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## Global Analysis of Marine Heatwave physical Processes

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Marine heatwaves (MHWs) are periods of extreme warm temperatures in the ocean and have been seen to exert substantial pressure to marine ecosystems around the world. For instance, they may drive widespread marine species die-offs, force coastal marine ecosystem regime shifts, promote toxic algal blooms, and/or alter the distribution of commercial fisheries on a scale of weeks to months. Recent studies have indicated a significant increase in MHW frequency and intensity throughout the 20<sup>th</sup> century, a trend which is likely to aggravate in the 21<sup>st</sup> century, according to future projections. Therefore, it is crucial to understand what are the climate drivers and physical processes governing MHWs in different regions of the global ocean and how these may change under the climate change regime. Here, we perform a mixed layer heat budget analysis, using a global ocean reanalysis product, to diagnose the relative role of ocean advection and atmosphere fluxes on the development of past MHWs around the world. Significant events are first identified using a consistent framework. Then, the heat budget results reveal that certain physical processes tend to be dominant in different regions, which can be traced back to specific local-scale dynamics. The global scale of this analysis provides a significant addition to the current literature which has, so far, been focused on the examination of the underlying mechanisms behind individual events. It also contributes to a better understanding of the variability and processes governing MHWs, offering also a potential ability for future event predictability.