

# Surface and Subsurface Marine Heatwave Impacts on North Atlantic Tropical Cyclone Intensification

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Anthropogenic global warming has contributed to more intense marine heatwaves (MHWs) around the world. As tropical cyclones (TCs) derive their energy primarily from warm ocean waters, growing interest has emerged in quantifying the relationship between MHWs and TC development. While previous studies have used sea surface temperatures to identify and constrain the influence of MHWs on tropical cyclone intensification, here we incorporate sea surface and subsurface MHWs based on a widely used, percentile-based, quantitative framework for identifying the presence of marine heatwaves. Further, we quantify the severity of MHWs to better understand the association between MHW severity and tropical cyclone intensity, as well as rapid intensification. Given the availability of potential temperature data, the recent 1993 to 2022 30-year period was adopted as the baseline for calculating the seasonally varying climatological mean and 90th percentile values for the sea surface and subsurface MHW severities, the latter of which is column-averaged to obtain column-averaged subsurface severities over different depth ranges. Preliminary analyses of all North Atlantic storm tracks that passed over a MHW, whose genesis and lifetime maximum intensity or highest maximum sustained wind speed was achieved within the 0° to 40°N latitude and 15° to 100°W longitude bounds, show a significant, albeit weak, association between higher maximum wind speeds and the presence of strong subsurface MHWs. Additionally, periods of high heatwave severity appear to be associated with periods of rapid intensification. Moreover, along the TC tracks that passed over MHWs, on average, the maximum TC intensity is often reached about one day after it passes through a moderate MHW event. Ultimately, examining surface and subsurface MHWs in relation to tropical cyclone intensification can help us understand how heatwaves enable, maintain, or facilitate rapid intensification and lead to more intense storms, critical for climate adaptation and resilience efforts.