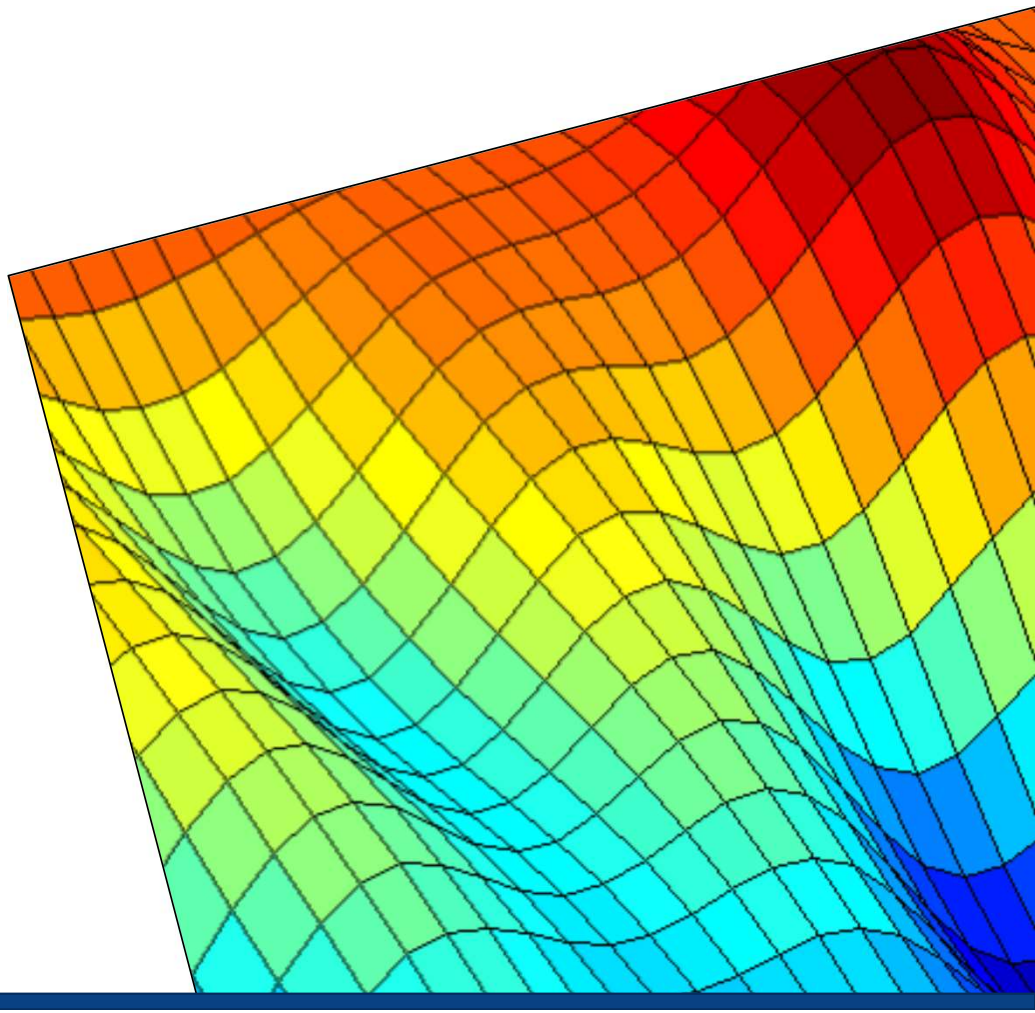
Theme 3:
Coastal Compartment Modelling and Visualisation



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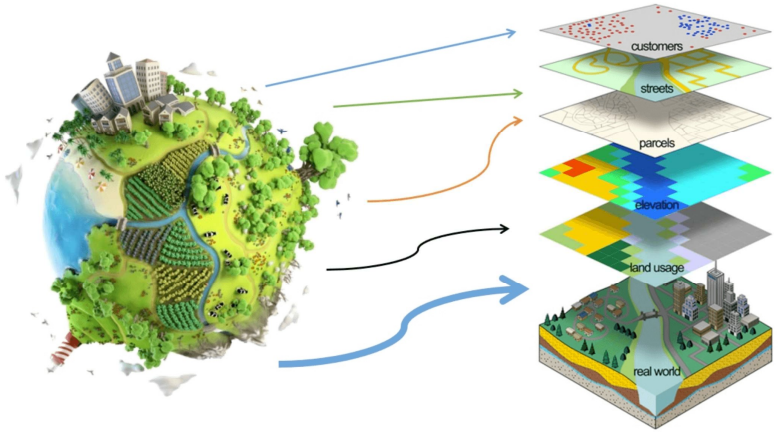
Research Questions

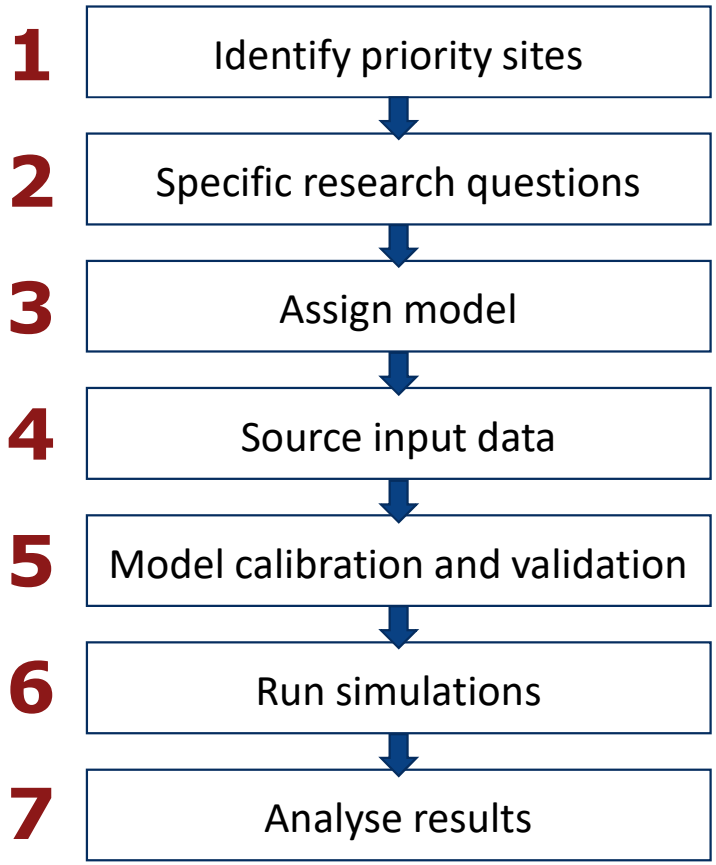


Improve our process-based understanding
Represent | Explore | Predict

Using innovative numerical modelling techniques to **understand and predict** the morphodynamic behaviour of key coastal sites along the Victorian Coastline.

1. Identify key driving processes
2. Model shoreline dynamics
3. Predict shoreline change
   - Sediment transport pathways
   - Response to changing environmental conditions (CC)

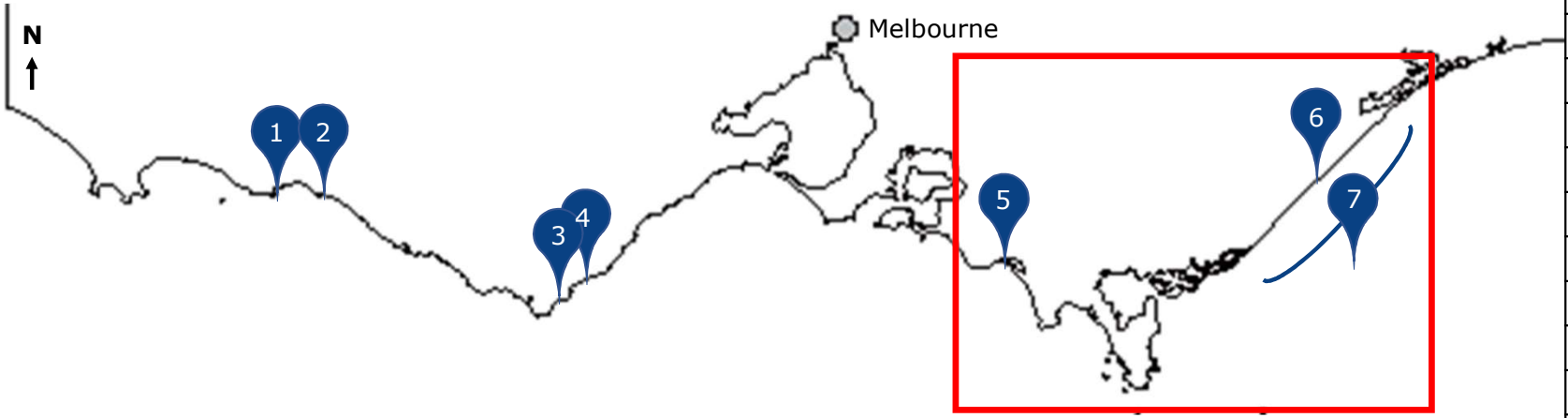
Project Design



Project Design

		Example
1	Identify priority sites	Inverloch
2	Specific research questions	Dynamics of sand spit
3	Assign model	XBeach
4	Source input data	DEM, storm characteristics
5	Model calibration and validation	Historic storm conditions
6	Run simulations	Run simulations
7	Analyse results	Analyse results

Priority Sites



1	Anglesea
2	Apollo Bay
3	Cowes
4	Frankston
5	Inverloch
6	Killarney
7	Marengo
8	Point Lonsdale
9	Port Fairy
10	Portarlington
11	Portland
12	Seaspray
13	Skenes Creek
14	St. Leonards
15	Warrnambool

1—Port Fairy

2—Warrnambool

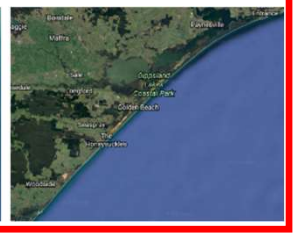
3—Mounts Bay

4—Apollo Bay

5—Inverloch

6—Seaspray

7—Gippsland



Numerical Models

Delft3D FLOW-WAVE

XBeach

CEM2D

COVE

1. Delft3D

3D morphodynamic modelling of complex processes

Days - Years
1 – 10’s kms

xxx

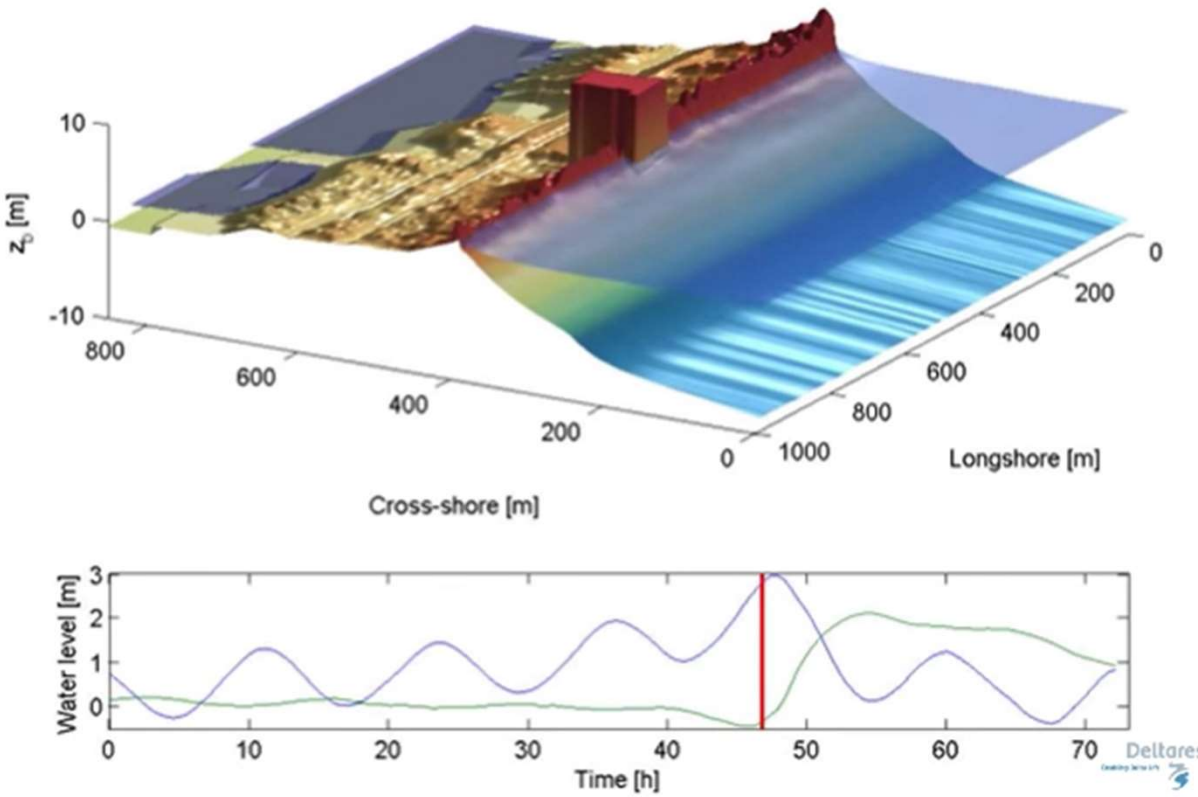
SIMULATION

2. XBeach

eXtreme Beach behaviour model

Two-dimensional response of coastal systems to storm events

e.g. Hurricane Sandy



Nederhoff, K., 2014. Modeling the effects of hard structures on dune erosion and overwash; Hindcasting the impact of Hurricane Sandy on New Jersey with XBeach (Doctoral dissertation, PhD thesis, Delft University of Technology, Delft).

3. CEM2D

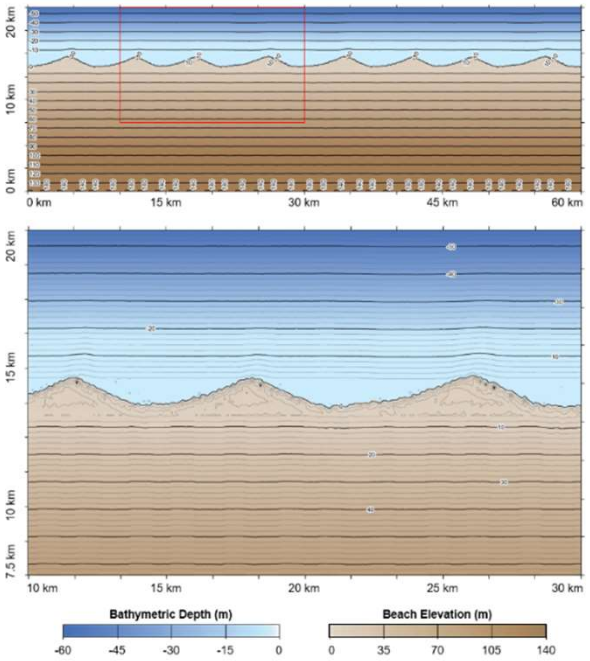
Mesoscale two-dimensional ('smudge-line') coastal evolution model

First case study application.

Years – Centuries
10's – 100's kms

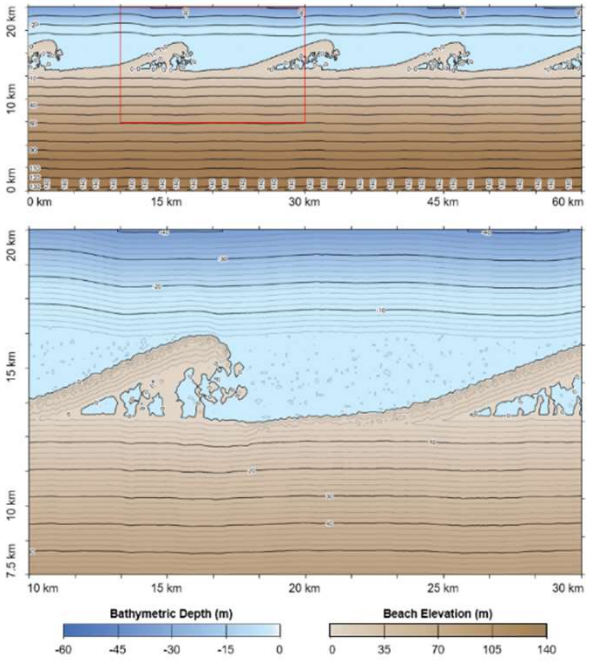
Morris, C. (2019) Modelling the morphodynamics of sandy coastal systems under a changing climate [PhD Thesis]. University of Hull, UK.

Cuspate Forelands



A = 0.5, U = 0.55

Reconnecting Spits



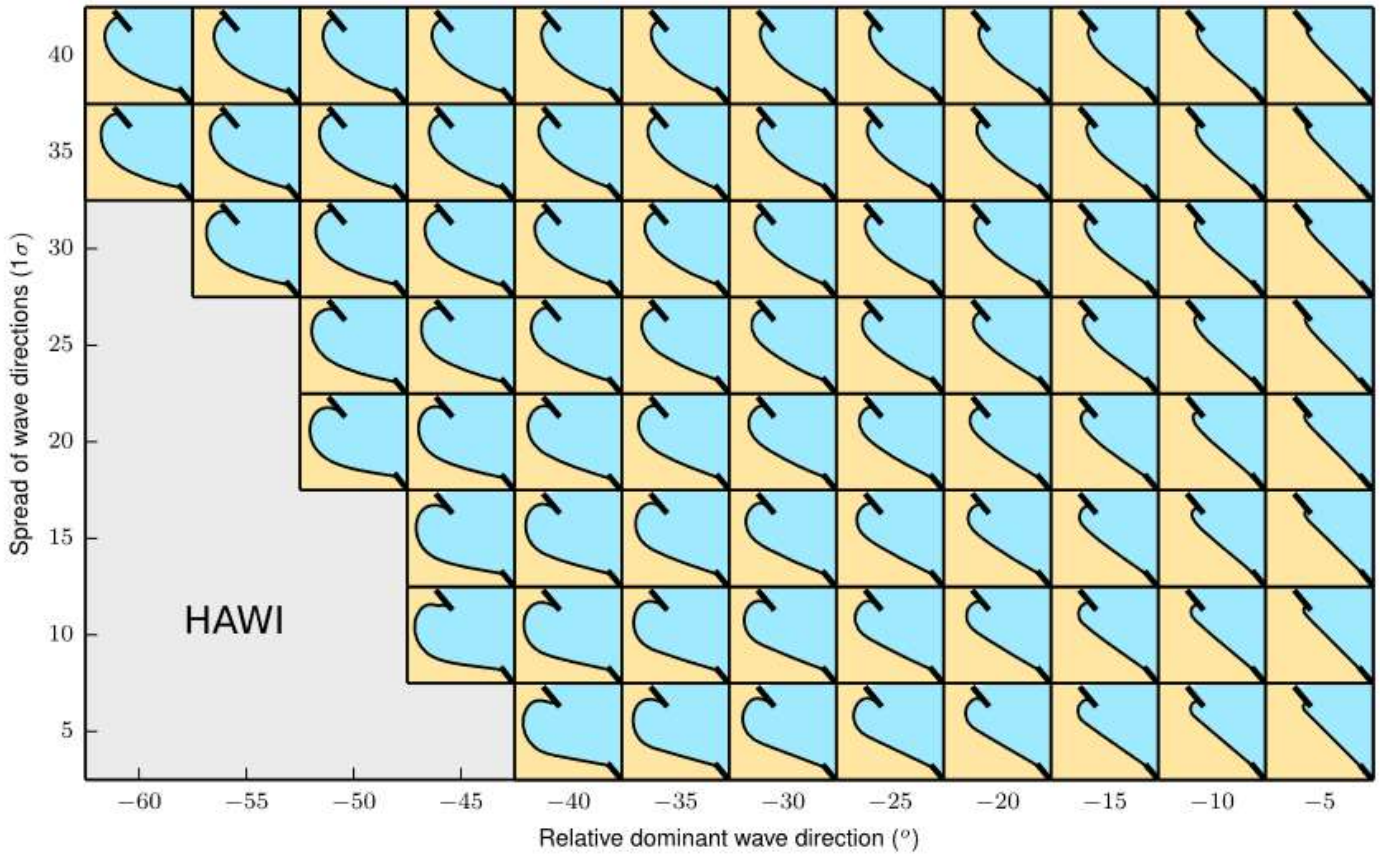
A = 0.7, U = 0.65

4. COVE

the COastal Vector Evolution model

Vector Model – suitable for high curvature and crenulate shoreline

Years – Centuries
10's – 100's kms

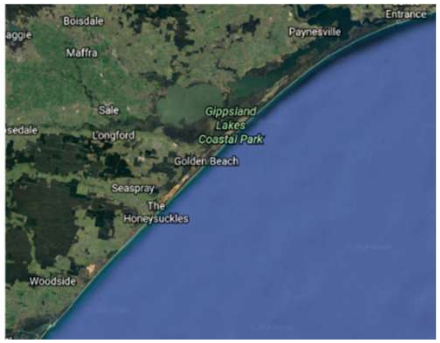


Hurst, M. D., A. Barkwith, M. A. Ellis, C. W. Thomas, and A. B. Murray (2015), Exploring the sensitivities of crenulate bay shorelines to wave climates using a new vector-based one-line model, J. Geophys. Res. Earth Surf., 120, 2586–2608, doi: 10.1002/2015JF003704.

Numerical Models

Delft3D FLOW-WAVE	XBeach	CEM2D	COVE
⇩	⇩	⇩	⇩
6—Seaspray	5—Inverloch	7—Gippsland	2—Warrnambool

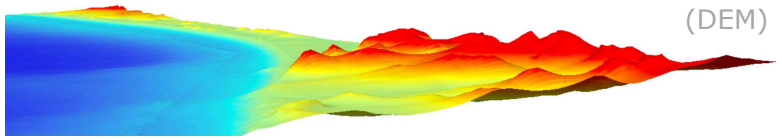
EXAMPLES



Model Inputs

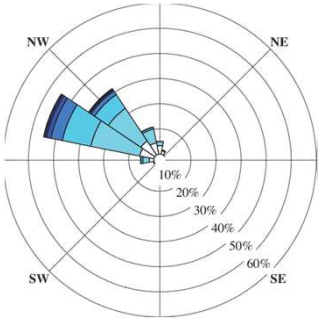
Digital Elevation Model

(DEM)



Hydrodynamics

waves | storms tides | SLR

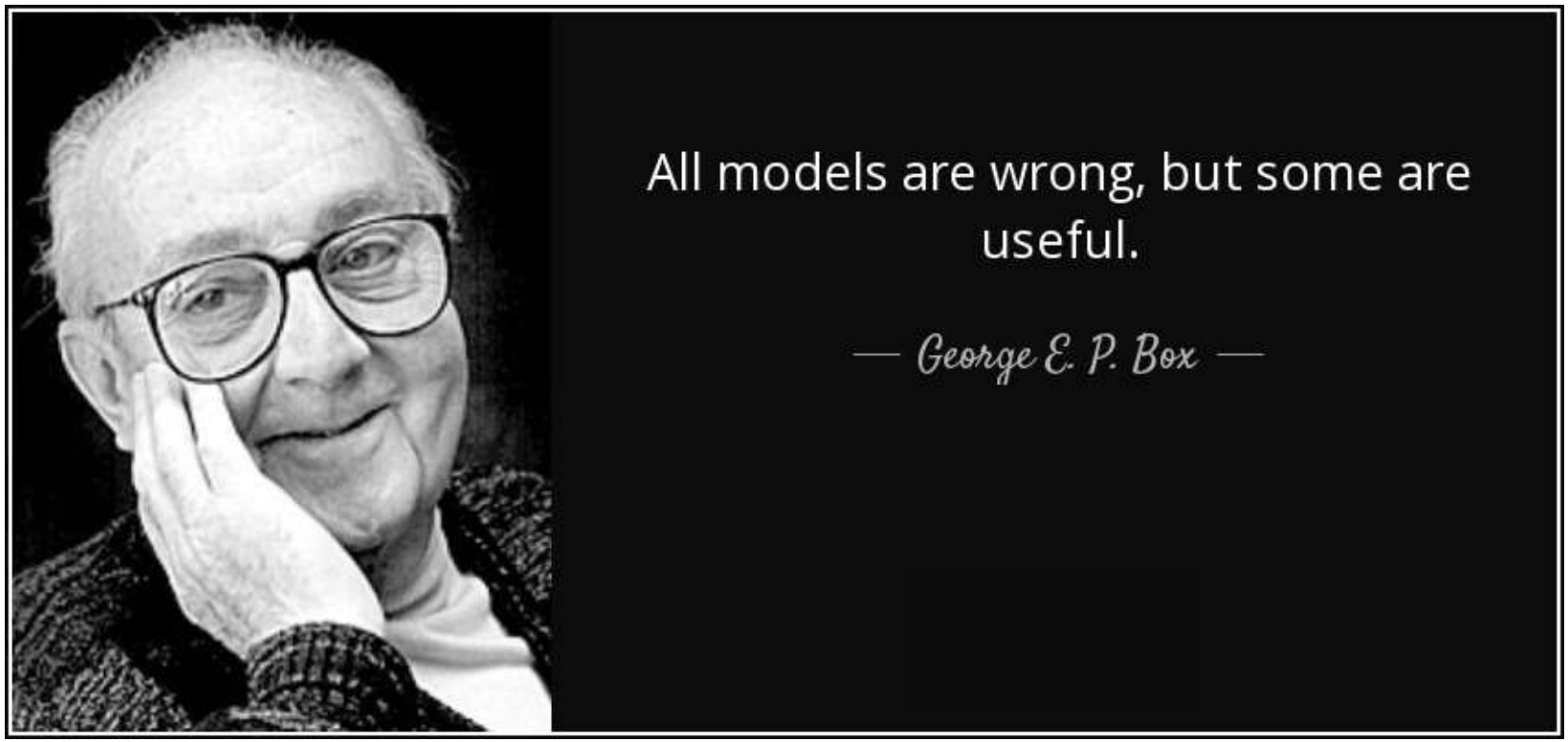


Sediment

Vegetation

	Xbeach	Delft3D	CEM2D
Morphology	x	x	x
Roughness		x	
Wave Climate	x	x	x
Wave Breaking and Transformation	x	x	x
Wind	x	x	
Tides	x	x	x
Time Varying Water Level	x	x	x
Groundwater Flooding	x		
Flow	x	x	
Viscosity		x	
Salinity		x	
Temperature		x	
Heat flux		x	
Pollutants and Tracers		x	
Sediment Transport	x	x	x
Avalanching	x		
Dredging/Dumping		X	
Dunes	x		
Vegetation	x		
Obstacles		x	

Considerations



Resolution and Scale

VCMP UAV Citizen Science Data

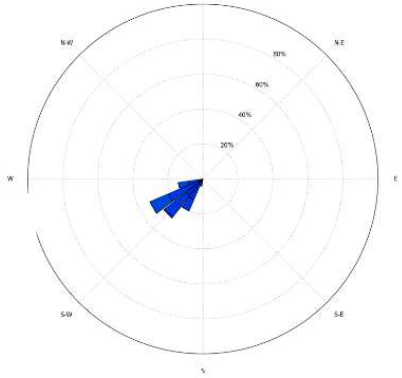
Delft3D

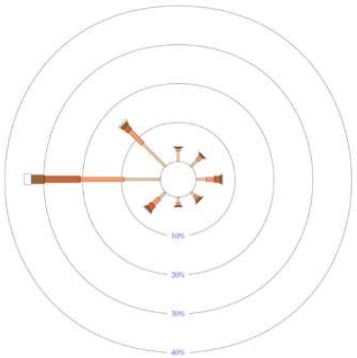
CEM2D

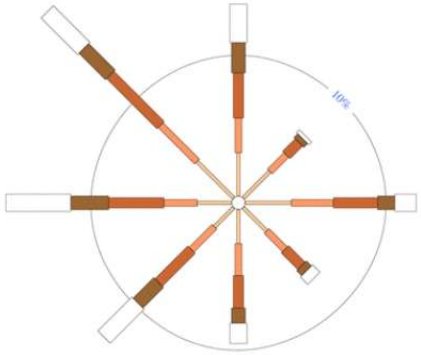
Future Coast bathymetry data

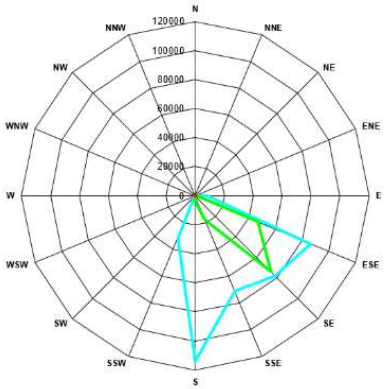
Data e.g. Wave Climate

A | CAWCR Wave Hindcast 1979-2010	B | East Sale Wind Rose 1943 - 2016	C | Cape Otway Wind Rose 1861 - 2016	D | Lakes Entrance Waves 2008-2018

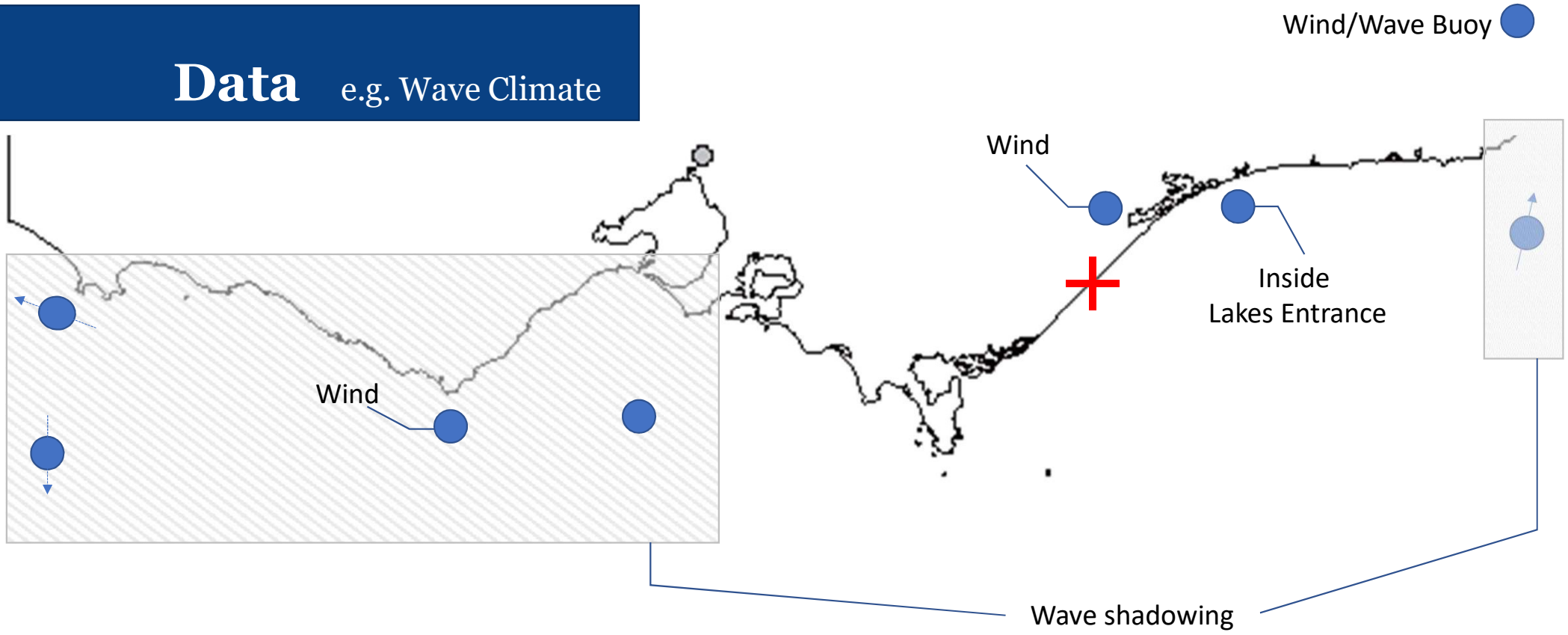








Data e.g. Wave Climate



Wave climate suitability for site-specific modelling
e.g. Seaspray - wave shadowing

Climate Projections

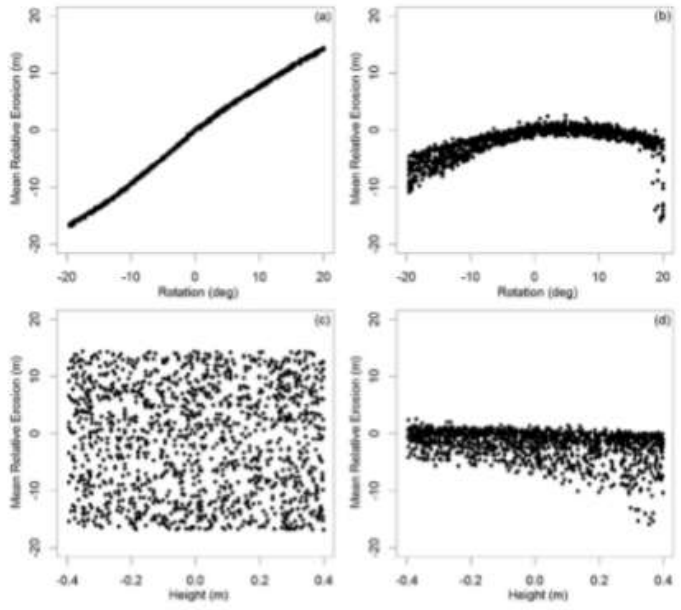
Wave Climate

North
(wave shadowed)

South
(wave exposed)

Rotating the wave angle by ±20%

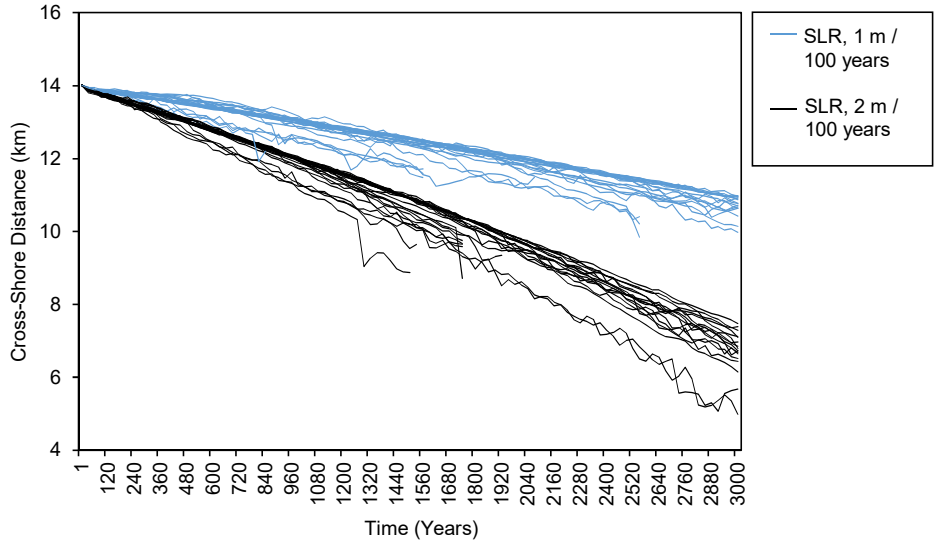
Changing the wave height by ±0.4m



Barkwith, A., *et al.,* (2014) Coastal vulnerability of a pinned, soft-cliff coastline – Part I: Assessing the natural sensitivity to wave climate, Earth Surf. Dynam., 2, 295-308

Sea Level Change

Coastal recession under rates of sea level rise of 1 m and 2 m per 100 years, for 25 coastal systems driven by different wave climate conditions



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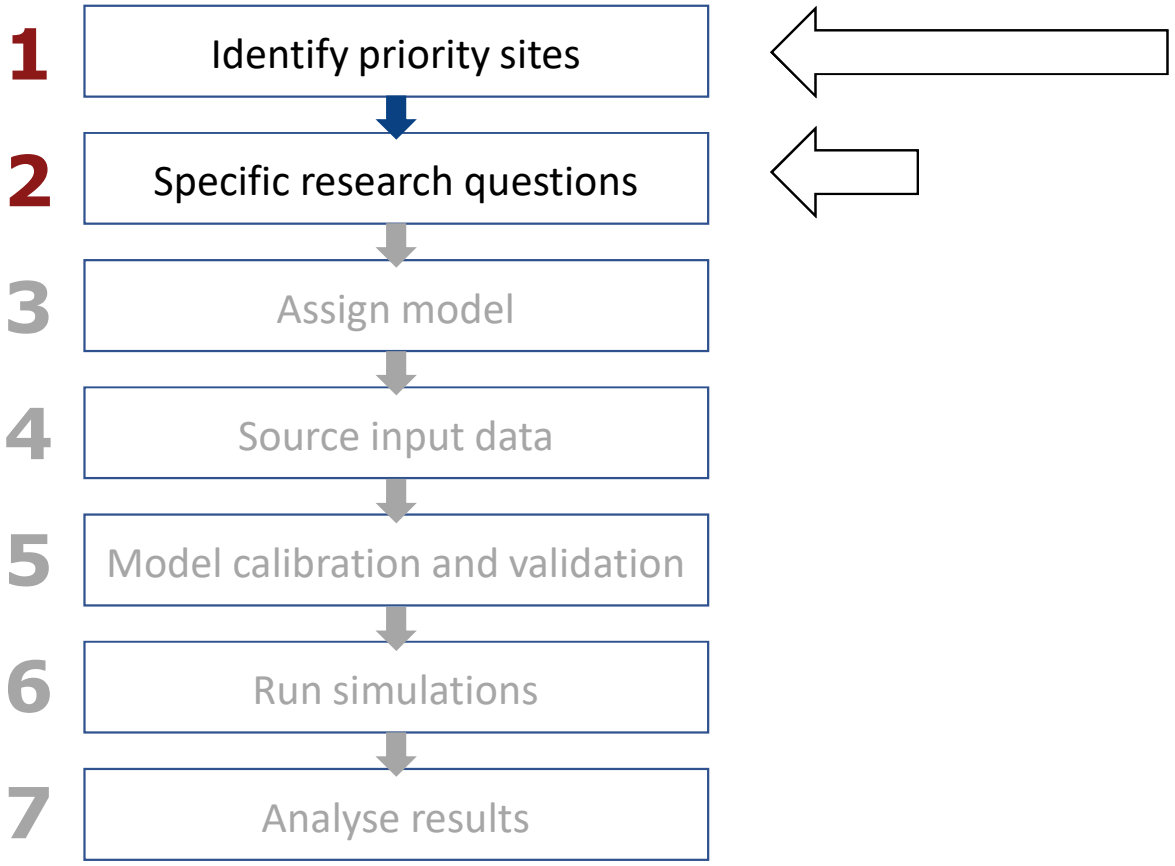
Number of Runs

Next Steps


1
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Next Steps

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SPARTAN
Performance & Flexibility

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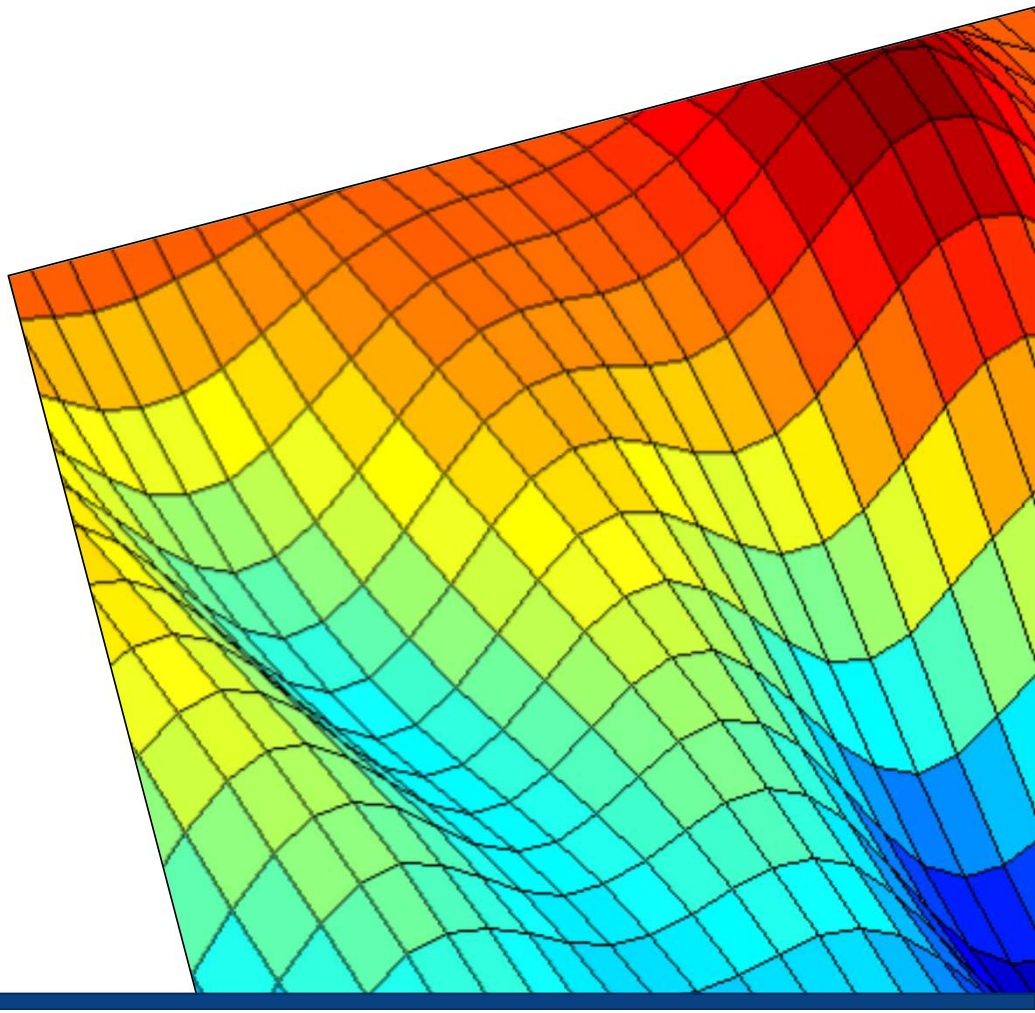

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