Title: Global climate change evaluation correction by identification of residual urban heat island (UHI) bias in land surface temperature records

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Research program

Global change and warming is one of the most important worries of our times. Yet, to properly understand it, it is necessary to correctly evaluate its real magnitude.

It is claimed that the global surface land has warmed since the pre-industrial time, that is since the period 1850-1900, by more than a 1 °C. Yet, the raw temperature data measured in the weather stations are processed before being used to compile the climate records which are later used to interpret climate changes. This process is called "homogenization" and it is required to clean the station raw temperature data of any non-climatic artifacts such step-change biases linked to station moves and changes in instrumentation, and, finally, it is also claimed to correct trend biases such as those induced by urbanization development. The last claim refers to the so-called "urban heat island" (UHI) effect that occurs because of the direct release of urban anthropogenic heat and because of the cities' dense concentrations of materials like asphalt, concrete and buildings that absorb more heat during daytime and release it more slowly at night than the soil and vegetation that characterize the rural areas. Although in stationary conditions UHI should not change climatic averages and trends, a warming bias occurs in meteorological records when rural landscapes are progressively transformed and included into urban areas as it happened during the last century nearly everywhere. Homogenization methodologies, however, have severe limits particularly when extended regions are urbanized and UHIs can influence the same rural regions used to detect and quantify the bias of the nearby urban centers (e.g.: de Gaetano, 2006; Pielke et al., 2007a, 2007b; Soon et al., 2015). Indeed, several studies have pointed out that the climatic records still contain a residual non-climatic warming due to inefficiently corrected or estimated UHI effects (e.g.: McKitrick and Michaels, 2007; Soon et al., 2018). More recently, Scafetta and Ouyang (2019) developed a new methodology to detect residual UHI biases based on the evaluation of the divergence between Tmax and Tmin records and efficiently applied it to the China temperature network. The important open issue is to generalize the study to the entire world with the purpose to find the region where uncorrected non-climatic biases, including those based on UHI effect, are still present.

Proposal for a PhD position

This research aims at using all available climatic temperature records and to determine the world regions where uncorrected non-climatic biases are still present. Temperature climatic data produced by different research groups and referring to both land and satellite measurements will be analyzed and compared. The results will also be compared against global climate model predictions. The project aims to study in detail all regions where an apparent bias is found and to interpret the possible causes. Finally, the collected knowledge will be used to improve the existing climate temperature records. The PhD candidate will follow a work schedule articulated as follows:

1st year: Bibliographic research on the subject; learning about climate records, global climate models, visualization climate software and learning fundamentals of signal statistical analysis.

2nd year: Data analysis and result interpretation. Participation possibly as a speaker to an International Congress.

3rd year: Interpretation of results; writing of PhD thesis.