

Debris-covered glacier anomaly? Morphological factors controlling changes of Himalayan glaciers

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What are the main morphological factors that control the heterogeneous responses of debris-covered glaciers to climate change in the southern central Himalaya? A debate is open on the thinning rates of debris-covered glaciers compared to those of clean ones. Previous studies have adopted a deterministic approach, which is indispensable, but is also limiting in that only a few glaciers can be monitored. In this context, we propose a statistical analysis based on a wider glacier population as a complement (not an alternative) to these deterministic studies. We analysed 28 glaciers situated on the southern slopes of Mt. Everest (central southern Himalaya) during the period 1992-2008. This study combines data that refer to the same glaciers over the same period that come from three recent published works (Nuimura et al., 2012, Salerno et al., 2012, Thakuri et al., 2014) in a unique statistical analysis. Generally, slope was the main morphological factor controlling the features and responses of the glaciers to climate change. In particular, the key points that emerged are as follows. 1) Reduced downstream slope is responsible for increased glacier elevation lowering. 2) The development of supraglacial ponds is a further controlling factor of glacier elevation change; that is, where supraglacial ponds develop, the glaciers register further surface lowering. 3) Debris coverage was not found to be significantly responsible for the development of supraglacial ponds, changes in elevation, or shifts in snow line altitude. However, we noted that this analysis is limited in that it considers, as a morphological factor, only the surface coverage and not the thickness of debris.