Waterways Postgraduate Student Conference **2023**

Tuesday 7 November 2023
Te Whare Wānanga o Waitaha | University of Canterbury, Christchurch, New Zealand

Waterways Centre

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Conference Programme

Time	Presentation	
8:30	Registration	
9:00	Mihi Whakatau – Liz Brown, Te Amokapua Māori Tuarua, Deputy Assistant Vice-Chancellor Māori	
9:05	Welcome – **Professor James Brasington, Director, Waterways Centre**	
9:15	Assessing temporal variation in groundwater recharge to a braidplain aquifer using active-distributed temperature sensing	Alice Sai Louie, PhD Candidate
9:30	Numerical analysis of the water table response to sea-level rise	Amandine Bosserelle, PhD Candidate
9:45	Regional flood frequency analysis based on sub-regions of New Zealand	Farhana Sweeta Fitriana, Masters Candidate
10:00	Rising waters: groundwater hazard exposure in the Waimakariri District of Canterbury, New Zealand	Desmond McCloy, Masters Candidate
	Lightning talks	
10:15	Unlocking the archives: shoebox myths and legends	Romy van der Boom, Masters Candidate
10:20	New Zealand daily weather patterns and large scale climatic patterns as heavy rainfall drivers	Andrea Pozo Estivariz, PhD Candidate
10:25	Using isoprostanes as a wastewater biomarker to monitor community health and wellbeing	Tino Berl-Deplazes, Masters Candidate
10.30	**Morning Tea**	
11:00	Connecting models and depositional environments, Rangitata River	Justin Rogers, PhD Candidate
11:15	Multiple stressors impact mayfly life history: a plastic response to agricultural stress	Harrison Keesing, Hons Candidate
11:30	Environmental justice in the hydropower sector of Nepal: conceptualizing a new model	Amrit Poudel, PhD Candidate

11:45	Bridges causing troubled waters	Kathryn Bates, Masters Candidate
12:00	Improving flood mapping by including stopbank breaching	Thomas Wallace, PhD Candidate
	Lightning talks	
12:15	Assessing microbial pathogen transport in groundwater from the Hekeao/Hinds managed aquifer recharge scheme	Madeline Inglis, Masters Candidate
12:20	Assessment of water quality and nuisance algae blooms in urban stormwater ponds in Ōtautahi Christchurch, Aotearoa New Zealand	Stephanie Koviessen, Masters Candidate
12.30	**Lunch – POSTER SESSION 1 pm in Ngaio Marsh Theatre**	
1:30	The role of New Zealand coastal lakes in the life history of a diadromous fish species	Chris Meijer, PhD Candidate
1:45	Influence of soil databases on parameter sensitivities and prediction uncertainty	Ehsan Qasemipour, PhD Candidate
2:00	Green walls: an opportunity to treat and reuse greywater in New Zealand	Moeen Gholami, PhD Candidate
2:15	Rates of salinization of offshore fresh groundwater under changes in onshore groundwater levels.	Connor Cleary, PhD Candidate
2:30	Are triggers for adaptation to sea level rise on coastal lowland agricultural land aligned between local and regional councils and farmers?	Katherine Manning, Masters Candidate
	Lightning talks	
2:45	Data worth analysis to improve modelling of shallow groundwater levels under sea-level rise	Matthew Jones, Masters Candidate
2:50	Risk assessment of emerging contaminants in tyre rubber for Aotearoa New Zealand	Emelia Livingstone, Masters Candidate
3:00	**Afternoon Tea**	

3:30	Ecological role of amphidromous fish (*Galaxias* spp.) in freshwater food-webs	Ben Crichton, PhD Candidate
3:45	Alpine catchment source determination and snowmelt to streamflow timing	Zane Shadbolt, Masters Candidate
4:00	Maximising the physical, ecological, social, and cultural outcomes of stormwater-related urban blue-green infrastructure	Tyler McNabb, PhD Candidate
4:15	Groundwater hindcasting: what is it, how do we do it, and why is it important?	Tara Forstner, PhD Candidate
4:30	**Drinks and Nibbles**	

Poster Title	Presenter
Using riskscape to measure the impact of flood uncertainty on decision-making	Clevon Ash, PhD Candidate
Using isoprostanes as a wastewater biomarker to monitor community health and wellbeing	Tino Berl-Deplazes, Masters Candidate
Building future urban development scenarios into assessments of future flood risk	Katherine Booker, PhD Candidate
Simulation of sediment loads in Lake Opuha using the SWAT+ model	Maria Borges Briceno, PhD Candidate
Development of farmer-led irrigation for sustainable use of groundwater in sand rivers	Cesário Cambaza, PhD Candidate
Back to the future: hindcasting groundwater systems to inform transdiciplinary approaches to ecosystem rehabilitation	Tara Forstner, PhD Candidate
Assessment of water quality and nuisance algae blooms in urban stormwater ponds in Ōtautahi Christchurch, Aotearoa New Zealand	Stephanie Koviessen, Masters Candidate
Rising waters: groundwater hazard exposure in the Waimakariri District of Canterbury, New Zealand	Desmond McCloy, Masters Candidate
New Zealand daily weather patterns and large-scale climatic patterns as heavy rainfall drivers	Andrea Pozo Estivariz, PhD Candidate
Splitting streamflow	Zane Shadbolt, Masters Candidate
Spatiotemporal analysis of groundwater quality patterns in the Mid Canterbury Region	Romy van der Boom, Masters Candidate
Improving flood mapping by including stopbank breaching	Thomas Wallace, PhD Candidate

How to find presenters

Presenters, committee members and staff can be identified by coloured name tags. Presenters are keen to hear your questions and feedback, so please feel free to approach them throughout the day. Also, please let a committee member know if you need any assistance.

Posters

There is a scheduled poster session in the foyer from 1:00 to 1:30 pm when all poster presenters will be available at their poster for questions and discussion. However, please feel free to approach poster presenters throughout the rest of the day.

Welcome

Tēnā koutou katoa,

A very warm welcome to our 13th Waterways Postgraduate Student Conference! This event is a firm favourite in the Centre's calendar, as it represents a vital opportunity for our students to engage with the wider freshwater community and a chance for them to showcase their remarkable research.

Today, we're joined by more than 100 external delegates representing over 30 organizations, spanning the breadth of the freshwater sector, including industry, government and community groups. This diverse convergence of minds offers our presenters a unique platform to refine their presentation skills, gather valuable feedback and connect with key stakeholders, professionals and freshwater enthusiasts. As always, we have a broad programme that offers something for everyone, and hopefully some new and exciting ideas that might spark future collaborations and new research directions.

It has been an important year for the Centre; marked by the first time we've run our new Masters programme in Water Science and Management. This has kept the staff busy writing and delivering new papers on topics that range from Freshwater Restoration and Recovery, to Water Governance and Catchment Hydrology. I contributed my own new paper on 'Hydrological Extremes', a topic which feels all too relevant as we look back on the last 10 months. The confronting nature of this theme makes what we are hoping to do in this new programme all the more relevant. The case for new professionals entering the freshwater sector, emboldened with

contemporary research perspectives and practical skills has never been clearer.

I would like to recognize all those who have made today possible. As many of you will know, the students don't just make up the presenters, but they are also the organizers of the whole event, supported by the tireless Suellen Knopick. So, a warm thank you to you all for making this happen.

I would also like to acknowledge the generous support of our sponsors, from whom we have received over $6,000 that very much makes this event possible. I know I speak for all when I say that your support and encouragement is vital.

Ngā mihi nui,

Professor James Brasington
Director, Waterways Centre

Oral Presentation Abstracts

Assessing temporal variation in groundwater recharge to a braidplain aquifer using active-distributed temperature sensing

Alice Sai Louie, PhD Candidate
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Supervisors: Leanne Morgan
David Dempsey
Eddie Banks
Scott Wilson

Globally, braided river systems are a major groundwater recharge mechanism for alluvial aquifers, yet little is known about this process. The aim of this project is to demonstrate the use of A-DTS for measuring temporal variations in braided river losses. We hypothesise that under stable river conditions (constant flow and river stage), there will be minimal change in river leakage over the course of a survey.

Twelve consecutive A-DTS surveys were conducted during a 24-hour period when river stage height and discharge were relatively stable. This A-DTS experiment was conducted using a horizontal subsurface hybrid fibre optic and heating cable installed perpendicular to the braided Waikirikiri Selwyn River. Using the temperature measurements, and fitting the Hantush-Jacob analytical solution, specific discharge was estimated at high spatial and temporal resolution across the entire width of the active channel.

Specific discharge within the braid plain aquifer exhibited minimal variation occurring at each location along the cable during the experiment. This confirms our hypothesis and demonstrated the use of A-DTS for quantifying temporal variation in braided river loss. In future, this will enable quantification of seasonal variation in groundwater recharge from braided rivers to inform water allocation and management practices.

Research / Career Interests

- Braided rivers, surface water – groundwater interaction, Active-Distributed Temperature Sensing

Numerical analysis of the water table response to sea-level rise

Amandine Bosserelle, PhD Candidate
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Supervisors: Matthew Hughes
Leanne Morgan

Coastal shallow groundwater is susceptible to negative impacts from climate change-induced sea-level rise (SLR). The mean sea level rose globally by 0.20 m over the last 140 years and impacted both the groundwater quality and levels. Coastal groundwater systems seek equilibrium with the ocean causing the groundwater levels to rise. The majority of investigations on the effects of SLR on coastal groundwater focused on water quality and salinization caused by saltwater intrusion. The shallow groundwater levels' response to SLR is not largely studied and could cause flooding and infrastructure issues.

In this study, numerical variable-density flow and transport modelling of SLR within an idealised cross-sectional unconfined coastal aquifer setting was carried out using SEAWAT. The rate of groundwater rise under both historical and predicted SLR scenarios was quantified for different inland boundary conditions and hydrogeological parameter combinations. The numerical analysis provides valuable insights into the relationship between the rate of SLR and the rate of water level rise.

In general, for the realistic aquifer settings used in our simulations, we found that the rate of water table rise was closely related to the rate of SLR, although smaller. There was a lag of years to decades between changes in the rate of SLR and changes in the rate of water table rise. The rate of water table rise decreased with distance from the coast and reached a maximum value faster for high hydraulic diffusivities.

Research / Career Interests

- Coastal groundwater; Urban hydrogeology; Sea-level rise impacts

Regional flood frequency analysis based on sub-regions of New Zealand

Farhana Sweeta Fitriana, Masters Candidate

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Supervisors: Markus Pahlow
Shailesh Singh
Svenja Fischer

Floods are the most common and costliest natural climate disaster globally, including New Zealand. Flood risks significantly impact human life, causing loss of life, damaging infrastructure and property, displacement of populations, and biodiversity loss. In many engineering tasks, it is crucial to estimate design floods, which is a flood discharge associated with a specific annual exceedance probability.

The main aim of this study is to devise a methodology to carry out a Regional Flood Frequency Analysis within hydrologically similar sub-regions in New Zealand to estimate design floods. Using annual maximum flood data from 366 catchments across New Zealand, preliminary results show that a sub-division into regions based on the River Environment Classification climate levels leads to higher degree of homogeneity than a sub-division into North and South Island. Cluster analysis based on catchment attributes was applied to further delineate homogenous regions, which resulted in 21 sub-regions. Next, the Generalized Additive Model coupled with the index flood L-moment approach was employed to estimate regionalized design floods of various return periods. A Jackknife procedure will be applied to assess the performance of the models.

The result of this study will allow for a robust design flood estimation in both gauged and ungauged catchments and contribute to a more region-specific approach to flood risk management in New Zealand.

Research / Career Interests

- Flood analysis, water resources management, statistical methods in hydrology

Rising waters: groundwater hazard exposure in the Waimakariri District of Canterbury, New Zealand

Desmond McCloy, Masters Candidate
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Supervisors: Leanne Morgan
Zeb Etheridge

Groundwater shoaling because of sea level rise (SLR) is one of the many challenges associated with climate change. High water tables can result in damage to infrastructure and increase the severity of flooding during extreme rainfall events. Despite this, little has been done to understand the exposure of coastal assets to this hazard.

The aim of this study is to complete a groundwater shoaling analysis to provide information on the exposure of coastal assets to water table shoaling under SLR. This will provide supporting information for the design of an early warning monitoring system for adverse impacts from SLR-driven rising groundwater levels. The case study area is the Waimakariri District in New Zealand, which has a range of agricultural and community assets situated on top of a coastal unconfined aquifer.

To assess exposure, we analysed existing interpolated water table data and groundwater level spot and time series data for variance and spatial coverage using QGIS. To increase spatial coverage, two 4-meter deep piezometers have been installed within Tūhaitara Coastal Park in locations where spatial coverage was sparse. Data from these piezometers will be combined with existing data to interpolate multiple depth-to-groundwater surfaces under specified SLR-driven water table increases and to show the associated groundwater hazard exposure. Analysis of time series variance in depth-to-groundwater monitoring data will then be used to evaluate the statistical power for detection of water table change.

Research / Career Interests

- Groundwater monitoring techniques, interaction between climate change and groundwater

Unlocking the archives: shoebox myths and legends

Romy van der Boom, Masters Candidate
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Supervisors: Issie Barrett
Leanne Morgan
Carolynne Hultquist

The Mid Canterbury Catchment is on the East Coast of the Te Waipounamu/South Island of Aotearoa/New Zealand. The land use in the catchment is mostly agricultural. The boundaries of the catchment were set as the Rakaia River to the Rangitata River up to the foothills.

The Mid Canterbury Catchment Collective identified that historic water quality data has been stored in a variety of sources from electronic databases through to shoe boxes in personal garages. This project aimed to identify and collate all available water quality data for the Mid Canterbury catchment.

The catchment collective identified people possessing regional expertise or potential sources of raw data. Furthermore, technology has changed over time and data has been stored in different formats, raising yet more challenges in collation of this data. I will discuss everything I learnt in the process of gathering data from these historic sources, working with a catchment collective, accessing archived material and the summer student experience.

Research / Career Interests

- Water quality, data science

New Zealand daily weather patterns and large scale climatic patterns as heavy rainfall drivers

Andrea Pozo Estivariz, PhD Candidate
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Supervisors: Matthew Wilson
Emily Lane
Marwan Katurji
Fernando Méndez

Based on previous work in the field this study presents a new synoptic classification of 49 Daily Weather Types (DWTs) for the New Zealand region, using Mean Sea Level Pressure (MSLP) and 500 geopotential height as predictor variables. It provides a probabilistic description of the relationship between the DWTs and local extreme rainfall events using as a study site the Wairewa catchment (Little River), which increasingly suffers from flooding.

Meaningfully and useful relationships have been found between the DWTs, the rainfall data, and the large-scale climatic patterns. More than a half of the DWTs are linked to the occurrence of extreme rainfall events, and sometimes to flooding. Most of these DWTs represent cyclonic states and intense north westerlies winds, however, some of them are characterized by anticyclonic conditions and mild winds. Time-scale variability of the predictor variables plays a very relevant role, which translates to the DWTs and then to the time scale variability of storms and flooding events. Large scale climatic patterns (such as El Niño Southern Oscillation) condition the DWTs frequency of occurrence and in some cases impact the occurrence of extreme rainfall events and flooding.

The synoptic climatological approach proposed is of qualitative value since it can help in the interpretation of the weather conditions and climatic patterns that can lead to extreme rainfall and flooding; but also, of quantitative value, possibly helping in the prediction of these events.

Research / Career Interests

- Flood modelling, hybrid methodologies, climate change

Using isoprostanes as a wastewater biomarker to monitor community health and wellbeing

Tino Berl-Deplazes, Masters Candidate
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Supervisors: Sally Gaw
Matt Hobbs
Andrew Chappell

Real-time indicators of community health and wellbeing are required to evaluate the status and the efficacy of public health interventions. Wastewater based epidemiology (WBE) has shown to be an effective tool as a large-scale early warning and surveillance tool/method for public health interventions to improve community health and wellbeing.

Isoprostanes i.e. 8-iso-prostaglandin F2α and prostaglandin E2 are produced by people when they are stressed or unwell, are excreted in urine and if flushed down drains will reach and enter centralised community wastewater treatment plants. 8-iso-prostaglandin F2α and prostaglandin E2 have been detected and quantified in wastewater samples across differing communities internationally and have been proposed as human biomarkers of community oxidative stress.

However, limited assessments have investigated the relationship between community health and the concentrations of isoprostanes in community wastewater. Therefore, this research will determine the concentrations of 8-iso-prostaglandin F2α and prostaglandin E2 in wastewater from communities around New Zealand. The measured isoprostanes concentrations will then be compared to other indicators of human health e.g. health location index, New Zealand deprivation index and median house price. This will determine if the amount of isoprostanes detected in a communities wastewater can indicate the health and wellbeing of its population.

Research / Career Interests

- Water resource management, water quality, environmental monitoring and wastewater treatment

Connecting models and depositional environments, Rangitata River

Justin Rogers, PhD Candidate
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Supervisors: James Brasington
Jo Hoyle
Jono Tonkin

Excess fine sediment can alter fluvial form, ecosystem health and groundwater recharge. The advent of large-scale mapping technologies has enabled reconstruction of fluvial substrate facies over broad scales, and now spurs a re-examination of what can be learned from repeat surveys and models with varying degrees of complexity.

Detailed observations of the Rangitata River have created a greater understanding of substrate composition at the time of survey, but hydrodynamic and/or sediment transport models are required to connect the flow record to the river form and gauge whether altered hydrology has led to sediment infill.

A library of 2D hydrodynamic model results combined with a DEM of difference shows relationships between hydraulics and some areas of fine sediment deposition and helps answer whether the observed prevalence of surficial fine sediment is explained only by large floods or can be connected to smaller flow events.

Research / Career Interests

- Rivers, lakes, estuaries and oceans; big data and numerical modelling

Multiple stressors impact mayfly life history: a plastic response to agricultural stress

Harrison Keesing, Hons Candidate
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Supervisors: Issie Barrett
Elissa Cameron

Environmental stress by anthropogenic activities creates unfavourable conditions for instream biota and leads to the loss of habitat. This impacts biota at the community level, driving the loss of biodiversity and changes in aquatic communities. However, changes may also occur at the individual level through impacts on species life history traits such as development, growth, and reproduction.

This study investigated the influence of multiple stressors on growth and development of *Deleatidium spp*. mayflies across an agricultural gradient. The study was conducted across 10 sites in Canterbury, New Zealand along a gradient from pristine to highly impacted streams. Abiotic characteristics including sediment cover, dissolved oxygen and conductivity were measured and incorporated into a multivariate model using body size as a response and developmental stage as an interacting factor.

Differences between body sizes in *Deleatidium spp*. is likely to be a plastic response in relation to their unfavourable environment, promoting quicker development and emergence with smaller body size. Smaller adults are likely to have lower fitness and reduced reproductive success. Future monitoring in freshwater should also focus on the health and response of individuals to stress and not just community composition. Restoration strategies should recognise local populations might need additional action to overcome certain thresholds for them to recover in the long term.

Research / Career Interests

- Macroinvertebrate life histories, restoration, biomonitoring, responses to environmental stress

Environmental justice in the hydropower sector of Nepal: conceptualizing a new model

Amrit Poudel, PhD Candidate
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Supervisors: Hamish Rennie
Sylvia Nissen

Hydropower development has been considered as the potential to create various socio-economic and environmental benefits. Alternatively, there are Environmental Justice issues arising in the environment and society from hydropower projects.

This research investigates the Environmental Justice concerns of fair distribution of both environmental benefits and risks, inclusiveness in environmental decision-making, fair recognition of the various sociocultural elements and consideration of social well-being using the case study of the hydropower project of Nepal.

How environmental justice is perceived, and the ways that it is engaged with and operationalised, depends significantly upon the specific local context. It is anticipated the results of the research will shed light on contextual aspects of attempting to implement concepts of Environmental Justice in the hydropower sector of Nepal.

The preliminary findings indicate that prevailing legislative procedures, institutional processes, and complex socio-cultural settings of the country lag in recognizing the rights of marginalized and indigenous groups of people affected by the development of the hydropower project. These people have less influential power in environmental decision-making because of weak institutional frameworks and socioeconomic barriers persisting in the community. Because of such complex dynamics, the project benefits are more exploited by “outsiders’ while the project-impacted communities have to face adverse consequences. These will hinder in advancement of the abilities for the effective functioning and well-being of life of individuals and communities and are thus more prone to vulnerabilities.

Bridges causing troubled waters

Kathryn Bates, Masters Candidate
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Supervisors: Issie Barrett
James Brasington

Civil infrastructure is an indispensable requirement of contemporary society. However, construction activities can have adverse effects on the environment, especially when it comes to activities near water bodies.

Despite regulated implementation of various environmental protection measures by the industry, the methods and materials commonly used pose a significant risk to the ecological viability of waterways potentially creating severe or long-lasting impacts beyond the duration of a construction project.

Through a comprehensive evaluation of several 'best practice' environmental guidelines across multiple countries, the concept of optimal environmental practices has revealed significant disparities in definition and implementation. Certain established practices for sediment and erosion control have the potential to shorten project durations. Nevertheless, these same practices and materials outlined in many of these guidelines, can pose significant harm to the environment. It is also apparent that there is a lack of evidence-based research to substantiate their permitted and widespread implementation.

This research aims to understand industry awareness of best practices, including use of these specific materials and procedures in and around waterways, environmental guideline usage, and awareness of freshwater regulations.

Research / Career Interests

- Holistic freshwater management, ecology, climate change

Improving flood mapping by including stopbank breaching

Thomas Wallace, PhD Candidate
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Supervisors: Tom Logan
Kaley Crawford-Flett
Matthew Wilson

Floods are New Zealand's most frequent and damaging natural hazards, with over 100 flood-prone communities. Stopbanks are one of the primary strategies employed within New Zealand to ensure people and infrastructure are out of harm's way.

The need for detailed hydraulic flood modelling of stopbank breaching and failure has been highlighted internationally as critically important. However, stopbank breach modelling is often limited to where there have been historic breaches or worst-case scenarios.

This research presents a framework for determining the probability of flooding under breaching. This allows us to see which areas have a higher susceptibility to flooding, given a breach occurs. By comparing the flooding extents from historical events with and without breaching, we can see how stopbank breaching generally increases flooding (up to 50%) but, in exceptional cases, can reduce inundation (up to -12%). We can also see which breach locations are predicted to cause the greatest flooding.

The method proposed may be adapted to other council flood models to give authorities a deeper understanding of how breaching can alter flooding and which regions of a stopbank have the greatest consequence if breached.

This may be valuable to floodplain managers as these stopbank sections may be targeted for additional reinforcement or monitoring during a flood event, ultimately reducing our communities' flood risk.

Research / Career Interests

- Flood simulations and wider river management

Assessing microbial pathogen transport in groundwater from the Hekeao/Hinds managed aquifer recharge scheme

Madeline Inglis, Masters Candidate
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Supervisors: Leanne Morgan
Hilary Lough

Groundwater is the primary source of drinking water for millions of people worldwide, and approximately 40% of New Zealanders (Panckhurst, 2020); yet significant knowledge gaps remain on the fate of microbial pathogens in the groundwater system (Banasiak et al., 2023). Strong links have been made between elevated levels of *Escherichia coli* (E. coli) (used as indicator organism for faecal contamination) in drinking water and gastrointestinal disease in humans. As such, further research into the transport of pathogens through groundwater is significant globally. Managed Aquifer Recharge (MAR) can be used to improve groundwater quality by discharging relatively clean water into the receiving aquifer (Guo et al., 2023; PDP, 2022).

In South Canterbury, MAR is being implemented by the Hekeao/Hinds Water Enhancement Trust (HHWET) to help reduce elevated nitrate-N in the region, which has occurred as a result of farming in the area. While MAR is intended to have a net positive effect on groundwater quality, pathogens can impact groundwater as a result of the surface water source (the Rangitata River) typically having greater concentrations of pathogens than the groundwater. The aim of this study is to explore the transport and removal rate of E. coli through groundwater as a result of MAR, to help improve the understanding of potential impacts on drinking water supplies.

Water samples from the MAR storage ponds, and from groundwater bores both up- and down-gradient of a MAR site will be collected on a regular basis and analysed for E. coli concentrations (MPN/100ml) using Colilert testing (IDEXX, 2023). The E. coli concentration time series will then be used to assess the correlation and lag between E. coli at the MAR site and in surrounding groundwater. They will also be used to inform modelling of E. Coli removal at the site and assess the usefulness of different modelling approaches.

Research / Career Interests

- Groundwater quality, hydrogeology

Assessment of water quality and nuisance algae blooms in urban stormwater ponds in Ōtautahi Christchurch, Aotearoa New Zealand

Stephanie Koviessen, Masters Candidate
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Supervisors: Issie Barrett
Tadeu Siqueira

Cyanobacteria can produce natural toxins (cyanotoxins) which pose chronic and acute health risks if ingested. These potentially toxic algal blooms (CyanoHABs) are the subject of intense interest as they become more frequent due to land-use intensification and associated nutrient run-off, as well as climate change pressures. CyanoHABs are also becoming more prevalent in urban stormwater and recreational reserves, posing increasing risks to human and animal health.

Local councils are adopting climate change adaptation strategies focused on stormwater management and providing additional services to enhance ecological, cultural, and community values alongside water quality improvement. These strategies rightfully focus on protecting communities from current and projected flood risks but have also created more nutrient rich stormwater ponds where algae and cyanobacteria will thrive. As the use of stormwater ponds expands beyond flood mitigation and towards multiuse facilities, the key drivers influencing CyanoHAB development need to be better understood.

My research takes an in-depth look at these systems to better inform CyanoHAB management and prediction, including effective design parameters in urban stormwater ponds, the current state of water quality and algal communities in urban stormwater ponds, the dominant cyanobacteria species in Ōtautahi, and whether they are toxin producers.

Research / Career Interests

- Planktonic cyanobacteria, cyanotoxins, biodiversity gradient, water quality

The role of New Zealand coastal lakes in the life history of a diadromous fish species

Chris Meijer, PhD Candidate
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Supervisors: David Schiel
Michael Hickford
Duncan Gray

Across the Southern Hemisphere, galaxiid fishes provide many examples of adaptable life-histories, with partial or complete loss of migration occurring repeatedly within diadromous populations. Īnanga (*Galaxias maculatus*) is a widespread species with a normally migratory life-history, but non-migratory populations have established in lowland lakes in Australia, Chile, and Argentina. However, the extent of īnanga populations in NZ's lowland lakes is poorly understood.

We selected 15 lowland lakes/lagoons from the NZ Freshwater Fish Database and surveyed their tributaries for populations of lake-associated īnanga. Īnanga were found in tributaries of 5 of the 15 lakes, with a subset of 50 individuals taken at each lake for otolith analysis.

Simultaneously, working in Te Waihora – Lake Ellesmere, previously considered to have robust īnanga populations, we batch-dyed migrating īnanga to determine if the lake was used for further development before these juveniles entered the tributaries.

We will discuss evidence that only diadromous otolith signatures were identified for lake-associated īnanga, and, in Te Waihora, dyed individuals were immediately caught entering nearby tributaries. We conclude that NZ's lowland lakes likely do not provide suitable habitat for īnanga due to a combination of predation, recruitment failure, and lack of food and habitat resources.

Research / Career Interests

- Conservation, freshwater fish, migrations, food webs, modified habitats, threatened species

Influence of soil databases on parameter sensitivities and prediction uncertainty

Ehsan Qasemipour, PhD Candidate
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Supervisors: Markus Pahlow
Tom Cochrane
Clemens Altaner

Parameter sensitivity and uncertainty analysis is an important step in the modelling process. It leads to identification of the most influential parameters, reduction of the computational time in model calibration, and quantification of uncertainty. In this work, we conducted a sensitivity and uncertainty analysis for a SWAT+ hydrological model of the Mohaka catchment on the North Island of New Zealand. The aim was to determine the parameter sensitivities and discharge prediction uncertainties using five different commonly used soil databases. The most influential parameters were identified using the Morris method as part of the Parameter Estimation software (PEST). The Iterative Ensemble Smoother (iES) was used to quantify the prediction uncertainty.

Although the parameter sensitivities varied between the different soil databases, the plant uptake compensation factor, the soil evaporation compensation factor, the baseflow factor, the groundwater coefficient and the percolation coefficient were the most influential parameters controlling the surface runoff and evapotranspiration processes. It was also found that the biophysical parameters had an influence that in some cases exceeded that of the one observed by the surface runoff/evapotranspiration parameters. Although less commonly considered, we showed that the inclusion of biophysical parameters proved to be influential in the simulation of surface flow processes. Model performance improved when these were included in the model calibration. The iES method reduced the uncertainty compared to prior parameter ensembles.

Research / Career Interests

- Hydrological modelling (surface/groundwater modelling)

Green walls: an opportunity to treat and reuse greywater in New Zealand

Moeen Gholami, PhD Candidate
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Supervisors: Aisling O'Sullivan
Hamish Mackey

The national average household water use is 252 L/ p.e./d. The majority (60%) of this used water ends up as greywater and, combined with blackwater, is treated in wastewater treatment plants. Greywater is generated from household activities such as laundry, cleaning, handwashing, dishwashing, showering, whereas blackwater is from toilet waste. Greywater has a low pathogenic pollutant load compared to blackwater and so separating black and grey wastewater streams could offer numerous opportunities for greywater reuse such as irrigation, toilet flushing, and laundry, widely implemented overseas but minimally in New Zealand. Demands on freshwater consumption for outdoor irrigation (17%) and toilet flushing (18%) could be lessened by substituting freshwater with greywater for these activities. It would also reduce wastewater volumes, and associated collection and pumping costs, currently being treated in wastewater treatment plants.

Green walls provide multiple benefits including energy conservation, air purification, noise and thermal insulation and enhanced biodiversity. As living systems, they sequester carbon through photosynthesis. Additionally, green walls could be adapted to treat greywater at source, removing pollutants from the low pathogenic wastewater stream. Internationally, lab-scale green walls were demonstrated to remove organic matter (>90%), suspended solids (>99%), nitrogen (>85%) and phosphorus (>60%) from greywater. These early data are promising to support the principle of on-site wastewater treatment using green walls.

This research looks at treatment of greywater by natural biofilters. More specifically, it looks at treatment of greywater using green wall systems focusing on the application of 3D printed media for the removal of nutrients.

Research / Career Interests

- Academic, industry

Rates of salinization of offshore fresh groundwater under changes in onshore groundwater levels

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Leanne Morgan

Many alluvial aquifer systems in New Zealand are likely to contain offshore fresh groundwater (Morgan and Mountjoy 2022). This can be due to both high aquifer hydraulic conductivities allowing for flow of fresh groundwater offshore, and low aquitard hydraulic conductivities preserving fresh groundwater offshore during glacial cycles. This offshore fresh groundwater is typically a high-quality water resource, and in some cases non-renewable.

When coastal groundwater levels are lowered due to groundwater use, salinization of offshore fresh groundwater increases. This can eventually lead to salinization of onshore groundwater resources (Knight et al. 2018).

We analysed an ensemble of models of semiconfined coastal aquifers to understand how offshore fresh groundwater is salinized under changes in head. Aquifers were modelled using python and MODFLOW. We found that the hydraulic conductivity of the aquifer and the vertical hydraulic conductivity of the aquitard had the biggest effect on the fraction of offshore fresh groundwater salinized. Results give an indication of time to complete salinization of offshore fresh groundwater.

Research / Career Interests

- Groundwater science and modelling. Research and consulting

Are triggers for adaptation to sea level rise on coastal lowland agricultural land aligned between local and regional councils and farmers?

Katherine Manning, Masters Candidate
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Supervisors: Steve Urlich
Alison Bailey
Paula Blackett

Farms in the coastal lowlands are increasingly vulnerable to physical and biophysical changes associated with rising groundwater resulting from sea level rise. These changes pose fresh challenges to agricultural land management practices and complicate compliance with increasingly stringent regulations to protect freshwater. The growing complexity associated with managing lowland farms, coupled with competing influences on when and how land managers and councils react to groundwater and sea level changes requires ongoing exploration.

The intersection of sea level rise, agriculture, and policy within coastal lowlands will be explored through this research which is supported by the MBIE-funded NIWA Future Coasts Aotearoa project. The project's overarching aim is to enhance the evidence base of sea level rise consequences on agricultural practices and inform the successful adaptation of coastal, lowland communities within planning processes.

Focusing on the Rakahuri Ashley River catchment, a content analysis and semi-structured interviews will inform an analysis that exposes the adaptation triggers for farmers, policy and planning direction. Through the insights into how two groups, farmers and councils, are anticipating, reacting, and planning for the consequences of unstoppable sea-level rise, alignment and misalignment can be identified.

The results of this study will inform adaptation processes in similar lowland environments vulnerable to sea-level rise.

Research / Career Interests

- Equity and justice within adaptation planning, processes, and outcomes

Data worth analysis to improve modelling of shallow groundwater levels under sea-level rise

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Supervisors: Leanne Morgan
Wes Kitlasten

Data worth analysis is being used to reduce model predictive uncertainty of shallow groundwater levels as part of Future Coasts Aotearoa. Climate change induced sea-level rise is predicted to effect groundwater levels in coastal regions. Being able to make accurate predictions about the localised effects of sea-level rise on groundwater is important for effective planning.

A groundwater model of a study area in the coastal region between the Ashley and Waimakariri Rivers is built to make predictions of how groundwater in the area will behave under sea-level rise. Groundwater modelling uses expert knowledge about material properties, their spatial distributions, and fluid flow to inform predictions about future groundwater levels. Sparse subsurface data in the area contributes to model predictive uncertainty and limits the ability of the model to provide useful information.

History matching to available water level data helps reduce model uncertainty. Selecting ideal locations for additional monitoring will be useful for providing data with the highest potential to reduce model predictive error. The model predictive uncertainty is quantified and data worth analysis used to identify locations for additional monitoring which could have the greatest effect in reducing this predictive uncertainty.

It is hoped that the results of this investigation will be beneficial in decision making for designing the local groundwater monitoring network and planning for the effects of sea-level rise.

Research / Career Interests

- Groundwater, environmental modelling, environmental decision making, science in society

Risk assessment of emerging contaminants in tyre rubber for Aotearoa New Zealand

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Andrew Chappell

This project aims to investigate environmental presence of contaminants in tyre rubber and perform a risk assessment for Aotearoa New Zealand.

Internationally chemical additives in tyre rubber have been identified as contaminants of emerging concern. Currently, there is no reported data on environmental concentrations of these contaminants in Aotearoa New Zealand. Furthermore, there is no data available on the toxicity of these compounds to Aotearoa New Zealand flora and fauna.

The source-pathway-receptor rationale is used to design a methodological framework for risk assessment. Tyre rubber is the source of contaminants. This includes tyres used for vehicular applications as well as recycled tyre rubber for other outdoor applications. Urban runoff and road dust are prioritised as key pathways for these contaminants to enter the environment. Road dust and surface water samples from an urban population centre will be analysed for selected key contaminants, including 6PPD-Q, DPG, DCA, DCU and HMMM.

This research focuses on the aquatic environment, given recent findings of acute toxicity to fish at environmentally relevant concentrations. International literature will be used to inform a risk assessment for the Aotearoa New Zealand environment, including potential cultural, economic, and social implications.

Research / Career Interests

- Environmental chemistry, contaminants of emerging concern, environmental monitoring

Ecological role of amphidromous fish (*Galaxias spp*.) in freshwater food-webs

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David Schiel

Understanding how the exploitation of amphidromous fishes alters species interactions, energy flow, and community composition within freshwater ecosystems is vital for obtaining a robust evaluation of fishery sustainability. In New Zealand, the 'whitebait' fishery harvests post-larvae of five Galaxias species as they migrate from the sea into freshwater.

We investigated whether fishing-induced reductions in post-larvae of three endemic kōkopu species (*Galaxias fasciatus, G. argenteus*, and *G. postvectis*) altered freshwater fish community composition and food-web characteristics by limiting a potentially important marine-derived prey subsidy. To test this, we compared mass-abundance relationships, and diet (using stable isotope analyses) of fish communities in five fished and three unfished streams on the West Coast before and after peak whitebait influxes.

We found that communities within unfished streams had more small-bodied fish, particularly after whitebait influxes, but similar densities of large-bodied fish to fished streams. While unfished streams had more small fish, medium-sized fish were comparatively underrepresented before peak whitebait migrations, suggesting that they were not utilising small fish prey during this time. Using stable isotope analyses, we identified that this was because large-bodied predators were monopolising small fish prey. However, in closed streams, peak whitebait influxes were sufficiently large that subordinate fishes could also benefit from these marine subsidies.

This emphasises the importance of adopting an 'ecosystem-based' fisheries management approach that incorporates the intricate predator-prey interactions and density-dependent competition underpinning community dynamics.

Research / Career Interests

- Freshwater fish management and conservation

Alpine catchment source determination and snowmelt to streamflow timing

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Supervisors: Shelley MacDonell
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Cryosphere processes are pivotal for regulating water availability in headwater catchments worldwide. Understanding these processes is increasingly crucial in our changing climate. Seasonal snow cover, acting as temporary water storage in alpine regions, significantly impacts downstream water resources.

New Zealand's eastern alpine headwater catchments, especially Canterbury, face shifting precipitation patterns and accelerated warming due to climate change. This study aims to quantify snowmelt and rainfall contributions to streamflow and investigate hydrometeorological processes in a Canterbury headwater catchment.

In order to investigate the atmospheric and hydrological processes that occur in the alpine catchment of Camp Stream a sampling campaign was conducted. Daily stream samples along with monthly precipitation, snow, and groundwater samples were analysed for isotopes of $\delta^{18}O$ and d-excess to identify and estimate the different sources of streamflow in the catchment. The isotopic composition of the different end member source waters varied over space and time. Variations between storm events were also observed and traced through the snowpack with a secondary outcome aiming to understand how quickly snowmelt reaches the stream in an alpine headwater catchment.

This research enhances our understanding of streamflow sources and fills a critical gap in New Zealand's hydrological knowledge. Helping to determine stream sources and the speed with which snowmelt reaches waterways will help deepen our understanding of the country's water resources and their potential response to a changing climate.

Research / Career Interests

- Alpine catchments and surface water management in a changing climate

Maximising the physical, ecological, social, and cultural outcomes of stormwater-related urban blue-green infrastructure

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Ed Challies
Rita Dionisio

The impacts of climate change and COVID-19 have necessitated the consideration of multi-functional approaches to urban stormwater management. Blue-green infrastructure (BGI) has been identified as a nature-based method to mitigate the impacts of these hazards through the provision of bio-physical and socio-cultural co-benefits. BGI has been defined as the infrastructure of natural, semi-natural, and artificial spaces that mimic natural processes.

BGI has been shown to provide a range of benefits, including; reduced urban flood risks and temperatures, improved water quality, enhanced biodiversity, improved mental and physical wellbeing, the facilitation of social cohesion and a sense of place, and enhanced cultural connections and values. However, existing research has neglected the potential socio-cultural benefits of BGI, perhaps limiting its multi-functional potential. As such, this research seeks to understand (1) the ways in which urban BGI may provide these benefits to the surrounding communities in practice, and (2) what design characteristics may influence the efficacy of BGI projects.

Christchurch-based case studies were then undertaken to understand the provision of co-benefits. These case studies included the use of surveys, focus groups, and interviews with communities and practitioners. Results thus far have confirmed that while BGI can provide a diverse range of benefits in practice, these can invariably be influenced by the design process. This research may then contribute to maximising the bio-physical and socio-cultural outcomes of stormwater-related BGI projects through more explicit design decisions.

Research / Career Interests

- Blue-green infrastructure, social resilience, multi-functional urban design

Groundwater hindcasting: what is it, how do we do it, and why is it important?

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Cath Moore
Wes Kitlasten

Although extensive groundwater resource development has occurred mainly within the industrial period (circa 1970s), changes to land use, landscape modifications and extensive clearing of native vegetation has been occurring since early anthropogenic settlement. Future water resource management increasingly demands a more robust understanding of past hydrological conditions within the Holocene, such as (a) past hydrological trends and variability, (b) conditions to support sustainable restoration strategies, and (c) responsibly recognize alternative facets to human-water relationships and Indigenous cultural values associated with water.

Past conditions can be modelled using hindcasting approaches which simulate or predict hydrologic regimes of the past based on conceptual models, historical data and proxies.

This review is the first synthesis of previous research studies applying hindcasting approaches to groundwater reconstructions within the Holocene. Due to the scarcity of instrumental data prior to the 20th century, we investigate historical data which can be used to constrain hindcasts. In addition, we explore hindcasting methods and find there are two main approaches to modelling groundwater reconstructions: archival and extensional approaches. We compare these approaches in terms of application, temporal and spatial scales of reconstructions, and their ability to resolve past hydroclimatic variability and impact of anthropogenic activities.

We discuss future opportunities, highlighting a novel application using Indigenous Knowledge to reconstruct groundwater conditions prior to European arrival in the Heretaunga Plains, NZ.

Research / Career Interests

- Groundwater modelling, hindcasting, groundwater-dependant ecosystems, Mātauranga Maori

Posters

Using riskscape to measure the impact of flood uncertainty on decision-making

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Carolynne Hultquist

Flooding is a major hazard in Aotearoa. In 2022 and 2023 alone, the combined cost of damage was more than 3.5 billion dollars. To address this problem, flood hazards and the potential impacts in New Zealand need to be better understood.

The RiskScape modelling platform is one such solution. Jointly developed by NIWA and GNS, RiskScape is an open-source data processing application that can be used for multi-hazard risk analysis. Now in its second iteration RiskScape can analyse probabilistic hazard scenarios with customised damage functions and localised data as inputs. The outputs can include both risk assessments and loss estimates which can be tailored to show specific elements and aggregated results across a region. Using these outputs decision-makers at the national and council levels can implement appropriate mitigation strategies to minimize the impact from future flood events.

This project aims to test how the uncertainty produced by these RiskScape outputs is represented and how that uncertainty influences the cases by case decisions made by New Zealand planners. Initial results from RiskScape simulations using data from the Kaiapoi region north of central Christchurch will be displayed.

Research / Career Interests

- Disaster management, climate change, resilience and capacity building, emergency information management

Using isoprostanes as a wastewater biomarker to monitor community health and wellbeing

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Matt Hobbs
Andrew Chappell

Real-time indicators of community health and wellbeing are required to evaluate the status and the efficacy of public health interventions. Wastewater based epidemiology (WBE) has shown to be an effective tool as a large-scale early warning and surveillance tool/method for public health interventions to improve community health and wellbeing.

Isoprostanes i.e. 8-iso-prostaglandin F2α and prostaglandin E2 are produced by people when they are stressed or unwell, are excreted in urine and if flushed down drains will reach and enter centralised community wastewater treatment plants. 8-iso-prostaglandin F2α and prostaglandin E2 have been detected and quantified in wastewater samples across differing communities internationally and have been proposed as human biomarkers of community oxidative stress.

However, limited assessments have investigated the relationship between community health and the concentrations of isoprostanes in community wastewater. Therefore, this research will determine the concentrations of 8-iso-prostaglandin F2α and prostaglandin E2 in wastewater from communities around New Zealand. The measured isoprostanes concentrations will then be compared to other indicators of human health e.g. health location index, New Zealand deprivation index and median house price. This will determine if the amount of isoprostanes detected in a communities wastewater can indicate the health and wellbeing of its population.

Research/ Career Interests

- Water resource management, water quality, environmental monitoring and wastewater treatment

Building future urban development scenarios into assessments of future flood risk

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Supervisors: Iain White
Matthew Wilson

The devastating impact of flood events demonstrates the need for more comprehensive assessments of future flood risk in urban policy. Risk assessments based on **future** flood projections paired with **current** urban plans are missing a key characteristic of the hazard – what will urban areas in Aotearoa-NZ look like in 2050 or 2100?

The aim of this research is to determine how urban growth models can be utilised to generate alternative long-term scenarios of future urban form for integration into assessments of future flood risk. Areas for investigation include: the evolution of urban growth modelling and the advantages and limitations of different methods with respect to long-term prediction and scenario generation; how modelling methods vary across NZ and what would be useful tools for urban planners and policy makers; what model benchmarking reveals about model sensitivity and prediction uncertainty; and how urban future scenarios can be integrated with flood and risk models.

The research goal is to computationally simulate a range of possible urban futures that can be coupled with flood projections to provide a more comprehensive picture of the uncertainties of future flood risk.

Research/ Career Interests

- Data science, urban modelling, model building, decision support tools

Simulation of sediment loads in Lake Opuha using the SWAT+ model

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Supervisors: Tom Cochrane
Markus Pahlow
Arman Haddadchi

One of the main challenges of sustainable reservoir management is the excess of suspended sediments, which affects a range of functions by reducing their potential for energy generation, water supply and recreational benefits.

This study presents a sediment yield simulation of the Lake Opuha catchment using the Soil and Water Assessment Tool (SWAT+). The objectives of this research are to: (1) use the SWAT+ model to quantify the sediment load that reaches the lake, (2) identify different sediment sources, and (3) determine the most efficient measures to reduce suspended sediments in the reservoir.

The methodology employed involves the calibration and validation of the model using data from flow and sediment monitoring stations. Sediment samples from the lakebed and suspended sediment samples from the tributaries and lake have been analysed to identify sediment sources and include them in the model. Subsequently, scenario-based simulations are conducted to assess the effect of a range of land management practices and soil conservation measures on sediment yield dynamics under climate change, with a focus on extreme events.

This research contributes to the broader field of sustainable water resource management by providing a comprehensive understanding of sediment dynamics in the catchment, as well as understanding the limitations of SWAT+ regarding the simulations of processes associated with point sources of sediment and sediment routing, with the aim to subsequently implement improvements.

Research / Career Interests

- Hydrological modelling, sediment dynamics in river systems, watershed management

Development of farmer-led irrigation for sustainable use of groundwater in sand rivers

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Pieter van der Zaag
Annelieke Duker

The Limpopo River Basin is in a semi-arid region, which makes the development of sustainable and viable irrigation challenging, mainly because of the lack of water during the dry season, climate unpredictability, and high implementation costs. However, the Limpopo Sand River (LSR) has water stored in its sandy riverbed that can be used for smallholder irrigation.

This study aims to develop a strategy for sustainable and economically viable farmer-led irrigation from the LSR, considering uncertainty. The study will (1) provide insights into how to strengthen the resilience of rural communities in the face of climate variability and other environmental challenges; (2) provide a comprehensive understanding of the opportunities and constraints for irrigation development; (3) evaluate the socio-economic feasibility of Farmer-led Irrigation Development (FLID); and (4) generate practical recommendations for promoting sustainable irrigation development and improving the livelihoods of rural communities. The study will be conducted in Chókwè and Mapai districts, Gaza province, Mozambique. It will employ a mixed-methods approach, combining quantitative and qualitative data gathering and analysis techniques.

The findings of this study will contribute to the development of evidence-based policies and practices for sustainable groundwater irrigation development in the LSR and other similar contexts. The study will also provide insights into the role of FLID strategies in achieving the SDGs related to food security, poverty reduction, environmental sustainability, and adaptation to climate change.

Research / Career Interests

- Sand rivers, irrigation, water resources management, hydrology, rural development, soil and land management

Back to the future: hindcasting groundwater systems to inform transdiciplinary approaches to ecosystem rehabilitation

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Supervisors: Leanne Morgan
Cath Moore
Wes Kitlasten

Hindcasting (ie. modelling the past) is being undertaken to investigate the recent (< 500 years) evolution of groundwater discharge to a site of high cultural significance for the tāngata whenua of Pakipaki in Te Matau-a-Māui. Although groundwater resource development has occurred mainly within the industrial period (circa 1970s), changes to land use, landscape modifications and extensive clearing of native vegetation has been occurring since early settlement. Catchment development has impacted water quantity and quality manifesting today as seasonally persistent declines in water levels and increases in contaminants from surface sources (ie. agriculture, urban sprawl, industrial works).

Many efforts are focused on the physical aspects (ie. quality, quantity) of rehabilitation of freshwater resources, however, future strategies need to achieve multidimensional views through the inclusion of indigenous values. Te Mana o te Wai is a concept focused on restoring and preserving the balance between wai, taiao and tāngata. Water has many facets of cultural importance to Māori, such as providing mahinga kai, wellbeing, and a link between the spiritual and physical world. This research seeks to better understand the evolution of changes to the water regime, which may also provide critical insights to the evolution of indigenous socio-hydrological states.

This research highlights a novel application of groundwater modelling using a transdisciplinary approach. We explore the process of weaving mātauranga maori and western scientific knowledge towards the co-creation of a modelled lens into the past. This work then aims to inform future rehabilitation strategies supported by multidimensional perspectives.

Research / Career Interests

- Groundwater modelling, hindcasting, groundwater-dependant-ecosystems, Mātauranga Maori, restoration/rehabilitation, transdisciplinary science

Assessment of water quality and nuisance algae blooms in urban stormwater ponds in Ōtautahi Christchurch, Aotearoa New Zealand

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Supervisors: Issie Barrett
Tadeu Siqueira

Cyanobacteria can produce natural toxins (cyanotoxins) which pose chronic and acute health risks if ingested. These potentially toxic algal blooms (CyanoHABs) are the subject of intense interest as they become more frequent due to land-use intensification and associated nutrient run-off, as well as climate change pressures. CyanoHABs are also becoming more prevalent in urban stormwater and recreational reserves, posing increasing risks to human and animal health.

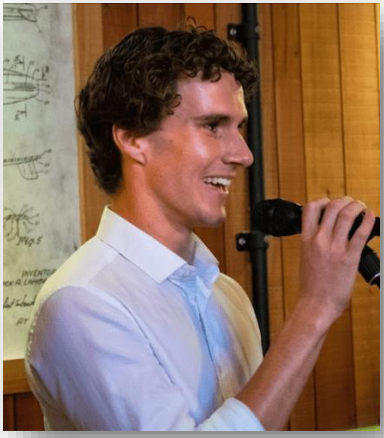
Local councils are adopting climate change adaptation strategies focused on stormwater management and providing additional services to enhance ecological, cultural, and community values alongside water quality improvement. These strategies rightfully focus on protecting communities from current and projected flood risks but have also created more nutrient rich stormwater ponds where algae and cyanobacteria will thrive. As the use of stormwater ponds expands beyond flood mitigation and towards multiuse facilities, the key drivers influencing CyanoHAB development need to be better understood.

My research takes an in-depth look at these systems to better inform CyanoHAB management and prediction, including effective design parameters in urban stormwater ponds, the current state of water quality and algal communities in urban stormwater ponds, the dominant cyanobacteria species in Ōtautahi, and whether they are toxin producers.

Research / Career Interests

- Planktonic cyanobacteria, cyanotoxins, biodiversity gradient, water quality

Rising waters: groundwater hazard exposure in the Waimakariri District of Canterbury, New Zealand



Desmond McCloy, Masters Candidate
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Supervisors: Leanne Morgan
Zeb Etheridge

Groundwater shoaling because of sea level rise (SLR) is one of the many challenges associated with climate change. High water tables can result in damage to infrastructure and increase the severity of flooding during extreme rainfall events. Despite this, little has been done to understand the exposure of coastal assets to this hazard.

The aim of this study is to complete a groundwater shoaling analysis to provide information on the exposure of coastal assets to water table shoaling under SLR. This will provide supporting information for the design of an early warning monitoring system for adverse impacts from SLR-driven rising groundwater levels. The case study area is the Waimakariri District in New Zealand, which has a range of agricultural and community assets situated on top of a coastal unconfined aquifer.

To assess exposure, we analysed existing interpolated water table data and groundwater level spot and time series data for variance and spatial coverage using QGIS. To increase spatial coverage, two 4-meter deep piezometers have been installed within Tūhaitara Coastal Park in locations where spatial coverage was sparse. Data from these piezometers will be combined with existing data to interpolate multiple depth-to-groundwater surfaces under specified SLR-driven water table increases and to show the associated groundwater hazard exposure. Analysis of time series variance in depth-to-groundwater monitoring data will then be used to evaluate the statistical power for detection of water table change.

Research / Career Interests

- Groundwater monitoring techniques, interaction between climate change and groundwater

New Zealand daily weather patterns and large scale climatic patterns as heavy rainfall drivers

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Marwan Katurji
Fernando Méndez

Based on previous work in the field this study presents a new synoptic classification of 49 Daily Weather Types (DWTs) for the New Zealand region, using Mean Sea Level Pressure (MSLP) and 500 geopotential height as predictor variables. It provides a probabilistic description of the relationship between the DWTs and local extreme rainfall events using as a study site the Wairewa catchment (Little River), which increasingly suffers from flooding.

Meaningfully and useful relationships have been found between the DWTs, the rainfall data, and the large-scale climatic patterns. More than a half of the DWTs are linked to the occurrence of extreme rainfall events, and sometimes to flooding. Most of these DWTs represent cyclonic states and intense north westerlies winds, however, some of them are characterized by anticyclonic conditions and mild winds. Time-scale variability of the predictor variables plays a very relevant role, which translates to the DWTs and then to the time scale variability of storms and flooding events. Large scale climatic patterns (such as El Niño Southern Oscillation) condition the DWTs frequency of occurrence and in some cases impact the occurrence of extreme rainfall events and flooding.

The synoptic climatological approach proposed is of qualitative value since it can help in the interpretation of the weather conditions and climatic patterns that can lead to extreme rainfall and flooding; but also, of quantitative value, possibly helping in the prediction of these events.

Research / Career Interests

- Flood modelling, hybrid methodologies, climate change

Splitting streamflow

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Supervisors: Shelley MacDonell
Travis Horton

Cryosphere processes are pivotal for regulating water availability in headwater catchments worldwide. Understanding these processes is increasingly crucial in our changing climate. Seasonal snow cover, acting as temporary water storage in alpine regions, significantly impacts downstream water resources.

New Zealand's eastern alpine headwater catchments, especially Canterbury, face shifting precipitation patterns and accelerated warming due to climate change. This study aims to quantify snowmelt and rainfall contributions to streamflow and investigate hydrometeorological processes in a Canterbury headwater catchment.

In order to investigate the atmospheric and hydrological processes that occur in the alpine catchment of Camp Stream a sampling campaign was conducted. Daily stream samples along with monthly precipitation, snow, and groundwater samples were analysed for isotopes of δ18O and d-excess to identify and estimate the different sources of streamflow in the catchment. The isotopic composition of the different end member source waters varied over space and time. Variations between storm events were also observed and traced through the snowpack with a secondary outcome aiming to understand how quickly snowmelt reaches the stream in an alpine headwater catchment.

This research enhances our understanding of streamflow sources and fills a critical gap in New Zealand's hydrological knowledge. Helping to determine stream sources and the speed with which snowmelt reaches waterways will help deepen our understanding of the country's water resources and their potential response to a changing climate.

Research / Career Interests

- Alpine catchments and surface water management in a changing climate

Spatiotemporal analysis of groundwater quality patterns in the Mid Canterbury Region

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Carolynne Hultquist

Groundwater quality responds to variables such as climate variations, rainfall, lithology, and land management practices. Previous studies surrounding groundwater nitrate levels in the Mid Canterbury region have found increasing concentration over time typically attributed to the change of land management, with many values exceeding international health guidelines.

My research will utilise historic groundwater quality data from ESR (Institute of Environmental Science and Research) and DSIR (Department of Scientific and Industrial Research) archives to conduct a spatiotemporal analysis of groundwater quality, climate, lithology, and land use to explore potential drivers of groundwater quality change. Here, I present initial exploration of the data and address some of the challenges in dealing with temporally and spatially sparse data. To gain further insight into reference conditions of nitrate in groundwater, the relationship between nitrate, manganese, and iron in redox zones, will be explored. As oxygen levels decrease or become depleted in groundwater, facultative anaerobic bacteria sequentially use nitrate, manganese and then iron (III) as alternative electron acceptors. The historical dataset includes measurements of iron and manganese concentrations that precede those of nitrate.

Therefore, an understanding of the relationship between these variables could fill some of the gaps in the dataset and add to the knowledge of groundwater transport and redox zones.

Research / Career Interests

- Groundwater quality, spatial analysis, groundwater chemistry, Bayesian interpolation

Improving flood mapping by including stopbank breaching

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Floods are New Zealand's most frequent and damaging natural hazards, with over 100 flood-prone communities. Stopbanks are one of the primary strategies employed within New Zealand to ensure people and infrastructure are out of harm's way.

The need for detailed hydraulic flood modelling of stopbank breaching and failure has been highlighted internationally as critically important. However, stopbank breach modelling is often limited to where there have been historic breaches or worst-case scenarios.

This research presents a framework for determining the probability of flooding under breaching. This allows us to see which areas have a higher susceptibility to flooding, given a breach occurs. By comparing the flooding extents from historical events with and without breaching, we can see how stopbank breaching generally increases flooding (up to 50%) but, in exceptional cases, can reduce inundation (up to -12%). We can also see which breach locations are predicted to cause the greatest flooding.

The method proposed may be adapted to other council flood models to give authorities a deeper understanding of how breaching can alter flooding and which regions of a stopbank have the greatest consequence if breached.

This may be valuable to floodplain managers as these stopbank sections may be targeted for additional reinforcement or monitoring during a flood event, ultimately reducing our communities' flood risk.

Research / Career Interests

- Flood simulations and wider river management

About Our Platinum Sponsors

Environment Canterbury is the regional council for this magnificent region. In Canterbury we have one of the most astonishing environments in New Zealand – from the turquoise Lake Tekapo, the stunning Southern Alps, the widespread agricultural plains, and beautiful coastline – not to mention our 'capital' city of Christchurch – and everything in between. The regional council is responsible for this environment, with the community's support and in collaboration with many other organisations.

The work of Environment Canterbury takes place under five broad portfolios:

1. Water and Land;
2. Biodiversity and Biosecurity;
3. Climate Change and Community Resilience;
4. Air Quality, Transport and Urban Development;
5. Regional and Strategic Leadership.

Within these portfolios, the regional council covers such things as the Harbourmaster's Office, regional parks, coastal erosion, buses, pest management, flood protection, and air pollution.

A key part of the way we work is through our Ngāi Tahu Partnership. This is cornerstone to Environment Canterbury as a Tiriti (treaty)-based organisation but also enhances our ability to be an effective natural resource manager. We also work closely with central and other local government agencies, businesses, industry sectors and community and volunteer groups to manage natural resources.

We are proud to support the 2023 Waterways Postgraduate Student Conference. Water is the driving force behind much of our economy and protection of this precious resource requires science to mitigate negative impact to ensure that we have a positive impact.

Selwyn stretches across the Canterbury Plains, bounded by the Rakaia and Waimakariri Rivers, with Arthur's Pass National Park in the Southern Alps to the west and the Pacific Ocean to the east.

With a population of more than 80,000 Selwyn is the third largest territorial authority in the South Island, following years of sustained growth. While this growth was initially driven by relocation following the Canterbury earthquakes, it is now equally sustained by industrial and commercial movement towards the south west of Greater Christchurch. The district also supports a thriving primary production sector including dairying, assisted by ongoing irrigation investment.

Selwyn District Council is planning significant investment over the next 10 years in community services, facilities and infrastructure, including the management of our 5 Waters services – water supply, wastewater, stormwater, land drainage and water races. This is of course dependent on the Three Waters Reform.

The availability of clean, safe water and the safe disposal of wastewater are fundamental to the health of our community and natural environment. The Council takes an integrated approach to managing water resources, recognising that our 'mountains to sea' landscape means there is a strong connection between these services.

Much of the district lies within the catchment of Te Waihora/Lake Ellesmere, one of New Zealand's most important wetland systems, and central to the mana of Ngāi Tahu. The Council is working actively with Ngāi Tahu, Environment Canterbury and other partners on widespread cultural and ecological restoration projects.

Other priority projects include the expansion and upgrading of wastewater treatment facilities, increasing water supply capacity and the upgrade of water supply treatment plants.

Christchurch City Council

Across Christchurch and Banks Peninsula there is a network of waterways and lakes. These range from large lakes to narrow tributaries with intermittent flows, including:

- Lake Forsyth/Te Roto o Wairewa and part of Lake Ellesmere/Te Waihora, as well as a number of smaller lakes
- About 78 kilometres of rivers, including the Avon/Ōtakaro River, Heathcote/Opāwaho River, Styx/Puharakekenui River, and part of the Waimakariri River and Halswell/Huritini River, as well as a number of rivers on Banks Peninsula
- About 2605 kilometres of river tributaries and other smaller streams (many of them ephemeral).

Improving the quality of our waterways is a goal of our community and is a priority for the Council. It's also a requirement of the Council's Comprehensive Stormwater Network Discharge Consent (CRC214226).

Under the consent the Council:

- Monitors water quality at over fifty waterway and coastal sites within Christchurch City and Banks Peninsula monthly.
- Is developing stormwater management plans for river catchments where there are stormwater networks
- Is undertaking feasibility and technical studies to look at improving the performance of stormwater treatment facilities
- Is undertaking flood modelling to determine the level of stormwater volume mitigation required (using stormwater basins), to stop downstream flooding from new developments
- Working with industry to improve stormwater runoff from high-risk activity sites
- Has an advisor supporting the programme of work being carried out by the Community Waterways Partnership
- Has appointed a Mahinga kai / Nga wai Advisor to ensure mana whenua and cultural valves are incorporated across the consent work.

Lincoln Agritech is a multidisciplinary research and development company. We deliver leading-edge science and engineering for the environment, agriculture, and industry.

Our research areas are:

Environmental: Our environmental team is focused on shallow groundwater systems and the wider environment those systems interact with. We have particular expertise in research and consulting for groundwater and surface water quality and quantity management. Our experience in understanding interactions between the shallow groundwater systems and the surface (surface water or land, leaching, spring discharges, groundwater/surface water interaction) makes the Lincoln Agritech environmental team uniquely placed to help to solve current water resource and environmental issues.

Precision Agriculture: We apply and support development of sensing technologies, including remote sensing, to assess and understand spatial and temporal variability of soils, crops, and animals. We study how such data can improve decision-making.

Information Technology and IRRICAD™: IRRICAD™, is a world-leading computer software system for designing pressurised irrigation systems, which sells in more than 90 countries, and is available in eight languages. It is used by the world's largest irrigation company, Netafim.

New Materials: We develop new high-value materials from biological sources, including coarse wool and plant-derived cellulose. We partner with industry, including the Wool Research Organisation of New Zealand, and focus on commercial applications of new materials.

Sensing and Biotechnology: We provide agricultural and industrial clients with:

- smart sensing technologies that reduce costs, realise new revenue streams and improve decision-making – including capability in machine vision and electromagnetics;
- microbiome analyses and microbial biotechnologies for biocontrol to manage disease and to enhance plant growth systems;
- engineering-based methane mitigation and CO2 removal techniques to combat global warming and help New Zealand to reduce its greenhouse gas emissions.

About Our Gold Sponsors

NIWA is New Zealand's leading natural resources and environmental sciences service provider.

Our mission is to support the wellbeing of Aotearoa New Zealand's people and businesses through improved management of the environment, sustainable use of natural resources, and effective responses to global change.

We deliver on our mission by undertaking world-leading climate, freshwater and marine science, and providing a wide range of services to our stakeholders and clients. We typically conduct more than 1,300 projects each year for more than 100 different organisations, including government, industry and Māori.

We focus our science and services on New Zealand's greatest opportunities and most pressing challenges, such as increasing resilience to weather-related hazards and climate change, fostering regional economic growth, transitioning to a diversified low-carbon economy, preserving biodiversity and ecosystem health, improving water quality and allocation, and achieving social equity.

ENGEO is an award-winning firm of geotechnical engineers, geologists, environmental scientists and asbestos specialists. We are not just another typical engineering and environmental consultancy. Sure, we're professional, reliable, and customer focused, but we're also dynamic, innovative and creative. We truly live out our ethos that letting our people shine is best for our business and our clients. We thrive by finding meaningful opportunities to promote growth and prosperity for our clients, employees and communities.

Our team is focussed on minimising the environmental impact of our clients projects whatever and where ever they may be in New Zealand. From residential subdivisions and brownfield redevelopment sites through to former hospital demolition projects and hazardous materials remediation, we support making decisions that benefit the local environment, societies in which we work and make economic sense to our clients.

We recognise that water both globally and here in Aotearoa is increasingly under more pressure due to land use intensification and greater demand for this invaluable resource.

ENGEO offers a comprehensive range of hydrological services including groundwater supply and management, groundwater impact assessments, regulatory applications and consent management, and stormwater assessment and management.

At ENGEO we want to support all involved in the research and protection of our water and especially encourage those involved in the Waterways Postgraduate Student Conference.

Hill Labs is New Zealand's largest 100% privately owned and operated analytical testing laboratory with three major testing areas: agriculture, environmental and food.

Trusted for almost 40 years, our focus has remained unchanged: providing New Zealanders with the best analytical testing service on offer. Founded in 1984 by Dr Roger and Anne Hill, the company remains family owned today.

As a company we are firmly committed to developing our people through our career advancement framework, and fully support staff in gaining varied technical experiences. With branches located in Hamilton, Tauranga, Auckland, Wellington, Blenheim and Christchurch, Hill Labs is a significant employer of science graduates from New Zealand tertiary institutions.

manatiaki kōawa
rivers
GROUP
A joint technical interest group of Engineering New Zealand & Water NZ

The NZ Rivers Group is a technical interest group of Engineering New Zealand and Water New Zealand that formed in 2009 to provide a forum for those involved with, and with an interest in rivers, flood risk management and the operational and environmental issues of catchments and river systems.

Our members include engineers, geomorphologists, hydrologists, ecologists, scientists, planners, managers and others who are passionate about the successful management of river systems across New Zealand. The key objectives of the Rivers Group are:

1. To facilitate cross-disciplinary interaction between individuals, communities and professionals involved in catchment management, flood risk management and river management throughout New Zealand;
2. To promote best practice, leadership and the sharing of technical knowledge in all aspects of catchment management, including flood risk management, river restoration and river engineering throughout urban and rural environments in New Zealand;
3. To support and promote relevant science and research in river and catchment management and to disseminate that information among professionals, academics, decision makers and the general public;
4. To promote and facilitate input into local and central government policies, strategies, standards and programmes affecting catchment and river management;
5. To assist in the integration of the principles of the Treaty of Waitangi in best practice river management.

WAIMAKARIRI
DISTRICT COUNCIL

The Waimakariri District lies north of the Waimakariri River and extends from Pegasus Bay in the east to the Puketeraki Range in the west. Both the Waimakariri River and the Ashley River/Rakahuri catchments have high ecological, mahinga kai and recreational values.

There is a breadth of ecological habitats; braided rivers, beech forests, kanuka dryland remnants, coastal saltmarshes in Te Aka Aka, (the Ashley Rakahuri estuary), wetlands such Tūtaepatu Lagoon, and small coastal lakes such as Pegasus Lake and the Kaiapoi Lakes.

The District has a fast-growing population, which is currently about 68,000 inhabitants. Rangiora is the district seat and largest town, with other major towns including Kaiapoi, Oxford, Pegasus and Woodend. Waimakariri District Council provides three waters services as well as rural drainage and a stockwater race network among other services.

Our Council is a signatory of the Canterbury Water Management Strategy, and takes an active role in managing our environment. We support and carry out a diverse range of work for stormwater quality and protecting and enhancing indigenous biodiversity.

There are opportunities for student involvement with our diverse work programme, such as summer work or support for research topics which vary from year to year. Get in touch to find out what we have on offer.

Notes

Notes


Waterways
Centre


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