Ground Surface Temperature Map of Switzerland

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Evaluating ground surface temperature (GST) is common in applied and general geothermal research. Our main focus here is investigating GST for Switzerland because of its well-known impact on low-enthalpy resources, like borehole heat exchanger (BHE) utilization. Using mainly meteorological data, we determined the present-day GST distribution through different approaches.

First we analyzed the actual GST data from the last 20 years measured at the meteorological stations of the Swiss Meteorological Institute by investigating recent climatic history and annual variation behavior. Recent climate change seems to have a higher impact on Alpine regions than on the Alpine Foreland. Finally, we determined the GST altitude dependence in the range of 200 – 1800 m a.s.l., using non-linear fitting approaches and investigated the relationship between GST and surface exposure. Contrary to previous publications, no universal correlation between GST and surface exposure was found, due to local and rapid changing meteorological conditions.

A relationship between GST and surface air temperature (SAT) was defined based on the data from the Swiss Meteorological Institute. By applying non-linear approaches, we established three different altitude zones that require individual consideration. By further processing, an existing SAT map was converted into the first GST map of Switzerland. To verify this new map within the range of validity (up to altitudes of 1500 m a.s.l.), GST values extrapolated from boreholes were used as independent data sources. Generally a fit with a standard deviation of 1.0 K was achieved, but local deviations of 2 K also occurred.

The new GST map of Switzerland provides useful estimates of regional GST, but not for local effects. It represents an important improvement in evaluating geothermal resources and determines regional GST distribution under vegetation and weather conditions typical of central Europe.