Coastal Risk Information Service (C-RISe), the application of satellite data as a tool for managing coastal risk and sustainable development in the South West Indian Ocean

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BACKGROUND

C-RISe, the Coastal Risk Information Service, is a three-year project funded by the UK Space Agency (UKSA) International Partnership Programme (IPP). The project is, in a partnership between the UK, Mozambique, Madagascar, Mauritius and South Africa, delivering access to Earth Observation (EO) derived information on sea level, wind speed and wave heights and currents in the Western Indian Ocean Region.

C-RISe has three main objectives, to:

1. Deliver a Coastal Risk Information Service, providing satellite-derived information about coastal vulnerability to environmental threats such as sea-level rise and extreme wind and wave events.
2. Apply and evaluate the C-RISe service through a set of Use Cases, applying the C-RISe products to end use applications meeting local priorities.
3. Build local capacity to use satellite data for strategy development, governance and management of coastal areas to increase resilience to coastal hazards.

The project has explored pathways for translating scientific earth observation data into social and economic impact, building the capacity to use satellite observations amongst local users. The aim is to facilitate the uptake of marine earth observation data in the context of coastal development in the partner countries.

C-RISE DATA PRODUCTS AND ANALYSIS

A sea level data set for the South West Indian Ocean region (Figure 1) generated by NOC, has been made available, along with wind, wave and current climatologies, through a portal developed by the Council for Scientific and Industrial Research (CSIR).

The project also provides near real time (NRT) information on maritime conditions at http://www.satoc.eu/projects/c-rise/demo.html (http://www.satoc.eu/projects/c-rise/demo.html) (Figure 5, Use Cases).

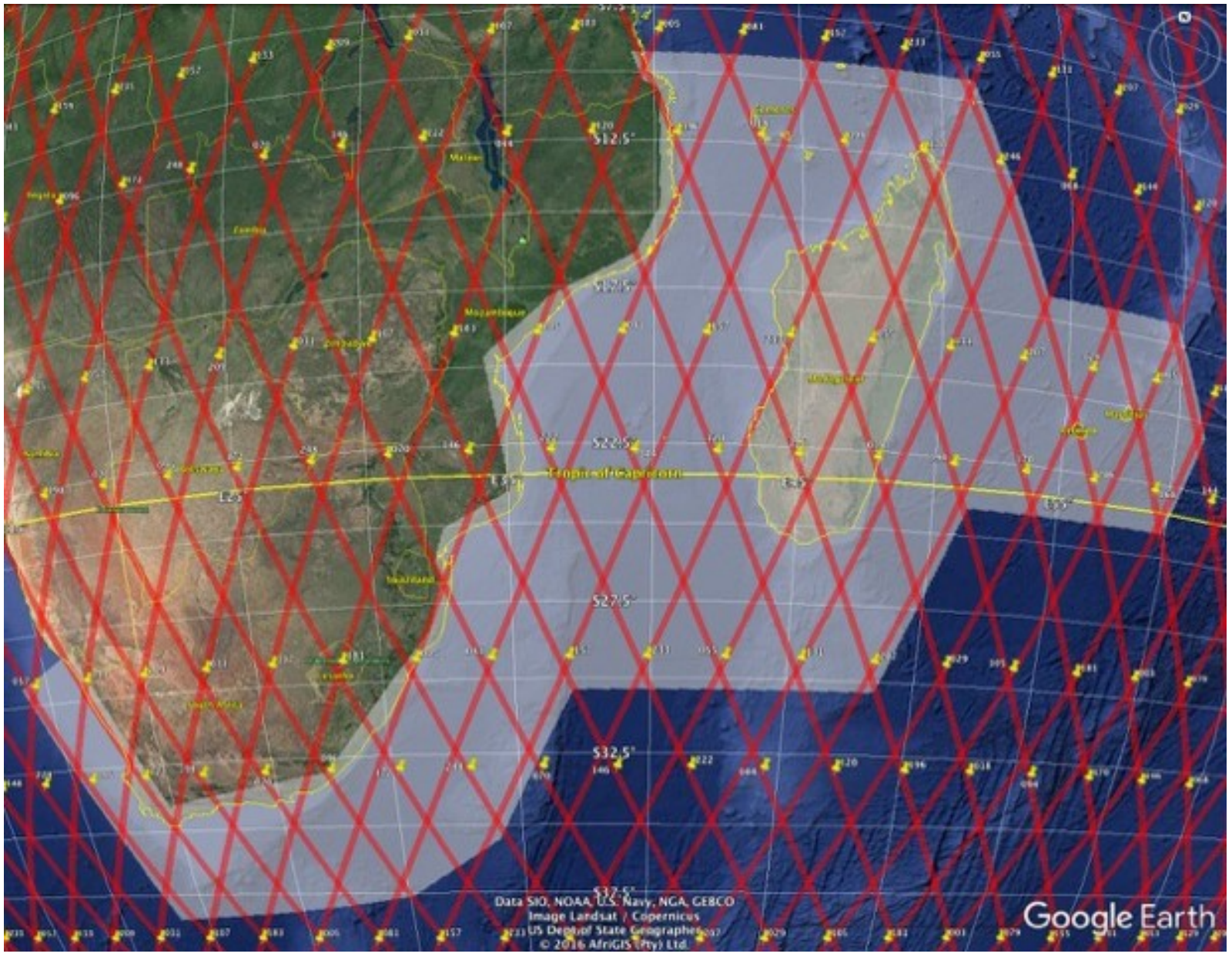

Figure 1. Coverage of C-RISe service (grey area) and altimeter ground tracks (red lines)

C-RISe generated a suite of demonstration analysis routines to view and process the EO data using python (Figures 2 & 3).

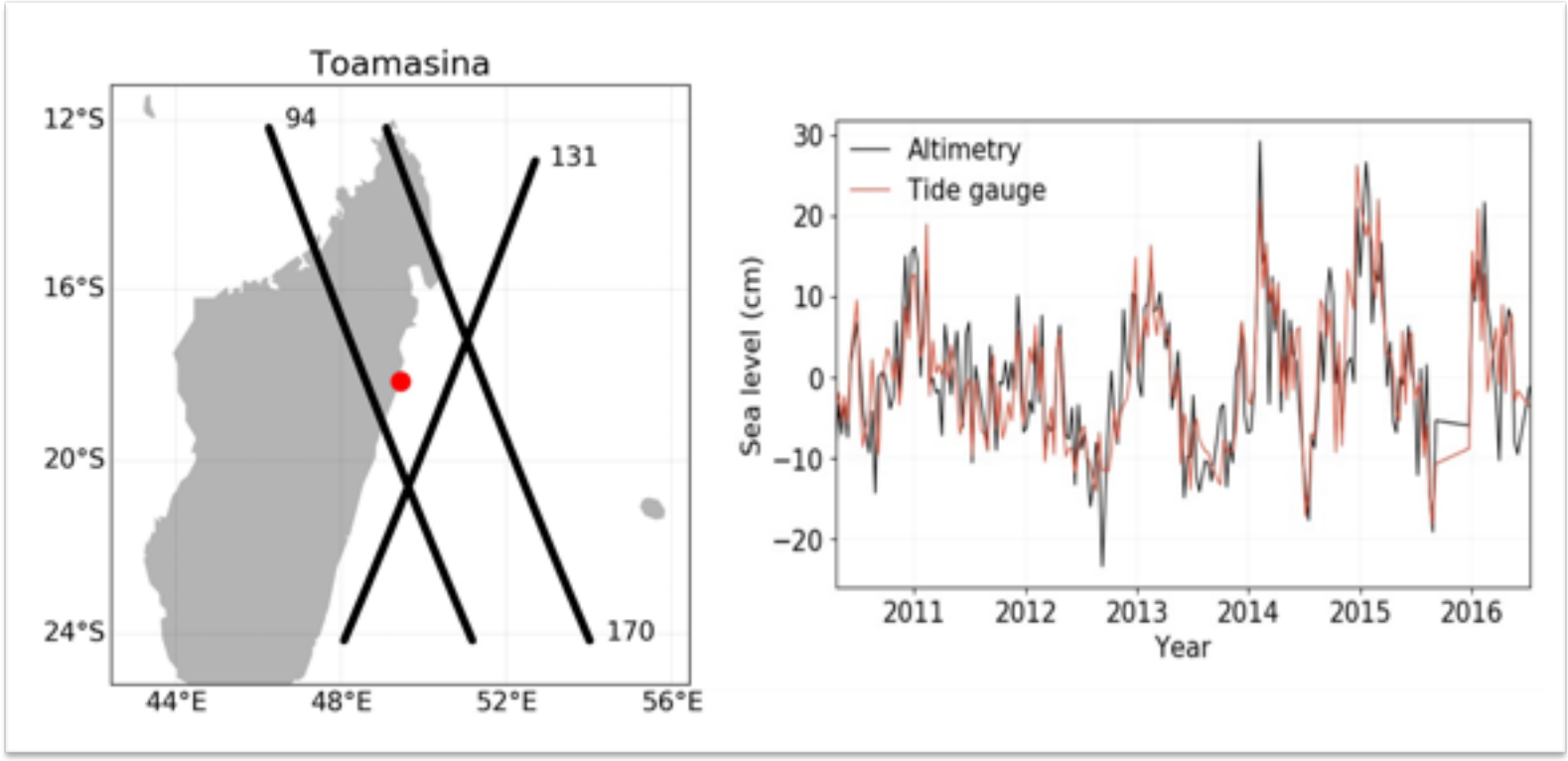

Figure 2. Validation of sea level data by R. Rajaonarivony (DGM)

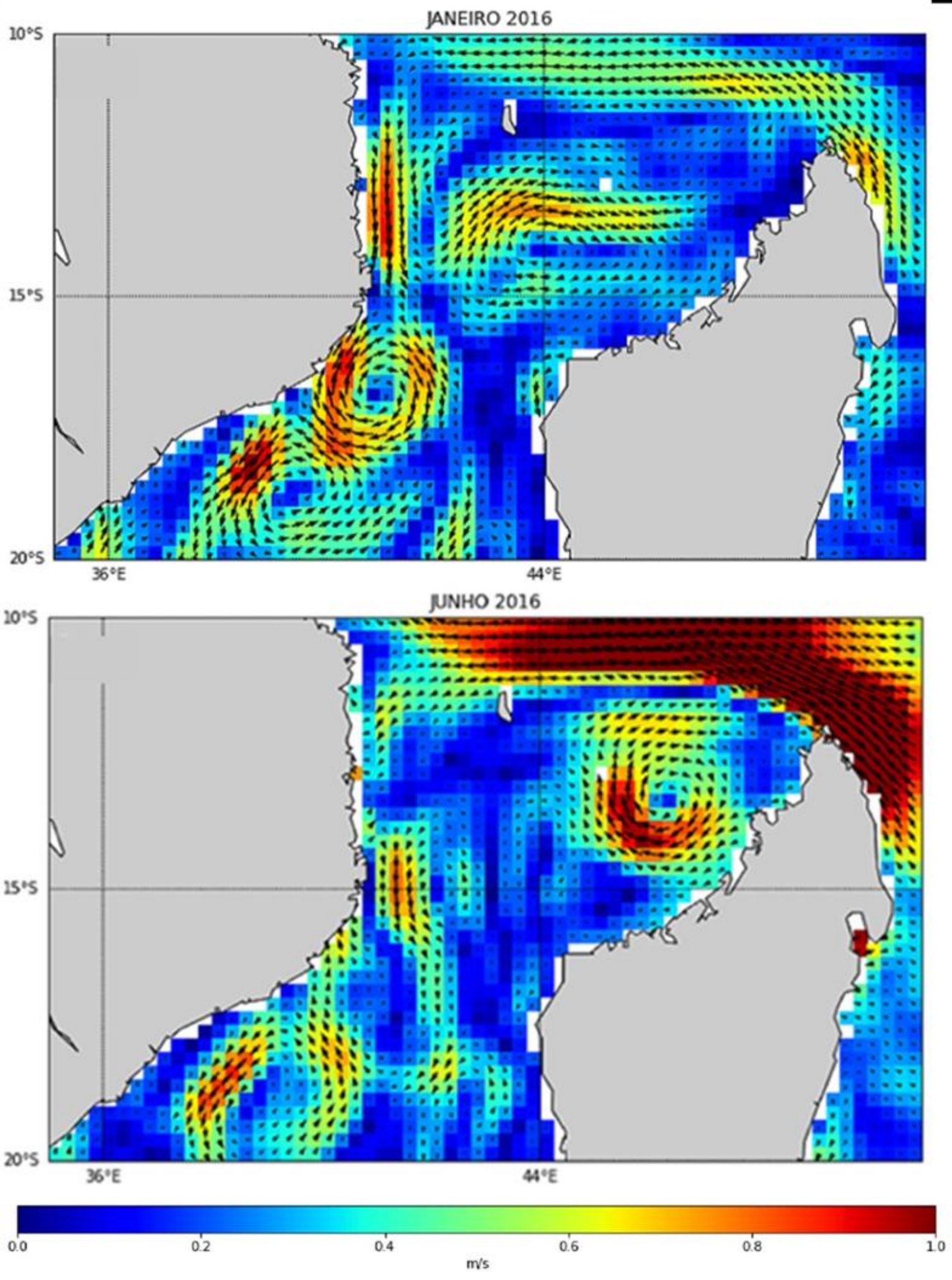

Figure 3. Monthly mean surface current for January and June 2016 in the Northern Mozambique Channel. Data from ESA GlobCurrent, analysed by L. Fernando (UEM)

USE CASES

One of the main aims of C-RISe was for in-country partners (Figure 4) to implement a set of Use Cases, in which they used the data provided as part of on-going projects, thereby demonstrating its utility. It was initially envisaged that the project would generate four Use Cases, however, to-date, our 10 in-country partners have delivered 22 Use Case reports.

Figure 4. Partner organisations in Mozambique, Madagascar, Mauritius and South Africa

The Use Cases fall in to five broad categories:

- Ocean climate data for coastal zone management; infrastructure protection and development; and operational planning
- Sea Level and Tidal Analyses for climate change mitigation and adaptation; coastal management; and infrastructure planning
- Near Real Time Marine environmental conditions support for community and operational safety and law enforcement
- Marine Protected Area (MPA) Management and Marine Ecosystem Monitoring
- Marine Fisheries Support

Example Use Cases

Improving maritime navigation security & safety in the North-Western of Madagascar

Centre de Fusion d'Informations Maritime (CFIM) are using the NRT information (Figure 5) in operational planning and decision making to improve maritime safety and security. Specifically, the data has been used to track Rosewood smuggling, drug trafficking and irregular migration.

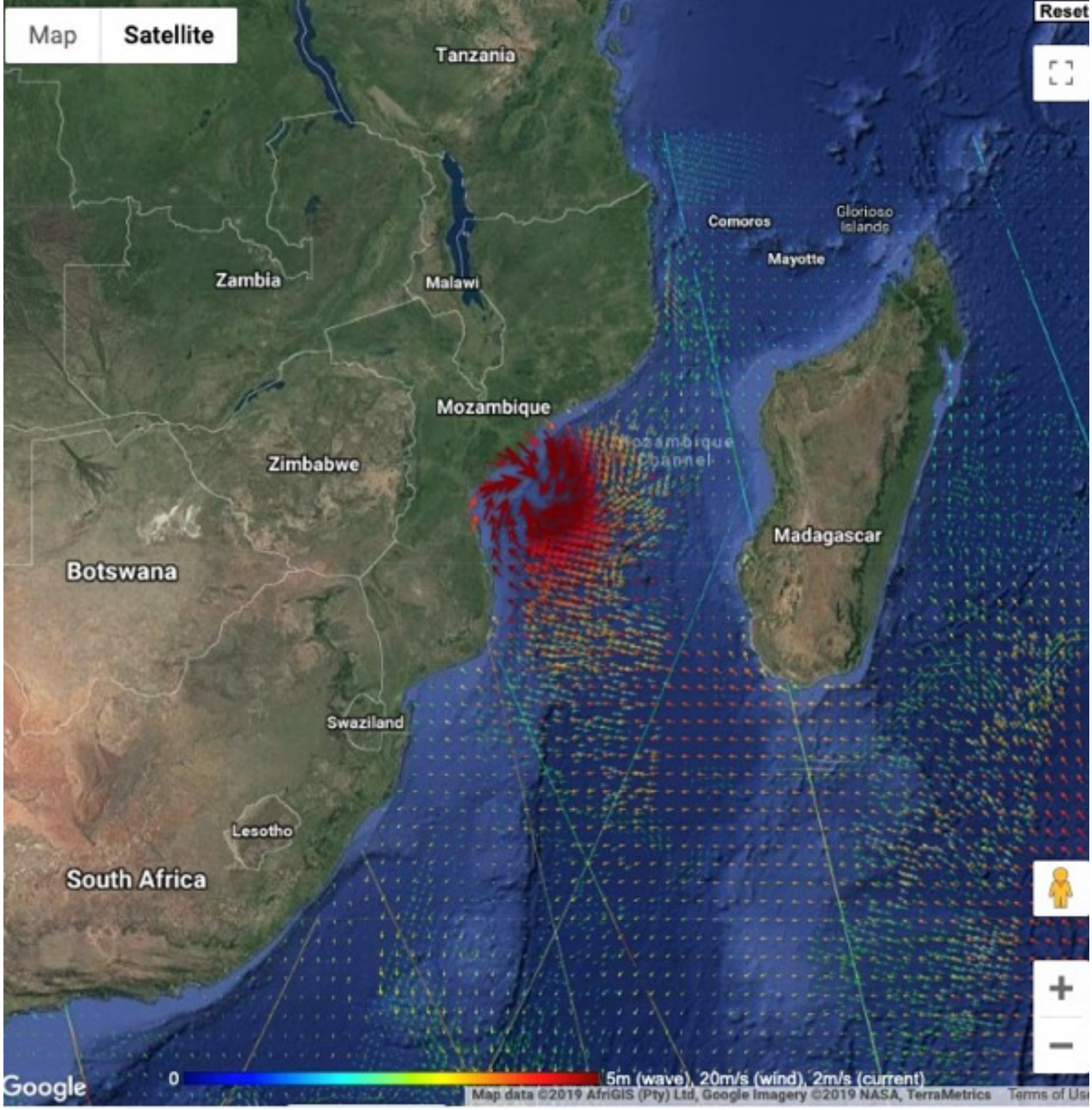

Figure 5. Near real time information portal. 14 March 2019, showing cyclone Idai making landfall

Marine Protected Area (MPA) management, Ambodivahibe, Madagascar

Conservation International (CI), Madagascar, have use satellite data provided by C-RISe to produce a detailed report on the state of the coastal eco-system of the Ambodivahibe MPA and model future climate change impacts. They will now develop a management plan, in consultation with communities and local stakeholders, which takes into account the projected impacts of climate change.

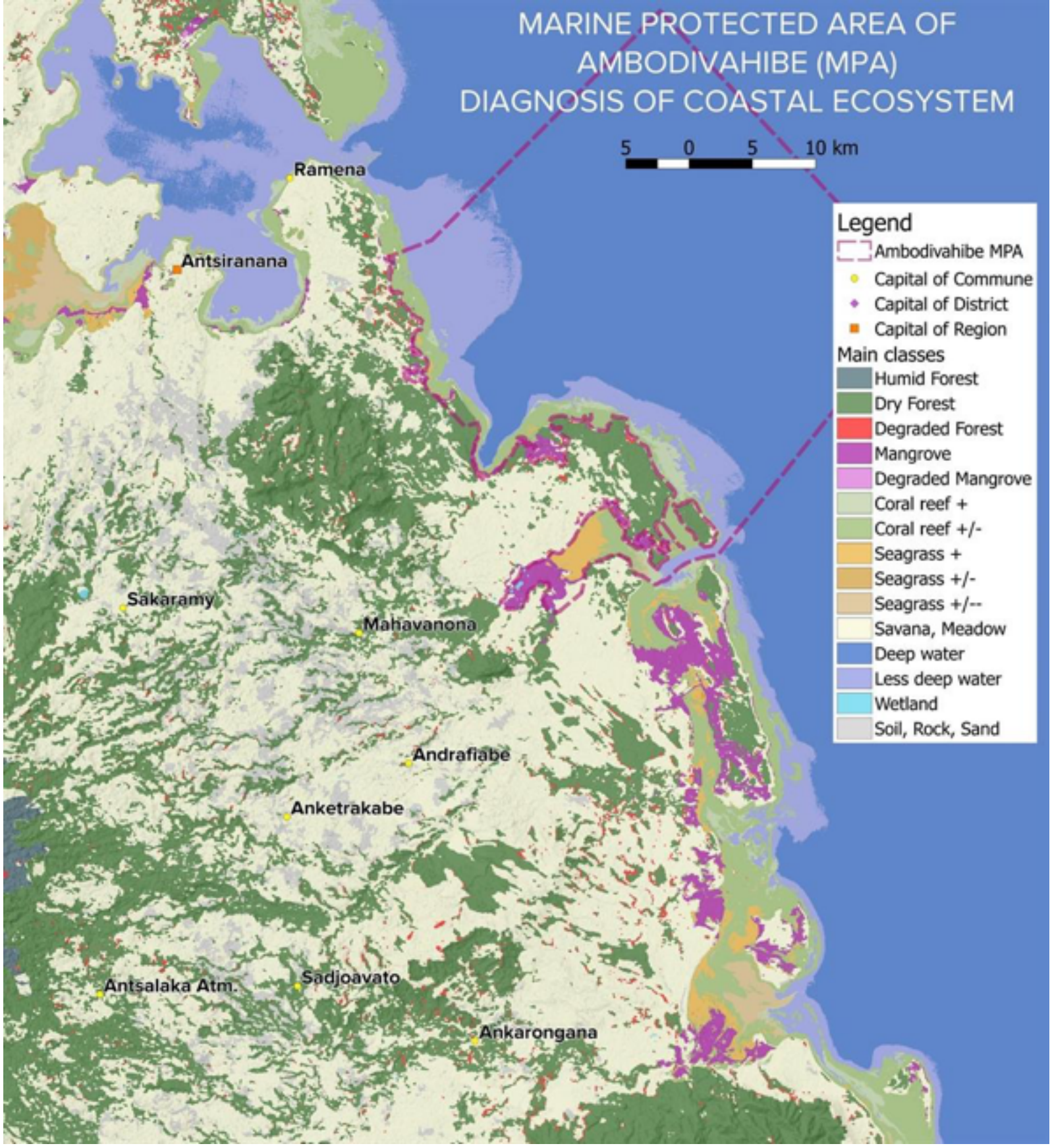

Figure 6. Coastal ecosystem characterisation of Ambodivahibe MPA by C. Rabenandrasana (CI Madagascar)

Current Climatologies for the Mozambique Channel

Accurate surface current information is important for navigation, port operations and port development. Students at Universidade Eduardo Mondlane (UEM), School of Coastal and Marine Science, supported by the Instituto Nacional de Hidrografia e Navegação (INAHINA), analysed EO derived surface current climatologies (ESA Globcurrent) to provide a summary of seasonal and inter-annual variability of surface currents in the Mozambique Channel (Figure 3, C-RISe Data Products and Analysis).

Sustainable Development Goals

Whilst the main focus of the project was to address UN SDG 1.5 (build resilience and reduce vulnerability to climate related extreme events), the breadth of the Use Cases means that they address several of the SDG targets. These include 13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural

disasters; 13.3 Improve education, capacity on climate change mitigation, adaptation; 9.A Facilitate sustainable and resilient infrastructure development; 14.2 by 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts; and 14.A increase scientific knowledge, develop research capacity and transfer marine technology.

CAPACITY BUILDING

Figure 7. Workshop at UEM, Maputo, Mozambique, October 2018

During the project we have increased the capacity of partner organisations to access and use EO data through a series of workshops hosted by UEM (Figures 7 & 8) in Mozambique and Direction Générale de la Météorologie (DGM, Figure 9) and Centre National de Recherches Océanographiques (CNRO) in Madagascar.

Figure 8. Workshops at UEM, Maputo, Mozambique, October 2017 and October 2018

Each workshop took place over one week and was presented through a mix of taught material, exercises, demonstrations and one-to-one discussions on the application of satellite data within C-RISe Use Cases.

Figure 9. Workshop at DGM, Antananarivo, Madagascar, December 2017

RECOMMENDATIONS

C-RISe partners are now working towards maintaining the project outputs and increasing impact. Several of the Use Cases have highlighted areas for further research or development to improve impact outcomes.

Project partners have identified the need for further training to consolidate and build on the skills acquired to date. In particular, further training in the analysis of in situ data alongside the EO data sets would be useful in ensuring that local partners are equipped to continue using satellite-derived information and deliver outputs to decision makers.

Existing efforts to build knowledge and skills could be complemented by adaptive capacity building activities. This could include the self-supporting regional network to enhance data sharing and learning across organisations and countries. Application of data together with policy considerations to explore future scenarios could enhance capacity to plan for potential changes and develop more effective management responses.

Sorry but time is up!

ABSTRACT

Global sea level is increasing and large-scale weather patterns are changing, however, across large parts of the world, there is a lack of observational data from in situ instrumentation on which to implement evidence-based coastal adaptation. Mozambique, Madagascar and Mauritius have coastal populations vulnerable to consequences of climate variability and change. C-RISe (Coastal Risk Information Service) is providing satellite-derived information about coastal vulnerability to environmental threats such as sea-level rise and extreme wind and wave events.

It has previously been difficult to retrieve satellite altimeter data close to the coast, due to land contamination of the return waveform. Using an innovative coastal processor, developed by the NOC, UK, a new satellite altimeter sea level dataset for the South East African coastline has been generated, validated against available tide gauge data and analysed for regional characteristics in sea-level variability, including long-term sea-level trends.

These data, together with climatological ocean wind, wave and surface current data, are being provided, through C-RISe, to partner organisations in Mozambique, Madagascar and Mauritius to inform decision-making and reduce impact of coastal inundation and increasingly variable weather patterns.

With access to improved regional information on coastal risk factors plans to protect coastal communities and safeguard economic activity are improved. This information can also contribute to improving industrial and commercial competitiveness in the maritime sector, heavily dependent on access to accurate relevant oceanographic information.

A key objective of C-RISe is to support development of local capacity to access, process and apply satellite sea-level data. Use Cases, led by in-country partners, evaluate the C−RISe service in different application areas including: maritime safety, coastal erosion, coastal defence planning, fisheries, marine and coastal ecosystem management. Local users are trained in the use of marine satellite data to quantify coastal hazards and incorporate information into ongoing programmes.

This presentation will introduce the project, summarise key findings, and present results from Use Cases, highlighting areas of most benefit and future interest.

SWITCH TEMPLATE