terminal lake, New Zealand, as determined by remote surveying techniques. Global and Planetary Change, 147: 1-11.*
9. *Purdie H, Anderson B, Mackintosh A and Lawson W (2018) Revisiting glaciological measurements on Haupapa/Tasman Glacier, New Zealand, in a contemporary context. Geografiska Annaler Series A, Physical Geography 100(4), 351–369.*
10. *Mankani, L., Glowacki, O., Smith W.A.P., Lewińska, P, (2026). Detection of glacier calving from time-lapse images using computer vision and neural network. Journal of Glaciology, 72, e5, 1-15.*

Importance of geospatial analysis to the proposed research

Geospatial data science is central to this project because it requires the PhD candidate to bring different kinds of location-based data into the same space and time frame to explore the complex interactions at the ice-lake interface. The project will combine lake depth and limnological surveys (already acquired), glacier displacement (from different SAR systems and already acquired camera images), to resolve ice-lake interactions at the glacier terminus. The project will utilise a unique and dense dataset of SAR data from the Radarsat Constellation Mission, which will be acquired between April 2026 and April 2027. Because of the size and diversity of data involved, combining remote sensing data with computer vision (ML, CNNs) will be key to resolving temporal differences between the datasets and to extract information from the dense, oblique camera dataset, such as calving events or cold-water plumes. By linking these data sources, the PhD student can track when and where calving occurs, how ice flow changes, and whether the shape of the submerged glacier

affects buoyancy. Integrating this data is crucial for answering the project's main research question and improving geospatial analysis techniques for glaciology.
Novelty and transdisciplinarity of the project This project is truly transdisciplinary (defined as integrating knowledge across multiple academic disciplines, including non-academic stakeholders). The PI has established working relationships with local glacier guiding company Glacier Explorers who operate on the glacier lake. Subaqueous ice remaps and iceberg calving present a significant hazard to their operation -knowledge gained through this project will inform operations decisions. Reciprocally, the guides hold intricate knowledge of the lake conditions and characteristics which will help researchers refine research methods and interpret data. This project will bring together freshwater lake dynamics, glacier ice dynamics, earth science, geospatial data science and computer science to answer a problem that cannot be solved by one field alone. The novelty comes from studying a lake terminating glacier and asking how the underwater glacier front shape affects its retreat. Calving processes affecting lake terminating glaciers are still poorly understood. Earth science provides understanding of glacier change, lake processes, and climate controls. Geospatial data science and computer science support the analysis of large image and satellite data sets and helps identify patterns in calving and ice movement over time, using modern frameworks (ML). Combining these fields will produce new science and practical knowledge of glacier hazards, tourism, and changing environments.
Project alignment with Vision Mātauranga. Ko Aoraki, te mauka ariki o Kāi Tahu iwi. Aoraki/Mount Cook in Ka Tiritiri-o-Te-Moana (Southern Alps) is regarded as a sacred ancestor to Kāi Tahu (Ngāi Tahu) iwi. The glaciers and waters flowing from the mauka (mountains) are regarded as taoka (treasures). Haupapa (Tasman Glacier), formed from ice flowing off the flanks of Aoraki and surrounding mountains, embodies the hau (breath) and ora (life) of ngā uri (ancestors). From a Māori perspective, taiao and hauora are inseparable - the health of people and communities is tied to the health of the environment. We acknowledge Te Rūnaka o Arowhenua, Waihao, and Moeraki hold kaitiakitanga (guardianship) of these mountains and glaciers. If successful, the PI will support the PhD candidate connecting them to their existing relationships with rūnaka, engaging in whakawhitinga kōrero (discussion) of rūnaka aspirations and exploring how this project can support local marae initiatives, whānau and hapori (community). Indigenous Innovation is addressed by enhancing understanding of how rapid ice loss is impacting hazards, tourism and recreation in the Te Manahuna/Aoraki region. Ngāi Tahu iwi are significant actors in the tourism industry, and knowledge gained will help inform sustainable tourism practices, contributing to regional economic resilience and supporting future opportunities.
Alignment and contribution of the project to UC's strategic vision for research (impact in a changing world), as described here: https://www.canterbury.ac.nz/about-uc/corporate-information/strategy-and-plans/uc-strategic-vision-2020-2030 This project is strongly aligned to the UC strategic vision of supporting multi-disciplinary research that positively impacts local and global challenges, specifically, the impact of climate change on water resources and tourism. This project also further develops and

maintains strong strategic local, regional and international academic partnerships and industry partnerships, through its collaboration with other national and international academic/research institutions (Victoria University, Environment Canada) and the tourism sector (Glacier Explorers). Although targeted as a PhD project this research also embraces whanaungatanga, aiming to lift researcher capacity and capability of post-graduate, early-career and established researchers. This proposal is well-aligned to newly developed 'core capabilities', specifically, spatial data and Earth analytics – mapping, modelling and interpreting a rapidly changing planet.

Project 2

Title: Using GeoAI and spatial modelling to advance the 3-30-300 rule's measurement and assess its impacts on equity

UC senior supervisor project leader	Department/School
Dr. Lindsey Conrow lindsey.conrow@canterbury.ac.nz	School of Earth and Environment
Other members of the supervision team	**Department/School**
Prof. Justin Morgenroth	School of Forestry
Prof. Simon Kingham	School of Earth and Environment.

Links with organisations outside the University of Canterbury

Christchurch City Council

Project outline

This project builds on recent research by Master of Applied Data Science student Rujal Shrestha that quantified how urban tree canopy influences residential property values in Christchurch using spatial hedonic pricing models. Findings demonstrated statistically significant positive effects of tree canopy cover on property values, with the strongest influence observed at neighbourhood scales (100–200 m), rather than at the level of individual properties. These findings suggest that urban greening functions not only as a local amenity but also reflects broader neighbourhood environmental quality. The proposed research extends this work by analysing how access to trees, green space, and urban infrastructure influences house prices at the city scale, and what this tells us about differences in environmental quality and wellbeing between neighbourhoods. In doing so, the project will explicitly engage with the 3-30-300 rule, a widely used framework in urban forestry and planning, which proposes that every resident should have visibility of at least 3 trees, 30% neighbourhood canopy cover, and access to a green space within 300 metres. Despite its adoption as a guideline, the 3-30-300 rule's evidence base remains limited in terms of consensus on measuring its components, scalability, and thresholds for socio-spatial impacts.

This research will examine the 3-30-300 rule components as benchmarks, using house prices and patterns of socio-spatial inequality as a lens for methodological scrutiny. The analysis will explore interactions to determine whether specific canopy or accessibility thresholds are associated with a greater magnitude of effect for pricing and inferred wellbeing.

Three core questions guide the research:

1. How can GeoAI advance scalable approaches to measurement, monitoring, and evaluation of the 3-30-300 rule, including canopy and green space quality and perceptual exposure?
2. How are tree canopy, tree visibility, and green space access spatially distributed, to what extent is that distribution equitable for various population groups, and how might it evolve over time?
3. To what extent do 3-30-300 amenities influence housing affordability and wellbeing in the context of establishing standards for healthier cities?

Answering these questions will produce a replicable, scalable approach to measuring the 3-30-300 rule, and help determine its robustness as an indicator of neighbourhood quality. Reducing uncertainties in measurement and impact will move the 3-30-300 rule from an unclear aspiration toward standards that can be measured and monitored; this means planners can use it to develop an evidence base for intentional planning and allocate resources for urban greening more efficiently and equitably.

Importance of geospatial analysis to the proposed research

Each component of the 3-30-300 rule requires distinct geospatial measurements and understanding how effects vary across space and scale is only possible with a spatial approach. LiDAR-derived tree canopy cover is calculated at multiple distances from a property to determine which scales and thresholds most strongly relate to price effects and socio-economic indicators. Similarly, geospatial approaches to network-based routing and buffering are necessary to derive and test multiple proximity-based accessibility metrics. These threshold analyses address a key uncertainty in measurement that limits the rule's practical utility. GeoAI methods, including image segmentation and detection models (Fig. 1) applied to Google Street View imagery, capture experiential aspects of tree exposure that are currently omitted in most models. Developing canopy and green space quality metrics alongside this analysis will also support modelling future growth and using spatial optimisation to effectively locate future urban greening investments. Spatial econometric models will then be used to analyse how these variables influence house prices while accounting for spatial dependence between nearby properties. This is important because property prices are not independent and are influenced by surrounding neighbourhoods; modelling this relationship gives us a mechanism for threshold testing with the 3-30-300 rule.

Novelty and transdisciplinarity of the project

The 3-30-300 rule is widely used in urban planning, but its specific thresholds have not been rigorously tested. We know trees and green space influence house prices, but uncertainty remains in both magnitude of effect at these thresholds and whether the rule's benchmarks reflect real differences in spatial processes.

The project addresses this gap via two main contributions. First, it applies GeoAI to derive window-level viewsheds from Google Street View imagery, which captures perceptual tree exposure at scale. Measuring the "3 trees" component of the framework is particularly difficult to quantify at city scale, and cannot be achieved with remote sensing alone, so the research develops approach. Second, it examines how amenities are spatially distributed across socio-economic groups which centres the analysis around spatial equity rather than aggregate impacts.

The research combines approaches from urban economics, geography, environmental science, and public health. This transdisciplinary approach allows us to develop a holistic picture of the relationships between urban greening, house prices, and spatial inequality. Incorporating these perspectives will produce insights that are more robust than any single discipline would develop on its own and, as with econometrics and geography, makes up for critical limitations.

Project alignment with Vision Mātauranga

This project engages with Vision Mātauranga through its focus on environmental wellbeing and the distribution of urban environmental benefits. It will examine how access to trees, green space, and related environmental features varies across space, including whether some communities have better access to these benefits than others.

The research recognises that access to environmental features such as tree cover and green space is closely linked to wellbeing, and that these benefits may not be evenly distributed. The project will therefore consider whether there are differences in access to these features across socio-economic groups, including Māori communities.

The project also acknowledges that house prices provide only a partial measure of wellbeing and do not capture all aspects of cultural and environmental relationships to land. Findings will be interpreted with this limitation in mind.

Where appropriate, opportunities to engage with Ngāi Tahu and Ngāi Tūāhuriri will be explored, particularly in relation to interpreting and applying the results.

Alignment and contribution of the project to UC's strategic vision for research (impact in a changing world), as described here: https://www.canterbury.ac.nz/about-uc/corporate-information/strategy-and-plans/uc-strategic-vision-2020-2030

This project aligns with the University of Canterbury's strategic vision of delivering impact in a changing world by addressing challenges related to urban sustainability, environmental change, and social inequality. The research will provide evidence on how trees, green space, and urban infrastructure influence house prices and neighbourhood quality. This has direct relevance for urban planning and policy, particularly in decisions about tree planting, green space provision, and transport infrastructure. Including Christchurch as a study area on variation in access, the project will have local impact by contributing to discussions about housing affordability and equitable access to high-quality urban environments. The project makes use of advanced spatial and analytical methods, contributing to UC's strengths in data-driven and interdisciplinary research. It also provides opportunities for collaboration with local government and other stakeholders, supporting the translation of research findings into planning and policy. Overall, the project contributes to UC's goals of sustainability, innovation, and community engagement, and aligns well with the SDGs, especially 3, 10, 11, 13 and 15.

Project 3

Title: Geospatial Pathways for an Equitable Clean Energy Transition in Aotearoa: A National Atlas for Just Transition Planning

UC senior supervisor project leader	**Department/School**
Dr. Rebecca Peer rebecca.peer@canterbury.ac.nz	Civil and Environmental Engineering
Other members of the supervision team	**Department/School**
Dr Jannik Haas	Civil and Environmental Engineering

Links with organisations outside the University of Canterbury

Community energy groups, MBIE, EECA, local councils, iwi organisations, social service providers.

Project outline

This PhD will develop a national geospatial atlas for New Zealand's clean energy transition, with a focus on energy access and just transitions. This work will identify optimal locations for centralised and decentralised production of energy commodities, transport corridors, and end-use demand clusters. The project will also assess how the benefits and burdens of the energy transition are distributed across households, communities, and regions.

The research focuses on communities that may face barriers to participating in the transition, including limited access to rooftop solar, electric vehicles, efficient heating, distributed storage, demand flexibility, or emerging hydrogen and low-carbon employment opportunities. By integrating GIS-based socio-economic vulnerability mapping with infrastructure accessibility and hazard exposure, the project will reveal where clean energy policies risk reinforcing existing inequalities.

This project can be separated into four linked work packages:

- WP1: Spatial baseline of energy poverty, deprivation, and vulnerability
- WP2: National infrastructure atlas for clean energy supply
- WP2: Mapping access to centralised and distributed clean energy technologies

- WP3: Integrated geospatial energy system optimisation of just transition pathways
- WP4: Community co-design and policy translation

The project will combine deprivation indices, tenure and housing quality, transport access, local energy costs, grid hosting capacity, climate hazard risk, technology availability, renewable resource potential, biogenic CO_2 availability, port infrastructure, and land-use constraints into a spatial decision-support framework. This creates high-resolution evidence base for identifying priority areas where households face both elevated energy burdens and limited access to clean energy solutions.

A key innovation is the development of spatial intervention scenarios that test the equity impacts of policy and investment options, such as community solar, targeted EV charging, efficient heating retrofits, distributed batteries, renewable fuels, and local employment pathways. These scenarios will support national and regional agencies in designing place-based, socially just decarbonisation strategies.

The project also includes a community co-design component, working with local stakeholders, councils, and potentially iwi and Māori energy initiatives to ground-truth spatial results and co-develop meaningful transition pathways.

We expect the project to deliver a national clean energy atlas. We will also develop a dashboard that integrates the project research for end-users and three to four Q1 journal publications, focused on interdisciplinary outlets.

Importance of geospatial analysis to the proposed research

Geospatial research is essential to understanding how the benefits and burdens of the clean energy transition are distributed across communities. Energy affordability, housing quality, access to low-carbon technologies, exposure to climate risks, and transport dependence all vary spatially, making GIS fundamental to identifying inequities that are invisible in national averages. This PhD will integrate socio-economic, demographic, infrastructure, and environmental datasets to map where communities face barriers to participating in the transition. Spatial analysis will reveal overlaps between deprivation, poor housing performance, limited public transport, grid constraints, and reduced access to distributed renewable technologies. The geospatial dimension allows the project to move beyond descriptive justice narratives toward actionable, place-based intervention pathways. It supports the identification of priority communities for targeted policies such as rooftop solar subsidies, electrified heating programmes, EV access, or resilience upgrades. By combining spatial vulnerability mapping with future energy pathway modelling, the project will create a decision-support framework for equitable transition planning. This is highly aligned with GRI's goal of using geospatial science to address complex societal challenges and produce tangible public impact.

Novelty and transdisciplinarity of the project

Geospatial analysis is fundamental to this research as it enables the identification of spatial patterns in Parkinson's disease outcomes that would not be detectable through traditional epidemiological methods alone. Through spatial statistical techniques, including Bayesian models, we can analyse geographic variations in disease outcomes and quantify their statistical significance, providing insights into potential environmental factors that may influence disease progression. The integration of environmental and social determinants of health through geospatial analysis, particularly using the Healthy Location Index and its domains, will identify key factors affecting disease outcomes. Furthermore, network analysis techniques will be crucial in examining healthcare accessibility, measuring travel times to specialist services, and analysing service catchment areas across New Zealand.

This advanced spatial understanding of both disease outcomes and healthcare delivery networks will provide valuable insights for health service planning and resource allocation, potentially identifying areas where healthcare access could be improved. The combination of spatial statistics, network analysis, and epidemiological data represents a powerful approach to understanding the complex interplay between location, environment, healthcare accessibility, and Parkinson's disease outcomes in New Zealand.
Project alignment with Vision Mātauranga This project has exceptionally strong Vision Mātauranga alignment because it directly addresses questions of equity, participation, place, and community wellbeing, which are central tikanga Māori. Spatial inequalities in housing, transport, energy affordability, and climate vulnerability often disproportionately affect Māori communities. This PhD creates a robust geospatial framework to identify where these barriers occur and how transition policies can better support Māori participation and outcomes. The project offers opportunities to work alongside iwi, hapū, Māori social service providers, and community energy initiatives to ensure local priorities are reflected in vulnerability indicators and intervention scenarios. This includes consideration of whānau wellbeing, access to healthy homes, transport connectivity, and fair participation in distributed energy benefits. By embedding Māori perspectives on fairness, collective wellbeing, and long-term guardianship into geospatial energy justice research, the project strengthens both methodological rigor and social legitimacy. It also supports bicultural approaches to public policy design and evidence-based community investment.
Alignment and contribution of the project to UC's strategic vision for research (impact in a changing world), as described here: https://www.canterbury.ac.nz/about-uc/corporate-information/strategy-and-plans/uc-strategic-vision-2020-2030 This PhD aligns strongly with UC's strategic vision by delivering high-impact, socially engaged research on climate transition fairness and community resilience. The project directly contributes to UC's goal of addressing major societal challenges through interdisciplinary research with practical impact. By focusing on who benefits from decarbonisation and who may be left behind, it positions UC at the forefront of socially responsive sustainability research. Its integration of geospatial science, engineering, and public policy supports UC's commitment to cross-disciplinary collaboration and community engagement. The project also strengthens links with councils, iwi, community groups, and public agencies, aligning with UC's vision for research that is deeply connected to societal needs. The outputs, including vulnerability maps, intervention frameworks, and policy tools, are highly actionable and can directly influence housing, transport, and energy investment decisions across New Zealand. This creates strong pathways for real-world impact, public trust, and future external funding.

Project 4 **Title: The human exposome: advancing geospatial and theoretical understandings of health and environmental interactions over time and space**	
UC senior supervisor project leader Dr. Matthew Hobbs matt.hobbs@canterbury.ac.nz	**Department/School** School of Health Sciences

Other members of the supervision team	Department/School
Prof. Elena Moltchanova Prof. Malcolm Campbell	Mathematics and Statistics School of Earth and Environment

Links with organisations outside the University of Canterbury

Christchurch Health and Development Study (CHDS), University of Otago, Christchurch, New Zealand (please see attached letter of support from Professor Joe Boden, CHDS Principal Scientist).

Project outline

Human health is shaped not by single exposures in isolation, but by the cumulative, dynamic totality of environmental conditions encountered across a lifetime. The exposome, encompassing all environmental influences from conception to death, offers a powerful theoretical framework for understanding this complexity; however, its spatial dimensions remain underdeveloped. Most epidemiological research captures only residential environments at one time point, reducing rich, multi-contextual exposure histories to a single address at a single point in time. This PhD project addresses that theoretical and methodological gap by advancing geospatial conceptualisations of the human exposome across home, school, and workplace settings over the full lifecourse. The project develops the concept of the geospatial exposome: a theoretically grounded and computationally realisable framework for representing how spatially distributed environmental conditions accumulate, interact, and produce health outcomes across time. Central theoretical contributions include formalising exposure trajectory modelling across multiple activity spaces, operationalising concepts of critical periods and sensitive windows within a spatial lifecourse framework, and articulating how place-based disadvantage compounds across domains to generate persistent health inequalities. The Christchurch Health and Development Study (CHDS), one of the world's most comprehensive longitudinal birth cohorts, tracking over 1,000 individuals from birth to midlife across four decades, provides an exceptional empirical testbed for this theoretical development. Building on geocoded residential histories established by Hobbs and Boden (2019-2024), the PhD candidate will integrate school records and employment histories to construct individual-level geospatial exposure trajectories spanning childhood, adolescence, and adulthood. Environmental exposures, including greenspace access, neighbourhood 5 Classification: In-Confidence socioeconomic deprivation, and ambient air pollution, will be quantified across all activity spaces using nationally consistent spatial datasets. Methodologically, the project confronts substantive computational challenges: integrating heterogeneous spatial and temporal data at individual scale, constructing mobility-weighted exposure surfaces, and modelling high-dimensional exposure trajectories across the lifecourse. These are addressed through a pipeline combining geospatial data infrastructure, machine learning (including random forests and gradient boosting for exposure prediction and variable importance), time-varying statistical models, and cumulative risk frameworks. This computational architecture is designed for transferability to other cohort settings and exposure domains. The project will generate both theoretical advances in spatial epidemiology and high-quality, policy-relevant evidence on how place-based disadvantage accumulates across life stages. It positions the GRI and UC at the forefront of exposome science in Aotearoa New Zealand, with implications for urban planning, public health, and the reduction of persistent health inequalities.

Importance of geospatial analysis to the proposed research.

Geospatial analysis is not merely a methodological tool in this project; it is theoretically constitutive of the research itself. The geospatial exposome framework rests on a foundational claim: that health is shaped by the totality of spatially distributed environments encountered across a lifetime, not reducible to a single residential address. Capturing and modelling this complexity is only possible through geospatial methods. The project constructs individual-level geospatial exposure trajectories by geocoding school and workplace locations across four decades of CHDS follow-up. Proximity analysis, network based accessibility modelling, buffer analysis, and areal interpolation are applied to assign environmental characteristics i.e. greenspace, air pollution, and socioeconomic deprivation across all activity spaces at each life stage. This multi-contextual exposure architecture operationalises the exposome in spatial terms. Geospatial analysis also enables explicit quantification of spatial inequalities in exposure, revealing how environmental disadvantage is distributed unevenly across populations and accumulates across the lifecourse. Computationally, integrating heterogeneous spatial datasets at individual scale across 40 years presents non-trivial data engineering and modelling challenges, requiring reproducible geospatial pipelines capable of handling temporal misalignment and spatial uncertainty. This positions the project at the frontier of spatial epidemiology and geospatial data science internationally.

Novelty and transdisciplinarity of the project

The project's primary novelty lies in formalising the geospatial exposome as both a theoretical construct and a computational framework. Existing spatial epidemiology almost universally operationalises exposure through residential addresses or at one time point. This project challenges that foundational assumption, developing a dynamic, multi-contextual framework integrating home, school, and workplace environments into coherent individual exposure trajectories across four decades. The application of this framework to CHDS, enabling identification of spatially-defined critical periods and sensitive windows, is, to our knowledge, rare internationally. 6 Classification: In-Confidence Novelty also lies in the computational architecture required: constructing mobility-weighted, temporally aligned exposure surfaces at individual scale from heterogeneous spatial datasets is a substantive data science problem, and the reproducible geospatial pipeline developed here will be transferable to other cohort settings globally. The project is inherently transdisciplinary, requiring and producing knowledge spanning health geography, spatial epidemiology, public health and computer science. The supervisory team reflects this deliberately: Hobbs brings spatial data science and lifecourse epidemiology; Campbell contributes geospatial computing and data infrastructure; Moltchanova provides biostatistical modelling expertise; and Boden offers longitudinal cohort leadership and epidemiological depth. This team brings established international publications across all core domains, providing the candidate with supervisory depth rarely achieved in a single project

Project alignment with Vision Mātauranga.

This project aligns substantively with Vision Mātauranga through its focus on place, environment, and health, themes resonating directly with Māori understandings of Hauora and Taiao. The geospatial exposome framework, positioning place as fundamentally constitutive of health across the lifecourse, shares meaningful philosophical ground with these traditions. The project will explicitly examine how environmental exposures and access to health promoting resources, including greenspace and safe neighbourhoods, are distributed unequally across ethnic groups within the CHDS. Where data permit, analyses will be stratified by ethnicity, including Māori, to identify differential exposure trajectories and outcome disparities. This is a substantive research aim, not a sensitivity analysis, grounded in recognition that spatial and structural inequalities are experienced differently across communities. Throughout, the project adopts a strengths-based perspective, avoiding deficit framing and examining how protective environments contribute to positive health trajectories. Established partnerships with Hobbs and Boden provide a strong foundation for meaningful engagement: Whānau Whanake will inform interpretation and dissemination; CHDS's existing Māori community relationships will be utilised; and Atawhai Te Hau, Kaiārahi Māori for the Faculty of Health, will provide ongoing cultural guidance. Hobbs brings direct experience in Māori health inequity research, including peer-reviewed work he led the publication of in The Lancet.

Alignment and contribution of the project to UC's strategic vision for research (impact in a changing world), as described here: https://www.canterbury.ac.nz/about-uc/corporate-information/strategy-and-plans/uc-strategic-vision-2020-2030

This project aligns directly with UC's Strategic Vision 2020–2030 across research, engagement, and sustainability objectives. Under Research: Impact in a Changing World, the project exemplifies the strategy's call for transdisciplinary research addressing local and global challenges. Spanning health geography, spatial data science, epidemiology, and computer science, it advances the national research profile in spatial epidemiology and develops transferable geospatial infrastructure, contributing to UC's commitment to state-of-the-art e-infrastructure. The 7 Classification: In-Confidence CHDS collaboration with the University of Otago strengthens the strategic national partnerships the Vision prioritises. Under Engagement, the project responds directly to UC's objective of making a positive impact on hauora wellbeing and social sustainability in Ōtautahi Christchurch and Waitaha Canterbury. Generating rigorous evidence on how environmental disadvantage accumulates across the lifecourse is precisely the policy-relevant, community-facing research the engaged university model demands. Partnerships with Whānau Whanake and CHDS's existing Māori community networks further embed the project in Ōtautahi's social fabric. The project contributes directly to SDG 3 (Good Health and Well-being) and SDG 10 (Reduced Inequalities), aligning with UC's commitment to resolving global sustainability challenges through research. Finally, training a PhD candidate at the interface of geospatial computing and population health develops the next generation of researchers UC's vision prioritises.