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Megaclasts of Eastern Samar (Philippines) – Implications for the long-term hazard of extreme waves

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The Eastern Visayas region in the Philippines experiences some of the most violent tropical cyclones on Earth, exemplified by Typhoon Haiyan (7–9 November 2013) or Typhoon Hagupit (6–8 December 2014). Moreover, strong earthquakes along the Philippine Trench have triggered tsunamis in the past, both implying significant hazards of coastal flooding through extreme waves for the Pacific coast of the island of Samar. Not much is known, however, about frequency-magnitude relationships and maximum magnitudes on centennial and millennial scales, which can be derived from geological traces and which should be considered in coastal hazard management. We studied a large boulder field on the north coast of Eastern Samar distributed over an elevated reef platform to understand mechanisms of boulder transport and to derive implications for the maximum spatial extent, depth and velocity of coastal flooding.

Methods: (i) Documentation of location, shape, morphological features, length, orientation of main axes of >250 boulders (1.5 m<a-axes<11.9 m) in the field; (ii) UAV-based 2D/3D-mapping; (iii) creation of SfM-based models of prominent boulders; (iv) interviewing elders of the local community for past events; (v) inverse modelling of coastal flooding and comparison with Deft3D-based numerical models of Haiyan and Hagupit; (vi) multi-temporal analyses of Pléiades and Worldview-3 scenes to reconstruct boulder movement during recent events; (vii) estimate the age of the carbonate platform and the timing of transport through 230U-Th dating.

Preliminary results: (i) the platform's age is mid-/late Holocene, boulder transport occurred over the late Holocene; (ii) Haiyan and Hagupit shifted boulders up to 115 t in steps of <32 m only at the seaward margin of the boulder field; (iii) transport during Haiyan and Hagupit clearly reflects the individual approaching angle of waves; (iv) size-distance relationships of the entire boulder field are unclear (r^2=0.46 at best) and large clasts are located up to 1,300 m from the platform edge indicating that also major long-period waves (infragravity waves, tsunamis) have occurred in the past; (vi) flow velocities of up to 6–7 m/s were inferred for Hagupit, while largest clasts more inland (up to 11.9x8.1x4.2 m^3; 433 t) require minimum values >10 m/s.