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Hyporheic temperature dynamics of an alpine stream

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Few detailed studies of water temperature dynamics exist for alpine river systems despite these environments' high sensitivity to climate change and variability. Hence, this research examined water column and hyporheic (streambed to 0.4m depth) temperature at 15 min resolution for three alpine streams in the French Pyrénées during summer 2002 and 2003. Temperature was monitored for: (a) the Taillon Glacier stream, (b) the Tourettes groundwater-fed tributary, and (c) downstream of the confluence of (a) and (b). Water column and streambed temperature was analysed with reference to hydrological (transient snowline altitude and river discharge) and climatological (air temperature, incoming short-wave radiation and precipitation) data to identify dominant thermal controls and infer processes. Over the summer melt season, streambed temperature at all depths was coldest (warmest) and most (least) variable for the Taillon (Tourettes) stream. Downstream of the confluence of the Taillon and Tourettes streams, streambed temperature and variability was consistently intermediate to (a) and (b). Temperature response was generally lagged and attenuated with increasing depth into the streambed at all sites, although this pattern of thermal dampening was most pronounced for the Tourettes groundwater-fed tributary. At the event time-scale (sub-hourly), precipitation and storm flow responses were associated with temperature decreases of up to 10ºC in the water column and 0.05m depth, 7.5ºC at 0.20 m depth and 5ºC at 0.40 m depth in the streambed. These inter-site differences indicated the main influences on streambed temperature to be: (1) water column thermal variability (forced by energy receipt at the air-water interface), (2) sediment calibre, (3) river discharge fluctuations, most notably during storm events, and (4) inferred nature and magnitude of groundwater-surface water interactions. Overall, the variability

of water column and streambed temperature observed here shows alpine stream to be highly thermally heterogeneous.