High biodegradability of water-soluble organic carbon in soils at the southern margin of the boreal forest

Supplementary Text:2

Supplementary Table:1

Supplementary Text

S1. Additional details of the analysis of WSOM by spectroscopy

Fluorescence Regional Integration (FRI) and the percentage of fluorescence response ($P_{i,n}$) were used for further analysis of the fluorescence spectra in five regions. The volume of the Excitation-Emission Matrix (EEM) i(Φ_i) was obtained through the formula (1) by integrating the area under the excitation-emission spectra. $\Delta\lambda_{ex}$ and $\Delta\lambda_{em}$ represent the intervals of excitation and emission wavelengths, respectively. I （$\lambda_{ex}\lambda_{em}$） is the fluorescence intensity for each matching set of excitation-emission wavelengths. MF_i is the multiplication factor for each region. The normalized volumes of the excitation-emission regions （$\Phi_{i,n}$, $\Phi_{T,n}$） and the percentage of fluorescence response （$P_{i,n}$） were calculated using the following formulas (Chen et al., 2003):

$$\Phi_i = \sum_{ex}\sum_{em} I(\lambda_{ex}\lambda_{em})\Delta\lambda_{ex}\Delta\lambda_{em}$$

$$\Phi_{i,n} = MF_i\Phi_i$$

$$\Phi_{i,n} = \sum_{i=1}^{5}\Phi_{i,n}$$

$$P_{i,n} = \frac{\Phi_{i,n}}{\Phi_{T,n}} \times 100\%$$

S2. Calculation of BWSOC content and *k*

The calculation formulas for the content and relative proportion of BWSOC under specific incubation days are as follows (Houston, 2012; Vonk et al., 2015):

$$\mathrm{BWSOC}_t = \mathrm{WSOC}_{t=0} - \mathrm{WSOC}_t$$

$$\mathrm{BWSOC}(\%)_t = \frac{\mathrm{BWSOC}_t}{\mathrm{WSOC}_{t=0}} \times 100\% = \frac{\mathrm{WSOC}_{t=0} - \mathrm{WSOC}_t}{\mathrm{WSOC}_{t=0}} \times 100\%$$

Microbial utilization of low-concentration substrates follows first-order reaction kinetics, wherein the change in BWSOC over time follows the formula:

$$\frac{d\mathrm{BWSOC}}{dt} = k\mathrm{BWSOC}$$

Where BWSOC represents the microbial degradable water-soluble organic carbon at any given time, k is the reaction kinetic constant, and t is the incubation time. Integrating the above equation yields:

$$\mathrm{BWSOC} = \mathrm{BWSOC}_u \times \mathrm{e}^{-kt}$$

Where BWSOC_u is the total amount of microbial degradable water-soluble organic carbon in the substrate. Therefore, the value of BWSOC_t at any incubation time t can be expressed as:

$$\mathrm{BWSOC}_t = \mathrm{BWSOC}_u \times (1 - \mathrm{e}^{-kt})$$

Non-linear exponential fitting is performed on BWSOC_t to obtain the reaction kinetic constant k value.

Supplementary Table

Table S1. Partition range of fluorescence spectra, Ex represents the excitation wavelength, and Em represents the emission wavelength.

Region	Ex	Em	Component
I	220-250	250-330	Tyrosine-like aromatic protein
II	220-250	330-380	Tryptophan-like aromatic protein
III	220-250	380-500	Fulvic acid-like matter
IV	250-400	250-380	Soluble microbial byproduct-like matter
V	250-400	380-500	Humic acid-like matter

Reference

Chen, W., Westerhoff, P., Leenheer, J. A., and Booksh, K.: Fluorescence Excitation−Emission Matrix Regional Integration to Quantify Spectra for Dissolved Organic Matter, Environmental Science & Technology, 37, 5701-5710, 10.1021/es034354c, 2003.

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