

Geomorphological analysis of mountain slope processes using high-definition topographic data

*Yuichi S. Hayakawa¹, Fumitoshi Imaizumi³, Norifumi Hotta², Ryoko Nishii⁴

1. Faculty of Environmental Earth Science, Hokkaido University, 2. Graduate School of Agricultural and Life Sciences, The University of Tokyo, 3. Faculty of Agriculture, Shizuoka University, 4. Institute for Research Promotion, Niigata University

Natural landscapes and their changes are fundamental factors concerning human lives, where sustainable development is required to preserve nature and to make human lives better. Various approaches are present to balance the development and preservation, for which basic understandings of the current status, in particular for decadal to century scales, of natural landscapes is crucial. Although there had been limited availability in measuring natural landscapes precisely and frequently, recent advances in the topographic measurement techniques have enabled us to obtain high-definition data of the Earth surface. Mountain slopes in natural landscapes are one of the domains having a vast amount of unknown areas regarding their geomorphological processes including mass movements and sediment transportation due to the previous limitation in the measurement, but we now have several innovative approaches tackling the hidden processes occurring in such areas. The combination of an unmanned aerial system (UAS) and Structure-from-Motion Multi-View Stereo (SfM-MVS) photogrammetry is a strong tool to measure the detailed topography in remote or inaccessible areas. Also, airborne or terrestrial laser scanning (ALS/TLS) can be utilized to detect mass changes or small morphological features exposed on the land surface. Here we present some case studies using UAS and TLS for detecting geomorphological processes in mountain slopes at relatively high spatial and temporal resolutions. The study sites are Ohyakuzure Landslide (Shizuoka, Japan), Shichimensan Landslide (Yamanashi, Japan), and Täschgüfer (Täsch, Switzerland). In these areas, processes including debris flows, gravitational deformations, fluvial erosion, and freeze-thaw weathering are explored with high-definition topographic measurements with various sensors. We also discuss the potential future applications of the latest sensors and platforms, including mobile lidar and multispectral image sensors, for further clarification of the geomorphological processes of and anthropogenic effects on natural landscapes.

Keywords: high-definition topographic data, geomorphology, slope processes