

Earth Observation for Sustainable Fisheries & Marine Aquaculture: a Southern African example

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Consortium Structure



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Benguela Current Commission

Trilateral resource management at ministerial level, coordinating the user engagement, training and policy/impact engagement components.

Council for Scientific and Industrial Research

Lead, developing core IT systems & services and support. User, training and policy engagement

ABALOBI

NPO empowering artisanal fishing communities through mobile ICT

> **Mauritius MOI** Nansen-Tutu Centre Associates







Coastal Oceans Research and Development in the Indian Ocean

Leading coastal and coral reef applications regionally, economic value assessments



University of Dar es Salaam

Leading coastal & resource focused applications & user development, training in Tanzania

Western Indian Ocean Marine **Science Association**

Resource management at regional level, coordinating the user engagement, training and policy/impact engagement components.

Eduardo Mondlane University

Leading coastal & resource focused applications & user development, training in Mozambique

National Sea Rescue Institute

Leading end-user application testing of new real time met-ocean information and forecasts.









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marcoSOUTH: Conceptual Model

WEK

User engagement & quantitative mechanisms for user <u>co-designed</u> systems

USER

WORKSHOPS,

CO-DESIGN &

GROWTH

Partners & users can determine their level of engagement with the EO technical aspects, based on some mix of the two endpoints:

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- Pure consumers with no EO engagement, shaping the services from an applications perspective
- EO/scientists with high level of development and/or regional research involvement



Central acquisition, processing and serving of user optimised products

> Provision of lightweight, high value web- and app-based services



| | Strategic | Tactical | Logistical |
|-------------------------|-----------|--------------------------|------------------------|
| | ← | | ABALOBI |
| Fisheries & Aquaculture | ← | (SST fronts -> pelagics) | Aquaculture West Coast |
| | | | Aquaculture East Coast |
| Coastal Monitoring | < | Coral Bleaching Alerts | — Water Quality |
| Marine & Maritime | ~ | — Vessel Tracking | NSRI/Ops at Sea |





Solutions for communities...

Supporting development & operations of artisanal seaweed farming & other small scale aquaculture in Tanzania & Kenya...



Supporting small scale fishing communities through improving fishing effort & safety across the region with the ABALOBI app...aiming to provide information in English and Portuguese...

Using web & mobile tech...



Supporting national sea rescue institutes regionally through provision of improved search and rescue capabilities through web services and the SAFETRX app...



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Solutions for industries...



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Supporting the aquaculture industries across abalone, bivalve, shellfish and finfish sectors through bloom risk, site selection and operational optimisation support.... Providing regionally optimised observation, forecast and monitoring products for maritime operations...

Supporting the regional small and large pelagic fishing industries across a range of scales, in the coastal and oceanic environments...

Viking[®]

AQUNION

ABAGOLD









Hangana

SEA FLOWER

Solutions for government...

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Supporting aquaculture & fisheries development policies & regulatory mechanisms across the region...



Allowing policy makers to quantify and understand the economic and socioeconomic value of ecosystem services in high value coastal regions...



Providing enhanced monitoring systems for water quality and vessel pollution for compliance and regulation....



Providing new capabilities of vessel monitoring in regional EEZs, enhancing maritime, fisheries and environmental security....

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User co-design : a critical part of service development



Quantitative user engagement & co-design mechanisms allowing development of complex operational systems from multiple view and architecture considerations. MarCoSouth uses the Reference Model for Open Distributed Processing (RM-ODP), providing a set of viewpoints for partitioning the design of a distributed system.



What infrastructure (paper + IT) is needed to operationalize



Service 1A: Fishing Zones Monitoring and Protection

User Needs & Decision Making



Value propositions

- Provision of freely available products e.g. high resolution SST, fronts, ocean colour, oceanography in real time and historical modes...
- Work with regulators to improve stock assessment, catch/effort analyses, compliance & IUU, sustainability across sectors...
- Work with industry to improve national & regional competitiveness e.g. MSC certification,...
- Investigate industry needs for further value adds in private sector, e.g. PFZ capabilities for specific sectors, voyage & infrastructure management,...





African Union





Service 1: Aquaculture and Fisheries comparison

User Needs & Decision Making

| Aquaculture & HABs | | | |
|--|---|--|--|
| Community • Very open, interactive & developing community that have suffered severe HAB losses recently and welcome any improved HAB observations User Archetypes: farm/facility managers; government monitoring & regulatory departments; desalination plant engineers & managers ; disaster management | Emerging Approach 100% public service model for 1st phase Open technical advisory group Farms provide daily phytoplankton counts Sharing of all NRT and historical EO & in situ data WhatsApp groups (user preferred system) provides information sharing & consensus risk evaluation | | User needs are high specific & domain- sensitive e.g. the comparison betwee aquaculture & fishe sectors |

Fisheries Support

Community

Actually many different industry communities ٠ from artisanal through small/large pelagic to agri-business demersal hake etc – all with different competitiveness, investments in"business intelligence" etc . Regulators & industry associations

User Archetypes: artisanal; pelagic; demersal; associations; fisheries regulators...

Emerging Approach

- 100% public service model inappropriate requires mixed sectors-specific approach
- Open technical advisory group but some • industry users prefer closed one-one
- Primary engagement with fisheries ministries as regulators and sector guides
- Marine stewardship certification increasingly valuable as collaborative engagement...

hly 'n ries

Key part of service design is to find where MarCoSouth can really provide value and innovation fairly quickly - this is a pragmatic choice...



Service 1A: Fishing Zones Monitoring and Protection

Testing, Validation & Service Operation

• Integration of available catch data, initially from South African DAFF as below, progressing to integration of ABALOBI and regional catch data





Service 1A: Fishing Zones Monitoring and Protection

Improving Service Focus for delivery by end 2020

Focus on the earth observation innovation around small scale fisheries though ABALOBI as key partner, with highly focused products & development of new tools for

- Frontal & other products for optimised fisher decisions
- Improved safety at sea forecasts
- New artisanal phenology used to analyse event scale environmental conditions optimal for fishing, and to use this for predictive supply chain management

Provision of freely available potential fishing zone products for pelagic fishers & engagment through industry partners







Service 1B: Aquaculture Site Monitoring and Protection

User Needs & Decision Making

Example questions of a user survey for the aquaculture support tool conducted for the South African aquaculture sector in 2018/2019 – a further optimised survey will be conducted for Namibia (similarly strucured sectors) and the utility of an adapted survey will be assessed for the very different artisanal East African sectors....











Service 1B: Aquaculture Site Monitoring and Protection

User Needs & Decision Making

Example of regionally optimised Sentinel 3 HAB classification product for the Benguela – a good example of a cutting edge highly-localised EO product that is now in operational service under OCIMS and GMES-Africa. This image focuses on a potentially very damaging bloom in 2019, where mortalities where avoided through a combination of greatly improved farm mitigation infrastructure and better decision making based on these products....

Smith & Bernard, Frontiers in Marine Science (in review), attribution to GMES-Africa





Figure 6. Satellite products derived from S3A-OLCI for the 24th of February 2019. The top panel shows [Chl-a], whilst the bottom panel shows the derived phytoplankton type dassification; dasses include dinoflagellate (red) and *Pseudo-nitzschia* (yellow) dominated waters, as well as high (green) and moderate (blue) biomass mixed assemblages.



Understanding impacts of changing climate for aquaculture is also a focus arae – example 15 M.Sc year study showing bloom refuges on the south coast (Aphiwe Mtentandaba)





Figure 4.3 spatial concentration of Chl a (mean in blue, standard deviation in red) along longitude highlighting regions with high phytoplankton biomass.

Service 1: Fisheries & Aquaculture Support Service





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Fisheries and Aquaculture Support Service



| Harmful Algal Blo | oom Risk | (| • н | igh Bloom Act | ivity 🔵 Stable | e/Unknown (| No Data |
|-----------------------|------------|------------|------------|---------------|----------------|-------------|------------|
| Area | 2019-11-19 | 2019-11-18 | 2019-11-17 | 2019-11-16 | 2019-11-15 | 2019-11-14 | 2019-11-13 |
| Namaqua Shelf | ٠ | • | • | • | • | • | • |
| Greater St Helena Bay | • | • | • | • | • | • | • |
| SW Cape | • | • | ٠ | ٠ | • | • | • |
| False Bay | • | • | ٠ | ٠ | ٠ | ٠ | • |
| Overberg | • | • | • | ٠ | • | • | ٠ |
| Langeberg | • | • | ٠ | ٠ | • | • | ٠ |
| Garden Route | • | • | ٠ | • | ٠ | ٠ | ٠ |
| Algoa Bay | • | • | • | • | ٠ | • | • |
| Wild Coast | • | • | • | • | • | • | • |
| KZN South Coast | • | • | • | • | • | • | • |
| KZN North Coast | • | • | • | • | • | • | • |
| Elephant Coast | • | • | • | • | • | • | • |

Now viewing: MODIS Switched Algal Bloom Detections





Example screenshot of the main aquaculture support tool, providing harmful algal bloom, productivity and temperature products and analytics...should be live in 2019





Fisheries and Aquaculture Support D

Sentinel 3 bloom monitoring as of this morning....

African Union

AND AFRICA





Service 1B: Aquaculture Site Monitoring and Protection

Testing, Validation & Service Operation

...of course, what many users really want is just a WhatsApp group...





1:41 PM



Service 2B: Water Quality Monitoring

Involvement of the private sector, focuing on the high resolution water quality monitoring service using the CyanoLakes SMME EO service provider....



anolakes









Service 3A: Ship Traffic Monitoring

User Needs & Decision Making

Users often need to

- 1) Find and track specific vessels
- 2) Be warned of vessels inside restricted areas
- 3) Find the history of a vessel
- 4) See the normal behaviour of vessels over history
- 5) Find vessels that are not transmitting their position

These requirements are used in:

- Fisheries enforcement
- Tracking of vessels suspected of smuggling
- Pollution monitoring
- Determining port activity









Real time knowledge of the maritime domain allow for the optimal deployment of national assets for security and fisheries compliance....

SARAH BAARTMAN

Allowing for the prevention and deterrence of activities that represent threats to security and economic sustainability, such as illegal fishing....



Service 3A: Ship Traffic Monitoring

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| URRENT SHIP | S GEOFENCES SAR | | | |
|-------------|-----------------|------------|-------------|------------|
| MMSI | Name | ▲ Callsign | Flag | Remove All |
| 371179000 | EVERBEAUTY | 3EKP2 | Panama | remove |
| 538008115 | HL SALDANHA BAY | V7EC5 | Marshall Is | remove |
| 636017550 | SWEET IRINA | D5LM7 | Liberia | remove |

53

Search for ship name/mms

| C | hi | m | - | |
|---|----|----|---|--|
| | | Ρ. | - | |
| | | | | |

| Name | SWEET IRINA | CAR 9.3 knots |
|---------------|-------------------------------|-------------------------|
| MMSI | 636017550 | |
| Position | [-36.19 , 29.88] | |
| Position | S36°11.264' E29°52.786' | |
| IMO | 9566813 | - Watto |
| Callsign | D5LM7 | No. of Concession, name |
| Source ID | IVT DEST WS (Testing) | |
| Reported Time | 11/19/2019, 2:08:29 PM (SAST) | State of the second |
| Heading | 82.00 ° | Image sup |
| Flag State | Liberia | |
| Track | Refrest Remove | |
| Avg Speed | | |



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Image supplied by Marine Traffic



Service 3A: Annual Fishing Effort Synthesis



GMES AND AFRICA



Application M3.1.1: Ship Traffic Monitoring

Testing, Validation & Service Operation

The IVT system has already assisted in tracking vessels known to carry drugs and to provide exact details on Ports visited. The system has also assisted in identifying vessels that have been fishing within Marine Protected Areas.

LOOK: Cocaine worth R720m seized on ship in Port Elizabeth docks

EASTERN CAPE / 8 JANUARY 2019, 1:11PM / RAAHIL SAIN





Members of the Hawks hold bags of cocaine seized in a big bust in the Port Elizabeth docks. Picture: African News Agency (ANA)

NEWS

'Rogue' fishing vessel seized in PE harbour

Nine tons of fish found on boat without permit

▲ PREMIUM

BY GUY ROGERS - 08 May 2019



