

# Surface changes of rock slopes in the Hakuba-Daisekkei Valley, northern Japanese Alps

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## Introduction

In the northern Japanese Alps, rock slope failure has caused mountaineering accidents frequently. In Hakuba-Daisekkei Valley, rock slope failure with victims occurred in 2005 (Kariya, 2006). However, the process and geomorphological characteristics of rock slope failure are unclear. As a reason, it is difficult to investigate the steep rock slope directly. The purpose of this study is to clarify the process of rock slope failure on different rock types in Hakuba-Daisekkei Valley using UAV and SfM methods.

## Study area

Hakuba-Daisekkei is a perennial snow patch located at the bottom of the Hakuba-Daisekkei Valley. The valley is a popular mountaineering route to Mt. Hakuba-dake (2932 m asl). More than 10,000 people pass the route every year. Hakuba-Daisekkei Valley is surrounded by Mts. Shakushi-dake and Hakuba-dake. Mt. Hakuba consisted of felsic tuff and tuff breccia. Mt. Shakushi consisted of Felsite. Hakuba-Daisekkei Valley is high annual precipitation through summer and heavy snow climate in Japan.

## Methods

We observed the retreat process of rock slopes using images of UAV, Cessna and aerial photography with SfM (Structure from Motion) technology.

## Results

We confirmed the difference in the retreat process between Mt. Shakushi-dake and Mt. Hakuba-dake. On the rock slope of Mt. Shakushi-dake, we observed the discriminatory retreat that depended on rock joint density. On the other side, we observed the sudden retreat process with a tension crack opening on the rock slope of Mt. Hakuba-dake.

Keywords: rockfall, rock slope failure, SfM, UAV, freezing and thawing, ICP