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Comparison and combination of airborne digital photogrammetry, satellite SAR interferometry, GPS and terrestrial surveying for monitoring rock mass movements

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The pronounced recent glacier retreat observed for most mountain regions of the world leads to glacier volume losses in particular in the glacier terminus sections. The related debutressing of the adjacent valley flanks may under certain geological conditions cause a number of types of slope instabilities, not least deep-seated rock mass movements. Such rock slides increasingly present problems and threats to mountain infrastructure. The tongue of Aletsch Glacier, Switzerland, appears as a natural laboratory for such mass movements due to the significant glacier thickness loss and the geologic conditions found. A number of rock mass movements is currently active in the area.

Surface kinematics are investigated for two different rock mass movements at Aletsch Glacier. Standard digital aerophotogrammetry provided elevation models and elevation changes over 20 years. Different matching algorithms between repeat images provided complete surface displacement fields. Satellite SAR interferometry based on ERS, JERS, Envisat, ALOS PALSAR, and TerraSAR-X gave a detailed picture of the recent acceleration phase of one of the creeping masses. GPS and terrestrial surveying was used for validation and annual velocity variations. One of the instable rock masses studied (c. 0.5 km2 in area) moved with velocities of 0.1 m/yr and more in average since 1976. The other mass (c. 1 km2 in area) showed in the recent years an exponentially increasing acceleration towards close to 0.3 m/yr in 2008. In this contribution we compare and discuss the methods used, and draw general conclusions for measurement methodology.