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How aggressive are coastal cliff environments? Monitoring micro-environmental conditions on an actively eroding rock cliff.

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Despite their widespread occurrence, the behaviour of coastal rock cliffs, and in particular the balance between the marine and subaerial conditions that promote erosion, is poorly understood. This is mainly due to a lack of direct, quantitative data on process and response in this type of environment. This paper investigates how near-cliff environmental processes can be associated with the occurrence of rockfalls, which we argue contribute the majority of material lost from coastal cliffs. A detailed recent history of rockfall volumes, dating back to 2003, has been collected using repeat terrestrial laser scans of a 70 m high cliff section on the North Yorkshire coast, UK. This dataset is complimented with a bespoke environmental monitoring system installed upon the cliff face, which allows the influence of weathering and erosion processes on the magnitude and frequency of rockfalls to be analysed. This system is comprised of three instrument clusters at nodes that correspond to three main lithological units of the cliff, hard wired to a communications unit at the top of the cliff face. Data is collected on air temperature, humidity, irradiance, wind and precipitation. Within the near surface of the rock mass we also measure temperature, rock moisture, surface wetness and strain, to allow the direct physical response of the rock to be quantified. The cliff (local) environment monitoring system demonstrates that the rock undergoes significantly greater variability than can be identified from more generic regional weather and tide datasets, predominantly as a function of the angular geometry of the cliff face, resulting in rapid gradients of change. For example, daily variations in temperature and moisture can be seen to have a significant and direct effect on the strain responses of the rock. We seek to establish this as a long-term dataset, to provide a new quantitative assessment of the links between regional and hinterland weather conditions and those found on the cliff face, and to assess the efficacy of these conditions as drivers of sub-aerial weathering and its relative contribution to rock cliff retreat.