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Projections of global groundwater temperatures due to climate change

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Abstract: Groundwater plays important roles in catchments by providing baseflow to rivers and sustaining groundwater-dependent vegetation. Like surface waters, groundwater is projected to be impacted by climate change-driven modifications to the hydrological cycle. The projected impacts of climate change on processes like streamflow and groundwater recharge have been extensively investigated. In comparison, studies on how groundwater temperature responds to surface warming have not been as widely studied.

Groundwater temperature influences water quality by enhancing leaching and/or microbial activity at higher temperatures. Groundwater discharge also maintains thermal refugia in rivers and streams. Increased temperature of groundwater discharge can thus impact temperature sensitive groundwater-dependent ecosystems. Understanding potential changes in future groundwater temperature are likely required to inform investigations to assist water resources and ecosystem management.

To facilitate further investigations into the potential impacts from increased groundwater temperature, Benz et al. (2024) used projected soil temperatures from the CMIP6 global climate models and a simple analytical solution to model recent and future global groundwater temperature change. The model is validated against >8000 groundwater temperature measurements. Spatiotemporal groundwater warming projections are available for "Middle of the Road" (SSP2-4.5) and "Fossil Fuelled Development" (SSP5-8.5) scenarios.

Projected groundwater warming rates are highly spatially variable, dependent on the depth to the water table and topography. Relative to the year 2000, the 2100 average water table temperature is projected to warm by 2.1 °C (between 0.6 and 3.6 °C) for SSP2-4.5, and 3.5 °C (between 0.8 and 7.1 °C) for SSP5-8.5 median projections. The projected groundwater temperatures from the study are transferrable to future research via a Google Earth Engine App that can be used to extract projected water table temperatures or temperature-depth profiles (https://susanneabenz.users.earthengine.app/view/subsurface-temperature-profiles), and via spatial model outputs available on an online data repository (Benz, 2024). We provide an overview of the generation of the datasets and on how the model outputs can be used to inform future investigations.

REFERENCES

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