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Groundwater temperature as a tracer to estimate anthropogenic impacts: past, present and future

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Abstract We evaluated the potential variations of aquifer temperature attributed to anthropogenic effects in the past, present, and future in the Sendai Plain, Japan. To simulate the heat transport in the subsurface layers, the USGS numerical code (VS2DH) was used. For the climate predictions, HADCM3, MIROC and ECHAM5 models under the A2, A1B and B1 scenarios were used. The overall results from nine scenarios estimate 0.7–2.1°C subsurface temperature change in 2100 at 12 m depth which is notably higher than the past urbanization effect seen in Sendai. Moreover, groundwater temperature was considered as a proxy to develop a relationship between urbanization level and ground–surface temperature change. Results suggest that approximately 0.6°C ground surface temperature reduction can be achieved in the long-term by reducing the urban ratio by 10% in highly urbanized areas. These results imply the necessity of considering aquifer temperature variations attributed to climate change in habitat restoration programmes.

Key words groundwater temperature; VS2DH; climate change; urbanization; Sendai Plain, Japan