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## Real-time wave assimilation using low-cost sensor arrays (Extended Abstract)

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## Real-time wave assimilation using low-cost sensor arrays

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Buoy networks provide real-time and historical wave conditions along our coastlines. Augmented with regional now- and hind-casts from operational wave models, these networks provide vital wave information used for maritime, engineering, recreational and scientific purposes. Presently, buoy networks are primarily used to provide boundary conditions to models and assess model hindcast performance, but are not integral to the modeling system. However, efforts to develop rapid assimilation systems using networks of wave buoy observations have shown to massively improve model performance (e.g., [1]), and progressively improve model skill as the density of the observational network increases. Consequently, assimilation of dense observational networks has the potential to significantly and very efficiently improve nowcast and forecast capabilities along our coastlines.

Historically, data-assimilation has not been widely applied due to high cost (initial and operational) to deploy and maintain extensive networks of directional wave buoys. As a consequence, observations are sparse and assimilation potential limited. In the present work we propose a system that leverages recent modeling advances with the advent of Spooondrift Spotter, a low-cost, compact, solar-powered directional wave buoy [2]. By combining dense networks of low-cost sensing platforms with highly efficient assimilation methods, we can provide excellent constraints on models and considerable improvement in operational performance.

In this paper we present the underlying theory and principal results from a new real-time data-assimilation system in which we integrate a dense network of Spotters. The sensor network was deployed as part of the ONR Innershelf DRI experiment during the period from September 2017 till November 2017. The array consists of 18 Spotters, deployed seaward of Point Sal (California) along the 20-, 50- and 100-meter depth contours (Fig. 1). Each of these buoys provides estimates of the complete frequency-directional spectrum every hour. The wave spectra and directional moments are assimilated in real-time using an efficient backward ray-tracing algorithm to reconstruct the details of the offshore boundary conditions, which is subsequently used to drive a regional wave model [3] to produce a fully data-constrained nowcast of the regional wave conditions. We will discuss the data-assimilation framework developed in this study and compare assimilated results with predictions from conventional model predictions forced with predictions from the global NOAA WAVEWATCH III model [4].

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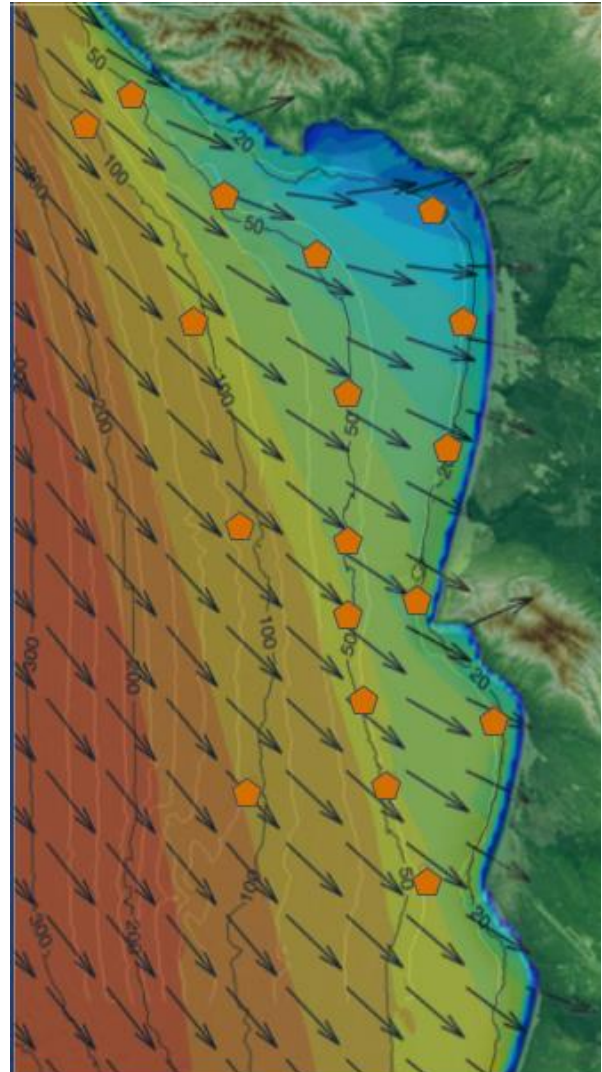


Figure 1. High density array of spotters deployed near Point Sal, CA

### References

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