Phase-based depth estimates at open beaches and tidal inlets

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In order to address the spatial resolution limitation of 3D-FFT methods to acquire ocean wave frequency and wavenumber information for the purpose of depth inversion, these parameters may alternately be estimated at a resolution on the order of one wavelength via exploitation of the spatial structure of the cross-spectral phase. The recently published cBathy algorithm employs this phase based method, but also employs self-reported uncertainty metrics to objectively update estimates in time via a Kalman filter. Here we extend application of the cBathy algorithm from the design scenario of optical image time series at an open beach to X-band marine radar image time series at a range of environments: open beaches and tidal inlets in North Carolina, Oregon/Washington, and The Netherlands. Estimate accuracy, assessed via comparison against concurrent sounding-based surveys, typically falls in the range of 30-60 cm RMSE and 10-35 cm bias. Due to the neglected Doppler shift, the presence of currents induce depth estimate errors; the incurred error can be significant at inlet mouths. We thus discuss the advantages and disadvantages of mitigation via tidal averaging, direct depth/current inversion, and inversion separation using outside information to identify tidal slack periods.