Debris Covered Glaciers

Along the shallow reaches of glacier tongues ice is often covered in debris. Between 10 and 20% of the total glaciated area globally is debris covered and in some areas in the Hindukush-Karakoram-Himalaya range this is even larger. In a warming climate and due to receding tongues and moraines and headwalls disintegrating, this fraction is expected to increase with time. While it is challenging to accurately map debris extent, the effect debris cover has on ice melt is even less understood. Debris thickness and debris properties are variable in space and debris covered tongues are often densely covered with ice cliffs and ponds forming on the surface. A combination of field work and modelling is undertaken to more accurately determine the contribution of sub-debris melt to runoff in High-Mountain Asia.

Surface Hydrology

Melt on debris covered tongues is generated (a) under debris, (b) on bare ice surfaces or ice cliffs and (c) at the base of supraglacial ponds (Figure 3). We develop energy balance models for these surface features (Steiner, 2015; Miles, 2016). Using high resolution imagery from UAVs (Immerzeel, 2014) we can link these point-scale model results to a larger distributed picture. A challenge so far not addressed is routing of melt water through the glacier (Figure 3 and 4).

Subsurface Hydrology

Using atmospheric data from a weather station and through the debris, we run an energy balance model simulating melt below debris (Figure 5, Reid and Brock, 2010). The biggest challenge is to have an accurate debris thickness and conductivity properties of the debris. Nothing is known about the moisture transport through the debris. Additionally we are trying to find out where the debris comes from and how it impacts the glacier flow.

References