

CMFRI

Winter School on
Impact of Climate Change
on Indian Marine Fisheries

Lecture Notes

Part 2

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RESPONSE OF THE GLOBAL WARMING AND HUMAN-INDUCED CLIMATE CHANGE IN THE ARABIAN SEA



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In recent years we are witnessing an unprecedented increase in natural disasters not only in India, but all over the world. On 26th December 2004 the fourth largest earthquake of this century occurred off the coast of Northern Sumatra which generated the Tsunami that affected the Indian Ocean rim countries. Close to the heel of this comes the torrential rainfall anomaly in Dhaka with 156 mm of rainfall within 24 hours in early July 2005. Later, on 26 July 2005, Mumbai experienced unique type of cloud burst with very intense shower lasting 12 to 18 hours recording 95 cm of rainfall. Another month later comes a series of Hurricanes from the Atlantic Ocean caused destruction to USA. A category 5 Katrina with a wind speed of 175 miles/h during late August 2005 followed by category 2 Rita in late September 2005 with a wind speed of 96-110 miles/h, and finally in late October 2005 category 4 Wilma with wind speed of 145 miles/h.

Are the above natural disasters isolated and spatially-separated phenomena or are we experiencing a more organized and globally connected climate shift? Many climate researchers and scientists think we are experiencing a global climate change induced by human activity. Climate variability can result either from natural (periodic or long-term changes) or human-induced factors such as change in the concentrations of green house gases (see figure 1) and land use pattern.

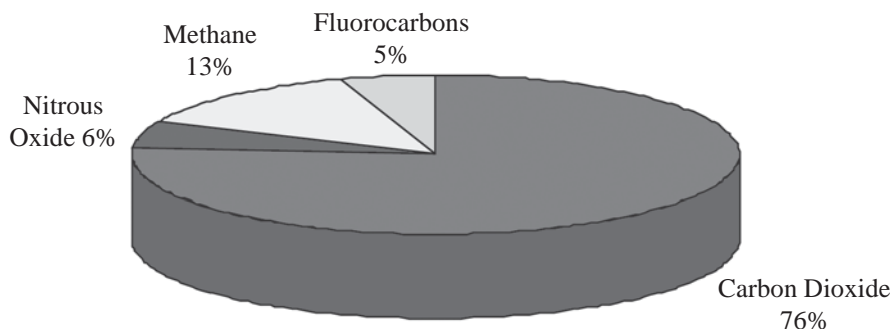


Figure 1. Percentage distribution of green house gases in the earth's atmosphere (taken from internet).

Note that though the percentage of the green house gases in the total composition of the atmosphere is very small, as given in Table 1, they play a vital role in regulating the temperature of the earth-atmosphere system.

Table 1 below give the average composition of the atmosphere up to an altitude of 25 km.* Variable gases (taken from internet)

Gas Name	Chemical Formula	Percent Volume
Nitrogen	N ₂	78.08%
Oxygen	O ₂	20.95%
*Water	H ₂ O	0 to 4%
Argon	Ar	0.93%
*Carbon Dioxide	CO ₂	0.0360%
Neon	Ne	0.0018%
Helium	He	0.0005%
*Methane	CH ₄	0.00017%
Hydrogen	H ₂	0.00005%
*Nitrous Oxide	N ₂ O	0.00003%
*Ozone	O ₃	0.000004%

The rising greenhouse gas concentrations, CO₂ for example, in the atmosphere due to the increased use of fossil fuel are trapping more infra-red radiation near the earth surface and leading to the increase in the earth's temperature as shown in the figure 1.

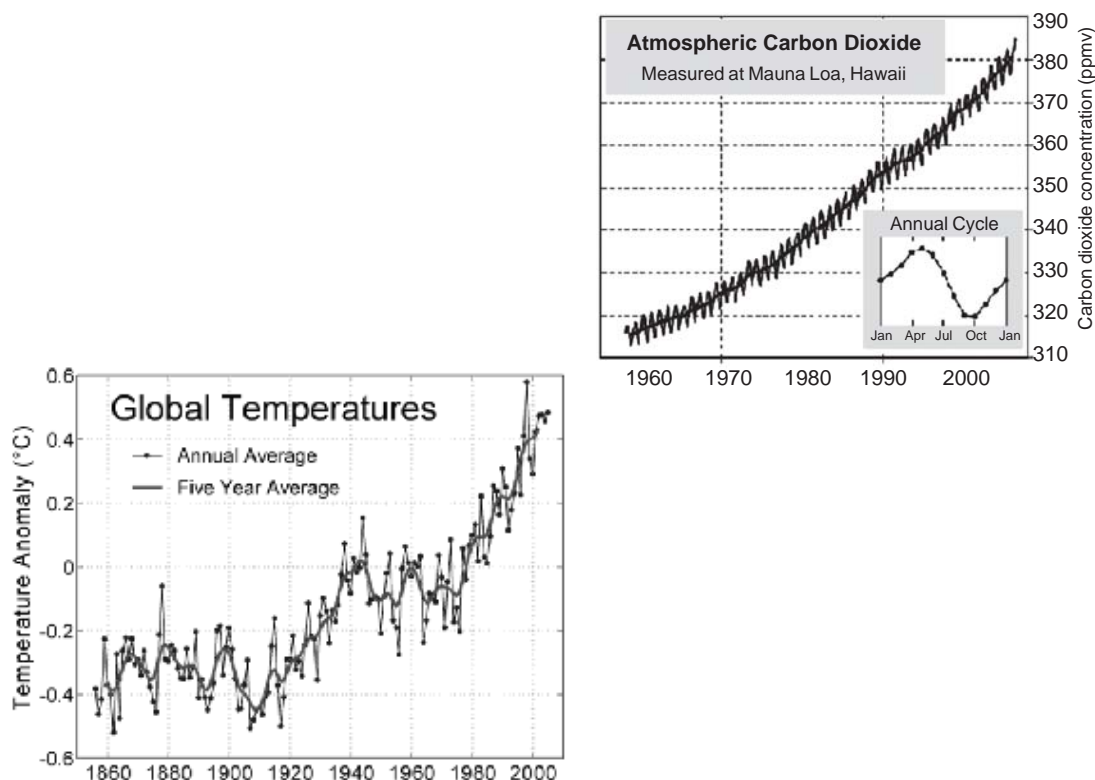


Figure 1. Picture showing (left) global temperature and (right) atmospheric carbon dioxide concentration measured at Manua, Hawaii (taken from internet).

Another indication of this global warming is the decline of perennial ice cover in the Arctic region shown in figure 2.

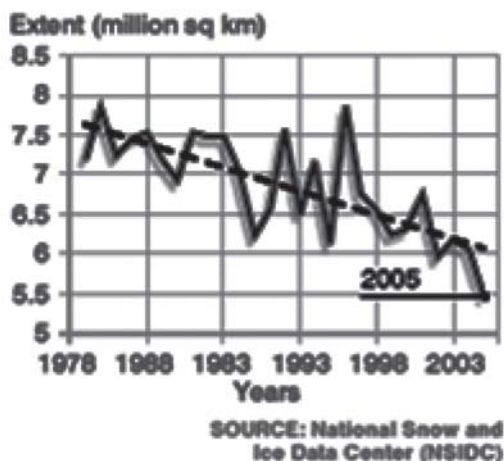


Figure 2. Arctic ice cover (left) and its changes over the years (right) (taken from internet).

Initially it was thought that oceans, being a reservoir of CO₂, are capable of absorbing the excess CO₂ released by human-activity. But the studies showed that ocean is absorbing only about half of the anthropogenically released CO₂.

Thus, one of the major concerns of the earth-system scientist of present day is the effect of global warming triggered by the ever increasing levels of atmospheric CO₂ due to anthropogenic activities. Human-induced global warming has different manifestations such as increased number and intensity of tropical cyclones, changing pattern rainfall and draught, increase in vector borne deceases, etc. Recent studies shows that the warming is not confined to the ocean surface alone but also started penetrating into deep oceans and the response of different ocean and the adjacent land mass to global warming and climate change is different. For example Rupa Kumar *et al.* (2002) reported an increase of 0.5oC in the sea surface temperature (SST) per 100 years in the Indian Ocean, while it was 0.4oC per 100 years for both the Arabian Sea and the Bay of Bengal (see figure 3). Recent study (Prasanna Kumar *et al.* 2008) showed that the Arabian Sea is responding to human-induced climate change and its effect is also felt in the adjacent Indian landmass. This will be discussed in detail in the presentation.

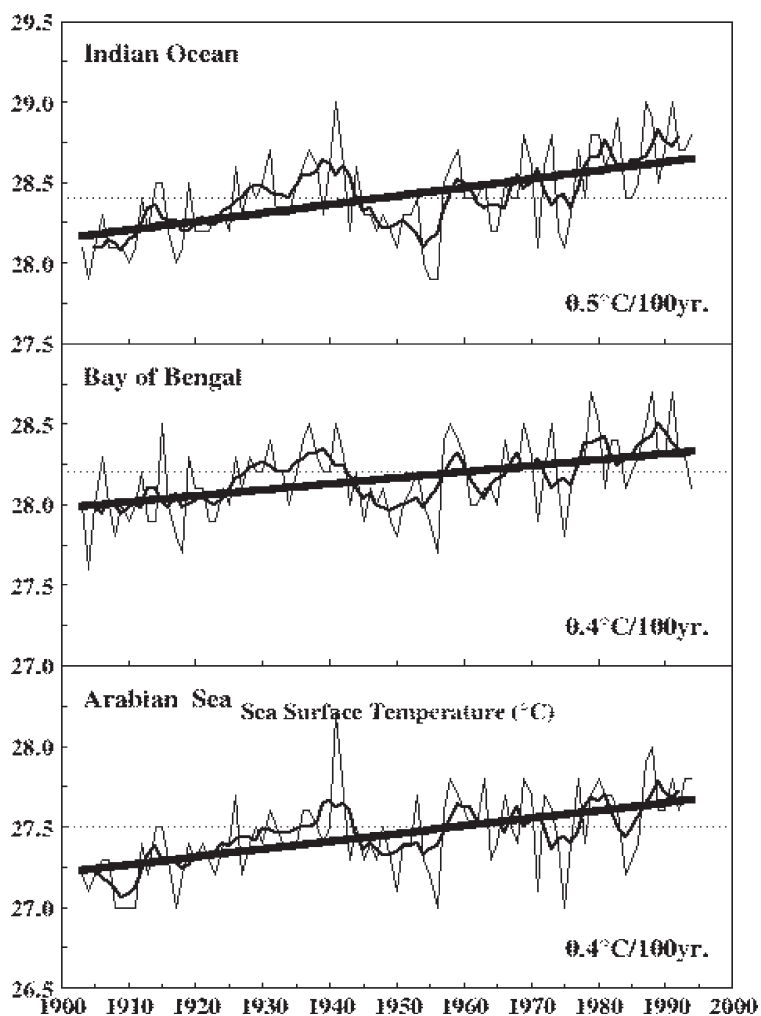


Figure 3. Annual SST during the 20th century over the Indian Ocean, the Bay of Bengal and the Arabian Sea. (reproduced from Rupa Kumar et al., 2002)

Acknowledgements

Figures 1 to 3 are taken from internet resources.

References

- Rupa Kumar, K. Krishna Kumar, R.G. Ashrit, S.K. Patwardhan and G.B. Pant (2002), Climate change in India: Observations and model projections. A chapter in NATCOM book on Climate Change.
- Prasanna Kumar, S., Roshin, Raj, P., Jayu Narvekar, Dinesh Kumar, P.K. and Vivekanandan, E (2008) Signatures of global warming and regional climate shift in the Arabian Sea S (unpublished manuscript).