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The Solomon Islands Tsunami of 6 February 2013 in the Santa Cruz Islands: Field Survey and Modeling

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On February 6, 2013 at 01:12:27 UTC (local time: UTC+11), a magnitude Mw 8.0 earthquake occurred 70 km to the west of Ndendo Island (Santa Cruz Island) in the Solomon Islands. The under-thrusting earthquake near a 90° bend, where the Australian plate subducts beneath the Pacific plate generated a locally focused tsunami in the Coral Sea and the South Pacific Ocean. The tsunami claimed the lives of 10 people and injured 15, destroyed 588 houses and partially damaged 478 houses, affecting 4,509 people in 1,066 households corresponding to an estimated 37% of the population of Santa Cruz Island. A multi-disciplinary international tsunami survey team (ITST) was deployed within days of the event to document flow depths, runup heights, inundation distances, sediment and coral boulder depositions, land level changes, damage patterns at various scales, performance of the man-made infrastructure and impact on the natural environment. The 19 to 23 February 2013 ITST covered 30 locations on 4 Islands: Ndendo (Santa Cruz), Tomotu Noi (Lord Howe), Nea Tomotu (Trevanion, Malo) and Tinakula. The reconnaissance completely circling Ndendo and Tinakula logged 240 km by small boat and additionally covered 20 km of Ndendo's hard hit western coastline by vehicle. The collected survey data includes more than 80 tsunami runup and flow depth measurements. The tsunami impact peaked at Manoputi on Ndendo's densely populated west coast with maximum tsunami height exceeding 11 m and local flow depths above ground exceeding 7 m. A fast tide-like positive amplitude of 1 m was recorded at Lata wharf inside Graciosa Bay on Ndendo Island and misleadingly reported in the media as representative tsunami height. The stark contrast between the field observations on exposed coastlines and the Lata tide gauge recording highlights the importance of rapid tsunami reconnaissance surveys. Inundation distance and damage more than 500 m inland were recorded at Lata airport on Ndendo Island. Landslides were observed on volcanic Tinakula Island and on Ndendo Island. Observations from the 2013 Santa Cruz tsunami are compared against the 2007 and 2010 Solomon Islands tsunamis.

The field observations in the Santa Cruz Islands present an important dataset to assess tsunami impact in the near-source region. The tsunami was also recorded at deep-ocean tsunameters and tide gauges throughout the Pacific. These observations allow us to further investigate the physics of tsunami generation caused by the seismic process (or other non-seismic mechanisms). We use numerical model MOST to analyze the large runup and complex impact distribution caused by the Santa Cruz tsunami. Source models obtained using seismic data / tsunami data are carried out to initialize the tsunami model. MOST uses two sets of numerical grids to investigate both the near- and far-field aspects of the tsunami. The basin-scale modeling results are computed using a spatial resolution of 4 arc min (approx. 7,200 m) and compared with measurements at deep-ocean tsunameters. The near-field modeling is carried out using a series of telescoped grids up to a grid resolution of tens of meters to compare with the tsunami runup and flooding extent obtained through the field survey in the Solomon Islands. The modeling results emphasize the contrast between the tsunami impact on the exposed coastline and the sheltered Lata Bay stressing the problematic interpretation of a tsunami in progress based solely on near-source tide-gauge measurements.

The team also interviewed eyewitnesses and educated residents about the tsunami hazard in numerous ad hoc presentations and discussions. The combination of ancestral knowledge and recent Solomon Islands wide geohazards education programs triggered an immediate spontaneous self-evacuation containing the death toll in the small evacuation window of few minutes between the end of the ground shaking and the onslaught of the tsunami. Fortunately school children were shown a video on the 1 April 2007 Solomon Islands tsunami 3 months prior to the Santa Cruz event and the headmaster of the school at Venga evacuated the later flooded school already during a foreshock. On Tomotu Noi Island at Bamoi the residents evacuated inland towards a crocodile infested lake, which was not reached by the tsunami inundation. Community-based education and awareness programs are particularly essential to help save lives in locales at risk from near-source tsunamis.