



Wave induced coastal flooding in Indian coastal regions during Kallakadal events

The present study evaluates a special case of swell-induced coastal flooding along the southwest coast of India, known as Kallakadal. We utilized a combination of WAVEWATCHIII and XBeach models to analyze major events from 2018 and 2024. Meteorological conditions in the southern ocean revealed the presence of Cut-off-Lows (COLs) during the events in April 2018, March 2024, and May 2024. The quasi-stationary nature of intense COLs resulted in strong winds (~25 m/s) over a large fetch in the southern Indian Ocean, causing long-period swell propagation (18-25s) towards the north Indian Ocean. This swell propagation was studied using wave drifter and buoy observations in the Indian Ocean. These swells led to high wave activity and flooding along the Indian coastal regions, depending on the local topography, and tidal conditions. While the teleconnection between long-period swell propagation and the blocking of westerlies by COLs is known, the transformation of long-period swells in the coastal zone and the mechanisms causing coastal flooding remain unclear. Our study shows the presence of infragravity waves (IGWs), with frequencies lower than swell waves, in coastal areas during flooding events. These IGWs are generated due to non-linear wave-wave interactions. The combined effects of low-frequency waves and the rise in coastal water levels due to wave setup caused inundation at a hotspot location along the southwest coast of India. The maximum runup extent is influenced by the steepness of the bathymetry and tidal conditions. This research will contribute to the development of a coastal wave-induced inundation prediction system for low-lying hotspots, utilizing a combination of WAVEWATCHIII and XBeach models.

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