

water@unsw



FRIDAY 11 SEPTEMBER 2026

MICHAEL CROUCH INNOVATION CENTRE (E10) G22

PROGRAM



UNSW
SYDNEY



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MORNING SESSION 1 - PREDICTING CHANGE

SESSION CHAIR: DR THAIS GUERRERO

Time	Activity	Presenter
9:00 A.M.	Arrivals and Registration	
9:20 A.M.	Welcome	Thais Guerrero
9:30 A.M.	Keynote: Look harder: are the solutions closer than we think?	Chanelle Webster
10:00 A.M.	Can a seasonal prediction system warn of upcoming compound hot–dry extremes in Australia?	Mahmood Fooladi
10:10 A.M.	From climate signals to local hydroclimatic risk: Improving prediction across time and scale	Sunil Thapa
10:20 A.M.	Rethinking design-rainfall estimation	Tias Ravena Maitsa
10:30 A.M.	Morning tea	

MORNING SESSION 2 - WATER IN MOTION

SESSION CHAIR: DR THAIS GUERRERO

Time	Activity	Presenter
10:50 A.M.	Interaction of rivers and the coastal ocean in Eastern Australia	Robert Mason
11:00 A.M.	Nitrogen flows and recovery opportunities in Greater Sydney's wastewater treatment plants	Shamim Aryampa
11:10 A.M.	Two decade range shifts of reef fishes across the sub-tropical–temperate transition zone of the Kuroshio Current	Maasaki Sato
11:20 A.M.	A multi-scale assessment of run-of-river hydropower reliability through spatial pooling	Mirza Kurniawan
11:30 A.M.	Characteristics and drivers of the coastal equatorward countercurrent along the southeastern Australian shelf	Claudio Cardoso
11:40 P.M.	Self-thinning processes in si e-structured vegetation models mediated by access to groundwater	Isaac Towers
11:50 P.M.	Mending meadows: restoring the endangered seagrass <i>Posidonia australis</i> in Gamay Botany Bay, New South Wales	Erin McCosker
12:00 P.M.	The missing third of hydrological modelling	Muhammad Hammad
12:10 P.M.	How wind resolution affects extreme wave simulations	Imee Bren Villalba
12:20 P.M.	Marine ascidian habitats support biodiverse epibiota assemblages, but do not enhance nitrous oxide production	Zuhairah Dindar
12:30 P.M.	Lunch break	

AFTERNOON SESSION 1 - TREATING WATER

SESSION CHAIR: CHANELLE WEBSTER

Time	Activity	Presenter
1:20 P.M.	Keynote: Mind the Gap: Regulations and equity in NSW water and wastewater services	Rafael Paulino
1:50 P.M.	Enhancing stormwater quality models through memory bias dynamics	Liu Tianxiang
2:00 P.M.	A rate-based approach to regulate contaminants: biochar from waste-water biosolids	Timothy Charlton
2:10 P.M.	Emerging contaminants in raingarden media	Fathiya Mufidah
2:20 P.M.	Fenton-based oxidative degradation of chlorinated hydrocarbons in groundwater at a legacy contaminated site	Steffi Joseph Perumpully
2:30 P.M.	Mitigation of batch effects in high resolution mass spectrometry of natural organic matter	Amirali Sadeghloo
2:40 P.M.	Effects of treatment conditions on the immediate removal and subsequent cell fate of <i>Chlorella vulgaris</i>	Lulu Zhang
2:50 P.M.	Closing the expanding gap between cyanobacterial problems and accelerating global climate & other anthropogenic changes	Theodorus Verhoeven
3:00 P.M.	A probabilistic shields framework for the incipient motion of non-spherical plastic particles	Felipe Condo Colcha
3:10 P.M.	Investigating antimicrobial resistance in urban stormwater wetlands	Aaneta Paul
3:20 P.M.	Afternoon tea	

AFTERNOON SESSION 2 - FROM EVIDENCE TO ACTION

SESSION CHAIR: CHANELLE WEBSTER

Time	Activity	Presenter
3:40 P.M.	Reforming urban river governance: lessons for and from Australia	Meredith Hagger
3:50 P.M.	Watching water: how environmental surveillance co-produces understanding and practices of water-related sustainability and justice	India Troughton
4:00 P.M.	Understanding hydrodynamic changes in a restored coastal wetland under rising sea levels	Abdul Jabbar
4:10 P.M.	Developing cryopreservation protocols to secure Australia's Blue forests	Catalina Musrri Fuenzalida
4:20 P.M.	A biocultural approach to marine restoration: understanding Aboriginal cultural values for seagrass	Amanda Schadeberg
4:30 P.M.	What returns with the kelp? Exploring community following kelp restoration	Silas Folgmann
4:40 P.M.	Cleaner waters ahead: evaluating safe limits of rare earth elements in Australian and global policies amid environmental interactions	Swaminathan Palanisami
4.50 P.M.	Awards ceremony and closing remarks	

KEYNOTE SPEAKERS

DR CHANELLE WEBSTER

POSTDOCTORAL FELLOW, UNSW SCHOOL OF BIOLOGICAL, EARTH AND ENVIRONMENTAL SCIENCES

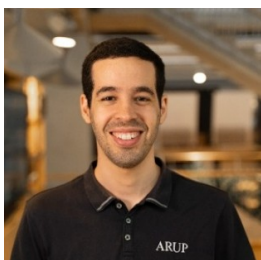


Dr Chanelle Webster is a marine ecologist whose passion for the water began in 2017, when her first research project took her beneath the surface to study seagrass. Watching this humble marine plant produce oxygen sparked a fascination that only grew as she discovered its extraordinary importance to marine ecosystems and the people who depend on them. Inspired by the idea that something so overlooked could have such a profound impact, she went on to complete a PhD investigating how seagrasses respond to environmental change, using field and laboratory experiments to better understand their resilience and inform conservation.

Chanelle likes to think of her career as a mission to champion the "underdogs" of the marine environment. Today, her research at UNSW focuses on restoring another overlooked ecosystem: Sydney's once-extensive kelp forests, which disappeared from the city's coastline. Her work combines experimental ecology, restoration science and communication. She is passionate about collaborating across disciplines with scientists, students, Traditional Owners, industry and local communities to tackle complex environmental challenges.

DR RAFAEL PAULINO

WATER RESOURCES ENGINEER, ARUP



Rafael Paulino is a water engineer at Arup, where he works within the Integrated Water Management team, contributing to projects across catchment modelling, geomorphology, infrastructure planning, and strategic water and wastewater services. He brings a multidisciplinary background spanning civil, environmental, and chemical engineering, with expertise in water quality, hydraulic and hydrologic modelling, remote sensing, and environmental assessment.

Rafael holds a Master's degree from the University of British Columbia (Canada) and a PhD from the University of New South Wales. His doctoral research focused on the removal of taste and odour compounds from drinking water, while his subsequent postdoctoral work explored the use of satellite and remote sensing technologies to monitor waterbodies. Throughout his career, Rafael has combined research excellence with practical engineering delivery, applying advanced analytical methods to address complex water and environmental challenges. His experience includes climate risk and water security studies, geomorphological assessments, and the development of digital tools and automated workflows for large-scale environmental data analysis. Rafael is passionate about bridging research and practice to deliver innovative, evidence-based solutions for sustainable water management.

ABSTRACTS

Mahmood Fooladi (School of Biological, Earth and Environmental Sciences)

Can a seasonal prediction system warn of upcoming compound hot–dry extremes in Australia?

Skilful subseasonal forecasting of hot, dry, and compounding hot–dry events has the potential to support effective planning and risk mitigation. This study evaluates the performance of the Australian Bureau of Meteorology's ACCESS-S2 seasonal prediction system for hot, dry, and compound hot–dry events across Australia using hindcast data from 1981–2018, focusing on 0-month lead time (the first forecast month following initialization), and validation against gridded daily observations. The ACCESS-S2 ensemble mean shows reasonable fidelity in capturing the frequency of hot, dry, and compound hot–dry events for the month ahead, with regionally averaged correlation scores of 0.75, 0.68, and 0.66 for interannual variability, and 0.55, 0.94, and 0.67 for interseasonal variability across Australia, respectively. For compound events, the system displays moderate skill in capturing both timing and frequency. However, event magnitudes are often underestimated, even when the full range of ensemble members is examined. These biases in compound events largely stem from biases in the underlying hot and dry univariate events, but also likely limited model skill in capturing the co-occurrence of hot and dry conditions. ACCESS-S2 is also capable of categorical prediction (predicting whether event frequencies are below or above climatological averages), with compound hot–dry events showing higher match rates compared to univariate events. Overall, we provide encouraging evidence of the ability of the ACCESS-S2 system to forecast compound hot–dry events at 0-month lead time for the month ahead in certain regions across Australia, particularly those with concentrated agricultural activity.

Sunil Thapa (School of Civil and Environmental Engineering)

From Climate Signals to Local Hydroclimatic Risk: Improving Prediction Across Time and Scale

Large-scale climate variability provides valuable information for anticipating droughts, water availability, fire weather and other hydroclimatic extremes. Yet translating these broad climate signals into reliable local predictions remains challenging because climate drivers and local responses often vary across different timescales, respond with delays, and influence multiple hazards in different ways. This work investigates whether hydroclimatic prediction can be improved by refining climate information before it enters the prediction model. We develop wavelet-based approaches that transform large-scale climate predictors so that their variability and timing are better aligned with the local responses of interest. The framework is further extended to situations involving multiple related responses, allowing shared climate information and their dependence to be represented jointly. The approaches are evaluated through controlled experiments and real-world applications in Australia. For drought prediction in Sydney, better alignment between climate predictors and local drought variability substantially improved predictive skill. At the continental scale, jointly representing drought and fire danger improved the prediction of their dependence, compound-event probabilities, severity and temporal evolution. Together, these results demonstrate that improving hydroclimatic prediction is not only a question of developing more complex forecasting models. Equally important is how effectively large-scale climate information is translated into a form that reflects the local processes being predicted. This perspective provides a general pathway toward more skilful and physically meaningful prediction of local water risks and interacting hydroclimatic extremes.

Tias Ravena Maita (School of Civil and Environmental Engineering)

Rethinking Design-rainfall Estimation

Reliable estimation of design rainfall underpins the intensity-frequency-duration (IFD) relationships used in engineering practice. When observed data are of insufficient length to characterise rare events directly, specifying an appropriate probability model becomes critical to obtain reliable design-value estimates. In characterising extreme events, classical extreme value theory rests on an asymptotic assumption and discards most of the record, using either annual maxima or peaks-over-threshold. Metastatistical Extreme Value (MEV), a recently developed probability model introduced by Marani and Ignaccolo (2015), relaxes the asymptotic assumption of classical extreme value theory. MEV uses all available ordinary events, and its yearly fitting enables it to capture year-to-year variability. This project assesses how MEV performs relative to the established two-step kappa approach proposed by O'Shea et al. (2023). A Monte Carlo synthetic experiment evaluates MEV and the two-step kappa approach where the true extreme quantiles are known, with both methods tested across varying record length. The synthetic experiment reveals that MEV overestimates the design quantiles, with a bias that persists as record length increases, even as its variance narrows. As a next step, evaluation on observed data will assess both methods under real-world conditions, providing a complementary test of the synthetic experiment findings.

MORNING SESSION 2

Robert Mason (School of Biological, Earth and Environmental Sciences)

Interaction of Rivers and the Coastal Ocean in Eastern Australia

Physical oceanography studies the processes of circulation and physical properties of the ocean, whilst hydrology studies the physics of rivers. Both fields are key to understanding how weather and natural hazards impact on human societies, and how humans impact the environment. Rivers flow into the ocean, and the change in salt and heat content of the ocean that this causes impacts ocean processes at our coastline. Though impacting onshore weather, the ocean also impacts rivers. Exactly how these interactions is only partly known and at the frontier of research. In this talk I'll present how rivers have such a dramatic impact on our ocean, and vice versa, and how research at UNSW Sydney is helping to reveal this intricate part of the water cycle.

Shamim Aryampa (School of Civil and Environmental Engineering)

Nitrogen flows and recovery opportunities in Greater Sydney's wastewater treatment plants

Wastewater is increasingly recognised as a valuable resource in the transition to sustainable and circular agricultural systems. It contains significant amounts of nitrogen (N), an essential nutrient for agricultural production, and N recovery can contribute to the sustainability transition of wastewater treatment WWT. However, N recovery from wastewater remains underutilised in Australia. Identifying recovery opportunities requires a clear understanding of current N flows and destinations. This study addressed two research questions: (1) How much N is released in wastewater across the Greater Sydney region and where does it end up? and (2) What are the short- and long-term opportunities for N recovery within Sydney's wastewater management system? Influent and effluent total N data were collected from 21 water resource recovery facilities (WRRFs) across the Sydney region over a three-year period (2022-2025). Results showed significant regional variation in both influent and effluent N concentrations and loads. Total influent N was 31,352.25 t N/a. The Inland region, comprising 11 WWTPs, had the lowest N loads in both influent ($5,159.09 \pm 243.50$ t N/a) and effluent (631.01 ± 48.86 t N/a), reflecting smaller plant sizes and stricter effluent N standards. In contrast, the Ocean region, with four WWTPs, had the highest N loads in both influent ($21,893.56 \pm 1,325.96$ t N/a) and effluent ($10,907.57 \pm 809.51$ t N/a), due to larger plant capacities and less stringent effluent N limits. Across Greater Sydney, most influent N was discharged in effluent ($21,329.89 \pm 806.59$ t N/a), followed by atmospheric emissions ($6,321.26 \pm 1,351.92$ t N/a), biosolids ($2,088.85 \pm 166.43$ t N/a), and water reuse applications (317.40 ± 76.32 t N/a). However, N fate varied significantly among regions and treatment process categories. Inland plants predominantly use biological N removal technologies or intermittent decant aeration lagoons (IDAL) for secondary treatment, whereas Ocean region plants rely primarily on primary treatment. These findings highlight substantial opportunities to improve N recovery and support circular nutrient management in Sydney's wastewater system.

Masaaki Sato (School of Biological, Earth and Environmental Sciences)

Two decade range shifts of reef fishes across the subtropical–temperate transition zone of the Kuroshio Current

Over recent decades, the world's oceans have warmed substantially under global climate change. Warming rates along western boundary currents are approximately three times faster than the global mean, making these regions global hotspots of ocean warming. Despite this, distribution changes and range shifts of reef fishes have been little examined along the Kuroshio Current, one of the major western boundary currents. Using underwater visual surveys, we quantified changes in density of 15 reef fish species – including damselfishes (three tropical and three warm-temperate species), butterflyfishes (two tropical and one warm-temperate species), and herbivore fishes (three tropical and three warm-temperate species) – from 2005-2010 to 2020-2024 across seven sites spanning subtropical (24°N) to temperate reefs (35°N) in the Kuroshio Current region. We provide the first evidence of the range expansion of tropical damselfishes (*Dascyllus* and *Chromis*) and herbivores (*Acanthurus*, *Ctenochaetus* and *Scarus*) in this region, as well as increases in warm-temperate herbivores (*Siganus*, *Calotomus* and *Scarus*) in temperate reefs from the 2000s to the 2020s. We also detected increases in overwintering survivors of tropical species (*Dascyllu* and *Acanthurus*) in temperate coasts, suggesting that tropical fish populations are establishing in temperate regions. In contrast, juveniles of tropical butterflyfish (*Chaetodon*) declined sharply in temperate reefs largely following extensive coral loss after an extreme cold event in the winter of 2018. Together, these results indicate that the subtropical-temperate transition zone along the Kuroshio Current are undergoing tropicalization, yet environmental conditions remain unstable and unfavorable conditions for the recruitment and persistence of some coral-dependent tropical species.

Mirza Kurniawan (Civil and Environmental Engineering)

A Multi-Scale Assessment of Run-of-River Hydropower Reliability through Spatial Pooling

Hydropower systems, particularly run-of-river schemes, are increasingly exposed to climate-driven flow variability, increasing the risk to energy security. Unlike impoundment hydropower plants that rely on large reservoirs to regulate flow, run-of-river systems have limited storage and mostly depend on real-time river discharge. This makes them especially vulnerable to seasonal variability, droughts, and climate-related changes in rainfall. As run-of-river hydropower expands globally due to its relatively low environmental footprint, improving its operational reliability has become an important challenge. This study investigates spatial pooling as a resilience-based strategy to enhance the reliability of run-of-river hydropower generation. Spatial pooling aggregates energy output from multiple river catchments with differing hydrological behavior to reduce variability through asynchronous flows. Two complementary analyses are conducted. First, a single catchment case study is examined in the Mount Nancar catchment within the Daly River system, which consists of five sub-catchments. The results show a clear and systematic improvement in hydropower reliability as additional sub-catchments are aggregated, with the highest reliability achieved when all five sub-catchments are pooled. Second, the analysis is extended to a national scale using 467 catchments from the Australian Hydrologic Reference Station network, representing a wide range of hydroclimatic conditions. Catchments are grouped into four geographic regions: East Coast, West Coast, Tasmania, and the Tropical region. Daily runoff is simulated using calibrated catchment models, converted to run-of-river hydropower, and aggregated into pooling groups of up to ten catchments within each region. Spatial pooling improves hydropower reliability across all regions, with the strongest gains on the East Coast and the weakest on the West Coast, while Tasmania and the Tropical region show intermediate responses. Although demonstrated using Australian catchments, the proposed framework is transferable and provides a scalable approach for improving run-of-river hydropower reliability under increasing climate variability.

Claudio Cardoso (School of Biological, Earth and Environmental Sciences)

Characteristics and drivers of the coastal equatorward countercurrent along the southeastern Australian shelf

The southeastern Australian shelf is strongly influenced by the East Australian Current (EAC) and the eddies shed from it. Yet recurrent equatorward flow is frequently observed inshore of the EAC southern extension (along southern NSW), despite receiving little attention to date. Here, we use a 10+ year mooring record off Narooma, together with satellite observations, to characterise this coastal countercurrent and investigate its drivers. We detect equatorward flow events from in situ velocity data and extract key metrics that enable their classification into distinct event types differing in frequency, duration, vertical structure, northward extent, and water-mass properties. We show that this equatorward flow is not a single dynamical feature, but a recurrent manifestation arising from multiple mechanisms, including Bass Strait winter outflow, remotely forced shelf responses associated with wind-driven sea-level anomalies and coastal trapped waves, and local enhancement by cyclonic eddies. These results provide a new framework for interpreting coastal current variability and highlight the need to distinguish among the dynamical pathways that produce similar current manifestations. This has important implications for understanding along-shelf water-mass transport, with potential consequences for primary productivity and ecological connectivity in a region of rapid environmental change.

Isaac Towers (School of Biological, Earth and Environmental Sciences)

Self-thinning processes in size-structured vegetation models mediated by access to groundwater

Forest stands typically undergo a process throughout their development known as self-thinning, whereby density-dependent competition for shared resources such as soil water leads to increased mortality rates. Although self-thinning lines i.e. the relationship between plant density and mortality are well described statistically, mechanistic understanding of the processes underlying self-thinning remain understudied. In particular, it is unclear how access to groundwater mediates the self-thinning line, given that it should preferentially improve the productivity and survivability of larger individuals with deeper root systems in arid ecosystems. We use a size-structured model of forest development i.e. the plant model to investigate how the presence of groundwater at a variety of table depths influences stand development including variation in the carrying capacity, temporal rate of development and the slope of the relationship between mortality and density. We also investigate how these effects vary based on rainfall variability, hypothesising that access to groundwater becomes increasingly important when forests are exposed to long droughts. Mechanistic understanding of self-thinning processes governed by water dynamics has important implications for forecasting the outcome of management decisions in forestry, carbon storage and ecological restoration.

Erin McCosker (School of Biological, Earth and Environmental Sciences)

*Mending meadows: Restoring the endangered seagrass *Posidonia australis* in Gamay (Botany Bay), New South Wales*

Coastal marine ecosystems such as seagrasses provide vital ecosystem services such as carbon capture, coastal protection and food security, but are also vulnerable to human disturbance. Indeed, despite more than a decade of protection, in some densely populated locations on Australia's east coast the endemic temperate seagrass *Posidonia australis* has continued to decline. This has compelled efforts to actively restore endangered *Posidonia* meadows that have become fragmented over time due to anthropogenic pressures. Gamay Botany Bay is a heavily modified estuary in New South Wales that has lost more than half of its *Posidonia australis* seagrass meadows over the past five decades. In Gamay, Operation *Posidonia* brings together marine ecologists, indigenous rangers and citizen scientists to restore *Posidonia* meadows by replanting seagrass fragments that naturally wash up on local beaches, removing the need to harvest donor material from existing meadows. In this presentation I will share results from three years of monitoring of our *Posidonia* restoration efforts in Gamay, along with an overview of outreach work to engage with the local community and build environmental stewardship. Importantly, I will also

highlight some of the key challenges and lessons learned that have helped to shape Operation Posidonia over time. As we enter the second half of the U decade on ecosystem restoration, sharing knowledge and working collectively to reverse the decline of ecosystems such as seagrass meadows is more pertinent than ever before.

Muhammad Hammad (School of Civil and Environmental Engineering)

The Missing Third of Hydrological Modelling

Hydrological models often fail to fully capture catchment responses, which leaves systematic residuals between modelled and observed flow. In ungauged catchments, these model struggle to learn from hydrological occurring due to scarce records. Here, we present a state-dependent, two-stage residual modelling framework that separates residuals into modelling error, arising from structural and parametric limitation, and observation error, coming from measurement and forcing data uncertainty. The residuals are estimated conditional on hydrological states, allowing the error dynamics to vary across flow regimes rather than assuming stationarity. The residual model is trained on 124 CAMELS-AU catchments from diverse climatic regions across Australia and is tested on 384 independent catchments from the continent. The results demonstrate improved correction across all flow regimes, specifically for high (>95th percentile) and extremely high flow (>99th percentile). To enhance the generalizability, Minimum Redundancy Maximum Relevance (mRMR) feature selection is employed to identify the most important catchment attributes, which are used as static inputs alongside the dynamic model states and hydrological forcings. The framework is applicable to fully calibrated, partially calibrated, and uncalibrated hydrological models, and remains effective under limited or absent streamflow data. By explicitly modelling residuals as separable state-dependent processes, the proposed framework provides a robust method for improved streamflow correction, with particular relevance for peak flow estimation and applications in data-scarce environments.

Imee Bren Villalba (School of Civil and Environmental Engineering)

How Wind Resolution Affects Extreme Wave Simulations

Accurate wind forcing is essential for regional oceanic numerical modelling, particularly for the simulation of extreme wave events generated by tropical and extratropical cyclones. While high-resolution atmospheric reanalysis datasets are increasingly available, the influence of wind forcing resolution on the representation of extreme winds and the resulting simulation of extreme waves across different regional cyclone environments remains insufficiently quantified. This study examines the effects of wind forcing resolution on extreme wind representation and wave simulations using an event-based regional modelling framework in two contrasting cyclone environments: extratropical cyclone-dominated southeastern Australia and tropical cyclone-affected eastern Philippines. Numerical wave simulations are conducted using the Simulating Waves Nearshore (SWAN) wave model, forced with five wind datasets derived from two reanalyses: ERA5 (0.25°, 1°) and BARRA-R2 (0.11°, 0.25°, 1°). Simulations are performed for 50 extreme wave events in each region, identified using a Peaks-Over-Threshold approach applied to existing ERA5 wave data at selected coastal and offshore sampling points. Results show that coarse-resolution wind forcing systematically underrepresents extreme wind speeds and leads to underestimation of extreme wave heights, with the largest discrepancies occurring in coastal regions where wind gradients at the land/sea interface are strongest. Resolution effects are more spatially consistent under extratropical cyclones, whereas tropical cyclone events exhibit greater variability due to compact storm structures and rapid radial wind decay. Very intense tropical cyclones, such as Typhoon Haiyan (2013), show pronounced sensitivity to wind forcing resolution, with higher simulated wave extremes at finer resolutions. Differences in resolution sensitivity between the two regions further suggest the influence of coastal geometry, topography, and dominant cyclone characteristics. These findings highlight the importance of high-resolution wind forcing for improving the reliability of regional wave simulations under extreme extratropical and tropical cyclone conditions, particularly in coastal regions where impacts are most severe.

Zuhairah Dindar (School of Biological, Earth and Environmental Sciences)

Marine ascidian habitats support biodiverse epibiota assemblages, but do not enhance nitrous oxide production

Climate-driven shifts in species distributions often lead to the loss of habitat-forming species and the emergence of novel ecological states. The biodiversity and ecosystem functions of these habitats remain poorly understood. In temperate eastern Australia, warming-associated range shifts are driving widespread declines of kelp forests, which in some areas are replaced by dense aggregations of the filter-feeding ascidian *Herdmania grandis*. Although *H. grandis* is recognised as a habitat-former, the biodiversity supported by this ascidian's biogenic structures has not been quantified. Recent work shows that *H. grandis*' microbiota contribute to the production of the greenhouse gas nitrous oxide (N₂O), but whether associated macro epibiotic communities influence this production remains unknown. In this study, we first quantified the diversity of epibiota residing within *H. grandis* aggregations and compared them to kelp forests and adjacent urchin-dominated habitats. We then tested whether N₂O production by *H. grandis* is influenced by the presence of epibiota via incubation experiments using a real-time N₂O sensor. We found that *H. grandis* supports unique epibiotic assemblages that displayed higher abundances and species richness than kelp forests, with comparable diversity. Additionally, both kelp and *H. grandis* epibiotic communities were substantially more diverse than urchin habitats. Removal of the epibiotic communities associated with *H. grandis* did not influence N₂O production, suggesting that microbial communities directly associated with the ascidian are responsible for the production of the gas. With *H. grandis* densities changing on warming reefs, its habitat-forming role and its contribution to N₂O-driven climate feedback are likely to become increasingly important.

AFTERNOON SESSION 1

Tianxiang Liu (School of Civil and Environmental Engineering)

Enhancing stormwater quality models through memory bias dynamics

Process-based build-up/wash-off models underpin urban stormwater quality management, yet structural simplifications and environmental non-stationarity often induce systematic biases that erode decision reliability. This study explores a pivotal question: Can biases, long treated as model “defects”, be reframed as information assets that strengthen decision-grade predictive credibility? This paper proposes a model-agnostic machine learning error correction strategy. The core idea is to recast model-observation errors not as random noise but as structured, information-rich signals carrying “memory bias”. By learning the dynamic patterns within recent errors, this correction layer enables real-time, non-intrusive adjustments to the physical model's output. In the study catchment, it raised pollutant NSE compared baseline by roughly 20 % on average with hydrologic inputs and 66 % with lagged errors. Testing across two catchments demonstrates that the proposed framework achieves superior accuracy and stability compared with traditional and pure machine-learning baselines. This approach evolves traditional models from static tools requiring periodic recalibration into responsive systems capable of dynamic output correction. By making systematic biases 'learnable' and 'usable', the model can effectively respond to environmental fluctuations, ensuring its long-term validity and reliability in a constantly changing environment.

Aaneta Paul (School of Civil and Environmental Engineering)

Investigating Antimicrobial Resistance in Urban Stormwater Wetlands

Antimicrobial resistance (AMR) is a growing global health threat where bacteria acquire resistance to antimicrobials, reducing the effectiveness of treatments for infectious diseases. As resistance spreads, infections become difficult to treat, turning common illnesses into life-threatening conditions. By 2050, AMR is estimated to cause more than 8.22 million deaths annually highlighting the urgent need to understand and mitigate its environmental source and drivers. AMR can emerge anywhere bacteria are exposed to antimicrobial drugs. Although AMR has been widely studied in clinical settings, increasing evidence shows that the environment plays a critical role in the emergence and spread of AMR genes. Stormwater wetlands are important reservoirs for AMR-carrying bacteria. These resistance genes can subsequently be transported through connected waterways into rivers, estuaries and coastal ecosystems, contributing to its broader environmental spread. In public health and environmental science, effective intervention strategies cannot be developed until the sources, mechanisms and dynamics of the problem are comprehensively mapped. Despite growing recognition of urban wetlands as potential reservoirs of AMR, their role in AMR persistence and spread remains poorly understood. This research investigates the “invisible reservoir” of AMR in urban wetlands by identifying the specific resistance genes that persist and proliferate. Using water and sediment samples collected from stormwater ponds in Centennial Park, Sydney, this study characterizes the diversity of AMR genes alongside heavy metal concentrations and key water quality parameters. It further examines how environmental conditions, particularly heavy metal mobility and bioavailability promote the persistence and dissemination of AMR-carrying bacteria. By integrating these parameters, addressing the fundamental questions of “why” and “how” AMR spreads, this research aims to understand the ecological and microbiological processes driving AMR-carrying bacteria and help provide scientific foundation needed to mitigate this environmental threat.

Fathiya Mufidah (School of Civil and Environmental Engineering)

Emerging Contaminants in Raingarden Media

Urban stormwater runoff contains various emerging contaminants, such as tire-derived compounds, pharmaceuticals, and plasticizers, which have become a global concern due to their toxicity even at trace levels. As a stormwater treatment strategy, raingardens have been widely installed in urban areas to remove pollutants and improve water quality. Several studies have shown that raingardens, also known as bioretention systems or biofilters, are effective in removing emerging contaminants from stormwater. However, the accumulation of emerging contaminants that captured in the filter media may affect their long-term treatment performance. This study investigates the accumulation of emerging contaminants in field-scale raingarden systems. Biofilter media samples were collected from raingardens across Sydney representing different land use types, including residential, mixed commercial use, industrial, and public recreation. The selected sites ranged in age from newly constructed systems to 19-year-old installations. Results showed the widespread occurrence of the targeted compounds in the raingarden media samples. The findings of this study provide essential insight into the fate of emerging contaminants in urban stormwater systems.

Steffi Joseph Perumpully (School of Civil and Environmental Engineering)

Fenton-Based Oxidative Degradation of Chlorinated Hydrocarbons in Groundwater at a Legacy Contaminated Site

Chlorinated hydrocarbons (CHCs) are toxic contaminants that pose significant risks to human health and the environment, highlighting the need for effective and sustainable remediation strategies. At the Botany Industrial Park (BIP), Sydney, Australia, historical chemical manufacturing activities have resulted in extensive groundwater contamination by CHCs, predominantly 1,2-dichloroethane (1,2-DCA). The existing groundwater treatment plant is energy-intensive and is approaching asymptotic CHC recovery levels. Therefore, alternative remediation technologies are required to address residual contamination. Advanced oxidation processes, which generate highly reactive species capable of rapidly transforming a broad range of organic contaminants, offer a promising alternative. This study investigates a Fenton based in-situ chemical oxidation approach that utilises naturally occurring iron in BIP sediments to activate hydrogen peroxide (H_2O_2). Laboratory microcosm experiments were conducted using BIP groundwater and sediments. Significant degradation of CHCs, particularly 1,2-DCA, was achieved following multiple H_2O_2 injections, demonstrating effective sediment-mediated activation of H_2O_2 . Additional experiments confirmed degradation of other CHCs, including trichloroethylene (TCE) and tetrachloroethylene (PCE). Product analysis confirmed chloride release and the formation of organic acids, with no chlorinated by-products detected. Overall, the findings demonstrate that naturally occurring iron can provide a potentially sustainable pathway for in-situ chemical oxidation of CHC contaminated groundwater and represent a promising alternative. These results provide a scientific basis for field-scale evaluation of Fenton-based treatment at BIP and potentially at other legacy CHC contaminated sites.

Amirali Sadeghloo (School of Chemical Engineering)

Mitigation of Batch Effects in High Resolution Mass Spectrometry of Natural Organic Matter

There is increasing interest in exploring more detailed molecular characterization of Natural Organic Matter (NOM) in water, as changes in NOM composition can affect water treatment performance and the formation of harmful disinfection by-products. High-resolution mass spectrometry is commonly being used for this purpose, with Orbitrap mass spectrometry becoming a more accessible alternative to Fourier transform ion cyclotron resonance mass spectrometry for NOM analysis. However, the high sensitivity of Orbitrap mass spectrometry means that equipment drift and technical variation between analytical runs can strongly influence the resulting data and make samples analyzed on different days difficult to compare directly. The aim of this study was to investigate the extent of this batch-related variation in non-targeted NOM analysis and evaluate strategies to reduce it while preserving meaningful chemical differences. To investigate these effects, a multi-run environmental NOM dataset was generated using a Thermo Fisher Q Exactive HF Orbitrap mass spectrometer. The dataset included five environmental water samples, three standards, and three pooled quality-control (QC) sample types distributed across five analytical runs arranged in two blocks separated by two weeks. Data was processed from Compound Discoverer (V3.4) outputs and analyzed using a range of correction strategies, including simple data-driven normalization methods, batch-correction approaches, and QC-based machine-learning methods. Comparisons were made using principal component analysis (PCA), QC relative standard deviation, and feature-level tests to assess both batch effects reduction and preservation of real chemical differences. The results showed that different correction strategies had different strengths. Methods focused mainly on QC correction were effective at improving QC compactness, while broader technical-variation correction methods performed better when both batch reduction and preservation of meaningful sample structure were considered together. Overall, this work shows that batch effects are a major issue in NOM characterization and that their treatment requires a balanced correction strategy rather than reliance on QC precision alone.

Mengxi (Lulu) Zhang (School of Chemical Engineering)

*Effects of Treatment Conditions on the Immediate Removal and Subsequent Cell Fate of *Chlorella vulgaris**

Coagulation and flocculation provide the primary barrier for algal cell removal in conventional drinking water treatment. Although immediate removal has been widely studied, the downstream behaviour of residual cells and flocs over time remains poorly understood. This study investigated how treatment conditions influence both immediate removal and post-treatment behaviour of *Chlorella vulgaris* in synthetic water. A full factorial design was used to examine alum dose, alkalinity, flocculation time and pre-oxidation. Cell removal was evaluated alongside coagulation pH, zeta potential and floc size to interpret removal mechanisms. Residual cell concentration, activity, membrane damage and dissolved organic carbon were then monitored over time. Immediate removal was mainly controlled by coagulation chemistry. Alum dose interacted strongly with alkalinity, indicating that alum dosing should be adjusted with consideration of alkalinity, particularly when increasing the coagulant dose. Longer flocculation generally improved removal and produced larger flocs. Pre-oxidation had little effect on immediate removal, but markedly increased cell inactivation and reduced regrowth potential. However, pre-oxidised samples also showed greater membrane damage and higher dissolved organic carbon release during storage. These results show that immediate cell removal alone is insufficient to assess algal treatment performance. Coagulation conditions determine physical separation, while pre-oxidation mainly influences the later stability of residual cells. Considering both immediate and time-dependent responses provides a stronger basis for balancing removal efficiency, regrowth control and organic matter release.

Theodorus (John) Verhoeven (School of Civil and Environmental Engineering)

Closing the expanding gap between cyanobacterial problems and accelerating global climate and other anthropogenic changes

Freshwater cyanobacterial blooms and cyanotoxins have significant adverse economic, environmental, social and cultural impacts on water users and ecosystems globally. The urgency to minimise bloom effects stems from accelerating population-driven global climate change and other anthropogenic changes termed global changes. Although much is known about these global changes and their impacts in general, governments' cyanobacterial policy and management responses over the past two decades have been insufficient. This research assesses current bloom management practices and future management opportunities to better minimise bloom effects under global changes. The case study research method was used to analyse four national basin cases in Australia, the USA, South Africa and Scotland, obtaining qualitative data from participants in semi-structured interviews. Key findings include the need for scientific studies to assess the impacts of global changes on the causes and effects of blooms, to inform cyanobacterial management strategies and related legislation. Because national climate legislation does not reference cyanobacteria, legislation and policies should be developed to frame management strategies targeting bloom effects. Governments need to monitor and model coupled natural-human systems impacted by global changes and identify adverse bloom-related changes and their causes to better inform the management responses of jurisdictions. The urgency to minimise bloom effects in an environment of global changes necessitates implementing multiple management strategies to prevent, control and mitigate blooms there is no 'single silver bullet' solution. Research needs are identified. Applying these findings to the Murray-Darling Basin as a study demonstrates the significance of the research in addressing global changes impacts on blooms, in developing an analytical framework for evaluating practices addressing global changes, and in incorporating bloom management as part of integrated water quality management.

Felipe Condo (School of Engineering and Technology)

A Probabilistic Shields Framework for the Incipient Motion of Non-Spherical Plastic Particles

Tiny pieces of plastic are now found in rivers around the world, but predicting when these particles start moving with the flow is surprisingly difficult. Unlike smooth, round grains of sand, plastic particles come in many shapes, causing them to interact with riverbeds in different ways. In this study, we examined cylindrical plastic particles ranging from short, disk-like shapes to long, rod-like forms. Through laboratory experiments, we measured the flow conditions needed to set these particles in motion and explored how their shape affects their stability on the riverbed. We found that particles of the same size did not behave the same way. Instead, their shape played a critical role in determining whether they stayed put or were carried away by the current. Using these findings, we developed a new model that accounts for both particle shape and the natural randomness of turbulent river flows. The framework builds on the classic Shields criterion, a widely used tool in sediment transport, and extends it to better predict the movement of non-spherical plastic particles in rivers.

Tim Charlton (School of Biological, Earth and Environmental Sciences)

A rate-based approach to regulate contaminants: Biochar from Waste-water Biosolids

Biosolids from waste water treatment plants can be applied to agricultural land because of their fertility benefit. They also contain toxic and hazardous organics and heavy metals. Pyrolysis treatment of biosolids provides a method to reduce the risk from these contaminants. This paper provides a rationale to regulate application of biochar from biosolids that includes the criteria maximum allowable concentration in soil.

AFTERNOON SESSION 2

Meredith Hagger (School of Law, Society and Criminology)

Reforming urban river governance – lessons for and from Australia

Urban rivers in Australia and across the world have followed a broadly comparable trajectory of degradation as the cities in which they are embedded have grown. There have been efforts to change this, ranging from the very local to the global, and motivated by values which include Indigenous rights, the rights of nature, and the sustainability and wellbeing of urban populations. In many cities, including Sydney, healthy and accessible waterways are an equity issue for people who live long distances from the coast. They will become increasingly important as cities grow hotter with the escalation of the climate crisis, and as populations are increasingly concentrated in urban areas. The OECD has long recognised that many water problems are essentially governance problems. In the context of urban rivers, governance initiatives need to integrate technological, scientific, social, organisational, legal and political dimensions to bring about change. This presentation will begin by outlining research on the challenges of urban river governance, and what scholarship suggests are important to improve governance in these contexts. The presentation will then consider some of the broader schools of thought on governance within which the relatively small literature on urban river governance is situated. In particular, I will explore the different logics and prescriptions of theory on adaptive, collaborative, and relational governance, and how these can help us think about governance reform. Finally, I will explore some different models for urban river governance that have been trialled in Australia and other countries.

India Troughton (School of Law, Society and Criminology)

Watching Water: How Environmental Surveillance co-produces understanding and practices of water-related sustainability and justice

In a place of increasing environmental destruction, overextraction and environmental injustice, the technology we use to respond to such issues may have ramifications on whose access to the environment, knowledges or voices are prioritised; and whose are excluded. One such technological implementation has been the use of environmental surveillance, or technologies that collect and analyse data to monitor the environment, to enforce water laws within NSW and promote the sustainable use of water in NSW. Surveillance studies have critiqued surveillance as a social process, entrenching social hierarchies or power dynamics; such as racial, gendered or economic inequalities or harms. However, little research attention has focused on how environmental surveillance may exacerbate power dynamics within environmental issues, shaping access to the environment or environmental-decision making. As such, my honours thesis questions the social impacts of using environmental surveillance within NSW water regulation. In particular, my thesis considers how environmental surveillance shapes the identities, behaviours and relationships between water regulators, users, rural communities and practices with the environment itself. My presentation would provide an overview of my project and discuss some of the preliminary results of my thesis. I intend to describe how environmental surveillance is being applied in a top-down manner that may exacerbate distrust between regulators and water users, not reflect the technical complexity required to monitor water theft and overall be led by a political desire to improve sustainability, at the cost of deprioritising key methods of improving compliance; such as community education.

Muhammad Abdul Jabbar (School of Civil and Environmental Engineering)

Understanding Hydrodynamic Changes in a Restored Coastal Wetland under Rising Sea Levels

Restoration efforts on the coastal ecosystem through tidal reconnection are increasingly implemented to recover ecosystem function. However, the impact of future sea-level rise on restored hydrodynamic connectivity remains poorly understood. This study examines how tidal reconnection and projected sea-level rise alter hydrodynamic connectivity, tidal asymmetry, and sediment-transport tendency within a restored tidal creek and its receiving estuary, using the Yandina Creek wetland restoration (Blue Heart project, Maroochy River, Queensland) as a case study. A two-dimensional hydrodynamic model (RMA2), calibrated and validated against observed water levels was used to simulate six scenarios: a disconnected (pre-restoration) setting, a reconnected condition, and four incremental sea-level-rise scenarios (+0.1 to +0.4 m). Nodes along the creek and main river channel were analysed for tidal range, current velocity, and net tidal residual transport. Tidal prism was assessed across the whole creek and main channel system, alongside a spatial analysis of intertidal inundation extent across the restoration area. Model results indicate that restoration converts a near-stagnant tidal oscillation into a landward-damped progressive wave, increasing tidal energy in the mid- and lower creek and producing a flood-dominant tendency along the creek. A significant increase in tidal prism and floodplain inundation was also observed, indicating enhanced material exchange between the estuary and the restoration area that supports intertidal wetland development. Restoration effect extends the main channel, with tidal range declining further upstream. Under sea-level rise, hydrodynamic response changes non-uniformly, where tidal range and velocity were amplified, alongside an expanding floodplain inundation and extent. These findings suggest that restoration re-establishes tidal connectivity and how sea-level rise amplifies hydrodynamic change across the whole system. This study may be used for management implications to monitor bed stability and floodplain inundation trends, particularly at the lower creek section.

Catalina Musrri Fuenzalida (School of Biological, Earth and Environmental Sciences)

Developing cryopreservation protocols to secure Australia's Blue forests

Global declines in seaweed forests are reducing genetic diversity and, consequently, the resilience of these habitats to changing environmental conditions. Biobanking will be key to conserving genetic diversity and securing these important coastal habitats into the future. We aim to develop cryopreservation protocols for gametes and germlings of the fucoid seaweeds *Phyllospora comosa* and *Durvillaea potatorum*, which are essential habitat-forming species along the Eastern coast of Australia but are also highly vulnerable to anthropogenic stressors. Work to date has focused on testing traditional cryopreservation protocols on *Phyllospora*, using cryoprotectant agents commonly used in seaweed cryopreservation (dimethyl sulfoxide, ethylene glycol, glycerol, methanol and propylene glycol). Non-lethal cytotoxic effects of cryoprotectants on germlings and sperm were observed, including a reduction in length (germlings), motility and concentration (sperm). Freezing trials resulted in post-thaw sperm survival. Best results were observed with 10% glycerol (final, v/v) under a freezing rate of $-42.4 \pm 5.7^\circ\text{C}/\text{min}$, displaying 18.7% post-thaw motility and 1.5×10^6 sperm/mL, compared to an initial motility of 44.9% and 6.4×10^6 sperm/mL in untreated sperm samples. Germlings could not be revived after thawing, despite testing several freezing rates, cryoprotectant concentrations (5-30%), equilibration times (10-60 minutes) and added sugars. These results demonstrate that live *Phyllospora* sperm can be recovered following cryopreservation, providing an opportunity to store diverse genotypes for breeding and enhancing genetic diversity in distant populations. However, further work is required to improve the efficiency of cryopreservation protocols, apply them to other species and integrate them into conservation practices.

Amanda Schadeberg (School of Biological, Earth and Environmental Sciences)

A biocultural approach to marine restoration: Understanding Aboriginal cultural values for seagrass

Urbanised estuaries are complex social-ecological systems, where the needs of growing populations threaten the integrity of the environment and where traditional Aboriginal practices of caring for Country have been disrupted by the ongoing impacts of colonisation. Environmental restoration is quickly becoming an important tool to tackle ecological degradation in these settings, but a purely natural-scientific approach to restoration can overlook the social components of the system. We have therefore collaborated with local Aboriginal groups to develop a biocultural restoration project for the endangered seagrass *Posidonia australis* at two sites in New South Wales (Awaba/Lake Macquarie and Gamay/Botany Bay). Two-way knowledge sharing methods such as focus group discussions (yarning), on-Country walks, and collaborative art making have strengthened relationships between Aboriginal knowledge holders and scientists. Learning from one another, we show that seagrass meadows are important sites for cultural education, food provision, and spiritual practices. By combining local Aboriginal knowledge with cutting-edge science in this biocultural approach, marine restoration projects can support both parts of the social-ecological system: restoring seagrass meadows in culturally-significant sites improves the ecological health of the estuary, in turn supporting the health, wellbeing, and identity of local Aboriginal communities.

Silas Folgmann (School of Biological, Earth and Environmental Sciences)

What returns with the Kelp? Exploring Community Following Kelp Restoration

Temperate kelp forests are among the most productive and biodiverse marine ecosystems, providing habitat, food, and nursery grounds for a wide range of organisms. Along the Sydney coastline, forests of the habitat-forming seaweed *Phyllospora comosa* declined dramatically during the twentieth century, likely driven by urbanisation-related declines in water quality. Through the Operation Crayweed restoration program, *Phyllospora* populations have been successfully re-established, creating a unique opportunity to investigate how marine biodiversity responds to habitat restoration. As part of a broader assessment of restoration success, this study examines whether associated biodiversity recovers alongside restored *Phyllospora* forests. Two complementary components of the ecosystem were investigated: epifaunal communities living on the kelp and understory assemblages developing beneath the kelp canopy. Together, these communities provide important indicators of ecological recovery and biodiversity restoration. Epifaunal communities were quantified by identifying and counting associated morpho-species collected from individual kelp thalli, while understory assemblages were assessed using image-based surveys and point-count analysis. Community composition, abundance patterns, and understory differences were compared between restored and natural *Phyllospora* habitats along the Sydney coastline. Preliminary analyses suggest that restored kelp habitats can support distinct patterns in associated marine epifaunal communities compared with natural reference habitats. Ongoing analyses are investigating how epifaunal and understory assemblages vary between restored and natural sites, and which components of these communities contribute most strongly to observed differences. These results will help improve understanding of how habitat restoration influences ecological communities beyond the return of the primary habitat-forming species.

Swami Palanisami (School of Civil and Environmental Engineering)

Cleaner waters ahead: Evaluating safe limits of rare earth elements (REEs) in Australian and global policies amid environmental interactions

Cleaner water is vital for ecosystems and human survival. In our current industrialized era, prioritizing the welfare of all living organisms is paramount. Healthy communities and individuals across aquatic ecosystems are essential for achieving this goal. However, emerging pollutants of aquatic systems, such as Rare Earth Elements (REEs), present significant challenges. REEs, increasingly utilized in modern technologies, lack sufficient regulation regarding their toxicological impacts, particularly when combined with other contaminants in the environment. Current ecotoxicity assessments primarily focus on the whole activity responses of a considered toxicological biomarker enzyme, ignoring the insights that individual enzyme isoforms provide into cellular stress responses. This short communication proposes strategic actions focused on Australia and the global system to establish inclusive safety limits for REEs. These actions include synthesizing existing data, conducting controlled and mesocosm experiments involving biomarker profiling, and investigating potential synergies with emerging contaminants. Addressing how REE exposure influences specific biomarker isoenzymes is imperative before implementing biomonitoring strategies for attaining cleaner water. Through the forward-thinking exercise, Australia plan to set international environmental benchmarks aimed at preserving ecosystems from the potential hazards linked to REE contamination, given its role as one of the nations involved in REE extraction.