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Diurnal patterns of hydrochemistry and isotopic compositions of a meltwater stream on King George Island, Antarctica

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Antarctica is increasingly vulnerable to climate and environmental change. Especially, climate change can lead to the thawing of permafrost and increase the thickness of the active layer in polar regions, resulting in variations in hydrological pathways. This study aims to understand the hydrologic flow paths of a meltwater stream on King George Island, Antarctica, during the snowmelt season using hydrochemical and isotopic compositions. During the summer with cold events, as the amount of snowmelt decreased, the flow rate of the stream also decreased. Hence, the electrical conductivity (EC) increased because the contribution of supra-permafrost groundwater relatively increased more during the cold period than during the warm period. In addition, diurnal variations in the stable isotopic compositions ($\delta^{18}O$ and δD) of snowmelt were clearly observed in the stream water, indicating that runoff was the dominant flow path of meltwater during the summer with cold events. In contrast, during summer with warm events, the snowmelt rate increased, and the EC value decreased by the dilution effect. Moreover, diurnal variations in the isotopic compositions of the stream water were attenuated during the warm period compared with the cold period. This attenuation effect was not due to the increased contribution of groundwater; instead, it was due to the contribution of snowmelt with a low-amplitude signal in the diurnal variations of stable isotopes. Therefore, the observed diurnal variations in the stream indicate that this catchment is dominated by runoff during summer. These findings are helpful for improving our understanding of climate-related changes in the hydrological processes and water-related ecosystems of snow-dominated headwater catchments, Antarctica.