Geophysical Research Abstracts
Vol. 15, EGU2013-7287-2, 2013
EGU General Assembly 2013

Comparison of parallel temperature measurements from conventional and automatic weather stations at Fabra Observatory (Barcelona).

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Fabra Observatory , located in a promontory at 411 meters above sea level in the outskirts of Barcelona, hosts a continuous climate record since 1913. Additionally, it has been recording since 1996 simultaneous temperature and precipitation data with conventional instruments and automated systems. The automatization of recording sites employed with climatological purposes is happening elsewhere in the country and across the globe. Unfortunately, in most cases long lasting parallel measurements, are not kept. Thereafter, this site offers an excellent opportunity to study the impact of the introduction of Automatic Weather Stations (AWS).

The conventional station (CON) equips a liquid in glass thermometer, located inside a standard Stevenson screen. The automatic measurements (AWS) have been taken using MCV-STA sensors sheltered in a MCV small plate-like ventilated screen between 1996 and the end of July 2007. For our analysis, this MCV period is split in two (T1, T2) due to an obvious jump in the differences AWS-CON in October 2002, produced by unknown reasons. From August 2007 to the present (T3), a Vaisala HMP45AL sensor was placed inside a Stevenson Screen and used for automatic measurements.

For daily maximum temperatures, the median differences reach 3.2ºC in T1, 1.1ºC in T2 and merely -0.1ºC in T3. In this later period, 94% of the differences are comprised in a $\pm$0.5ºC range, compared to 23% in T2 and only 6% in T1. It is interesting to note how the overheating of the MCV screen dominates the difference series, as 85% of the AWS values taken in T1 and T2 are warmer than the conventional measurements, contrasting with only 27% of cases during T3, when the automated measurements were taken inside a Stevenson screen. These differences are highly temperature dependent: low (high) AWS temperatures are associated with small (large) differences with the CON series. This effect is also evident if temperatures are analyzed by seasons: summer differences are much higher than winter differences in T1 (median value of 3.6ºC vs 2.6ºC) and T2 (1.7ºC vs. 1.0 ºC). In T3, the effect of sheltering makes winter AWS temperatures slightly cooler (-0.2ºC), meanwhile summer median difference is 0.0ºC. This effect is also noticed when looking at other elements such as the sunshine hours. Days with very short sunshine periods (<=3 hours) are characterized by lower median differences in T1 and T2 (1.6ºC/0.4ºC) compared to those days with more than 10 hours of sunshine (3.8ºC/1.6ºC). For T3, in days with low sunshine duration, the AWS tends to be cooler by -0.2ºC, meanwhile the median difference for days with more than 10 hours of sunshine is 0.0ºC. Also, windy, rainless and high pressure days are linked to high temperature differences in T1 and T2.

The AWS-CON differences for daily minimum temperatures are smaller and more uniform in all cases. In T1 and T2 (0.4ºC for both periods) compared to those found in the daily maximum values. Also, the percentage of differences in a $\pm$0.5º range approaches 50% in T1 and T2. In contrast, T3 median difference doubles to -0.2ºC, compared to daily maximum temperature, although the percentage of differences inside the $\pm$0.5 range remains at 94%. As can be seen, the sheltering differences become less important during nighttime. Not surprisingly, about 80% of the values in T1 and T2 and 93% in T3 are cooler in the AWS. Seasonally, in winter, the 3 periods show a median difference of -0.3º. During summer, nighttime values recorded at the MCV screen (T1, T2) differ by -0.5ºC to the conventional thermometer readings, meanwhile the Vaisala sensor sheltered inside a Stevenson screen, has a median difference of -0.1ºC with the conventional data. Also, although there is a relation with other climate elements such as sunshine duration, pressure, wind or precipitation, it is less remarkable than in the daytime values.

In the framework of the Spanish project CGL2012-32193, "Determination and evaluation of the bias introduced by the automatation of meteorological stations in climate time series", the different segments of Fabra Observatory, as well as other series across the country with available parallel measurements, will be further evaluated and adjusted using state-of-the- art correction methods.