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Terrestrial Laser Scanner (TLS) as a tool for the reconstruction of extreme wave event characteristics

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The shores of the Northern Indian Ocean were exposed to extreme wave inundation in the past. Two relevant hazards, storm surges triggered by tropical cyclones and tsunamis, are known to occur in the region but are rarely instrumentally recorded. Various sediment deposits along the coast are the only remnants of those past events. A profound understanding of return periods and magnitudes of past events is essential for developing land-use planning and risk mitigation measures in Oman and neighboring countries.

A detailed investigation of these deposits, in this case primarily blocks and boulder trains but also fine grained sediments, provides insight on parameters such as wave height and inundation distance. These parameters can then be used for modeling inundation scenarios superimposed on modern infrastructure. We are investigating the spatial 3D-distribution of the extreme wave event sediments along the coastline through a high-precision survey of the event deposits using a Faro Focus 3D X330 TLS. A TLS is capable of recording high-detail and colored point clouds, which allows detailed measurements and has proved to be a powerful tool in geosciences. These multi-parameter point clouds in combination with dating results serve as a base for extreme wave event return period and magnitude estimations.

Relevant parameters on large sediments are size, shape, volume, mass as well as relative arrangement, sorting and orientation. Furthermore, the TLS data is used to distinguish between the various boulder lithologies using a multi-scale supervised classification. Surface roughness as a result of weathering can serve as an indicator for exposure time of boulders and hint on various generations of extreme wave events. The distribution of the boulders relative to the site they were quarried from indicates on the flow direction of the waves and consequently might help to distinguish between storm and tsunami waves.