ネパール・ヒマラヤ トラカルディン氷河における氷壁ダイナミクスの解明

Ice cliff dynamics in Trakarding Glacier, Nepal Himalaya

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Glaciers in High Mountain Asia are valuable indicator of climate change, and their meltwater have an important role for the regional water resources (e.g. Pritchard, 2019). We thus need to estimate Himalayan glacier fluctuation. However, the lower part of large Himalayan glaciers is generally covered with debris mantle, which makes the melting process complicated. Several previous works pointed out a role of ice cliffs that promote local enhancement of the ice melting (e.g. Sakai et al., 1998; Brun et al., 2018). The ice cliff’ s spatio-temporal distribution and their dynamics (evolution and decay) are important to understand debris-covered glaciers melting process.
In this study, we generated high resolution digital elevation models (DEMs) and orthomosaic images from aerial photographs taken at four different times at the Trakarding glacier, Nepal Himalaya in order to trace ice cliff dynamics.
In-situ observations and aerial photogrammetry surveys were carried out in 2007, 2017, 2018, 2019 post-monsoon seasons over the entire debris-covered area. These photographs were analyzed using Structure from Motion technology and created high resolution (0.2 - 2.0 m) terrain data. From each image, about 500 ice cliffs were extracted and analyzed these ridge lengths, slope areas, gradients, aspects and spatial distributions.
DEM differencing indicate that the surface mass balance has been strongly negative (-1.65 m w.e. yr^{-1}) from 2007 to 2019. Spatially, we observed that the more significant surface lowering happens, the higher cliff density is remarked. The result suggests the ice cliff locally enhances glacier melting. In addition, a significant correlation between ice cliff length and its slope area was observed, which means that it is possible to estimate the slope area of cliff from the cliff length using coarser satellite data. Analysis of ice cliff aspect elucidated that north-west facing ice cliffs are predominant. And their aspects had heterogeneous distribution. Finally, we estimated ice cliff dynamics and its mechanism from the results of spatial cliff density, aspect and elevation change analysis in Trakarding Glacier.

キーワード：氷河、ヒマラヤ、リモートセンシング、UAV
Keywords: Glacier, Himalaya, Remote Sensing, UAV

