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Agulhas & Somali Current Large Marine Ecosystems Project

6th GEF International Waters Conference
Special Session on Translating Science into Management and Governance

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Developing National and Regional Mechanisms for Linking Science and Governance for More Effective Long-term Ecosystem Management

Exploring the case of the western Indian Ocean LMEs as an example

The Governance and Policy Needs in LMEs

Management of Marine Ecosystems requires accurate knowledge upon which to base decisions (including ‘best assessments’ of trends and predictions)

It then needs effective resources to implement those decisions

So Policy Makers need to prioritise country actions for effective management both in terms of:

A. Available knowledge and

B. Available resources

This Management and Policy approach needs to be adaptive to capture the inputs from changing/improving information and prediction

The Linkages between Science and Governance

So, scientific data and knowledge are essential to guide and advise management and policy

Yet equally, managers and policy-makers need to better define the information that they need (scientific) and what are their priorities

In order for this relationship to be effective there needs to be a better understanding by the 'Users of the Information' of the implications of scientific results/conclusions BUT…

There also needs to be sensitivity and pragmatism in terms of guidance given to policy-makers that is realistic in its understanding of wider policy issues and resource constraints

The Science-to-Governance Process

Exploring the requirements and mechanisms that may be able to bridge the disconnect between Science, Management and Governance

A Science-to-Governance Round-Table

In June 2011, the ASCLME project along with its partners in SWIOFP and IUCN organised a Science-to-Governance Roundtable in Grahamstown South Africa. The purpose of this roundtable was

1. To view a selection of predictive 'cutting edge' scientific presentations that reach some specific conclusions identifying implications for management and policy
2. To discuss the conclusions of these presentations and their implications for potential management decisions and policy realignment
3. Emphasis should be on political and socioeconomic pragmatism as much as scientific principle
4. To develop some guidelines for an effective mechanism for translating scientific analysis and knowledge into management and policy decisions

The long-term objective was to review and fine-tune the conclusions and management advice from these presentations and to take them to the First Policy Advisory Committee for the western Indian Ocean LMES and discuss the mechanism and approach with policy-makers (PS and DG level)

Any final mechanism that is adopted down the road should be built into the Strategic Action Programme for the WIO LMEs

The Presentations

- On the Recent Warming of the Indian Ocean: Mathieu Rouault
- Eddies and Productivity in the Mozambique Channel: Mike Roberts
- Impacts of Climate Change/Variability to Coral Reefs and its Effects on Fisheries and Tourism: David Obura
- Ports and Ballast Water & Impacts to Human Society: Adnan Awad
- Integrated Spatial Planning for MPAs: The Case of Planning for a Network of MPAs in the WIO Islands: Remy Ratsimbazafy
- Linking science to Fisheries Management: The Case of Tuna and the IOTC Decision-making Process: Rondolph Payet

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The Objective of this Session

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Similar to the first Experimental Round-Table in South Africa, we would like to explore the problems and issues with an audience consisting of regional and global experts on LMEs, management and governance. The aim is to:

A. Review and consider the global LME management concerns and relate this to some cutting-edge science from the WIO region that shows a need for urgent management considerations
B. Discuss the implications of this science in terms of management needs and policy decisions that need to be made in order to mitigate or adapt to predicted changes
C. Refer the discussion to a panel of experts (country managers and decision-makers, agency leaders, IGO executives, etc)
D. Encourage a direct interaction between the LME and IW experts throughout the room with the panel
E. Attempt to arrive at some conclusions in terms of a way forward (including challenges, constraints and innovations) that would allow the ASCLME region to pilot a science-to-governance process that may act as a best-practice and be replicable elsewhere in the IW community

Phase One of the Session

A. Review and consider the global LME management concerns and relate this to some cutting-edge science from the WIO region that shows a need for urgent management considerations

As it would have been impractical and costly to bring to IWC 6 the original scientists who gave their presentations on cutting-edge issues and discoveries back in Grahamstown last June, we have abbreviated their presentations (with their assistance and approval) and also added one or two more that were proposed since

Any mistakes in representation are ours but please see this process as one that aims to provoke responses in terms of management decisions and policy rather than as scientific presentations in their own right although we will be happy to discuss the science and its implications where possible

Climate Change and its Effects on LMEs

- Sea-Level Rise
- Sea Temperature Changes
- Ocean Acidification

Changes within Large Marine Ecosystems

Marine ecosystems are already showing signs of anthropogenic impacts including those from climate change

These include:

- Range shifts, with species moving both polewards and to deeper waters
- Changes in water column stratification and significant de-oxygenation
- Increased frequency of harmful algal blooms
- Shifts in species composition in phyto/zooplankton communities (mainly large to small individuals) and changes in diversity and species richness of fishes
- Species acting as 'invasives' creating negative ecosystem impacts
- Regions with naturally high environmental variability appear to be equally vulnerable to change and are not necessarily pre-adapted
- Changes in fisheries distribution and associated fleet structure and operations
- Management implications for harvesting of 'shifting biomass', especially across jurisdictional boundaries
- Synergistic effects such as increased frequency of extreme events and temperature changes may prevent biomass rebuilding after a reduction in fishing effort

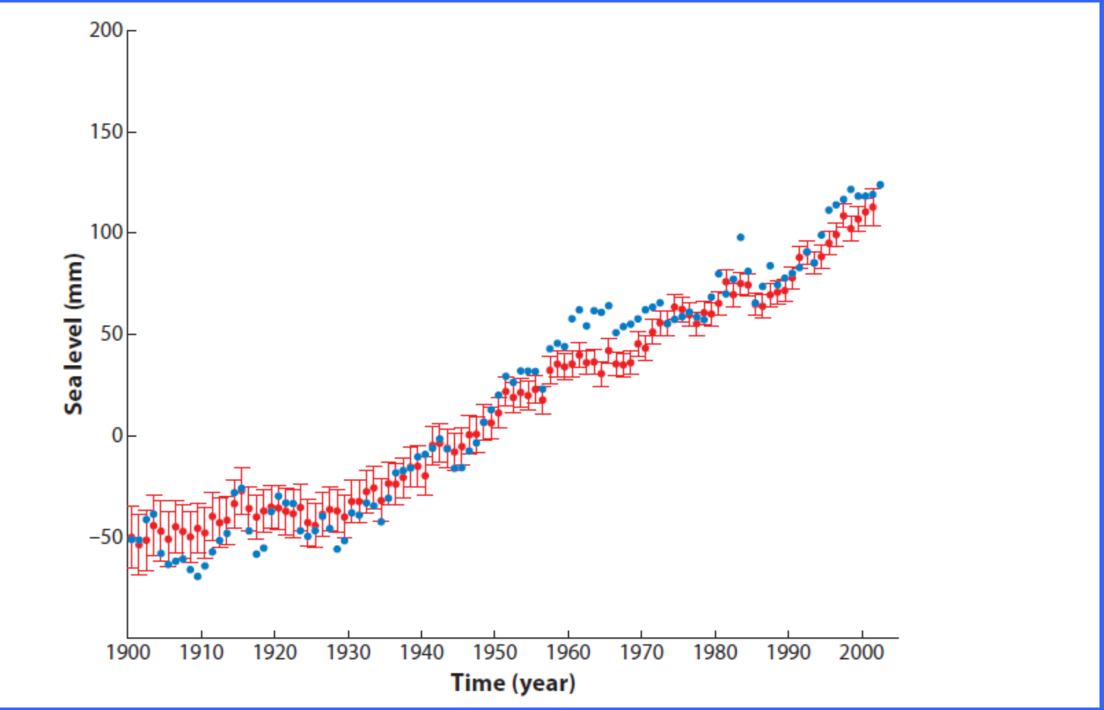
Global Sea Temperature Rise

Aside from thermal expansion, increasing sea temperatures will likely:

- Result in shifts in ecosystems as thermal tolerance ranges in a warming ocean change the distributions of species. This has already been observed in a number of areas with range expansions of tropical species; range contractions of temperate and cold water species.
- Increase the risk, frequency and severity of coral bleaching.
- Ocean warming has occurred from the surface to a depth of about 700 meters, the zone in which most marine life thrives.
- May increase the threat from invasive species.
- Agulhas Current (particularly within the Mozambique Channel) and SW Madagascar regions are warming particularly fast relative to global mean increases (“hotspots”).

Global Sea Level Rise

Observed global mean sea level (from tide gauges) between 1900 and 2001



Since 1980's it is about 3.5 mm per year globally. This has been confirmed by altimetry measurements since 1991. Global Sea level rise is now faster than predicted.

N.B. although the mean trend is 3.5 mm per year, this rise in not globally uniform

A trend of up to 10 mm per year is apparent around a number of Indian Ocean Islands

From Cazenave, A., and W. Llovel. 2010. Contemporary sea level rise. *Annual Review of Marine Science* 2(1):145-173

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Ocean Acidification: “The Other CO_2 Problem”

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The oceans have absorbed approximately half of all anthropogenic CO_2 emissions in the past 200 years (Sabine *et al.*, 2003)

The rate and scale of changes in pH are unprecedented and may be beyond the ability of some species to acclimate/adapt/survive. (e.g. Dupont *et al*., 2008)

Model calculations indicate a fall of 0.1 pH since pre-industrial times at the current 380 ppm CO_2 level. Increasing levels are expected to result in further decreases of 0.3-0.5 pH by 2100

Changes in acid-base status will almost certainly exacerbate the effects of climate change on marine species, particularly on “lower” invertebrates, further reducing their geographical distribution (Pörtner, 2008).

This effect is not limited solely to calcifiers as physiological effects of a higher pCO_2/low pH ocean are systemic throughout life history stages – and even more poorly understood in non-calcifiers than calcifiers. e.g. the responses of fish to higher pCO2 are poorly understood (Kurihara, 2008)

Sea Level Rise: Effects on Africa

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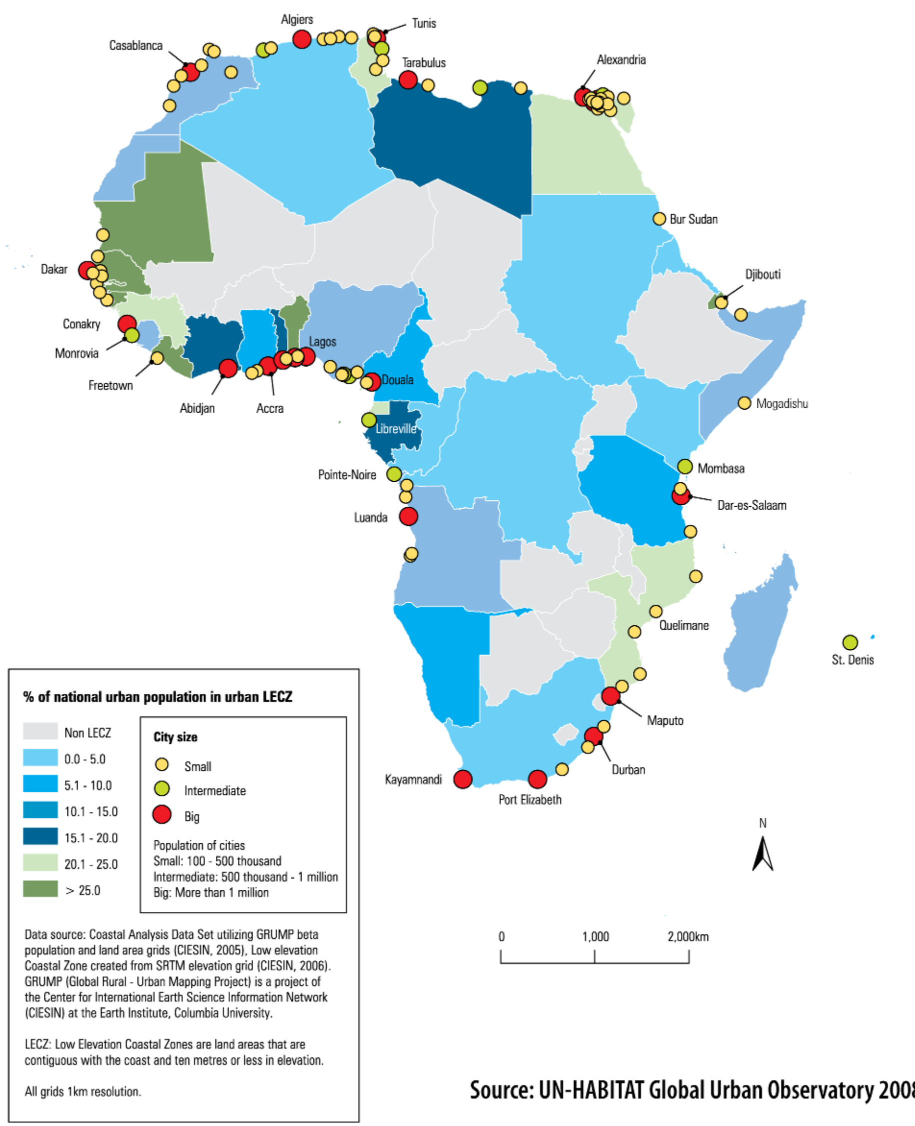
AFRICAN CITIES AT RISK DUE TO SEA-LEVEL RISE



Source: UN-HABITAT Global Urban Observatory 2008

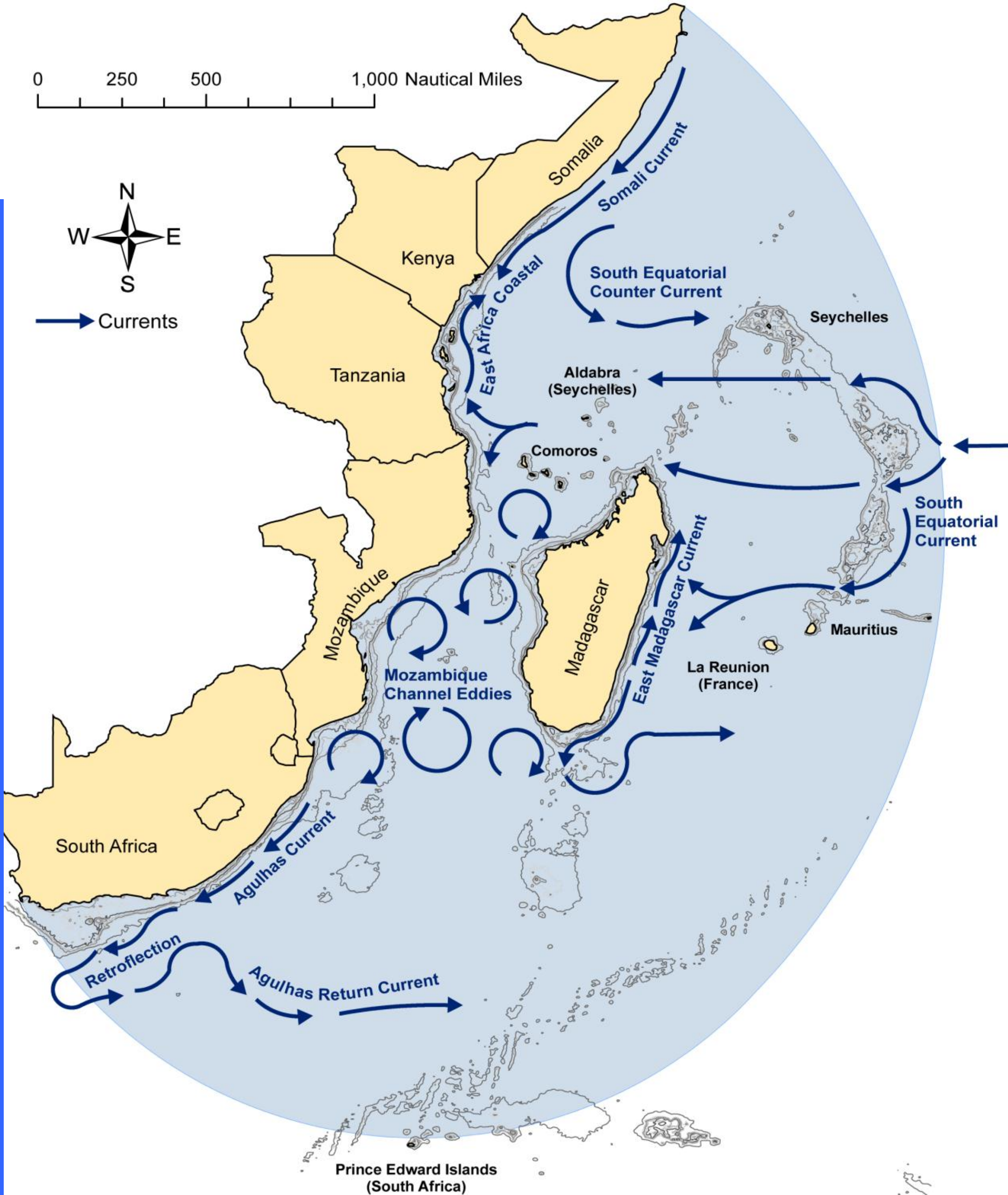
- Many important coastal cities are low-lying
- Mozambique considered to be at high risk
- SIDS also particularly vulnerable
- What happens to important habitats like mangroves, coral reefs & seagrasses (and low lying coastal wetlands)?

Climatic and Ecosystem Variability

- How are climate change, variability and associated extremes manifesting themselves in the WIO LMEs?
- What is driving the changes?
- How does this translate into ecosystem variability and impacts?

The ASCLME Project in the Western Indian Ocean

How is Climate Change manifesting itself here?



Effects of Climate Change on the western Indian Ocean and its LMEs

The El Niño Southern Oscillation (ENSO)

El Niño and La Niña are the respective warming and cooling of sea-surface temperatures in the equatorial Pacific Ocean which influence atmospheric circulation, and consequently rainfall and temperature in specific areas around the world

Effects of ENSO's warm phase (El Niño) on southern Africa and WIO:

- Drier than normal conditions in Southern Africa and wetter than normal conditions over equatorial East Africa (from December to February)

Effects of ENSO's cool phase (La Niña) on southern Africa and WIO:

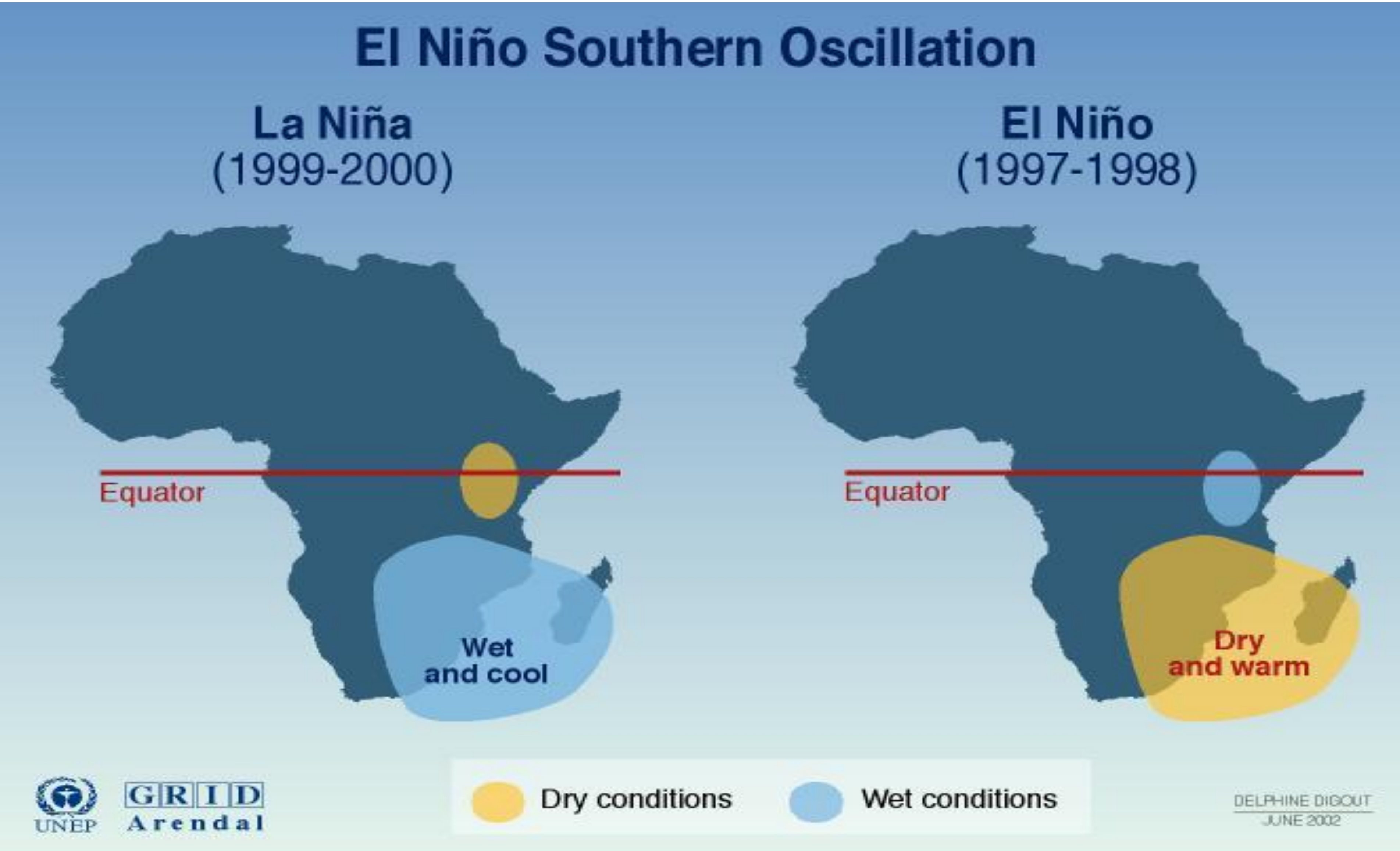
- Wetter than normal conditions in Southern Africa and drier than normal conditions over equatorial East Africa (from December to February)

During the last several decades the number of El Niño events have increased, and the number of La Niña events decreased

The question is whether this is a random fluctuation or a normal instance of variation for that phenomenon, or the result of global climate changes towards global warming

The answer is that we need more observations and targeted data collection

Effects of Climate Change on the western Indian Ocean and its LMEs



Sources: Climate Prediction Center-NCEP.

ENSO Impacts on Southern Africa

ENSO is the most dominant perturbation responsible for inter-annual climate variability over eastern and southern Africa.

The 1997-1998 ENSO events resulted in extreme wet conditions over eastern Africa while the 1999-2000 is thought to have caused devastating floods in Mozambique

Humans have adapted to patterns of climate variability through land-use systems that minimise the risk, and through agricultural calendars closely tuned to typical conditions and choices of crops and animal husbandry that reflect the prevailing conditions

Rapid changes in this variability could severely disrupt production systems and livelihoods, leaving little room for adaptation

(2011 – UNEP/GRID- Arendal)

ENSO Prediction in the WIO region

Scientists are still not able to predict spatial patterns of impacts with certainty sufficient to allow adaptive responses to be developed. However, it is clear that the oceans play an important role in affecting rainfall across the WIO and southern/eastern Africa

Consequently, sea surface temperatures are believed to be a key indicator for monitoring drought and heavy rain conditions in this region

The Indian Ocean Dipole

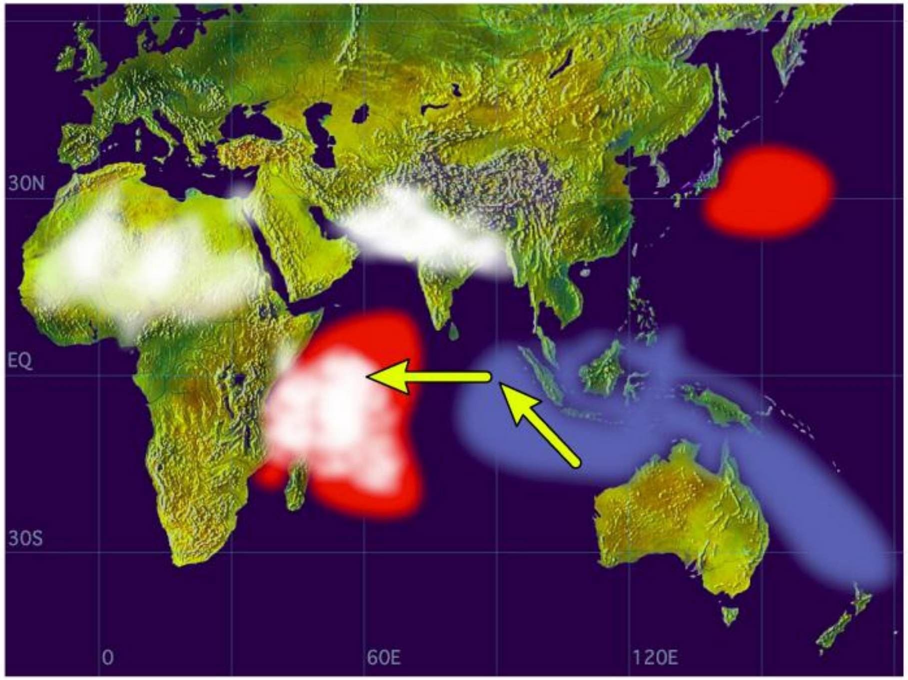
The Indian Ocean Dipole (IOD) is an oscillating coupled ocean-atmosphere phenomenon in the Indian Ocean whereby warm and cool surface waters at either side of the Indian Ocean periodically swap places

It is normally characterized by anomalous cooling of SST in the south-eastern equatorial Indian Ocean and anomalous warming of SST in the western equatorial Indian Ocean

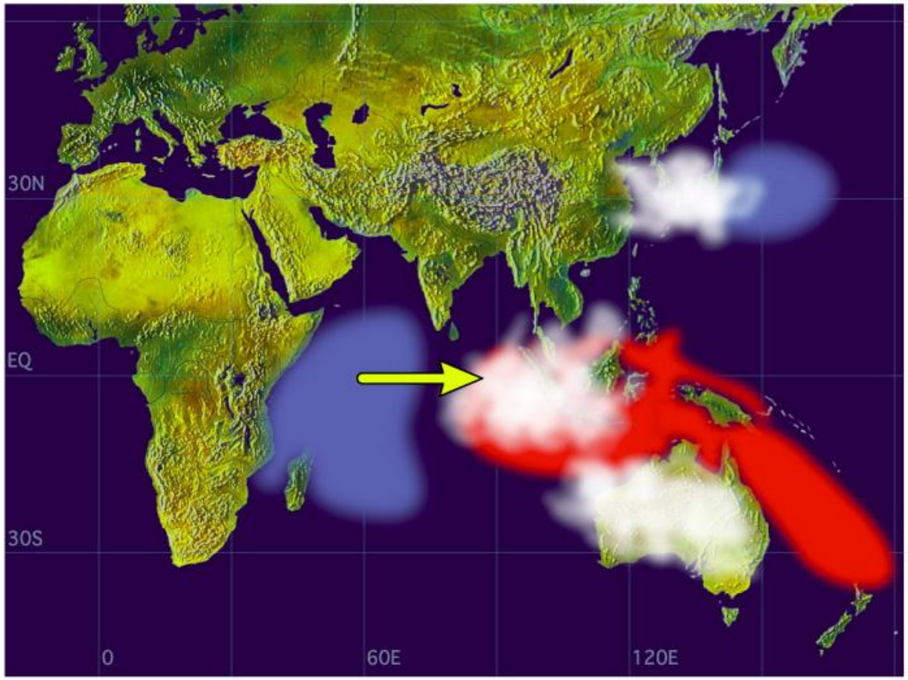
Associated with these changes, the normal convection situated over the eastern Indian Ocean warm pool shifts to the west and brings heavy rainfall over east Africa and severe droughts and forest fires over the Indonesian region.

Effects of Climate Change on the western Indian Ocean and its LMEs

Positive Dipole Mode



Negative Dipole Mode



Red = SST warm anomalies. Blue = SST cold anomalies

White patches indicate increased convective activities and arrows indicate anomalous wind directions during IOD events

(After JAMSTEC 2001)

Impacts from the Indian Ocean Dipole

Convection (heat transfer) over the eastern and western Indian Ocean during the monsoon behaves like a seesaw; enhancement of one is associated with the suppression of the other

During ‘positive’ Dipole events, there is a tendency for increased rainfall in the tropical eastern Africa and WIO region and drought in Indonesia

Recently there have been far more positive events and far less negative dipole modes than recorded in the past

The variability of east African rainfall has a profound impact on the livelihoods of millions of people in the developing countries in the WIO region, who mainly depend on rain-fed agriculture and regional fisheries

The Impact of IOD on the climate of the entire Indian Ocean and bordering countries is significant and, therefore, it is absolutely necessary that the scientific community be able to forecast its evolution well in advance

(after P N Vinayachandran *et al*. ’Current trends in Science’, 2009)

Effects of Climate Change on the western Indian Ocean Sea Temperatures

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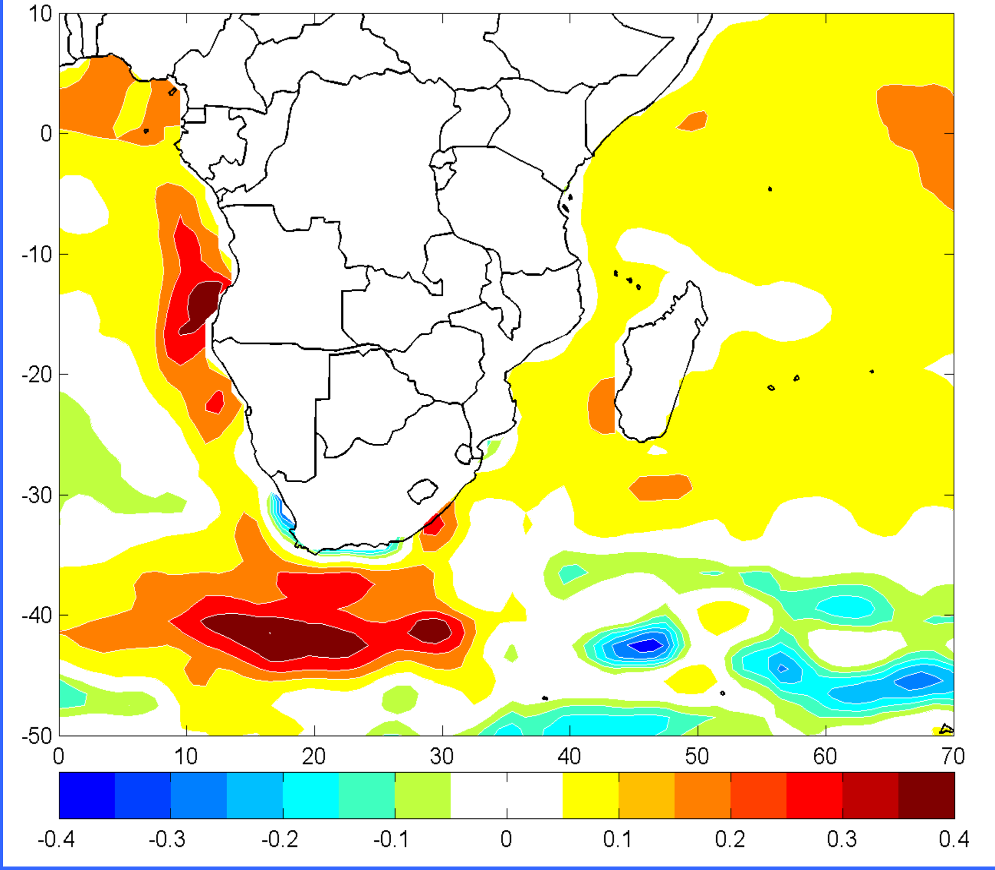
The Oceans have absorbed most of the heat that has resulted from man-made greenhouse gases and this has tended to mitigate global warming to some extent. However, it is now believed to be leading to changes in the overall global climate system as well as regional climates and associated ecosystems

The Indian Ocean has experienced some of the strongest warming globally (up to 1º C increase since 1950)

Work undertaken in the WIO region during the ASCLME project has shown that the Agulhas Current has significantly warmed by up to 1.5º C since the 1980s (Rouault *et al*. 2011. Univ. of Cape Town)

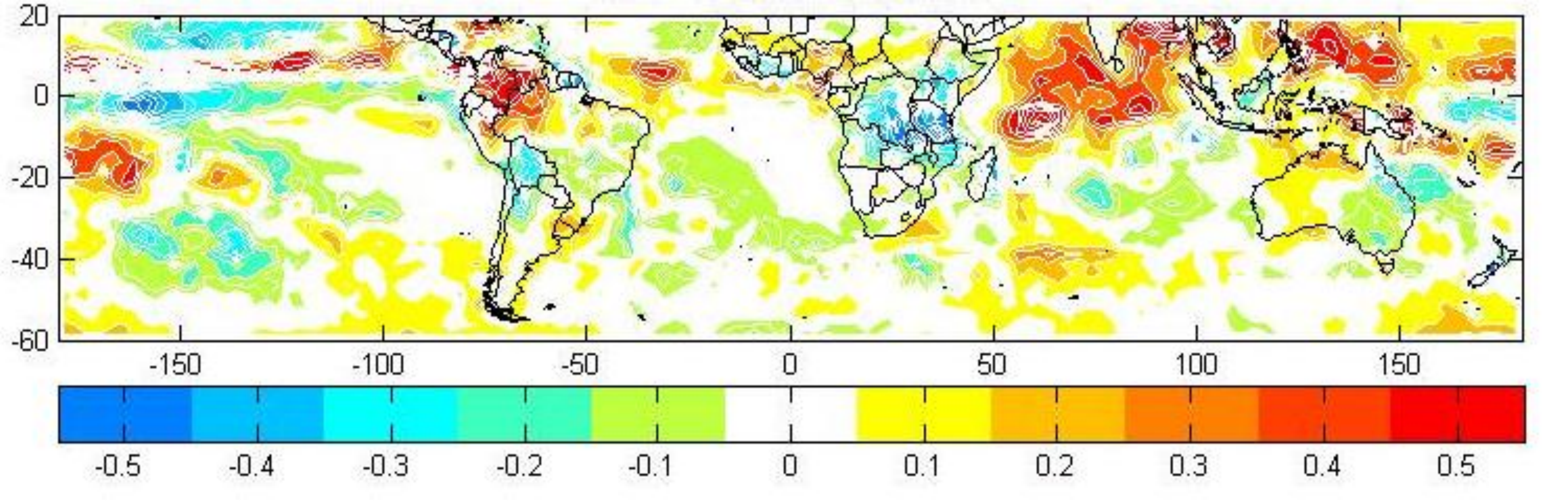
Linear trend in SST since 1982 in C per decade



Rouault *et al*. provide evidence that this warming is due to an intensification of the Agulhas Current system in response to increase in trade wind in the south Indian Ocean

Effects of Climate Change on Rainfall in the Indian Ocean

1979-2009 linear trend (mm/day per decade) in rain rate using 2.5 x 2.5 degree resolution rainfall data estimated from satellite remote sensing



Rouault *et al*. also note that a substantial increase in rain fall has been recorded above the Indian Ocean between 15º N and 15º S

They also concur that this is the cause of an observed decrease in rainfall over east Africa

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Translating the Trends into Ecosystem Variability and Impacts – the South African Scenario

Sardine, anchovy, west coast rock lobster and horse mackerel have shifted their distributions southwards and eastwards (van der Lingen *et al.* 2006; Cockcroft *et al.* 2008)

In the 1980s and 1990s, anchovy and sardine were concentrated on the west coast (Barange *et al.* 1999). However, in 1996, anchovy spawners shifted in distribution from the western Agulhas Bank to the central and eastern Agulhas Bank (van der Lingen *et al.* 2002).

By 1999, the proportion of sardine biomass located to the east of Cape Agulhas exceeded that on the west coast, and by 2004, sardine were found solely in the east (van der Lingen *et al.* 2005)

In effect, it seems like a critically important LMR may be moving from one LME (BCLME) into another (ASCLME)

This begs the question of how these climate variations and changes might actually be effecting the very boundaries and definitions of the LMEs themselves

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Coming in to Land

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Some of the Effects of Climate Change may be driven from the Oceans but they are far-reaching






Estimated Climate Change Damage to Crops in South Africa by 2050

Predicted cost of crop damages and loss to South Africa in next 40 years if no action is taken to curb and reduce climate change impacts

CROP	RANGE OF LOSS	CERTAINTY
Maize	$6-100 million	High
Barley	$1.5-6 million	Strong
Sorgum	$1-2 million	Probable
Wheat	$8-17	Probable
Sugar Cane	$21-43 million	Probable

Crop details and ranges taken from ‘Economic Impacts of Climate Change in South Africa: A Preliminary Analysis of Unmitigated Damage Costs’ – J. Turpie *et al*.

Predicted Changes in terrestrial vegetation types and distribution in South Africa by 2050

Predicted losses in existing biomes in South Africa in next 40 years if no action is taken to curb and reduce climate change impacts

BIOME	CURRENT AREA (in hectares)	AREA LEFT IN 2050	%GE LEFT IN 2050
Forest	721,154	0	0%
Fynbos	7,720,960	2,915,069	38%
Grassland	33,340,446	14,320,700	43%
Nama Karoo	29,768,902	8,211,192	28%
Savanna	42,525,186	30,608,402	72%
Succulent Karoo	8,257,625	1,557,116	19%
Thicket	4,156,647	0	0%
TOTAL	126,490,920	57,612,479	46%

'Vacated' areas would support a much more arid-adapted and species-depauperate vegetation. Drastic loss of the unique Succulent Karoo would threaten 5,500 endemic species and 30% of endemic Proteas are likely to become extinct

Biome details and ranges taken from 'Economic Impacts of Climate Change in South Africa: A Preliminary Analysis of Unmitigated Damage Costs' – J. Turpie *et al*.

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Focusing Down – The Case of the Mozambique Channel

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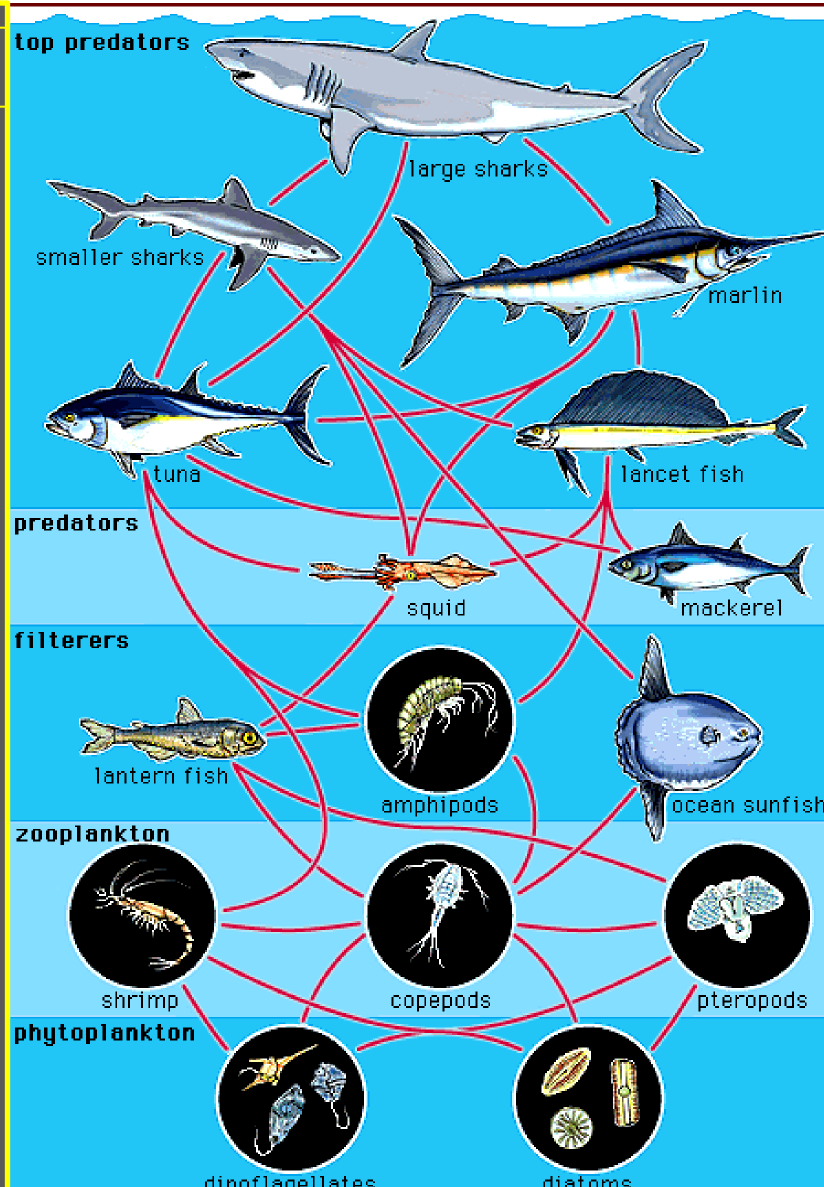
Biodiversity & Tourism



Subsistence & fisheries

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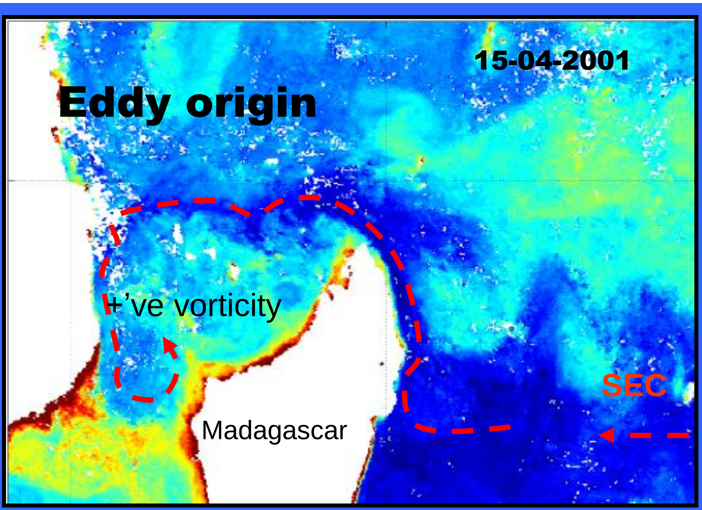
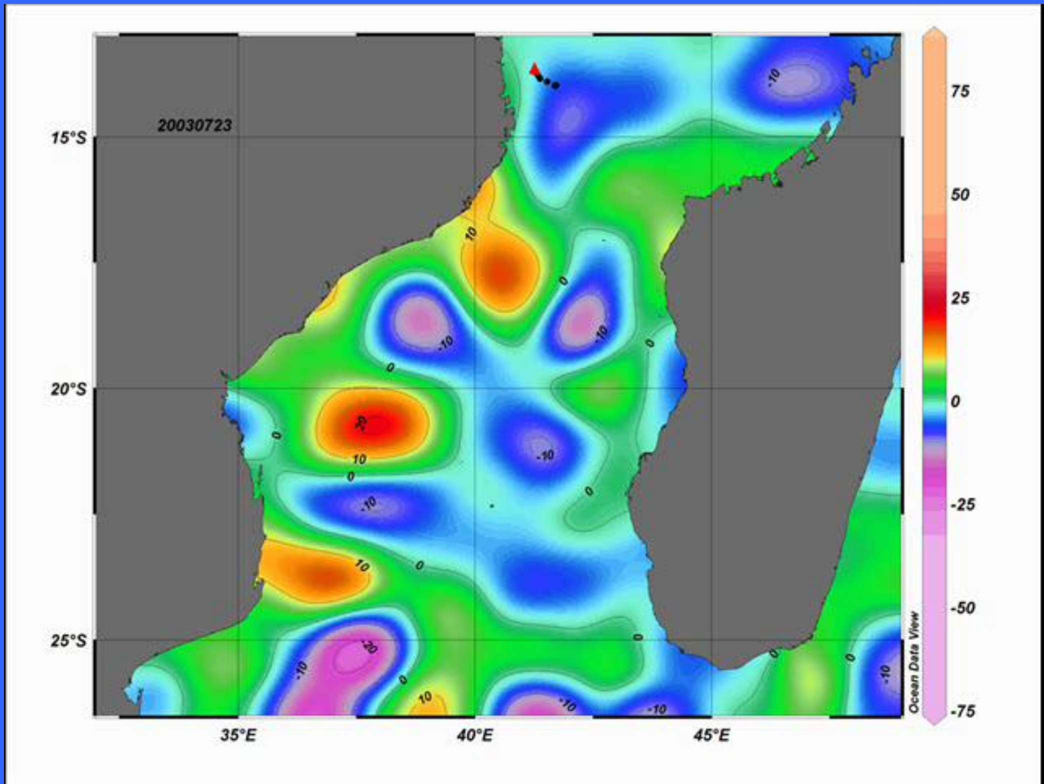
From 'Straight' to 'Bent'
The Strange Case of 'Mozambique Eddy'



A turbulence-driven ecosystem?

Unique due to Madagascar



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Research in the Mozambique Channel

(Part of an ASCLME Cruise in 2008)

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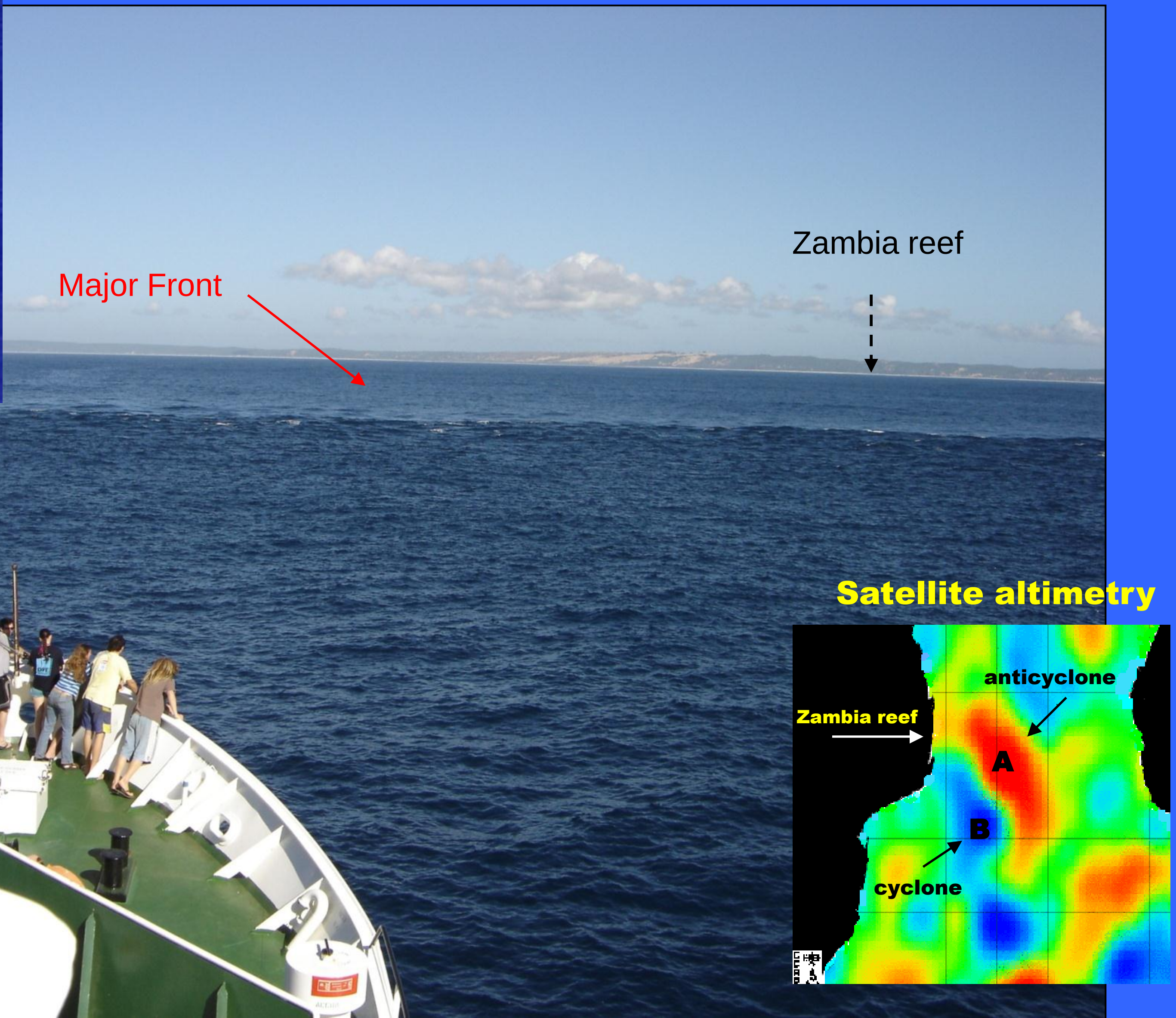
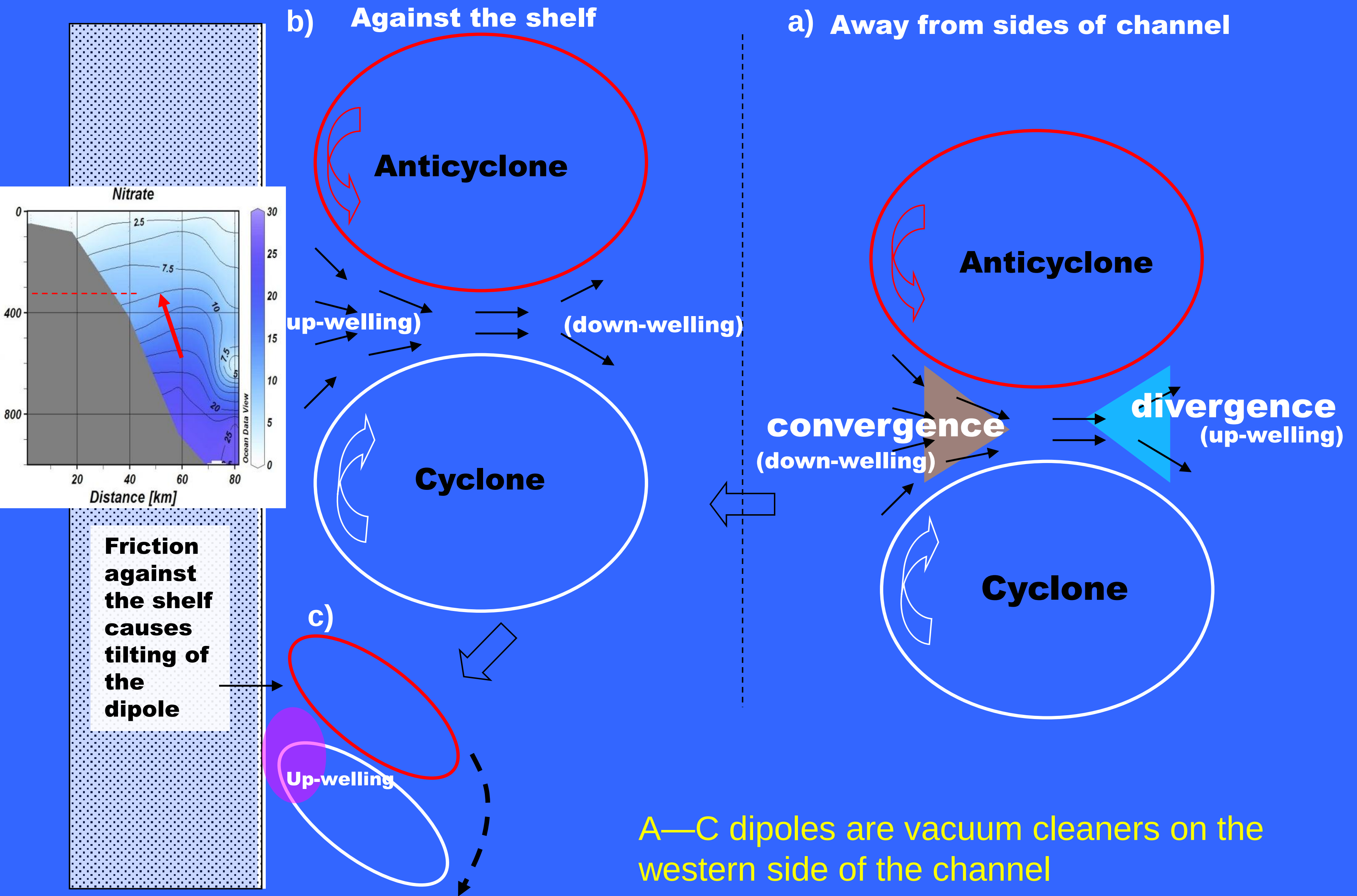


Ecosystem: — Mechanisms underlying observations **(after Roberts)**



A—C dipoles are vacuum cleaners on the western side of the channel

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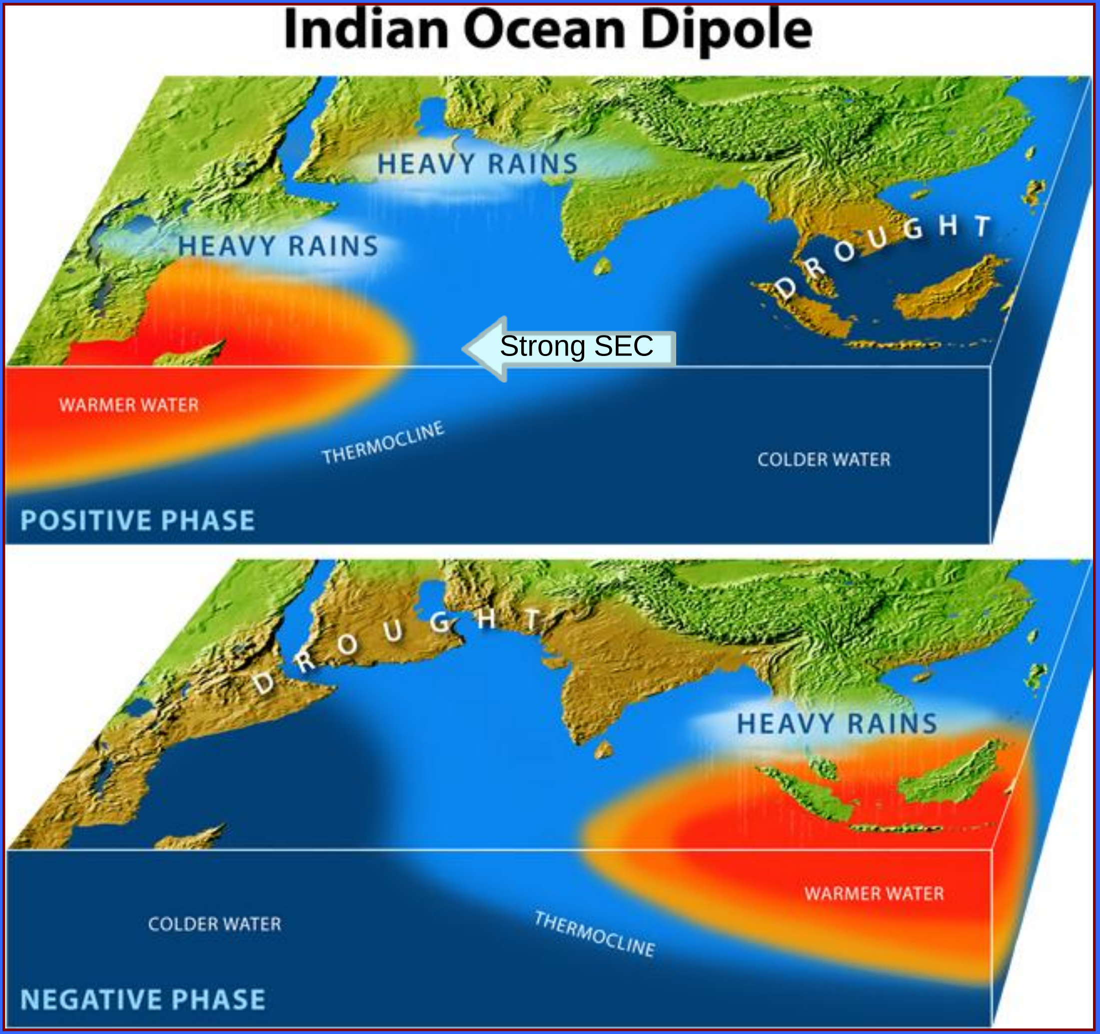

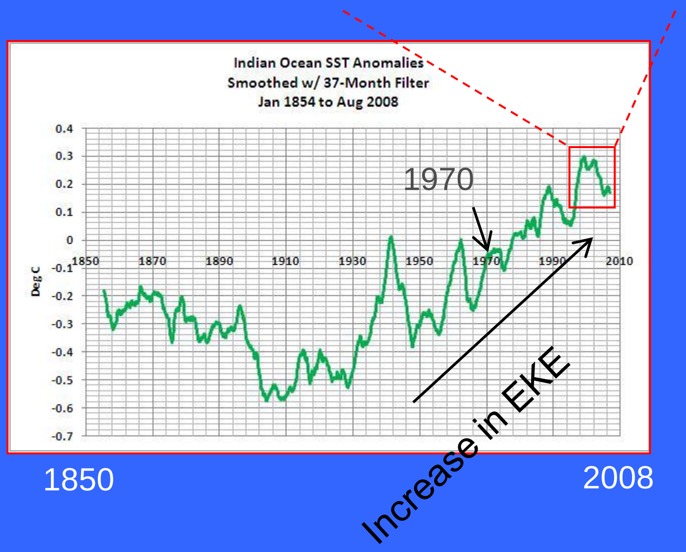

Also strong case for inter-decadal variability!

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But Eddy is potentially Unstable!!

More recent evidence shows that these dipole eddies in the Mozambique Channel are strongly influenced by sea temperature and winds

Consequently the effects of the Indian Ocean Dipole at the decadal level can be seen in terms of the changes to the kinetic energy of these eddies (EKE)

These changes also become apparent at the inter-decadal level and suggest that the kinetic energy driving these eddies is starting to fall

The concern now is whether the Mozambique eddy system might collapse in the next few decades, what would replace it, and how would this effect productivity within the entire Agulhas current system. The trends suggest that we could be looking at a potential ‘shut-down’ in the complex eddy system of the Mozambique Channel with consequent massive deterioration in productivity levels

Inevitably this would effect the coastal communities along the entire south-eastern coast of Africa and around western Madagascar, Millions of subsistence communities could find themselves struggling for food sources

(from Roberts *et al*. presented at the Joint ASCLME/SWIOFP/IUCN 1st Science-to-Governance Roundtable, Grahamstown, June 2011)

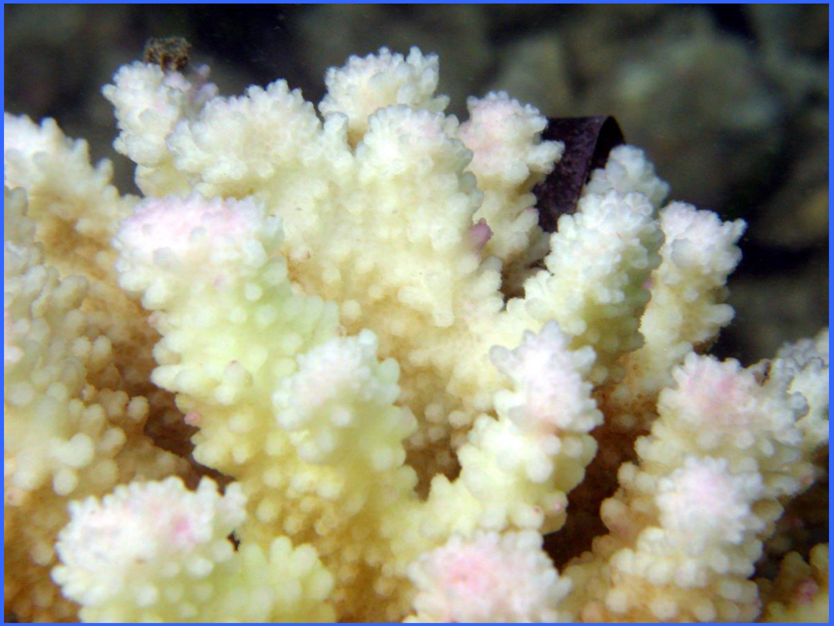
Impacts of Climate Change and Variability on Coral Reefs

The coral reefs of the ASCLME region are being impacted by the following changes in their environment:

- Warming air and sea temperatures
- Rising Sea Levels
- Changing Storm/Seasonal Weather Patterns
- Altered Currents
- Increase in CO_2 and Acidity

One of the primary indicators of stress is, of course, coral bleaching

Corals are the foundation of many tropical and subtropical ecosystems. Coral Bleaching results in loss of ecosystem health and productivity



Impacts of Climate Change and Variability on Coral Reefs

Bleaching is a result of:

A. The loss of zooxanthellae (commonly 60-90%)

B. And/or a reduction in photosynthetic pigments within the zooxanthellae (commonly 50-80% loss)

Bleaching is caused by excessive temperature and UV light, salinity changes, diseases, sedimentation and pollution

Bleaching is patchy because:

1. The susceptibility differs by species
2. Certain areas have corals that are more resistant/resilient

Bleaching is therefore very variable within and between eco-regions

Impacts of Climate Change and Variability on Coral Reefs

According the work done by Sheppard (2003) the most vulnerable latitude will be 10º S and it will hit the danger-point within the next 10 years

But different assumptions and outputs from various models provide different findings on resilience factors and their effects on bleaching

So, the long-term picture is still difficult to assess due to inherent complexity within the ecosystem and uncertainty regarding actual changes

One concern is that, although it may be predictable that the long-term trends of climate change will exceed coral limits in many areas in the next 10-30 years, this does not necessarily take into account wide fluctuations in these limits that may occur considerably earlier

And… this then has to be viewed in terms of synergistic impacts beyond just the pressures of climate change (e.g. coastal development, destructive fishing, pollution, acidification)

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The Value and Importance of Coral Reefs in the ASCLME Region

ECOSYSTEM SERVICES

Supporting

Primary and Secondary production

Nutrient cycling

Foundation resources that sustain other goods and services

Provisioning
- Food
- Materials
- Medicines
- Waterways

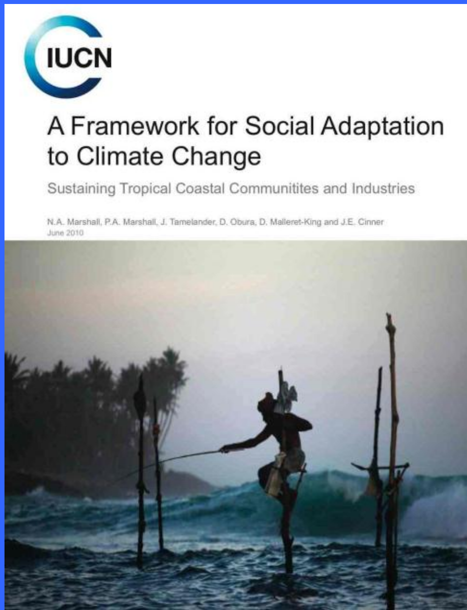
Regulating
- Carbon sequestration
- Seawater buffering
- Climate regulation
- Coastal protection
- Disease/pest control

Cultural
- Recreation
- Spiritual
- Aesthetic
- Educational

In real terms - for coastal communities – reefs provide:

- Food Security
- Security of Livelihoods (Income)
- Protection for the community (from storm surge, tsunami, etc)
- Materials (coral sand for building)
- Transportation (channels)
- Recreational opportunities
- Cultural sustainability

Climate Change and other Pressures will require adaptive measures not only focusing on management of reefs but also with a focus on the associated coastal communities



Coral Health Index (CHI)

Source: Kaufman L, Sand

1. How much fish biomass is present?
2. How much of the benthos is covered with reef builders (corals and coralline algae)?

GOOD scenario – Phoenix Islands, 2002-9.
Reef health is sufficient to power recovery even after a bleaching event…..

Source: Kaufman L, Sandin S, Sala E, Obura D, Rohwer F, and Tschirky T (2011) Coral Health Index (CHI): measuring coral community health. Science and Knowledge Division, Conservation International, Arlington, VA, USA. *Photos, left to right:* © David Obura, © David Obura, © Randi Rotjan.

'lite' version, as most locations don't have microbial data

BAD scenario – Caribbean, 1980s-2000s
Reef health is undermined by overfishing so that recovery after a bleaching event fails

Source: Kaufman L, Sandin S, Sala E, Obura D, Rohwer F, and Tschirky T (2011) Coral Health Index (CHI): measuring coral community health. Science and Knowledge Division, Conservation International, Arlington, VA, USA. *Photos, left to right:* © Bob Steneck, © Peter Edmunds.

Coral Health Index in the western Indian Ocean

Looking at studies done in Kenya…

In Kenya, fish populations are worryingly low – not just for sustainability of fisheries, but for long term survival of the coral reefs themselves.

In the ASCLME region it looks as though we are following the Caribbean scenario …

Understanding Fisheries – Small is Large!

- Why are we underestimating fisheries effort, catch and predictability?
- The implications of these inaccuracies on such MDGs as food security, poverty, sustainability of fisheries

Reconstructing what we know about Fisheries
'Small-Scale is not so Small'!

There are those who maintain that studies on small-scale fisheries are a waste of time because, " industrial fisheries in the South and the North provide the bulk of the fish" (!).

This standpoint seems to be justified because for most countries the official statistics do not identify small-scale fisheries, suggesting such catch, if any, is negligible.

On the other hand there are cultural anthropologists and other social scientists who assert in thesis after thesis and paper after paper that small-scale fisheries are important in the villages they studied

Historically, hard numbers have been missing which would document in a compelling fashion that small-scale fisheries, rather than being marginal activities conducted by marginal people, are a vibrant part of the rural economy of numerous countries, providing livelihood to millions of people

In fact, through reconstruction of fisheries data, it is becoming apparent that small-scale fisheries (especially in the WIO) rather than being a marginal sub-sector, represent most of the people working in fisheries, and generating nearly half of the fish and invertebrate catch, often of high values, destined for human consumption

Furthermore, because they use far less fuel energy than industrial fisheries per tonne of fish landed, small-scale fisheries may point to, or even be, the future of fisheries in a world economy shaped by high fuel cost

Reconstructing Fisheries Data – the case of Mozambique

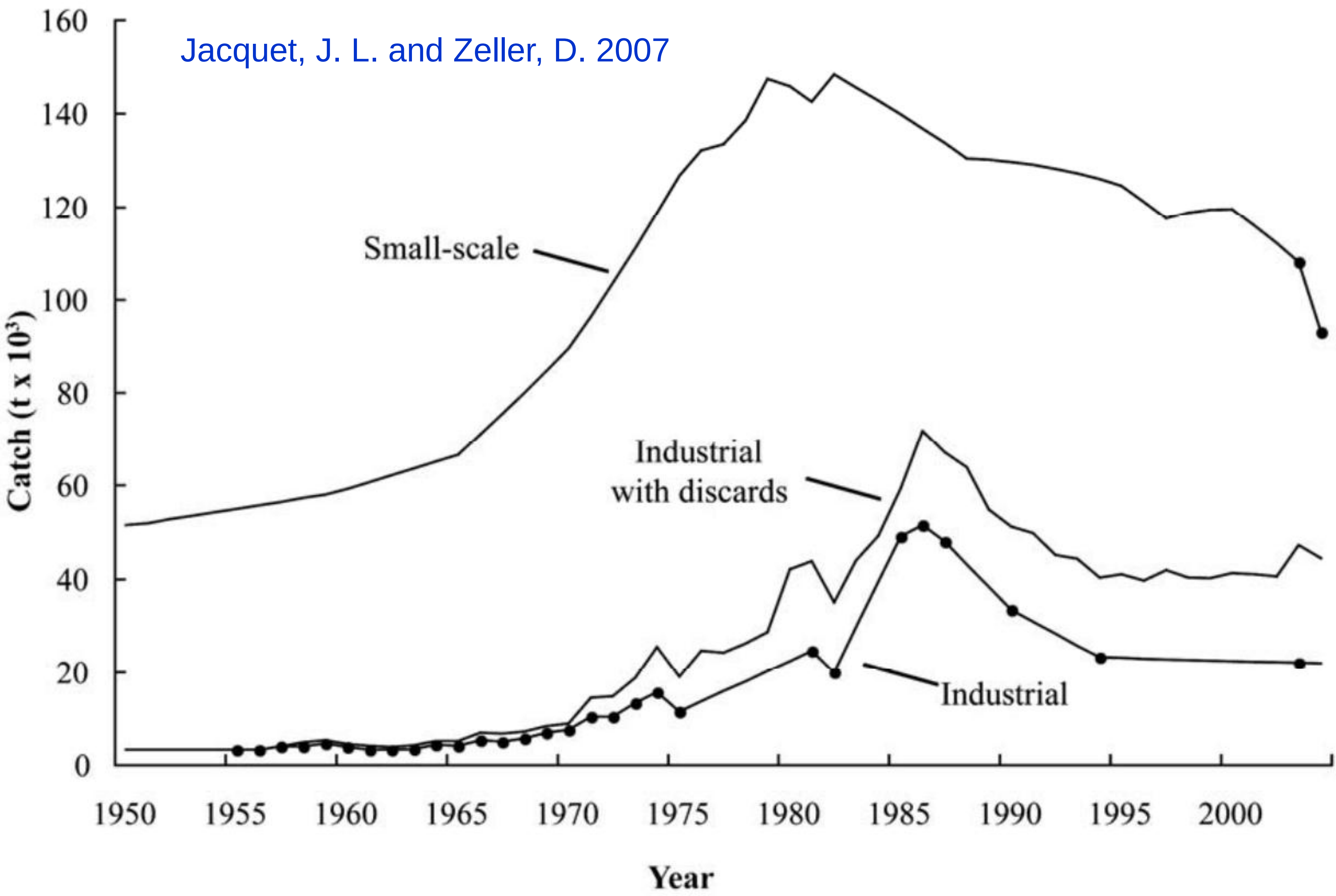
Mozambique is one of the poorer countries in the world in terms of GDP. However, it is rich in marine resources.

Since the 1950s, when the compilation of global fisheries data by FAO began, Mozambique has reported primarily industrial catches and has vastly under-reported the nation's small-scale fishing sector due to lack of resources and civil strife.

Reconstruction of fisheries data for Mozambique by the Seas Around Us group (UBC) demonstrates that since 2000, the fishing sector as a whole has landed between 115,000 and 140,000 tonnes per year

This reconstruction process shows that overall, small-scale catches may actually account for an average of 87% of Mozambique's national marine fisheries landings

(Jacquet, J. L. and Zeller, D. 2007. National conflict and fisheries: Reconstructing marine fisheries catches for Mozambique)



Mozambique catch reconstructions for the small-scale fisheries sector, industrial sector and estimates of total industrial catch including discards, 1950-2004.

Reconstructing Fisheries Data – the case of Tanzania

Recent studies indicate that the coastal population of Tanzania is exploiting fisheries resources to a degree that may now be threatening their food security

A combination of population growth and destructive fishing gear (including dynamite) is considered to be one major cause

Increasing global markets for seafood are also to blame

Unless there is a way to ensure local fishers receive the benefits of an export fishery it could be very dangerous to allow international markets to stimulate additional fishing effort

Much of the problem lies in unreliable catch data and related inaccurate statistics. Recent studies demonstrate:

1. Chronic under-reporting off catches for mainland Tanzania
2. The omission of Zanzibar from official catch reports

In fact, reconstructed Tanzanian catches are found to be 1.7 times larger than the catches presented through the data given to FAO over the 1950-2005 period

(Jacquet, J. & Zeller, D. (2007). Putting the 'United' in the United Republic of Tanzania: Reconstructing marine fisheries catches,)

Reconstructing Fisheries Data – the case of Madagascar

Actual catches taken by Malagasy fisheries had been under-reported by over 500% in earlier catch reports. At present, however, this under-reporting may be closer to 50%

The largest component of total domestic fisheries catches is taken by small-scale artisanal and subsistence fishers, which account for 72% of total catches in the 2000s.

While commercial fisheries have experienced declining catches for a few years, small-scale catches appear to continue to increase (although the data have been marginalized and poorly monitored).

Recent studies suggest that highly important small-scale fisheries are reaching a plateau in terms of total catches and are projected to start declining within the next decade.

These trends have serious ramifications for domestic food security.

In a country with few if any livelihood alternatives, it has been suggested that sustainable small-scale fisheries should be viewed as a human-rights issue and should be given precedence over export-oriented commercial or foreign access fisheries.

The consequences of diminishing fisheries resources are particularly severe in a island nation in which over 50% of children under five years of age are suffering from malnutrition, and where persistent food insecurity affects over 65% of the population

(Frédéric Le Manach et al. (In Press), Unreported fishing, hungry people and political turmoil: the recipe for a food security crisis in Madagascar?)

"Small Scale" vs. Large Scale/Industrialised Fisheries

This graph compares small-scale with large-scale fisheries on a global basis. It probably underestimates the role of small-scale fisheries. Also, we would achieve most stated aims of fisheries management plans (particularly their social aims) by dedicated access arrangement for small scale fisheries. (But, of course, we must leave enough fish for the rest of the ecosystem to function and to meet to challenges of global warming).

FISHERY *BENEFITS*	LARGE SCALE	SMALL SCALE
Number of fishers employed	about ½ million	over 12 million
Annual catch of marine fish for human consumption	about 29 million tonnes	about 24 million tonnes
Capital cost of each job on fishing vessels	$30,000- $300,000	$250- $2,500
Annual catch of marine fish for industrial reduction to meal and oil, etc.	about 22 million tonnes	Almost none
Annual fuel oil consumption	14 – 19 million tonnes	1 – 3 million tonnes
Fish caught per tonne of fuel consumed	= 2 – 5 tonnes	= 10 – 20 tonnes
Fishers employed for each $1 million invested in fishing vessels	5 - 30	500 – 4,000
Fish and invertebrates discarded at sea	10-20 million tonnes	Little

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WIO Small-Scale Fisheries
Conclusions

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Based on calculations by a number of fisheries specialists who have recently reviewed catch statistics for the Western Indian Ocean countries, the evidence shows that the estimations that the official statistics provided reflect, at best, less than half of the total real catch, and sometimes considerably less

The role of Small-Scale Fisheries has been grossly under-estimated. The extreme importance of Small-Scale fisheries, however, in terms of food security, poverty alleviation and long-term fisheries sustainability (3 of the MDGs!) is only now becoming apparent

Data collection and knowledge related to small-scale fisheries should therefore be given one of the highest priorities

Some of the recent supporting literature

- van der Elst, R. et al. (2005), Fish, fishers and fisheries of the Western Indian Ocean: their diversity and status. A preliminary assessment.
- Pauly, D. 2006. Major trends in small-scale marine fisheries, with emphasis on developing countries, and some implications for the social sciences.
- Jacquet, J & Zeller, D. 2007. National conflict and fisheries: Reconstructing marine fisheries catches for Mozambique,
- Jacquet, J. & Zeller, D. (2007). Putting the ‘United’ in the United Republic of Tanzania: Reconstructing marine fisheries catches,
- Frédéric Le Manach et al. (In Press), Unreported fishing, hungry people and political turmoil: the recipe for a food security crisis in Madagascar?

Understanding the Value of the Ecosystem

- What are various ecosystem services worth?
- What do these ecosystem services represent to the WIO countries in terms of jobs and salaries?
- How can the region achieve the full economic potential of ecosystem goods and services whilst maintaining their sustainability?

VALUE OF MARINE AND COASTAL RESOURCES OF WIO

The ASCLME/SWIOFP joint Cost Benefit Analysis has estimated that the coastal and marine resources of the ASCLME region contribute almost US$22.4 billion a year to the GDP of the countries of region. Coastal tourism contributed the largest to GDP at over US$11 billion a year, followed by fisheries, coastal agriculture and forestry

The fisheries of the ASCLME are estimated to generate a resource rent of just about US$68 million per year currently, of which about US$59 million are generated by ASCLME countries and the remainder by countries outside of the region.

VALUE OF MARINE AND COASTAL RESOURCES OF WIO

The fisheries of the ASCLME are estimated to support almost 6 million workers, generating wages of about US$366 million per year. On the other hand, owners of fishing capital earn normal profits of US$60 million per year

Rebuilding and effectively managing fisheries of the ASCLME could result in annual gains in economic rent of US$ 221 million while wages and economic impact are likely to increase by US$10 million and $43 million per year, respectively

VALUE OF MARINE AND COASTAL RESOURCES OF WIO

In terms of distribution and equity, we find that most of the economic benefits from the coastal and marine resources of the ASCLME remain in the countries of the region. Also, workers in the sector capture a multiple of what owners of capital capture from the gross revenues generated from the resources of the ASCLME

The potential economic value of the ASCLME is much higher than the current value that is obtained from it

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Understanding the WIO LMEs in the Global Context

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Global climatic trends and variability are seen to influence the well-being and sustainable status of the WIO LMEs

However, Ocean-Atmosphere interactions in the ASCLMEs also have an effect on global climate

The Effects of ASCLME region on Climate Change!!

Recent studies are increasingly realising a significant role for the Agulhas Current in the world's climate, particularly with regard to the Atlantic Meridional Overturning Circulation (AMOC).

It appears that the weakening of the AMOC (driven by freshwater inputs from melting ice sheets in Greenland) may be counteracted by increased inputs of warm, salty water from the Agulhas Current through Agulhas Rings, Eddies and Filaments into the Atlantic, stabilising the climate of North American and Europe.

The Agulhas leakage is increasing with warming climate and related southward shifts (and strengthening) in wind patterns in the Southern Hemisphere.

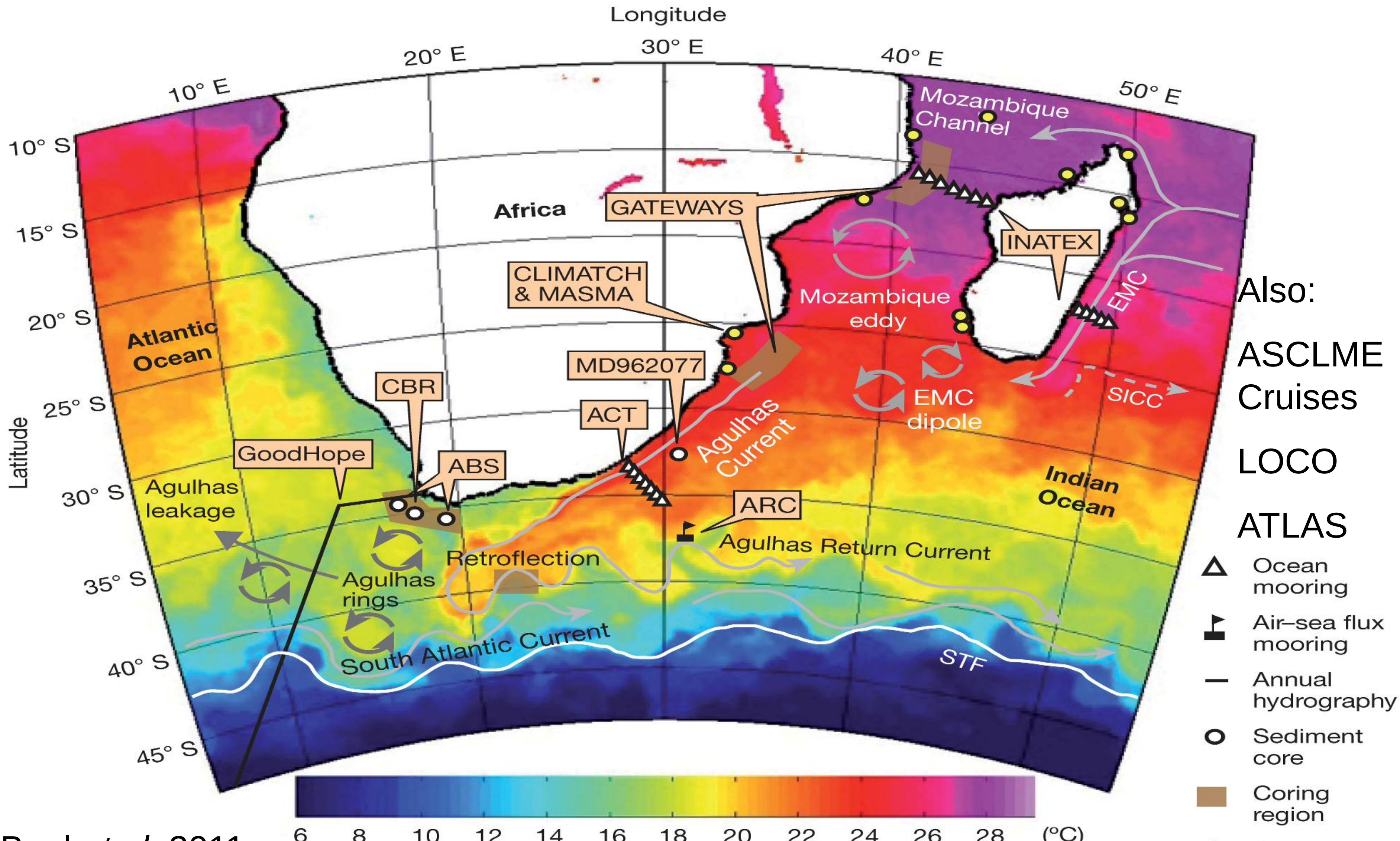
The Agulhas leakage appears to have been important (through its linkages to the AMOC) in the rapid onset of interglacial periods over the late Pleistocene epoch; conversely, the most severe glacial periods are associated with an extreme weakening or possibly complete cessation of Agulhas leakage.

IPCC models do not currently sufficiently resolve Agulhas leakage and its influence on AMOC and global climate, possibly significantly weakening their predictive capabilities

These new facts are driving major international multidisciplinary research interest in the region to better understand the greater Agulhas Current system

(See Beal *et al*. 28th April 2011, Vol. 472. Nature, pp.429-436)

Recent Research Interest



Beal *et al*. 2011

Also:

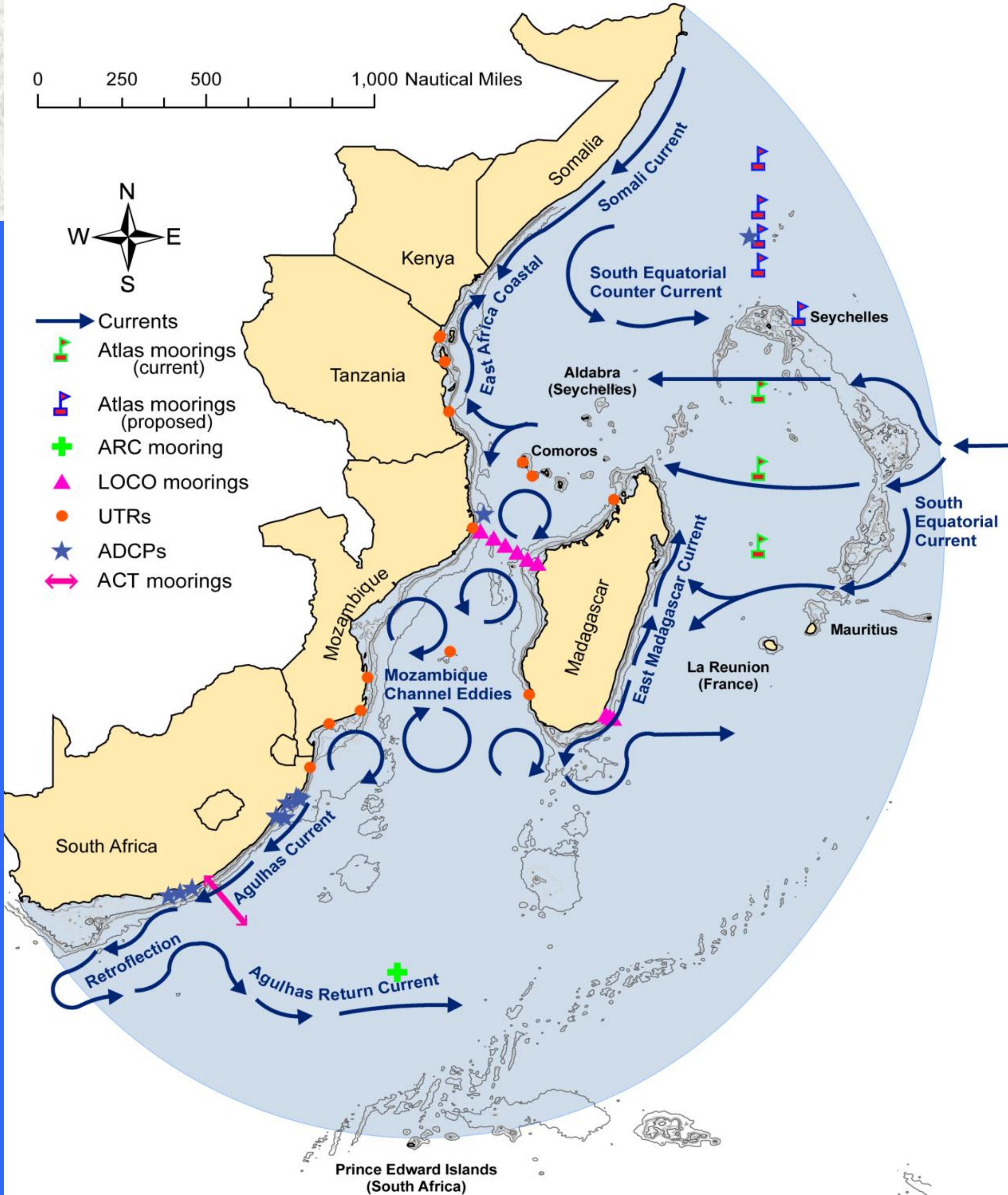
ASCLME Cruises

LOCO

ATLAS

A Proposed Annual Cruise of Alliance Partners

- Maintain existing moorings
- Expand existing UTR network
- Expand existing tide gauge network
- Expand ADCP network
- Monitor specific Indicators as part of an overall annual Ecosystem Assessment



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So what does all this mean?

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It means that there is an urgent need to:

- Complete the on-going studies within the ASCLME region at both the offshore and coastal levels in order to determine an effective baseline (Productivity, Fish and Fisheries; Ecosystem Health and Pollution Modules)
- Finalise the assessments at the socioeconomic level in terms of understanding community linkages to the ecosystem and potential impacts of change (Socioeconomic Module)
- Implement an effective monitoring and observation programme with appropriate indicators that can warn us of forthcoming impacts both within the ecosystem and, by extrapolation, within the communities
- Parallel this monitoring and observation programme with urgent targeted research that can confirm and strengthen 'confidence' in identified trends
- Evolve a mechanism to translate the comprehensive and specialised science from the monitoring and observations into adaptive management and good governance through policy and decision-making (Governance Module)
- Adopt an Alliance of partners both from within and beyond the ASCLME region that can ensure that this is maintained in a sustainable and flexible (adaptive) long-term programme that captures the outputs of the TDA and provides an effective vehicle for SAP implementation

Phase Two of the Session

(or How to Earn a Cup of Tea or Coffee!)

B. Discuss the implications of this science in terms of management needs and policy decisions that need to be made in order to mitigate or adapt to predicted changes

Next Steps in this Session

We would now invite questions, comments and observations from the floor

Can we ask you please to recall the spirit of this session which is to address the disconnect between Science and Governance

We therefore particularly seek inputs that relate to how the peer-reviewed work shown plus the various trends that have been noted should be addressed both in terms of adaptive management decisions, governance and policy, and (just as importantly) strengthening the scientific confidence and justification


WWW.ASCLME.ORG
WWW.SWIOFP.NET
THANK YOU FOR YOUR ATTENTION AND INTEREST

The Objective of this Second Half of the Session

- Refer the discussion from the earlier session (the science and its management implications) to a panel of experts (country managers and decision-makers, agency leaders, IGO executives, etc)
- Encourage a direct interaction between the LME and IW experts throughout the room with the panel
- Attempt to arrive at some conclusions in terms of a way forward (including challenges, constraints and innovations) that would allow the ASCLME region to pilot a science-to-governance process that may act as a best-practice and be replicable elsewhere in the IW community

Summary of Knowledge and Trends

- The WIO region is warming faster relative to the global mean (global 'hotspot')
- Sea-level rise around the vulnerable Islands in the WIO is seen to have a trend of 10 mm per year, higher than the average global trend of 3.5 mm
- Species ranges and distribution are changing (expanding/contracting) as a result of sea temperatures, acidification, etc (including commercial species)
- Certain critical habitats like coral reefs (the 'foundation of much of the coastal component of the WIO LMEs) are deteriorating and their Health Index is showing a trend towards a loss of ecosystem health/productivity that could represent a threat to food security, income and livelihoods, protection of coastlines, tourism, recreation and cultural values, etc
- Only just starting to understand the important role of the Mozambique Eddies on productivity and fisheries within the Channel and south around Madagascar and South Africa. There is evidence of a trend that suggests these productive eddies may be moving toward a period of reduced energy which would also reduce productivity and potential fish catches
- Rapid changes in the variability of ENSO and IOD events may severely disrupt production systems and livelihoods due to more frequent and extreme floods and droughts with threats to fisheries, aquaculture, distribution of ecosystem elements and consequent impacts on socioeconomics and human well-being
- Fisheries data capture and consequent fisheries management has overlooked small-scale fisheries which now appear to be of huge importance in terms of size, food security, sustainability of stocks, national/regional economic value

Outputs from the original Round-Table in Grahamstown June 2011

- Need for countries to be better prepared for abnormal events which are now not so abnormal (flood, drought, red tide)
- Actual variability in environment and changes in resource distribution (as we are already seeing) through climate variability may be more compelling in the short-term than long term climate change
- Limited numbers of climate scientists and trained technicians represents a long–term risk
- Scientific findings need to be packaged for the private sector (e.g. fishing industry) as well as governments
- Political regime-change needs re-education (because of 5 year political cycles). Continuity lies in middle to senior management
- Effective scientific advise to policy-makers needs reliable observations
- There IS sufficient knowledge and we CAN measure key variables accurately enough to act NOW on climate variability and change
- Different levels of confidence are required for decisions at different scales (e.g. national or regional)

Outputs from the original Round-Table in Grahamstown June 2011

- Emphasis needs to be on HOW we arrive at and make decisions and facilitate an effective debate (Science-Governance) rather than WHAT is decided
- Scientists should not be too cautious when they have facts available. Politicians and other interest group may take advantage of lack of consensus
- Inappropriate communication or interpretation of science creates confusion and does more damage to credibility of scientists
- There is a strong responsibility for accurate reporting within the media. Therefore they need to be engaged into this process
- Peer Scientific Advisory Groups such as IPCC offer credibility to a specific argument or observation
- In many cases there is sufficient and reliable information available to allow a safe and effective movement from the Precautionary Principle toward a peer-supported Weight-of-Evidence
- Transboundary issues are a particular problem as countries tend to put their national priorities first
- Presenting scenarios as options for decision-makers is much more likely to elicit a response leading to a management or policy decision
- Most importantly, there are many drivers of policy besides science (socioeconomics; culture/religion; electoral popularity). Other priorities may be more compelling and need to be addressed as part of the package

Round-Table Discussion – Bridging the Disconnect

It was understood that often scientific results are not entirely conclusive and there is a tendency to want to do more studies on the same topic to refine the conclusions (achieving reliable Confidence Limits)

In terms of Marine Ecosystem management we need to embrace the Precautionary Approach, but we need to go further and develop a mechanism that can arrive at a 'Weight of Evidence' related to evolving 'trends" in data and conclusions that is:

A. Accepted by scientific peers to be reliable enough to guide management decisions and..
B. Upon which decision-makers can act immediately while accepting that the science may need further 'fine-tuning'

One very real challenge will be developing the skill-set that can define the reliable 'Weight of Evidence' and can translate existing science into 'Confident' advice for policy-makers and managers

THE CONFIDENCE-BASED APPROACH

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It is understood that such an approach relies on conclusions that are drawn based on mathematically-proven 95% or 99% confidence limits in the scientific data and findings

Problem:

Scientists are highly confident in their conclusions and predictions. Very reliable but usually requires detailed and repetitive studies over a long time period

Managers and Policy-Makers cannot risk waiting for these ‘high-confidence’ conclusions and have to act faster to protect the interests of their ‘stakeholders’ (primarily the community at large)

THE PRECAUTIONARY APPROACH

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Problem:

Managers are uncomfortable at basing their management plans/strategies on what is often seen as ‘supposition’ or limited observation with limited supportive scientific evidence

Policy-Makers do not feel fully justified in making policy decisions which may threaten or impact on other social or economic priorities unless they have reliable ‘justification’ (clear advice from scientists) to support their decisions

Scientists are therefore understandable reticent to ‘stick their necks out’ and provide advice/guidance based on anything less than very high confidence limits (95% +)

The Adaptive Management approach

A MORE DYNAMIC MANAGEMENT APPROACH

One possible approach that was discussed at the Grahamstown Round-Table:

A. Moving immediately from the Precautionary approach to identify appropriate Indicators that will provide an early 'indication' of trends

B. Seek to establish a Weight-of-Evidence that scientists and their peers feel comfortable in agreeing defines a clear indication or trend - and which can give managers and policy-makers sufficient confidence upon which to act (even if not 95% certain)

C. Use this WoE to initiate predictive modelling to support conclusions and upon which to compare continued monitoring of Indicators

D. Fine-tune models and guidance to Managers and Policy-Makers as move toward acceptable confidence limits

The Advantages to the Scientific Community

A. This will raise the profile and importance of science generally in the policy-making and management process and encourage more support and funding to arrive at more reliable results as quickly as possible

B. It will also provide more precise guidance to the scientific community on which areas of research are priority and most likely, therefore, to attract funding

The Advantages to the Policy-makers

A. This approach will take decision-making beyond the ‘precautionary’ approach which is often seen as being based more on supposition than strong evidence and which therefore leaves policy-makers feeling vulnerable and indecisive

B. It will also provide senior government leaders at the economic/finance level and management level with clearer guidance on where to prioritise activities and funding in terms of both immediate management needs and further research (this also extends to the funding agencies of course)