Pathways to Impact: Application of Satellite Altimetry as a Tool for Managing Coastal Risk in Mozambique, Madagascar and South Africa

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C-RISe – Coastal Risk Information Service

The coastal populations of Mozambique, Madagascar and South Africa are highly vulnerable to the consequences of climate variability and change. In particular, Mozambique and Madagascar are exposed to the surges associated with cyclones, and have economically important coastal ecosystems sensitive to climate change.

Access to improved regional information on coastal risk factors (sea level, wave and wind extremes) will support improved plans to protect coastal communities and safeguard economic activity. This information can also contribute to improving industrial and commercial competitiveness in the maritime sector.

C-RISe is a project funded by the UK Space Agency, through the International Partnership Programme. It will deliver, in a partnership between the UK, Mozambique, Madagascar and South Africa, access to information on sea level rise, storm surge, wind speed and wave heights derived from satellite altimetry and validated with local in-situ measurements over the area shown in Fig. 1. The goal is to enable local stakeholders to reduce the social & economic impact of coastal inundation and increasingly variable weather patterns.

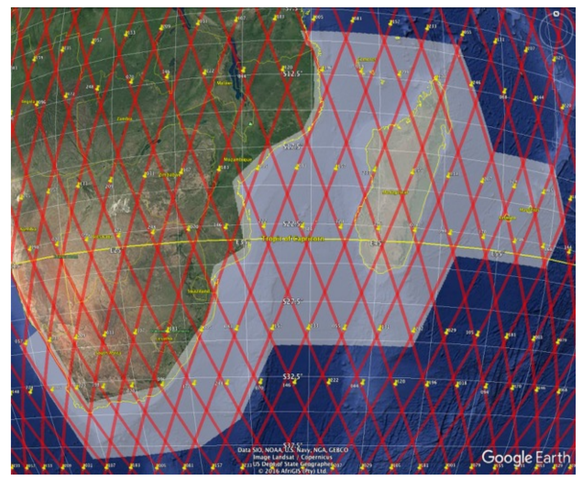

Figure 1. Coverage of C-RISe service and altimeter ground tracks

Sea Level and Climate Change

It is well established that global sea level is increasing and large-scale weather patterns are changing. However, even within the Indian Ocean, changes are not geographically uniform or steady in time, with short-term variability on a range of time scales.

Satellite altimeter data have been providing highly accurate data on global sea level change since 1992 (Fig. 2), and can also provide information on regional patterns of sea level change

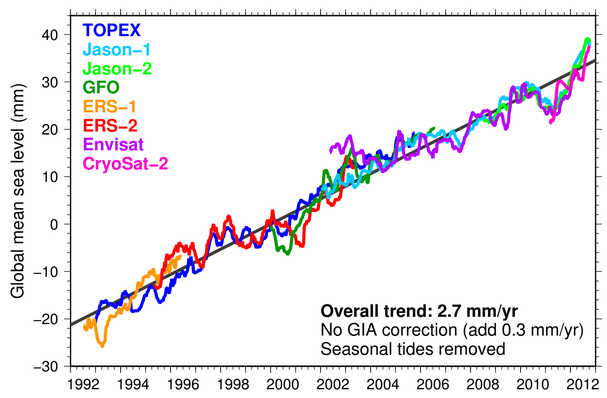

Figure 2. Global Sea Level change since 1992 from satellite altimeters. Credit Altimetrics LLC

Satellite Altimetry at the Coast

In the past, due to land contamination of the return waveform, it has been difficult to retrieve useful data from satellite altimeters close to the coast. To address this, the National Oceanography Centre, UK (NOC), developed the "ALES" altimeter re-tracker for coastal regions (ALES - Passaro et al., *Remote Sens. Environ.*, 2014, 145, 173.), Fig. 3. This delivers the potential to reprocess altimeter data from past missions and provide a continuous satellite altimeter coastal sea level time series of over 20 years.

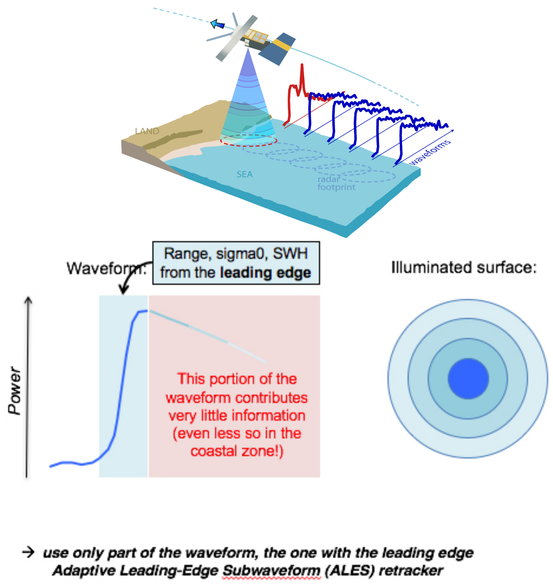

Figure 3. Principle of operation of the ALES altimeter coastal processor developed at NOC

C-RISe Products

The NOC ALES coastal processor will be used to generate a 14-year coastal sea level data set for the SE Africa coastal region, which will be analysed for characteristics of regional variability. These data and analyses will be provided, together with wave and wind climatologies, and near-real-time wave and wind data (Table 1.), to a range of local users, through a bespoke data portal developed by CSIR (South Africa).

The service will be applied to a number of use cases, through which the practical benefits of the service will be assessed.

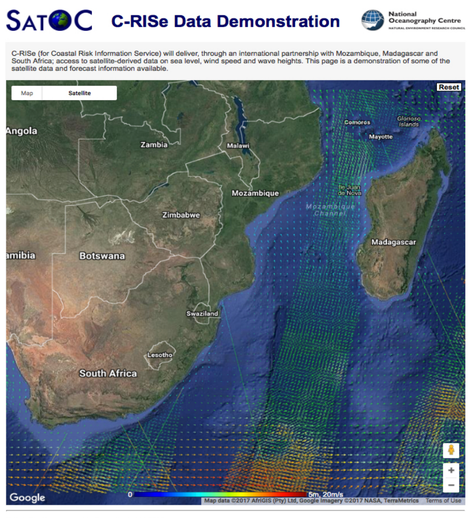

Figure 3: Demonstration of daily updated wind and wave data

Table 1. Satellite data to be included in C-RISe service

Parameter	Description	Time Coverage	Satellites
Total Water Level Envelope, significant wave height, surface radar backscatter	Along track data from the NOC coastal processor	2002-2016	Jason-1, Jason-2, Jason-3
Significant Wave Height and Wind Speed Climatologies	Monthly, 1° x 1° gridded climatologies,	1992-2014	ERS-1, ERS-2, Envisat, Topex, Jason-1, 2,3
Significant Wave Height, wind speed	Near Real Time along track data	Daily updated	Jason-2,
Wind speed and wind direction	Near Real Time data across scatterometer swath (25km resolution)	Daily updated	Metop/ ASCAT-A

C-RISe Training Programme

One of the primary C-RISe objectives is to build local capacity in using satellite data to provide scientific decision support for strategy development, governance and management of coastal areas to increase resilience to coastal hazards.

The development of local capacity to use coastal altimetry data in combination with other data sets and information sources is seen as a key target, necessary to ensure a viable long-term service.

Training will be provided through a series of workshops (in Mozambique and Madagascar) together with online training material.

These tools will include Bilko (see http://www.learn-eo.org/software.php), a tool first developed for UNESCO to provide a free earth observation (EO) image processing capability for education use, which is being updated to include data from the Sentinel satellites.

Ambodivahibe Bay Marine Protected Area (MPA), Madagascar

- WWF is implementing adaptation projects in six pilot marine protected areas (MPAs) in order to increase the resilience of coastal ecosystems in the face of future climate conditions.
- Among them are Nosy Hara National Park and Ambodivahibe in the northern part of the country.
- Ambodivahibe (Fig. 6) is a community-led MPA managed by Conservation International (CI) with the local communities, on the northeast coast, ~25 km from Antsiranana. It covers a total of 39794 ha and is a well-preserved marine environment recognized for its diversity of coral reefs and marine species.

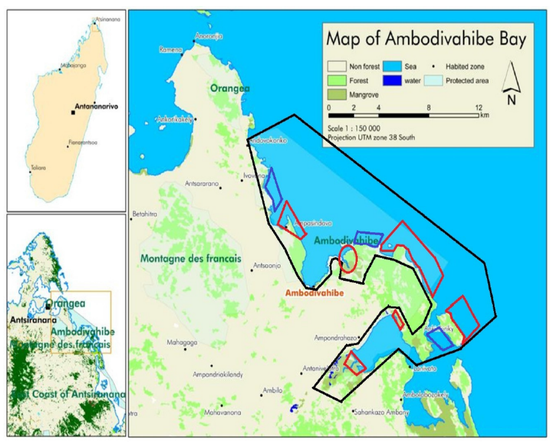

Figure 6. Ambodivahibe Marine Protected Area, North East Madagascar

Connecting Satellite Data to the MPA project

- CI and WWF have engaged the Malagasy Met Office (DGM) and funded the installation of a meteorological station, enabling the local community to gain a better understanding of weather patterns, and provide access to information that can help decision making.
- CI, WWF and DGM are interested in understanding how satellite information can be used both in MPA management and to improve services delivered to local communities.

Pathways to Impact: C-RISe Use Cases

Through the development of a series of example use cases, C-RISe is exploring pathways for translating scientific EO data into social and economic impact (Fig. 5) by building local capacity to use satellite observations, in the context of coastal development.

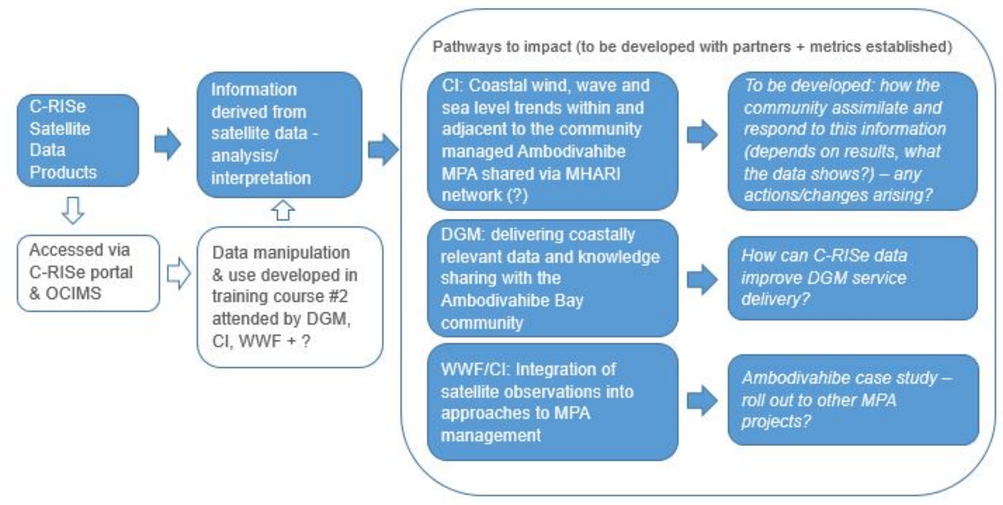

Figure 5. How C-RISe will establish pathways to impact

C-RISe Extension?

The C-RISe team are planning to increase the coverage provided by the service, so that it extends north to the Gulf of Oman, and south to include the Prince Edward Islands, Fig. 7.

We are therefore inviting participation in this extended project from organisations not already involved. We would especially welcome participation from organisations in Tanzania, Kenya, and Indian Ocean Island States.

If you are interested, come and talk to us!

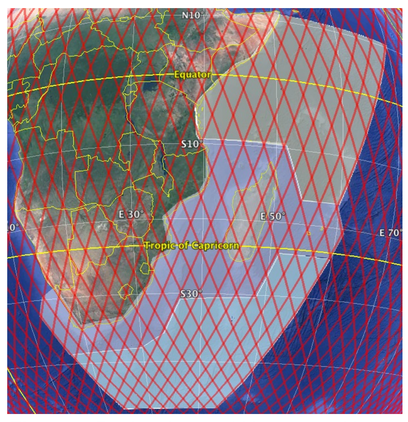

Figure 7. Region that could be covered by an extended C-RISe service

http://www.satoc.eu/projects/c-rise