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Ablation and runoff generation on debris covered Keqikar glacier in the upper Aksu catchment, China.

Martin Juen (1), Christoph Mayr (1), Elisabeth Mayer (2), Astrid Lambrecht (3), Wilfried Hagg (2), Han Haidong (4), and Liu Shiyin (4)

(1) Commission for Glaciology, Bavarian Academy of Sciences and Humanities, Munich, Germany (martin.juen@kfg.badw.de), (3) Institute for Meteorology and Geophysics, University of Innsbruck, Innsbruck, Austria (Astrid.Lambrecht@uibk.ac.at), (2) Geography Department, Ludwig-Maximilians-University, Munich, Germany (lisa-mayr@gmx.de), (4) State Key Laboratory of Cryospheric Sciences, Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou, China (hhd@lzb.ac.cn)

The main goal of the project AKSU-TARIM-MELT is to quantify ablation on and meltwater runoff from glaciers in the Aksu basin, China. The project is part of a DFG project bundle about climate change and water resources in western China (AKSU-TARIM). During the ablation season 2010 a series of ablation measurements were performed on the Keqikar glacier, a representative glacier in the Aksu basin. 43 ablation stakes with varying debris thicknesses were installed and observed to collect a dataset of ablation rates with a high temporal resolution. To calculate temperature gradients and energy available for ice melt, temperatures in varying depths in the debris layer were recorded, using digital data loggers. For the determination of the melt water contribution from steep ice cliffs to the total runoff, such surface features with varying exposure have been investigated, using ablation stakes and photogrammetry. The meteorological data is recorded at several sites at and on the glacier by the Chinese partners from the Cold and Arid Regions Environment and Engineering Research Institute (CAREERI).

The largest daily mean ablation rate was measured under a thin debris layer of about 0.1 cm, due to a lower albedo in contrast to bare ice, resulting in higher absorption of shortwave radiation. In comparison to bare ice, ablation rates decreased for debris thicknesses of more than 2 cm. The insulating and shielding effect of the debris cover is getting stronger with increasing debris thickness. Thermistor measurements show a strong diurnal signal that diffuses downward with decreasing amplitude and increasing lag. The mean daily temperature gradient was found to be linear with depth. The overall areal distribution of the debris cover thickness shows a clear dependence on elevation but also varies on a smaller scale spatially, depending on the slope angle. In the leftovers of supraglacial lakes fine grained sediments are accumulated. The measurements indicate that the ablation and the resulting melt water runoff are strongly influenced by the presence of ice cliffs and supraglacial lakes.

The results of these measurements form the experimental basis for the development of a sub-debris ice melt model. A conceptual runoff model including this ablation routine for debris covered glaciers will be applied to simulate current conditions and forthcoming changes in the hydrological cycle. Results from the climate modeling group (AKSU TARIM-CLIM) can then be used to estimate the amount of ablation and runoff after a projected climate change.