Hi, I'm
Pan Xinxin

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19 Feb 2025

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1. **Personal Introduction**

2. Research & Work Experience

1. Personal introduction

● Education

- **MSc** | National University of Singapore | 2023-2024

  Civil Engineering (Sustainable Climate Resilience)
- **BEng** | Hohai University in China | 2016-2020

  Water and Hydropower Engineering

● Research Interests

- Coastal Hydro- & Morpho-Dynamics;
- Coastal Protection;
- Numerical Models & CFD;
- Shoreline Model & ML Algorithm;
- Nature-based Solutions (NbS).

● Work Experience

- Hydraulic and Coastal **Engineer** | 2020-2022; Sep 2024 - Present

  Shenzhen Water Planning & Design Institute Co., Ltd., China

● Expertise in Sediment & Wave Dynamics and Numerical Modelling

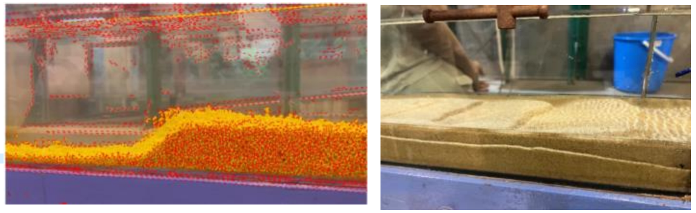
- Small-Scale **Sediment Transport** Analysis in Fluvial Processes (FLOW3D, MATLAB).
- Large-Scale **Morphologic** Analysis in Coastal Processes (Delft3D, Python/MATLAB).
- **Fluid- & Wave-Structure Interaction** Modeling (OpenFOAM, FLOW3D).
- **Geospatial Data** Visualization and Processing (QGIS, Civil3D).
- **Prediction** using Artificial Neural Networks (ANNs-LSTM) and **Statistical Analysis** (Python, R).

CONTENTS

1. Personal Introduction

2. Research & Work Experience

2.1.1 Sediment Transport Dynamics



- Dunes and Ripples in a Lab Flume

◻ Small-Scale Sediment Transport Processes

● Methods:

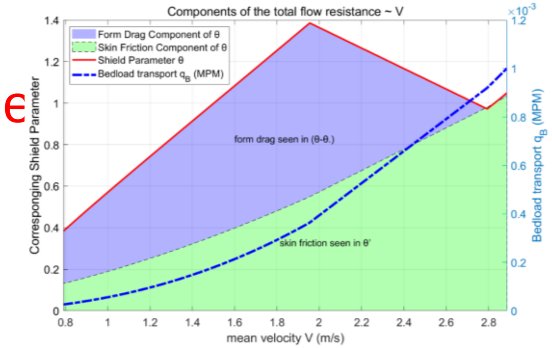
I. Proposed a MATLAB framework to assess bedload/suspended transport, with depth-integrated equations.

$$q_s = \int_{b_*}^{D} ucdz, \quad \Phi_s = \frac{q_s}{\sqrt{(s-1)gd^3}}$$

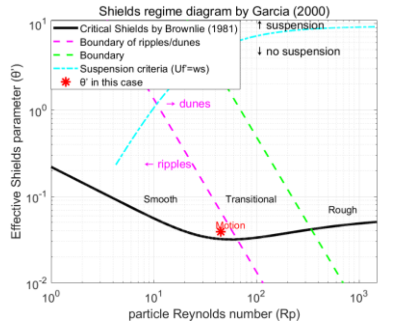
$$\text{where}: \ b_* = \max\left\{b, \frac{k_*}{30}\right\}$$

$$c = c_b\left(\frac{D-z}{z}\frac{b}{D-b}\right)^{w_s/(\kappa U_f)}$$

$$w_s = \sqrt{\frac{(\gamma_s-\gamma)\frac{\pi}{6}d^3}{c_D\frac{1}{2}\rho\frac{\pi}{4}d^2}} = \sqrt{\frac{4(s-1)gd}{3c_D}}$$



- Flow Resistance Component



- Shields Criteria

II. Conducted ADV measurements of velocity distributions above dunes/ripples as model validation.

III. Visualized effect of grain size on sediment concentration profiles, and changes in flow resistance components & bedform transitions in currents.

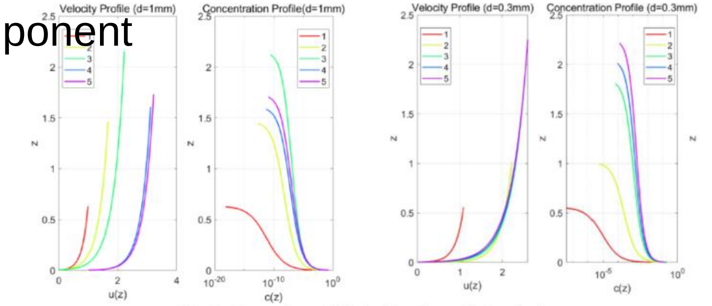
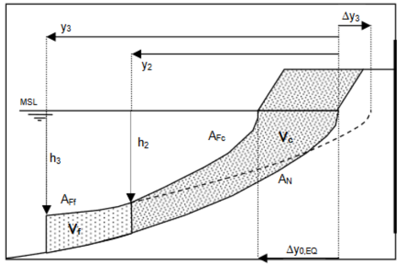
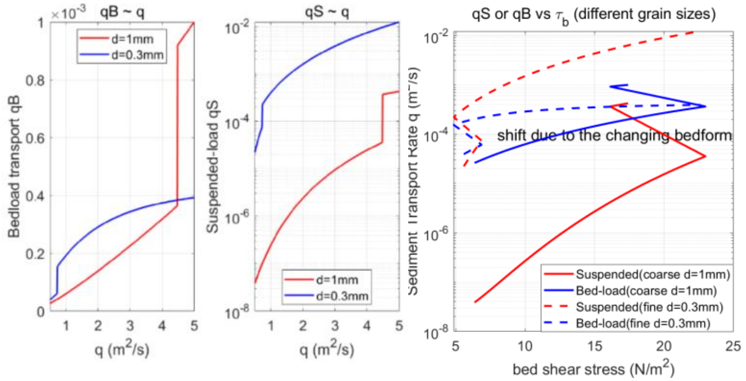


Fig 16. Comparison of Vertical Profiles with 2 grain sizes

IV. Used Van Rijn's empirical method and CERC formula to analyse post-nourishment profile.



- Cross profile and sorting

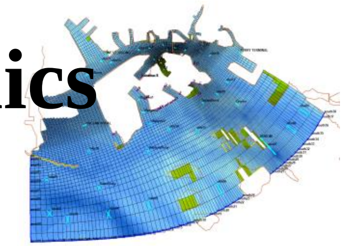


- Grain-Size Effect on SSC

● Experience:

Solid background in sediment dynamics and analytical solutions in Matlab and experiments for sediment analysis.

2.1.2 Sediment Transport & Coastal Hydrodynamics



◻ Thermal Evaluation & Morphology Analysis in Ocean Simulation

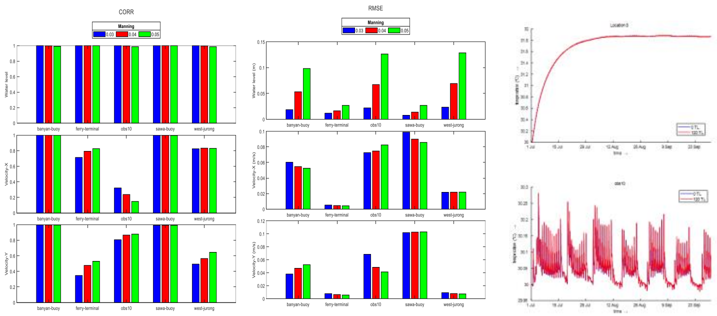
- **Objectives:** Defined an optimal discharge location and the max. allowable discharge into the ocean around SG's JR Island. Analyzed the impact of +1m SLR on bedload transport.
- **Solutions:**

I. Built a flexible mesh using regular grids;

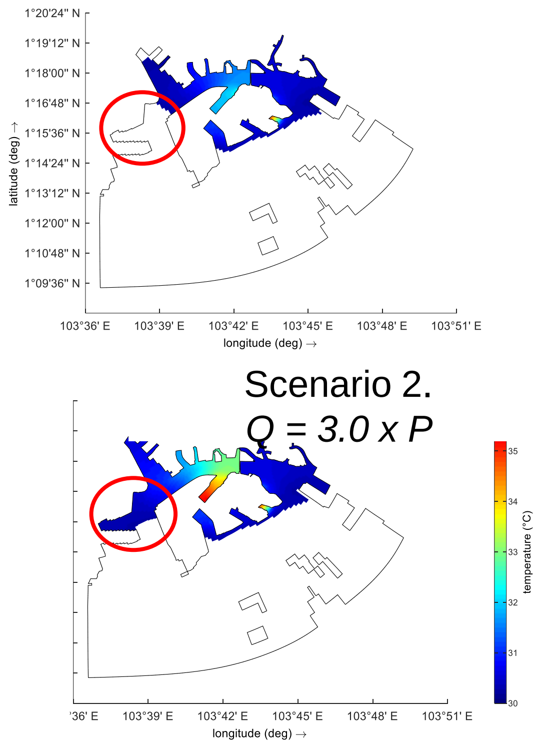
II. Selected a suitable *n* for model calibration;

III. Defined a baseline, and compared heat diffusion extent to define a critical location.

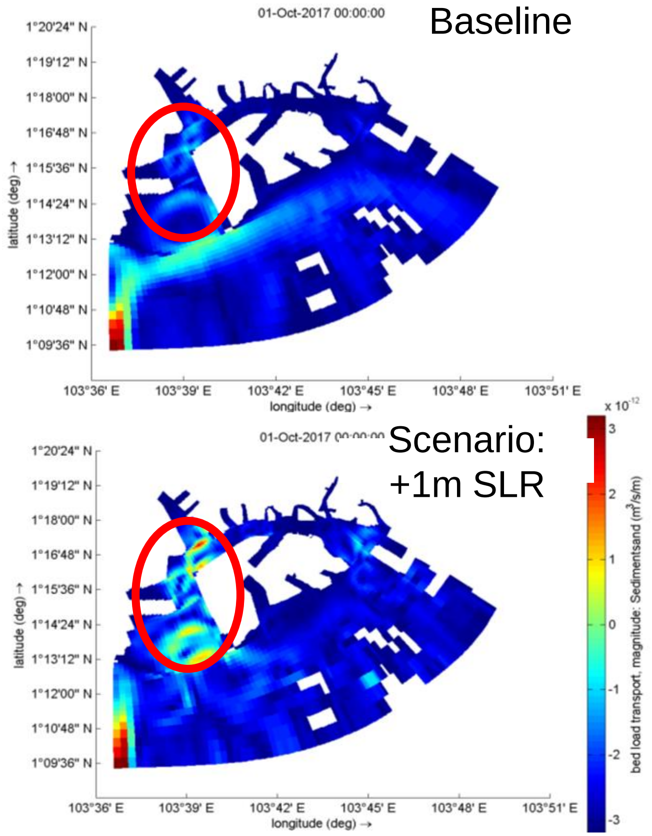
IV. Set up +1m SLR changes in water level for both initial and boundary conditions.



- Model Calibration & T-H time Test



- Comparison of Thermal Impacts

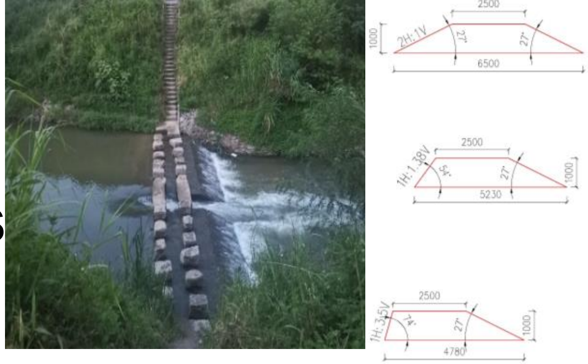


- Comparison of Bedload Transport

- **Experience:**

Proficiency with numerical modeling Delft3D in coastal processes and open-source software compiling.

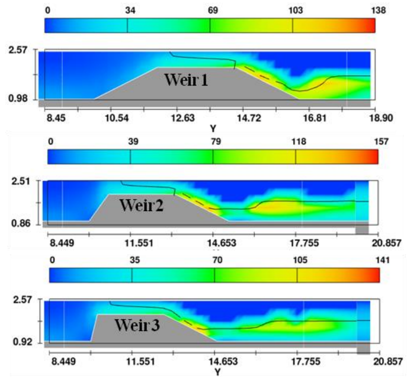
2.1.3 Sediment Transport Analysis



- Different Weirs in River

Erosion Assessment in a Widening Channel Affected by Weirs

- **Objectives:** Evaluated impacts of weirs on erosion and deposition in MATLAB framework, using flow conditions and TKE simulations from FLOW3D.
- **Solutions:** Simulated flow across weirs using *RNG k-ε* model. Compared sediment transport rates using my previous MATLAB framework, and analysed erosion condition in Shields Regime Diagram.



- Comparison of TKE

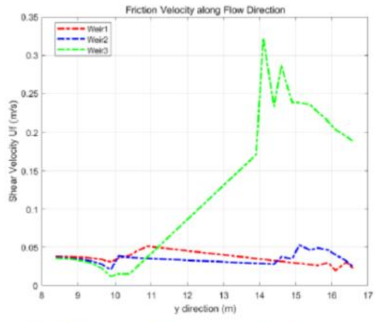


Fig. 18 Friction Velocity along Flow Direction

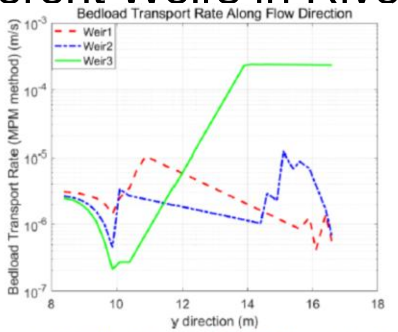


Fig. 19 Bedload Transport Rate (MPM method) qB

- Bedload Transport Analysis

A One-line Model for Longshore Sediment Transport Affected by Groynes

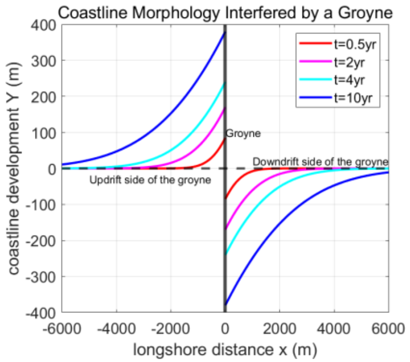
- **Solutions:** 1) Derived a one-line model for coastline development (Pelnard's) with simplifying boundary conditions. 2) Assessed **long-shore sediment equilibrium profiles affected by groynes** within various wave conditions using analytical solutions in MATLAB.

- Continuity Equation

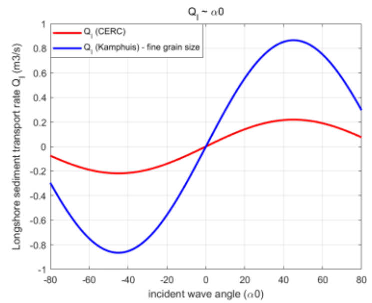
$$\frac{\partial Y}{\partial t} = -\frac{1}{h_p(1-n)}\frac{dQ_l}{d(\partial Y/\partial x)}\frac{\partial^2 Y}{\partial x^2}$$

- Analytical Solution:

$$Y = Y_0' \frac{1}{\sqrt{\pi}}\left[\sqrt{4K_1 t}\exp\left(-\frac{x^2}{4K_1 t}\right) - x\sqrt{\pi}\left(1 - F\left(\frac{x}{\sqrt{4K_1 t}}\right)\right)\right]$$



$$Q_l = \frac{0.0004\rho\sqrt{g}\tan\beta H_{bs}^{3.5}}{\rho_s d}\sin(2\alpha_{bs})$$



- Long-shore Sediment Evaluation

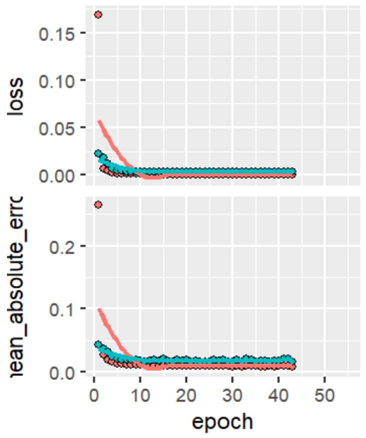
2.2 Machine Learning(MLP/LSTM) Algorithm -Hydrology

☐ Rainfall-Runoff Modelling using ANN/RNN

● Solutions:

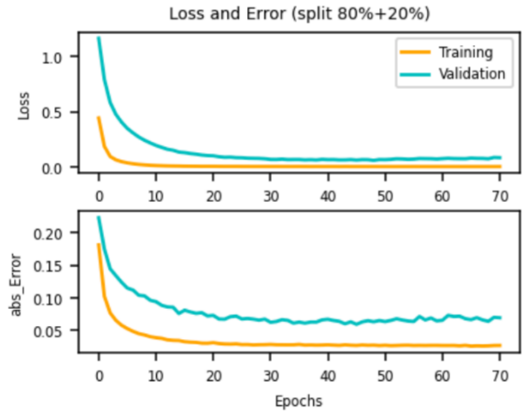
I. Trained a MLP model Keras platform in R, using given rainfall-runoff sequential data.

II. Trained a LSTM model with TensorFlow and Keras platform in Python.



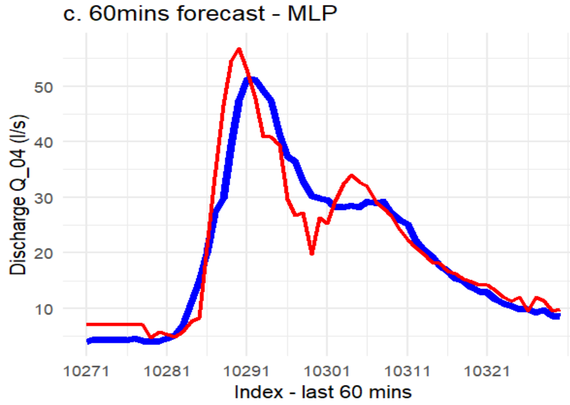
- Performance Metrics for MLP

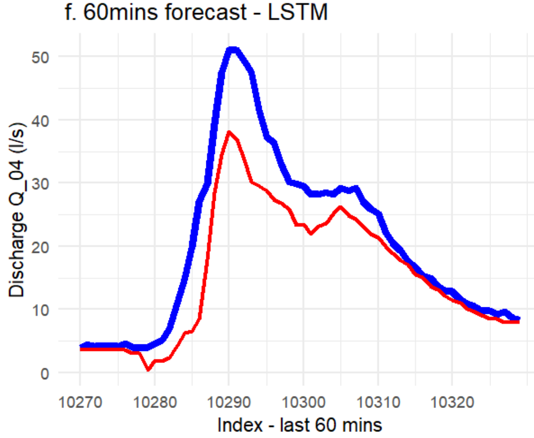
No.	MLP layer	Evaluation from loss & error	accuracy	RMSE
DL.3	8+16	Good-fit	0.6111	7.8209
DL.4 (S1)	4+8	Good-fit	0.9553	11.6950
DL.4-2		Good-fit	0.9840	11.5005



- Performance Metrics for LSTM

No.	Wrapped	Input/ Lstm	epochs	accuracy	RMSE
LSTM.1	10	(10, 4)/ 8	80	0.9960	9.9919
LSTM.2	10	(10, 4)/ 4	80	0.9562	6.9175
LSTM.3	10	(10, 4)/ 5	70	0.9934	5.3363





- Comparison of MLP & LSTM 60-min Forecast

● Experience:

Machine Learning for Forecast & Bigdata Processing.

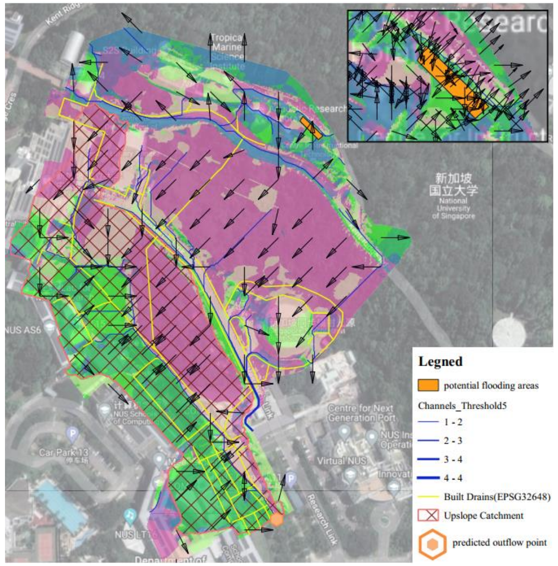
2.3 Watershed Analysis

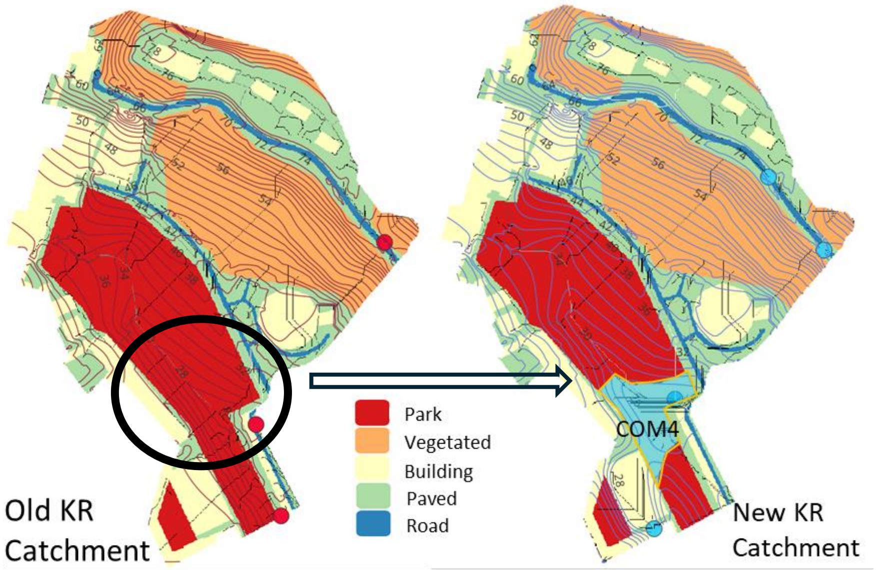
◻ Watershed Analysis in QGIS

● Solutions:

I. Based on the given elevation points in a catchment, use GRASS tool to delineate streams.

II. A sensitivity analysis of the impact of land use changes on rainfall-runoff processes: Developing a new processing algorithm as Python scripts to adapt land runoff coefficients to land use changes.





- Flow Direction and Potential Outlet
- Visualize Land Use Changes in Old/New Map

● Experience:

Geospatial Analysis and Processing Algorithm in QGIS .

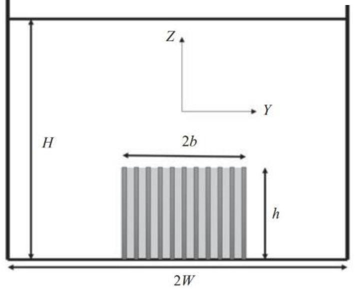
2.4 Nature-based Solution & Wave-Structure Interaction

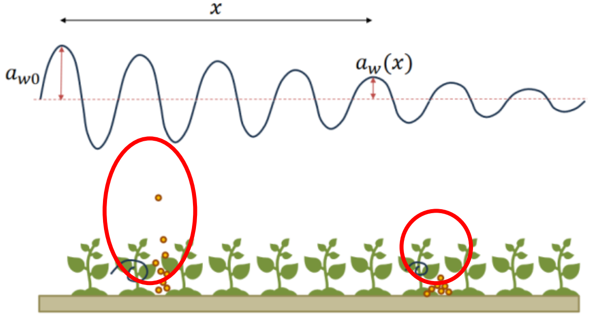
☐ Study of Flow Development within Seagrass Meadows

- **Objectives:** Modeled submerged and merged seagrass/mangrove, and applied into NbS design and flow assessment, thus connecting flow condition to sediment deposition/ evaluation.

$$\frac{U_1}{U_0}(fully\ developed) = \frac{1}{1 - \frac{bh}{WH}\Phi + \sqrt{\frac{C_D abh}{2C(b+h)(1-\Phi)}}\left(\frac{WH-bh}{WH}\right)^3}$$

$$\frac{a_w(x)}{a_{w0}} = \frac{1}{1+K_D a_{w0} x} \qquad K_D = \frac{8kC_D}{3\pi} nD \left(\frac{\sinh^3 kl + 3\sinh kl}{3\sinh kh\,(\sinh 2kh + 2kh)}\right)$$





- Current Development (3D) and Wave Attenuation within NbS

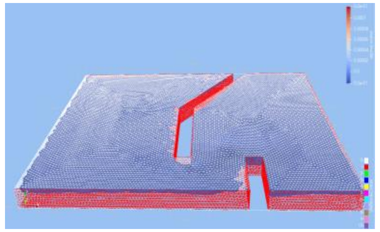
☐ Wave Barrier Design (OpenFOAM/Salome) - WSI

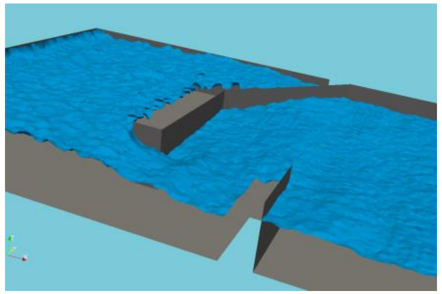
- **Objectives:** Assessed the impact of tidal and wave conditions on both the inner bay water levels and the maximum wave height outside the structure.

- **Solutions:**

I. Modelled wave barrier structure and generated mesh grid in Salome;

II. Applied *interFoam* solver in OpenFOAM to simulate two-phase flow in wave-structure interaction.





- Modelling and Simulating

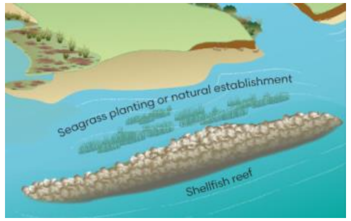
2.4 NbS - Living Shoreline Design

◻ Artificial Submerged Reefs at Byron Bay, AUS

- **Solutions:**

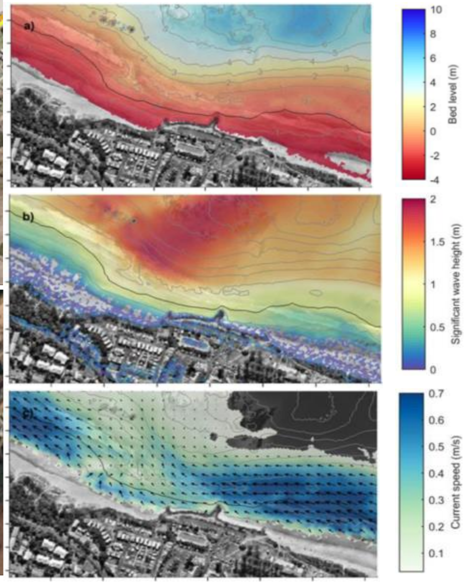
I. Selected a suitable location with slow wave-current velocity, water depth in a surf zone, using SWASH modeling results of wave dynamics;

II. Defined ARs array based on flow patterns.



- ARs Cases

- Shoreline Changes & ARs Layout

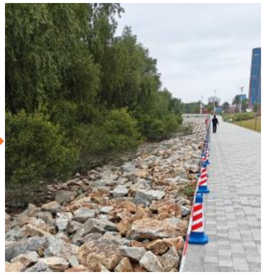


- Hydraulic Data in SWASH model

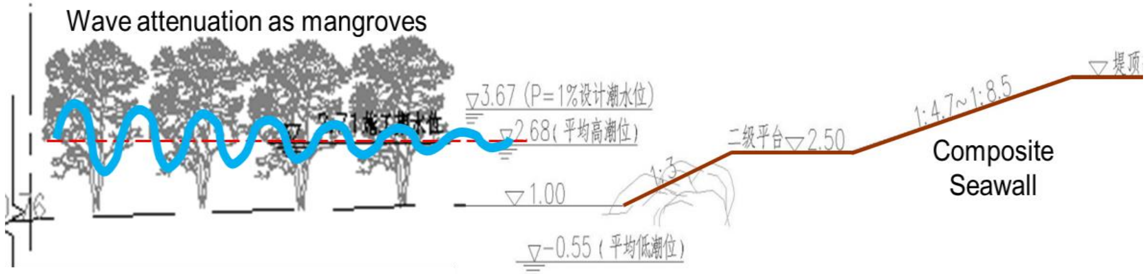
◻ Hybrid Coastal Protection Design (Mangroves + Revetment)

- **Objectives:** Optimized the height and shape of seawall considering wave attenuation as mangroves in foreshore zone.

before
- -
after



- **Solutions:** Assessed mangrove biomass and potential tidal-wave coupled scenarios to parameterize and estimate wave attenuation effect using NbS theoretical model and case comparison -> 40% wave attenuation. Conducted topographical analysis for site selection.



- Seawall Sketch Profile – Wave Attenuation as Mangroves

Thank you!

"Your satisfaction is our top priority. So if you could try to act really satisfied, that would be a big help."

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