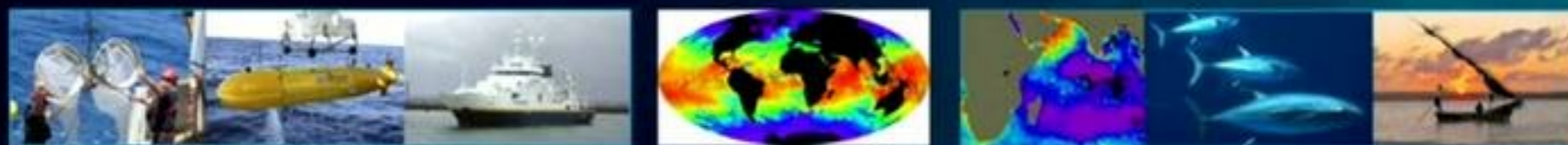


Marine Robotics as an Alternative to Traditional Ocean Observation Systems: Gliders, Drones and Vessels



Professor Michael J Roberts
UK-SA Bilateral Research Chair: Ocean Science & marine Food Security



1. The hidden crisis in the Western Indian Ocean

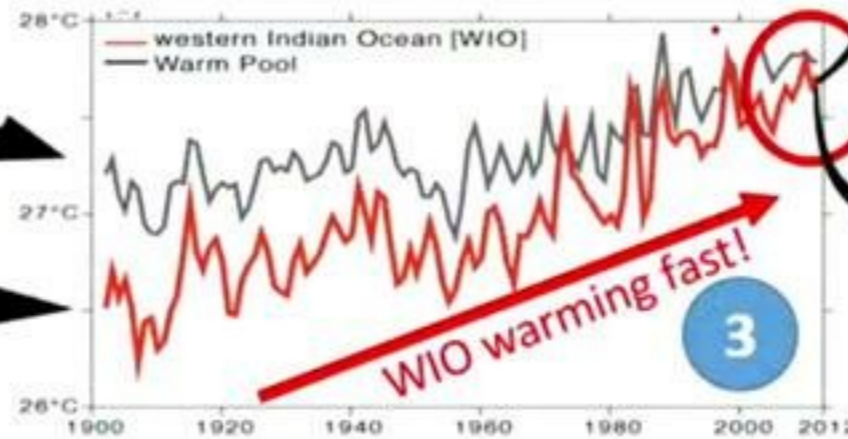
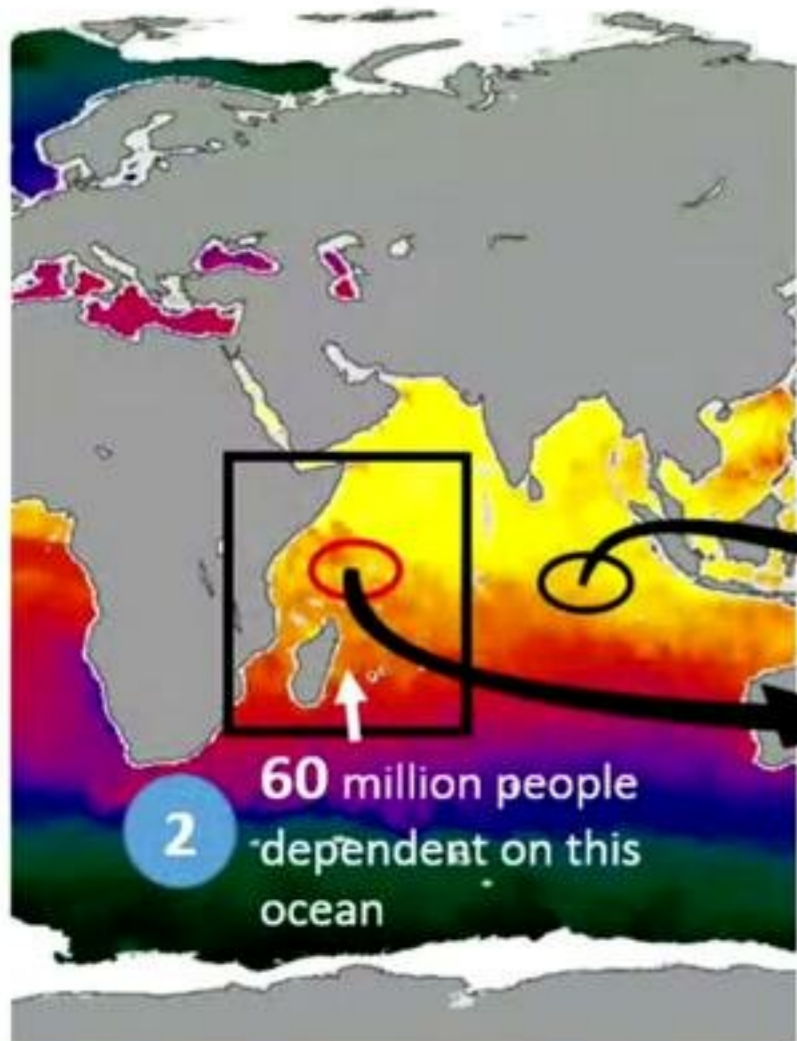
1 A fast warming Western Indian Ocean

Fisheries collapse



2035
starvation
ensues

6



Reefs die



URGENT ACTION REQUIRED

7 Need to get this on UN Agenda



1. The hidden crisis in the Western Indian Ocean



2035
starvation
ensues

6

1

A fast warming Weste

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URGENT ACTION REQUIRED

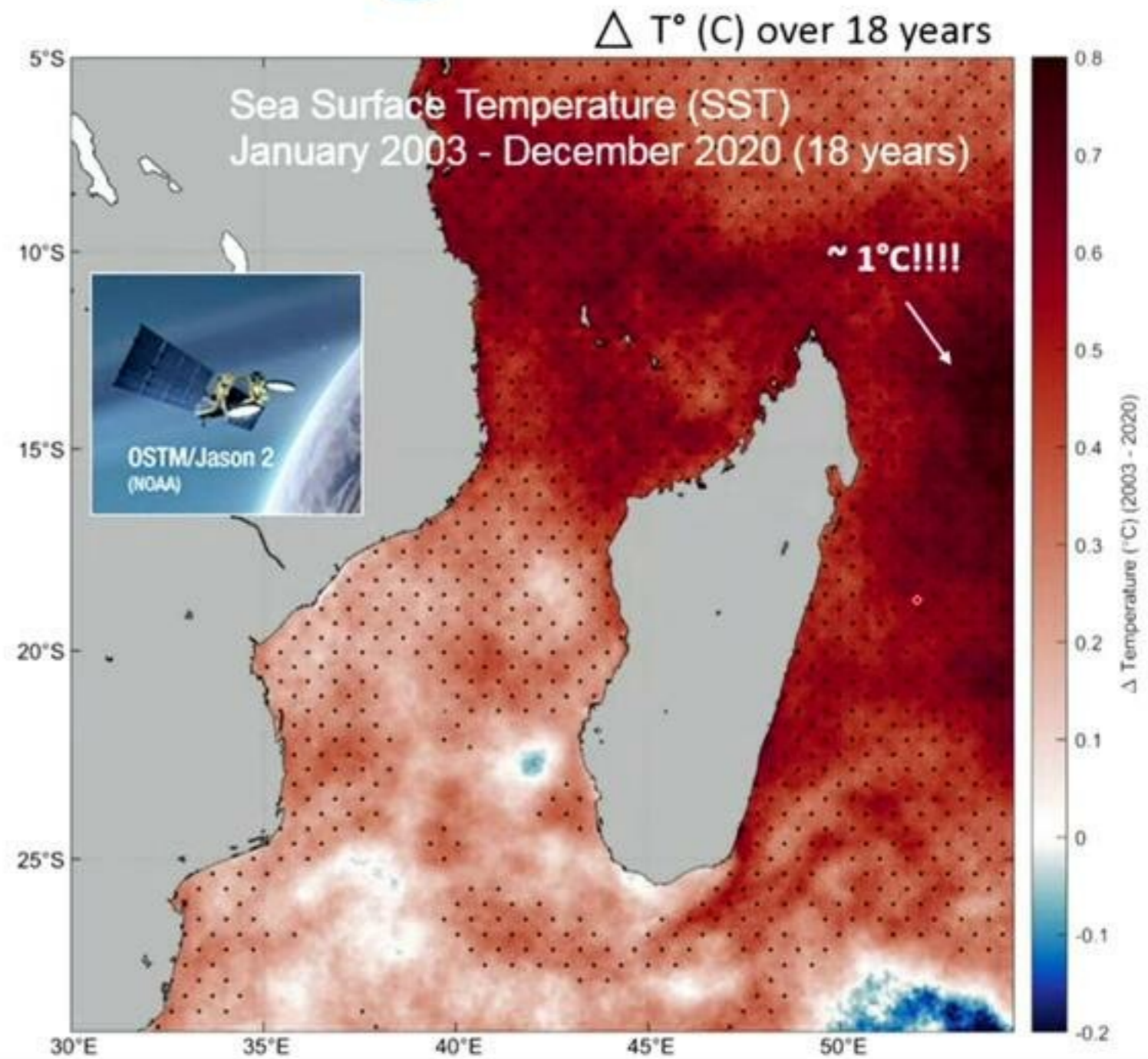
7

Need to get this on UN Agenda



2. How is Global Warming affecting Mozambique?

8 Use satellite technologies



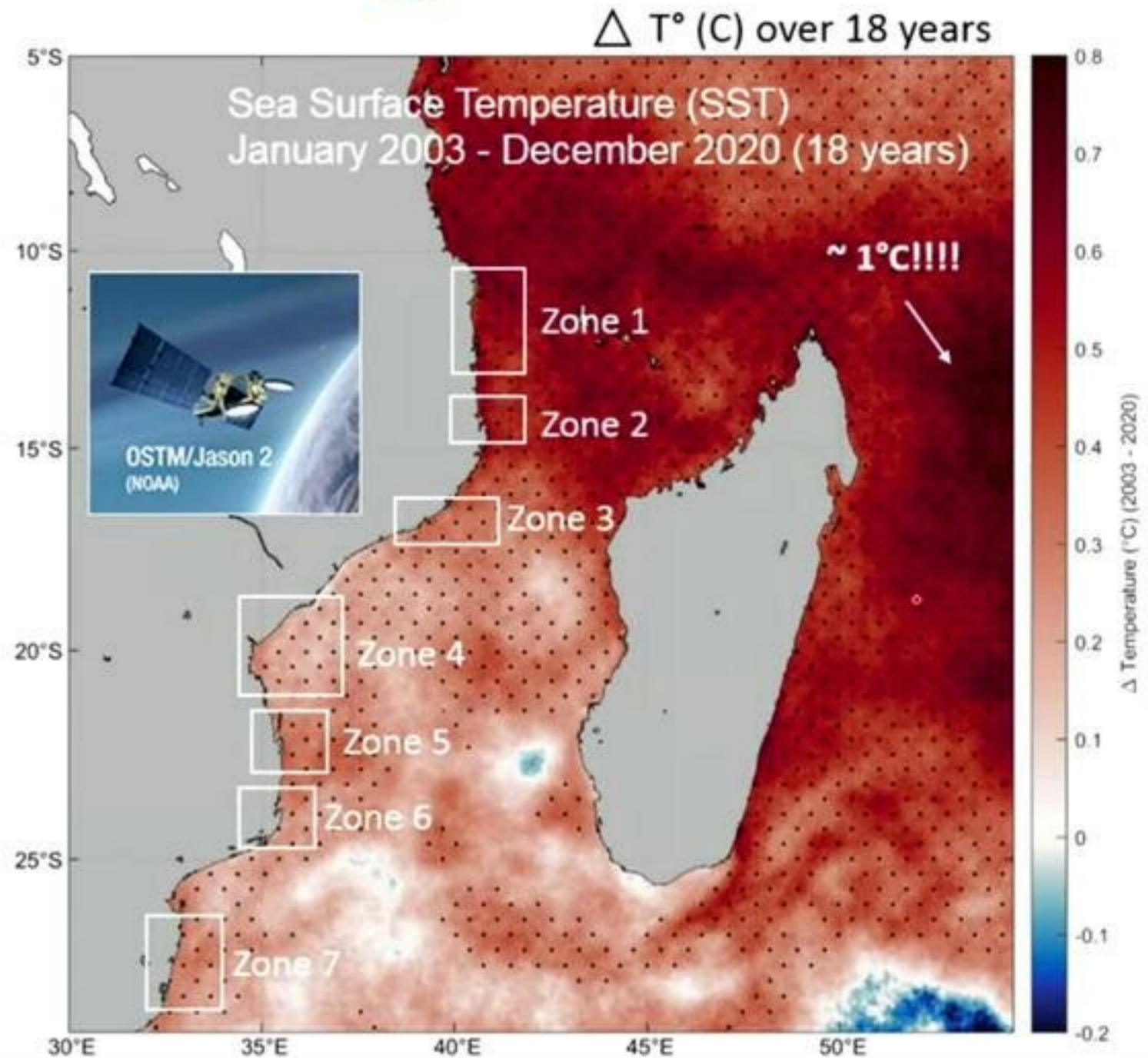
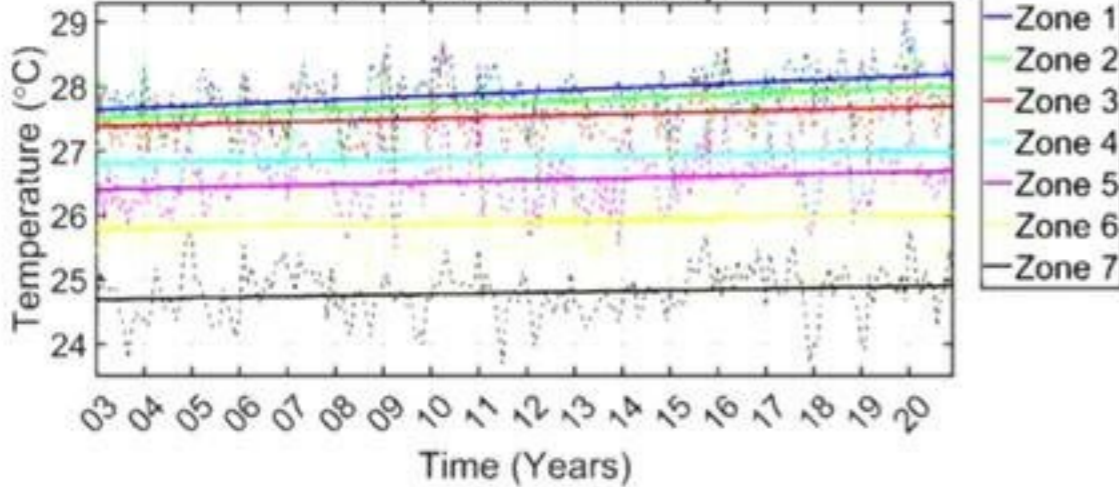
2. How is Global Warming affecting Mozambique?

8 Use satellite technologies

ΔT° (C) over 18 years

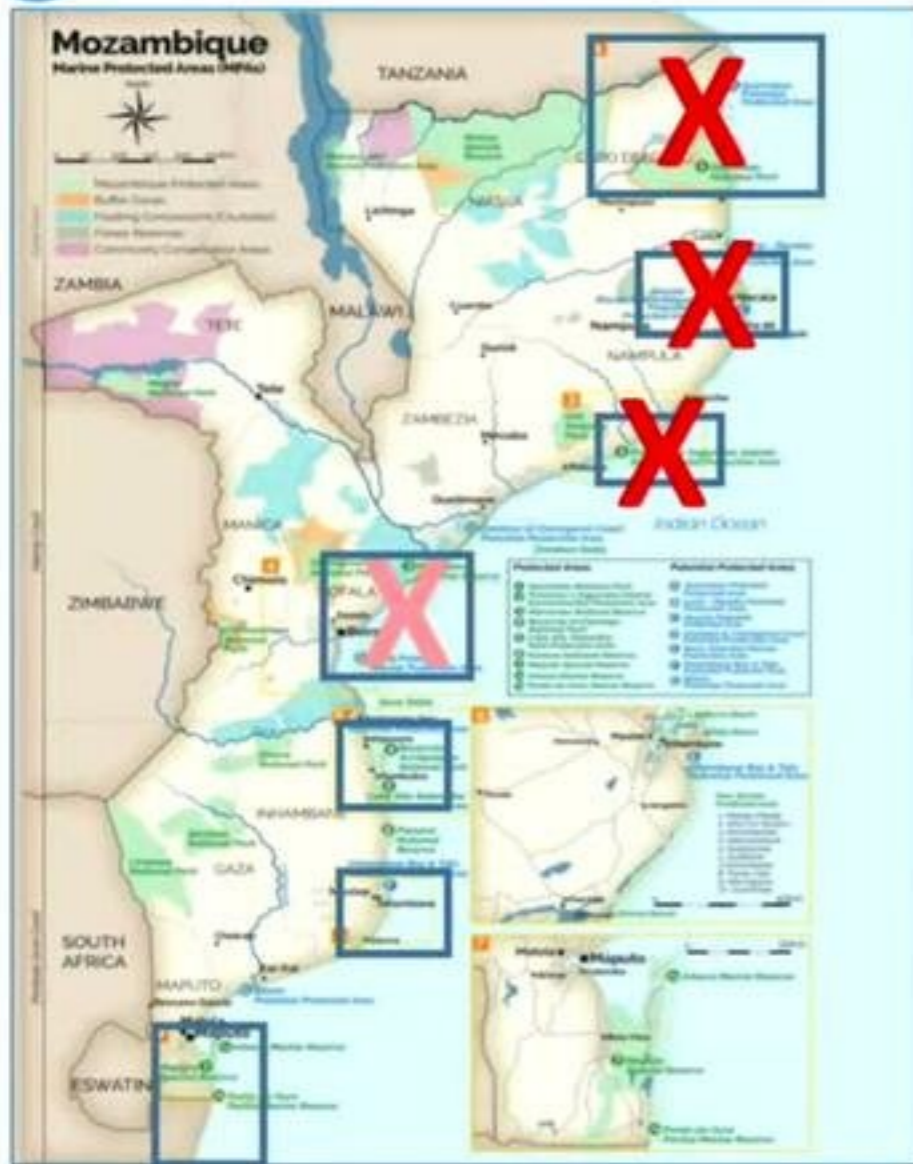
- 1: delta T = + 0.55 C
- 2: delta T = + 0.49 C
- 3: delta T = + 0.32 C
- 4: delta T = + 0.18 C
- 5: delta T = + 0.29 C
- 6: delta T = + 0.22 C
- 7: delta T = + 0.21 C

SST (Deseasonalized)

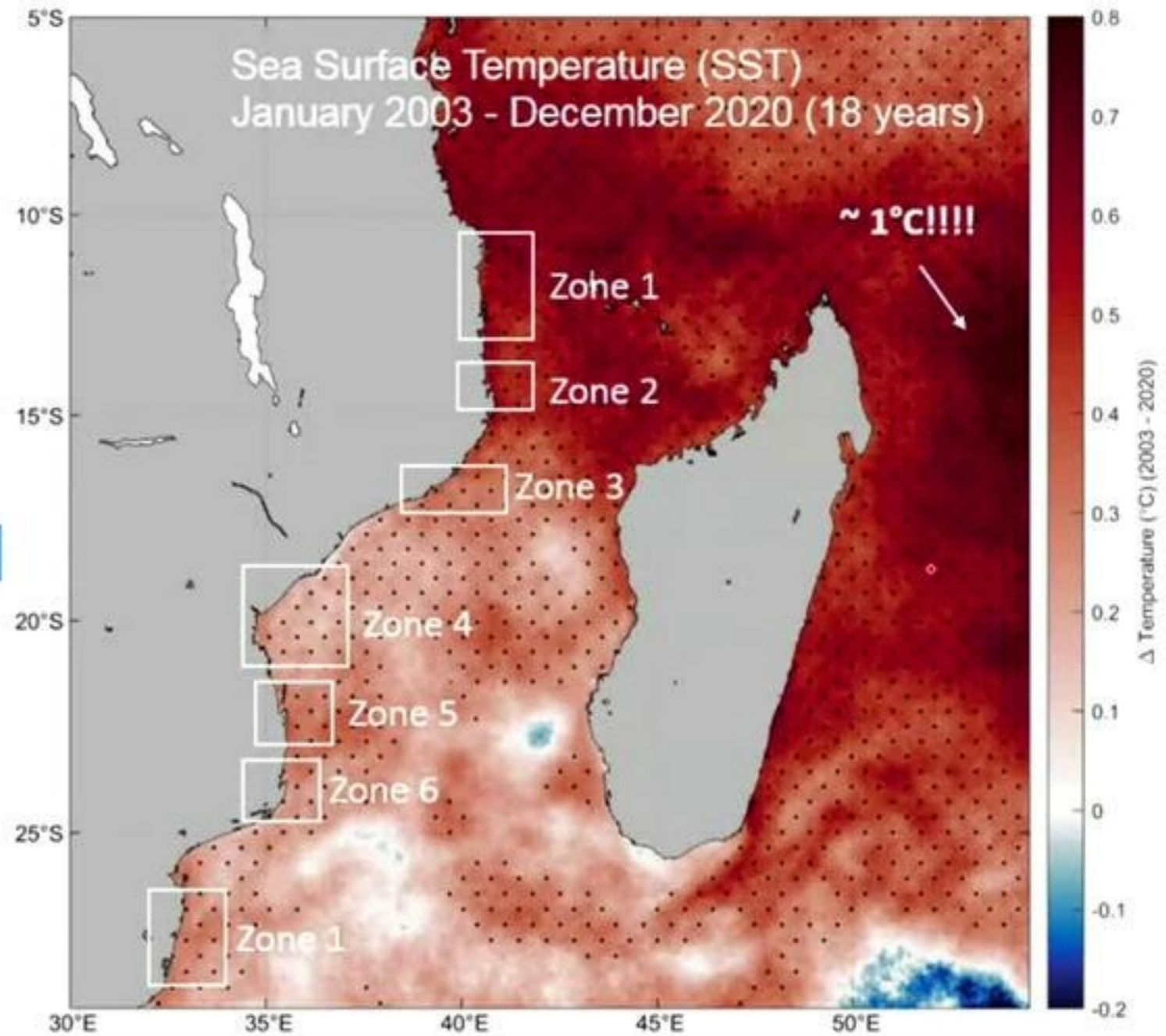


2. How is Global Warming affecting Mozambique?

9 Making remarkable conclusions



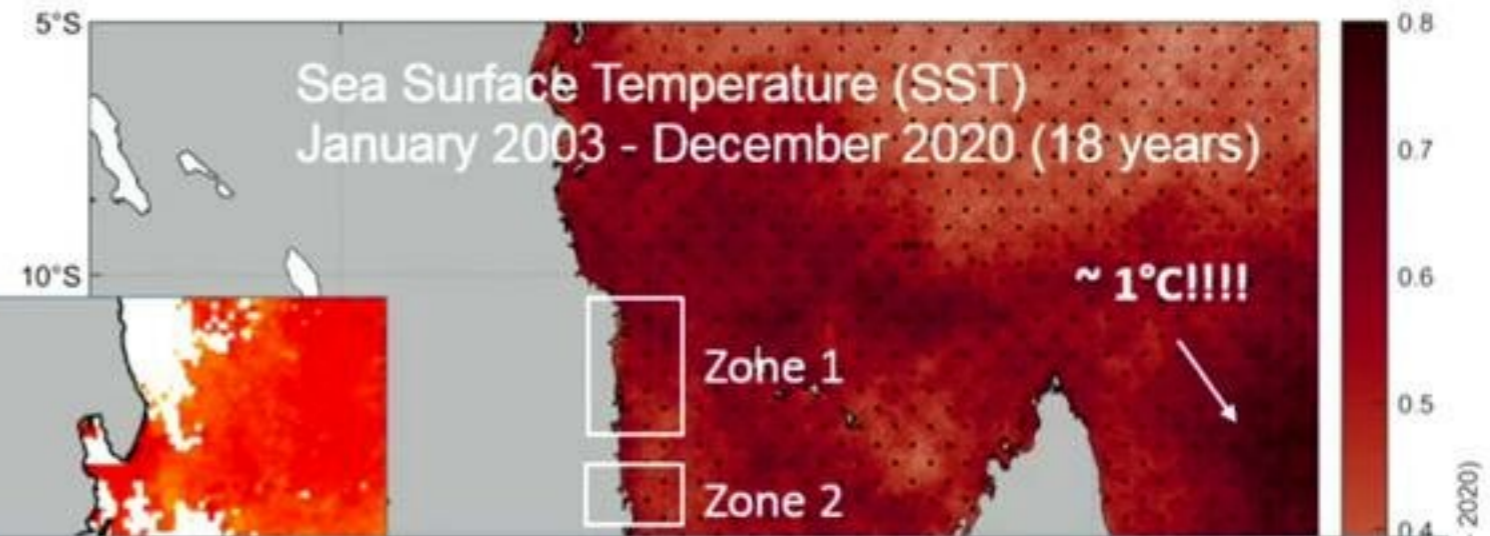
Use satellite technologies
 ΔT° (C) over 18 years



2. How is Global Warming affecting Mozambique?

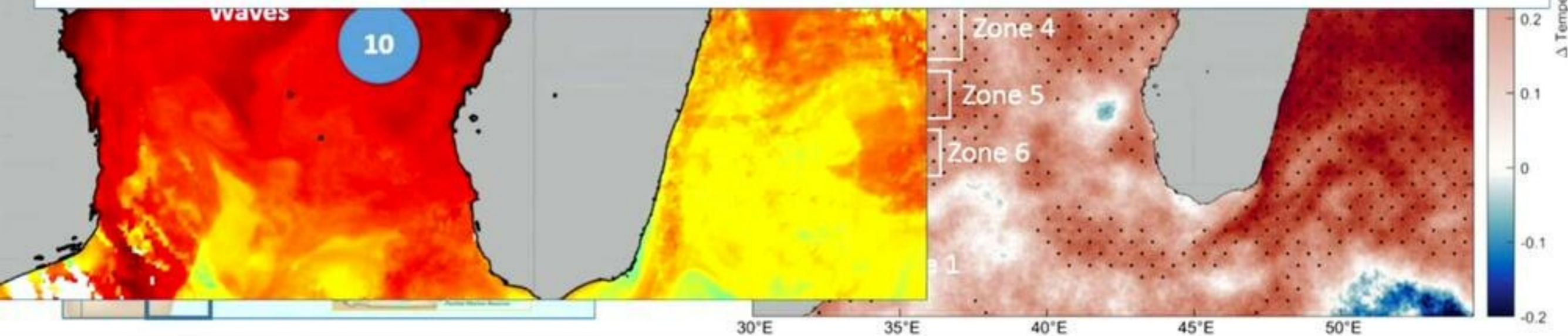
Use satellite technologies
 ΔT° (C) over 18 years

9 Making remarkable conclusions



11

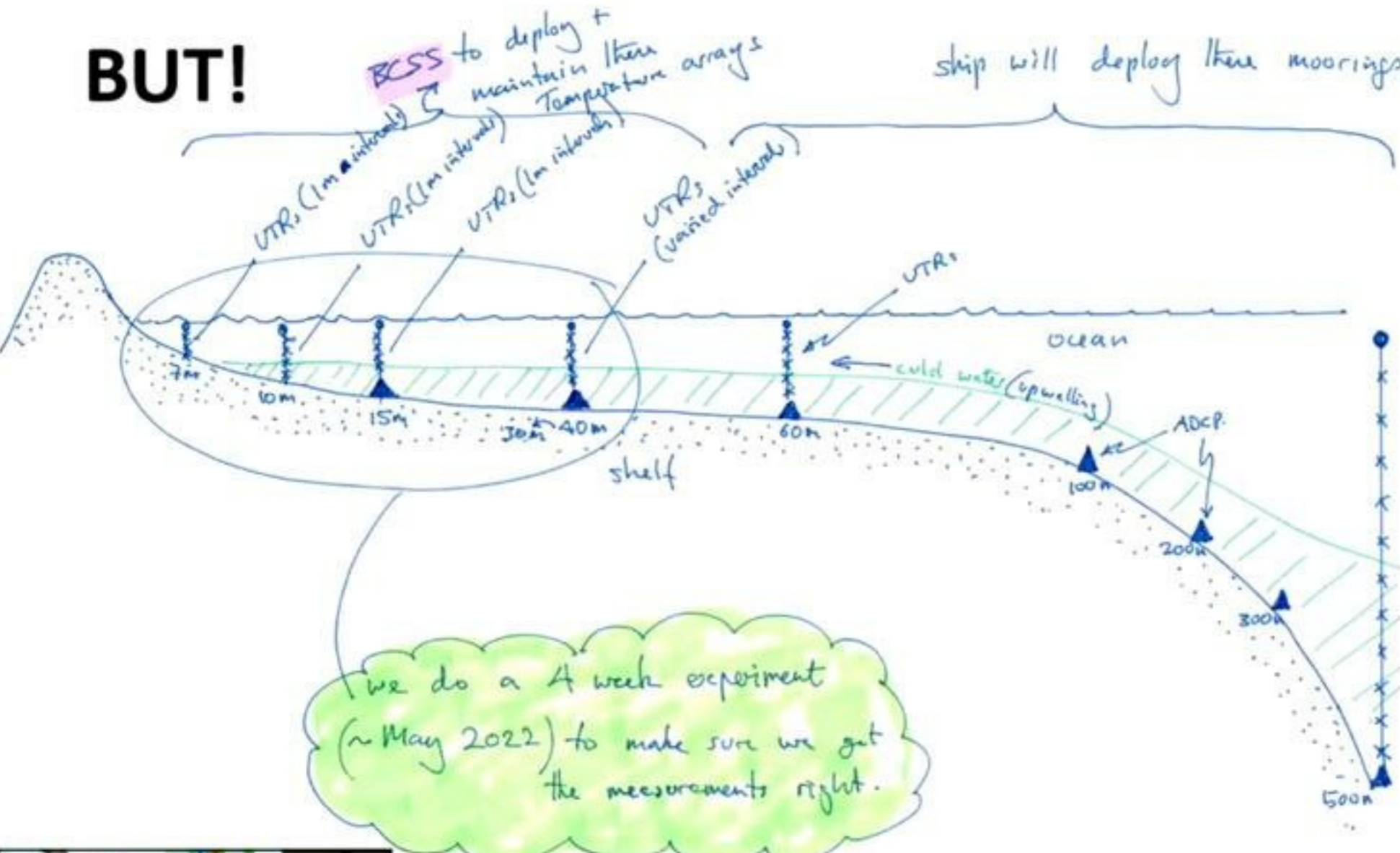
We Need To Be Certain of our data!



BUT!

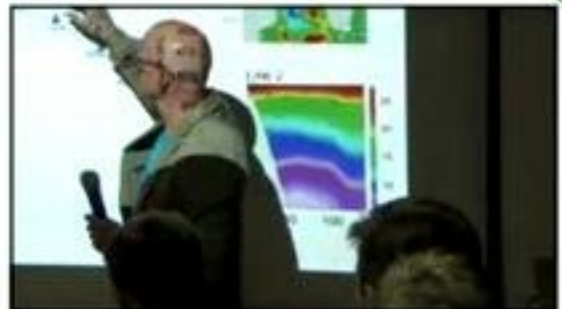
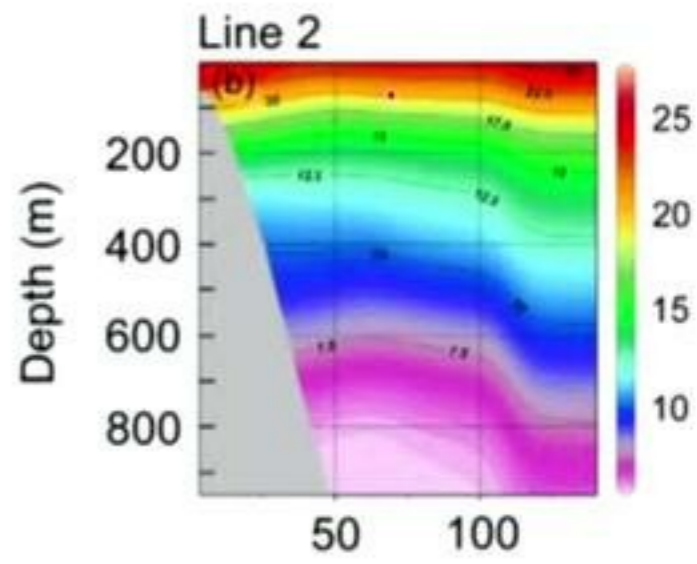
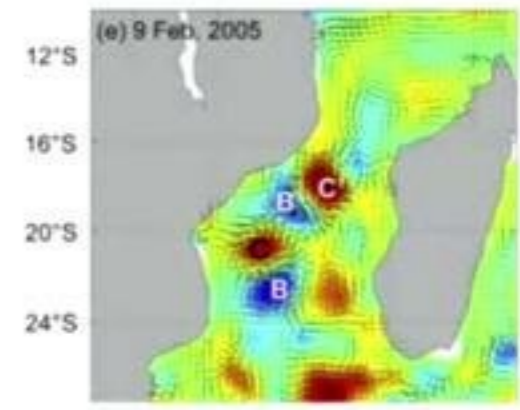
BCSS to deploy + maintain these Temperature arrays

ship will deploy these moorings.



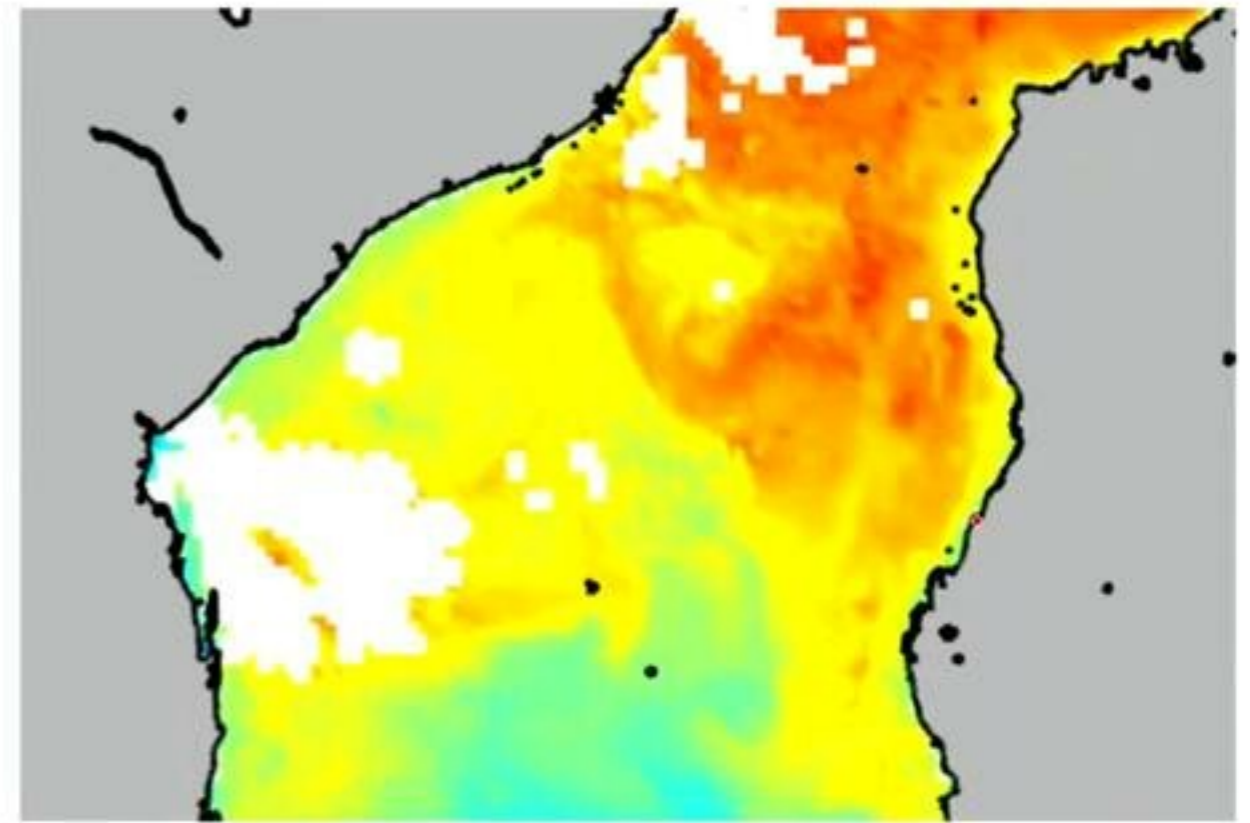
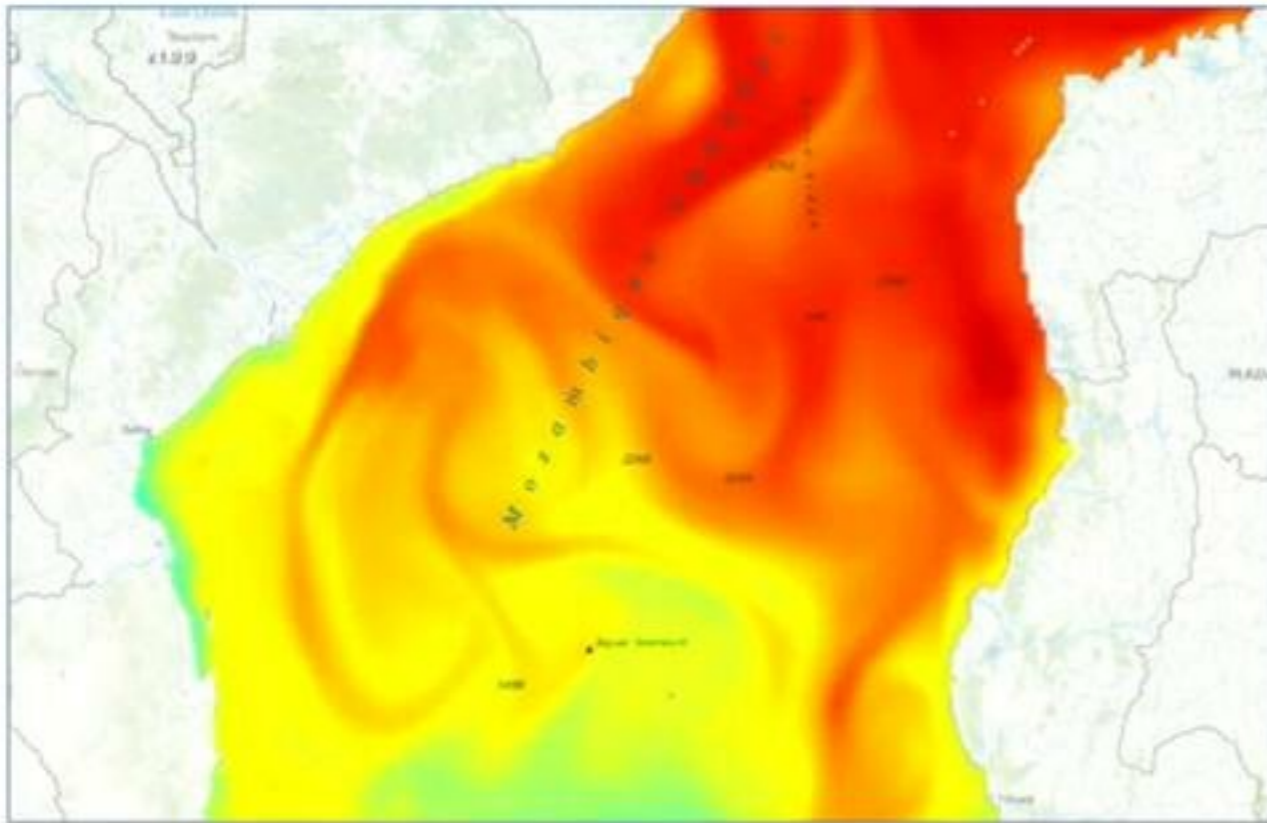
We do a 4 week experiment (~May 2022) to make sure we get the measurements right.

Eddies



Operational Oceanography

5 June CMCC model vs SST

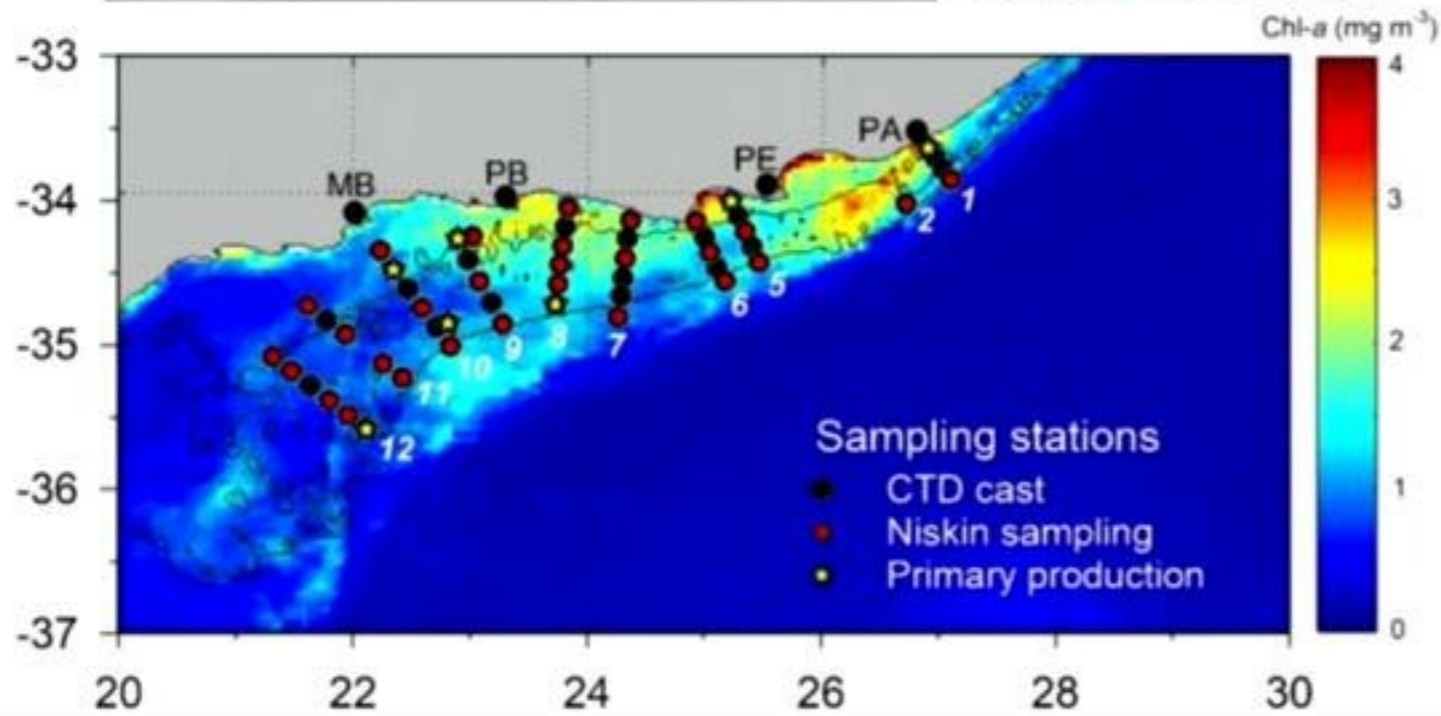


Need more Realtime observations!

ocean measurements!

BUT →

Method



BUT →

13

In WIO = Major challenges

1. Ships very expensive!!!
2. Foreign owned = no control + seldom
3. East African shelf narrow + shallow



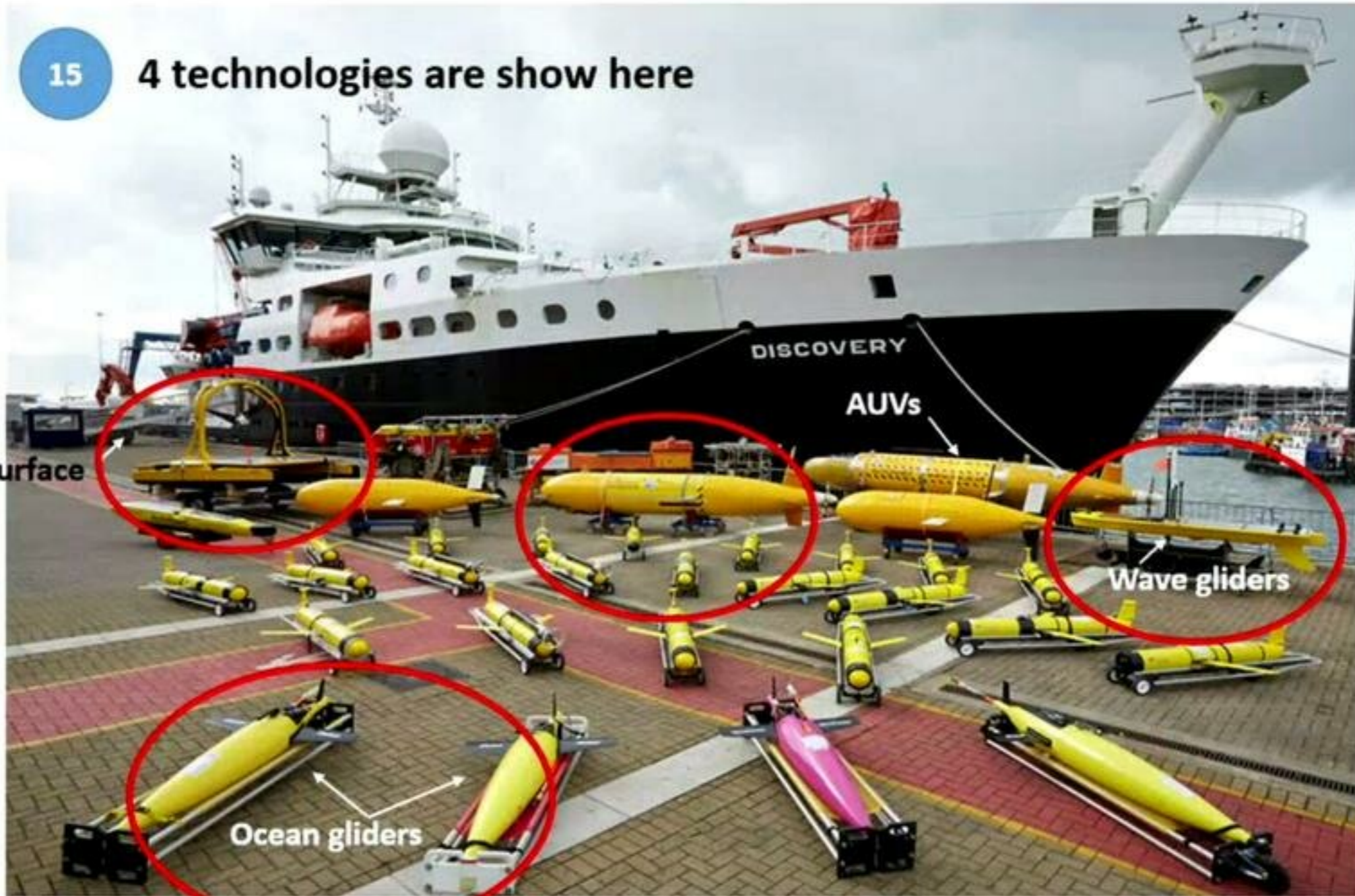
Age of sophisticated Global and Robotic *In situ* Measurement Systems



4. Marine robotic systems — autonomous ocean gliders + surface platforms (gliders)

15

4 technologies are show here



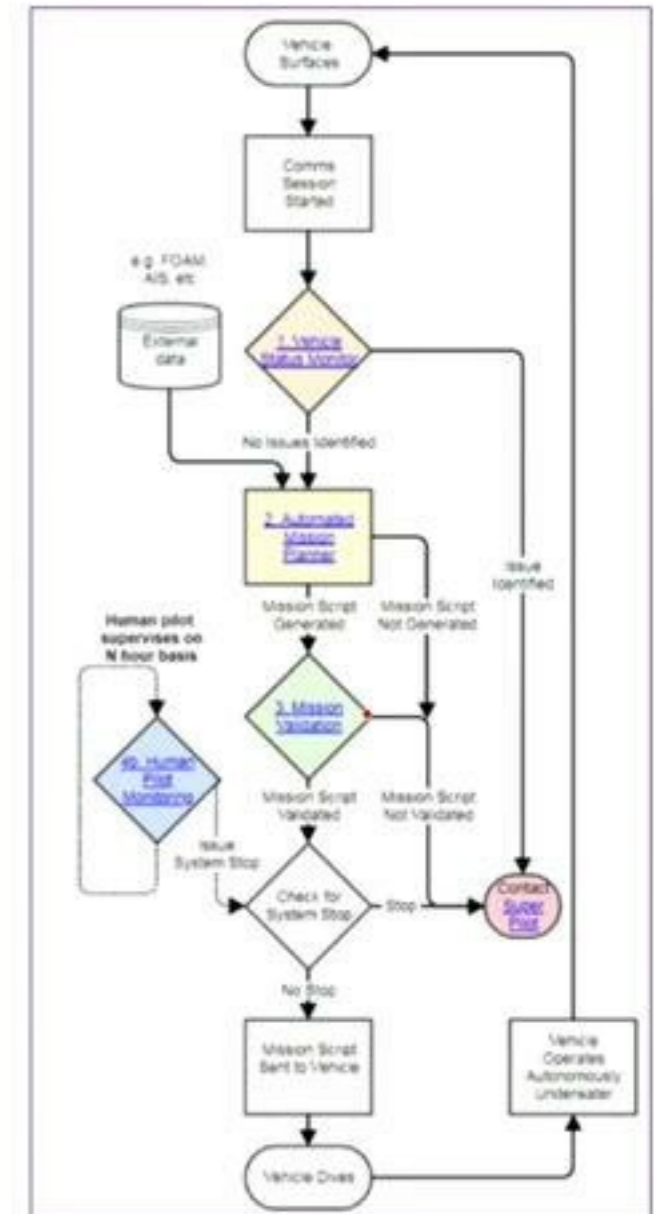
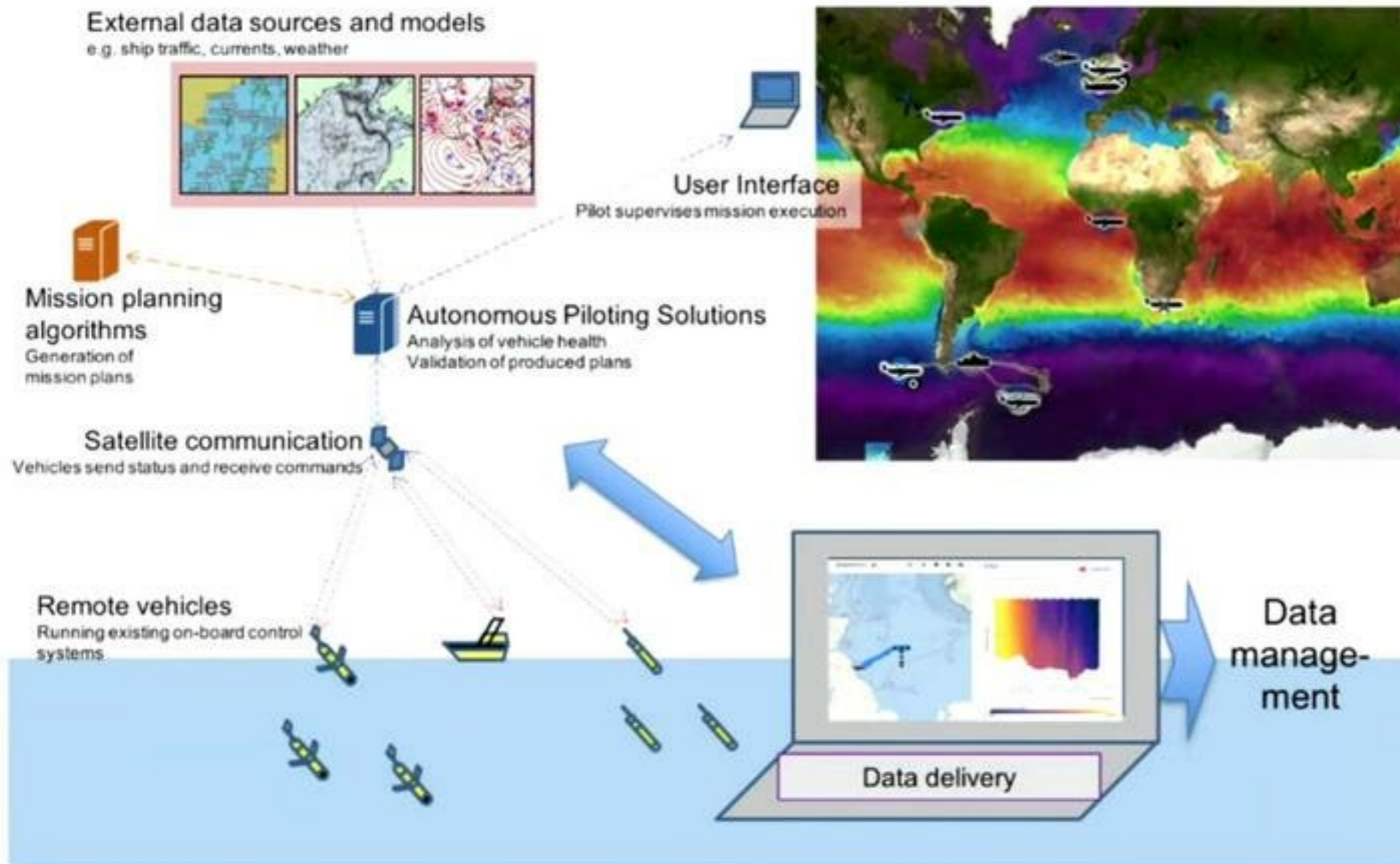
Unmanned Surface
vehicles

AUVs

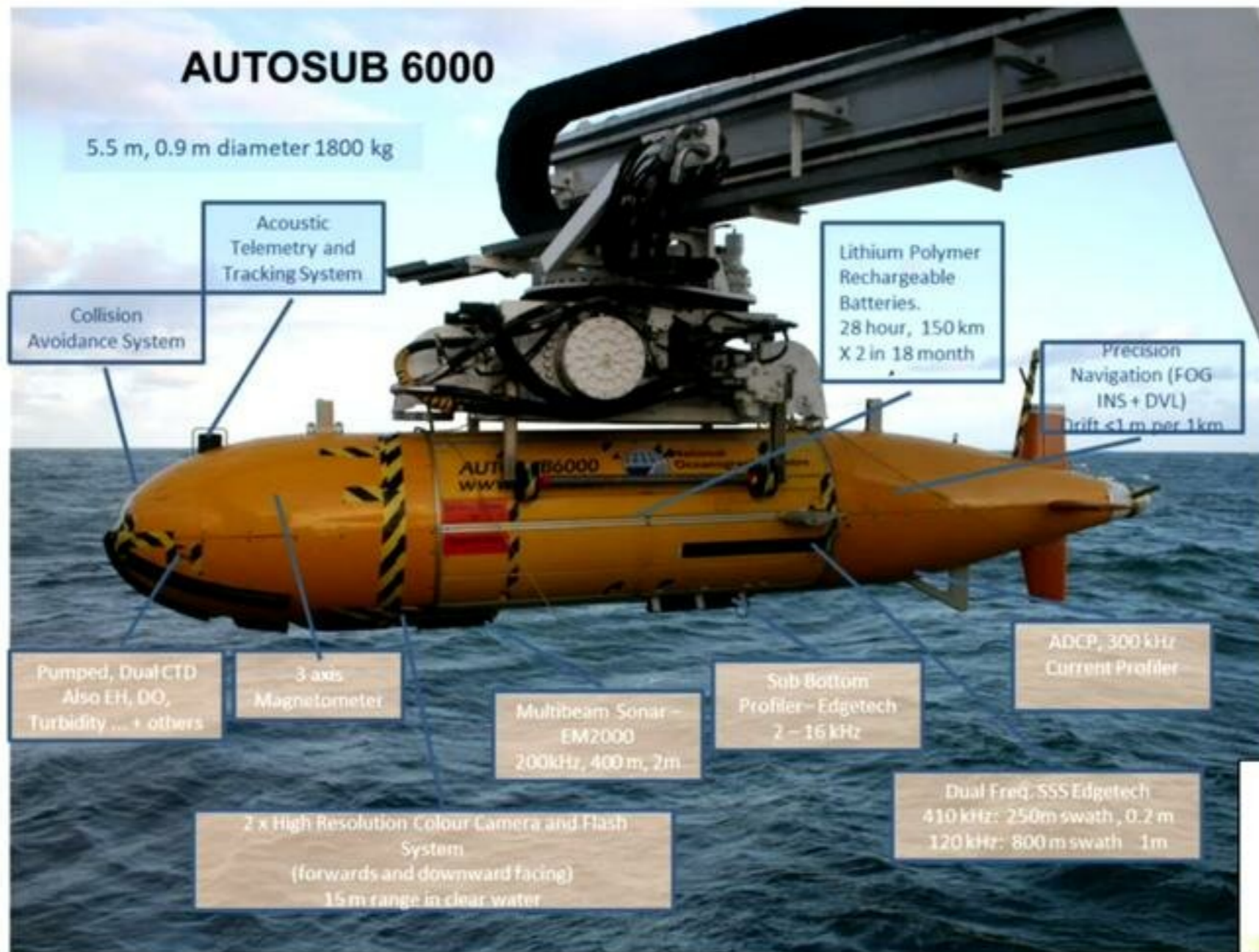
Wave gliders

Ocean gliders

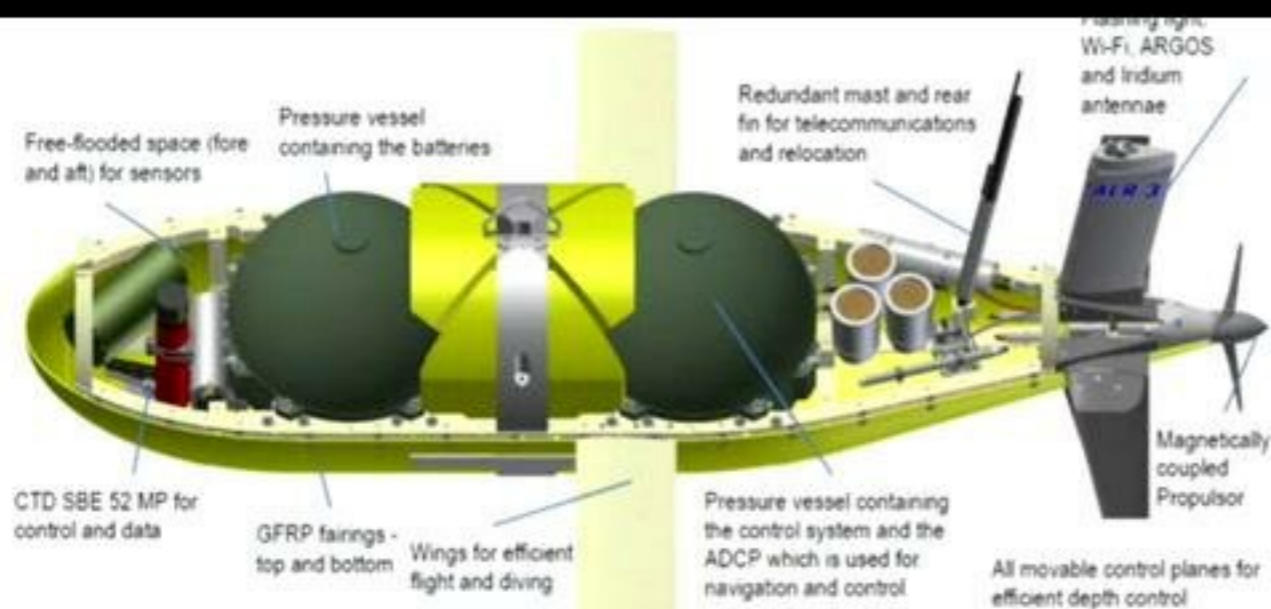
Autonomous command and control (C2)



4. Marine robotic systems — autonomous ocean gliders + surface platforms (gliders)



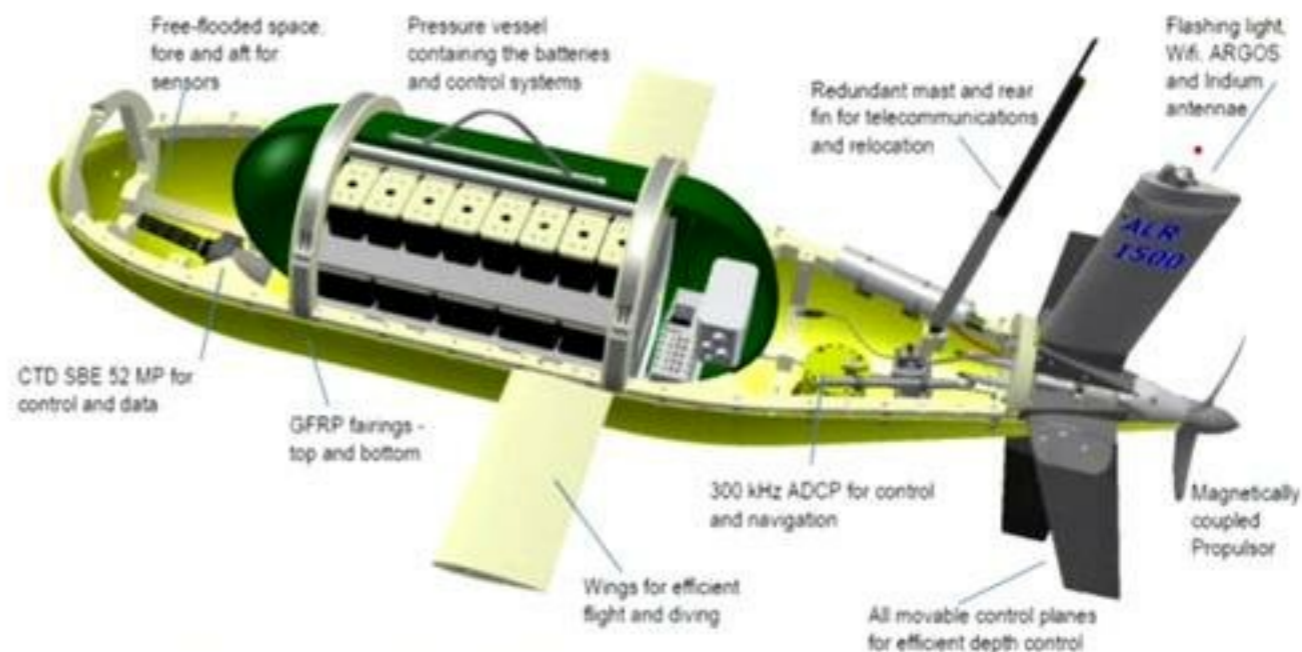




- **2 x Pressure Vessel**
- **38kWhrs Primary LTC Batteries**
- **6000m** depth rating
- Mass \approx 800 kg
- Length \approx 3.5m
- Top Speed \approx 1m/s
- Max Range \approx **2000km**

Autosub Long Range 6000 (ALR6000)

- **1 x Pressure vessel**
- **95kWhrs Primary LTC batteries**
- **1500m** depth rated
- Mass \approx 800 kg
- Length \approx 3.5m
- Top Speed \approx 1m/s
- Max Range \approx **6000km**

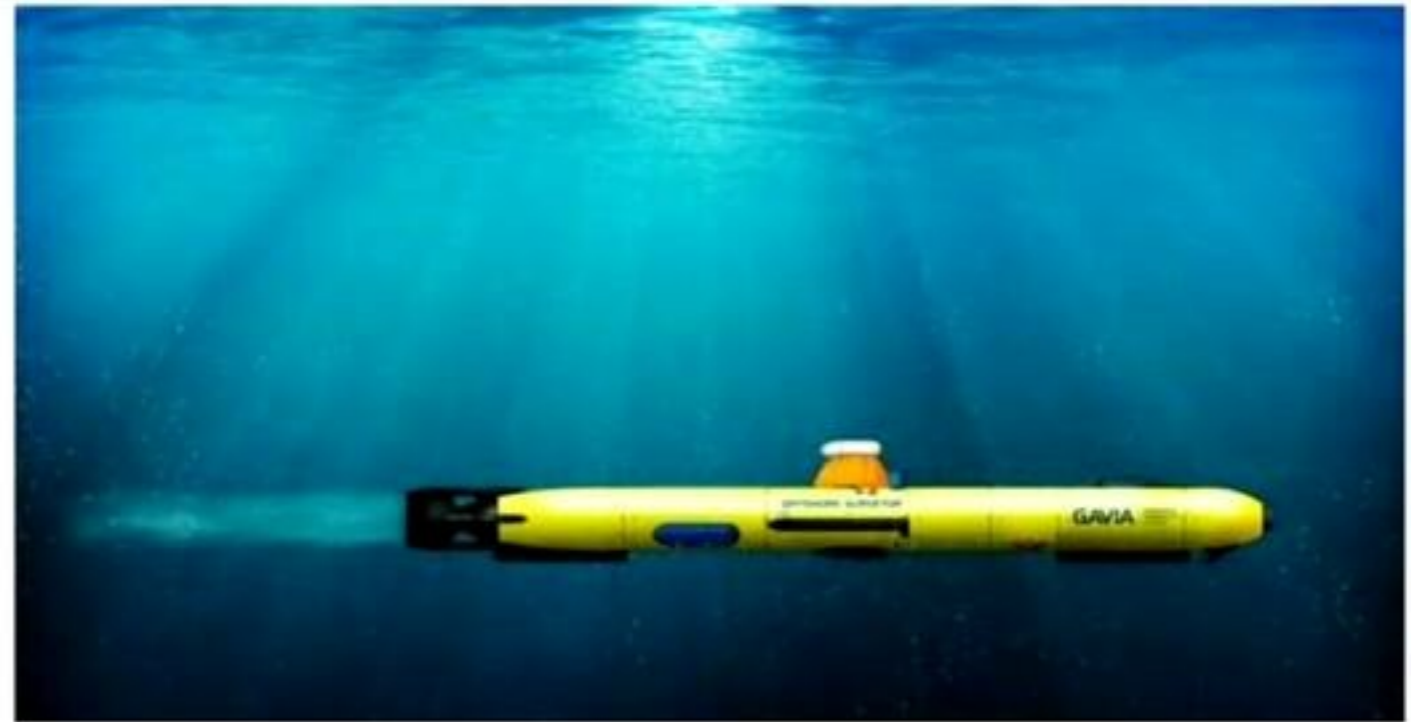


Autosub Long Range 1500 (ALR1500)



GAVIA Teledyne

Length	1.8 – 4.5 m
Weight	50 – 130 kg
Speed	5.5 knots
Range	4-60 km
Operation	2 people



Highly portable!

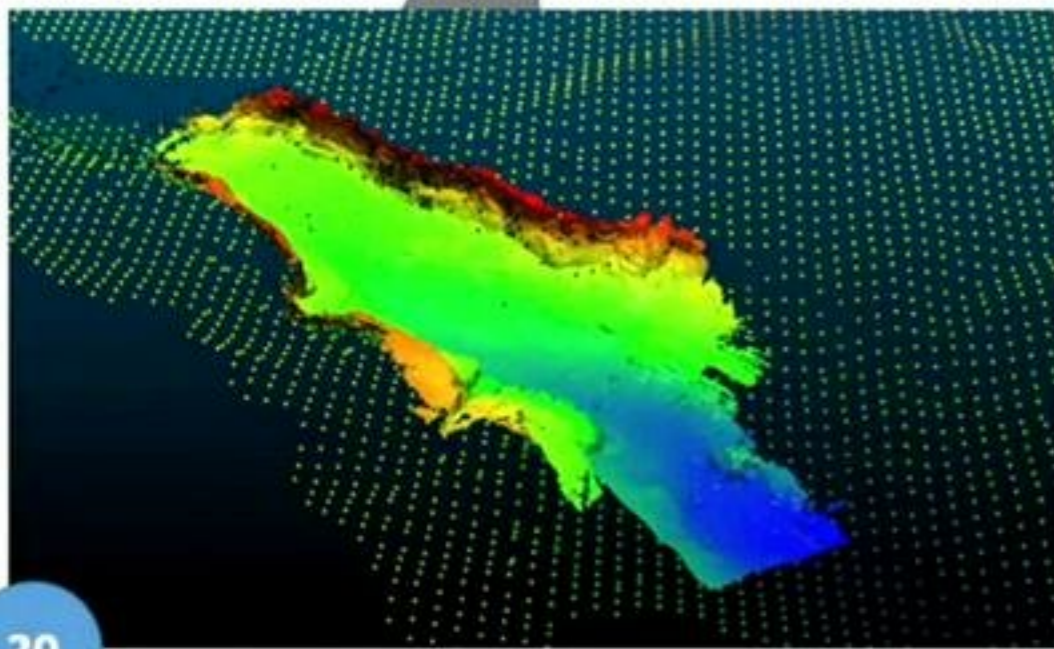


5. AUV missions — mapping and photogrammetry



18

Mapping

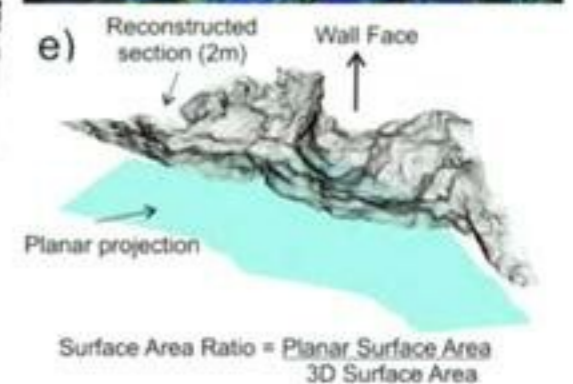
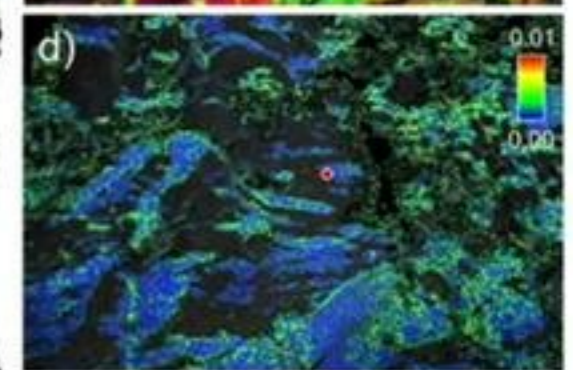
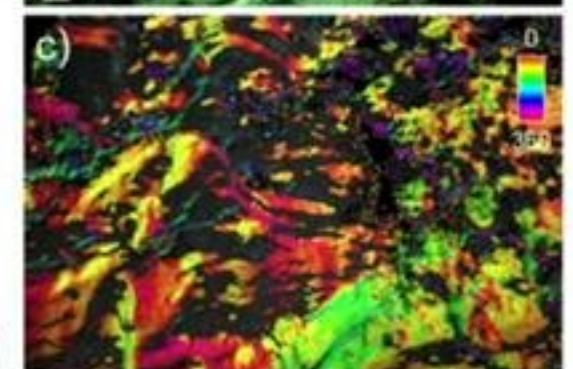
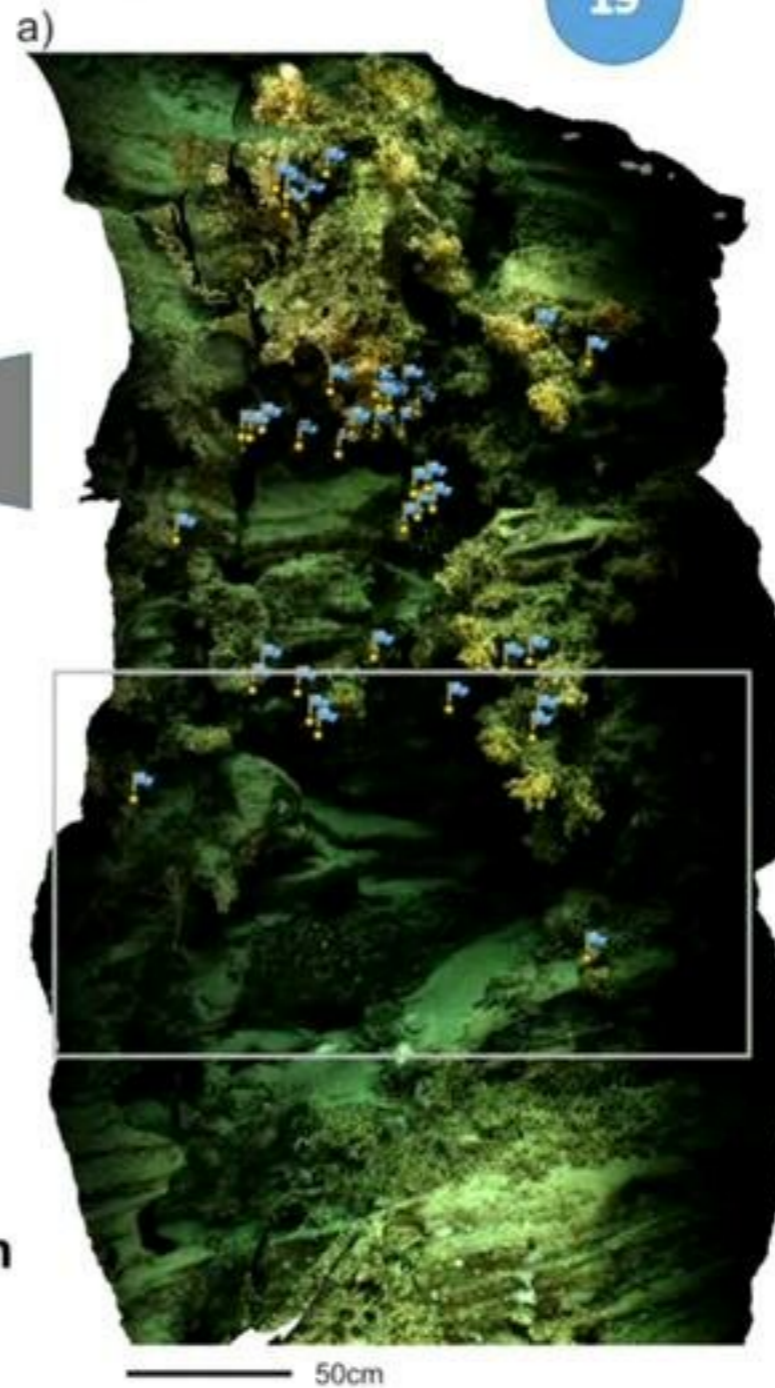


20

Ship > 50 m; ROV > 1 m; AUV > 1 m resolution

19

photogrammetry



Marine robotic systems — autonomous ocean gliders + surface platforms (gliders)

15

4 technologies are show here



Unmanned Surface
vehicles

AUVs

Wave gliders

Ocean gliders

Marine robotic systems — autonomous ocean gliders + surface platforms (gliders)

15

4 technologies are show here



Unmanned Surface
vehicles

DISCOVERY

AUVs

Wave gliders

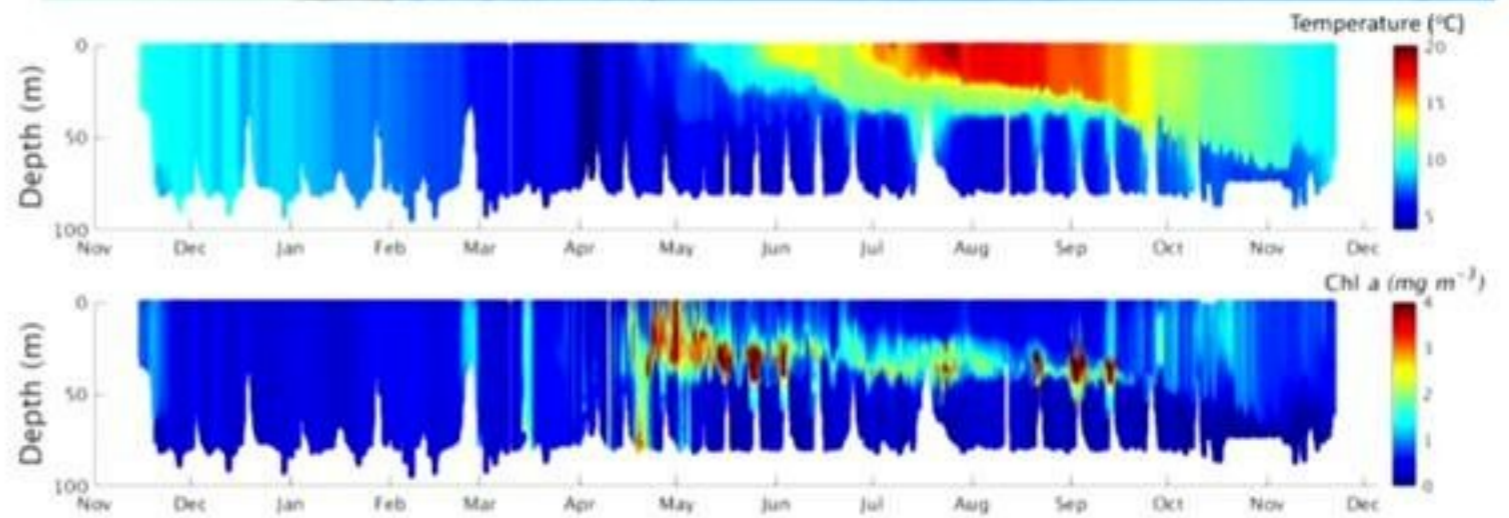
Ocean gliders

Profiling glider missions



22

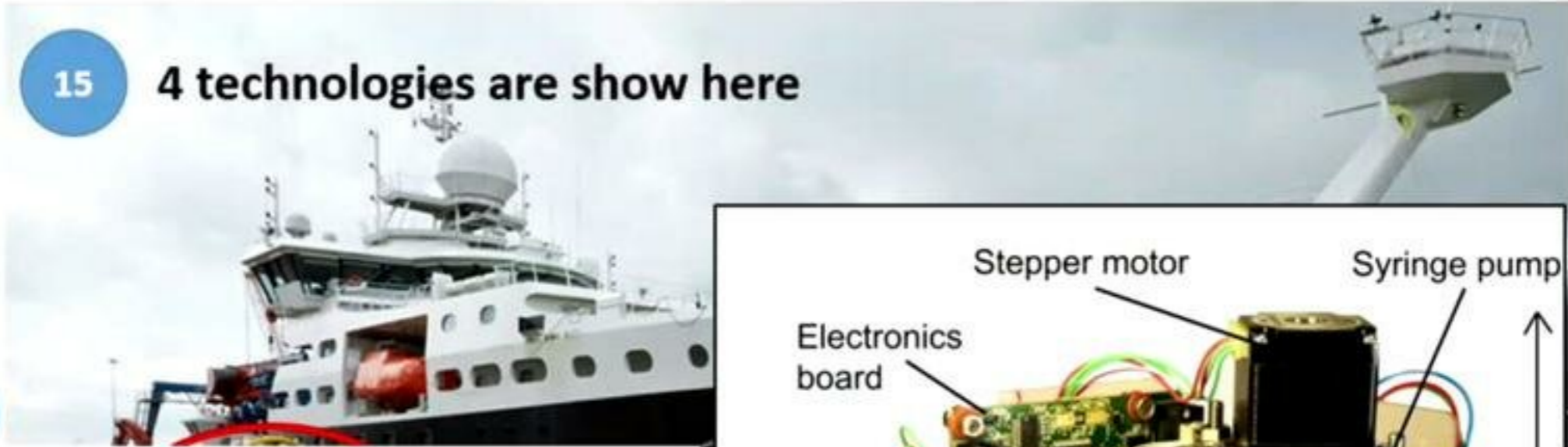
Vertical transects of T°C + Chl



4. Marine robotic systems — autonomous ocean gliders + surface platforms (gliders)

15

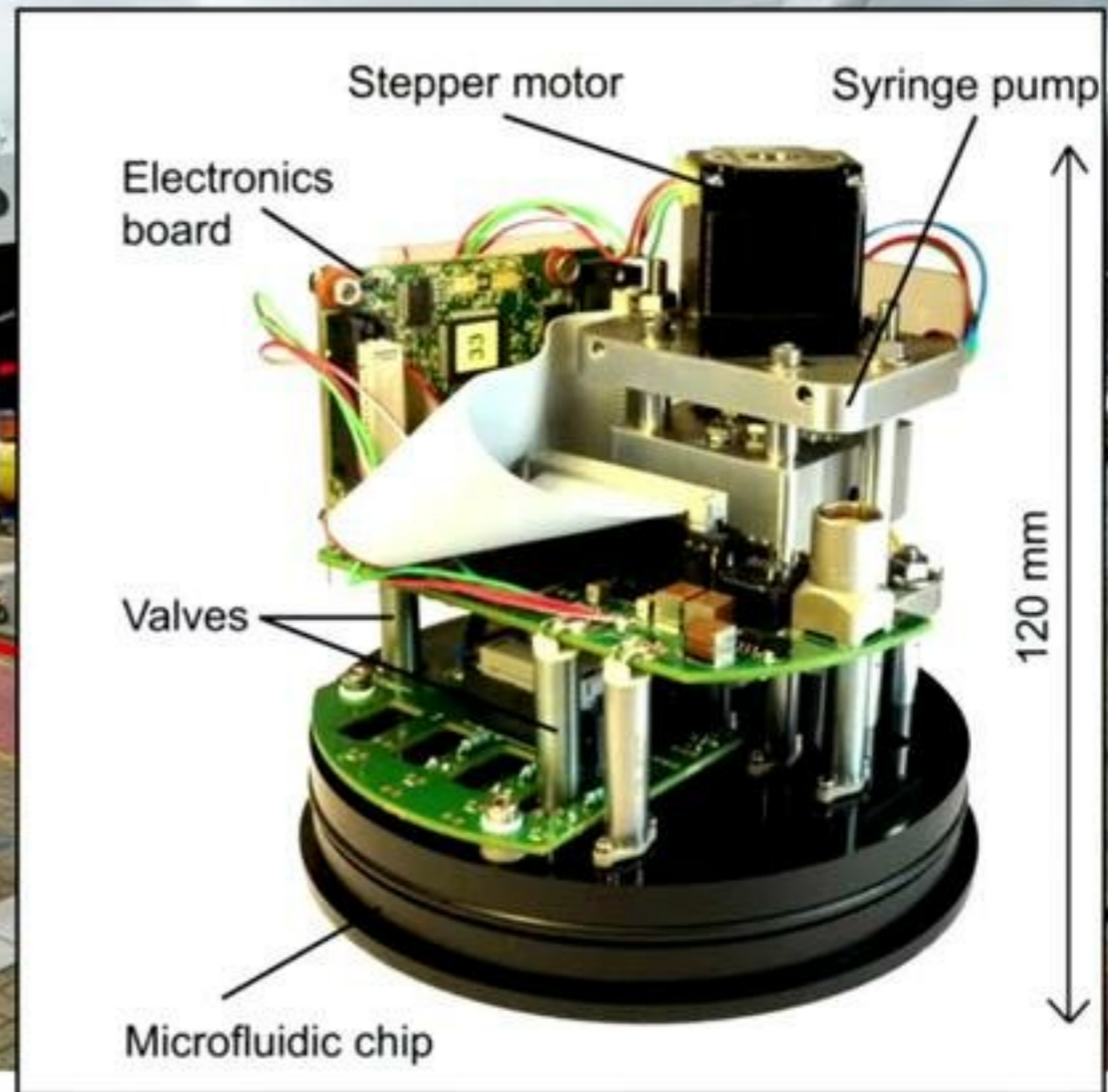
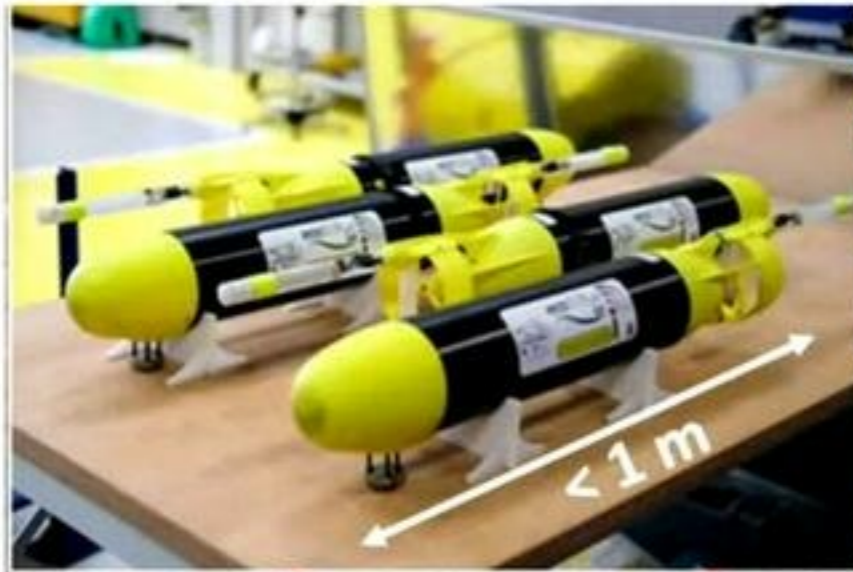
4 technologies are show here

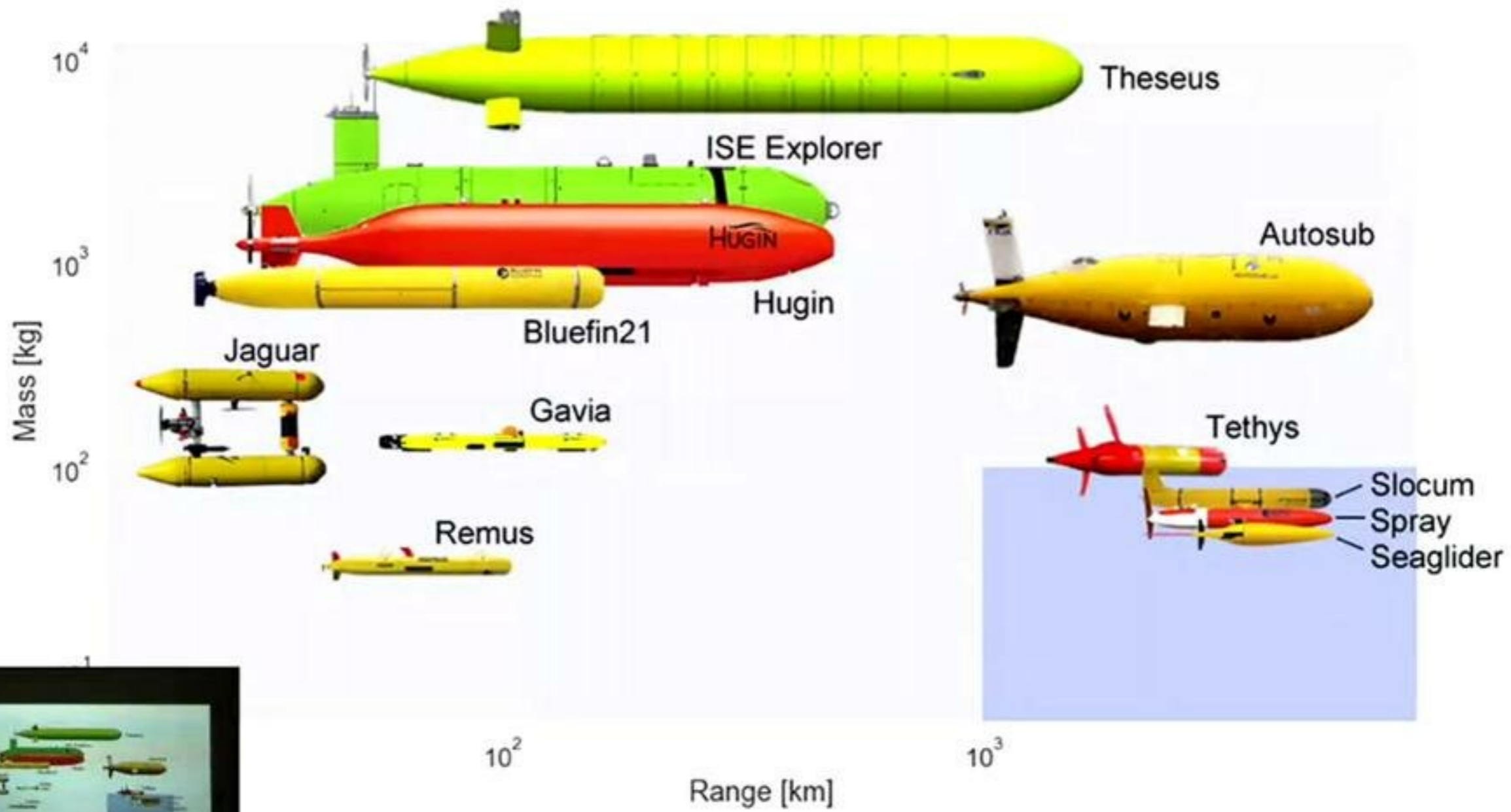


16

Now mini - robots

Unmanned vehicles





Sala iBOOT

Password:

inova sa04moz21

INOVACAO4moz21

CISCO4nem - ^{password} laptop

link de acesso a lista:

www.facebook.com/uiformoz

8. Summary

Marine Robotics are the future for WIO countries

- Highly affordable
- Easy to set-up with modest workshops/laboratories
- Do not require huge infrastructure i.e. ships
- Highly transportable
- Easy to deploy
- Require small teams of scientists and technicians
- Controlled remotely
- Compliment other high-tec as satellites and models

BUT

- Need highly skilled team team! This WIO can do easily