

Scale-dependent changes in stream gradients and its relationship to slope morphology for a mountain watershed

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Since failures in steep slopes are often mutually related to bedrock river incision, bedrock erosion in streams is a key element in shaping landforms in mountain watersheds. Here we analyze longitudinal changes in stream gradient of bedrock rivers in a mountain watershed at Ikawa University Forest, central Japan, using a high-resolution (1 m) digital elevation model acquired from airborne laser swath mapping (ALSM). Stream gradient is computed with different measurement lengths in the rivers, revealing scale-dependent changes in the gradient, and relative steepness of bedrock riverbed is then quantified. Spatial distribution of relative steepness in the watershed indicates that riverbed morphology often correspond to morphological condition of surrounding slopes with differing types of channel head. Subwatersheds with gentle slopes have smaller steepness of streams, whereas those with steep slopes in which failures are frequent have larger steepness of streams. Such topographic differences of subwatersheds are unlikely caused by lithological, tectonic or climatic conditions, which do not considerably vary in the watershed. History of geomorphic evolution in the watershed more likely accounts for the differing subwatershed morphologies.