

## **Projected wave climate in the Gulf of Mexico based on synthetic tropical cyclones derived from CMIP6**

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Tropical cyclones are one of the most significant natural hazards affecting coastal regions worldwide, causing substantial damage and loss of life. In addition to the wind, storm surge, and rainfall associated with tropical cyclones, ocean waves generated by these events are critical design parameters for maritime structures. With climate change expected to change the frequency and intensity of tropical cyclones, it is crucial to assess how these changes will impact associated hazards, including ocean waves. This study assesses tropical cyclone-derived waves in the Gulf of Mexico based on synthetic tropical cyclones generated under historical and future climate conditions. The study uses the CMIP6 experiments and scenario SSP5-8.5 to derive synthetic events and force a third-generation wave model to estimate the probability of extreme waves for the end of the century. The findings of this study highlight the importance of considering non-stationary wave climates when designing and planning maritime structures to reduce the probability of structural failure as we transition into a future climate with an increased likelihood of extreme waves. Emphasis is given to comparing the results derived from synthetic events to the American Petroleum Institute design recommendations based on historical events. Understanding how tropical cyclone-derived waves are likely to change under different climate scenarios can inform coastal infrastructure design, help prepare for and respond to extreme events, and reduce the potential impact of future tropical cyclones.