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Boulder-based wave hindcasting underestimates storm size

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Large boulder-size clasts represent an important archive of erosion and wave activity on the coast. From tropical coral reefs to eroding cliffs in the high-latitudes, boulders have been used to hindcast the frequency and magnitude of cyclones and tsunami. Such reconstructions are based on the balance between the hydrodynamic forces acting on individual clasts and the counteracting resistive forces of friction and gravity. Here we test the three principle hindcasting relationships on nearly 1000 intertidal boulders in North Yorkshire, U.K using a combination of field and airborne terrestrial LiDAR data. We quantify the predicted versus actual rates of movement and the degree to which local geomorphology can retard or accelerate transport. Actual clast movement is significantly less than predicted values, regardless of boulder volume, shape or location. In situ cementation of clasts to the substrate by marine organisms and clustering of clasts increases friction thereby preventing transport. The implication is that boulders do not always provide a reliable estimation of wave height on the coast and reliance solely on hindcasting relationships leads to an under prediction of the frequency and magnitude of past storm wave activity. The crucial need for process field studies to refine boulder transport models is thus demonstrated.