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Modeling the climate change impact on snow and runoff in the alpine space

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The snow cover in the Alps is heavily affected by climate change. Recent data show that at altitudes below 1200 m a.s.l. a time-continuous winter snow cover is becoming an exception rather than the rule. This will also change the timing and characteristics of river runoff in Alpine catchments. A numerical study of the impact of climate change on hydrological discharge has been conducted using Alpine3D, a model for the high resolution simulation of alpine surface processes, in particular snow, soil and vegetation processes. We present here an assessment of future snow and runoff in the Swiss Canton of Grisons running the model with a 200 m resolution. The canton has been divided into more than 45 catchments, each having their individual hydrological response split between rain, snow melt and glacier melt, both for a reference period and a climate change scenario (A2) for 2075. The catchment hierarchy allows the analysis of alpine headwater catchments as well as the comparative assessment of the larger scale response at larger rivers and lower altitudes. The data from more than 35 Automatic Weather Stations have been used for the reference scenario and modified for building the climate change scenario. The predicted changes in snow and runoff are drastic in the headwater catchments. While the current climate still supports permanent snow and ice at the altitudes of the highest peaks above 3000 m a.s.l., this zone will disappear under the future climate and smaller glaciers will fully melt. The hydrology of small, relatively high elevations will show significantly more winter runoff, earlier spring melt peaks and reduced summer runoff while larger, lower elevation catchments will show much smaller changes, since they are already now dominated by summer precipitation. It is important to realize that total water availability will decrease due to a significantly increased evapotranspiration. This has important consequences for irrigation and hydropower generation planning.