

Influence of the Agulhas Current on crossing swells along South African coasts

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Abstract

The Agulhas Current, recognised for its intense and complicated dynamics, has a significant impact on the South African wave climate. The study investigates wave-current interactions along the South African coast, focusing on current-induced crossing swell conditions through numerical modelling. The Agulhas Current interacts with south-westerly waves, causing wave refraction, steepening, and crossing swell conditions that endanger maritime safety. We assessed wave-current interactions using the numerical wave model Wave-Watch III (WWIII) in both current and non-current instances. Model validation against coastal buoy measurements showed good agreement in all the wave parameters, although discrepancies remain for smaller wave heights. Simulations revealed that the presence of the Agulhas Current modifies wave properties. Notably, the percentage of crossing swells at locations within the heart of the Agulhas Current increases from 20% to 40-65% with the inclusion of wave-current interactions. These patterns are due to significant current-induced refraction and the directionality of secondary swells. Crossing swell conditions were notably more likely to occur along the north-east coast from East London to Richards Bay. This research highlights the critical implications for maritime safety and coastal management. The findings highlight the importance of continuing to improve numerical models to accurately depict complicated wave-current interactions in dynamic systems.