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# Relating dissolved organic carbon quality to biodegradability along land-use and longitudinal gradients in Vesdre River catchment, Belgium

Gretchen Gettel (1), Luz Bravo-Palacios (1), Saurabh Gupta (2), Abraha Weldemariam (1), and Dagne Dibar (1)
(1) UNESCO-IHE Institute for Water Eduction, Delft, The Netherlands (dibar1@unesco-ihe.org), (2) Department of Forests and Wildlife Preservation, Chandigarh India (iamsaurabh.gupta@gmail.com)

It is increasingly recognized that in order to accurately determine terrestrial carbon budgets, we must understand how dissolved organic matter (DOM) in rivers is lost via microbial respiration. The amount of respiration that can be supported – or lability – is related to DOM quality, but little is known about this relationship. Fluorescence spectroscopy is increasingly used to characterize DOM quality in a simple and cost-effective manner. However, only a small portion of the total DOM pool fluoresces, and how these characteristics relate to its lability is not known. In this study, we use the fluorescence and absorbance characteristics of DOM from a variety of land-uses in the Vesdre River catchment and relate them to the degredation kinetics of DOM. Results from winter and autumn sampling provide insight into the effect of leaf fall on these relationships. The specific objectives of this study were to: 1. Characterize DOM quality in diverse land-use types and along a longitudinal gradient in the Vesdre River using optical properties; 2. At the same sites, relate fluorescence characteristics to DOM lability, which was quantified by microbial respiration; and 3. Examine the effects of leaf fall on DOM quality and biodegradation by comparing results from winter and autumn seasons. The Vesdre basin is 710 km2, contains 429 people/km2, and is characterized by peat and forested land uses in its headwaters and agricultural, and urban land uses lower in the catchment.

Surface water samples from main stem sites (14), tributaries (13), and reservoirs (2) were collected along a 40 km section of the River Vesdre in November 2012 (autumn) and Janurary 2011 (winter). Main stem sites were used to examine the effect of longitudinal processing while tributary sites were used to assess the effects of land use, which included peat, forest, agriculture and urban. Samples were analyzed for DOC and total N (TN) concentration as well as inorganic nutrients (ammonium, nitrate, phosphate), dissolved oxygen, conductivity, and pH. Fluorescence and aborbance spectra were measured. Excitation-emission matrices (EEM's) were generated and analyzed in a 13-component parallel factor analysis (PARAFAC) model. Lability was determined by 42-day incubations in which DOC consumption was fitted with a 3-pool kinetics model, which partitioned the DOM into labile, semi-labile, and refractory pools and generated a decay rate (k) for each pool. Mulitivariate regression was used to relate land use and river position to fluorescence properties and DOM lability. Winter and Autumn lability and fluorescence characteristics were compared using ANOVA.

For January 2011, the a high concentration of DOC and intensity of fluorophore C (humic-like fraction) were associated with forested and peat lands, whereas low DOC concentration and high intensity of fluorophore T, the tryptophan-like fraction, characterized agriculture and urban areas in downstream portion of the catchment. This pattern was echoed by the PARAFAC results, which showed that Component 5 (C5) was also higher in the forested and wetland sections, whereas C8 was higher in the agricultural and urban areas. Fom the three-pool model, the labile, semi-labile, and refractory pools were related to both land use and DOM quality. Peat was positively correlated with the size of the refractory pool, whereas agriculture and urban land use were positively correlated with the semi-labile pool. The labile pool was positively correlated with C1, while the refractory pool was correlated with C5 and C9 (the humic acid portion). Interestingly, degradation constants (k) from 3- pool model were not correlated with land use or with fluorescence characteristics.

These results will be compared to those of November 2012 sampling, which are currently being analyzed, but conclusions thus far show that not all aspects of the fluorescence properties were important to the functional properties of DOM, and experimentation provides information about which aspects are most important to measure in future in-situ instrumentation. These results indicate that fluorescence may be useful in river-network models that aim to relate processing to land use and longitudinal gradient, but caution must be used in interpreting processing rates soley from EEM's.