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Fluorescence property of solvent extractable organic aerosol in a cold-temperate forest area of Japan

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Organic aerosol (OA), a major component of atmospheric aerosol, is considered to be one of the key players in atmospheric radiative balance and climate change. Chromophoric OA, termed as brown carbon (BrC), is a component that can absorb solar radiation in the ultraviolet and short-wavelength visible regions and is composed of a wide range of poorly characterized compounds. Whereas light absorption properties were analyzed to characterize chromophoric OA, fluorescent properties also provide information on them. In this study, the fluorescence property of solvent extractable organics in submicron aerosol particles collected in a forest in the cool-temperate zone of northern Japan, was characterized.

Aerosol samples were collected on quartz filters (cut-off diameter: ≤0.95 micrometer) in Tomakomai Experimental Forest of Hokkaido University. Organic aerosol components in the samples were extracted and fractionated on the basis of their polarity by the combination of solvent extraction and solid-phase extraction methods. Water-soluble organic matter (WSOM) and water-insoluble organic matter (WISOM) were extracted sequentially by using multiple solvents. Two fractions, humic-like substance (HULIS) and highly-polar water-soluble organic matter (HP-WSOM), were fractionated from WSOM by solid phase extraction. The excitation−emission matrices (EEMs) were measured using a fluorescence spectrometer, and the fluorescence property of the extracts was characterized by the classification of EEM profiles using a Parallel Factor (PARAFAC) model.

From the PARAFAC analysis, five types of fluorescent components were identified for each of WSOM and WISOM fractions. A fluorescence component with the characteristics reported to be associated with (HULIS) accounted for large fractions of the fluorescence from WSOM and WISOM (mean: 68% and 84%, respectively). The relative contribution of the fluorescent components for WSOM shows a clear seasonal variation of the characteristics of WSOM. Furthermore, from each of HULIS and HP-WSOM fractions, five types of fluorescent components were identified. Fluorescence components with the characteristics of protein-like compounds identified in previous EEM studies accounted for a large fraction of the fluorescence from HP-WSOM (mean: 53%),

whereas the contribution of protein-like compounds was smaller in the case of the HULIS fraction (mean: 23%).