OUR PARTNERS

OVERVIEW

Ocean Accounts Framework applicability in Algoa Bay.

Erika Brown

GIS Product Developer, Research Associate and Consultant

Community of Practice: Western Indian Ocean, Ocean Accounts Work Programme 2 Progress

Workshop 3 Report: October 2021

Workshop 3 Report: October 2021

Team:
Juliet Hermes – Project lead and SAEON Egagasini Node Manager
Nicole du Plessis – Project lead and SAMREF/SA IORAG Science Officer
Tommy Bornman – Project lead and SAEON Elwandle Node Manager
Erika Brown - GIS product developer, research associate and consultant

1. Executive Summary

The third workshop for the National Research Foundation (NRF) Community of Practice: Western Indian Ocean, Ocean Accounts Framework Work Programme 2 (WP2) was held on the 30th September 2021, in a follow up to the first two workshops held in December 2020 and March 2021. Stakeholders were first provided a recap on what Ocean Accounts is and how it could be implemented in South Africa and, then were provided information and transparency in the WP2 approach to accessing and utilizing oceanographic biophysical and biochemical data in Algoa Bay as a case study for implementing Ocean Accounts. While preliminary suggestions were made regarding data already acquired for use in an Ocean Accounts Framework (OAF) (i.e. modelled and tabular data), additional data gaps, needs, and/or redundancy will be determined by ongoing stakeholder engagement and feedback. A follow up webinar will be hosted in November/December 2021 to showcase a representative GIS platform and online user tool of Ocean Accounts related spatial data from the Algoa Bay area and a final stakeholder and policy maker engagement within the greater Algoa Bay Project group early in the New Year (2022).

This third stakeholder engagement was successful in raising awareness about Ocean Accounts in South Africa, introducing the topic to new participants and introducing the alpha version of the online data visualization tool and ESRI based interactive map viewing application. Attendance was higher than the previous workshop as well as many new attendees.

Next steps will include a technical report (November) and final summary report (December), the continued development of a GIS database and associated oceanographic layers according to the extent specifications and depth related ‘Levels’ shown in each workshop to date as well as a publicly accessible online ‘Map Atlas’ and user tool for visualizing any biophysical Ocean Accounts data, and lastly, a series of Ocean Accounts tables of extent and condition of ocean assets, services and ecosystems in Algoa Bay will be made available upon completion.

Acknowledgement: This research was funded by the South African Research Chairs Initiative through the South African National Department of Science and Innovation/National Research Foundation, by a Community of Practice grant in Ocean Accounts Framework (UID: 125455). The opinions expressed in this publication are not necessarily those of the funding bodies.

Table of Contents

2. Workshop Focus

NRF Community of Practice in Western Indian Ocean- Ocean Accounts Framework (OAF) data development, needs, gaps and insights. A broad introduction to the Ocean Accounts Framework and Work Programme 2's work on the contribution that oceanographic research and large datasets can make to spatially-based ecosystem accounting models within the OAF.

Purpose: To engage with stakeholders policy/decision makers and other ocean user communities to highlight the progress of OAF Work Programme 2 in Algoa Bay spatial data development for extent and condition accounts, data needs/gaps for populating the accounts, and demonstrate a prototype multi-user GIS platform/online tool for informing and accessing outputs from the WP2 and greater OAF process in South Africa.

Who Should Attend: Algoa Bay stakeholders, collaborators, CoP WP research teams, ocean user communities, marine professionals and researchers.

Table 1. WP2 Workshop 3 Agenda.

Time Available:	**Agenda Items:**
10:00 – 10:10 am	Opening, Rules of Engagement & Introductions -Erika and Team
10:10 – 10:30 am 10:30 - 10:45 am	Introduction of Ocean Accounts Framework Spatial data structure, tabling process, format and example account.
10:45 – 11:00 am	Q & A + 5-10 min Break
11:00 – 11:15 am 11:15 - 11:30 am 11:30 - 11:45 am	Synopsis of WP2 and spatial data development and recap of previous workshops. Where are we at and where are we going? GIS Platform/Online Tool –Introduction, conceptualization and demonstration. Who has access and how, this is set up to be adaptable. How will this product evolve over time. How will the stakeholder, policy maker, ocean user community inform, access and utilize this platform? Filling in the gaps with data, Algoa Bay satellite and model data, as well as further needs. Case Study review/Indicators/Alignment with other groups/what has worked what is still required. Outreach, building awareness, streamlining with other groups.
11:45 am -12:00 pm	Q & A, Discussion and Reflections, Conclude

3. Workshop Content

A multi-part workshop that entailed a recap of the Communities of Practice Western Indian Ocean Working Group Ocean Accounts Framework (OAF) as developed by the Global Ocean Accounts Partnership (GOAP) by Erika Brown and a detailed update on Algoa Bay oceanographic data development and product output by Erika Brown was presented and discussed. To view the presentations refer to this link.

(https://drive.google.com/drive/folders/1FGz3fI33JZHs0091irO8jOwdJpYxiEhx?usp=sharing)

3.1 Part1: Introduction to Ocean Accounts

The oceans are facing increasing anthropogenic pressures and with the oceans considered the next economic frontier, this is likely set to increase in coming years. This is apparent in international discussions on the development of ocean economies or blue economies including such initiatives as the High Level Panel for a Sustainable Ocean Economy, the Global Ocean Accounts Partnership, the GOAP Africa CoP Pilot Study Project being led by CPUT, including Kenya, Mozambique and South Africa, and more locally the African Union 2050 Africa's Integrated Maritime Strategy and South Africa's Oceans Phakisa Programme, to name a few.

South Africa is also one of five countries participating in the UN Natural Capital Accounting & Valuation of Ecosystem Services Project (led by Stats SA and SANBI nationally) which aims to assist the participating partner countries to advance the knowledge agenda on environmental and ecosystem accounting and initiate pilot testing of the System of Environmental-Economic Accounting (SEEA) Experimental Ecosystem Accounting (EEA), now EA after a recent review process, with a view to improving the management of natural biotic resources, ecosystems and their services at the national level as well as mainstreaming biodiversity and ecosystems in national level policy, planning and implementation.

Additionally in the context of the Africa Blue Economy, Ocean Accounts can inform each of the thematic areas that make up the Agenda 2063 (Figure 1), as mentioned the 2050 African Integrated Maritime Strategy, and the 2015 – 2025 Decade of African Seas and Oceans.These well established programmes are working at continental, regional and local scales and countries such as Mozambique, Kenya and South Africa are at the forefront.

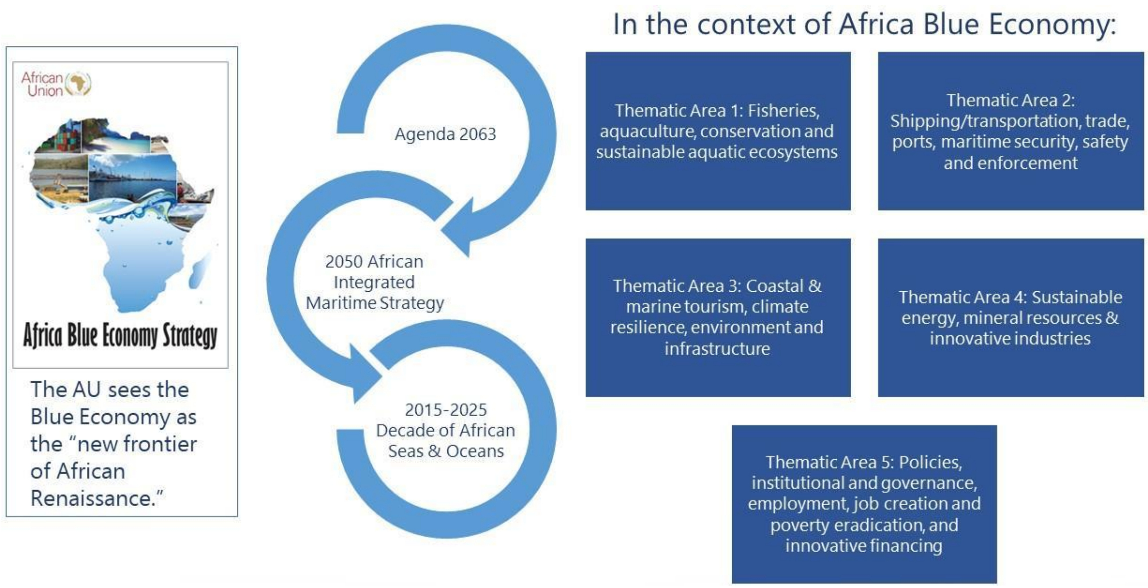


Figure 1. The Africa Blue Economy and associated themes (right side) under the Agenda 2063 that Ocean Accounts can help inform.

The Ocean Accounting component is in development, and the established NRF Communities of Practice - 'Western Indian Ocean: Assessing the applicability of the ocean-accounts framework' aims to engage with these international programmes to develop oceans accounts in South Africa and contribute to the above mentioned initiatives.

3.1.1 Ocean Accounts Framework and the Work Programmes

The ocean-accounts framework (OAF) provides a common, consistent and standardised information infrastructure for organising and integrating ocean data from various domains. It is increasingly being recognised as an important ocean-governance and policy-development instrument, which boosts the transdisciplinary power of data for marine spatial planning, integrated coastal management (ICM) and international reporting. The goal of this community of practice (CoP) is to assess the applicability of the OAF in South Africa and the Western Indian Ocean (WIO) as a central component of a wider strategy to ensure that ocean governance contributes as optimally as possible to the broader sustainable goals of South Africa and the other Indian Ocean Rim Association (IORA) member States by ensuring the inclusivity, safety, security and sustainability of coastal communities.

The aim of the CoP will be achieved through the following phased objectives during phase 1 over the course of 2020 to 2021:

(a) to investigate and assess the efficacy and relevance of the OAF in the process of sustainable and inclusive ocean-policy development and implementation and in the process of applying ocean-governance instruments in three of the coastal provinces of South Africa (the Eastern Cape, KwaZulu-Natal and the Western Cape);

(b) to explore the role of gender and culture in the OAF through the identification and disaggregation of data; and

(c) to ascertain the extent to which the OAF can contribute to the assessment of the risk and associated hazards, exposures and vulnerabilities associated with climate change, food security and unsustainable development in the three provinces.

Due to the severe impact of the COVID-19 pandemic on research activities, the main focus of the CoP will be on the Algoa Bay area, without excluding readily available data and case studies relating to other coastal locations in the three provinces. The work of the CoP is organised under eight work programmes (WP).

WP1 - Legal environment and regulatory aspects of the oceans-account framework

WP2 - The role of oceanographic research and large datasets for ocean accounting models within ocean governance

WP3 - The structure of the ocean-accounts framework in ocean governance

WP4 - Women's economic empowerment in the Western Indian Ocean

WP5 - Socio-ecological aspects of the oceans account framework

WP6 - Blue-carbon-habitats aspects of the oceans account framework

WP7 - Risks and vulnerability in the ocean

WP8 - Focuses on OAF-related knowledge-production opportunities across the other WPs.

3.1.2 An overview of the focus of Work Programme 2

Work Programme 2 focuses on the contribution that oceanographic research and large datasets can make to spatially-based ecosystem accounting models within the OAF and aims to review biophysical datasets and their applicability of use to develop spatially based ecosystem accounts (of extent and condition) and natural capital flows to social and economic domains and to identify data deficiencies and needs for the data development approaches required for spatially based Oceans Accounting.

Identifying ecosystem assets are important within the System of Environmental Economic Accounting (SEEA) ecosystem accounting (EA) framework as these assets form the basis of the statistical units for EA, for which statistics are ultimately compiled. For ecosystem assets this is the information with regard to their extent, condition, the services they provide and their value.

How to spatially delineate marine areas and how to assess or envisage this is currently under review by the UN SEEA programme so South Africa is well-placed to provide valuable feedback and advice.

The Global Ocean Accounts Partnership's "Technical Guidance on Ocean Accounting for Sustainable Development", version 0.9, 2019, is a valuable resource to refer to for advice on how to approach implementation of an OAF. There have been several iterations of this guide and it will continue to evolve at least into the near future. It puts all of the aforementioned frameworks and accounting systems in context and provides some guidance when embarking on establishing an OAF.

There are five main points included in the guide (see below) and Points 4 and 5 fall under the mandate for WP2.

1. Sustainability Indicators,
2. Sectoral Evaluation, Finance and Investment,
3. Strategic Sectoral Development Planning,
4. Spatial Management, and
5. Ocean Analyses, Monitoring and Assessment.

Ocean complexity begs for integrated management plans like we see globally in countries like the Netherlands, the UK and Israel for example, and can only improve locally at a national level through the South African Marine Spatial Planning process, SANBIs NBA 2018 and the work they are doing in Natural Capital Accounts with Stats SA, and at a bay or regional scale through current work by Nelson Mandela University's, Algoa Bay Project (Figure 2).

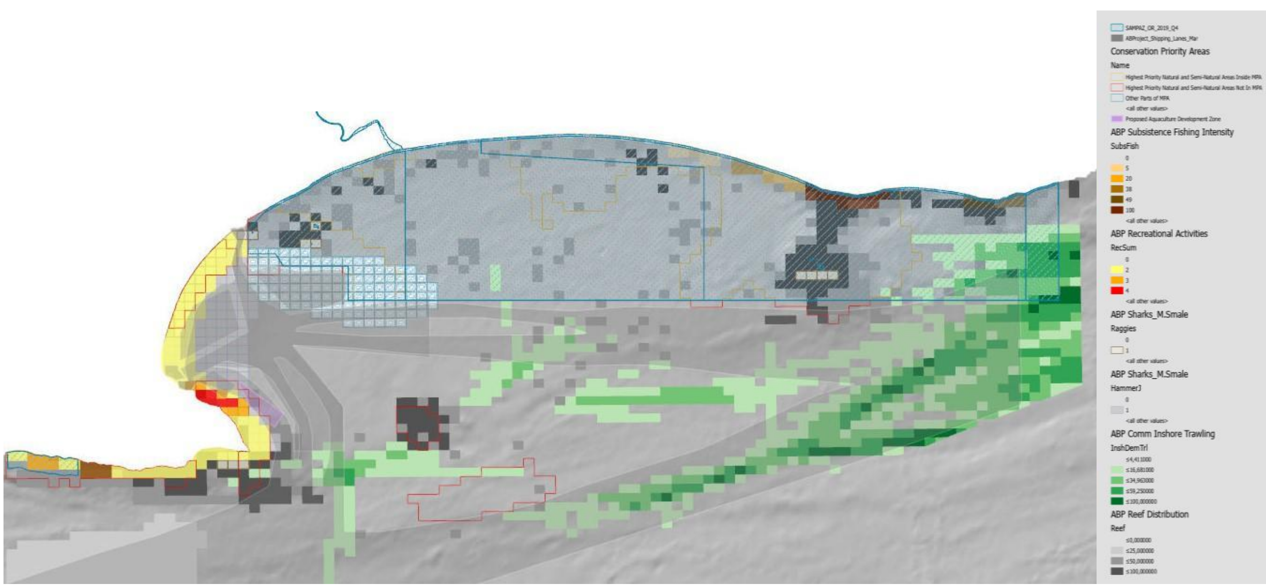


Figure 2. Example of the complexity of multiple users in an ocean space (Algoa Bay) and the Marine Spatial Planning process that seeks to consider all.

Humans derive numerous benefits from complex ocean systems through ecosystem and abiotic services. Both market and non-market values, and assets require accounting in the estimation of the contribution of oceans to societal well-being, as do the impacts of economies on environment. New "blue economy" approaches to ocean governance are required to account for inclusivity and sustainability (Figure 3).

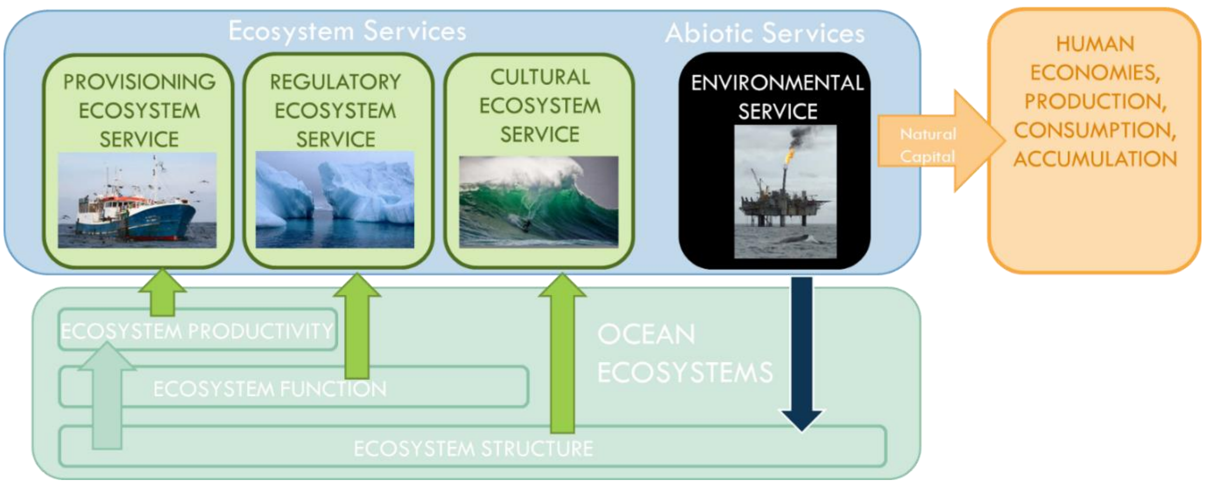


Figure 3. Flow diagram of how oceanographic variables relate to and inform ecosystem and abiotic services which creates the Natural Capital supplying our economies. Source: CPUT, Findlay K., 2020.

Why Ocean Accounts?

1. Development of integrated indicators that decision makers can understand for informed decision making that includes sustainability and inclusivity within ocean planning (extends from an ecosystem level to a National Accounts level).
2. The development of inventories that strengthen national statistical systems.
3. Integration of large volumes of novel ocean data and identification of data gaps and needs.
4. Justification of the value of research, management, and policy in the ocean space.

When considering why Africa at large can benefit from Ocean Accounts, some facts to recall are 70%, that's 38 of Africa's 54 sovereign states, are coastal. Africa has a coastline of approximately 30,500 km – 40, 000km. South Africa alone has 3,200 km of coastline. Africa's oceans and inland water areas are three times the size of its land mass. Maritime zones under Africa's jurisdiction total approximately 13 million square kilometres and about 6.5 million square kilometres of relatively accessible continental shelf. Ninety percent of Africa's imports and exports are conducted by sea.

When considering ocean governance, a definition of ecological governance captures the essence of Ocean Accounts - "a process of informed decision-making that enables trade-offs between competing resource users so as to balance environmental protection with beneficial use in such a way as to mitigate conflict, enhance equity, ensure sustainability and allow accountability" (Turton *et al*. 2007). Governance is about Trade-Offs which require valuations (across nested environmental social and economic domains). They are all intertwined and connected and value can no longer be strictly determined by Gross Domestic Product (GDP) (Figure 4). This is an unsustainable practice. Ocean Accounting aims to try and achieve a new way forward.

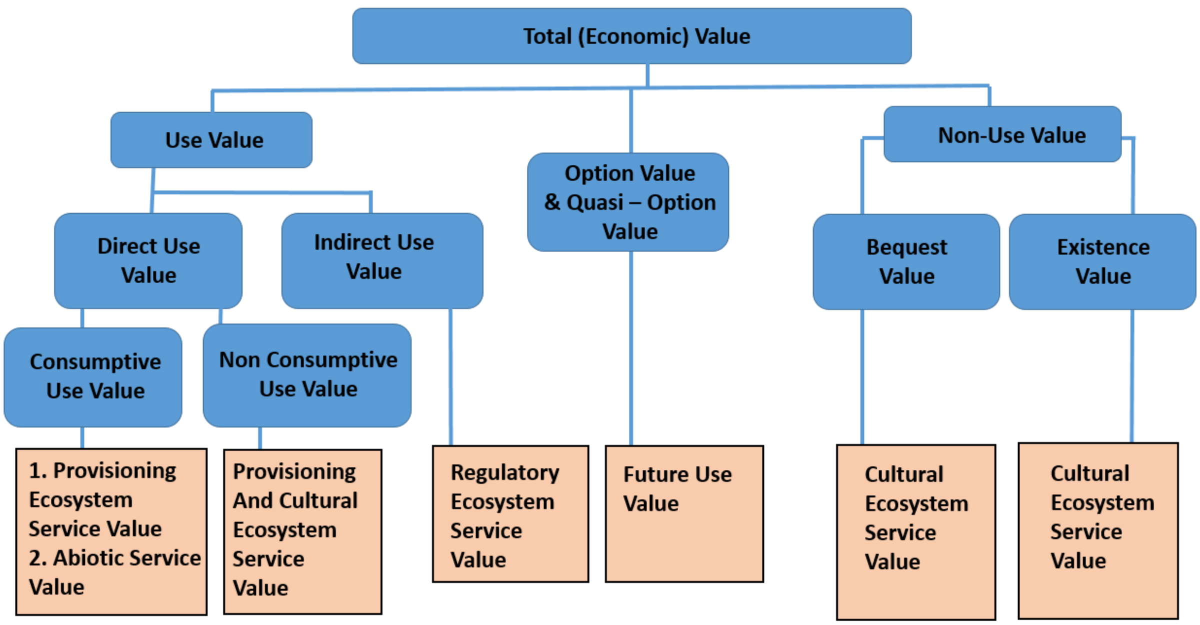


Figure 4. Flow chart of how ecosystem services feed into economic use values and non-use values, as well as the option between the two. Source: CPUT, Findlay, K., 2020.

3.2 PART 2: WP2 development in spatial data collation, needs/gaps and an alpha version of an online data visualization tool

Because oceans are changing (naturally and anthropogenically), ocean measurement and analyses are changing, and human resource use of oceans are changing, it is clear, as highlighted above, that how we value and quantify this process must also change.

The aim is to contribute to the international dialogue for developing ecosystem asset extent and condition accounts by reviewing available datasets and their applicability for use to develop spatially based Ecosystem Accounts (through case studies), with the outcome to provide a GIS platform and an online tool to visualize the accounts.

The WP2 role in the greater OAF project is to engage with stakeholders around dataset availability, and potential for collaborations and shared experiences; develop and implement a GIS platform, using oceanographic data provided; develop ecosystem assets, extent, condition and ocean ecosystems typology derived from the data; identification of ecosystem flows to social and economic domains; and finally, translate GIS information into accessible stakeholder and policy maker knowledge (Figure 5).

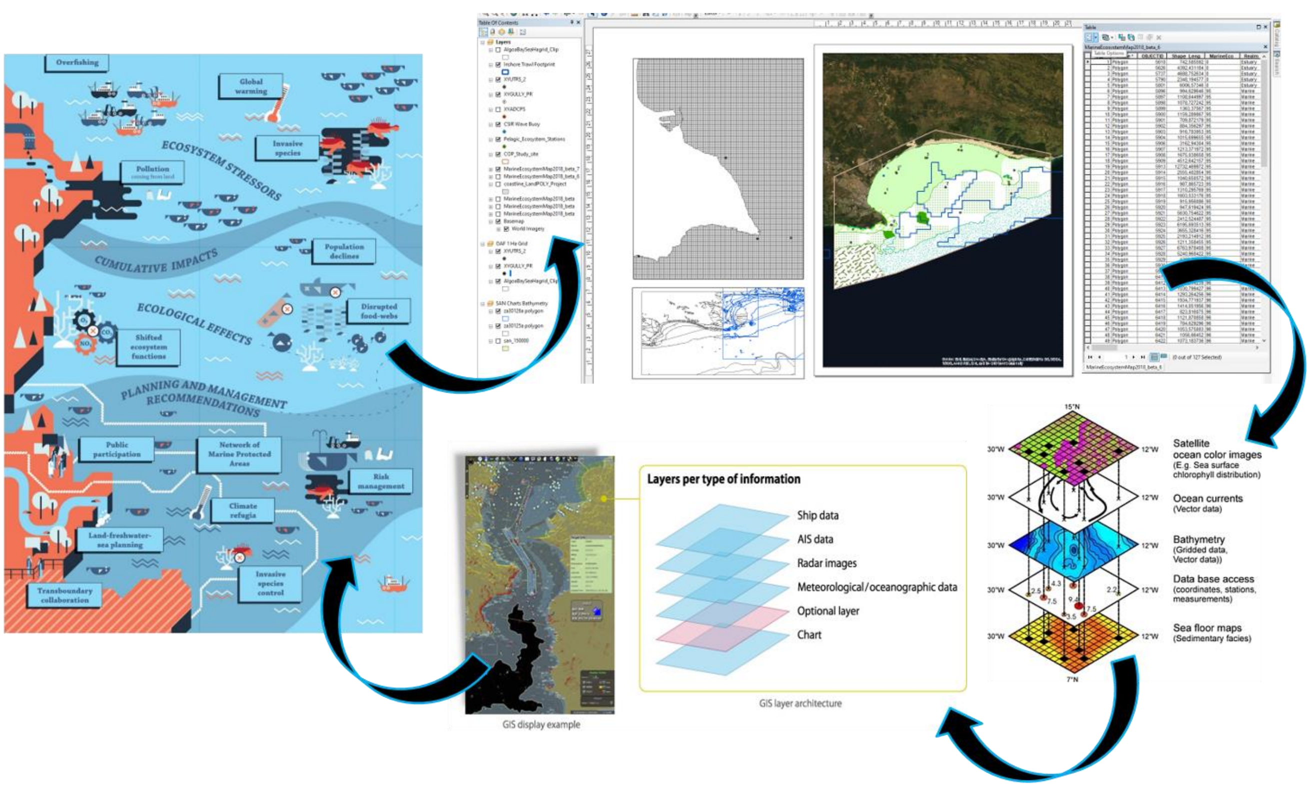


Figure 5. OAF data flow to inform planning, management and policy makers.

Algoa Bay is the initial area of focus because of the COVID-19 pandemic limitations which led to scaling back the original scope of the project. Algoa Bay is a representative area to test applicability of this framework because of its complex web of users, productive upwelling environment, dynamic oceanographic forcings in the bay, long term data availability, multi-organisation collaborations are ongoing, and topical work in process at present through the work of SANBI, The Algoa Bay Project and the MSP strategy (under the jurisdiction of the new Marine Spatial Planning Act (Government of South Africa, 2019)).

Ecosystem extent accounts, along with ecosystem condition accounts, usually form the basis of ecosystem accounts. This workshop addressed, building awareness and understanding of Ocean Accounts and how oceanographic data can contribute to its development.

Ocean Accounts forms a holistic valuation, a step in the larger process to policy and governance. Below is a diagram to show OAFs position within the greater MSP process (Figure 6). As our oceans change, as measurement of our oceans change, and as our use and protection of our oceans and its resources change, Ocean Accounts can support monitoring and adapting to these inherent changes.

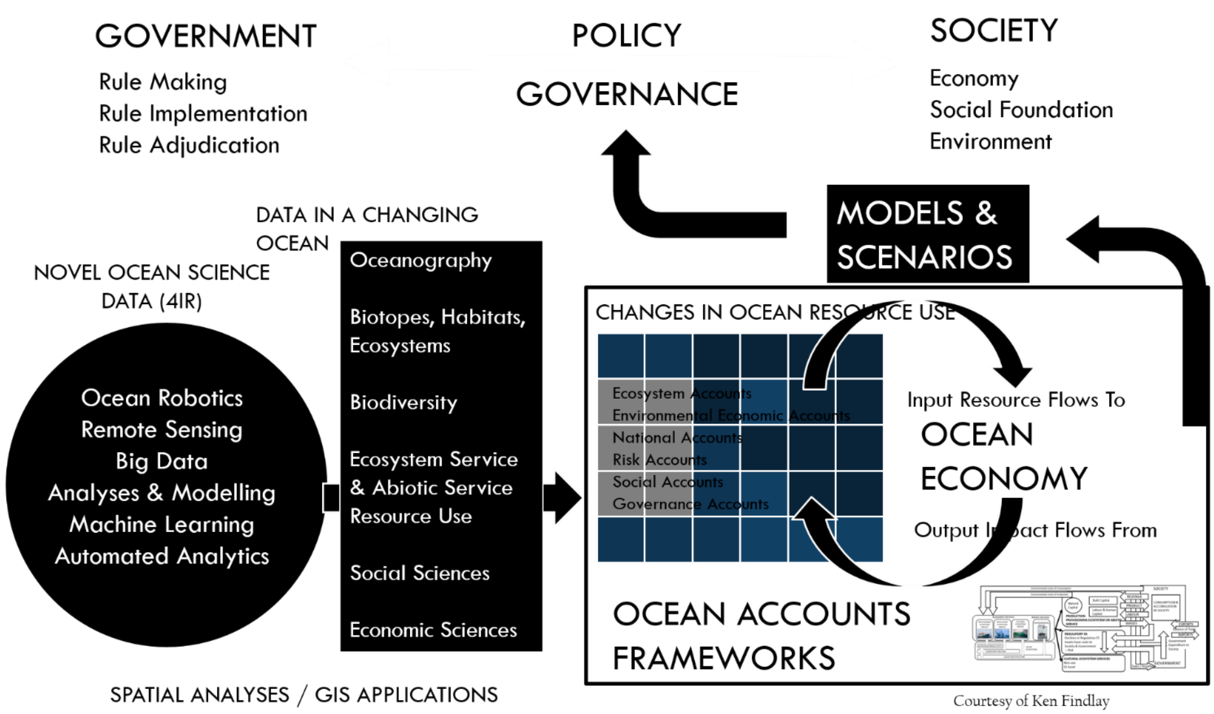


Figure 6. A diagram depicting a holistic approach to valuating Natural Capital and how OAF informs policy, governance, government and society.

3.2.1 OAF Algoa Bay data

Basic elements of the spatial data infrastructure should include shoreline, bathymetry and the designation of spatial units (i.e., Marine Basic Spatial Units (MBSUs or BSUs for short) based on a grid or other spatial framework) (Figure 7). Other elements would be overlaid as either asset types, uses or conditions.

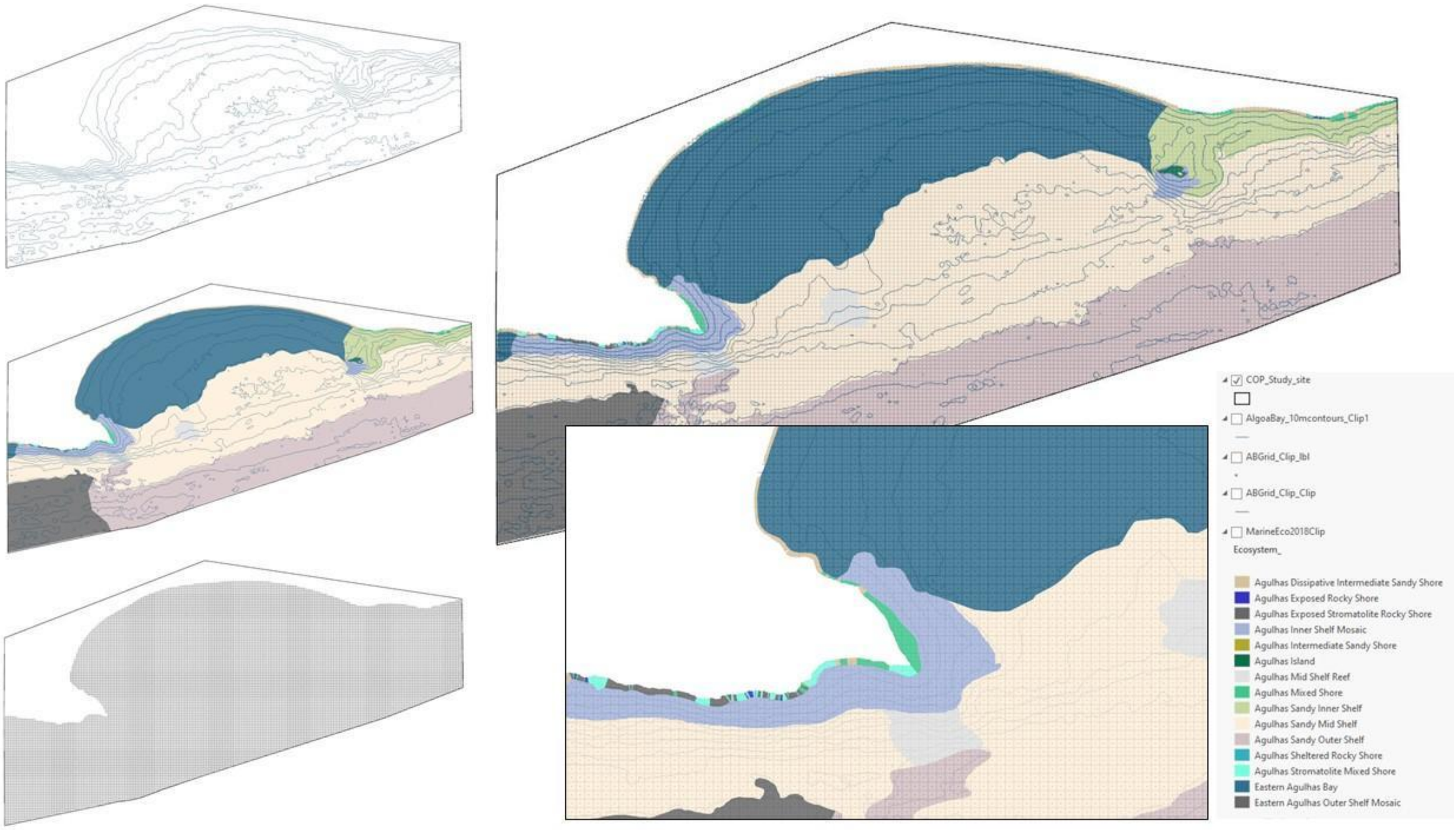


Figure 7. **A series of maps showing the basic elements of the spatial data infrastructure for Algoa Bay (study area, 10 m contour bathymetry, SANBI 2018 ecosystems types, and bay scale grid).**

The choice of condition measures will be informed by national priorities and data availability. For example, data on nutrient concentrations would inform concerns about algal blooms or eutrophication, chlorophyll-a data can give an indication of biological productivity, while sea temperature and sea height can indicate warming or cooling trends over time or sea level change. There are many approaches to “reference condition” and these should be agreed and policy relevant (e.g., pristine, sustainable, specific date in the past, pre-industrial, etc.). Generally, reference conditions should be distinct from “target conditions”, which may be set by policies, but not necessarily consistent with maintaining or improving capacity to provide optimal long-term ocean services.

Some key condition variables that would inform multiple ocean-related concerns include:

— pH (acidity)

— BOD, COD, Chlorophyll a, primary productivity (an indicator of eutrophication)

— Species diversity, ecosystem diversity (Shannon index of diversity)

— Concentration of floating plastics

— Sea surface temperature (SST)

— Coral condition (cover, % living, %bleached)

— Seagrass and mangrove cover (%)

In the case of Algoa Bay, seagrass and mangrove cover could be replaced by kelp forest cover (% cover) for instance.

Initially the SAEON Sentinel Site, NMU, SAIAB, and Rhodes University data from Algoa Bay will be utilized to inform a case study application (Figure 8). Gully Temperature Probes (GTU), Underwater Temperature Recorders (UTR), Acoustic Doppler Current Profiler (ADCP), and Conductivity Temperature Depth (CTD) instruments that have been recording oceanographic conditions as a part of a long term monitoring project in Algoa Bay will be used. Oceanographic and biological variables will include depth (m), sea temperature (˚C), salinity (PSU), dissolved oxygen (ml/L), nutrients (nitrate, phosphate, silicate in μM), and chlorophyll (Chl-a). While data spanning 2008 -2020 exists and will be incorporated by the end of 2021, initially data from 2018 and 2019 were used. Most of the data captured is up to 30 m depth, with exceptions up to 70m.

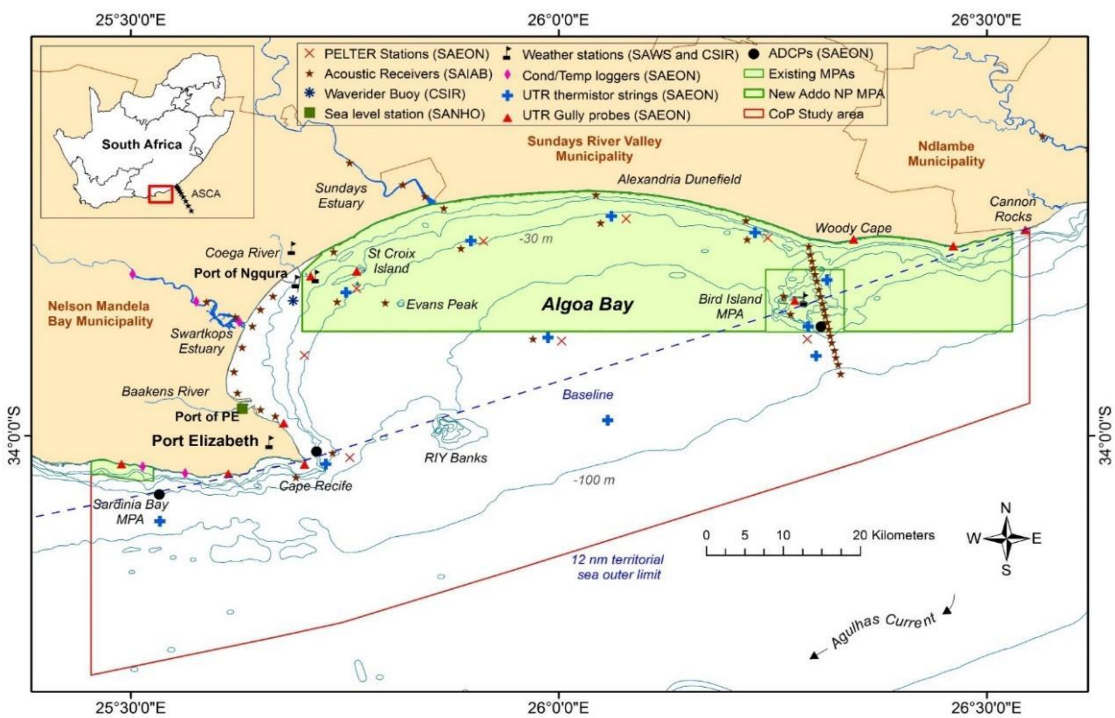


Figure 8. A map showing the SAEON Sentinel Site and associated instrument locations in Algoa Bay. Data from the PELTER Stations, CTDs, UTR thermistor, UTR Gully Probes and the ADCP's will be used to create a GIS database and associated spatial layers.

The ocean is large, three-dimensional, moving, much is outside national jurisdictions and spatial data are collected by many local, national and international organizations. This poses challenges to mapping; therefore, only 20 percent of the global ocean seafloor has been mapped in terms of depth (bathymetry) and less than 0.001 percent has been sampled in terms of substrate and biota (DOALOS, 2016, Chapter 33). Although remote sensing provides global data, only the surface of the ocean is visible from satellite. This requires special attention to establishing a spatial data infrastructure that will serve to integrate many types of data including from local in situ studies.

While extensive data sets do exist in this area, one of the key aims of this work is to discern which data sets and related locations, in x, y and z space, are relevant and applicable for OAF purposes.

Following a study by Sayre et al., 2017 (Figure 9), an ocean mesh for assessing extent and condition of oceanographic variables in x, y, z space will be used: from a global to a regional context, Algoa Bay grid zonation (Figure 7) will be defined as:

- 100m x 100 m grid blocks (1 ha)
- Additionally 25m, 50m, resolution (5m when considering estuarine data) will be considered
- Discrete point data should fall within 50 m of centroid within block
- Cluster data at the centroid.
- Column of oceanographic data represented up to 70 m depth with current data sets

The WP2 group suggestions for delineating extent for oceanographic variables being considered are as follows*:

- Extent in an oceanographic context has not only x and y values, but also z values so we will look at 2D and 3D extent
- High water mark to 30 m depth contour – coastal ‘realm’
- 30 m depth contour to 200 m depth contour – nearshore, past 200 m depth (Shelf edge –Neritic zone)
- In z space, 2 zones within the photic zone, 0 – 30 m through the water column, and 30 – 200 m
- Both spatial and temporal disaggregation in data will need to be flagged and tracked

- Data will be batched into 5 Levels -Sea surface, Water column (WCI - 0-30m and WCII - 30 – 200m), Sea floor, and Sub sea floor

*It's important to note that the MSP group have categorized extent in AB as follows: Onshore- 50 m above the high water mark to the low water mark, Coastal- 0 (low water mark) to 50 m depth, Offshore- 50 m to depth (presumably 500m), Marine Islands, and last, Kelp Forests and Shallow Reefs. At some stage in the near future, a standardized zoning should be agreed upon and set.

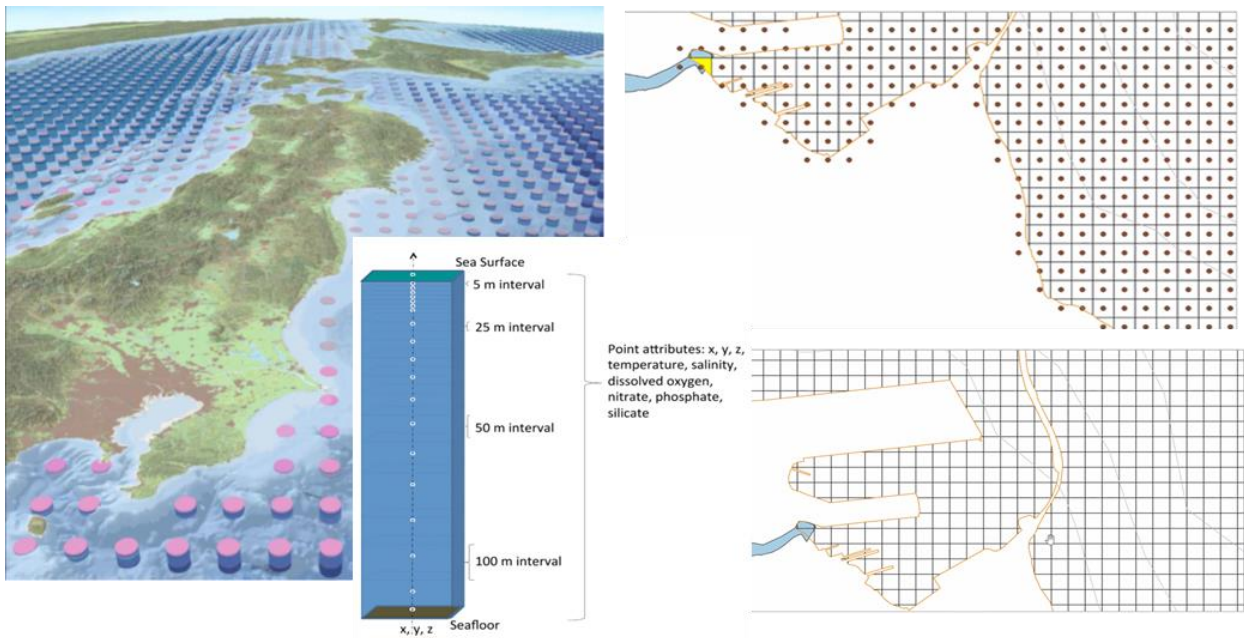


Figure 9. Sayre et al., 2017 global ocean mesh grid system and associated xyz water column with centroid representation, on the left. Example of Algoa Bay local scale1 ha grid system with centroid points, on the right.

The Basic Spatial Unit (BSU) may be as small as a remote sensing image pixel (30-100m), a national grid reference system (1nm) or small administrative units (e.g., marine statistical area). Smaller BSUs have the advantage of being more homogenous. That is, when delineating ecosystem extent, some ecosystems, such as mangroves, or estuaries, may be in strips of 5m wide and therefore undetectable by satellite at 100m resolution. Since ecosystems tend to be more complex in coastal areas and data tends to be more generally available, some countries maintain data at finer resolution near the coast. In this case, it may be practical to distinguish between coastal units (CBSU) and marine units (MBSU). Coastal Basic Spatial Units and Marine (nearshore) Basic Spatial Units will be developed from oceanographic variables in x, y, z space and over time to determine ocean ecosystem types in Algoa Bay.

Out of 150 SANBI (NBA 2018) ecosystem (habitat) types along the SA coastline, 15 are present and delineated in Algoa Bay (SANBI NBA, 2018). The goal is to establish extent and condition in an OAF to derive ocean ecosystem types. The two approaches are connected but different. Will biodiversity ecosystem types correlate to ocean based ecosystem types?

Will there be crossover, differences, similarities? When the z factor is included as defined Levels (depth) how will the ecosystem type change or not? These are questions that will be considered through the second phase of WP2.

3.2.2 Spatial database

Ocean accounts can be built from maps (spatially explicit) or tables (spatially independent), but the power is in combining them. Maps can be used to generate tables and data in tables can be allocated to areas of the ocean.

The following guidance is provided in the Global Ocean Accounts Partnership. Technical Guidance on Ocean Accounting for Sustainable Development, United Nations, 1st edition, 2019. Establishing the spatial database for Ocean Accounts is an important early step that will facilitate the integration of spatial data from many sources. If the data sources already adhere to the standards of a National Spatial Data Infrastructure (NSDI) that includes coastal and marine areas (or Marine Spatial Data Infrastructure, MSDI), then spatial standards will not have to be developed specifically for the pilot. If not, then an ocean accounting pilot may be the catalyst to expand an existing NSDI to the country's EEZ. These considerations will be developed further and synchronized among all of the WPs by WP3.

Many pilots have begun by compiling maps as a basis for a physical ocean asset extent account. If there is no NSDI/MSDI, then standards such as shoreline vector, definition of "coastal", projections and scales will need to be established. It is possible to generate initial analytical results by overlaying spatial data in a GIS without creating an integrated spatial data infrastructure. However, this does not facilitate the production of the accounting tables. That is, to produce a physical Ocean Asset Extent Account, it is best to first align data (e.g., separate maps of mangroves, coral, seagrasses, kelp beds etc.) using the same shoreline and spatial units. Doing this will ensure validation of the data by revealing gaps and overlaps.

Although the Ocean Accounts Framework suggests spatial units and ecosystem classifications, pilot physical Ocean Asset Extent Accounts typically begin with existing national spatial units and ecosystem classifications. SANBIs NBA 2018 will be largely drawn upon as well as the work of NMUs The Algoa Bay Project for reference and where relevant comparison.

3.2.3 Online GIS platforms and user tools

In an attempt to assess the applicability of the role that oceanographic data can play in the OAF a brief review of already available GIS platforms and online user tools was conducted (Figure 10, see Annexes 3-4). In addition a detailed synopsis of data to be compiled, global and regional data providers and sources and an Algoa Bay focused data catalogue have been compiled and can be viewed in Annexes 2 – 4 at the end of this report.

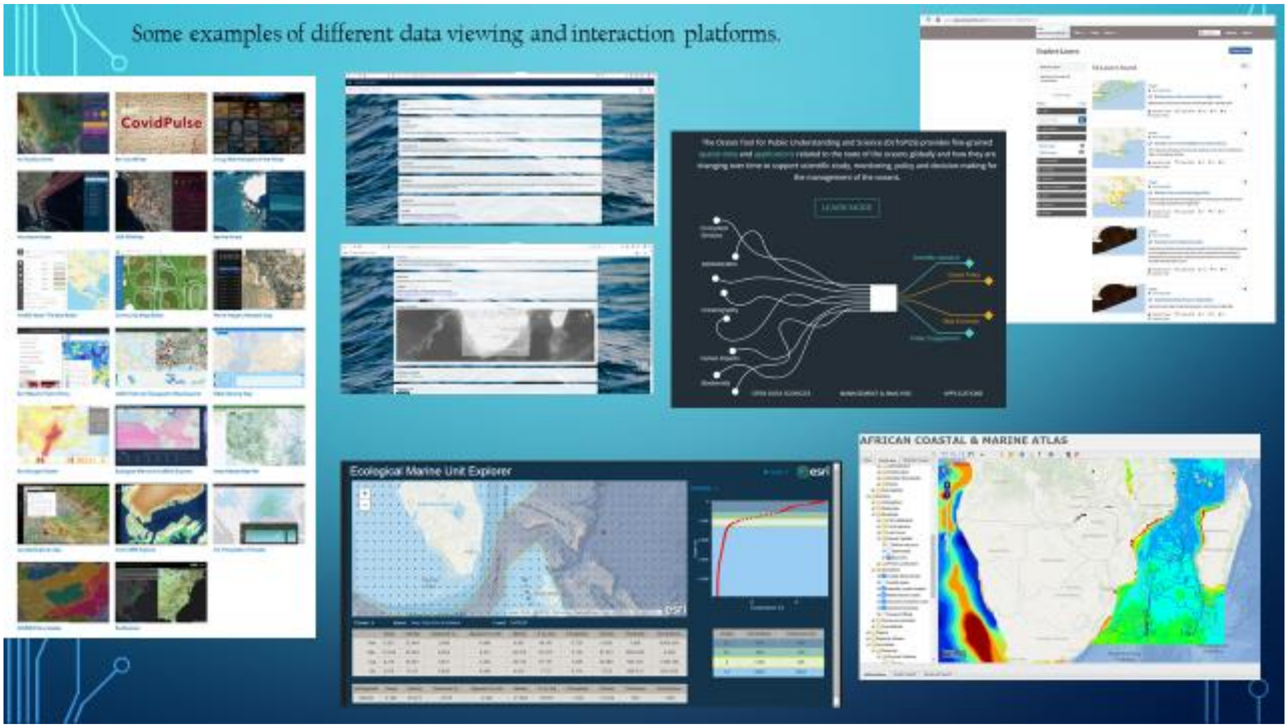


Figure 10. GIS based online user platforms for viewing oceanographic data (see Annexes 2 – 4 for references and more information).

Additionally, an alpha version of an online interactive mapping platform modeled after the Sayre et al. 2017 approach and the ESRI based Ecological Marine Unit Explorer was presented. This online data visualization tool was developed by the WP2 team and the SAEON uLwazi node.

A test Dash application has been embedded in what's termed an ESRI 'experience'. 'Experience' here means that it's an online interactive platform so the user can move the map on the left around and when they click on an Algoa Bay Sentinnel Site station point, the window pane on the right will update, allowing users to view and access a suite of oceanographic and biological parameters in a continuous data format. At present, physical and some biological data from 2018 to 2019 has been incorporated and the full suite of historic datasets and associated stations will be added in (Figure 11). This application is not publically available yet, but will be and importantly can be migrated to other platforms.

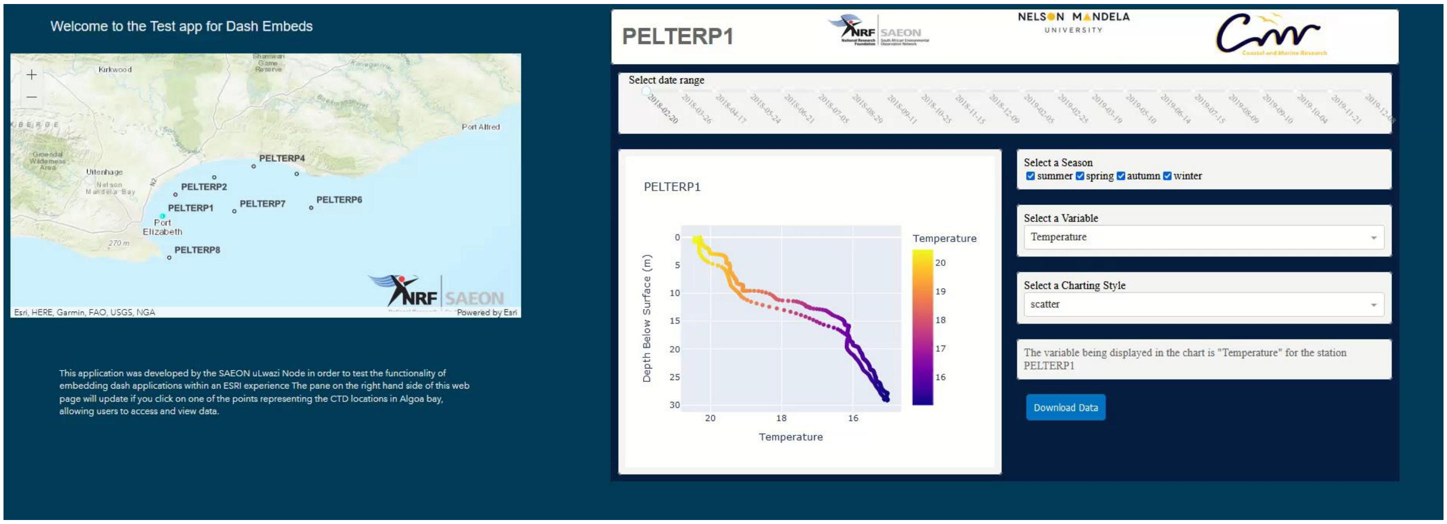


Figure 11. Interactive test application for data visualization in Algoa Bay. The app includes monthly data spanning 2018 to 2019, across four seasonal timeframes, six different variables, and two different charting types for each Pelagic Ecosystem Station in the bay.

The second phase of this online tool development is to embed this application (seen above) in an ESRI based web portal where a series of interactive map pages or a 'map atlas' can be viewed as well as associated charts, tables, descriptive text, and metadata (Figure 12).

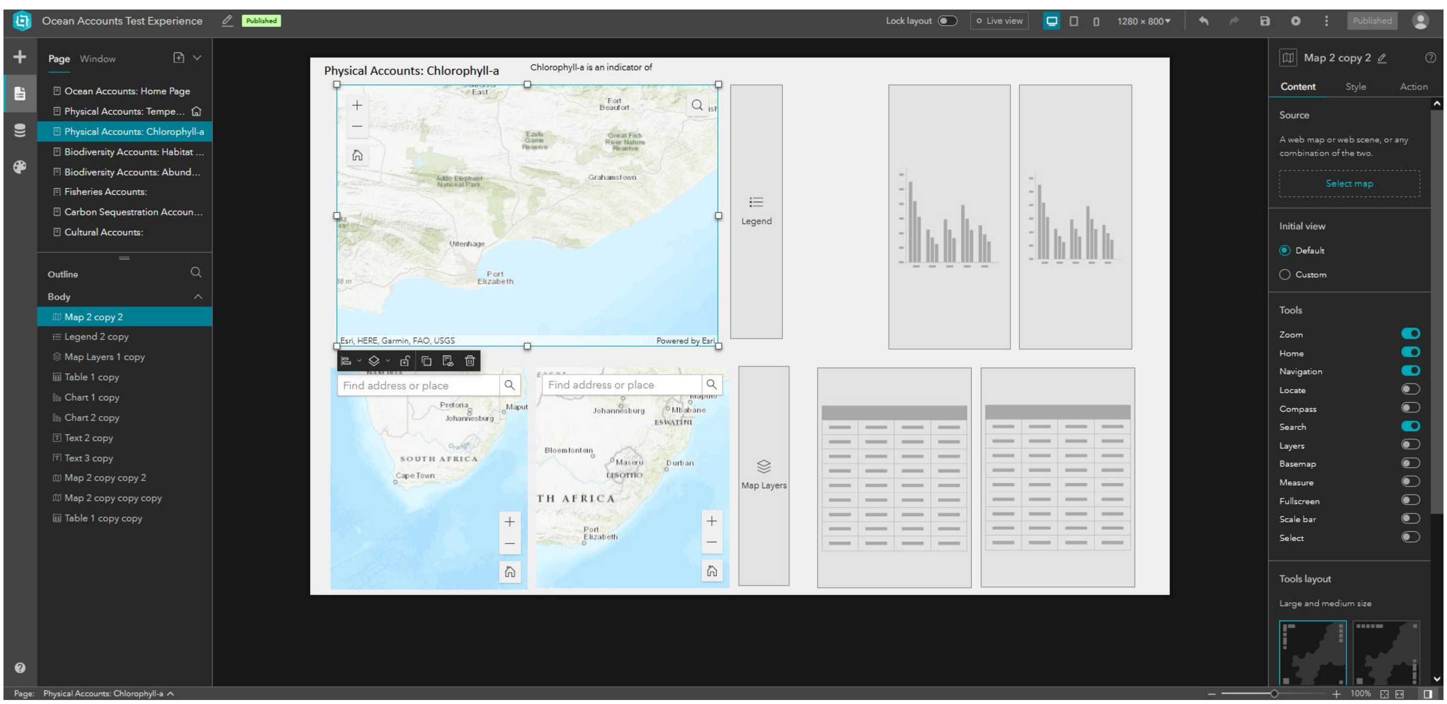


Figure 12. Interactive test application for data visualization in Algoa Bay. The app includes monthly data spanning 2018 to 2019, across four seasonal timeframes, six different variables, and two different charting types for each Pelagic Ecosystem Station in the bay.

The novel aspects of ocean accounting means that there is considerable scope for experiential dialogue from across African case studies in the accounts refinement process as well as drawing on work already underway internationally with respect to development and implementation, and in the manner of use in decision making processes.

This project will work extensively with external partners, including the Global Ocean Accounts Partnership, the High-Level Panel for a Sustainable Ocean Economy (through GOAP), WIOGEN, IORA Academic Groups and the African Natural Capital Accounts Working Group on Ocean Accounts as well as draw on the National and local work by SANBI NBA 2018 and The Algoa Bay Project working group, respectively.We also endeavor to engage with and share in as many additional local, regional, and national groups as feasible and willing.

3.2.4 Remotely sensed and modelled data

In a country like South Africa, where *in situ* data can be costly and sparse, remotely sensed and modelled data plays an important role for assessing the state of an ocean ecosystem. In the previous workshop, Workshop 2, Dr. Giles Fearon demonstrated the advances in modelled hind and forecasted oceanographic data for Algoa Bay.

Recent work within OCIMS on bay scale modelling ‘downscales’ global ocean models (BRAN, HYCOM, GLORYS) to high resolution over Algoa Bay (~500 m) where hindcast simulations validated against 2.5 years of in-situ observations from ADCPs, UTRs and GTPs located in the Bay provide a snap shot of sea surface temperature (Figures 13 and 14). Along with supporting various research and training objectives, uses for this type of product include scenario testing (for managers and policy makers) as well as identification and dissemination of key historical metrics and indicators.

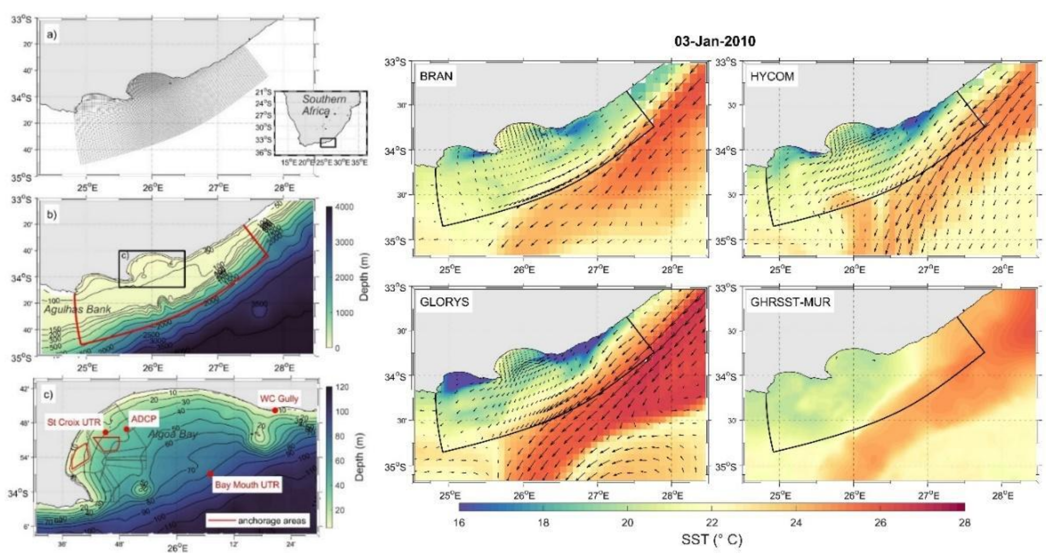


Figure 13. Downscaling of global ocean models, BRAN, HYCOM, GLORYS, for the purpose of high resolution hindcasting of SST over Algoa Bay.

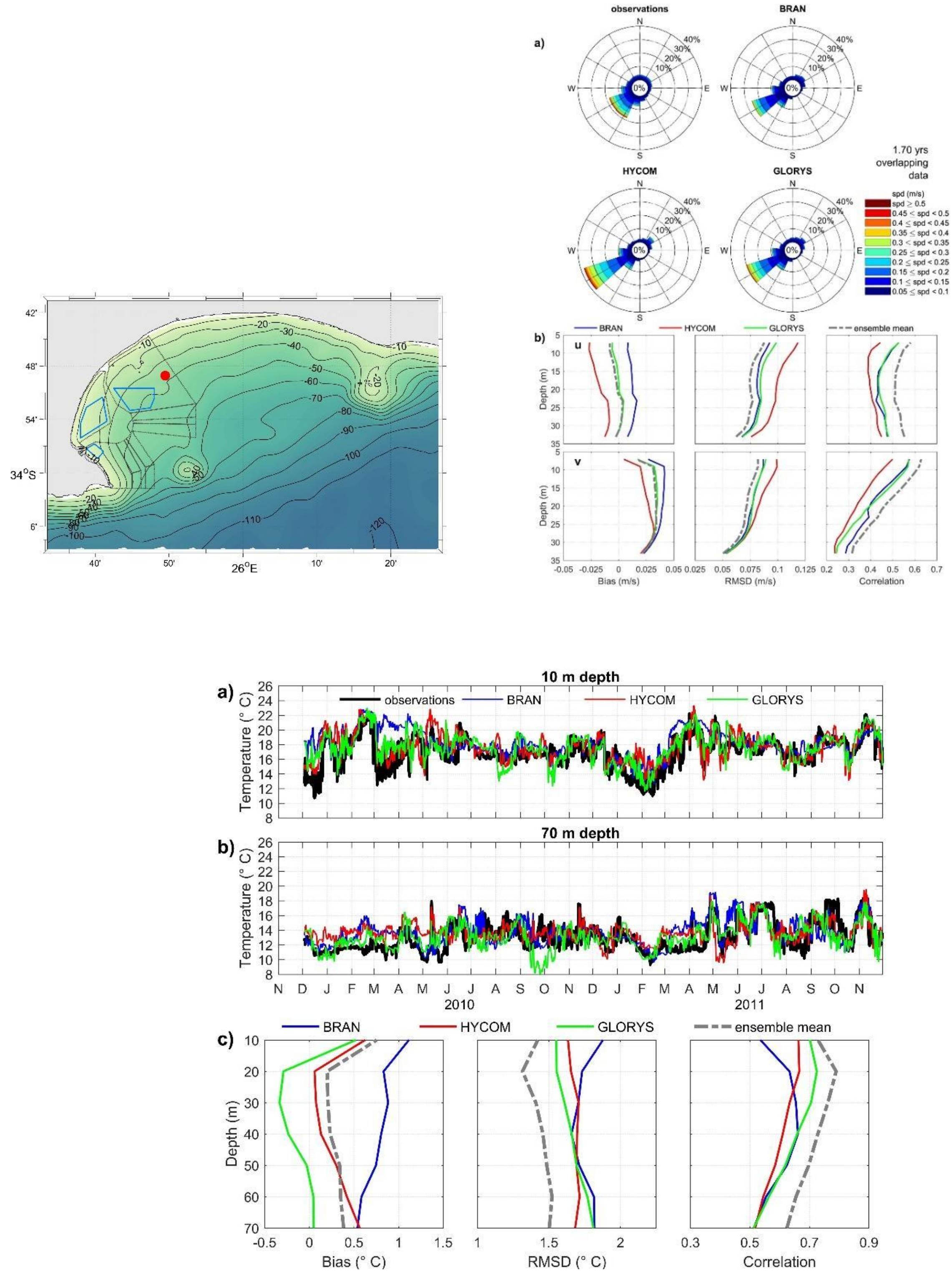


Figure 14. Evaluation of Algoa Bay model against in situ observations provided by SAEON eLwandle coastal node and of Lwandle Marine Environmental Services (on behalf of PetroSA).

In workshop 3, the inclusion of various satellite products and modelled data in Algoa Bay as layers in the GIS platform were introduced. Work from Egagasini Node's SOMISANA team into the ESRI Experience application by way of .netcdf files has been initiated.

The SST product used is called OSTIA, it is a reprocessed 5km SST product (SST_GLO_SST_L4_REP_OBSERVATIONS_010_011) and comes from Copernicus, a European Union earth observation programme that utilizes a suite of satelites to acquire freely accessible data. The marine based information that can be accessed here is known as CMEMS (Copernicus Marine Environment Monitoring Service). The Chl-a product which can be used in unison with in situ chl-a as a proxy for biological productivity and water quality was also demonstrated (Figure 15). Refinement of these products is still underway. The link to CMEMS data is as follows:
https://resources.marine.copernicus.eu/?option=com_csw&view=details&product_id=SST_GLO_SST_L4_REP_OBSERVATIONS_010_011

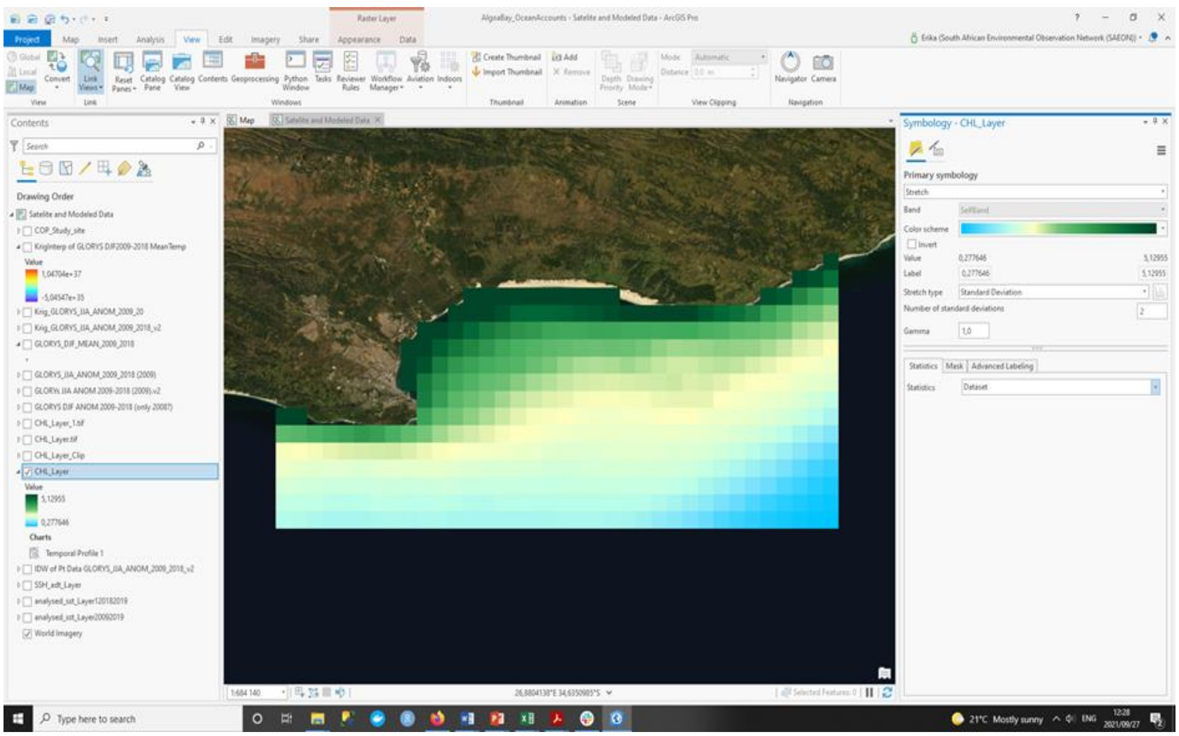


Figure 15. A .netcdf file depicted as a raster layer in ArcGIS Pro of Chl-a monthly mean over a one year period, 2018-2019.
https://resources.marine.copernicus.eu/?option=com_csw&view=details&product_id=SST_GLO_SST_L4_REP_OBSERVATIONS_010_011

Finally, a layer depicting modelled winter (June, July, August) sea surface temperature anomaly over a 10 year period (2009 – 2019) in Algoa Bay was created and shown, but more work needs to be dedicated to giving an accurate depiction of this information in GIS (Figure 16). NetCDF (network Common Data Form) is a file format for storing multidimensional scientific data (variables) such as temperature, pressure, wind speed, and direction. Each of these variables can be displayed through a dimension (such as time) in ArcGIS by making a layer or table view from the netCDF file.

The user should be able to specify a time dimension and display the associated layer representing the measurements recorded in that time (e.g. sea temperature anomaly in 2009). However, extracting this type of information proved dubious and refinement is ongoing.

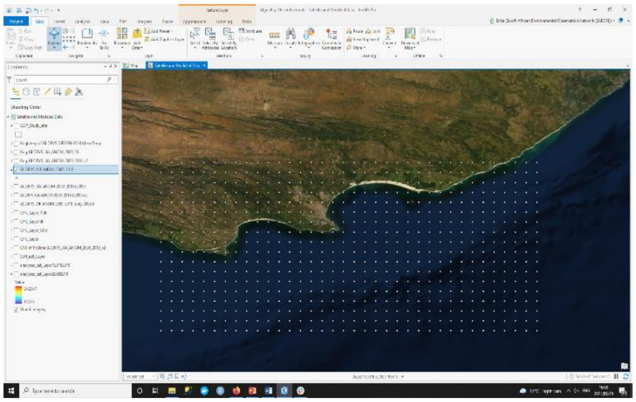
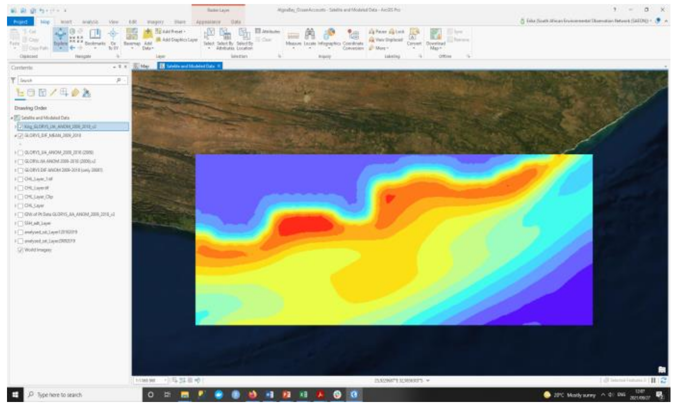



Figure 16. Modeled point data of winter SST anomaly over a 10 year period, 2009-2019, in Algoa Bay was interpolated using a krigging method in ArcGISPro.

Within an OAF concept, products like these can aid measuring change over time within the environment of focus. Additionally, elaborate simulations can be created based on local oceanographic conditions that would support risk and response scenarios and associated decisions in planning and management. An example of this is the OCIMS test platform for high resolution model forecasts for Algoa Bay and can be accessed here link where a hypothetical oil spill model simulation can be viewed.

3.2.5 OAF Ecosystem accounting tables

Finally, examples of the associated accounting tables for Ecosystem Accounting within an Ocean Accounts Framework where stock accounts and flow accounts are broken up into physical accounts and monetary accounts respectively were presented (Figure 17). Once finalized by the WP3 team, these accounts will be linked to the GIS platform. The first step in this process is establishing streamlined ecosystem categories and associated extent accounts. Achieving multiple group and organization cohesion is a challenge in this process, but not unsurmountable. The first part of this work is establishing where those misalignments are present (see Figure 18) and rectifying any discrepancies based on sound ecosystem assessment strategies. Engagement with SANBI and the MSP working group in Alga Bay is ongoing and issues like these are being addressed.

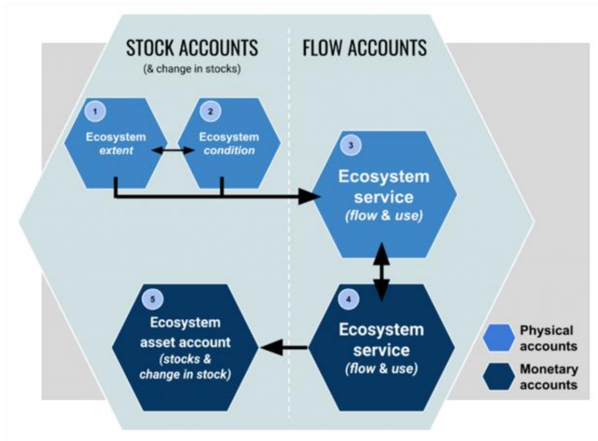


Figure 17. Ecosystem accounts and how they relate to one another, https://seea.un.org/ecosystem-accounting.

Ecosystem_Primary	BroadEcosystemGroup	TypeExtent_km	Totals_km
Agulhas Mixed Shore	Rocky and mixed shore	188,08	Mixed Shore 426,48
Agulhas Stromatolite Mixed Shore	Rocky and mixed shore	8,36	
Agulhas Exposed Rocky Shore	Rocky and mixed shore	89,52	
Agulhas Exposed Stromatolite Rocky Shore	Rocky and mixed shore	8,30	
Agulhas Sheltered Rocky Shore	Rocky and mixed shore	1,32	
Agulhas Dissipative Intermediate Sandy Shore	Sandy shore	116,45	
Agulhas Intermediate Sandy Shore	Sandy shore	14,45	
Eastern Agulhas Bay	Bay	1631,19	Bay 1631,19
Agulhas Island	Island	6,78	Island 6,78
Agulhas Inner Shelf Mosaic	Shallow rocky shelf	1853,57	Shallow Shelf 2375,12
Agulhas Sandy Inner Shelf	Shallow soft shelf	521,55	
Agulhas Mid Shelf Reef	Deep rocky shelf	51,89	Deep Shelf 38446,83
Agulhas Sandy Mid Shelf	Deep soft shelf	20233,09	
Agulhas Sandy Outer Shelf	Deep soft shelf	7058,51	
Eastern Agulhas Outer Shelf Mosaic	Deep rocky shelf	25966,23	

Size of ecosystems

Ecosystems					
Classification used in study:	On-shore	Coastal system (0-50m depth)	Offshore (deep sea/open ocean – 50m+ depth)	Marine islands	Coral reefs/wreckages
2018 NBA Synthesis Report classification	Sandy shore & rocky and mixed shore	Shallow soft shelf & shallow rocky shelf	Deep soft shelf & deep rocky shelf	Island	Kelp forest & shallow reef
Island Proximity				3,560	
Reefs					45,925
Agulhas Bays East		101,001			
Agulhas Mixed Shore	1,374				
Agulhas Sandy mid-self			136,209		
Total (ha)	***4,980***	***124,626***	***264,844***	***3,863***	***45,989***

Figure 18. Draft tables exemplifying ecosystem extent accounts from the OAF and the MSP Asset Research group. Alignment of ecosystem classification extent between working groups is critical and work is underway in addressing these discrepancies.

4. Concluding Remarks

Virtual workshop attendance and participation increased and was satisfactory. Since the start of the year additional stakeholders have been engaged with and attended the follow up workshop where data needs and gaps as well as product development were addressed. Additional stakeholder engagement, more advanced final workshop notice, increased participant numbers and policy maker connections are goals for the next function. The final workshop/webinar and GIS platform product showcase is planned for November/December 2021.

4.1 Questions and challenges to date

- Implementation of OA – Is there National level interest?
- What would it take to shift thinking and approach to planning and policy frameworks
- based on an OAF model?
- More cross disciplinary collaboration required – marine scientist, social scientists, statistician's, data scientists, etc. working together.
- Streamlining end product platforms across organisations
- Developing a national level agreed upon ecosystem assessment of condition and agreed upon indicators
- Working on an open source platform
- Continuation of the project in 2022

4.2 Suggestions and Next Steps

Suggestions

- In order for data sharing to be more forthcoming, Ocean Accounts needs to be formally adopted, advertised and promoted so that across organization and national departments can develop better understanding and formal channels for further and comprehensive data sharing
- National MSP working group adopt Ocean Accounts as a part of the MSP process
- Share all work progress with the Algoa Bay Project group, the national MSP working group and OCIMS.
- Attend upcoming SANBI led workshop on ecosystem assessment development

Next Steps

- Finalize incorporation of historic biophysical data into the Dash application
- Complete GIS platform product in the form of a 'Map Atlas'
- Final stakeholder engagement in unison with the Algoa Bay Project group
- Submit technical document for mapping application development and final report

5. List of Acronyms

AODN	Australian Ocean Data Network
BGIS	Biodiversity Geographic Information System
BSU	Basic Spatial Unit
CoP	Community of Practice
CPUT	Cape Peninsula University of Technology
CSIR	Council for Scientific and Industrial Research
DEFF	Department of Environment, Forestry and Fisheries
DST	Department of Science and Technology
EA	Ecosystem Accounting
EBSA	Ecological and Biological Significant Area
EEZ	Exclusive Economic Zone
ESRI	Environmental Systems Research Institute
GDP	Gross Domestic Product
GIS	Geographic Information System
GOAP	Global Oceans Accounts Partnership
IMOS	Integrated Marine Observing System
IODE	International Oceanographic Data and Information Exchange
IORA	Indian Ocean Rim Association
MARISMA	Marine Spatial Management and Governance Programme
MBSU	Marine Basic Spatial Unit
MSDI	Marine Spatial Data Infrastructure
MSP	Marine Spatial Planning
MMU	Nelson Mandela Metropolitan University
NBA	National Biodiversity Assessment
NCA	Natural Capital Accounting
NRF	National Research Foundation
NSDI	National Spatial Data Infrastructure
OAF	Ocean Accounts Framework
OCIMS	National Oceans and Coastal Information Management System
SEEA	System of Environmental Economic Accounting
SAEON	South African Environmental Observation Network
SAIAB	South African Institute for Aquatic Biodiversity
SAMREF	South African Marine Research and Exploration Forum
SANBI	South African National Biodiversity Institute
UN	United Nations
WIO	Western Indian Ocean
WP	Work Programme

6. References

Chafiq, T., Octavian, G., Jarar Oulidi, H., Ferki, A., Alexandru, R., and Saadane, A. 2013. Spatial data infrastructure. Benefits and strategy. Scientific Annals of Alexandru Ioan Cuza University Of Iaşi, Vol. LIX, No.1, S. II c.

Division for Ocean Affairs and Laws of the Sea (DOALOS), 2016. Chapter 33. https://www.un.org/Depts/los/global_reporting/WOA_RegProcess.htm

ESRI. 2010. Spatial Data Infrastructure. A Collaborative Network. Redlands, ESRI.

European Commission. 2016. MSP Data Study: Evaluation of data and knowledge gaps to implement MSP. Luxembourg, Publications Office of the European Union.

Global Ocean Accounts Partnership (GOAP). 2020. Technical Guidance on Ocean Accounting for Sustainable Development (United Nations, 1st edition, 2019).

Hu, Y., and Li, W. 2017. Spatial Data Infrastructures. J. P. Wilson (ed.) The Geographic Information Science & Technology Body of Knowledge.doi:http://dx.doi.org/10.22224/gistbok/2017.2.1

Interdepartmental Directors' Consultative Committee North Sea (Interdepartmental Directeurenoverleg Noordzee - IDON). 2015. Integrated Management Plan for the North Sea.

IOC-UNESCO. 2009. Marine Spatial Planning: A Step-by-Step Approach toward Ecosystem-Based Management. Paris: UNESCO.

Jafari, S. M. 2014. The Analysis of Open Source Software and Data for Establishment of GIS Services Throughout the Network in a Mapping Organization at National or International Level. Ph.D. thesis, Politecnico di Torino, IT.

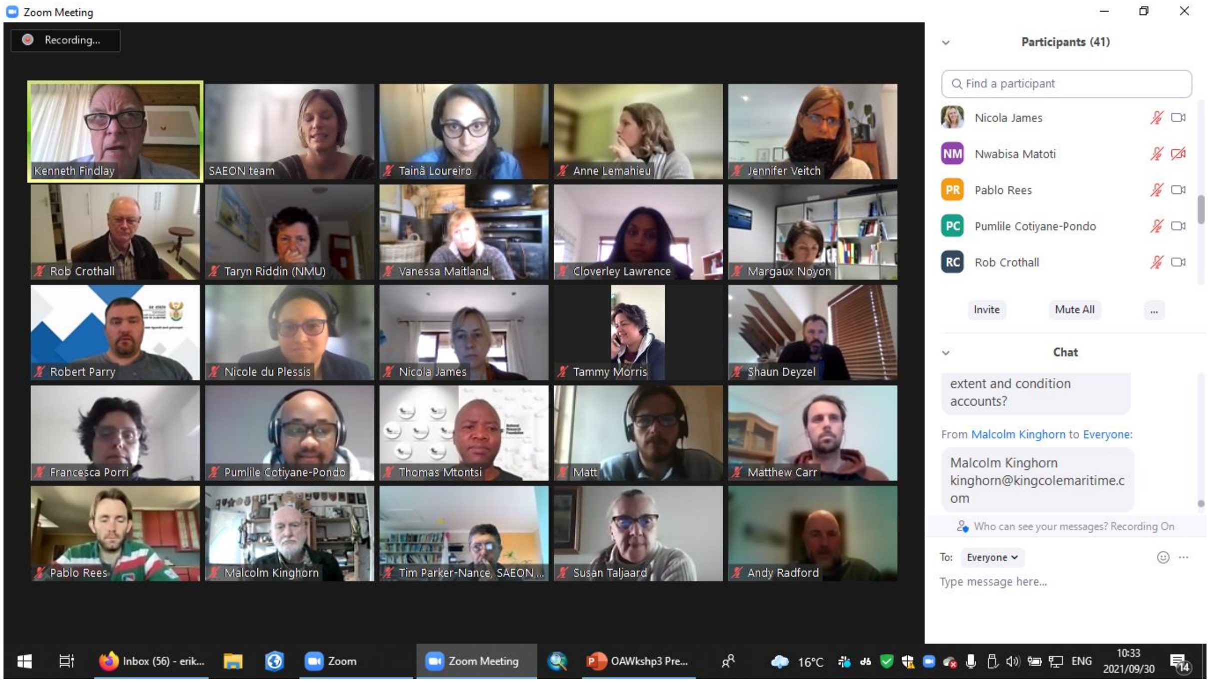
Sayre, Roger G.; Wright, Dawn J.; Breyer, Sean P.; Butler, Kevin A.; Van Graafeiland, Keith; Costello, Mark J.; Harris, Peter T.; Goodin, Kathleen L.; Guinotte, John M.; Basher, Zeenatul; Kavanaugh, Maria T.; Halpin, Patrick N.; Monaco, Mark E.; Cressie, Noel A.; Aniello, Peter; Frye, Charles E.; and Stephens, Drew, "A threedimensional mapping of the ocean based on environmental data" . 2017. Faculty of Engineering and Information Sciences - Papers: Part B. 114. https://ro.uow.edu.au/eispapers1/114

Sink KJ, van der Bank MG, Majiedt PA, Harris LR, Atkinson LJ, Kirkman SP, Karenyi N (eds). 2019. South African National Biodiversity Assessment 2018 Technical Report Volume 4: Marine Realm. South African National Biodiversity Institute, Pretoria. South Africa. http://hdl.handle.net/20.500.12143/6372

Turton, AR, Hattingh, J, Maree, GA, Roux DJ, Claassen M, Strydom WF. 2007. 'Governance as a Trialogue: Government-Society-Science in Transition', Water Resources Development and Management Series, ISBN-10 3-540-46265-1, Springer-Verlag Berlin Heidelberg.

7. Annex 1: Participants

7.1 Names, affiliated institution and contact details of participants



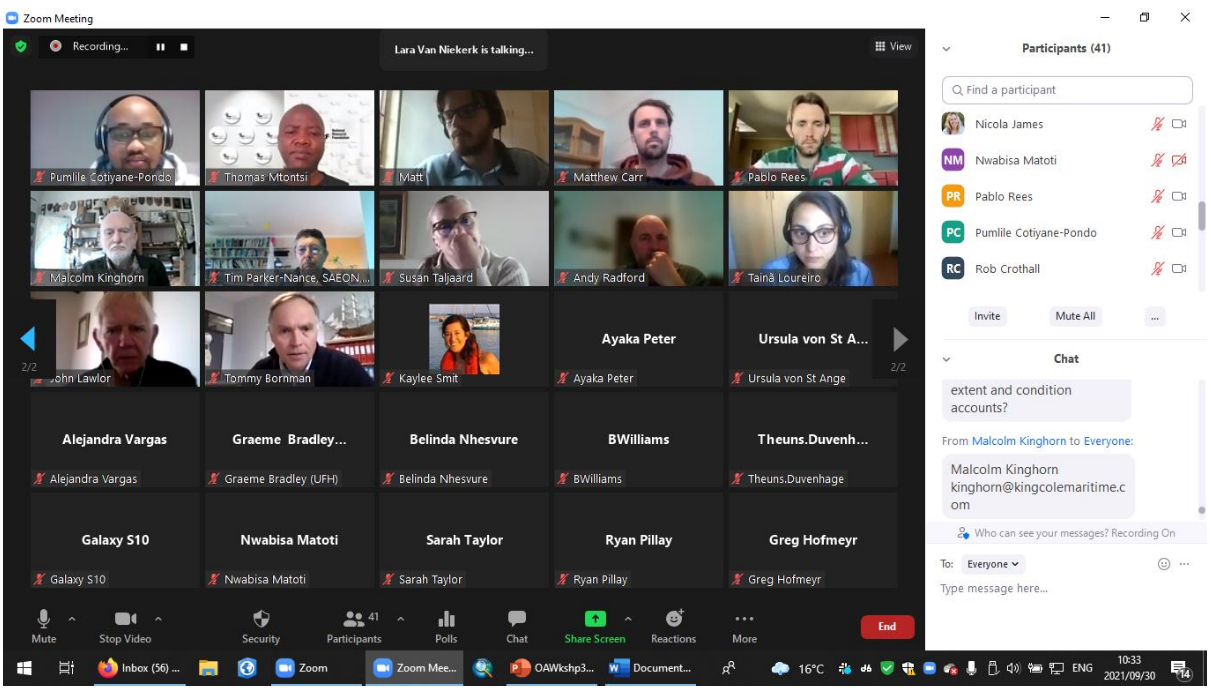


Figure 19. Zoom screenshots of the WIO: WP2 OAF Workshop 3 participants.

Table 2. WP 2 workshop 1, 2 and 3 participants, 10 December 2020, 25 March, and September 30 2021, respectively.

No	Name	Workshop Attendance	Institution and Position
1	Ammaarah Abrahams	1 & 2	NMU, CoP OAF Administrator
2	Caroline Sejeng	1	SAEON/UCT student
3	Cloverly Lawrence	1& 3	n/a
4	Erika Brown	1, 2 & 3	GIS Product Developer CoP OAF WP2
5	Estee Vermeulen	1 & 3	PhD Candidate in Marine Spatial Planning at NMU
6	Hayden Wilson	1, 2 & 3	SAEON Ulwazi Node, Scientific Program Officer
7	Jordan Van Stavel	1	SAEON/NMU MSc student
8	Juliet Hermes	1, 2 & 3	SAEON Egagasini Node, Node Manager
9	Lara Atkinson	1	SAEON Egagasini - Offshore benthic scientist
10	Lara van Niekerk	1& 3	CSIR, Principle Scientist
11	Lauren Williams	1 & 3	DEFF
12	Maxhoba Jezile	1	DEFF, Environmental Officer at Directorate Sustainable Aquaculture Management
13	Michelle Pretorius	1	DEFF
14	Millicent Makoala	1	DEFF, Branch: Oceans and Coasts. Control Environmental Officer: Marine Species and Ecosystems Management
15	Nasreen Burgher	1	SAEON, physical oceanography intern
16	Nicole du Plessis	1, 2 & 3	SAEON Egagasini Node, Science Officer
17	Ntombovuyo Madlokazi	1	DEFF Oceans & Coasts- Antarctic and Southern Ocean Management, Control Environmental Officer
18	Prideel Majiedt	1& 3	SANBI, Marine Research and Policy Practitioner
19	Rob Anderson	1	Stats SA, Director
20	Rudzi silima	1	SAEON MSc student
21	Sarah Taylor	1& 3	National Oceanography Centre UK, Environmental Socio-Economist
22	Shaun Deyzel	1, 2 & 3	SAEON Elwandle Node, Science/Data Coordinator & Plankton Ecologist
23	Stuart Laing	1	Blue Economy Research Institute,University of Seychelles
24	Susan Taljaard	1& 3	CSIR
25	Tainã Loureiro	1, 2 & 3	CIB/SUN post-doc (Marine Lab)
26	Tim Parker-Nance	1, 2 & 3	SAEON Elwandle Node, Senior Developer (Coastal)
27	Tommy Bornman	1, 2 & 3	SAEON Elwandle Node, Node Manager
28	Victoria Goodall	1 & 2	Data management consultant on the Algoa Bay project
29	Ttanci	1	Unknown participant
30	Dr. Jenny Veitch	2 & 3	SAEON, Egagasini
31	Dr. Giles Fearon	2	SAEON
31	Laetitia Piers	2	WWF-SA
33	Jessica Leigh Thorton	2	NMU
34	Prof Patrick Vrancken	2	NMU

35	Matthew Carr	2 & 3	SAEON, Product Developer
36	Dr Tajudeen Sanni	2	NMU
37	Kaylee Smit	2 & 3	NMU
38	Mr. Phumlile Cotiyane-Pondo	3	SAEON, Elwandle Node, Plankton Ecologist
39	Dr. Anne Lemahieu	3	NMU, Postdoc
40	Dr. Taryn Riddin	3	NMU, Research Assistant
41	Dr. Nicola James	3	SAIAB, Senior Scientist
42	Rob Crothall	3	Rob Crothall and Associates, Owner
43	TJ Duvenhage	3	Zutari, Technical Director
44	Caroline Mbelwa	3	SAEON, Student
45	Ms. Nwabisa Matoti	3	SAIMI, Senior Manager Operation Phakisa Skills
46	Vanessa Maitland	3	ACHA, Maratime Archeaologist
47	Andy Radford	3	One Ocean Hub, Programme Manager (SA)
48	Belinda Nhesvure	3	SAEON Egagasini Node, SAASTA Volunteer
49	Ken Findlay	1, 2 & 3	CPUT, Research Chair
50	Thomas Mtontsi	3	NRF-SAEON Egagasini Node, Environmental Science Education Officer
51	Ayaka Peter	3	Eastern Cape Parks and Tourism Agency, Conservation Manager
52	John Lawlor	3	NMB maritime Cluster -Board member
53	Matt Bentley	3	Asset Research
54	Pablo Rees	3	Asset Research
55	Malcom Kinghorn	3	King Cole Maritime
56	Alejandre Vargas	3	Earth Collective
57	Graeme Bradley	3	University of Fort Hare, Professor BioChem and MicroBio
58	Theuns Duvenhage	3	Zutari, Technical Director
59	Briege Williams	3	SAHRA, Heritage Officer: Maritime and Underwater
60	Ursula von St Ange	3	CSIR, Data Manager Coastal Engineering and Ports
61	Greg Hofmeyer	3	PE Museum Bayworld Marine Mammal Curator
62	Ryan Pillay	3	NMU
63	Francesca Porri	3	SAIAB
64	Robert Parry	3	Stats SA
65	Tammy Morris	3	Weather SA
66	Margaux Noyen	3	NMU, PhD Ocean Sciences and Food Security

7.2 Discussion and comments from participants

Below are several questions or comments that were addressed during the end of workshop discussion and included the following very important points. Also comments from several of the participants were captured in the ‘chat room’ and are also included below.

Discussion Points

- For estuarine data (related to blue carbon sequestration as an ecosystem service), 5m x 5 m grid is recommended (an unstructured, nested grid system), WorldView3 by Maxar could be a useful remote sensing resource to facilitate this process and fill in where data gaps may exist. LvN

- The capacity to share data with IODEs African Coastal and Marine Atlas platform is advisable and would be advantageous. KS
- Engaging with the ARIES platform (the SEEA group) is strongly recommended. KF
- Take note that SANBI is downscaling their next iteration of ecosystem classification to fall in line with work coming from STATS SA, a first phase standardisation for accounting purposes in the marine space. LvN
- Collaboration with maritime archaeologists in South Africa is desired for wrecks and maritime sites, WP 5 engagement is recommended, ABP platform available for this information. VM
- Collaboration with the ABP CoP was questioned and indeed it is happening, all data and product development will be shared with the ABP group. FP
- Social scientists from the participants commented on how important sharing this work is and how it provides a context for them in understanding where and how this information could be represented and how appreciative they are of being included. RP
- IOE2 Meeting in February, strongly recommended to submit an abstract on this work related to integration Oceanography in Decision Support and the Decade Ocean Science for Sustainability and in connection to GOAP work. KF
- The upcoming SANBI workshop on ecosystem assessment and establishing standardized measure of condition was highlighted. KS
- Condition indicators, our habitats are smaller and more sensitive, we have three different oceans, plus bay scales. International guidelines can be very limiting so be weary of them and apply our own standards. LvN
- What is the tipping point and who should be setting these thresh holds? Economist, environmentalists, fisheries scientists, etc. This is a global issue that is being grappled with across countries. LvN
- Relative rather than absolutes is important when looking at change over time in data, data confidence imperative, oceanographic data provides this standard. KF
- Comment on Coastwise's (Kerry Sink, Linda Harris et al.) work and possible workshop in November, contact Megan Von Der Bank for information. LvN

8. Annex 2: List of Data To Be Compiled

Table 3. Types and themes of data to be collected.

Ecological data	Physical data	BioGeoChem Data	Human / socio-economic data	Others
Coastal Ecosystems	Bathymetry	Productivity/Chl-a	Fisheries	Administrative Boundaries
Marine Ecosystems	Temperature	Nutrients (Phosphate, Silicate, Nitrate)	Aquaculture	Population Distribution
Estuarine Ecosystems	Depth Zones	Dissolved oxygen	Tourism	Maritime/marine related policies/acts/laws
Areas of High Biodiversity	Waves		Recreation	

Areas of High Endemism	Wind		Maritime Transportation	
Areas of High Productivity	Turbidity		Ports	
Aggregation Sites	Salinity		Offshore Oil & Gas	
Spawning / Breeding Areas	Ocean Acidification/pH		Offshore Renewable Energy	
Feeding / Foraging Areas	Flood Risk		Telecommunication Cables	
Nesting Areas	Seismic Threat		Mining concession areas	
Nursery Areas	Sediment type		Sand & Gravel Mining	
Migration Routes / Migration Stopover	Benthic habitat type		Dredged disposal site	
Environmental Health	Tide		Seabed Mining	
Ecozones	Current Direction		Desalination Plants	
Eco Regions	Current Velocity		Carbon Sequestration Sites	
			Military Areas	
			Maritime and Underwater Cultural Heritage	
			Scientific Research	
			Marine Protected Areas	
			EBSAs	
			CBAs	
			Effluent Outfall Pipes/Areas	

9. Annex 3: Potential data sources and providers

A Spatial Data Infrastructure (SDI) is a framework of technologies, policies and institutional arrangements that combined enable the creation, exchange and use of geospatial data and related information across an information-sharing community. SDI extends a Geographic Information System (GIS), ensuring geospatial data and standards are used to create official datasets linked to policies (ESRI, 2010), which can aid administration of current policies, as well as the development of new policies.

SDIs are particularly useful in the context of todays ‘big data’, when large volumes of geospatial data and web services are readily available (Hu and Li, 2017). A successful SDI interconnects leadership, people, computer networking, publishing and access software, data, policies, and metadata into a framework that helps put the appropriate tools and rules in place to maintain data and turn them into useful information products to support operations and decision-making (Jafari, 2014, IOC Technical Series, 161, 2021). Building an SDI not only sets a precedent to allow free access to spatial data for governmental authorities, stakeholders and citizens, but also provides many benefits to it's users (Table 4) (Chafiq et al., 2013, IOC Technical Series, 161, 2021).

Table 4. Benefits of Spatial Data Infrastructures (Adapted from Chafiq et al., 2013 and IOC Technical Series, 161, 2021).

Financial	Strategic	Social	Users
Reduces the costs of spatial data collection, avoiding duplication	Improves data authorship	Improves working relationships between stakeholders and public administrators	Improves access to data
Reduces the costs of data access and sharing	Improves data privacy	Improves relationships between citizens and public administrators	Facilitates data use
Reduces the costs of data maintenance	Improves partnerships through efficient data sharing agreements	Improves understanding about relevance of spatial data	Improves services to users
Reduces the time of integration of data and interoperability	Improves data quality	Improves understanding about the issues related to the data	Improves users' responsiveness
Reduces the risks and the costs of development of new applications	Improves documentation of metadata	Reduces redundancy in available applications	Improves data standards and expectations
Refocuses funding streams	Improves transparency about data collection, processing and updating		Attracts participation

The aim of this annex is to review the current SDIs available at different levels (global and regional) in order to identify potential data sources and providers that could contribute to the development of the OAF pilot area in Algoa Bay, South Africa, as well as contribute to a regional process going forward. A systematic analysis of global and regional SDIs was carried out to identify functional status and relevance to the OAF process in the pilot project based on an adaptation of the European "MSP Data Study" (European Commission, 2016).

The criteria considered are:

A. Type of infrastructure (SDI Type)

- Data Catalogue: a data list, its availability and how to source
- Data Portal: online direct access to datasets
- Data Viewer: service to display spatial data
- Information Service: service which aggregates data into information product (e.g., factsheets)
- Decision Support Tool: method or specialised tool to support further analysis and interpretation

B. Scale

- Global
- Regional

C. Goal

- Describe the marine area: state of the environment and distribution of maritime activities
- Describe interactions in the marine area: pressures and impacts of maritime activities
- Integrated management: integrated assessments, including monitoring and evaluation

D. Scope

- Marine
- Terrestrial

E. Data type

- Ecological
- Physical
- Socio-economic

Review of SDIs with relevance to Algoa Bay

A total of 19 SDIs that could be useful for OAF purposes were identified (Table 5).

Table 5. Overview of Spatial Data Infrastructures identified with potential relevance to the OAF development process in South Africa and for this case study within Algoa Bay.

Name	URL	SDI type	Scale	Goal	Scope	Data type
The Algoa Bay Project	http://www.algoabaydata.com/	Data Portal, Data Viewer, Information Service	Regional	Describe the marine area and uses	Marine	Ecological, Socio-economic
South African National Biodiversity Institute	http://bgis.sanbi.org/	Data Portal, Data Viewer, Information Service	Regional	Describe the marine area	Marine & Terrestrial	Ecological
The Marine Information Management System	https://data.ocean.gov.za/about/	Data Information Service	Regional	Describe the marine area and uses	Marine	Physical
The National Oceans and Coastal Information Management System	http://ocimstest.ocean.gov.za/aloga_bay_model/	Data Viewer, Information Service	Regional	Describe the marine area	Marine	Physical
Ecologically or Biologically Significant Marine Areas	https://cmr.mandela.ac.za/Research-Projects/EBSA-	Data Viewer, Information Service	Regional	Describe the marine area	Marine	Ecological

	Portal/South-Africa					
Gov.UK	https://explore-marine-plans.marineservices.org.uk/	Data Viewer, Information Service	Regional (UK)	Describe the marine area and uses	Marine	Ecological, Physical, Socio-economic
Symphony for MSP in Sweden	https://www.havochvatten.se/en/eu-and-international/marine-spatial-planning/symphony---a-tool-for-ecosystem-based-marine-spatial-planning.html	Data Viewer, Information Service	Regional (Sweden)	Describe the marine area	Marine	Ecological, Physical, Socio-economic
ESRIs Ecological Marine Unit Explorer	https://livingatlas.arcgis.com/emu	Data Viewer, Information Service	Global	Describe the marine area	Marine	Physical
Copernicus Marine Service	https://myocean.marine.copernicus.eu/data	Data Portal, Data Viewer	Global	Describe the marine area	Marine	Physical
Ecologically or Biologically Significant Marine Areas	https://www.cbd.int/ebsa/	Data Portal, Data Viewer, Information Service	Global	Describe the marine area	Marine	Ecological
Ocean Data Viewer	https://data.unep-wcmc.org/	Data Portal, Data Viewer, Information Service	Global	Describe the marine area	Marine	Ecological
The General Bathymetric Chart of the Oceans	https://www.gebco.net/data_and_products/gridded_bathymetry_data/	Data Portal, Data Viewer	Global	Describe the marine area	Marine	Physical
Marine Important Bird Areas (IBA) e-atlas	https://maps.birdlife.org/marineIBAs/	Data Viewer, Information Service	Global	Describe the marine area	Marine	Ecological
Ramsar	https://rsis.ramsar.org/	Data Viewer, Information Service	Global	Describe the marine area	Marine & Terrestrial	Ecological
Submarine Cable Map	https://www.submarinecablemap.com/	Data Catalogue, Data Viewer	Global	Describe the marine area	Marine	Socio-economic
Information Integration System for Marine	https://instaar.colorado.edu/~jenkinsc/dbseabed/	Data Portal, Data Viewer	Global	Describe the marine area	Marine	Physical

Substrates (dbSEABED)						
Ocean Color Web	https://oceancolor.gsfc.nasa.gov/	Data Portal, Data Viewer	Global	Describe the marine area	Marine	Ecological
IW:LEARN Spatial Lab	http://geonode.iwlearn.org/	Data Portal, Data Viewer	Global	Describe the marine area	Marine	Physical
Ocean Tool for PUblic Understanding and Science, University of Oxford	https://octopus.zoo.ox.ac.uk/	Data Portal, Data Viewer, Information Service	Global	Describe the marine area	Marine	Ecological, Physical, Socio-economic

10. Annex 4: Algoa Bay data catalogue to date

Table 6. Ocean Accounts Framework related data acquisition for Work Programme 2, 2021.

Dataset	Contact/Owner	Acquisition Status	Visualisation Ready?	Publication to ODP ready?	Type of additional Analysis need	Responsible Person	Published to ODP	Metadata Link	Published to ESRI	Published to Living Atlas?

					e d ?					
Sea Temperature	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
Salinity	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
Dissolved Oxygen	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
pH	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
Chl-a	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
Turbidity	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
Nutirents (Phosphate)	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
Nutrients (Silicate)	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
Nutrients (Nitrate)	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
Currents	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
Waves	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
Bottom Temperature	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
Sentinel Site Biological and Physical Station Locations	SAEON Tommy Bornman or Shaun Deyzel	Acquired								
Algoa Bay 1 hectare grid	CPUT Ken Findlay	Acquired								
Algoa Bay Study Area	SAEON Tommy Bornman	Acquired								
SANBI 2018 layers	SANBI Kerry Sink, Prideel Majiedt	Acquired								
Ecosytem Types 2018	SANBI Kerry Sink, Prideel Majiedt	Acquired								
Benthic and coastal habitat Types	SANBI Kerry Sink, Prideel Majiedt	Acquired								
Pelagic Threat Status	SANBI Kerry Sink, Prideel Majiedt	Acquired								
Pelagic Protection	SANBI Kerry Sink, Prideel Majiedt	Acquired								
EcoRegions and EcoZones	SANBI Kerry Sink, Prideel Majiedt	Acquired								
Benthic and Coastal Condition	SANBI Kerry Sink, Prideel Majiedt	Verbally Approved								
Combined Pressures	SANBI Kerry Sink, Prideel Majiedt	Verbally Approved								
Coastline	SANBI Kerry Sink, Prideel Majiedt	Acquired								
Algoa Bay Project layers	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Bathymetry 10 m contours	ABP NMU Hanah Truter, Victoria Goddall	Acquired								

SAHRA Terrestrial Middens	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
SAHRA Terrestrial Heritage Sites	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Marine Heritage Sites	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Subsistence Fishing Intensity	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Squid Spawning Areas	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Shark distribution	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Top Predator distribution	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Algoa Bay Priority Conservation Areas	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Reef Distribution	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Recreational Activities	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Recreational Spearfishing	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Rec SkiBoat Fishing Intensity	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Rec Shore Fishing Intensity	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Planning Units for Systematic Conservation Plan	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Linefish distribution	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Kayak fishing areas	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
EBSAs	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Algoa Bay Dive Sites	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Commercial Shark Longline Fishing	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Commercial Linefishing Effort	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Commercial Inshore Trawling	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Commercial Squid Fishing	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Coastal Birds (Terns) Distribution	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
South African Dive Sites	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Cetacean Sitings	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Bird Abundance and Richness	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Algoa Bay Islands	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Abelone Reefs	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Fish Distribution	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
SAWS weather stations	ABP NMU Hanah Truter, Victoria Goddall	Acquired								

Kelp harvesting intensity	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Shipping Lanes Mariculture Anchors	ABP NMU Hanah Truter, Victoria Goddall	Acquired								
Wind	SAWS	Needed								
Tides	SA Hydrographers Office	Needed								
Estuarine physical data	NMU SAIAB Janine Parker-Nance	Needed								
Socio-Economic Data	Industry/Muncipality/WPs	Desired								
Mining Concession Areas	Private or DMR	Desired								
Mining Application Areas	Private or DMR	Desired								
Estuarine carbon sequestration data	NMU SAIAB Janine Parker-Nance	Desired								
Effluent outfalls	Muncipality	Desired								
Telecommunication cables	Muncipality	Desired								
Aquaculture concession areas	Private	Desired								