Wave Driven El Nino Impacts to Water Level Anomalies in the Pacific

Stopa, Justin Edward; Chapron, Bertrand; Ardhuin, Fabrice

Laboratorie d'Océanographie Physique et Spatiale (LOPS), Univ. Brest, CNRS, IRD, IUEM, Ifremer, Plouzane, France

E-Mail: justin.stopa@ifremer.fr

Large scale climate oscillations play an important role in the Earth system. To predict future coastal hazards it is essential to quantify relationships between these large scale oscillations and dangerously high water levels. In this study we examine the dynamic component of water level through wave-driven processes in the North Pacific. We track extra-tropical storms within the wave field generated from a hindcast forced by the Climate Forecast System Reanalysis (CFSR) over the period 1980-2016. Like previous studies of Barnard et al., (NGEO 2015), we find that El Nino has a significant impact on sea level anomalies in the Pacific. Our analysis is concentrated on the boreal winter when the effects El Nino are the strongest. The arrival time of the peak swell energy generated by the extra-tropical storms correlates with high water level anomalies across the Pacific. Each phase of the El Nino Southern Oscillation: La Nina, Neutral, and El Nino have distinct spatial patterns in the quantity and magnitude of the strongest wave events. The El Nino events have a significant impact on California coastline and our method of tracking the wave systems directly shows the importance of properly modeling wave events and the swell component. In future climate projections, the dynamical wave component of high water level events should be considered along with the proper treatment of the swells. This is because it is expected that the extra-tropical storms will continue to shift trajectories creating a systematic patterns making some geographic regions more vulnerable sea level rise.

Keywords: tracking wave systems, swell impacts, El Nino Southern Oscillation, wave climate