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The Swiss Alpine Glacier's Response to the "2°C Target"

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The "2°C target" for global warming (relative to pre-industrial level) became a main focus in the climate change debate since the UN Climate Change Conference in Copenhagen (COP15) in December 2009 at the latest. While this target implies to be a 'clear' goal for politicians and decision makers, the effective impacts that a global mean air temperature increase of 2°C has on natural and human systems on regional to local scales remain complex. So far, most impact studies use only relative and static 2°C delta change approaches. Here, however, we use results from latest climate model outputs an take into account the warming that has already occurred in a specific region. Global warming is not equally distributed around the globe. Observations show that during the last century air temperature trends significantly differ between regions. In Switzerland, for example, air temperature has increased about twice as much as the global mean during the last century.

In glacierised mountain regions, where glaciers represent an important source for fresh water and control a great part of the hydrological cycle, the retreat or disappearance of glaciers as a consequence of climatic changes will have major socio-economical consequences on the people living there and the adjacent lowland. A trend to negative glacier mass balances is observed and well documented for many mountain ranges all over the world. Based on climate model projections it is very likely that this trend continues or even accelerates. Here, we make an effort to assess the impact of a global 2°C (that is about 4°C for Switzerland) air temperature increase compared to pre-industrial conditions for the Swiss Alpine glaciers. We use 12 homogenised long-term climate observations to define the warming that has already taken place. The 'remaining' temperature increase up to the level of 2°C, is based on results from a selection of Regional Climate Model results that have been simulated in the recently finished EU-funded ENSEMBLES program. The RCM results are bias corrected and then taken as input for a distributed mass balance model in order to assess time and mass balance trends for the Swiss Alpine glaciers with regard to a 2°C. The different runs of the glacier mass balance model show a variety of future scenarios, depending on the driving RCMs. All scenarios have in common that numerous glaciers will loose their accumulation area before or when the 2°C target is reached. It must be emphasized, that a global 2°C temperature rise is likely to impact with a warming of more than 2°C on the Swiss Alps and thus our scenarios represent a lower limit for the changes to be expected. Therefore, we additionally consider a 4°C increase in our study.