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Abstracts

Andrew E.F. Allison[1], Victoria Huang[2], Paula E. Blackett[1], Alex Fear[3], Connon Andrews[3], Scott A. Stephens[1], Paula Holland[3], Christo Rautenbach[4] and Chen Wang[2]

[1]Urban Intelligence, Auckland, [2]NIWA, Wellington, [3]NIWA, Hamilton, [4]Waikato Regional Council, Hamilton

Big data for little agents – identifying agent classes for climate change adaptation simulation using a serious online game

Agent-based models simulate the actions of autonomous agents interacting with their environment – an agent is anything that can make a decision for itself, usually people. Traditionally, agents have been populated to follow a set of simple rules, where environmental conditions or the actions of other agents instigate an agent to behave in a certain way.

The Future Coasts Aotearoa research team have devised a new way to obtain quantitative data to populate agents – through a serious online game called the Future Coasts Aotearoa Game. The game was created by Paula Blackett and Alex Fear as a tabletop game and converted by Hot Mustard/Hum Interactive and the research team into an interactive simulation of four interacting hazards – sea level rise, groundwater, coastal storms and fluvial (river) flooding – impacting a rural community in New Zealand. Players choose from one of five characters (two townspeople, two farmers and a kaumātua character) and choose adaptation actions to attempt to avoid or mitigate the impacts of a changing climate.

As of July, 3000 people have played the game and data is collected for every action they take, alongside data on hazard impacts and financial stability. A K-means cluster analysis is being undertaken to group players together into agent classes – groups of people who behave a similar way in response to hazards or to pre-empt hazard impacts. The cluster analysis will be used to generate agents that are then coded into an agent-based model simulating climate change in the coastal lowlands of Bay of Plenty. The agents will have preferred adaptation strategies and will implement these strategies according to rules observed in the online game-play data.

Once developed, the model will be tested using a robust decision-making approach – stress-testing the adaptation strategies of different agent groups against multiple plausible future climate states to identify which adaptation strategies perform best for each scenario, and across the suite of scenarios. This project will shed light on the drivers of adaptation, different classes of adaptation preference (i.e. do some players have a firm preference for hard engineered structures while some prefer nature-based solutions), and different and evolving adaptation strategies over time. The end result of this process will be stress-tested adaptation strategies that are robust against future uncertainty and will allow New Zealanders living in rural coastal lowlands to better understand how the decisions they make today impact their future physical, social, cultural and economic well-being.

andrew.allison@urbanintelligence.co.nz

Oral Presentation

Cindy Asmat, James Brasington, Sarah Sweeney

[1]University of Canterbury, Christchurch.

Dynamics of flood inundation and barrier beach evolution in the Lower Kowai River

River and coastal environments are increasingly becoming impacted by climate change, posing serious risks to local communities. At the dynamic interface of these environments, estuaries and coastal river mouths are particularly vulnerable. While extensive research has been conducted on riverine and coastal systems independently, there has been less focus on the combined dynamics of these environments, particularly in cases where a river's outlet to the sea is intermittently closed. The Kowai River at Leithfield Beach, North Canterbury, provides an ideal case study for investigating the complex interactions between fluvial and coastal morphodynamic processes. Closure via formation of a mixed sand gravel barrier creates significant flood management challenges for surrounding communities and infrastructure.

This research applies a coupled modelling approach using HEC-RAS and XBeach-G to simulate the interplay between beach barrier evolution and flood hazards under future climate scenarios. These models enable the integration of historical data with predictive simulations to evaluate how the beach barrier may evolve over the next 100 years and affect flood dynamics. By analysing river breaching events and the propagation of floods in coastal regions, this research will provide insights into potential future risks to help inform flood management strategies. The integration of these models provides a comprehensive view of the physical processes involved, enhancing the understanding of how different factors contribute to flood risks. The research will advance our ability to accurately predict floods by concentrating on these interactions. The findings are intended to guide future research on coastal river systems, not just in Canterbury but also in other regions facing similar challenges.

Preliminary modelling commenced in 2024, with field data collection and validation studies provided by Hurunui District Council. The presentation covers the methodological development of the coupled modelling framework, calibration against historical events, and assessment of flood risks under combined hazard scenarios for different climate change pathways.

This research aims to identify the main drivers of hydrodynamic and morphodynamic processes during severe weather events with a closed beach barrier, assess the future evolution of the barrier over 50 and 100 years, and evaluate the resulting implications for flood extent. It examines these processes across multiple temporal scales by combining long-term hazard assessments with climate projections, using 50-year and 100-year flood magnitudes under RCP 8.5 sea-level rise scenarios. The research advances predictive capabilities for flood risk assessment in coastal river systems and provides a transferable methodology for similar environments facing climate change pressures.

cindy.asmatcaceres@pg.canterbury.ac.nz

Oral Presentation

Ed Atkin[1], Ted Conroy[1], Shaw Mead[1] and Raphael Krier-Mariani[2,3]

[1]eCoast Consulting and Research, [2]Dunedin City Council, [3]Scripps Institution of Oceanography

A Multifaceted and Interconnected Modelling Framework to Build coastal Resilience –Saint Clair Saint Kilda

Dunedin City Council (DCC) completed the St Clair to St Kilda Whatakekerau Rakiātea Rautaki Tai (Coastal Plan) in February 2022. The Coastal Plan develops a range of proactive and integrated coastal management approaches for the St Clair to St Kilda Embayment (the Embayment). It was developed over a period of two and a half years with more than 2,300 people providing input into the plan. The aim of the Technical Support Services for Modelling the St Clair to St Kilda Coastal Plan project (The Project) is to provide an improved understanding of the vulnerability and exposure of the coast to erosion and an understanding of likely evolution of the coast, and consider the efficacy of potential future management strategies outlined in the Coastal Plan.

The modelling framework provides the following key components:

- Long-Term Shoreline Evolution: Model results will provide the plan-shape shoreline position over a 50-year time period (i.e., 2024 to 2074).
- Medium-Term Morphology Response: embayment wide morphological changes over a timescale of 1 year due to waves, hydrodynamics and sediment transport.
- Short-Term and Event Morphological Response: embayment wide morphological changes for discrete events due to waves, hydrodynamics and sediment transport.
- Phase Resolving Simulations: 2D phase resolving simulations of hydrodynamics and wave breaking patterns following medium-term morphological response. 1D simulations are used to consider morphological response.

The modelling framework was used to forecast long-term coastal evolution under climate change and sea level rise scenarios and to test the effectiveness of various engineering interventions (renourishment, groynes, offshore breakwaters, seawalls).

This presentation outlines a multifaceted and interconnected modelling framework which has been developed to provide simulations of highly dynamic phase resolving waves, short-term, event-based and medium-term morphological response, and long-term shoreline evolution. The methods, limitations and how they were addressed and some of the modelling results of integrating the conceptual management options into the framework are presented; potential interventions are compared to the results to the baseline modelling (i.e., do nothing/no interventions).

e.aktin@ecoast.co.nz

Oral Presentation

Ryan PS. Abrey[1], Grant Lorimer[1],Katja Huls[1], Kirstie Thorpe[1], Jason Ng[2], Branko Veljanovski [2]

[1]STANTEC, Auckland, [2]AUCKLAND COUNCIL, Auckland

Where Stormwater Meets the Sea: Integrating Coastal Outfalls into Auckland Council's Inlets and Outfalls Guideline

In 2025, Auckland Council released for feedback the Guideline Document GD08 Auckland Council's Inlets, Outlets and Coastal Outfalls, and the final version is expected to be published in November/December 2025. While this document was originally a formalisation of TR2013/018: Hydraulic Energy Management – Inlets and Outlet Design for Treatment Devices, Stantec was engaged to expand its scope to include coastal outfalls. These are an essential component in stormwater infrastructure guidance for the region. This document reflects a growing need to address the complexities of discharging stormwater into sensitive coastal environments, particularly in the face of climate change, urban intensification, need for resilience, and increasing regulatory scrutiny.

The new guideline document introduces considerations for coastal outfall design, offering qualitative guidance on structural options, environmental integration, and risk mitigation. The guideline outlines a range of outfall typologies, from diffuser manifolds and naturalised channels to flap gates and surge chambers. Each of these have been evaluated for suitability across varied coastal settings. It also addresses critical issues such as backflow prevention, sedimentation, and long-term erosion control, supported by schematic diagrams and real-world examples.

In addition to engineering and environmental considerations, the GD08 introduces new emphasis on Place and Aesthetics. Recognising that stormwater infrastructure, particularly coastal outfalls, exists within highly visible and culturally significant landscapes. The guideline encourages designers to consider the character of the receiving environment, integrate structures with the surrounding coastal form, and minimise visual intrusion. This includes selecting materials and forms that blend with natural features and aligning with mana whenua values and community expectations. This reflects a shift toward more holistic, place-based design that acknowledges the social and cultural dimensions of coastal infrastructure.

The development of this guideline was led by Auckland Council's subject-matter experts and Stantec, and informed by extensive collaboration with industry experts and practitioners. Key design principles include geotechnical stability, hydraulic performance, ecological sensitivity, and cultural values, with emphasis on Safety in Design and whole-of-life considerations.

This presentation will explore the technical and consultative journey in producing the GD08, focusing on the integration of coastal outfalls. It will highlight lessons learned from stakeholder engagement, showcase innovative design responses, and discuss how the guideline supports resilient, context-sensitive infrastructure outcomes. The GD08 demonstrates how local authorities could embed environmental and cultural resilience into coastal stormwater planning.

Ryan.abrey@stantec.com

Oral Presentation

Edouard Basquin[1], Karin R. Bryan[1], Giovanni Coco[1], Ian H. Townend[2]

[1]The University of Auckland, Auckland, [2]University of Southampton, United Kingdom

Using an equilibrium model to explore the influence of climate variations on estuarine evolution

Climate change is a key factor in estuarine morpho-dynamics evolution. Indeed, these complex systems at the land-ocean-river interface, undergo numerous forcings that evolve with changing climate. New Zealand's 350 estuaries exhibit wide spatial variation in their forcing mechanisms, morphologies, and tidal prisms. Research (Leuven et al., 2019) has shown that sea-level rise (SLR) responses differ between estuary types, complicating predictions of climate-induced changes. SLR depends on the location and can even be negative in some areas due to vertical land movement. Rainfall patterns are also expected to change with some regions, becoming either more or less intense, inducing changes in river discharge and sediment supply. These changes highlight the importance of estuary-scale modelling to consider regional variability in long-term responses over decades to centuries.

In this study, we used the numerical model ASMITA (Aggregated Scale Morphological Interaction between Tidal basin and Adjacent coast), which is a scale-aggregated numerical model (Townend et al., 2016) based on an equilibrium approach. The estuary is subdivided into different elements that are assumed to be in an equilibrium state under constant hydrodynamic conditions.
We first assessed how model settings (e.g. horizontal and vertical transport coefficients) influence the morphological responses. Next, a sensitivity analysis was conducted on a cyclical pattern in river discharge and sediment concentration, reproducing the increase in extreme dry and rainy events. This was applied to an artificial estuary to examine the role of river-driven morphological responses to SLR. This sensitivity analysis led us to select Tairua Harbour, New Zealand, as the estuary to study the role of various forcing mechanisms, including sea-level rise (SLR) and rainfall projections. After reconstructing historical bathymetry and applying a calibration framework, the morphological responses of the estuary were simulated for the next century, using the corresponding SLR and rainfall projections.

The sensitivity analysis shows different estuarine behaviours under constant and cyclic river inflow conditions in the context of steady SLR. When constant, the estuary gradually becomes deeper in response to SLR and eventually reaches a new steady state. However, when including a cyclic behaviour for the river inflow, after the estuary becomes deeper, both elements of the estuary become shallower. However, changes in response can still be observed on a yearly or decadal scale, corresponding to the oscillation period of river input changes. Given the range of SLR and rainfall projections for Tairua Harbor, the studied estuary showed varying responses and behaviours highlighting the importance of simulating multiple projections.
This study highlights the key role of river discharge and suspended sediment concentration in estuarine morphological responses to SLR. By examining Tairua Harbour responses to multiple projections, we show the variability in long-term morphological responses to climate change.

ebas390@aucklanduni.ac.nz

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Oral Presentation

Ben M. Batchelor-Cook[1,2], Colin N. Whittaker[1], Peter W. Quilter[2]

[1]University of Auckland [2]Tonkin + Taylor

A design approach for rock sizing of revetments in beyond shallow conditions

Coastlines are becoming more at risk of erosion due to increased exposure to wave forces. The continued rise of global sea levels in combination with more frequent storms presents a pressing issue for vulnerable coastal environments. Revetments can provide an immediate stabilisation method, creating a solid barrier between land and sea for which no further landward movement can occur. In many locations, the presence of a revetment has proven effective in mitigating wave impact and coastal erosion. If designed correctly, a revetment can be a viable coastal defence measure. New Zealand coastlines often have wide dissipative beaches, and the Coastal Policy Statement emphasises preserving the natural beach environment, meaning that coastal structures are usually placed on the upper beach. This means that revetments are often only reached by swash flows under normal conditions. As sea levels continue to rise due to climate change, the inland extent of swash motion would increase, potentially exposing more coastal structures and assets to frequent swash forces.

Currently, the widely accepted approaches for rock sizing include Hudson's formula and Van der Meer's equations. However, both these equations rely on a wave height at the toe of the structure, which is ineffective for sites where a foredune is present and the revetment toe is exposed. However, revetments in the swash zone will still experience wave forces during uprush and backwash even if waves are not breaking directly onto them; therefore, the rocks must still be sized to withstand the wave conditions. There is a clear gap in knowledge, as swash motion on revetments is not fully understood. Without a standardised design approach, current revetment design for very shallow waters tends to be conservative, which places strain on a smaller market like NZ, where sourcing and placing large rocks is difficult and costly. Understanding how a structure interacts with swash motion can be crucial for long-term planning and resilience, and can allow structures to be designed for site-specific conditions.

The current study aims to provide a design approach for rock sizing of revetments, considering swash zone processes rather than relying on deep-water-based design methods. This will be achieved by conducting wave flume experiments where a revetment is exposed to repetitive swash forces until the point of observable damage. The results will then form a design method to inform revetment design under specific wave conditions for beyond shallow waters.

This presentation will discuss preliminary numerical modelling of swash forces on a structure where wave run-up occurs on a compound slope, as opposed to a continuous equivalent slope, which is more common in previous research. Laboratory results from preliminary testing will also highlight a structure exposed to swash zone processes and conclude that the dominant failure mechanism associated with repeated uprush and backwash is slumping of the structure due to dislodgement of the armour units through rocking back and forth. The importance of toe protection is paramount for these wave conditions, as concentrated wave breaking on the exposed foreshore results in toe scour and undermining of the structure.

Bbat356@aucklanduni.ac.nz

Oral Presentation

Christopher Battershill[1]**,** François Thoral[1,2,3], Shane Orchard[3,4], Rahera Ohia[1,5], Neil Gemmill[6], Steve Wing[6], David R. Schiel[3]

[1] Coastal Marine Research Station, University of Waikato (Te Whare Wānanga o Waikato), Tauranga, [2] Earth Sciences New Zealand, Wellington, [3]Marine Ecology Research Group, University of Canterbury, Christchurch, [4]Waterlink Ltd., Christchurch [5] Ngāti Pūkenga, Ngāi Te Rangi, Waitaha; [6] Marine Science, University of Otago, Dunedin, New Zealand.

What happens to coastal productivity when the lights go out and reefs are buried in mud?

The world's coastal zone faces mounting, interacting stressors from both natural and human-driven sources. Sea-level rise, ocean acidification, marine heatwaves, more frequent and intense storms, overfishing, pollution and—arguably most damaging—coastal sedimentation are pushing marine ecosystems to the brink of functionality. In Aotearoa New Zealand, the *status quo* for managing rocky reefs is untenable. When intact, these reefs are among the earth's most productive habitats, turning light into carbon, drawing down CO_2, and underpinning marine food webs and the wider ecosystem. Many are these habitats are rapidly degrading, however, as turbid waters starve them of adequate light for photosynthesis, and fine sediments from numerous catchments physically smother them. Current management largely overlooks cross-ecosystem effects from land, like expanding urbanisation, intensified land use, and contaminant flows. Cyclone Bola in 1988 and the recent Cyclone Gabrielle are prime examples of massive whole-of-region sedimentation events affecting the coastal environment.

Where catchments remain relatively clear, freshwater and terrestrial carbon can subsidise a substantial share of coastal benthic carbon available to higher trophic levels. In contrast, sediment-laden catchments often result in highly compromised nearshore ecosystems. Lost production is stark. More than 4.3 tonnes of carbon per day per square kilometre of rocky/biogenic reef (≈4.3 g C m^{-2} d^{-1}, ~1.57 kg C m^{-2} yr^{-1}) can disappear, predominantly from suppressed kelp productivity. That deficit cascades upward, shrinking the carbon supply that supports commercial and recreational fisheries. The stakes are high. In the Hauraki Gulf alone, annual ecosystem services are valued at about $5.14 billion. The natural-capital asset value of combined services ranges from around $40 to $100 billion, underscoring how much is at risk as ecological condition declines.

Some stressors can be mitigated, but only through coordinated management. Urgent attention is needed to reduce sediment and contaminant runoff from poorly managed catchments. It is hoped that shedding light on the downstream consequences on the whenua will garner more effective management actions before true tipping points are reached coastwide.

Sources: NZIER valuation of Hauraki Gulf (2024); kelp forest NPP ranges and context for ~4.3 g C m^{-2} d^{-1} loss (global seaweed NPP syntheses and recent kelp studies). (**PMC**, **Frontiers**)

Christopher.battershill@waikato.ac.nz

Oral Presentation

Alison Bear[1], Derek Todd[1], Kate Attwood[1], Matt Sheppard[1],Ian Wiseman[1], Sarah Oliver[2]

[1] Jacobs NZ Ltd, Christchurch; [2]Christchurch City Council

The role of infrastructure provision in defining coastal hazard planning rules in District Plans – case study Christchurch

Christchurch City Council (CCC) are beginning a Plan Change process (PC12) to update their land use planning provisions in coastal hazards areas. The spatial extent and exposure to these hazards has been defined by the Tonkin & Taylor (2021) Coastal Hazards Assessment, However, CCC need to expand the scope of the assessment to include a technical engineering assessment of the impacts of these hazards on the provision and operation of core 3-waters and roading infrastructure to inform their Section 32 evaluation requirements for PC12.

The long-term functionality of these core infrastructure assets is central to supporting both existing land use activities and any future plan-enabled new or intensification of development within coastal hazard areas. Therefore, it is important to understand the potential consequences of the coastal hazards to the functionality of the core infrastructure and whether it is possible, and at what cost, to adapt the infrastructure to make it resilient to these hazards in the future, or whether issues and costs of providing core infrastructure in these areas justify more restrictive land uses under PC12.

The outputs for the core infrastructure assessment are to be spatially based, to help inform the identification of "precincts or management areas" within the District Plan where greater or less controls on activities may be justified due to the medium- or long-term functions of the core infrastructure being significantly compromised or not effected by the hazards respectively. Challenges to this delivery include lack or inconsistency of information on asset vulnerability, criticality, condition, lifetime, and level of service across the district, particularly in the Banks Peninsula part of the District.

The presentation will examine the rationale of including the provision of core infrastructure in decision making for land use planning and provisions in hazard areas and will provide an update of the findings from the Christchurch experience.

Alison.Bear@jacobs.com

Oral Presentation

Eddie Beetham[1], Jak McCarroll[2], Josh Bagg[1], Tom Shand[2], Peter Quilter[1], Richard Reinen-Hamill[1]

[1]Tonkin + Taylor, Auckland, New Zealand; [2]Tonkin + Taylor, Sydney, Australia

Future Coastal Change: Modelling 3D Coastal Evolution for Informing Hazards, Exposure and Adaptation

Traditional coastal erosion hazard assessments on mobile sand or gravel beaches simplify landforms into a slope and representative height, which does not conserve volume or account for the shape of the future coast. Components are derived to account for long-term trends (or sediment budget), sea level response, storms, and instability, which are summed to inform a line on a map that represents a timeframe, probability and sea level pathway. While this approach has value for broad-scale planning, it oversimplifies the inherently three-dimensional nature of coastal landform evolution and does not resolve details that are helpful form informing adaptation planning.

This presentation introduces a shoreline translation method for informing coastal change, exposure, and adaptation design, suitable for coasts where a dynamic beach interacts with fixed infrastructure. This approach utilises the ShoreTrans model, which is a volume balancing, rules-based tool for modelling profile adjustment to sea level rise, changes in sediment budget (erosion/accretion trends) and storms. The model can also represent management interventions such as beach nourishment, seawalls, backstop walls, and underlying hard layers that limit available sediment volume. Three-dimensional evolution of beach landforms can be represented by simulating a set of profiles, accounting for embayment trends in sediment flux of a littoral cell. The approach can also be implemented probabilistically to account for environmental uncertainty and is suitable for representing timesteps on the order of 1-10 years, representing timeframes for decades to centuries.

The ability to build in management interventions and fixed structures such as infrastructure assets is useful for informing exposure to coastal change, natural hazard risk and adaptation planning. The ability to represent different beach evolution responses, such as roll-over of gravel barriers also allows a more nuanced approach to coastal exposure to smothering, where the active berm rolls landward and can compromise transport networks or stormwater infrastructure. Being able to model the moving coast as a two or three-dimensional profile also allows assessment of exposure to undermining, accounting for structural depth, not just position.

Simplified, but robust 3D modelling of coastal evolution can inform coastal adaptation by efficiently comparing a base-case (e.g. do-nothing) situation with alternative management strategies including beach nourishment, control structures (e.g. groyne stabilising alongshore transport), hard structures, and other options such as asset relocation or accommodation. Creating a projected coastal terrain model that represents different plausible pathways also allows new opportunities for visualising coastal hazards, exposure, and adaptation options which could improve stakeholder engagement and management decision making. Another benefit is being able to iteratively model coastal inundation on a terrain that has evolved to represent beach morphology adjusted to sea level rise and natural or managed parameters, overcoming a limitation of existing inundation models that are based on present-day terrain.

This presentation will include a series of examples on how modelling coastal evolution has assisted with beach management, understanding coastal hazards, and informing coastal exposure and adaptation across New Zealand, Australia and the Pacific Islands.

EBeetham@tonkintaylor.co.nz

Oral Presentation

Holly Blakely[1], Tom Shand[2], Michael Paine[1], Richard Reinen-Hamill[1]

[1] Tonkin + Taylor Ltd., New Zealand. [2] Tonkin + Taylor Ltd., Australia

Adaptive Design and Long-Term Planning: Building Resilience in Pacific Atoll Nations

Pacific Island Countries (PICs), particularly low-lying atoll nations such as Tuvalu, Kiribati, and the Republic of the Marshall Islands (RMI), face increasing vulnerability due to the dual pressures of rapid urbanisation and intensifying climate-related hazards. Despite their small populations, internal migration and urban growth have led to densely populated urban atolls, significantly heightening exposure to coastal hazards. These challenges are compounded by limited economic resources, constrained land availability, and scarce natural materials, which restrict adaptive capacity and resilience-building efforts.

This paper presents insights from four projects undertaken Tonkin+Taylor and Deltares on behalf of Pacific governments and the World Bank, spanning national, regional, and local scales. At the national and regional scale, adaptation pathways were developed based on projected sea level rise increments of 0.25 m, 0.5 m, 1 m, and 2 m. The findings indicate that beyond 1 m of sea level rise, adaptation measures such as land raising and reclamation could cost tens of billions of USD and require hundreds of millions of cubic meters of aggregate and rock. These large-scale assessments are critical for understanding the magnitude and financial implications of long-term adaptation.
At an urban atoll scale, assessments focused on the unique challenges of atoll cities, where high population densities and limited climate-resilient infrastructure necessitate tailored adaptation strategies. This study focused on identifying possible short-, medium- and long-term strategies for the three urban atolls of Majuro, Funafuti, and South Tarawa. Considerations were made at a village scale, where these atolls were characterised into typologies based on urban characteristics such as infrastructure density and criticality. This intermediate scale of planning bridges the gap between broad regional strategies and localized village-level actions, highlighting the need for context-specific solutions.

At a smaller scale short to medium term actions are required to protect assets and communities from erosion and wave impacts considering lower extents of sea level rise. The Urban Resilience Project in RMI seeks to protect critical public assets and, while works focus on immediate to medium-term solutions, the ability to integrate these with long-term planning through adaptive design was considered.

This paper summarises the approach taken and findings of both the large-scale and long-term regional at urban scale planning, and shorter-term resilience projects, providing examples of how these project scales may be integrated efficiently and sustainably. Lessons learned from this process that can have applications across other PICs and New Zealand are also identified.

hblakely@tonkintaylor.co.nz

Oral Presentation

Ashlee R. Blaymires[1], Colin N. Whittaker[1], Conrad Zorn[1], Ryan Paulik[2]

[1]The University of Auckland, Auckland, [2]Earth Sciences New Zealand, Wellington

Beyond bathtub modelling: An assessment of built environment exposure to inundation as sea levels rise

Coastal inundation due to extreme sea levels (ESLs) poses significant risks to coastal zones and communities. As the adverse effects of global warming continue to drive global sea level rise, ESLs are becoming more frequent and impactful. Although low-lying coastal zones are particularly vulnerable, the effects of coastal inundation can reach surrounding communities through impacts on infrastructure such as access roads, power lines, or water supply systems. However, research surrounding cascading impacts remains limited, despite their importance. Additionally, ESL inundation is often assessed using overly simplified methods favoured for their efficiency and minimal data requirements, especially in resource-constrained regions. However, such methods rely upon assumptions that may not be valid in these dynamic environments, which may in turn limit their reliability for risk assessment and planning.

Assessments of land exposed to ESL inundation and the subsequent impacts have heavily relied on the traditional static “bathtub” model. Recent studies in New Zealand have applied modified versions of the bathtub model that incorporate basic hydro-connectivity. In some instances, the resulting data has been used to evaluate the direct and indirect impacts on communities. Despite including hydro-connectivity, the bathtub approach remains limited in its ability to capture key hydrodynamic processes.

This research aims to provide a computationally efficient alternative to the commonly used bathtub model in order to provide a more accurate assessment of ESL inundation. To achieve this, coastal inundation will be modelled across various return periods and emission pathways (SSPs 1-1.9 to 5-8.5) using a Rapid Inundation Model developed previously for tsunami applications, which will be adapted for ESLs. The resulting inundation will be compared with the traditional bathtub method to assess the additional influence of frictional losses over different terrain and land use types. Additionally, the research will explore the direct and indirect impacts of inundation on coastal zones and communities.

Results from this research have shown that New Zealand coastline is currently, and will increasingly be, exposed to coastal inundation driven by ESLs. Land exposure to ESL inundation varies spatially and temporally along New Zealand’s coast between 2020 and 2120, with an apparent overall increase in inundation extent projected over these 100 years. This trend is consistent across all five emission pathways modelled (with and without vertical land movement), for the 17th, 50th, and 83rd percentile ranges. Unsurprisingly, higher-emission pathways result in greater ESL inundation at earlier timeframes. For example, in Christchurch, the area of land projected to be inundated by 2120 under SSP1-1.9 is approximately equivalent to the area of land projected to be inundated for 2070 under SSP5-8.5.

Abla833@aucklanduni.ac.nz

Oral Presentation

Stuart Caie[1]

[1] Toitū Te Whenua Land Information New Zealand (LINZ)

Improving Key Baseline Datasets for Aotearoa's Coastal Resilience

In 2023 Toitū Te Whenua Land Information New Zealand (LINZ) commenced the 3D Coastal Mapping (3DCM) programme of work to improve the baseline data upon which resilience to coastal hazards and climate change impacts can be assessed and mitigated.

The programme represents a significant advancement in New Zealand's approach to coastal data collection and management. By creating comprehensive, high-resolution topographic-bathymetric datasets covering priority coastal areas, the programme is establishing a foundation for improved coastal hazard assessment, planning, and adaptation strategies.

The 3DCM programme consists of two streams of work; installing new or upgrading existing Global Navigation Satellite System (GNSS) equipment at existing tide gauge locations; and mapping up to 40% of the coastline, 200 metres inland extending seaward to a water depth of 25 metres with LiDAR. This equates to approximately 10,000 km^2.

In late-January 2025 two suppliers started the mapping component, completing about 1,900km^2 or 20% of the scope by May. As anticipated, New Zealand's coastal environment presented challenges for bathymetric LiDAR. Water clarity varies considerably throughout the regions, with turbidity conditions fluctuating dramatically, especially following rainfall events and subsequent river outflow and in estuarine environments. Frequent coastal weather systems significantly limit suitable flying windows, creating logistical hurdles for data collection efforts. Adding further complexity is New Zealand's intricate coastal morphology, characterized by a highly indented coastline featuring numerous islands, inlets, and diverse coastal formations - all of which necessitate sophisticated and meticulous flight planning to ensure the area is mapped efficiently.

The 3DCM data is designed to support a wide range of applications critical to New Zealand's coastal resilience and management. LINZ is engaged with stakeholders to ensure the data, when available, is used to demonstrate the value and benefit of the programme.

This presentation will provide an update on the programme, including the challenges of using bathymetric LiDAR in the New Zealand environment and some features of interest to others beyond the purpose of the programme.

scaie@linz.govt.nz

Oral Presentation

João Castro[1], Ed Atkin[1], Shaw Mead[1], Lee Munson[1]

[1]eCoast Marine Consulting and Research, NZ

Flood Resilience in Fiji's Coastal Villages Through Integrated Modelling and Nature-Based Solutions

Fiji's rural coastal communities face increasing risks from extreme rainfall, rising sea levels, and compounding flood hazards. As part of the "Enhancing Climate Resilience of Coastal Communities Project," a technical feasibility study to design flood-resilient infrastructure for three flood-prone villages was undertaken. The selected coastal village sites were Nadogoloa on Viti Levu, Vanuavou and Kanakana on Vanua Levu. The approach integrates hydrological (HEC-HMS) and hydraulic (HEC-RAS) modelling, topographic and hydrographic survey data, and climate change projections, combined with targeted Nature-based Solutions (NbS) to mitigate both fluvial and coastal flood risks. Using a 20-, 50-, and 100-year design storm approach, the modelling quantified inundation extents and depths under both present-day and future climate change scenarios (SSP5-8.5), including tidal influence.

The three sites had catchments ranging from 2.1 km^2 to 5.9 km^2, exhibited unique terrain and settlement patterns, requiring site-specific bund designs, drainage upgrades, and land use planning. NbS measures such as mangrove reforestation, riparian buffers, and wetland preservation were integrated where feasible, considering soil types, runoff response, and community feedback.
The project demonstrates the value of accessible modelling tools and layered data to inform practical, cost-effective adaptation options for small island communities. The process exemplifies the application of a replicable model for combining science, engineering, and participatory planning to reduce coastal flood vulnerability in remote communities in the southwest Pacific.

j.castro@ecoast.co.nz

Oral Presentation

Murry P. Cave[1]

[1] Gisborne District Council, Gisborne

Large Woody Debris on the beaches of Gisborne Tairawhiti

Since Cyclone Cook in 2017, large woody debris (LWD) has been a big issue in Gisborne/Tairawhiti's catchments and beaches. It may have been an issue previously, but documentation is limited. An investigation in 2017 lead to a methodology to accurately document the relative contribution of different wood species to the LWD problem. Over time, a methodology to quantify the volumes of LWD has also been developed.

LWD on the beaches of Gisborne/Tairawhiti meets the thresholds for a wicked problem and that problem was crystallised after Cyclone Hale when a young boy was killed by a freshly harvested pine log on Waikanae beach while in the following month a young girl was seriously injured by a log on the same beach after Cyclone Gabrielle.

2023 was a difficult year for the Gisborne-Tairawhiti region with eight severe storms and several irritating ones hitting the region. As a result of those storms, in particular, Cyclones Hale and Gabrielle, the June 2023 storm and the November 2023 storm; many thousands of tonnes of LWD were mobilised from the forests and smothered the beaches in the region. Council, with the support of central Government have spent in excess of $50m to reduce but not eliminate the impact of LWD on the community.

All of that effort may well be undone by the next severe storm many more thousands of tonnes of LWD will again smother the regions beaches. Changes to land use as a result of the Ministerial Inquiry into land use may ultimately lead to improvements but in the meantime very large areas of pine forest are within the optimal harvest window and even if harvest practices improve the sheer volume of LWD likely to be generated means that the problem will remain an issue for many years to come. The present access to Crown funding is allowing for the immediate problem to be managed but when that funding runs out the burden will fall to the local community who can ill afford the cost and social consequence.

murry.cave@gdc.govt.nz

Oral Presentation

Ted Conroy[1]

[1]eCoast, Raglan

Hydrodynamic Modelling of Circulation and Sediment Transport in Hawke Bay and the Impacts of Cyclone Gabrielle

Understanding the source to sink of sediment from rivers into the coastal ocean is a key process that has implications for marine ecology and land and river management. In rivers with episodic, high intensity discharge events, such as in Aotearoa New Zealand and other small mountainous river systems globally, understanding sediment transit across the inner shelf is particularly important. Measuring the sediment delivery to energetic coastal environments and the long-term fate of sediments is difficult observationally and is spatially limited. To address observational limitations, a three-dimensional coupled hydrodynamic-wave model was developed to simulate these dynamics in Hawke Bay, Aotearoa New Zealand. The developed model is well validated with a broad range of oceanographic data, and is used to characterise the understudied circulation in Hawke Bay, river plume dynamics, and the cross-shelf sediment flux. Mean circulation and stratification are primarily driven by buoyancy inputs, with persistent nearshore river plumes and coastal currents. Wind was found to be a key driver of river plume advection and mixing. Both the discharge event time scale and multi-year sediment deposition and erosion patterns were detailed throughout the Bay.

In February of 2023, Cyclone Gabrielle produced extreme rainfall, high winds and large waves in the Hawke's Bay region, which led to devastating flooding across the region. While terrestrial sediment deposition has been well documented, the marine impacts remain poorly understood. To better understand the marine impact, the developed numerical model was applied to the period of Cyclone Gabrielle. The high-intensity winds and waves during Cyclone Gabrielle drove a strong ocean circulation in Hawke Bay. The direction of river plumes and the initial sedimentation were strongly influenced by post-cyclone wind patterns. Following the cyclone, the mass of sediment transported into Hawke Bay deposited in varying depth ranges throughout Hawke Bay was quantified.

Key results from the modelling include:
a) By the end of April 2023, ~60% of Cyclone Gabrielle's sediment load had deposited in waters shallower than 20 m, with ~20% in deeper regions and ~20% exported beyond Hawke Bay.
b) Surface suspended sediment concentrations returned to pre-cyclone levels within one week; near-bed concentrations took five weeks to return to pre-cyclone levels.
c) Modelled sediment deposition ranged from ~125 mm near river mouths to a few mm beyond 40 m depth.

t.conroy@ecoast.co.nz

Poster Presentation

Jean P. Davis[1]

[1]Fisheries New Zealand, Dunedin

Harnessing big data to inform fisheries and coastal management

The cumulative effects of fishing, climate change, and coastal development on the nearshore marine environment are affecting many of our most financially and culturally valuable species. Fishery-independent surveys that help us monitor environmental impacts on fish stocks and fishing impacts on the environment are extremely costly and limited in scope. There is increasing demand for large-scale, readily updateable and affordable data on indicators of ecosystem health to inform fisheries management decisions.

Recent research projects funded by Fisheries New Zealand using freely available data to improve the management of inshore fisheries include: (1) aerial and satellite imagery to map the extent of urchin barrens in northeastern NZ and (2) satellite remote sensing to track the status and health of giant kelp. These projects have shown that readily available data sources can be used to develop indices of biodiversity and measure the effects of fishing at much broader scales than attainable with on the ground surveys. Furthermore, the outputs are of interest to entities beyond FNZ. There is an opportunity to align resources and data sharing across central and regional government, hapu, iwi and community groups to improve the management of our valuable nearshore environment.

jean.davis@mpi.govt.nz

Oral Presentation

Douglas, EJ,*[1] Lam-Gordillo, O,[1] Hailes, SF,[1] Lohrer, AM,[1] Cummings, VJ[2]

[1]NIWA, Hamilton, [2]NIWA, Wellington

Heatwave impacts in estuaries: implications for ecosystem resilience and carbon cycling

Intertidal estuarine habitats are inundated by seawater and uncovered with every tidal cycle, with potential exposure to both marine and atmospheric heat waves. Coastal intertidal ecosystems are therefore very vulnerable to climate change. Little is known about the temperature dynamics in these systems or what controls them. Therefore, our ability to assess vulnerability and effectively manage estuary ecosystems in a future of increasing frequency and intensity of heatwaves is limited.
This talk synthesises findings from a series of recent studies examining the ecological and biogeochemical consequences of heatwaves in estuarine environments. First, we present results from a multi estuary monitoring study, quantifying intertidal sediment temperature dynamics and the key environmental drivers including tides, sediment characteristics and weather conditions.
Second, we report outcomes from a multi-day experiment simulating a low tide atmospheric heatwave at two estuary intertidal flats (sandy/muddy) to test the responses of biodiversity and fluxes of methane and carbon dioxide. We provide evidence for cumulative effects of heatwave duration on biodiversity and greenhouse gas fluxes and show that increasing muddiness (often associated with estuary degradation) and increasing duration of extreme temperature events may change the carbon source/sink status of estuaries.

Finally, we examine organismal-level responses by assessing metabolomic changes in shellfish and resilience of ecological traits in macrofauna exposed to simulated heatwaves. These findings indicate sub-lethal stress responses, altered energy allocation, and potential disruption to populations.
These findings have important implications for estuary management: degraded ecosystems with reduced biodiversity and declining shellfish populations, may be more susceptible to the impacts of future climate change.

Emily.Douglas@niwa.co.nz
Orlando.Lam-Gordillo@niwa.co.nz
Sarah.Hailes@niwa.co.nz
Drew.Lohrer@niwa.co.nz
Vonda.Cummings@niwa.co.nz

Oral Presentation

John Duder[1], Sian John[2], Richard Reinen-Hamill[1]

[1]Tonkin & Taylor, Auckland, [2]Haskoning New Zealand, Auckland

Moanataiari inundation protection over 5 decades, but what next?

The Moanataiari inundation scheme in Thames, Coromnadel provides protection to a subdivision located on land claimed from the sea in the 1800s. Periodic storm surge flooding of roads and houses through an open work rock wall prompted Thames Coromandel District Council to engage Tonkin & Taylor to propose a solution.

The subdivision was built in the late 1960s and 1970s on a clay topping placed over historical deposits of gold mine tailings dumped over marine sediments and prone to ongoing settlement. Periodic flooding of Ferguson Drive was exacerbated by storm flooding from the adjacent hill catchment. Remedial works initiated in the late 1990s comprised raising the existing rock wall and waterproofing it on the inside with a clay liner bonded to the clay topping. Storm wave runup is countered by a concrete crest footpath and a 600mm timber wall. Catchment runoff is handled by a twin pump station. Additional works included dune building on the accreting Tararu beach to the north.

Completed in 2000 the works have provided inundation protection to the subdivision but are considered to have a finite life due to ongoing settlement of marine sediments, rising groundwater levels and contamination, and evidence of rising sea levels. Consequently, in 2019, the Council engaged Haskoning to develop a Coastal Adaptation Plan (CAP) for Moanataiari as part of the SMP project for the Coromandel. This determined that the residual risk/risk to life associated the existing defences being overtopped would be significant. Vulnerability is high and adaptive capacity is low. Relatively significant overtopping of the existing embankment (expected to overwhelm the existing pumping capacity) is predicted to occur during a 1% AEP storm event with just 0.2m of relative sea level rise (with subsidence exacerbating the rate of this rise), and affect property seaward of Moanataiari Street and north of the school (but not the school), as well as the Refuse Transfer Station. With 0.4m of relative sea level rise, these locations would be affected by a 5% AEP storm event and larger storm events would affect additional locations north and landward of the school (but not the school).

Consequently, the CAP advocated ‘managed retreat’ as the appropriate adaptation strategy in the medium to long term. Implementing this strategy will include a need to manage the potential release of contaminants from the historic landfill south of the township and the goldfields reclamation. However, in the short term, it proposed that the existing flood protection and pumping capacity should be maintained at the existing level of service (or improved). This should include protection of the historic tip site. In addition, where possible, floor levels should be raised and properties retrofitted.

Tonkin & Taylor's 2023 review of the performance of the seawall explored the potential to maintain or raise its design height. Options assessed included raising the timber upstand 200mm, effectively returning the crest elevation to the original design level and providing short term protection; replacing the existing timber upstand with a higher concrete wall to provide increased resilience over the next 30-40 years; or a more significant upgrade requiring crest raising of around 1.7m. So, what next?

jnduder@gmail.com

Oral Presentation

Jana Echave[1], David Johnson[1]

[1]OCEANUM, Raglan

Enabling Coastal Data Workflows Through a Unified Data Model and Cloud-Native Infrastructure

Quality and availability of environmental data have significantly improved in recent years, leading to the rise of data-based approaches in climate and coastal research such as Machine Learning and statistical downscaling. These techniques are currently applied to identify long-term environmental trends, support predictive climate wave models, and inform both scientific assessments (e.g., IPCC reports, shoreline change detection) and socio-economic activities such as aquaculture planning or emerging-energetic activities such as offshore wind farms. The success of those techniques relies on solving challenges related to data volumes, format heterogeneity, data provenance, and access restrictions for pre-processing and providing harmonisation of large, multi-source big data. This process is further complicated when the need for downscaling to finer spatial and temporal resolutions is required and adds a significant layer of complexity to operational workflows.
The Oceanum Datamesh was developed in New Zealand and meets those challenges through an efficient cluster-selection, scalable infrastructure where the storage and retrieval of geo-referenced multidimensional datasets is facilitated by a comprehensive query language (OceanQL), common coding libraries (Python, R and Matlab) and proxying connection with external environmental data-providers. The system is supported by data-caching mechanisms, sharing permission rules and a robust cloud-based infrastructure preserving key patterns and extremes, making them suitable for hindcast validation, statistical downscaling, or model training. The system natively supports historical observations, hindcasts, real time data, forecasts, and climate projections.

We demonstrate its applicability across multidisciplinary projects: SeaScope Aotearoa, which aggregates real-time and forecast data into a public-facing web app; a backend service for Auckland Council delivering wave and hydrodynamic forecasts with alerting capabilities; the Antarctic Science Platform, which supports discoverable and programmable research data; and coastal climate programs in New Zealand and Chile (Our Changing Coast in NZ and Olas del Futuro in Chile) that rely on federated data infrastructure for sharing interim and final model outputs. We also showcase a wave hindcast validation tool enabling user-driven comparisons with satellite altimetry.
The concept of unified data models has been considered for many years, but the advent of widespread AL/ML is expected to accelerate new developments that allow machines to more effectively augment human-led analyses. The development of scalable, interoperable data systems is a key enabler for future coastal applications, supporting faster insight generation and more informed decision-making.

jana@oceanum.science
d.johnson@oceanum.science

Oral Presentation

Constanza Flores[1,2], Daniel Nilsson[1], William Power[3], Erica Kuligowski[2]

[1]University of Canterbury, Christchurch,[2]Royal Melbourne Institute of Technology, Melbourne,[3]GNS Science, Lower Hutt.

Integrated pedestrian and car agent-based models of tsunami evacuation

Aotearoa-New Zealand, situated in the South Pacific, is exposed to tsunamis coming from distant, regional, and local sources. Of particular concern are near-field tsunamis generated in the Hikurangi Subduction Zone. These tsunamis pose a significant threat for coastal communities on eastern coastlines. Given that 430,000 people (9% of New Zealanders) reside within tsunami risk zones, rapid evacuation is fundamental to minimize casualties in these areas.

To improve the understanding of evacuation dynamics within coastal communities exposed to local tsunamis, geographically explicit agent-based models are currently under development. The models implemented in NetLogo, integrate both pedestrians and car agents and are focus on three study sites: Christchurch in the South Island, and the cities of Napier and Gisborne in the North Island. New Zealand has one of the world's highest per capita car ownership rates, making it highly probable that a significant proportion of evacuees will opt to drive during a tsunami event. This study thus incorporates two primary evacuation modes: on foot and by car. Intra-modal interactions such as pedestrian-pedestrian and car-car, and a preliminary proposal for inter-modal interactions such as pedestrian-car and car-pedestrian is proposed. To tune the suggested interaction parameters, empirical data from the study sites is necessary.

Since 2021, the Winter Fireworks event in New Brighton, Christchurch has gathered around 30,000 people every year. Except from residents, most attendees get to New Brighton by car. In previous years, following the event, crowding and heavy traffic have been observed in the surroundings of the New Brighton Pier. Because of these conditions, this event represents a unique opportunity to collect data useful to calibrate the agent-based models.

On July 5th, 2025, pedestrian and traffic data were collected during the New Brighton Fireworks event. Traffic flows were recorded at the Bridge St roundabout and Pages Rd using cameras mounted on tripods. Immediately after the fireworks concluded, two drivers drove along Marine Parade and Union Street towards Bridge Street, recording traffic conditions. To estimate the number of cars parked at the time of the event, a biker recorded parked vehicles on streets between the two roundabouts before the fireworks began. A walker recorded pedestrian dynamics along Hawke Street. Lastly, a thermal camera was used to record pedestrian-car interactions outside the Countdown parking lot and traffic transitions.

The contribution of this work lies in sharing the methodology employed for this large-scale data collection and by presenting preliminary findings. For future work, the collected data will be utilized to calibrate the implemented car-following model and to set parameters for inter-modal interactions. Subsequently, the calibrated model can be extended to the remaining two study areas.

cfl75@uclive.ac.nz

Oral Presentation

Georgina J. L. Flowers[1] Anna Madarasz-Smith[2], Becky Shanahan[2], Fiona McDuie[1]

[1]Hawke's Bay Regional Council, Napier, Hawke's Bay, [2]Pattle Delamore Partners, Napier, Hawke's Bay

After the storm: Impacts of Cyclone Gabrielle on sedimentation and estuarine communities

Cyclone Gabrielle hit Hawke's Bay in February 2023 delivering staggering amounts of rainfall that exceeded volume and intensity records across the region. Over 300,000 landslips occurred across the East Coast, and river levels surpassed many historical records. Consequently, enormous volumes of sediment were transported to Hawke's Bay's coastal environments. To explore ecological impacts in coastal environments before and after Cyclone Gabrielle we used sedimentation plates, macrofaunal cores and Ponar grab samplers. Of the two estuaries monitored for sediment accumulation, Ahuriri Estuary showed little increase post cyclone, but sedimentation rates in Waitangi were considerably greater – 135 mm deposited by November 2023, equating to an accumulation rate of 186 mm/year compared to the national guideline of ~2 mm/year. Shifts in macrofaunal community composition after the cyclone were evident at two of the nine estuary monitoring sites: upper Ahuriri and Maungawhio Lagoon. Finally, in the nearshore areas around Hawke Bay, sediment mud contents rose by an average of 19.5 %, with greatest increases near river mouths - up to 87.6% at Tangoio. As severe weather events become more frequent with climate change, understanding impacts to coastal environments will be vital to direct management decisions and ensure essential ecosystem functions and services are safeguarded.

Georgina.flowers@hbrc.govt.nz

Oral Presentation

Shari L. Gallop[1], Lara Taylor[2], Akuhata Bailey-Winiata[1], Lucy Kaiser[3], Milly Grant-Mackie[4]

[1]Pattle Delamore Partners, Tauranga, [2]E Oho! Awakening Aotearoa, Tāmaki Makaurau, [3]Massey University & Earth Sciences New Zealand, Ōtautahi, University of Auckland Tāmaki Makaurau

Ngā Herenga o Papatūānuku: Establishing a tangata whenua climate adaptation network

Storms are intensifying, seas are rising, and taonga species are shifting. Communities, hapū and iwi around the country are being bit hard by storms, floods and landslides. The strength of our communities and place-based bio-physical understandings is our superpower for adaptation. However, we need to find ways to come together, for well-meaning words and frameworks to come off the page and into action.

This presentation introduces a new multiscale project under the National Resilience and Hazards Platform, focused on enhancing Māori resilience to natural hazards. We are working to reframe multiscalar resilience centred in whakapapa-based perspectives to build sustained resilience to climate change and natural hazards. We work alongside tangata whenua —including our own iwi and hapū— to identify challenges and co-create solutions to climate adaptation.

Through wānanga across the motu, we are building a Te-Tiriti centric waka hourua: a collaborative vessel to navigate adaptation together. In partnership with the Aotearoa Society of Adaptation Professionals, and under the korowai of Ngāti Whātua Ōrākei and the National Iwi Chairs Forum, our waka rangahau was launched—amid wild weather and powerful tohu.

Here we reflect on the voyage so far, learnings, challenges, and what's next.

shari.gallop@pdp.co.nz

Oral Presentation

Marli A. Geldenhuys[1], Maureen Cuevas[1], Natasha Carpenter[1] , Ross Roberts

[1]Auckland Council

Asset Management Planning for specialised Assets: Auckland Council's first Coastal AMP

The Auckland region comprises 3,200 km of coastline with approximately 1,300 specifically coastal assets. These carry a range of functions from shore protection (e.g. seawalls), maritime (e.g.wharves or boat ramps) or recreational waterfront (e.g. piers or swimming pontoons), which are managed by Auckland Council (this excludes assets that have both a coastal and a parks component such as pathways, boardwalks etc). The assets are spread over a large geographical area with varied coastal exposure. A key driver for Auckland Council is an ability to adapt to climate change impacts, focussing attention on the lifecycle management of all assets improving the Auckland region's resilience This aligns with the Community Assets: Climate Mitigation and Adaptation Report (2023) which was influenced by the 2023 flood events.

To better understand the coastal asset portfolio, an initial data review and analysis was undertaken. The biggest inconsistency identified appeared to be in relation to asset classification definitions of the coastal asset portfolio. In response, an asset classification per 'type' (i.e. seawall) and 'subtype' (i.e. masonry wall) was proposed and workshopped with internal and external stakeholders including the NZTA data standards team for wider alignment. Secondary to the classification, specific assumptions relating to each asset and asset subtype, such as expected useful lives, unit of measurements and unit costing were reviewed.

The initial iteration of the AMP had some suggested improvements which have been packaged into programmes of work. These include:

- Data updates
- Coastal Condition Inspection Programme
- Coastal Unit Costing
- Coastal Maintenance Programme

One of the biggest challenges of asset management is how to ensure that public funds are spent as efficiently as possible while still maintaining a good level of service to end users. As part of this different budget scenarios were tested including climate change, population growth and demographic changes. to the scenarios were linked to key risks, advantages and disadvantages. Asset lifecycle modelling was also iterated to test different input assumptions.
Having a whole of life view on spend can improve outcomes for the same budget quantum. As such the work had a strong focus on understanding the costs; including the asset value, replacement costs and maintenance costs. Linked to that is a better understanding of the asset condition and linked remaining life, this resulted in proposed a tailored coastal condition inspection programme.
This presentation will provide a high-level oversight of the development of the first Coastal AMP including the key challenges, assumptions made, focus areas and proposed improvements.

marli.geldenhuys@aucklandcouncil.govt.nz
Maureen.cuevas@aucklandcouncil.govt.nz
Natasha.Carpenter@aucklandcouncil.govt.nz
Ross.roberts@aucklandcouncil.govt.nz

Oral Presentation

Andrea Glockner[1], Shannon Weaver[1]

[1]Hawke's Bay Regional Council, Napier

Looking beneath the surface: The subtidal habitats of Hawke's Bay

Coastal and marine habitats in the Hawke's Bay are highly dynamic and productive, supporting communities and species important for commercial and recreational fisheries. Estuaries and intertidal reefs have been studied as part of the Hawke's Bay Regional Council's (HBRC) State of the Environment monitoring programme. However, little is known about the location, extent and condition of the subtidal habitats. From February 2019 to March 2025, HBRC deployed a remotely operated vehicle (ROV) to capture underwater footage and determine the substrate and biogenic components of two extensive coarse sediment areas in Hawke's Bay. Wairoa Hard and Clive Hard are both recognised as significant conservation areas for their role providing habitat for fish and serving as nurseries. The footage revealed remarkable differences between the two sites, as well as significant macroalgae and invertebrate assemblages strongly associated with the contrasting substrates and topography. Changes observed following Cyclone Gabrielle, such as sediment redistribution and alterations in macroalgal cover, emphasised the importance of ongoing monitoring to identify community shifts and understanding long-term recovery patterns of these key habitats.

andrea.glockner@hbrc.govt.nz

Oral Presentation

Eduardo Gomez-de la Pena[1], Giovanni Coco[1], Karin Bryan[1], Nick Young[2]

[1]School of Environment, University of Auckland, Auckland [2]Centre for eResearch, University of Auckland, Auckland

End-of-Century Shoreline Change Projections in Aotearoa New Zealand: Our Changing Coasts Project

As coastal populations grow, so too does the risk of social and economic losses in the face of a changing climate. Understanding where and when coastal erosion will occur is critical for effectively planning mitigation and adaptation strategies. Recent advances in satellite imagery have unlocked a wealth of shoreline change data which, when combined with sea-level rise projections, enables spatially extensive shoreline retreat modelling. Here, we present estimates of shoreline retreat along Aotearoa New Zealand's coasts over decadal timescales up until 2100.

The *Te Ao Hurihuri, Te Ao Hou: Our Changing Coast* programme is an MBIE-funded initiative designed to provide New Zealanders with actionable scientific knowledge to anticipate and respond to sea-level rise and its impacts. As part of this programme, we present shoreline retreat estimates using the Bruun Rule—one of the most widely used tools for assessing shoreline response to sea-level rise over decadal timescales. These projections are based on a range of IPCC Shared Socioeconomic Pathway (SSP) sea-level rise scenarios and incorporate vertical land movement data from the NZSeaRise Project, which provides location-specific projections every 2 km along Aotearoa New Zealand's coastline. Beach slope data was derived from satellite observations using the CoastSat toolbox.

This approach is applied across the entirety of Aotearoa New Zealand's coastline. The results serve as a baseline for understanding projected shoreline change across a wide range of coastal settings.

eduardo.gomez.de.la.pena@auckland.ac.nz

Oral Presentation

David A Greig [1] Stephen Gardner[2]

New Zealand Transport Agency, Auckland[1], Christchurch [2]

NZTA Coastal Hazards Guide for Land Transport Infrastructure

The New Zealand Transport Agency (NZTA) has recently ratified a Coastal Hazards Guide for Land Transport Infrastructure (Guide) that is to be applied to all NZTA projects.

A copy of the guide is available **here** on the NZTA website.

The Guide is focused on the process of identifying and dealing with coastal hazards and infrastructure rather than technical specifications.

NZTA has its own policy and objectives in relation to coastal hazards and developing and operating transport infrastructure in the coastal environment. The Guide provides for meeting these requirements across various projects covering new, existing and emergency situations, and the varying stages of these. It also aims to ensure a national consistency in approach.

Generally, the Guide seeks analysis of three issues for development of infrastructure:

a) coastal processes and hazard identification

b) engineering design, and

c) environmental effects

The Guide defines the level of assessment of each issue at the different stages of the projects (based on business cases), and states specific outcomes and outputs sought. Tables and spreadsheets have been used to streamline and simplify the assessment processes, along with guidance on reporting structures. This will strengthen reasoning for solution development and support statutory authorisations needed.

Throughout the Guide references are made to relevant NZTA policy and guidance on issues such as climate change, resilience and nature-based solutions. These matters are actively being developed or modified through internal and external drivers. These will be discussed to update the conference attendees.

Examples of the application of the Guide to existing and future projects will be provided and the benefit to business processes such as procurement strategies and integration with other disciplines will be highlighted. These projects will cover Wellington, Auckland, Kaikoura, Coromandel and various Northland projects. A comparison with coastal risk assessment guides from regional, national and international sources will be provided to identify why the NZTA approach has been developed.

Currently the Guide is now required in all procurement processes to ensure it drives creation of fit for purpose assets that meet resilience needs and best practice in respect to environmental issues. Monitoring of sought outcomes and coastal asset performance is being established based on risk.

NZTA's Taumata Taio (Environmental Standard) is being adjusted to ensure environmental risks are clearly identified and addressed alongside the engineering design issues. Updates on this and consequences to stakeholders will be provided.

David.greig@nzta.govt.nz
Stephen.Gardner@nzta.govt.nz

Oral Presentation

Lana Greig[1], Kate MacDonald[1], Derek Todd[1], Gareth Taylor[2]

[1] Jacobs NZ Ltd, Christchurch; [2]Collaborations, Christchurch

Nature based solution feasibility case studies on the Canterbury Coast

ECan received funding from MfE to investigate the feasibility of using nature-based solutions (nbs) incorporating Mātauraka Māori values, to build resilience from future coastal flooding and erosion hazards at two coastal lagoon/wetlands sites – 1) between the Opihi & Orari River in South Canterbury, and at Muriwai/Coopers Lagoon in Central Canterbury.

The first part of the project considered how the coastal geomorphology, groundwater, and ecology within the study areas may respond to coastal hazards with sea level rise over the next 100 years if no further interventions ("non-intervention scenario") are undertaken to manage the risks from these hazards to adjacent wetlands and farmland. General findings were that over these time scales there will be significant loss of coastal wetland habitat within the study areas, having detrimental impacts on ecology and cultural values of the area.

In the second part of the project, three 'options', comprising of several mitigation measures, were developed with the aim of reducing the impacts of coastal flooding and erosion on the adjacent farmland and ecology. These three options were developed across a range of objectives, with 'option 1' having a higher priority of retaining existing land use into the future, through to 'option 3', which prioritises the natural evolution of the shoreline and enhancement of ecological values through large areas of wetland development. These options were assessed against a feasibility framework developed with ECan and local Tangata Whenua using a SWOT analysis approach to discuss the options against a holistic range of themes.

The assessment found there are significant challenges in developing nature-based solutions in a highly dynamic and mobile coastal environments, which will continue to change in the future with SLR and climate change. When considering the scale of the coastal hazards within the study area in the future, it became apparent that it was unlikely that nature-based solutions on their own would not be sufficient to attenuate flooding at the scale observed in significant events, both now and in the future with SLR.

Lana.Greig@jacobs.com

Oral Presentation

Sophie Horton[1], Andy Howell[1], Harry Jol[2]

[1]University of Canterbury, [2]University of Wisconsin Eau Claire

Extent of contemporary and late Holocene marine terrace cover deposits on Kaikōura Peninsula

Rock coasts with preserved Holocene marine terrace sequences occur along seismically active coastlines and are formed as the result of repetitive co-seismic uplift. Shore platforms extend from the base of marine terraces and occur within the intertidal domain of rock coastlines, being sculpted by the local tidal range and the wave and weathering environment. While not all marine terraces are remnant shore platforms (i.e., marine terraces also include beach ridges that mark former tidal limits), on tectonic coastlines, intertidal shore platforms often proceed to be part of the supratidal marine terraces sequence, which are covered by post-seismic cover deposits. The approach of this project combines existing data on the contemporary processes of shore platform breakdown following the 2016 Kaikōura earthquake with mapping of late Holocene landforms. Using ground penetrating radar (GPR) profiles with LiDAR mapping of the late Holocene marine terraces around the Kaikōura Peninsula, transects were used to determine the spatial extent of the buried shore platforms and their relationship to late Holocene beach ridges. The extent of recent cover deposits over the incipient marine terrace were also mapped to determine the rate and extent of cover deposit build-up.

sophie.horton@canterbury.ac.nz

Oral Presentation

Sian A. John[1], Greer Lees[2]

[1]Haskoning New Zealand, Auckland, [2]Auckland Council, Auckland

An adaptation planning decision-making process for infrastructure owners

Following the Anniversary Weekend floods in January 2023, Auckland Council developed its Resilient Tāmaki Makaurau programme, which brought together work from different parts of Council on adaptation. A workstream called Strategies to Build Better was developed to assist infrastructure owners in managing assets in hazard-prone areas and try to embed adaptation thinking into all aspects of infrastructure planning. One of the Strategies objectives is to have a regular cadence of proactive adaptation planning, which will integrate climate adaptation into infrastructure planning and consider community adaptation planning in the process. Currently, there can be a disconnect between infrastructure and community planning, where separate timeframes and priorities exist.

Stage 1 of the Strategies to Build Better work set the scene, while the objective of Stage 2, which this talk will cover, was to explore an adaptation process and implementation pathways that prevent like-for-like replacement of infrastructure as a default in high hazard areas or where infrastructure serves present or future highly impacted communities. The work is focused on developing a proactive approach for infrastructure / asset owners to incorporate adaptation into infrastructure decision-making. It relates to Three Waters (stormwater, wastewater and drinking water) infrastructure, transport infrastructure (roads, rail, ferries, buses, walking and cycling networks), open spaces (parks), and community facilities (libraries, community centres and domestic waste facilities), but needs to relate to community adaptation planning.

Three likely outcomes are envisaged where a risk is identified:

1. The existing infrastructure can accommodate the risk. No level of service (LOS) change is experienced by the community it serves. The community adaptation planning process is unaffected.
2. The existing infrastructure cannot accommodate the risk, but the community it serves can accommodate a different and/or more flexible LOS. Flexible approaches should then be considered and reflected in the community planning process in due course.
3. The community is at significant risk and the infrastructure must be redesigned to accommodate the hazards. This will influence the community planning process and, therefore, should be reliant upon it / may need to be flexible in the meantime.

To support infrastructure / asset owners in navigating their way through this, an adaptation planning 'decision-making process' has been developed and is being trialled.

sian.john@rhdhv.com
greer.lees@aucklandcouncil.govt.nz

Oral Presentation

Ivana Jurasovic[1]

[1]Davis Coastal Consultants, Auckland

Tailoring hazard management responses - Bridging the gap between policy direction and real-world feasibility in coastal management

Managing coastal hazards in New Zealand, especially at the site-specific level, can often involve trying to strike a balance between achieving consistency with longer-term broadscale policy frameworks, and developing a workable approach that is suitable for asset development or protection in the short-medium term.
This presentation reviews experience gained in two years working in the field postgraduation, where there is often a necessity to tailor hazard management responses to site-specific conditions, individual circumstances, and the stage in the project that coastal practitioner input is sought.

The study draws on a few recent projects to illustrate the ways in which this tension can be encountered; these run from early-stage input to coastal subdivision, where there is both capacity and will to avoid exposure to hazard risk, through to later-stage specialist engineering input where avoiding hazard risk is much less practicable. This can lead to significant tension, especially in the absence of a comprehensive national programme for managing future hazard risk.

It will touch on the technical challenges, planning hurdles, and the way in which historic decision making has in some ways 'forced the hand' of present-day practitioners.

ivana@daviscoastal.co.nz

Oral Presentation

Pamela L. Kane-Sanderson[1]

[1]SLR Consulting New Zealand Ltd, Whangarei

Seagrass (Zostera muelleri) Recovery and Seasonal Dynamics Following Sand Excavation in Matapouri Estuary, New Zealand

Matapouri Estuary in Northland New Zealand is a significant natural feature, opening into the southern end of the beautiful Matapouri beach. It is a relatively small tidal estuary and is fed by two main streams.

The recovery and seasonal fluctuations of seagrass (Zostera muelleri) in the Matapouri Estuary, was monitored, following sand excavation in July 2021. The excavation was conducted for beach replenishment and ongoing maintenance of Matapouri beach. As part of the requirements of the resource consent, a three-year post-excavation monitoring program was initiated, focusing on seagrass area and cover class.

Monitoring followed the established methods of Schwarz et al., (2006), which involved estimating percentage cover to the nearest 5% and then classifying these estimates using the Braun-Blanquet (1932) cover scale. This internationally recognised standard helps minimise observer bias in seagrass assessments. While late summer was the intended monitoring period, two of the three post-excavation surveys were conducted in winter due to unforeseen circumstances. This deviation, while limiting direct comparisons with the pre-excavation baseline, provided crucial insights into the seasonal dynamics of seagrass.

Our findings reveal a notable increase in both seagrass area and cover class during the summer months. This highlights the significant influence of seasonality on seagrass growth and distribution. The results emphasise the critical importance of considering seasonal factors in future monitoring efforts and broader ecological assessments of estuarine systems.

pamela.kanesanderson@slrconsulting.com

Oral Presentation

Chamika Kannangara[1,2], Erica D. Kuligowski[1], Varuna V. Adikariwattage[2], Chandana Siriwardana[3], Sajani Jayasuriya[1], Guomin Zhang[1], Mahinda Bandara[4]

[1]RMIT University, Australia, [2]University of Moratuwa, Sri Lanka, [3]Massey University, New Zealand, [4]Edinburgh Napier University, United Kingdom

Evacuation Behaviour during Tsunamis in Sri Lanka

This study investigates the stay-or-go decisions of individuals during evacuation in a tsunami event. While previous research has identified various predictors of this decision, such as socio-demographic characteristics, household factors, and environmental cues, these relationships are often inconsistent across studies. Researchers suggest that this inconsistency may stem from unaccounted mediating variables, such as threat assessment, risk perception, and other underlying variables influencing the decision-making process. This study aims to address this gap via mediation analysis. Using stated-preference survey data collected from 530 coastal residents in the Southern and Western provinces of Sri Lanka, this study examines evacuation (stay or go) decisions in tsunami events. The analysis considers three information conditions: (1) receiving an earthquake alert from an official source advising attentiveness, (2) receiving an official evacuation order recommending relocation to a safe area, and (3) personally observing unusual environmental cues indicative of a potential tsunami. Applying an existing evacuation theory (the Protective Action Decision Model), this research employs Structural Equation Modelling to examine how psychological variables such as risk perception (beliefs about the likelihood of being personally impacted by the hazard), protective action perception (beliefs about the effectiveness, feasibility, and ability to perform protective actions), and stakeholder perception (trust in the information, actions, and expertise of relevant stakeholders) mediate the relationship between evacuation behaviour and its causal factors.

This study found that the selected perceptions significantly influenced the stay-or-go decision across all three information conditions. Among them, protective action perception had the strongest positive effect, followed by risk perception, which also had a positive effect, while stakeholder perception had the least effect, showing a consistently negative influence on evacuation decision. Also, the analysis identified several consistent relationships between individual, household, and environmental factors and psychological variables. For example, protective action perception was higher among individuals with greater household income, awareness of evacuation zones, closer proximity to the coast, and residence in hilly terrain, while it was lower among older individuals, those with higher education, larger households, and private vehicle ownership. Risk perception was positively associated with tsunami knowledge and confidence in infrastructure but negatively influenced by household size, presence of elderly members, and higher education attainment. Stakeholder perception increased with the presence of household emergency plans and living in extended families but declined among individuals in larger households and those with favourable views of existing infrastructure.

These findings reinforce prior research highlighting the inconsistent direct effects of socio-demographic variables on evacuation decisions and underscore the value of examining their influence mediated by perceptions. The strong influence of protective action perception suggests that communication strategies should prioritize building confidence in the effectiveness and feasibility of evacuation, particularly among highly educated individuals and vehicle-owning households, while response plans should account for vulnerable populations such as older adults, whose lower perception may reflect physical limitations or a reduced capacity to evacuate. The positive link between risk perception and tsunami knowledge highlights the importance of sustained public education, especially in larger households or those with elderly members where perceived risk may be reduced. The negative influence of stakeholder perception on evacuation intentions underscores the need to foster trust in authorities and promote inclusive disaster planning. Tailoring communication and preparedness strategies to these perception pathways can more effectively shape the evacuation behaviour of individuals from diverse demographic and geographic contexts.

s3957718@student.rmit.edu.au

Oral Presentation

Raphael, Krier-Mariani[1,2], Matt Balkham[3], Ed Atkin[4], Kate McDonald[3], Ted Conroy[4], Shaw Mead[4], Derek Todd[3], Lee Paterson[5], Andy Burrel[6], Kate Downes[7]

[1]Dunedin City Council, [2]Scripps Institution of Oceanography, [3]Jacobs, [4]eCoast, [5]Stantec, [6]Landpro,[7]DML

Developing a technical coastal program to build coastal resilience – the Saint Clair Saint Kilda case study.

With projected sea level rise and intensifying extreme sea states, coastal resilience has become a central focus of climate adaptation strategies for local governments. Across Aotearoa, coastal adaptation plans are typically developed following the Ministry for the Environment (MfE) guidelines. While these guidelines provide a standardised planning framework, they have limitations, particularly regarding the data and technical assessments required to evaluate the feasibility and performance of adaptation pathways. This can be especially problematic in data-poor regions, leading to delays or shortcomings in implementation.

This presentation outlines a technical coastal program designed to address these challenges, using the St Clair–St Kilda embayment in Dunedin as a case study. This key coastal cell protects low-lying South Dunedin from the high-energy Southern Ocean swells. The program integrates two core components: coastal monitoring and numerical modelling. The monitoring uses repetitive UAV-photogrammetry surveys to identify erosion hotspots and assess infrastructure response to extreme events, while also providing boundary conditions for nearshore model development based on nearshore wave buoy data, topo-bathy LiDAR and multibeam surveys. Modelling (using both phase-averaged and phase-resolving approaches) is used to forecast long-term coastal evolution under climate change scenarios and to test the effectiveness of various engineering interventions (renourishment, groynes, offshore breakwaters, seawalls).

Together, these approaches inform the development of a site-specific adaptation pathway that leverages the embayment's morpho-hydrodynamic processes to enhance coastal resilience. This science-based approach ensures that the adopted resilience strategy works with natural coastal processes rather than against them, promoting long-term sustainability and effectiveness.

Raphael Krier-Mariani: I received the 2019 PhD NZCS Scholarship for my work on wave transformation over shore platforms. I hold a Bachelor of Science (Honours) in Oceanography, a Master of Research in Applied Coastal Sciences from Plymouth University, and a PhD in Coastal Geography from the University of Otago. My research has focused on a range of coastal processes, including the dissipation of storm waves in the English Channel (UK) using offshore buoy data; the morphological response of Narrabeen Beach (Australia) to El Niño–La Niña cycles using nearshore wave hindcasts and beach surveys; and the dynamics of non-linear shallow-water waves using pressure sensor arrays. I am currently a Postdoctoral Researcher at Scripps Institution of Oceanography, where I develop coastal hazard monitoring and forecasting tools. In parallel, I serve as the Lead Coastal Scientist for the Dunedin City Council, leading the development of coastal resilience strategies. My work bridges applied and fundamental science, combining coastal monitoring, wave modelling, and machine learning to assess and predict coastal hazards.

Raphael.Krier-Mariani@dcc.govt.nz or rkrier@ucsd.edu

Oral Presentation

Raphael, Krier-Mariani[1,2], Wayne Stephenson[3], Sarah Wakes[3], Mark Dickson[4]

[1]Dunedin City Council, [2]Scripps Institution of Oceanography, [3]University of Otago, [4]Auckland University

The influence of nearshore submerged flats structures on wave refraction and energy distribution patterns.

Submerged flat structures, such as shore platforms or coral reefs, are common coastal features. While wave transformation over these types of landforms has been extensively studied, little is known about the effects of submerged flats on the nearshore energy distribution of different wave frequencies composing wavefields. Such information can be particularly useful to understand how natural landforms redistribute wave energy and serve as coastal protection. This presentation summarises a recent body of work composed of field observation and numerical modelling on wave transformation carried out in New Zealand, which aimed to address this knowledge gap.

The field observation components of this research consisted of developing a method allowing the observation of wave transformation in two dimensions was developed using a synchronised array of pressure sensors. The array was used to define the energy of various frequency bands of the wave field and wave directional spectra over the platform surface. The analysis was repeated for platforms with various geometries in Mahia and Otago to observe wave refraction and energy patterns over platform surfaces. It was found that directional and wave energy patterns over platform surfaces varied depending on the platform geometries and differed between wave frequency bands. In general, wave energy was enhanced in areas where waves converged and attenuated in areas where waves diverged.

The numerical modelling components of this research focused on identifying the processes linking wave energy distribution and wave directional patterns over the surface of concave and convex edge platforms. To this effect, a spatiotemporal decomposition method inspired by quantum fluid dynamics was applied to wave simulations obtained from a non-linear Boussinesq wave model (FUNWAVE-TVD). It was found that coherent wave interaction (defined by the interaction of oblique wave trains with similar frequency and phase) controlled by the shore platform edge curvature can amplify wave energy and play a key role in the behaviour of incident wave frequencies, but also of their harmonics and subharmonic components. As a result, platform curvature can determine the relative dominance of wind, swell and infragravity waves across platforms. Alongshore, coherent wave interactions governed the nodal structure of stationary patterns in the infragravity frequencies.

Raphael Krier-Mariani: I received the 2019 PhD NZCS Scholarship for my work on wave transformation over shore platforms. I hold a Bachelor of Science (Honours) in Oceanography, a Master of Research in Applied Coastal Sciences from Plymouth University, and a PhD in Coastal Geography from the University of Otago. My research has focused on a range of coastal processes, including the dissipation of storm waves in the English Channel (UK) using offshore buoy data; the morphological response of Narrabeen Beach (Australia) to El Niño–La Niña cycles using nearshore wave hindcasts and beach surveys; and the dynamics of non-linear shallow-water waves using pressure sensor arrays. I am currently a Postdoctoral Researcher at Scripps Institution of Oceanography, where I develop coastal hazard monitoring and forecasting tools. In parallel, I serve as the Lead Coastal Scientist for the Dunedin City Council, leading the development of coastal resilience strategies. My work bridges applied and fundamental science, combining coastal monitoring, wave modelling, and machine learning to assess and predict coastal hazards.

Raphael.Krier-Mariani@dcc.govt.nz or rkrier@ucsd.edu

Oral Presentation

Jeff Lillycrop[1], Quin Robertson[1], Kyle McKay[1], Dan Kruimel[1], Lorraine Claydon[2]

[1]Woolpert, USA, [2]Woolpert NZ, Napier

Harnessing high resolution topo-bathymetric data for coastal zone management

New Zealand's 3D Coastal Mapping (3DCM) programme is collecting high resolution topographic and bathymetric data for approximately 40%of the nation's coastline, with a particular emphasis on high population areas. The primary technology being utilized is bathymetric lidar given its proven effectiveness to efficiently map the challenging coastal zone. These data set the stage for informing decisions across a diverse array of sectors and management challenges ranging from natural hazards to ecosystem management to maritime safety. Using two case studies from the United States where bathymetric lidar technology has been in operation for over 15 years covering approximately 65,000 square kilometres, this presentation explores how detailed mapping data collected in 3DCM can unlock other forms of analysis and ultimately lead to more integrated coastal zone management.

The United States' National Coastal Mapping Program (NCMP) leverages topographic and bathymetric lidar data to understand and manage their nation's coastlines. The NCMP was established to provide the US Army Corps of Engineering (USACE) and coastal managers with topographic and bathymetric elevations and high-resolution imagery to inform decisions regarding navigation, flood risk management, coastal storm impacts, and ecosystem management decisions at federal projects and across the public sector. The Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) and NCMP have expanded their use of data through special data products intended to capture more information from the data and created tools to aid users in coastal evaluations.

Example 1 – Coastal Engineering Resilience Index (CERI): The first example from the NCMP highlights how New Zealand's 3DCM programme can leverage high resolution topographic and bathymetric datasets to understand coastal change. Standardized metrics derived using the JALBTCX Toolbox include transect generation along with positions of shoreline, dune toe, dune crests, bluff/cliff toe, bluff/cliff crests, sandbar troughs, and sandbar crests. Shoreline changes are quantified using the mean high water (MHW) positions, and volume changes are quantified between each transect. Additional metrics include beach and bluff/cliff slopes. The Coastal Engineering Resilience Index (CERI) is quantified by comparing the local tide, wave, and storm conditions to the protective width, height, and density of the coastal profiles. This is an excellent tool for communicating the condition of the NZ coast to stakeholders and the public.

Example 2 – Bight Ecological Model: Hurricanes and coastal storms expose residents and economies to flood risk globally, and a series of projects in New York and New Jersey (northeast United States) are exploring management actions to reduce flood risk in balance with ecological and social outcomes. Across this region, communities are considering a diversity of measures for mitigating flood risks, including structural actions (e.g., levees, floodwalls, storm surge barriers), non-structural measures (e.g., buy-outs, elevation of structures, flood-proofing), and natural and nature-based features (e.g., wetland creation, reefs for breakwaters). The New York Bight Ecological Model (NYBEM) is being developed and applied to assess the impacts of these actions on the extent and quality estuarine ecosystems at scale of more than 7,000 square kilometres. High resolution mapping provides the fundamental starting point for these models as well as a means to parameterize detailed hydrodynamic models.

New coastal mapping data position communities across New Zealand to make more informed decisions across a variety of management contexts. This presentation uses examples from other geographies to demonstrate and explore the utility of these data.
daniel.kruimel@woolpert.com

Oral Presentation

Emily M. Lane[1], Sam Dean[2], Cyprien Bosserelle[1], Alice Harang[1], Céline Cattoën[1], Graeme Smart[1], Rose Pearson[1], Trevor Carey-Smith[2], Raghav Srinivasan[2]

[1]ESNZ (formerly NIWA), Ōtautahi Christchurch, [2]ESNZ (formerly NIWA), Te-Whanganui-a-Tara Wellington

The influence of Sea Level Rise on Freshwater Flooding around Aotearoa New Zealand

The two greatest impacts of climate change on the inundation hazard facing Aotearoa New Zealand are sea level rise (SLR) and increases to rainfall. Considerable work has gone into assessing the impact of sea level rise on direct inundation of the coastline as well as the effect it will have on coastal inundation through exacerbating storm-tide. Likewise, Mā te Haumaru ō te Wai: Flood Resilience Aotearoa, has developed a workflow to model freshwater flooding (fluvial and pluvial) for both current and future climates.

With more than 65% of New Zealanders living within 5km of the coast, also of interest is the intersection between these two aspects of climate change. I.e., How does SLR affect freshwater flood inundation on coastal flood plains? It is well known that the downstream boundary condition of a flood model can have a significant effect on the flood inundation on the coastal floodplain. Because of this, considerable effort has been put into assessing joint probabilities of storm surge with on-land flooding or the occurrence of high tide coincident with the arrival of the flood pulse at the coast.

Within Mā te Haumaru ō te Wai: Flood Resilience Aotearoa, freshwater flood hazard (fluvial and pluvial) was modelled at a national scale for the 1% AEP for current climate and also additional warming of +1˚, +2˚, and +3˚C above current climate (which approximately translate to +2˚, +3˚, and +4˚C above pre-industrial climate as the world is already over 1˚C above pre-industrial temperatures). Modelling has been undertaken for all coastal floodplains with LiDAR available. The offshore boundary condition was a MHWS tide for that location with the high tide timed to coincide with the arrival of the flood pulse at the coast. An additional scenario was modelled for these coastal floodplains of +3˚C additional warming plus SLR of 1.5m. This height is around the upper end of relative SLR (i.e., including vertical land movement) expected by 2100, and the SLR expected by around 2160 in SSP3-7.0. While this represents an extreme scenario, the intent is primarily to understand the sensitivity of freshwater flooding to SLR. Because of our national-scale coverage, we can use this sensitivity test to map out those locations where freshwater flooding is sensitive to SLR and those places where it is irrelevant.

The results from this study can be used to inform future flood modelling under climate change, highlighting those locations where SLR needs to be explicitly accounted for in future scenarios. Because SLR is dependent not just on the amount of warming that has occurred but also on how long it has occurred over (SLR will continue for some time, even if we reach a peak in warming) understanding this sensitivity will help inform where this needs to be accounted for in future modelling and where it does not.

Emily.Lane@niwa.co.nz/Emily.Lane@earthsciences.nz

Oral Presentation

Anna Madarasz-Smith[1], Becky Shanahan[1]

[1]PDP, Napier

Ecological Considerations for Coastal Hazard Mitigation: Enhancing Outcomes for Coastal Ecosystems

Coast hazard mitigation is increasingly necessary to protect communities and infrastructure from erosion, storm surge, and sea-level rise. However, conventional interventions such as seawalls, rock revetments, and beach nourishment can have unintended consequences for coastal ecosystems if ecological considerations are not integrated into planning and design.

Developing solutions that address both hazard protection and ecosystem health requires a thorough understanding of the structure and function of coastal habitats. Consideration of habitat connectivity, species life cycles, and sediment dynamics can inform designs that minimise habitat loss, fragmentation, and disruption of ecological processes. Early collaboration with ecologists during project planning can identify sensitive areas, seasonal constraints, and opportunities for habitat enhancement. Long-term monitoring and maintenance plans that incorporate ecological indicators are also critical to ensure that interventions continue to support biodiversity and ecosystem services over time.

While engineering costs, and increasingly carbon emissions, are typically quantified during the planning and procurement process for coastal hazard mitigations, the loss of ecosystem services is rarely incorporated. This is despite the critical role intertidal ecosystems play in carbon sequestration.

Incorporating ecological values into design, such as allowing space for habitat migration or adopting nature-based solutions, can reduce ecological trade-offs and deliver win-win solutions.

anna.madarasz-smith@pdp.co.nz

Oral Presentation

Preston Maluafiti, Duong Le, Chris Hepburn

University of Otago, Dunedin

Variability of bioactive compounds within *Undaria pinnatifida* in Otago Harbour

The kelp *Undaria pinnatifida*, commonly known as wakame is native to the Northwestern Pacific Ocean and is now broadly distributed globally as an invasive species. *Undaria pinnatifida* was first documented in Wellington harbour, New Zealand in 1987 and arrived via international shipping. Since then, it has spread to all major ports in New Zealand and has expanded to the open coast across most regions. Recent surveys within Customary Protection Areas (CPAs) in Southern New Zealand demonstrate that *U. pinnatifida* is now a dominant component of seaweed communities on shallow subtidal reefs. Pilot *Undaria* control programmes led by Kāi Tahu Tangata Tiaki (customary fishery managers) focused in CPAs began in 2022. Hand removal has proven an effective control methodology, but cost is a major consideration, limiting sustainability of these operations.

Kāi Tahu is currently investigating products from the invasive kelp to fuel a sustainable control programme There is strong commercial demand for seaweed products across the world. *Undaria pinnatifida* is a valuable food and a known source of high-value bioactive compounds which can be transformed into health supplements. Known health benefits include the suppression of postprandial blood glucose, obesity, assistance of lipid digestion, anticancer, antioxidant and antihypertensive.

Although, *U. pinnatifida* clearly possesses compounds of economic value to New Zealand, extraction of compounds, facilities and labour is a costly expense. Consequently, there are seldom studies on how bioactives present in *U. pinnatifida* are modulated by environmental drivers. In general, our understanding of how macroalgae respond physiologically to environmental drivers is a developing field of study. Therefore, understanding the connection between environmental variability and bioactives in *U. pinnatifida* could fuel an industry of high-value compounds to support local control operations of the invasive kelp.

Lastly, although this project looks to find clear relationships, investigations in to how to maximise compound extraction is taking place. This study also provides the opportunity for the business to expand into native kelp aquaculture, such as using *Macrocystis pyrifera*.

Prestonmalua@gmail.com

Poster Presentation

Ruby Mckenzie Sheat[1], Peter Meihana[2], Corey Hebberd[2], Shaun Williams[1], Cyprien Bosserelle[1], James Battersby[1], John-Mark Woolley[1], Ryan Paulik[1], Jay Hepi[1], Andrew Lorrey[1]

[1]Earth Sciences NZ, Christchurch, [2] Rangitāne o Wairau Trust, Blenheim

Iwi-led consequence modelling of inundation hazards: a case study at Te Pokohiwi o Kupe | Wairau Bar

Climate change is intensifying coastal hazard risks across Aotearoa New Zealand, including for wāhi tapu and taonga of cultural significance. At Te Pokohiwi o Kupe (Wairau Bar) in Marlborough, one of Aotearoa's earliest known archaeological sites (c. 1280 AD) is increasingly threatened by sea-level rise (SLR), flooding and erosion. This whenua represents a nationally significant landscape and tangata whenua, Te Rūnanga a Rangitāne o Wairau (Rangitāne o Wairau), were keen to ensure its effective protection. Working alongside Rangitāne o Wairau whānau is an important and significant part of this research, looking to understand local knowledge of historic inundation events and impacts from a tangata whenua perspective.

Using Te Pokohiwi o Kupe as a case study, this research investigates the spatiotemporal impacts of coastal inundation on Māori cultural heritage, co-developing methods to embed Te Ao Māori within coastal risk assessment and adaptation planning. Key elements include: 1) the weaving of mātauranga Māori through collaborative wānanga and hui with Rangitāne o Wairau kaumātua and whānau to inform the development of culturally grounded consequence/risk frameworks and statistical models; 2) geospatial mapping and surveying of taonga and wāhi tapu using local knowledge and mātauranga, ground penetrating radar and drone-based LiDAR; 3) numerical simulations of tsunami, climate-driven SLR and storm surge inundation hazards in the area; 4) configuration of risk modelling workflow to weave iwi-defined taonga exposure layers, consequence functions and hazard models to quantify the threat and sociocultural impacts of compounding inundation under a warming climate.

Initial findings suggest that the landscape where much of the cultural taonga are located is at risk from 100-year storm wave inundation under present-day climate conditions. With 1 m of SLR, which might be reached by the early 2100's under current emissions rates, up to 75% of the site could be affected in the same event. The entire site would be significantly inundated by a major tsunami event (2,500-year, 84th percentile) sourced at the Hikurangi or Wairarapa-Nicholson fault systems arriving at high tide, with flood depths and velocities exceeding 2 m and 3 m/s, respectively, at approximately half of the site.

These insights underscore the vital need for integrated, culturally inclusive adaptation strategies that give effect to kaitiakitanga and ensure the intergenerational protection of Aotearoa's Māori heritage, particularly at sites of national significance, such as this one, which holds deep historical importance as one of the first settlement sites in Aotearoa, referred to by Rangitāne o Wairau as "the birthplace of the nation". This work also helps contribute to national efforts on developing processes and methods to ensure mātauranga Māori is embedded in coastal science and hazard risk planning, with potential for broader application to other sites at risk across Aotearoa.

ruby.mckenziesheat@niwa.co.nz

Poster Presentation

Matthew McNeil[1]

[1]Auckland Council

The transforming coastline of Tamaki Makaurau in the wake of a triple dip La Nina cycle

This presentation covers the Auckland Council article contained in the NZ Coastal Society Special Publication 6, Embracing Coastal Transformation in Aotearoa, July 2025.

The eastern coastline Tamaki Makaurau, Auckland was subjected to notable change through the three consecutive years of La Nina conditions between 2020-2023. This resulted in beach erosion and damage to coastal infrastructure and assets.

This presentation outlines some of the changes observed during this period, and the resulting coastal management challenges and responses undertaken by Auckland Council.

The impacts and differing coastal management responses at four sites along the eastern coastline are presented, being Snells Beach, Orewa Beach, Browns Bay, and Murrays Bay. These sites range in exposure to coastal processes, the assets affected, and the urgency of required response. The coastal management approach applied to each site considered what was at risk, the driving coastal processes, and overarching policy direction, while ensuring the regulatory requirements were met. This presentation considers the success of each response to date.

matthew.mcneil@aucklandcouncil.govt.nz

Oral Presentation

Richard Measures[1], Arman Haddadchi[1]

[1]Earth Sciences New Zealand, Christchurch

Monitoring and modelling the supply of beach grade sediment from rivers to the coast

River sediment forms a key component of coastal sediment budgets and can be a significant source of uncertainty when predicting coastal erosion hazard. Only the coarser sediment particles contribute to beaches, so the particle size distribution of transported sediment is important as well as the total sediment load.

Advances in monitoring allow us to better quantity sediment load, particle size distribution and their temporal variability. Modelling can extend this to predict how sediment supply is changing in response to gravel/sand extraction, water extraction/storage and climate change.

We present case-study examples demonstrating advances in:

- **Direct measurement of sand load and grain size distribution in rivers during flood events.** Advances in sensor technology allow deployment of laser diffraction particle size analysis instruments into rivers during floods to profile sediment concentration and particle size distribution. Profiling allows better quantification of near-bed (i.e. coarser) suspended sediment load. Sediment gaugings on the Waimakariri River in Canterbury were conducted to constrain uncertainty on sand load and inform coastal erosion modelling for Christchurch. The gauging data was applied to assess changes in future sand supply due to climate change, gravel extraction and irrigation abstraction.
- **Continuous monitoring of suspended sediment loads.** Utilising a combination of acoustic backscatter and optical turbidity sensors, calibrated to sample data, allows continuous monitoring of multiple size fractions. Continuous monitoring in the Rangitata River (Canterbury) and Oreti River (Southland) has been used to understand temporal sediment dynamics.
- **Modelling bedload supply, including the effects of gravel extraction.** Morphodynamic modelling of the Tukituki River in Hawke's Bay was calibrated to observed bed level changed and used to predict current and future gravel supply to the eroding Haumoana littoral cell. Scenario testing was used to explore the effects of river gravel extraction and sea level rise.

Richard.measures@niwa.co.nz

Oral Presentation

Jack O'Carroll[1], Lucy Underwoord[2], Robyn Dunmore[3], Reid Forrest[3], Marcus Cameron[2]

[1]SLR Consulting, Wellington, [2]Tonkin + Taylor, Auckland, [3]SLR Consulting, Nelson

Field methods used to monitor colonisation of subtidal reef enhancement units

The installation of 56 subtidal reef units parallel to the Ngā Ūranga ki Pito-One section of Te Ara Tupua's shared pathway was a novel component of a broader habitat loss compensation and biodiversity enhancement package. The subtidal reef units, each 5 m x 4 m x 4 m in dimension, were installed between the 7 m – 9 m depth contours approximately 150 m offshore, running parallel with the shared pathway. The physical structure of reef units was designed to provide increased opportunities for shelter and foraging opportunities for fish taxa, to provide rocky reef habitat for algal taxa and invertebrates, and to provide opportunities for mahinga kai.

Consent conditions require detailed monitoring of the colonization of the reef units by fish, invertebrates, and algae. To-date, one baseline and two post-installation surveys have been conducted. Several data collection methods have been employed; quadrat imagery, video transects, baited underwater video systems, and sediment sampling. This is complemented by Kaitiaki (cultural monitors) integrating mātauranga Māori practices of observation, experience, and interaction with the natural environment.

SLR Consulting led the data collection in the field partnering with iwi Mana Whenua Taranaki Whānui and representatives of the Te Ara Tupua Alliance. This presentation provides an overview of the pre- and post-installation monitoring methods employed to-date, the lessons learned, and how the monitoring methods have been adjusted over time.

jocarroll@slrconsulting.com

Lucy.Underwood@te-ara-tupua.co.nz

rdumore@slrconsulting.com

rforrest@slrconsulting.com

Marcus.Cameron@te-ara-tupua.co.nz

Oral Presentation

Rahera Ohia[1,2,]

[1] Coastal Marine Research Station, University of Waikato (Te Whare Wānanga o Waikato), Tauranga, New Zealand
[2]Ngāti Pūkenga, Ngāi Te Rangi, Waitaha

Focusing Indigenous Knowledge and Community on Reef Resilience

For Ngāti Pūkenga, the moana is more than a physical space, it is part of who we are. Our relationship with the ocean is one of whakapapa, responsibility, and care. As reef ecosystems come under increasing pressure from sedimentation, warming seas, and disrupted marine cycles, our communities are responding not only with concern but with action, rooted in mātauranga and tikanga passed down over generations.

This kaupapa shares how Ngāti Pūkenga is leading an approach to reef resilience grounded in Pā Whakawairua, a framework developed through lived experience, whānau knowledge, and a deep sense of intergenerational responsibility. Rather than being an overlay, mātauranga Māori sits at the heart of the project: defining success, informing priorities, and guiding each step forward. Seasonal indicators such as the maramataka and Matariki shape the timing of our activities. Kōrero tuku iho and place-based understandings define what matters most and how to act with integrity. This mātauranga supports the Toka ākau toitu Kaitiakitanga – building a sustainable future for coastal reef ecosystems MBIE programme (grant UOWX2206).

Our approach builds from the ground up, recognising that whānau and hapū are the experts of their rohe. Co-design and partnership are not about consultation, but about recognising iwi as decision-makers in their own right. While science and monitoring tools can support this kaupapa, they are not the drivers, our values are. This is a shift from engagement to empowerment; from participation to tino rangatiratanga.

The project is a living example of what it looks like to restore mauri through a community-first, Indigenous-led process. It also demonstrates how meaningful environmental action must be connected to cultural wellbeing and whakapapa obligations. As we look to the future, our efforts are not just about healing reefs, they are about healing relationships, restoring balance, and preparing the way for the next generations of kaitiaki.

This is an invitation to reimagine resilience, not as a technical fix, but as a return to who we are.

rahera.ohia@tapiriatu.co.nz

Oral Presentation

Jokotola Omidiji[1], Kala Sivaguru[1], Alan Moore[1]

[1]Planning & Resource Consents, Auckland Council, Auckland

Balancing Acts: Coastal Erosion, Public Space, and Private Erosion Protection Structures on Esplanade Reserves

Coastal management decisions often involve balancing private property protection with the preservation of public coastal spaces and natural shoreline processes. Using shoreline sections at Point Wells located on the western section of the Whangateau Harbour, North Island, New Zealand, as a case study, this research examines the decision-making challenges associated with approving private hard protection structures on adjacent public esplanade reserves. These esplanade reserves are intended to provide public access, support coastal ecosystems, and accommodate natural shoreline changes. Yet, as private landowners seek to protect their private titles from erosion, private hard coastal protection structures such as rock revetments, timber retaining walls, are increasingly constructed on public land, potentially disrupting sediment transport and estuarine dynamics.

This study investigates the intersection of statutory and non-statutory frameworks—including the Reserves Act, the New Zealand Coastal Policy Statement (NZCPS), the Auckland Unitary Plan (AUP), and Auckland Council's Shoreline Adaptation Plans (SAPs)—to examine how governance structures shape coastal management decisions. The AUP's E36 provisions allow for coastal protection structures provided they do not exacerbate erosion or compromise hazard management, yet their placement on public land also triggers the Reserves Act, which prioritises public access, amenity, and long-term stewardship. This tension raises a central question: how do these frameworks interact when private protection structures intersect with public land management? SAPs, meanwhile, provide a strategic, long-term approach for council-owned coastal assets, offering adaptive responses such as managed realignment, hold the line, limited intervention, and no active intervention. While the "do nothing" approach may appear cost-effective, it risks significant long-term impacts. A critical review of policy documents, consent decisions, and stakeholder perspectives, highlights how overlapping policy frameworks produce tensions between enabling private property protection and safeguarding coastal resilience, public values, and adaptive management pathways.

This study contributes to discussions on sustainable coastal management and the effectiveness of existing policy frameworks in addressing competing interests. The findings will inform future decision-making on coastal adaptation strategies, particularly in the context of climate change and increasing coastal hazards.

tola.omidiji@aucklandcouncil.govt.nz

Poster Presentation

Ryan Paulik[1], Nick Horspool[1], Josh Hayes[1], Shaun Williams[1]

[1]Earth Sciences New Zealand, Aotearoa New Zealand

RiskScape: A modelling engine for coastal hazard risk analysis

RiskScape is open-source software featuring a flexible modelling engine designed for coastal hazard risk analysis. It enables users to define custom risk quantification workflows as model pipelines. These pipelines consist of sequential steps and functions that analyse hazard, exposure, and vulnerability data across diverse spatio-temporal domains using geoprocessing and spatial sampling operations.

The RiskScape engine supports both deterministic and probabilistic risk quantification, with multiple modes for probabilistic analysis. It advances multi-hazard risk modelling through several key implementation features. Notably, RiskScape operates independently of fixed input data standards, allowing users to work with various hazard types, intensity metrics, and temporal occurrence data. These inputs are geometry-processed and spatially sampled to generate coverage datasets for simultaneous or sequential multi-hazard events at exposure locations. Impact escalation from single or multiple hazard events is evaluated using user-defined conditional or nested logic, applying vulnerability functions in a temporal sequence of hazard and impact occurrence. RiskScape's support for open geospatial consortium (OGC) standards ensures compatibility with widely used geospatial data formats and operations, enhancing its adaptability for coastal hazard risk modelling at any geographic scale.

This presentation outlines core RiskScape functions that enable deterministic and probabilistic risk quantification, as applied in several national-scale coastal flood risk assessments for New Zealand.

ryan.paulik@niwa.co.nz

Poster Presentation

Simone Phillips[1], Emma Hudson-Doyle[1], Marion Tan[1], Sally Potter[2], Sara Harrison[3]

[1]Massey University, Wellington, [2]Canary Innovation, Tauranga, [3]Earth Sciences New Zealand, Lower Hutt

Community voices in flood warning systems: Learning from local initiatives in Aotearoa New Zealand

Warnings save lives, but only if they reach, and resonate with, those most at risk. Despite advances in flood forecasting technologies, gaps persist between official alerts and the protective actions taken by communities. Recent events in Aotearoa New Zealand and abroad have highlighted this disconnect and the urgency needed to address this issue, especially for communities frequently impacted by coastal or riverine flooding. This research investigates how communities in Aotearoa contribute to and interact with flood warnings and how their knowledge and lived experiences can strengthen the overall system.

This two-phase research is grounded in the understanding that effective warning systems must go beyond top-down dissemination to be embedded within the social fabric of communities, including the needs, values, and capacities of those most at risk. Phase one of this study involved interviews with institutional actors along the official warning chain, as well as researchers and leaders with localized expertise in community resilience. These interviews highlighted both current practices and a growing recognition of the need to better integrate local knowledge into our official systems.

The current, second phase of the project focuses on in-depth, place-based case studies of communities with experience in locally led or co-produced warning initiatives. Among the cases is a coastal community that has experienced storm surge and tidal flooding, prompting grassroots efforts to improve local warning systems. Community-based warning initiatives engage across the four pillars of effective warning systems: risk knowledge; monitoring and observing; communication; and response capability. They also reflect the unique environmental, cultural, and relational contexts in which these systems are embedded. Using qualitative methods of interviewing, observing, and document analysis, this work explores how local priorities, relationships, and knowledge integration can shape more inclusive and effective warnings.

As Aotearoa's coastal communities navigate a future of intensifying flood risk, regulatory shifts, and climate uncertainty, this research highlights the importance of co-navigating warning systems to ensure they are both scientifically robust and socially grounded.

simone.phillips.1@uni.massey.ac.nz

Poster Presentation

Malintha Ranasinghe[1], Raj Prasanna[1], Marion Tan[1], Emma Hudson-Doyle[1], Celine Cattoen[2],

[1]Joint Centre for Disaster Research, Massey University, Wellington [2]Earth Sciences New Zealand

HydroNetNZ: A Crowd-sourced and Machine Learning Driven Approach for Impact-Based Flood Forecasting and Warning at Household Level in New Zealand

Flooding is New Zealand's most frequent natural hazard, regularly causing impacts such as fatalities and economic disruption despite existing early warning systems. With climate change expected to increase the frequency of severe weather events, there is an urgent need for more effective flood warnings. Impact-Based Forecasts and Warnings (IBFW), endorsed by the World Meteorological Organisation (WMO), respond to this need for effective warnings. IBFW services aim to provide more actionable information to decision makers and at-risk communities by focusing on not just the expected hazard but also the potential impacts of weather-related events like floods. While IBFW is a promising solution for effective flood warnings, the practical implementation of IBFW services for floods remains challenging, particularly in New Zealand. A key barrier is the need for rapid hazard and impact modelling within the short forecast lead-time (a few hours) of weather events (like storms), which is computationally intensive with conventional modelling approaches.

This research addresses this modelling challenge by developing 'HydroNetNZ', an experimental household-level IBFW system for floods in New Zealand. We employ a deep learning (DL)-based emulator modelling approach to forecast high-resolution flood inundation maps. These inundation maps are then translated to household-level impact forecasts using a novel machine-learning-based method. The 'HydroNetNZ' mobile app, currently under development, will facilitate a crowd-sourced implementation of this experimental IBFW system across multiple case study areas in New Zealand. The app will also serve as a data collection tool to calibrate and validate the models.

To identify efficient model architectures for flood hazard modelling, we benchmarked five state-of-the-art DL emulator model algorithms from the literature. Because these models are typically developed for specific case study areas, we trained and tested each model using the same computational resources for a single United Kingdom case study area. This case study was selected because of the availability of high-quality hydrodynamic simulation data and its prior usage in benchmarking DL-based emulator flood inundation models, allowing for a fair and reproducible comparison. This benchmarking process helped us select a computationally efficient DL algorithm suitable for flood inundation modelling in New Zealand.

To ensure the system meets the practical needs of its users, the design and development of the 'HydroNetNZ' mobile app and DL-based emulator models are informed by ongoing engagement with key stakeholders, including emergency managers, hydrologists, and local authorities. Using a user-centric approach, this research underpins a robust and efficient AI-driven platform for household-level IBFW, improving the resilience of flood-prone communities in New Zealand.

malintha.mahindakumarage.1@uni.massey.ac.nz

Poster Presentation

Nazli Raudhati[1], Syamsul Bahri Agus[1], Rinny Rahmania[2]

[1]Department of Marine Science and Technology, IPB University, West Java, Indonesia.

[2]National Agency of Research and Innovation (BRIN), Jakarta, Indonesia.

*Corresponding author: **nazliraudhati@apps.ipb.ac.id**

Spatial Analysis of Blue Carbon Potential in the Mangrove Ecosystem at Muara Gembong Beach-Indonesia, as a Climate Change Mitigation Effort

Blue carbon ecosystems-such as mangroves, seagrass beds, and coastal marshes-play a crucial role in naturally absorbing and storing carbon. Among them, mangroves are particularly effective due to their high carbon storage capacity, making their conservation vital in efforts to mitigate atmospheric carbon emissions. Muara Gembong, located in the northern part of Bekasi Regency and bordering Jakarta Bay, Indonesia, supports a mangrove ecosystem currently used by the local community for fisheries (ponds) and ecotourism. This study aims to evaluate the blue carbon storage potential of mangroves in the Muara Gembong coastal area. Using Sentinel-2 satelite imagery and the Mangrove Vegetation Index (MVI) algorithm (threshold range: 2.0 to 20), the assessment was conducted through ENVI and QGIS software. The analysis estimated a mangrove area of 776.40 hectares, with a total carbon stock of approximately 93,089 MgC (megagrams of carbon). These findings highlight the significant potential of Muara Gembong's mangrove ecosystem as a blue carbon sink and underscore the need to integrate its conservation into sustainable climate change mitigation strategies.

Keyword: Mangrove Ecosystem, Blue Carbon, Mangrove Conservation

nairarauzati05@gmail.com

Poster Presentation

David R Schiel[1], Christopher Battershill[2], Rahera Ohia[3]

[1]Canterbury University, [2]Waikato University, [3]Ngāti Pūkenga

The value of intact marine ecosystems – can we please manage for that?

It is a fact of our complex societies that obvious problems do not always lead to obvious or effective solutions. Complications occur because of cross-sectoral issues, the balance between short-term returns of commercial enterprises and the long-term gains of conservation, exacerbated by the jurisdictional thicket of cross-ecosystem management. The nearshore marine environment has some of New Zealand's greatest biodiversity and per-area primary productivity, especially of kelp assemblages on our vast rocky coastline. For decades, we have been fixated on marine protected areas as the primary tool of marine ecosystem management – which is fine if overfishing and disruption of trophic cascades through the food web are the major influences.

Increasingly, however, it is cross-ecosystem flows of contaminants from land to sea that are devastating coastal ecosystems, especially by delivering huge amounts of sediments and debris that smother kelp beds, kill benthic species, prevent recruitment and recovery, darken the water column and compromise foundational primary productivity. These severely reduce the ecosystem services that human populations rely on and the ecological connections that are crucial to ecosystem functioning. Much of these disastrous flows are a consequence of harvesting exotic forests, followed by storm events like Cyclone Gabrielle in 2023, but there are many examples. Forestry covers vast tracts of NZ, driven by carbon sequestration and credits. At the least, it is debatable whether the value of these outweighs the opportunity costs of obviating other land uses and the local employment and services they bring. It is unequivocal, however, that the societal cost of downstream effects on coastal ecosystems is born by coastal iwi and communities, and all New Zealanders.

Our large research programme -- *Toka ākau toitu Kaitiakitanga -building a sustainable future for coastal reef ecosystems*, funded by MBIE – uses a nexus or mātauranga Māori and modern science tools (e-DNA, stable isotope and environmental chemistry, drones, acoustics, satellites) to provide the underpinning, spatially explicit knowledge necessary to inform management options for the stressors we can do something about.

The integrity of the nation's marine environment is important to safeguard cultural and societal values, as well as a burgeoning marine economy valued at $3.8 billion/yr. We can improve how we manage across ecosystems, and we obviously need to do so soon!

david.schiel@canterbury.ac.nz

Oral Presentation

Sam Scott-Kelly[1]

[1]Davis Coastal Consultants, Auckland

He raru ki tai - Walking uneasily between two worlds

This presentation is on charting the tension that exists between practitioners of coastal engineering and mātauranga māori, told through my personal experience of endeavouring to grow our capacity to walk more consciously between these two worlds. I've been practising as a coastal engineer since 2013, and started learning te reo in 2017. After six years of study I'm now relatively fluent, but have also struggled to have our work kaupapa where there is a direct engagement between the private property owners and local iwi live up to the depth or quality that I'd hoped for.

This is to be illustrated using a specific project in Mōkau, north of New Plymouth, where development and unconsented works have occurred on a mobile sand spit at the mouth of the Mōkau River. The site is also an urupā and site of huge significance to local iwi. The site, and the issue we endeavoured to grapple with, combines a history of dispossession and ill-treatment of the tangata whenua by local and national authorities, ill-conceived development in an area prone to morphological change, an absence of any cohesive local authority response, and the challenges we as practitioners can face when we are engaged solely as experts in our field, with limited ability to affect the wider process at play.

sam@daviscoastal.co.nz

Oral Presentation

Ana Serrano[1], Nic Newman[1]

[1]Bay of Plenty Regional Council, Tauranga

Four Years On: Starting and Sustaining Community-led Climate Adaptation in the Bay of Plenty

Where do we begin?

Which communities do we start with?

At what scale?

What kind of support is needed?

What is our role without clear government direction?

These were the questions facing Bay of Plenty Regional Council in 2021, as we sought to initiate climate adaptation at the community level. In response, we developed a community-led adaptation initiative that has grown steadily over the past four years.

This presentation will share the journey of breaking the inertia from those early uncertainties to a region-wide programme that supports communities to lead their own adaptation planning. It will outline how we structured initial support, how our approach has evolved, and what we've learned along the way—from funding mechanisms and technical guidance to building trust and navigating pace.

Rather than prescribing solutions, we've focused on enabling readiness, fostering ownership, and supporting communities to work in ways that reflect their values and priorities. The initiative has demonstrated that local government can play a meaningful role in empowering communities—without leading them.

We hope this presentation offers practical insights and inspiration for other parts of Aotearoa looking to begin their own journey of community-led climate adaptation, grounded in trust, partnership, and place.

ana.serrano@boprc.govt.nz
nic.newman@boprc.govt.nz

Oral Presentation

Yaxiong Shen[1], Colin N. Whittaker[1], Mark E. Dickson[1]

[1]The University of Auckland, Auckland

Cliff erosion by wave abrasion: Insights from wave flume experiments

Cliff-top seismic monitoring techniques have been used to quantify wave impacts on coastal cliffs. Ground motion is influenced by the type of cliff-front wave impact (broken, breaking, or unbroken), which is determined by the combined effects of water level and wave height. For a given wave height, increasing water depth shifts the dominant impact type from broken to breaking to unbroken, producing an initial increase in ground motion, peaking under breaking impacts, and then decreasing. Similarly, for a given water depth, increasing wave height shifts the dominant impact type from unbroken to breaking to broken, again with the largest motions occurring during breaking impacts.

Field studies have found that during storm periods, ground motion can increase by about one order of magnitude, and cliff-face volume loss may be up to two orders of magnitude greater than the long-term rate. Based on anecdotal evidence from the field, a number of studies have therefore interpreted ground motion (i.e. wave impact) as a proxy for cliff erosion, under the assumption that larger ground motions (i.e. larger wave impacts) correspond to greater cliff erosion. This assumption may hold for highly fractured cliffs, where high-impact pressures and associated ground motions could promote crack growth and structural weakening. However, the universality of this relationship to all cliff types, particularly strong rock with few or no fractures, remains uncertain.

Field settings involve many interacting processes, and cliffs are likely to be exposed to a range of wave conditions, making it difficult to isolate the effects of wave breaking types. To address this, we conducted controlled laboratory experiments using synthetic foam as a homogenous rock analogue. This choice excluded quarrying processes and allowed us to focus solely on abrasion. Model cliffs were exposed to broken, breaking, and unbroken waves, with cliff vibrations and erosion measured simultaneously.

Consistent with previous findings, breaking waves generated the largest ground motions, followed by broken and unbroken waves. However, erosion was greatest under broken waves, followed by breaking waves (two orders of magnitude lower) and negligible under unbroken waves. This is attributed to broken waves entraining the greatest amount of sediment, which impacted upon and abraded the cliff face. In contrast, breaking waves entrained only a small amount of sediment, and there was a complete absence of sediment impact on the cliff face during unbroken wave impact experiments. These results demonstrate that, for hard and homogeneous cliffs, ground motion alone may not be a reliable proxy for erosion. In many natural situations, the primary mechanism of erosion in uniform rock is likely to be abrasion from sediment impacts. These findings offer new insights into the mechanisms driving erosion in uniform rock cliffs.

yaxiong.shen@auckland.ac.nz

Oral Presentation

Amy Sheppard[1], Jennifer Hart[1], Winnie Pan[1], Nick Petkov[2], John Howarth[2]

[1]Beca Limited, Auckland [2]Wellington International Airport, Wellington

Wellington Airport Southern Seawall Renewal – armour unit selection process and 2D physical model testing

Wellington International Airport is located in Lyall Bay at the south end of the North Island. The site is situated on the open coast and directly exposed to southerly swells propagating north from the Southern Ocean. The southern end of the runway is reclaimed land with an Akmon seawall, constructed in the 1970s to provide shoreline protection against erosion and wave overtopping. The sea defences are approaching the end of their usable life and are under-designed by today's standards. An options assessment was undertaken for the replacement structure. A concrete armour unit overlay was selected due to the constructability complexities of the site. This presentation provides an overview of the concrete armour unit selection and the 2D physical modelling undertaken at University of New South Wales Water Research Laboratory (UNSW WRL).

The concrete armour unit selection considered: interlocking or mass-based stability; 1- or 2- layer armour; design slope; engineering performance and failure modes; casting complexity and production rate; transport and logistics; national availability of plant required for placement; placement method, ease and rate of placement at an exposed site; underlayer tolerance; ability to be placed on curves; licence/patent arrangements; and technical support. As a result of the selection process a two-layer Cubipod® system was identified as the most suitable option to overlay the existing Southern Seawall and was progressed to preliminary design.

Cubipod® units were developed by Spanish construction company SATO (Sociedad Anónima Trabajos y Obras) and Universidad Politecnica de Valencia (UPV) and patented in 2007. The benefits of the unit for this project included unit size, tolerance of underlayer, placement method, resilience and ability to "self repair".

The preliminary design was developed based on a two-layer Cubipod® system. A 2D physical model at a scale of 1:37.5 was undertaken at the UNSW WRL to confirm the size of the unit. Both 15.5t units and 24.5t units were tested at model scale (the latter as a contingency). A number of progressive tests were carried out to investigate hydraulic stability, wave overtopping and toe stability for a range of cases including a design case 1% AEP and overload 0.1% AEP for 50 year relative sea level rise scenarios. No units were displaced for the 15.5t and 24.5t during testing, and only intermittent rocking was observed during the tests. Based on the 2D physical model results and constructability considerations, the 15.5t units were progressed to detailed design.

Beca worked in partnership with Professor Jentsje van Der Meer (Expert Advisor), UNSW WRL (Physical Modelling), SATO (Cubipod ® patent holder), McConnell Dowell (ECI Contractor) and Tonkin + Taylor (Peer Reviewer).

Amy.Sheppard@beca.com

Oral Presentation

Rose B. Somerville[1], Teresa Konlechner[1]

[1]University of Otago, School of Geography – Te Ihu Whenua

An assessment of the threats and vulnerabilities of pīkao (*Ficinica spiralis*) in Ōtākou (Otago).

The conservation of threatened species is a constant challenge in the face of global biodiversity loss, with many species facing extinction due to habitat degradation, climate change, and spread of invasive species. Aotearoa, New Zealand, is recognised as a biodiversity hotspot but also as a leader in conservation of rare and threatened species. However, the efficacy of conservation strategies is varied with some species exhibiting continued decline despite targeted management efforts.

Pīkao, a sand binder endemic to Aotearoa, has suffered persistent decline primarily due to long-standing alterations to active coastal dune environments. This loss of habitat is evident in Ōtākou where the area of active duneland decreased by 41.4% between 1950 and the mid-1990s. However, no recent regional assessment exists for this species.

This research aims to establish critical baseline data and provide insight into the future of pīkao within Ōtākou. It does so by combining remote sensing techniques, botanical surveys, and habitat mapping informed by plant vigour at a reference site.

Mapping of suitable habitat from historic aerial imagery indicated pīkao would have been widely abundant prior to the last inventory in the 1990s when its population was already reduced. Now, pīkao exists primarily as small and scattered populations within Ōtākou often found in association with invasive species. Results gathered from the reference site found pīkao to have higher relative abundance and density in the absence of these competitors, illustrating pīkao within Ōtākou as highly dependent on active management for long-term persistence.

Somro693@student.otago.ac.nz

Oral Presentation

Harper Spurway[1], Associate Professor Jacqui Allen[2], MD, FRACS

[1]Te Kura Tuarua o Pātiki, Avondale College, [2]Waipapa Taumata Rau, University of Auckland

From Glory to Gutter – Our Degrading Manukau Harbour water

Te Manuka o Hotonui (Manukau Harbour) covers 520km of coastline, 394 km^2 of water and has a 4m tidal variation. It permanently houses >20% of Aotearoa wader bird population and > 60% utilize the harbour temporarily. Ten marae are located on the foreshore and it is a recognised taonga. Industry has flourished in the inner harbour and the Māngere Wastewater Treatment Plant (MWWTP) at Puketutu Island continues to discharge partially treated wastewater into the Harbour. Contamination of water from industry and MWWTP and street run off, has affected aquatic quality, flora and fauna.

AIM: To evaluate water quality around the Manukau Harbour at multiple shoreside locations, using commonly available testing apparatus.

METHODS

Ten test sites around the Harbour were included. **Inner**: Norana Park, Favona Factory Walkway, Mangere Bridge mangroves, Holcim Cement site. **Mid**: Onehunga Reclaimed Beach, Te Tauranga Onehunga Lagoon, Taylors Bay, Kiwi Esplanade Beach. **Outer**: Ambury Farm Park, Green Bay. Each site was visited on six occasions, 3 at high tide and 3 at low tide, with water samples collected and immediate water readings taken at shoreside (60 total samples, each with nine variables measured: pH, temperature, TDS [total dissolved solids], EC [electrical conductivity], salinity, ammonia, nitrate, nitrite, phosphate) using visual colorimetric grading and handheld meters. Raw data was recorded, and parametric and nonparametric testing was conducted.

RESULTS

Ammonia and nitrate levels varied significantly across sites ($p<0.05$). Ammonia concentrations were highest in mid-harbour sites and 76% of samples were above EPA toxic thresholds (0.1ppm) with whole-harbour mean 0.22ppm. Nitrate concentrations were greatest at inner harbour sites, with 88% of all samples recorded above the toxic 5ppm threshold and whole-harbour mean at 7ppm. Mean harbour phosphate concentration is 0.32ppm, just below the toxic threshold (0.4ppm). Harbour pH (7.94) is below recommended seawater levels (8.1) and varied significantly by site.

SUMMARY

Overall Manukau Harbour water quality is poor. Elevated levels of nitrate, ammonia and phosphate are present harbour-wide with nitrate and ammonia exceeding recommended safe levels for human and aquatic life. Inner harbour sites exhibited worse measures across all parameters. These findings reinforce previous water quality analysis but indicate further deterioration since work reported by ARC (Kelly et al, 2009), suggesting insufficient controls and remediation relating to water discharge into the Manukau Harbour. Greater monitoring and more stringent requirements for water remediation are needed to protect critical marine environments.

j.allen@auckland.ac.nz

Oral Presentation

Catriona F. Thompson[1], Yaxiong Shen[1], Mark Battley[1], Mark Dickson[1], Colin Whittaker[1]

[1]University of Auckland

Designing a temporary beach structure to mitigate swash energy during storms

Future sea-level rise and increases in storm magnitude and frequency are expected to exacerbate coastal erosion and flooding. Permanent engineered interventions to mitigate these issues may not be sustainable in the long-term due to costs and ecosystem impacts. This project aims to develop a temporary, transportable, and cost-effective solution for reducing storm-wave energy in the swash zone. This study explores a design paradigm focused on reducing storm wave energy to limit wave runup, coastal inundation, and erosion, while simultaneously encouraging sediment deposition. Unlike conventional coastal protection strategies aim to uniformly reduce energy across all swash flows, this approach targets the most energetic wave events. By prioritizing the dissipation of peak energy within the upper range of storm-driven flows, the design seeks to more effectively mitigate extreme impacts, offering a tailored and potentially more resilient method of shoreline management.

The proposed structure, named the Swash Energy Attenuation Fence (SEAFence), is a permeable, low-crested barrier that introduces reflection and turbulence while allowing water and sediment exchange. It aims to allow small bores to pass through while attenuating the impact of larger, more energetic bores.

A series of physical laboratory experiments were carried out in a wave flume to design a SEAFence prototype that was most efficient at reducing wave energy under a range of swash-scale forcing conditions while remaining structurally robust and easily deployable. best prototype was then field-tested at Muriwai Beach on the west coast of Auckland, NZ. Field deployment focused on short-term performance under moderate wave energy conditions, using pressure sensors and drone video analysis to quantify transient energy reduction. Results indicate that the SEAFence can reduce swash energy up to 20 % causing a lower flow intensity behind the barrier and a redistribution of sediment.

The findings suggest the SEAFence can be effective at mitigating erosion and minor inundation under certain conditions which is beneficial for post-storm recovery or event-based risk management. This research highlights the potential for flexible, temporary, and ecologically sensitive interventions in dynamic beach environments. Further testing and development are underway, but early results show promise for future integration into coastal hazard response toolkits.

catriona.thompson@auckland.ac.nz

Oral Presentation

François Thoral[1,2,3a], Shane Orchard[3,4], Matthew H. Pinkerton[2], Christopher N. Battershill[1], Rahera Ohia[1,5], David R. Schiel[3]

[1] Coastal Marine Research Station, University of Waikato (Te Whare Wānanga o Waikato), Tauranga, [2] Earth Sciences New Zealand, Wellington, [3] Faculty of Science, University of Canterbury (Te Whare Wānanga o Waitaha), Christchurch, [3]Marine Ecology Research Group, University of Canterbury, Christchurch, [4] Waterlink Ltd., Christchurch, [5] Ngāti Pūkenga, Ngāi Te Rangi, Waitaha

River Radii: A National Framework for Satellite Remote Monitoring of Water Quality and Environmental Change at River Mouths

River mouths are important indicators and mediators of interactions between rivers and the sea that mark the dispersal point for catchment-based stressors and subsidies. Satellite remote sensing data products and algorithms present many new possibilities for monitoring these dynamic and often inaccessible environments. In this study, we describe a national-scale comparative framework based on proximity to river mouths and show its application to the monitoring of coastal ecosystem health in Aotearoa New Zealand.

We present results from light attenuation coefficient (K_d) analyses – as a proxy for water clarity and sedimentation – to develop the framework considering data products of differing resolution and the effects of coastline geometries which might obscure the influence of catchment-derived stressors. Ten-year (2013–2022) K_d values from the highest-resolution product (500 m) showed significant differences ($p < 0.01$) in successively larger radii (1–20 km) despite the confounding influence of adjacent river mouths. Smaller radii returned a high variability that dropped markedly > 5 km. Tests of a 10 km radius showed that coastline geometry had a significant influence on K_d ($p < 0.001$), which is also likely for other water quality indicators. An analytical approach stratified by coastline geometry showed significant effects of stream order on open ($p < 0.01$) but not enclosed coasts, differences between marine bioregions ($p < 0.05$), and a degradation trend in the 90th percentile of K_d on enclosed coasts, which is indicative of extreme events associated with catchment erosion or sediment resuspension.

We highlight applications of the framework to explore water quality indicators and trends across many other meaningful scales (e.g., jurisdictions and ecosystem types) in addition to tracking changes at individual river mouths. This new framework is a crucial step towards linking land uses and catchment processes to coastal rocky reef ecological health, as an incoming tool for state of the environment reporting. This work is supported by the Toka ākau toitu Kaitiakitanga – building a sustainable future for coastal reef ecosystems MBIE programme (grant UOWX2206).

francoisthoral@gmail.com

Oral Presentation

François Thoral[1,2,3a], Shane Orchard[3,4], Matthew H. Pinkerton[2], Christopher N. Battershill[1], Rahera Ohia[1,5], David R. Schiel[3]

[1] Coastal Marine Research Station, University of Waikato (Te Whare Wānanga o Waikato), Tauranga, [2] Earth Sciences New Zealand, Wellington, [3] Faculty of Science, University of Canterbury (Te Whare Wānanga o Waitaha), Christchurch, [4]Marine Ecology Research Group, University of Canterbury, Christchurch, [4] Waterlink Ltd., Christchurch, [5] Ngāti Pūkenga, Ngāi Te Rangi, Waitaha

Evidence of coastal darkening and marine darkwaves: Towards an operational framework leveraging remote sensing to link land practices to coastal ecosystems health in Aotearoa New Zealand

Coastal ecosystems in Aotearoa New Zealand are increasingly impacted by land-derived stressors, particularly sedimentation from forestry, agriculture, urbanisation, and coastal development. These stressors compromise underwater light environments, threatening the resilience and productivity of shallow-water benthic autotrophs such as macroalgal forests. In this presentation, we introduce a national-scale remote sensing framework to monitor long-term changes in coastal water clarity and seabed light conditions, using satellite-derived light attenuation coefficients (Kd) and seabed irradiance as proxies for sedimentation and water quality. Drawing from the MfE State of the Environment reporting, we show evidence of long-term changes in coastal water quality around Aotearoa New Zealand.

Alongside long-term changes, episodic events such as sediment delivery and resuspension following intense rain and large waves, cause acute reductions in water clarity and underwater light availability. Such discrete events are increasingly seen as key drivers that can deteriorate shallow benthic ecosystems, yet a consistent event-based framework for reduction of underwater light does not exist. Here we present “Marine Darkwaves” (MDWs) as a general framework for quantifying extreme and discrete periods of reduced underwater light, which complements the coastal darkening concept and draws from definitions of other oceanic extreme events. We show evidence of such extreme events based on *in situ* and remotely sensed data, notably following cyclone Gabrielle in February 2023.

Finally, we expand on how coastal darkening and marine darkwaves can be linked to land uses and practices, enabling scalable assessments of coastal ecosystem health, from local catchments to national reporting, and supports the development of land-use strategies that safeguard underwater light conditions critical to macroalgal productivity and ecosystem services. The work is part of the Toka Ākau Toitū Kaitiakitanga MBIE programme (grant UOWX2206), aimed at building a sustainable future for coastal reef ecosystems.

francoisthoral@gmail.com

Oral Presentation

Megan E. Tuck[1] and Aidan McLean[1]

[1]Auckland Council, Auckland

Understanding Coastal Change in Tāmaki Makaurau: Key Insights from Auckland Council's Coastal Monitoring Programme

Te Kaunihera o Tāmaki Makaurau | Auckland Council's Coastal Monitoring Programme has been tracking shoreline change in Tāmaki Makaurau since the 1960s, building a long-term dataset that supports coastal hazard planning and coastal management decision-making in Auckland. The 2025 State and Trends Assessment examines 12 beaches across four coastal settings (west coast, open east coast, inner Hauraki Gulf, and Tāmaki Strait), assessing variations in beach width, volume, dune dynamics, and beach rotation over both long- and short-term periods.

Several important patterns emerge:

1. Site-specific beach dynamics: Beaches with similar wave climates and geographic setting exhibit highly contrasting patterns of change.

2. Shifting long-term trends: Several beaches previously considered stable, including Pākiri and Maraetai, are now revealing trends of long-term erosion, underscoring the need for ongoing monitoring to detect trend shifts.

3. Human interventions: Sand transfers, dune planting, beach renourishment, and the construction of coastal structures affect observed beach behaviour, having the potential to amplify or mask natural processes.

4. Vulnerability of urban beaches: Inner Hauraki Gulf beaches, constrained by hard structures and limited sediment supply, are highly sensitive to storm-driven erosion with many beaches exceeding historic lower limits of beach elevation in the last decade.

5. Cyclical patterns: Several open coast beaches exhibit 5-to-10-year cycles of sand accumulation and loss, potentially linked to ENSO and other climatic oscillations.

Auckland Council's Coastal Monitoring Programme has also investigated storm impacts on Auckland beaches including Cyclone Lola (October 2023) and Cyclone Tam (April 2025), highlighting the vulnerability and variability of Auckland's beaches to storm events.

Looking forward, our new initiatives such as drone-based surveys, nearshore bathymetry mapping, and further analysis of our wave buoy and coastal camera networks, will enhance monitoring capability, improving our understanding of Auckland's beaches and enabling proactive and adaptive coastal management.

megan.tuck@aucklandcouncil.govt.nz

Oral Presentation

Sally J. Watson[1,2*], Marta Ribó[3], Grace Frontin-Rollet[1,4], Scott Nodder[1], Sarah Seabrook[1], Stacey Deppeler[1], Rachel Hale[1], Jenny Hillman[2], Tom Brough[1], Eva Leunissen[1], Lee Rauhina-August[5] & Māia Holman-Wharehoka[5]

[1]Earth Sciences New Zealand [2]Institute of Marine Sciences, University of Auckland [3]AUT, [4]Victoria University of Wellington, [5]Ahumai Holdings Ltd

Measuring the impacts of ship anchoring

Routine vessel anchoring impacts the seabed with direct and indirect implications the health of the shallow marine environment. Even still, anchoring practices remain largely unmeasured, undocumented, and most importantly, unregulated. Remarkably, anchoring is absent from any national and international policies designed to reduce human impacts on the marine environment.

While the shipping industry is known to contribute to air, water and noise pollution, the physical impact of shipping practices, such as anchor use on the seafloor, has received much less attention. We present results from our pioneering field experiments measured the real-time impacts of anchoring in a multi-vessel campaign. We used two vessels: RV Ikatere, a 14 m catamaran used for data collection before, during and after the anchoring event; and RV Tangaroa, a 73 m blue water research vessel, which was at anchor for 24 hours in the Wellington Harbour anchorage, Aotearoa/New Zealand.

The datasets collected during this field campaign delineate the complete environmental signature during anchoring practices, including physical, chemical, biological, ecological changes. Our results show that the seabed impact of ship anchoring in Wellington Harbour has increased substantially over the last ~15 years with physical impacts lasting at least a decade. We quantify differences in seafloor morphology associated with areas characterised by intense ship anchoring and further assess sedimentological characteristics of these impacted sites. We are now able to demonstrate the spatial extent and severity of anchoring impacts, and provide real-time observations (e.g., sediment plume, noise pollution) and longer-term (e.g., seabed structure and composition modification) impacts of anchoring. The results of this experiment provide new insights into the types of disturbance we can expect across the anchorages around New Zealand and globally, including potential consequences for the health of marine and coastal ecosystems generally.

To achieve more sustainable and lower-impact shipping corridors, the hidden costs of ship anchoring must be incorporated into future global trade strategies and environmental management. Our new approaches are timely and will have global relevance, and as such could be presented to the Marine Environmental Protection Committee at the IMO.

sally.watson@niwa.co.nz

Oral Presentation

Shaun Williams[1], Cyprien Bosserelle[1], Yvette Turua[2], Stephano Rampling-Tou[2], Rose Pearson[1], Judith Giblin[3], Ryan Paulik[1], Juli Ungaro[1], Anonio Espejo[3], Moritz Wandres[3], Matt Blacka[2], Herve Damlamian[3]

[1]Earth Sciences New Zealand, Aotearoa New Zealand; [2] Climate Change Cook Islands, Office of the Prime Minister, Cook Islands; [3]Pacific Community, Geoscience, Energy and Maritime Division, Fiji

Challenges in Applying National-Scale Coastal Flood Risk Information across Pacific Island Contexts

This presentation synthesises findings from a series of interrelated studies investigating the implications of extreme sea-level inundation for exposed elements across multiple spatial and governance scales—from local to national levels—within Pacific Island states. The work highlights the role of geospatial and numerical representations of sea-level rise (SLR) hazard exposure in supporting coastal flood adaptation planning and resilience decision-making under varying contextual constraints.

We examine the differences between simplified static-planar inundation models (e.g., Allis et al., 2020) and more complex dynamic inundation simulations (Bosserelle & Williams, 2023), using high-resolution LiDAR-derived digital elevation models (DEMs). A case study from Nauru—a small island state with a total land area of approximately 23 km^2—is presented, demonstrating the differential impact of model selection on exposure estimates across key sectors, including population, buildings, transport infrastructure (roads, ports), utilities and lifelines (e.g., electricity distribution, water storage), croplands, and overall land availability.

A second case study focuses on the Cook Islands, where national-scale SLR exposure mapping was conducted using a composite DEM. This integrated 1 m LiDAR DEMs (where available) with the 30 m global FABDEM product for islands lacking high-resolution data. We assess the implications of DEM resolution and island typology (low-lying atolls vs high-elevation volcanic islands) on modelled hazard extent and resulting exposure estimates (Pearson et al., in prep). Particular attention is given to the performance limitations of coarse elevation data in representing coastal inundation dynamics in topographically constrained or data-poor environments.

The presentation discusses key challenges in developing fit-for-purpose geospatial risk models within resource-constrained contexts, including trade-offs between static and dynamic modelling approaches, DEM accuracy, and the capabilities of open-source modelling frameworks such as RiskScape. Finally, we reflect on the implications of these modelling differences for applied decision-making across various sectors, highlighting how model selection and data quality influence risk assessment outcomes and adaptation prioritisation.

shaun.williams@niwa.co.nz

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Oral Presentation

R. Paul Wolf[1]

[1]Ocean Wolf, Nelson

Enabling Coastal Stewardship: The Role of Taxonomy in Marine Monitoring and Biosecurity

New Zealand's coastlines and estuaries are among the most biologically rich and dynamic environments in the world; however, much of their biodiversity remains poorly documented. As pressures from aquaculture, climate change, and invasive species increase, the accurate and timely identification of marine invertebrates becomes more critical than ever.

Despite this urgency, New Zealand's taxonomic infrastructure is under-resourced. Many coastal monitoring efforts face a widening gap in invertebrate identification capacity, particularly for cryptic, small-bodied, or poorly described taxa. This taxonomic bottleneck hampers environmental reporting, weakens biosecurity preparedness, and limits our ability to track ecosystem changes.

New tools, such as environmental DNA (eDNA) and artificial intelligence, offer exciting opportunities; however, these advances rely on robust taxonomic baselines and curated reference data to be effective. Field-ready expertise and morphological identification remain essential, especially in cases of new incursions or habitat assessments in under-surveyed areas.

This presentation draws on recent examples from coastal monitoring and marine industry contexts to highlight current barriers and emerging solutions. It advocates for a coordinated national approach to build taxonomic capability, integrate AI and eDNA meaningfully, and ensure that Aotearoa can protect and sustainably manage its coastal and estuarine ecosystems in the future.

paul@ocean-wolf.com

Oral Presentation

R. Paul Wolf[1]

[1]Ocean Wolf, Nelson

A 6,000m^2 Challenge: Responding to the Ficopomatus Infestation in Ahuriri Estuary

Ficopomatus enigmaticus, a globally invasive serpulid polychaete, is increasingly impacting estuarine systems throughout Aotearoa New Zealand. First recorded in Whangārei Harbour in 1967, this tube-building worm now creates biogenic reefs in several North Island estuaries, including Ahuriri Estuary and the Clive River in the Hawke's Bay region. In local estuaries, these reef structures exceed 6,000 m^2, posing significant challenges to estuarine health, biodiversity, and flood infrastructure.

This poster highlights findings from a management assessment commissioned by the Hawke's Bay Regional Council. The review synthesises global studies, identifies control techniques, and outlines feasibility criteria for local eradication or population suppression. Special emphasis is placed on the worm's ecological traits, which make it a powerful ecosystem engineer and a persistent pest.

This poster aims to foster discussion about the risks associated with this threat and the potential for indirect control through estuarine restoration. It underscores the critical importance of timing interventions outside reproductive seasons to prevent mass larval release and emphasises the role of tracking population dynamics. Although successful eradication attempts are rare worldwide, the relatively limited presence of *F. enigmaticus* in Hawke's Bay presents a valuable opportunity for action—provided that management is strategic, culturally informed, and sustained over the long term.

paul@ocean-wolf.com

Poster Presentation

Julion Wright[1], Andrew Welsh[1]

[1]Otago Regional Council, Dunedin

Otago coastal hazards monitoring planning

Due to the impacts of sea-level rise and changing storm patterns, an increasing number of people will be exposed to coastal hazards in Otago over the next 100 years and beyond. As such, the Otago Regional Council (ORC) must understand the physical processes that drive coastal hazards to help build resilience for Otago's coastal communities. To achieve this, quality data on physical processes is required. However, there has been limited consistent monitoring of the processes that drive coastal hazards in Otago; monitoring has often been driven through resource consenting rather than a comprehensive network of data collection. Notwithstanding, this presents an opportunity for the ORC to design coastal hazards monitoring for the Otago coast that addresses the current and potential future challenges faced by Otago's coastal communities.

This presentation details ORC's approach to coastal hazards monitoring planning and offers insights from the project. Firstly, a regional-scale coastal hazards screening was conducted, which aimed to identify localised coastal hazard 'hotspots' and larger spatial scale systems of importance. RiskScape software (Paulik et al., 2022) was used to model the exposure of risk elements within community areas (population, buildings, and critical community facilities) to potential coastal hazards (erosion/instability and inundation). Each community area was classified with a level of exposure to screen in a long list of hotspots. Following this, other factors (e.g., timeframe for exposure, vertical land movement, current evidence of hazard, compounding/cascading hazards, etc.) were used to prioritise hotspots based on urgency. In total, 30 hotspots were identified for site-specific monitoring.

The results of the screening process were then used to develop strategies for coastal hazards monitoring. The next stage of the project is to seek collaboration from a range of potential partners, e.g., territorial authorities, community groups, universities, and mana whenua. Some insights from the project are a) varied exposure characteristics present an array of monitoring challenges, e.g., coastal hazard exposure on the Waitaki coast is primarily from erosion/instability so monitoring of geomorphic change is required for extensive sections of coast; b) coastal hazard exposure will likely interact with fluvial hazards and flood protection schemes under relative sea-level rise and potentially compound impacts beyond those directly from coastal hazards, e.g., Taieri Plains and the Clutha Delta; and c) coastal hazards monitoring offers ORC an opportunity to engage with communities through citizen science programmes to build trust for possible future projects.

Julion.Wright@orc.govt.nz

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Oral Presentation

Zhonghou Xu[1]

[1]Earth Sciences New Zealand, Hamilton

The compound flood during ex-TC Gabrielle could have been forecasted with operational flood model forced by high-resolution numerical weather prediction

The extensive flooding due to the ex-Tropical Cyclone Gabrielle has devastated Hawke's Bay and Gisborne. Although heavy rainfall was issued before the event, the extent of flooding was unknown. To enable fast response to extreme flood events in the future, we are developing a real-time compound flood forecast system for New Zealand. We force the hydrodynamics model BG-Flood with high-resolution numerical weather prediction (NZCSM), which produces 48 hours weather forecasts. With the weather forecast, our model can obtain at least 80% accuracy for "predicting" the maximum flood depth (>10 m) 24 hours before the flood peak during Gabrielle in Gisborne. Although the maximum flood depth was underestimated, it still gives the magnitude and impact of the event and leaves plenty of time for evacuation and preparation if the flood forecast model were operational before the event. We are working to make such a flood forecast system fully operational to prepare New Zealanders for future extreme flood events.

Zhonghou.Xu@niwa.co.nz

Oral Presentation

Jialin. Zhao[1], Bruce Melville[1], Colin Whittaker[1]

[1]Department of Civil and Environmental Engineering, The University of Auckland, Auckland

The effects of structural complexity on the turbulent structure around cubic artificial reefs: An Experimental Study with Ecological Insights

The global ocean environment has suffered from severe deterioration in recent decades due to human activities and climate change. A key issue in this context is the degradation and loss of marine habitats, which may cause irretrievable damage to marine biological resources. To address this challenge, artificial reefs (ARs) have been employed as a potential solution to improve benthic habitats (David Da Costa et al., 2022).

This experimental study investigated the hydrodynamic characteristics around a standard cube and four Menger–type artificial reefs (ARs) which are characterized by multiscale cavities. Experiments were conducted in a hydraulic flume under controlled conditions with constant water depth and inflow velocity. A two–dimensional particle tracking velocimetry (PTV) system was applied to measure the velocity field. Porosity (P) and surface area ratio (S) were used to quantify the structural complexity of the ARs. Meanwhile, this study also explored how solid versus hollow reef structures influence the flow field. The results show that the structural complexity metrics have significant effects on the turbulent structure around the ARs.

The results reveal that the horseshoe vortex weakens and shifts close to the model with increasing P and S, while the wake recirculation length and resting area follow a non-monotonic trend, peaking at $P = 0.61$ and $S = 1.9$. Regarding turbulent characteristics in the vertical sectional plane, the area of regions with low Reynolds shear stress (*RSS*) and low turbulent kinetic energy (*TKE*) increases with increasing P and S. In the horizontal sectional plane, the dominant vortex shedding frequency initially increases with porosity, reaching a peak at P=0.38, and then drops with further higher porosity.

This study preliminarily quantifies the relationship between the hydrodynamic features and the structural complexity metrics of cubic ARs. Based on the findings, hollow structures with high porosity and moderate surface area ratio are considered more favorable for improving hydrodynamic performance of artificial reefs.

jzha967@aucklanduni.ac.nz

Oral Presentation

Remy Zyngfogel [1], Simon Weppe [1], Peter McComb [2]

[1]Calypso Science Ltd., [2]Oceanum Science Ltd.

Seascope Aotearoa: An Open-Access Platform for Integrated Ocean Observations and Forecasts

Seascope Aotearoa is a free, open-access web application that amalgamates a wide range of observational data within New Zealand's marine environment and provides a simple, intuitive interface for the public. The platform integrates near real time waves, water levels, sea temperatures, subsurface profiles, coastal meteorological stations and coastal cameras. The system relies on open access from initiatives such as the Aotearoa Moana Observing System, Argo, and the WMO Global Drifter program. Regional councils and university monitoring programmes are key contributors, along with ports, defence, aquaculture and offshore industries.

To complement these important observations, Seascope Aotearoa provides colocated tide predictions, wind forecasts, and high-resolution wave forecasts - including spectrograms. The combined view of measured and nowcast site-specific parameters allows users to better assess the current conditions and anticipate short term changes in the conditions. The system is designed to support decision-making for a broad range of users, from the general public to marine professionals, and its modular architecture built on the OCEANUM.IO Datamesh enables rapid integration of new datasets or adaptation for other regions and thematic applications.

The presentation will outline the platform's interface, the underlying technology stack, and numerical modelling framework, with examples such as tsunami monitoring. We also invite collaboration from the coastal community to expand the system and co-design applications for real-world needs, along with maximising the societal value of marine observations.

r.zyngfogel@calypso.science

Oral Presentation

Te Hunga Takutai o Aotearoa
NEW ZEALAND
COASTAL SOCIETY

conferences@engineeringnz.org