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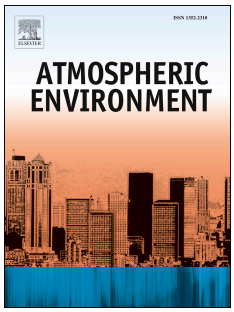

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Atmospheric Inputs of Organic Matter to a Forested Watershed: Variations from Storm to Storm over the Seasons

Lidiia Iavorivska[1,*], Elizabeth W. Boyer[1], Matthew P. Miller[2], Michael G. Brown[1], Terrie Vasilopoulos[3], Jose D. Fuentes[4], and Christopher J. Duffy[5]

[1] Department of Ecosystem Science and Management, the Pennsylvania State University, University Park, PA 16802
[2] U.S. Geological Survey, Utah Water Science Center, West Valley City, UT 84119
[3] Department of Anesthesiology, University of Florida, Gainesville, FL 32610
[4] Department of Meteorology, the Pennsylvania State University, University Park, PA 16802
[5] Department of Civil and Environmental Engineering, the Pennsylvania State University, University Park, PA 16802

*Corresponding Author e-mail: lui100@psu.edu. Submitted to: *Atmospheric Environment*

Abstract

The objectives of this study were to determine the quantity and chemical composition of precipitation inputs of dissolved organic carbon (DOC) to a forested watershed; and to characterize the associated temporal variability. We sampled most precipitation that occurred from May 2012 through August 2013 at the Susquehanna Shale Hills Critical Zone Observatory (Pennsylvania, USA). Sub-event precipitation samples (159) were collected sequentially during 90 events; covering various types of synoptic meteorological conditions in all climatic seasons. Precipitation DOC concentrations and rates of wet atmospheric DOC deposition were highly variable from storm to storm, ranging from 0.3 to 5.6 mg C L^{-1} and from 0.5 to 32.8 mg C m^{-2} hr^{-1}, respectively. Seasonally, storms in spring and summer had higher concentrations of DOC and more optically active organic matter than in winter. Higher DOC concentrations resulted from weather types that favor air advection, where cold frontal systems, on average, delivered more than warm/stationary fronts and northeasters. Using a mixed modeling statistical approach revealed that factors related to storm properties, emission sources, and to the chemical composition of the atmosphere could explain more than 60% of the storm to storm variability in DOC concentrations. This study provided observations on changes in dissolved organic matter that can be useful in modeling of atmospheric oxidative chemistry, exploring relationships between organics and other elements of precipitation chemistry, and in considering temporal changes in ecosystem nutrient balances and microbial activity.

Keywords: Precipitation; Organic matter; Dissolved organic carbon; Temporal variation; Seasonal; Critical zone observatory.