

Improved sea state characterization in support of marine renewable energy projects

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The Spotter (Spoondrift Technologies, LLC) is an accurate, low-cost, easily deployable and robust solar powered, web-integrated solution for collecting ocean wave data. The low-cost and compact Spotter platform facilitates deployment of arrays of multiple wave buoys, which was previously cost prohibitive or not feasible with traditional wave buoys. A well-designed array can provide assessments of wave characteristics, such as wave propagation speeds and direct measurement of the directional wave spectrum, which cannot be accomplished with measurements from a single buoy. To explore this, a series of experiments were performed, where multiple Spotters were deployed in a variety of configurations to directly measure the time-evolution of wave decorrelation scales, wave propagation speeds, directional spreading, and directional spectra. Using a two-dimensional array of Spotters, directional spreading functions were estimated from the spatial cross-spectral density matrix and compared to maximum likelihood and maximum entropy methods. The array also allowed for the application of plane-wave beamforming techniques to compute wave directional spectra. For the conditions during the experiment, time series of surface elevation recorded simultaneously by two Spotters separated in space showed significant decorrelation when buoy separations exceeded the distance associated with the inverse of the spectral width. Derived wave propagation speeds were found to compare favorably with those estimated using linear wave theory. These results show that wave parameter measurements and derived wave characteristics provided by multiple wave buoys in a domain can be assimilated to improve sea state predictions for more effective wave energy converter (WEC) active tuning through controls. Further, directional spectra that are directly measured by multiple wave measurement buoys can provide more accurate data for wave resource characterization, WEC siting, and WEC environmental assessments.

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