Geophysical Research Abstracts
Vol. 12, EGU2010-4009, 2010
EGU General Assembly 2010

Climatological effects of replacing mechanic thermometers with electronic thermometers.

Alessandro M.S. Delitala and Giuliano Fois

Hydrometeoclimatological Department, ARPAS (Regional Environmental Protection Agency of Sardinia), Sassari, Italy (adelitala@arpa.sardegna.it / +39-079262681)

In the last decade of 20th century, most of the traditional temperature recording systems of meteorological networks worldwide were replaced by electronic stations. Both sensors and data processing systems were changed.

Before the above instrumental change, mechanical thermographers had bimetallic sensors inside and liquid-in-glass thermometers usually contained lead or other liquids. Nowadays, electronic thermometers are based upon resistors or thermocouples.

In order to register those data, mechanical thermographers would make continuous analogical recording upon paper strips while liquid-in-glass thermometers were read every day. Modern stations, on the other hand, digitally process measures from their thermometers by means of data-loggers.

The impact of such a major instrumental change received little attentions by meteorological services, except for a few scientific analysis, although it is likely to have been quite significant upon long time series of observation, as it has been pointed out even by the World Meteorological Organization.

The authors of the present talk analysed about ten years of measures registered between 1996 and 2007 by a couple of stations: one mechanical thermographer and one electronic thermometer, operated in parallel in the same field in Sardinia. The two stations were operated by two different institutions: the "Department of Agronomy and Agrarian Vegetal Genetics of the University of Sassari" and the Italian research institute "CRA-CMA"; they both received a fair maintenance and their site was well cured by the hosting institution.

A systematic difference of +0.9°C in minimum temperatures was detected, almost independent of seasons. A very low mean bias (+0.1°C) was highlighted in maximum temperatures, instead; however the authors detected a seasonal effect, ranging from +1.1°C in January to -0.8°C in June. The very high number of records renders such results very robust from a statistical point of view.

The authors then made two attempts to interpret their results in terms of different boundary layer processes, affecting the two types of instruments in different ways.

In the first place, they assessed if the biases detected in minimum and maximum temperatures are dependent upon thermal advection due to local winds. An increase in the bias of minimum temperature seems to arise for advection greater than 0.0005°C/s; such a results is however very noisy.

Secondly, they verified if different boundary layer stability conditions play different roles. In order to do that, they estimated biases in each Pasquill stability classes, considering nocturnal stability conditions for minimum temperatures and diurnal stability conditions for maxima.

A minor bias, ranging from -0.2°C to +0.5°C, arose in maximum temperatures. A much greater bias was detected for minimum temperatures. In particular a bias of +2.1°C and +4.3°C was detected for Pasquill classes F and D respectively.

The authors eventually pointed out that the observed biases in minimum temperatures can be explained in term of the different lag times of mechanic and electronic thermometers. As matter of fact, rapid temperature variations due to the turbulence of the boundary layer appear as a noise to the fast responding electronic thermocouples while they are almost completely filtered out by slow responding bimetallic thermometers.