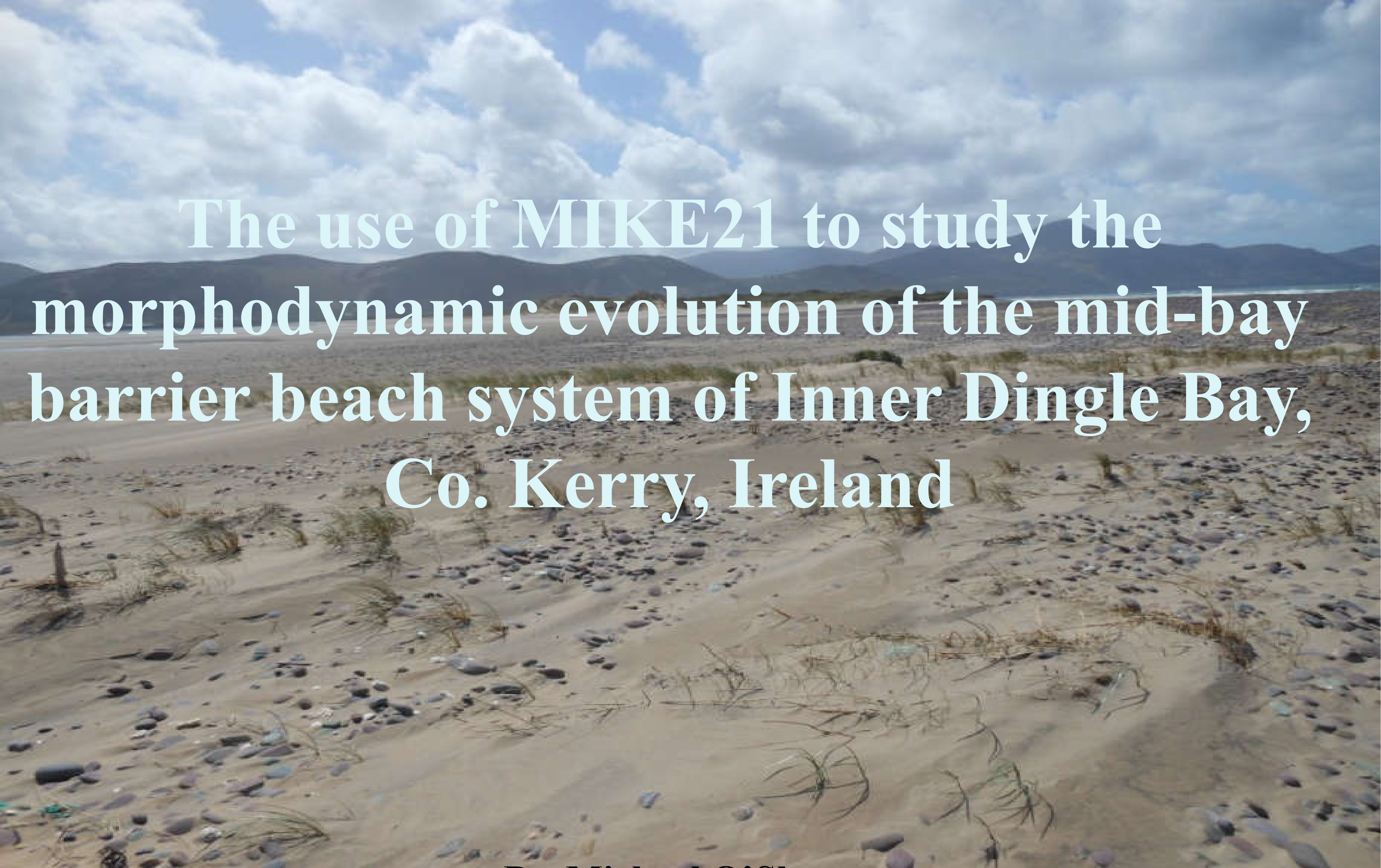
The use of MIKE21 to study the morphodynamic evolution of the mid-bay barrier beach system of Inner Dingle Bay, Co. Kerry, Ireland



Dr. Michael O’Shea

Malachy Walsh and Partners

Contents

- Why Study Morphodynamics of A Barrier Beach System - Dingle Bay?
- Tools and Methods
- Numerical Modelling
- Main Findings of Study

Study Site - Dingle Bay

Why Study Barrier Breaching in Dingle Bay?

Scientific Value – Apparent Naturally Evolving Dynamic Coastal System

Civic Concern – Flooding, Impact on Economic Value, Loss of Habitat/Amenity

Why Study Barrier Breaching in Dingle Bay?

Breaching of Rossbeigh – 2008

5 Million Tonnes Eroded
Breach in Barrier grows to almost 1Km

Why Study Barrier Breaching in Dingle Bay?

Reported increase in Flooding - **Assess Flood Risk**

Barrier Beach Behaviour - **Compare with Established Concepts**

Rapid Change in Coastal Landscape - **Predict Evoluti**

Methodology & Tools

1. Imagery Analysis
2. Coastal Evolution Monitoring
3. Sediment Analysis
4. Hydrodynamic Analysis

Methodology & Tools

1.Imagery Analysis – Aerial Photography, Satellite Imagery, Admiralty Charts and Historic Maps

Predominantly Qualitative

Longer Term Evolution of Barrier Beach

Identifies Morphological pattern during breaching period 2000-2012

Characterises Morphodynamic Zones on Rossbeigh

Methodology & Tools

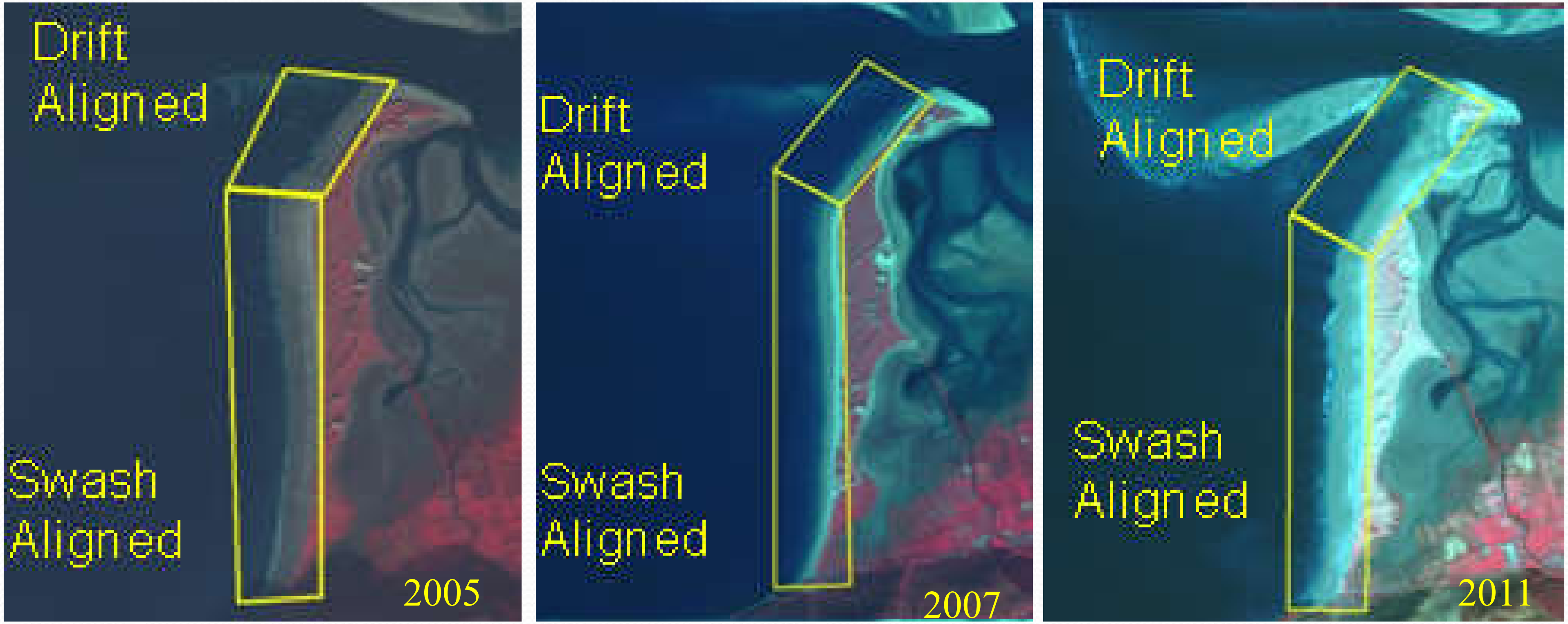
1.Imagery Analysis – Long Term Morphology

Methodology & Tools

1.Imagery Analysis – Morphodynamic Zones on Rossbeigh

Swash Aligned –Shore Normal Incident Wave Direction - Stable

Drift Aligned – Shore Angled to Incident Wave Direction –Dynamic



Methodology & Tools

2. Coastal Evolution Monitoring – Topographic and Bathymetric Surveys

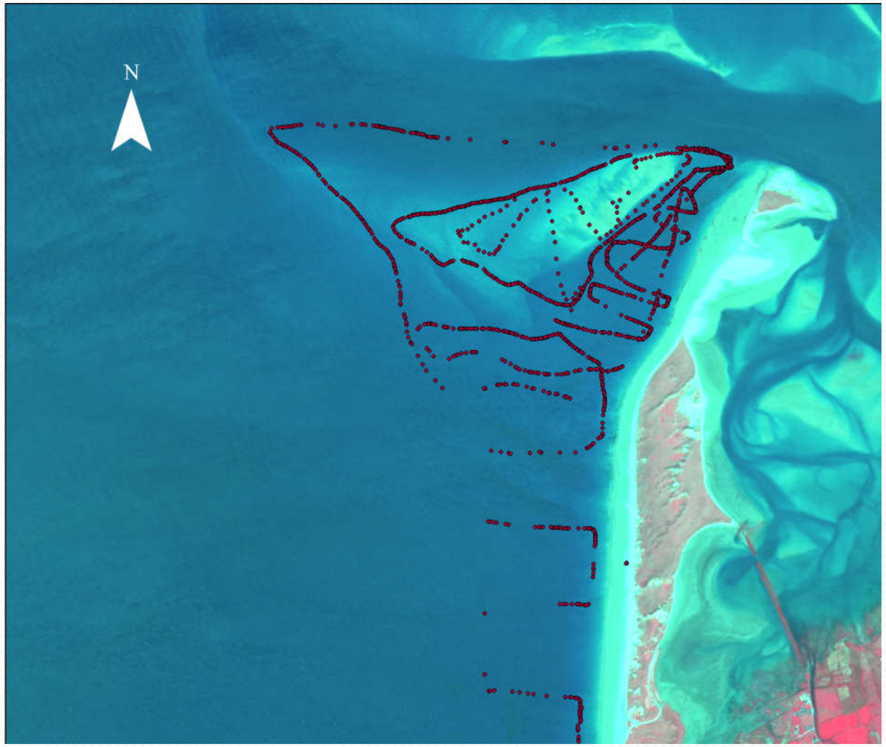
Quantitative – Rates of Shoreline Change, Volumes of Erosion/Deposition

Compare Recession Rates with Established Coastal Formulas (Van Rijn CERC)

Developed Surf Zone Bathymetry Craft

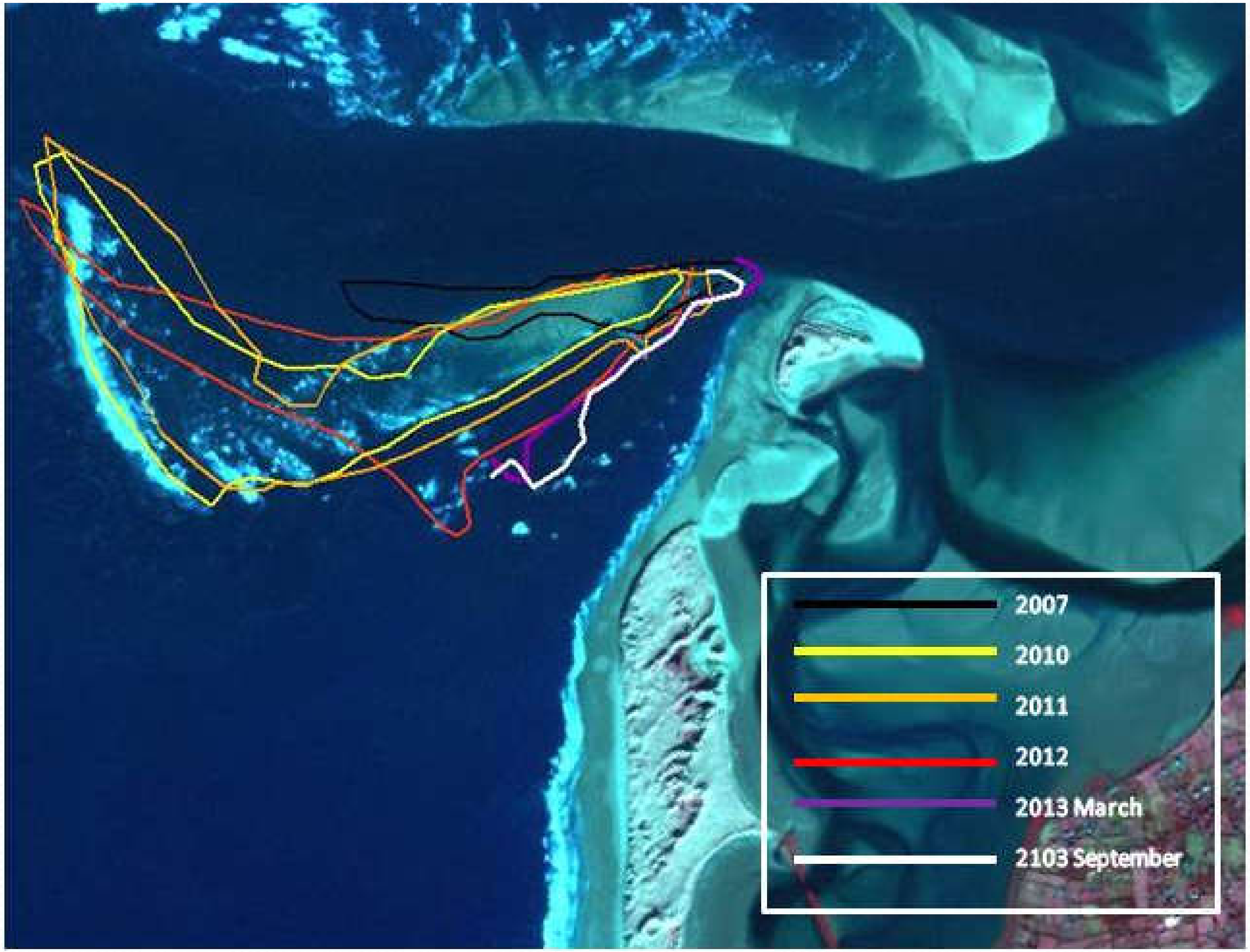
Assess post breaching evolution of Rossbeigh

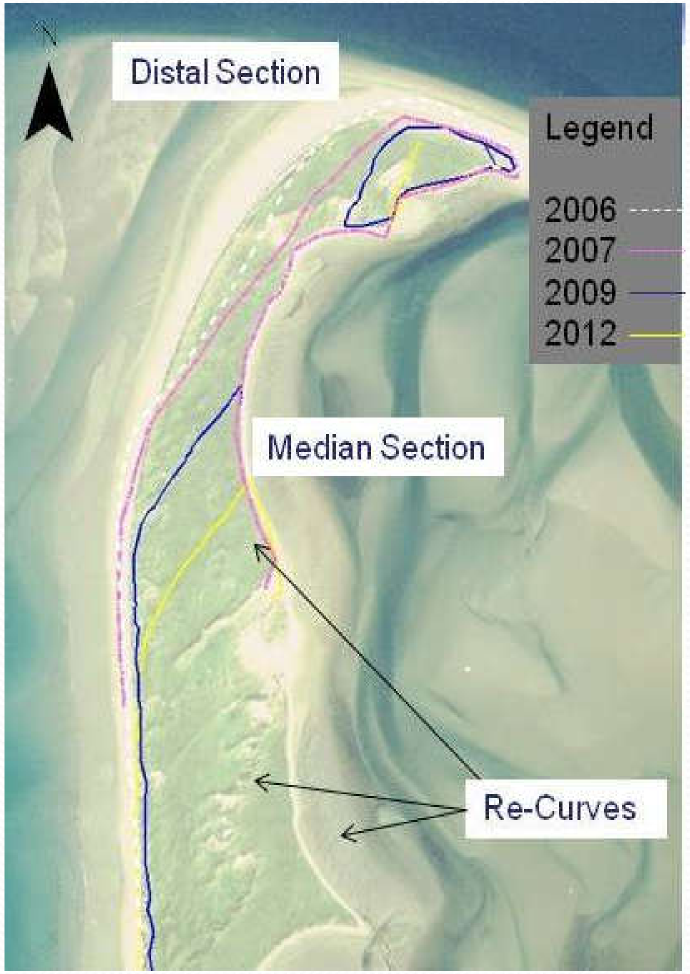
Monitor Evolution of Ebb Tidal Bar



Methodology & Tools

2. Coastal Evolution Monitoring – Ebb Tidal Bar Migration - Breach Development



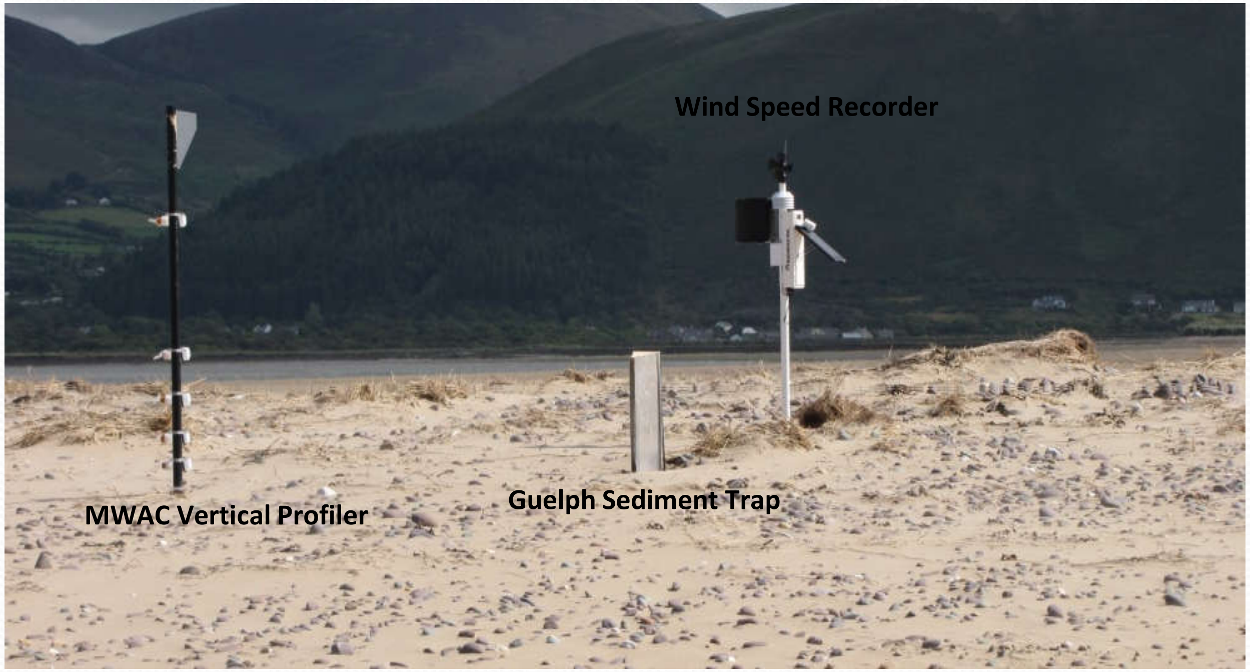


Methodology & Tools

3. Sediment Analysis – Sediment Sampling, Aeolian transport, Wind Speed, Sediment Dye testing

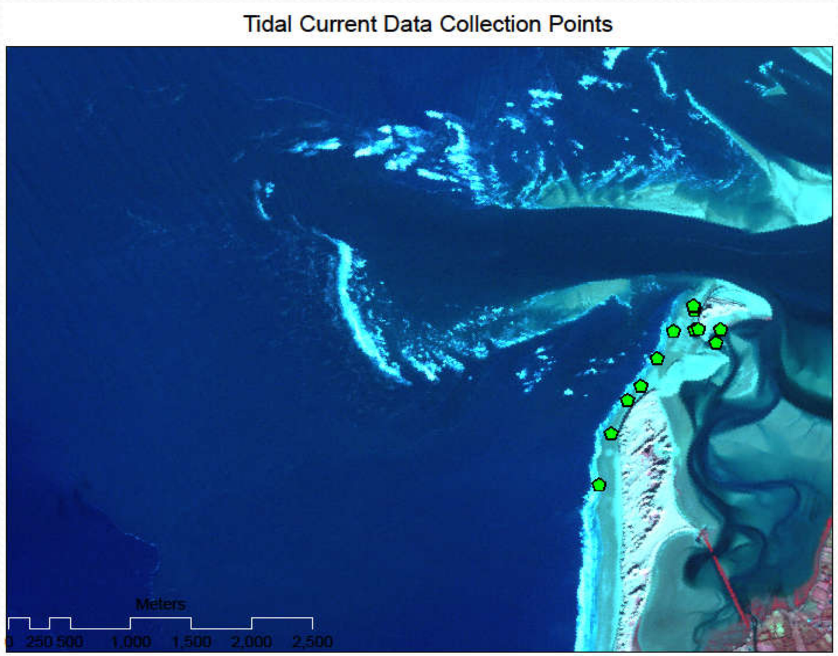
Quantifying Sediment Transport Climate on Rossbeigh

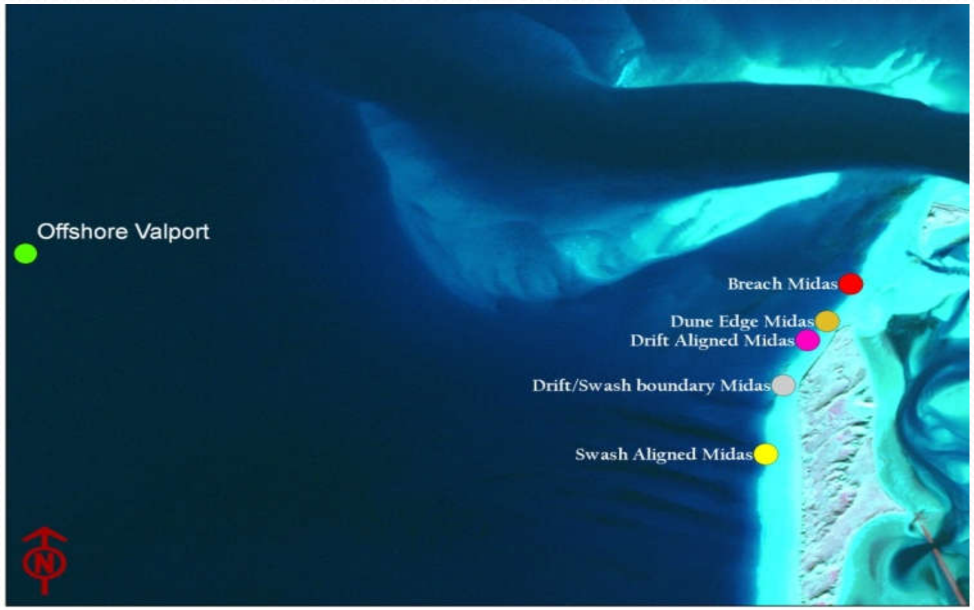
Examining Role of Aeolian Transport – Regeneration of Dunes



Methodology & Tools

4. Hydrodynamic Analysis – Wave Gauges, Tidal Current Meters,





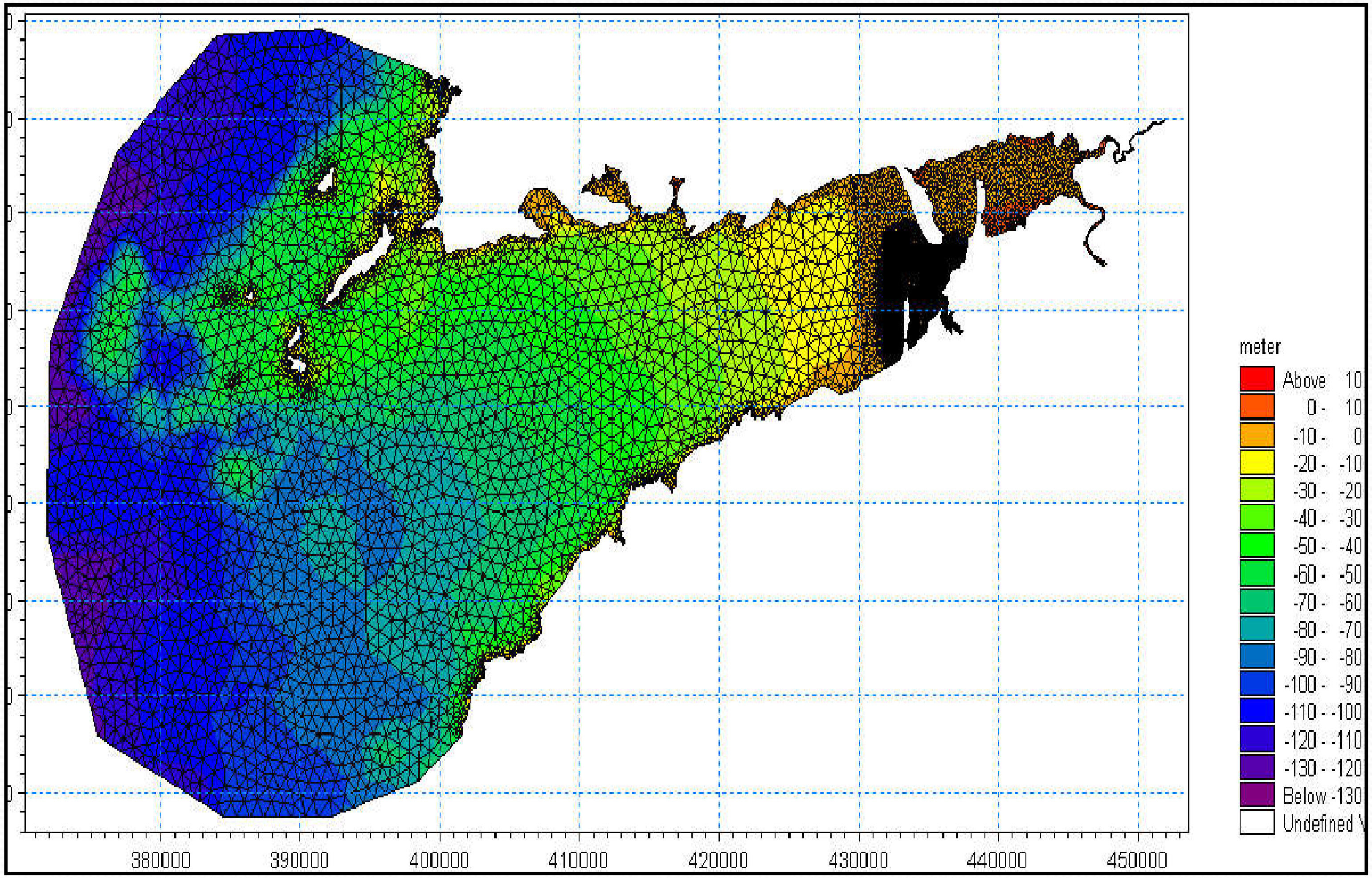
Morphodynamic Modelling

DHI Mike 21 ST HD SW

1. Short Term Hydrodynamic Modelling
2. Long Term Morphodynamic Modelling
3. Grain Size Trend Analysis Validation
4. Ocean Radar Trial – Results Validation

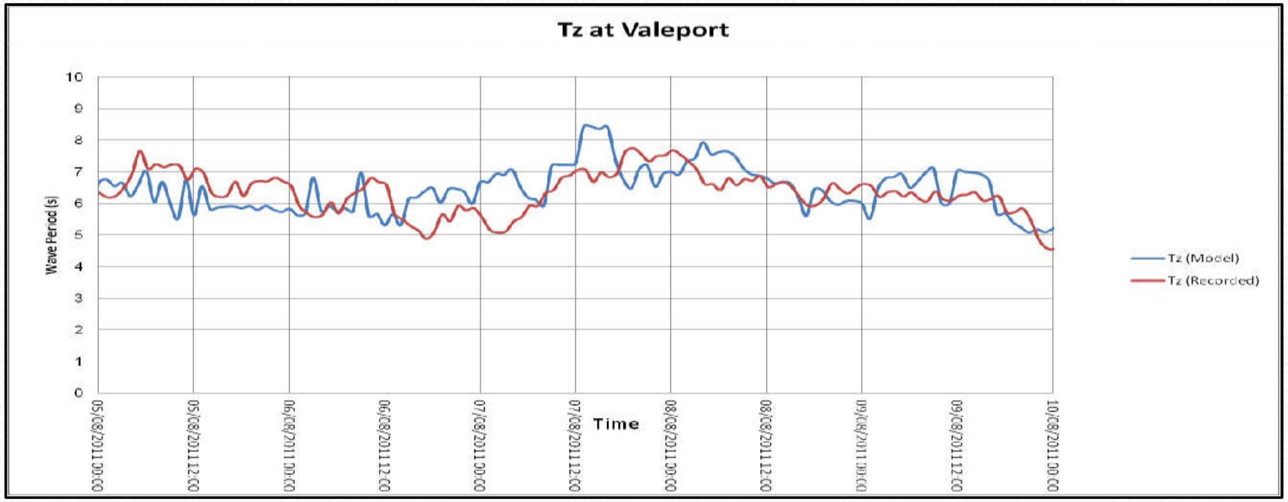
Morphodynamic Modelling

Model Domain – Dingle Bay



Morphodynamic Modelling

Calibration – Wave and Tidal



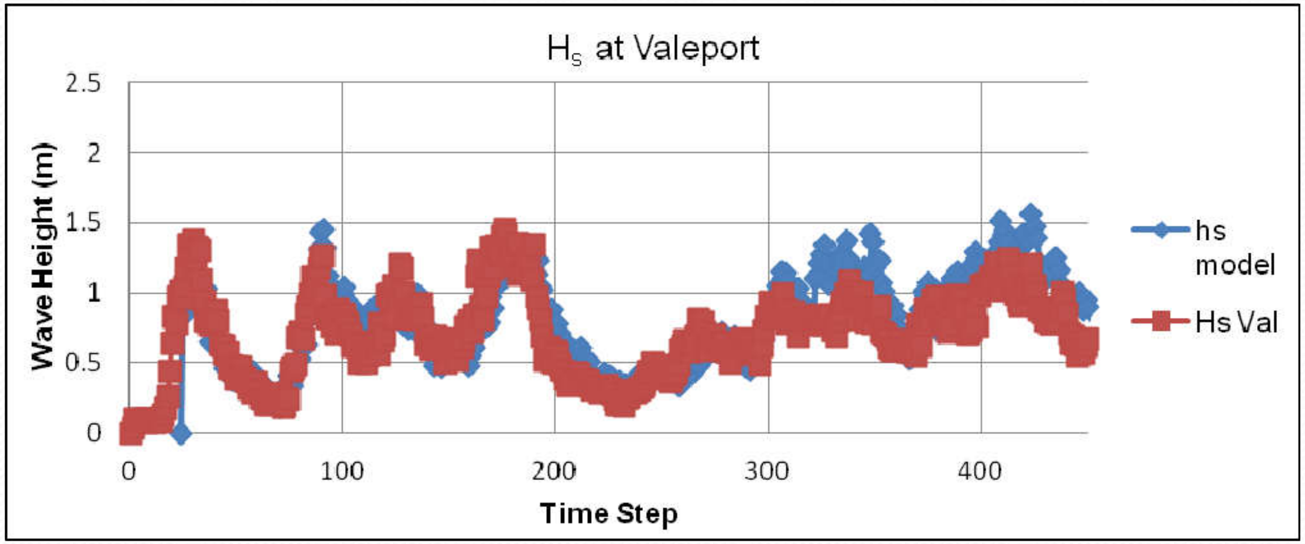


Table 6.1 Final model parameter values

Morphodynamic Modelling

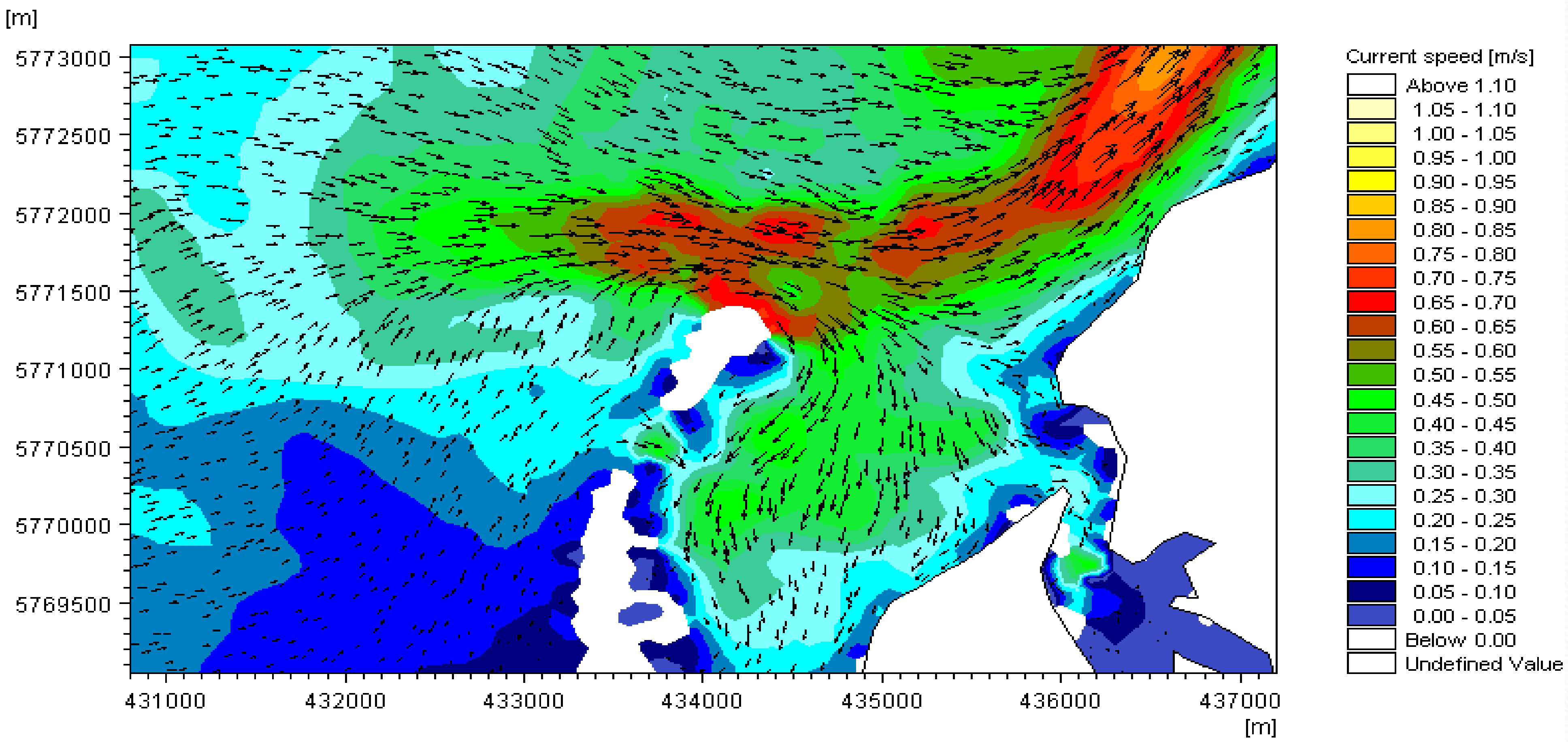
Calibration – Parameter Tuning

Module	Parameter	Value
HD	Eddy Viscosity - Smagorinsky	0.28
	Bed Resistance (Manning)	32 m^{-3}/s
ST	porosity	0.4
	grain size	0.25
	Bank erosion slope failure	30 Deg angle of repose
SW	Spectral	Fully spectral
	Time	Interstationary
	Spectral discretisation	25 frequencies, min of 0.055hz
	Directional discretisation	16 over 360 Deg rose
	Wave breaking	Gamma of 0.8 Alpha 1
	White capping	4.5 - constant
	Directional Spreading Index	4

Hydrodynamic Modelling

Hydrodynamic Analysis Short Term Numerical Modelling

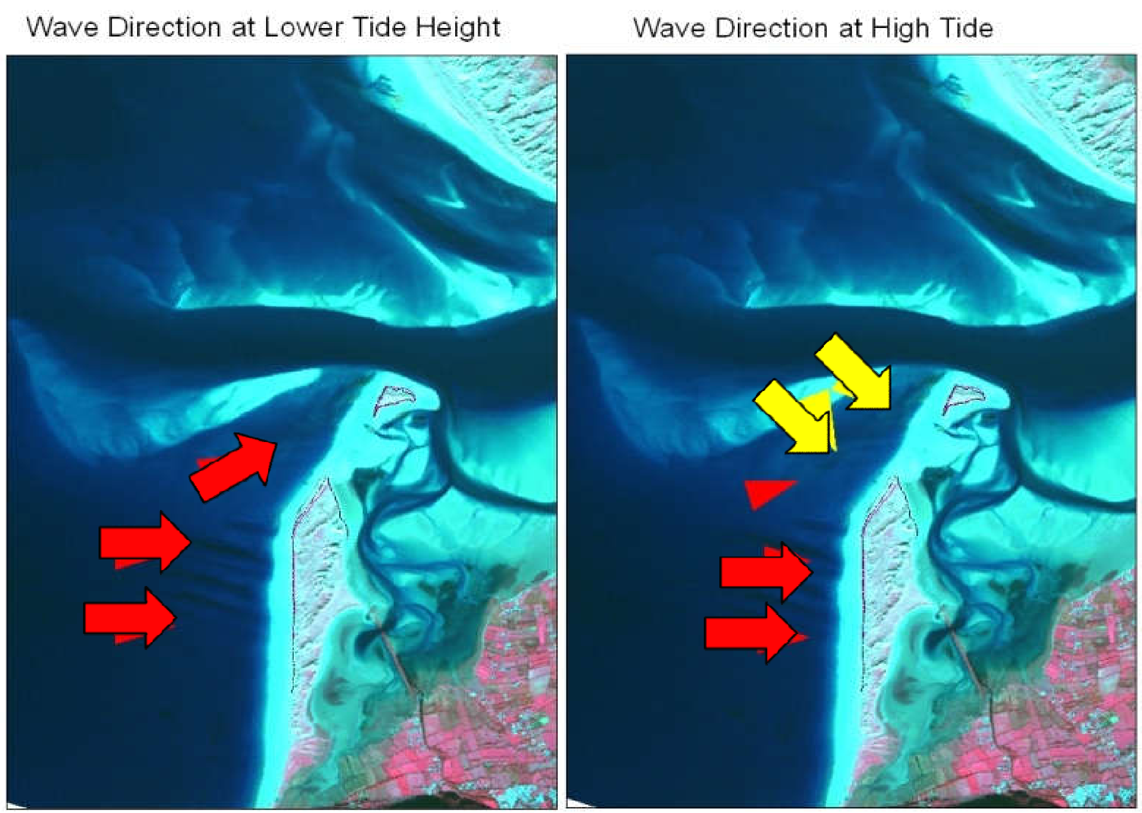
Quantify the Hydrodynamic drivers of Coastal Evolution



Hydrodynamic Modelling

Hydrodynamic Analysis –

Identify key features Influencing Morphodynamics – e.g. Ebb Tidal Bar Turning Waves



Long Term Morphodynamic Modelling

Adopted an experimental **Schematised** approach

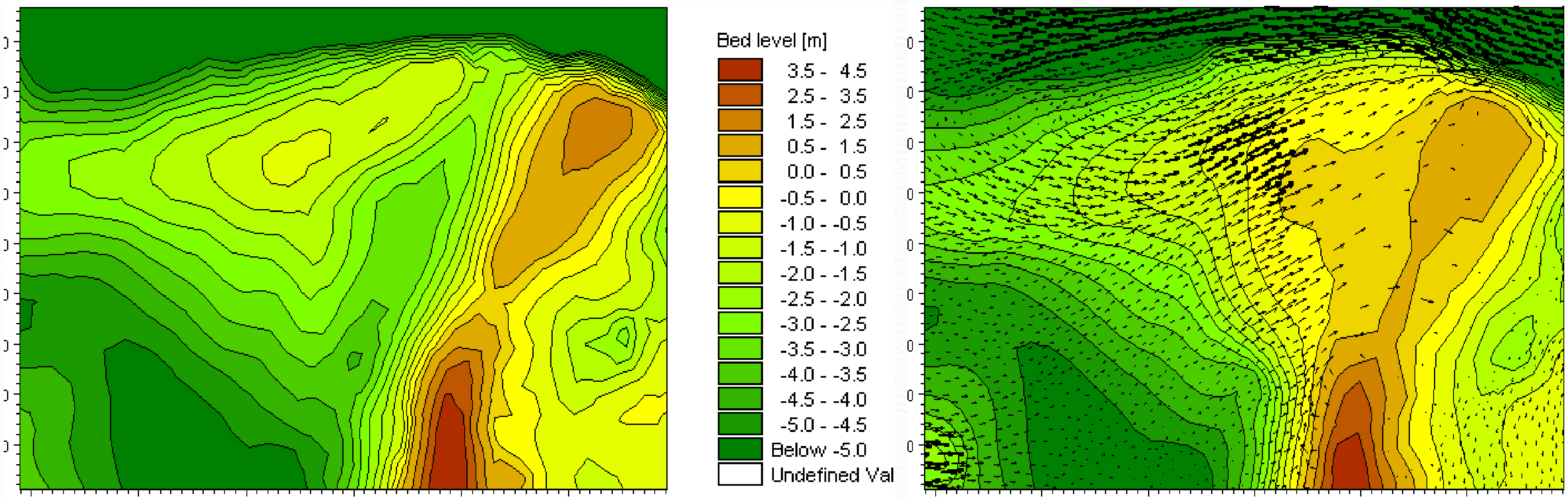
Developed evolutionary timeline by extrapolating trends of measured rates of sediment transport

Updated Bathymetry

Monthly Tidal Cycle +Representative Wave Climate +Morphological Scale Factor

= Reduction in Simulation (Years to Weeks)

2013 Bathymetry 2035 Bathymetry



Main Findings – Evolutionary Timescale

5 Phase evolutionary Cycle – 35 years from Erosion to Stability

Monitored

Stage 1 (2001-2007)
swash platform removal
drift aligned dune erosion
channel straightening

Stage 2 (2008-2015)
barrier breaching in drift aligned
emergence of drift aligned channel
ebb tidal bar growth
drift aligned zone growth
NW wave influence at high tide

Stage 3 (2015-2025)
widening of breach
island erosion
migraton of ebb tidal bar

Predicted

Stage 4 (2025-2030)
welding of ebb tidal bar to drift shore
removal of island
slowdown of breach dune erosion

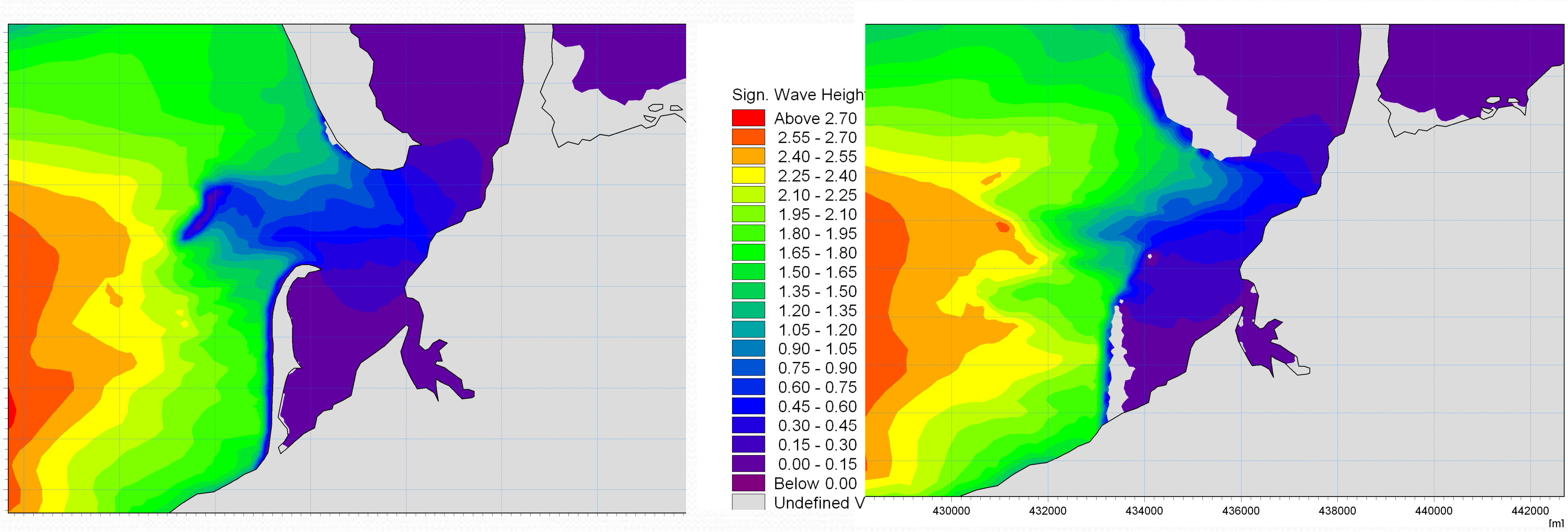
Stage 5 (2030-2035)
swash platform growth in drift aligned zone
aeolian regeneration of dunes

Coastal Flood Risk Modelling

3 Scenarios (Past, Present and Future)

4 m surge at high tide

2000 **2013**



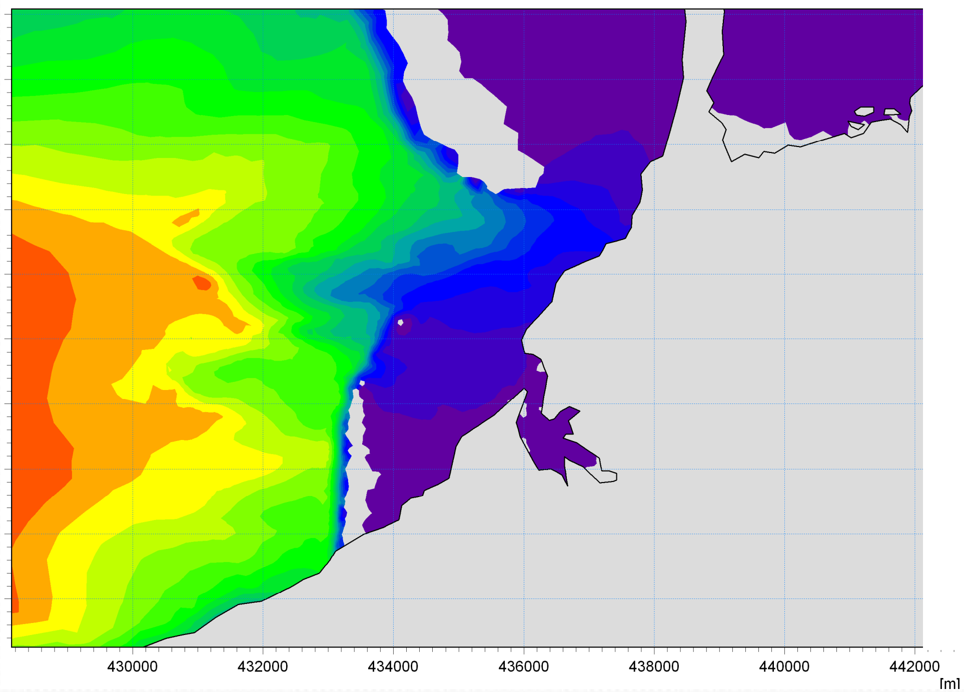
Coastal Flood Risk Modelling

3 Scenarios (Past, Present and Future)

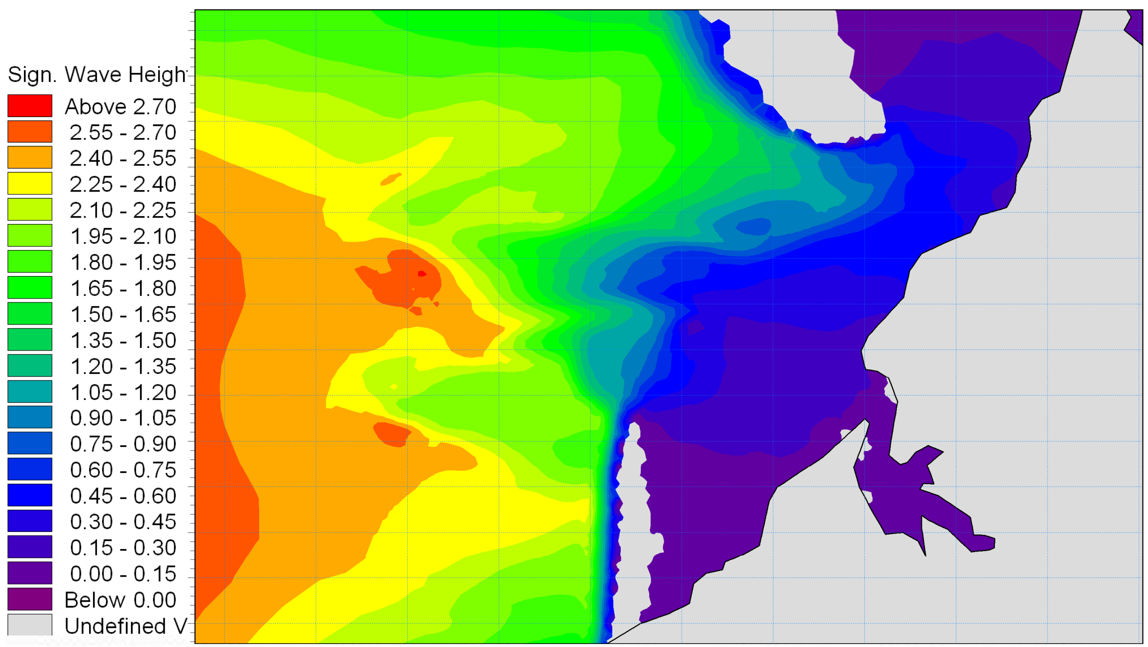
4 m surge at high tide

Increase in Water Level – due to deepening of channel rather than flow through breach

2013



2030 (Stage 4)



Summary of Findings

Identified Morphodynamic Factors Influencing Breaching

Predicted Evolution of Breached Barrier System to the year 2035

Developed Schematised Numerical Modelling Method for Long Term Morphodynamics

Quantified the Flood Risk

Further Work

Continued Surveys to update Numerical Model

Assess SLR impact on predictions

Questions?

Thank You

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