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Creating

**Safer Coastal and Port  
Infrastructure**

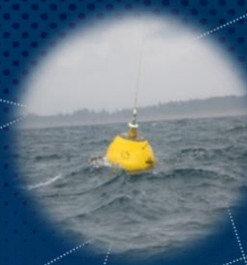
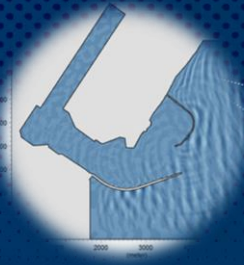
with

**Innovative Physical and  
Numerical Modelling**

**Kishan Tulsi**

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**70** Years  
Ideas that work



## • Physical and Numerical modelling

- Breakwater Monitoring
  - Armour track

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- Vessel manoeuvring simulations for safe port design and operations
  - Simflex software – bringing vessels in and out of ports (Force Technology)
  - Dmax – Maximum underkeel clearance of vessels
  - Keoship software
  - Keofloat software
  - Wavescat
  - Passcat
  - Quaysim
  - Harbour watch

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- Wave current and environmental monitoring
  - IPOSS – Integrated Port Operations Support System
  - Virtual Buoy

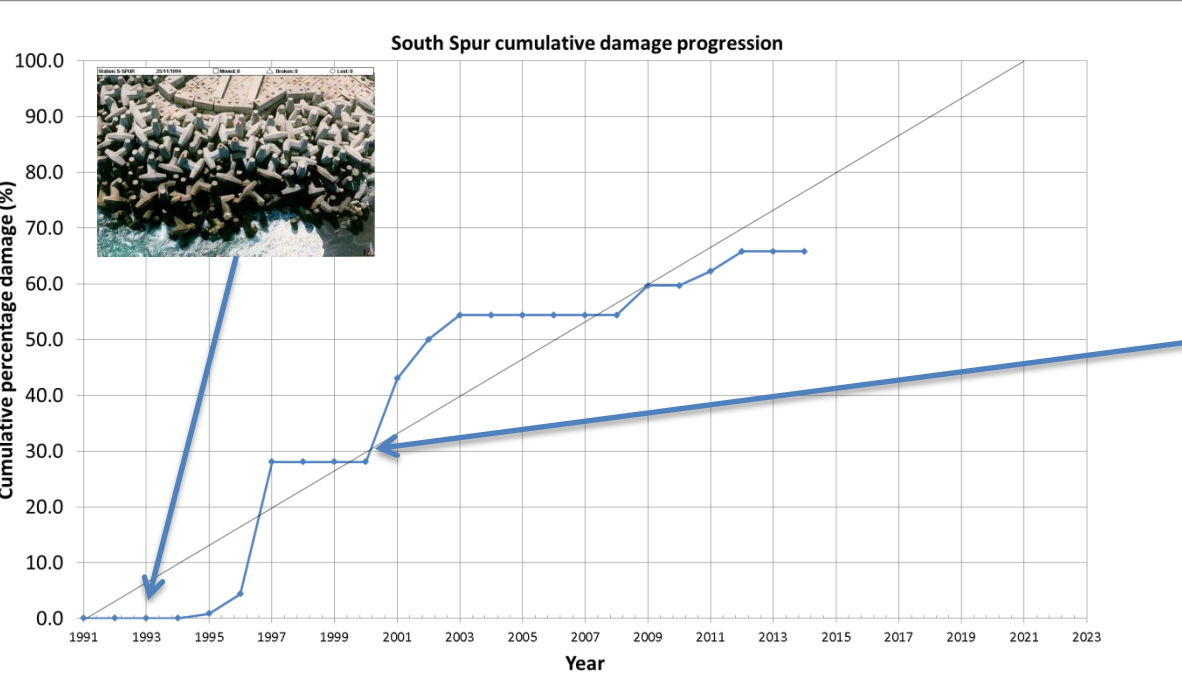
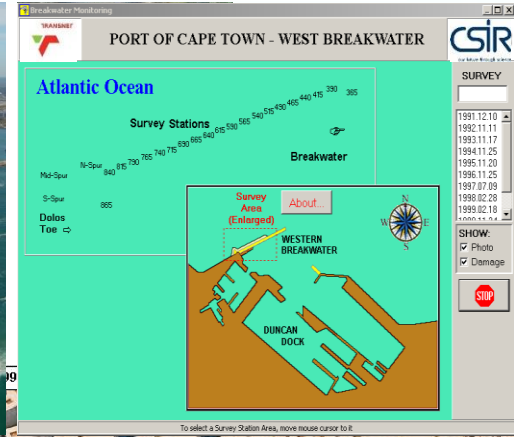
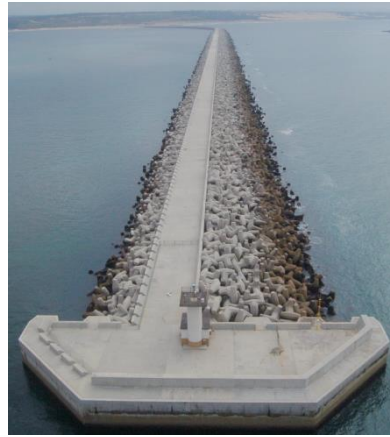
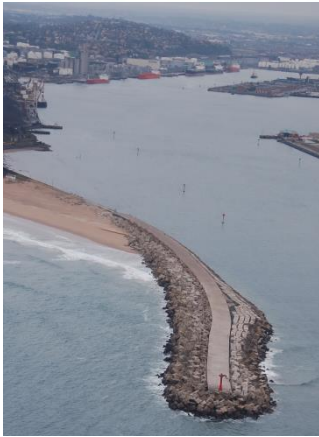
Physical modelling

Numerical modelling



# Armour Track

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# Armour Track

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# Armour Track

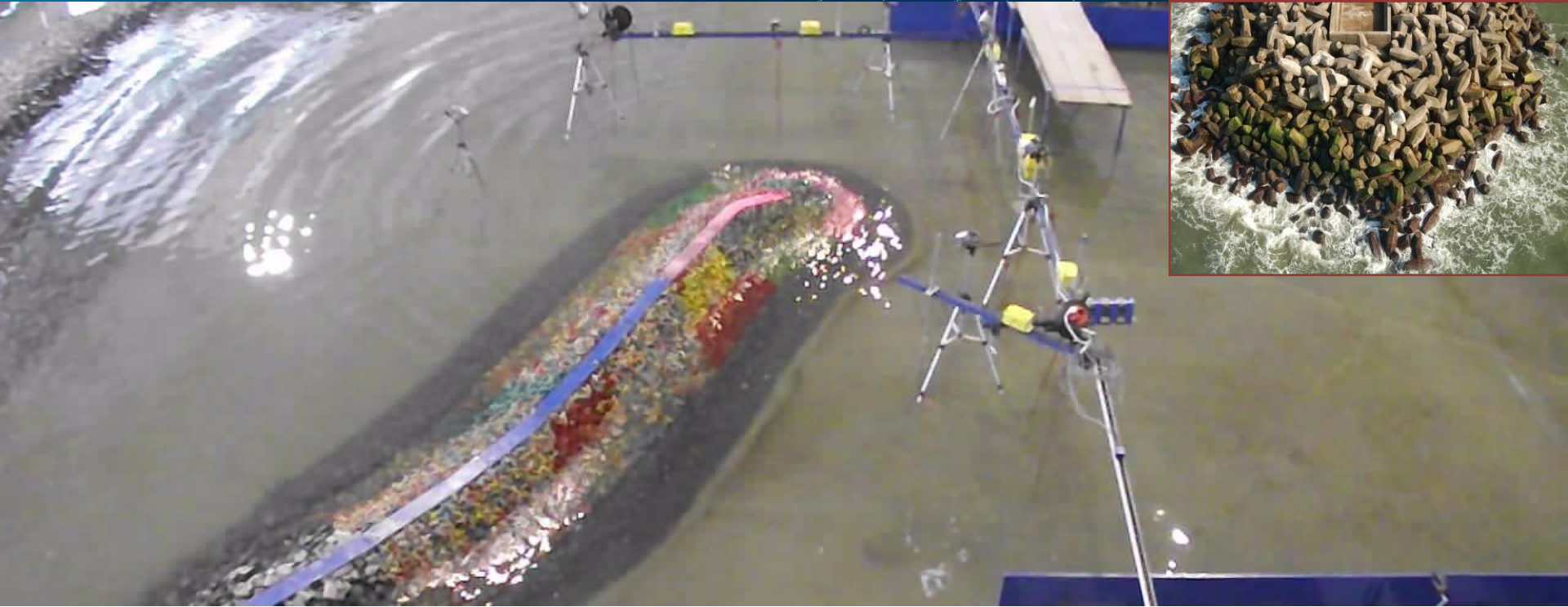
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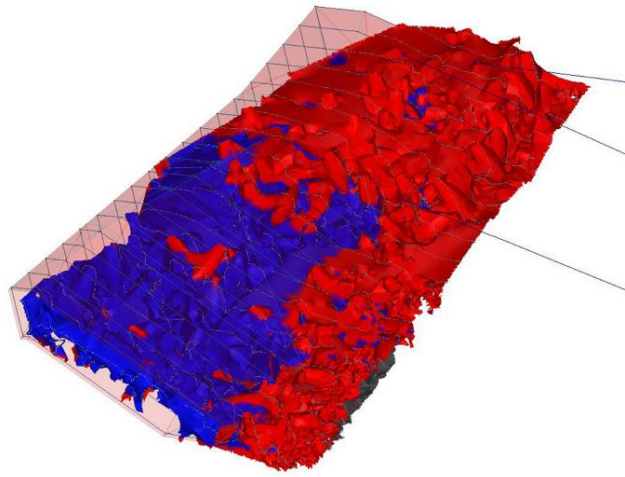
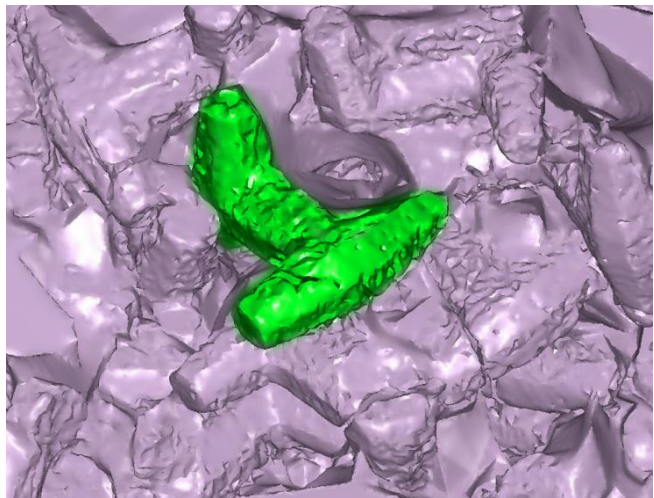
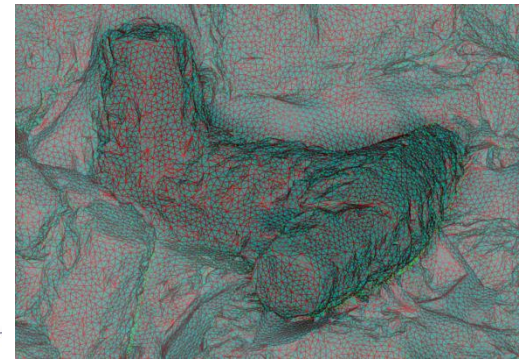
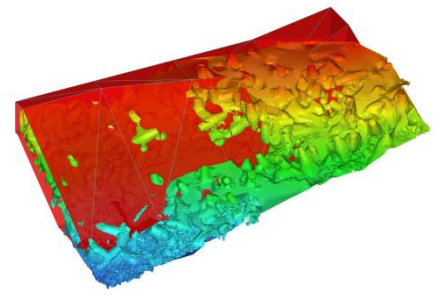
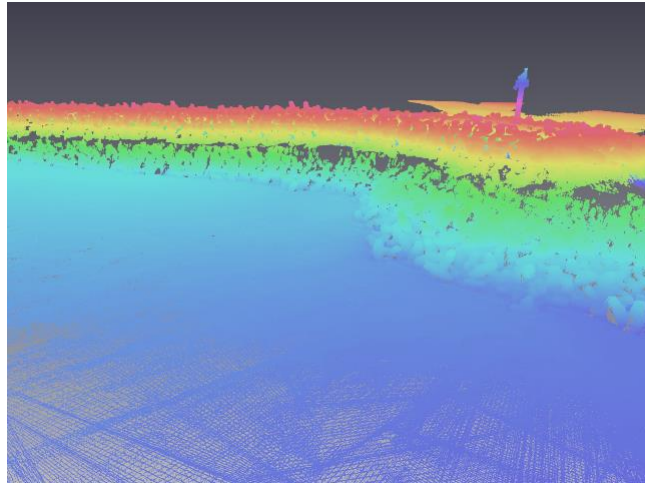
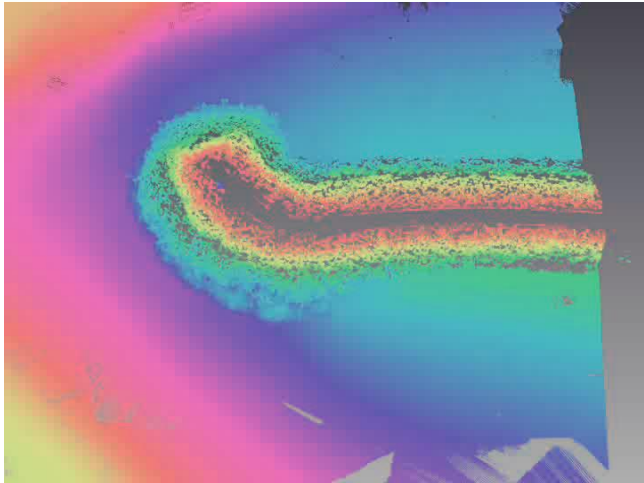


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# Armour track using 3D data points

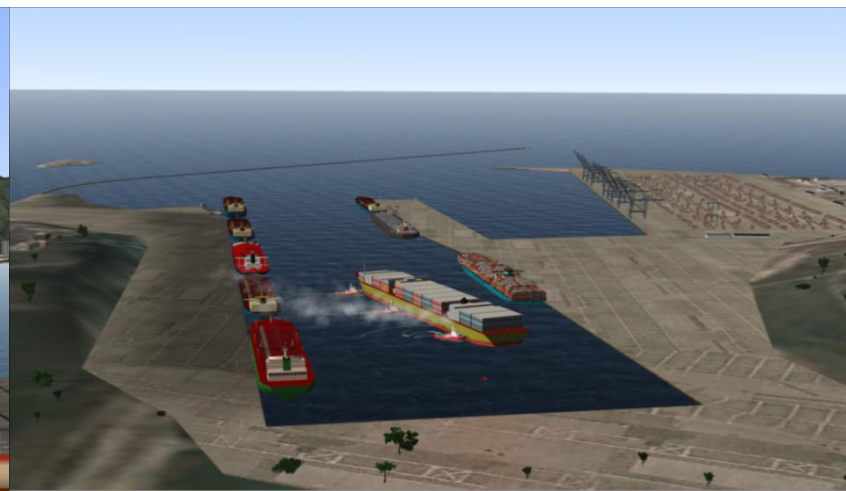
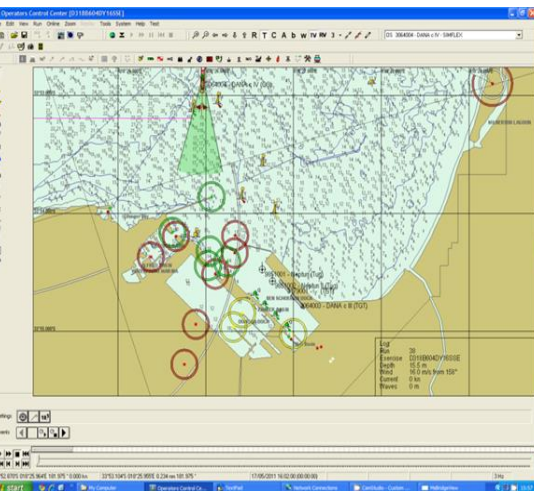
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# Ship manoeuvring simulations:

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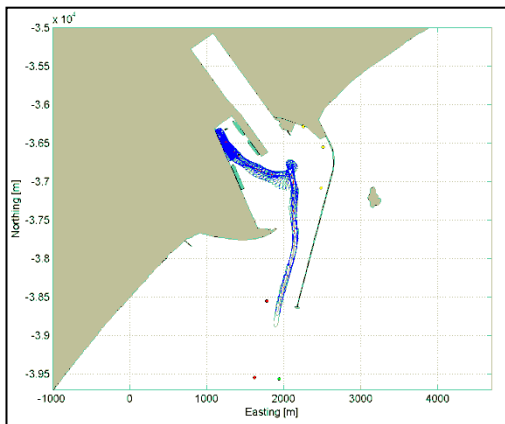




# Ship Manoeuvring simulations

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## Port of Ngqura simplex simulator bridge View



identifying solutions and alternatives to difficult manoeuvres  
Designing of ports and training of pilots



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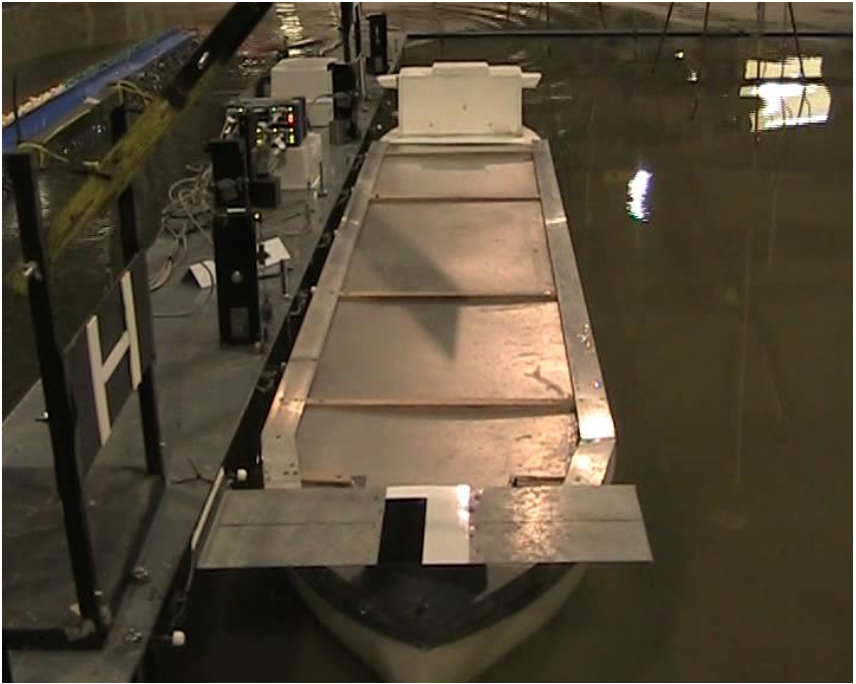
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# Long waves and moored vessels

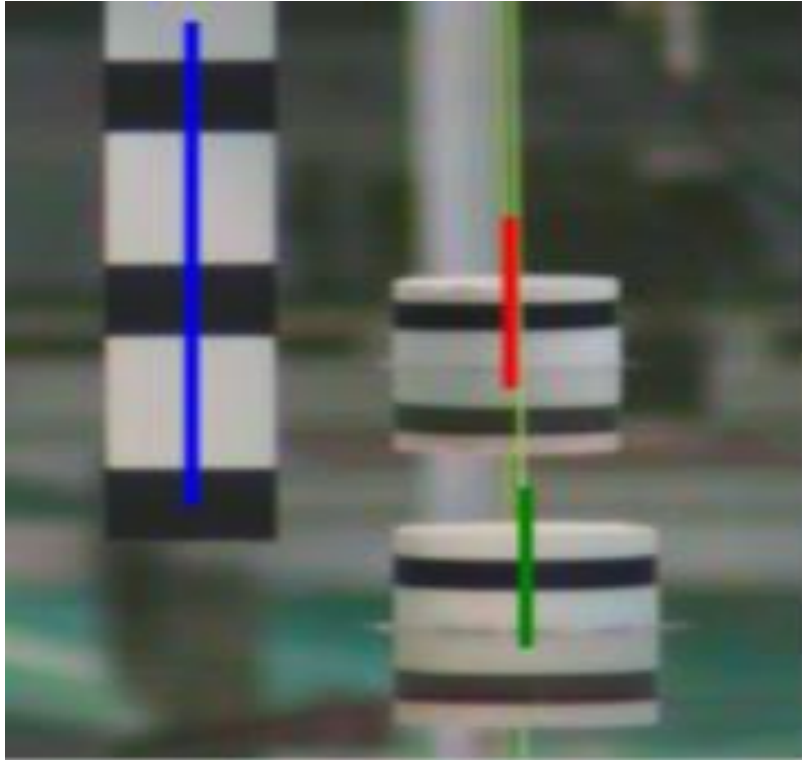
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- Ship motion monitoring of multiple ships at berth to optimize port layouts and mooring configurations
- Assess wave induced motions of free-running ships using our fleet of model ships and in-house software



# Measuring long waves: Keofloat and Keoship systems

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Keofloats used to measure very small waves



Keoship camera system viewing a vessel docked along a jetty

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# Numerical models for ship motion: WAVESCAT, PASSCAT & QUAYSIM

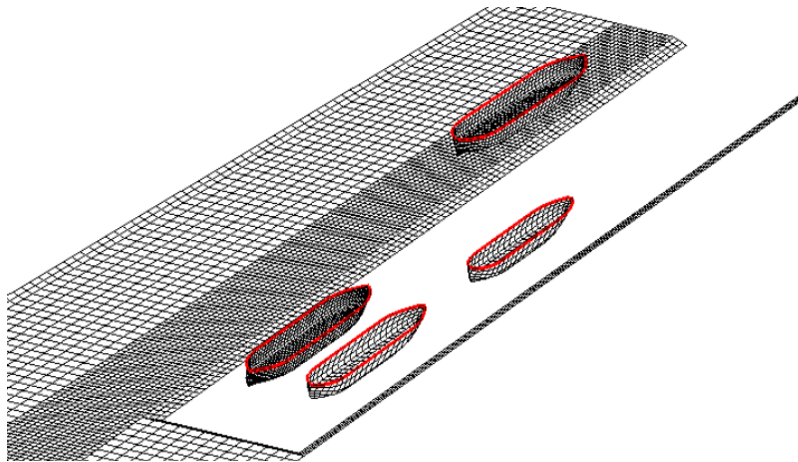
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## WAVESCAT

- Computes wave and hydrodynamic forces
- Boundary-integral equation model (BIEM)

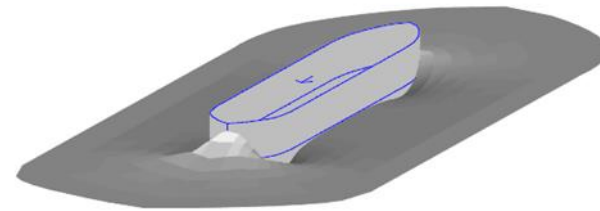
## PASSCAT

- Computes forces due to passing ship

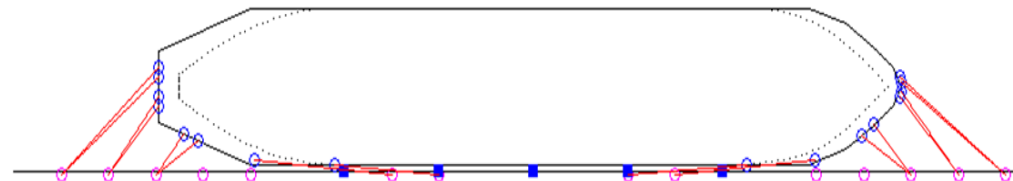
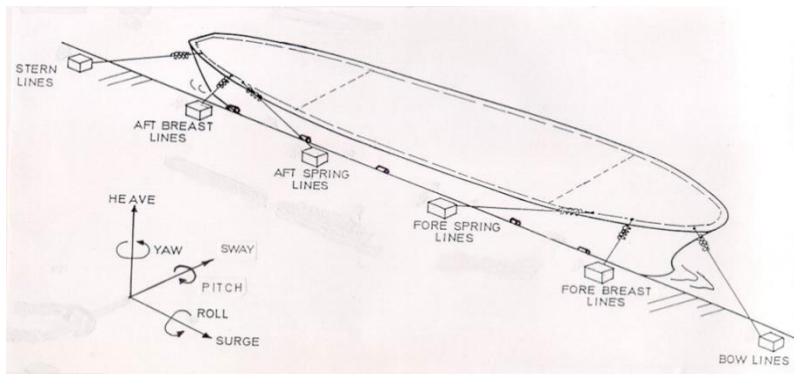


## QUAYSIM

- Time domain ship motion simulation model
- Computes ship motions and mooring forces due to waves, current and wind



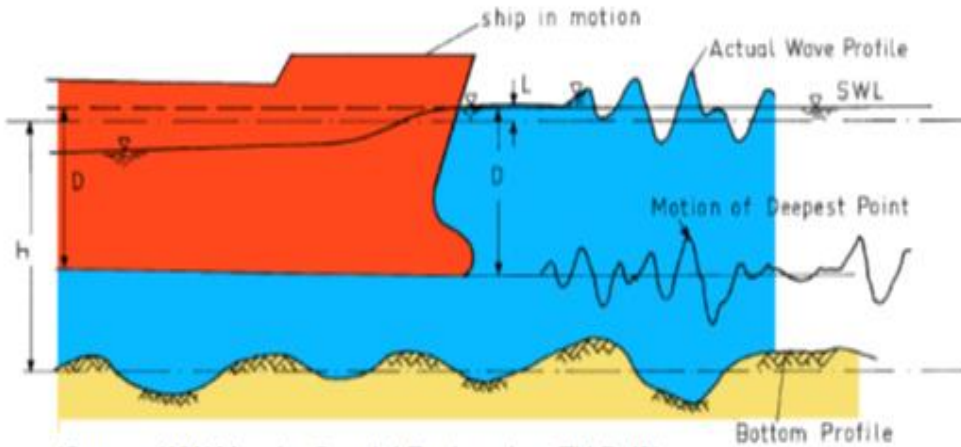
## QUAYSIM model setup with mooring lines and fenders



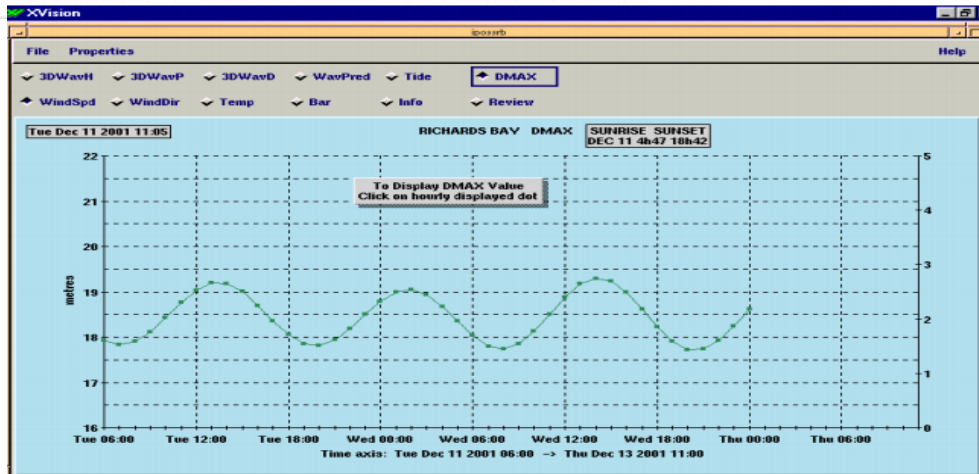
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# Calculating the maximum allowable safe draught: DMAX



(Source: WW Massie, Coastal Engineering, TU Delft)



Typical images generated by the DMAX model





# Harbour Watch

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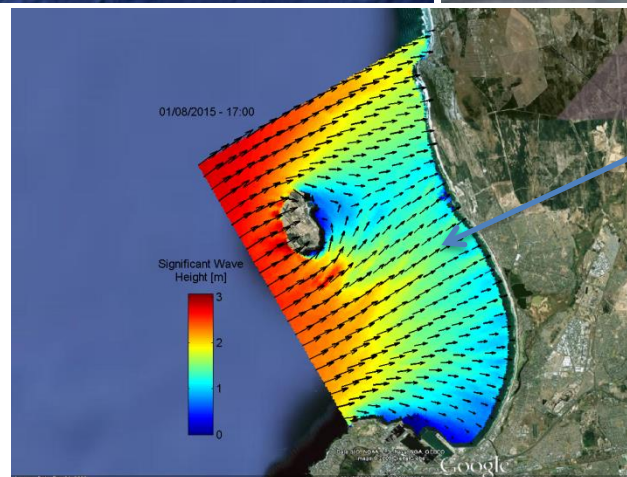
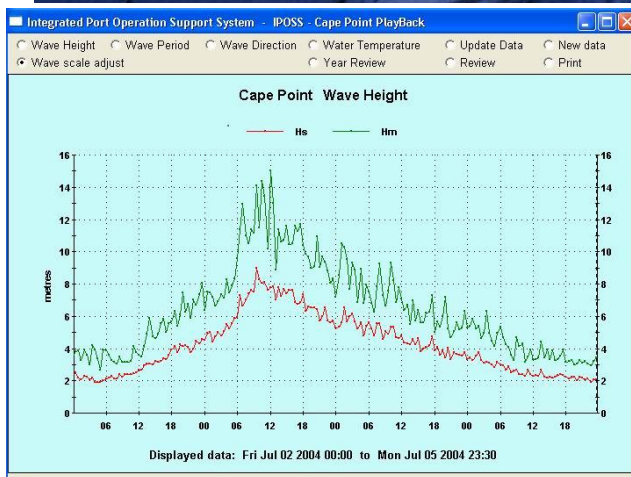
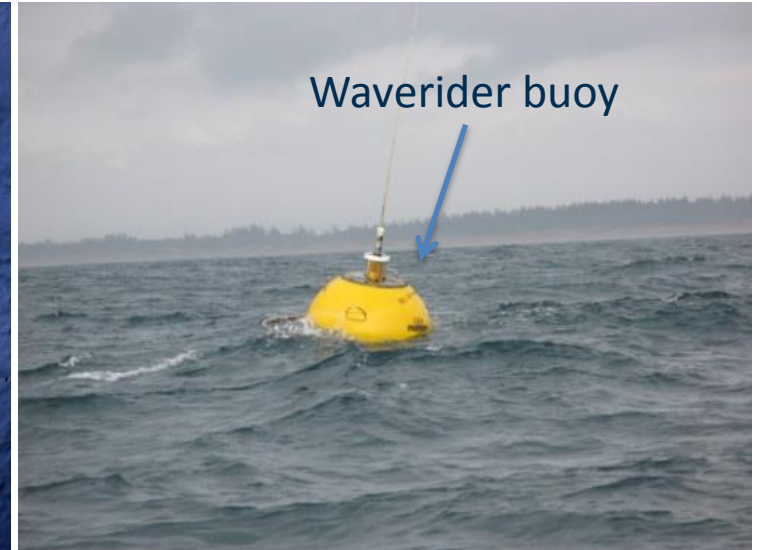


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# Monitoring Nearshore Conditions: IPOSS and Virtual Buoy

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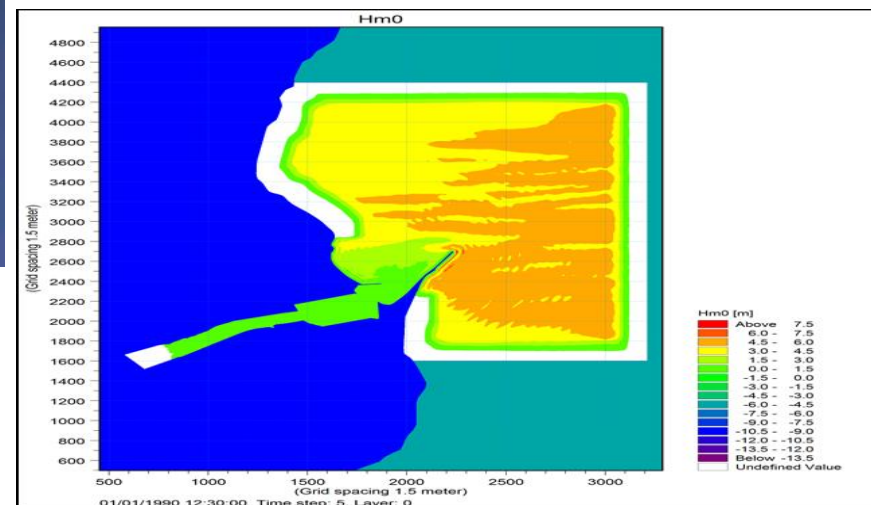
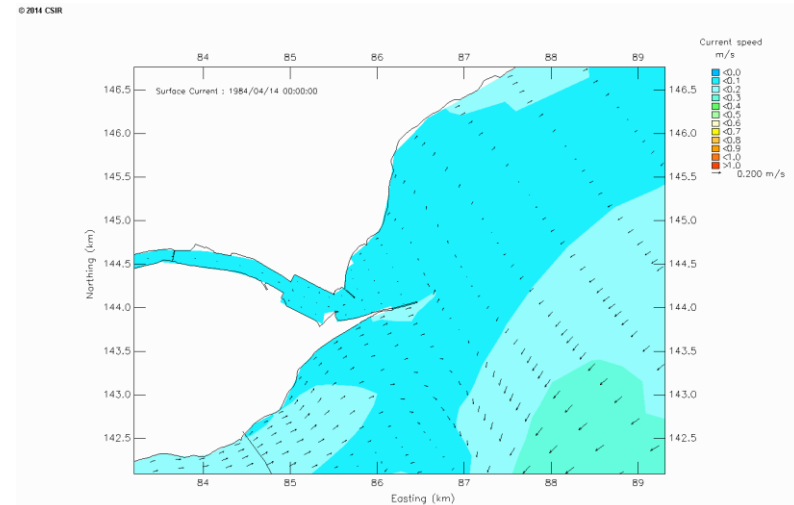


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# Numerical Modelling

## Mike 21 Boussinesq wave and flow

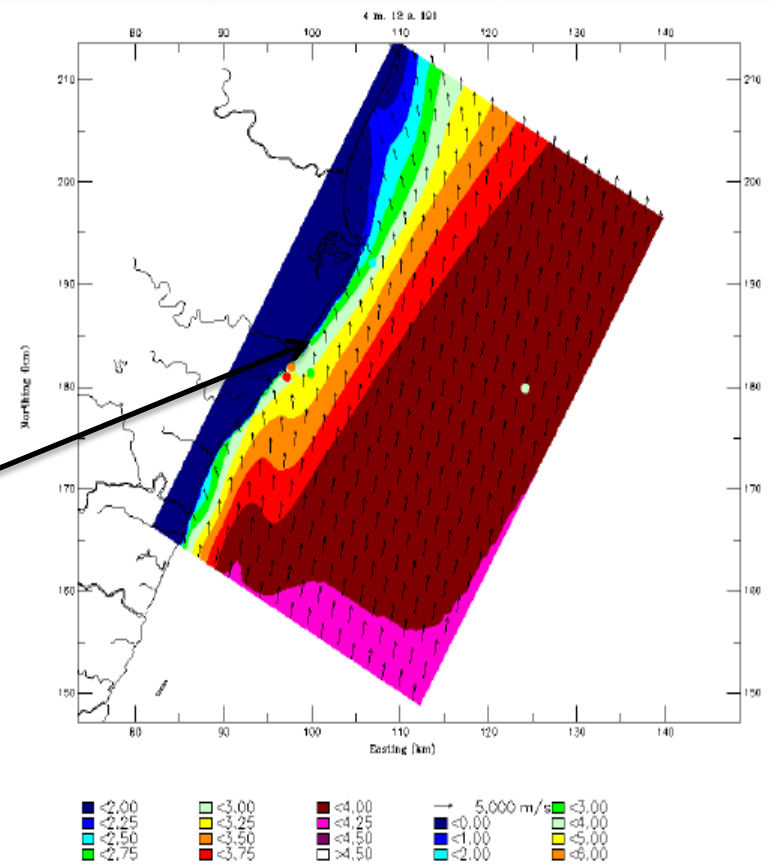


Port of East London Mike 21 BW Model Outputs



# Numerical Modelling Delft 3D-SWAN

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Proposed Durban Dig Out Port  
Long Waves Studies

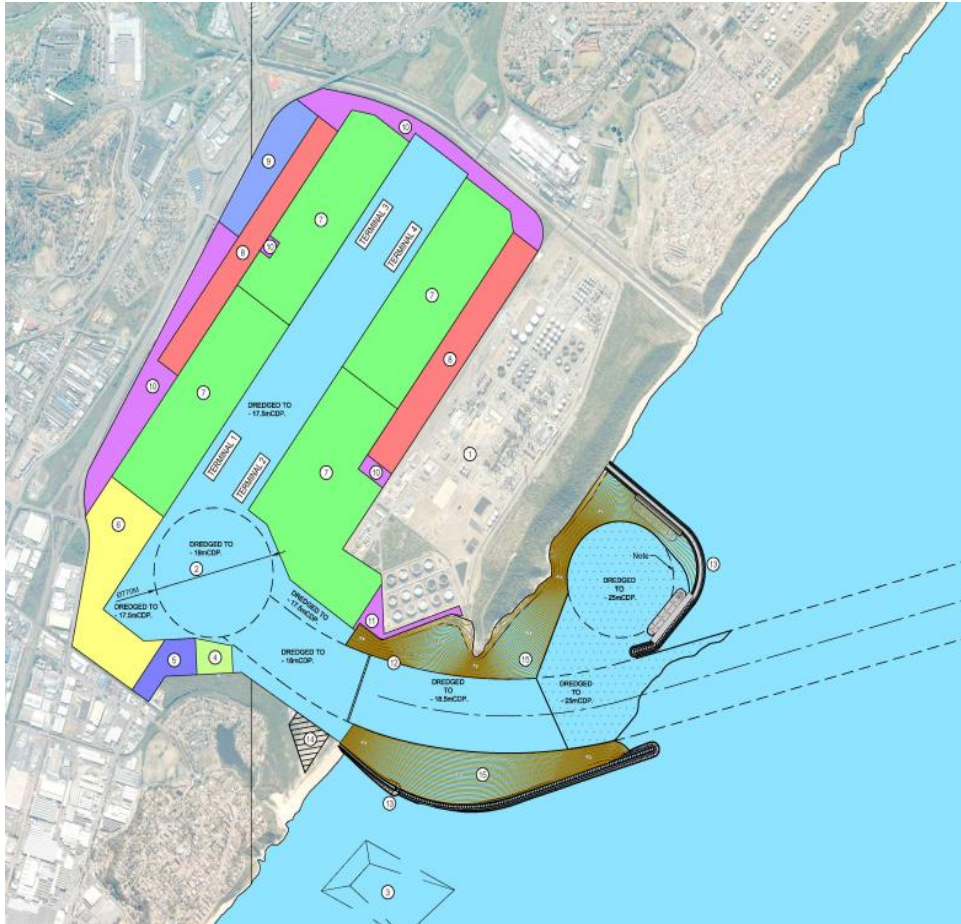
Swan Long  
Waves Output

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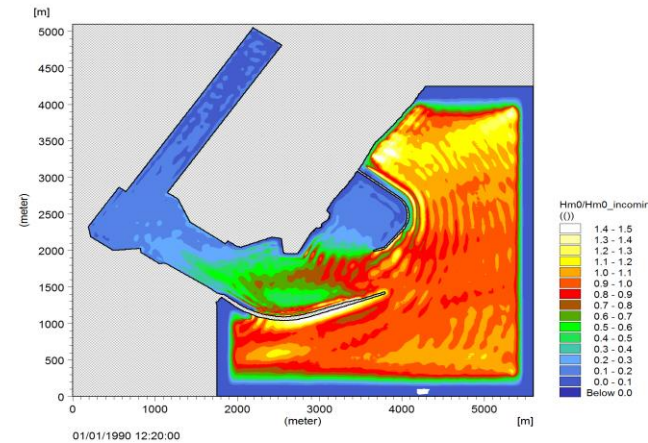
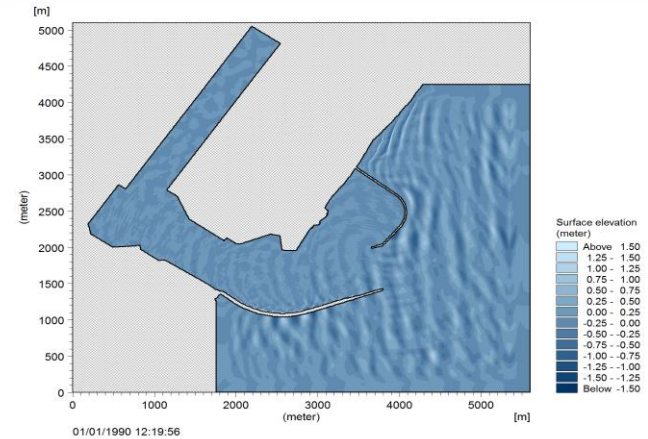
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# Numerical Modelling Mike 21 Boussinesq Wave (BW)

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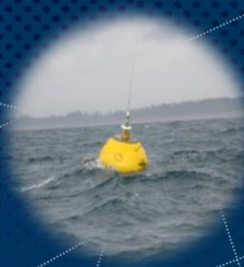
Durban DigOut Port Layout



Mike 21 BW Model  
Outputs

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# Thank you



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