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SPATIAL VARIATION OF CARBON SPECIES IN AN URBANIZED WATERSHED IN THE PIEDMONT OF SOUTH CAROLINA

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Urbanization alters the terrestrial landscape of watersheds which may affect the biogeochemistry of carbon in streams. Small headwater streams should be most affected most by urbanization, given their strong connections to terrestrial ecosystems. This study focuses on the spatial variation of carbon species in the urbanized headwaters of the Brushy Creek watershed in the South Carolina piedmont.

Water samples were collected in the summers of 2005 and 2006. Temperature and pH were measured in situ at each sample locality. Dissolved organic carbon (DOC) and alkalinity were measured for all samples. Carbonate speciation and the partial pressure of carbon dioxide were calculated using a thermodynamic model. Detailed sampling in headwater streams fed by shallow groundwater shows that headwaters were supersaturated with respect to atmospheric carbon dioxide by as much as 630 times, which decreased rapidly downstream. Shallow wells also indicate that groundwater had dissolved carbon dioxide concentrations ranging from 10-50 mg/L and was up to 400 times supersaturated. Downstream supersaturation was variable reflecting variations in stream flow. Samples collected from a headwater branch in summer 2005 showed that carbon dioxide concentrations decreased rapidly from 44 to 5 mg C/L over the first 370 m but then increased to 21 mg C/L over the next 300 m. Detailed sampling of another headwater branch showed no clear downstream trend in carbon dioxide concentrations. However, when compared with concentrations in the main channel, carbon dioxide concentrations were higher in the headwaters. In the summer of 2005 carbon dioxide concentrations ranged from 0.8 to 82 mg C/L, which is comparable to the summer 2006 range of 0.5 to 90 mg C/L. DOC concentrations increased slightly downstream, whereas total dissolved carbon concentrations decreased downstream, reflecting a decrease in dissolved carbon dioxide. In contrast, bicarbonate concentrations showed little downstream variation.

We interpret these trends to indicate rapid degassing of headwater streams, followed by increases in DOC possibly as the result of instream decomposition of organic matter. This suggests that urban headwaters may be a significant source of carbon dioxide to the atmosphere.

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