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Learning from the interplay between discharge and water temperature for signals of hydrologic and atmospheric change

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The interplay between river discharge and water temperature regimes determines the habitat quality of river ecosystems, and understanding their interplay is thus critical to assess future ecosystem health in the context of climate change and anthropogenic impacts.

Beyond the evident practical importance for ecosystem management, understanding this water temperature-discharge interplay also has great potential to gain new insights into the dominant hydro-climatological processes occurring at the catchment scale.

Central to this is the analysis of bivariate distributions between discharge and water temperature, in combination with simple thermal models, at different temporal scales and across many catchments. Potential insights to be gained include: i) the relative roles of rain, glacier, snow, and groundwater inputs, ii) the influence of atmospheric forcings, and iii) the mixing of the stream network. Using detailed records from Swiss catchments, we show the relative importance of these drivers, how they vary between catchments, as well as their susceptibility to change over time. This work provides a data-based, yet physical basis for understanding how the thermal regime of rivers is regulated by hydrologic and atmospheric processes, and thus provides a template to understand the thermal range of aquatic ecosystems. Such a physical understanding is critical in order to better interpret changing stream temperatures, and the thermal flux they provide to downstream lake and ocean environments.