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Combined wave-current-surge model and its implication on Storm Surge modeling studies

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The combined effects arising due to non-linear interaction between current-tide-surges on evolution and propagation of surface waves is recognized as an important field of research. The resultant wave-setup in the near-shore areas arising from the complex interaction of these components is an essential pre-requisite for storm surge modeling studies. These effects are considered important in near-shore and coastal waters requiring a comprehensive understanding of these non-linear interactions in both space and time scales. The effects include (i) modification of effective surface roughness, hence the effective fetch in presence of strong currents arising from wave age, (ii) shoaling depths increasing tidal amplitude towards the coast which is ultimately reversed by the bottom frictional effects, (iii) doppler shift in wave frequency leading to varying wavelength and wave heights from wave action conservation, and (iv) variation of bottom friction factor in presence of varying currents. In the present study, effects due to non-linear interaction between currents, tides and surges under varied central pressure drops for a synthetic track and its overall effect on significant wave heights for a localized region in the Bay of Bengal has been investigated. The study reveals that effect of tides (ebb and flood phases) has significant impact in modifying the free surface elevation which in addition also alters the near-shore wave breaker regime. Further, the effects of wave age in modifying the surface drag coefficient were also investigated. Based on these findings it could be advocated that these results have a significant bearing on storm surge modeling studies.