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Gas/particle partitioning of water-soluble organic aerosol in Atlanta

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Abstract. Gas and particle-phase organic carbon compounds soluble in water (e.g., WSOC) were measured simultaneously in Atlanta throughout the summer of 2007 to investigate gas/particle partitioning of ambient secondary organic aerosol (SOA). Previous studies have established that, in the absence of biomass burning, particulate WSOC ($WSOC_p$) is mainly from secondary organic aerosol (SOA) production. Comparisons between $WSOC_p$, organic carbon (OC) and elemental carbon (EC) indicate that $WSOC_p$ was a nearly comprehensive measure of SOA in the Atlanta summertime. $WSOC_p$ and gas-phase WSOC ($WSOC_g$) concentrations both exhibited afternoon maxima, indicating that photochemistry was a major route for SOA formation. An additional nighttime maximum in the $WSOC_g$ concentration indicated a dark source for oxidized organic gases, but this was not accompanied by detectable increases in $WSOC_p$. To study SOA formation mechanisms, WSOC gas/particle partitioning was investigated as a function of temperature, RH, NO_x, O_3, and organic aerosol mass concentration. No clear relationship was observed between temperature and partitioning, possibly due to a simultaneous effect from other temperature-dependent processes. For example, positive temperature effects on emissions of biogenic SOA precursors and photochemical SOA formation may have accounted for the observed similar proportional increases of $WSOC_p$ and $WSOC_g$ with temperature. Relative humidity data indicated a linear dependence between partitioning and predicted fine particle liquid water. Lower NO_x concentrations were associated with greater partitioning to particles, but WSOC partitioning had no visible relation to O_3 or fine particle OC mass concentration. There was, however, a relationship between WSOC partitioning and the $WSOC_p$ concentration, suggesting a compositional dependence between partitioning semi-volatile gases and the absorbing organic aerosol. Combined, the overall results suggest two dominant SOA formation processes in urban Atlanta during summer. One was the photochemical production of SOA from presumably biogenic precursors that increased with the onset of sunrise and peaked in the afternoon. The other, which showed no apparent diurnal pattern, involved the partitioning of semi-volatile gases to liquid water, followed by heterogeneous reactions. The co-emission of water vapor and biogenic

VOCs from vegetation may link these processes.

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