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Environmental controls on coastal cliff change

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This paper presents the results from the exploration of a 3 year monitoring program which investigates the link between coastal rock cliff erosion and environmental influences. A detailed understanding of change to the cliff face is obtained from monthly monitoring using a terrestrial laser scanner and 3D surface modelling. This is combined with environmental monitoring of the wave climate, tidal regime, the delivery of seismic energy to the cliff, weather and cliff hydro-geology. The findings from the study reveal information on both the spatial and temporal nature of cliff evolution and its response to marine and climatic processes. This has led to the development of a new precursory analysis of rock cliff failure.

The data demonstrate that coastal erosion is a process made up from a continuum of changes which range in magnitude and frequency, with only a limited number of these events resulting in any significant alteration of the position of the cliff line. This raises significant questions with regards the treatment of data derived from aerial imagery for assessing coastal change. The data set, which comprises in excess of 300,000 discrete volume changes, is used to explore the conventional controls on cliff erosion, such as notch development. The data shows a perhaps surprising insensitivity to prevailing environmental conditions, with a consideration of antecedent conditions adding little.

Analysis of the temporal patterns of activity in the dataset suggest that the cumulative volumes of small rockfall can be treated as precursory indicators of larger cliff failures. Precursory behaviour also appears in many instances to be scale dependant both in time and space. Although environmental conditions have a perhaps surprisingly limited impact on triggering rockfall, they may however have a significant role in ‘preparing’ the cliff for failure. The behaviour of the rock mass prior to the largest

events recorded appears consistent, following a hyperbolic acceleration through time. This has implications for understanding of both the conditions within the rock mass that lead to rock falls and how these events combine to result in change to the cliff line.