

Multi-year analysis of Groundwater Temperature fluctuations in relation to climate change

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Abstract:

Groundwater temperature (GWT) regulates geochemical, biological, and physical processes within both the surface and subsurface with wide-ranging environmental and societal impacts. In this study, we examined five years (2015-2019) of GWT and surface water temperature (SWT) data from the stream and wells located in a riparian buffer zone within central Illinois. The five years of temperature data show both seasonal trends and annual changes in air temperature; precipitation follows similar trends. This study aims to gain a better understanding of the hydrological and geological controls on GWT as well as how it has changed in response to ongoing climate change.

Measurements of GWT and SWT were taken using Onset level/temperature loggers, Deacon Stage-Conductivity-Temperature loggers, and YSI 85. This data reports five consecutive years at bi-weekly intervals between May 2015 to August 2019. GWT was measured at 1.5, 2.3, 3.0, and 4.6-meter depths. AT measurements were taken using Onset Pendants, reporting on 15-minute intervals between May 2016 and March 2019. Precipitation data are from Weather Underground.com from Bloomington Airport.

Initial analyses have shown that GWT follows both the cyclical trend due to seasonality, as well as an observed annual decrease in AT. Average annual AT dropped from 11.9 to 11.4 degrees Celsius from 2017 and 2018, which was paralleled by a drop in GWT from 11.3 to 11.0 degrees Celsius. Furthermore, maximum AT decreased from 46.9 to 41.5 degrees Celsius, and minimum AT decreased from -23.8 to -29.0 degrees Celsius between 2016 and 2018. Similarly, between 2016 to 2018 we observed a similar trend in maximum and minimum GWT. Maximum GWT decreased from 25 to 22.7 degrees Celsius, and minimum GWT decreased from 3.6 to 0.9 degrees Celsius. A dampened response across depth was also observed, as average GWT decreased from 12.7 degrees Celsius at 1.5 meters to 12.4 degrees Celsius at 4.5 meters. Further analysis using auto and cross-correlation will aid in determining whether AT is the sole control over GWT.