



## **The 2018 Sulawesi tsunami: Field survey and eyewitness video analysis using LiDAR**

Hermann M. Fritz (1), Costas E. Synolakis (2,3), Nikos Kalligeris (4), Vassilis Skanavis (2), Fajar J. Santoso (5), Mohammad Rizal (5), Gegar Prasetya (6), Yibin Liu (1), and Philip L-F. Liu (7)

(1) Georgia Institute of Technology, Civil and Environmental Engineering, Atlanta, GA 30332, United States (fritz@gatech.edu), (2) Department of Civil and Environmental Engineering, University of Southern California, Los Angeles, CA 90089, USA (costas@usc.edu), (3) Department of Environmental Engineering, Technical University of Crete, Chanea 73100, Greece (costas@usc.edu), (4) Department of Civil and Environmental Engineering, University of California, Los Angeles, CA 90095, USA (nkalligeris@gmail.com), (5) Department of Agrotechnology, Tadulako University, Palu, Sulawesi Tengah 94145, Indonesia (fajar\_joe@yahoo.com), (6) Indonesian Tsunami Scientific Community, Jakarta 12950, Indonesia (gegar.prasetya@gmail.com), (7) Department of Civil and Environmental Engineering, National University of Singapore, Singapore 119077, Singapore (philiplfui@gmail.com)

On September 28, 2018, a magnitude Mw 7.5 earthquake occurred in the neck of Sulawesi's Minahasa peninsula. The combined effects of the earthquake and tsunami caused catastrophic damage and more than 2000 deaths. An international tsunami survey team (ITST) was deployed 3 weeks after the event to document flow depths, runup heights, inundation distances, sediment deposition, damage patterns at various scales, performance of the man-made infrastructure and impact on the natural environment. The 23 to 29 October ITST covered a 100 km stretch of coastline circling the entire Palu Bay and adjacent coastlines along the Makassar Strait. A 200 km long reconnaissance flight with an Indonesian Army Mil Mi-17 helicopter provided oblique aerial photography of impacted sites. The collected field survey data includes 130 tsunami runup and flow depth measurements. The tsunami impact peaked inside Palu Bay with flow depths above ground reaching 6 m and maximum runup heights exceeding 10 m. Inundation and tsunami damage was mostly limited to within 0.5 km of the shoreline except along rivers. A rapid decrease of tsunami heights was observed towards the bay entrance and outside of the Palu Bay along the Makassar Strait coastlines. Two tsunami eyewitness video recording locations inside Palu Bay were surveyed for subsequent video image calibration, tsunami hydrograph and flow velocity analysis. We deployed a Leica BLK360 scanner from the NHERI RAPID facility. We acquired precise topographic data using terrestrial laser scanning (TLS) at selected video sites with multiple scans acquired from different instrument positions. These ground-based LiDAR measurements produce 3-dimensional "point cloud" datasets. Digital photography from 3 scanner-mounted cameras yields full dome panoramic images overlaid on highly accurate point clouds. The main coastal road in Palu was overwashed with flow velocities of more than 7 m/s. Field observations, drone videos, helicopter and satellite imagery are presented. Eyewitnesses interviewed based on established protocols indicate rapid tsunami arrivals within a few minutes of the earthquake. We educated residents about tsunami hazards as community-based education and awareness programs are essential to save lives in locales at risk from locally generated tsunamis.