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Air - Ground - Bedrock Temperature Coupling, Its Monitoring at Borehole Climate Observatories

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Reconstructing ground surface temperature (GST) histories from present-day temperature-depth logs is now generally accepted as one of the independent and physically justified method to obtain information about the past climate history on the time scale of hundreds to thousands years. Any temperature change at the Earth's surface slowly propagates downward and deeper we go farther back in time the measured temperature carries certain memory on what has happened on the surface in the past. Due to diffusive character of the process, however, the resolution quickly decreases for the remote events and the reconstructed GST at a given moment is a weighted average of temperature over a certain period of time. For better understanding of the temperature state in the subsurface T(z) logs can be suitably completed with long-run temperature-time monitoring at selected depth intervals, namely within the near-surface active layer affected by seasonal temperature variations (usually uppermost 30-40 m). In addition to GST inversions applied on deep T(z) profiles existing all over the world, several permanent borehole climate observatories were actually established in the last two decades to test the validity of the assumption that GST variations track the SAT (surface air temperature) changes as well as to study various environmental/local effects, such as the vegetation cover type/change, rain/snow precipitation, thawing/melting/freezing, etc. which controls the whole heat transfer process. Long-term monitoring of the shallow subsurface temperature field in suitably geographically located sites may additionally also help to understand the different conditions in e.g. urban vs. countryside environments and to assess the potential anthropogenic contribution to the present-day warming rate within the natural climate variability. This presentation summarizes main results obtained at the Czech borehole sites since 1992 completed with brief comparison of similar results collected elsewhere.