Distinguishing between Temperature and Humidity Data Artifacts on MicroAeth® Black Carbon Monitors and Generating Data Correction Algorithms

Stefanie Moncayo[1], James Ross[2], Steven N. Chillrud[2]

[1]Dominican College of Blauvelt, [2]Lamont-Doherty Earth Observatory of Columbia University

Black Carbon (BC) is an air pollutant released from the incomplete combustion of carbon-based fuels, with impacts on regional and global climate as well as human health. One instrument for making BC measurements is the microAeth® AE51 which is small enough for drone, balloon or personal monitoring campaigns, all of which can have rapid changes in temperature (T) or relative humidity (RH). Previous studies found that these impacts could be ameliorated during personal monitoring by use of a nafion drier inlet when temperature changes are buffered by wearing the unit under clothes. However, recent use in a mobile monitoring study where the unit was worn by bikers outside of the clothes observed large BC artefacts that could extend for 30 - 60 minutes in early spring and late fall when outdoor temperatures are quite low compared to indoor temperatures, but it was unclear whether the artifacts were due to the RH or T. Therefore, this study focused on distinguishing the impacts of T and RH in controlled experiments. RH changes were examined by moving the monitors from a dry environment to a moist environment at constant temperature. Alternatively, T changes were examined by moving the monitors from a cold environment to a hot environment, with both dry. The two experiments were also examined inversely. These controlled experiments suggest the primary cause of data artifacts in AE51 monitors to be rapid T changes. These impacts are reproducible with similar impacts during heating and cooling on each unit but with large differences between units. Minor RH changes cause short-term deviations, which can be avoided through the use of a Nafion dryer inlet. An algorithm was successfully written by correcting its reference and sensing raw detector data based on the internal temperature change monitored by the AE51.