

## Summary

### **Characterization of low-to-high polar organics in sub-micrometer forest aerosol in Hokkaido, Japan: abundances, light absorption, and fluorescence**

(日本の北海道のサブマイクロメートル森林エアロゾルに含まれる低極性から高極性の有機物のキャラクタリゼーション：存在量・光吸収・蛍光)

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Organic aerosol (OA) constitutes a large fraction of atmospheric aerosol but their overall structural characteristics, and relationship with properties and sources remains poorly understood to date. The abundance, light absorption, and fluorescence of solvent extractable OA were characterized in this study to understand chemical structural characteristics, seasonal variations, source and their contribution to the absorption of solar radiation. Sub-micrometer aerosol samples collected in Tomakomai Experimental Forest in Hokkaido. Water-soluble organic matter (WSOM) was extracted and then fractionated into Humic-like substance (HULIS) and highly-polar water-soluble organic matter (HP-WSOM) by solid phase extraction. Further, water-insoluble organic matter (WISOM) was extracted using multiple solvents.

HULIS, the medium polar OA fraction, was the most abundant fraction (51%). Correlation analysis revealed that biogenic secondary organic aerosols (BSOA) significantly contribute to HULIS, particularly in summer. The mass spectra obtained using a high-resolution aerosol mass spectrometer (HR-AMS) showed that HULIS and HP-WSOM were oxygenated OA fractions, whereas WISOM had a low O/C ratio and

more hydrocarbon-like structures. The WISOM fraction was the predominant light-absorbing organics. HULIS and WISOM showed a noticeable seasonal change in mass absorption efficiency at 365 nm ( $MAE_{365}$ ), which was highest in winter. Organic compounds with O, N and S atom were contribute significantly to OA's light absorption. Further, HULIS were shown to be less absorbing than those reported for urban sites. The lower light absorbing characteristics of forest aerosols support the cooling effect of BSOA in forest regions, in terms of the direct effect of aerosols on radiative forcing.

WISOM also had the highest normalized fluorescence volume and the fluorescence volume corresponding to the atmospheric abundance among all OA fractions. Fluorescence was also found to be correlated with O- and N- containing compounds. Parallel factor (PARAFAC) analysis identified five components from the of excitation-emission matrices (EEMs) of OA fractions. The fluorescence characteristics of the components were similar to those of HULIS-like compounds and one to those of protein-like compounds. The components with oxygenated structures have significant contribution in OA fluorescence and should be taken into consideration for the detection of PBAP using fluorescence technique in the forest region.