

Integrating regionally optimised sea surface temperature and ocean color earth observation products to detect and monitor harmful algal blooms in support of small scale fishers and the abalone aquaculture industry in the Southern Benguela Upwelling System



Christo Whittle, Marié Smith and Stewart Bernard
Council for Scientific and Industrial Research, South Africa

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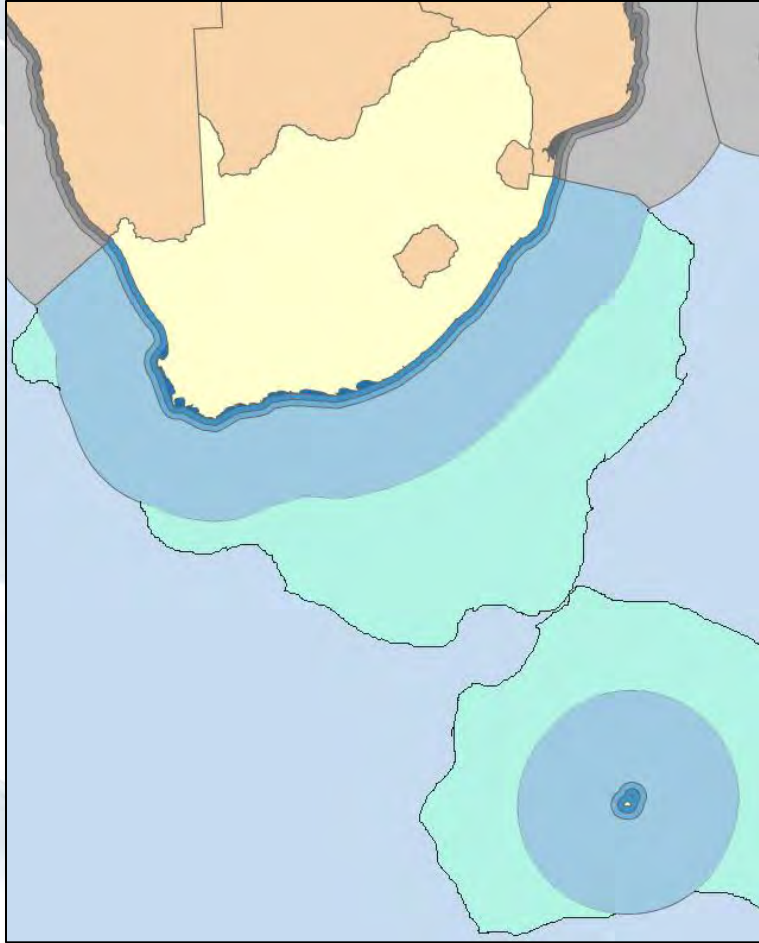
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National Context - OCIMS

Developing the oceans economy: Operation Phakisa



Land Size:

1.2 million km²

Exclusive Economic Zone (EEZ) Size:

1.5 million km²

SA is responsible for managing >3000 km of coastline and an oceans space that is greater than the land territory

National Context - OCIMS

Developing the oceans economy: Operation Phakisa



Land Size:

1.2 million km²

Exclusive Economic Zone (EEZ) Size:

1.5 million km²

2014 - Operation Phakisa

To accelerate a "better life for all citizens in an inclusive society"

National Context - OCIMS

Developing the oceans economy: Opera

2015 - CSIR to facilitate and co-develop OCIMS

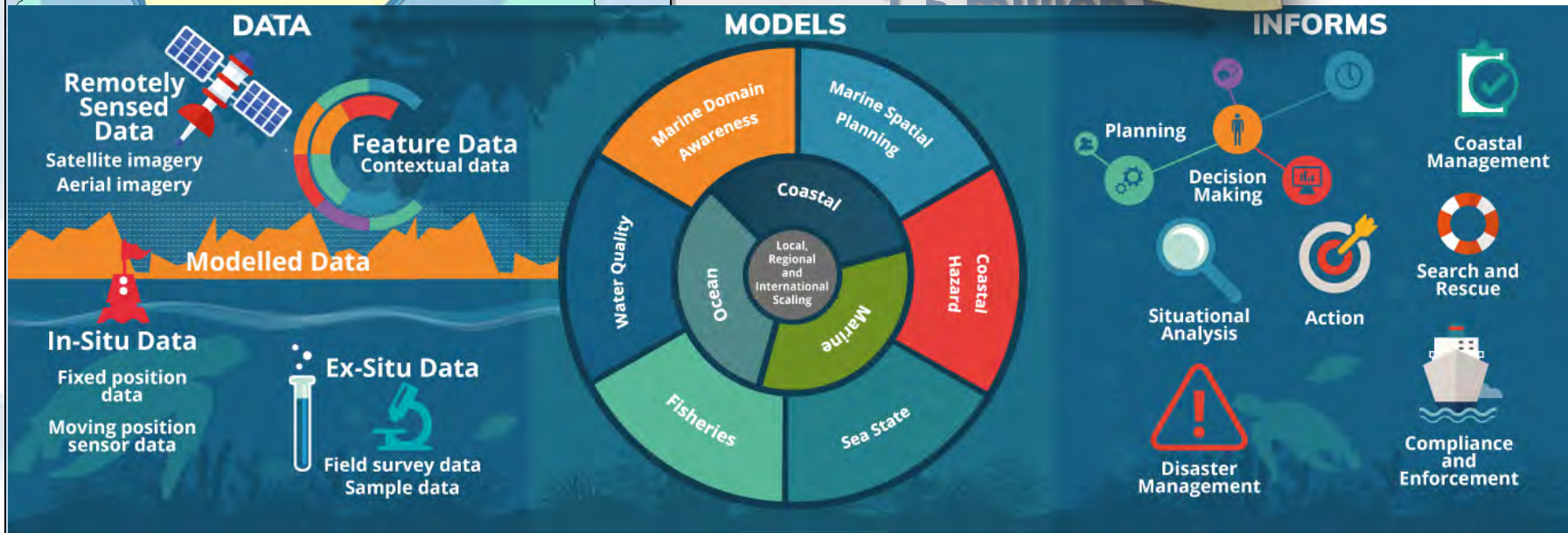


Land Size:

1.2

Exclusive E

1.5 million

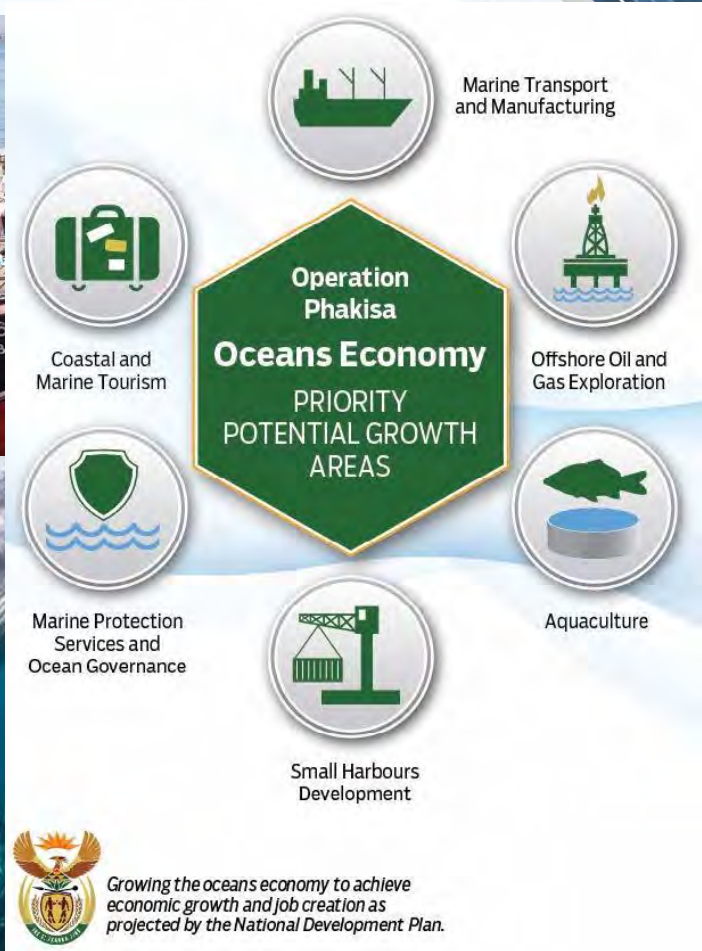


National Context - OCIMS

Developing the oceans economy: Operation Phakisa



To Produce information that will have a measurable socio-economic impact on the South African landscape by identifying, interpreting and monitoring the environmental factors that promote the safe, sustainable exploitation of living and other marine resources...



Small-scale Fisheries in South Africa...

Small-scale fishers excluded from the Marine Living Resources Act of 1998...



Small-scale Fisheries in South Africa...



- ✓ South African Small-Scale Fishers Policy adopted in 2012
- ✓ Marine Living Resources Act amended in 2014
- ✓ 15 year long-term fishing rights assigned to rural coastal communities in 2020



Harmful algal bloom impacts...

[Home](#) > [Scitech](#) > [Science](#) > [Environment](#)

Tons of lobster die after red tide

ENVIRONMENT / 12 February 2015, 11:02am

[Melanie Gosling](#)

Cape Town - Two hundred tons of West Coast rock lobster – starved of oxygen

[Home](#) > [South Africa](#) > [Article](#) >

Lobster warning as red tide spreads

Staff reporter | 11 February, 2015 14:59



Willem, a member of the Hout Bay Artisanal Fishers Association, checks the size of a lobster in the waters off Cape Point

Another 80 tons of West Coast Rock Lobster washed out in Eland's Bay this morning as a result of the harmful algal bloom - red tide - that was detected on the West Coast more than a week ago.

[Home](#) > [News](#) > [South Africa](#) > [Wcape](#)

Red Tide outbreak on Garden Route

WESTERN CAPE / 15 December 2015, 8:22pm

[Jabulile S. Ngwenya](#)

Cape Town - An outbreak of Harmful Algal Bloom (HAB), also known as Red Tide, has been confirmed along the Garden Route coastal area, the Department of Environmental Affairs (DEA) announced on Tuesday.

DEA spokesperson Zolile Nqayi said some of the HAB-affected areas along the coastal route included popular tourist spots Plettenberg Bay, Knysna and Wilderness

Harmful Algae Kills 200 Tons of Rock Lobsters Off South Africa

[Wednesday, 11 February 2015](#) Written by Bloomberg



Aquaculture in South Africa...



Aquaculture in South Africa...



- Under Operation
Phakisa umbrella:*
- ✓ Aquaculture Development Bill (2018)
 - ✓ Inter-departmental Authorizations Committee
 - ✓ Aquaculture Development Fund

Aquaculture in South Africa...

HEADLINES 2019: SA economy reaps the rewards of Operation Phakisa

“...to Aquaculture in South African has shown strong growth in 5 years, with **production from 2014 up 5 fold to 20,000 tonnes...**”

“...The Aquaculture sector in South Africa now **employs 15,000 people in direct and full time jobs....**”

“Jobs in Aquaculture sector seen as **quality jobs, improving livelihoods in rural communities...**”

“...experts estimate the **revenue contributed by Aquaculture to South Africa’s economy to be as much as R 3 Bn...**”

““...exciting momentum built in Operation Phakisa evidenced by **Aquaculture’s inclusive growth...**”



Abalone



Oyster



Mussels



Finfish



Aquaculture in South Africa...



Aquaculture in South Africa...



Harmful algal bloom impacts...

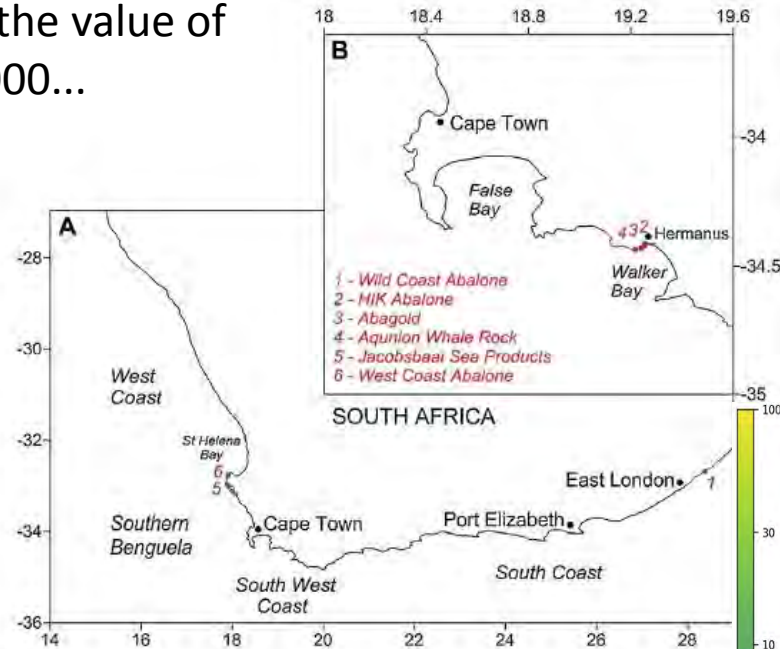


Losses to the value of R50,000,000...

THE BLUE BEAUTY OF THE BEAST

What the sea lacks in beauty in the daytime during the red tide, it makes up for at night with spectacular displays of phosphorescence in Walker Bay. According to resident Ronnie Hazell there have been beautiful displays in the breaking waves and spray along the Hermanus coastline.

PHOTO: Ronnie Hazell



Monstrous red tide is the largest ever

De Waal Steyn

bloom stretches at times well over 3 km into the ocean from the shoreline and can be viewed on satellite imagery from the West Coast past Cape Point up to Cape

"We are lucky that the current red tide is not toxic and ingesting shellfish or sea water will probably only cause a mild upset stomach. The impact on marine life

oxygen. This may lead to significant losses for abalone farms," adds Tim.

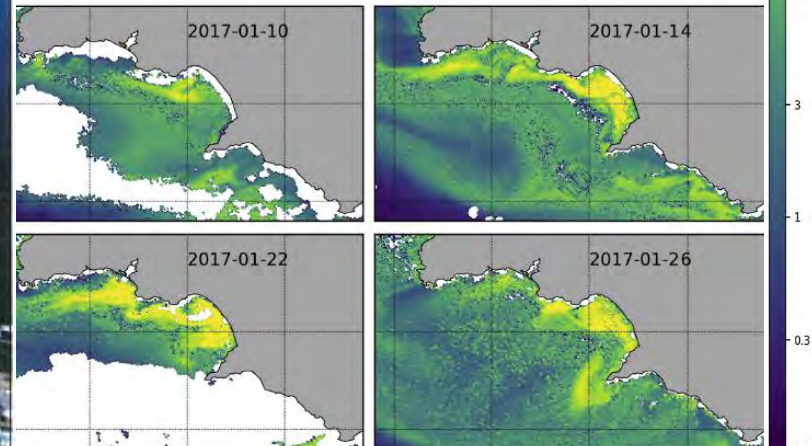
But, according to him, Abagold's employees have

year, but when the excessive volume of the bloom started on 16 January we were ready to put all our energy into combating the effects of the red tide.

flush out the tanks at least once a day. By reducing the number of animals in each tank and by diluting the infected water with as much clean water as possible

This red tide is huge - this is definitely mother nature at her most powerful and the sheer size of the algae bloom is astounding. A red tide of this magnitude never been recorded in Hermanus before," says Tim Hedges, Managing Director, Abagold.

According to Tim, the algae

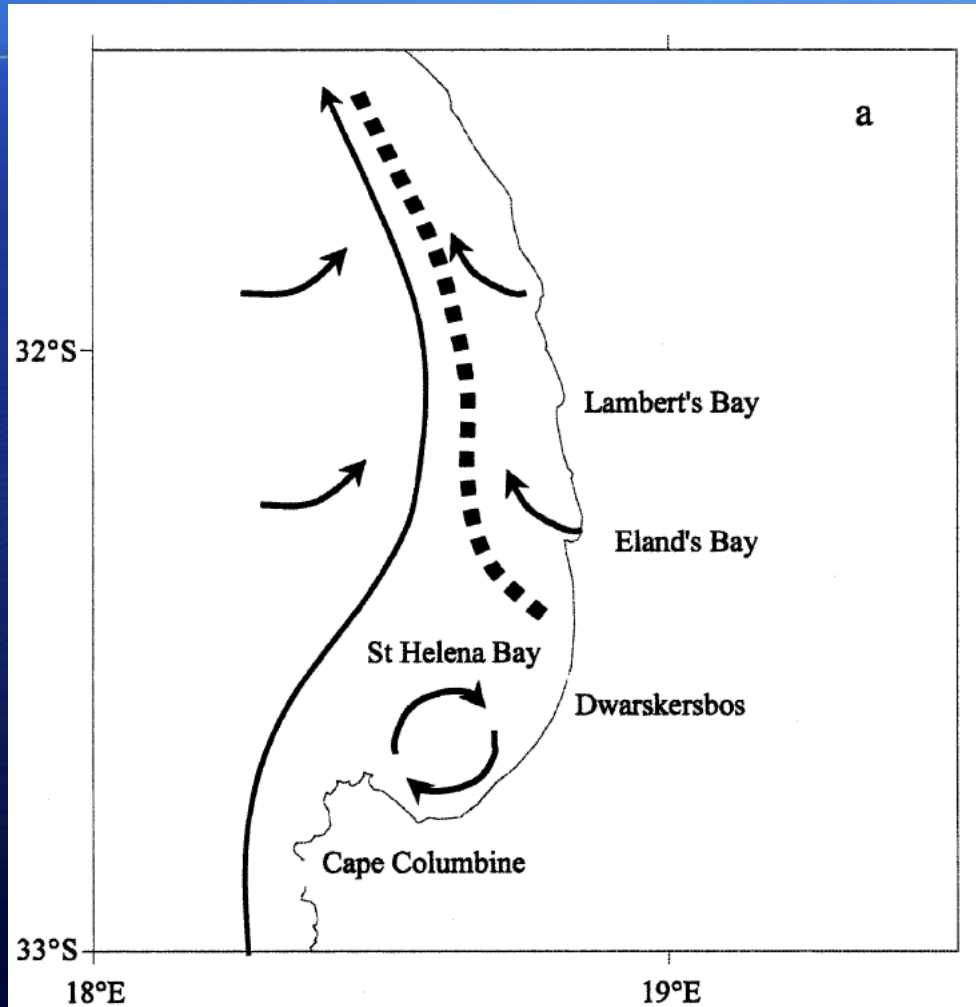


Red Tides...



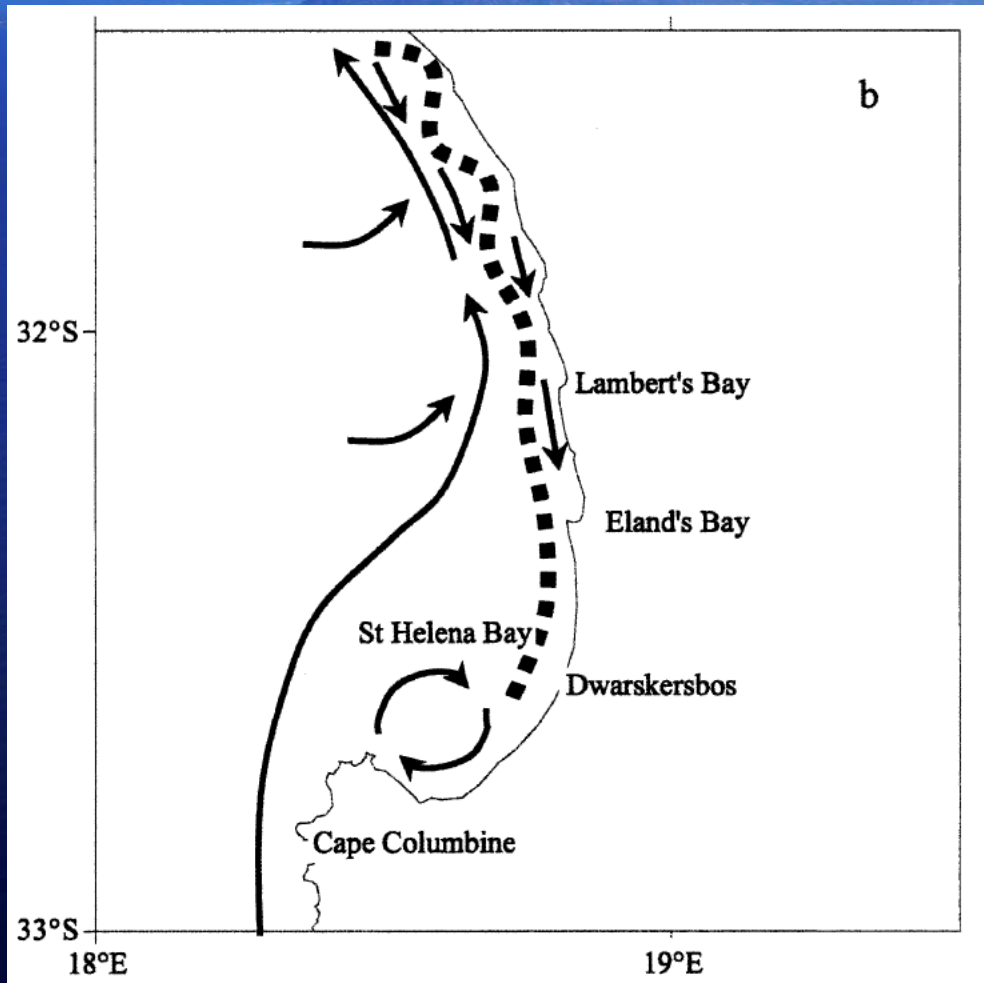
False Bay Bloom, Feb 2007, Photo by Anthony Allen;
Pitcher et al 2008

Red Tides...



- ✓ Active upwelling...
- ✓ Convergence between upwelling plume and core northward flow...
- ✓ Dinoflagellates accumulate offshore...

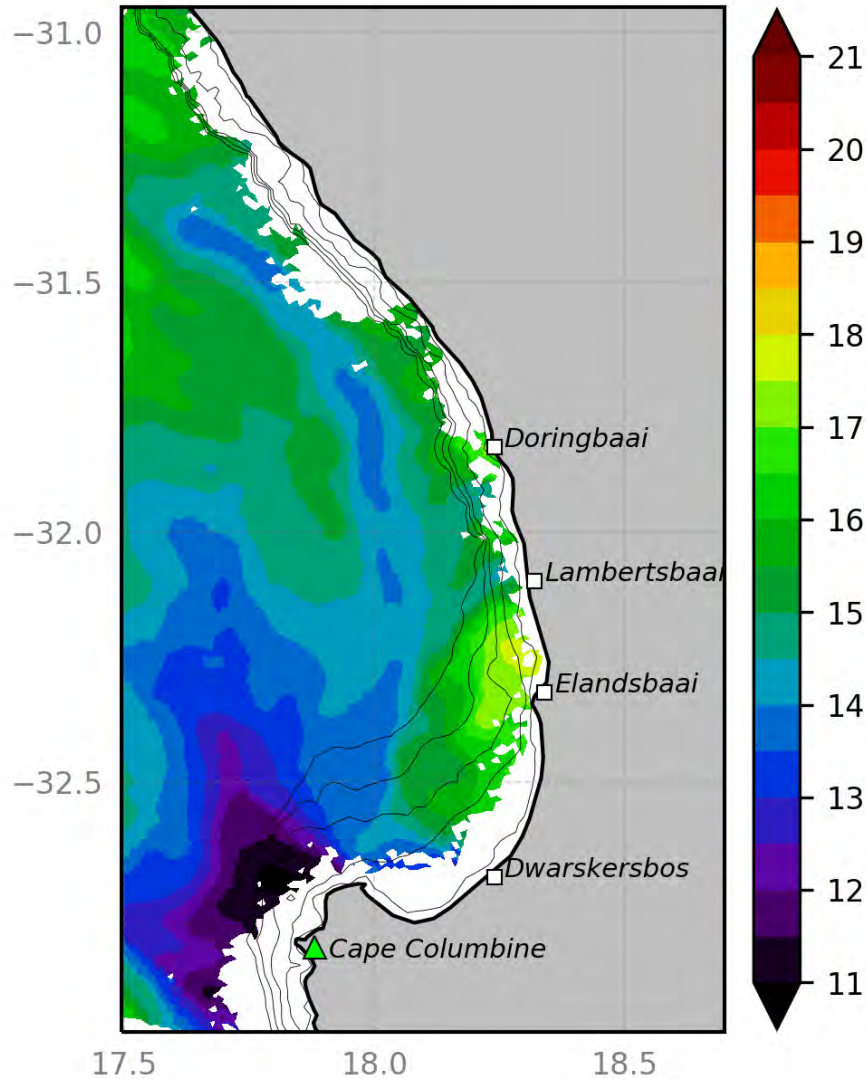
Red Tides...



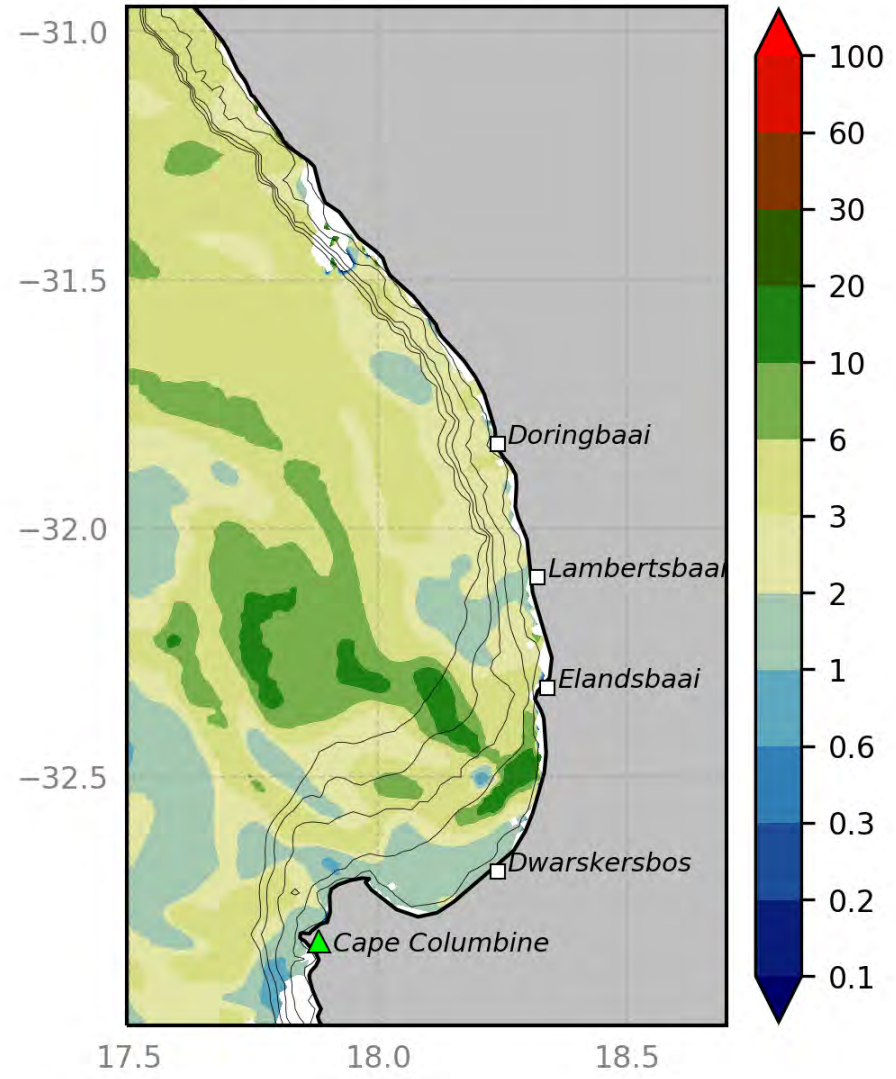
- ✓ Wind relaxation...
- ✓ Stratification...
- ✓ Shoreward bloom accumulation
- ✓ Southward translation of blooms...

Red Tides... shoreward accumulation.

2020-01-18 SLSTR SST (°C)

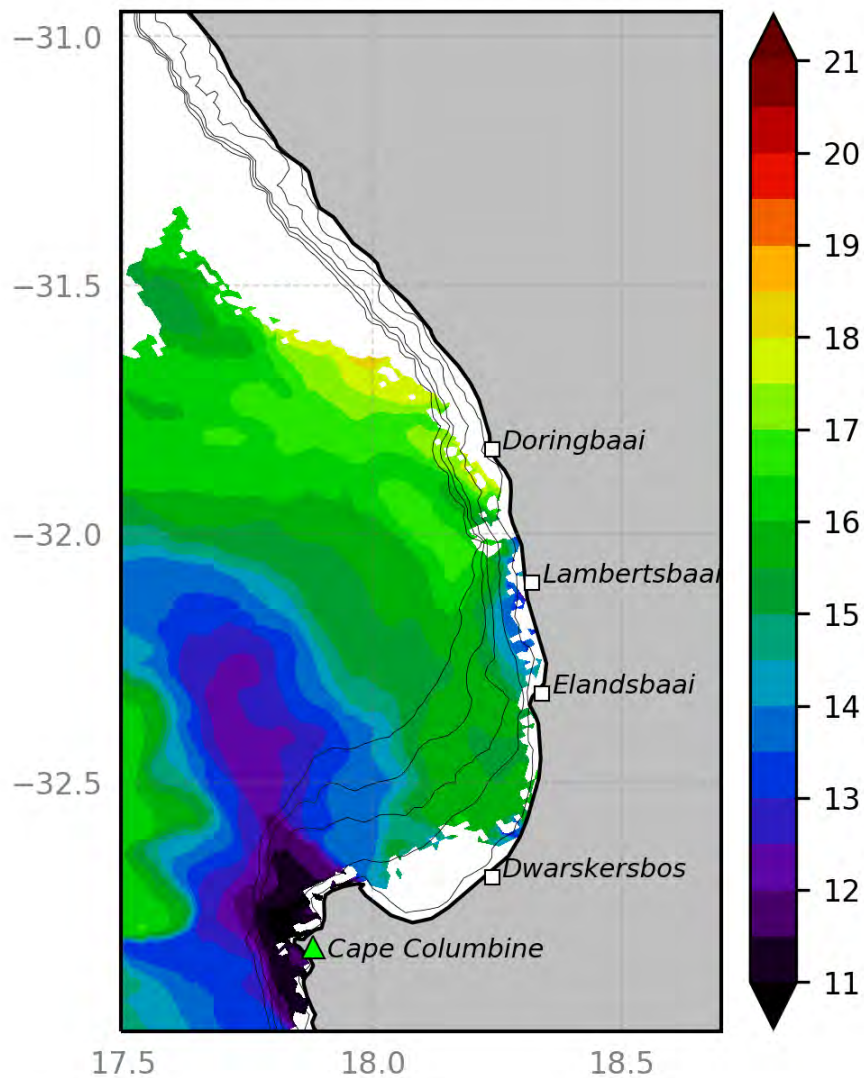


2020-01-18 OLCI Chl-a (mg m⁻³)

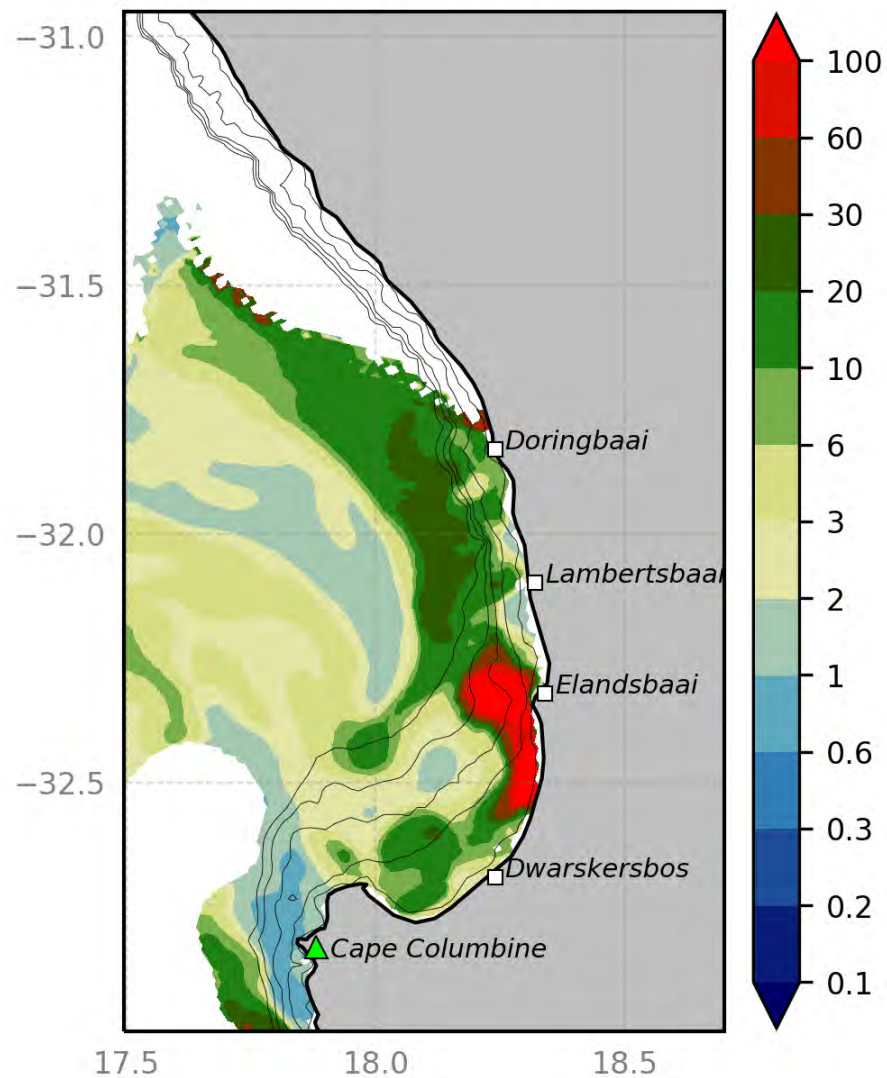


Red Tides... shoreward accumulation.

2020-02-12 SLSTR SST (°C)

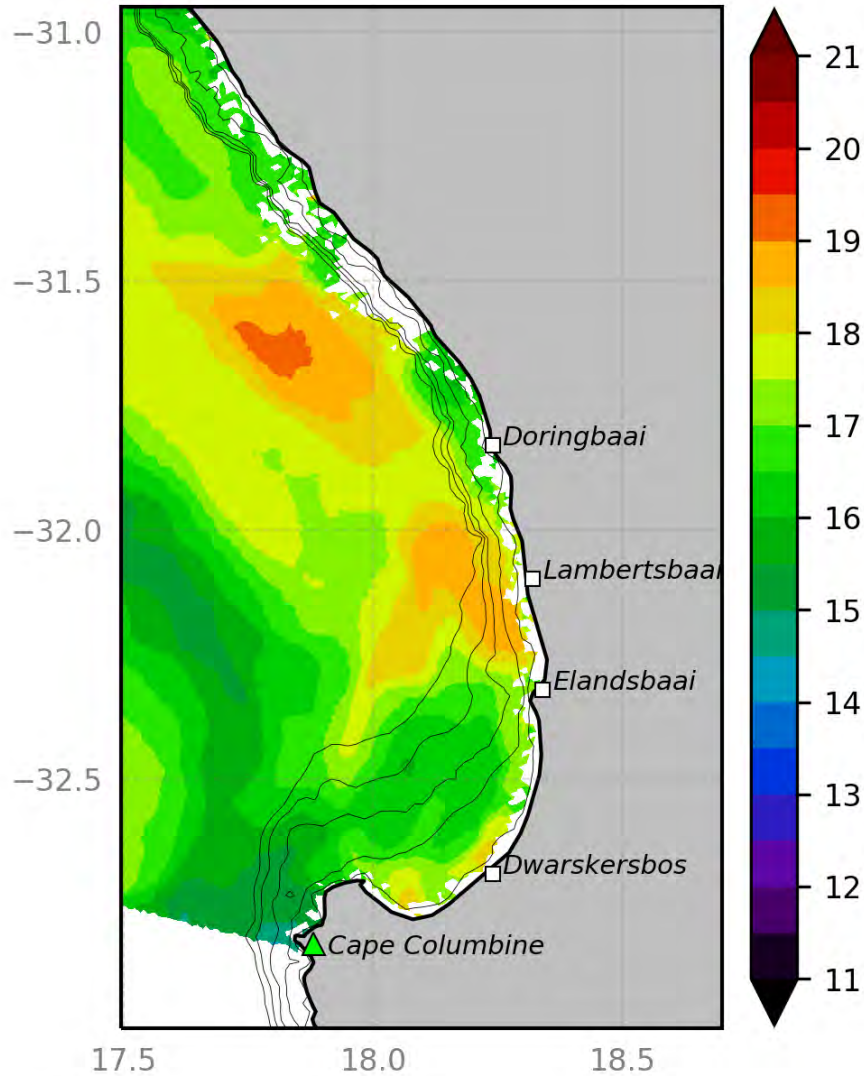


2020-02-12 OLCI Chl-a (mg m⁻³)

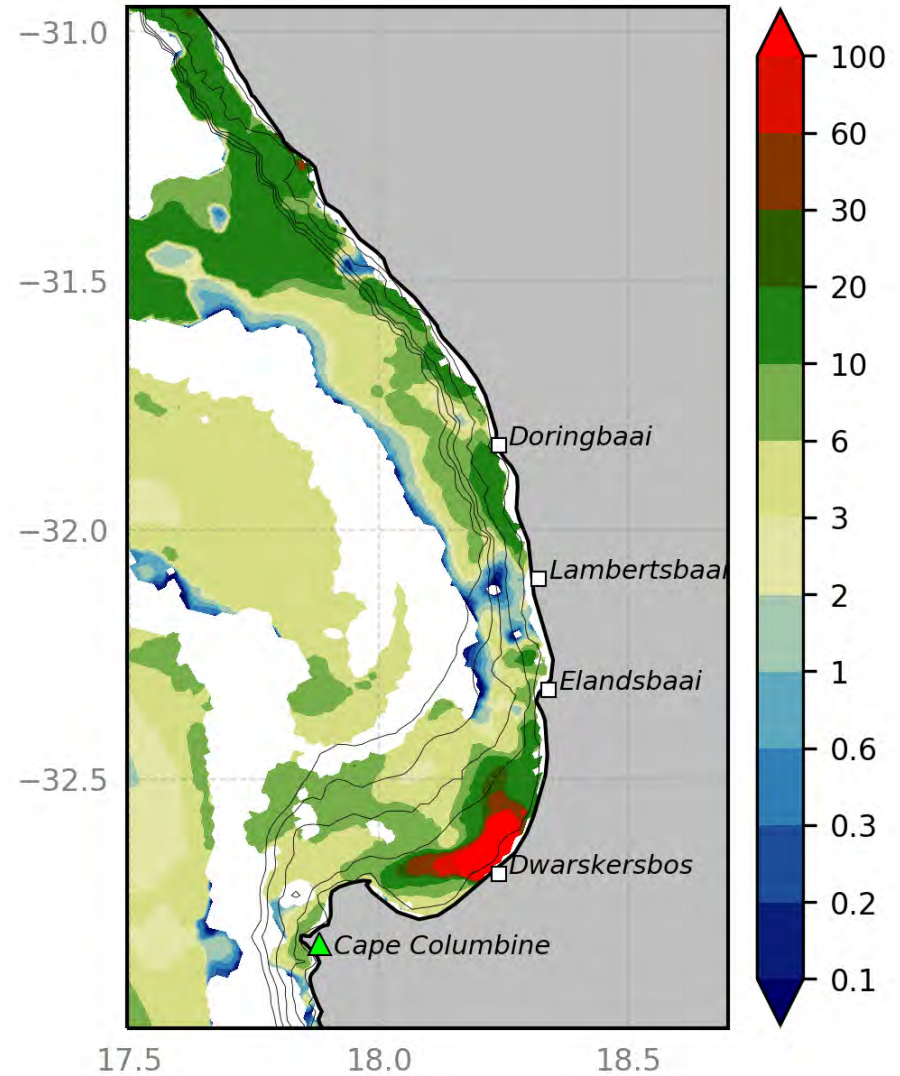


Red Tides... shoreward accumulation.

2020-02-18 SLSTR SST ($^{\circ}\text{C}$)

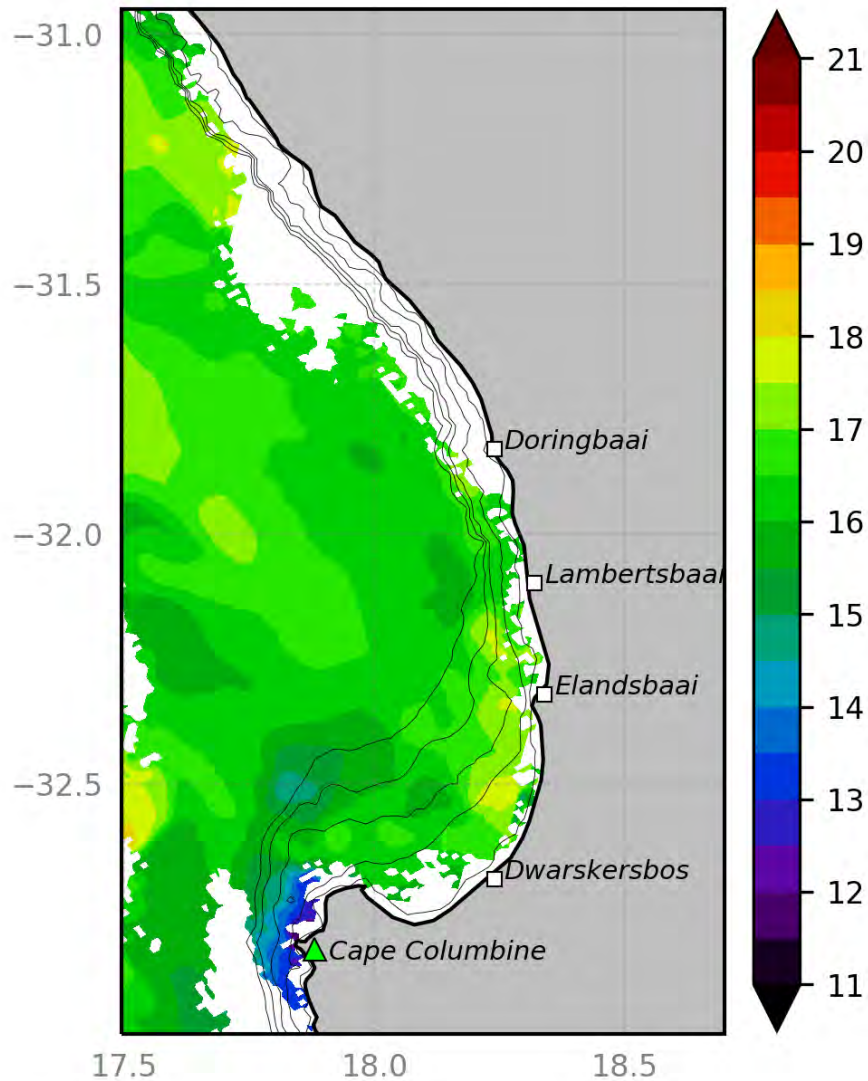


2020-02-18 OLCI Chl-a (mg m^{-3})

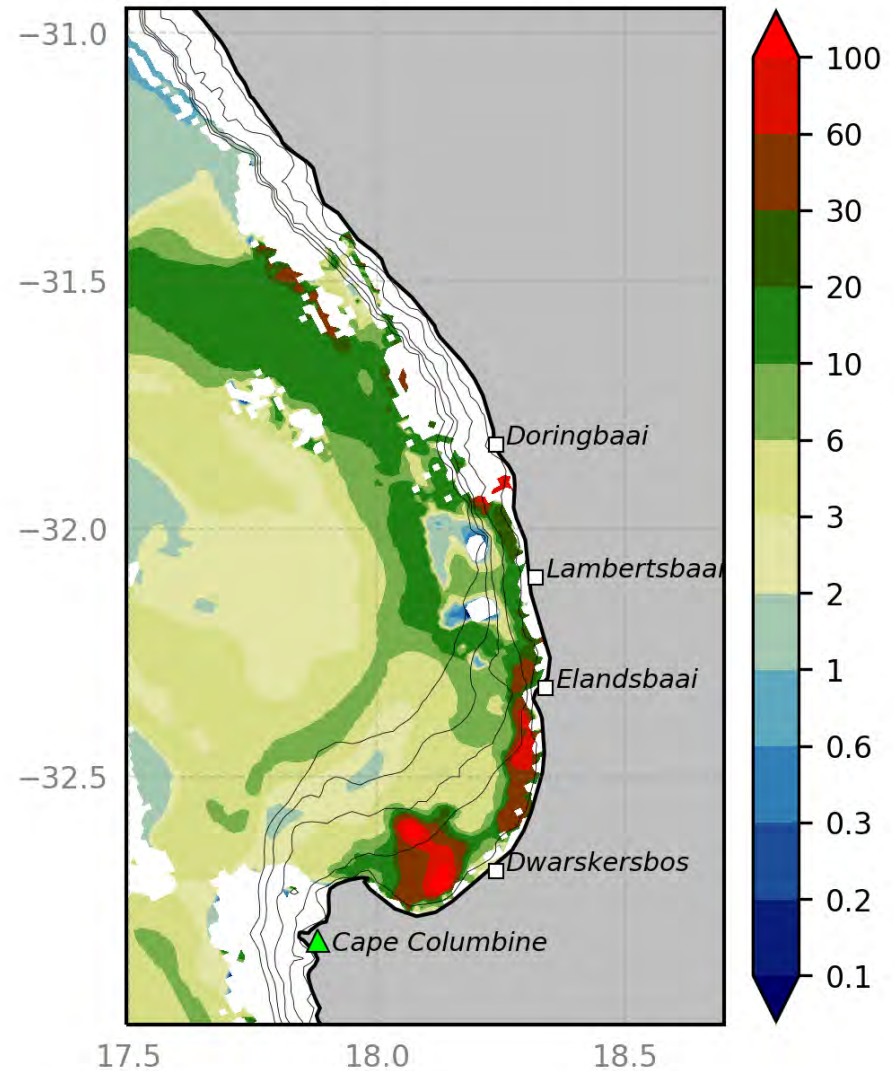


Red Tides... shoreward accumulation.

2020-02-21 SLSTR SST ($^{\circ}\text{C}$)

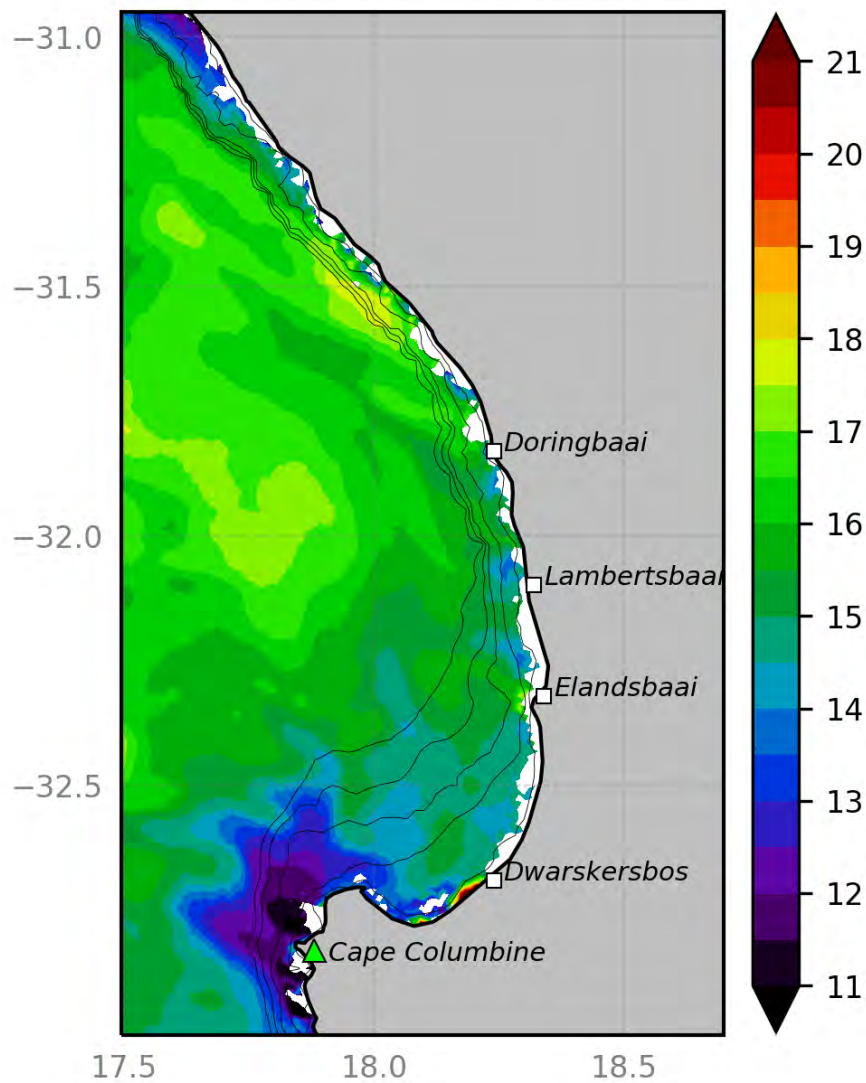


2020-02-21 OLCI Chl-a (mg m^{-3})

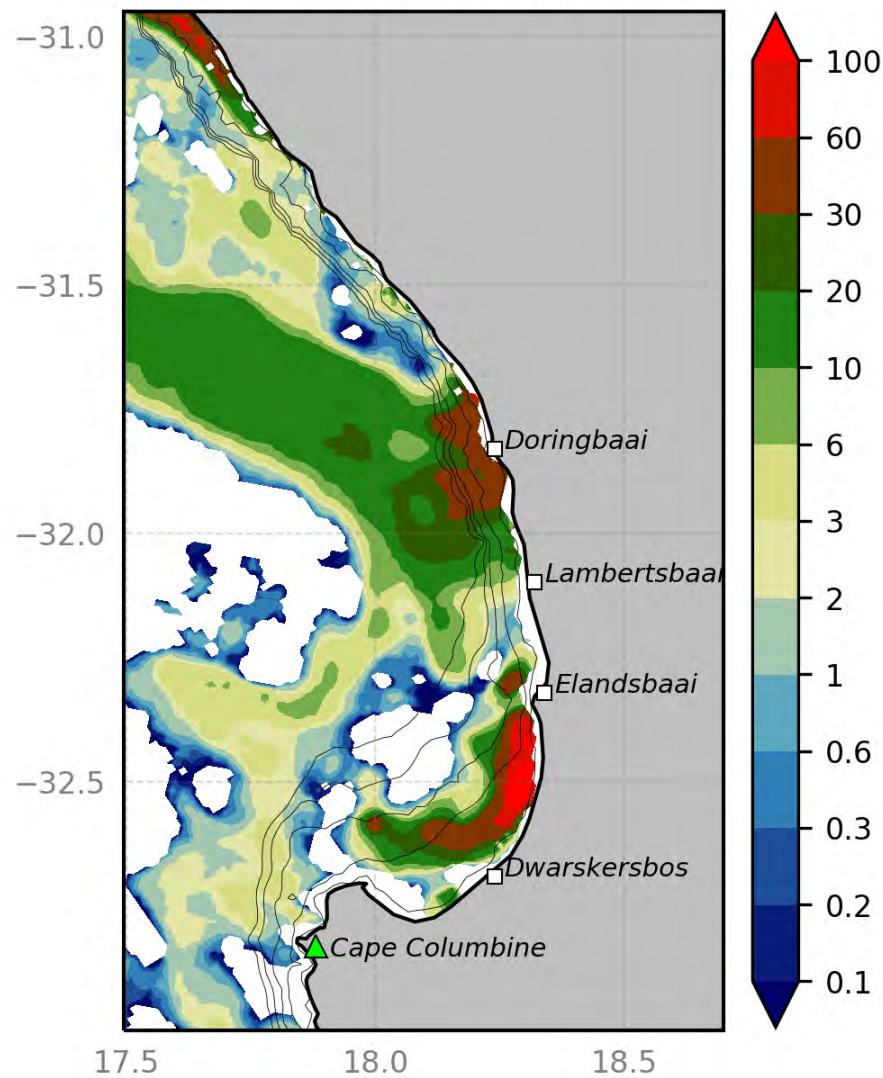


Red Tides... shoreward accumulation.

2020-02-23 SLSTR SST ($^{\circ}\text{C}$)

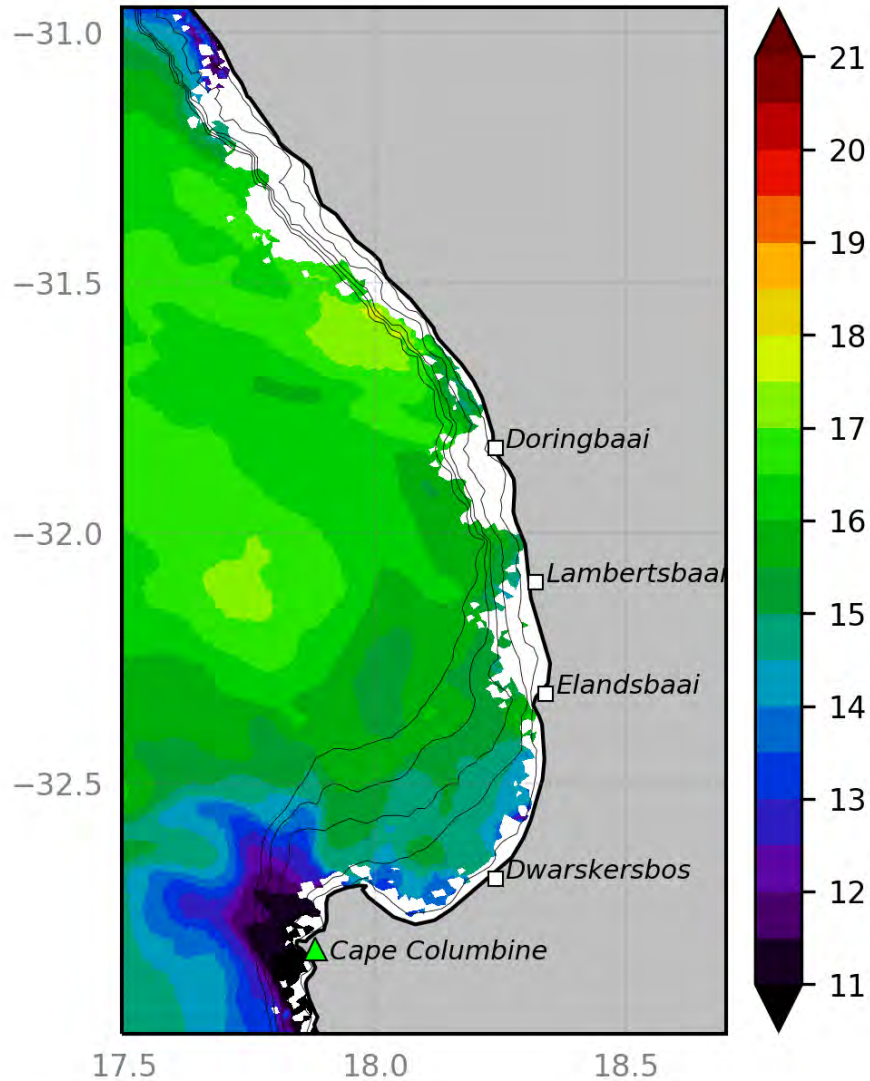


2020-02-23 OLCI Chl-a (mg m^{-3})

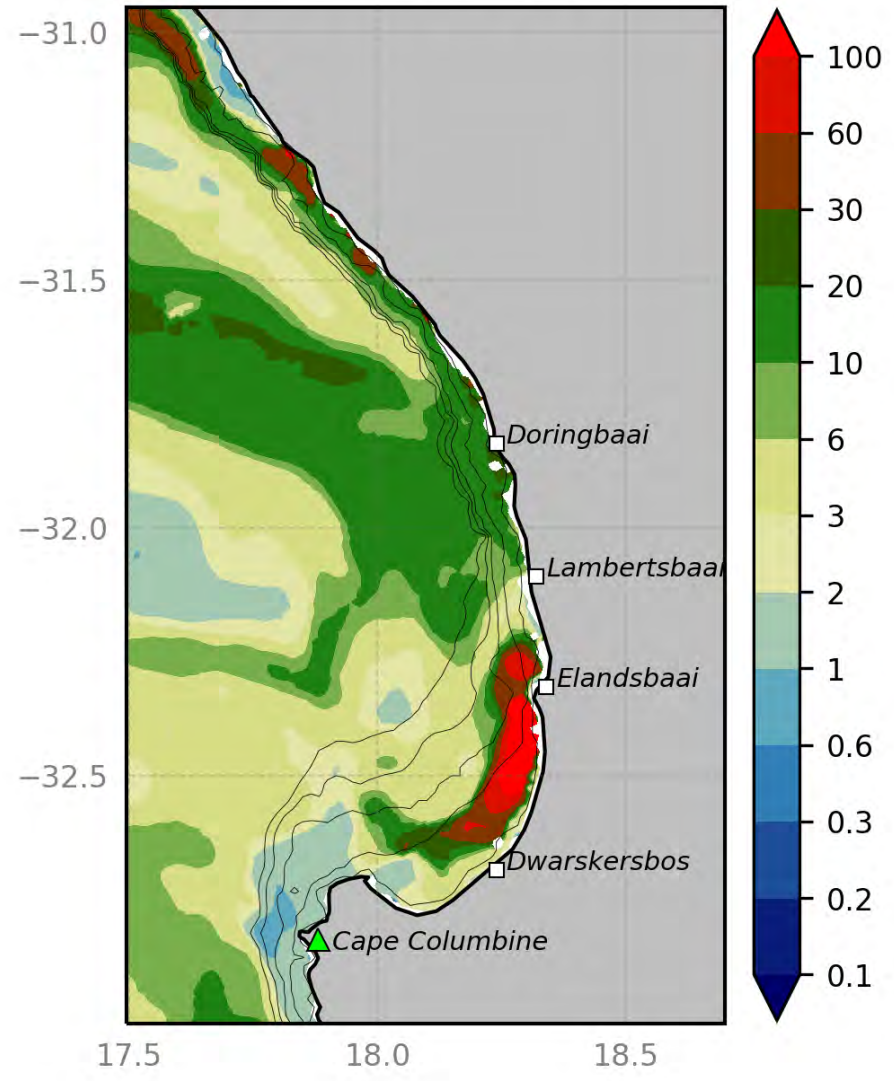


Red Tides... shoreward accumulation.

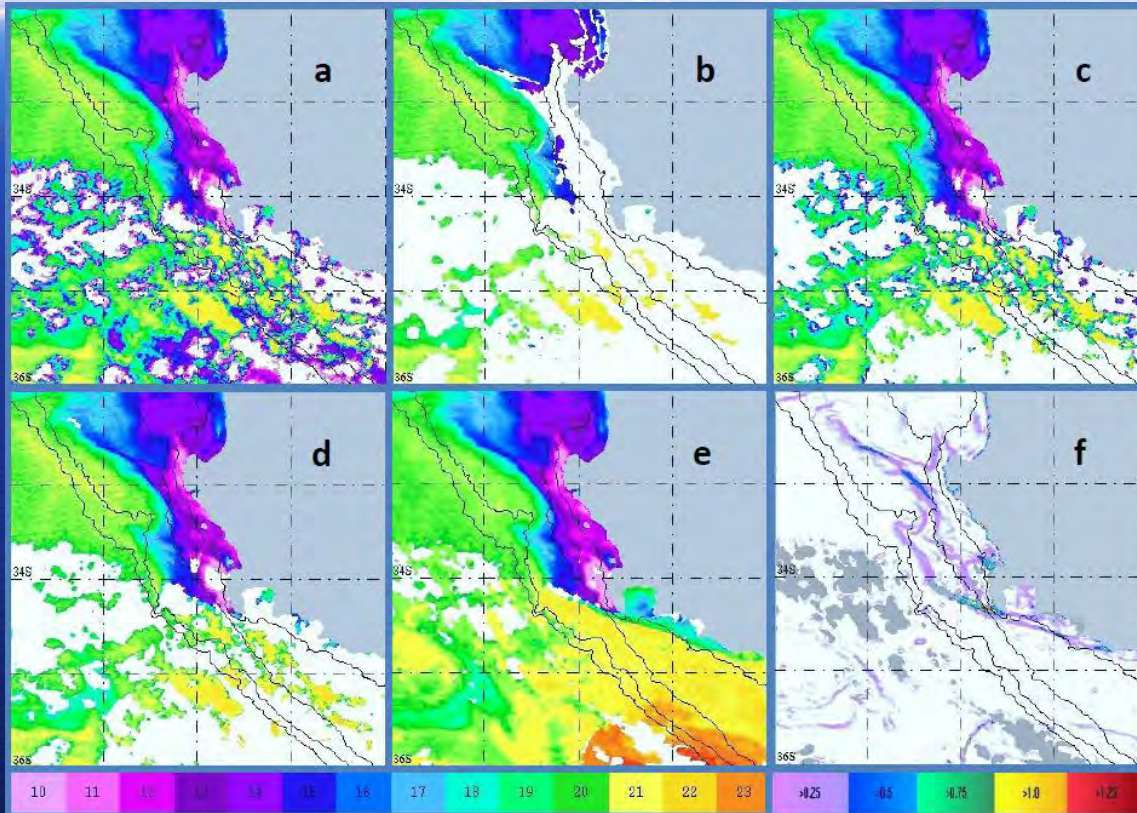
2020-02-24 SLSTR SST ($^{\circ}\text{C}$)



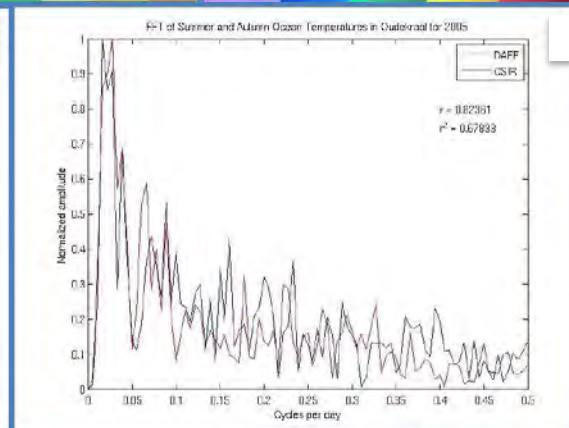
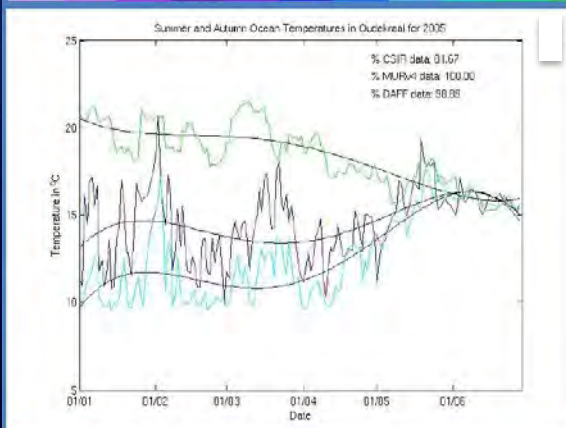
2020-02-24 OLCI Chl-a (mg m^{-3})



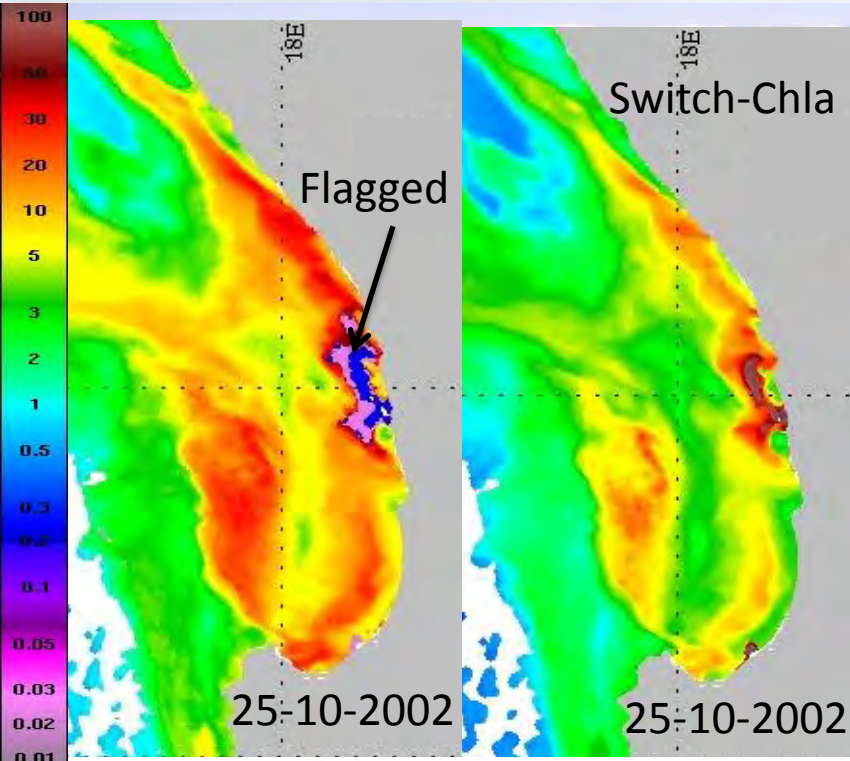
EO Product development and validation...



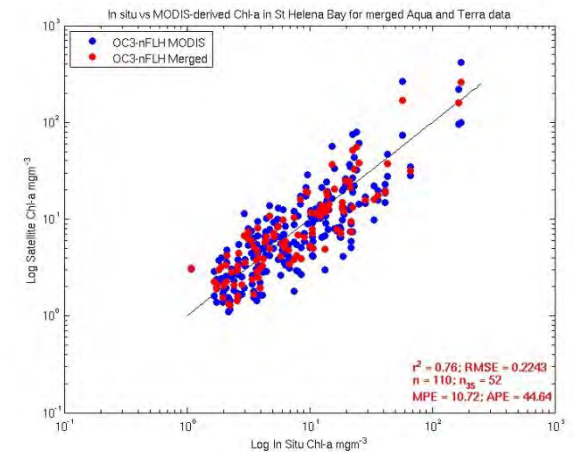
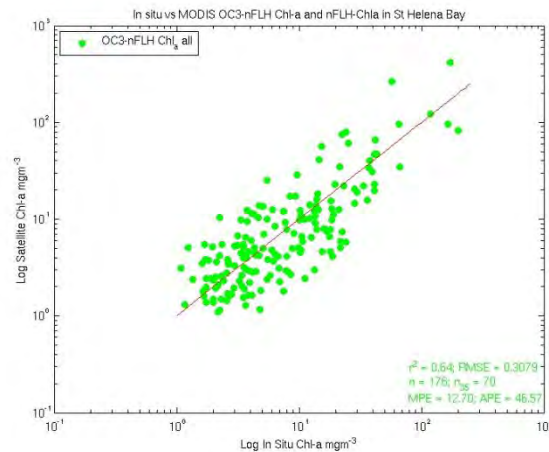
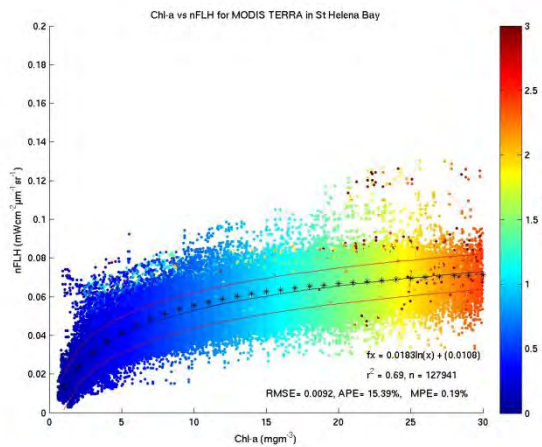
- ✓ Standard cloud flagging options inadequate...
- ✓ CSIR developed own cloud flagging...
- ✓ Create daily averages from both MODIS sensors...
- ✓ Validate CSIR MODIS SST product against GHRSSST MUR and in situ data...
- ✓ SLSTR SST to be included to maintain time-series continuity...



EO Product development and validation...



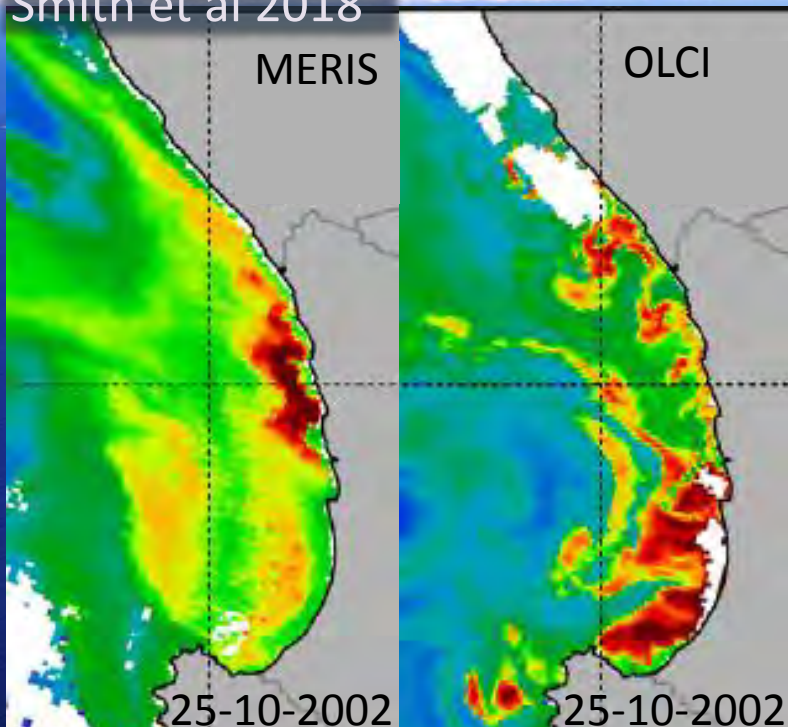
- ✓ MODIS OC4 Chla algorithm fails at high biomass...
- ✓ nFLH correlated with Chla through power function...
- ✓ CSIR developed optimized MODIS Chla switching algorithm...
- ✓ Validate CSIR MODIS Chla product against in situ data...



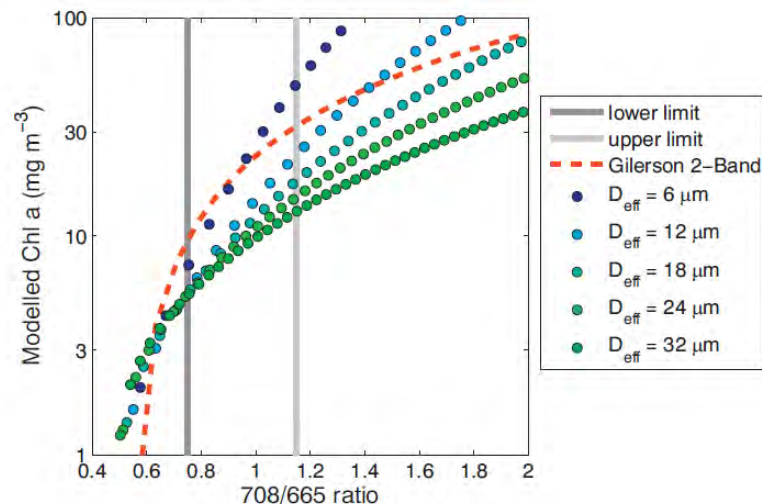
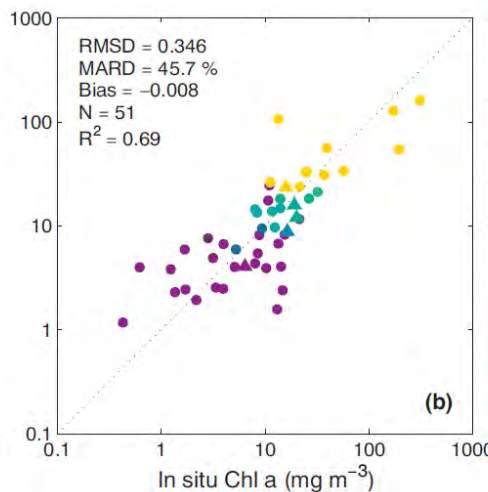
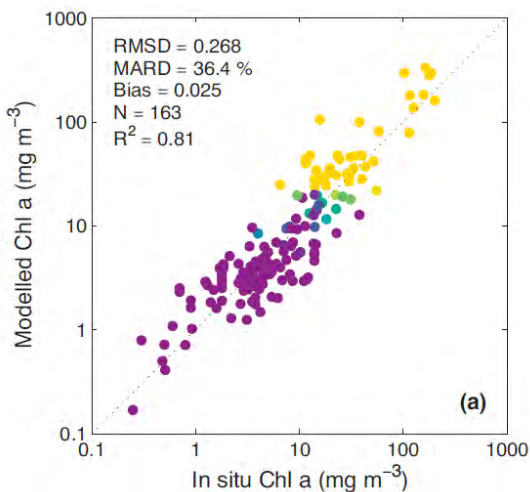
EO Product development and validation...



Smith et al 2018





- ✓ MERIS/OLCI empirical blue-green algorithm fails at high biomass...
- ✓ Red-NIR band-ratio algorithm works best for high biomass...
- ✓ CSIR developed optimized MERIS/OLCI Chla switching algorithm...
- ✓ Validate CSIR MERIS/OLCI Chla product against in situ data...





2016/2017 2017/2018 2018/2019 2019/2020 2020/2021

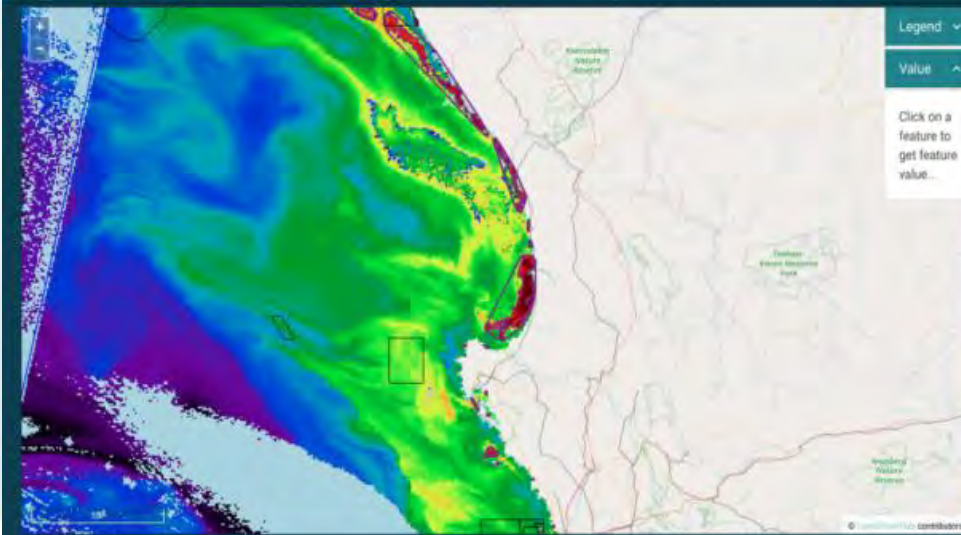
<p>Early Warning Support</p>	<p>Harmful Algal Bloom (HAB) detection</p>	<p> HAB – aquaculture enhancement & technical support</p> <p>Fisheries support</p> <p>Oil spill/bilge detection</p>	
<p>Compliance and Enforcement</p>	<p>Integrated Vessel Tracking (IVT)</p>	<p>IVT enhancement & technical support</p> <p>Compliance and enforcement extension</p>	
<p>Operations Support</p>	<p>Planning operations at sea</p>	<p>Search and rescue support</p> <p> Local fisherman support</p>	
<p>Planning and Assessment</p>	<p>Coastal Flood Hazard Tool (CFH) – Bathtub model</p> <p>Marine Spatial Plan viewer and support</p>	<p>CFH enhancement & technical support</p> <p>Coastal Flood Hazard Tool – Hydrodynamic model</p> <p>Marine Spatial Planning tool - Requirements</p> <p>Water Quality</p>	

OCIMS Decision Support Tool Portal...

Fisheries and Aquaculture DeST

NATIONAL
OCIMS

Fisheries and Aquaculture Decision Support Tool



Harmful Algal Bloom Risk

Area	SENTINEL 3				MODIS			
	2020-02-24	2020-02-23	2020-02-22	2020-02-21	2020-02-20	2020-02-19	2020-02-18	
Namiquas Shelf	●	●	●	●	●	●	●	
Greater St Helena Bay	●	●	●	●	●	●	●	
SW Cape	●	●	●	●	●	●	●	
False Bay	●	●	●	●	●	●	●	
Overberg	●	●	●	●	●	●	●	
Langeberg	●	●	●	●	●	●	●	
Garden Route	●	●	●	●	●	●	●	
Algoa Bay	●	●	●	●	●	●	●	
Wild Coast	●	●	●	●	●	●	●	
KZN South Coast	●	●	●	●	●	●	●	
KZN North Coast	●	●	●	●	●	●	●	
Elephant Coast	●	●	●	●	●	●	●	

Now viewing: MODIS Switched Algal Bloom Detections



HIGH RISK AREAS: **ST HELENA BAY** SW CAPE GARDEN ROUTE ALGOA BAY

DATE ON VIEW: 2020-02-24

SEEK TO SPECIFIC DATE: -1 DAY +1 DAY

PICK DATE: 2020-02-24



NATIONAL
OCIMS

OPERATION
PHAKISA



environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

CSIR
our future through science

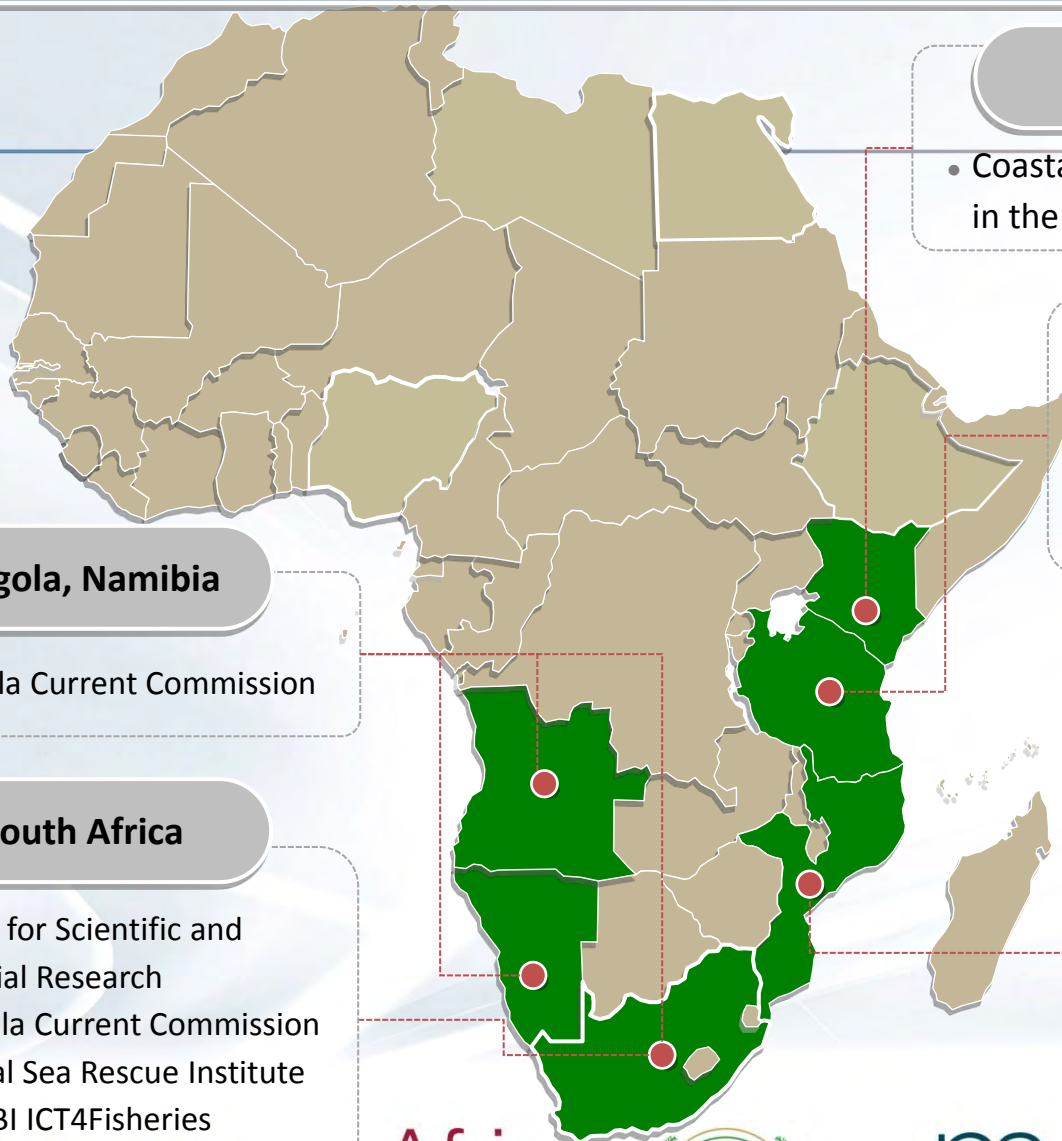
Regional Context - MarCOSouth

2017 - CSIR and regional partners awarded the MarCOSouth Project



**GMES
AND AFRICA**

GMES-Africa Marine and Coastal Service Development for Southern Africa (MarCoSouth)



Kenya

- Coastal Oceans Research and Development in the Indian Ocean

Tanzania

- Western Indian Ocean Marine Science Association
- University of Dar Es Salaam

Angola, Namibia

- Benguela Current Commission

South Africa

- Council for Scientific and Industrial Research
- Benguela Current Commission
- National Sea Rescue Institute
- ABALOBI ICT4Fisheries

Mauritius MOI Nansen-Tutu Centre

Associates

Mozambique

- Eduardo Mondlane University



**GMES
AND AFRICA**



marco
SOUTH

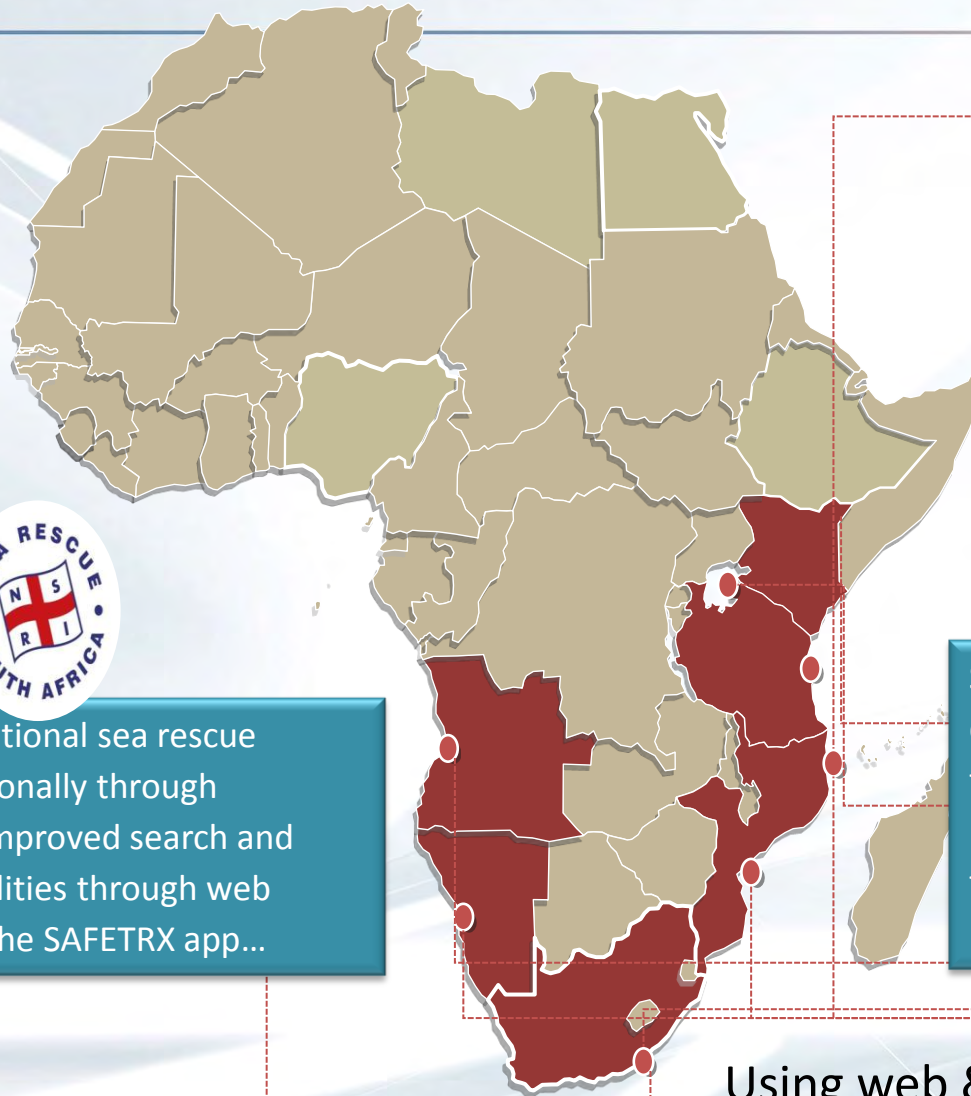
CSIR
our future through science



**GMES
AND AFRICA**



Solutions for communities...



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

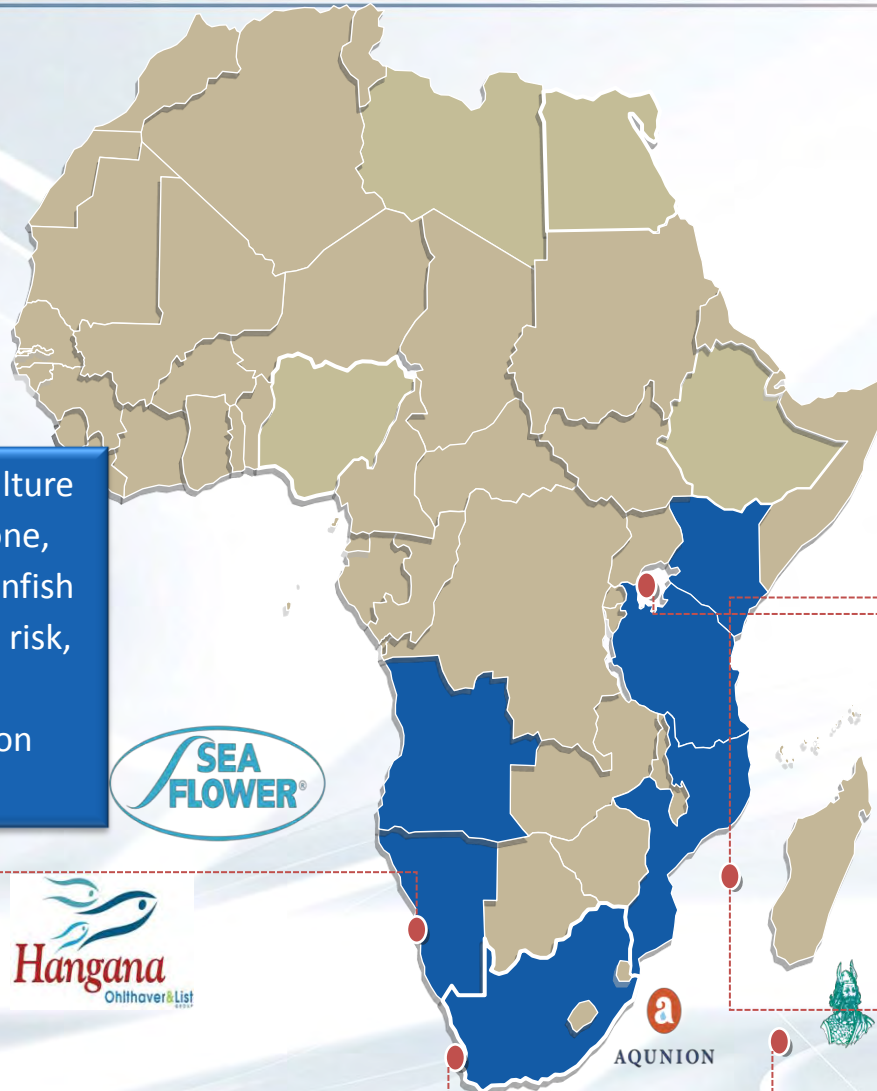


Supporting national sea rescue institutes regionally through provision of improved search and rescue capabilities through web services and the SAFETRFX app...

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...



Solutions for industries...



Supporting the aquaculture industries across abalone, bivalve, shellfish and finfish sectors through bloom risk, site selection and operational optimisation support....



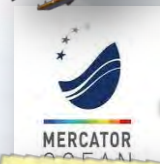
Providing regionally optimised observation, forecast and monitoring products for maritime operations...



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



MarCoSOUTH: Conceptual Model



- ✓ Variable level of engagement...
- ✓ Pure consumers interested in applications...
- ✓ Researchers involved in marine ecosystems management...

Central acquisition, processing and serving of user optimised products



User engagement & quantitative mechanisms for user co-designed systems

USER WORKSHOPS, CO-DESIGN & GROWTH

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



OCIMS impact...

NATIONAL OCIMS IMPACT TO DATE

The rock lobster industry contributes R200 million per annum to South Africa's GDP and a red tide event in 2015 caused a walk-out of lobster stock worth R114 million

2015

2016

In 2016 the OCIMS Integrated Vessel Tracking tool assisted with the tracking of foreign vessels that entered South Africa's EEZ without declaring 600 tonnes of squid

In 2017 a harmful algal bloom caused aquaculture farm losses to the excess of R50 million. The Aquaculture and Fisheries support tool can monitor and predict these events.

2017

2019

In 2019 a similar bloom resulted in no mortalities due to improved farm mitigation measures and information from the Aquaculture and Fisheries tool on bloom location and operational planning.

In 2019 the (IVT) tool has been used operationally to support several operations and is being used for evidence by the Prosecution in two Court Cases.

2019

2020

Since the beginning of 2020, the IVT tool is providing early warning of commercial vessels heading for South African ports from a possible corona virus risk.



Thank you GHRSSST!