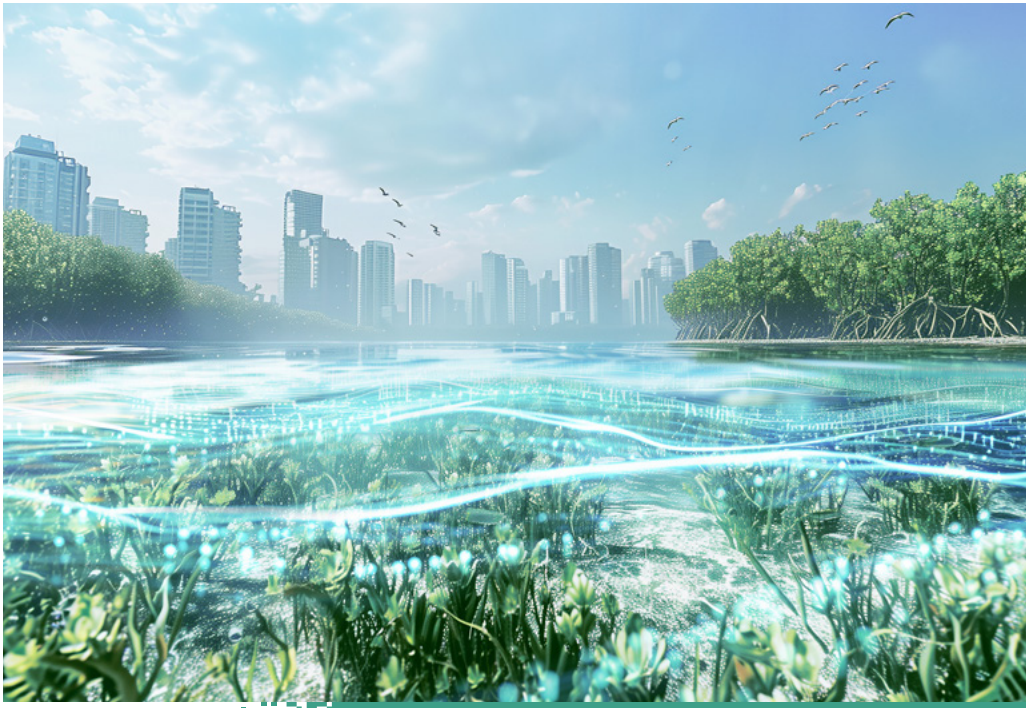
Taking a Leaf Out of Nature's Book



Shore protection with integrated nature-based solutions — Hydro (SPINS-Hydro)

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What is this about?

This project develops and tests hybrid coastal protection strategies that blend traditional engineering structures with nature-inspired solutions.

What is the goal?

- Examine the mechanical performance of hybrid solutions under various flow conditions.
- Assess how nature-based solutions respond to the effects of climate change.
- Develop physical models to quantify the wave attenuation properties of hybrid structures.
- Formulate engineering guidelines for the standardisation of hybrid solutions.

How is this done?

- Controlled physical tests on model-scale hybrid solutions, measuring forces with load cells, and observing the response of nature-based elements using instruments such as high-speed cameras, acoustic doppler velocimeters and wave gauges.
- Transition successful laboratory experiments to field locations to evaluate the effectiveness of hybrid solutions under real-world conditions.

Why does this matter?

- A crucial facet of Singapore's strategic response to rising sea levels, providing robust coastal protection while integrating ecological benefits.
- The inclusion of mangroves and seagrasses not only strengthens coastal defences but facilitates carbon sequestration and enhances biodiversity.
- Outcomes will help refine Singapore's coastal management practices — leading to resilient, highly adaptable infrastructure.

Data-Driven Rain Prediction

Enhancements of Singapore's convective rainfall prediction

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What is this about?

This project explores the application of advanced technologies and methodologies to boost the speed and accuracy at which PUB, Singapore's National Water Agency, predicts heavy rainfall.

What is the goal?

- Advance knowledge in dynamic and thermodynamic processes that influence the intensity of extreme convective storms in urban settings.
- Boost computational capabilities to support high-resolution, convection-permitting simulations of weather patterns that support inland flood modelling.
- Leverage machine learning (ML) and weather generators to improve real-time forecasting of convective storms and rainfall extremes.

How is this done?

- Combine existing rainfall monitoring networks to create a comprehensive re-analysis product and deploy high-resolution systems to assess the spatial-temporal variability of precipitation.
- Utilise microwave links and CCTV cameras for real-time rainfall mapping.
- Employ convection-permitting climate models to explore the impacts of climate change and urbanisation on rainfall extremes.
- Implement ML and stochastic weather generators for both short- and long-term rainfall forecasting.

Why does this matter?

- Provides Singapore with high-resolution rainfall re-analysis products, merging all available rainfall data for better accuracy and detail.
- Enables the development of algorithms that incorporate microwave links and CCTV footage into near real-time gridded rainfall products.
- Generates insights into how climate change and urbanisation affect convective rainfall patterns — supporting policy and planning.
- Refines hydrological models using physics-informed ML approaches for a better representation of hyperlocal convective rainfalls — bolstering flood response and management.