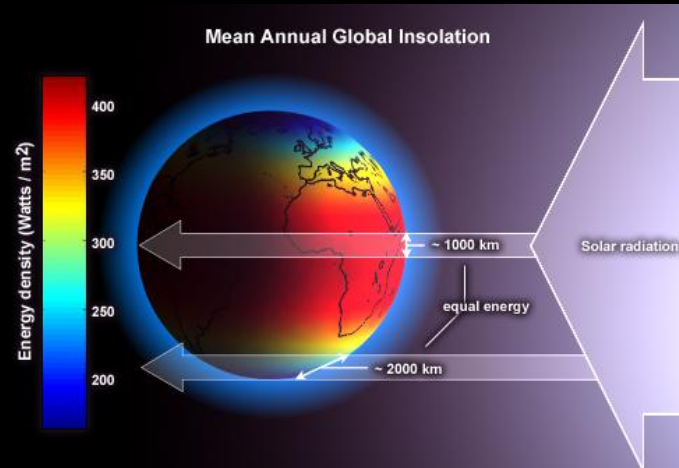
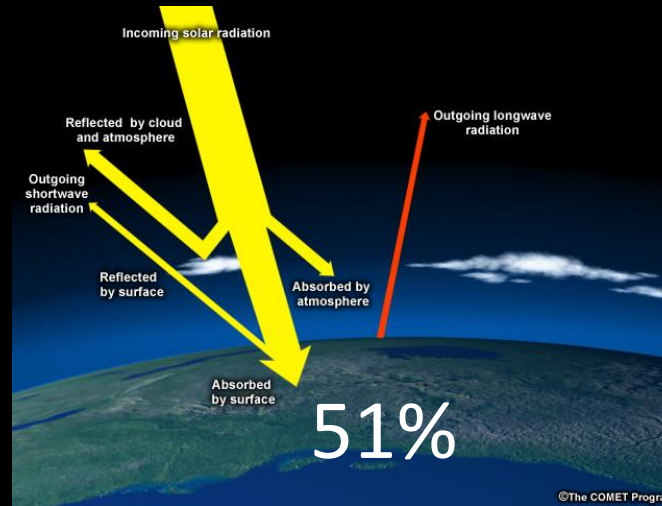
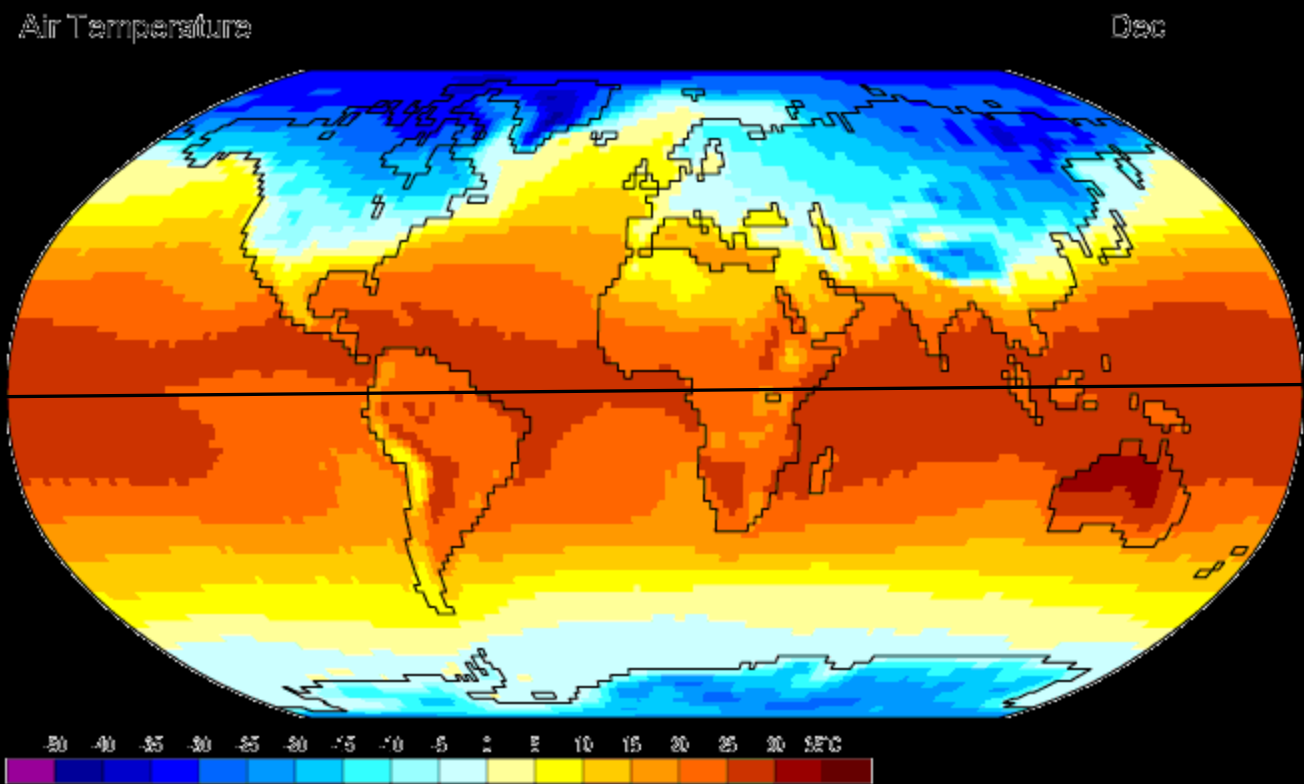
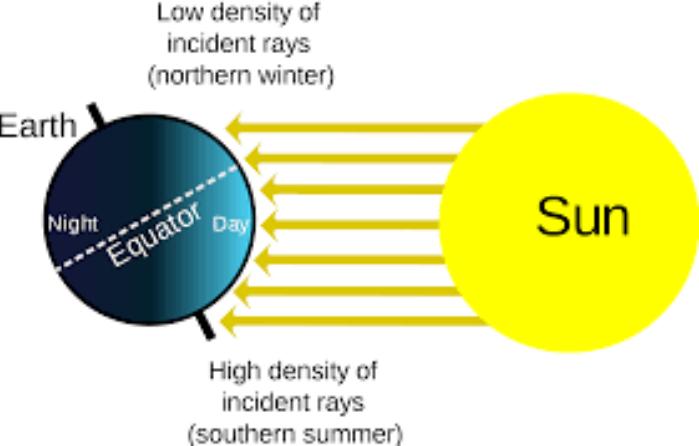
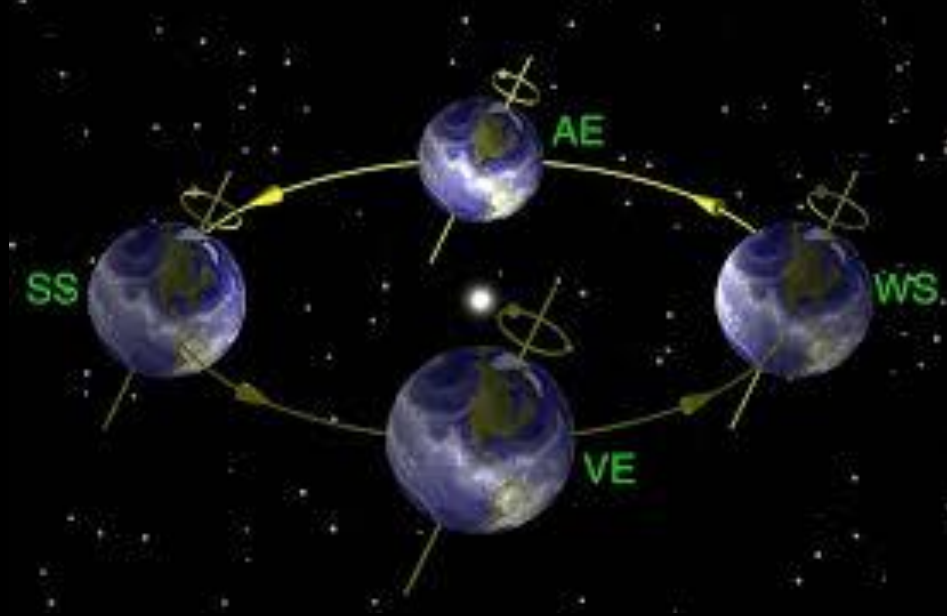


# Fisheries + Climate Change in a nutshell

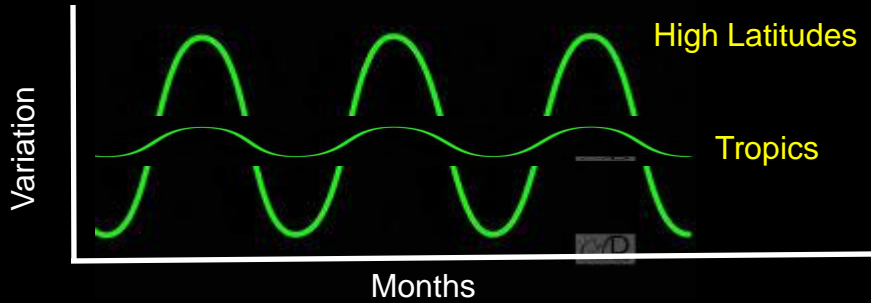


Sun Energy

# Earth's axis: most fundamental cause of change!

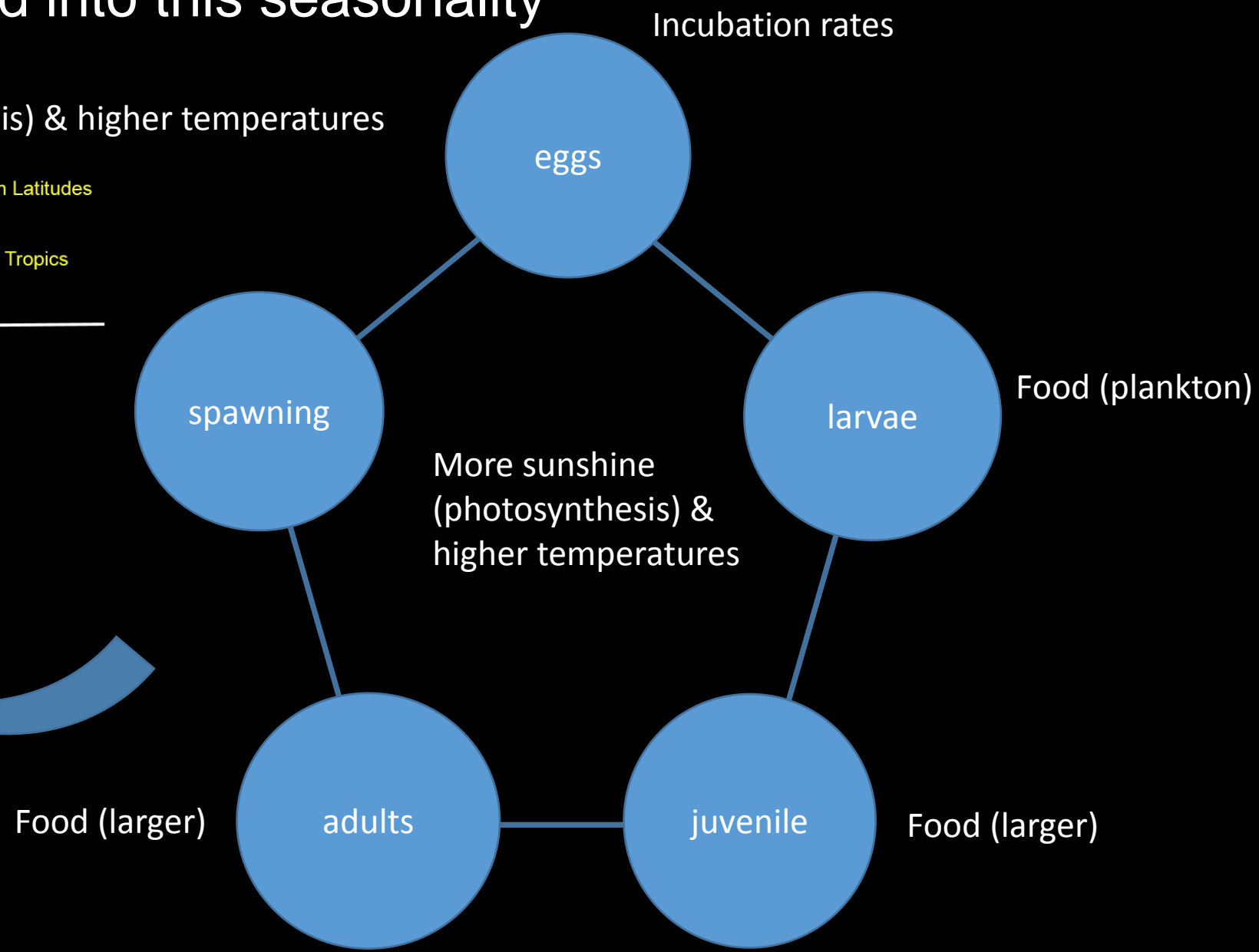
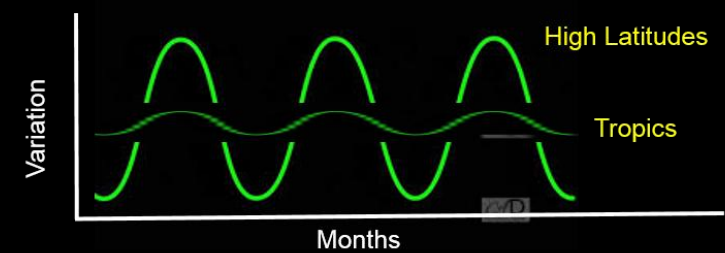


Data: NCER/NCAR Reanalysis Project, 1979-1997 (1moleglobe)  
Animation: Department of Geography, University of Oregon, March 2000



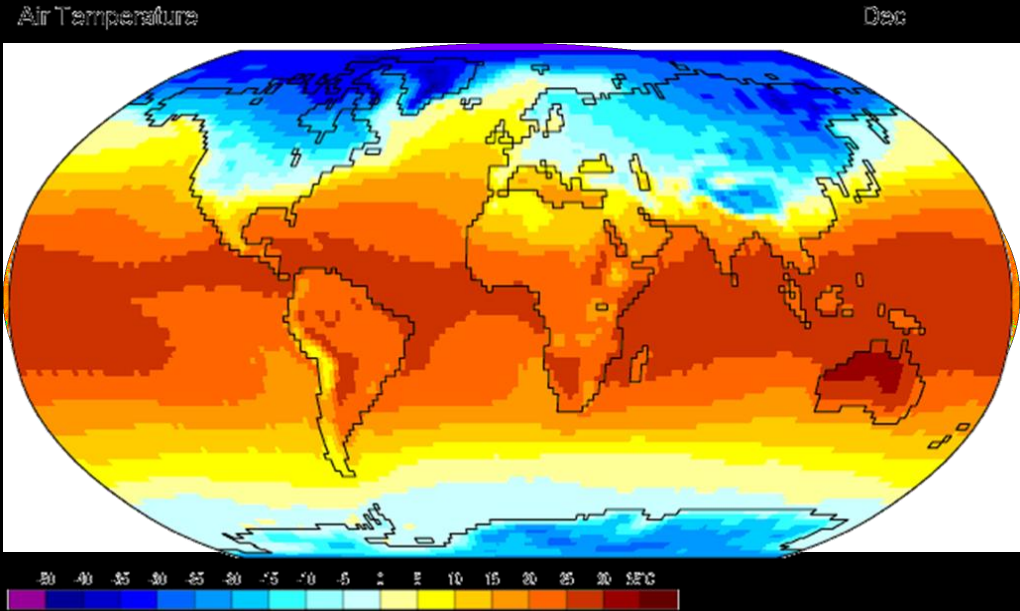
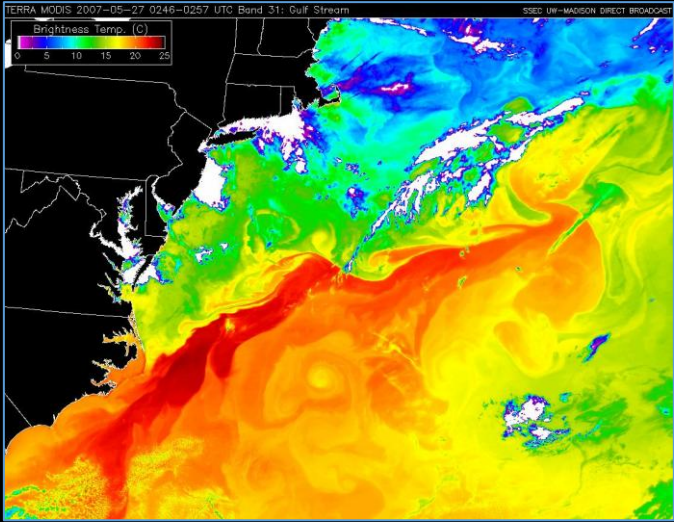
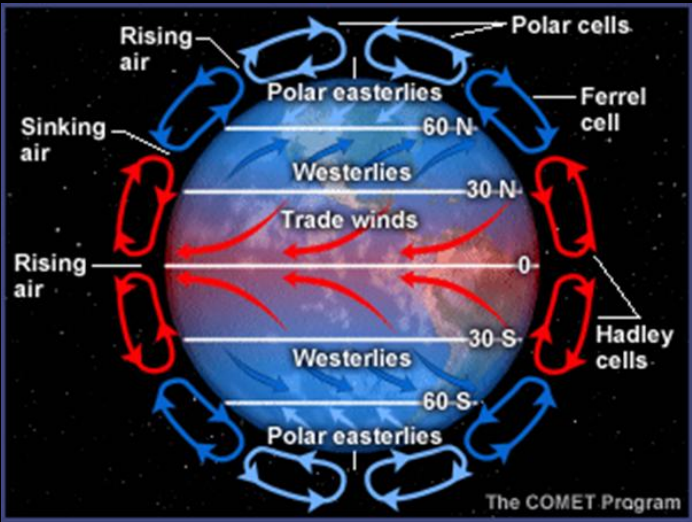
# Life cycles are tied into this seasonality

More sunshine (photosynthesis) & higher temperatures



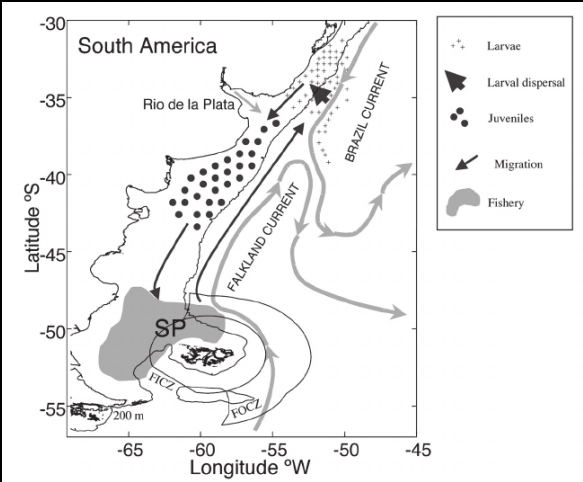
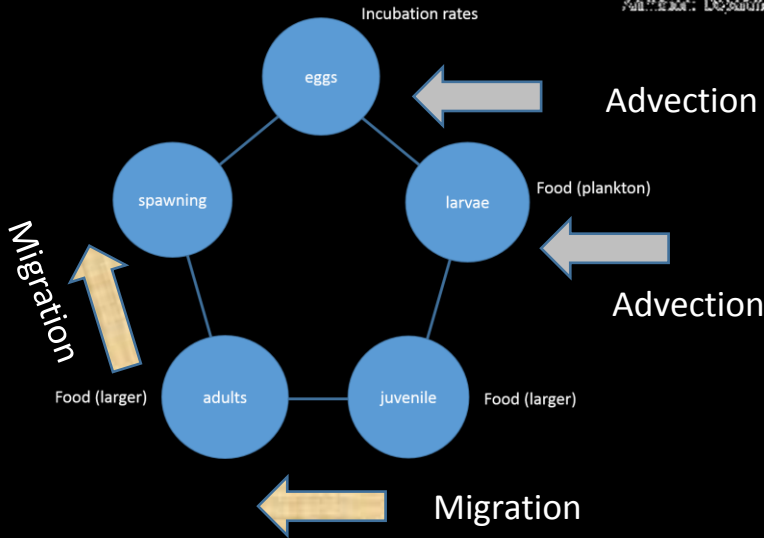
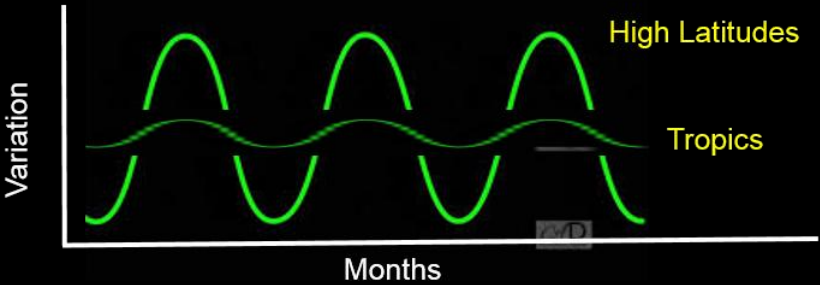


# Heat is distributed over the planet (~ Steady State)

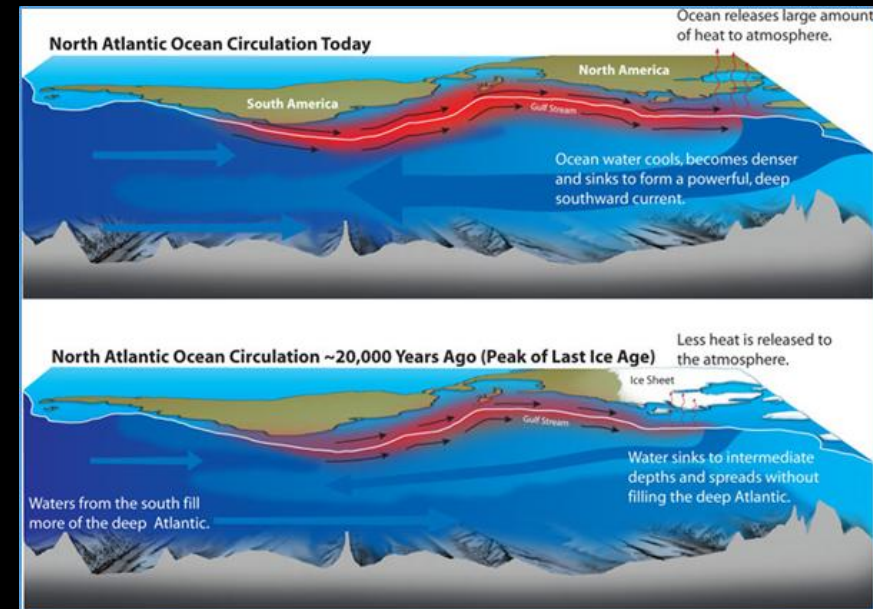
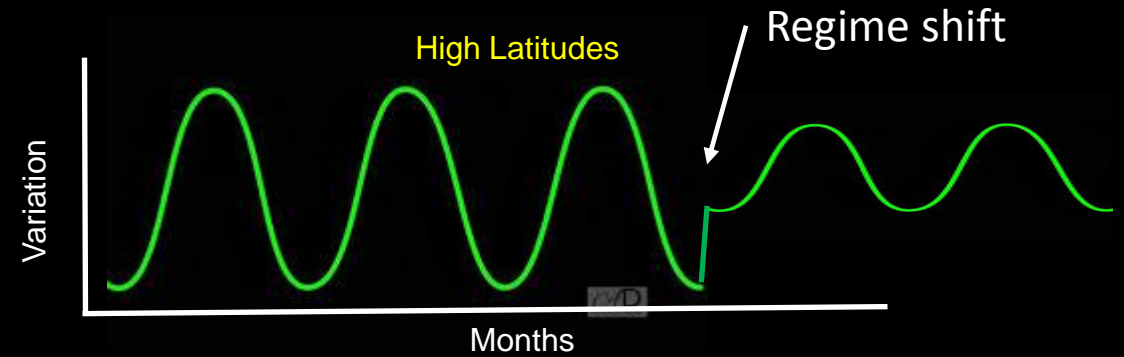
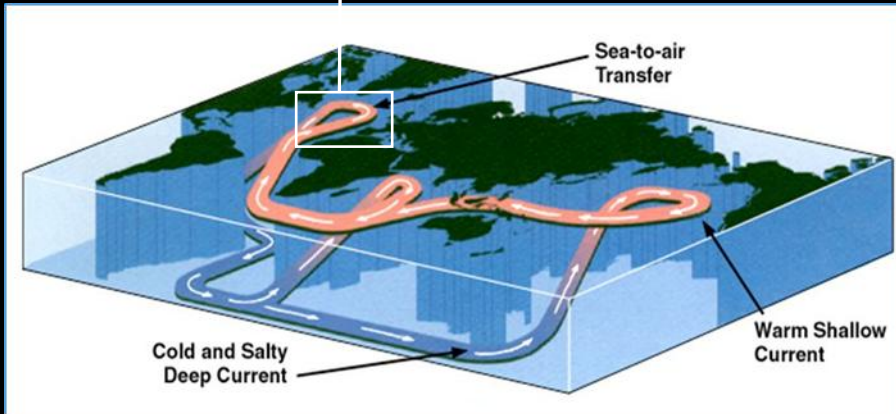
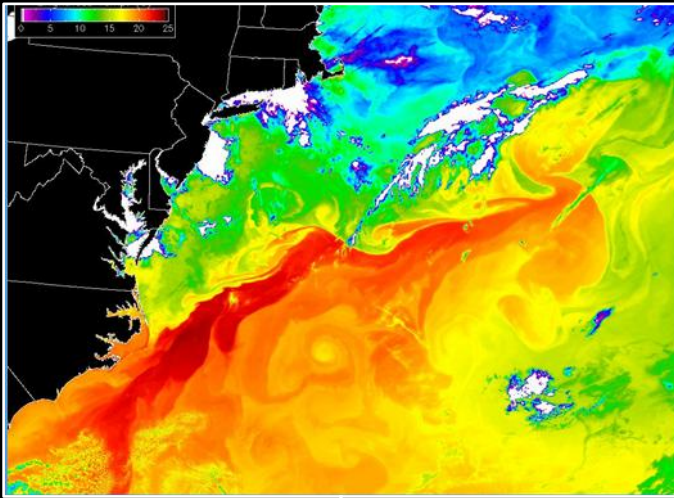


Data: NCEP/NCAR Reanalysis Project, 1959-1997  
 Attribution: Department of Geography, University of Georgia, Athens GA

Example: Argentinian squid

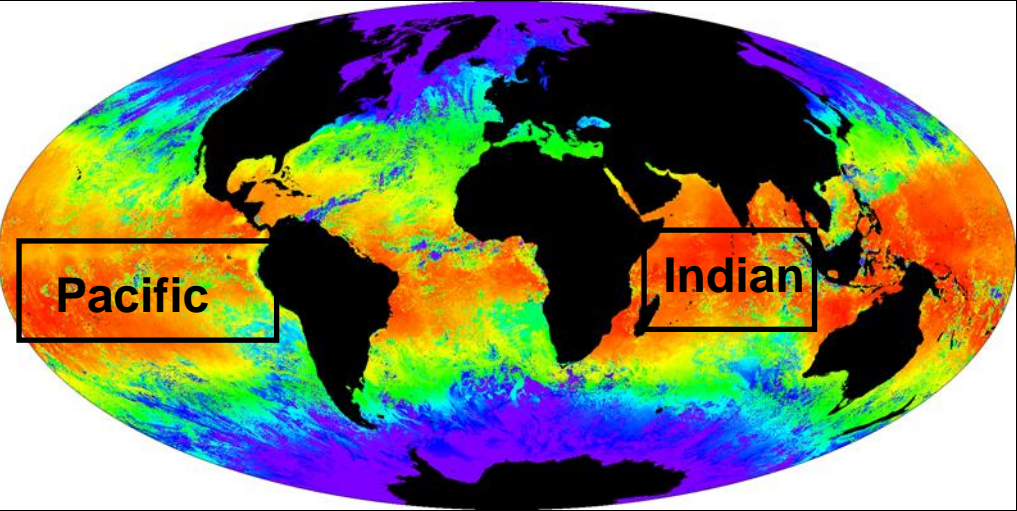


# Intrinsic variability - Thermohaline circulation

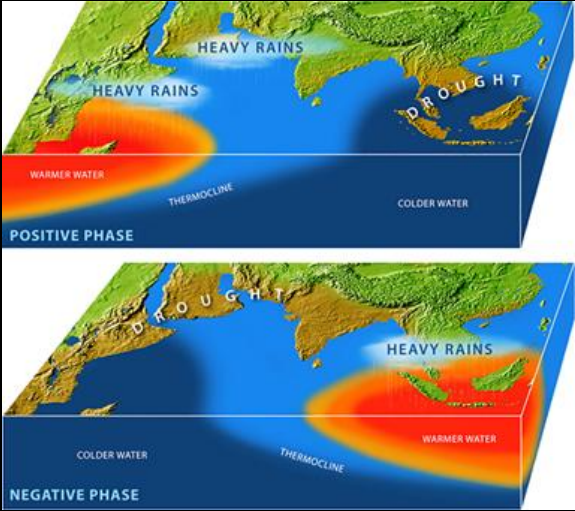




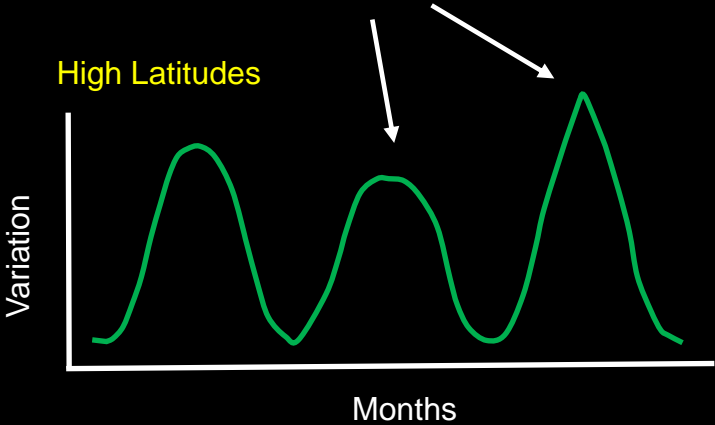
# Intrinsic variability - ENSO



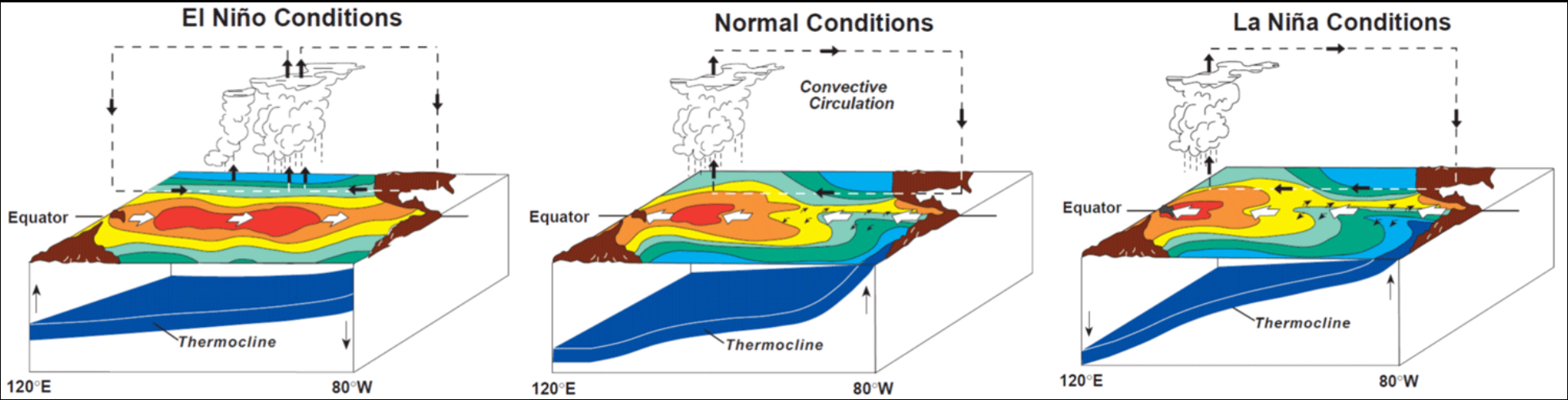
Indian Ocean



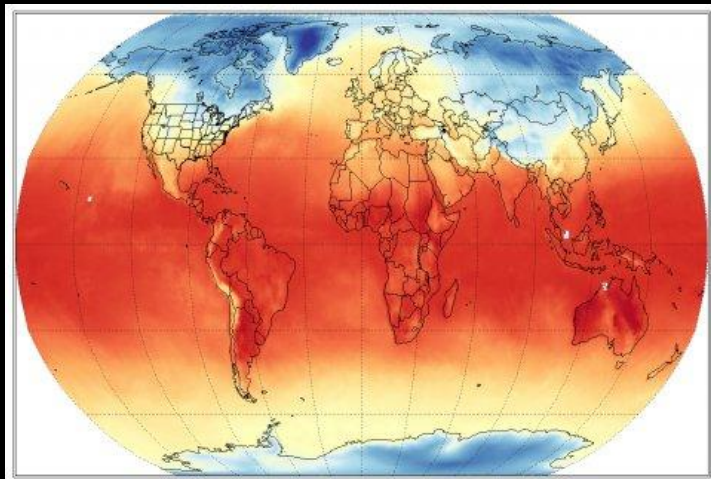
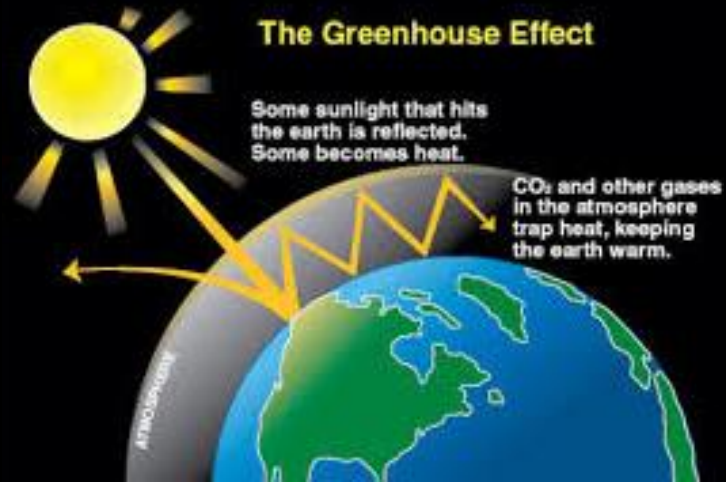
Inter annual variability



Pacific Ocean



# Enter humans + Fossil fuel burning

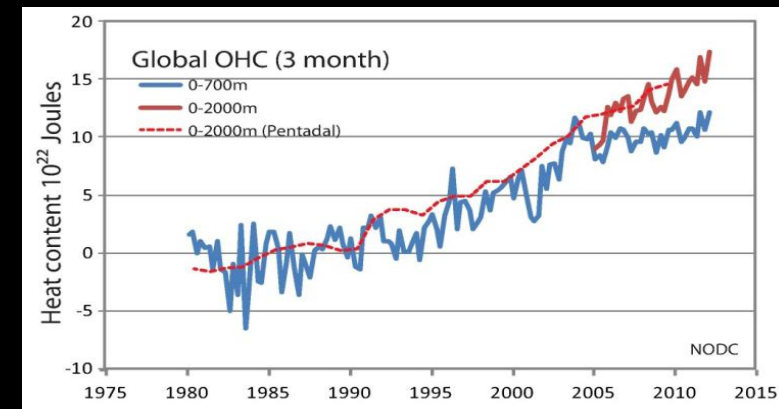
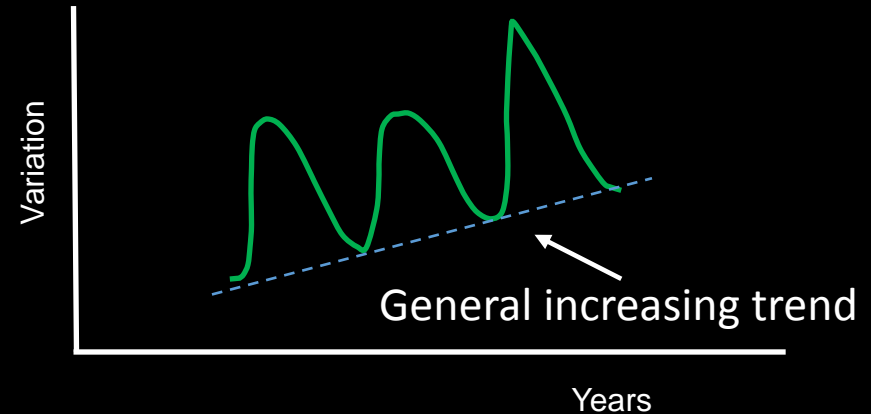


90% of the extra heat is being absorbed by the ocean

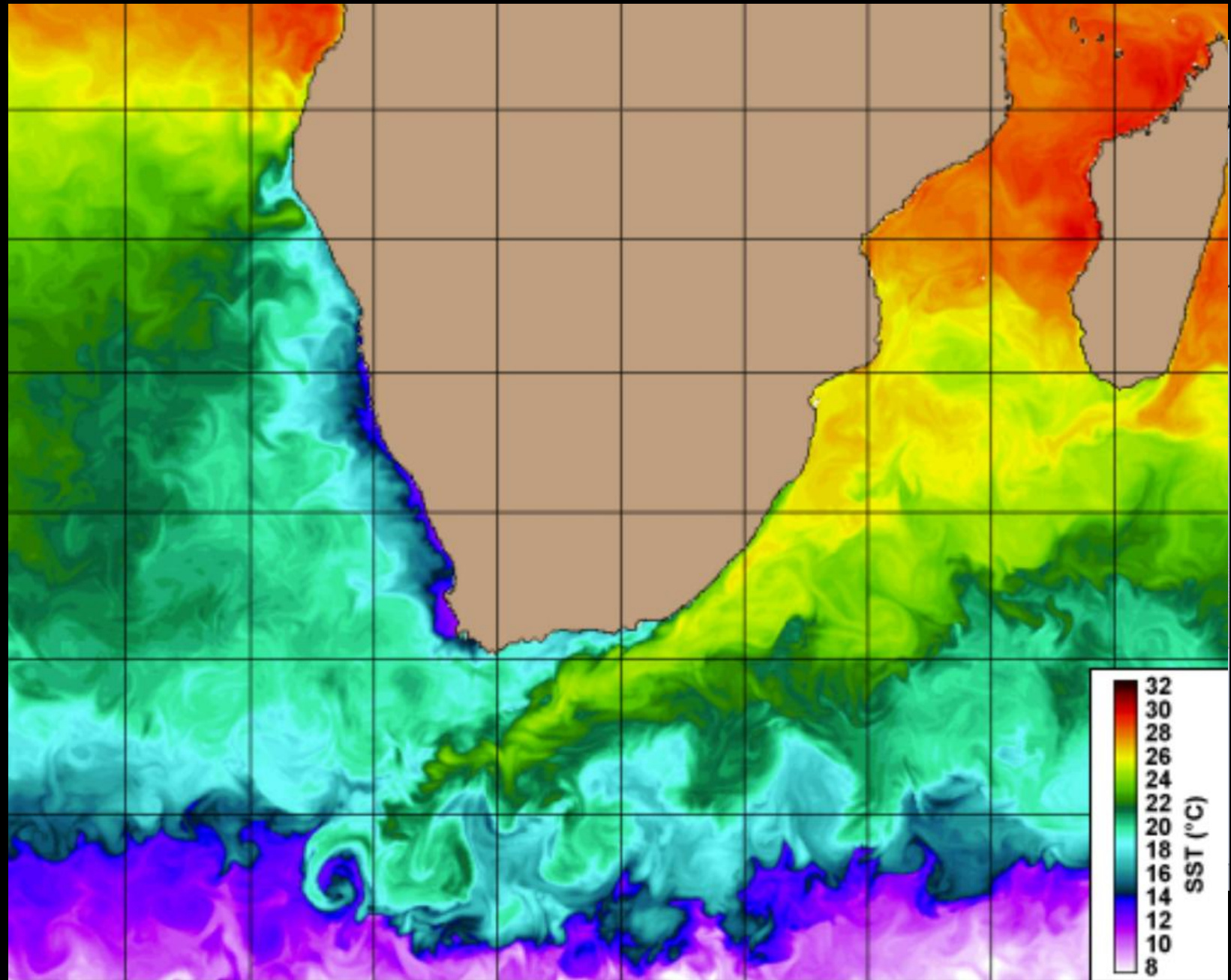
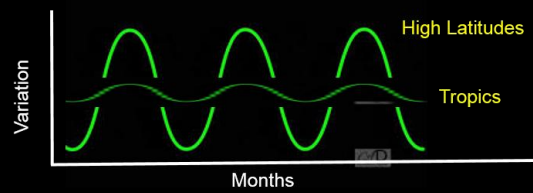
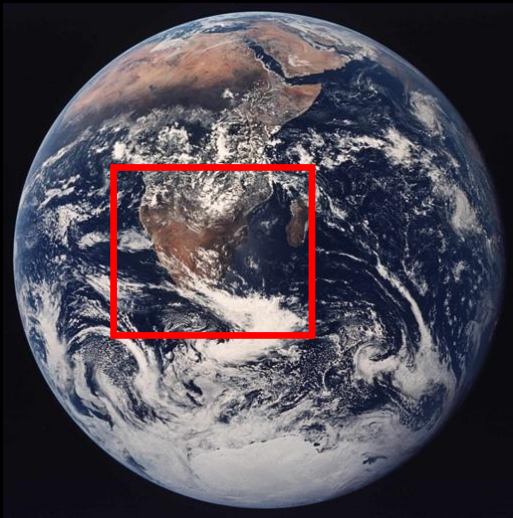
Increased energy Impacts:

- Gas solubility in H<sub>2</sub>O
- Sea level
- Circulation
- Biogeochemistry
- MLD

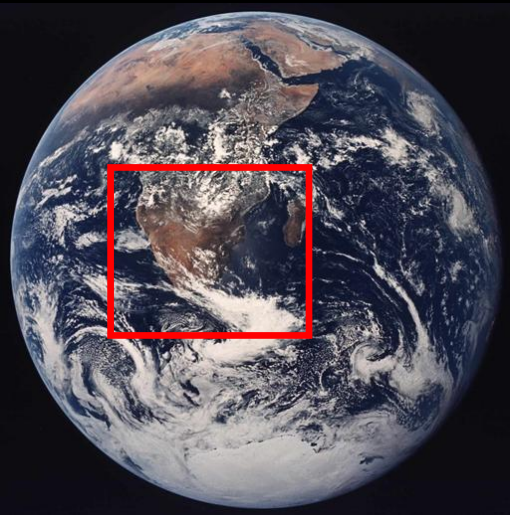
High Latitudes



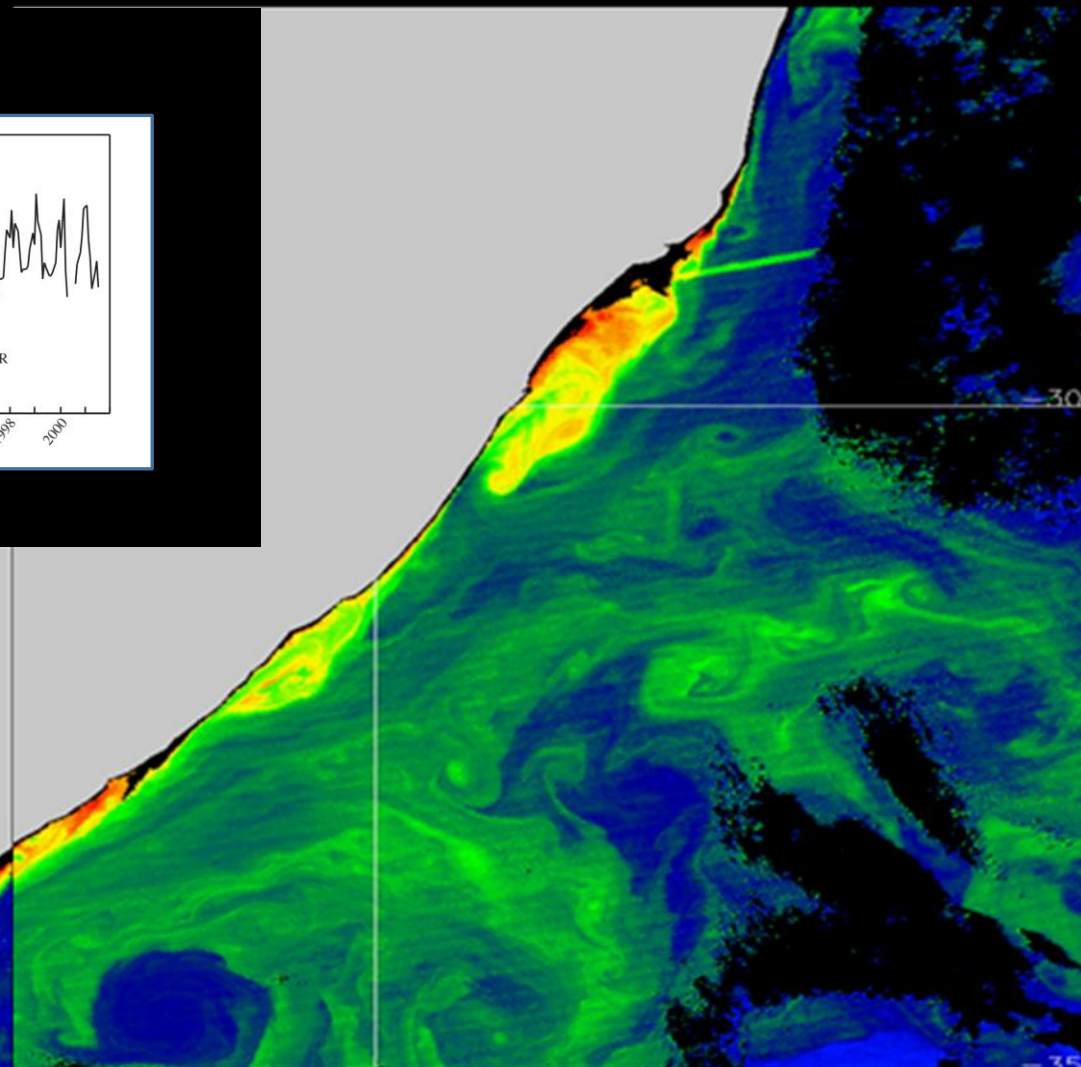
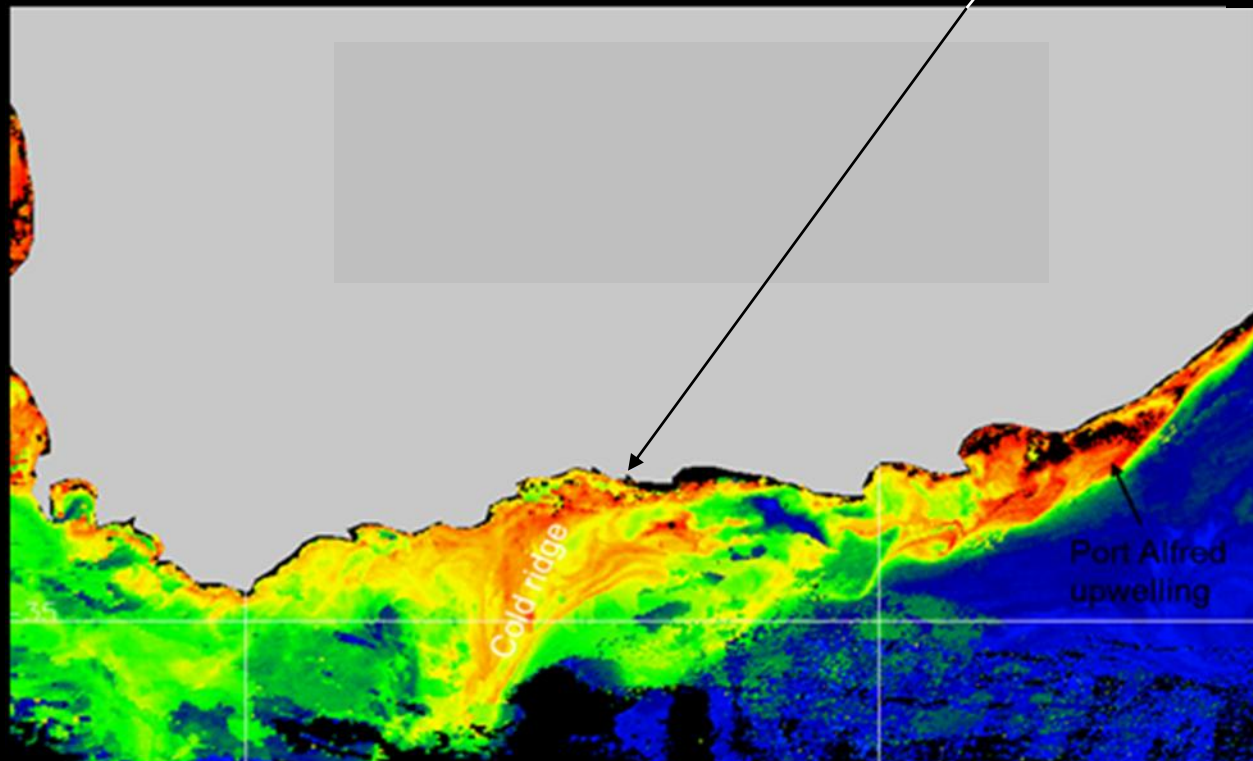
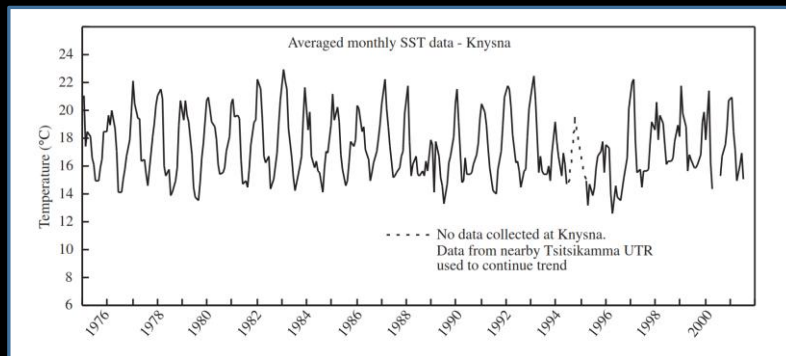






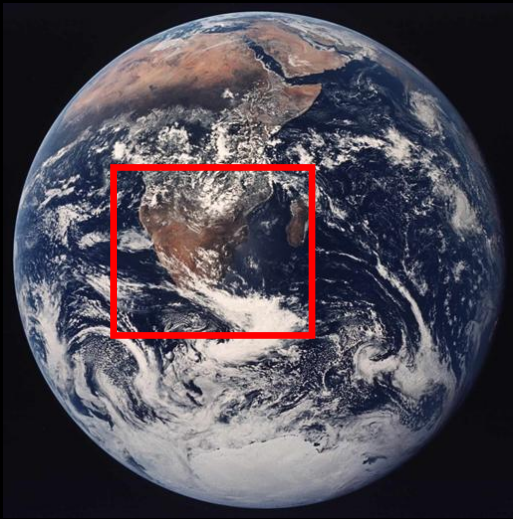


## SST Knysna



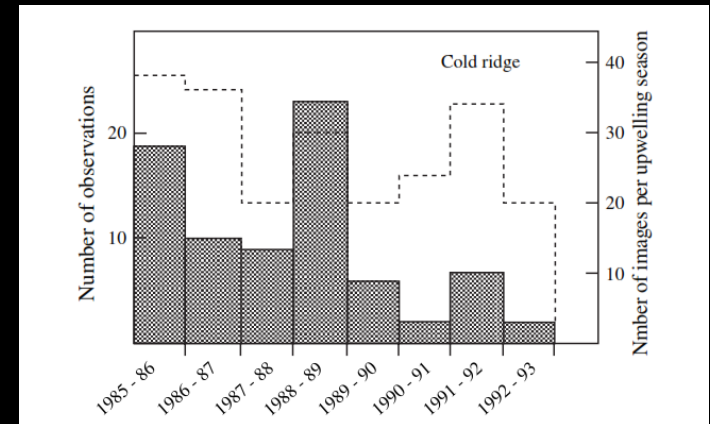
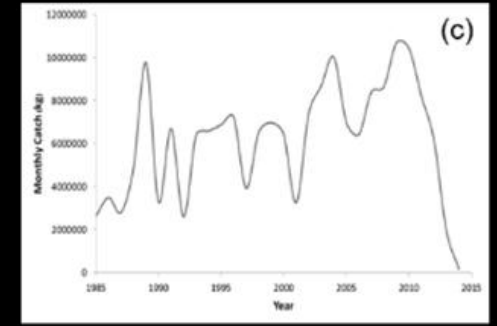
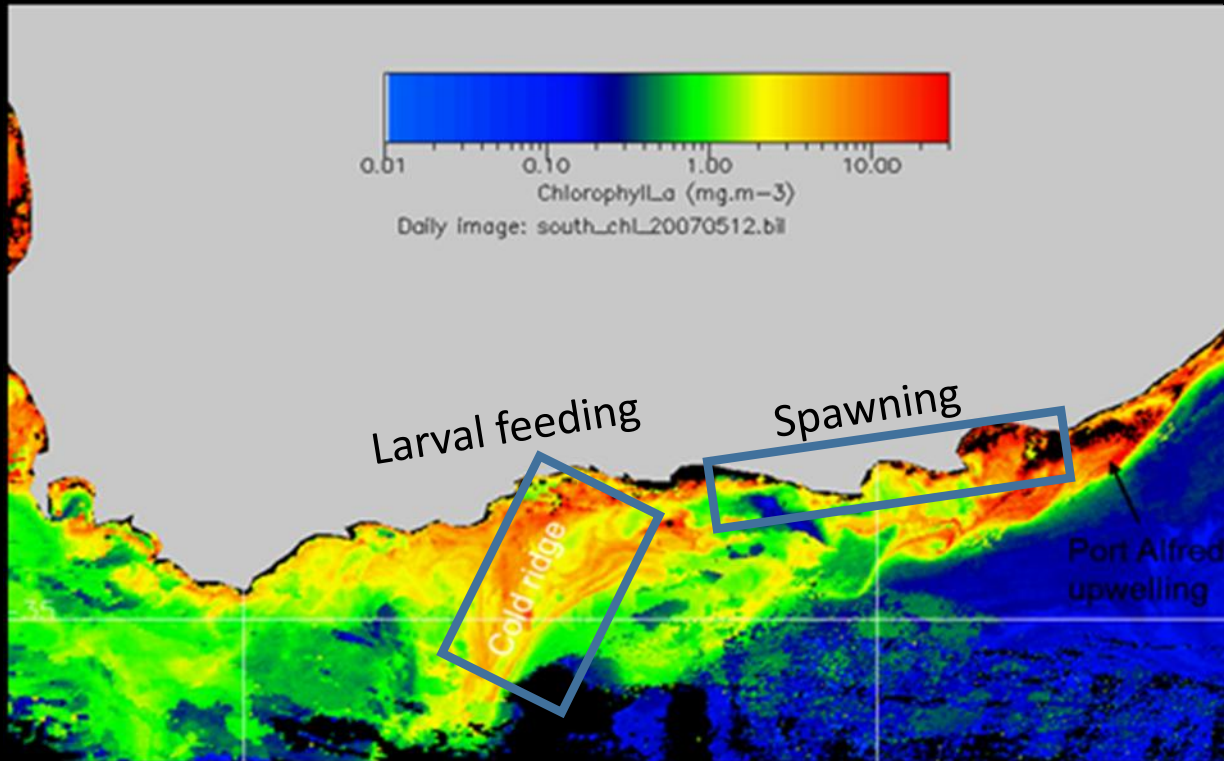
Chlorophyll



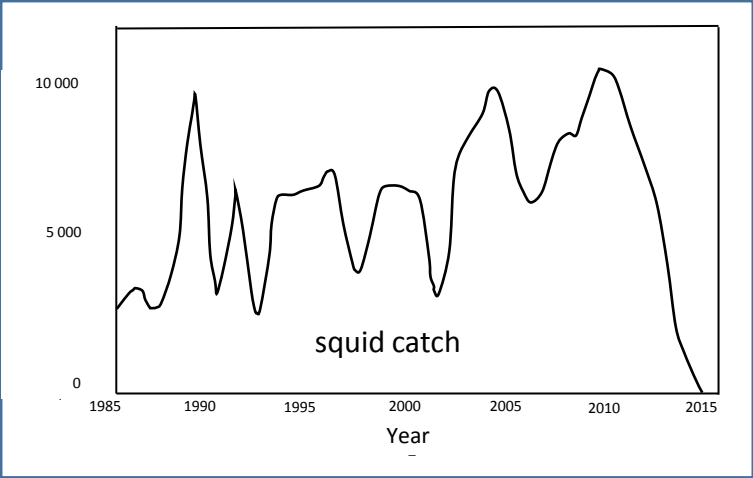


# SA squid fishery

## Life cycle



# SA squid fishery

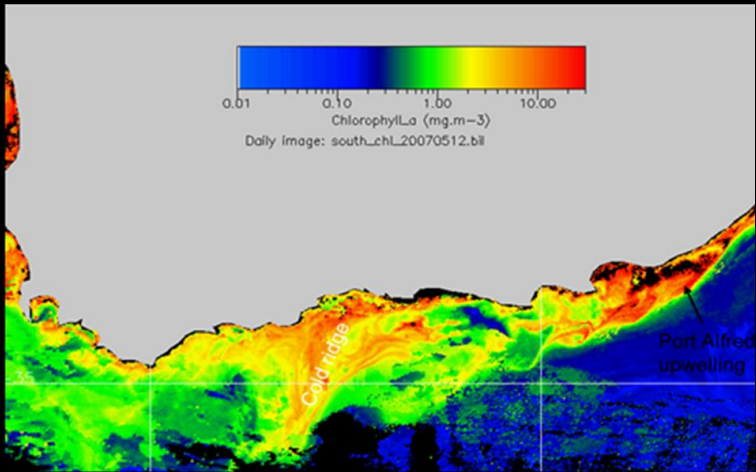
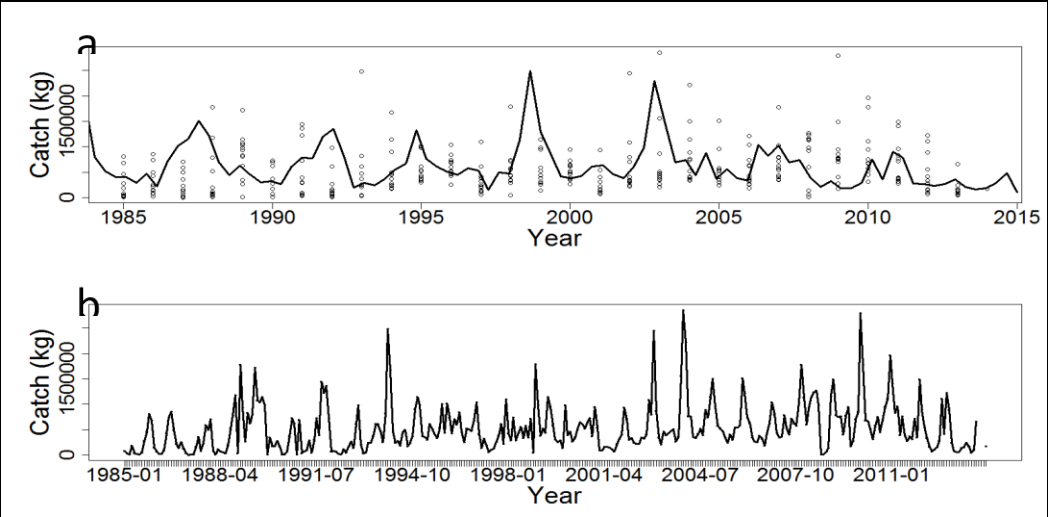


$$\text{Catch} \sim BT + \text{Var}BT + SST + \text{Var}SST + \text{Var}WS + WD + \text{Var}WD + P + \text{Var}P + ONI + Chl$$
  
$$+ \text{Max}WS + \text{Min}WS + \text{Mode}WD + \text{Easterlies} + AAO$$

TB

Cold R

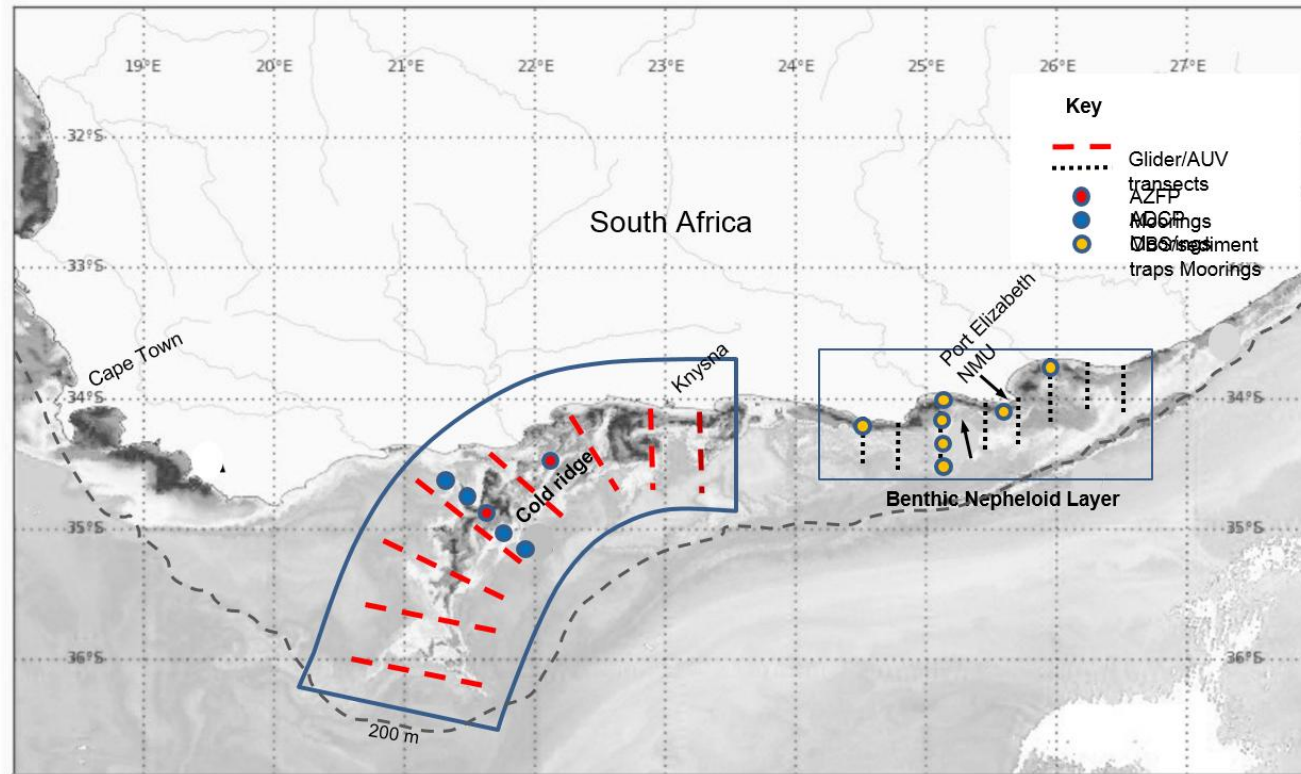
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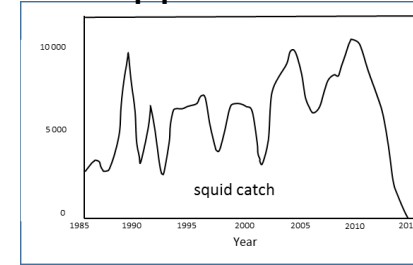
Jess Joyner (MSc)



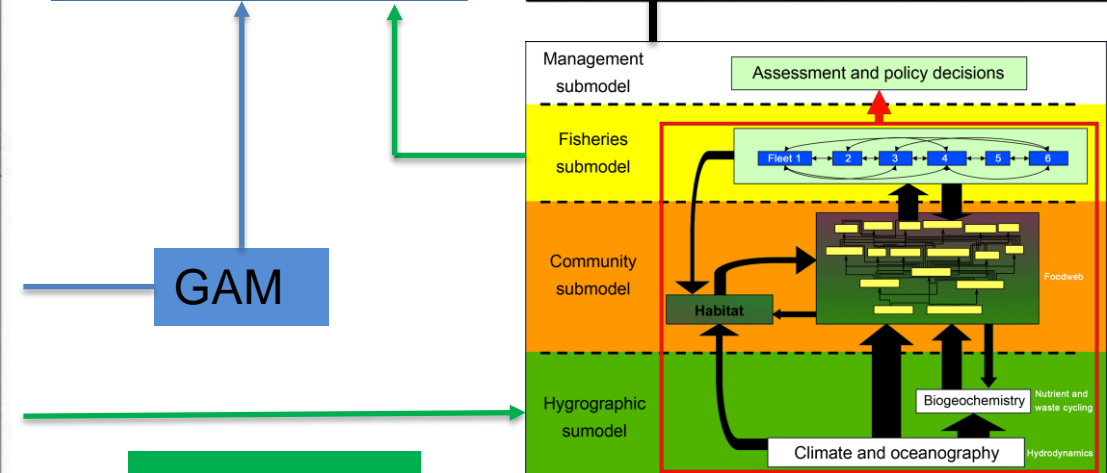
# Squid Fishery Modelling Approach



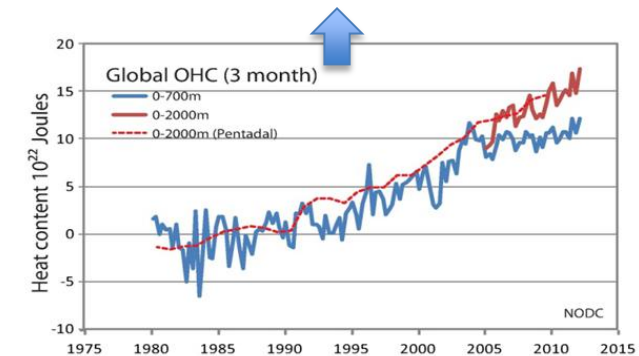
Approach 1



Approach 2



End-2-End ecosystem

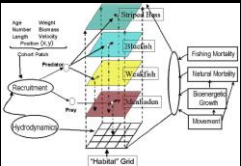


People Prediction Life Cycles Fisheries Environment

Fishery Management, Socio-economic, adaptation



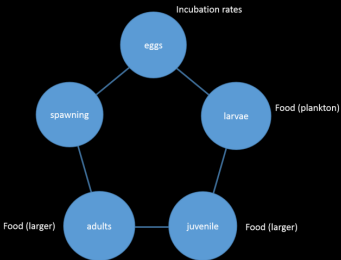
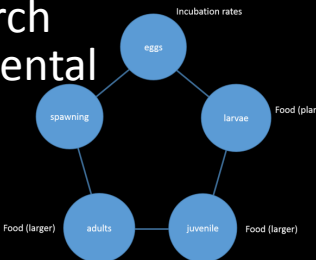
Modelling



= Prediction

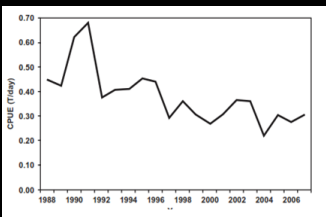
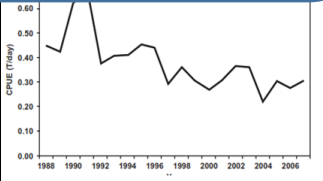
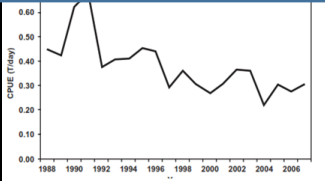
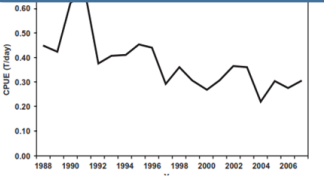
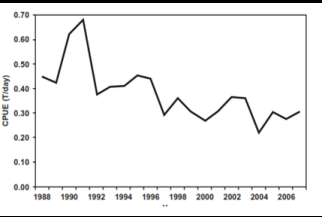
Physical, BGC, trophic , e.g. MICE

Research & Experimental



**DUMMP & ADAPT Approach**  
**Discover, Understand, Monitor, Model, Predict and Adapt**

Monitoring (Data)



Fishery

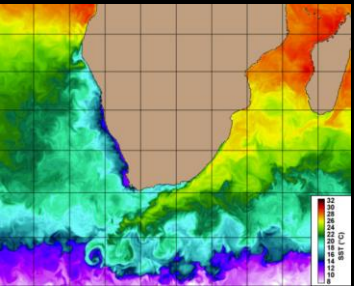
Fishery

Fishery

Fishery

Fishery

Monitor key processes (Drivers)



Coupled models



= Prediction

Level 5

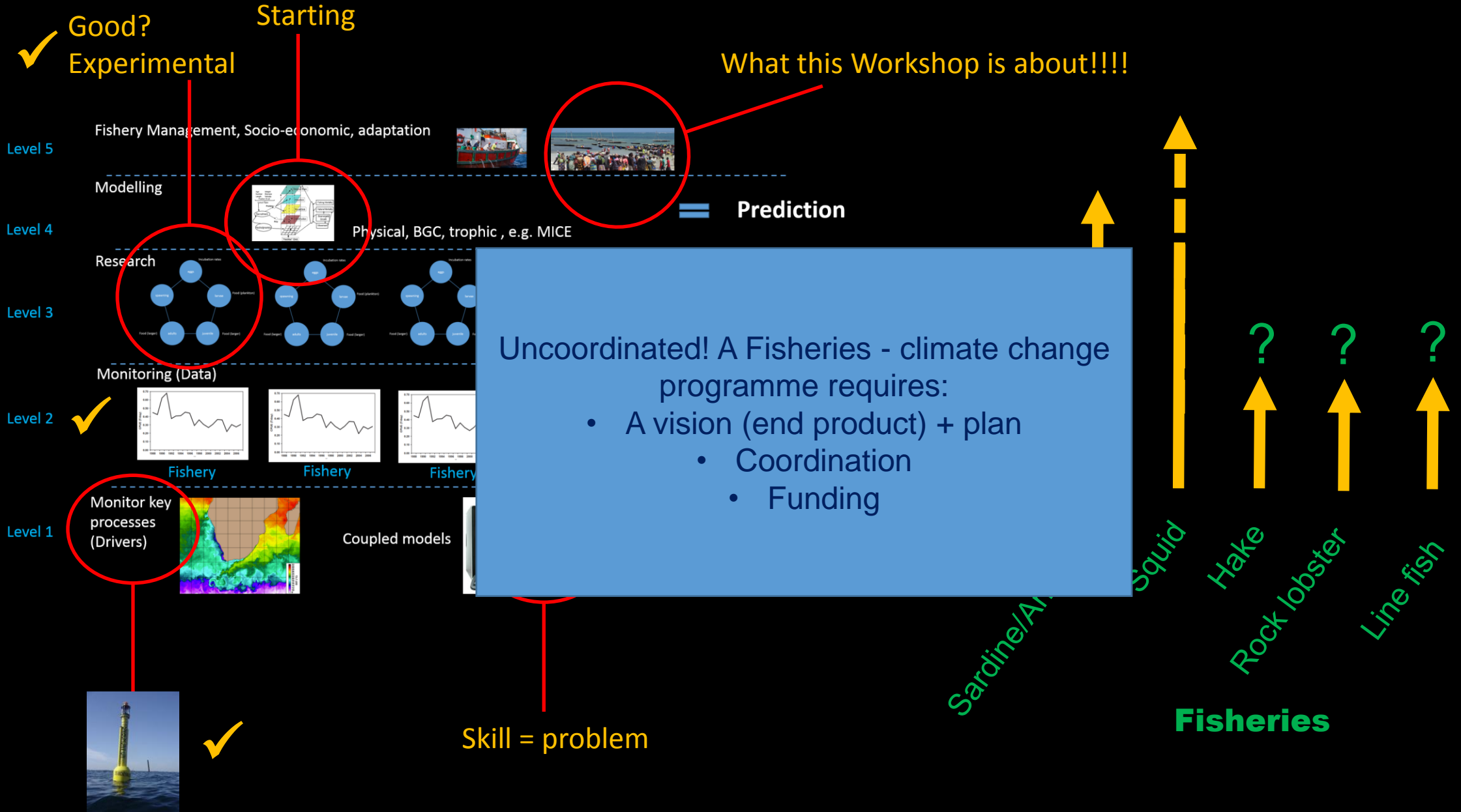
Level 4

Level 3

Level 2

Level 1

# Where are we in South Africa?



WARNING! Data base - SADCO collapsing