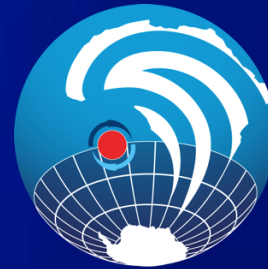


Seb Swart & Pedro Monteiro  
SOCCO, NRE

Hannes Zietsman & Niel Goslett  
DPSS

Janet Coetzee  
Department of Agriculture, Forestry and Fisheries

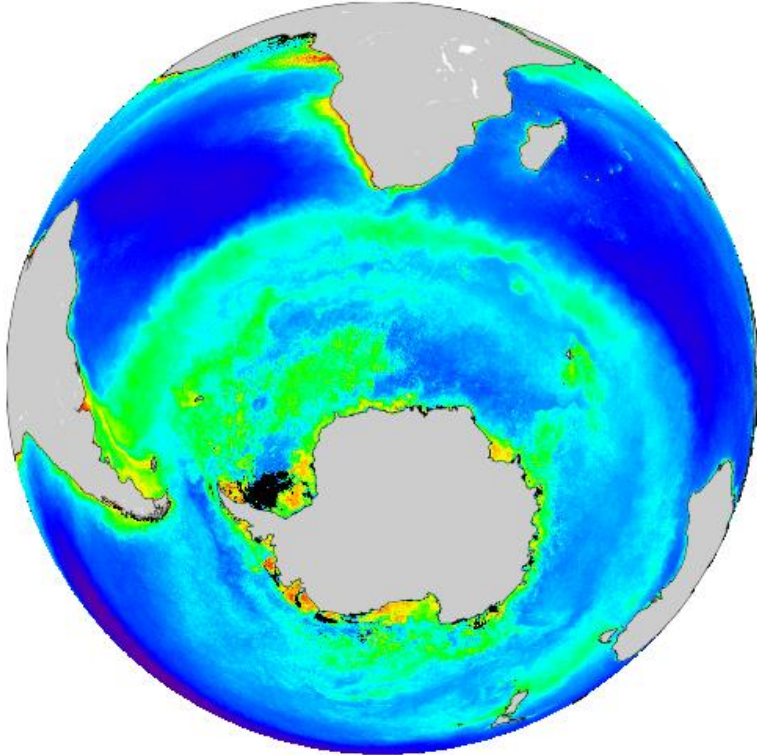


SOCCO  
Southern Ocean Carbon and Climate Observatory

**Ocean robotics: 21<sup>st</sup> century sustainable science & marine  
resource management**

## Satellite chlorophyll-a

January

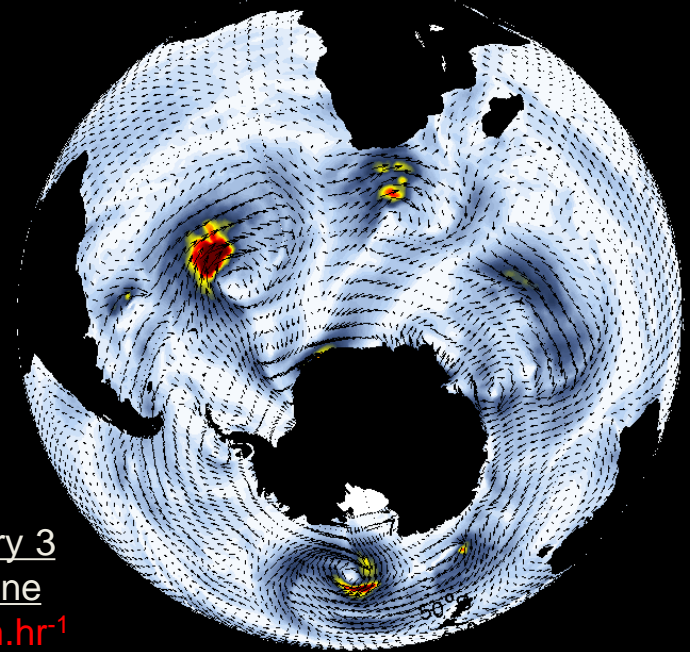


How do we observe variability at this frequency?

So much going on at short time scales and small space scales!

## Satellite wind stress

Wind Stress [ $\text{N}\cdot\text{m}^{-2}$ ]: 2007-01-06 12hrs



Category 3  
hurricane  
>170  $\text{km}\cdot\text{hr}^{-1}$

Sarah Nicholson



Storms are strong and persistent through summer

Our problem: The Southern Ocean is massive & remote!

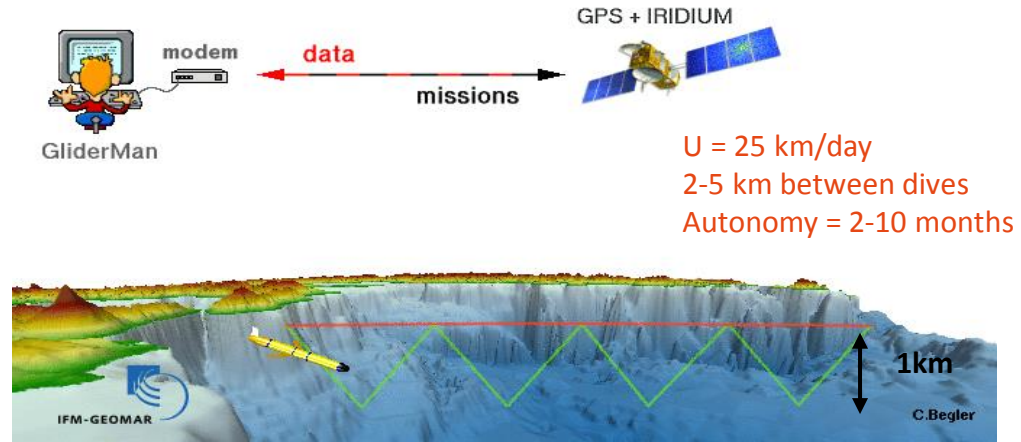
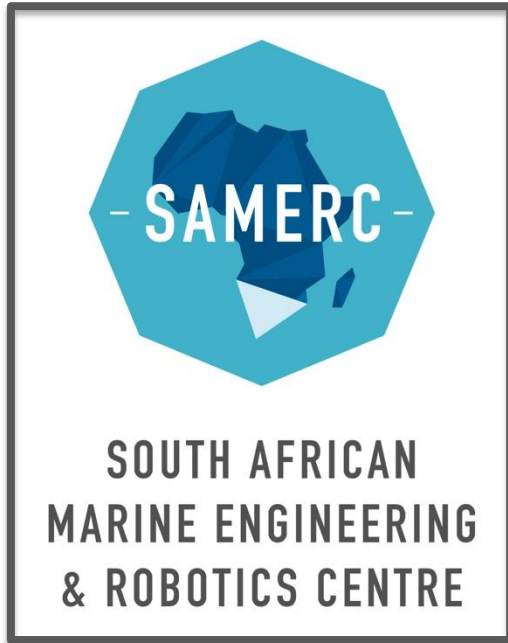


The problem: The Southern Ocean is rough!  
(need new technologies to sample whole system & season)

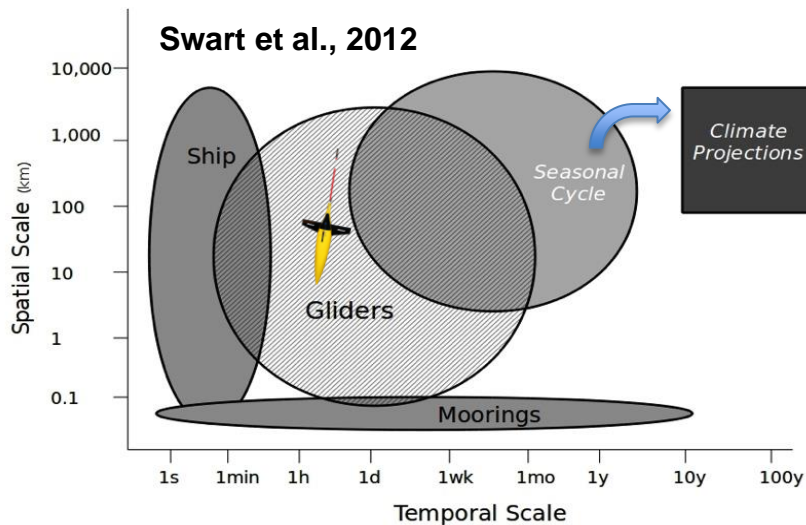


# Why we utilise marine robots?

Robotics activities are well suited to meet our scientific sampling objectives  
Cost to data ratio is remarkable compared to ships



overcoming the very low frequency “snapshot” sampling from ships





**SOCCO**  
Southern Ocean Carbon and Climate Observatory



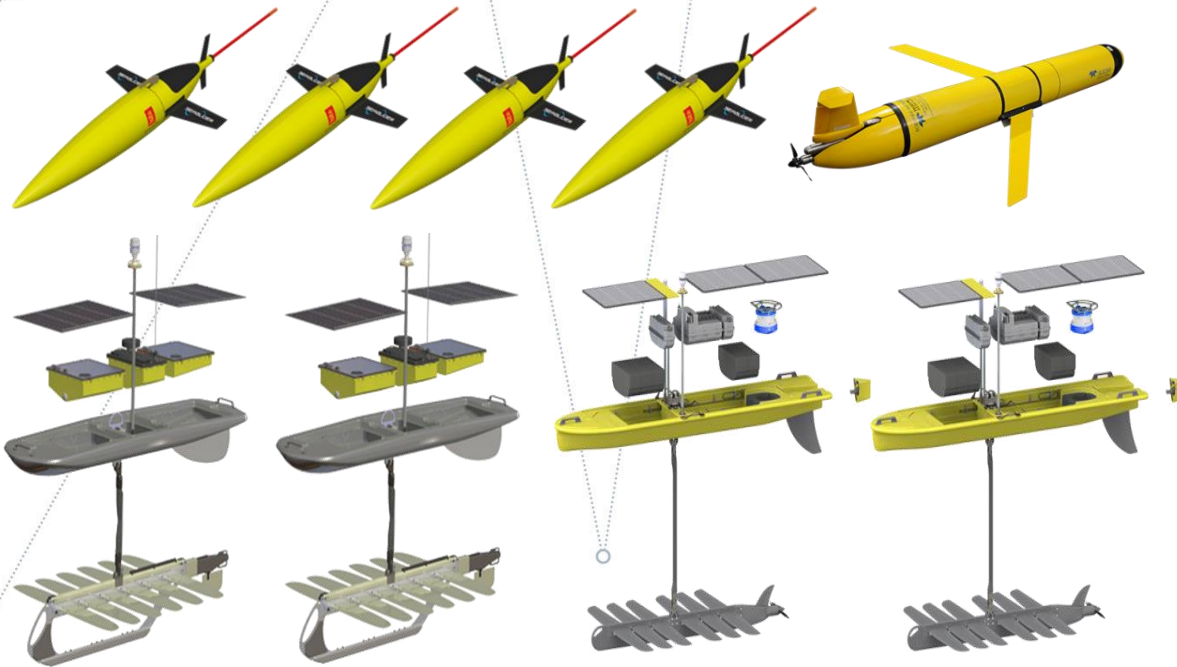
science  
& technology

Department:  
Science and Technology  
REPUBLIC OF SOUTH AFRICA

The 5th CSIR  
**CONFERENCE**  
IDEAS THAT WORK  
8-9 October 2015 | CSIR ICC

# The CSIR Glider Fleet

14 GLIDERS: 5 PROFILING & 4 SURFACE GLIDERS



**CSIR**  
our future through science

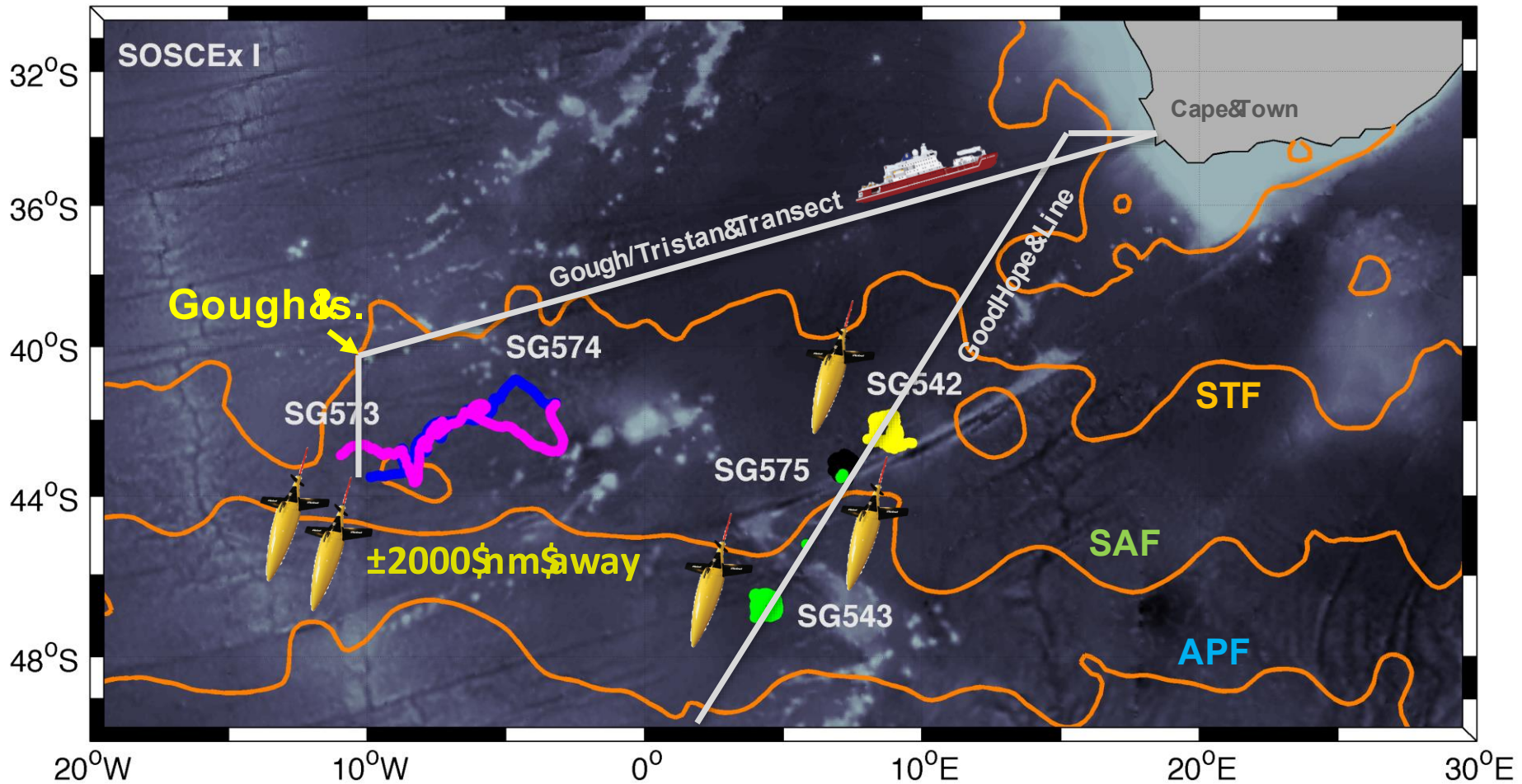
CELEBRATING  
**70** Years  
Ideas that work

# SOSCE<sub>x</sub> 2012

SOUTHERN OCEAN SEASONAL CYCLE EXPERIMENT

● = Glider deployment & ship CTD station

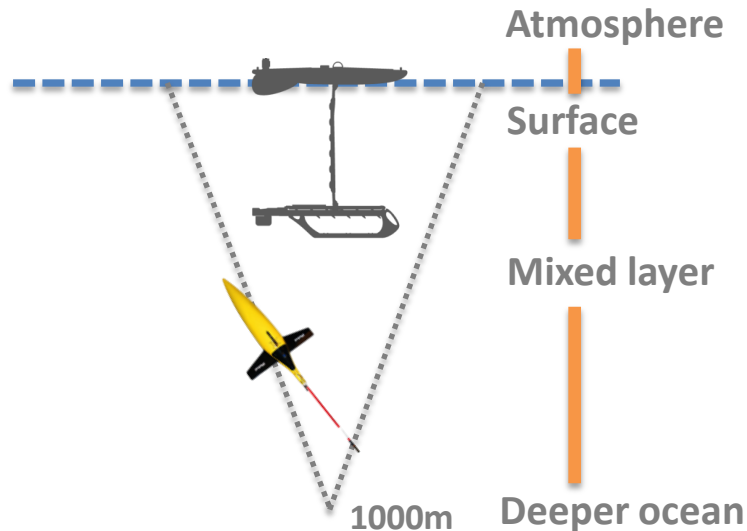
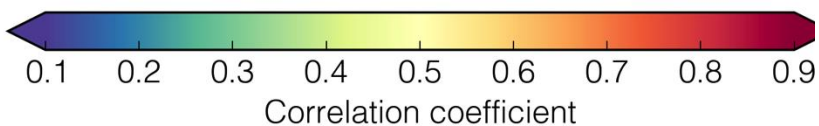
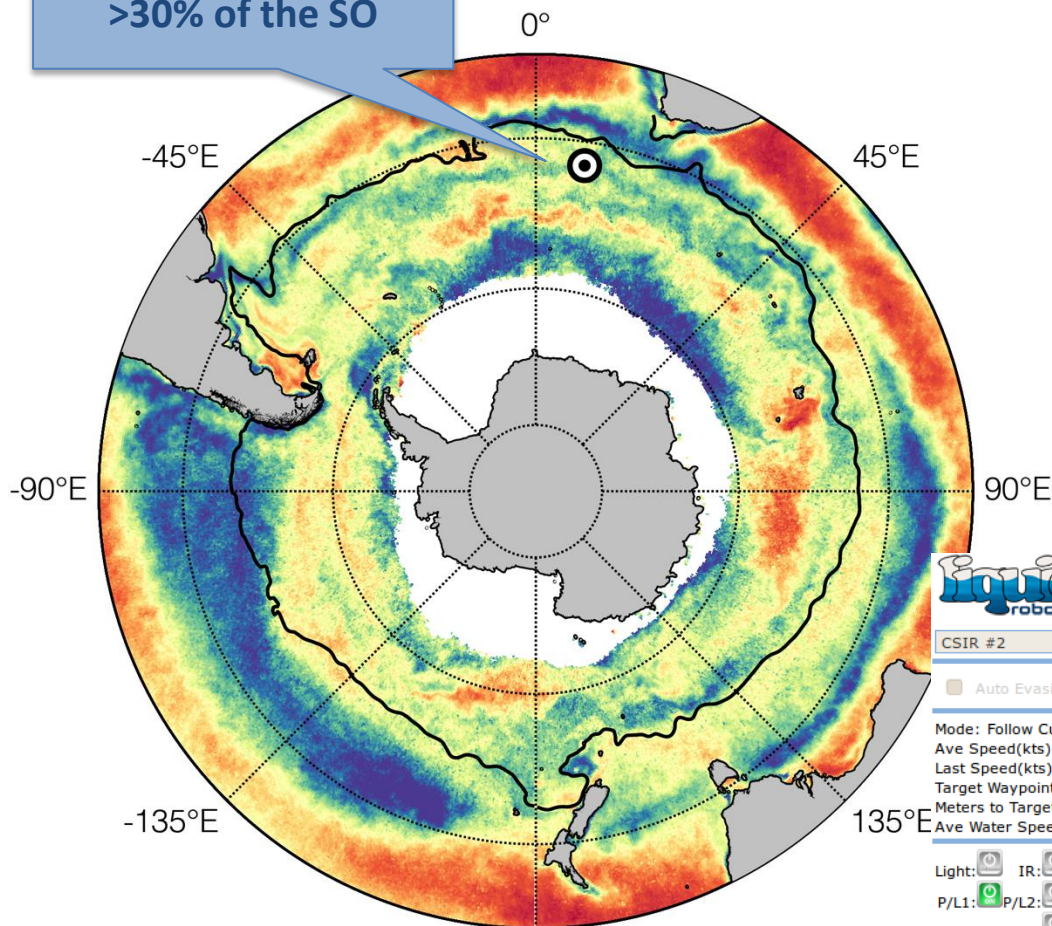
— = ship based underway measurements



September 2012 – March 2013

# SOSCEx II: October 2013 – 9 February 2014

Region of high intra-seasonal dynamics:  
>30% of the SO



CSIR #2

Auto Evasion

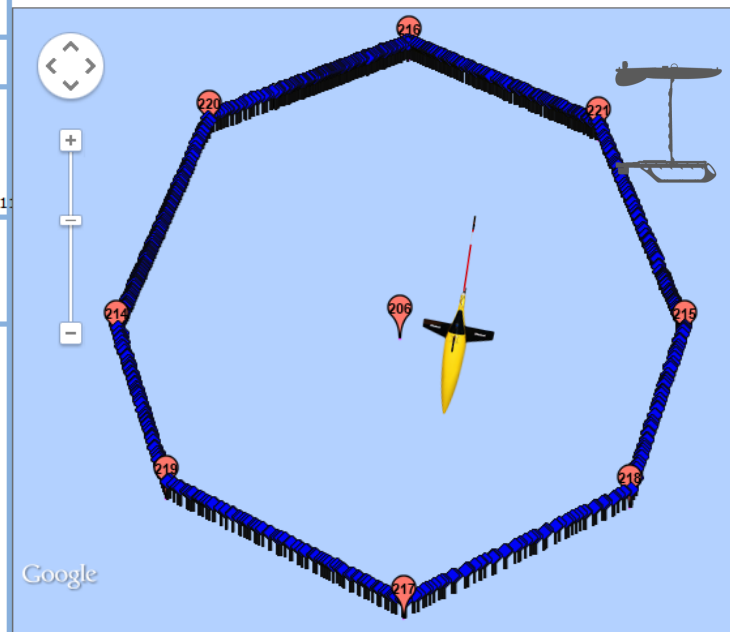
Mode: Follow Custom Course  
Ave Speed(kts): 0.89  
Last Speed(kts): 0.48  
Target Waypoint: 220  
Meters to Target: 1522.4  
Ave Water Speed(kts): 1.19181

Light:  IR:  XBee:   
P/L1:  P/L2:  Sub:   
P/L3:  PEP:

- Follow Sequential Course
- Hold Station At Waypoint
- Follow Custom Course
- Hold Current Position
- Follow Fixed Heading
- Set Parameter
- Comment
- More Commands ...

Alarms:  Last refresh: Fri-Nov-22-2013 6:23:29 (Pacific Standard Time)  Autorefresh

Duration: 3 days Prior To: Now Switch To: Date Range Submit



Follow the gliders on Twitter:  
[@SOCCOgliders](https://twitter.com/SOCCOgliders)



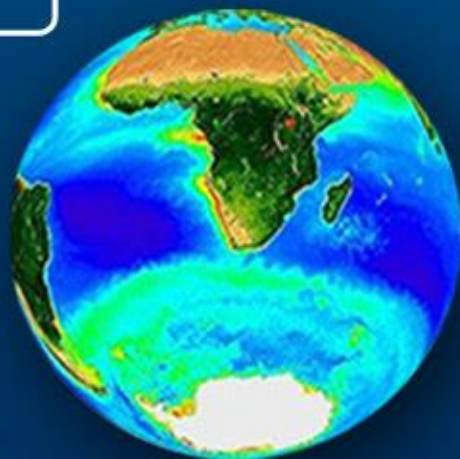
## CHPC

Center for High Performance Computing

- Global and regional high resolution modelling (CSIR)



Integrated earth systems  
scale climate research in the  
Southern Hemisphere



## OCEAN ROBOTICS

Interdisciplinary observational facilities

- Physics, carbon, bio-optics (CSIR)
- Engineering R&D (STS)



## SATELLITES

Sustained long term observations and interdisciplinary process studies

- In situ algorithm validation and development
- Asses ecosystem variability at required spatial and temporal scales



## POLAR RESEARCH VESSEL

Sustained long term observations and interdisciplinary process studies

- Iron (Fe) clean analytical chemistry
- High precision CO<sub>2</sub> and pCO<sub>2</sub> (CSIR)
- High precision Bio-optics (CSIR)
- Nutrient & Oxygen biogeochemistry (UCT)
- Ocean productivity (UCT)



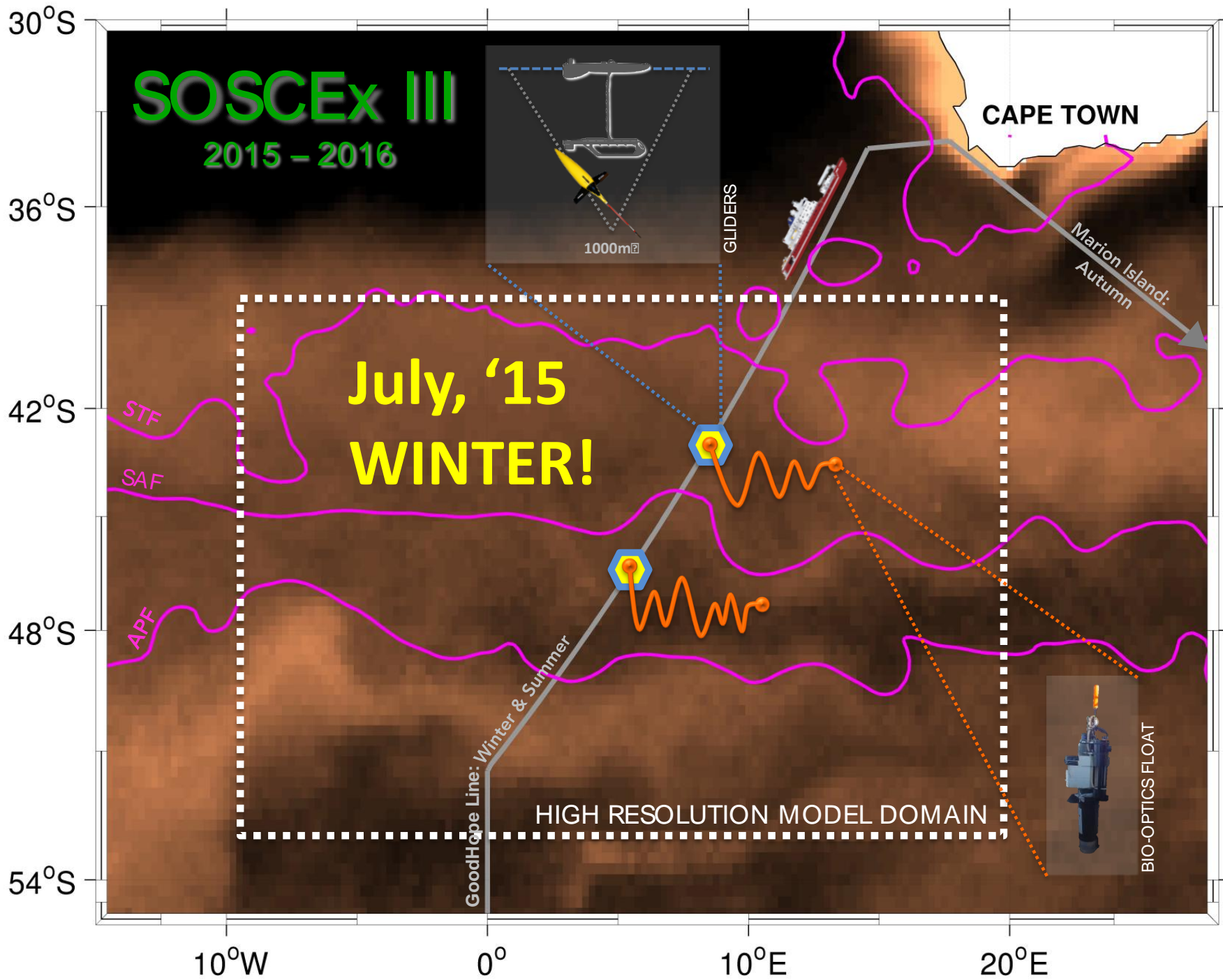
**Platform integrations: our novel research niche**

# BIO-FOULING



SG574  
148 days  
590 dives  
1180 profiles  
>2000 km  
1.9km / profile





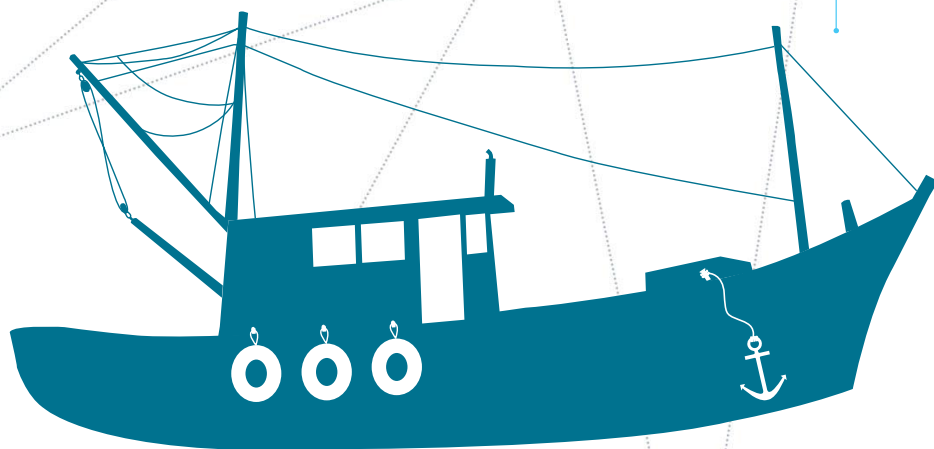
## FACT: THE STATUS OF COMMERCIAL LINEFISH IN SOUTH AFRICA

### 11% OVEREXPLOITED:

Yellowbelly Rockcod (1998);  
Elf/shad (1996);  
Smoothhound shark (2007).

### 68% COLLAPSED:

Silver kob (1999);  
Dusky kob (1997);  
Geelbek (1999);  
Dageraad (1992);  
Seventy-four (2006);  
Red steenbras (1991);  
White steenbras (1993);  
Red stumpnose (1999);  
Roman (1992);  
Scotsman (2005);  
Englishman (2005);  
Carpenter (1999).



### 5% UNDER REVIEW:

White stumpnose

### 16% OPTIMALLY EXPLOITED:

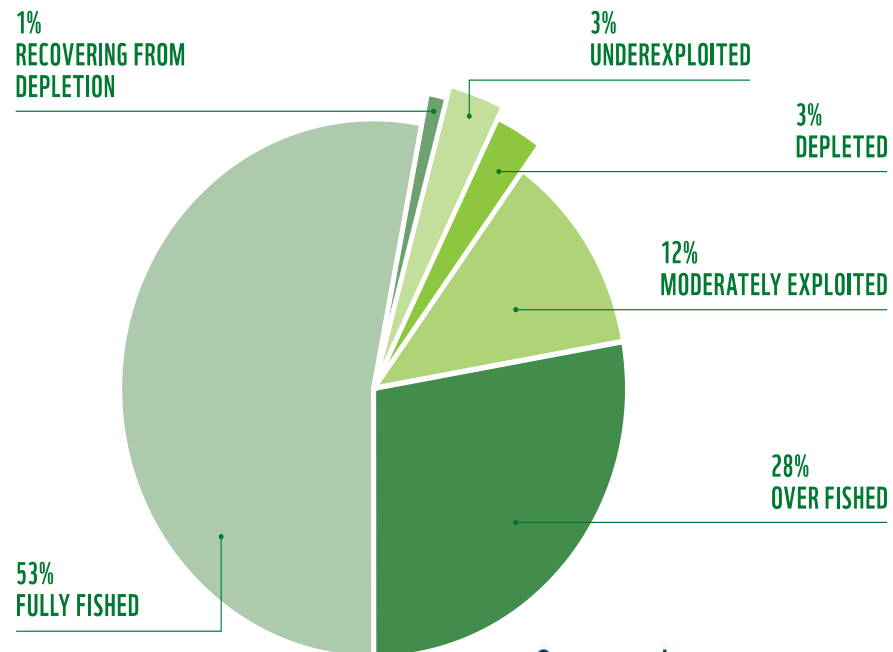
Soupin shark (2007);  
Snoek (1999);  
Yellowtail (2001).

# The 5th CSIR CONFERENCE

## IDEAS THAT WORK

8-9 October 2015 | CSIR ICC

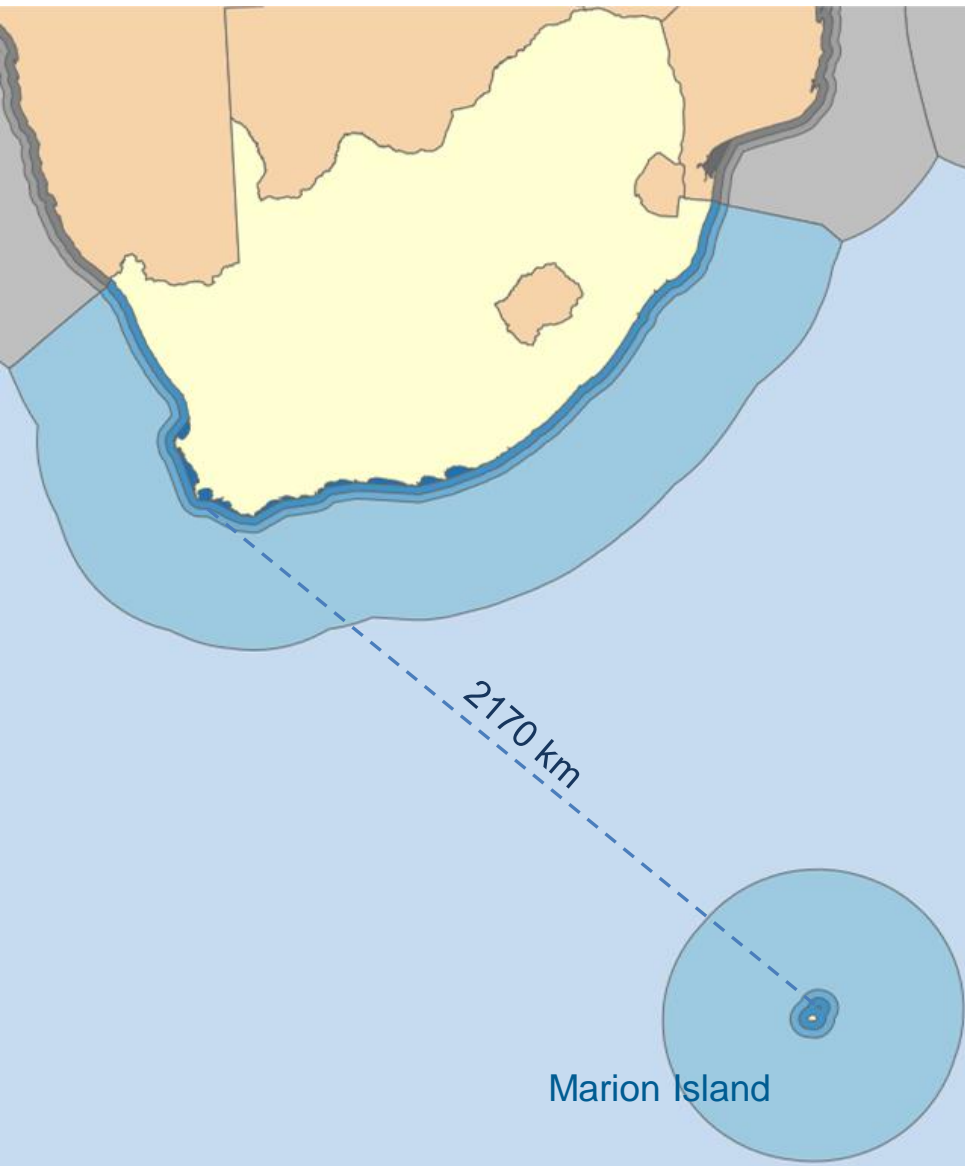
## FACT: STATUS OF GLOBAL FISH STOCKS IN 2008



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**70** Years  
Ideas that work

# The bigger picture



## Land Size

1.2 mn km<sup>2</sup>

## EEZ Size

1.5 mn km<sup>2</sup>

- ❑ South Africa is responsible for managing an **ocean space** that is **greater** than the **land territory**
- ❑ The extended continental shelf claim will **double** the size of its **ocean geography**
- ❑ Poaching, piracy, border guarding, resource management, Marine Protected Areas
- ❑ Not enough land-based radar, no radar satellites, optical satellites limitation, etc.

## And yet...

We are only able to collect fisheries data during an expensive ship survey 1-2 times per year

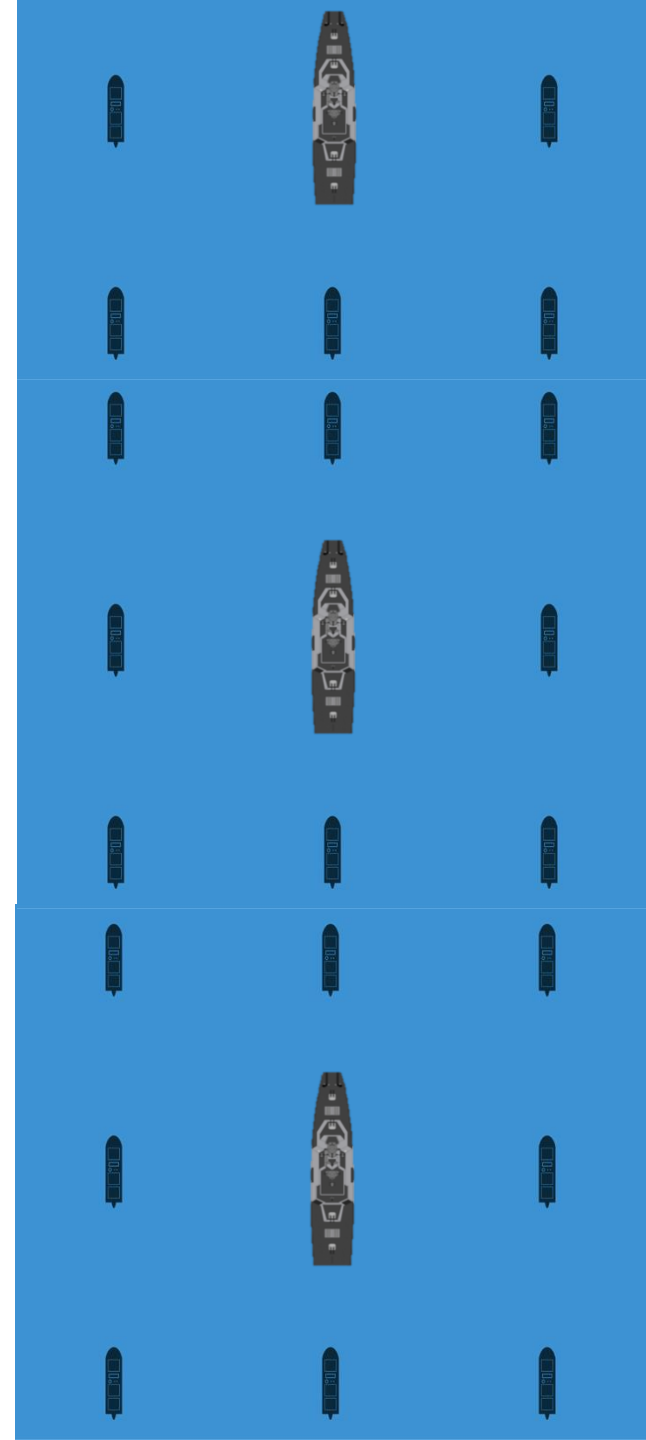
.... Cost per survey: R50-60m

### **The problem**

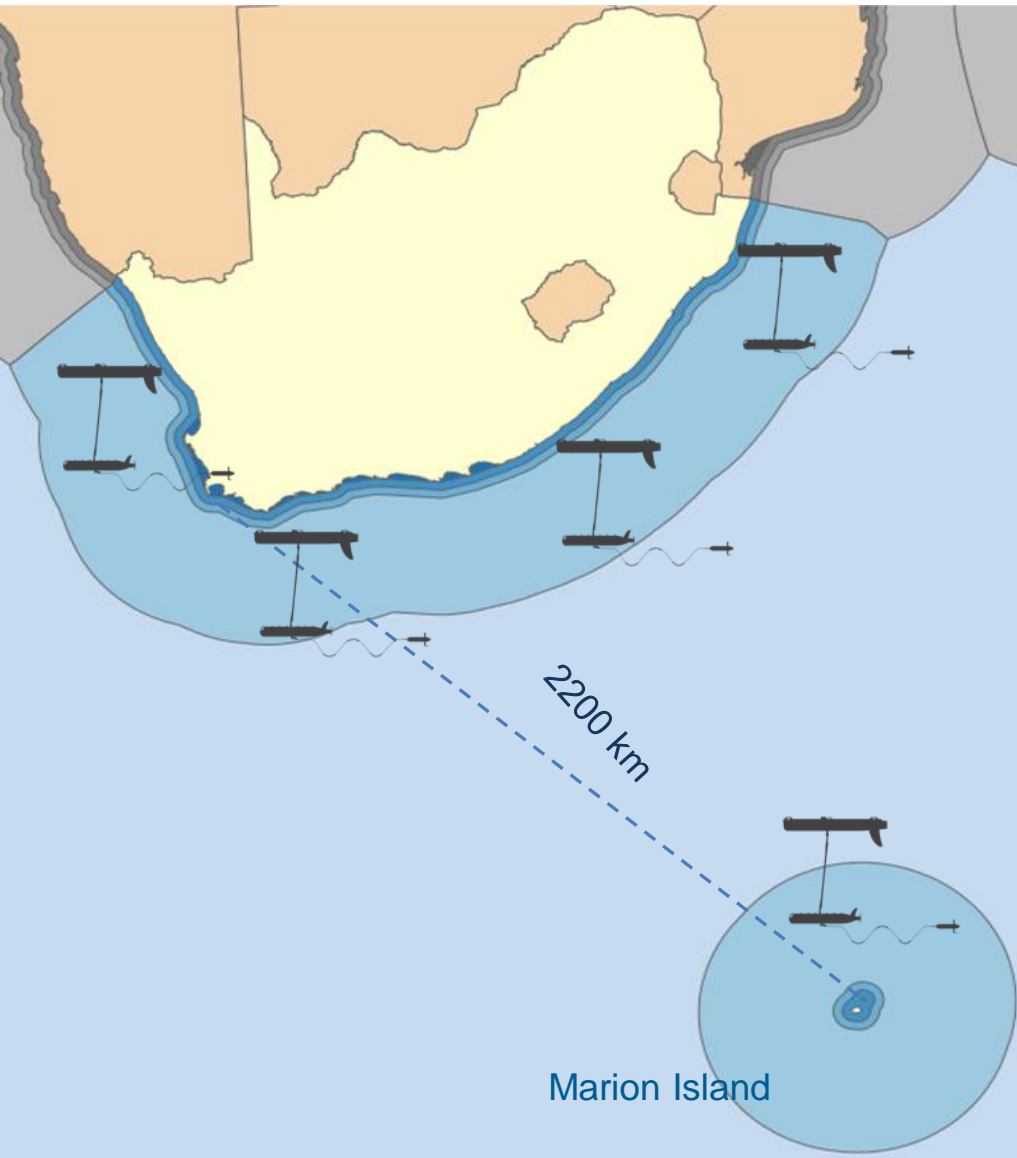
DAFF surveys are done yearly and requires large ships with highly trained crew to man and maintain

### ***The Solution***

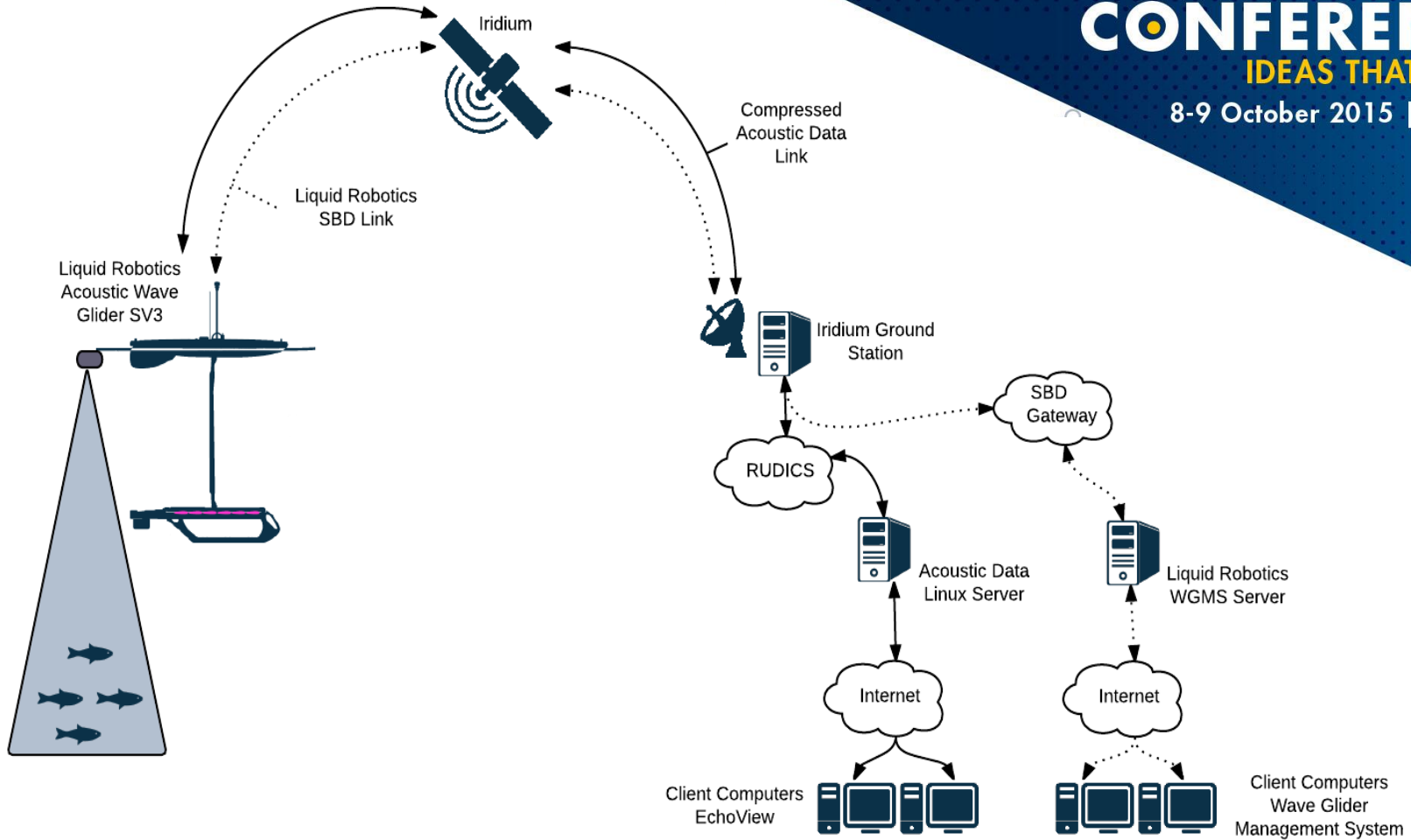
- Deploy Wave gliders in conjunctions with DAFF survey runs will improve data and reduce time at sea
- Improve information on fish migration patterns during the year
- Reduce the reliance on ship base surveys.



# The bigger picture



- 24/7/365 Persistent Presence
- Multi disciplinary fleet
- **Applications:**
  - Science observations
  - Stock Assessment
  - Environmental Monitoring
  - Oil Spill Response
  - Weather
  - Maritime Security



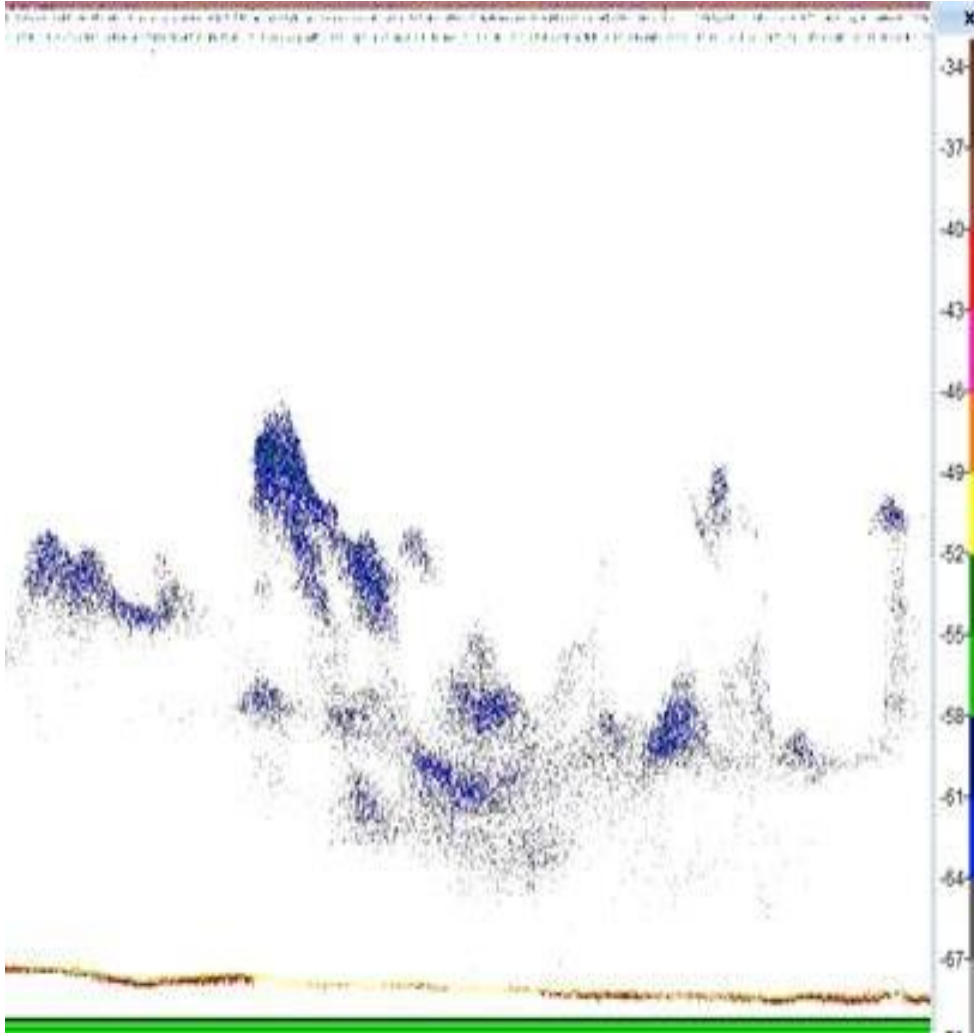
# Fisheries Acoustics Wave Glider



# Fisheries Acoustics Wave Glider



# Fisheries Acoustics Wave Glider

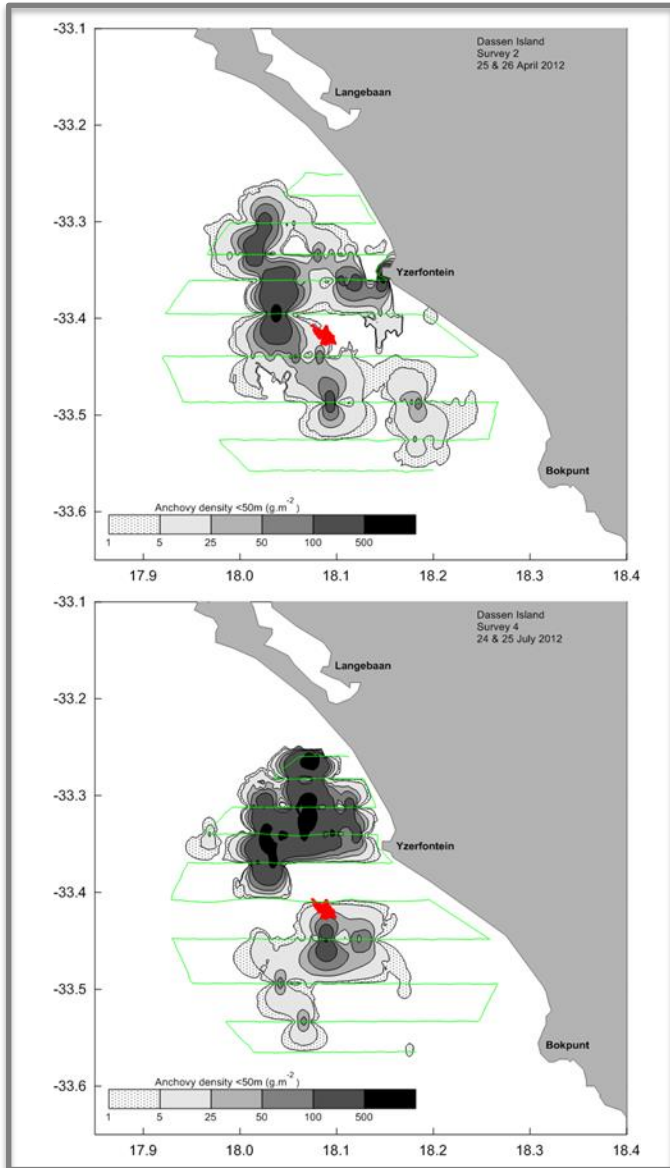


- 38kHz Scientific Grade Echosounder
- Real-time data feed
- Sample from surface layer (no hull)
- Augment existing capabilities
- In situ sampling - Guess the fish?



# Recent sea-trials (Aug-Sept 2015)

## By boat/small ship

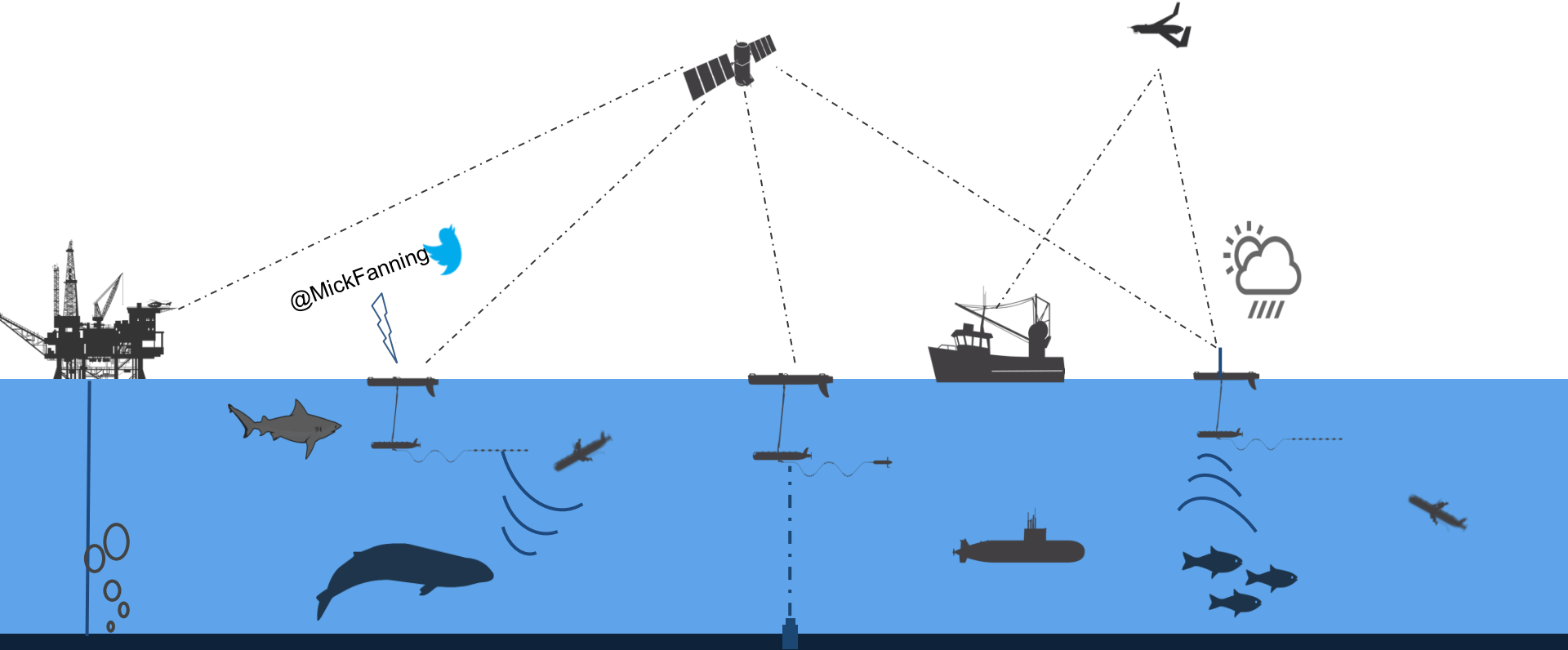


## By Wave Glider alone



# Glider Applications Summary

## Applications



### Concept

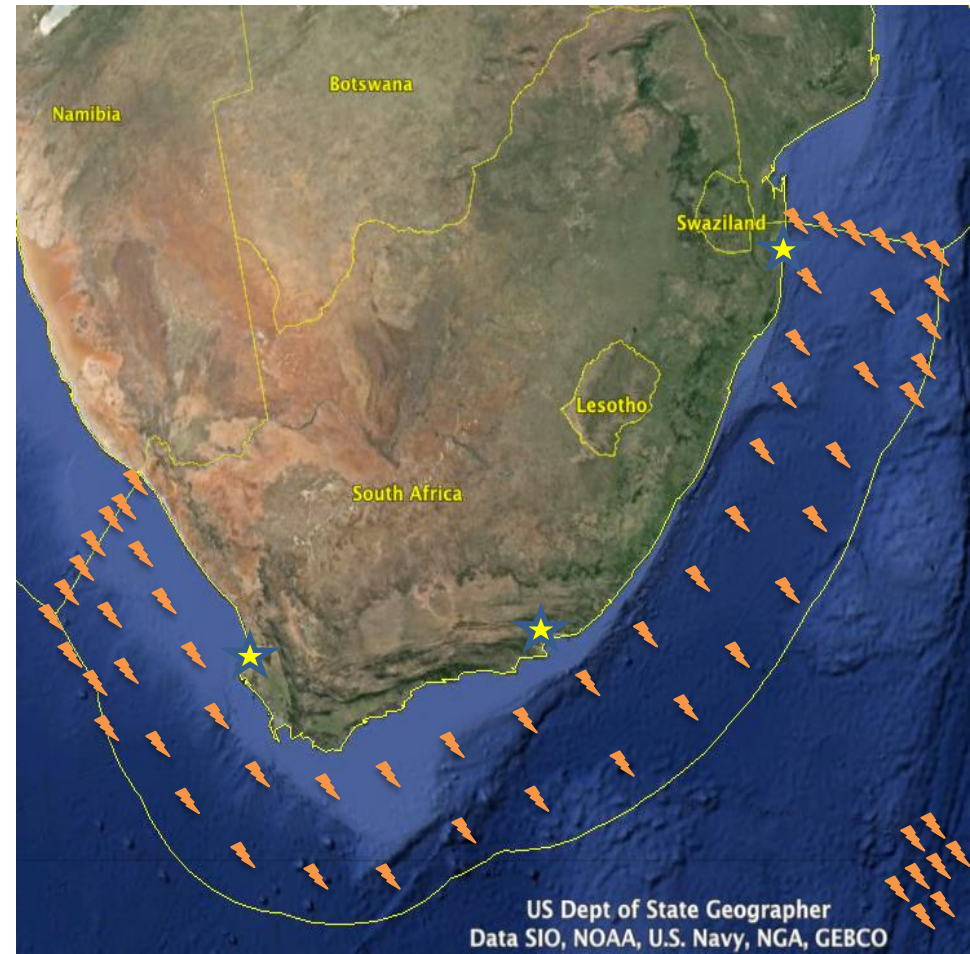
- Real-time in-situ weather
- Passive acoustics - marine mammals
- Active Acoustics - fish stock assessment
- Hydrocarbon monitoring
- Hydrographic profiling
- Marine Domain Awareness

### Benefits

- Long duration, persistent data
- Multi-disciplinary platform
- 24/7/365 low cost in situ observations
- Augment existing assets

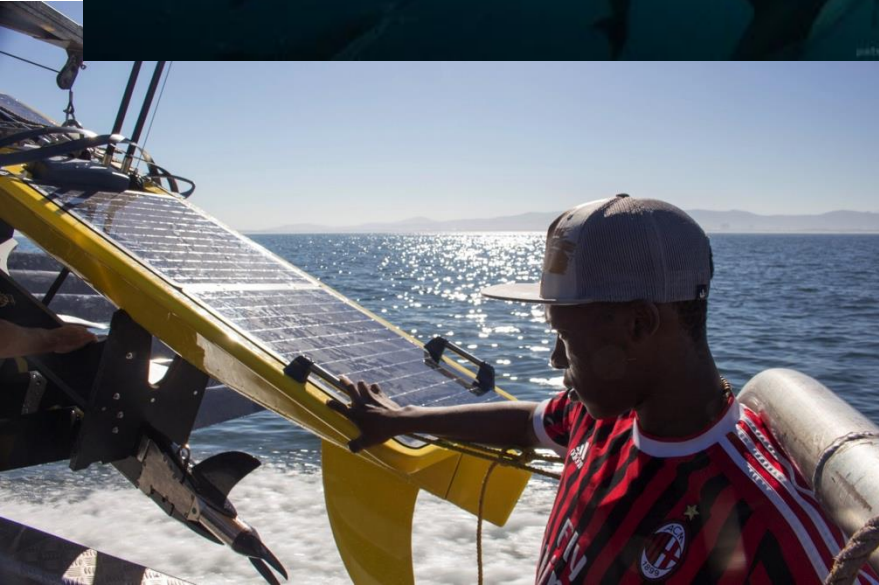
# Some benefits...

- Wave gliders can be **locally manufactured** under license form Liqueate Robotic.
- Private sector can be contracted to manage service centres
- Wave Gliders are **easily handled and does not require special infrastructure** such as large ports.
- **Data can be secured and controlled by South Africa**




Is it not time we protect  
our valuable resources?!

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IDEAS THAT WORK  
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Ideas that work



# Thank You!

## Questions

@SOCCOgliders  
[www.socco.org.za](http://www.socco.org.za)

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