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Spatial analysis of multiple-scale knickzones detected from airborne LiDAR DEM in a mountain watershed in central Japan

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Erosion by bedrock rivers is a fundamental geomorphic process shaping mountainous landforms. Although knickpoints or knickzones are a key agent enhancing the bedrock river incision, their location has rarely been identified especially in the uppermost steep mountainous watersheds. Using a high-resolution DEM derived from airborne LiDAR survey, a GIS-based analysis is performed to quantitatively identify the location of knickpoints and knickzones within a steep mountain watershed at the Ikawa University Forest in the Southern Japanese Alps, and their spatial distribution within the watershed is examined in relation to lithologic substrate and other environmental factors. We utilize stream gradient and a local steepness index, showing relative steepness of rivers, in order to identify knickpoints and knickzones at different spatial scales: relatively steep reaches at a longer scale (ca. 10^2m) are defined as knickzones, while those at a shorter scale (ca. 10^1m) are defined as knickpoints. The spatial distribution of the knickzones/ knickpoints suggest that the knickzones more likely reflect a signal of incision wave caused by local tectonics or long-term climate change, whereas the knickpoints are more likely affected by local lithologic characteristics such as joint spacing.

Keywords: landform, knickpoint, knickzone, airborne LiDAR, DEM, length scale