EGU21-13001
https://doi.org/10.5194/egusphere-egu21-13001
EGU General Assembly 2021
© Author(s) 2021. This work is distributed under
the Creative Commons Attribution 4.0 License.

River Temperature Evolution in Switzerland over the 21st Century

Adrien Michel[1,2], Jannis Epting[3], Michael Lehning[1,2], and Hendrik Huwald[1,2]
[1]EPFL, ENAC, CRYOS, Lausanne, Switzerland (adrien.michel@epfl.ch)
[2]WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland
[3]Applied and Environmental Geology, University of Basel, Basel, Switzerland

Climate change has and will have many impacts on natural and human systems, and many of these impacts are already well described in the literature. One impact of climate change that received less attention is the increase in river temperature, even though it is recognized as a key variable controlling the water quality of freshwater ecosystems. It influences both the metabolic activity of aquatic organisms and biochemical cycles. It is also a key variable for many industrial sectors, and favorable for the spreading of certain diseases affecting fish.

In a previous study (Michel et al., 2020) we showed a clear increase of +0.33 ± 0.03 °C per decade in water temperature over the last four decades in Switzerland. Important differences between lowland and alpine catchment were identified. Indeed, the warming rate in alpine catchments is only half of that observed in lowlands rivers. This difference is attributed mainly to the contribution of cold water from snow and glacier melt in mountainous area during summer, mitigating the impact of air temperature warming.

As a follow up, the response of selected Swiss catchments in lowland and alpine regions to the future forcing is numerically assessed using the CH2018 climate change scenarios for Switzerland. This is done using a sequence of physics-based models. The CH2018 climate change scenarios have been extended to a new set of alpine meteorological stations and downscaled to hourly resolution (Michel et al., 2021).

The results show an increase in water temperature for any of the RCP (2.6, 4.5, and 8.5) scenarios and a strong impact of climate change on alpine catchments caused by changes in snowfall/melt, glacier melt, and surface albedo. Indeed, we see a rapid acceleration of the warming in alpine catchments which “catch-up” with the warming already observed in lowland catchments. This can lead to a warming of up to +7 °C by the end of the century in some alpine rivers with the RCP8.5 scenario. An important shift in the hydrological regime is also observed, particularly in high-altitude rivers.

As a result, river ecosystems will be severely impacted. In addition, the combined changes in water temperature and discharge have an important impact on the groundwater temperature annual cycle, as we discussed in Epting et al. (2021). Seasonal shifts in rivers water infiltration associated with increased groundwater recharge during high runoff periods could be an important factor

affecting future groundwater temperatures.

REFERENCES

Epting, J., Michel, A., Affolter, A., & Huggenberger, P.: Climate change effects on groundwater recharge and temperatures in Swiss alluvial aquifers, Journal of Hydrology X, 11, 100071, 2021, doi:10.1016/j.hydroa.2020.100071.

Michel, A., Brauchli, T., Lehning, M., Schaefli, B., & Huwald, H.: Stream temperature and discharge evolution in Switzerland over the last 50 years: annual and seasonal behaviour, Hydrological and Earth System Science, 24, 115–142, 2020, doi:10.5194/hess-24-115-2020.

Michel, A., Sharma, V., Lehning, M., & Huwald, H.: Climate change scenarios at hourly time-step over Switzerland from an enhanced temporal downscaling approach, International Journal of Climatology, under review