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Factors controlling scale and shape of the Himalayan debris-covered glaciers

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Debris-covered glaciers in the Himalayan region are classified into two types: glaciers having moraine dammed lake in its terminus and without lake. Understanding the critical conditions between these two types is very important not only for glaciological aspect but also for hazard mitigation with respect to glacial lake outburst flood. Previous statistical analyses reported that glacial lake should not be developed over the glacier whose surface inclination steeper than 2 degree and vice versa. However, no physical theory has been proposed to explain this tendency. Moreover, little is known what factors determine the surface inclination of the debris-covered glacier.

In this study, we examine influences of several factors (debris supply, scale of accumulation area, and profile inclination of bedrock etc) on the surface inclination of debris-covered glacier using a numerical glacier dynamics model. Simulation results indicate that surface inclinations and glacier lengths of the debris-covered glacier are strongly dependent on these factors. Our results help to understand why the Himalayan debris-covered glaciers show large variety in scale and shape even under the same climate condition and why the steep glacier does not have glacial lake in its terminus.

Keywords: Himalaya, Glacier lake, Debris-covered Glacier, Glacier form