Goldschmidt 2024 Abstract
https://doi.org/10.46427/gold2024.23938

Contribution of seasonal source waters to Arctic hydrology separated by a numerical model

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The global climate change resulted in earlier snowmelt in spring, deeper active layer thickness, and larger rainfall in the summer season in the Arctic terrestrial regions, which were strongly linked to the change of seasonal hydrological processes identified as higher summer evapotranspiration and river discharge in autumn and cold season. However, little is yet known about the contribution of the seasonal source waters (i.e., snow, rain, and ground ice) to the changes in the hydrological processes. This study quantified their contribution rates using a land surface model, coupled a tracer scheme tracking along the flow route of individual source waters in the hydrological processes over the pan-Arctic scale during the period of 1979–2019. As the first step, the simulated fraction of source waters in the river discharge was validated by the values separated by observed water tracer data. The simulation represented a higher fraction of snowmelt water in the spring peak discharge. The contribution of the summer rain water to evapotranspiration and river discharge was significantly increased during the study period. Interestingly, the summer rain water was connected to the peak river discharge and evapotranspiration in spring of the following year, implicating to soil freezing and thawing. The permafrost degradation-associated ground ice meltwater showed a weak connectivity to river discharge and evapotranspiration. This study suggests an insight that the summer source water showed relatively increased contribution to the changing Arctic ecohydrological processes.