



The Illgraben sediment cascade, 1963–2009

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Several studies have identified the importance of landslides and remobilization of stored sediment in debris flow generation. Long-term sediment budgets are required to understand the relative contribution of these processes to sediment transfer in debris flow dominated catchments and to identify source zones for debris flows. In this study we used digital photogrammetry to quantify erosion, storage and remobilization of sediment within the active rock face and main channel of the Illgraben debris flow catchment, southwest Switzerland, in the decades following a large bedrock landslide in 1961 that choked the channel with $3\text{--}5 \times 10^6 \text{ m}^3$ sediment.

We produced Digital Elevation Models (DEMs) for 1963, 1986, 1992, 1998, 2007, 2008 and 2009. To ensure a common reference plane all DEMs were registered to the 2005 Swiss-Topo LIDAR DEM in the ETH-developed LS3D. Error bounds, calculated based on the standard deviations of selected stable points used in registration, are between 0.6 and 2.7 m. We quantified sediment transfer in two main zones: the active rock face to the south of the channel head, and the channel between its head and the upper fan.

Over the observation period the active rock face eroded at a rate of $0.4 \text{ m}\cdot\text{yr}^{-1}$, feeding sediment into a cascade of sediment storage zones along the debris flow channel. Decadal cycles of sediment depletion and recharge occurred along the channel but with an overall depletion of 20% of the sediment deposited in the 1961 rockfall, at rate of $0.1 \text{ m}\cdot\text{yr}^{-1}$. Channel residence time of sediment, calculated as the ratio of stored sediment to debris flow flux, was ~ 90 years. In total $8 \times 10^6 \text{ m}^3$ sediment was evacuated, which is in good agreement with the part estimated and part measured debris flow flux over the period, 90% of which was from the rock face zone.