

GLOBAL CLIMATE CHANGE



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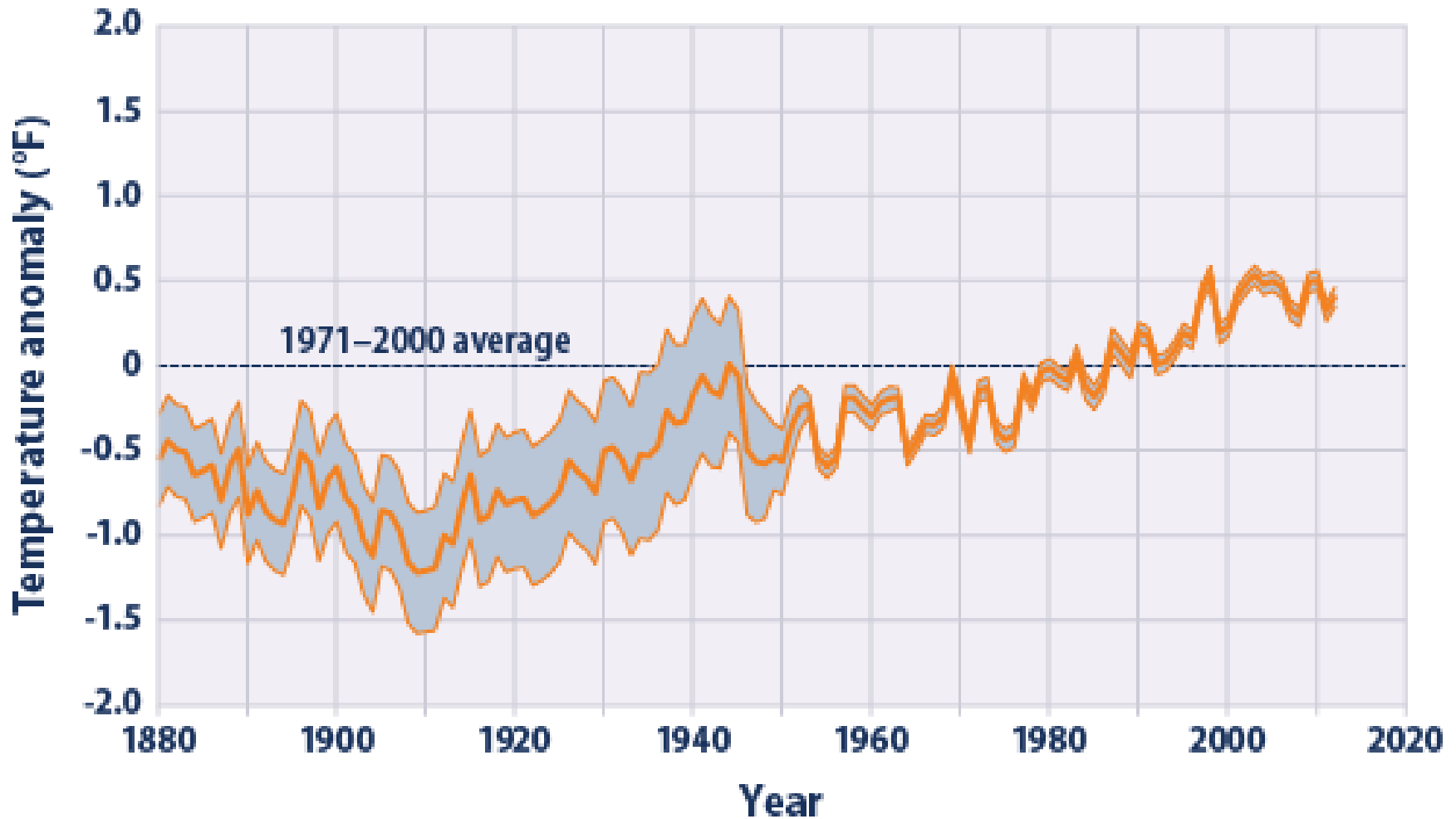


CONTENT

- What is Climate Change?
- What we know about Climate Change?
- What we need to know about Climate Change?
- What we can do to mitigate Climate Change?
- Conclusions
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- Recommendations



What is Climate Change?

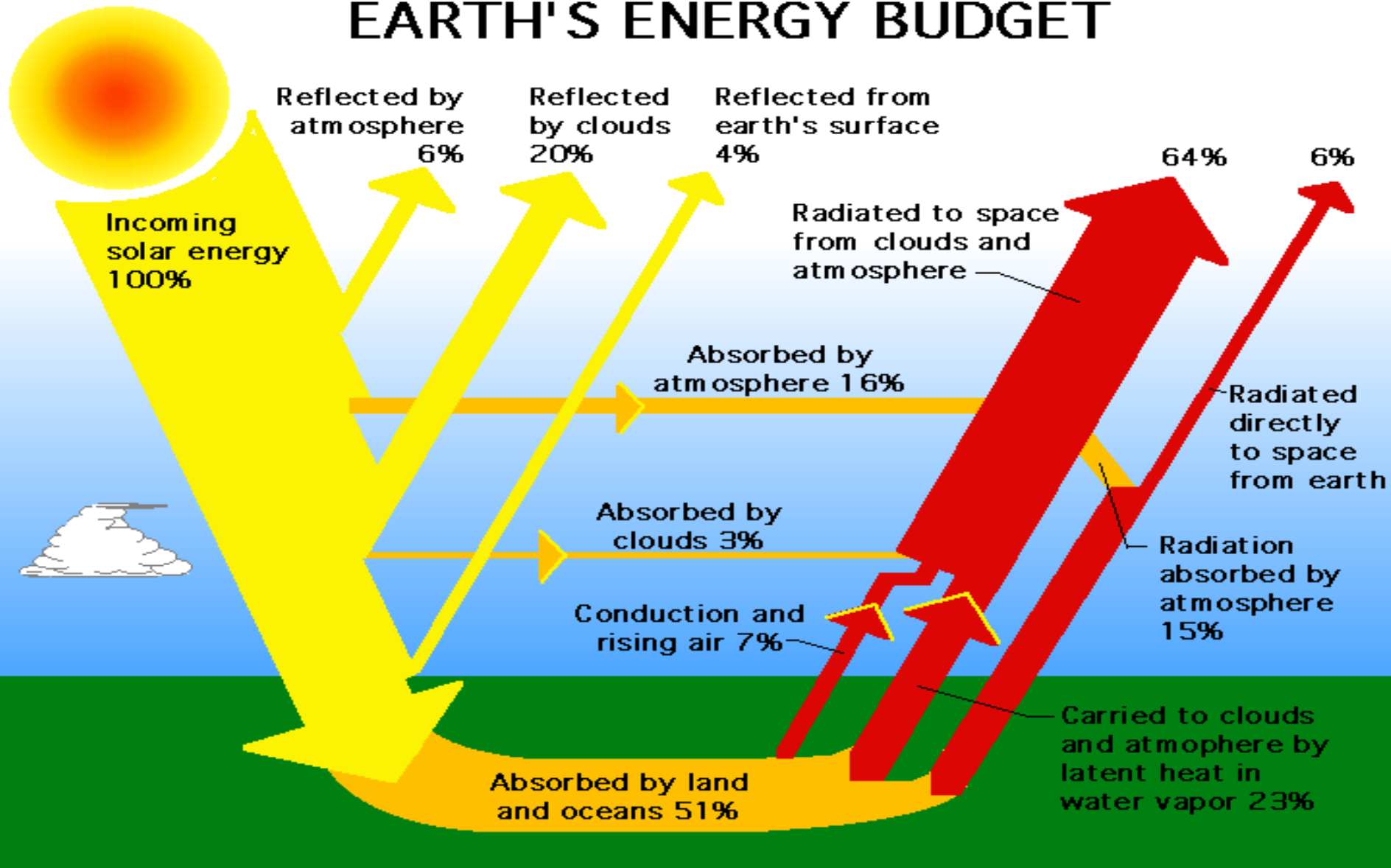


Climate change is the rise in the average temperature of Earth's atmosphere and oceans since the late 19th century and its projected continuation

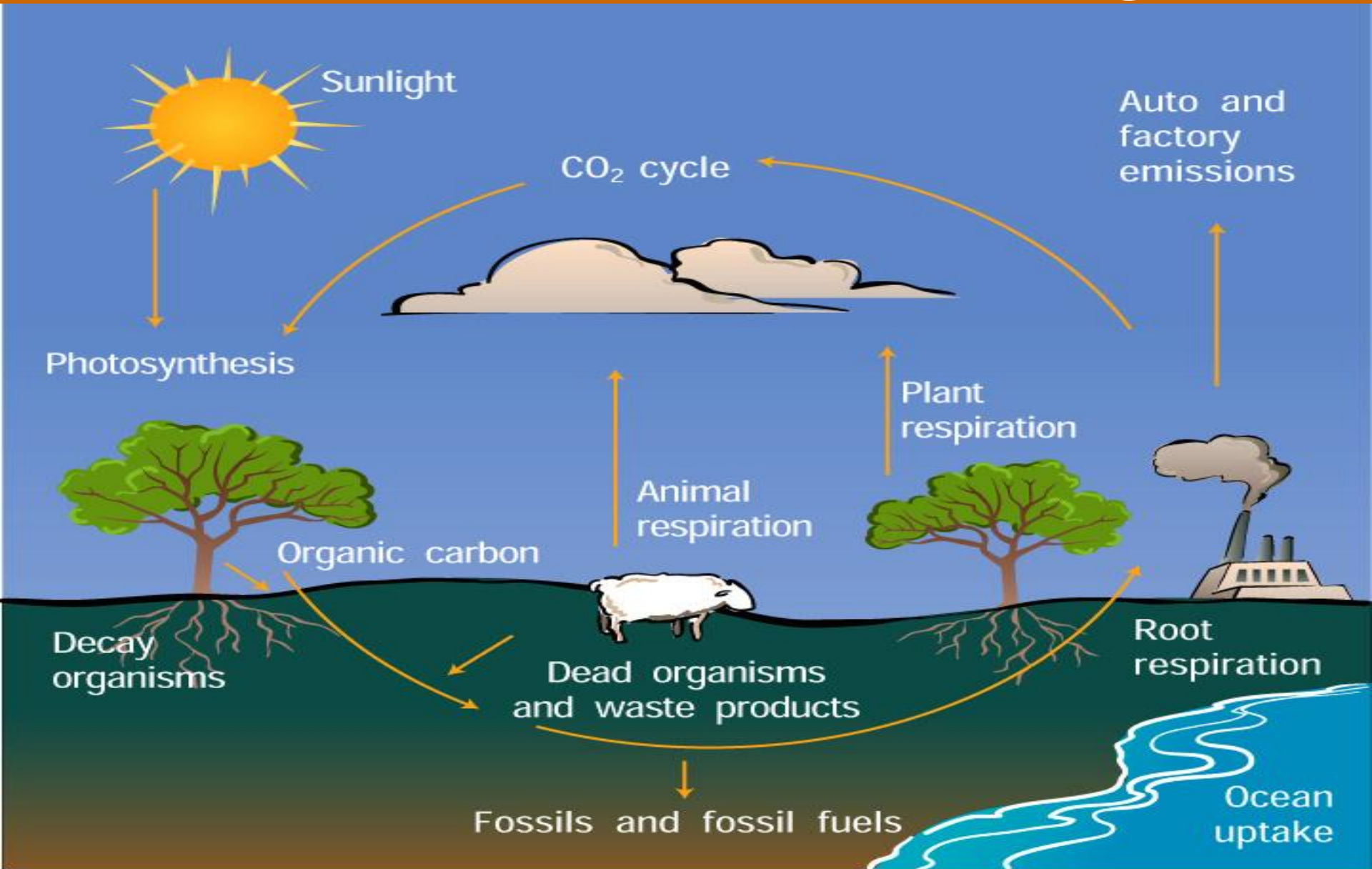


What we know about Climate change?

EARTH'S ENERGY BUDGET



What we know about Climate change?



What we know about Climate change?

Where humanity's **CO₂** comes from

91% 33.4 billion metric tonnes



photo credit: Kadda

Fossil Fuels & Cement 2010

9% 3.3 billion metric tonnes



Land Use Change 2010

Where humanity's **CO₂** goes

50% 18.4 billion metric tonnes



photo credit: Shreyash

Atmosphere 2010

26% 9.5 billion metric tonnes



Land 2010

24% 8.8 billion metric tonnes



Oceans 2010

What we know about Climate change?

Year	Carbon Emissions (bmt/year)
2012	9.7
2011	9.47
2010	9.19
2009	8.74
2008	8.77
2007	8.57
2006	8.37

Data for Global Carbon Emissions
(Fossil fuels, cement, land-use change)



Annual Global Carbon Emissions 2015 Global Carbon Budget

		Global Emissions		
	Year	Total	Fossil Fuel & Cement	Land-Use Change
	2014		9.795 GtC	~ 0.9 GtC
	2013		9.735 GtC	
	2012		9.575 GtC	
	2011		9.449 GtC	
	2010	9.995 GtC	9.140 GtC	0.855 GtC
	2009	9.567 GtC	8.700 GtC	0.867 GtC
	2008	9.666 GtC	8.740 GtC	0.926 GtC
	2007	9.472 GtC	8.532 GtC	0.940 GtC
	2006	9.355 GtC	8.363 GtC	0.992 GtC

Source Data [Global Carbon Project](#) [[.xlsx](#)]



What we know about Climate change?

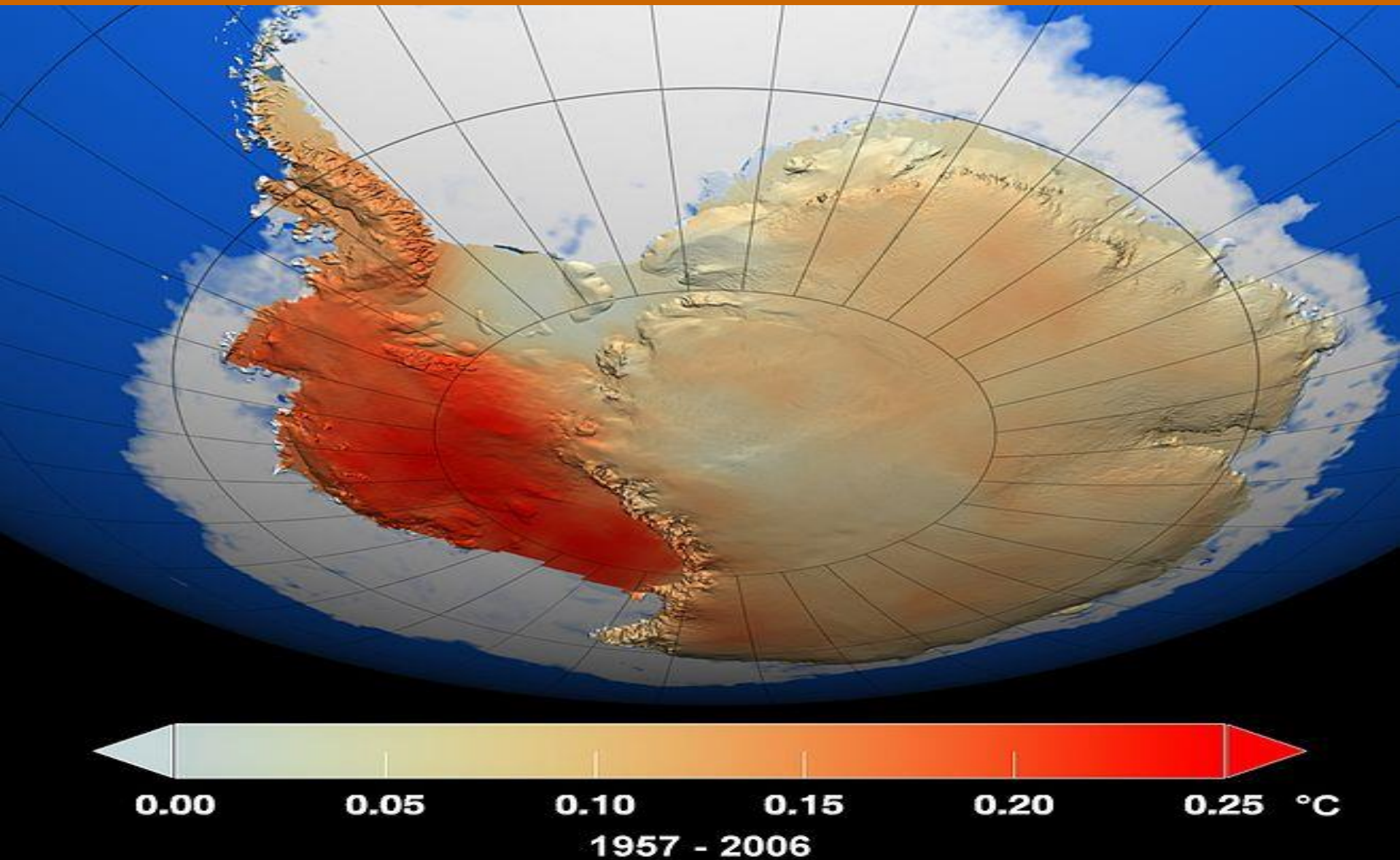


A Warmer Ocean

The ocean has absorbed 80 percent of the heat added to the Earth's system by climate change.



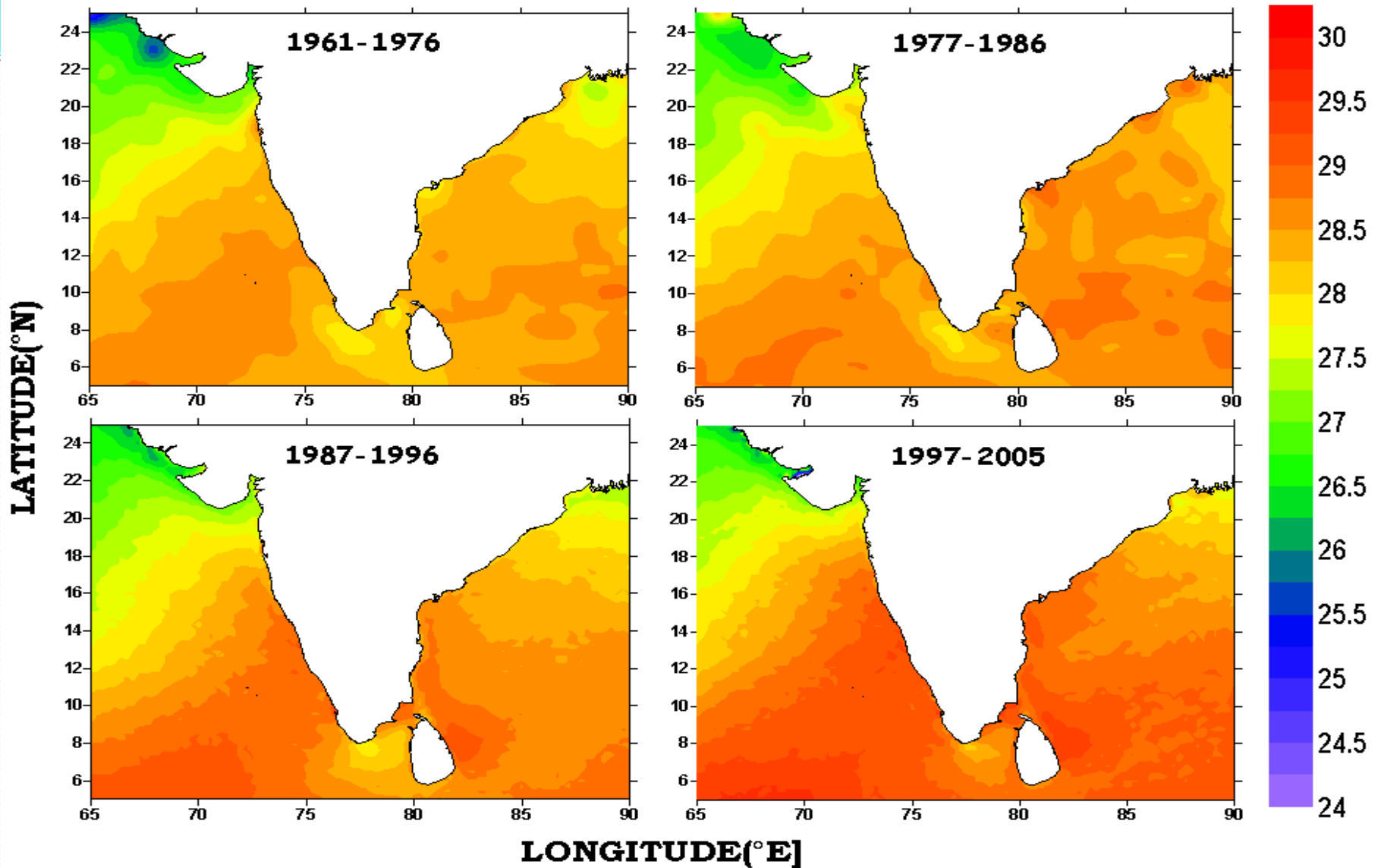
What we know about Climate change?



Analysis of weather station and satellite data, showing the continent-wide warming trend from 1957 through 2006.



What we know about Climate change?

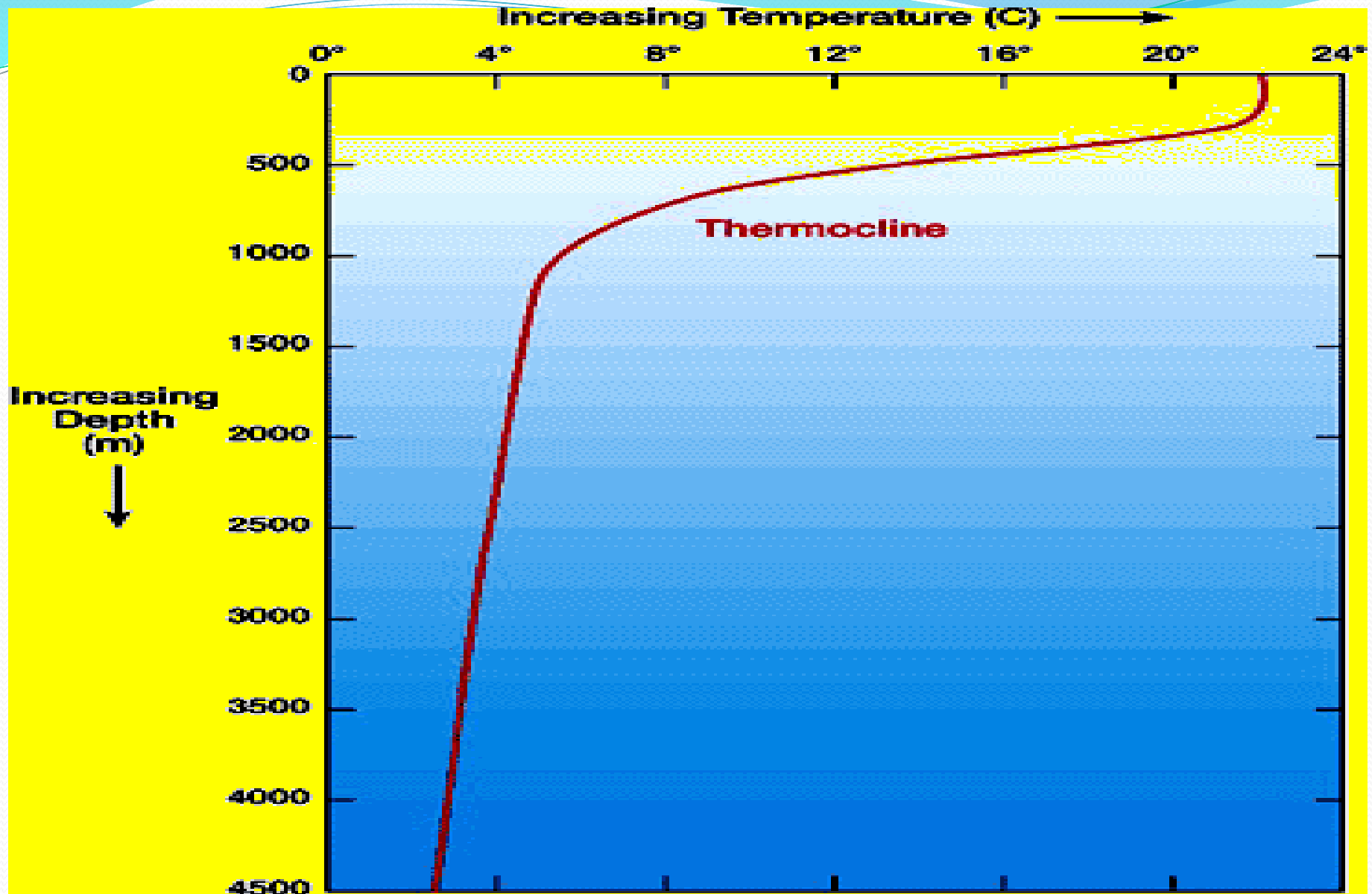


SST pattern along the Indian Coast

Data Source : ICOADS and AVHRR data from NOAA/NASA



What we know about Climate change?



Changes in Thermocline layer



What we know about Climate change?



Changes in Ocean Circulation



What we know about Climate change?



Many animals' migratory patterns can change as the currents they follow are altered.



What we know about Climate change?



© FRANK BAENSCH | bluereefphoto.org

Richard Ross, California Academy of Sciences

Many species that depend on ocean currents for reproduction and nutrients will be affected. For example, many reef-building coral and reef fish species rely on dispersal of their larvae by currents.



What we know about Climate change?



Changes in winds

The trade winds in the Pacific Ocean are weakening as a result of global warming, according to a new study that indicates changes to the region's biology are possible.



What we know about Climate change?

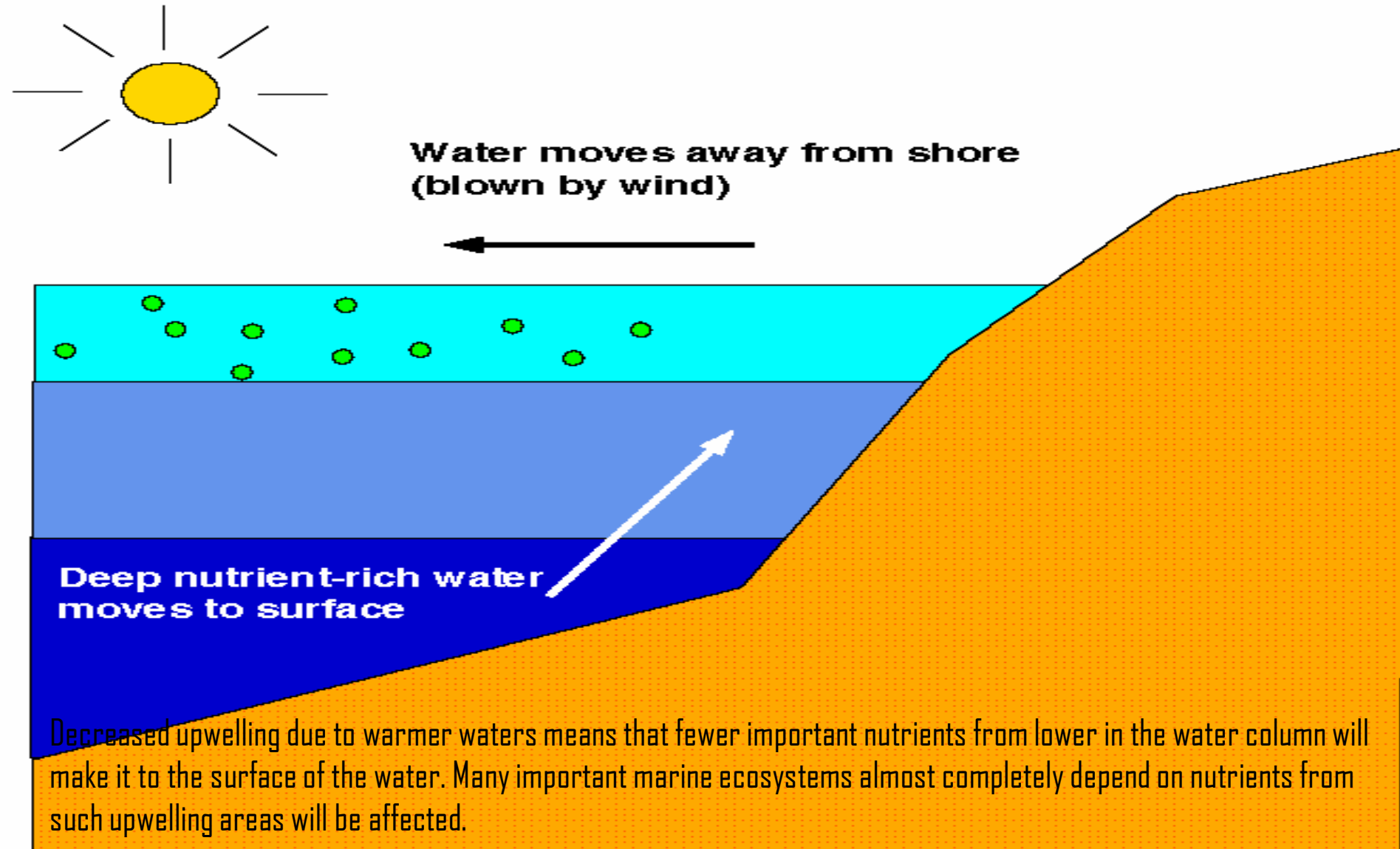


Changes in rainfall

A warmer climate spurs the evaporation of water from land and sea and allows the atmosphere to hold more moisture-thus setting the stage for more extreme precipitation.



What we know about Climate change?



Changes in coastal upwelling



What we know about Climate change?

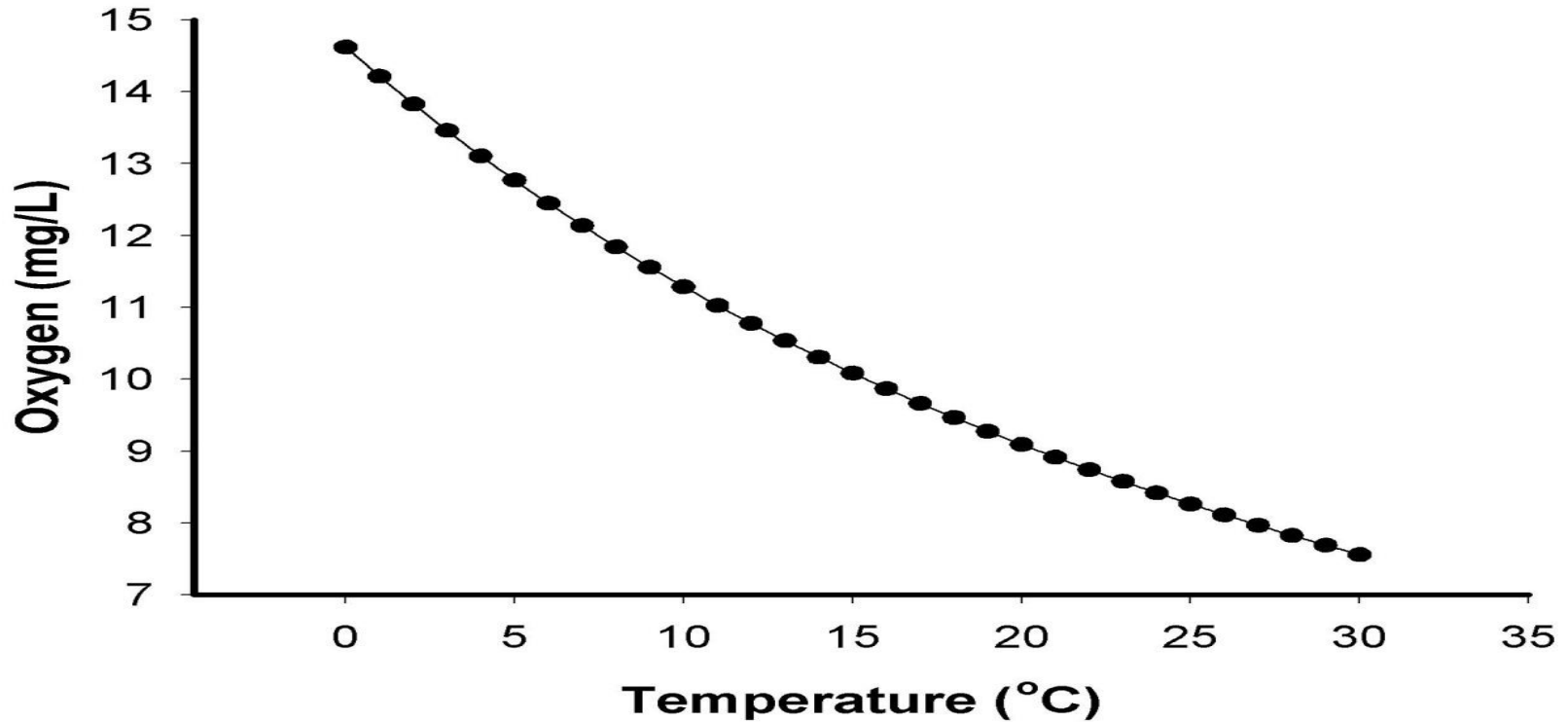


Changes in wave speed



What we know about Climate change?

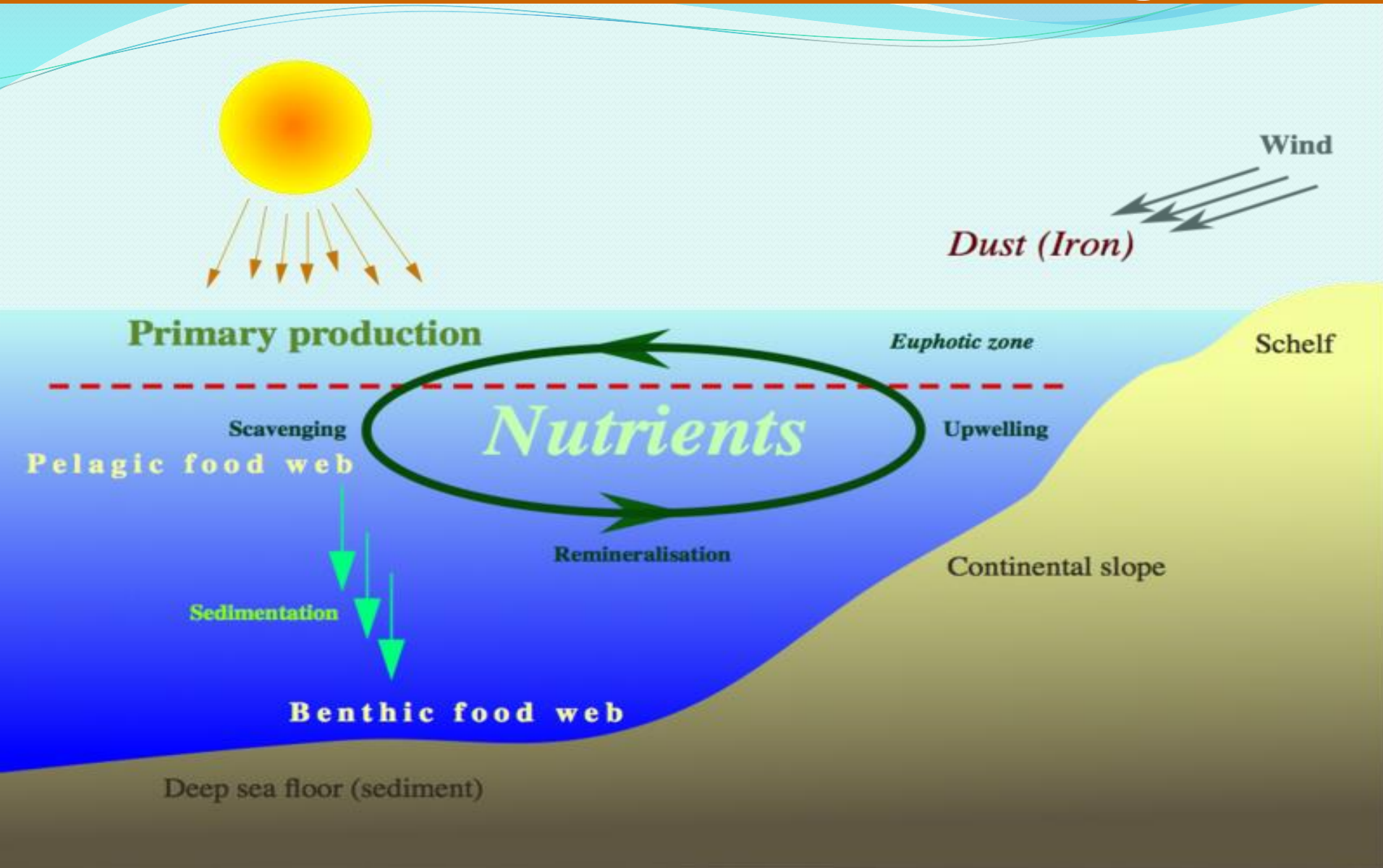
Solubility of oxygen with temperature



Changes in Dissolved oxygen



What we know about Climate change?



Changes in nutrient supply



What we know about Climate change?



Warmer waters cause coral bleaching, which in turn negatively impacts the entire coral ecosystem.



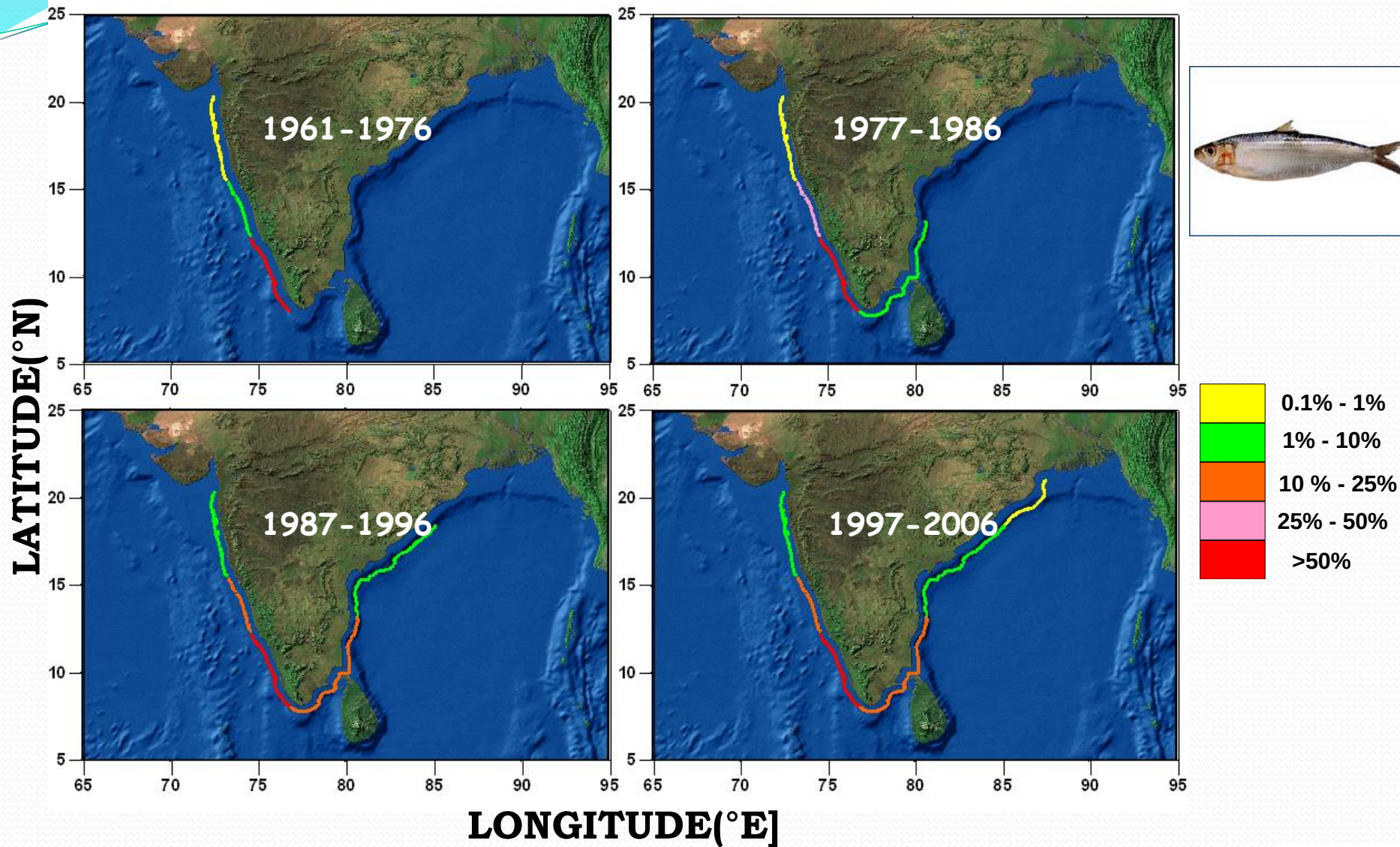
What we know about Climate change?



Coral Bleaching



What we know about Climate change?

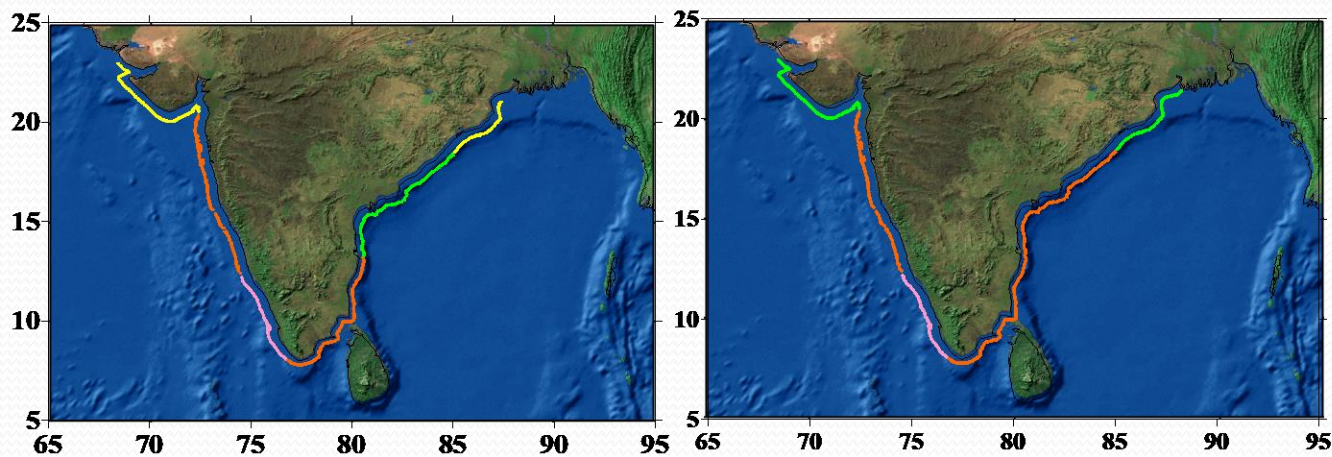
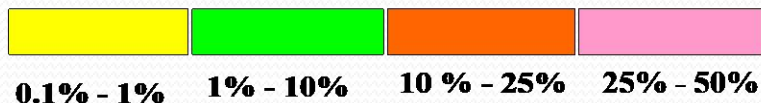
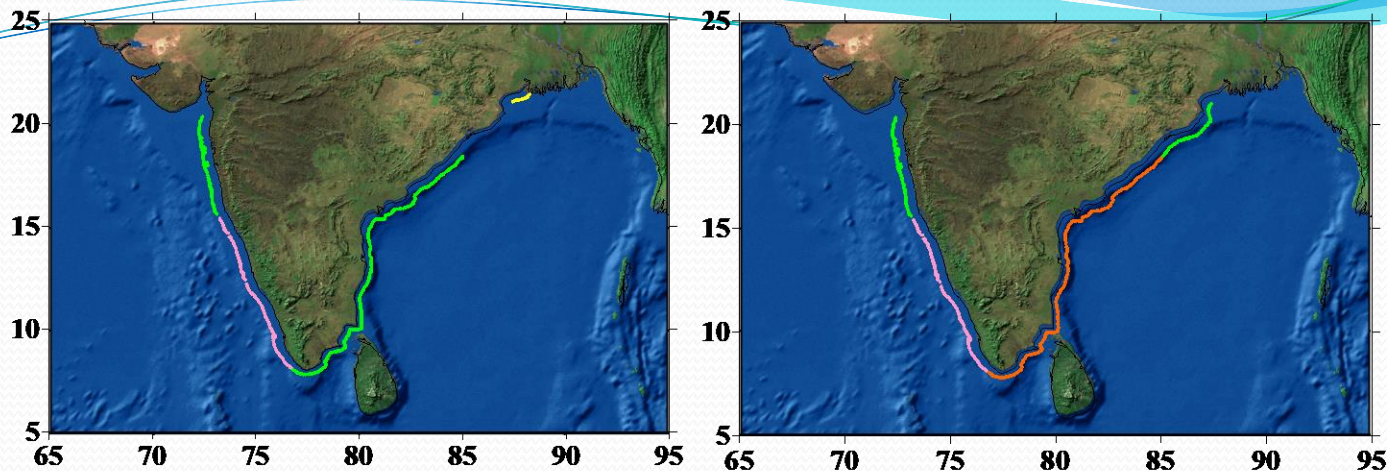


Many species will be forced to migrate so they can maintain the temperature conditions they need for feeding and reproduction.



What we know about Climate change?

Latitude (°N)



1987-96

1997-06



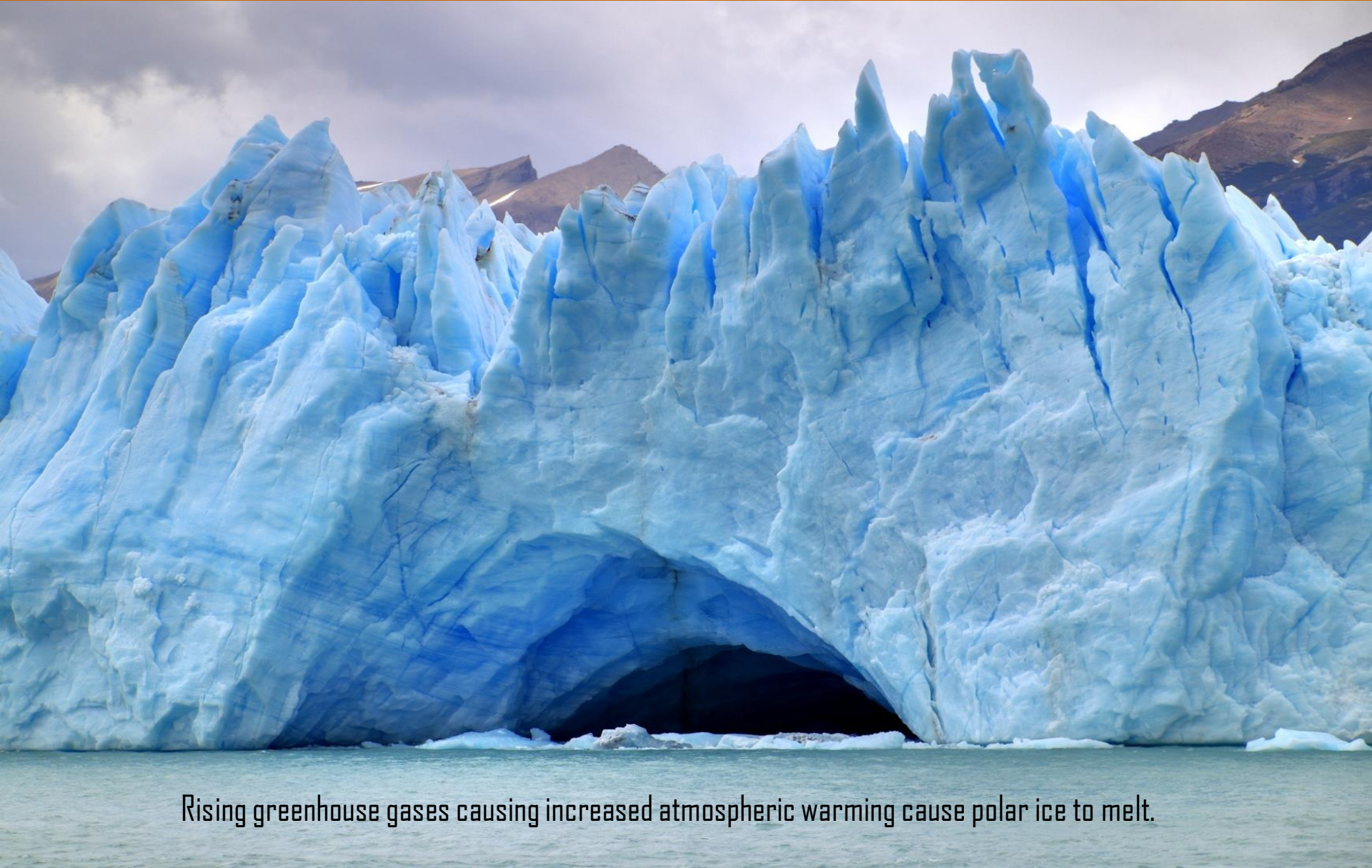
What we know about Climate change?



Alteration to water temperature can directly impact development, age of sexual maturity, timing of spawning, growth, and survival of most fish and cephalopods.



What we know about Climate change?

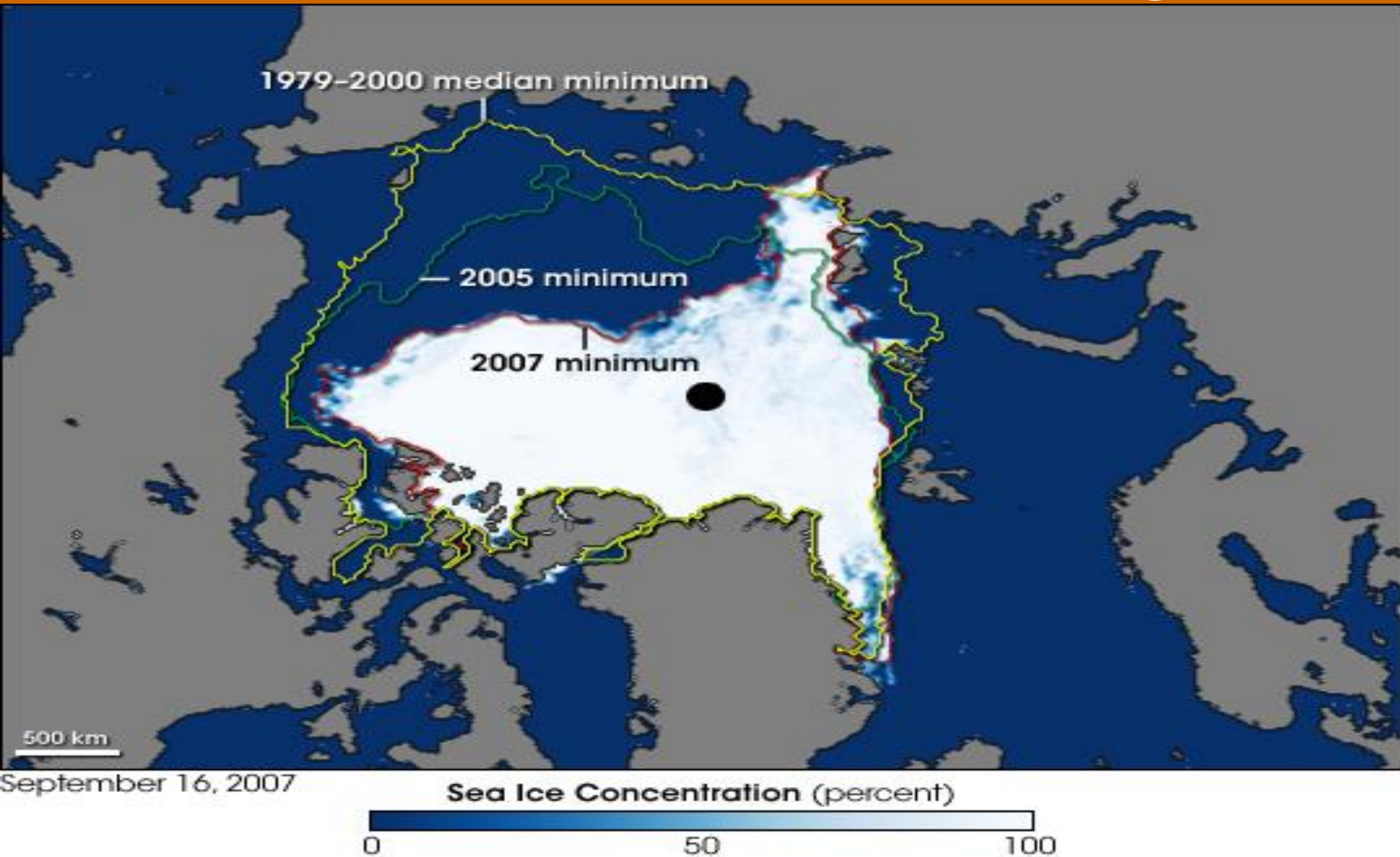


Rising greenhouse gases causing increased atmospheric warming cause polar ice to melt.

Glaciers melting



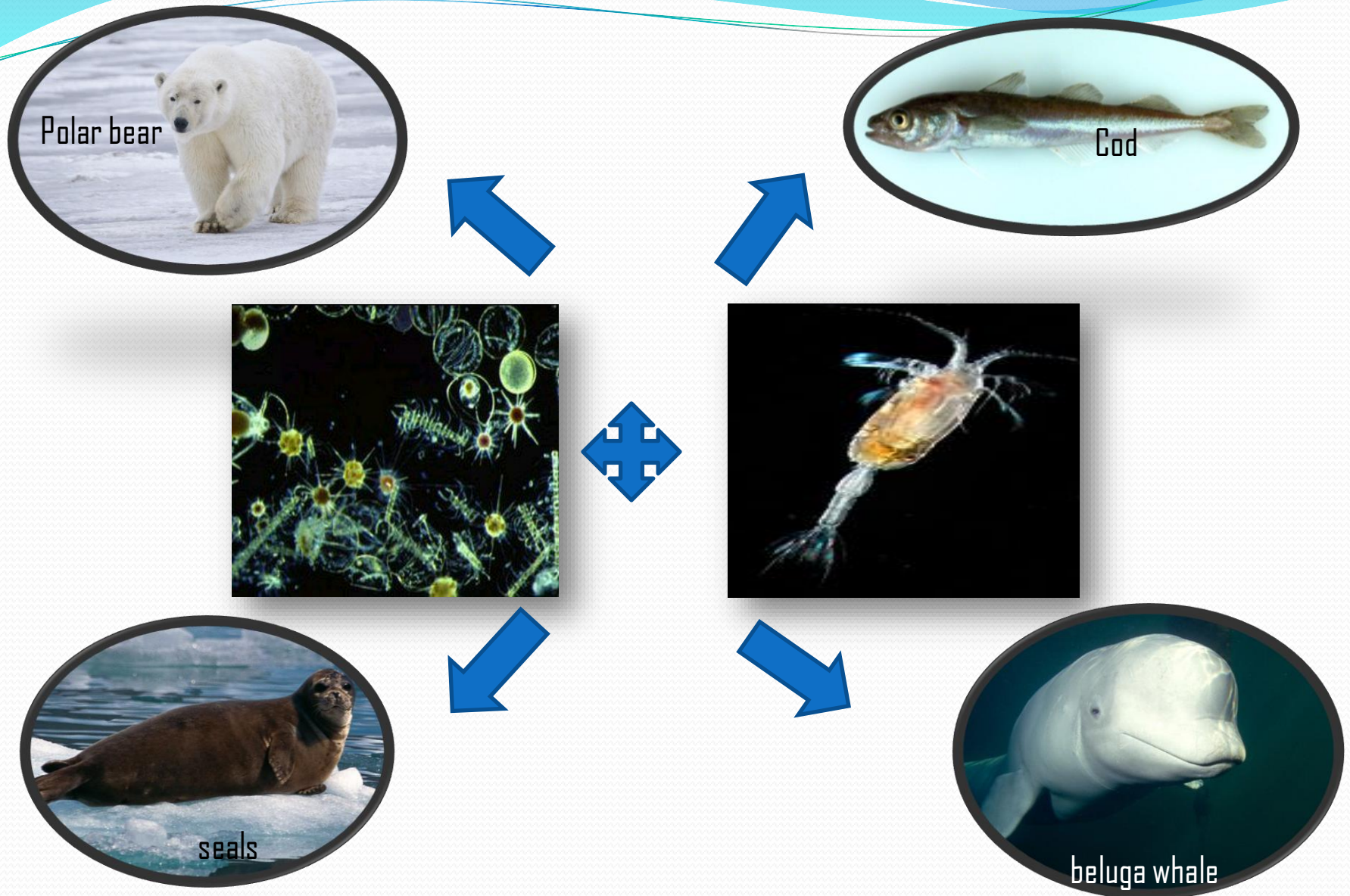
What we know about Climate change?



This image shows the Arctic as observed by the Advanced Microwave Scanning Radiometer for EOS (AMSR-E) aboard NASA's Aqua satellite on September 16, 2007. The image shows a record sea ice minimum in the Arctic.



What we know about Climate change?



As sea ice diminishes, algae diminish, then cod diminish, creating a ripple effect throughout the food web.



What we know about Climate change?



Diminished sea ice results in the loss of vital habitat for seals, walruses, polar bears, penguin, orcas, minke whales, and other megafauna in the Arctic and Antarctic.



What we know about Climate change?



Sea ice is a critical habitat for Antarctic krill, which are the food source for many seabirds and mammals in the Southern Ocean. In recent years, as sea ice has diminished, Antarctic krill populations have declined, resulting in declines in the species dependent on the krill.

Warming driven Habitat loss



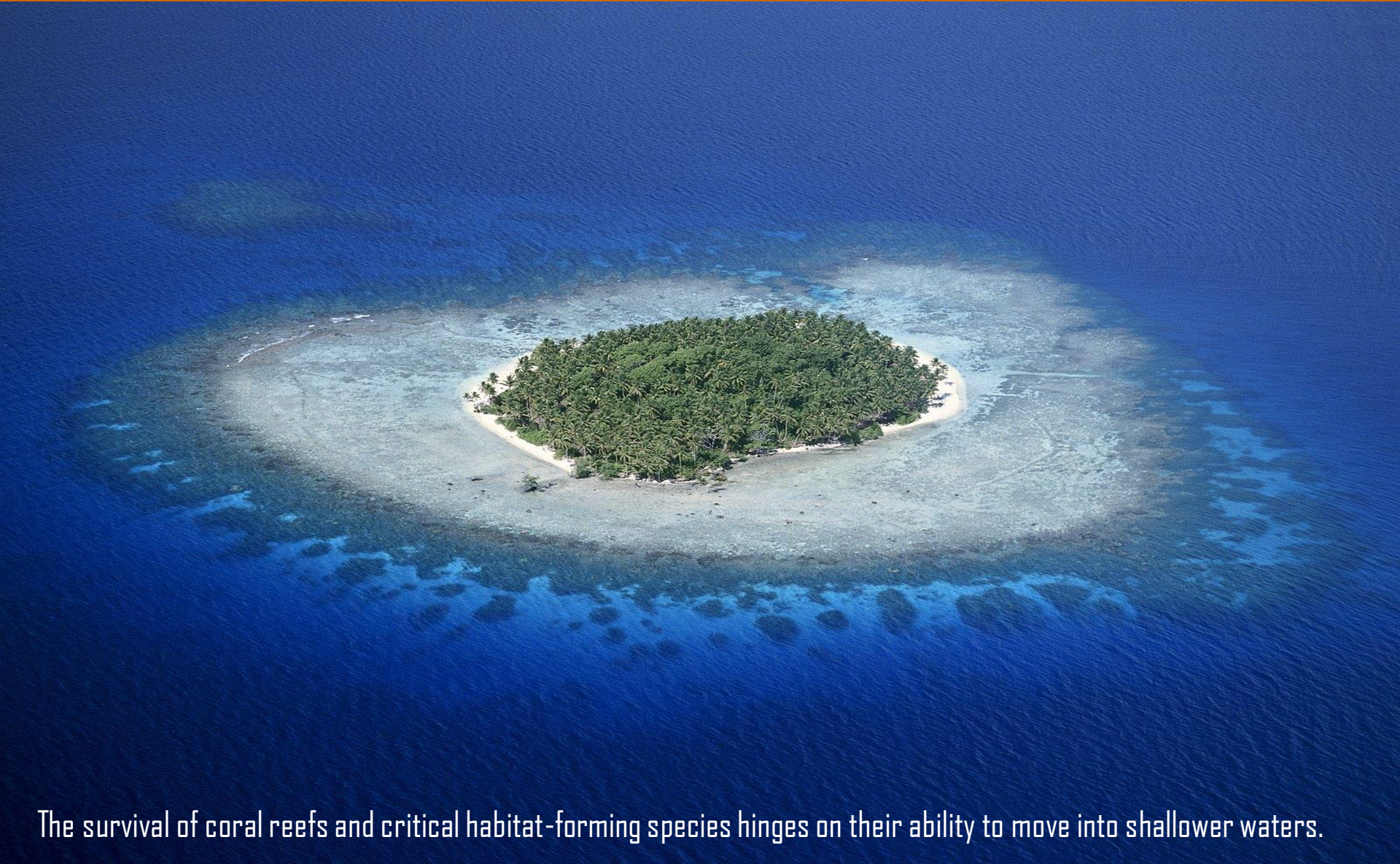
What we know about Climate change?



Global sea levels may rise by more than 60 centimetres during the next 100 years due to the melting of glaciers and polar ice, and thermal expansion of warmer water. The amount of light reaching offshore plants and algae dependent on photosynthesis could be reduced, while coastal habitats are already being flooded.



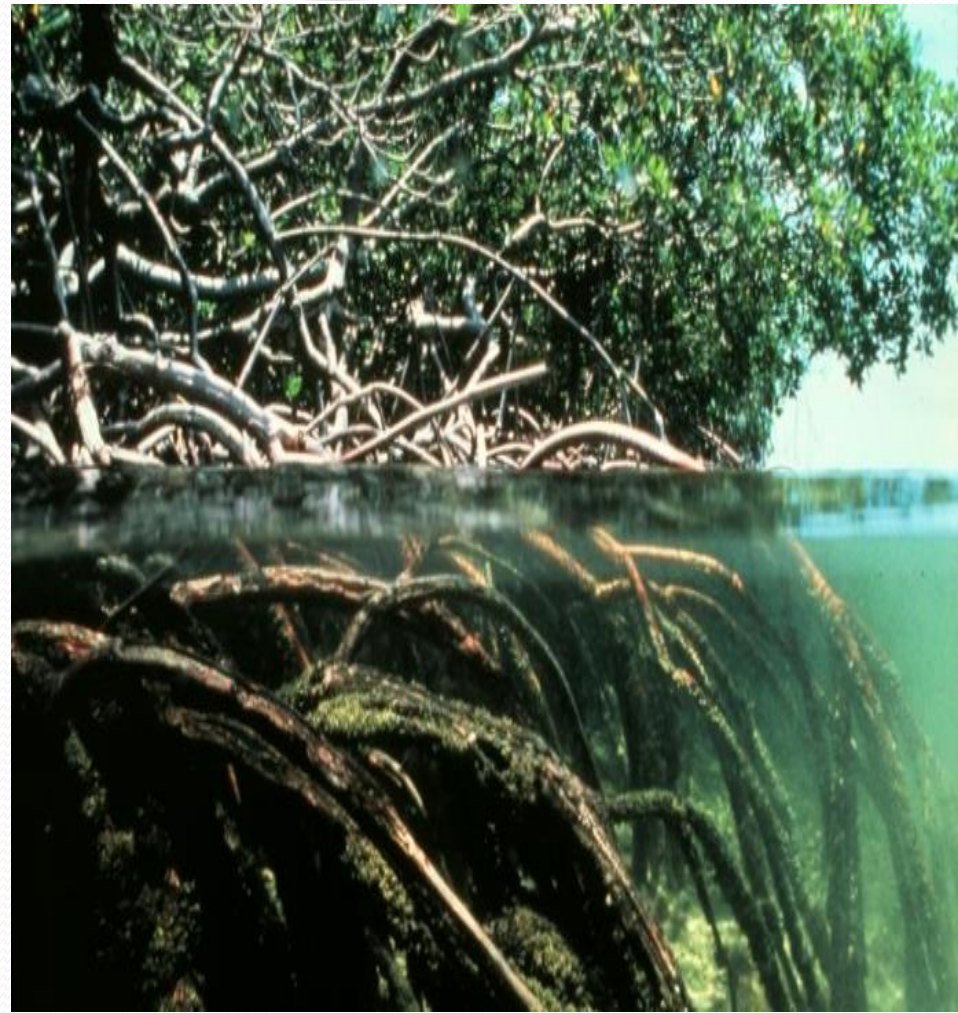
What we know about Climate change?



The survival of coral reefs and critical habitat-forming species hinges on their ability to move into shallower waters.



What we know about Climate change?



The survival of mangroves and associated species hinges on their ability to move into shallower waters.



What we know about Climate change?



The survival of sea grasses and their associated species find their way to move into shallower waters.



What we know about Climate change?



Slow-growing and slow moving species are most unlikely to be able to keep pace with the rising sea level.



What we know about Climate change?



Critical coastal habitats—for instance, sea turtle nesting beaches—are lost as the sea level rises.



What we know about Climate change?



Coastal barriers such as cliffs & sea walls stand in the way of migrating further inland.



What we know about Climate change?



Coastal structures inundated further towards inland.

Getty



What we know about Climate change?



Costal developments stand in the way of migrating further inland.



What we know about Climate change?



Costal transportations washed away.



What we know about Climate change?



Coastal flooding

What we know about Climate change?



Port & Harbors will be emptied



What we know about Climate change?



Sea level expand (Rodanthe, Cape Hatteras, North Carolina)



What we know about Climate change?



Frequent algal bloom incidence will be expected due to CC

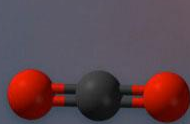


What we know about Climate change?

OCEAN ACIDIFICATION

HOW WILL CHANGES IN OCEAN CHEMISTRY AFFECT MARINE LIFE?

CO₂ absorbed from the atmosphere



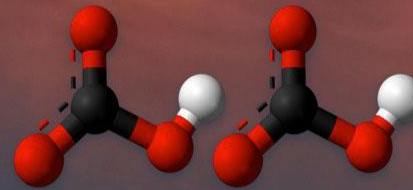
carbon dioxide



water



carbonate ion



2 bicarbonate ions

consumption of carbonate ions impedes calcification

The burning of fossil fuels that is increasing greenhouse gas levels in the atmosphere, is altering the chemical composition of seawater, making it more acidic.



What we know about Climate change?

Time	pH	pH change	Source
Pre-industrial (1700s)	8.179	0.000	Key et al (2004)
Recent past (1990s)	8.104	-0.075	Key et al (2004)
2050 (2×CO ₂ = 560 ppm)	7.949	-0.230	model
2100 (IS92a)	7.824	-0.355	model

Periodic changes in ocean pH

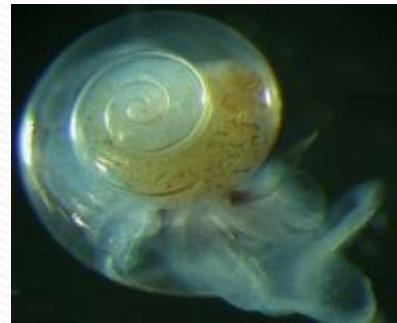
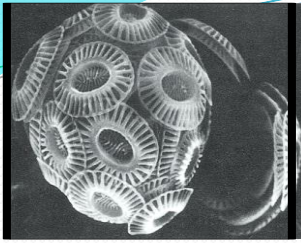


What we know about Climate change?



The burning of fossil fuels that is increasing greenhouse gas levels in the atmosphere, is also altering the chemical composition of seawater, making it more acidic. More acidity adversely impact on the calcification of coral reefs

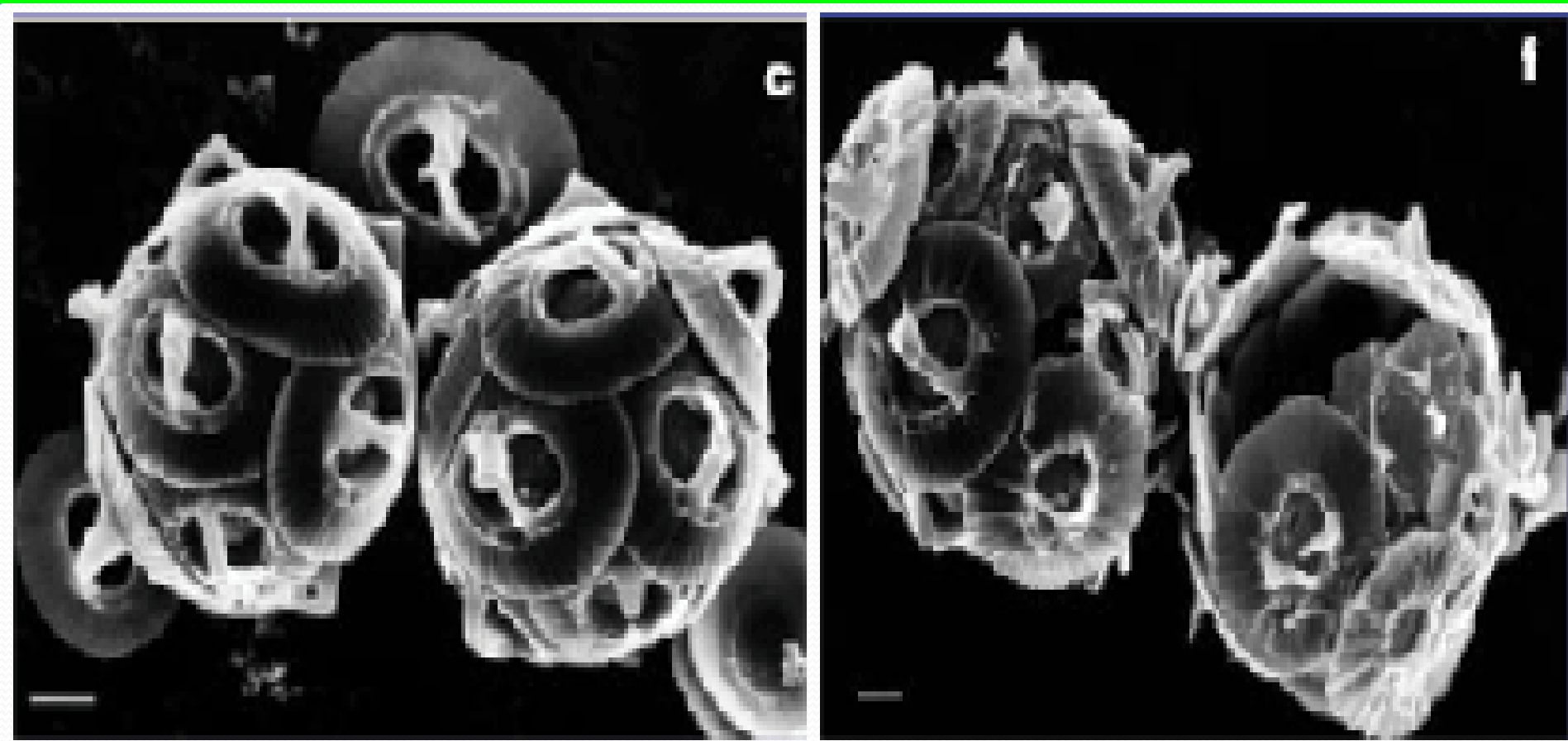
What we know about Climate change?



- Reduced calcification rates
 - Significant shift in key nutrient and trace element speciation
 - Shift in phytoplankton diversity
 - Reduced growth, production and life span of adults, juveniles & larvae
 - Reduced tolerance to other environmental fluctuations
 - Changes to fitness and survival
 - Changes to species biogeography
 - Changes to key biogeochemical cycles
 - Changes to food webs
 - Changes to ecosystem & their services
 - Uncertainties great – research required
- Meroplankton is the most sensitive to CO₂ induced OA.



What we know about Climate change?



20 to 40 percent reduction in biogenic calcification of coccolithophores, resulting in malformed calcareous plates and layers of plates and lose half their protective coatings.



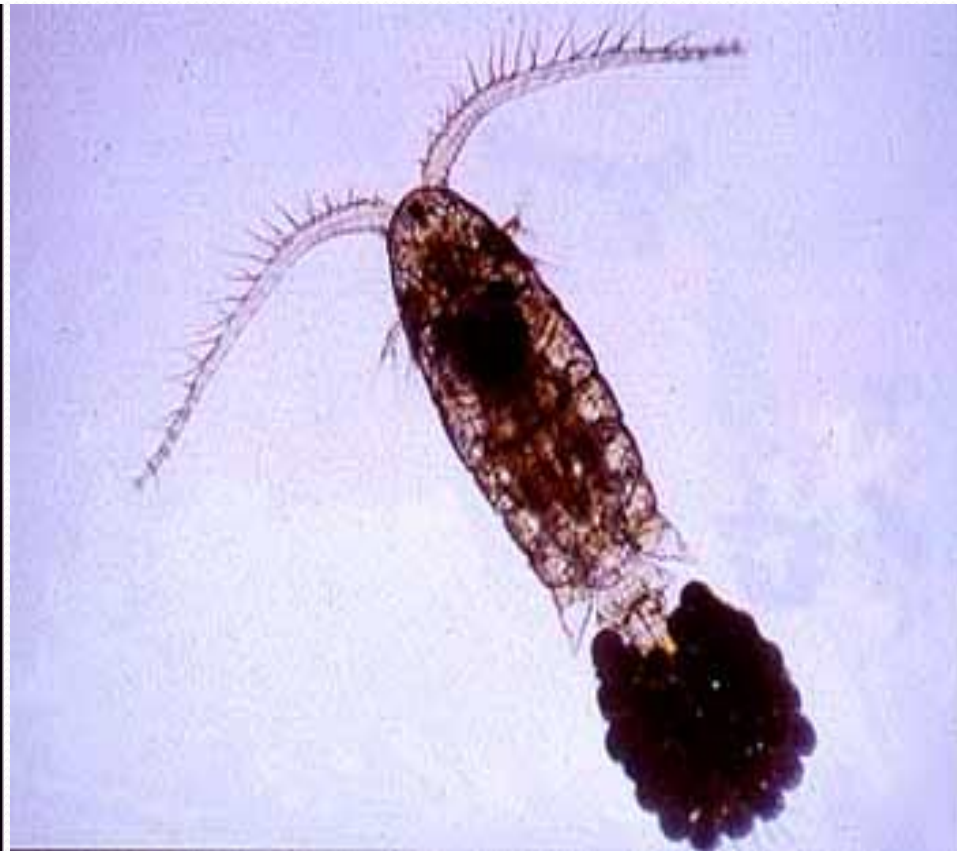
What we know about Climate change?



Pteropods are particularly threatened by ocean acidification because of the high solubility of aragonite



What we know about Climate change?

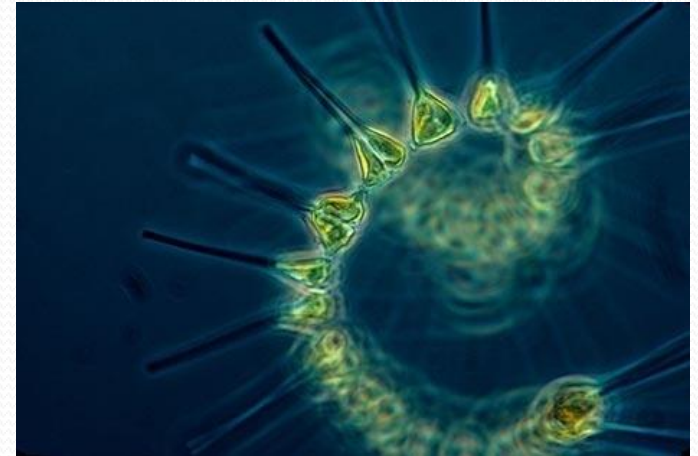
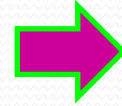


Ocean acidification showed significant negative impacts on egg hatching success and naupliar survival of copepod. Ocean acidifications decreases the ability of male copepods to detect, track and capture a female.

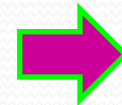


What we know about Climate change?

Changing in nitrogen and iron concentration due to CC can leads to reduction in primary production and phytoplankton growth

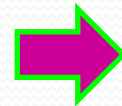


Changes in primary production can reduces the zooplankton production & growth

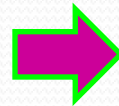


What we know about Climate change?

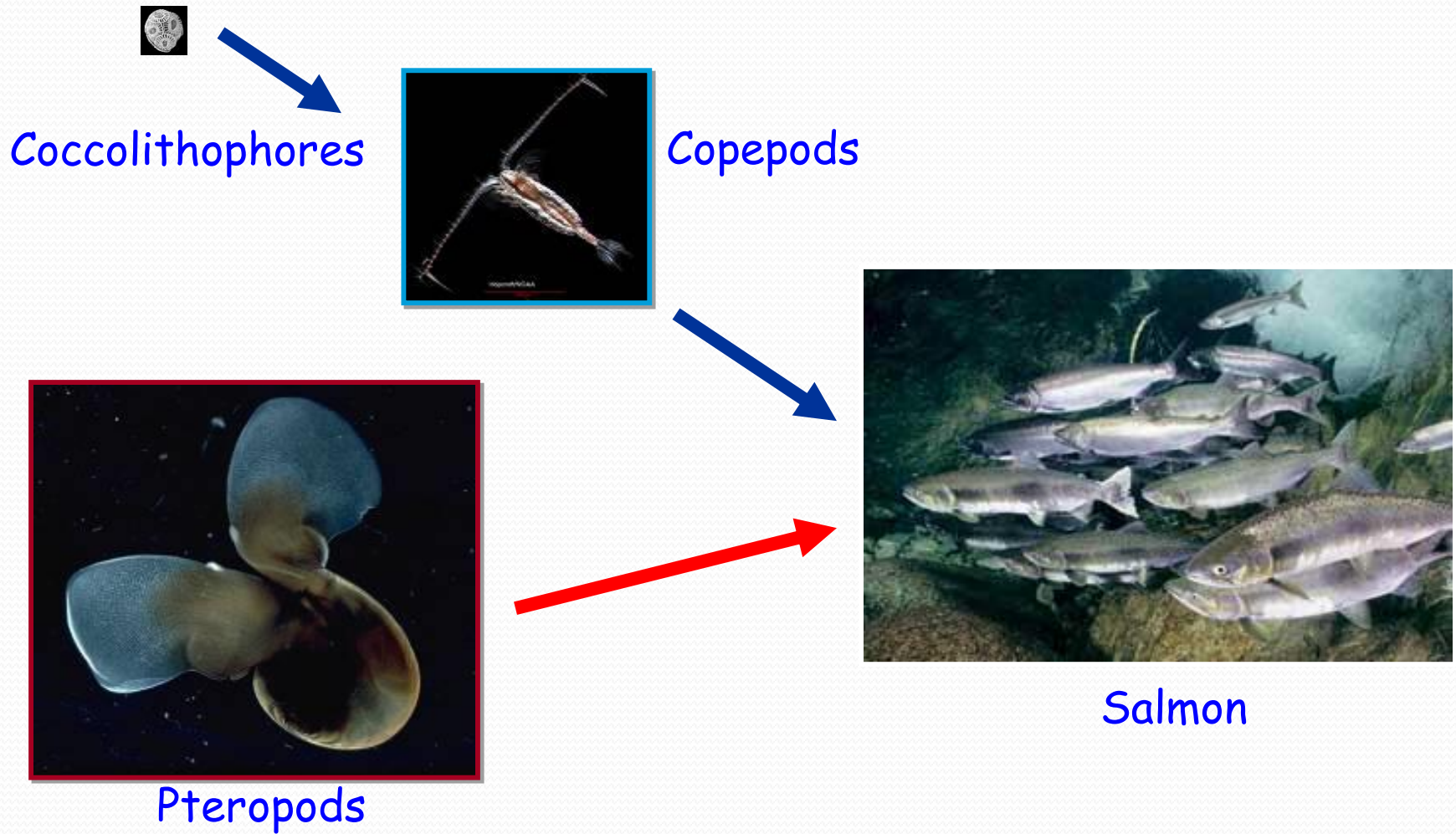
A decrease in plankton production, which could result from a CC, would mean less food for fish populations. In addition, CC are expected to increase in shift many species. And changing climate can affect the fish breeding and spawning



The eggs and larvae of many fish species are sensitive to CC. The naturally high mortality of fish larvae can be possible



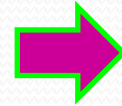
What we know about Climate change?



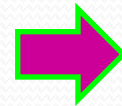
The CC and CO₂ driven ocean acidification can reduce the salmon stock which depends on calcified plankton for their food

What we know about Climate change?

Many of the seabirds that prey on fish and plankton are likely to have their food supply reduced and CC can influence the breeding and nesting of seabirds.

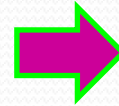


Due to glaciers melting the Penguins are facing threats due to lack of climate, habitat, foraging grounds and migration

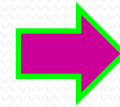


What we know about Climate change?

The predicted reduction in primary and secondary productivity that could result from CC would inevitably reach the top of the food web with supplies for marine mammals being affected.



Temperature increases in the Arctic have caused sea ice to break up earlier in the summer allowing polar bears less time to build up vital fat reserves to last them through the winter months. If this trend continues a decline in the weight of adult polar bears and birth rates, will become a serious threat to their survival.



What do we need to know?

- How will the distribution and abundance of marine species and communities alter with CC?
- Which marine species will be the best sentinels of CC impacts?
- Within large marine regions such as the south-east, south west or northwest, where are the hotspots of warming?
- How will productivity alter with CC?
- How would reduction in non-climate related stress indicators increase ecosystem resilience to CC?
- To what extent will marine CC impacts affect socially and economically important uses of marine ecosystems?



What do we need to know?

- ❖ We should understand **why some species might benefit from CC** as it is to understand **why others are negatively impacted**.
- ❖ Data available so far are clear enough to demonstrate that **we need to reduce our CO₂ emissions**. As scientists we still have to spread the word and provide new and convincing evidence about what will happen in the near future, but may be it is time to **propose some solutions**.
- ❖ In order to allow society and policy makers to address the big environmental questions, **we need good quality information to predict what will happen at the local level and develop strategies to minimise impacts**.
- ❖ We need to *identify the **species, populations and ecosystems** that are most at **risk** and **suggest some key areas for conservation efforts***.
- ❖ We should also put some more effort into the investigation of **adaptation potential**, understand **geographical variation in organism responses to CC** and try to identify and isolate **CC resistant strains/populations of keystone or economically important species**.



What can we do?

- ❖ This approach may allow us to rescue some **key ecosystems** in the future ocean and help to develop some **sustainable aquaculture approaches**.
- ❖ **Planktonic ecosystems** are complex nonlinear systems, and the consequences of Global warming on such ecosystems are largely unknown. The effect of CC on **primary producers** (**phytoplankton**) and **secondary producers** (**zooplankton**) should be thoroughly studied.
- ❖ Research into the synergistic effects of CC **on marine food webs** and **the potential transformative effects** these changes could have on marine ecosystems is urgently needed.
- ❖ It is important to have a firm understanding of the degree to which CC influences critical physiological processes such as **respiration, photosynthesis, feeding, reproduction** and **nutrient dynamics**, as these processes are important drivers of **ecosystem structure, biodiversity**, and ultimately **ecosystem health**.
- ❖ Future CC research needs include **increased resources** and efforts devoted to **lab, mesocosm**, and ***in situ experiments***, all of which will aid in determining the biological responses of marine taxa to increased CC.



What can we do?

- ❖ Determine the **direct** and **indirect effects** of **Climate change** on **marine organisms** and **ecosystems**.
- ❖ Develop **better predictive models** of **Climate change**.
- ❖ **Explore** and **implement management options** that help protect **marine ecosystems** from **Climate change**.
- ❖ Support **Climate change research legislation**.
- ❖ Support **carbon dioxide emission reductions**.



CONCLUSIONS

- ❖ More funds are needed for ocean warming research. Understanding the implications of ocean warming will facilitate the development of strategies to counteract the detrimental impacts of Climate change by the scientific and management communities.
- ❖ The only long term solution to Climate change is a substantial reduction in carbon dioxide emissions to the atmosphere.
- ❖ It is imperative that ocean warming research move forward while strategies to reduce carbon dioxide emissions are formulated and debated.



Suggestion to policy makers

- Establishing more **Protected Areas & Marine Biosphere Reserves.**
- Establishing **Gene Bank & DNA Storage** for GW sensitive species.
- Establishing **Aquariums.**
- Restoration of **Endangered species & Ecosystem.**
- Establishing more **Ecotourism & Restoration of Bioshield.**
- **Public Awareness & Incentives**
- Developing the **alternate renewable energy fuels.**
- Regular **monitoring** and **survey** of **marine resources.**
- Conservation of **Keystone Resources & Species.**
- Regular **Environmental Impact Assessment.**
- Encouraging more **Marine Research Programmes.**
- **Fellowship, Awards and Recognition.**
- Establishing **Centers of Excellence.**
- Developing **strict laws** to limit the environmental degradation.
- Alternate livelihood through **banking** and **subsidies.**
- Identify the **endangered species** & controlling harvest of the **species.**
- Develop the technology for use of **non edible fishes.**
- Increased the **aquaculture production.**
- Develop the technology for **culture of non-cultivable species.**



SUGGESTION TO STAKEHOLDERS

- ❖ **Deforestation** and **conversion of crop land** should be stopped.
- ❖ **Chemical** and **pesticides** should be controlled by replacing by **organic fertilizers**.
- ❖ **Industrial** and **domestic wastes** should be properly treated before discharges into the **sea** or **river**.
- ❖ **CRZ Act** must be followed when establishing the road, restaurant, commercial shops and residential building.
- ❖ **Dredging** and **mining** activities should be avoided at or nearby **sensitive ecosystems**.
- ❖ Dumping of **ship wastes, plastics, oil** and **toxic substances** into the sea should be stopped.
- ❖ Do not cut the **mangroves** & Don't allow the cattle grazing in **mangrove forest**.



RECOMMENDATIONS

- ❖ So far, surveys and inventorization have been conducted only in **selected areas** and only on **major commercial species**. So complete survey on all **marine flora** and **fauna** is needed.
- ❖ There is a demand for **Marine Taxonomist**. So expertise in taxonomy should be appointed and youngsters should be encouraged for **taxonomical investigation**.
- ❖ **Marine Biodiversity & Taxonomy** is being taught as subject in the curricula of **school** and **undergraduate** level.
- ❖ The separate courses should be started in undergraduate and postgraduate level on **Marine Biodiversity** and **Conservation**.
- ❖ More **employment & Research** opportunities should be created to who study **Marine Science, Marine Biology, Marine Biodiversity & Oceanography, Oceanography** and **Aquaculture**.



RECOMMENDATIONS

- ❖ The effective **management** and **conservation programmes** is highly essential.
- ❖ To involve **public, better awareness programmes** are the need of the hour.
- ❖ The **stakeholders** should be involved in **sustainable utilization of marine resources**.
- ❖ Conservation of **nature** and **natural resources** must be followed.
- ❖ **Fisherman's** and other **stakeholders** should be involved in other **alternate livelihood** for **better conservation**.
- ❖ The **individual** and **groups** must involves in **restoration of plants** to reduce the **carbon level** in the atmosphere.
- ❖ **Home gardening** and **roof gardening** can be helpful to solve **Climate change** related issues besides biodiversity conservation.
- ❖ Use of **arid salt land** for **salt tolerant crop** and **bio-shield** should be practiced.
- ❖ **Microalgae culture** on **house roofs** and **coastal areas** are considered to be a potential remedial measures for Climate change.



How do meet the challenge?

Avoid past mistakes

Ambitious implementation of the conservation policies

Greening of the environment

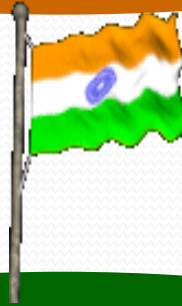
Eliminating CO₂

Fighting Climate change



How do meet the challenge?

We need political will
and ambition!



We need to go from
words to action for true
conservation!





SAVE OCEAN SERVE NATION

**BIODIVERSITY IS LIFE
BIODIVERSITY IS OUR LIFE**

Thanks

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