

# Distribution and intensity of marine heatwaves over Brazilian coral reefs: relationships with bleaching events

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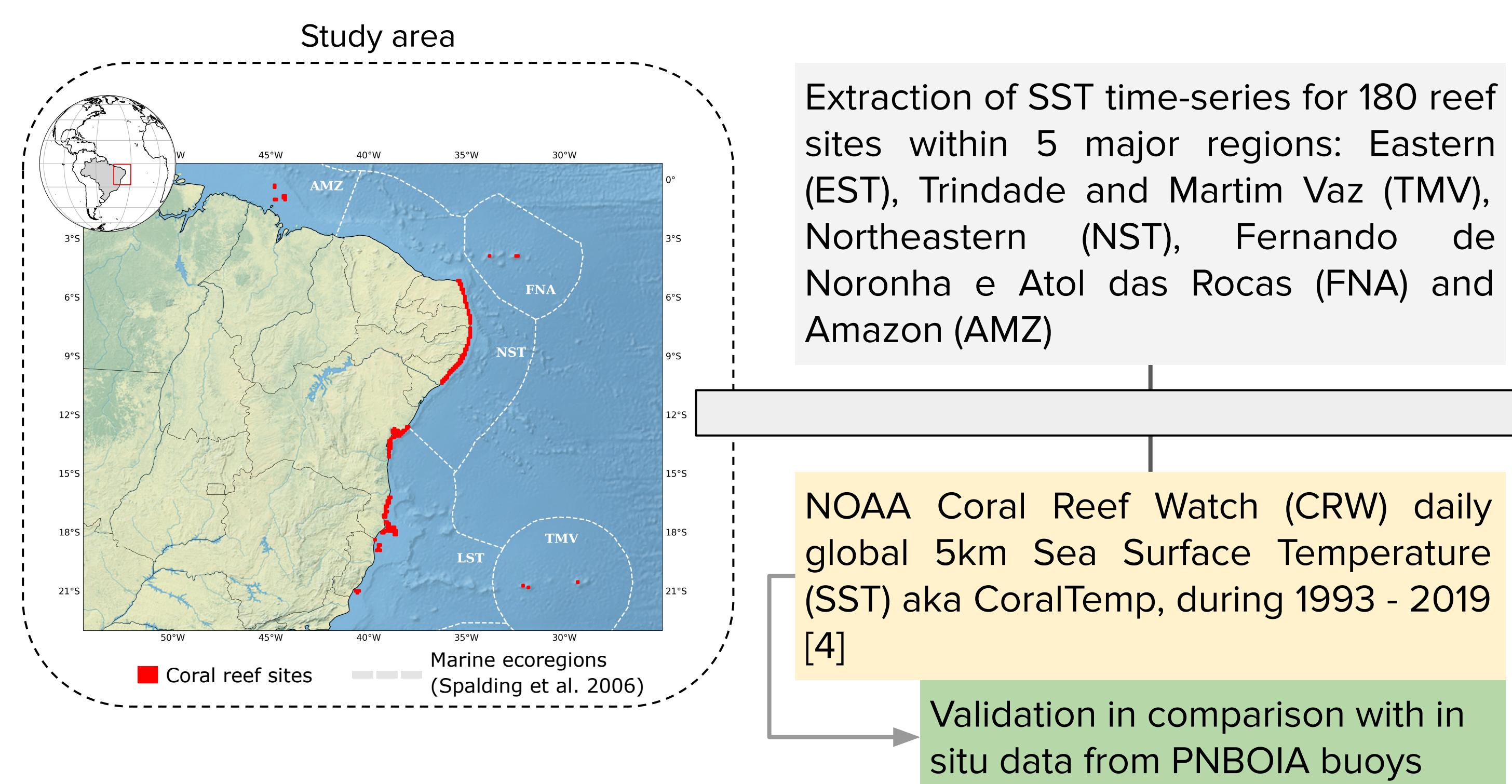
## What is a marine heatwave?

- Marine Heatwaves (MHWs) are defined as high-impact events in which the sea surface temperature (SST) stays above a climatological threshold ( $> 90^{\text{th}}$  percentile) for at least five consecutive days [1];
- MHWs can be caused by a range of atmospheric and oceanographic process, such as air-sea heat fluxes, sea surface temperature fronts and climatic modes (e.g. ENSO, AMO) [2];
- Due to climate change and ocean warming, MHWs has intensified its frequency and intensity over the past years [3].

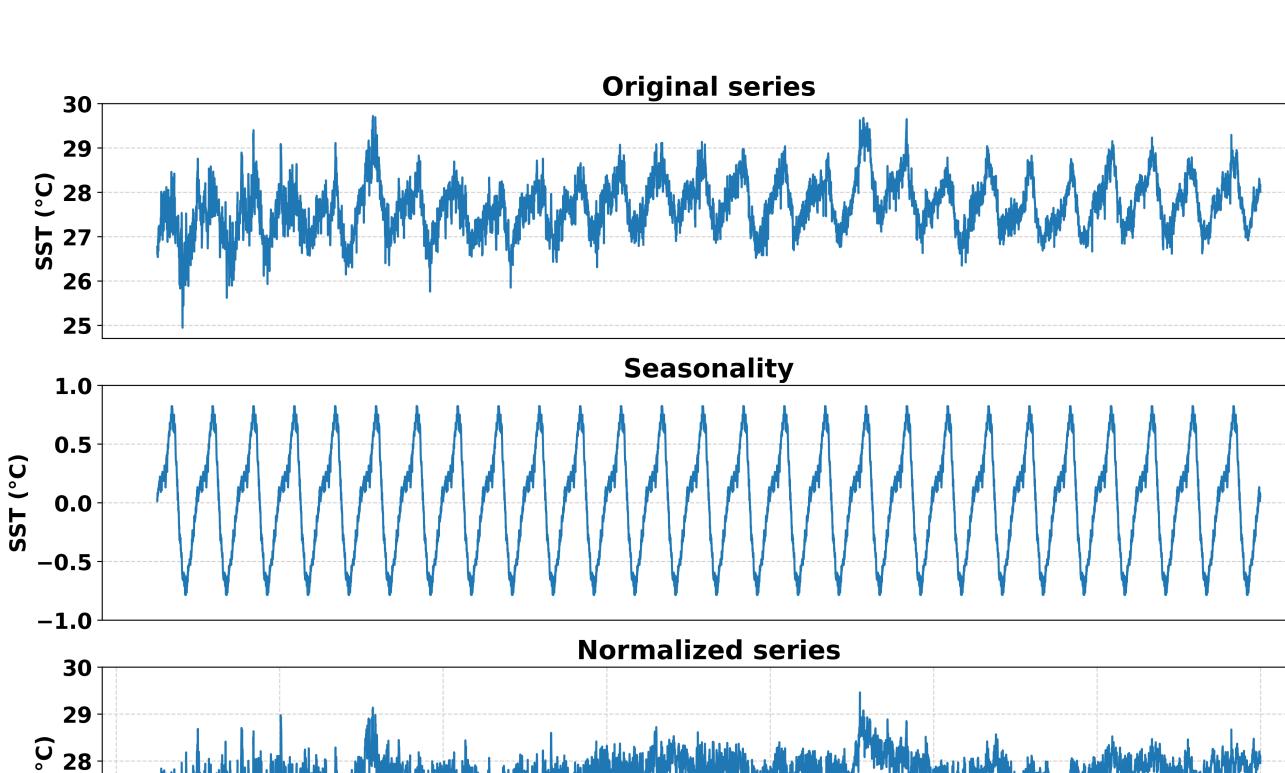
## Introduction

- Historically, South Atlantic coral reefs seem less susceptible to heat stress, where predictability of bleaching events based on temperature is not as accurate as worldwide [4];
- However, recent MHWs occurrences over Brazilian coast had lead to major coral bleaching and mortality episodes, threatening reef conservation in the region [5];
- Here we propose to identify the occurrence of marine heatwaves on Brazilian coral reefs, investigating its distribution, intensity and potential relationships with historical coral bleaching events.

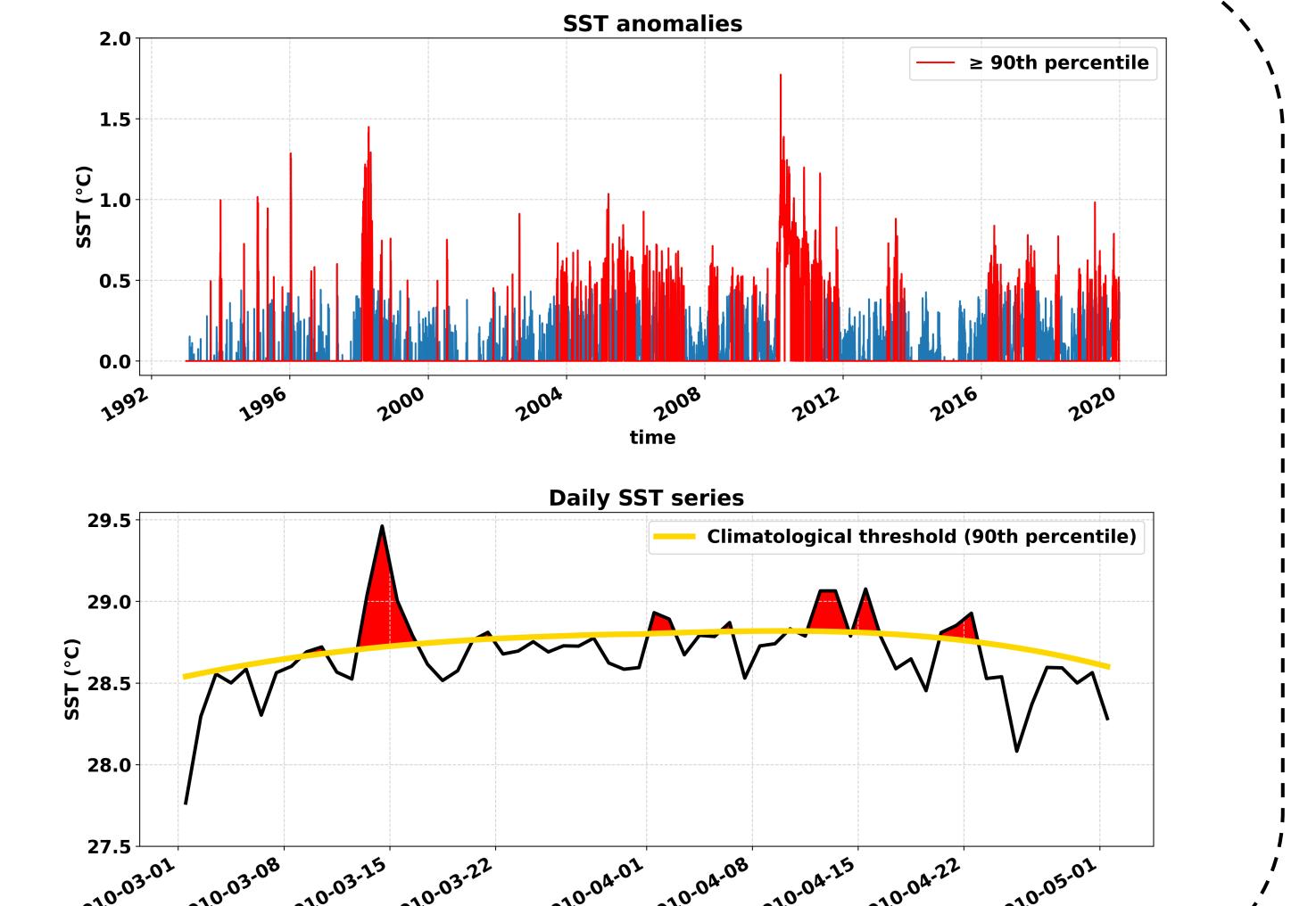
## Methodology



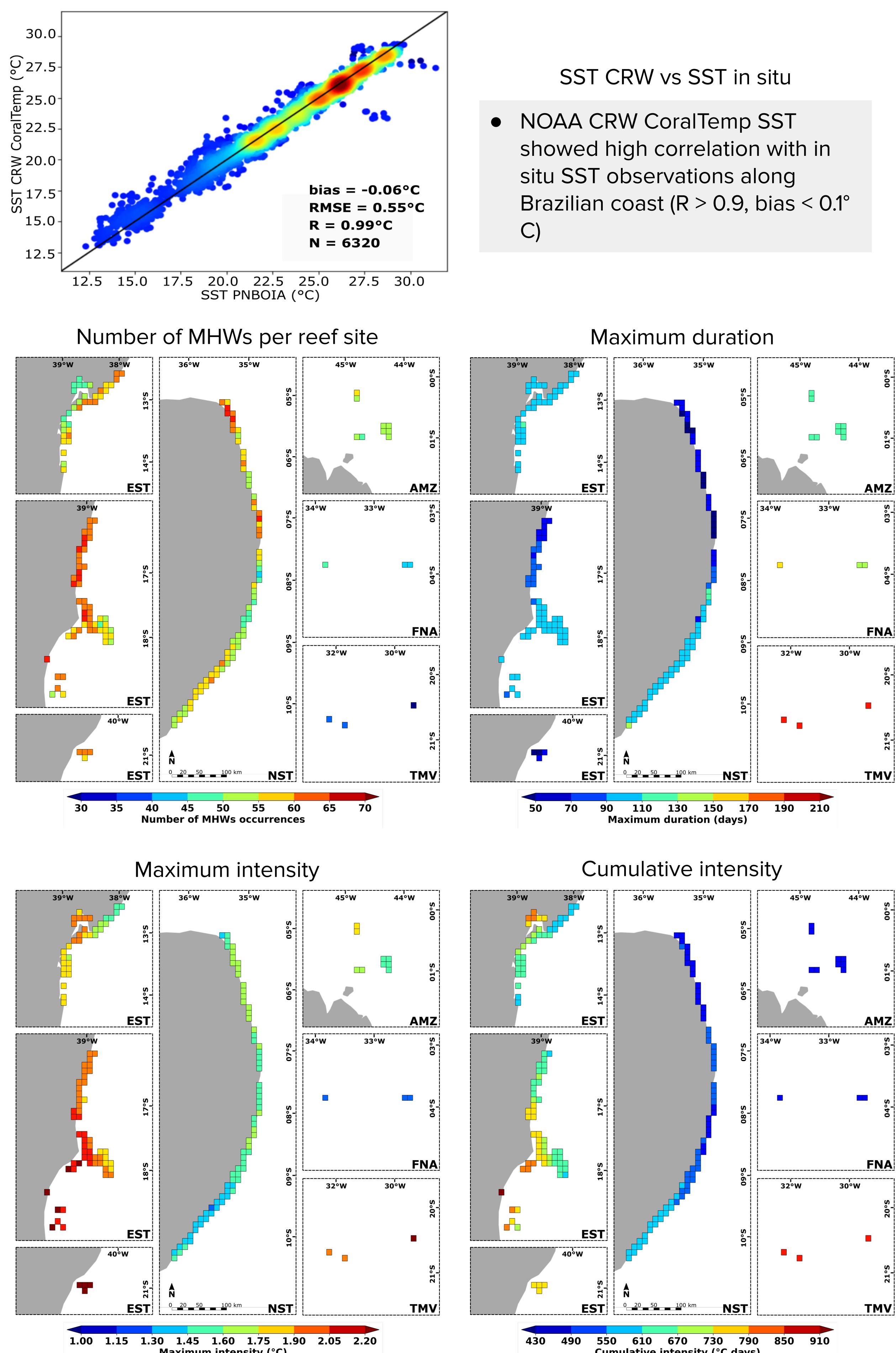
### Time-series decomposition for seasonality removal



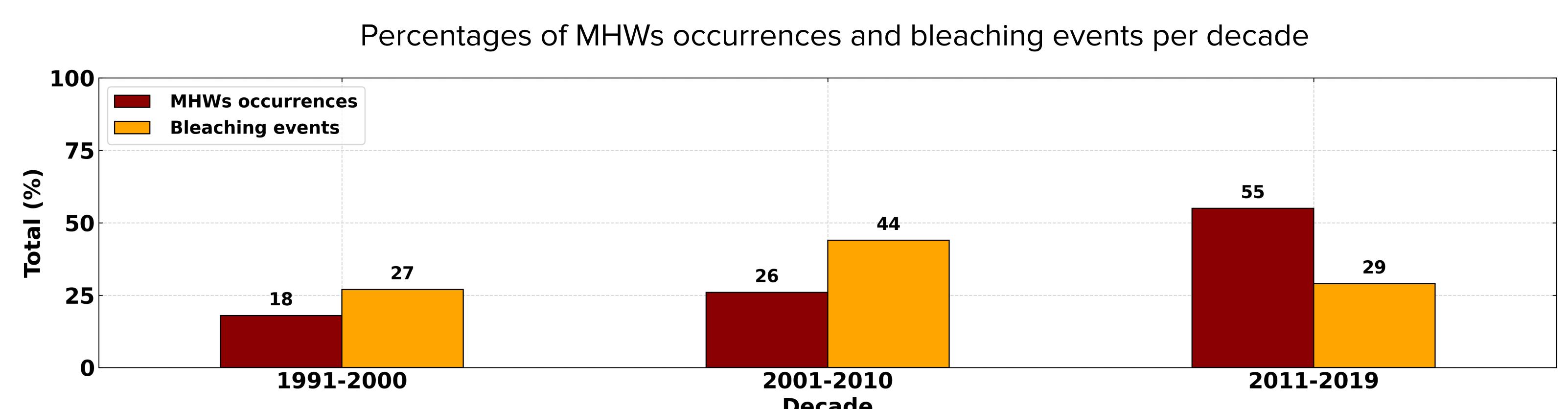
### Identification of SST anomalies above 90th percentile during ≥ 5 days



## Results



Region	Number of MHWs occurrences	Average duration of MHWs (days)	Average intensity (°C)	Average cumulative intensity (°C days)	Summary of MHWs per region (Average ± Standard Deviation)	
					Number of bleaching events reported	
EST	59 ± 5.4	90 ± 15.5	2.45 ± 0.19	688.21 ± 74.7	25	
NST	56 ± 5.0	82 ± 26.9	1.74 ± 0.12	515.80 ± 42.0	16	
AMZ	52 ± 1.8	122 ± 3.2	1.82 ± 0.13	446.55 ± 15.6	1	
FNA	43 ± 2.5	144 ± 5.7	1.29 ± 0.01	479.94 ± 13.7	4	
TMV	35 ± 5.0	184 ± 19.3	2.27 ± 0.15	860.90 ± 8.5	2	



- Higher maximum and cumulative intensities were mainly observed at EST coral sites (i.e. southern regions);
- Bleaching events reported along EST and TMV may be associated with higher number of MHWs occurrences at this regions;
- TMV presented most durable MHWs and highest average of cumulative intensity, besides low bleaching observations;
  - This may be due to potential lack of constant monitoring at the region;
- > 80% of MHWs occurred in the last two decades, with > 70% of bleaching reports during the same period;
- Ultimately, further analyses are being conducted to understand the correlation between MHWs and most severe bleaching reports.

## References

- Hobday, Alistair J., et al. "Categorizing and naming marine heatwaves." *Oceanography* 31.2 (2018): 162-173.
- Holbrook, Neil J., et al. "A global assessment of marine heatwaves and their drivers." *Nature Communications* 10.1 (2019): 1-13.
- Oliver, Eric CJ, et al. "Marine heatwaves." *Annual review of marine science* 13 (2021): 313-342.
- Mies, Miguel, et al. "South Atlantic coral reefs are major global warming refugia and less susceptible to bleaching." *Frontiers in Marine Science* (2020): 514.
- Duarte, Gustavo AS, et al. "Heat waves are a major threat to turbid coral reefs in Brazil." *Frontiers in Marine Science* (2020): 179.
- Skirving, William, et al. "CoralTemp and the coral reef watch coral bleaching heat stress product version 3.1." *Remote Sensing* 12.23 (2020): 3856.

## Acknowledgments: