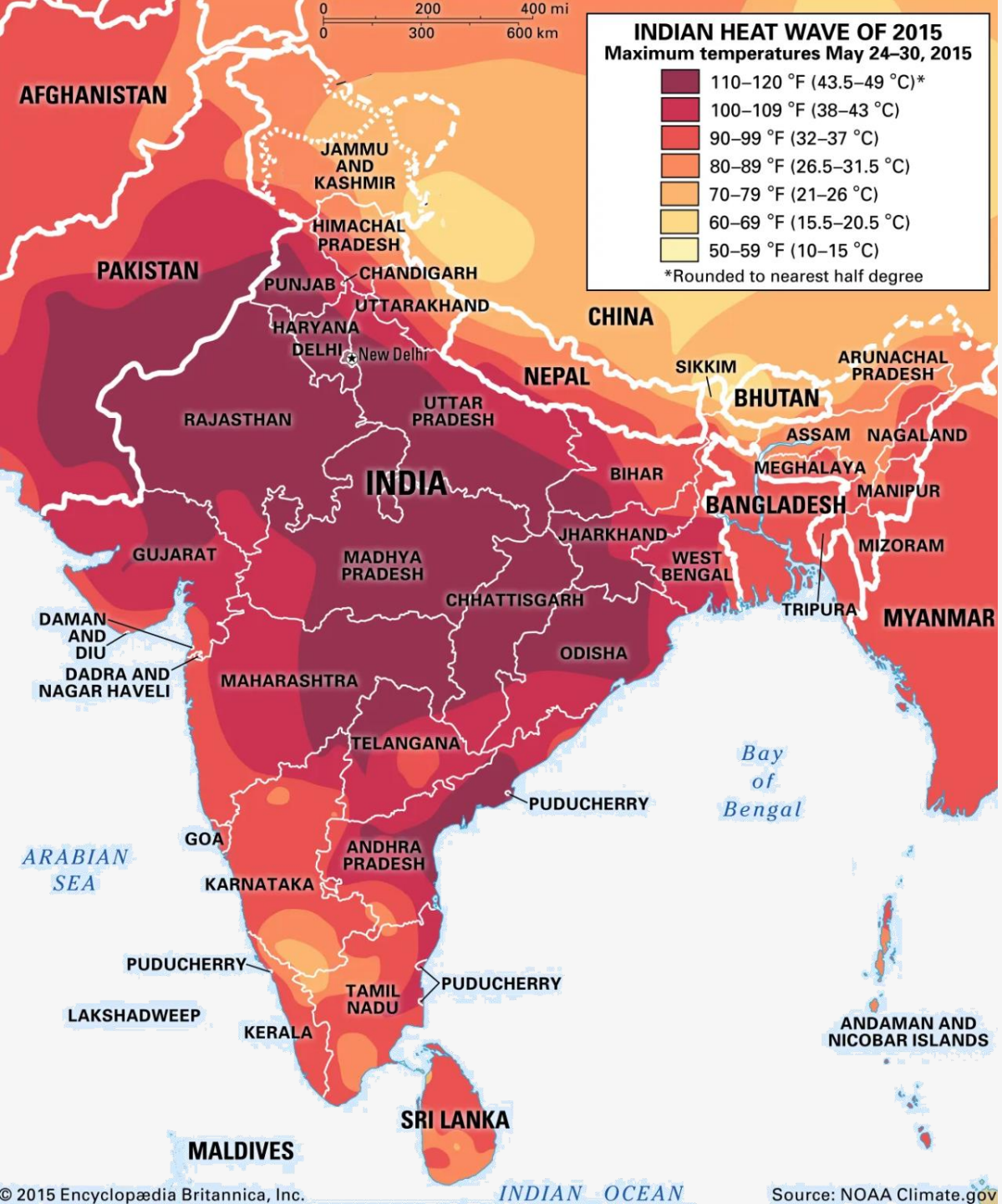
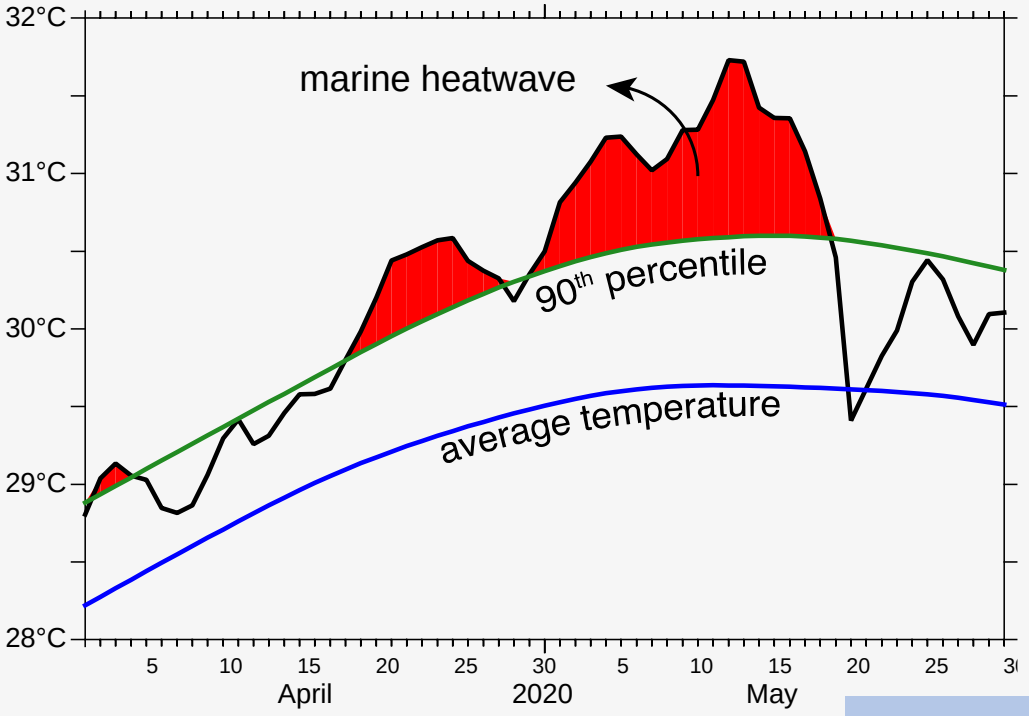


Marine heatwaves, tropical cyclones and terrestrial heatwaves

cascading in a changing climate

Roxy Mathew Koll, Vineet Singh, Saranya J. S.
Indian Institute of Tropical Meteorology
Ministry of Earth Sciences, Govt of India

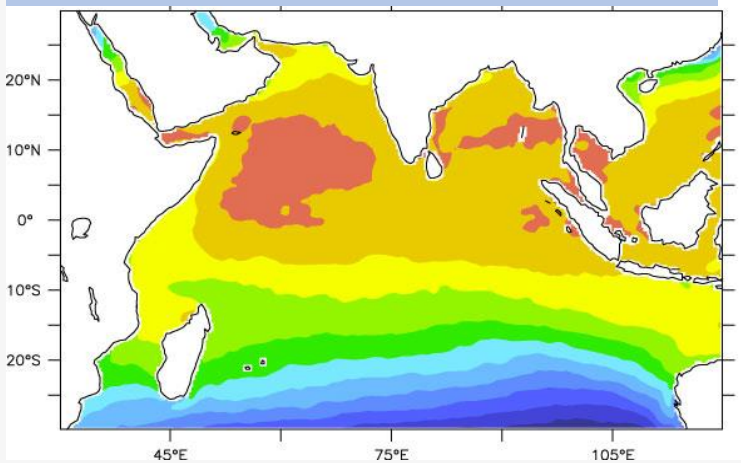
Marine heatwaves. Heatwaves in the ocean



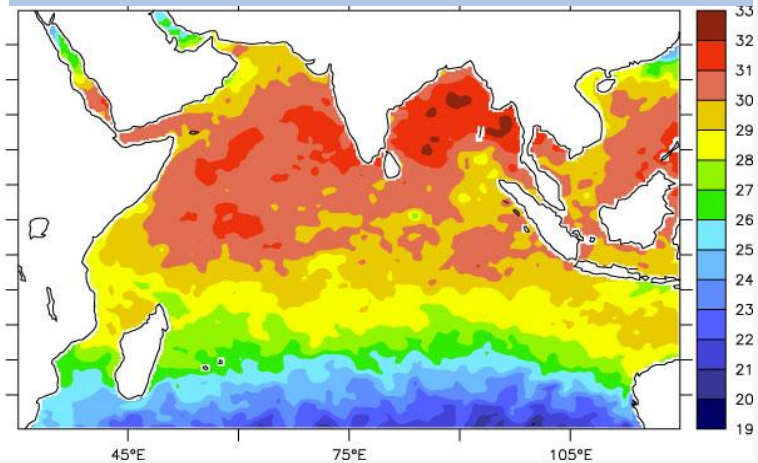
Marine heatwaves are periods of extremely high temperatures in the ocean (above the 90th percentile).

These events cause marine habitat destruction due to coral bleaching, seagrass destruction, and loss of kelp forests, affecting the fisheries sector adversely.

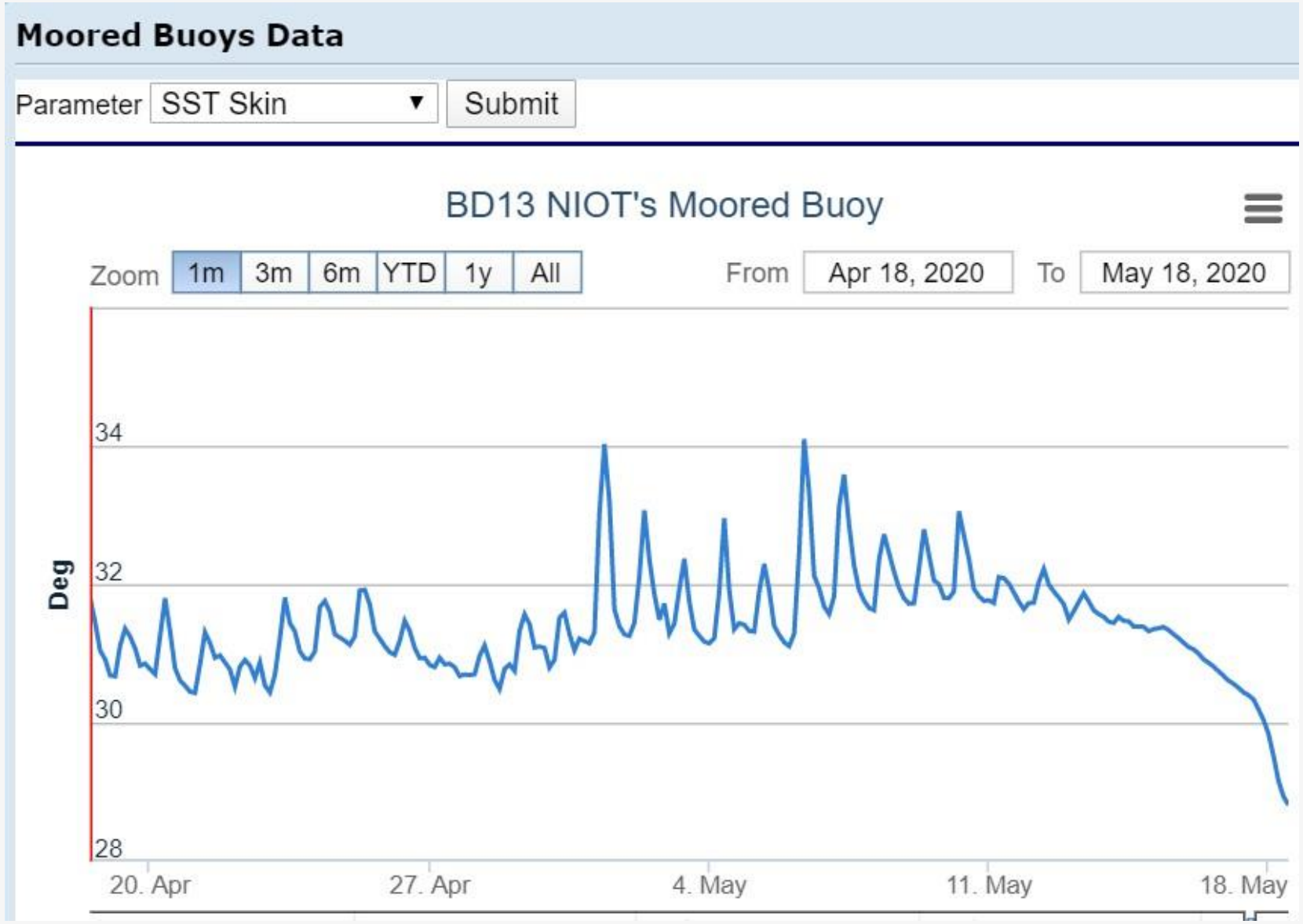
SSTs — mean conditions

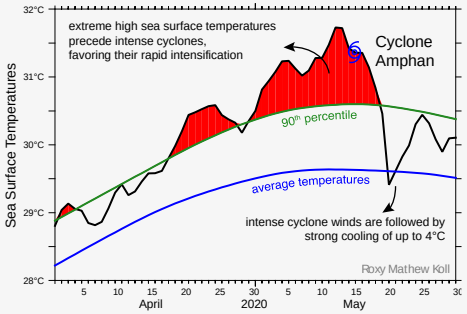


SSTs during marine heatwave



In-situ observations show much higher temperatures for marine heatwaves



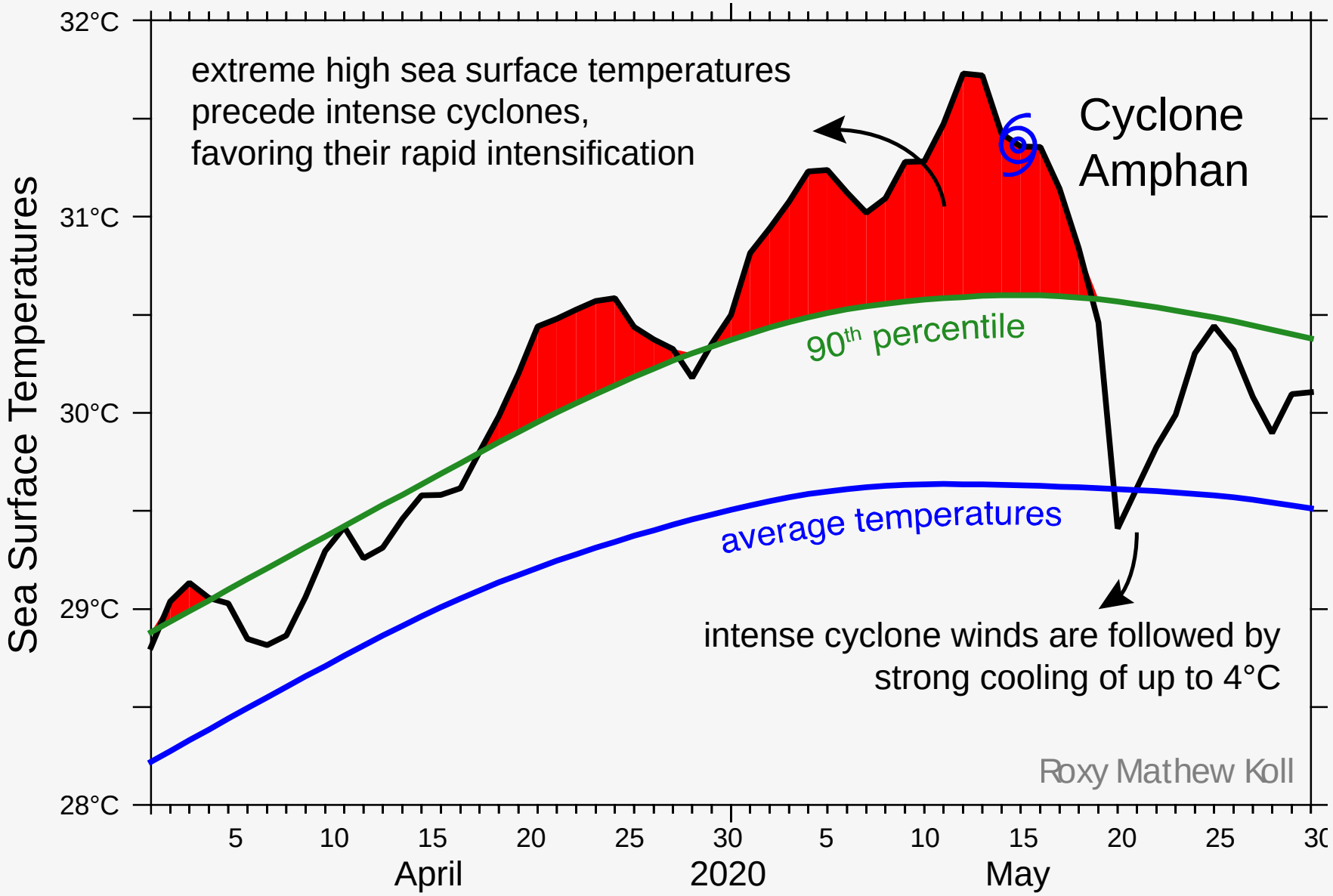


Bay of Bengal recorded surface temperatures of 32-34°C, before Cyclone Amphan.

We have never seen such high values until now.

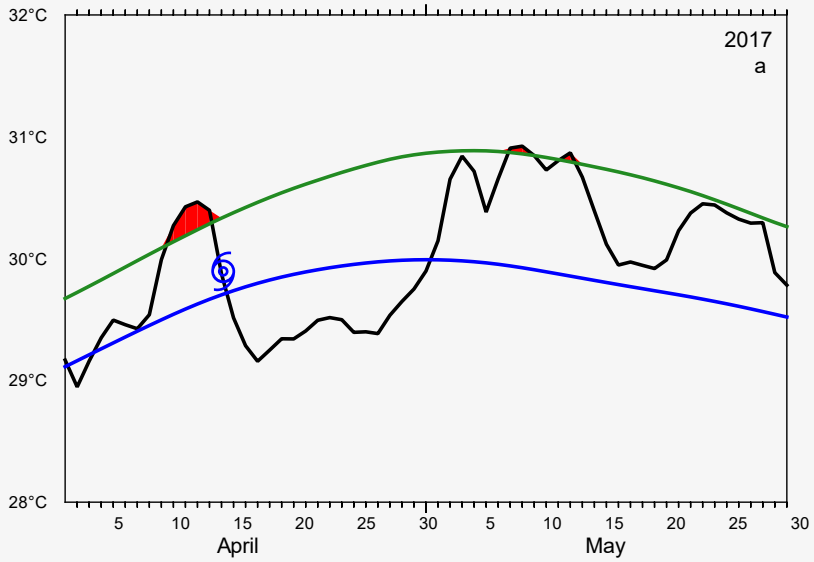
We need better ocean observations in the ocean!

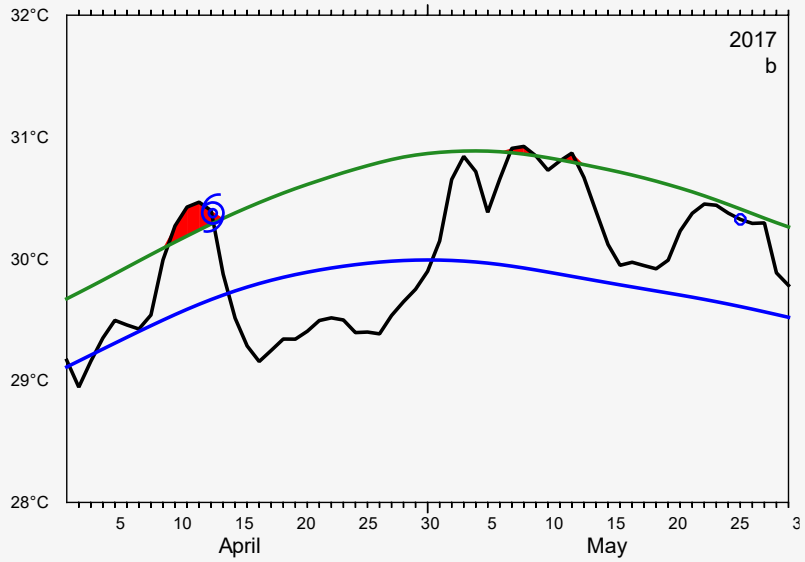
Marine heatwaves intensifying cyclones



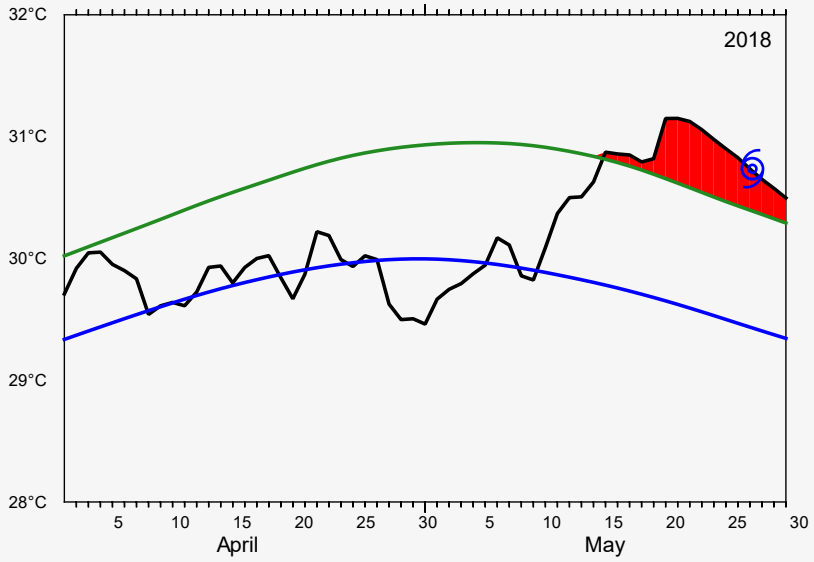
Extremely warm waters act as a strong source of heat and moisture, helping cyclones to intensify

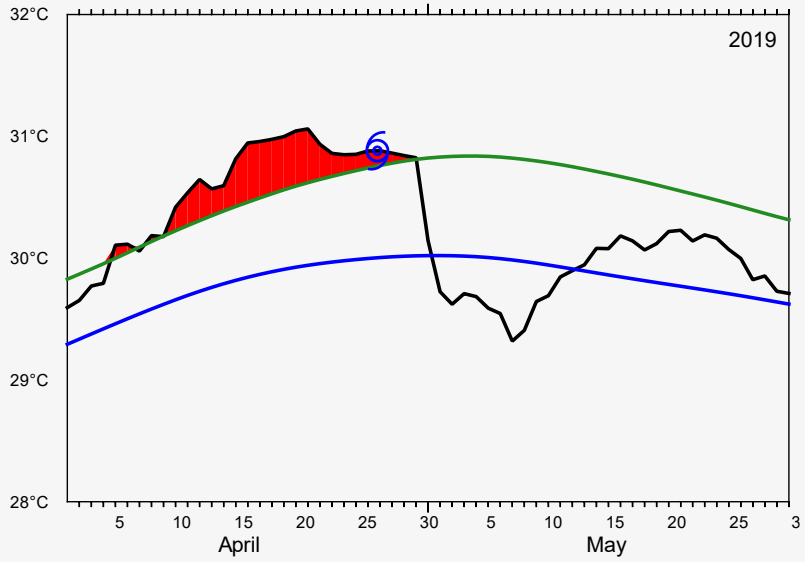
Marine heatwaves intensifying cyclones

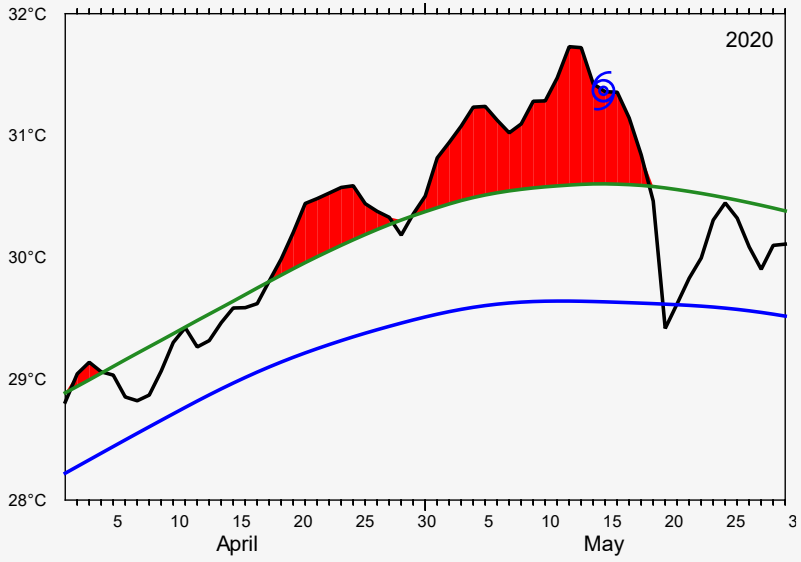




About 90% of the cyclones in the north Indian Ocean were preceded by marine heatwaves (1980–2020)

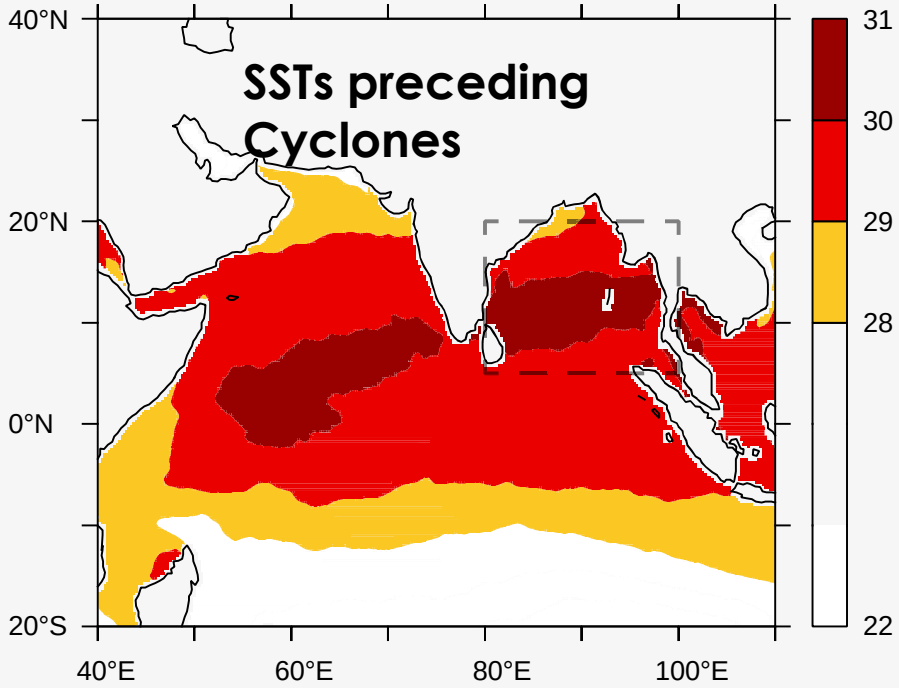


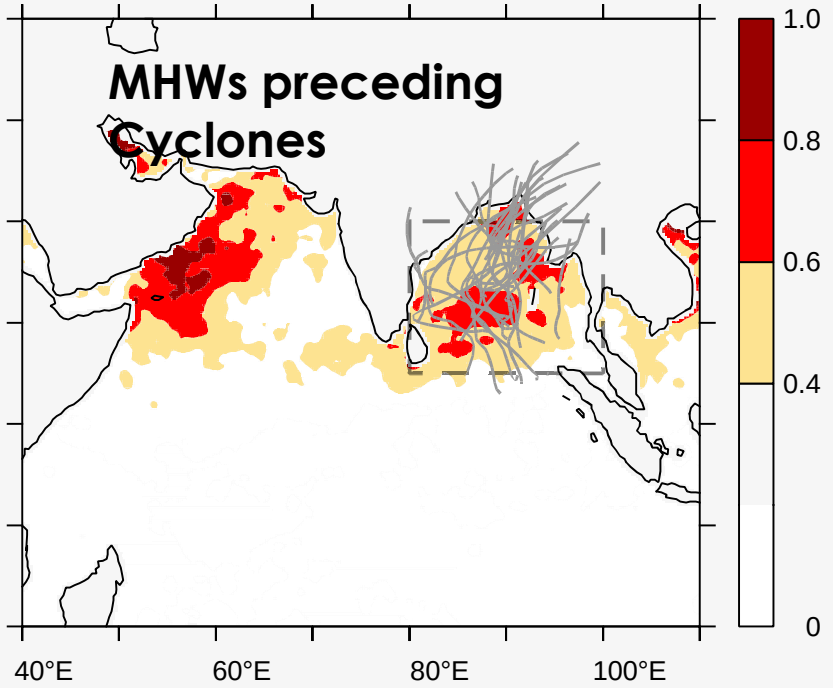




Roxy et al. 2024

Marine heatwaves intensifying cyclones





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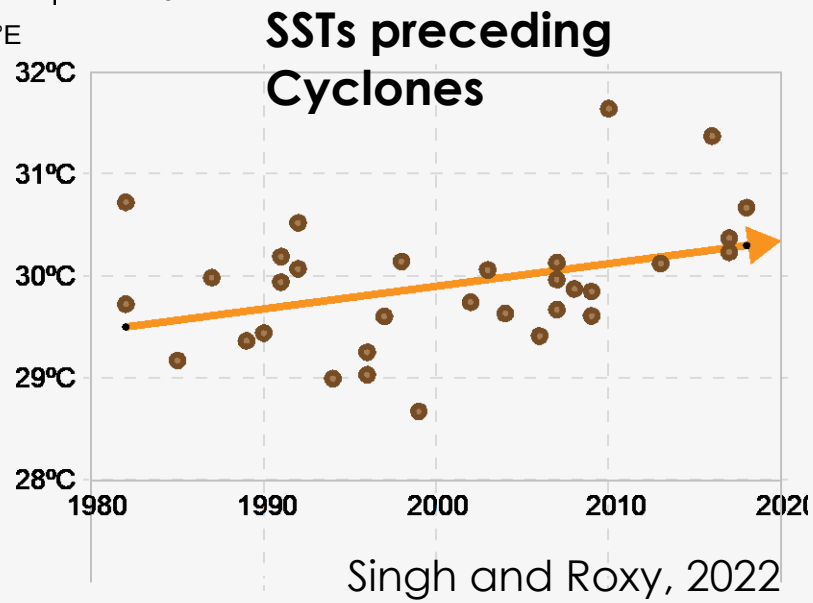
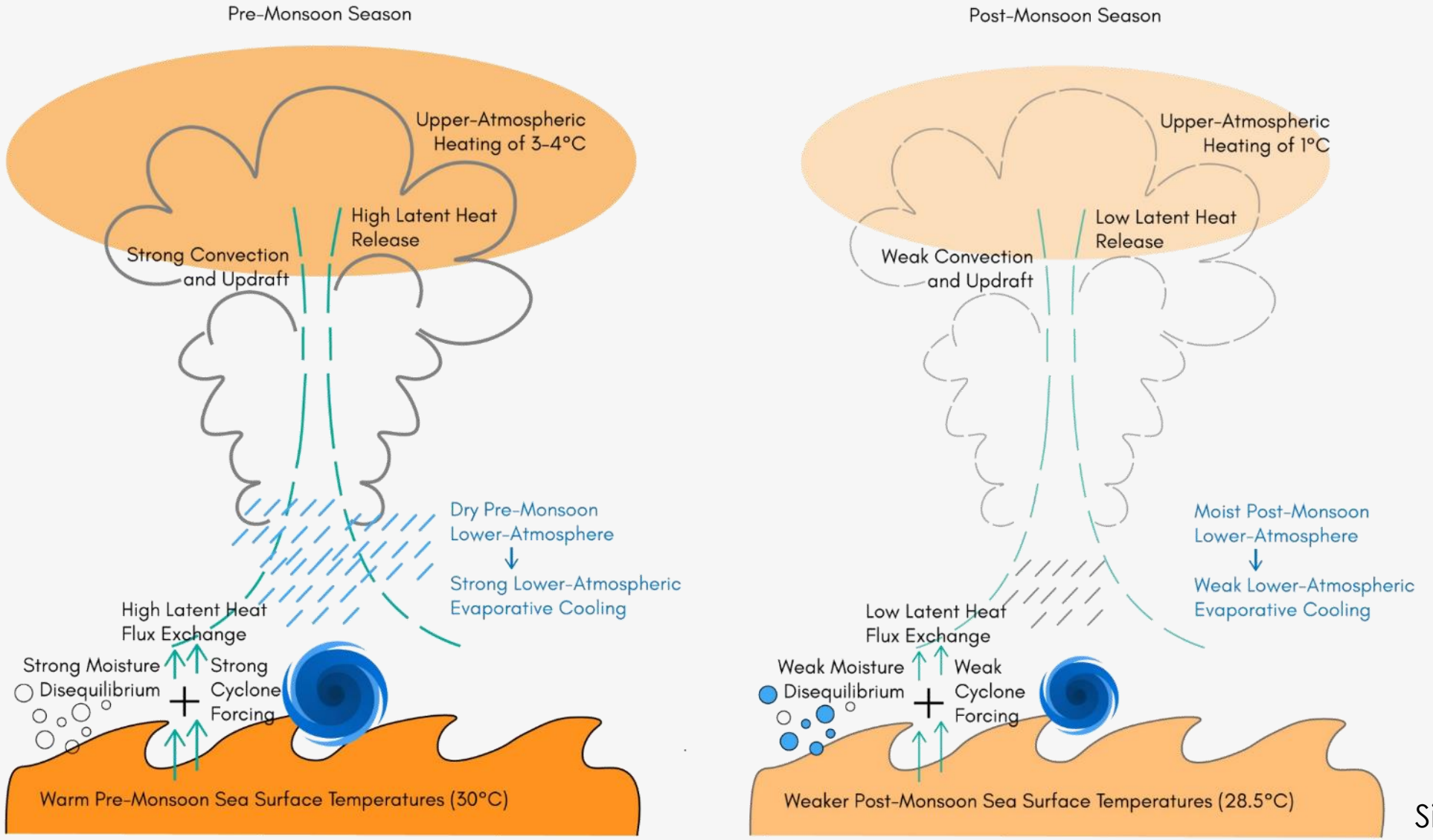


Singh and Roxy, 2022

High SSTs and MHWs precede cyclogenesis, and these SSTs have been increasing in the Bay of Bengal

Atmospheric response to warm SSTs — during pre and post-monsoon

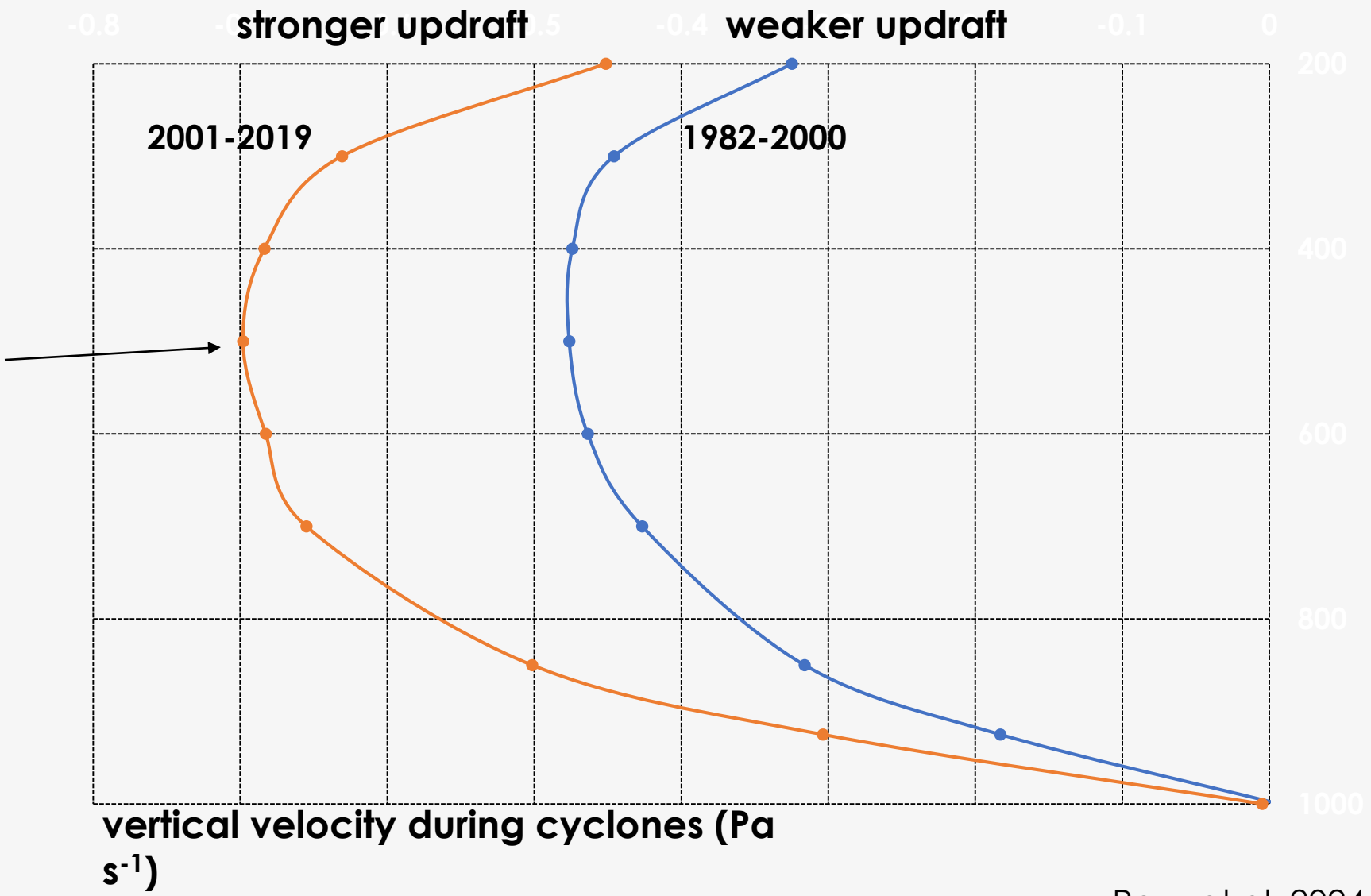


Singh and Roxy, 2024

Cyclone updrafts are increasing with Marine heatwaves

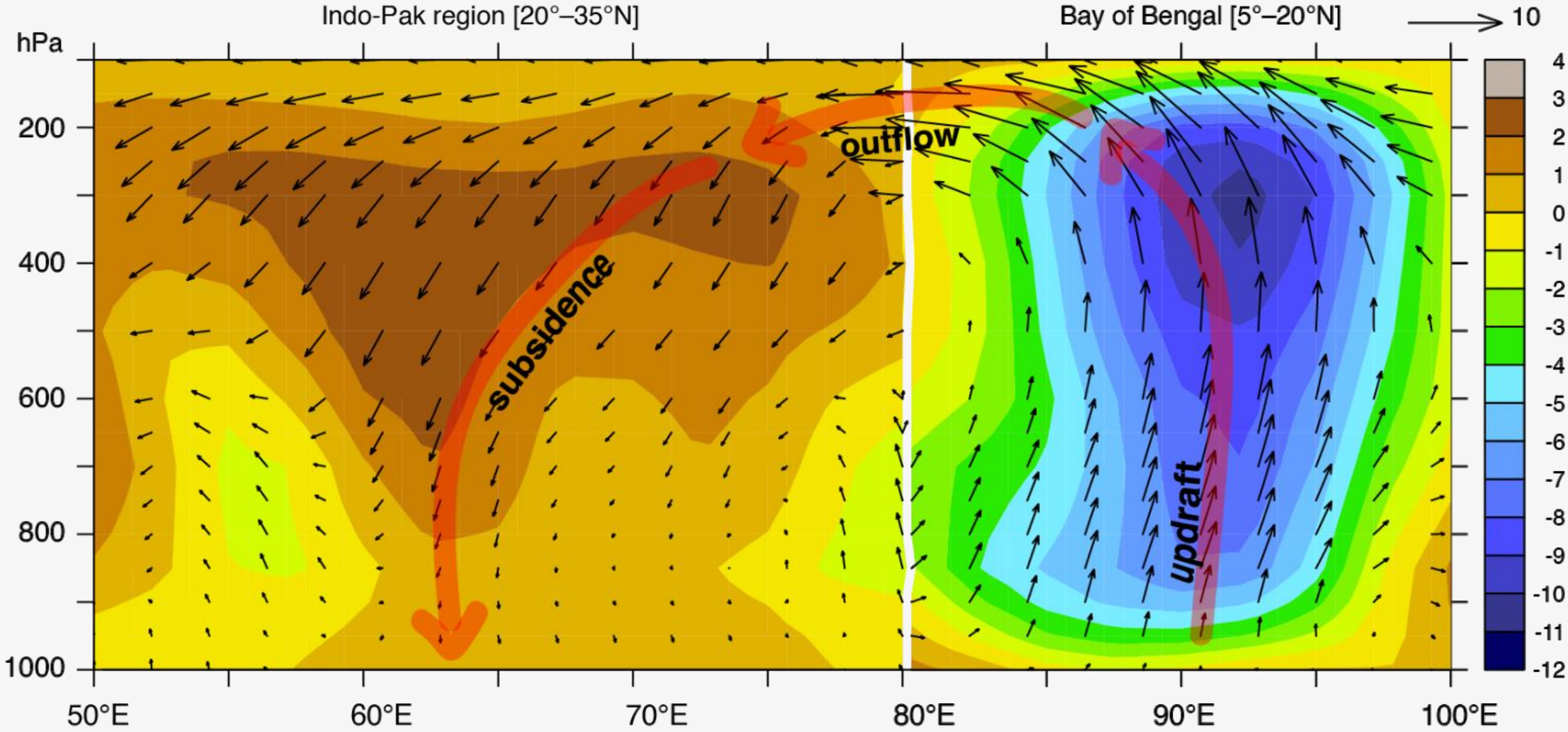
High ocean temperatures and latent heat release from cyclones lead to enhanced updraft…

… and these cyclone updrafts have been increasing.



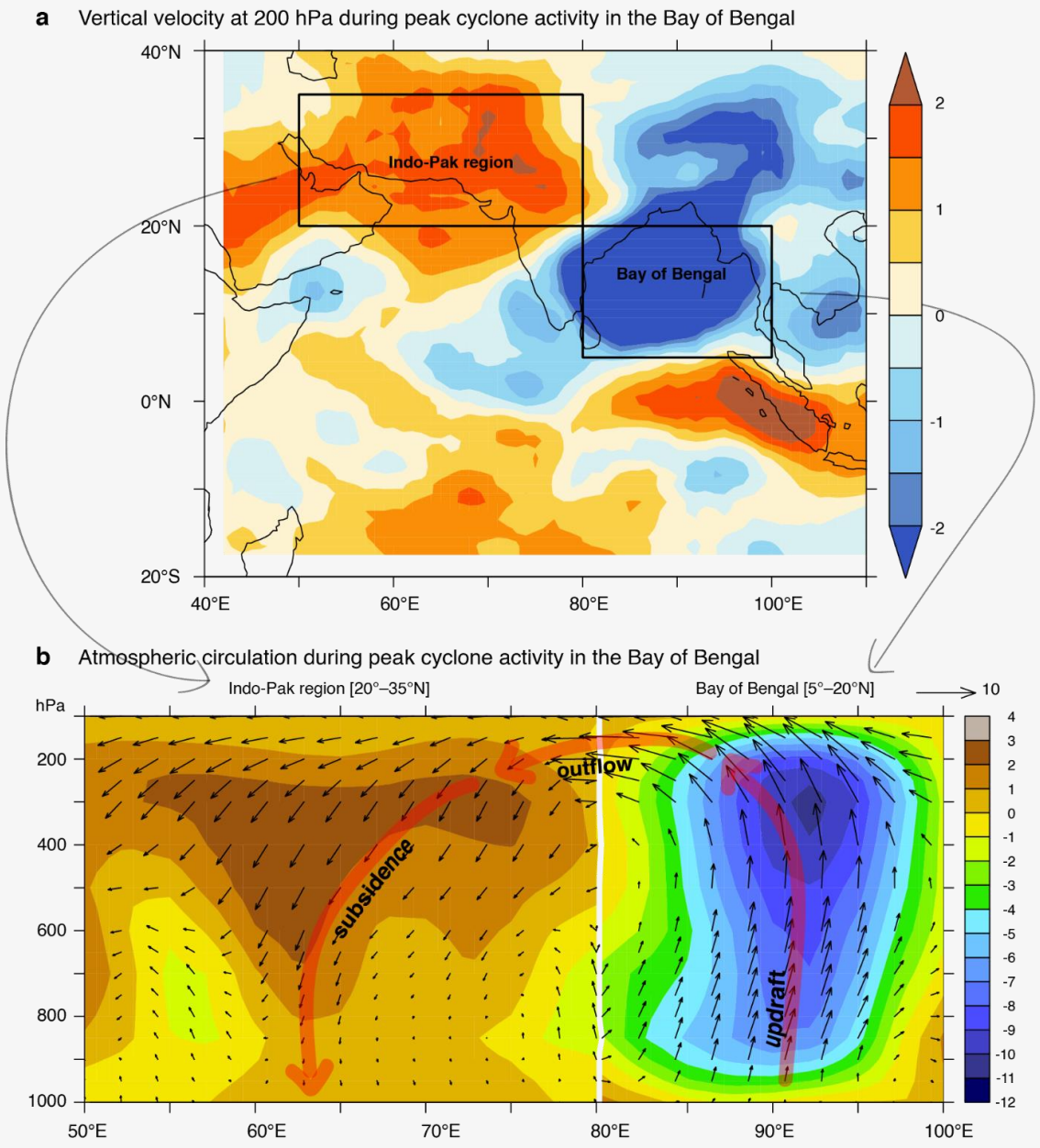
Roxy et al. 2024

Enhanced cyclone updraft leads to dry air subsidence over land. But where?



Roxy et al. 2024

Enhanced cyclone updraft leads to subsidence over the Indo-Pak region

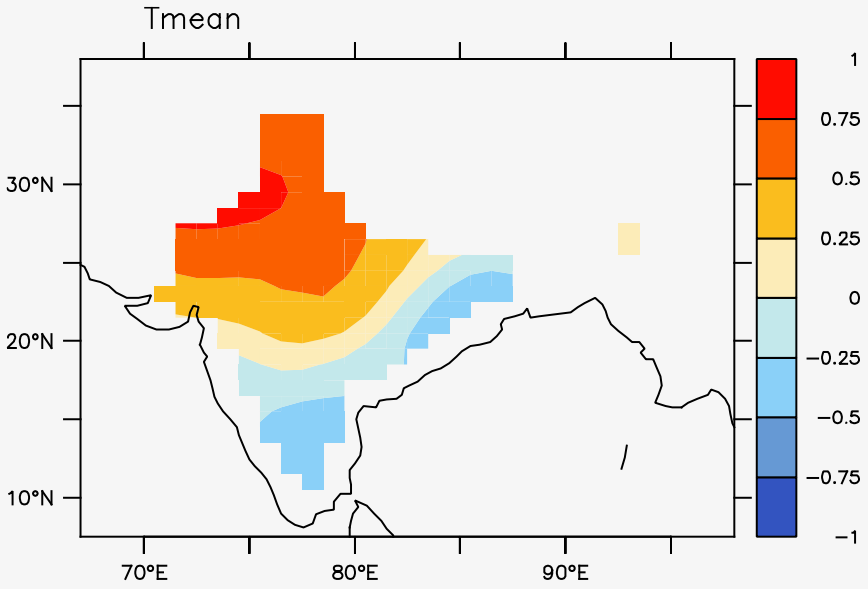


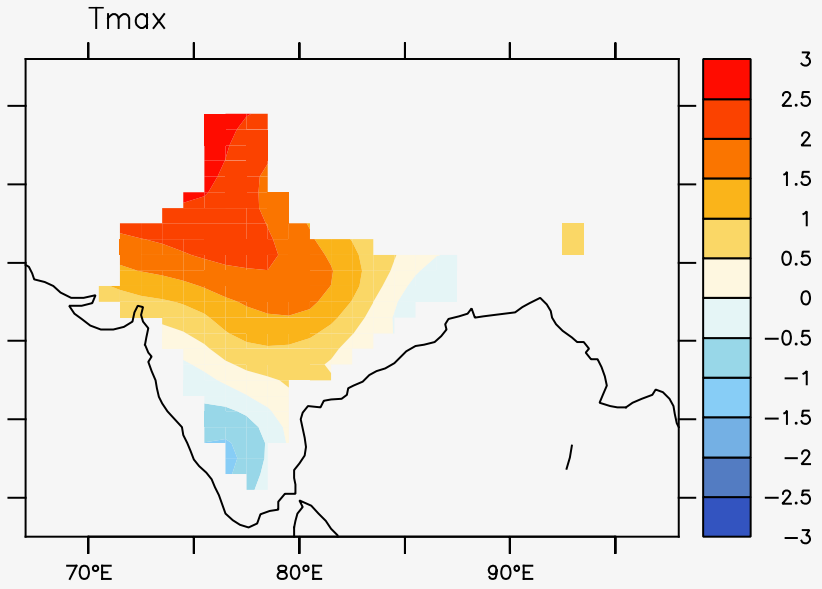
The spatial distribution of the circulation cells show enhanced updraft over the Bay of Bengal and subsidence over the Indo-Pak-Saudi region

Subsiding air heats the atmosphere by adiabatic compression, inhibiting convection and preventing the formation of clouds. Reduction of clouds increases shortwave radiation reaching the surface, facilitating heatwaves.

Roxy et al. 2024

Temperature anomalies following subsidence





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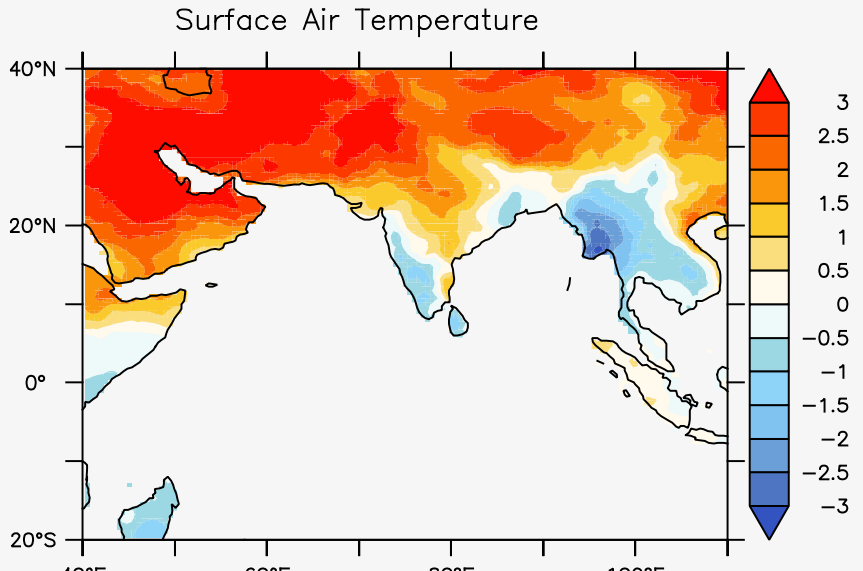
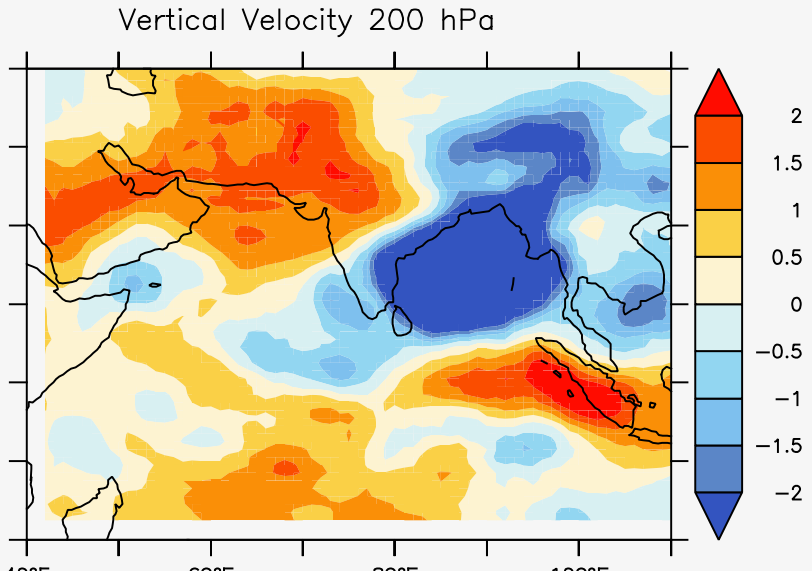
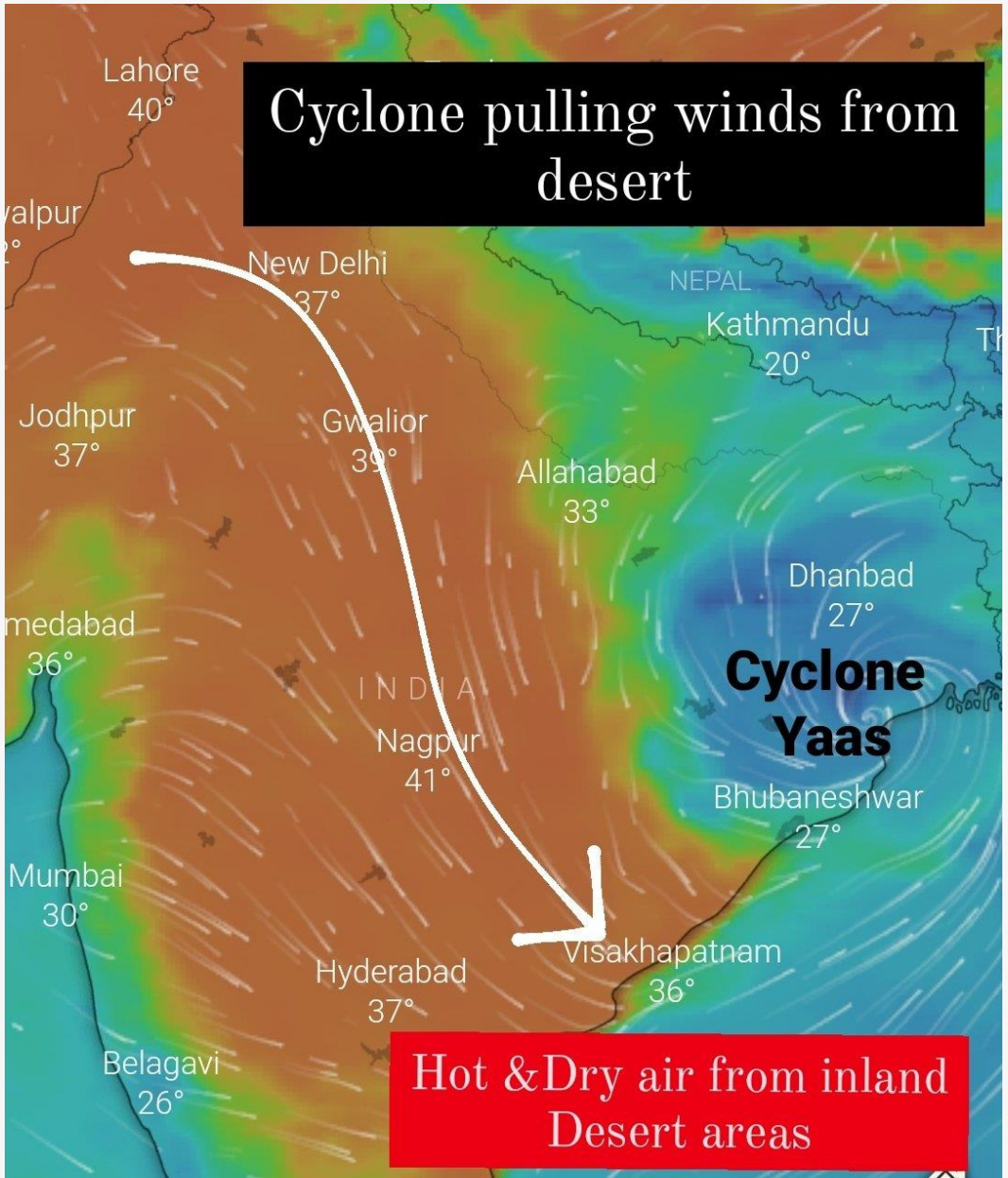
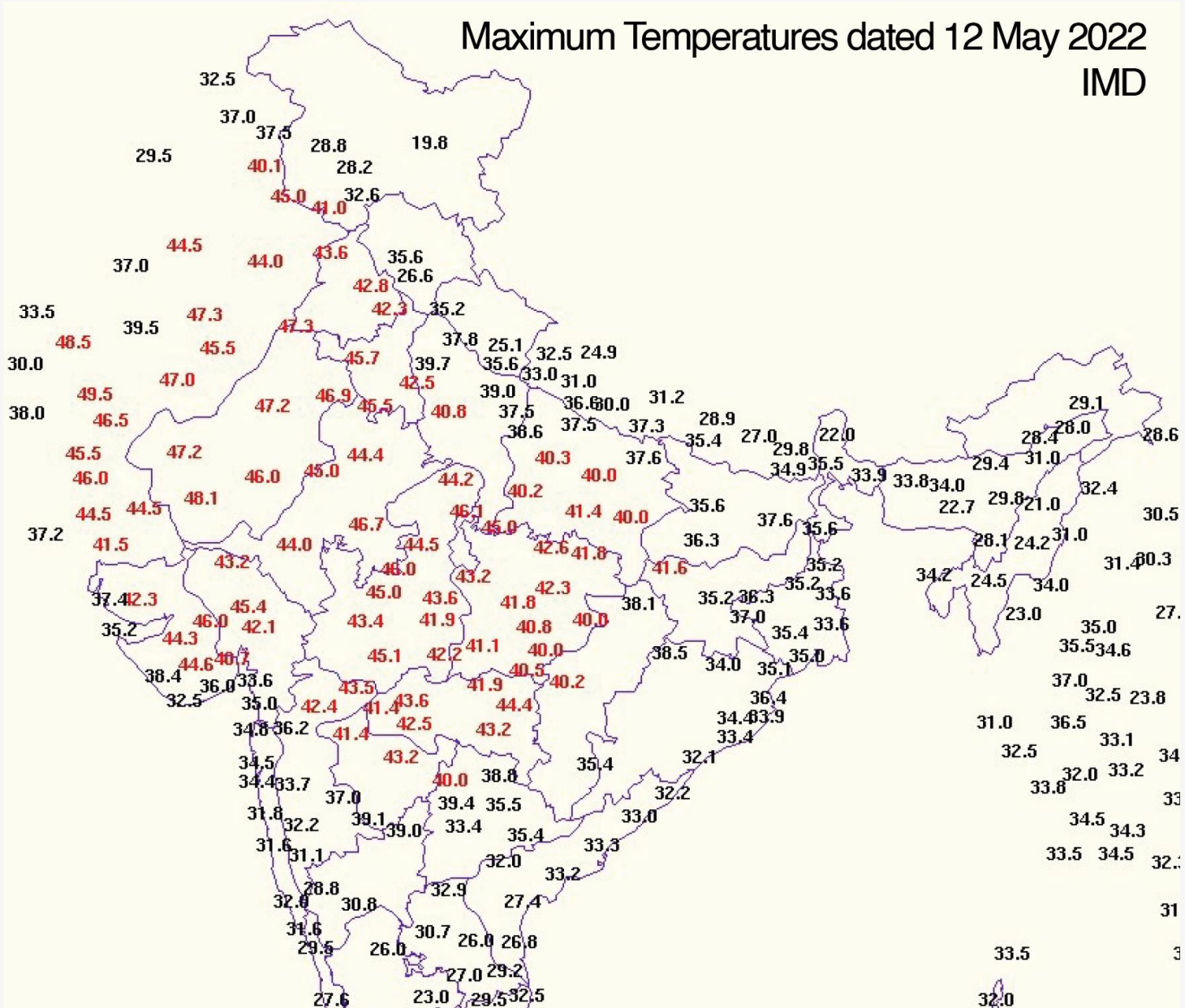


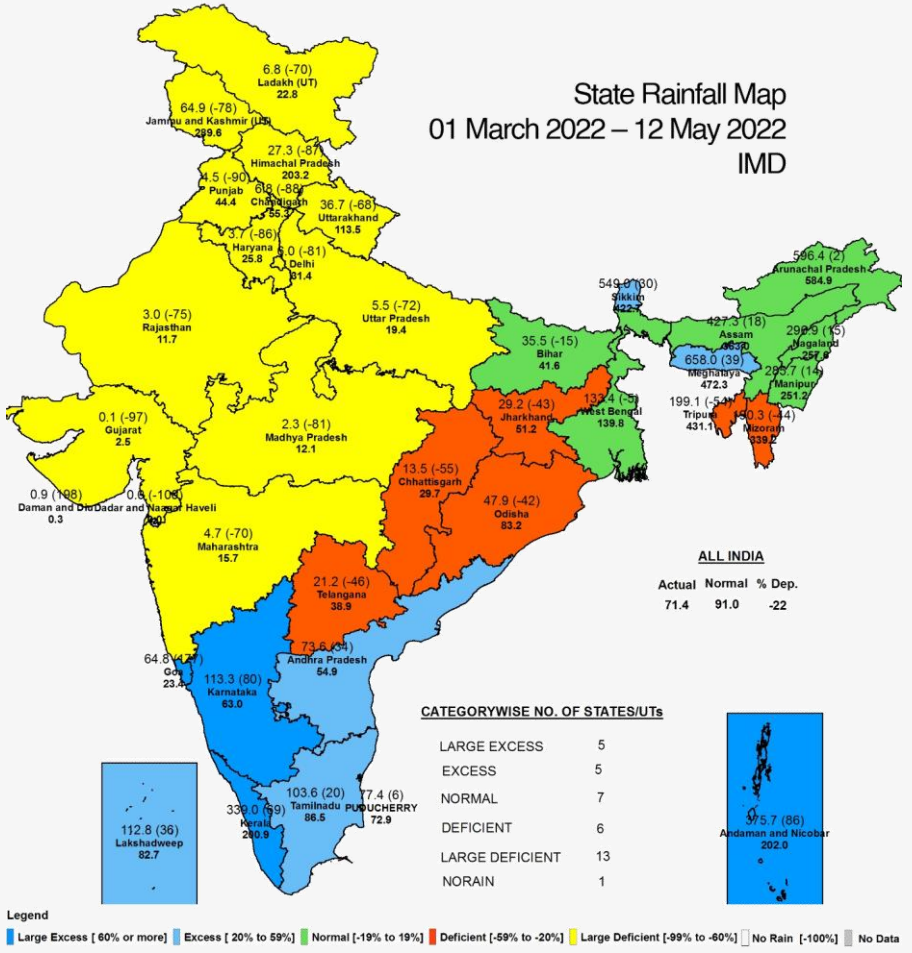


Heat and Rainfall deficits following Bay of Bengal Cyclone Yaas

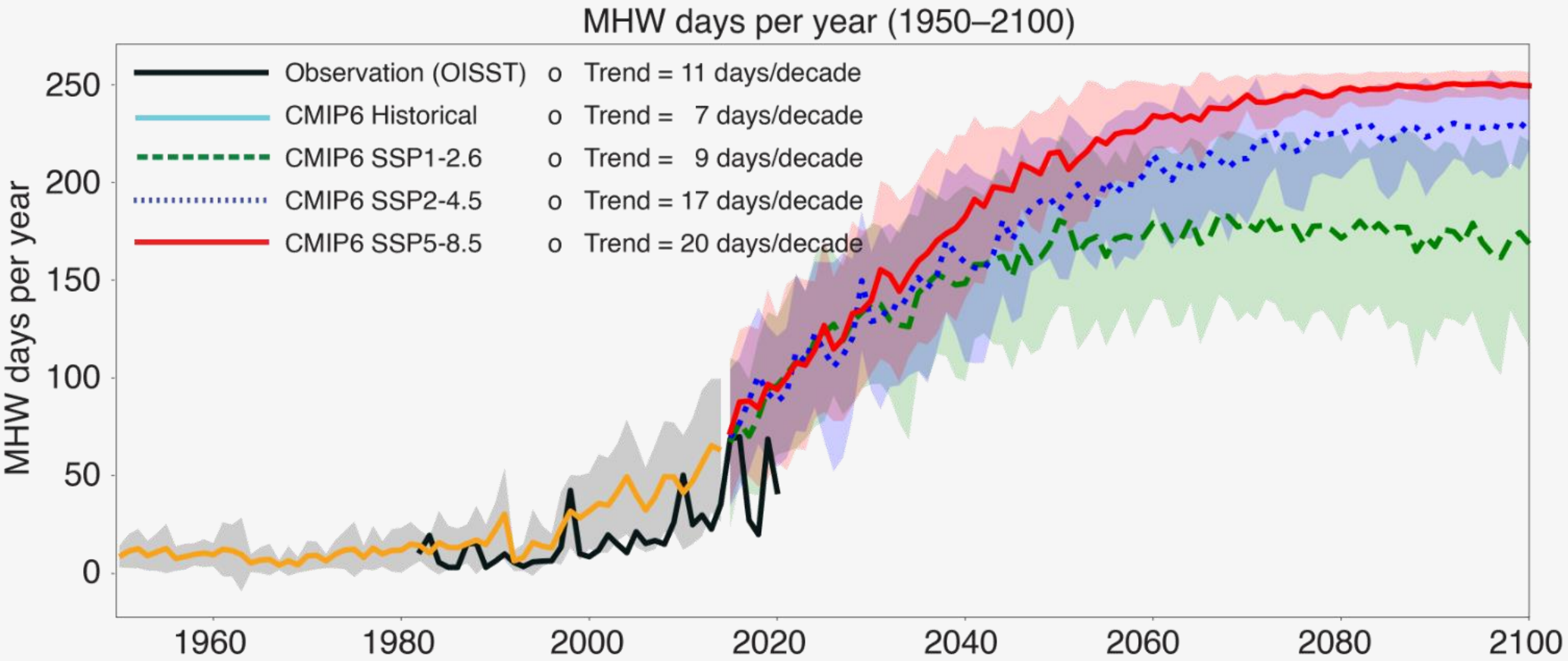


Heat and Rainfall deficits following Bay of Bengal Cyclone Asani





Indian Ocean gearing up for a near-Permanent MHW state



Thank you!

Roxy et al. *Future projections of the tropical Indian Ocean*, 2024