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A Newly Identified Artifact of Sunset Semi-Continuous Carbon Analyzer Caused by Baseline Correction Method

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Sunset Semi-Continuous Carbon Analyzer (SCCA) was widely used in carbonaceous aerosol studies, especially in secondary organic aerosol characterizations. The SCCA data quality assurance and control was based on uncertainty studies, including artifact-source identification and corresponding reduction method. During a field work conducted with Sunset SSCA in Beijing, a new type of artifact was identified to rise from baseline correction method. Much more fluctuating instrument blanks were seen with Singe-Point (SP) baseline correction method than Multi-Point method (MP), for its inability in efficiently excluding background signal, which could introduce considerable overestimation of Total Carbon (TC) under low ambient concentrations. However, under high ambient concentrations, the default MP method could result in TC underestimation of 10% to 40%, while SP performed rather steady. The discrepancy of TC determined by SP and MP (SP-MP discrepancy) was characterized for both sucrose standard and ambient samples, with two IMPROVE (Interagency Monitoring of PROtected Visual Environments)-like protocols (IMPshort and IMPlong) and one NIOSH (National Institute for Occupational Safety and Health)-like protocol(rtNIOSH). Both the emerging threshold carbon load (TCL) and the magnitude of this discrepancy were determined, and were shown to be dependent on both sample type and thermal temperature protocol. Ambient samples were found to have a much lower TCL than sucrose, indicating it was much more susceptible to this artifact. TCL of IMPshort dropped from $\sim$29μgC of sucrose to undetectable level for ambient samples. Although TCL for IMPlong and rtNIOSH was beyond the range in sucrose tests (i.e. larger than 42 and 84μgC of sucrose carbon, respectively), they are both observed at a much lower value for ambient samples, being 10μgC and 20 μgC, respectively. Moreover, the magnitude of SP-MP discrepancy was higher for summer samples than winter ones. In addition to the higher TCL, NIOSH-type protocol was also shown to be steadier in terms of the lower magnitude of SP-MP discrepancy, underestimating ambient TC by only 10%. In comparison, when above TCL, the IMPshort and IMPlong could underestimate ambient TC by 40% and 20%, respectively. Possible influencing factors and measures to reduce this artifact are discussed. These findings indicated potential needs for re-analysis of data reported in heavily polluted areas or periods.