Workshop on Identifying and Coordinating Research as an Adaptation to Climate Change in the South African Marine Fisheries and Marine Aquaculture Sectors

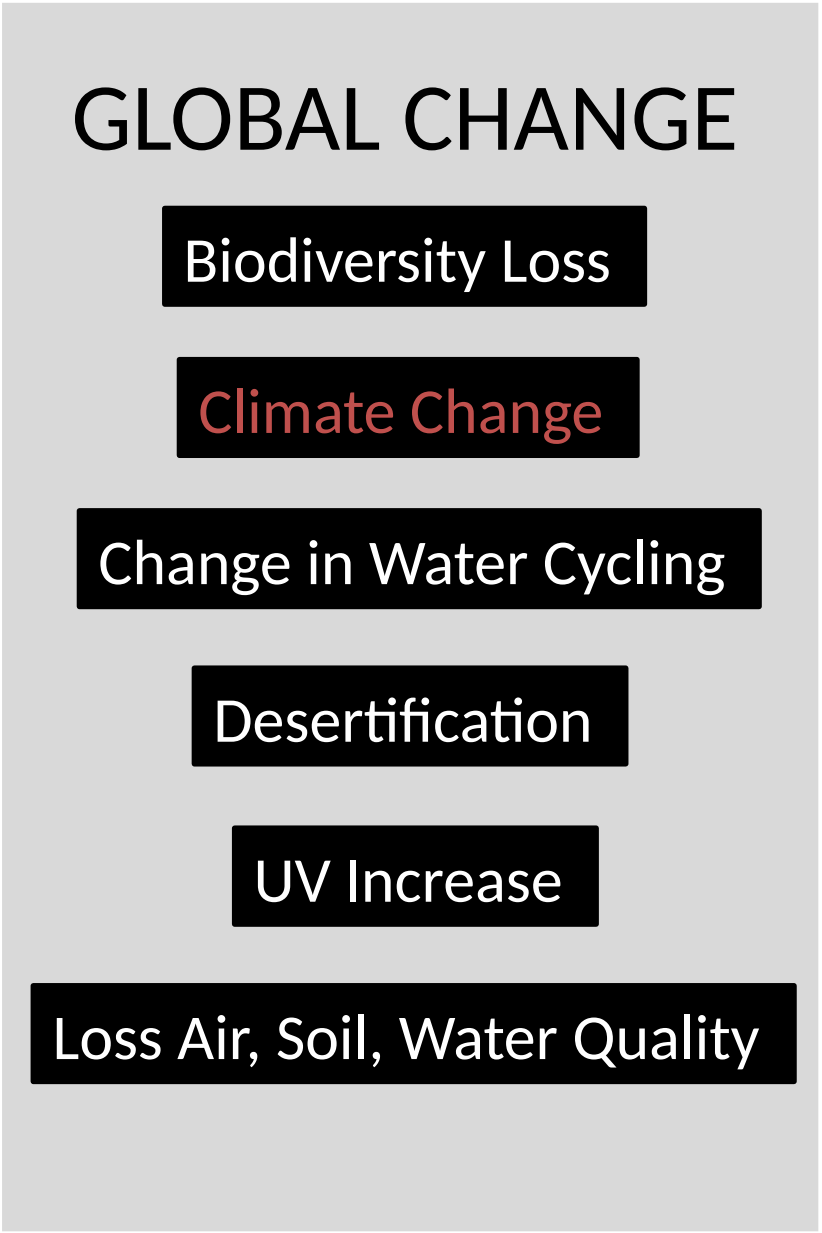
"The trouble with our times is that the future is no longer what it used to be" Paul Valery (1937)

Duarte C. 2014. Global change and the future ocean: a grand challenge for marine sciences. *Frontiers in Marine Science* 1:63

Global Change [of which Climate Change is one component] should more accurately be referred to as Anthropogenic Global Change which should be defined as:

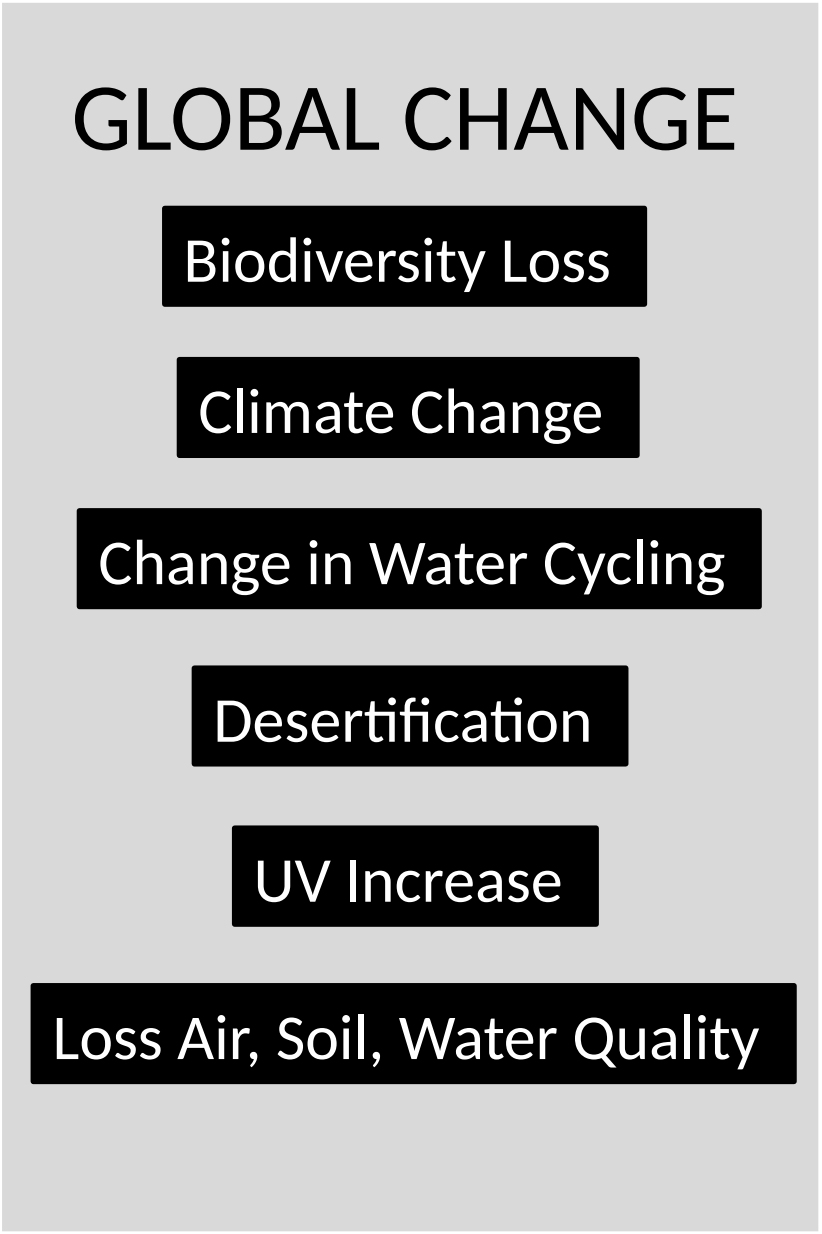
"Global-scale changes resulting from the impact of human activity on the major processes that regulate the functioning of the Biosphere" .

The term change in global change does not refer to the changes in biosphere processes, which are all dynamic and are always changing, but to the fact that it is the nature of these processes themselves that has changed. If the term change referred to states rather than processes, this concept would be trivial as its antonym, global constancy, does not exist, rendering the concept of global change a spurious one.



Human activity operates as the motor of global change through the combination of two forces, the growth in human population and the growth in per capita resource use, and the product defines the ever-growing increase in resource use by humanity

The dominant role of human activity in driving changes in these processes led Crutzen (2002) to propose the term *Anthropocene* to refer to the present era, where human activity has emerged as a dominant force controlling biospheric processes and driving global change.



WHAT CHANGES IN OUR OCEAN CAN WE ATTRIBUTE TO CLIMATE CHANGE?

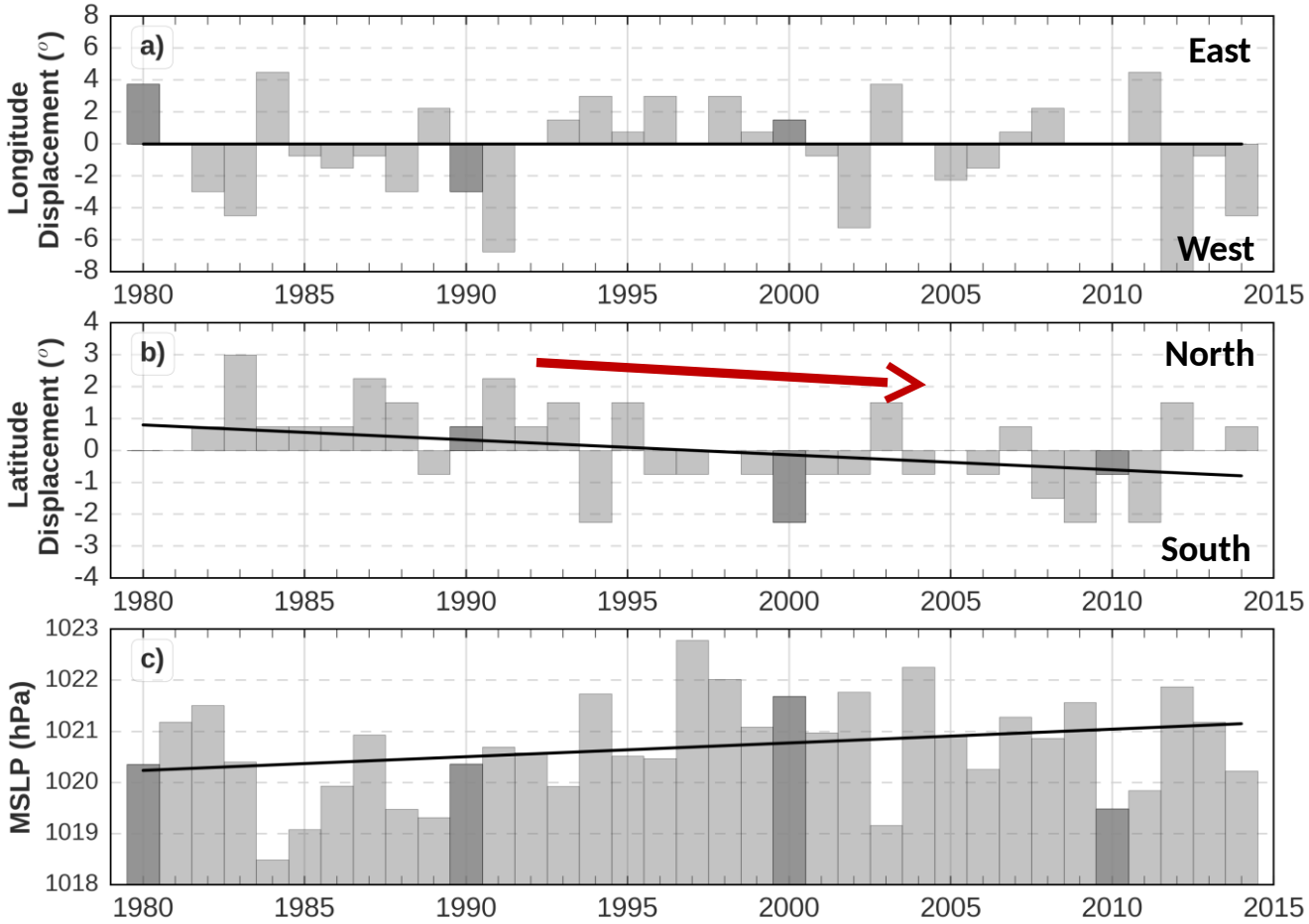
The Atmosphere over the South Atlantic

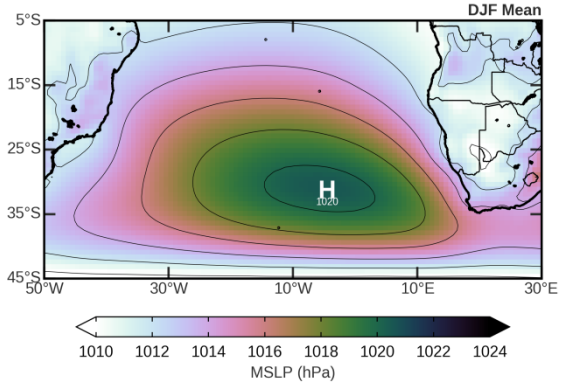
A synopsis on mean state, recent trends and projected change

By Ross Blamey, Fabien Desbiolles and Chris Reason

Department of Oceanography, University of Cape Town

FUTURE CLIMATE FOR AFRICA

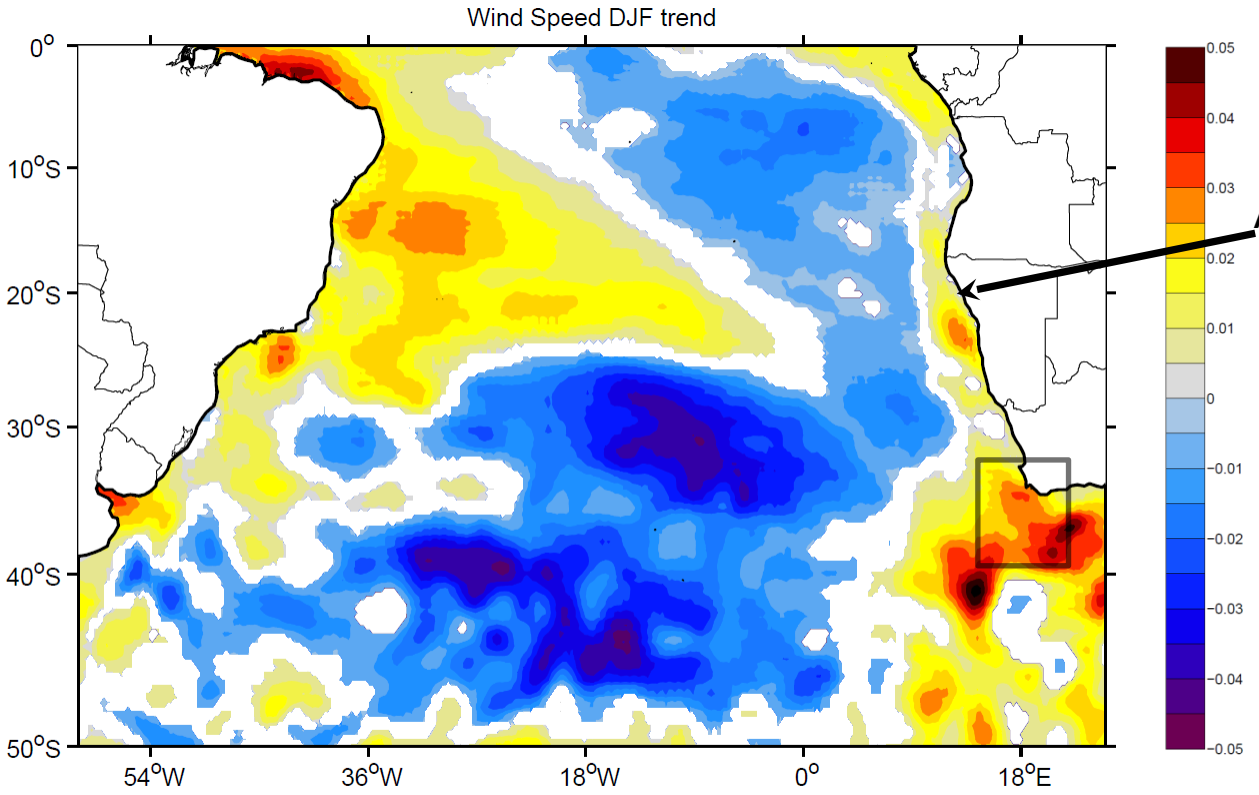




Changes in the South Atlantic High Pressure

(Top) The east/west displacement of the SAHP during the summer months (DJF) for 1980-2014 (no change evident). **(Middle)** the north/south displacement with the solid line showing the downward trend of -0.4° per decade. **(Bottom)** The maximum pressure value at the centre of the SAHP (increasing trend of 0.24 hPa per decade).

What does that mean for wind patterns along the West Coast?



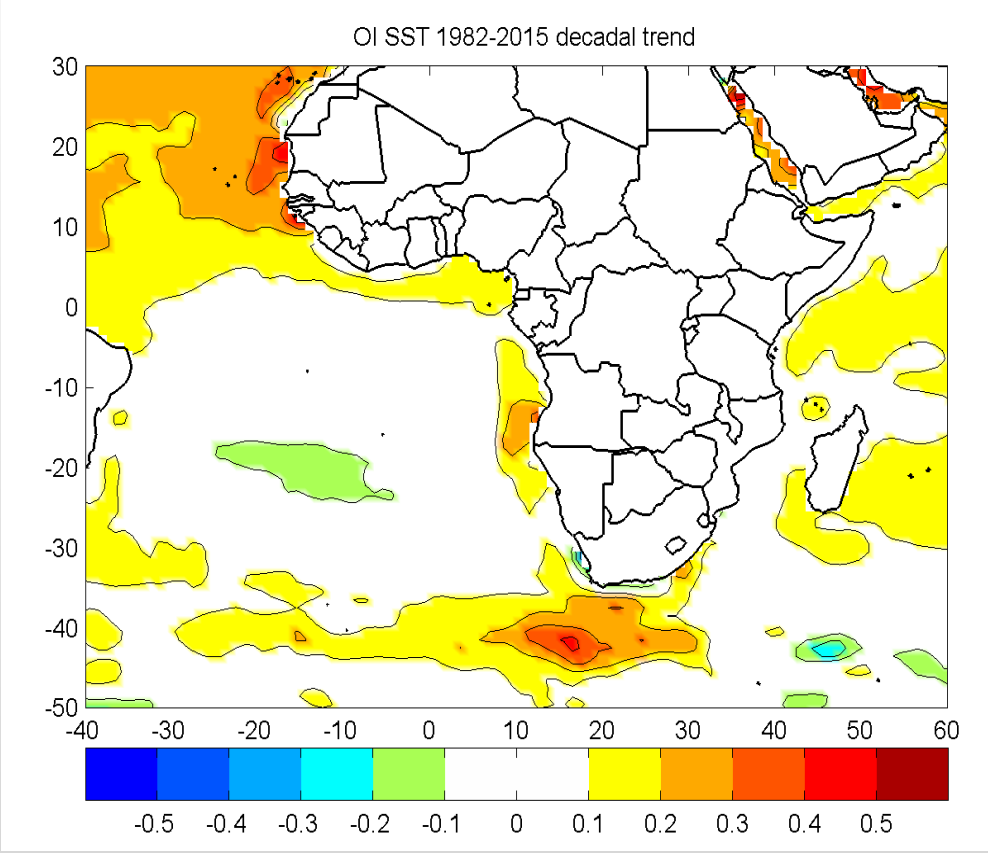
Summer wind speed trend over the South Atlantic derived from 20 years of satellite data

Implications for regional SSTs? – Coming up next in Mathieu's presentation

Ocean Climate Change and Variability in the Benguela Upwelling

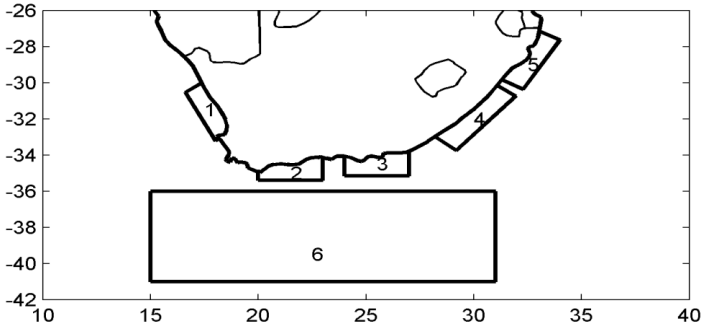
Mathieu Rouault

Nansen-Tutu Centre, Department of Oceanography, Mare Institute, University of Cape Town



Linear trend Reynolds OI Sea Surface Temperature 1982-2015 in C per decade
(updated from Blamey et al, 2015)

Funding from WRC, NRF, ACCESS, FP7 EU Preface project, Nansen Tutu Center, ESA.



1, West Coast

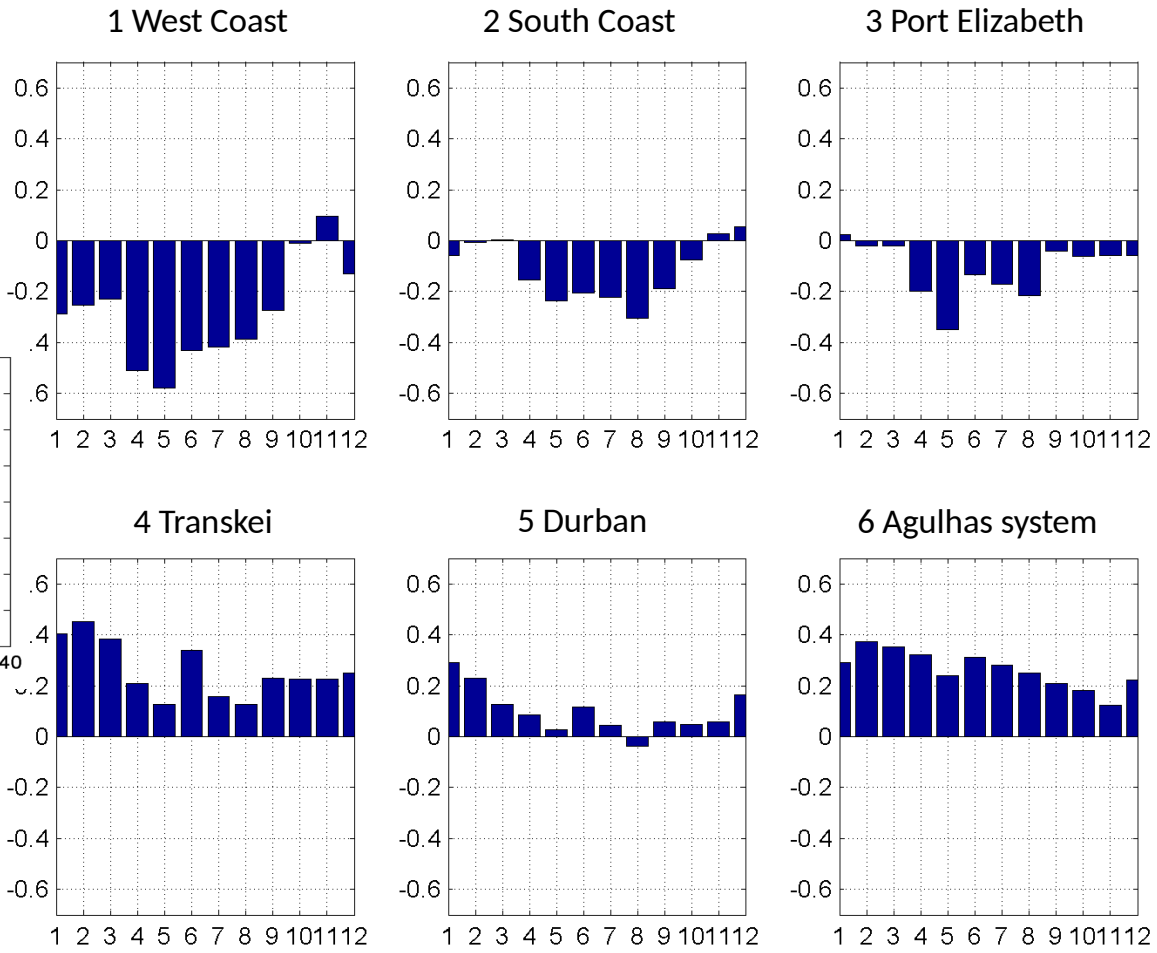
2, South Coast

3, Port Elizabeth/Port Alfred

4, Transkei

5, KwaZulu–Natal

6, Agulhas Current system



Linear trend in ℃ per decade for each month of the year from 1982 to 2016

Anything above 0.3 C and below - 0.3 C is statistically significant at 95 %

(updated from Rouault et al. 2010).

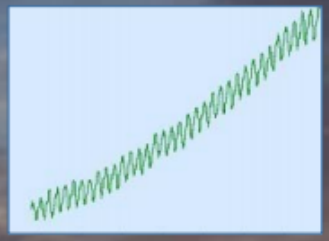
Warren Joubert

Ocean Acidification

South African Weather Service

ISO 9001 Certified Organisation

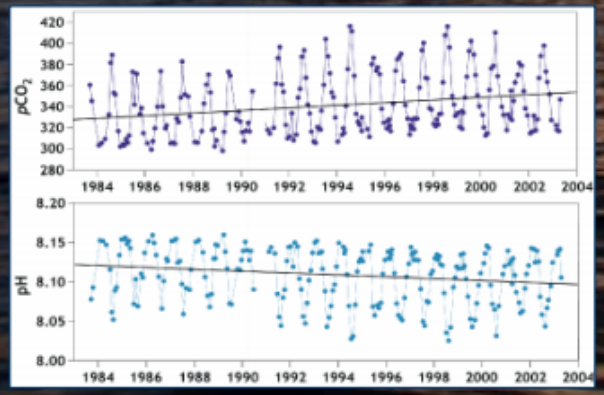
What is Ocean Acidification?



This is resulting in increased carbon dioxide (CO_2) in the atmosphere causing global warming

Mankind is burning fossil fuel

Oceans are vast and are taking up the CO_2

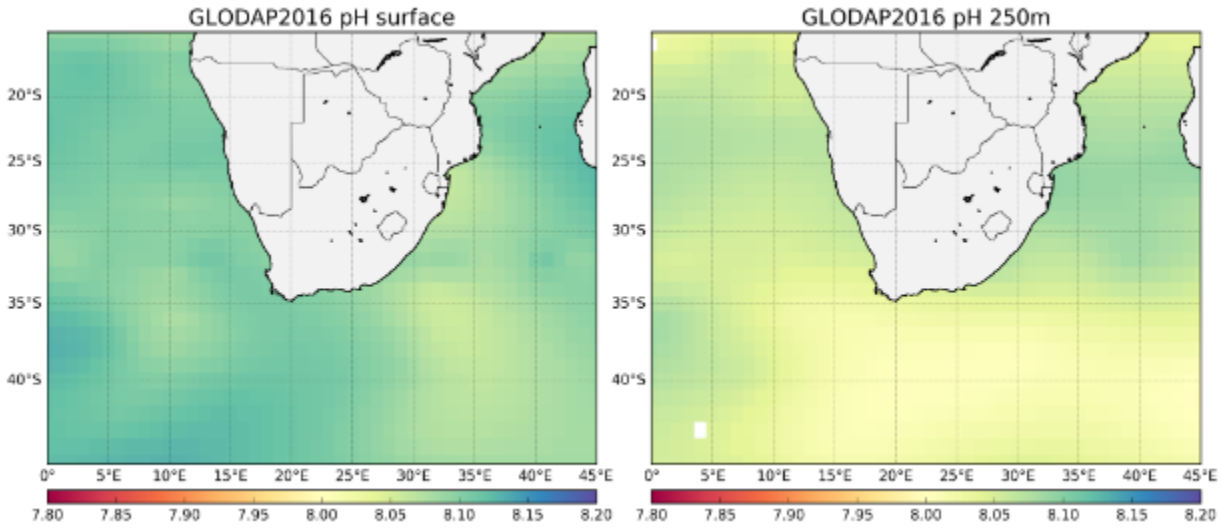


When CO_2 is added to water it becomes an acid…

…so the oceans have become 30% more acidic, lowering the pH of seawater

….by 2060 the oceans could become 120% more acidic

pH climatology South Africa



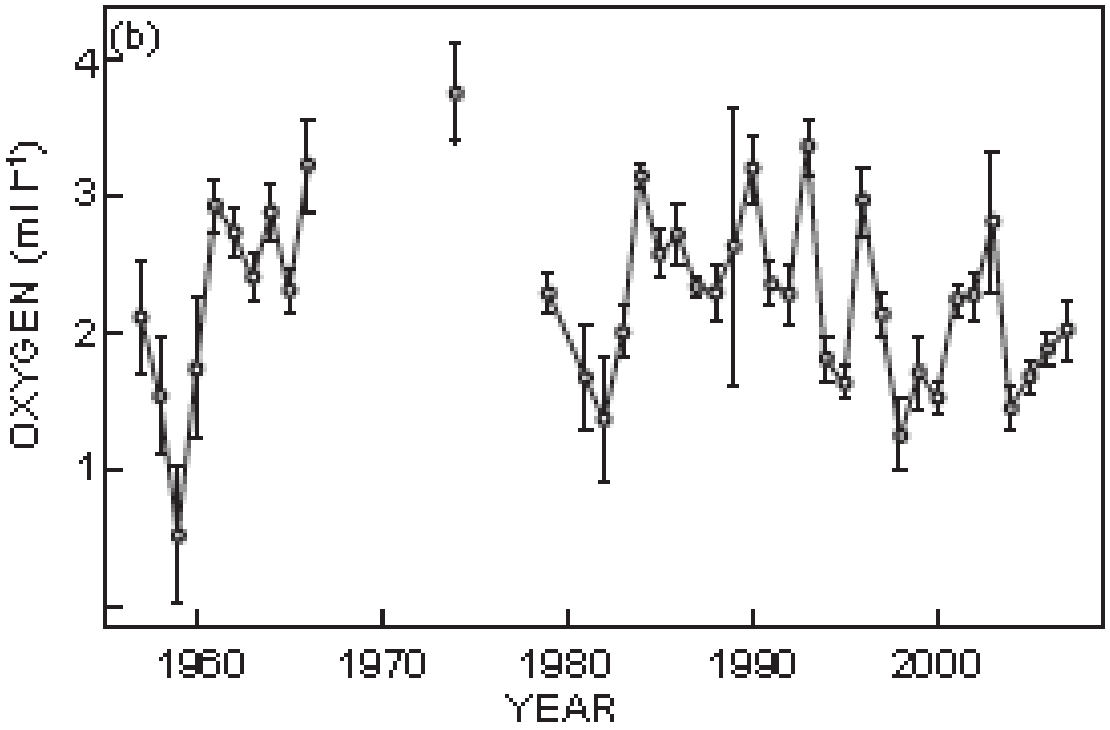
ARE OUR OCEANS CHANGING IN RESPONSE TO CLIMATE CHANGE

DEOXYGENATION OF SOUTH AFRICA'S OCEAN

GRANT C PITCHER

Workshop on Identifying and Coordinating Research as an Adaptation to Climate Change in the South African Marine Fisheries and Marine Aquaculture Sectors

Hutchings et al. 2012. St Helena Bay (southern Benguela) then and now: muted climate signals, large human impact. *African Journal of Marine Science* 34: 559-583

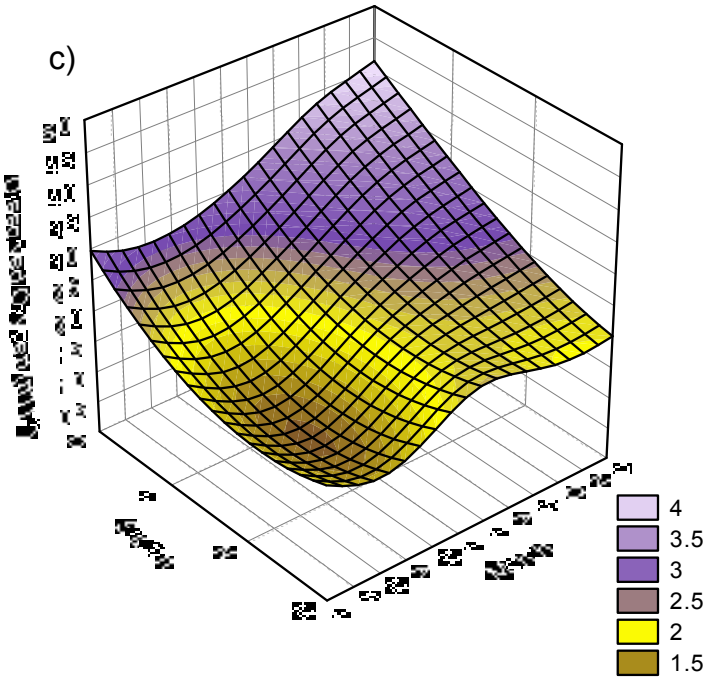


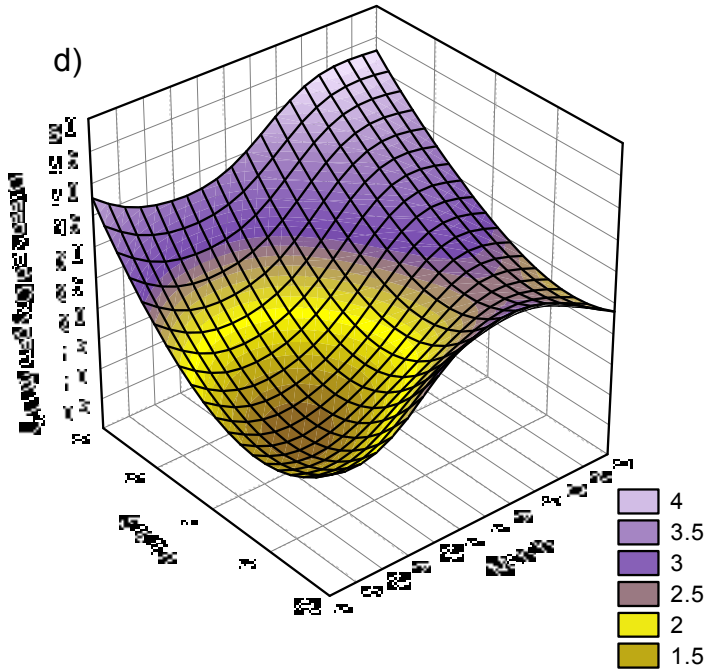
Presented entire time series of bottom O_2 concentrations from 1957 claiming decadal-scale variability with an increase from 1957 to 1975, followed by a long erratic decrease [updated from J. Currie, UCT, unpublished].

Three-dimensional plots of the 2 d
sets showing remarkable similarit
[both spatially and seasonally]
indicating an absence of any long
trend in bottom O_2.

Any differences are likely to be
attributed to the comparison of d
from different station positions ar
depths [e.g., the greater seasonal
evident in the recent data is a like
result of the inclusion of data from
shallower depth].

Pitcher et al. 2014. Dynamics of oxy
depletion in the nearshore of a coas
embayment of the southern Bengue
upwelling System. *Journal of Geophy
Research, Oceans* 119: 2183–2200





Are our oceans changing in response to climate change?

What **Ocean Colour** tells us about **phytoplankton variability**….

Tarron Lamont
Department of Environmental Affairs

Why monitor Phytoplankton?

Critical role in a number of key marine processes

- CO_2 exchanges
- Food web modulation
- Nutrient cycling
- Etc. etc.

Why use Ocean Colour measurements?

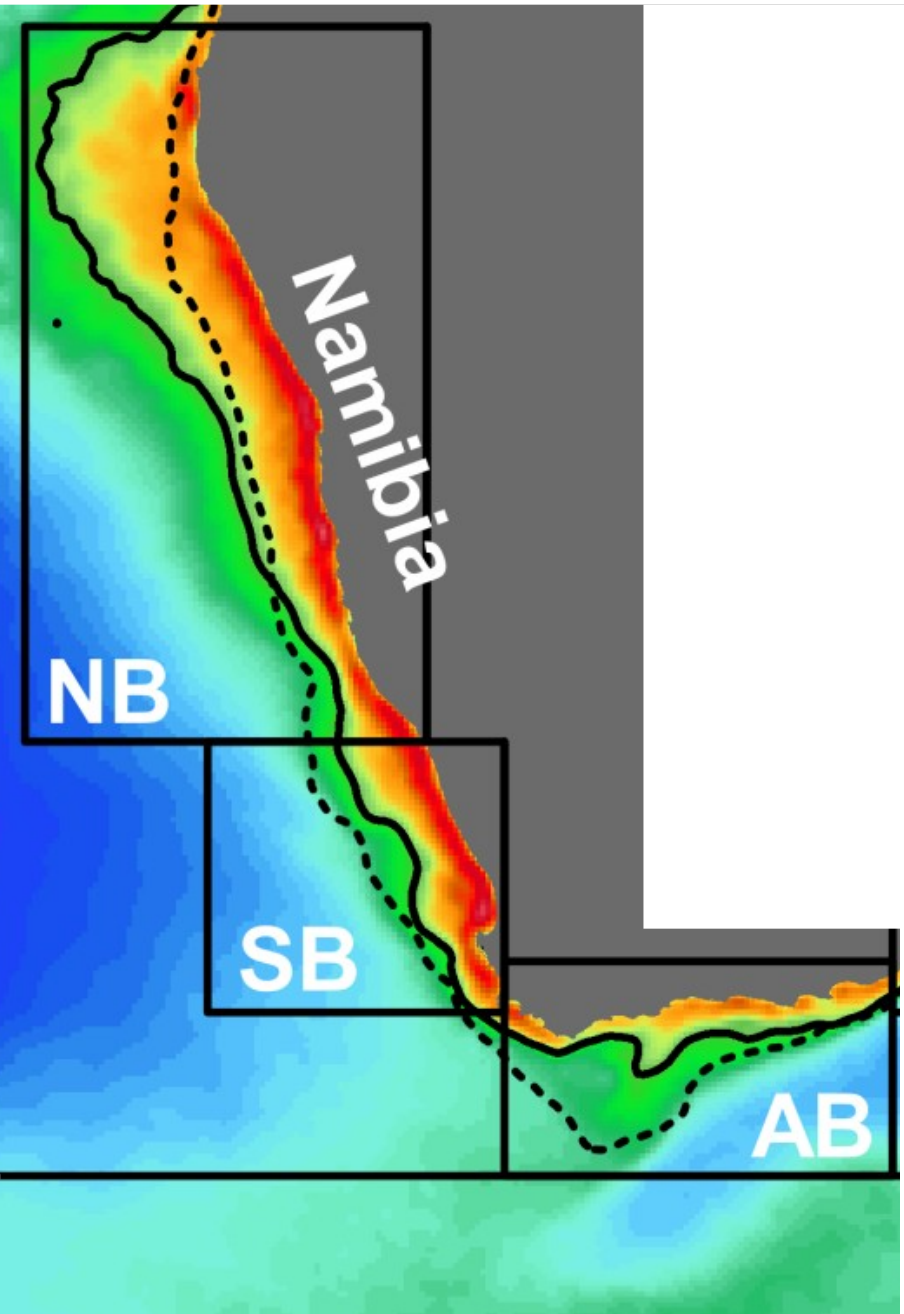
In situ measurements are

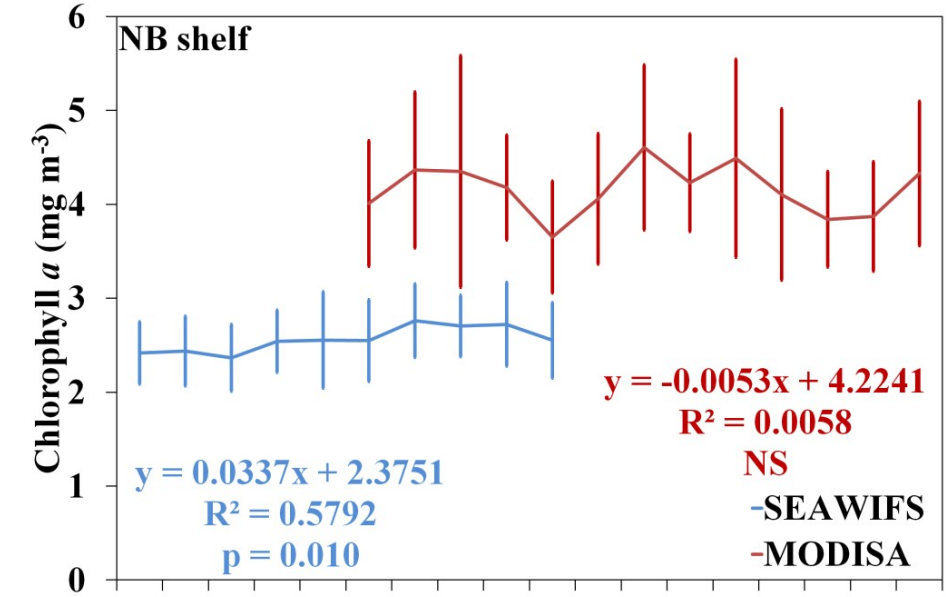
- Very expensive
- Time-consuming
- Spatially limited
- Temporally limited

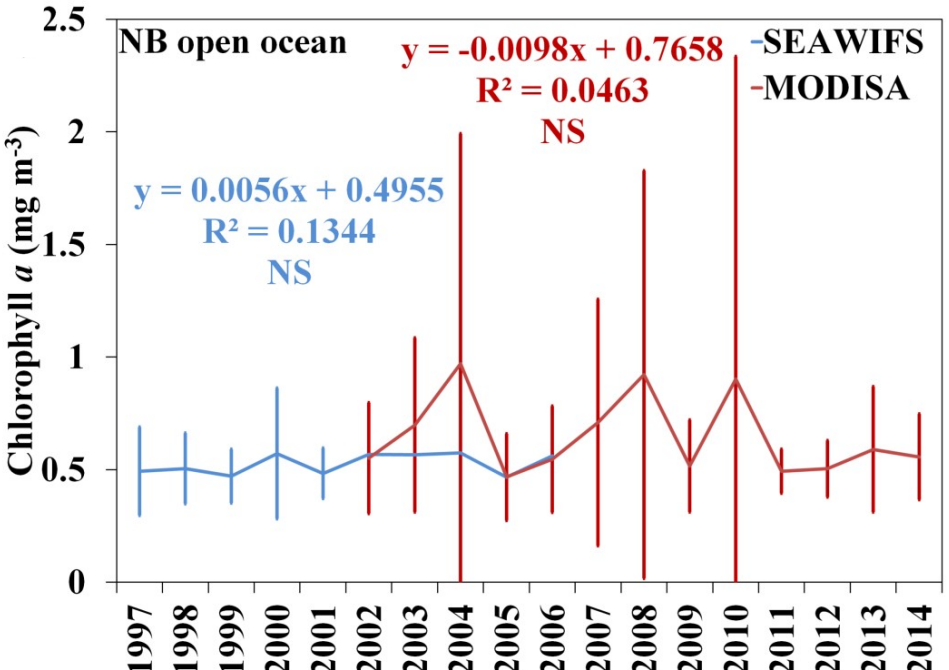
Many products besides biomass

CZCS (1978 – 1986)
SeaWiFS (1997 – 2007)
MODIS Aqua (2002 - present)
MODIS Terra (2000 - present)
MERIS (2002 – 2012)
ViRRS (2012 – present)

Temporal variations in biomass







So…what does Ocean Colour tell us?

Are our oceans changing in response to climate change?

Short answer: Nobody knows !!

Long answer: There is a lot of detailed information with many pros and cons

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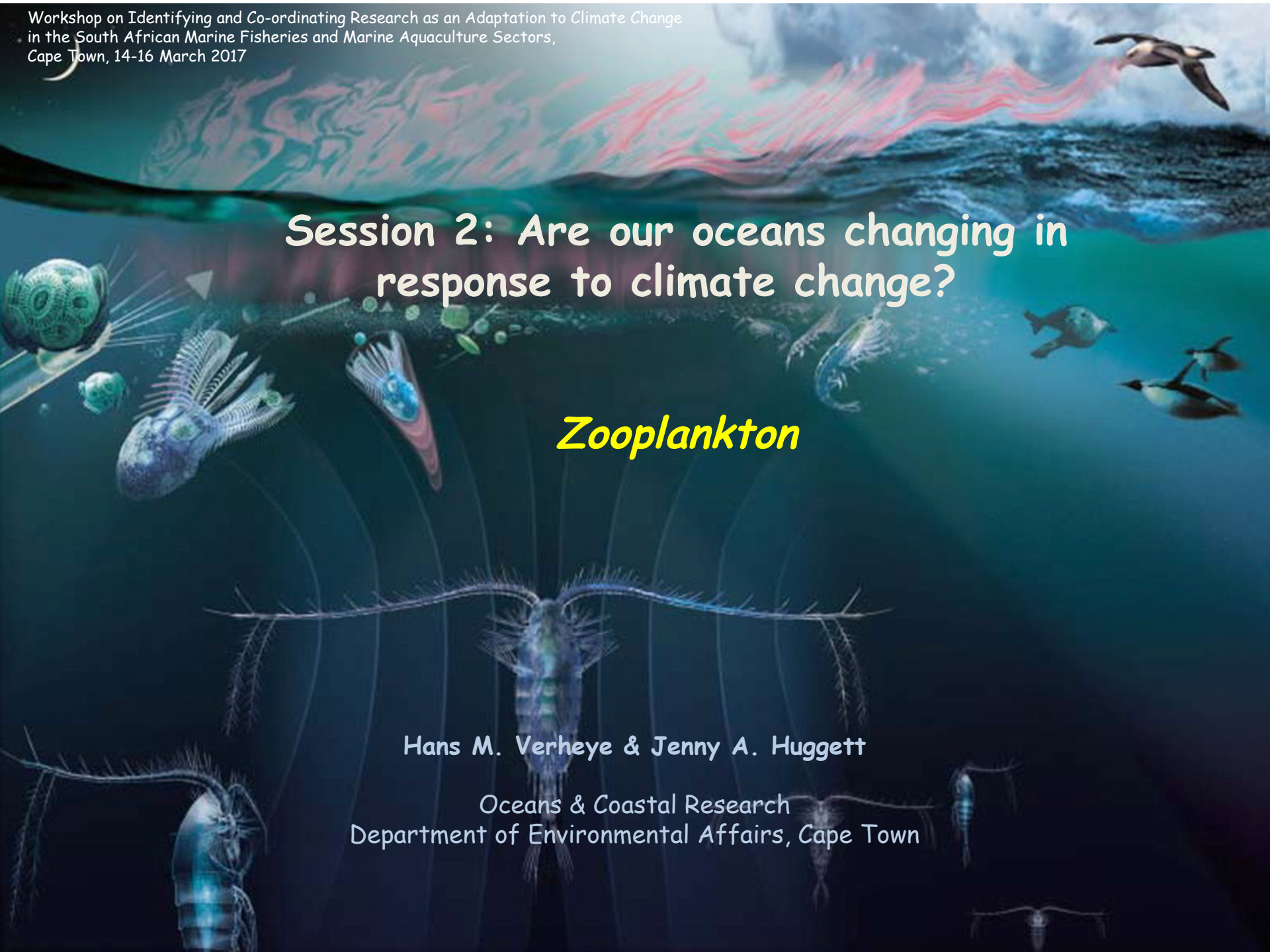
in the South African Marine Fisheries and Marine Aquaculture Sectors,
Cape Town, 14-16 March 2017



Session 2: Are our oceans changing in response to climate change?

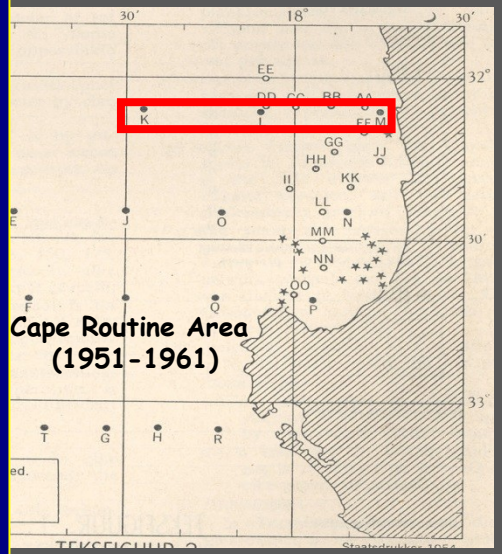
Zooplankton

Hans M. Verheye & Jenny A. Huggett

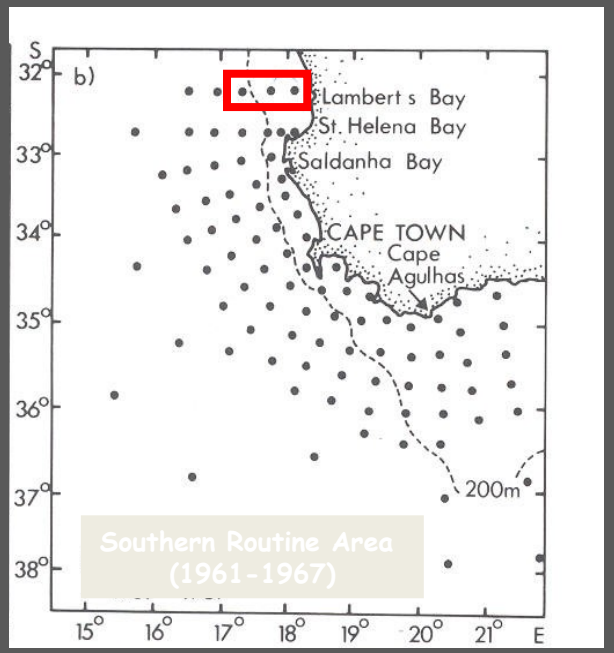
Oceans & Coastal Research
Department of Environmental Affairs, Cape Town

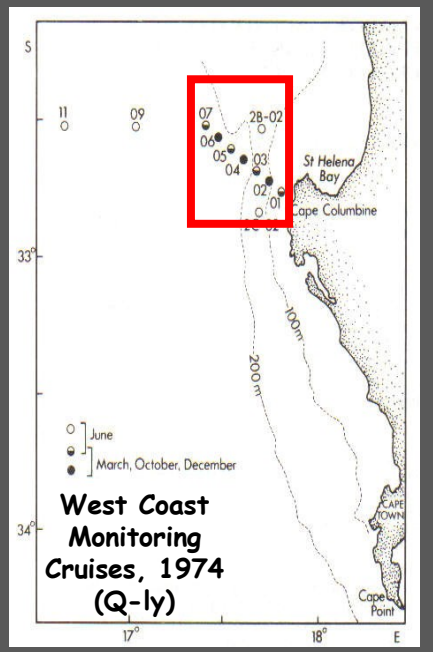
WEST COAST: St Helena Bay time-series

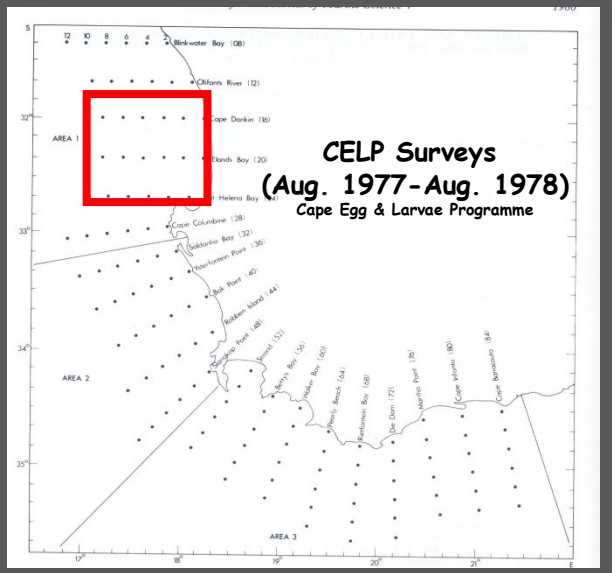
Long-term zooplankton time-series constructed from retrospective analysis of selected AUTUMN samples from 8 sampling programmes, 1951-2016

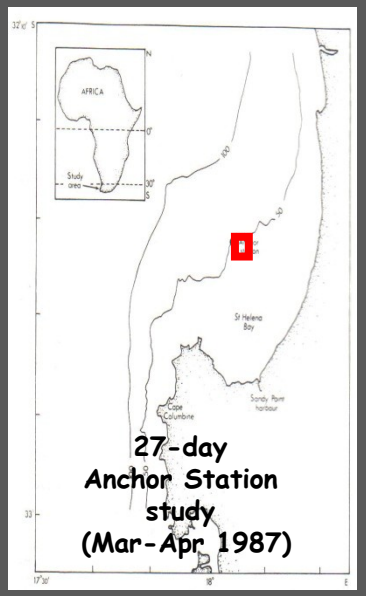


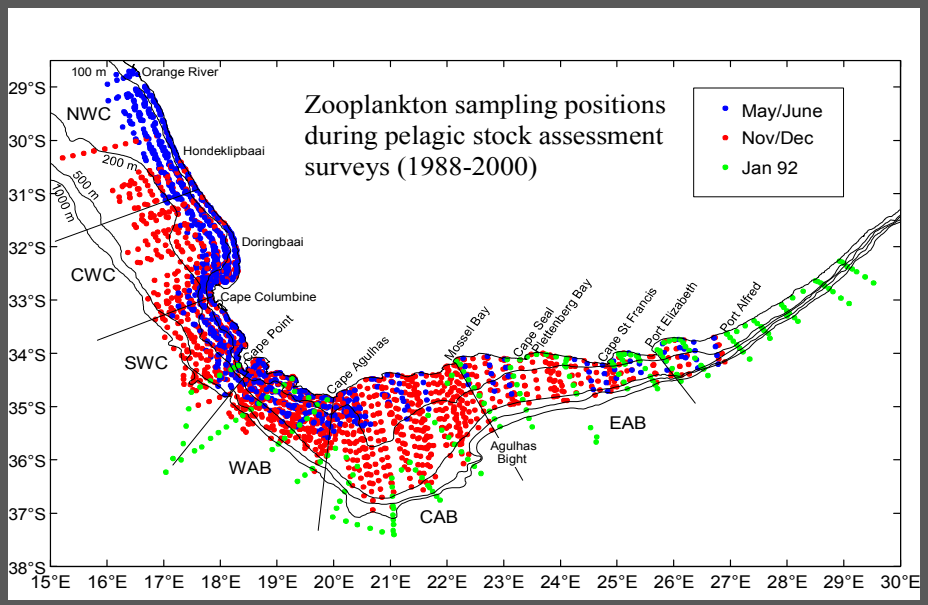
Minor methodological differences – accounted for

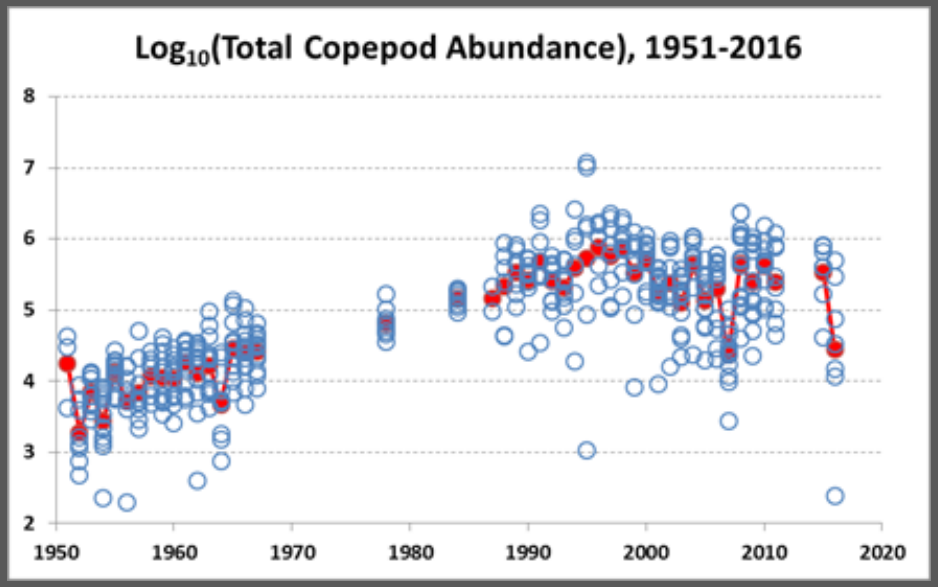






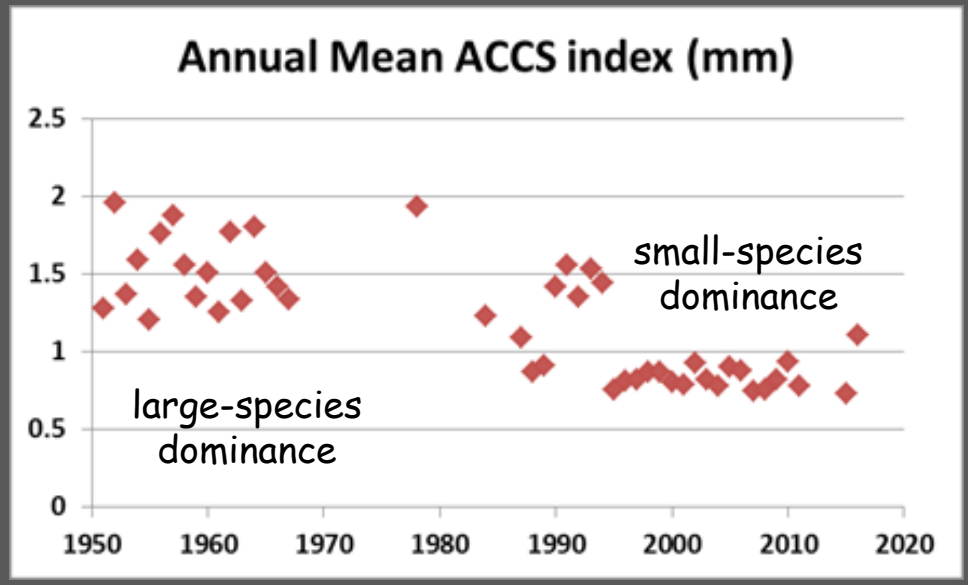






ACCS index (Average Copepod Community Size)

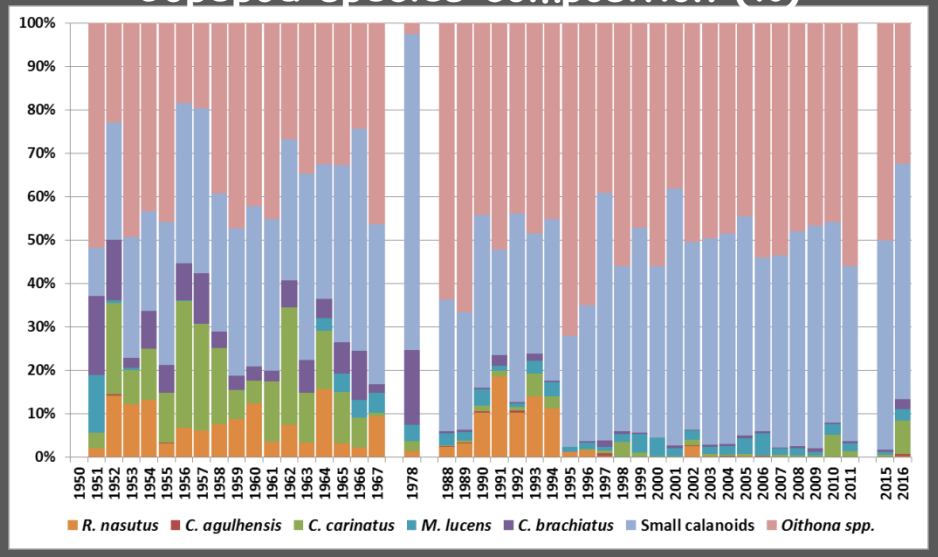
= zooplankton size index based on abundance and body length of adult female copepods (=weighted mean body size)



Shift in autumn copepod community size structure, from large-species (>1 mm; 1950s–1960s) dominance to small-species (<1 mm; mid-1990s–2000s) dominance

= usually indicative of ocean warming!!

Copepod species composition (%)



Body size: large spp. ✉ small spp.

IS OUR OCEAN ENVIRONMENT CHANGING IN RESPONSE TO CLIMATE CHANGE

ANSWER REQUIRES: sustained accurate measurements at the required temporal and spatial scales to identify long-term trends against a background natural variability.

	APPROPRIATE DATA [score /5]	ESTABLISHED A RESPONSE TO CC
TEMPERATURE	3	POSSIBLY
PH	0	NO
OXYGEN	2	NO
PHYTOPLANKTON PRODUCTION	2½	NO
HABS	2	NO
ZOOPLANKTON PRODUCTION	2½	NO

DATA ISSUES: length of data sets; required scales [absence of systematic sampling]; changes in technology and methods; use of proxy measurements; discontinued data collection; poor understanding of variability [natural variability, short-term variability, growing uncertainty progressing from CC to ocean response to biological impact]; little attempt to look back in time.

WHY ARE WE NOT DOING BETTER?

No plan;
No leadership or communication;
No vision;
No vehicle;
No co-ordination [efforts are fragmented];
Data bases [data availability] inadequate;
Models found wanting [regional models];
No designated funding.

WAY FORWARD

Make a plan