Measuring air temperature without shading by using virtual sensors of zero surface area

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Goal

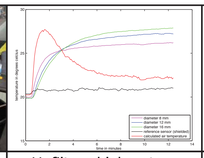
Based on an idea by dr. Gaylon Campbell, discusssed at the 2010 EGU Generall Assembly, a prototype for an air temperature sensor that does not have to be shielded was build.

Air temperature sensors must always be shielded from direct sunlight to avoid solar radiation heating up the sensor. A small array of sensors with different (known) diameters was build. By measuring the temperature of all sensors and extrapolating the temperature-diameter curve, the temperature of a virtual sensors of zero surface area can be estimated, which only measures air temperature and is not heated by solar radiation.

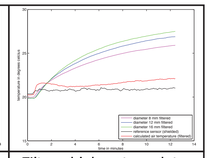
Laboratory experiment

A table size windtunnel was build in the laboratory of Delft University of Technology to test the sensor in controlled wind and radiation conditions.

Laboratory setup to test sensors in different wind and radiation conditions



Unfiltered laboratory data, including calculated air temperature

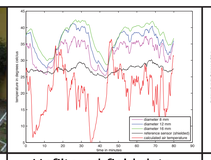


Filtered laboratory data, including calculated air temperature

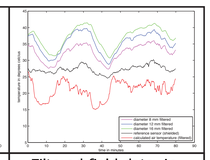
Field experiment

The setup was tested in South Africa and Zambia. Results show that individual sensor signals have to be filtered before air temperature is calculated.

Field test of the sensors in South Africa



Unfiltered field data, including calculated air temperature



Filtered field data, including calculated air temperature

Test it!

The table size windtunnel build for this project is presented below. In the tunnel, 3 sensors of 8, 12 and 16 mm diameter respectivly are positioned below the lamp. By turning the power-nob, you can change the amount of radiation. By pressing the buttons, you can change the windspeed.

On the screen, the temperature readings from the three sensors are plotted in a moving graph.

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