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The impacts of possible climate futures upon Alpine catchment water balance: demonstration of extreme sensitivity to temperature effects

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Alpine river basins may be exceptionally sensitive to 20th century climate change because of the importance of snow accumulation and snowmelt for the water balance. Even if there are no significant precipitation changes over this time period, it is possible that there are substantial water balance changes because of the effects of temperature upon the intra-annual and inter-annual accumulation and release of water from cryosphere dominated parts of these river basins. Understanding such changes is difficult in many cases because Alpine basins have also been subject to direct human intervention associated with, for example, changes in land use and land management practices, or water management for hydro-electricity. In this poster, we take the opportunity to assess possible future changes in Alpine catchment water balance for a river basin that is heavily protected and where both in the recent past and the next century it is likely that human impacts within the basin will be relatively insignificant: the Avançon catchment in the western Swiss Alps. We apply the fully-distributed WaSIM-ETH hydrological model to this basin (Schulla, 2012), a model that has been calibrated using a Bayesian MCMC approach (Balin et al, 2010), to determine daily river flows. We couple the model to 21st Century climate model simulations. Analysis of the first results indicates significant changes in hydrological regime to the 2050s especially under the warmer and drier A2 scenario but these changes do not relate to changes in the magnitude of precipitation but, rather, to the effects of progressive temperature rise on the intra-annual stockage of snow in the basin. By the 2050s, there is significantly lower accumulation of snow in the basin, an effect that translates simultaneously into: (1) a greater probability of extended summer base flow; (2) a greater probability of higher winter baseflow; and (3) a reduced probability of extreme river flow because the stock of snow available in the late spring and early summer is commonly reduced, just as the intra-annual probability of orographically-forced convective rainfall events starts to increase, so reducing the probability of major rain-on-snow events. Such changes in flow duration imply serious concerns for water resource management in Alpine river basins and the need to adapt management at the intra-annual scale if a more secure water future is to be achieved.