Geophysical Research Abstracts
Vol. 19, EGU2017-3737, 2017
EGU General Assembly 2017

Observations and Simulations of the Impact of Wave-Current Interaction on Wave Direction in the Surf Zone

Julia Hopkins (1,2), Steve Elgar (2), and Britt Raubenheimer (2)

(1) Massachusetts Intitute of Technology, Cambridge, MA United States (hychenj@mit.edu), (2) Woods Hole Oceanographic Institution, Woods Hole, MA United States (jhopkins@whoi.edu)

Accurately characterizing the interaction of waves and currents can improve predictions of wave propagation and subsequent sediment transport in the nearshore. Along the southern shoreline of Martha's Vineyard, MA, waves propagate across strong tidal currents as they shoal, providing an ideal environment for investigating wave-current interaction. Wave directions and mean currents observed for two 1-month-long periods in 7- and 2-m water depths along 11 km of the Martha's Vineyard shoreline have strong tidal modulations. Wave directions shift by as much as 70 degrees over a tidal cycle in 7 m depth, and by as much as 25 degrees in 2 m depth. The magnitude of the tidal modulations in the wave field decreases alongshore to the west, consistent with the observed decrease in tidal currents from 2.1 to 0.2 m/s. The observations are reproduced accurately by a numerical model (SWAN and Deflt3D-FLOW) that simulates waves and currents over the observed bathymetry. Model simulations with and without wave-current interaction and tidal depth changes demonstrate that the observed tidal modulations of the wave field primarily are caused by wave-current interaction and not by tidal changes to water depths over the nearby complex shoals. Sediment transport estimates from simulated wave conditions using a range of tidal currents and offshore wave fields indicate that the modulation of the wave field at Martha's Vineyard can impact the direction of wave-induced alongshore sediment transport, sometimes driving transport opposing the direction of the offshore incident wave field. As such, the observations and model simulations suggest the importance of wave-current interaction to tidally averaged transport in mixed-energy wave-and-current nearshore environments.
Supported by ASD(R&E), NSF, NOAA (Sea Grant), and ONR.