



Past, present and future glacierisation in the European Alps

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Glaciers, ice caps and continental ice sheets cover some 10% of the earth's land surface at present time, corresponding to about 80 m of sea level rise, if all land ice would melt away. The about 5,150 glaciers in the European Alps with a total area of about 2,900 km² in the 1970s would thereby contribute with less than a millimetre. However, in densely populated high-mountain areas such as the European Alps, glaciers are also unique resources of freshwater for agriculture and industry, an important economic factor for tourism and hydro-power production, as well as a serious source of natural hazards. Due to their proximity to melting conditions, glaciers are among the best natural indicators for climate change.

Glacier inventories, in-situ measurements and a numerical model (based on an empirical relationship between precipitation and temperature at the steady-state ELA) are used in combination with a DEM and GIS-techniques to analyse Alpine glacier fluctuations between 1850 and the end of the 21st century for the entire European Alps.

Overall area loss since 1850 is calculated to be about 35% until the 1970's and almost 50% until 2000. Rapidly shrinking glacier areas, spectacular tongue retreats and increasing mass losses are clear signs of the atmospheric warming observed in the Alps in the last 150 years and its acceleration over the past two decades, culminating in an ice loss of another 5-10% during the extraordinary warm year 2003. From the model experiment we find that a change of the regional climatic steady-state ELA of Alpine glacier of 100 m corresponds approximately to a temperature change of 1 °C or a precipitation change of 25%. A summer temperature rise of 3 °C combined with an increase in annual precipitation of 10% would reduce glacier area in the order of 75%.