

Total carbon analysis may overestimate organic carbon content of fresh waters in the presence of high dissolved inorganic carbon

Stuart Findlay^{1*}, William H. McDowell², David Fischer¹, Michael L. Pace³, Nina Caraco¹, Sujay S Kaushal⁴, and Kathleen C. Weathers¹

¹Cary Institute of Ecosystem Studies, PO Box AB, Millbrook, NY 12545

²Department of Natural Resources and the Environment, University of New Hampshire, Durham, NH 03824

³Department of Environmental Sciences, University of Virginia, Charlottesville, VA 22904

⁴University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Solomons, MD 20688

Abstract

Automated carbon analyzers often are configured to provide estimates of both total organic carbon (TOC) and nonpurgeable organic carbon (NPOC). We show there can be an overestimation of total carbon in the presence of moderate to large quantities of dissolved inorganic carbon. This leads to overestimates of TOC, which is measured as the difference between total carbon and inorganic carbon. Water samples were analyzed as both TOC and NPOC on a Shimadzu TC 5050 Carbon Analyzer. The difference between TOC and NPOC increased as a function of concentrations of dissolved inorganic carbon (DIC). Water samples spiked with DIC ranging from 0 to 100 mg DIC/L also reported increased TOC as large as 8 mg C/L. Our data suggest that the Shimadzu 5050 analyzer (and by analogy other instruments that estimate TOC by difference between TC and IC) overestimates total carbon (TC) when calibrated with an organic standard as recommended by the manufacturer. The magnitude of the overestimation varies both with the amount of DIC present in the sample and the extent to which measurement efficiency of the analyzer is less than 100%. The consequences will be most severe in analysis of samples from systems spanning a large range in DIC. Time series from individual systems are less likely to be affected because the necessary large change in DIC would be detected as changes in pH or other attributes well before any change in DOC. Systems with high DIC will, however, be susceptible to even small variations in measurement efficiency.
