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Patterns and origin of debris cover of the Oedenwinkelkees glacier, Hohe Tauern, Austria

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An increase of debris-cover on glaciers can be observed at many degrading glaciers in mountain environments. Incremented debris input to glaciers is a result of changing temperature regimes in the surrounding rockfaces leading to rise in sediment production and rockfall activity. Debris cover is thus another indicator of climate change impacts on mountain glaciers besides glacier length reduction or ice volume decrease. A debris cover significantly alters the glacier system with immediate effects on the surface thermal regimes and surface ablation rates. Characteristics and thickness of superficial debris on the ice determines whether a positive or negative impact on ablation rates is created. Thin debris cover increases the surface temperature and leads to increased glacier melt, while thick debris cover act as thermal barrier that insolates the ice leading to reduced melt and the preservation of dead ice. Consequently, debris cover strongly affects glacier mass balance quantification. However, the complex impacts of debris on glacier mass balance and long term glacier behaviour is still poorly understood.
We present a detailed map of the Oedenwinkelkees glacier forefield, Hohe Tauern, Austrian Alps, and surrounding slopes with special focus on debris cover, debris contributing processes and sediment source areas. We discuss patterns of debris cover and dynamics of debris contribution to the glacier with respect to debris characteristics, debris origin, glacier-headwall feedback and debris thickness.
The Oedenwinkelkees glacier is a small, debris covered valley glacier in the central Austrian Alps. The glacier originates in a north-oriented, amphitheatre-shaped valley head bounded by headwalls of 600-800 m height with maximum elevations between 2900 and 3450 m asl. The headwall is build-up of two distinct, stacked lithological units with an upper layer of penninic micaschists and amphibolites underlain by subpenninic granitic gneisses of the Tauern Window. This analysis is based on detailed geomorphological field mapping, debris sampling and analysis of high resolution digital elevation and image data derived from UAV-based photogrammetry.
The different lithologies become especially apparent by significantly different colouring and unlike block shape and size. While granitic gneisses are of brighter colour, schists and amphibolites are usually much darker. Correspondingly, gneiss boulders are generally larger and more cubic compared to smaller schists with much shorter c-axis. The pattern of debris cover on the glacier shows a distinct sorting with brighter debris on the western part and darker rocks deposited on the eastern part of the glacier, corresponding to the location of the different source areas in the headwall area. This pattern can be tracked also throughout the glacier forefield. Proglacial debris is characterised by large areas of blocky, angular debris indicating a deposition of supraglacial debris and strong debris cover already during and after the Little Ice Age (LIA).