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Permafrost kinematics from high resolution stereophotogrammetry – Application and Restrictions

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The dynamics of geomorphological processes in cold high mountain environments are evident in the geometrical changes of periglacial landforms. Especially periglacial systems close to their boundaries react most sensitive to changes of external factors such as temperature. These changes are not only assessable by morphometric analyses of the landforms but also by focusing on variations in energy and sediment fluxes within the system. A holistic approach using complementary high resolution remote sensing systems as well as in situ measurements is not only able to detect and characterize morphological changes of the landforms but also to describe spatiotemporal variations and extraordinary changes such as acceleration or degradation. Multitemporal and multisensoral high resolution airborne stereo imagery (GSD < 0.5m) is used to obtain digital elevation models of a periglacial mountain slope in Switzerland. A comprehensive accuracy analysis of the digital elevation models shows their spatially diverse performance and helps to interpret derived results accordingly. The sensor systems show different performances which have to be considered when using their products for further quantitative assessments .
The multitemporal data from the last two decades allows the identification and quantification of movement of slow moving landforms (frozen talus slopes and rockglaciers). Horizontal and vertical changes within the dynamic landforms are assessed and quantified during the different timesteps. Feature tracking and DEM differencing of the high resolution data show the spatial development and kinematic behavior of the landforms. Numerous geodetic measurements of very high accuracy (1-2 cm) complement the remote sensing products and give also a spatially restricted reference to their performance. Special attention is given to outstanding processes such as degradation of permafrost features and acceleration of processes manifested in these landforms (permafrost creep). The analysis of the extraordinary behavior yields to a better understanding of the controlling processes and parameters.