Geophysical Research Abstracts
Vol. 15, EGU2013-10837-1, 2013
EGU General Assembly 2013


# Improving stream flow discharge modelling during snow melt

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The importance of the snow cover for the hydrological cycle is well known but the understanding is still limited. For example, the effect of rain-on-snow on melt water runoff and the coupling between spring snow melt and stream flow discharge are difficult to describe quantitatively due to the complex nature of natural snow covers. Snow height can very over short distances and processes influencing the snow cover development, such as solar radiation and wind, are spatially highly variable in complex alpine terrain. These effects influence the layering of the snow cover and because layers with different snow properties also have different hydraulic properties, the relation between snow melt and snow cover runoff gets rather complex. However, it has already been shown that describing melt water flow through a snow cover using Richards equation, that takes into account the snow stratigraphy, is improving snow cover runoff estimations locally.

In this study, an advanced physical based snow cover model that solves Richards equation (SNOWPACK) is used in a distributed way in a spatially explicit model for alpine terrain (Alpine3D). The model setup simulates the snow cover development and stream discharge over a snow season for the Dischma catchment in Switzerland. A comparison between modelled and observed discharge of the catchment outlet shows that solving Richards equation for snow yields better agreement than simpler (bucket) methods for liquid water flow in snow. The simulations also show a strong variation in contribution of snow cover runoff between areas, depending on slope exposition. This can be associated with different shortwave radiation input for snow melt.

The results show that important improvements in estimating the contribution of snow cover runoff to the hydrological cycle can be achieved by solving Richards equation for snow. However, future research should also focus on a better estimation of hydraulic properties for a wider range of snow types and the understanding of lateral and preferential flow in snow.