





Shallow Marine and Coastal Research Infrastructure



SMCRI

-  Sentinel Sites
-  Satellite Sentinel Sites

Port Elizabeth = Central Coordinating Unit

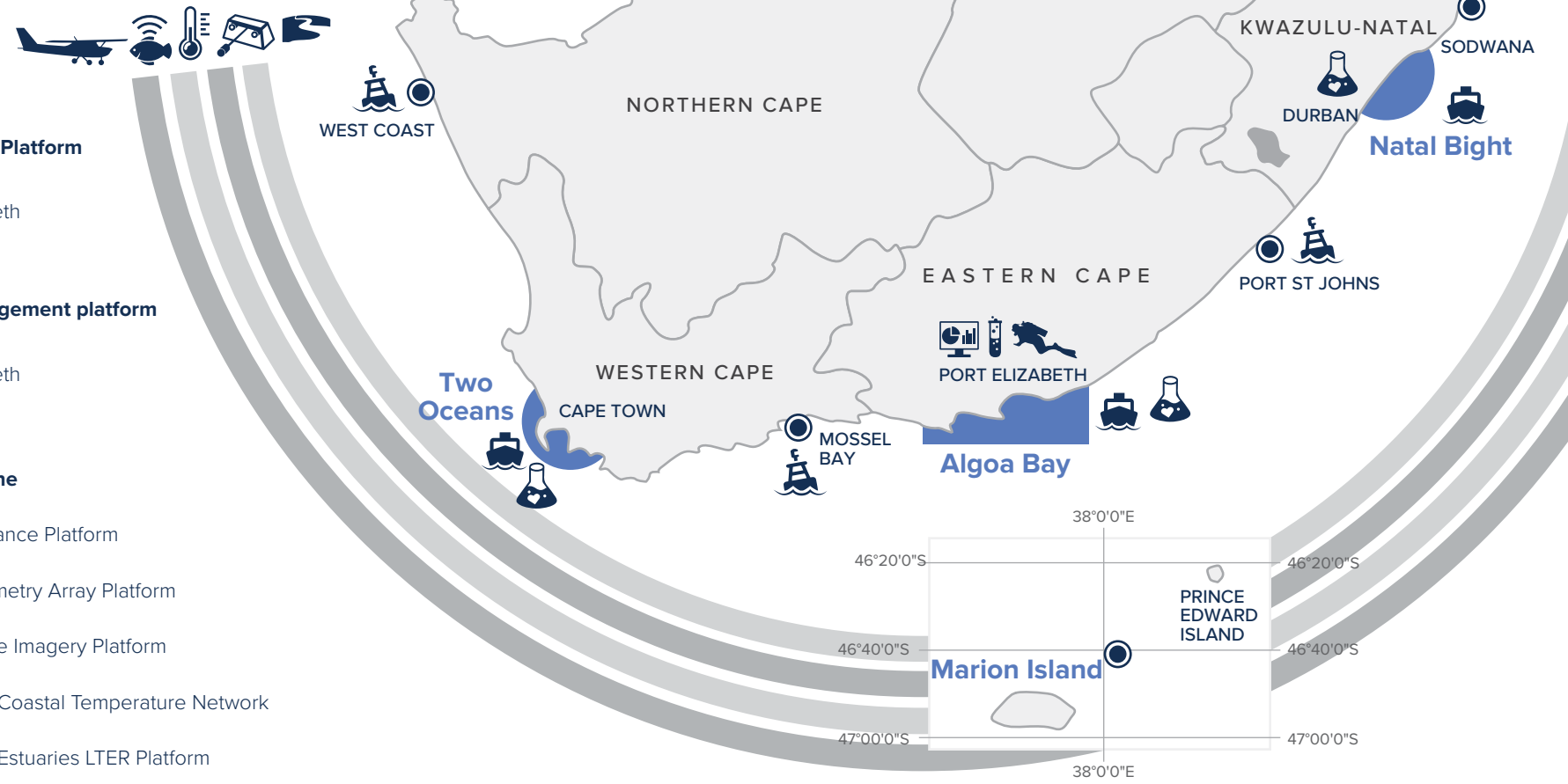
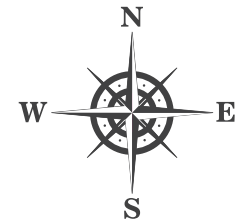
-  Coastal Biogeochemistry Platform
-  Dive and Hyperbaric Chamber Platform
-  Data Management Platform

-  **Coastal Craft Platform**
 - Cape Town
 - Port Elizabeth
 - Durban

-  **Science engagement platform**
 - Cape Town
 - Port Elizabeth
 - Durban

- Entire coastline**
-  Aerial Surveillance Platform

-  Acoustic Telemetry Array Platform
-  Marine Remote Imagery Platform
-  South African Coastal Temperature Network
-  South African Estuaries LTER Platform





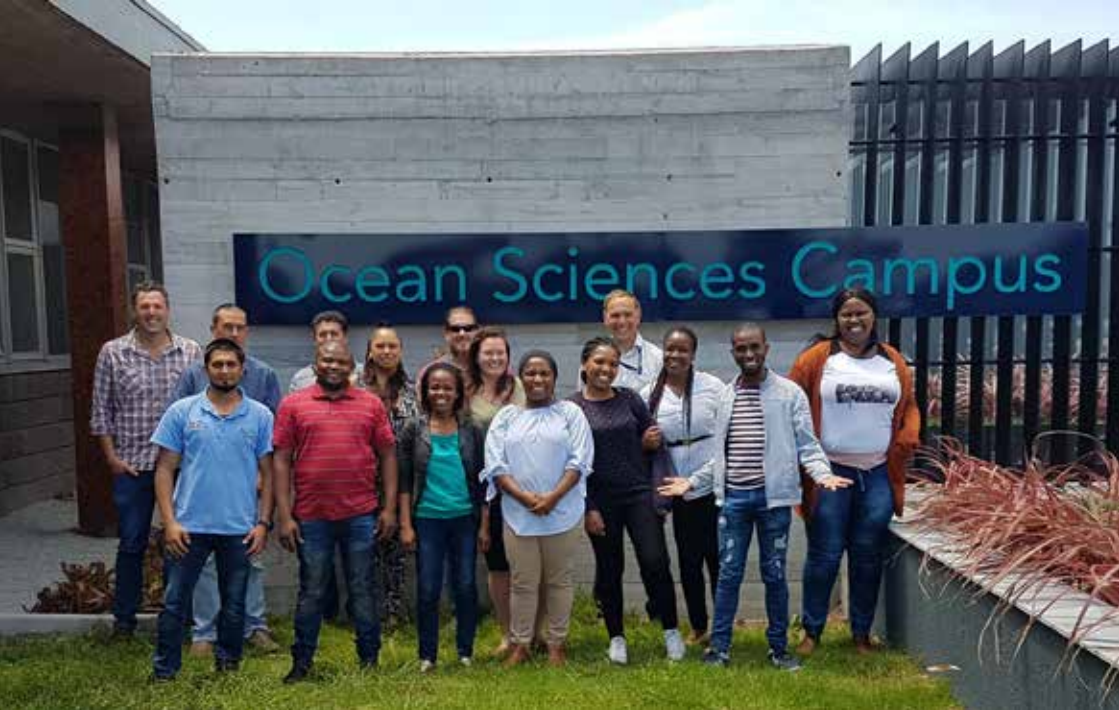
Introduction

The Shallow Marine and Coastal Research Infrastructure (SMCRI) is one of 13 large Research Infrastructures developed by the Department of Science and Technology (DST) as part of the South African Research Infrastructure Roadmap (SARIR). The SMCRI was established in 2016 to develop an array of instruments and physical research platforms around the coast of South Africa and its subantarctic islands to collect long-term reliable data for scientific research to help decision makers formulate appropriate environmental policies to lessen the risk and vulnerability of the coastal zone to climate and global change. The SMCRI is tapping into South Africa's geographical advantage by providing access to cutting edge research platforms and data at appropriate spatial and temporal scales in all the coastal biogeographic regions from all three oceans to stimulate innovative research and IP generation that is of global relevance. SMCRI is building on the suite of observatories, sentinel site and research platforms already established and maintained by the National Research Foundation's (NRF) South African Environmental Observation Network (SAEON) and the South African Institute for Aquatic Biodiversity (SAIAB).

Key stakeholders of the SMCRI include Higher Education Institutions, Research institutes and councils, Department of Environmental Affairs (Branch Oceans & Coasts, SAWS and SANBI), Department of Water and Sanitation, Department of Agriculture, Forestry and Fisheries, Department of Basic Education, conservation agencies, NGOs, industry and local & provincial government.

contents

	SMCRI DISTRIBUTED NETWORK	1
	Central Coordinating Unit	5
	Algoa Bay Sentinel Site	6
	Two Oceans Sentinel Site	8
	Natal Bight Sentinel Site	8
	Marion Island Sentinel Site	10
	Satellite Sentinel Sites	11
	Airborne Remote Sensing Platform	12
	Coastal Biogeochemistry Platform	13
	Hyperbaric Chamber Platform	14
	Data Management Platform	15
	Coastal Craft Platform	16
	Acoustic Telemetry Array Platform	17
	Marine Remote Imagery Platform	18
	Science Engagement Platform	19
	VALUE CHAIN	20



Central Coordinating Unit



The SMCRI is geographically dispersed, but managed from the Central Coordinating Unit (CCU) based at the newly established Ocean Sciences Campus of the Nelson Mandela University. The central location of the CCU relative to the Sentinel Sites allows for effective financial and operational management. The CCU being integrated with the SAEON Elwandle Coastal Node, means that CCU personnel (oceanography and data technicians, a systems developer and administrative staff) enjoy full operational support both in terms of human resources and infrastructure.

The Ocean Sciences Campus is well suited as an operational base for the CCU. Launched in October 2017 by the Nelson Mandela University, the Ocean Sciences Campus is envisaged to become a nucleus for innovation, research, teaching and engagement in key marine and maritime spheres. Through partnerships spanning disciplines transcending the socio-ecological spectrum, much needed human capital development and new knowledge will be generated to help steer the process of balancing pursuance of unlocking blue economic potential and sustainability. As a full partner in this initiative, SAEON and SMCRI will be embracing these challenges in the spirit of trans-disciplinarity and innovation. In so doing, considerable investment had been made by SMCRI in partnership with the university, which includes the establishment of a Marine Biogeochemistry Laboratory, Sedimentology Unit, Light Microscopy Laboratory, an Oceanography Electronics Workshop and significant infrastructural development in support of the Research Dive Unit.



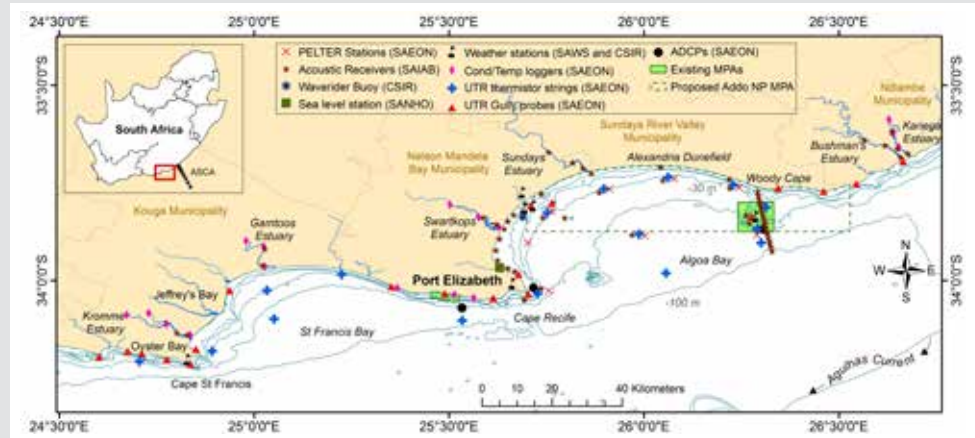


Algoa Bay Sentinel Site

essential ocean (EOV) and biodiversity variables (EBV) focussed on biogeochemical and plankton dynamics in Algoa Bay. Additionally, biological communities from the sandy beaches, rocky shores, subtidal reefs and islands are sampled at monthly to annual intervals. The objectives are to identify spatiotemporal trends of these key variables including the factors shaping their dynamics. These data types are also useful when studying ecosystem responses to periodic extreme meteorological, oceanic or biological events. Deep learning of such details not only aids the management of coastal ecosystems but also strengthens our ability to estimate how these aspects may change going forward. Algoa Bay is also a dynamic socio-ecological system where a productive coastal ecosystem interfaces with a vibrant socio-economic environment. As a natural socio-ecological laboratory, ABSS is thus well poised to make a meaningful contribution to regionally unique research opportunities in support of the grand challenge, which is to sustainably unlock South Africa's blue economy.



The Algoa Bay Sentinel Site (ABSS) located within the warm-temperate Agulhas Bioregion is the most comprehensive coastal observation network in South Africa spanning some 300 km of coastline between Port Alfred and Oyster Bay. Established in 2008, the ABSS now comprise more than 40 in situ coastal sensor moorings, 29 acoustic receivers, nine estuarine sensor moorings (temperature and salinity) and eight Pelagic Ecosystem Long-term Ecological Research (PELTER) sampling stations. Submerged coastal sensors measure water temperature, the velocity and direction of currents, swell/waves and gives valuable insight into how the physical environment is influenced by meteorological factors like winds and rainfall. The PELTER programme was established in 2010 and involves monthly sampling (~90 surveys to date) of key





Two Oceans Sentinel Site



The Two-Oceans Sentinel Site (TOSS), situated in the cold-temperate overlap region between the Agulhas Bioregion and the South-western Cape Bioregion, is still in the development phase. It is envisaged that the site will be located between Betty's Bay and Cape Town, incorporating False Bay and several Marine Protected Areas managed by SANParks and CapeNature. The equipment and sensors to be deployed will be similar to those in the Algoa Bay Sentinel Site, but the exact locations still need to be determined through a comprehensive consultative process. The activities in the TOSS will be similar to those taking place

in the ABSS, except that the TOSS will also include several Kelp LTER sites. Kelp forests are highly productive, protect the coast from storm surges and act as an important habitat for a range of commercially important species. Kelp is considered a good biological indicator of sea surface temperature change because the geographical limits of its distribution throughout the world are closely related to the maximum summer sea surface temperature. Close links have been forged by Kelp scientists in South Africa and the Santa Barbara Coastal Kelp LTER scientists in the USA as well as Australia.



Natal Bight Sentinel Site



The Natal-Bight Sentinel Site (NBSS), situated in the subtropical Natal Bioregion, is still in the development phase, but will be located in the area south of Durban to Richards Bay, incorporating the entire Natal Bight. The equipment and sensors to be deployed will be similar to those in the Algoa Bay Sentinel Site (ABSS), but the exact locations still need to be determined through a comprehensive consultative process. The activities in the NBSS will be similar to those taking place in the ABSS. A feature of the NBSS is the strong flowing Tugela River that supplies large volumes of freshwater, sediment and nutrients onto the Natal Bight Shelf, acting as an important driver of the pelagic and benthic ecosystem. Another unique feature of the NBSS is the presence of mangrove forests in the estuaries along the coast, in particular the Mhlathuze Estuary near Richards Bay, the largest mangrove forest in South Africa. Mangrove forests and salt marsh vegetation will play an important role in mitigating the impact of rising sea level as they have the capacity to accrete sediment and keep pace with the rising sea levels.





Marion Island Sentinel Site



Marion Island is one of two islands that form part of the Prince Edward Island group in the subantarctic, approximately 1769 km south-east of Port Elizabeth, forming the southernmost part of South Africa. Marion Island has an area of 290 km², a steep coastline of 72 km and a maximum elevation at Mascarin Peak of 1242 m above sea level. The island is part of the Southern Indian Ocean Islands tundra ecoregion that is host to a wide variety of species that are critical to conservation. As a result, the South African government declared the Prince Edward Islands a Special Nature Reserve in 2003 and 180 000 km² of ocean around the islands a Marine Protected Area in 2013, one of the world's largest environmental protection areas.

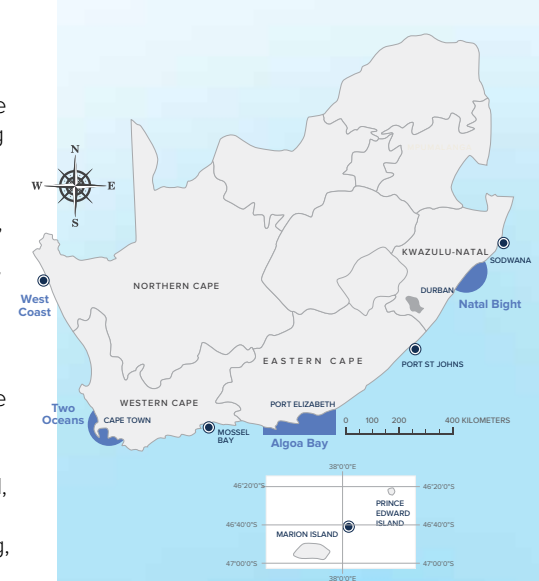
Global climate change in the Southern Ocean is causing shifts in the position and intensity of the major frontal systems and changes in oceanic circulation patterns within the region of the islands. The islands' climate has as a result changed significantly over the last few decades, becoming warmer and drier, causing the loss of the ice plateau and permanent snow cover on Mascarin Peak. The SMCRI, in collaboration and in consultation with the Department of Environmental Affairs, the South African Marine and Antarctic Research Facility, the South African National Antarctic Programme and various other research entities, will establish a suite of observatories in the coastal zone to study environmental drivers, ecological processes and change.



Satellite Sentinel Sites



Large stretches of the 2300 km long South African coastline are not represented by the four Sentinel Sites. To improve our understanding of these regions, satellite sentinel sites will be developed along the West Coast (Namaqualand), South Coast (Mossel Bay), Wild Coast (Port St Johns) and North Coast (Sodwana Bay). These sites will be equipped with a Coastal Observation Mooring, similar to those that will be deployed in the Sentinel Sites. These moorings will consist of a surface buoy equipped with a weather station and sensory package to transmit the data from the in situ surface and underwater sensors to the Central Coordinating Unit. The sensor package associated with the mooring will include an Acoustic Doppler Current Profiler (ADCP) on the seafloor (to measure current speed and direction as well as swell), a pCO₂ and pH sensor near the surface (to measure ocean acidification), a Conductivity/ Temperature /Depth (CTD) instrument attached to a profiler, a cabled acoustic telemetry receiving station (to record tagged marine species) and underwater temperature recorders (UTRs). The data will be rendered on a website in near real-time and will be accessible to the public. These moorings will, in addition to their scientific value, provide important data to improve marine forecasting, early warning systems, risk and vulnerability studies and marine safety.





Airborne Remote Sensing Platform

The SMCRI has acquired a single engine, high wing light aircraft equipped with complex and integrated sensory equipment for the purposes of conducting aerial surveys where accurate, geo-referenced high definition (HD) imagery are required for scientific purposes. The aircraft is a Glasair Sportsman, a modern design from the USA that offers exceptional performance capabilities for its class and is affordable to operate as it runs on automotive fuel (mogas) as opposed to aviation fuel (avgas). With 6 hours endurance and a cruise speed of 135 knots it allows for vast distances to be covered without refuelling.

The sensory pack is setup over open viewports in the fuselage floor which allows for the continuous capture of high quality overlapped, horizontal images. High definition, geo-referenced orthomosaics can be generated from these images using state

of the art post-processing software which corrects for angle distortions and drift by using information generated by the Inertial Measurement Unit (IMU) at the time of each image's capture. These surveys will be used mainly to document and monitor changes in vegetation, dune and shoreline migration, estuary mouth states and episodic events (e.g. Harmful Algal Blooms, oil spills, etc) along the entire coastline of South Africa. The initial sensor installation also allows for the capture of thermal Infra-Red (IR) images that are useful for mapping surface spatial temperature patterns. The intention is for both a hyperspectral sensor and LiDAR (Light Detection and Ranging) to be installed at a later stage to enable the platform to accurately measure the reflectance of the landscape/ocean as well as generate precise, three-dimensional information about the shape of the Earth and its surface characteristics down to a depth of 30 m.



Coastal Biogeochemistry Platform

The Coastal Biogeochemistry Platform is housed at the Ocean Sciences Campus of the Nelson Mandela University in Port Elizabeth. The platform currently consists of a Seal AA3 nutrient auto analyser (to measure marine and estuarine water for SiO_4 , NO_3^- , NO_2^- , NH_4^+ and PO_4^{3-}), a Milli-Q water purification system (to supply Type 1 Ultra-pure water), a Turner Designs fluorometer (to measure chlorophyll-a), a Hitachi UV-Vis spectrophotometer (to measure dissolved oxygen, pH and chlorophyll-a) and a Walz PHYTO-PAM fluorometer (to measure chlorophyll content and photosynthetic efficiency of microalgae). The laboratory will be expanded to also include a Flash Elemental Analyser (to measure nitrogen and carbon in sediment, organic material, seawater and on filters). The laboratory is operated by a dedicated team consisting of a marine biogeochemist, a laboratory technician and an intern.



The laboratory accepts samples from all the SMCRI Sentinel Sites and affiliated research projects around the coast of South Africa. Close links have also been forged with other Research Infrastructures forming part of the SARIR, in particular the Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON) and the Biogeochemistry Research Infrastructure Platform.

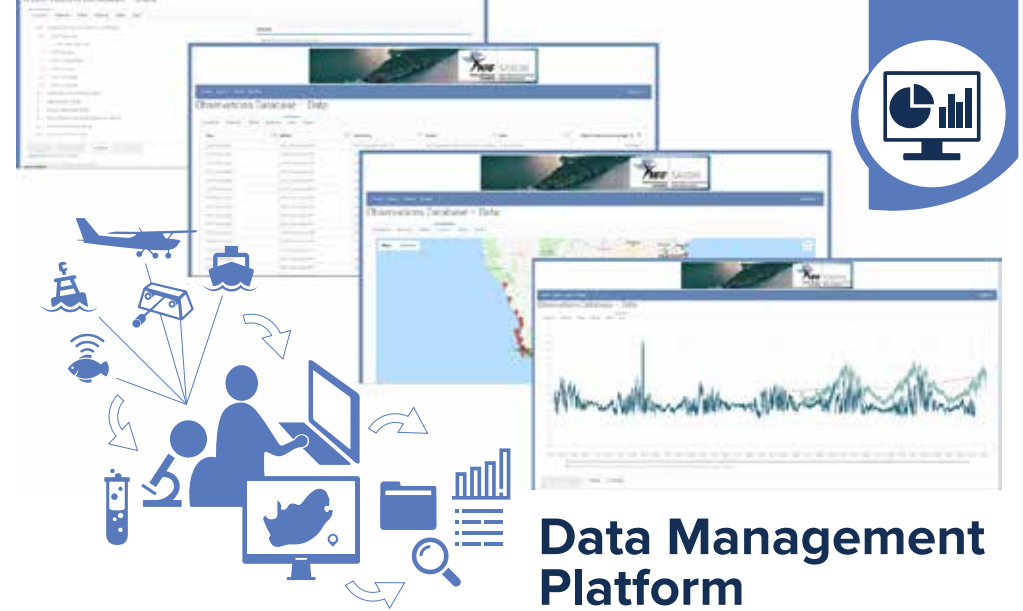


Hyperbaric Chamber Platform

SMCRI acquired a new fully functional Hyperbaric Chamber that has been installed at the Ocean Science Campus of the Nelson Mandela University in Port Elizabeth.

Twelve 50L air-banks, configured (2 x 6) for redundancy and connected to a digitally programmed and fully automated high-pressure (HP) compressor support the chamber unit. The chamber comprises an entry lock (2-man sitting) and the larger main lock (8-man sitting or 2-man supine) for the purposes of getting medical personnel or patient assistants into or out of the chamber whilst keeping the diver or occupants at constant uninterrupted pressure. Both locks are fitted with oxygen bibs which are fed by their own separate oxygen supply with external exhausts. The chamber comes complete with internal cameras, lighting, two way communications, state of the art gas analysers that constantly monitor O₂ and CO₂ accumulation as well as internal CO₂ scrubbing devices. It is also equipped with a pressurised medical hatch to transfer medication or food to occupants under pressure without interruption.

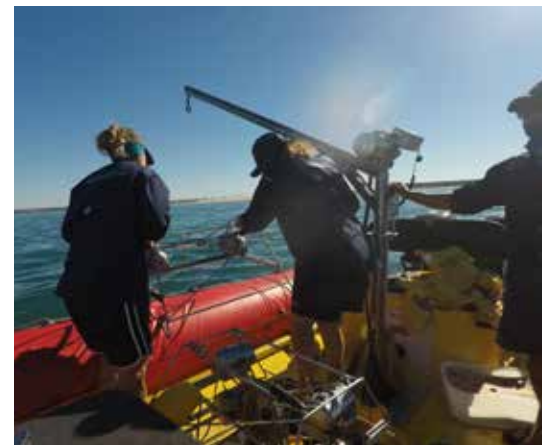
There has not been a functional hyperbaric chamber in the Eastern Cape for a number of years and the chamber will be operated as a 24 hr emergency facility available to the entire diving community (scientific, commercial, search and rescue and recreational). The chamber will also be used for scientific diver training (Class V and IV) by the two research diver training schools based at the Nelson Mandela University and the University of Cape Town.



Data Management Platform

The SMCRI will produce a variety of data products and services in support of scientific research and decision making at the interface of science, society and policy, locally as well as internationally. The Data Management Platform centralises the coordination of data workflows from the point of observation to implementation by the user. Responsibilities therefore include cleaning, verification, accessioning and effective dissemination of observational data. Infrastructural investment at the CCU allows for fast internet connection (Gigabit) and access to physical and cloud-based servers. Fast connection is operationally imperative to allow for movement of large data batches

to and from servers as well as handling the constant influx of continuously transmitted data from remotely stationed sensors like Coastal Observation Moorings. To meet the demand for safe storage and effective delivery of good quality data the SMCRI will utilise existing data products already in use by SAEON and partner institutions like the Observations Database, South African Estuaries Information System (SAEIS) and the Marine Information Management System (MIMS), while remaining responsive to future needs where such resources may not be sufficient. All data and data products produced by the SMCRI will be openly available and provided unencumbered through free and timely access.





Coastal Craft Platform



The SMCRI supports and expanded on the Coastal Craft fleet developed by the SAIAB through the African Coelacanth Ecosystem Programme (ACEP). The Platform will consist of at least three (> 9 m in length, but < 25 tons) coastal research vessels based at each of the three Sentinel Sites. The Coastal Craft are fully equipped with state-of-the-art scientific instruments for oceanographic work (CTD and ADCP), plankton sampling (plankton pump and bongo nets), benthic surveys, invertebrate collections (ROV and epi-benthic sled), habitat mapping (jump camera), benthic mapping (multi-beam), fishing, diving and sediment collection (benthic grab) and the physical infrastructure required to operate them, such as hydraulic winches, cranes, A-frames and computers. The coastal craft are crewed by a team of dedicated and experienced skippers and marine technicians, thereby allowing the scientists to focus on their research while out at sea. Additional instruments that are too costly to replicate on each vessel will also be available to be shared among the vessels depending on need and include a multibeam echosounder. The three vessels are CC Phakisa (based at the Natal Bight Sentinel Site), CC uKwabelana (currently based at the Algoa Bay Sentinel Site, but will be relocated to the Two-Oceans Sentinel Site) and CC Jahleel (under construction and will be based at the Algoa Bay Sentinel Site).



Acoustic Telemetry Array Platform

The Acoustic Telemetry Array Platform was developed by SAIAB and consists of over 100 in situ telemetry receiver stations along the coast from Cape Town to Ponto De Ouro. The receivers are located in depths from 15 to 80 m. The platform manages the receiver network (receiver deployment and retrieval) and manages a database of all detections. Collaborating partners tag species (> 30 different species) according to their research programmes and at present there are 573 known active transmitters in the water, the majority of which are long-life transmitters (up to 3 650 days). Currently, the receiver network comprises 66 offshore stations (12 Vemco VR2W units on Sub Sea Sonics acoustic releases, 15 VR2W units on diver-retrieved fixed moorings and 40 Vemco VR2AR receiver/release units) and 38 VR2W estuary stations. Although the ATAP is a mature platform, the SMCRI will improve the coverage and facilitate the expansion of the research infrastructure up the West Coast. ATAP is also well positioned on the international arena and continues to have strong ties with the Canadian-based Ocean Tracking Network (OTN) project.





Marine Remote Imagery Platform

The Marine Remote Imagery Platform (MAR-IP), managed by SAIAB, provides access to a variety of underwater imaging equipment that can be used to conduct exploratory and quantitative surveys of benthic, demersal and pelagic marine biota. The equipment includes a SAAB Seaeye Falcon remotely operated vehicle (ROV) capable of working down to 300 m depth and fitted with a 12 megapixel still camera, a high definition video camera and a 5 function manipulator arm for collecting specimen samples.



The platform also offers a broad variety of stereo-video camera systems including tethered (HD video cameras; depth rating = 350 m; n = 15) and untethered (HD video cameras; depth rating = 1000 m; n = 2) stereo baited remote underwater video systems (stereo-BRUVs), pelagic stereo-BRUVs (4K video cameras, depth rating = 50 m; n = 6) and a diver operated stereo-video system (4K video cameras; depth rating = 100 m; n = 1). In addition, the platform offers two multi-imaging drop cameras rated to 350 m depth and each fitted with a downwards facing 20mp mirrorless still camera and oblique facing 4K stereo-video cameras, as well as diver operated still camera systems. The platform includes a computer laboratory with all the required software for processing of imagery data, a large network attached storage system for the long-term archiving of all imagery samples and a comprehensive biodiversity data management systems linked into the Specify Software system used for managing biological specimen collections.



Science Engagement Platform



The Science Engagement Platform strives to bridge the gap between formal education and community development through awareness initiatives such as job shadowing opportunities, Career Festivals, National Science Week, National Marine Week and Ocean Sciences Campus Tours activities. Educational outreach seeks to expose and nurture grade 9, 10 and 11 learners to scientific activities to raise their awareness and enhance their scientific skills. The programme provides learner-teacher-support workshops that provide them with an opportunity to engage in hands-on science. The Schoolyard LTER programme is a school based monitoring example where schools collect and analyse data from weather stations provided to them by SAEON to develop projects.

Science camps offer hands-on experience opportunities to both learners and educators to engage in real science and develop scientific knowledge and skills whilst interacting with role models and practicing scientists. Selected learners are provided with an opportunity to participate in the annual SAEON Education Symposium,

where they present their school-based projects, or projects developed from SAEON/SMCRI data, in front of their peers, teachers, education officials and other guests. Learners who work on SMCRI-related topics are assisted by SMCRI staff in their preparations for the education symposium and ESKOM Science Expo for Young Scientists.

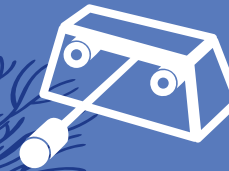




SMCRI VALUE CHAIN

OBSERVATIONS

- SS (x4) & SSS (x4)
- Aerial
- ATAP
- MaRIP
- Coastal craft



PUBLICATION

- Data management platform
- Central Coordinating Unit
- Biogeochemistry



- Data management platform
- Central Coordinating Unit
- Science engagement
- Hyperbaric platform

UPTAKE & IMPACT

- Leading-edge research and infrastructure platforms
- Innovation
- Science engagement
- Capacity building & training
- Inform coastal socio-economic decision making & policy
- Open data for open science





PHOTO CREDITS:

Bailey, S; Benjamin, S; Bernard, A; Bornman, T;
Cowley, P; Daly, R; Deyzel, S; Eriksen, T; Human, L.;
Kuntz, W; Melley, B; Murray, T; Parker-Nance, T.;
Parker-Nance, S.; Plön, S.; Slingsby, J.;
van Deventer, J.; Williamson, R.

CONTACT:

SMCRI Central Coordinating Unit,
SAEON Elwandle Coastal Node

📍 Ocean Sciences Campus, Nelson Mandela University
4 Gomery Avenue, Summerstrand
Port Elizabeth, 6000
South Africa

📞 +27 41 5044750

✉ smcri@saeon.ac.za

🌐 <http://smcri.saeon.ac.za>

🐦 SMCRI_ZA

Designed by caria@mydrawingroom.co.za