



Negative Power Law Scaling of Rockfalls along the Yorkshire Coast: Implications for Long Term Landscape Evolution

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An increasing body of evidence suggests that rockfalls follow a negative power law scaling in their magnitude-frequency distribution of the form $F = aM^{-b}$. Where F is the normalized frequency density, M is the event magnitude, and a / b are dimensionless scaling coefficients. Investigation using Terrestrial Laser Scanning (TLS) has produced an extremely high resolution inventory of rockfall magnitudes along the sea cliffs near Staithes, UK. Such data is ideal for erosion modelling. Once the scaling parameters have been estimated, the volume of eroded rock for events of magnitude x (V_x) is derived as $V_x = ax^{-b+1}$. Therefore, the total volume (V_t) of eroded rock between a minimum and maximum magnitude can be calculated by taking by integrating the above. An examination of monthly fluctuations in the scaling coefficients indicates greater variation within the winter months in response to higher deliveries of wave energy during these months. Initial results using geophone data indicate a relationship between the magnitude of the scaling coefficients and the amount of wave energy delivered to the cliff. Such linkages suggest the possibility of a predictive model for erosion based on wave climate, providing a predictive capability for the implications of environmental change. Model testing is to be accomplished using an innovative cliff recession model derived using cosmogenic isotope concentrations and paleoenvironmental data. Our cosmogenic dating model considers marine variables (tidal range, wave climate and inundation duration); Holocene relative sea level change; lateral cliff retreat, and the consequent changes in geometrical and marine shielding to establish the rate of retreat based on a continuum of Be^{10} concentrations.