



The role of debris covered glaciers in the high altitude water cycle in the Himalayas

Walter Immerzeel (1) and Francesca Pellicciotti (2)

(1) Department of Physical Geography, Utrecht University, Utrecht, The Netherlands, (2) Institute of Environmental Engineering, ETH Zurich, Zurich, Switzerland

Between 14-18% of the Himalayan glaciers is debris covered and they provide a significant amount of the total glacial melt water. Yet, their behaviour and response to climate change remains relatively unstudied. It was always assumed debris covered glaciers melt less quick than debris-free glaciers at similar altitudes due to the insulating effect of debris thicker than a few centimetres. However, recent remote sensing and field based studies reveal that their melt rates are similar to those of debris covered glaciers. The underlying mechanism may be related to the formation of supra-glacial lakes, ice cliffs, and englacial hydrological processes which may act as a catalyst for melt. In this study we review the current state of knowledge regarding novel techniques to monitor and map debris covered glaciers, recent progress in understanding the growth and survival of supra-glacial lakes and ice cliffs and we explore possible hypotheses to explain the anomalous behaviour of debris covered glaciers. Finally, we attempt to quantify the role that melt from debris covered glaciers play in the high altitude water cycle and we suggest future research priorities in this field.