Substrate properties, erosion and topography: a coastal case study.

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Developing new and better models of landscape evolution in subduction settings requires the community to deepen its understanding of substrate properties and variability. Substrate properties exert a first-order control on landscape evolution by effecting local changes in both the mode and rate of erosion. Properly capturing such controls in physical models is a challenge because of their complexity—landscapes are rarely composed of homogeneous media. There are many potential sources of material heterogeneity in landscapes, including variations in intact properties (e.g. shear strength), and discontinuities, which introduce zones of weakness. In addition, the interactions between substrate, process and form can give rise to a wide range of complex behaviors. These interactions are often highly non-linear. This problem can be tackled in numerous ways. One approach involves quantifying the lengthscale(s) at which substrate properties and topography are correlated. This information can be used to improve models of the physical processes at work. We have developed a method, based on the wavelet transform, that allows such correlations to be determined for the planform topography of a landscape. This method is generalizable to any planar curve, constructed from any pair of coordinates. We have chosen to focus on rocky coasts—a coastline is a natural laboratory that is well-suited for studying spatial variations in landscape material properties. We have explored the substrate dependence of physical processes acting on a 36 km stretch of rocky coastline in Cornwall, UK.