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Water Temperature Dynamics in High Arctic River Basins

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Despite the high sensitivity of polar regions to climate change, and the strong influence of temperature upon ecosystem processes, contemporary understanding of water temperature dynamics in Arctic river systems is limited. This research gap is addressed by exploring high-resolution water column thermal regimes for glacier-fed and non-glacial rivers at eight sites across Svalbard during the 2010 melt season. Mean water column temperatures in glacier-fed rivers (0.3 – 3.2 ºC) were the lowest and most thermally-stable near the glacier terminus but increased downstream (0.7 – 2.3 ºC km-1). Non-glacial rivers, where discharge was sourced primarily from snowmelt, were warmer (mean 2.9 – 5.7 ºC) and more variable, indicating increased water residence times in shallow alluvial zones with increased potential for atmospheric influence. Mean summer water temperature and the magnitude of daily thermal variation were similar to those of Alaskan rivers but low at all sites when compared to alpine glacierized environments at lower latitudes. Thermal regimes were strongly correlated ($p<0.01$) with incoming shortwave radiation, air temperature, and river discharge. Principal drivers of thermal variability were inferred to be: (1) water source (i.e. glacier melt, snowmelt, groundwater); (2) exposure time to the atmosphere; (3) prevailing meteorological conditions; (4) river discharge; and (5) basin-specific geomorphological features (e.g. channel morphology). These results provide insight into the potential changes in high-latitude river systems in the context of projected warming in polar regions. We hypothesise warmer and more variable temperature regimes may prevail in future as the proportion of bulk discharge sourced from glacial meltwater declines and rivers undergo a progressive shift towards snow- and groundwater sources. Importantly, such changes could have implications for species diversity and abundance in benthic communities and influence rates of ecosystem functioning in high-latitude aquatic systems.