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Quantifying geomorphology associated with large subduction zone ruptures

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The subduction of geomorphologic features, such as ridges and seamounts, increases basal erosion and subsidence of the accretionary wedge. Forearc basins form through such subsidence. Many subduction zone ruptures have been associated with these basins, where a great portion of the rupture asperities collocate with the basins. Mechanisms responsible for this spatial correlation include the initiation of stick-slip sliding beneath the accretionary wedge due to the subduction of topographic highs (e.g. seamounts), along-strike variations in crustal thickness and density of the overriding plate, and structural segmentation of the upper plate. For 30 rupture zones, we quantify forearc basin size and subducting seafloor roughness through a simple and traditional semivariance technique. Comparing semivariogram model parameters of each rupture zone to the same parameters of the mirrored area on the subducting seafloor, we see a relationship between forearc and subducting seafloor geomorphology, where rougher seafloor correlates to rougher forearc. Furthermore, ruptures of larger moment magnitude occur where the subducting seafloor is smoother, whereas rougher subducting seafloor corresponds to smaller ruptures.