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Comparison of surrounding land features on the glacier terminal areas in the Himalayas derived from DEM

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Radiation field on the surface of mountain glaciers is reported to be controlled by the surrounding land features and does not distribute uniformly. Net radiation, which is obtained as a result of radiation budget, has been reported as an important factor to melt the ice surface of glaciers in the Himalayas by the previous studies. On the other hand, the lower areas of many glaciers in the south area of Himalayas are covered with debris that has variety of thermal properties, which corresponds to the one of the factor to cause the spatial variety of ice melt rates fields. Considering the surrounding land form features in the radiation field is probably required for estimating thermal properties on the debris-covered glaciers accurately. However, in-situ observation of those phenomena cannot be conducted mainly due to the difficulties of accessibility to the Himalayas. Thus, application of satellite remote sensing techniques is a powerful tool as an alternate method.

This study focuses on the Lunana region, Bhutan, which corresponds to the target area where in-situ observation has been carried out since 2002, as a case study to estimate the influence of surrounding land features around the lower glacier areas on their radiation field. I calculated a distribution of azimuth and zenith angles from each target point (pixel) on the lower glacier areas to each direction to the skylines with an approximate method to derive surrounding land feature; the value 1 corresponds to the full sky view and it decreases to 0 with the decrease of openness. My first result, which was derived from 8 directions for each pixel with the limit of about 4.5 km far from the point as a line of sight, shows it ranges from 0.7 to 0.9 regarding the three glaciers; Thorthormi, Lugge and Lugge Ⅱ.

Because these values depend on the method to move the line of sight on the DEM, in other words, the method for processing the raster image as well as the accuracy of both elevations and horizontal positions, I would also like to present the other experimental results that were calculated with some different conditions to discuss the influence of the surrounding land form on the radiation field in the Himalayas.

Keywords: Digital Elevation Model (DEM), image processing, glacier melt rate, radiation budget, mountain glaciers, Himalayas