



Spatio-temporal Analysis of 150 Years of Alpine Glacier Fluctuations

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Fluctuations of mountain glaciers are among the best natural indicators of climate change. Thereby, mass balance is the direct and undelayed signal to yearly atmospheric conditions, whereas changes in length are an indirect, delayed and filtered but also enhanced signal.

Within the framework of the EU-project ALP-IMP (dealing with climate change within the greater Alpine region over the past 1000 years) the World Glacier Monitoring Service (WGMS) compiled an unprecedented Alpine glacier data set, containing one- to three-dimensional glacier fluctuation information dating back to 1850.

The spatio-temporal variability of mass balance, front variation and equilibrium line altitude data is analysed for glaciers with long time series on an annual basis. Additionally, area and hypsographic changes between 1850, 1973 and 2000 are investigated based on the new digital Swiss glacier inventory (SGI2000).

Increasing mass loss, rapidly shrinking glacier areas and spectacular tongue retreats are clear witnesses for the atmospheric warming observed in the Alps in the last 150 years and its acceleration during the past two decades. However, on short-terms or at a regional-scale, glaciers show a highly individual variability. Glacier behaviour depends not only on the regional climate but also on local topographic effects which complicate the extraction of the climate signal from glacier fluctuations. The latter are essential for the verification of mass balance and ice flow models, which are needed to quantify these effects.

It is important to continue the long-term glacier fluctuation series. The new methods developed in the SGI2000 could serve as a basis for glacier inventorying from space,

to be integrated into the global framework of the USGS-led Global Land Ice Measurement from Space (GLIMS) project and the WGMS.