

## DEM-based analysis on distribution of fluvial knickzones in Japanese mountains: Implications of their formative causes

# Yuichi S. Hayakawa[1]; Takashi Oguchi[2]

[1] Earth and Planetary Sci., Univ. Tokyo; [2] CSIS, Univ. Tokyo

<http://home.csis.u-tokyo.ac.jp/~hayakawa/>

Fluvial knickzones, defined as locally steep segments of rivers, can enhance stream erosion into bedrock, and they can be key morphologies highlighting interactions among earth surface processes such as erosion, tectonics and volcanism. This study examines longitudinal profiles of major bedrock rivers in Japanese mountain watersheds to illustrate the distribution of knickzones, and discusses their formative causes. Using digital elevation models with 50-m resolution, knickzones were extracted based on quantitative criteria. Totally 5,753 knickzones were identified in the bedrock rivers of 65,468 km long. Location of the knickzones was then examined in relation to topographic, hydraulic and geological factors. Overall, topographic and hydraulic conditions have dominant influences on knickzone abundance, while geologic controls on the knickzones are unclear. For instance, upstream steep reaches of the rivers are more favorable for knickzone existence, but lithological boundaries do not show significant correlations with the knickzone locations. The abundant knickzones in steep river reaches indicate hydraulic origins of the knickzones, where erosive force of streams is strong enough to modify bedrock morphology. Partial occurrences of supercritical flow in steep reaches seem to play an important role in forming such knickzones. Moreover, the knickzones are frequently observed around major stream confluences, at which stream discharge can abruptly increase. This indicates that hydraulic anomalies of water flows at the confluences can cause local riverbed incision and formation of adjacent knickzones. These knickzones can also recede upstream and dissipate after their formation. Other possible causes of knickzone initiation including volcanic and tectonic impacts are also suggested but limited in terms of knickzone numbers. The abundance of knickzones formed by stream hydraulics in Japanese mountain rivers suggests that fluvial landscape modeling needs to consider the initiation and development of knickzones.