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A global database with parallel measurements to study non-climatic changes

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In this work we introduce the rationale behind the ongoing compilation of a parallel measurements database, in the framework of the International Surface Temperatures Initiative (ISTI) and with the support of the World Meteorological Organization. We intend this database to become instrumental for a better understanding of inhomogeneities affecting the evaluation of long-term changes in daily climate data.

Long instrumental climate records are usually affected by non-climatic changes, due to, e.g., (i) station re- locations, (ii) instrument height changes, (iii) instrumentation changes, (iv) observing environment changes, (v) different sampling intervals or data collection procedures, among others. These so-called inhomogeneities distort the climate signal and can hamper the assessment of long-term trends and variability of climate. Thus to study climatic changes we need to accurately distinguish non-climatic and climatic signals.

The most direct way to study the influence of non-climatic changes on the distribution and to understand the reasons for these biases is the analysis of parallel measurements representing the old and new situation (in terms of e.g. instruments, location, different radiation shields, etc.). According to the limited number of available studies and our understanding of the causes of inhomogeneity, we expect that they will have a strong impact on the tails of the distribution of air temperatures and most likely of other climate elements. Our abilities to statistically homogenize daily data will be increased by systematically studying different causes of inhomogeneity replicated through parallel measurements.

Current studies of non-climatic changes using parallel data are limited to local and regional case studies. However, the effect of specific transitions depends on the local climate and the most interesting climatic questions are about the systematic large-scale biases produced by transitions that occurred in many regions. Important potentially biasing transitions are the adoption of Stevenson screens, relocations (to airports) efforts to reduce undercatchment of precipitation or the move to automatic weather stations. Thus a large global parallel dataset is highly desirable as it allows for the study of systematic biases in the global record.

We are interested in data from all climate variables at all time scales; from annual to sub-daily. High-resolution data is important for understanding the physical causes for the differences between the parallel measurements. For the same reason, we are also interested in other climate variables measured at the same station. For example, in case of parallel air temperature measurements, the influencing factors are expected to be global radiation, wind, humidity and cloud cover; in case of parallel precipitation measurements, wind and wet-bulb temperature are potentially important.