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The extreme sea-level event of 14-15 October 2016 on the coasts of British Columbia and Washington State caused by Typhoon "Songda"

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From 12 to 16 October 2016, a series of three strong low-pressure systems, including typhoon “Songda”, passed over the coasts of southern British Columbia (BC) and Washington State (WA). Typhoon “Songda” was generated on 2 October about 1,000 miles to the southwest of Hawaii. After passing along the coast of Japan, it turned eastward, crossed the Pacific Ocean, arriving off the coast of North America on 12 October, where it merged with local extratropical cyclones propagating along the coast of Vancouver Island. These three lows passed across the western coast of the island on 14-15 October, generating strong surface currents if the offshore region and significant sea level oscillations, including storm surges, seiches and infragravity waves along southern BC and northern Washington. Oceanic observations of the event included HF WERA radar data, offshore bottom sea pressure measurements from the Ocean Network Canada (ONC) observatories and sea level records from BC and WA tide gauges. Meteorological data analyzed included radar records, satellite imaginary, reanalysis synoptic data, and air pressure and wind surface measurements of remarkable spatial and temporal resolution from more than 150 school network stations. These extensive datasets allowed for a detailed tracking of atmospheric processes responsible for strong ocean surface currents and sea-level oscillations. Maximum currents of up to 50 cm/s were measured by the HF radar. The surge heights on the southern BC and northern WA coasts were higher than 80 cm, with maximum storm surge observed at La Push, WA (117 cm) and New Westminster, BC (101 cm). A particularly interesting phenomenon was observed on the west side of Vancouver Island, beginning at Tofino, where the tide gauge record indicated a sharp, knife-like 40-cm increase in sea level with a peak value at 07:01 UTC on 14 October. Slightly lower sharp sea level peaks were also observed at Bamfield, Port Alberni and Port Renfrew. The high negative correlation between sea level and atmospheric pressure is consistent with the inverted barometer (IB) effect. Sharp sea level peaks at Tofino, Bamfield and Port Alberni are shown to be related to the specific shapes of the air pressure variations at these sites (the minimum atmospheric pressure at Tofino was 971.4 hPa), but the sea level response was 1.5-2.5 times greater than the IB effect, demonstrating the topographic amplification of sea levels in the respective areas. Such oscillations at Tofino and surrounding regions, may be described as a “meteorological tsunami” that for this specific case has a character of a forced solitary wave.