

Severe ocean swell events by explosive cyclones and its generation mechanisms

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Waves, which originate in strong storms (e.g., explosive cyclones) in the north of the Sea of Japan, have recently devastated the coastal region of Toyama Bay. These type of events have been known for centuries, and the locals refer to them as YoriMawari-nami. Engineers have struggled to understand the origin of YoriMawari-nami events, though important for protecting our coasts, and they have been unable to reproduce them with typical models (phase-averaged wave models). We used data to characterize these events, which are always long, old waves (swells) with unusually large wave heights compared to the past wave climate. We use wave models and ray-tracing techniques to show how a swell arrives in the bay and bends over submarine canyons. The submarine canyon, like a prism separating light into different colors, separates out swells, and wave phases (the exact timing of an individual wave cycle) can no longer be ignored. In fact, the wave phases become crucial for understanding the enhancement of wave height. We were able to reproduce the observations with a phase-resolving model, giving hope for predicting these events in the future.

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