

Coastal remote sensing – towards integrated coastal research and management

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BACKGROUND

South Africa's coasts are affected by storms every year, causing major damage to public and private properties. The damage to eThekweni Municipality's infrastructure from the 2007 storms, for example, has been estimated in the range of R400 million (UNESCO, 2009). The destructive forces of storms mainly results from the impact of:

- Waves, leading to shoreline erosion
- Wind
- Flooding.

Coastal areas which are low-lying and sandy are particularly vulnerable, as can be found along most of Africa's east coast.

Climate change and coastal vulnerability: why should we worry?

Climate change is expected to increase the number of storms and their severity even further. We should be worried because:

- South Africa's coastline is about 3 500 km long
- About 60% of our population lives in the coastal zone (closer than 100 km to the coast)
- A major part of South Africa's economy depends on coastal natural resources and infrastructure (such as ports).

South Africa's coastal economy and infrastructure is highly vulnerable to the impacts of global and climate change.

What can we do about it?

The CSIR's coastal systems research group conducts trans-disciplinary research from basic research up to the provision of policies and technical guidelines to prepare the coastal communities in South Africa and beyond with coastal protection and climate change adaptation solutions. Through this, we constructively support coastal managers to establish and maintain the sustainable use of our natural coastal resources and anthropogenic infrastructure for a safer future.

What is the role of remote sensing?

The coastal zone connects terrestrial biophysical systems with marine systems. Some marine ecosystems cannot function without intact inland or near-shore supporting systems such as the essential role played by estuaries as nurseries for commercially relevant fish and crustaceans.

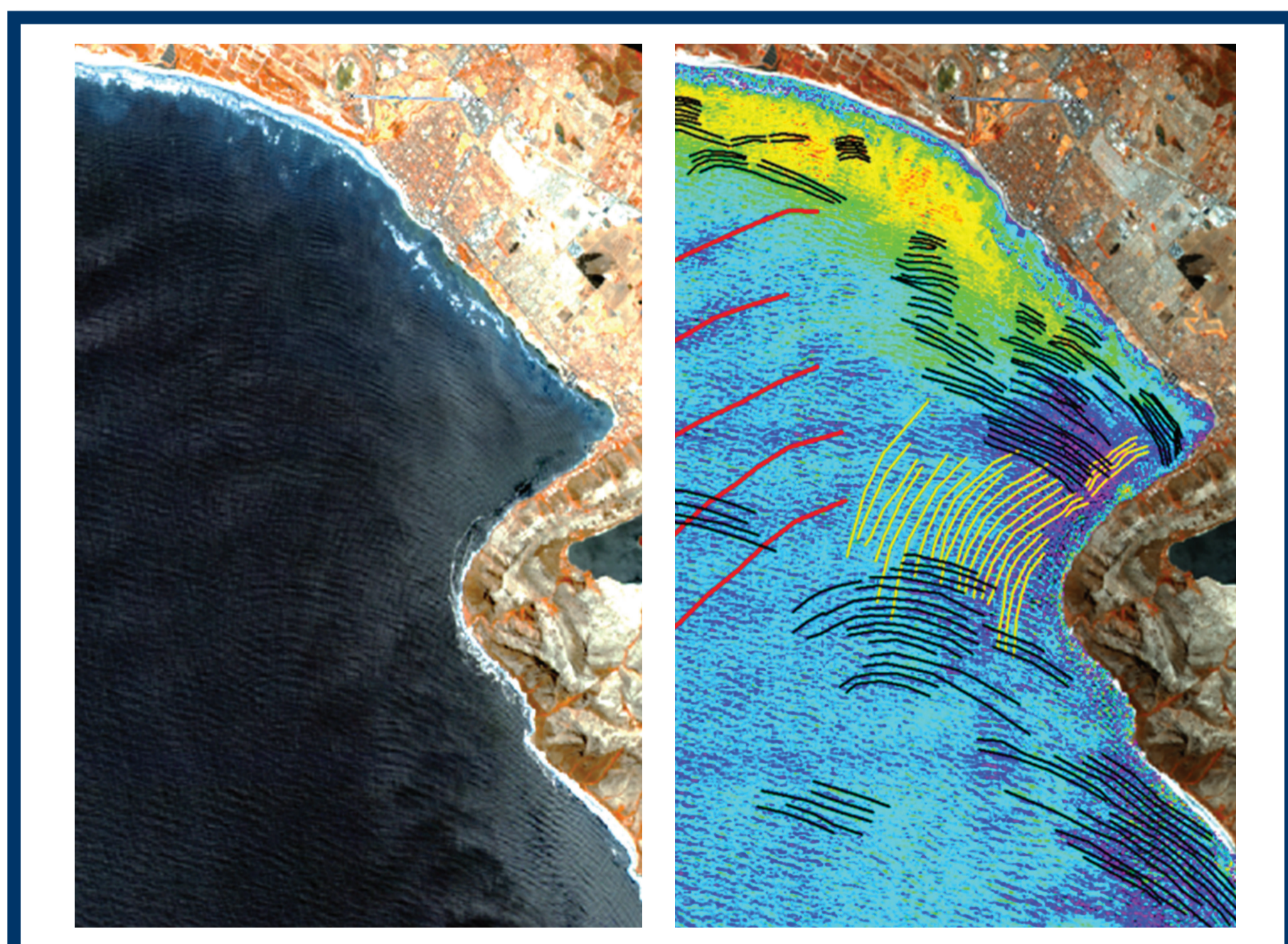
Therefore, the seamless spatial understanding of the links between processes in the coastal region is essential for the development of sound integrated management solutions.

To date, however, remote sensing applications usually focus on areas landward from the highwater line ('terrestrial' remote sensing), while 'marine' remote sensing does not pay attention to the shallow near-shore regions.

Coastal remote sensing focusses on the seamless assessment of processes and dynamics from the shallow near-shore ocean up to the terrestrial regions which are directly or indirectly related or affected by coastal processes such as shoreline erosion or flooding.

Coastal remote sensing, as we define it, is bridging the gap between classic terrestrial and marine remote sensing. However, to date, coastal remote sensing competency and applications are very scarce and undeveloped in South Africa and Africa.

Examples of typical applications

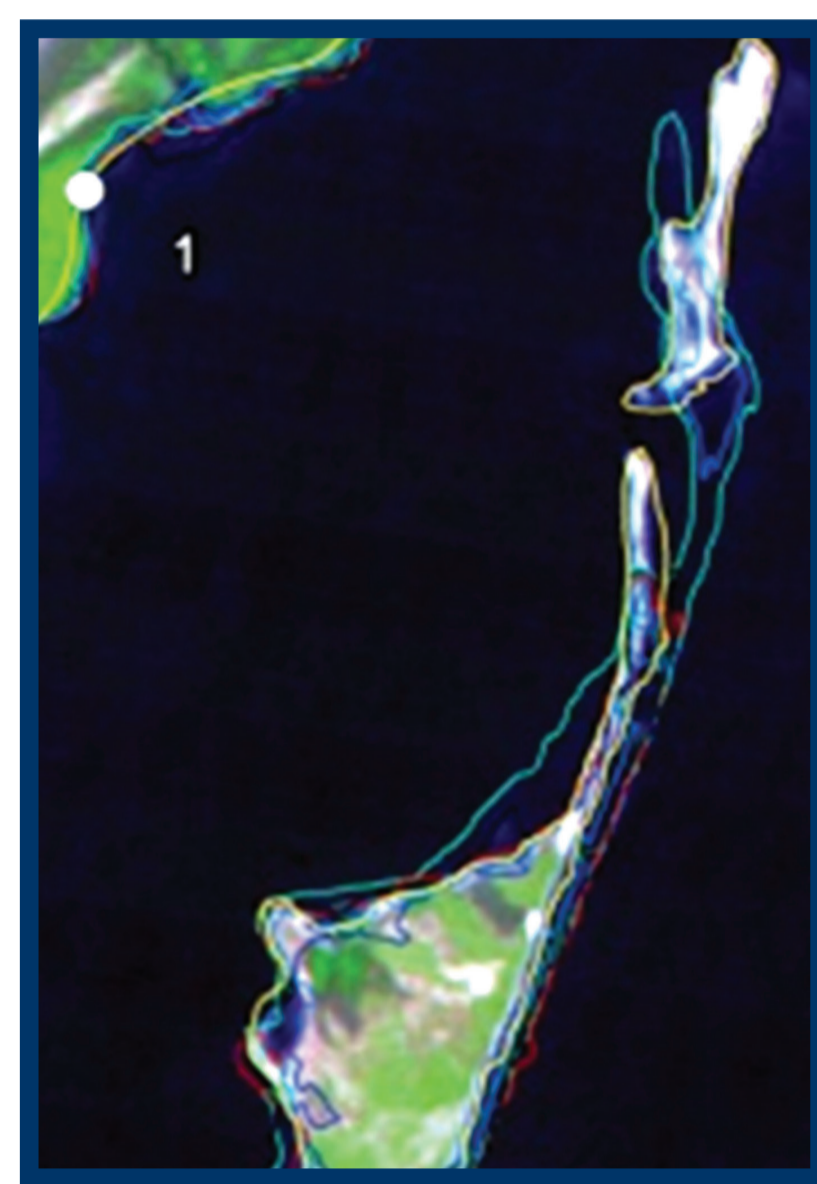


Extraction of wave patterns

RapidEye-derived, colour-scaled RedEdge NDVI image of eastern False Bay:

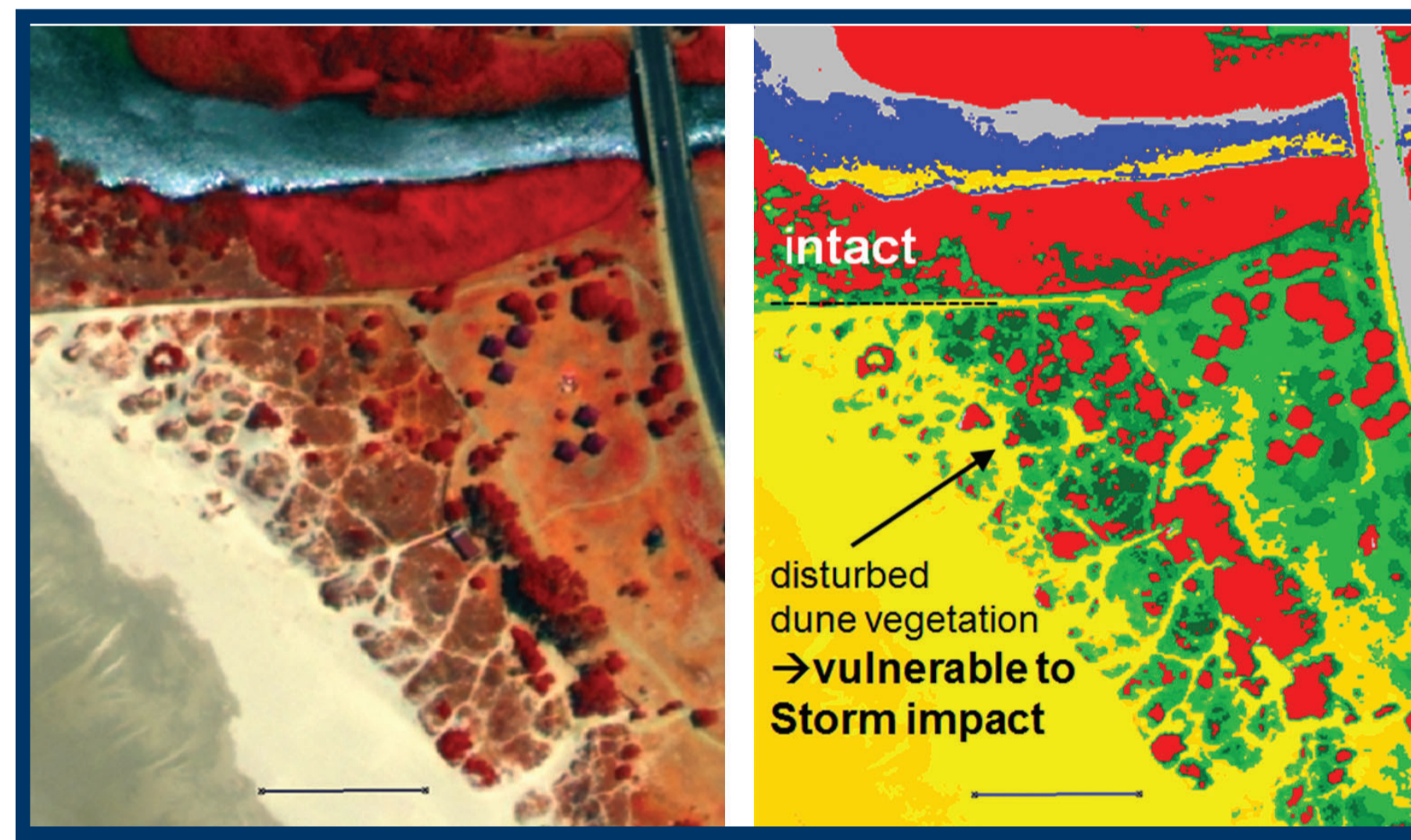
- | | |
|-------------------|-------------------------|
| – Internal waves | → allows extraction of: |
| – Ocean swell | - wave periods |
| – Reflected swell | - wave speed |
| | - wave energy |

as input for wave modelling for coastal protection planning.



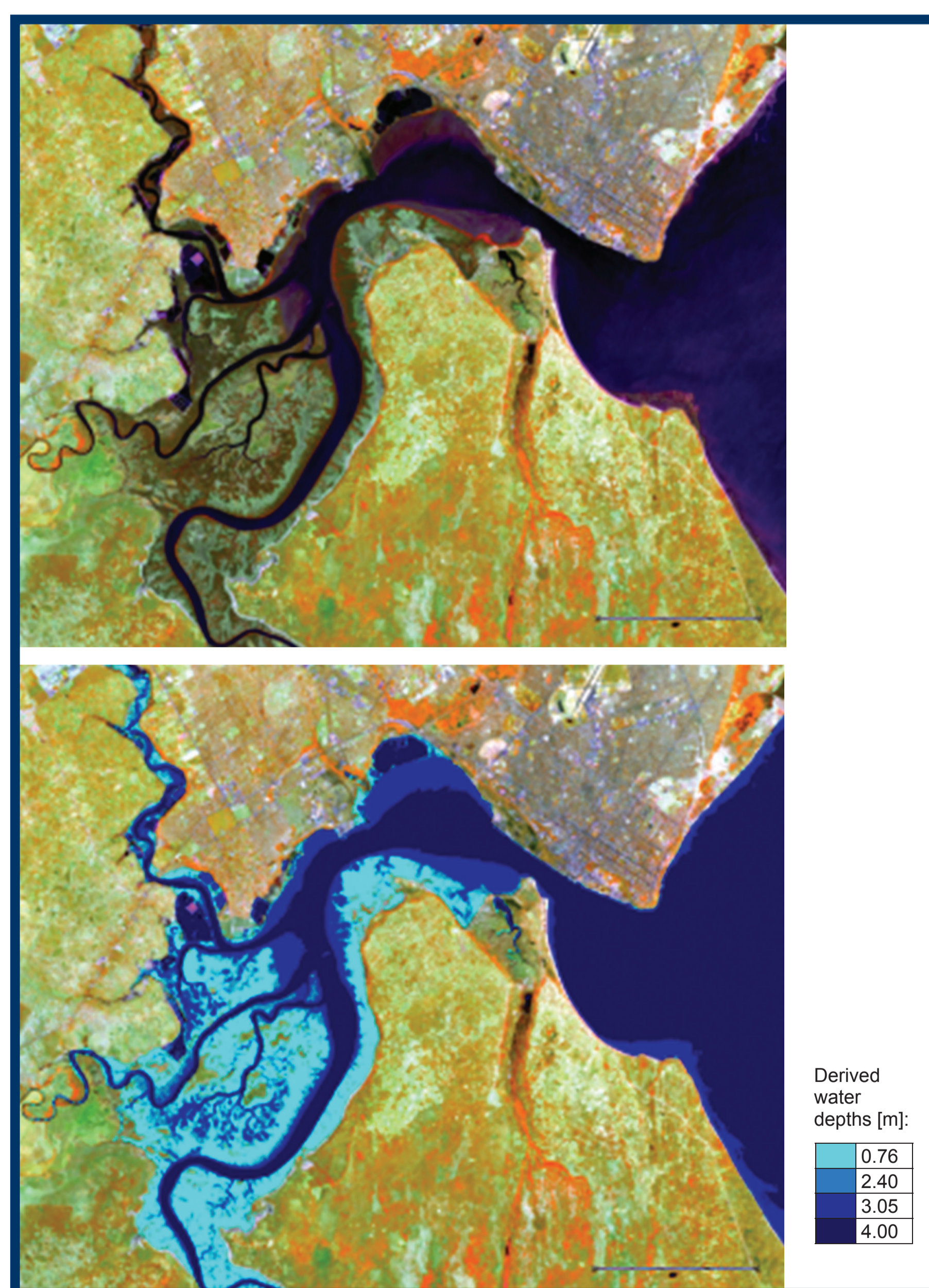
Detection of coastline dynamics
Extraction of coastline from time series of Landsat data as:

- Baseline for identification of erosion and accretion trends
- Input for the development of appropriate management solutions.



Assess coastal vegetation state

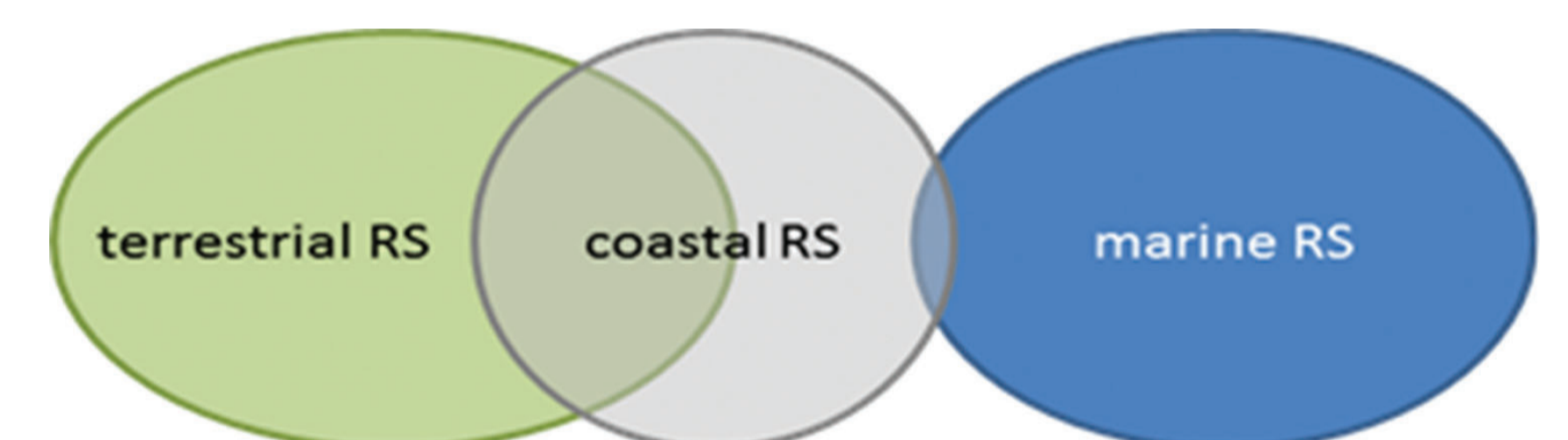
WorldView-2 derived information on disturbance of coastal dune vegetation in False Bay. This provided valuable baseline information for coastal management (e.g. regulation of coastal access).



Bathymetry derived from water colour

Useful for port and shipping channel design and management, as well as environmental (storm impact) modelling and management.

Coastal remote sensing focusses on the seamless assessment of processes and dynamics from the shallow near-shore ocean up to the land. This capability is, however, very scarce and underdeveloped in South Africa and Africa.



TRANS-DISCIPLINARY RESEARCH AND DEVELOPMENT

The CSIR's coastal systems research group is different from other coastal science organisations and institutions in South Africa insofar as we study the coast as a system – thus integrating across the different disciplines – to provide outcomes on a system scale rather than in single disciplines.

We have offices in Durban and Stellenbosch, South Africa. For general information on the group, contact Dr Louis Celliers at lcelliers@csir.co.za or +27 31 242 2412.