Geophysical Research Abstracts
Vol. 15, EGU2013-11864, 2013
EGU General Assembly 2013

The influence of snow on discharge at different temporal scales in Switzerland

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The temporal storage of precipitation as snow plays an important role for discharge generation. This is indicated for example by the frequent occurrence of snowmelt floods and rain-on-snow floods in the Alps. In terms of the former, it can be questioned whether the spring flood is a direct function of the winter snow amount; concerning the latter, it is known that flood forecasting is very challenging after short term snow accumulation. Hence, there is a need to improve our understanding of the role of snow on runoff generation. In this study we exemplarily studied the influence of snow on runoff at different time scales. First, the importance of the temporal storage of water as snow on a short time scale is illustrated by analyzing the snow melt contribution during a rain-on-snow event in October 2011 in Switzerland. This flood was a non-forecasted rain-on-snow flood that generated severe damages. We analyzed why the existing models were not able to forecast the event. Second, the seasonal influence of winter snow cover on spring floods are estimated by evaluating observational data from the Bernese Oberland, Switzerland, during the last 15 years. In addition, we set up a model-experiment combining the last 15 years of snow data with the last 15 years of weather conditions during springtime. Assuming that these years cover at least a part of the natural variability, exceedance probabilities for different winter snow amounts or different weather conditions can be derived. We found that the snow amount causes primarily higher mean flow values while the effect on spring flood peaks are a function of weather. Finally, we want to give an outlook, how these dispositions and exceedance probabilities might change under climate change conditions.