Marine heatwave, western Australia

31 January 2025

Key Points:

- A marine heatwave (MHW) is a period of sustained, anomalously warm ocean temperatures. These can have widespread harmful ecosystem and environmental effects, from coral bleaching to fish kills. The ocean is particularly susceptible to this kind of heat, as it absorbs more than 90% of the heat associated with Climate Change.
- Much of the ocean off the west coast of Australia has been in a MHW since September. Over the full scope of the region we analyzed at Climate Central (Fig. 1), the percentage of area in a heatwave state increased in mid-September to above 20% (Fig. 2) and continued increasing over time (despite a short dip in early December) before **a sharp increase in early January, when more than 60 percent of the region met the criteria for a MHW.**
- The hottest region is just off the northwest coast of Australia, where **average temperature anomalies over a 5 month period have exceeded 1.5 degrees Celsius** in much of the region (Fig. 1, Top). Additionally, much of this region has been in the MHW condition for more than 120 days since August 1, 2024 (Fig. 1, bottom).
- The Ocean Climate Shift Index (Ocean CSI) measures the impact of climate change on daily ocean surface temperatures. The Ocean CSI shows that during this prolonged MHW, daily ocean surface temperatures were made on average at least 20 times more likely to occur as a result of climate change throughout the event (Fig. 3). Meanwhile, during the most climate-impacted period **in Late November, temperatures were on average made in excess of 100 times more likely to occur across regions affected by the MHW.**
- The severity of this MHW is increasing. Even as a growing portion of the ocean in this region is in the MHW, **the unusual heat associated with the MHW has escalated and is continuing to escalate**. In September, average temperature anomalies stayed at around 1.2 degrees Celsius. Since then, average temperature anomalies have steadily increased. **In January, mean temperature anomalies never dipped below 1.6 degrees Celsius, and broke above 2 degrees Celsius on three separate occasions.**

Methods: We followed the methodology established by Hobday et. al (2016) to establish which regions analyzed were part of the MHW. This methodology suggests that areas above the 90th percentile temperature for that time of year for more than 5 days in a row are in a MHW. Using NOAA's Optimum Interpolation Sea Surface Temperature (OISST), we first found the 90th percentile sea surface temperature (SST) threshold across the region for each location for each calendar day (using an 11 calendar day rolling window) from 1991-2020 and computed the 90th percentile from those values. A location was in the MHW if its SST was above these thresholds for 5 days in a row (we call each period of 5 days or more above the 90th percentile a

persistent event), or if it was in a period of two days or less between subsequent 5 day persistent events. In other words, if a location experienced 5 days above the 90th percentile, then 2 days below the 90th percentile, then 7 days above the 90th percentile, all 14 days were deemed to be in the MHW. We used this determination to measure the coverage of the MHW during the time period as well as the temperature anomaly associated with this coverage. Finally, we used the Ocean CSI to measure the impact of climate change on this MHW. The Ocean CSI is grounded in peer-reviewed methodology and high-quality data. It quantifies the influence of climate change on sea surface temperatures. The Ocean CSI indicates how human-caused climate change has influenced the likelihood of daily sea surface temperatures occurring at nearly any location around the world's oceans.

Graphics:

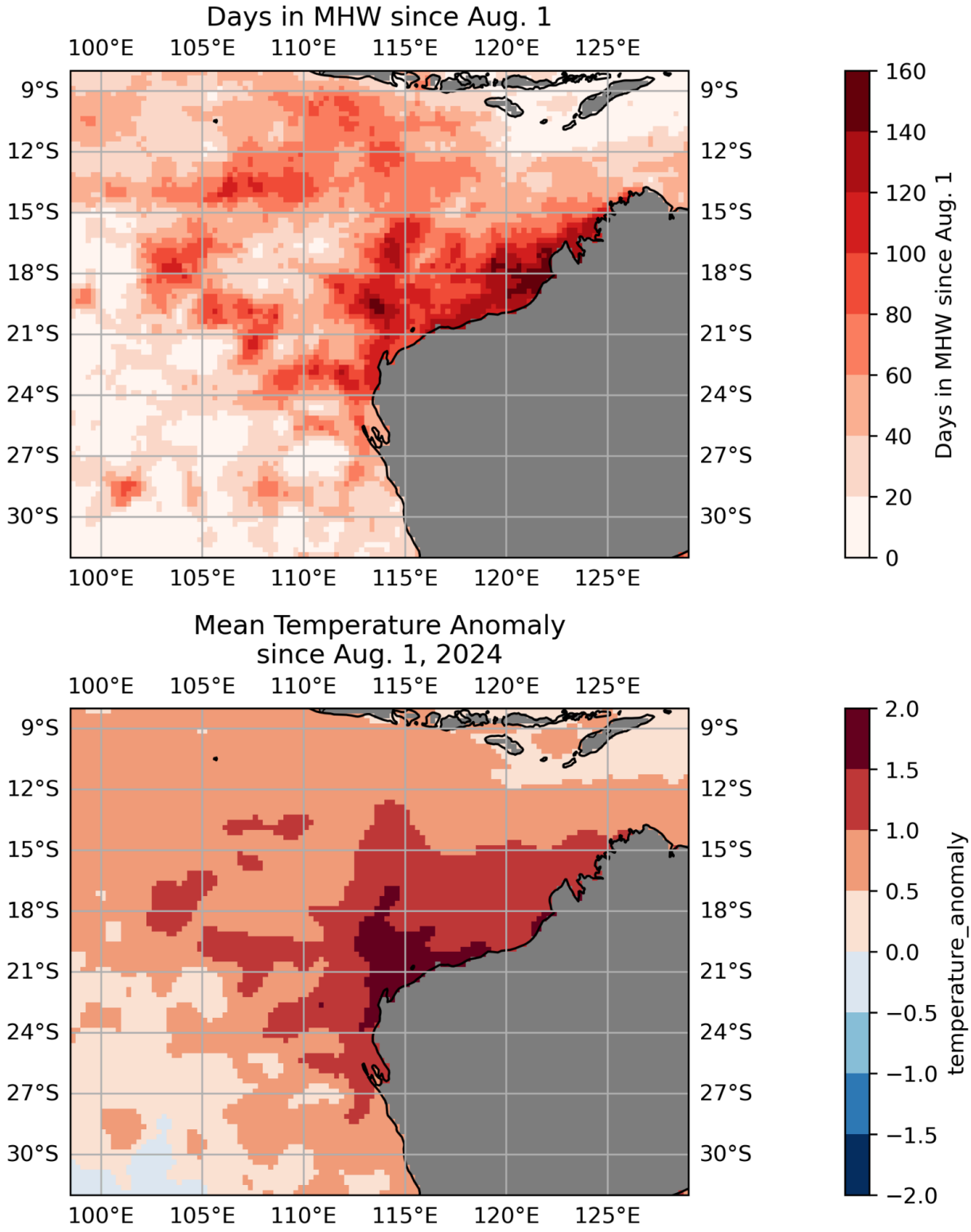

Figure 1: The number of days ocean locations off the coast of Australia have been in the MHW (top) and the mean temperature anomaly (bottom) from Aug. 1, 2024 to Jan. 29, 2025.

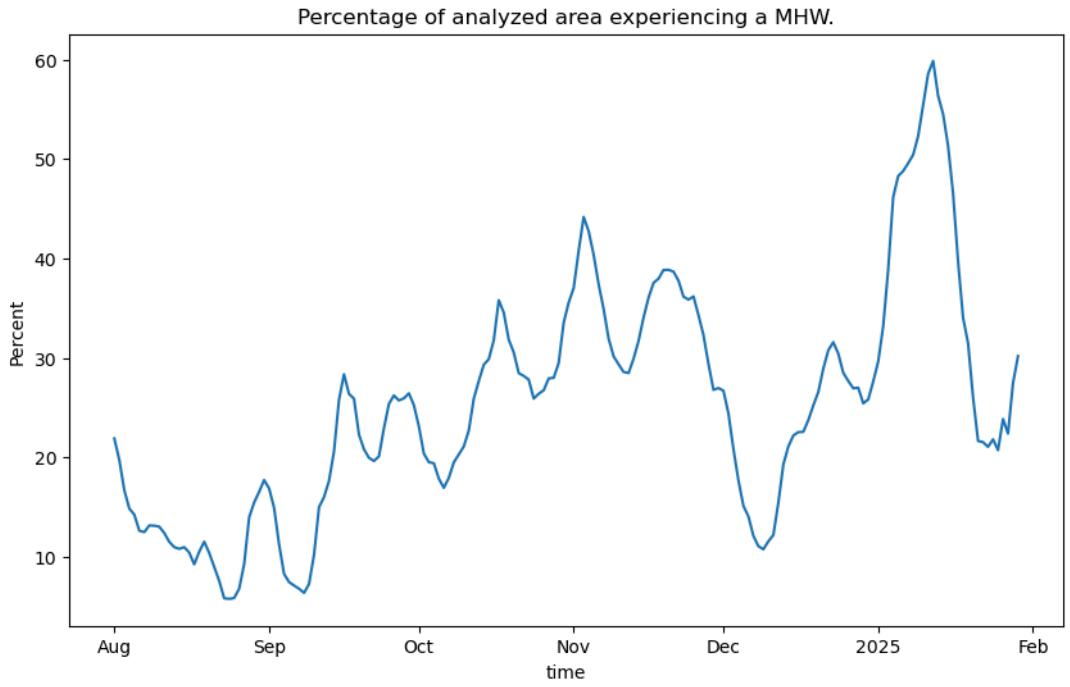

Figure 2: For each day Since Aug. 1, 2024, the percentage of the analyzed area (Fig. 1) that were in the MHW.

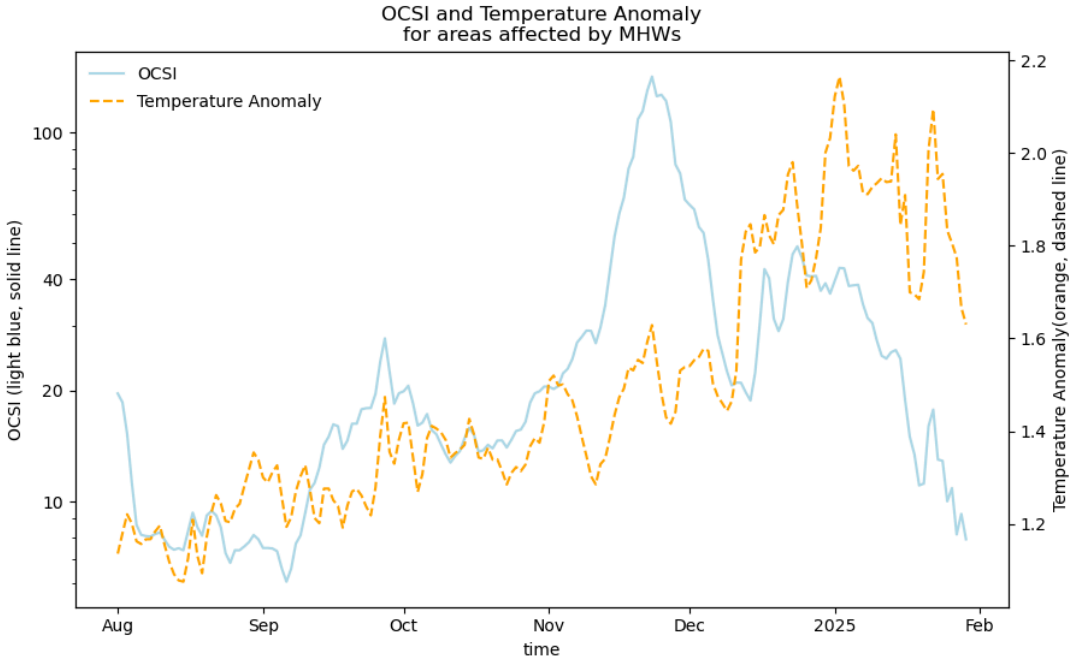

Figure 3: For each day since Aug. 1, 2024, the Ocean CSI (light blue, left axis) and temperature anomaly (orange, right axis) for those areas in the MHW.