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Temperature trend biases

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In an accompanying talk we show that well-homogenized national dataset warm more than temperatures from global collections averaged over the region of common coverage. In this poster we want to present auxiliary work about possible biases in the raw observations and on how well relative statistical homogenization can remove trend biases.

There are several possible causes of cooling biases, which have not been studied much. Siting could be an important factor. Urban stations tend to move away from the centre to better locations. Many stations started inside of urban areas and are nowadays more outside. Even for villages the temperature difference between the centre and edge can be 0.5°C. When a city station moves to an airport, which often happened around WWII, this takes the station (largely) out of the urban heat island.

During the 20th century the Stevenson screen was established as the dominant thermometer screen. This screen protected the thermometer much better against radiation than earlier designs. Deficits of earlier measurement methods have artificially warmed the temperatures in the 19th century. Newer studies suggest we may have underestimated the size of this bias. Currently we are in a transition to Automatic Weather Stations. The net global effect of this transition is not clear at this moment.

Irrigation on average decreases the 2m-temperature by about 1 degree centigrade. At the same time, irrigation has increased significantly during the last century. People preferentially live in irrigated areas and weather stations serve agriculture. Thus it is possible that there is a higher likelihood that weather stations are erected in irrigated areas than elsewhere. In this case irrigation could lead to a spurious cooling trend.

In the Parallel Observations Science Team of the International Surface Temperature Initiative (ISTI-POST) we are studying influence of the introduction of Stevenson screens and Automatic Weather Stations using parallel measurements, as well as the influence of relocations.

Previous validation studies of statistical homogenizations unfortunately have some caveats when it comes to the large-scale trends. The main problem is that the validation datasets had a relatively large signal to noise ratio (SNR), i.e. they had a large break variance relative to the variance of the noise of the difference time series. Our recent work on multiple breakpoint detection methods shows that SNR is very important and that for a SNR around 0.5 the segmentation is about as good as a random segmentation.

If the corrections are computed with a composite reference that also contains breaks, the bias due to network-wide transitions that are executed over short periods will reduce the obvious breaks in the single stations, but may not reduce the large-scale bias much. The joint correction method using a decomposition approach (ANOVA) can remove the bias when all breaks (predictors) are known. Any error in the predictors will, however, lead to undercorrection of any large-scale trend biases.