

Long-lasting marine heatwaves instigated by ocean planetary wave in the tropical Indian Ocean during 2015/16 and 2019/20

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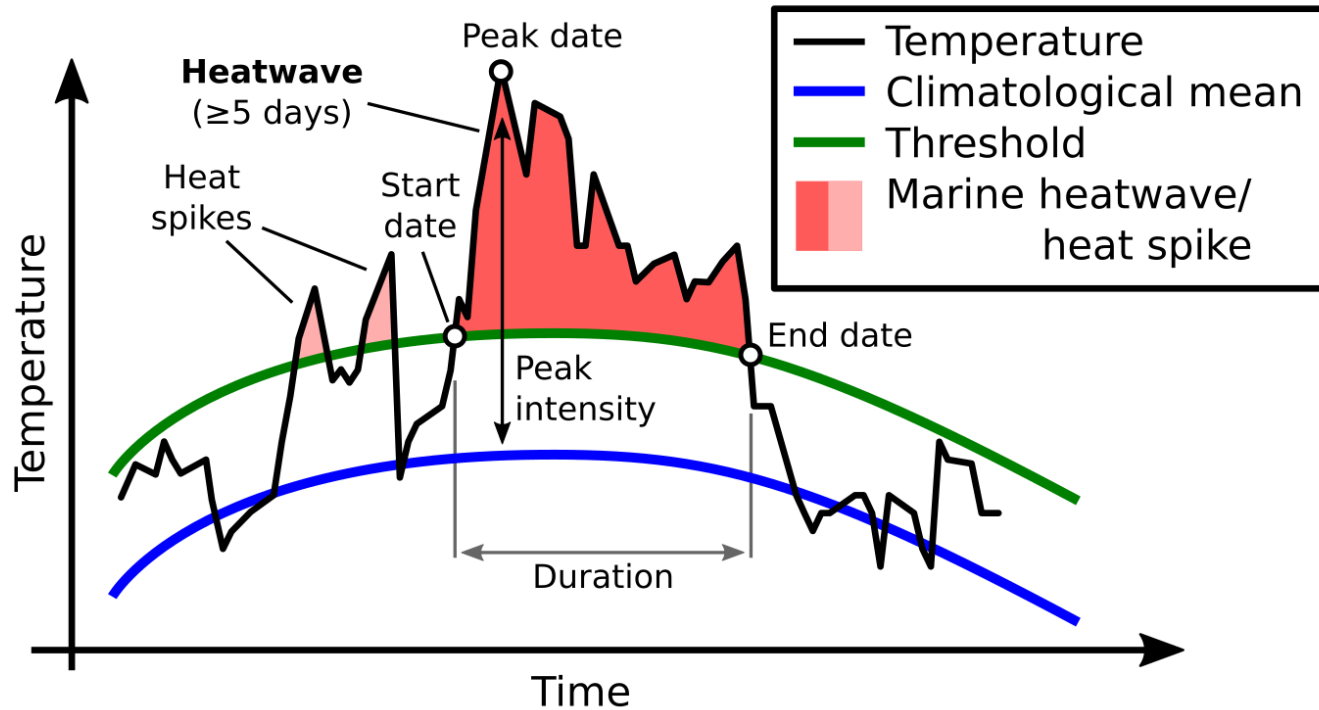
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What is marine heatwave?

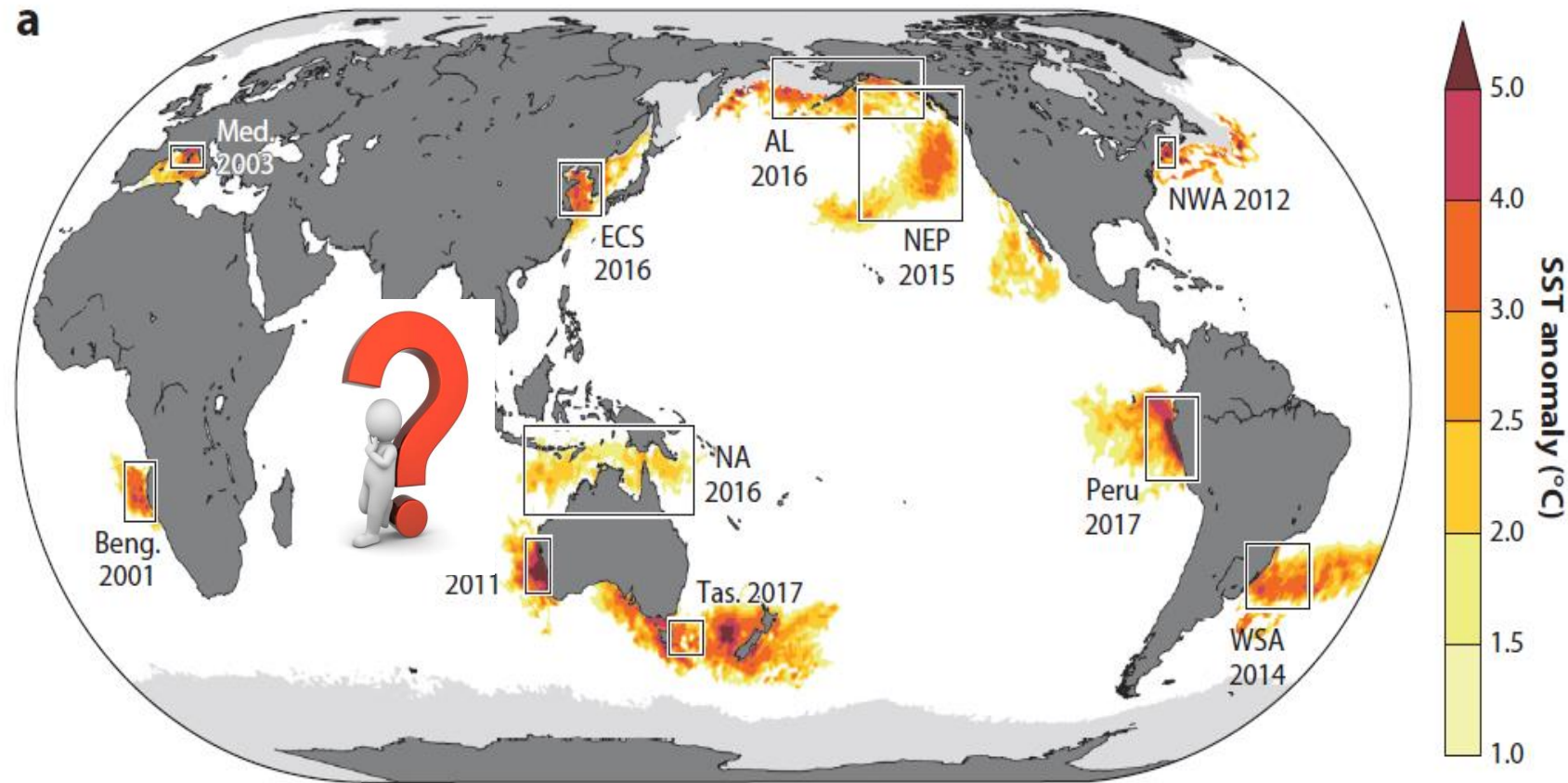


An anomalously warm event lasting for five or more days, with temperature warmer than the 90th percentile based on a seasonal climatology mean

- **Mean intensity:** the temperature anomaly averaged during a MHW event
- **Duration:** the time between the start and end dates of a MHW event
- **Frequency:** the number of all events in a year
- **Total MHW days:** the sum of the duration of all events in a year.

(Hobday et al., 2016)

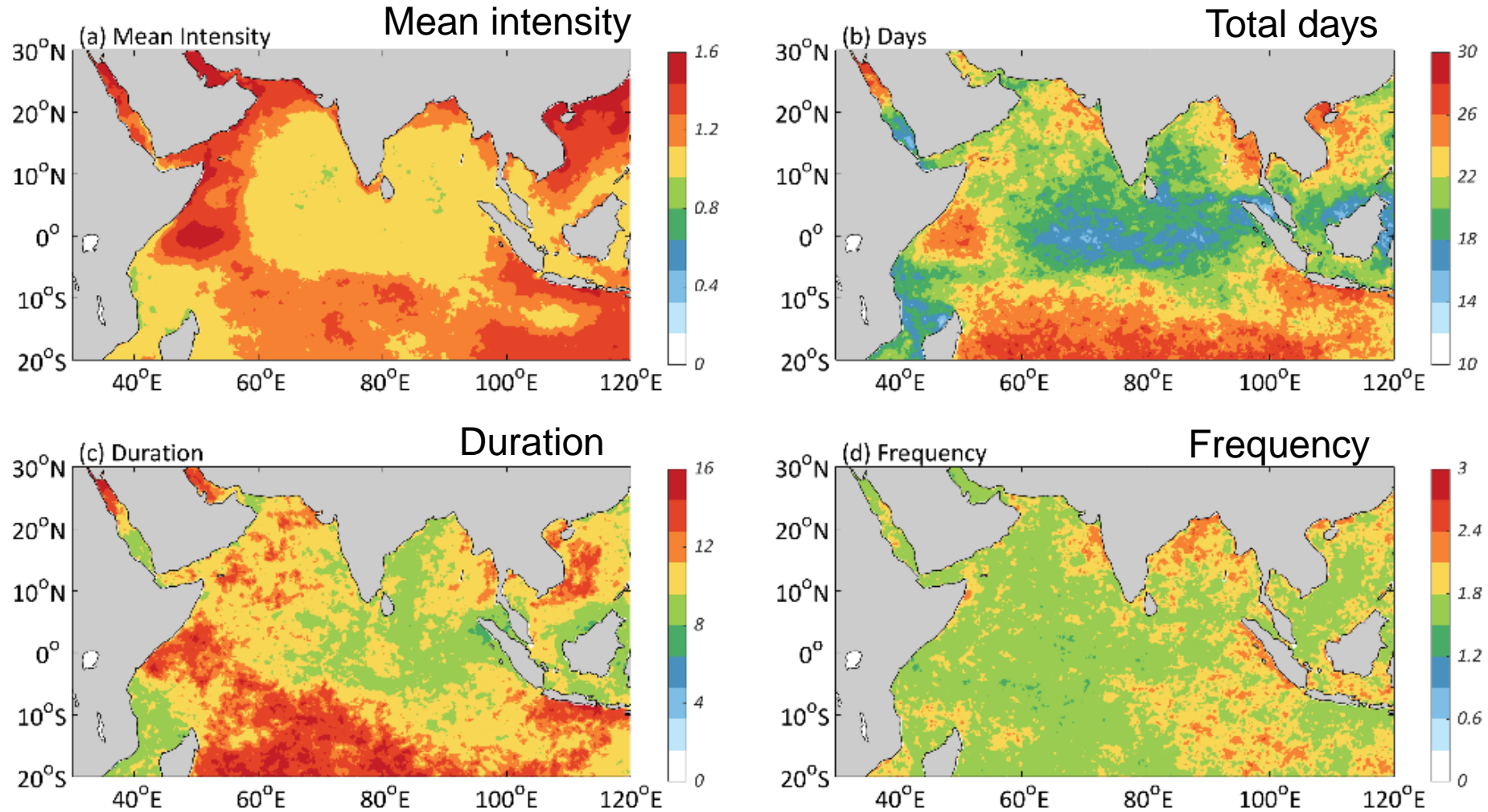
Limited research on marine heatwaves in tropical Indian Ocean



- Research on the tropical Indian Ocean MHWs is limited;
- Deeper understanding the characteristics and mechanisms of MHWs will help the development of forecasting systems.

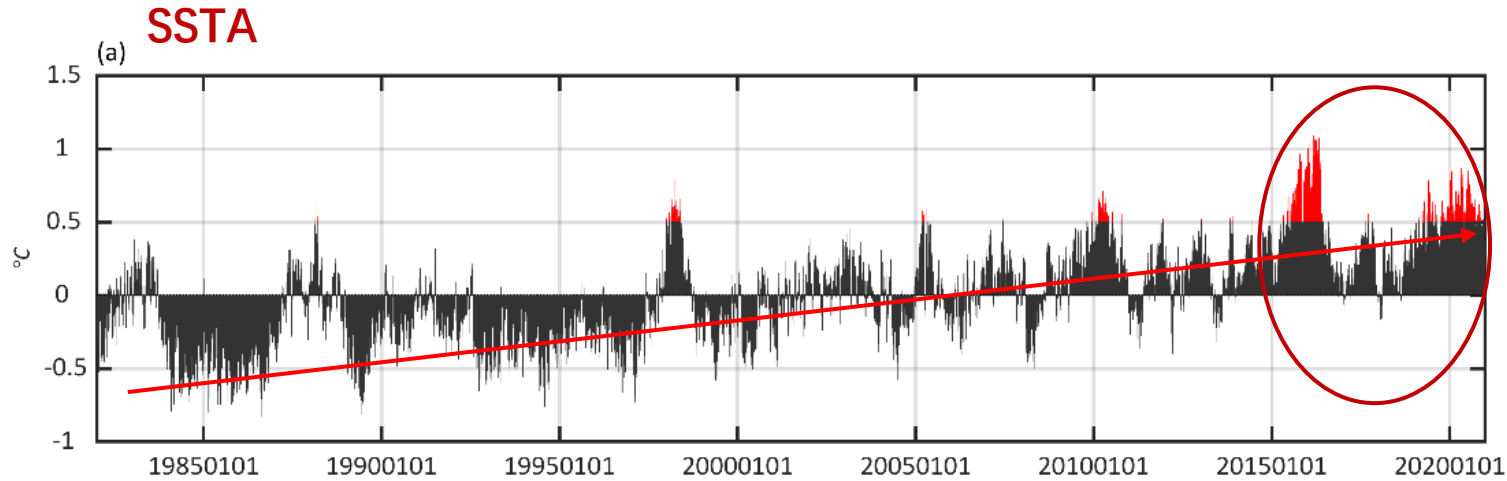
(Oliver et al, 2020)

Results: Marine heatwaves in the tropical Indian Ocean

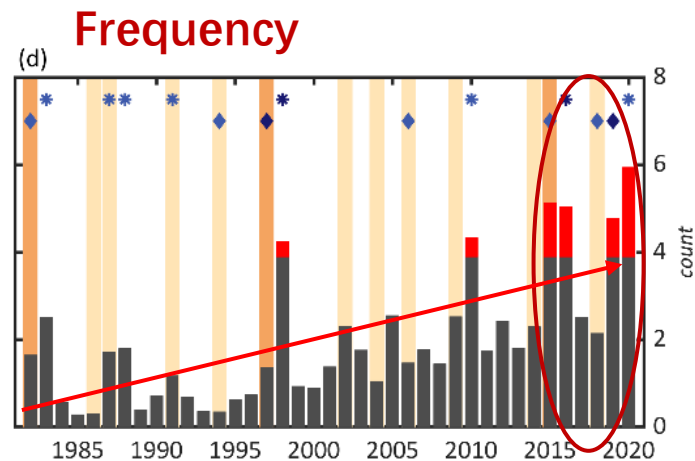
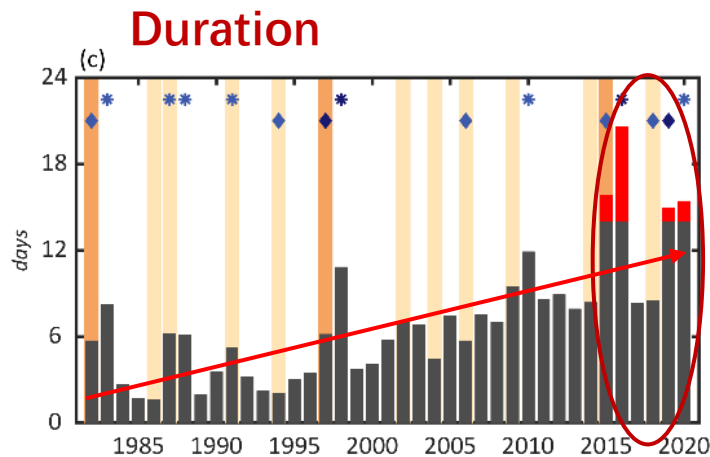


➤ Strong and long-lasting MHWs in the western, southeastern, and southern TIO

Results: Marine heatwaves in the tropical Indian Ocean

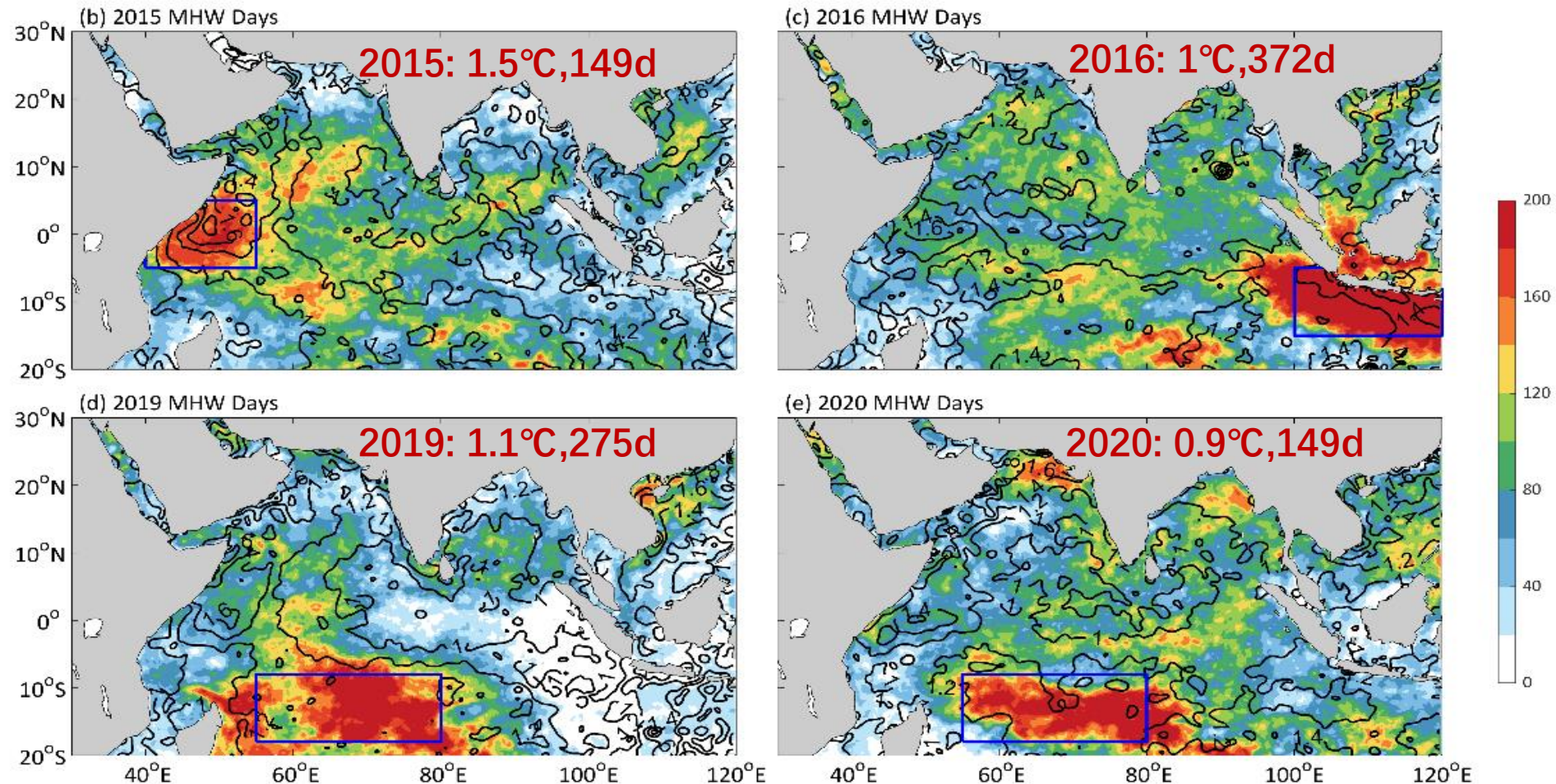


- The tropical Indian Ocean has undergone **a robust sea surface warming** in satellite observing era, as a result of anthropogenic forcing and internal variability.



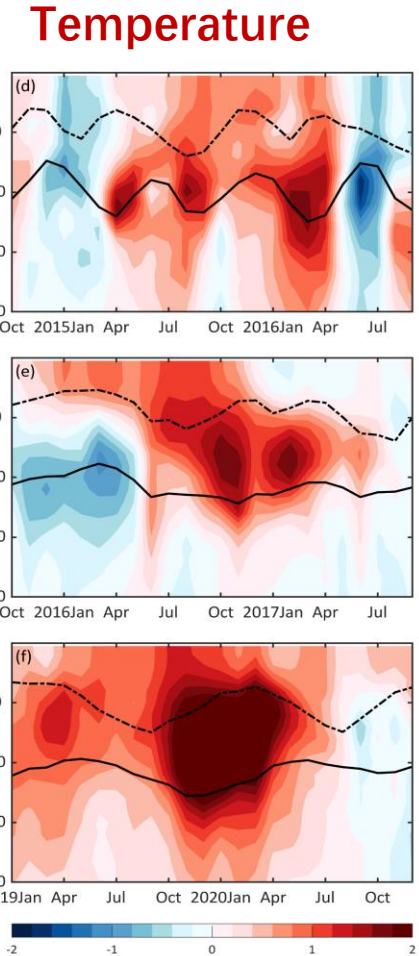
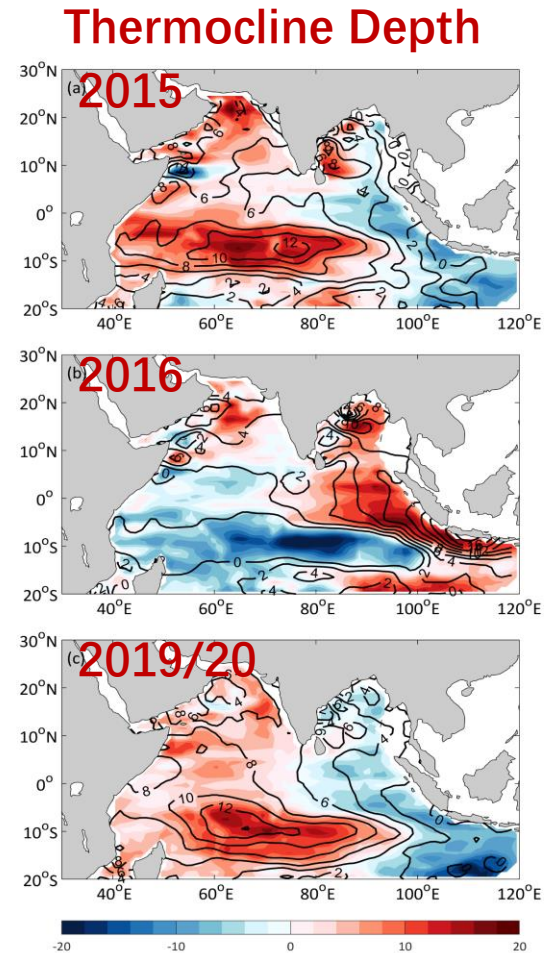
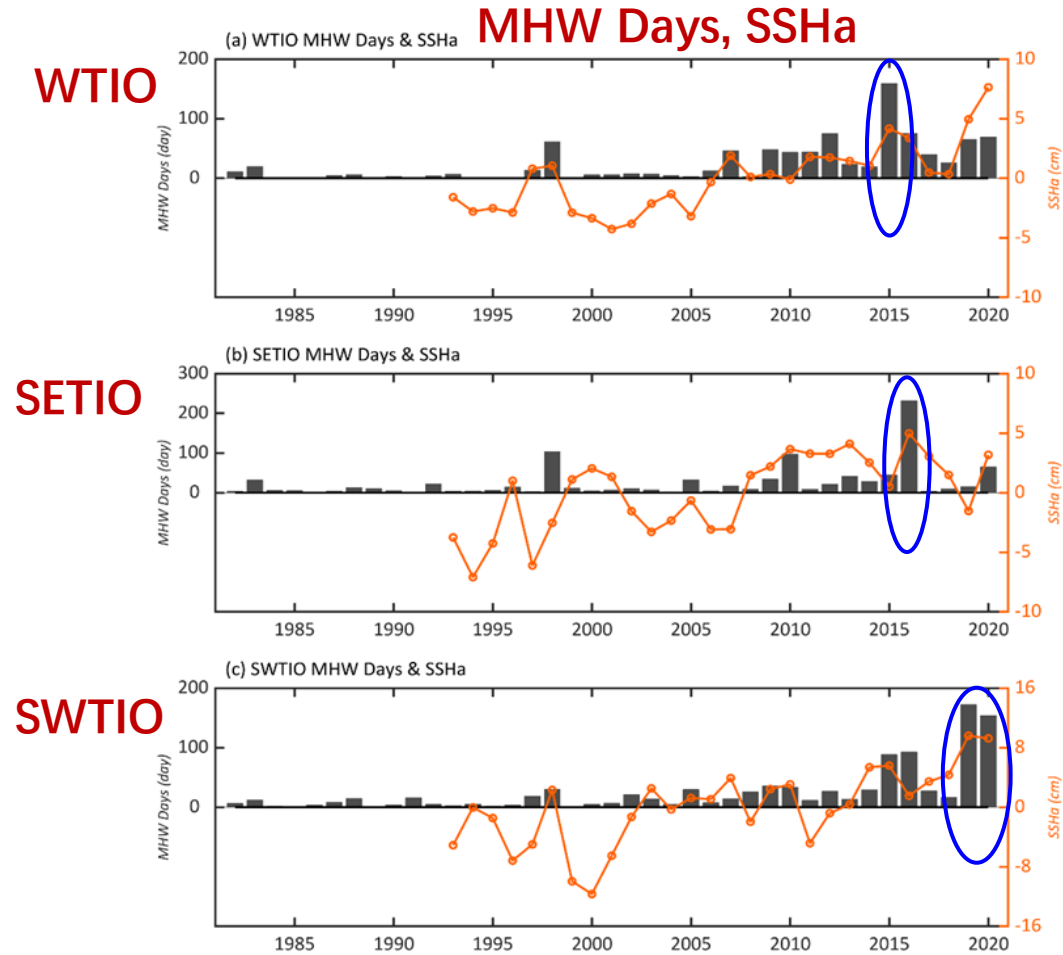
- **Longer and more frequent MHWs** were found, especially in **2015, 2016, 2019 and 2020**.

Results: Marine heatwaves in the tropical Indian Ocean



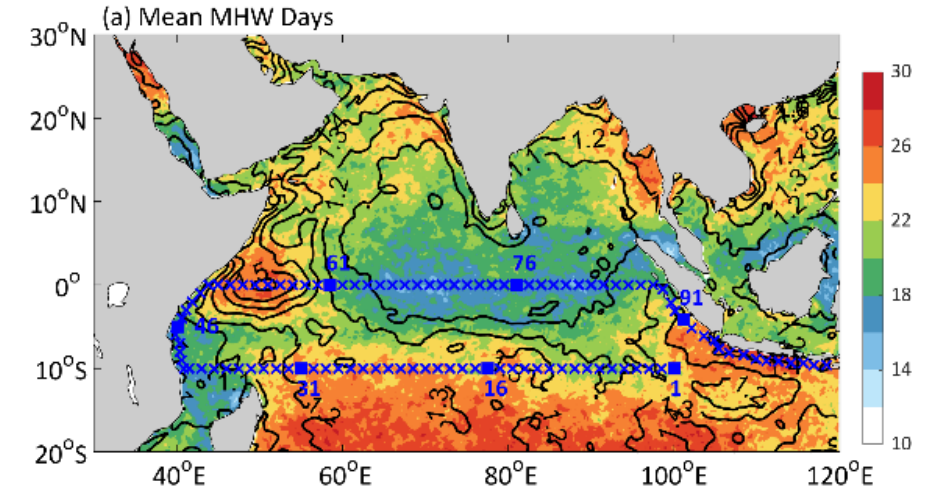
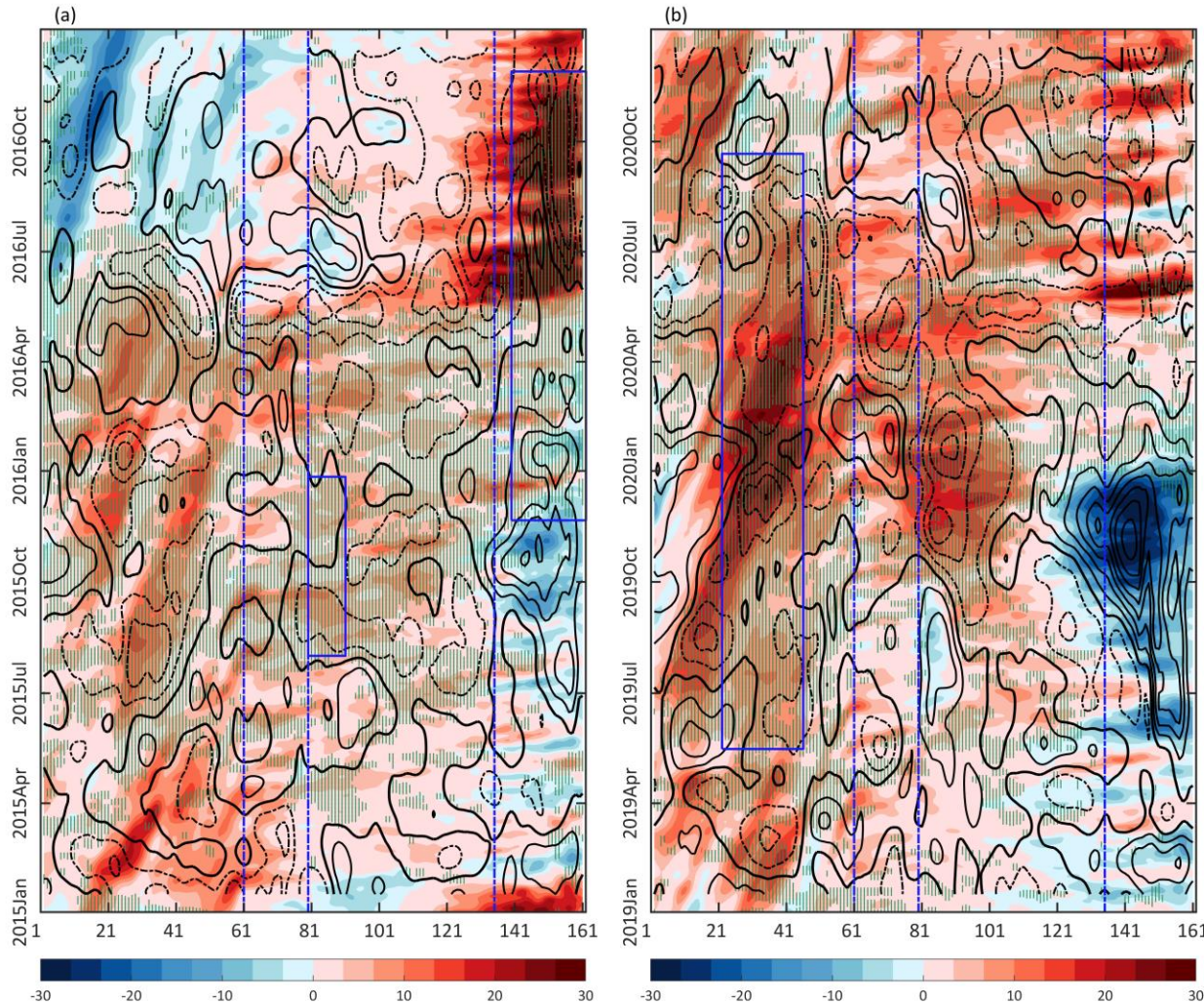
- Strong and prolonged MHWs occurred in the upwelling regions.
- 2015(1.5°C,149d)-WTIO; 2016(1°C,372d)-SETIO; 2019/2020(1.1°C,275d; 0.9°C,149d)-SWTIO.
- Associated with extreme 2015/16 El Nino and 2019 positive IOD events

Results: Ocean planetary waves & MHWs



- High correlation between MHW days and SSHa.
- Subsurface warming induced by downwelling oceanic waves lead to SST warming via oceanic dynamic processes.

Results: Ocean planetary waves & MHWs



- The downwelling Rossby waves propagates westward in the southern tropical Indian Ocean and the downwelling equatorial Kelvin waves propagate eastward along the equatorial Indian Ocean.

SSHA (shading), net air-sea heat flux (contours), MHW (dots)

Summary- Long-lasting Marine Heatwaves in the TIO

- Long-lasting MHWs occurred in the upwelling regions of the tropical Indian Ocean during 2015-16 and 2019-20
- The recent long-lasting MHWs are related to the super El Niño in 2015/16 and extreme positive IOD in 2019
- Oceanic downwelling waves induced-thermocline warming plays a crucial role in the long-lasting MHWs

Thank you! zhangying@scsio.ac.cn

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