

EGU21-6822

<https://doi.org/10.5194/egusphere-egu21-6822>

EGU General Assembly 2021

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Sediment analysis and modelling reveal short inundation distances and low onshore flow speed of the 2018 Palu-Donggala tsunami in Indonesia

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On 28 September 2018, a magnitude 7.5 earthquake struck north of Palu, Central Sulawesi, Indonesia. The earthquake generated a tsunami with inundation depths of up to 7.5 m and run-up of up to 10 m above sea level. Inundation distances were only partly topography dependent and reached less than 400 m inland even where terrain did not rise steeply beyond that point. A subsequent tsunami was generated by a combination of minor fault displacement and multiple submarine landslides. In places, co-seismic coastal subsidence of >1 m exacerbated the tsunami inundation. During a post-event field survey in November 2018, we sampled three transects for sediment analysis; two in Palu City and one on the eastern coast of Palu Bay. The tsunami deposits in Palu City are predominantly massive, fine- to medium-grained sand in thin layers (<5 cm) with patchy distribution of sediments. In contrast, sediments present near Pantoloan on the east coast of Palu Bay were coarser (medium- to coarse-grained sand), thicker (up to 12 cm) and more continuous. These tsunami deposits exhibited fining and thinning landwards, and are characterized by a continuous sand sheet that extends up to 250 m inland with few post depositional changes. The grain size ranges from coarse-grained sand to silty-fine-grained sand at the landward extent. The Pantoloan site also contained wave-transported blocks of sea wall weighing up to 4.7 t in addition to sandy deposits. The blocks together with grain size data suggest that water velocities reached $3 \text{ m}\cdot\text{s}^{-1}$ at more than 130 m from the coast. The tsunami deposits of Palu Bay generally exhibit sedimentological and stratigraphic characteristics shared by storm and tsunami deposits, which maybe be ascribed to the short wave length, relatively low power and short-term inundation of the tsunami and the limited availability of sediments in the nearshore environment.