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Stream temperature dynamics within a New Zealand glacierized river basin

S.L. Cadbury (1), **D.M. Hannah** (1), A.M. Milner (1,2), C.P. Pearson (3) and L.E. Brown (4)

(1) School of Geography, Earth and Environmental Sciences, University of Birmingham, Birmingham, UK, (2) Institute of Arctic Biology, University of Alaska, Fairbanks, Alaska, USA, (3) National Institute of Water and Atmospheric Research Ltd., Christchurch, New Zealand, (4) School of Geography, University of Leeds, Leeds, UK (sxc829@bham.ac.uk)

Stream temperature in European alpine basins has received recent attention; however, there remains a lack of data on river thermal dynamics in other mountainous regions. This study aimed to examine spatio-temporal dynamics in water column and streambed temperature within a New Zealand glacier-fed river basin over two melt seasons. Water column temperature was recorded at three sites along the mainstem channel and four hillslope/ groundwater-fed tributaries. Air temperature, precipitation and stream discharge were monitored to characterise hydroclimatological conditions. Streambed temperature was monitored at the upper and lower main river sites at 0.05, 0.2 and 0.4 m depth. Water column temperature rose on average 0.6˚C km^{-1} along the glacier-fed mainstem. Temperature was elevated during warmer periods but the downstream increase was reduced due to greater meltwater production (consequently a larger total stream flow volume for atmospheric heating) plus a proportional reduction in warm groundwater contributions. Hillslope/ groundwater-fed tributaries yielded a range of temperature patterns, indicating variable sourcing (meltwater or rainfall) and residence times. In the upper basin, streambed temperature was warmer than the water column, suggesting groundwater upwelling; however, during high runoff events, water column and streambed temperature converged, indicating downwelling/ heat advection by channel water. At the lower site, streambed temperature mirrored the water column, suggesting greater surface water/ atmospheric influences. Overall, key drivers of stream thermal regime were: (1) relative water source contributions, (2) prevailing hydroclimatological conditions, (3) distance from source and (4) stream flow volume.

In contrast to European alpine research, streams showed a reduced thermal range owing to the relatively mild, wet melt season climate. Stream temperature dynamics were modified by the shaded valley orientation; incised valley and channel geomorphology; and presence of beech forest, typical of New Zealand mountain streams. High magnitude precipitation events produced a contrasting stream thermal response to that reported elsewhere.