Geophysical Research Abstracts
Vol. 19, EGU2017-5363-1, 2017
EGU General Assembly 2017

The challenge of monitoring the cryosphere in alpine environments: Prepare the present for the future

Andrea Fischer (1), Kay Helfricht (1), Bernd Seiser (1), Martin Stocker-Waldhuber (1,2), Lea Hartl (1), and Hans Wiesenegger (3)

(1) Austrian Academy of Sciences, Institute for Interdisciplinary Mountain Research, Innsbruck, Austria (andrea.fischer@oeaw.ac.at), (2) Department of Geography, Physical Geography, Catholic University of Eichstätt-Ingolstadt, Ostenstraße 14, 85072 Eichstätt, Germany, (3) Hydrographical Survey of the Federal Government of Salzburg, Michael-Pacher-Straße 36, 5020 Salzburg

Understanding the interaction of mountain glaciers and permafrost with weather and climate is essential for the interpretation of past states of the cryosphere in terms of climate change. Most of the glaciers and rock glaciers in Eastern Alpine terrain are subject to strong gradients in climatic forcing, and the persistence of these gradients under past climatic conditions is, more or less, unknown. Thus a key challenge of monitoring the cryosphere is to define the demands on a monitoring strategy for capturing essential processes and their potential changes. For example, the effects of orographic precipitation and local shading vary with general circulation patterns and the amount of solar radiation during the melt(ing) season. Recent investigations based on the Austrian glacier inventories have shown that glacier distribution is closely linked to topography and climatic situation, and that these two parameters imply also different sensitivities of the specific glaciers to progressing climate change.
This leads to the need to develop a monitoring system capturing past, but also fairly unknown future ensembles of climatic state and sensitivities. As a first step, the Austrian glacier monitoring network has been analyzed from the beginning of the records onwards. Today's monitoring network bears the imprints of past research interests, but also past funding policies and personal/institutional engagements. As a limitation for long term monitoring in general, today's monitoring strategies have to cope with being restricted to these historical commitments to preserve the length of the time series, but at the same time expanding the measurements to fulfil present and future scientific and societal demands. The decision on cryospheric benchmark sites has an additional uncertainty: the ongoing disintegration of glaciers, their increasing debris cover as well as the potential low ice content and relatively unknown reaction of rock glaciers in the course of climate change, limits the number of potential candidates for future monitoring drastically.
In the light of these developments, sample sizes are a critical question for reliable monitoring, together with strategies for coping with changing monitoring sites and composition of time series. As a first step, the Austrian monitoring network has been analyzed from 1891 onwards. Past changes evident from the glacier inventories capturing all glaciers have been compared to the subsamples of glaciers monitored for length change, mass balance and ice flow velocities. The results show that for capturing the full bandwidth of regional changes, glacier inventories are necessary. Without the analysis of larger scale changes, the interpretation of records with very low sample sizes, such as mass balance or length change, has a high uncertainty level. For specific research or monitoring purposes, for example, the development of runoff master sites with all types of monitoring techniques improve the certainty of the spatial extrapolations of local records or the interpretation of volume changes.
The challenge of preparing the present network for the future requires a thorough analysis of potential future developments to be able to switch sites with a common observation period necessary to investigate the different sensitivities.