DKT Abstracts
DKT-10-66, 2015
10. Deutsche Klimatagung

Is the global mean temperature trend too low?

V.K.C. Venema and R. Lindau
University of Bonn, Meteorological institute, Bonn, Germany (victor.venema@uni-bonn.de)

The global mean temperature trend may be biased due to similar technological and economic developments worldwide. In this study we want to present a number of recent results that suggest that the global mean temperature trend might be steeper as generally thought.

In the Global Historical Climate Network version 3 (GHCNv3) the global land surface temperature is estimated to have increased by about 0.8°C between 1880 and 2012. In the raw temperature record, the increase is 0.6°C; the 0.2°C difference is due to homogenization adjustments. Given that homogenization can only reduce biases, this 0.2°C stems from a partial correction of bias errors and it seems likely that the real non-climatic trend bias will be larger. Especially in regions with sparser networks, homogenization will not be able to improve the trend much. Thus if the trend bias in these regions is similar to the bias for more dense networks, one would expect the real bias to be larger.

Stations in sparse networks are representative for a larger region and are given more weight in the computation of the global mean temperature. If all stations are given equal weight, the homogenization adjustments of the GHCNv3 dataset are about 0.4°C per century. In the subdaily HadISH dataset one break with mean size 0.12°C is found every 15 years for the period 1973–2013. That would be a trend bias of 0.78°C per century on a station by station basis. Unfortunately, these estimates strongly focus on Western countries having more stations.

Regional datasets can be better homogenized than global ones, the main reason being that global datasets do not contain all stations known to the weather services. Furthermore, global datasets use automatic homogenization methods and have less or no metadata. Thus while regional data can be biased themselves, comparing them with global datasets can provide some indication on biases. Compared to the global BEST and GISS datasets for the same countries, the national datasets of a small set of European countries and Australia a stronger long-term trend by about 0.4°C per century. Relative to CRUCY the trend biases are smaller and only statistically significant for the period since 1980.

The most direct way to study biases in the temperature records is by making parallel measurements with historical measurement set-ups. Several recent parallel data studies for the transition to Stevenson screens suggest larger biases: Austria 0.2°C, Australia 0.2°C, Spain 0.35°C. As well as older tropical ones: India 0.42°C and Sri Lanka 0.37°C. The smaller values from the Parker (1994) review mainly stem from parallel measurements from North-West Europe, which may have less problems with exposure.

Furthermore, the influence of many historical transitions, especially the ones that could cause an artificial smaller trend, have not been studied in detail yet. We urgently need to study improvements of exposure (especially in the (sub-)tropics), increases in watering and irrigation, mechanical ventilation, better paints, relocations to airports, and relocations to suburbs of stations that started in the cities and from village centers to location outside the village, for example. Our current understanding surprisingly suggests that the more recent decades may have the largest trend biases.

If the temperature trend were actually larger it would reduce discrepancies between studies for a number of problems in climatology. For example, the estimates of transient climate sensitivity using instrumental data are lower as the one using climate models, volcanic eruptions or paleo data. Furthermore, several changes observed in the climate system are larger than expected. On the other hand, a large trend in the land surface temperature would make the discrepancy with the tropospheric temperature even larger (radiosondes and satellites) and it would introduce a larger difference between land and sea temperature trends.

Concluding, at the moment there is no strong evidence yet that the temperature trend is underestimated.

However, we do have a considerable amount of evidence that suggests that there is a moderate, but climatologically important bias that we should study with urgency. As far as we know there are no estimates for the remaining uncertainty in the global mean trend after homogenization. Also studies into the causes of cooling biases are a pressing need.

(Many have contributed to this study, but it is not clear at this moment who would be official collaborators; they will be added later.)