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Effects of tropical cyclone characteristics on the surface wave fields in the Australian North West region

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The northwestern Australian coastline is subject to frequent extreme wave forcing resulting from tropical cyclones (TCs) during the summer months on Australia's North West Shelf (NWS). Compared to the northern hemisphere, knowledge about the wave climate, and TC generated waves in particular on the NWS is limited. TCs on the NWS show considerable variability in paths: some move predominantly parallel to the coastline, while others propagate in a coast-normal direction. It has been suggested that surface wave fields generated by coast-parallel moving TCs are different compared to TCs moving in a coast-normal direction across the shelf. In particular, wave heights generated by coast-parallel storms may be limited in size due to both refraction and bottom friction effects.

First, this study evaluates the performance of a numerical wave model (SWAN) to hindcast the surface wave fields under different TC conditions forced by a parametric TC wind model of the region. Hindcast simulations were run for 4 case studies: the coast-parallel TCs Nicholas (2008) and Bianca (2011), and the coast-normal TCs Lua (2012) and Christine (2013). Model output was compared both temporally and spatially by in situ wave buoy data and satellite altimeter data and generally showed a good agreement for throughout the history of these TCs. However, for the more intense and larger system TC Lua, the model was found to overestimate the significant wave heights, especially in the left front quadrant of the storm. A modified SWAN model using adjusted wave energy dissipation terms was found to improve model output under these conditions.

Second, output from the numerical simulations is used to analyse the mechanisms behind the generation and dissipation of the wave field and to relate them to tropical cyclone characteristics including the radius of maximum winds and the storm translation speed and direction.