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Alpine stream temperature response to storm events

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Despite continued interest in meteorological influences on the thermal variability of river systems, there are few detailed studies of stream temperature dynamics during storm events. This paper reports high-resolution (15 min) water column and streambed temperature data for storm events of contrasting magnitude, duration and intensity for three streams (draining glacier, snow and groundwater sources) across an alpine river system during summer 2002 and 2003.

The results demonstrate clear spatial and temporal differences in water column and streambed thermal responses to precipitation events and stream flow peaks. Analysis of all storms across the three sites showed a decrease in water column temperature for 75% of events, with significant negative relationships between stream temperature and precipitation magnitude, precipitation intensity, and stream discharge peaks. Temperature decreases of 10.4ºC were recorded but temperature increases were less marked at up to 2.3ºC. Streambed temperature response to precipitation was dampened with increasing depth into the streambed at all sites.

Spatial and temporal differences in thermal response to storm events were controlled by precipitation and stream discharge peak characteristics (above) plus antecedent basin conditions, which together determine the nature and rapidity of hydrological response. In this steep alpine basin, stream temperature variability appears to be enhanced by quick routing of precipitation to the river channel (i.e. direct precipitation/ channel interception, rapid surface flow over impermeable bedrock/ thin alpine soils and subsurface flow through highly weathered scree slopes).

This research highlights the need for integrated hydrometeorological research of precipitation event – hydrological response – stream temperature interactions to advance

understanding of runoff generation processes driving event-scale thermal dynamics in alpine and other river systems.