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Surface runoff evolution on moraines in silicate and carbonate proglacial areas of the Swiss Alps

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In many areas of the world, the surface of the earth is changing rapidly. Surface runoff is one of the processes that can dramatically modify the shape of our landscapes but is also affected by the land surface characteristics. However, our understanding of the evolution of overland flow characteristics and the feedback mechanisms between hydrological, pedological, biological and geormorphological processes that affect surface runoff is limited.

We used a space-for-time approach and studied 3 plots (4m x 6m each) on four different aged moraines (several decades to ~13.500 years) on the Sustenpass near the Steinglacier and in the karstic glacier foreland of the Griessfirn near Klausenpass (total of 24 plots) to determine how surface runoff generation changes during landscape evolution. We used artificial rainfall experiments with three different intensities to determine the surface flow ratio, peak flow rate, timing and duration of surface runoff. The addition of tracers (^{2}H and salt) to the sprinkling water and sampling of soil water allowed identification of the mixing of the water within the slopes and the interaction of overland flow pathways with the subsurface. In addition, the runoff samples and sensor-based turbidity measurements provide an estimate of the erosion rates during extreme events. In order to link the differences in surface runoff generation with the pedological and biological characteristics of the slopes, soil and vegetation samples were taken on each plot to determine soil texture and root characteristics and the saturated hydraulic conductivity was measured in situ at three different depths.

The results show that the surface runoff amount and related erosion rates, response times and mixing of surface runoff and soil water change during landscape development and can largely be explained by related changes in soil surface and near surface characteristics. However, the rate of these changes during landscape evolution depends on the geology.