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Monitoring of Glacier Variability at Pasterze Glacier (Austria) between 1982 and 2006 Using Very High Resolution Aerial Imagery

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The ecological influence of ongoing global warming and therefore the importance of glaciers in monitoring climate change are increasing and have been highlighted repeatedly in recent times. The Pasterze glacier as the largest in the Eastern Alps (located in the Hohe Tauern Range, Austria, 47˚04' N, 12˚44' E), is stage of several different projects gathering data using terrestrial as well as remote sensing methods. Annual measurements show that the glacier has not advanced since 1878 although short periods of cold summer temperatures temporarily caused positive net mass balances. These terrestrial measurements were carried out along 6 cross sections measuring surface elevation changes, glacier terminus behaviour, and horizontal surface displacements respectively. In terms of volumetric and aerial changes, monitoring of the 3.6 km long, partly debris-covered glacier tongue was carried out by using digital photogrammetry which was subsequently compared with data from tachymetric field surveys. Two sets of digital aerial images (acquired as early as 1982 and 2006) were used as a base to calculate e.g. volumetric changes. Orthorectified images were generated to delineate the aerial extent of the Pasterze glacier. The change in length of the debris-covered glacier part was approx. -360 m, and approx. -600 m on the clean ice part of the glacier tongue (period 1982 -2006). Glacier retreat is also documented in an average surface subsidence of -71 m, an aerial loss of 91 ha (-22%) as well as a decrease in volume of 295 * 10^6 m^3. Finally, measurements of vertical displacements along 3 cross sections were obtained and verified by using data from terrestrial surveys. In conclusion, the monitoring of the Pasterze glacier demonstrates the feasibility of using very high resolution aerial image data for multi-temporal monitoring of high mountain environments.