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High resolution daily gridded minimum, mean and maximum temperature datasets for Germany and river catchments

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Operating traffic and transport infrastructure sustainably requires enforced resilience to climate change impacts. Specific threats to the infrastructure are posed for instance by very cold and very hot temperatures as well as to freeze-thaw repetitions. Adaptation measures have to be determined and implemented in order to enhance the resilience of roads.
In Germany the adaptation to the impacts of climate change is framed in the German Strategy for Adaptation to Climate Change (DAS). This strategy applies to the whole public sector, including transport and infrastructure, and constitutes the legal basis for putting science and strategy into practice. The Federal Ministry of Transport and Digital Infrastructure (BMVI) – being responsible for the transport infrastructure in Germany – funded a comprehensive national research program on safe and sustainable transport in Germany. One column of this project is the "Adapting transport and infrastructure to climate change and extreme weather events".
The German Meteorological Service (DWD) provides climate data (observations and climate projections) appropriate for impact modelling and related studies. Bias correction methods are going to be applied to an ensemble of regional climate models using appropriate observational reference datasets. This is particularly important with regard to statistically robust conclusions about climate indices using fixed threshold definitions like frost days, tropical nights or heat days.
In this context a high resolution gridded reference dataset of minimum, mean and maximum temperature for Germany and river catchments is generated covering the period 1951-2015. The spatial analysis is based on observational data from over 1000 synoptical stations throughout Germany and neighboring areas. An algorithm developed by Frei (2013), which has been successfully applied to Switzerland, Austria and Norway, was adapted to German conditions and to the requirements of the project. Based on the superimposition of non-linear vertical profile fields and non-Euclidean distance weighted residual fields the method is especially designed for topographically complex areas. Methodological adjustments involve the analysis of daily temperature extremes, the much larger area compared to Switzerland, and the integration of urbanization and coastal effects. To increase consistency of the daily grids, extremes were interpolated as deviations from mean. Cross validation revealed a mean absolute error of less than 0.7°C. The integration of the urban heat island effect reduced the bias in urban areas.