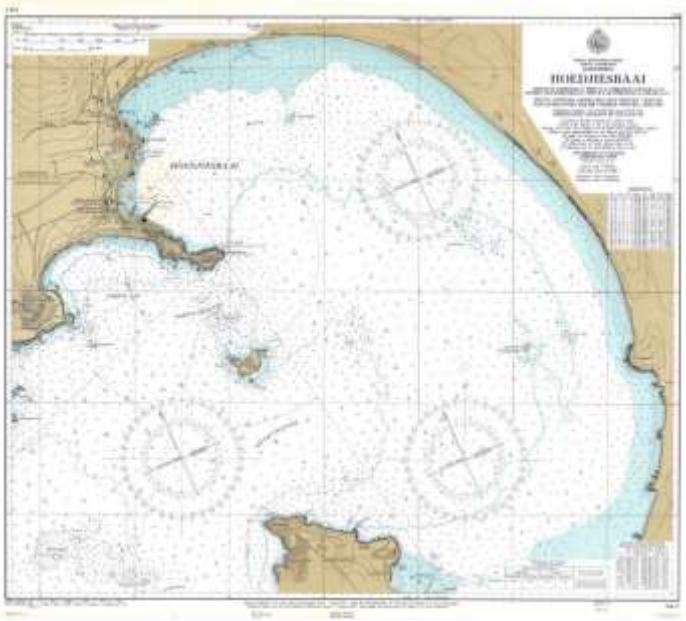
A Geophysical Review of Saldanha Bay and the Langebaan Lagoon

Saldanha Bay

Some Physical Facts

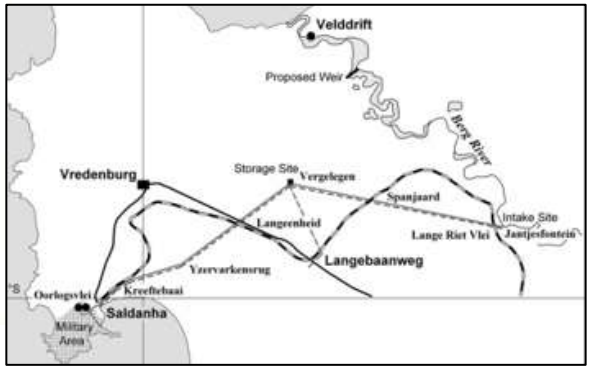
- The location and structure of Saldanha Bay and Langebaan Lagoon is unique.
- Saldanha Bay is the largest natural port in Africa.
- Lack of a river delta or inlet into Saldanha Bay is noteworthy.
- The potential of the Bay came to it's right during the Second World War and the region's development followed.

Harbour Defence



Naval Chart from 1955

Berg River-Saldanha water pipeline



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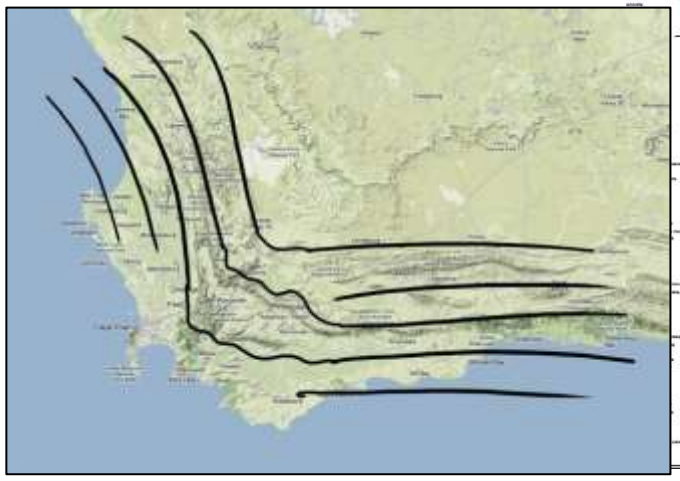
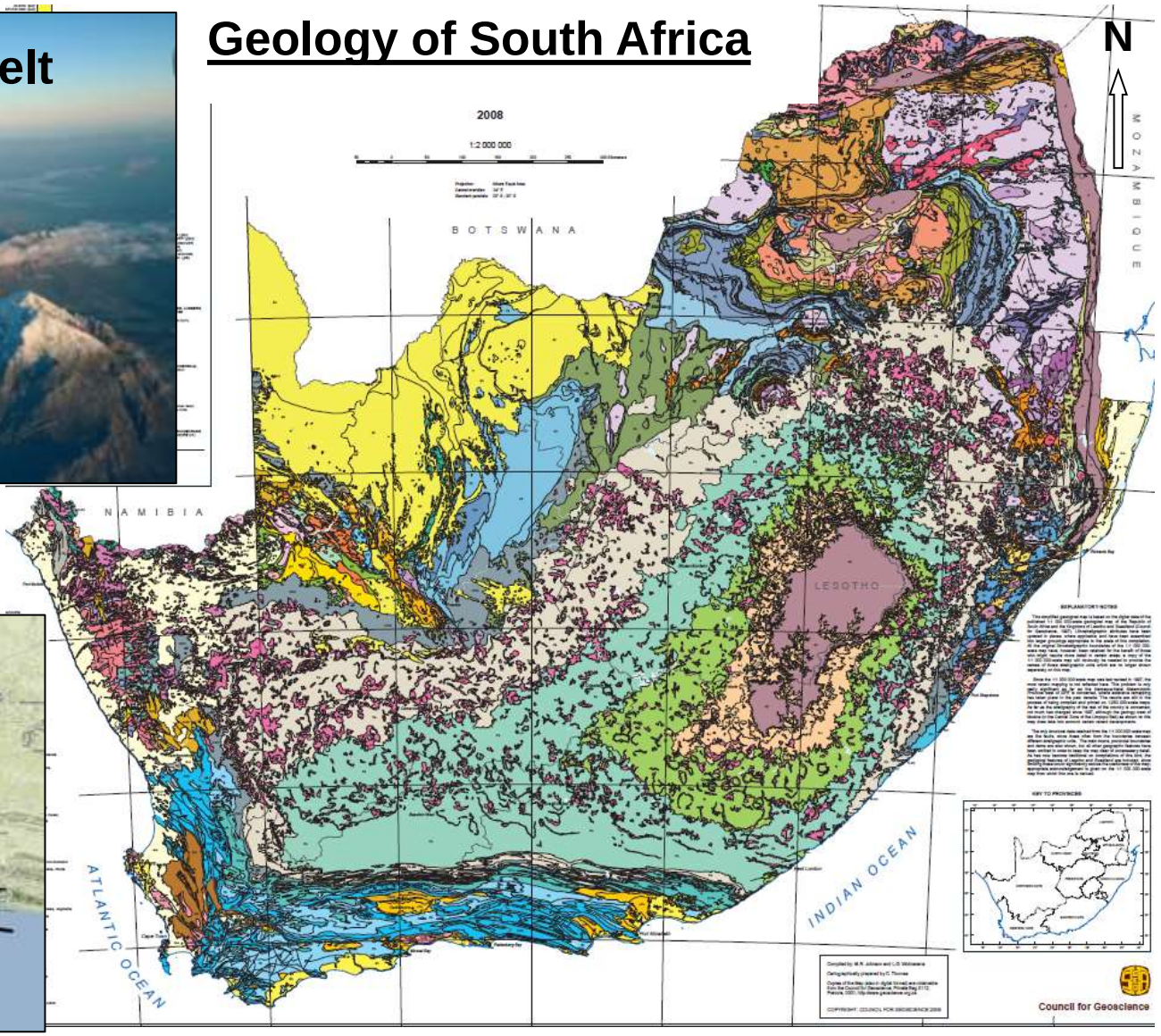
Geophysical History

The Cape Folded Belt

1300 km long fold-and-thrust mountain belt



Geology of South Africa



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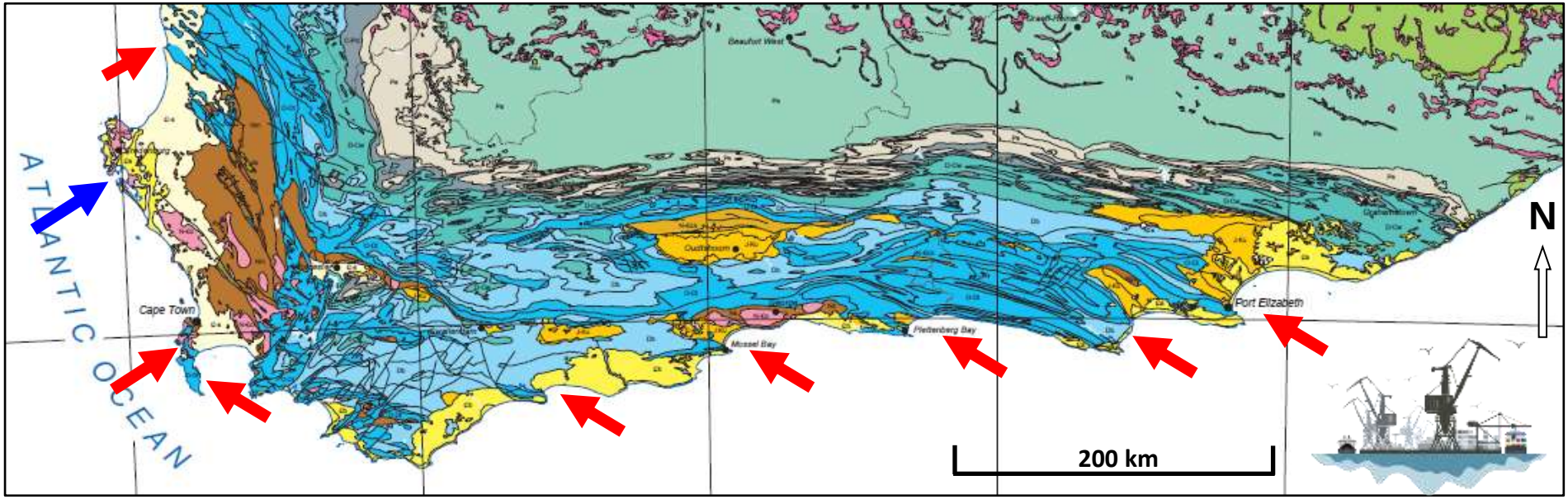
Geophysical History

The Cape Folded Belt (Sedimentary Rock)

Montague

The Point at Mossel Bay



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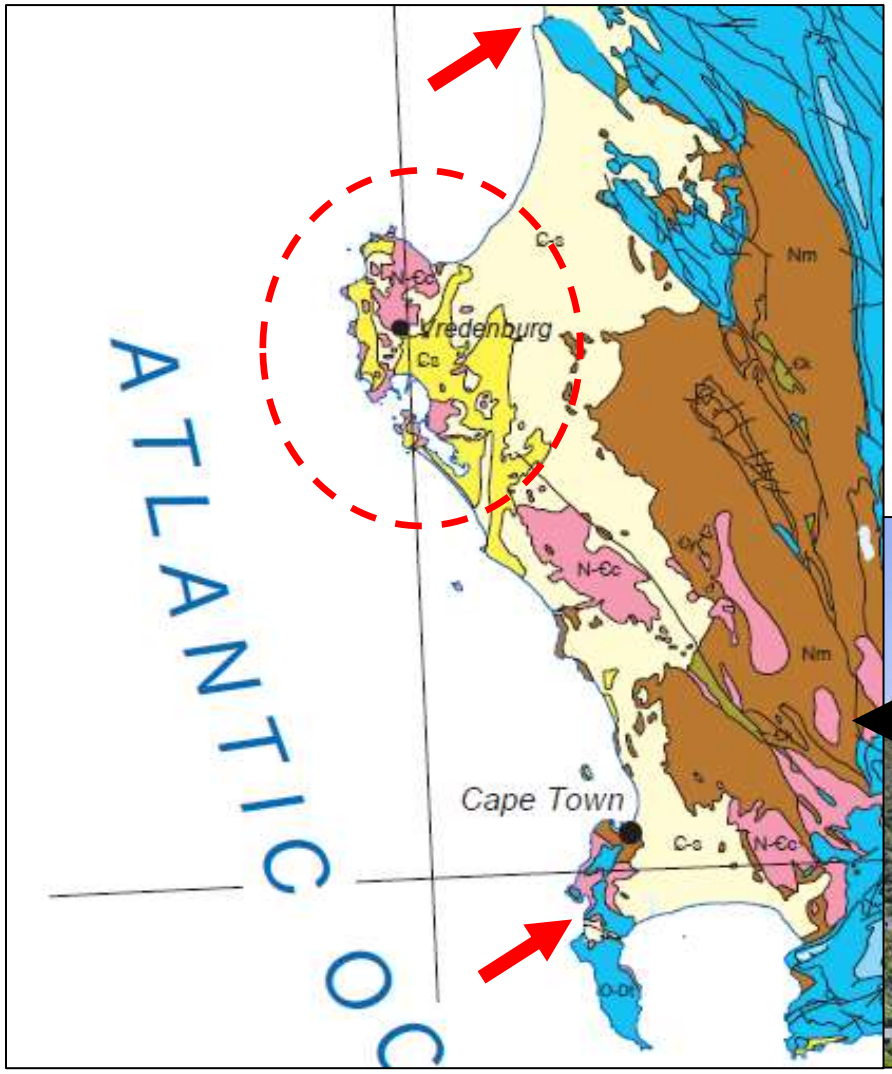
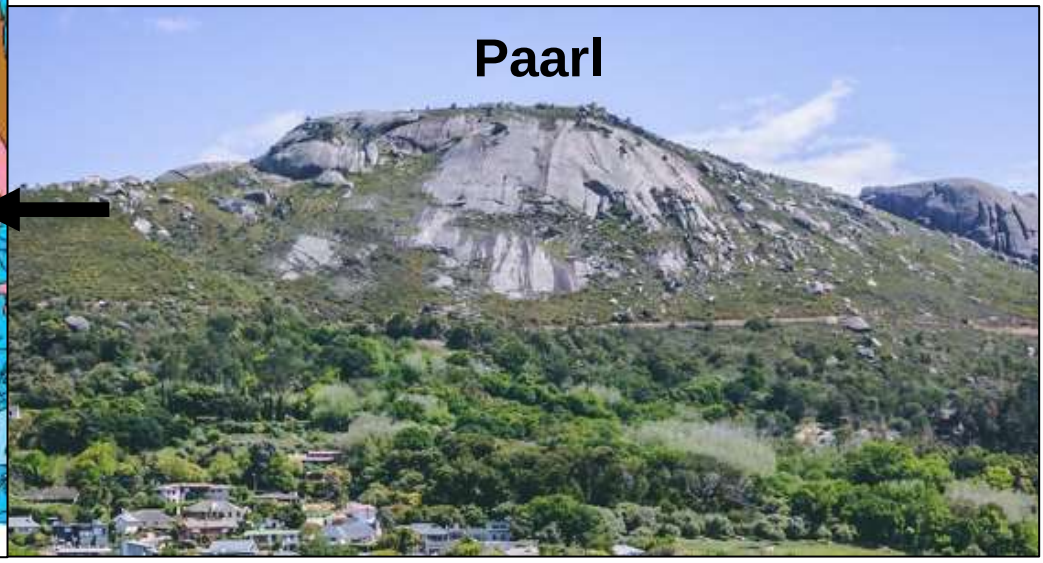
Geophysical History

The Cape Granite Suite contact with the Cape Folded Belt





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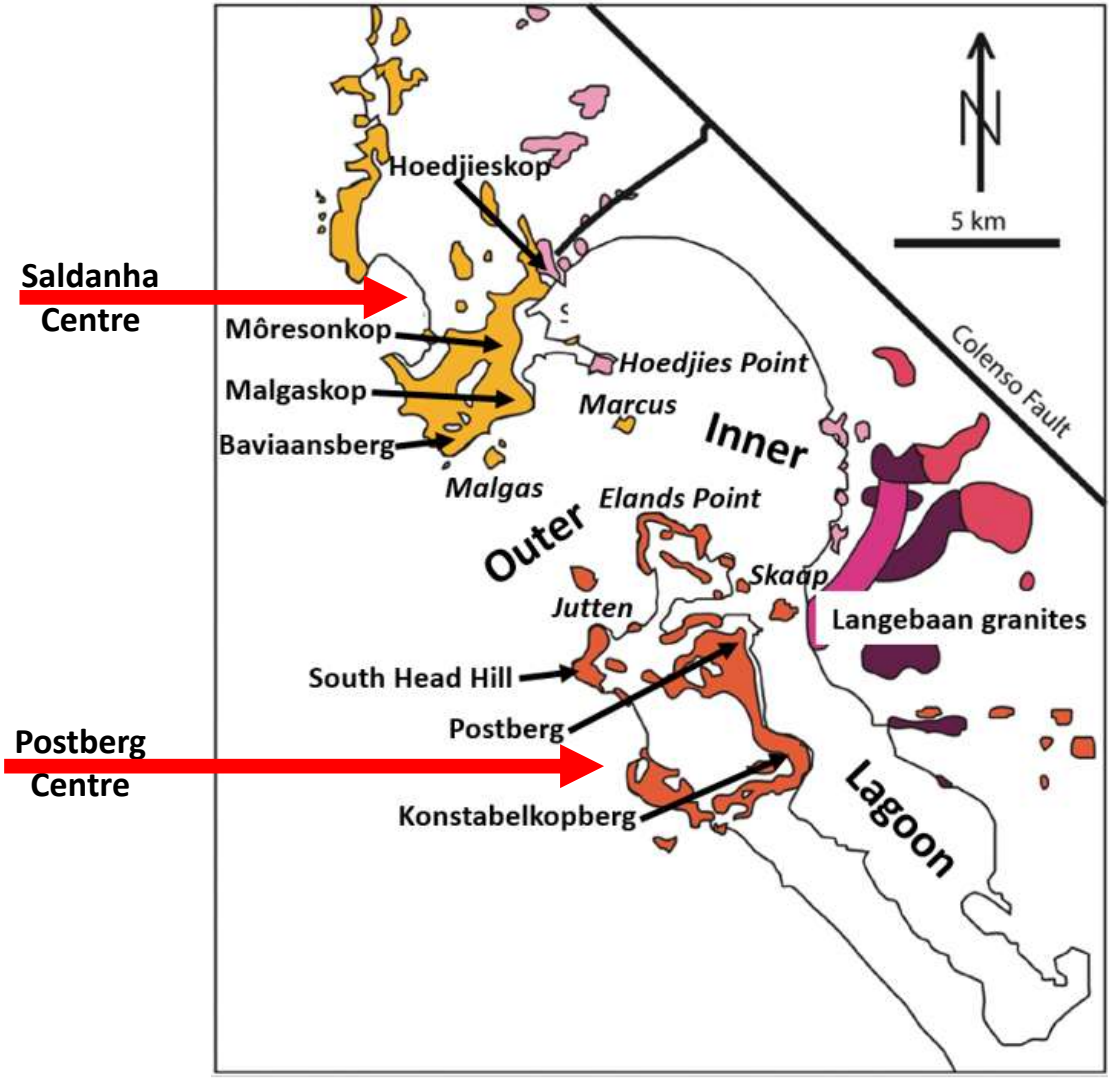
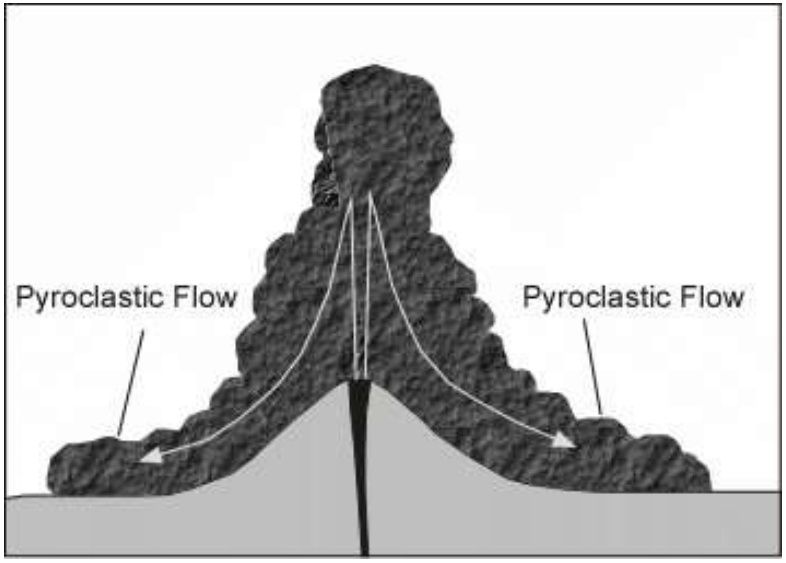
Geophysical History

A Geological Map of the Saldanha Bay Area



Pyroclastic origins of ignimbrites



- Saldanha and Jacobs Bay Ignimbrites
- Plankiesbaai and Tsaarsbank Ignimbrites
- Langebaan "granite porphyry"
- Trekoskraal granite
- Seeberg granite
- Hoedjiespunt granite

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Geophysical (Recent)

Typical Features of the Saldanha Bay

- The area around Saldanha Bay consists mainly of unconsolidated coastal and marine sediment.
- The sand dunes are of aeolian origin and mostly capped by calcrete layers.
- The underlaying bedrock is granite.

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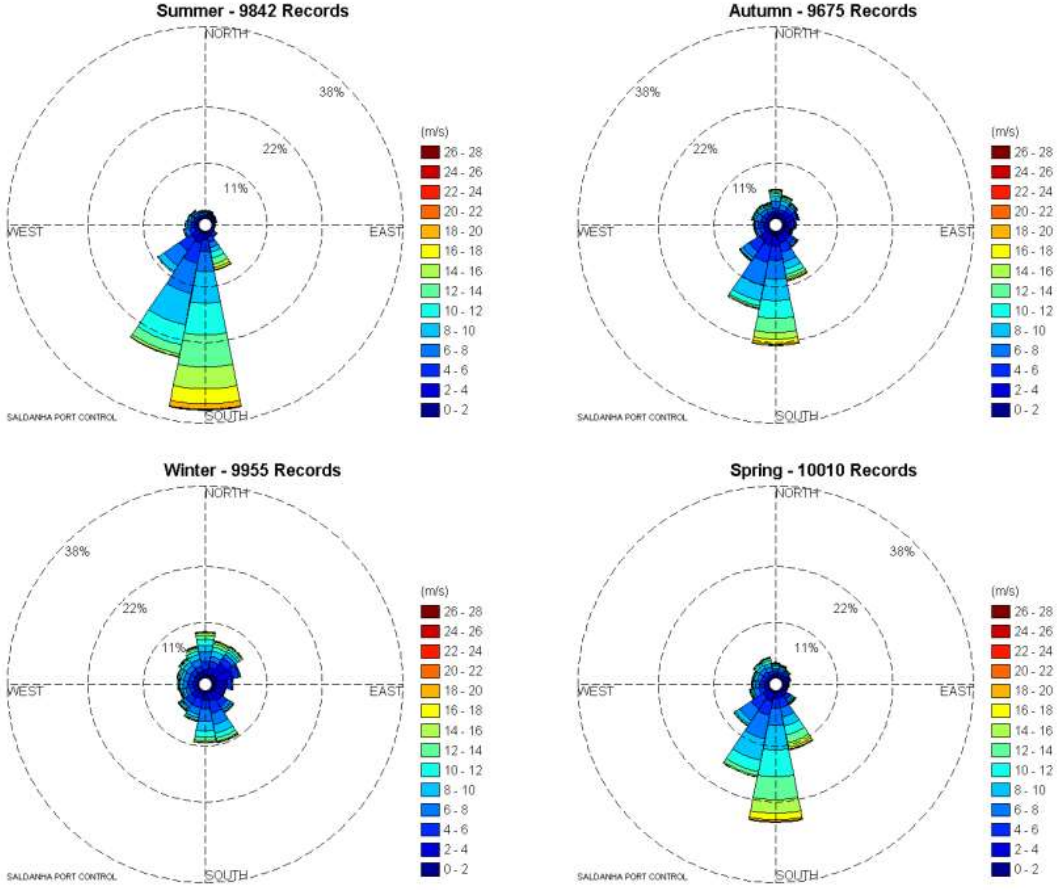
Geophysical (Recent)

Wind Action in Saldanha Bay

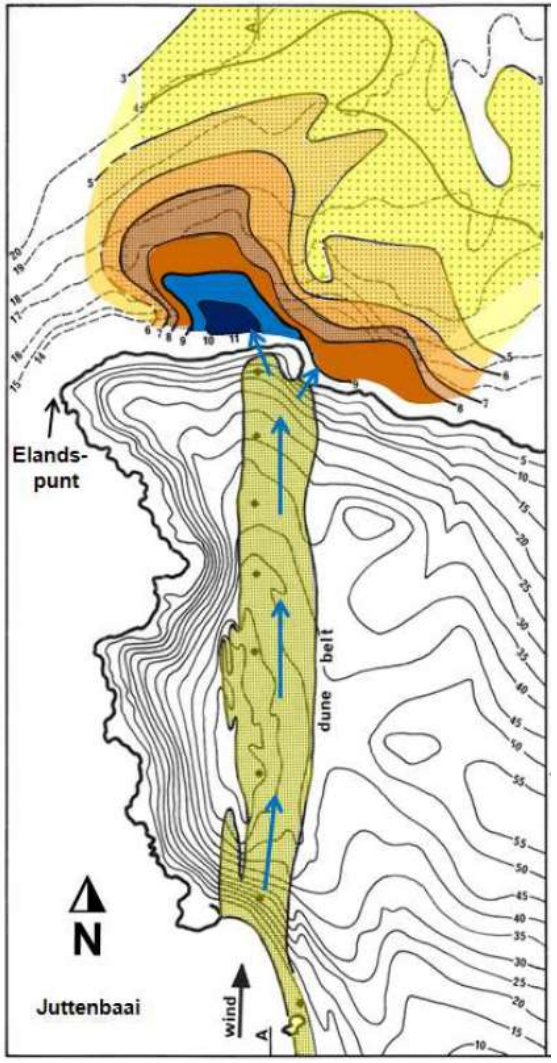
Wind Roses (Saldanha Port Control)



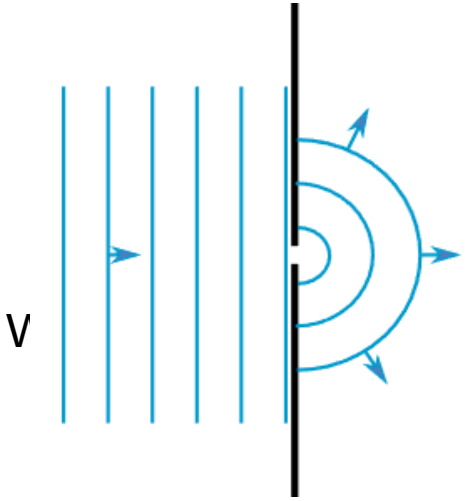
Geophysical (Recent)

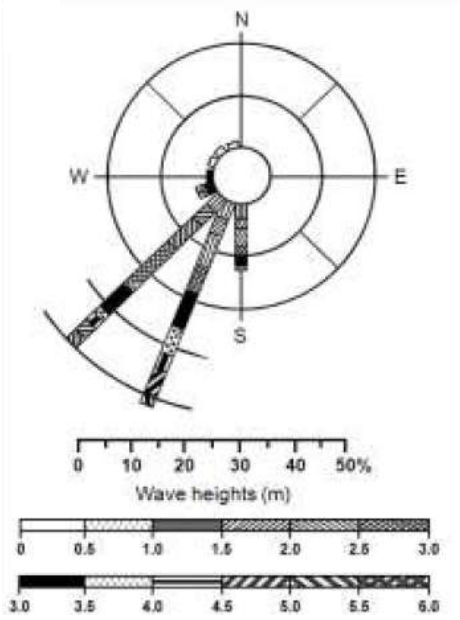
Wind Action in Saldanha Bay

Sediment transport across Donkergat peninsula



Geophysical (Recent)





Wave Action in Saldanha Bay

Google Earth image showing the Wave Diffraction

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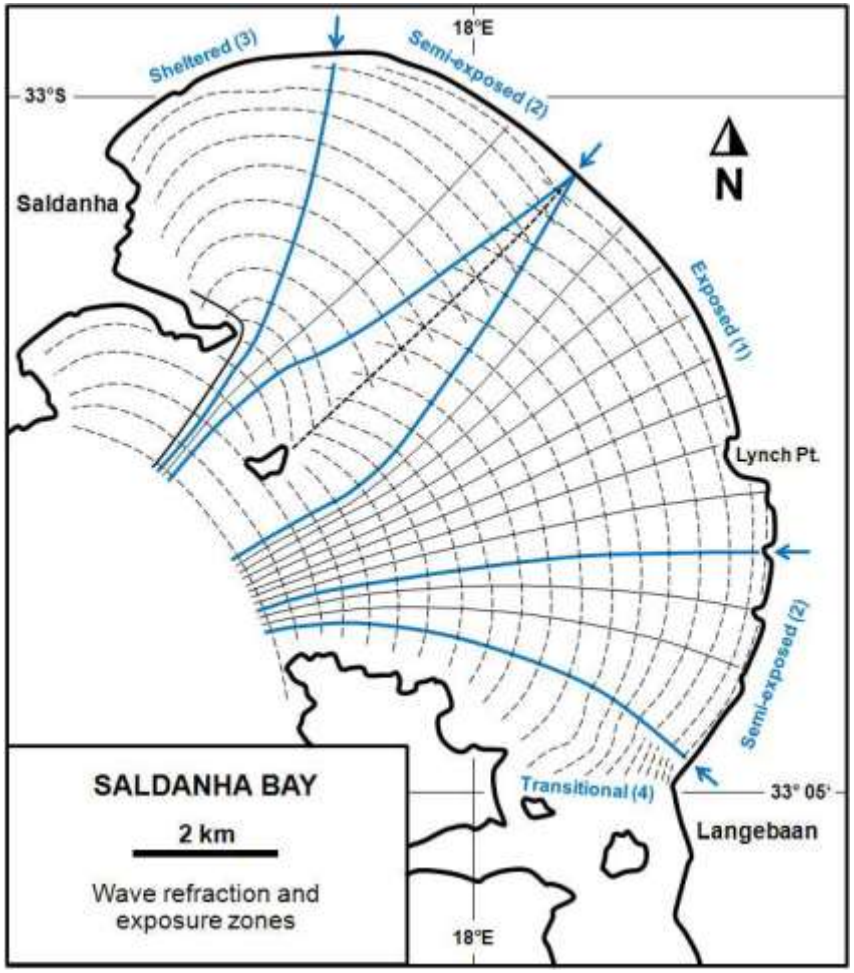
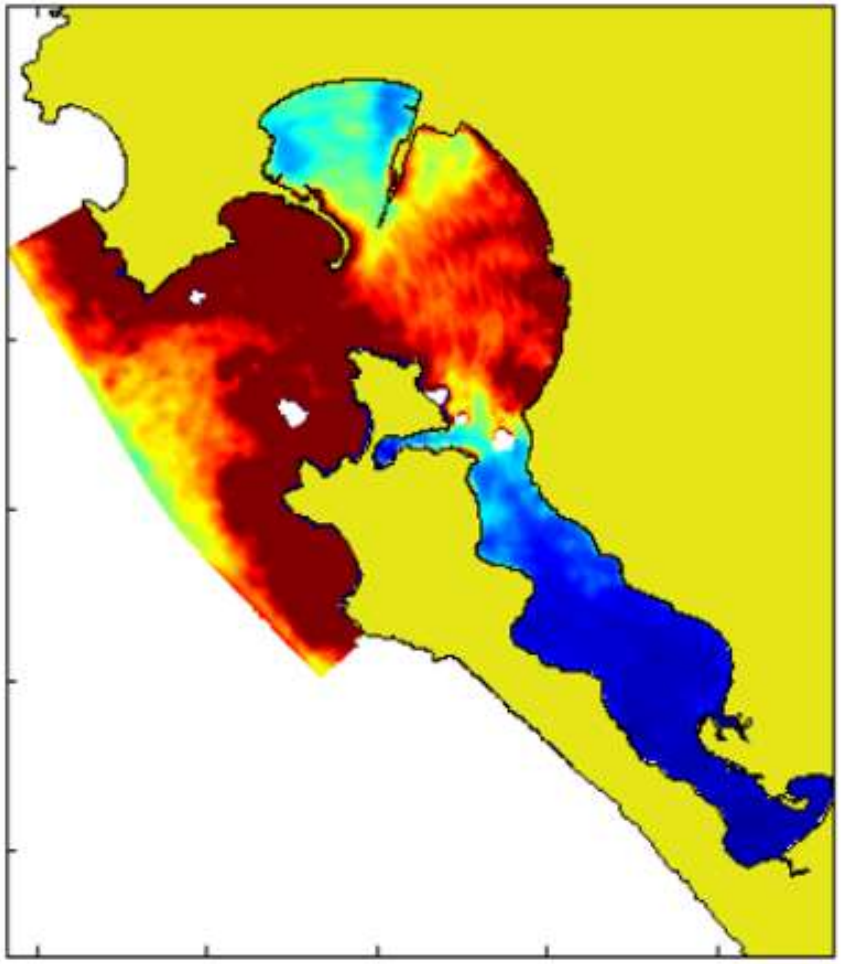
Geophysical (Recent)

Wave refraction and exposure zones in Saldanha Bay

Flemming (1977)



CSIR Model for long wave height

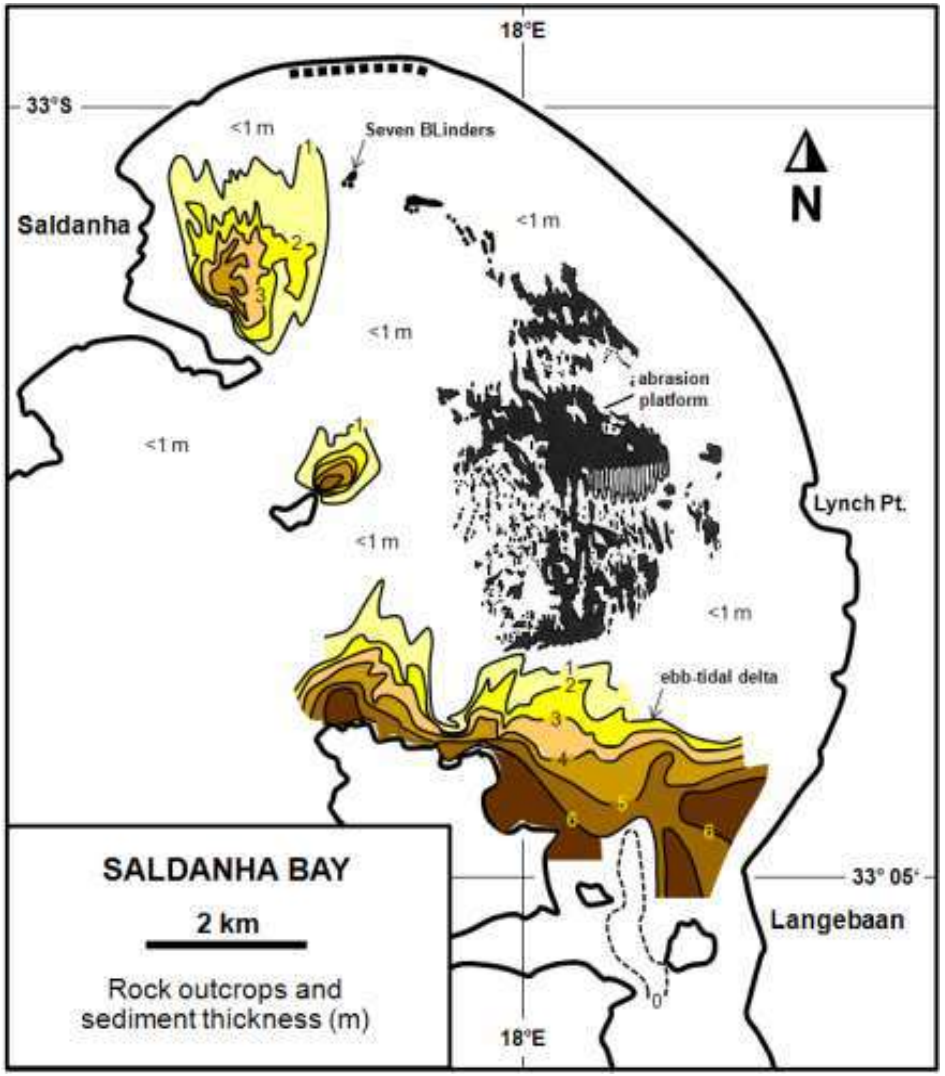


Geophysical (Recent)

Rock outcrops and thickness of unconsolidated sediments (1977)

Abrasion Platform

- With the exception of a few known granite outcrops, e.g. Lynch Blinder, Inner Lynch and Seven Blinders, the whole platform consists of exposed calcrete.



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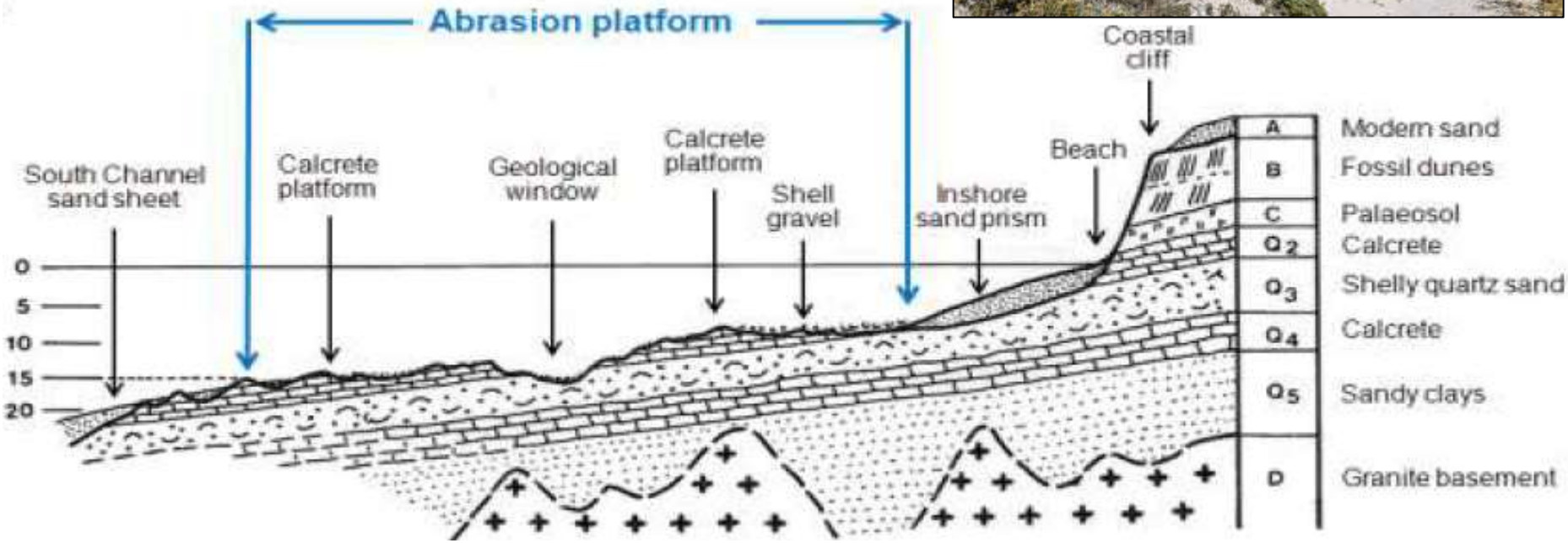
Geophysical (Recent)

Geological EW-profile



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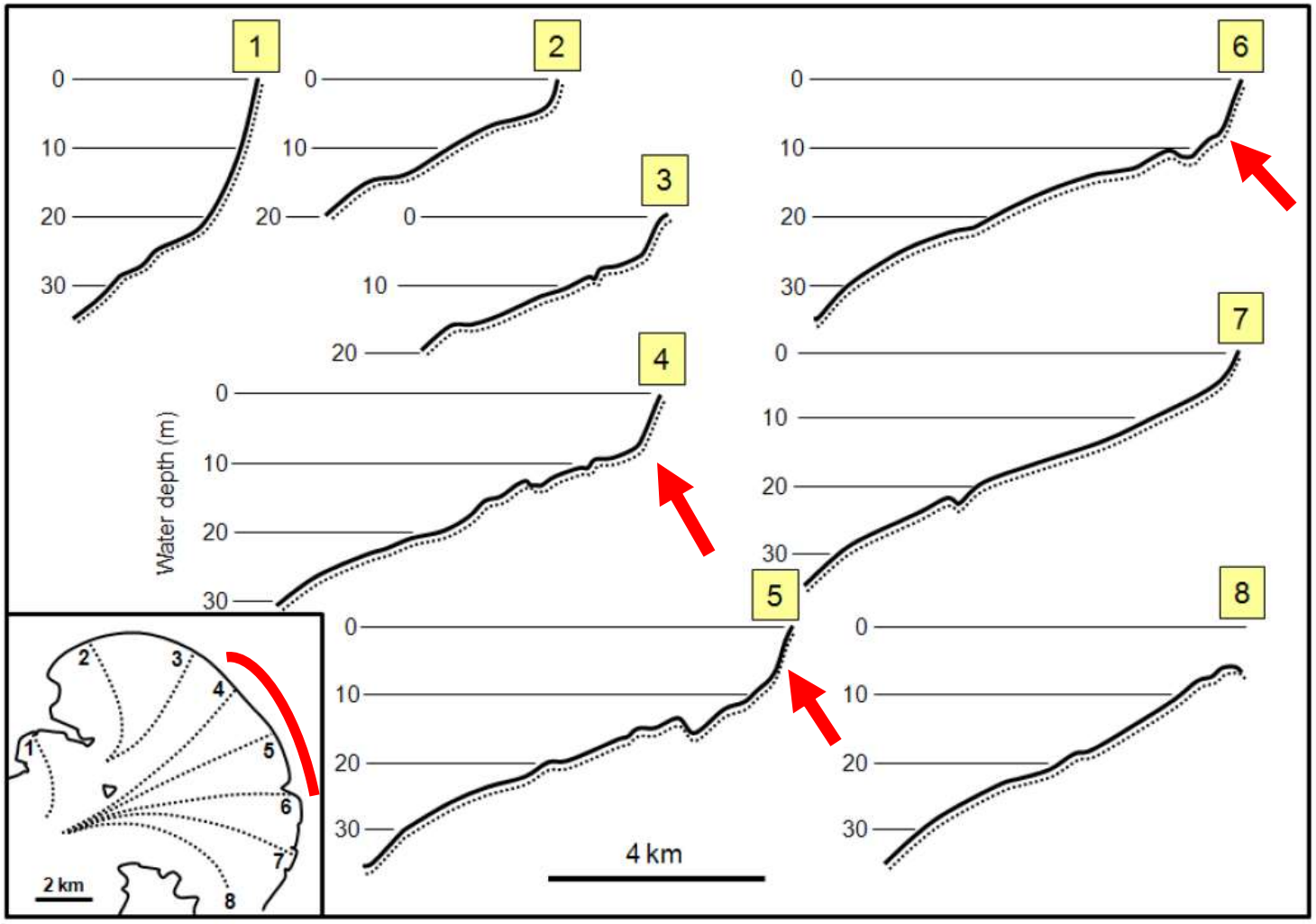
Geophysical (Recent)

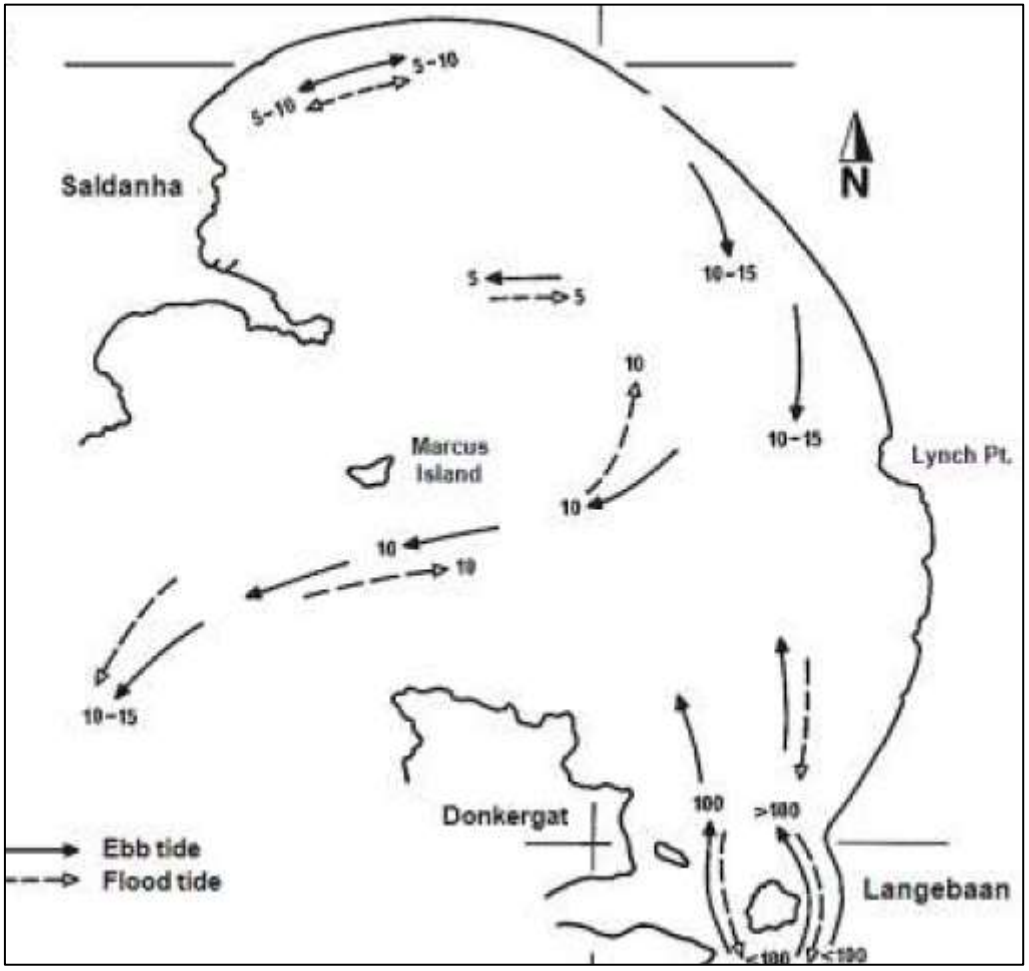
Bathymetric profiles from the shore into deeper water (1977)



Geophysical (Recent)

Tidal current strength (cm s^{-1})

- Sedimentation processes in Saldanha Bay is dominated by waves.
- Sedimentary processes in Langebaan Lagoon are controlled by tidal currents.

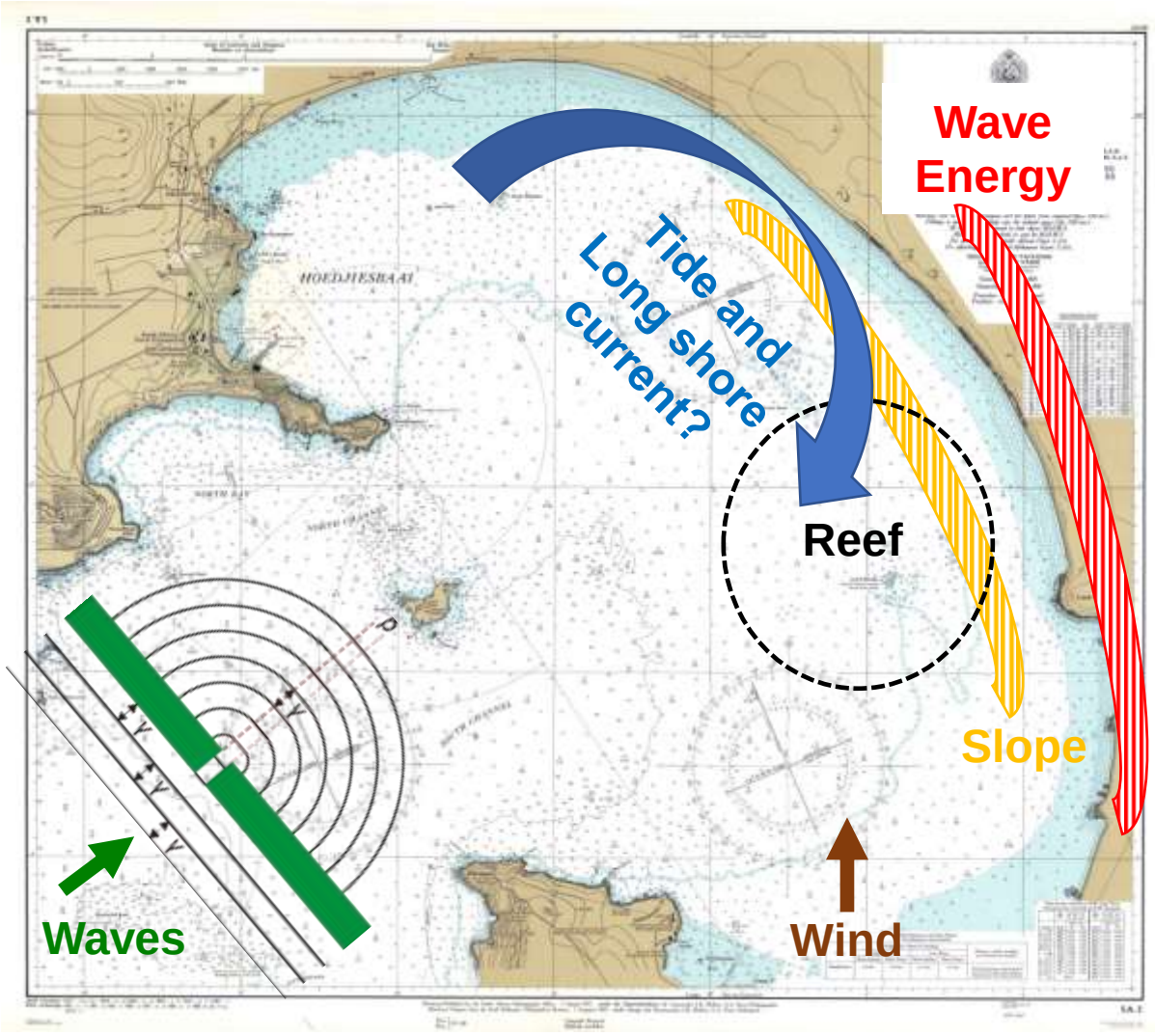


Development

Saldanha Bay Harbour Construction (1973 - 1976)

Model

- A hydraulic model of Saldanha Bay was built by measuring wave heights, directions and periods at different stations.
- The optimal harbour lay-out was determined.
- The plan was to first completed the breakwater between Hoedjies Point and Marcus Island and then the stockpile area, causeway and ore loading jetty. The breakwater required 20 million m^3 of sand.

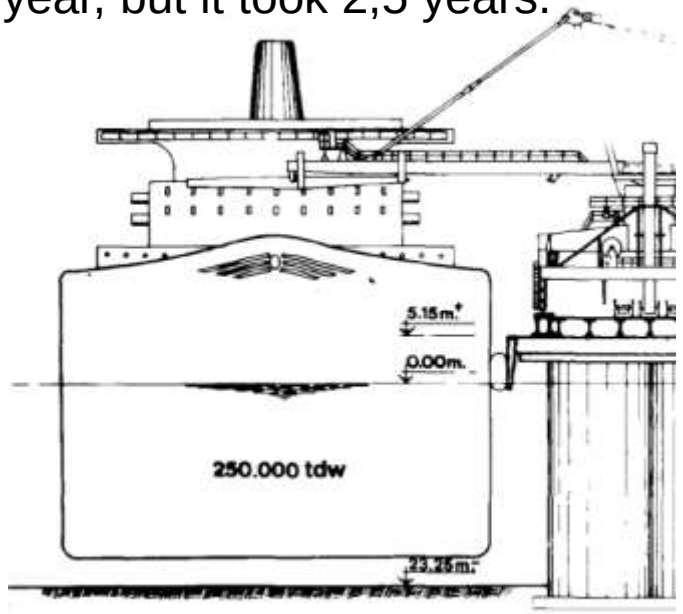


Development

Saldanha Bay Harbour Construction (1973 - 1976)

Construction Phase

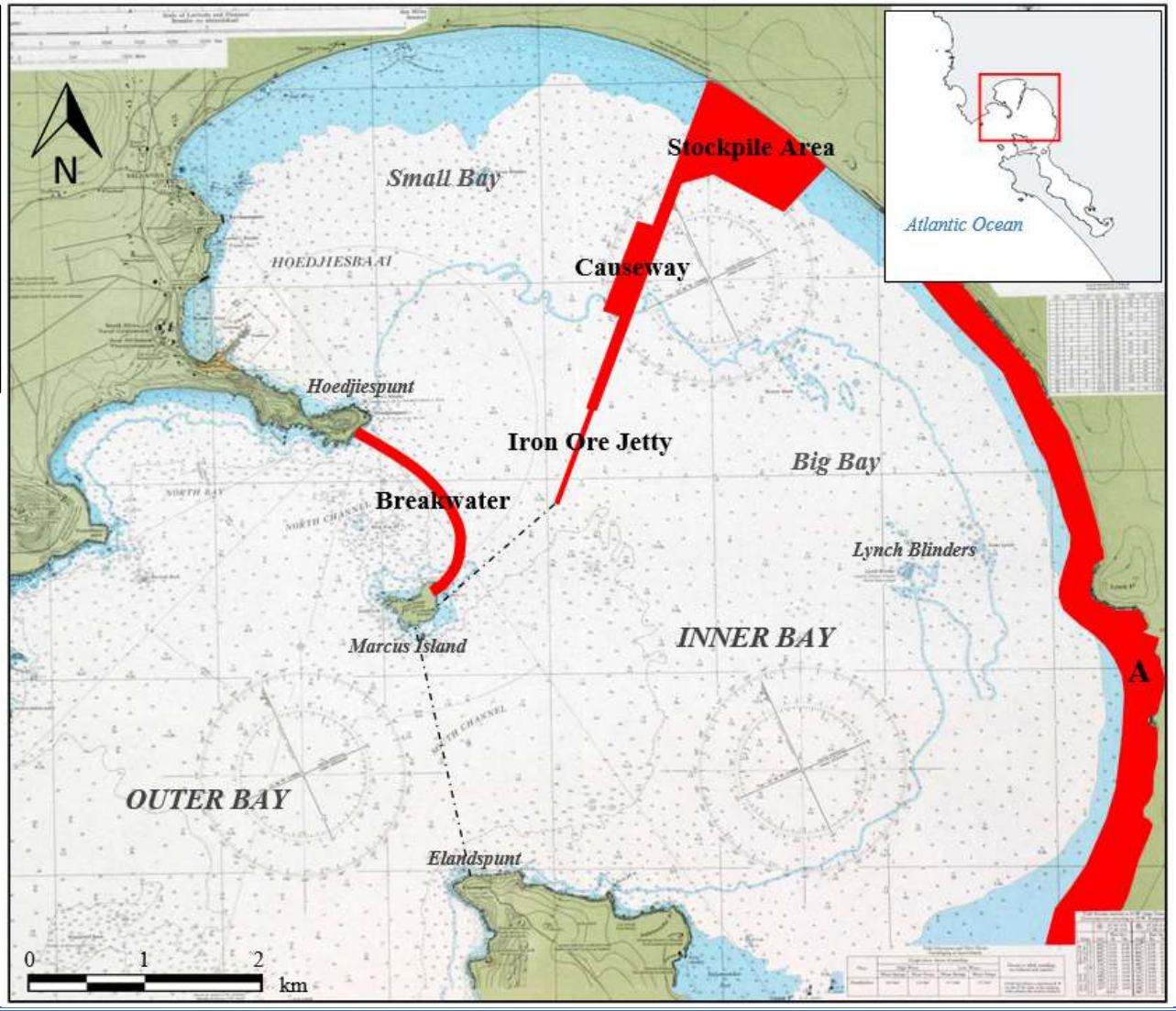
- Most of the fill had to be obtained from the dredging of subsoil that consists of loose and compacted sands on top of and in between layers of calcareous material.
- The estimated rate of dredging was far too optimistic because of a high lime content in the sediment (cemented).
- The breakwater was planned to be constructed in one year, but it took 2,5 years.
- The building of causeway, stockpile area and part of the ore loading jetty consequently had to take place in open sea conditions. Stockpiling of sand was done in the lee of Hoedjies Point.
- The first ship to be loaded, the Fernsea arrived in Saldanha on 23 September 1976.
- Multipurpose Cargo and Crude Oil loading followed.



Cross-section of the ore loading jetty, Saldanha Bay

Development

Saldanha Bay Harbour Construction (1973 - 1976)



Sediment needed

- Breakwater, Stockpile and Course Way - ***29 million m³***

Sediment dredged:

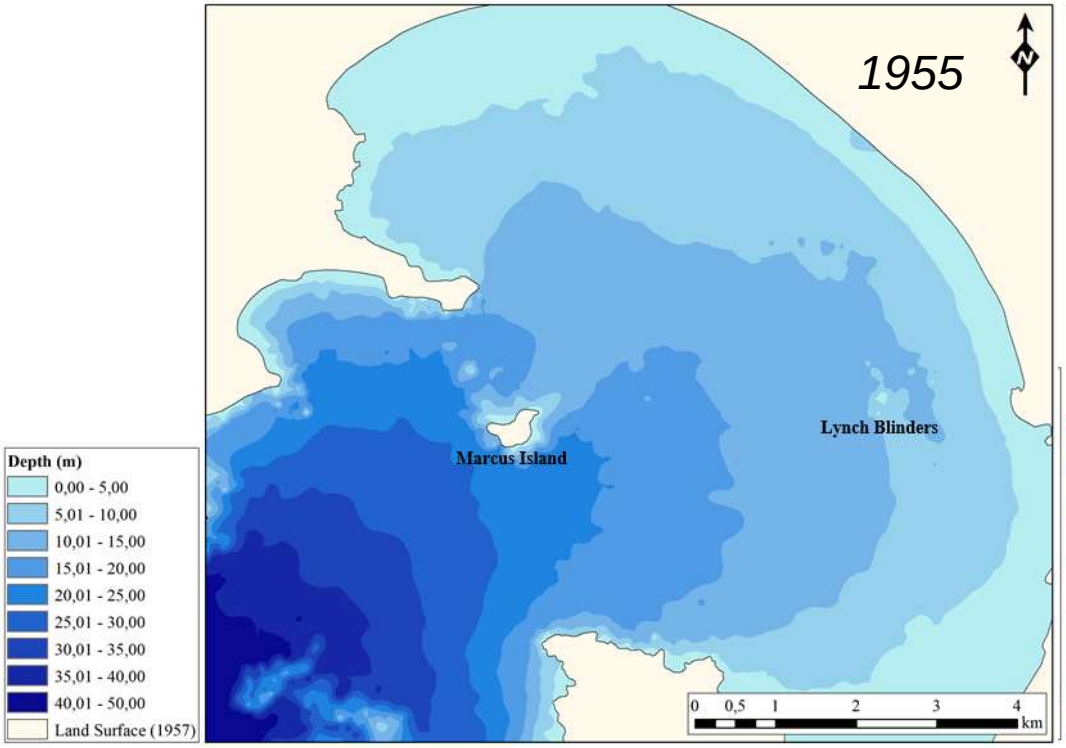
- Shipping Channel - ***9 million m³***

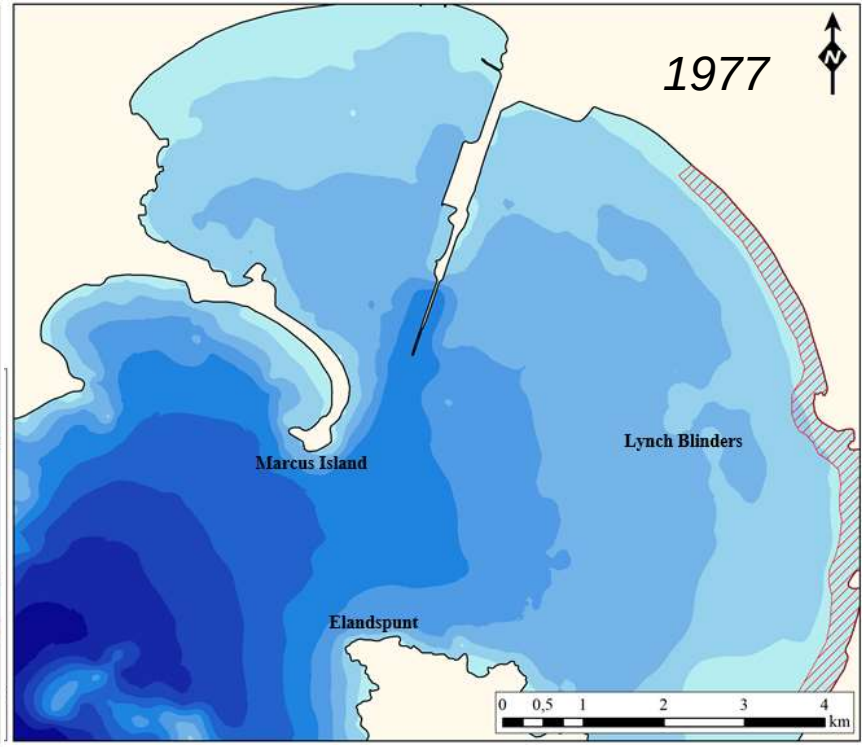
Sediment Deficit:

- Dredged elsewhere in the Bay - ***21 million m³***

Physical Impact

Bathymetry Maps before (1955) and after (1977) the Harbour Development





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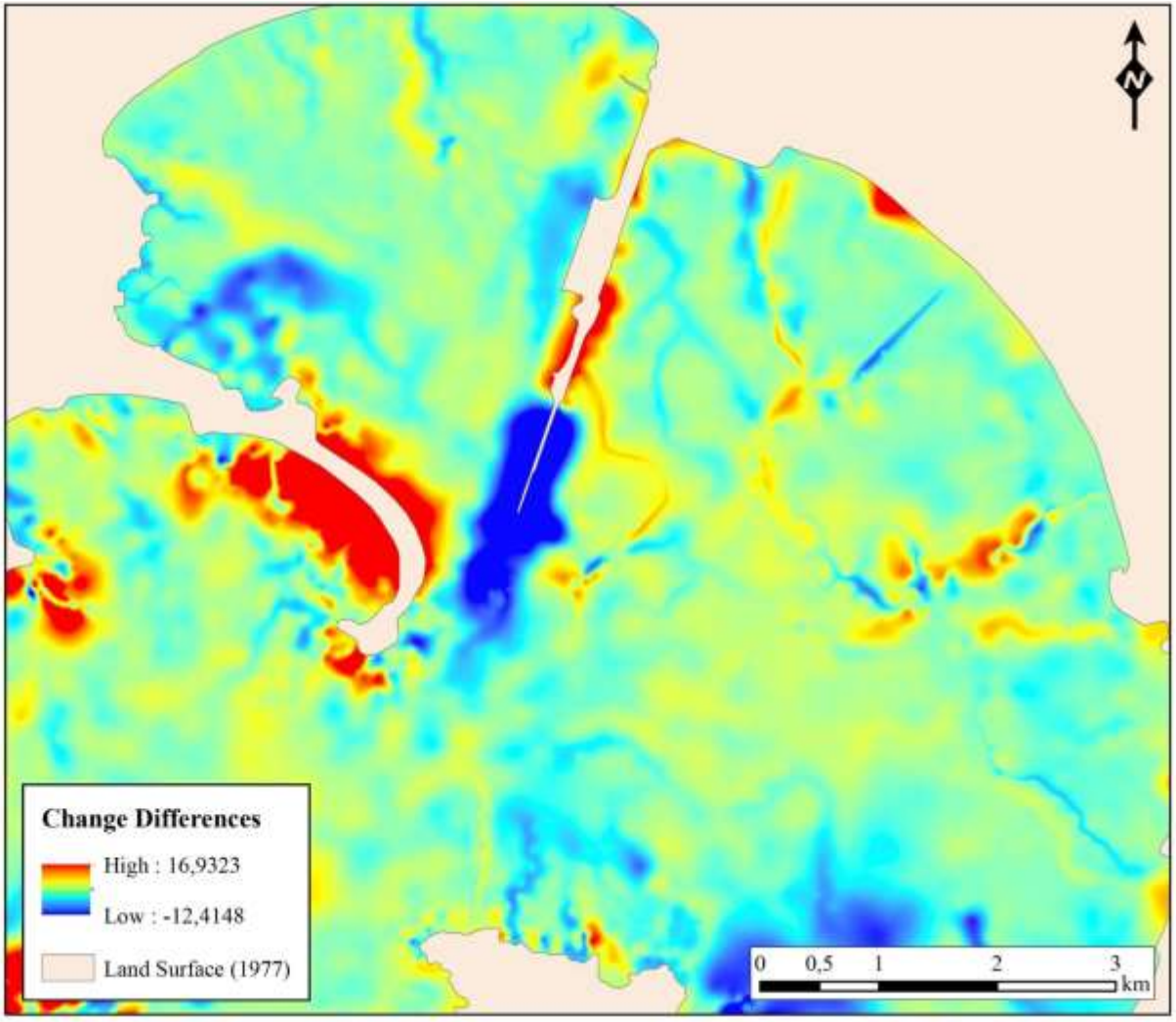
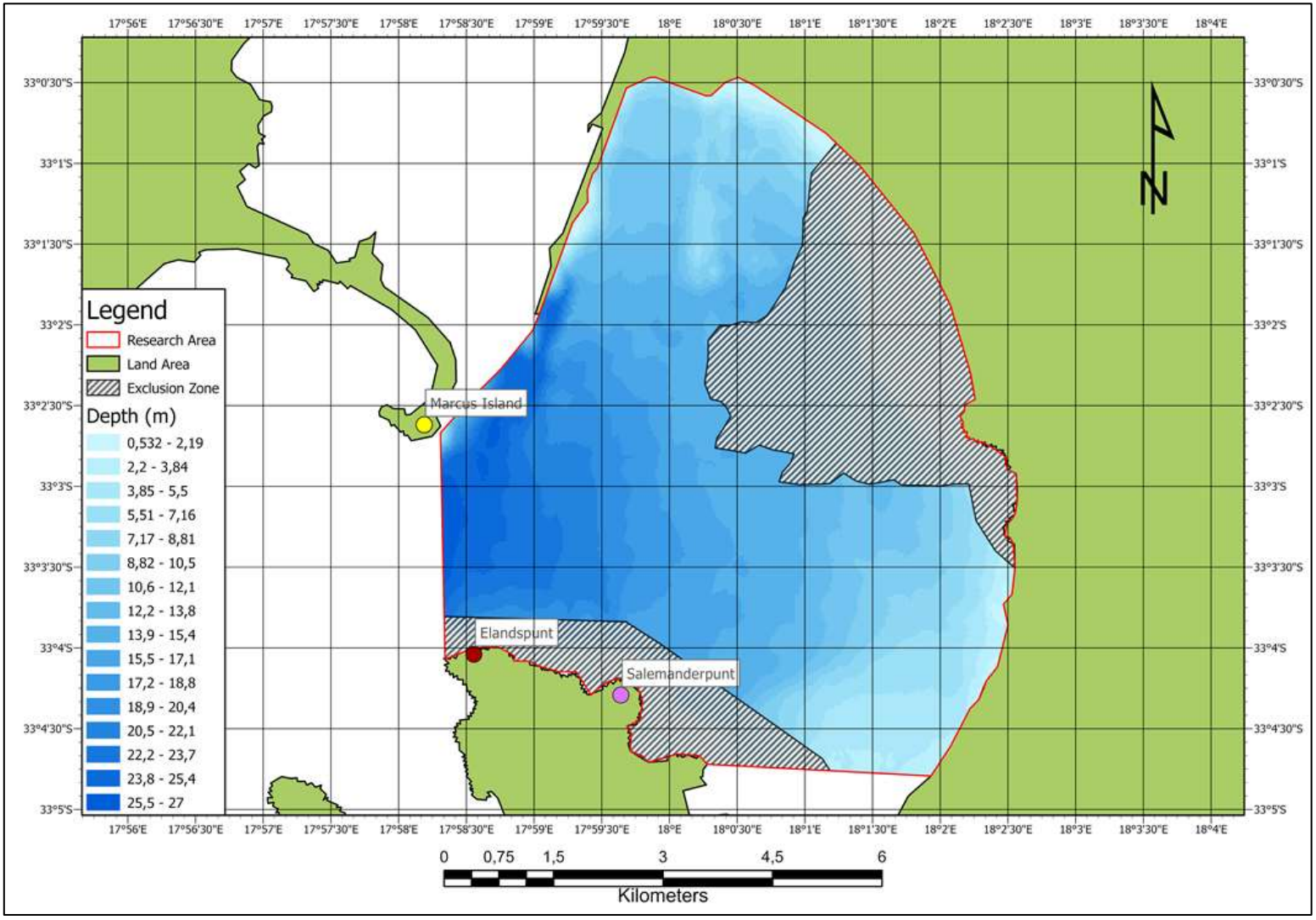
Physical Impact

A map showing the change in depth between 1955 and 1977



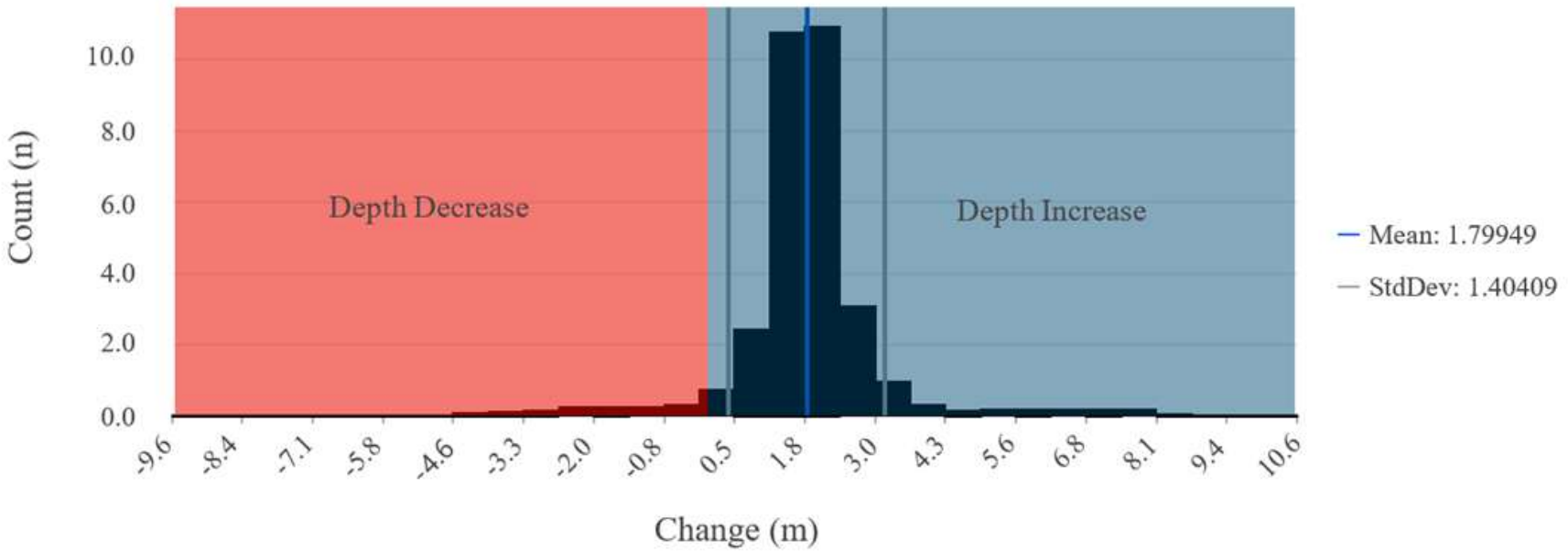
Physical Impact

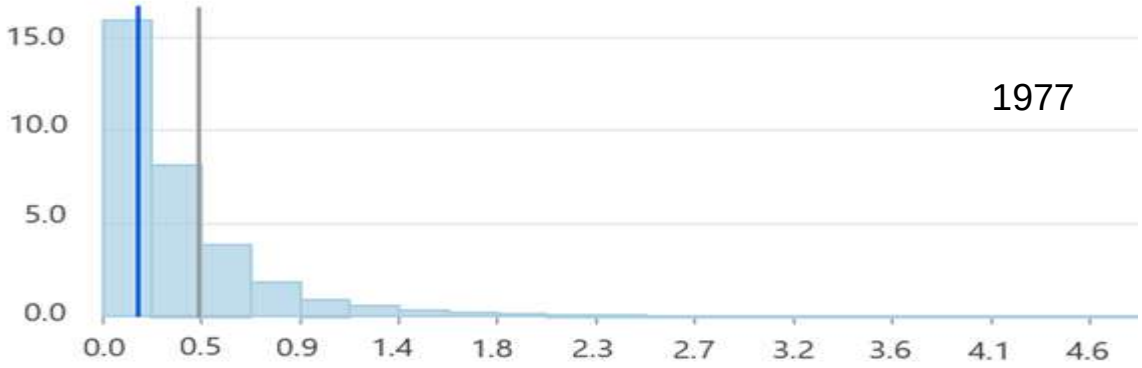
A map illustrating the 2021 survey area and bathymetry

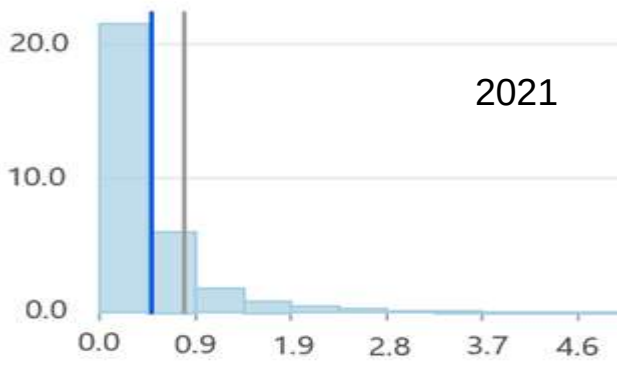


Physical Impact

Histograms of the change in bathymetry between 1977 and 2021

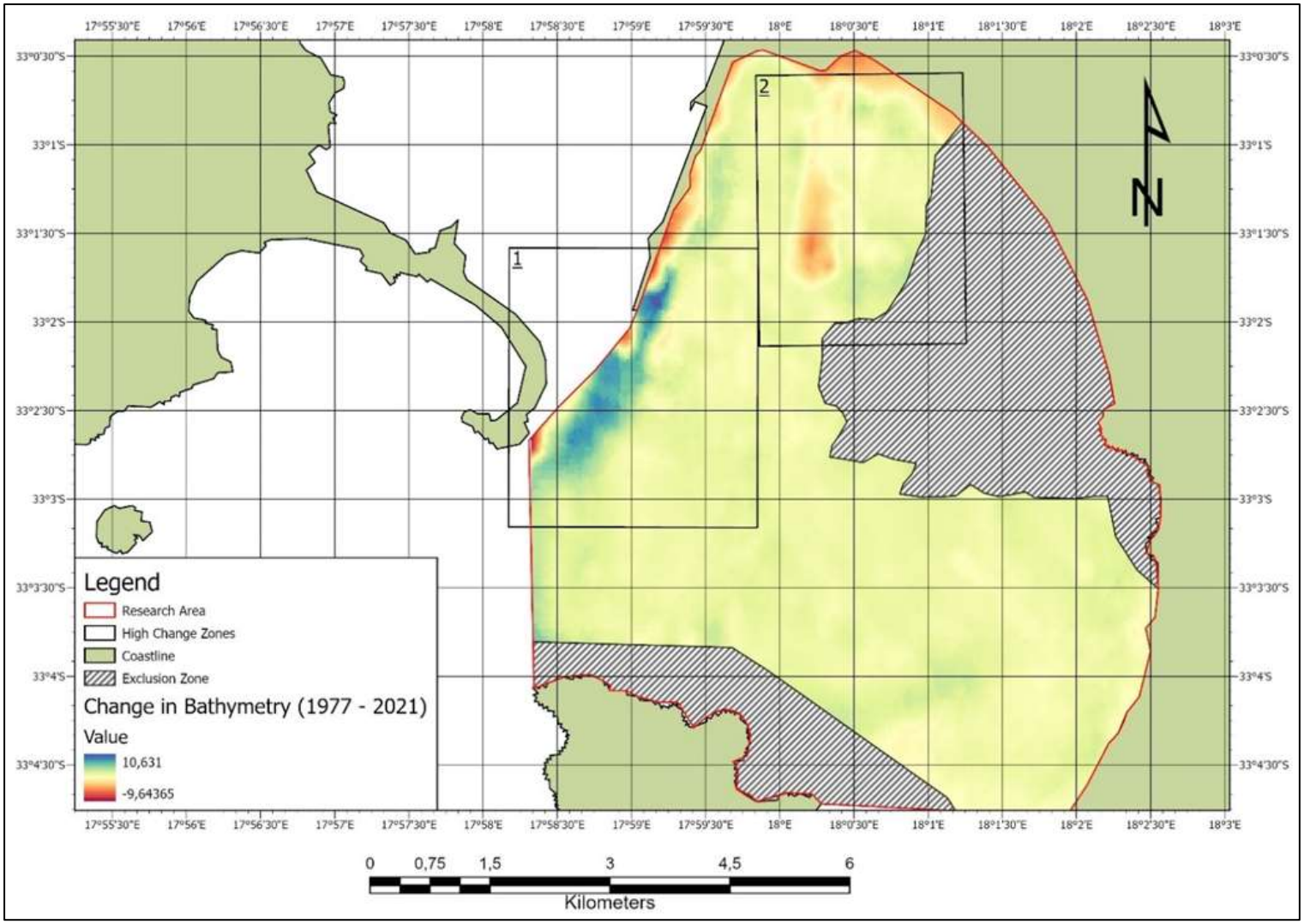






Physical Impact

A map illustrating change in bathymetry between 1977 and 2021



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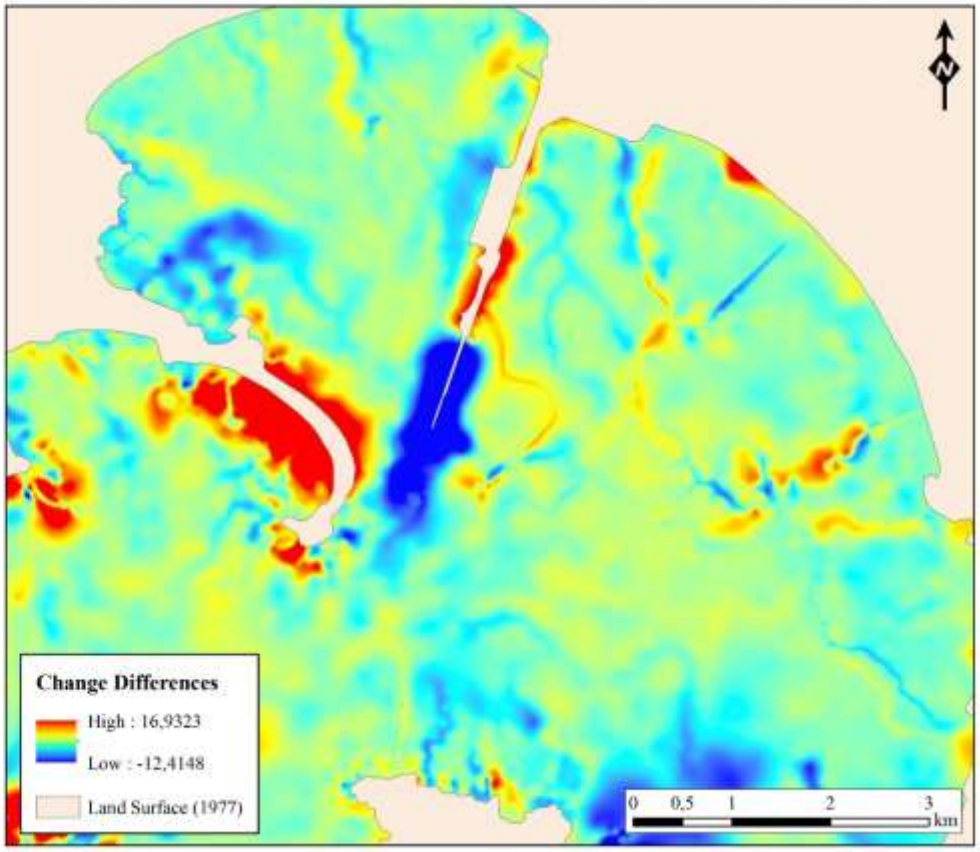
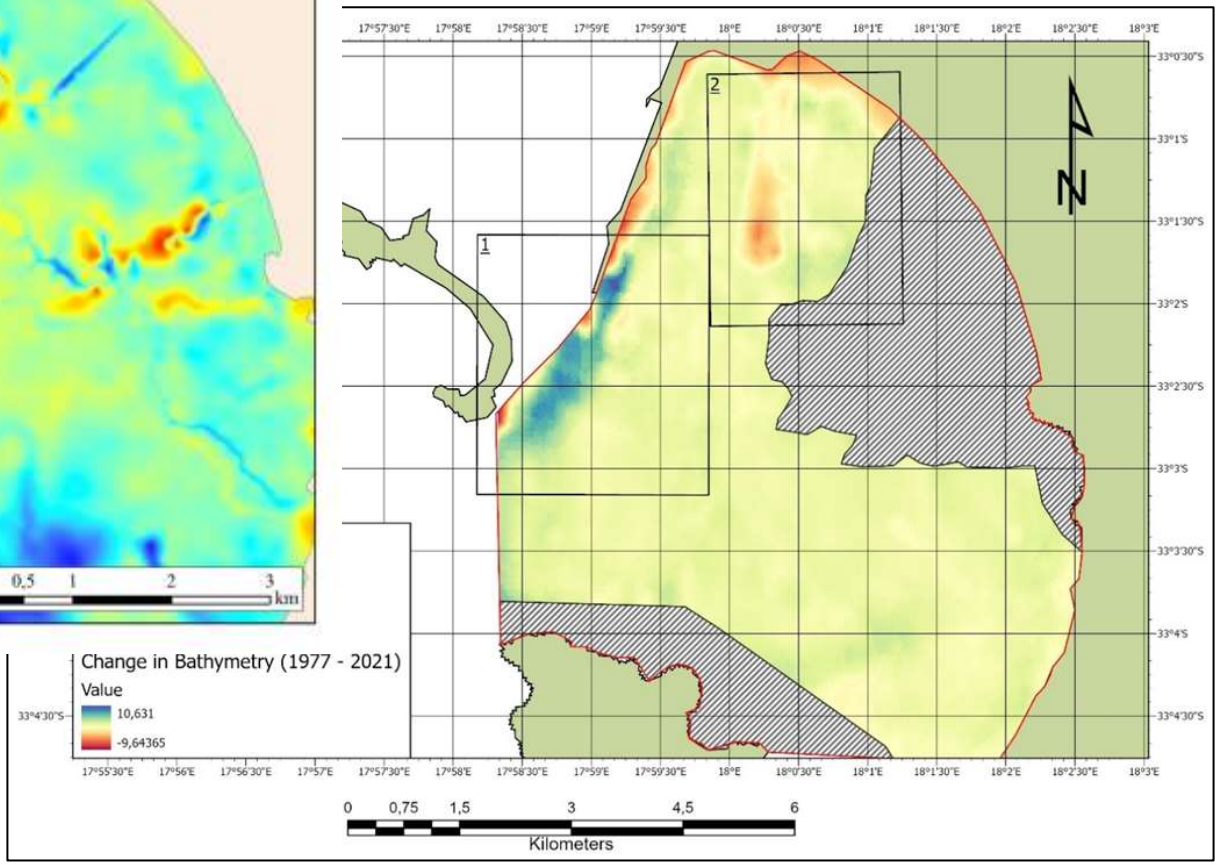
Physical Impact

Changes in bathymetry between 1955 to 1977 and 1977 to 2021





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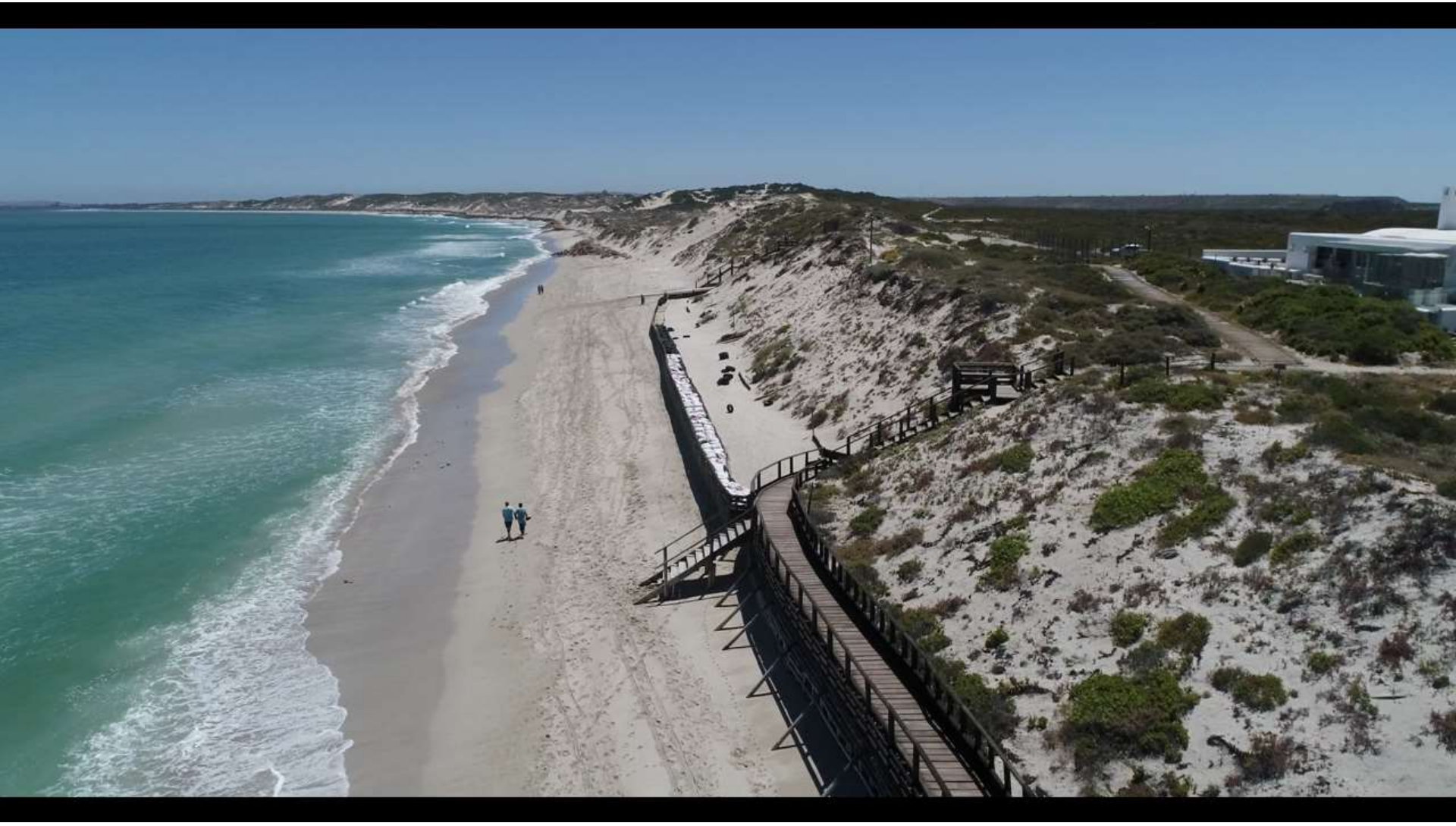
Physical Impact

Current Status



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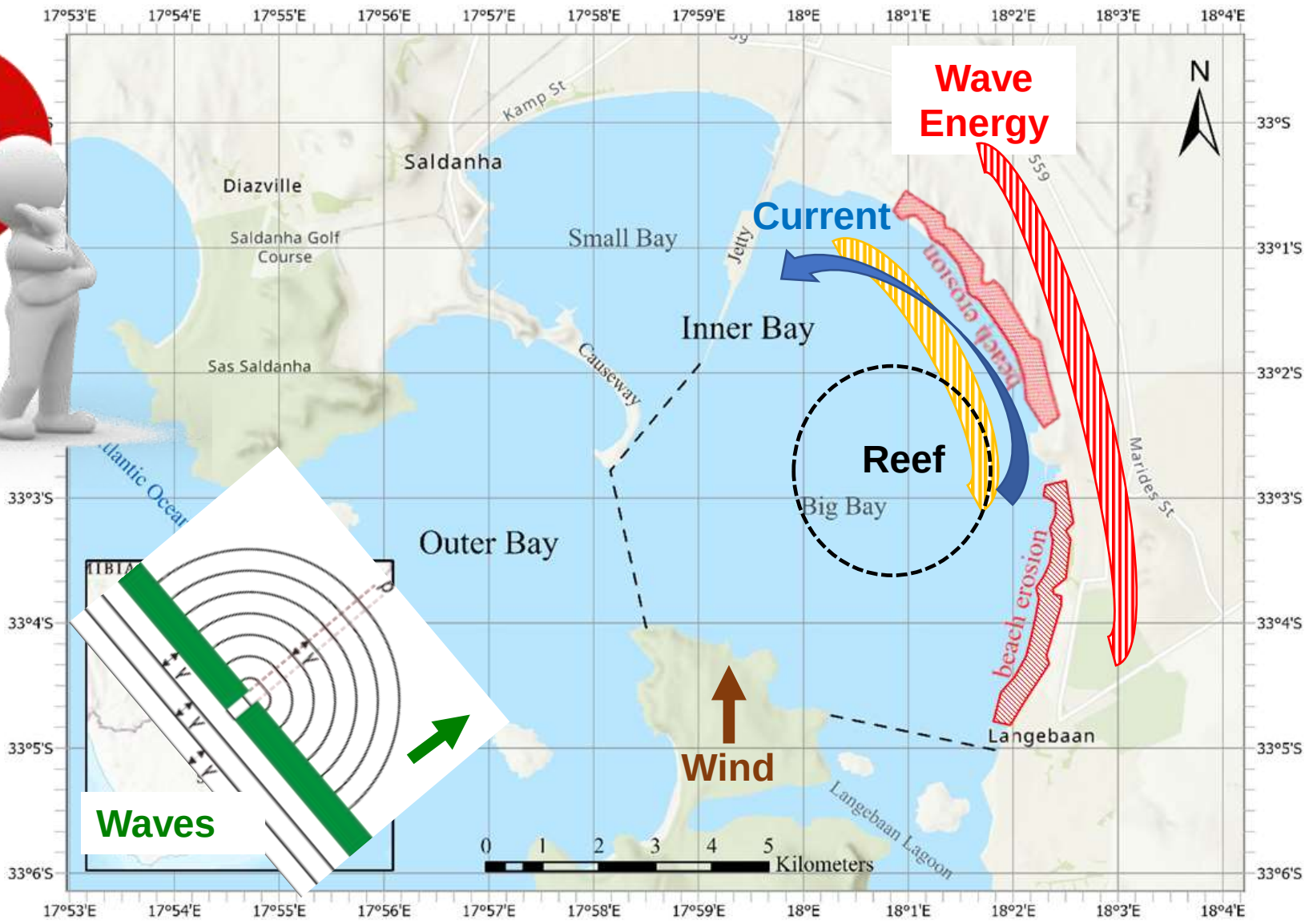
Future Perspective



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- *Dr Martin Klausen - Geologist*
- *Mr Kennedy Kilel - Student*
- *Mr Louis du Toit – Student*
- *Mr Ali Sehone - Student*

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