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Numerical wave modeling for Pacific Islands

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Wednesday, January 10, 2024 at 3:30 pm - 4:30 pm

In person: BIL 150
On zoom: Meeting ID: 950 8185 8686
Passcode: OREseminar

Hawaii is typical of most Pacific Islands with a complex wave climate containing a mix of persistent trade wind seas, year-round south swells, seasonal north swells, and storm waves from subtropical and tropical cyclones passing nearby. The steep volcanic islands modulate the wind fields to create regional wave patterns with large spatial variation. Wave-rider buoys were installed around the island to provide real-time measurement of ocean conditions. The buoy measurements are valuable and considered as ground truth, but are limited to sparse locations with irregular data gaps over time. The buoy measurement is best complemented by numerical wave modeling for a complete description of the complex wave conditions around the islands. We develop a numerical wave model system based on the third-generation spectral wave models WAVEWATCH III and SWAN on a suite of nested grids from the globe to the islands to resolve wave generation, propagation, and transformation from the open ocean to the shore. The model system was integrated into a storm surge modeling package for coastal inundation mapping in Hawaii. We also operate the wave model system to produce daily 7-day and 14-day wave forecasts for the US and affiliated Pacific Islands. The operational wave forecast provides useful information for maritime operations, coastal runup prediction, and marine recreation. The wave model system was further implemented to provide long-term wave hindcast for energy resources development, coastal ecosystem study, infrastructure designs, and shoreline change investigation. Recently, we have used the wave hindcast to investigate the impact of global climate cycles on coastal wave activities, and had some interesting findings.

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