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# Integrating terrestrial and aquatic processes toward watershed scale modeling of dissolved organic carbon fluxes☆

Xinzhong Du [a], Xuesong Zhang [b, c, *], Rajith Mukundan [d], Linh Hoang [e], Emmet M. Owens [d]

[a] Independent consultant, Edmonton, Alberta, T6H 5H2, CA
[b] Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD, 20740, USA
[c] Joint Global Change Research Institute, Pacific Northwest National Laboratory and University of Maryland, College Park, MD, 20740, USA
[d] Division of Water Quality, Bureau of Water Supply, Water Quality Science and Research, New York City Department of Environmental Protection, 71 Smith Ave, Kingston, NY, 12401, USA
[e] National Institute of Water & Atmospheric Research Ltd (NIWA), Gate 10 Silverdale Road, Hillcrest, Hamilton, New Zealand

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ABSTRACT

Dissolved organic carbon (DOC) is not only a critical component of global and regional carbon budgets, but also an important precursor for carcinogenic disinfection byproducts (DBP) generated during drinking water disinfection process. The lack of process based watershed scale model for carbon cycling has been a limiting factor impeding effective watershed management to control DOC fluxes to source waters. Here, we integrated terrestrial and aquatic carbon processes into the widely tested Soil and Water Assessment Tool (SWAT) watershed model to enable watershed-scale DOC modeling (referred to as SWAT-DOC hereafter). The modifications to SWAT mainly fall into two groups: (1) DOC production in soils and its transport to aquatic environment by different hydrologic processes, and (2) riverine transformation of DOC and their interactions with particular organic carbon (POC), inorganic carbon and algae (floating and bottom). We tested the new SWAT-DOC model in the Cannonsville watershed, which is part of the New York City (NYC) water supply system, using long-term DOC load data (from 1998 to 2012) derived from 1399 DOC samplings. The calibration and verification results indicate that SWAT-DOC achieved satisfactory performance for both streamflow and DOC at daily and monthly temporal scales. The parameter sensitivity analysis indicates that DOC loads in the Cannonsville watershed are controlled by the DOC production in soils and its transport in both terrestrial and aquatic environments. Further model uncertainty analysis indicates high uncertainties associated with peak DOC loads, which are attributed to underestimation of high streamflows. Therefore, future efforts to enhance SWAT-DOC to better represent runoff generation processes hold promise to further improve DOC load simulation. Overall, the wide use of SWAT and the satisfactory performance of SWAT-DOC make it a useful tool for DOC modeling and mitigation at the watershed scale.



## 1. Introduction

Recent studies have reported increasing concentrations of dissolved organic carbon (DOC) in surface waters across Europe (Whitehead et al., 2009) and North America (Monteith et al., 2007). Dissolved Organic Carbon (DOC) in surface waters, which accounts for more than 50% of the total organic carbon export from land to oceans (Cole et al., 2007), is important for the regional and global carbon cycle. In addition, while not a toxic contaminant itself, DOC could affect surface water quality because it facilitates co-transport of a number of contaminants and form toxic compounds through complexation. For example, DOC in surface waters directly influences the toxic heavy metals and organic chemicals partitioning processes (Allison and Allison, 2005). High concentrations of DOC also impact surface water supplies by acting as disinfection byproducts (DBP) precursors which can combine with chlorine, a commonly used disinfectant in drinking water supply systems, to

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* Corresponding author. Earth System Science Interdisciplinary Center, University of Maryland, College Park, MD, 20740, USA.
*E-mail addresses:* Xuesong.Zhang@pnnl.gov, xzhang14@umd.edu (X. Zhang).

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