

Regional scientific cooperation on Eastern Boundaries upwelling impacts: Example from the Humboldt and Benguela LME region



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Building international partnership to enhance science-based ecosystem
approaches in support of regional ocean governance
Cape Town, November 27, 2017



....in an open and coastal ocean losing its breath

Low oxygen waters:

$O_2 < 1-2 \text{ mg/l}$

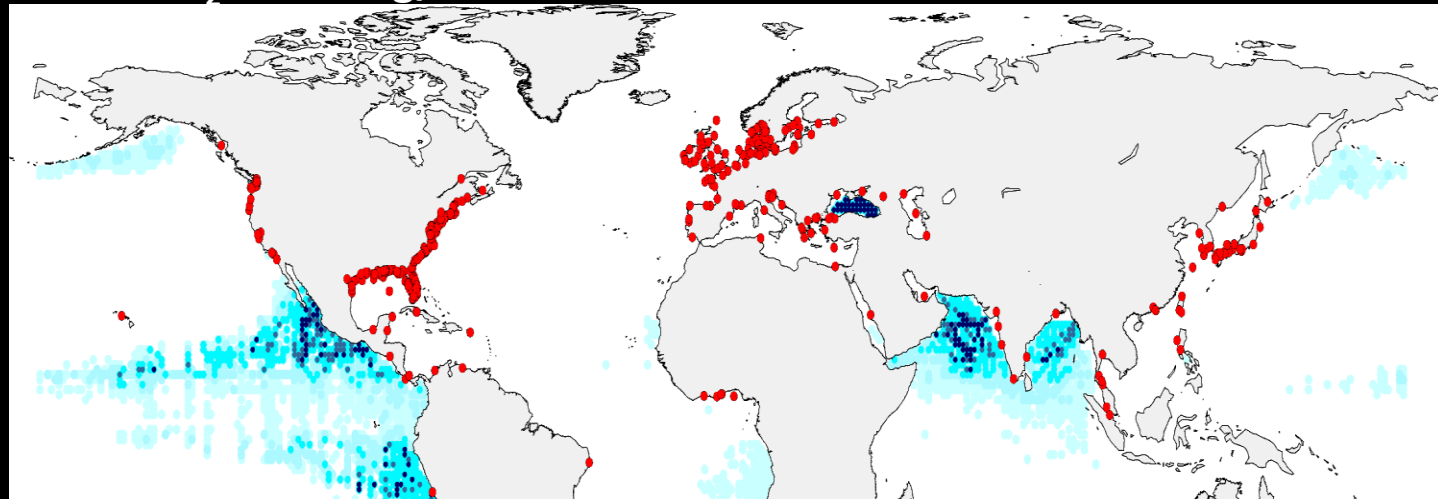
(oxygen concentration in the atmosphere = 300 mg/l)

● $O_2 < 2 \text{ mg/l}$

● $O_2 < 0.7 \text{ mg/l}$

● $O_2 < 0.07 \text{ mg/l}$

● Coastal hypoxic sites ($O_2 < 2 \text{ mg/l}$)



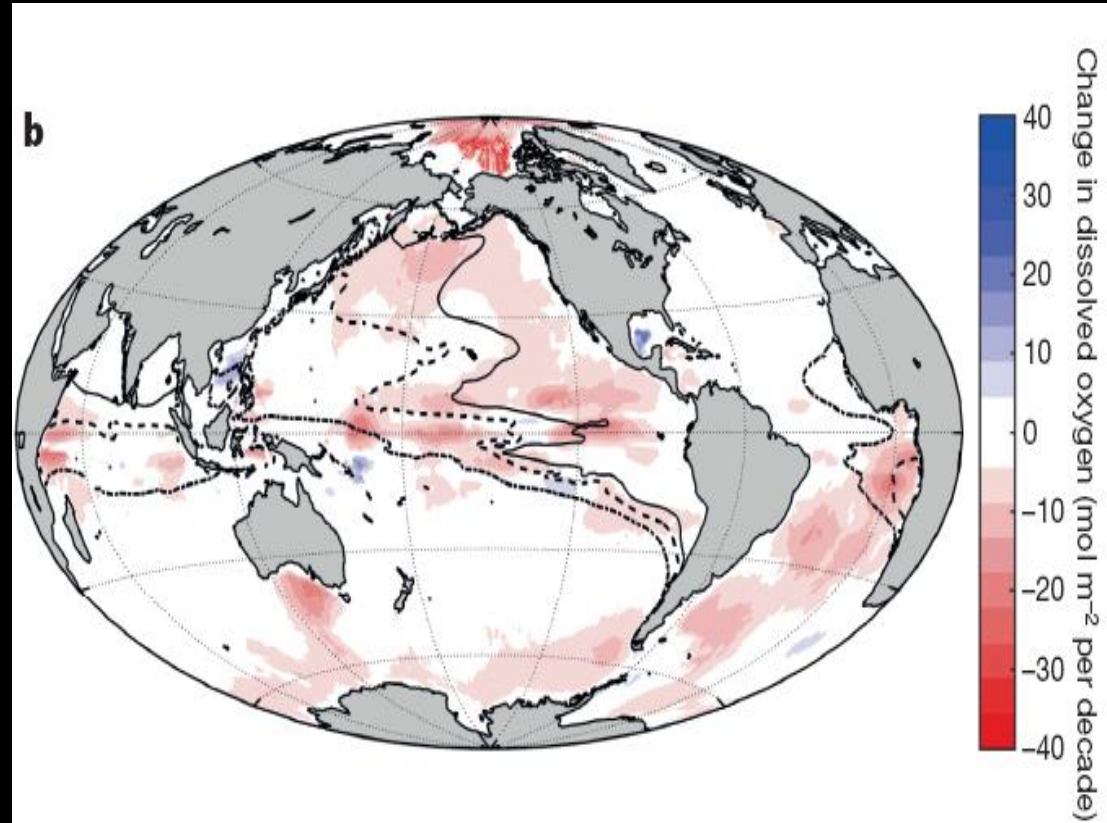
• Since 1950 - Over 500 coastal systems identified with $\leq 20-25\%$ oxygen saturation

• Since 1960 - The open ocean has lost 2% of its oxygen inventory = 77 billion tons O_2

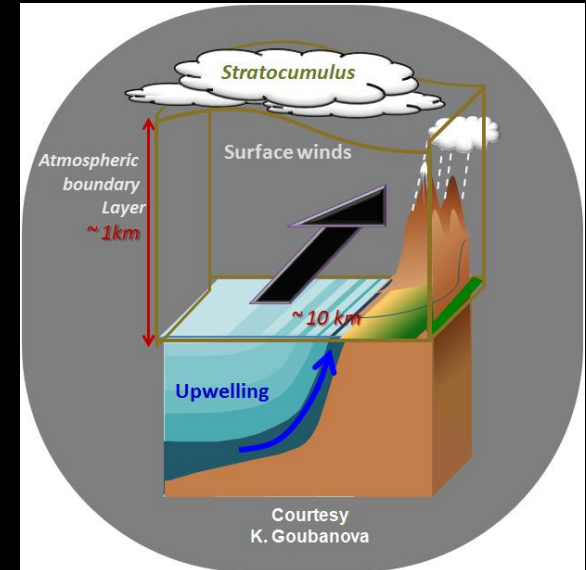
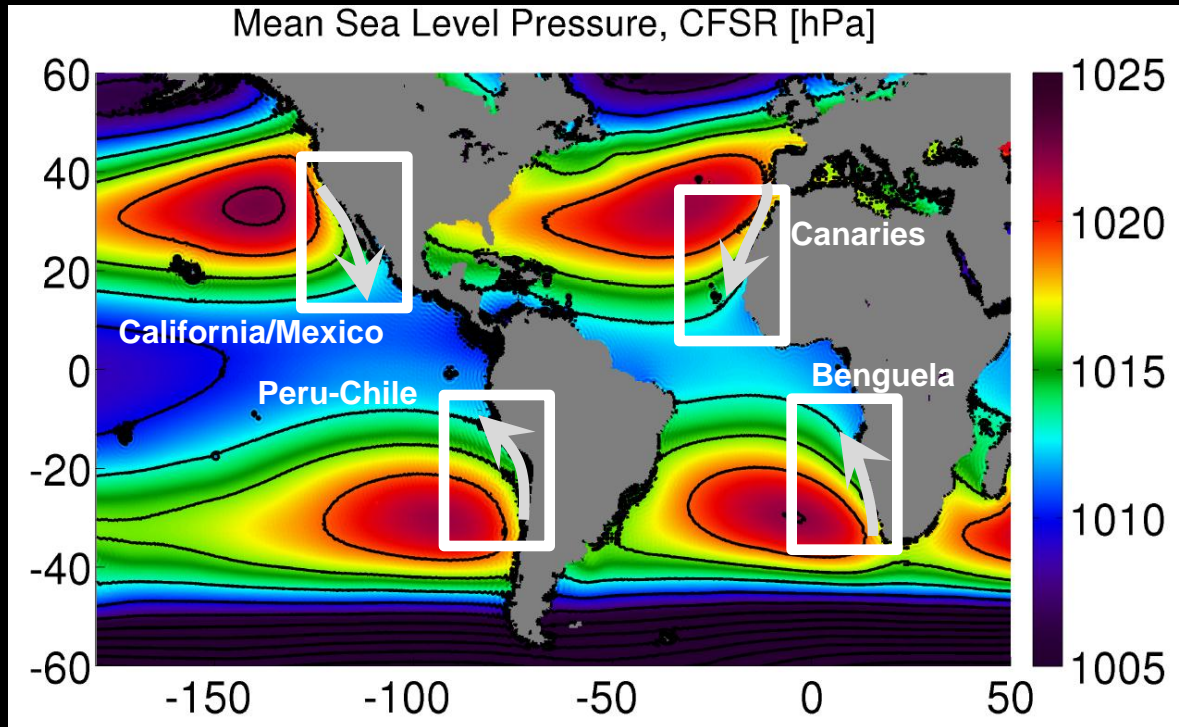
Robust evidences for ongoing ocean deoxygenation

OPEN OCEAN

Hot spots of changes
(**> 60 % of the oxygen loss**)
Tropical and North Pacific
Ocean,
Southern Ocean,
South Atlantic Ocean,
Arctic Ocean



Eastern Boundary Upwelling Systems : hot spots of change



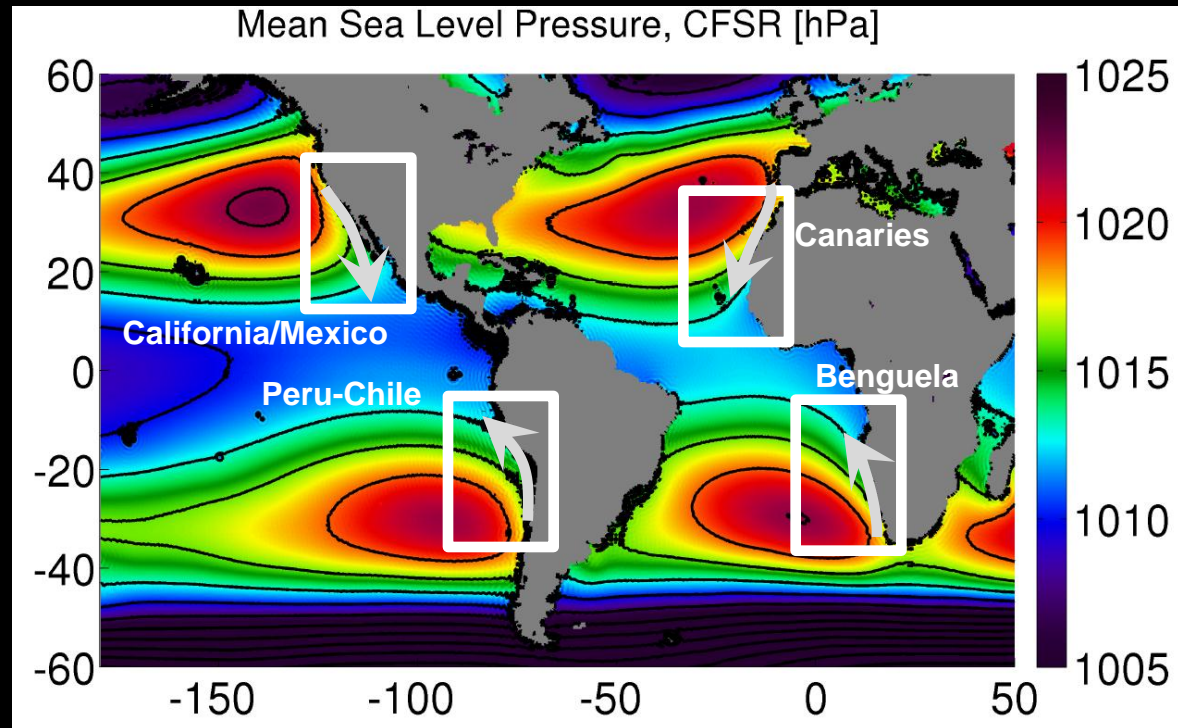
❖ COMPLEX SYSTEMS WITH HIGH IMPACTS :

High pressure → wind → upwelling

→ SST ↓ → Δ radiative transfer → Δ wind and clouds

➤ **CLIMATE**

Eastern Boundary Upwelling Systems : hot spots of change



Adapted from CFSR and L. Renault, pers. com.

❖ COMPLEX SYSTEMS WITH HIGH IMPACTS :

High pressure → wind → upwelling

→ SST ↓ → Δ radiative transfer → Δ wind and clouds

→ well lit layer fertilisation

→ short trophic chain → 20% of fish catch

→ Oxygen Minimum Zone

→ release of GHG CO₂, N₂O, ...

➤ CLIMATE



➤ ECOSYSTEMS

International initiatives on ocean deoxygenation thematic



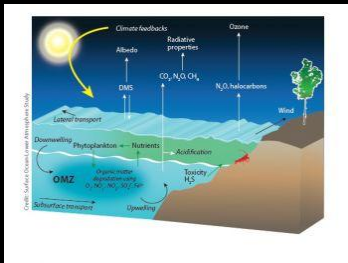
**GO₂NE Global Ocean Oxygen Network
2016 -**



2017 - 2022



**SCOR WG 155: Eastern boundary upwelling systems (EBUS):
Diversity, coupled dynamics and sensitivity to climate change
2018- 2021**



**SOLAS Science Plan : Integrated topics on Upwelling
2015-2025**



**Research Focus on Upwellings
2016 -**



GO₂NE

Global Ocean Oxygen Network

(((("VOICE"))))
VARIABILITY IN THE OXYCLINE & ITS IMPACTS ON THE ECOSYSTEM



Monterey Bay Research Institute, USA
11 – 15 September 2017

Listening to the calls by scientists and member states demanding:

- increased cooperation , communication, capacity building,
- definition of management and policy strategies,
- sustained oceanic multi-disciplinary observations in regional systems,

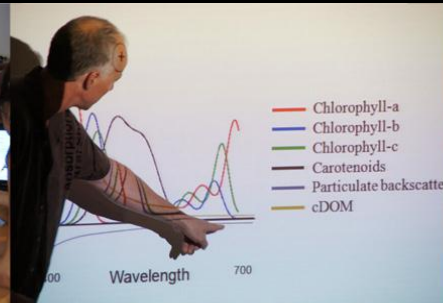
concerning **deoxygenation in the marine environment – in the Open Ocean and Coastal Areas**, including the impacts of climate change and eutrophication.

GO₂NE SS2019: GO₂NE Summer School

2-7 September 2019, Xiamen, China



**Capacity building
activities:
40 students
14 lecturers**





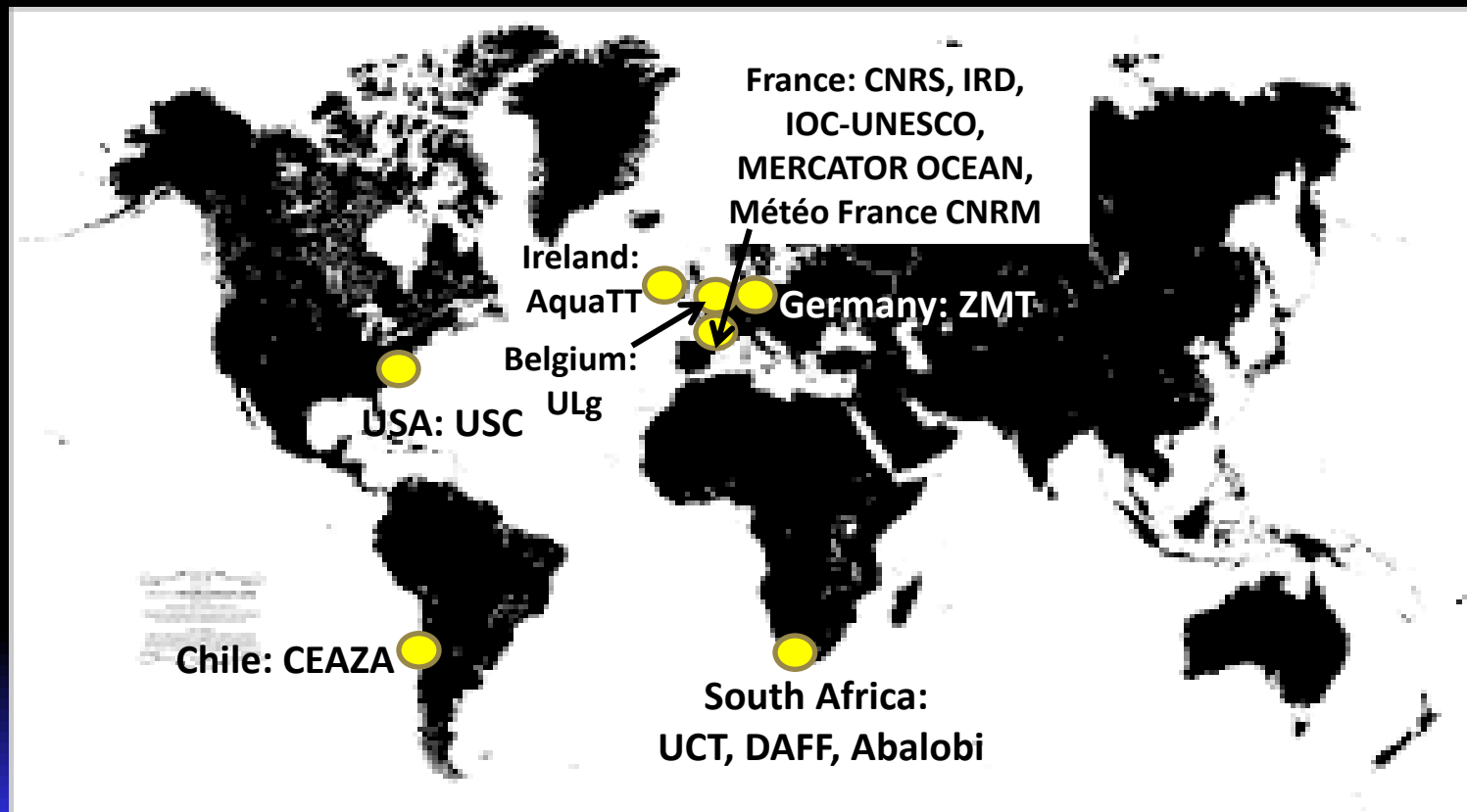
Future Earth Ocean KAN and Belmont CRA : Upcoming call on Ocean Sustainability



Accounting for and minimizing the impacts of global change:

....the multi-scale changes in ocean systems

....deoxygenationsocietal models - including both how changing patterns of migration, population, and human behavior act or will act as a driver of global change in ocean systems, and how changes in ocean systems will impact societies



Multi-scale science support



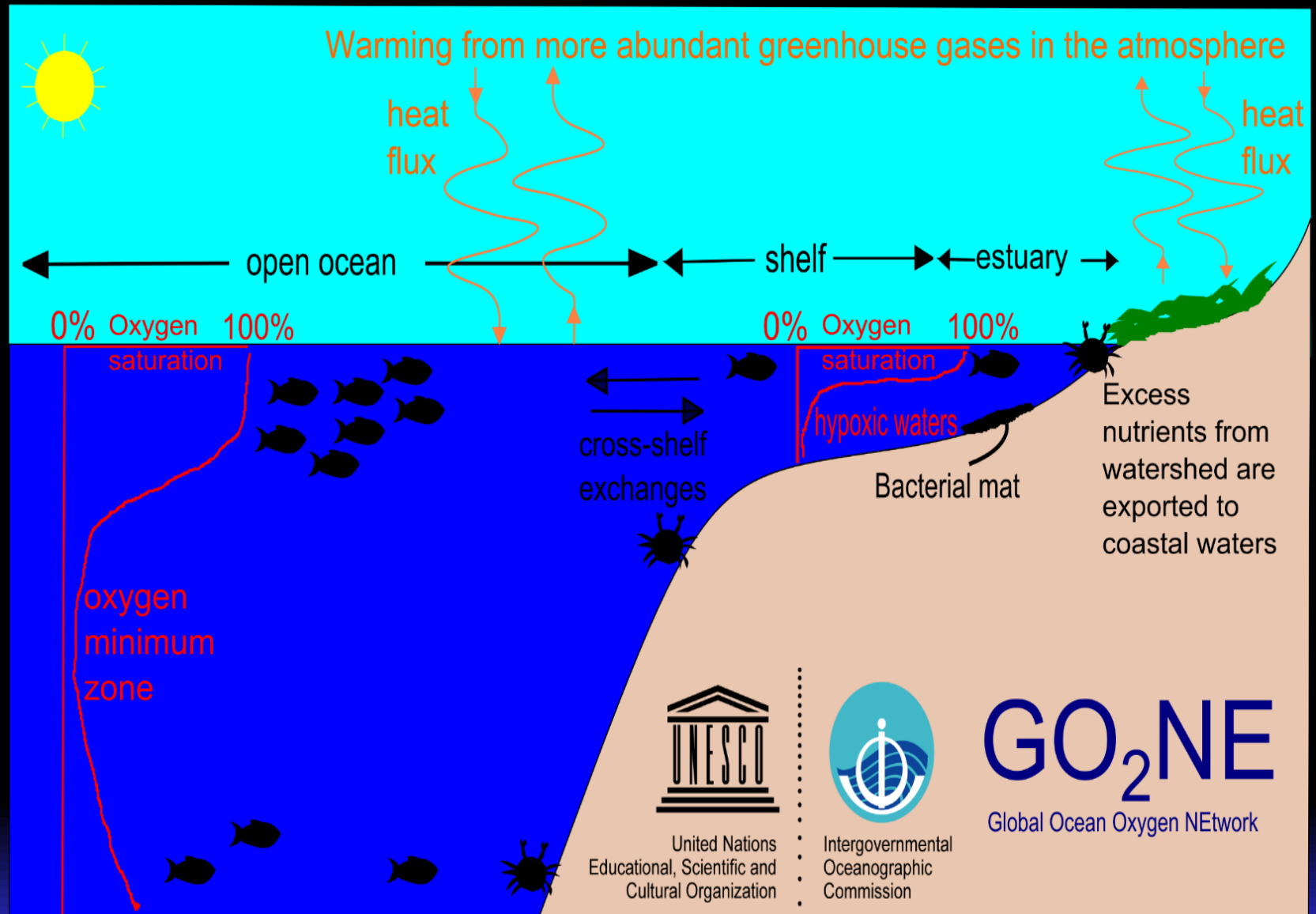
Global challenges, global data sets,
global options



Local challenges, local data sets,
local management solutions



Thank you for your attention!



An example



Ocean-Atmosphere Interaction

Satellite remote sensing

Operational Oceanography

Ocean modeling

Climate change modeling

Southern Ocean research

Physical-Biological modeling



Ecosystem modeling

Biogeochemistry

Ocean modeling

Ecosystem Approach to

Fisheries



ICEMASA
International Centre for Education,
Marine and Atmospheric Sciences
over Africa



Human dimension of
fisheries

Marine geoscience

Marine law



Why an International Laboratory for Ocean Sciences in Africa?

- We use the word *Laboratory* as a structural model for collaborative, interdisciplinary and multidisciplinary ocean sciences
- An *Institute* is a new player and a possible competitor, a *Laboratory* can be seen as a service provider and a shared asset
- A Laboratory can be multinodal, but needs to be a physical structure

Challenges

- **EDUCATION**

Building world-class capacities for young African scientists on key issues related to the ocean and of prime importance for African countries

- **RESEARCH**

Appraising the impacts of climate change and human activities on ecosystem services of the seas around Africa and the role of the Southern Ocean in the climate context

- **INNOVATION**

Translating research outcomes into societal benefits in Africa

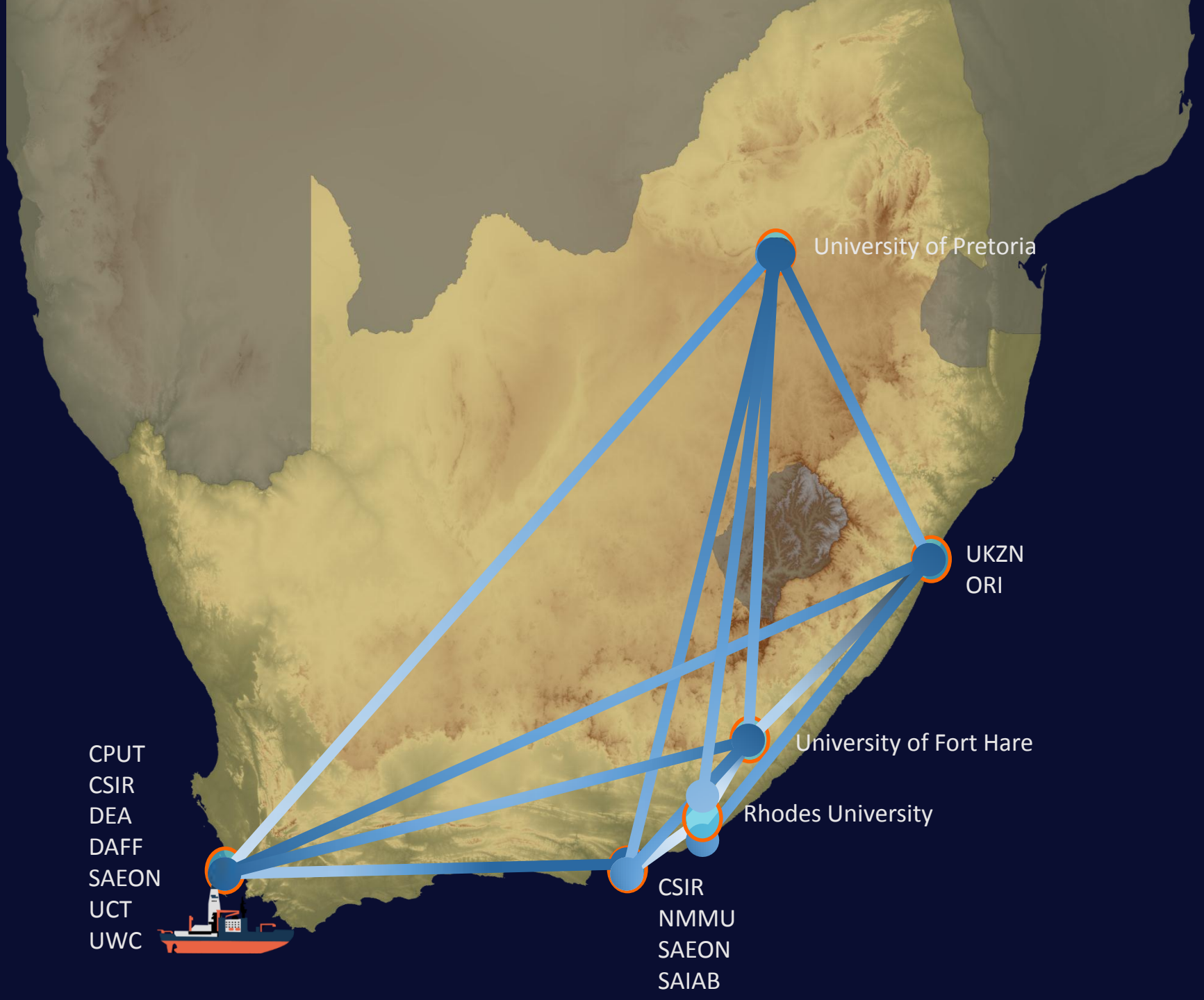
- **RISK MITIGATION**

Anticipating the main sea-related issues that Africa will have to face during the 21st century



Graphics:
Sven Ragaller

Cape Town
International Airport



Why the urgency to expand existing networks

- ICEMASA and Ma-Re will end in 2018, while new international partnerships are being formed at other SA institutions: **risk of losing expertise and momentum, and/or to duplicate and dilute efforts**
- Other South African institutions are growing expertise in marine sciences and can build on the existing network and experience
- Extend the multi-disciplinary aspect of the expertise
 - from open ocean to coastal areas
 - from physics to ecosystems
 - from observations to climate models
- The geographic advantage and the international contingency may become more attractive for new international partners

A new model

- The hub will be a logistical place to exchange international research, training and supervisors through **formal agreements** facilitated by the Lab administrative competency
- This is a completely different model from the one of overseas researchers that come for capacity building initiatives at various sites. An African voice is essential and should be the driving force
- Building on the already existing international collaborations and extending them to all the members is the key to success, because they have naturally emerged through the joint interests of SA and international scientists
- Consolidation and rationalization of research and investment efforts towards the SA strategic needs

Joint CNRS - IRD - Cirad Office in South Africa

Opening up Internationally

South Africa is the:

- 1st partner of CNRS in Sub-Saharan Africa
- 2nd most popular destination for African students after France
- 2nd third-country partner of the EU's H2020 regarding the number of funded projects

France is the 5th largest scientific partner of South Africa with more than 980 co-authored articles in 2016.

