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The influence of storms on rockfall occurrence

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Previous studies have highlighted complexity in the relationship between rockfalls and environmental drivers. Those relationships that have been identified are based primarily on time-averaged observations, where rockfall data is collected from surveys that are often irregularly spaced or separated by intervals that are considerably larger than either those of the recorded weather data or the interval between rockfall. For the case of storm events, which are suggested to be dominant in triggering a significant proportion of rockfall, the degree to which these events can be considered as preparatory factors or triggers of rockfall therefore remains difficult to address. Investigating how a rock face responds to storms is reliant on high temporal resolution of rockfall monitoring.
Here we examine the relationship between storm events and rockfall from an actively failing coastal rock slope. In order to do so, we draw on a rockfall inventory of > 180,000 rockfall, gathered between March 2015 – December 2015 from near-continuous hourly terrestrial LiDAR surveys. We find that the occurrence of storms drives an increase in the rate of rockfall activity above baseline ass wasting. These storm events account for up to 10% of the total long-term recorded erosion, suggesting a direct link between rockfall and rainfall. Our database includes storms Eva and Frank, which resulted in widespread flooding across the UK in December 2015. An analysis of the relationship between individual rockfall timing and the passage of these rainfall events shows that up to 30% of the largest 1,000 rockfall occurred during periods of rainfall, and 60% occurred within 24 h of rainfall. Moreover, rainfall events that are attributed to rockfall adhere to intensity duration relationships similar to those characterised for landsliding, though the duration of these events appears to be of greater importance than rainfall intensity. Over the entire rock face, cross-correlation of time series of rockfall occurrence and rain accumulation shows that a relationship is only significant for rainfall between 0-3 h prior to each individual rockfall. Our results help to define the role of intense rainfall during storms both in driving small rockfall, which may precede larger yet-to-fail events, and the triggering of larger rockfall.