Quantitative Seafloor Geomorphology And Offshore Geohazards

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Abstract:

Seafloor geomorphology reflects dominant geologic and tectonic processes. By quantifying the scale of geomorphic features, we can gain insight into the mechanisms that drive the erosive processes. If erosive processes follow frequency-magnitude relationships that are related to the driving mechanisms as they do on land (e.g. big and infrequent storms will cause lots of large landslides whereas small, frequent rainfall events will cause smaller landslides), then it stands to reason that the largest erosive features (i.e. landslides) are caused by infrequent events. Quantifying the dimensional and spatial variability of large-scale erosive features is crucial in characterizing future mass-wasting events. Using the GEBCO global bathymetry data, we are classifying continental margins based on their morphology. Calculating semivariance of submarine topography establishes the scales of different erosive features (via the sill) and gives a measure of the distribution of these features (via the range). Margins dominated by gullies and closely-spaced canyons should generate semivariograms with relatively small sills and ranges. These erosive features suggest frequent, small-scale erosive events, likely triggered by frequent earthquakes (here, ‘frequent’ being anywhere from 1 per 100 years to 1 per 1000 years). On these margins, slope failure largely depends on the nature of earthquakes (e.g. segmentation and ‘slow’ vs. ‘fast’ events). In contrast, margins with large and well-preserved landslides should yield semivariograms with large sills and ranges, and are suggestive of a less frequent process, such as sea level change with interspersed intervals of relative quiescence. These geostatistical characteristics can then be applied towards assessing submarine landslide and tsunami risk to coastal areas across the globe.