Changes in drainage basin characteristics following coseismic landslides by the 2018 Hokkaido Eastern Iburi Earthquake

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A strong earthquake (Magnitude 6.7) happened in the Iburi sub-prefecture of Southern Hokkaido on 6th September 2018, whose epicenter with focus depth of 37 km was located at 42.690˚N and 142.007˚E within the Ishikari Teichi Touen Fault Zone. Numerous coseismic landslides (n = 7837) covered over 700 km2. Tarumae-d tephra layer with fine-grained texture and high water infiltration capacity was considered as the inherent factor of the coseismic landslides. Gradual post-earthquake morphological changes on fluvial channels and change in slopes and drainage patterns are expected. This study aimed to identify the drainage basin geomorphological changes following the 2018 Hokkaido Eastern Iburi Earthquake with particular interests in fluvial characteristics and causal factors. The study sites are 2 catchments along the Atsuma River with less artificial modifications after the earthquake. Digital Elevation Models (DEMs) by Airborne Laser Scanning (ALS) of October 2012 and September 2018, as well as those by Unmanned Aerial Vehicle (UAV)-based Structure-from-Motion Multi-View Stereo (SfM-MVS) photogrammetry taken by 4 field surveys in April to October 2020 were used. Orthorectified images by the UAV-SfM were also utilized. In the multitemporal DEMs and orthophotos, morphological changes such as slid slopes, gullies, stream-bed deposition and stream network development were observed. Visual inspections and GIS analysis were performed for analyzing drainage basin morphology, channel network extraction, stream profile analysis, and morphological change detection with elevation differences analysis between multiple DEMs. Patterns of changes in drainage basin characteristics, including watershed geometry, drainage network, drainage texture, and relief characteristics were found. The pattern changes in characteristics of the study sites showed that channel developments on slid slope surfaces increased progressively, based on the increase on stream length and bifurcation ratio. Moreover, potentially higher surface runoff, gully development on the slid surfaces, and further slope deformations may be expected based on the obvious increase in drainage intensity. Furthermore, increase of stream length ratio and mean gradient indicated the active increase of potential soil erosion either by fluvial or freeze-thaw action with the interactions between slope and fluvial processes. Further assessments of factors on the morphological changes such as precipitation, slope angle and aspects, curvature and geological structure, as well as statistical analysis on the DEM-derived stream network, will be necessary.

Keywords: 2018 Hokkaido Eastern Iburi Earthquake, Tarumae-d tephra layer, Drainage basin, Morphological changes, Coseismic landslides

