Investigating the Contribution of Charge-Transfer Complexes to the Absorptivity of Brown Carbon Aerosol

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Introduction
Brown carbon (BrC), emitted by biomass burning, consists of aerosol particles that strongly absorb light in the range of 350 to 500 nm and, consequently, appear brown [1]. Whereas solely scattering particles have a cooling effect on climate, BrC has a significant but poorly constrained warming effect.

Hypothesis
Charge-transfer complexes contribute to the absorptivity of BrC.

Methods
In the laboratory, BrC is produced by smoldering wood in a quartz flow tube heated to 400°C and supplied with 2 L min⁻¹ of clean air.

After being collected on a filter, BrC particles are extracted in a solvent (water, methanol, acetonitrile or DMSO).

Results and Discussion
Solvent Dependence of BrC Absorbance
Solvents with different polarities were investigated. No systematic solvent dependence was obtained.

Temperature Dependence of BrC Absorbance
BrC absorption spectra were taken in a range of 15 to 45°C. No temperature dependence was observed. According to Le Chatelier’s principle, an increase in temperature would lead to increased dissociation, so there was no complexation.

Selective Reactions on BrC
Potential electron acceptor and donor sites of BrC were acetylated, which increased the absorption. Acetone and DMSO were effective solvents for BrC extraction.

Conclusion
No temperature or solvent dependence of BrC absorbance was observed, indicating that charge-transfer complexes do not contribute significantly to BrC absorptivity at the experimental conditions, consistent with the selective reactions on BrC.

References