Organic Carbon & Nitrogen Flux from a Lowland, Mixed Land Use Watershed in Fayette County, Kentucky

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Introduction

With concerns about carbon emissions, it is important to study a stream's contribution to the global carbon cycle. Limited data is available for carbon flux associated with sediment particulate organic matter. The objective of this study is to compare the carbon and nitrogen flux at an agricultural and urban sampling site.

A calibrated sediment yield model was used to generate three years of hourly sediment yield data for the site at the outlet. The variability of total organic carbon (TOC) and total nitrogen (TN) was investigated over a three year period.

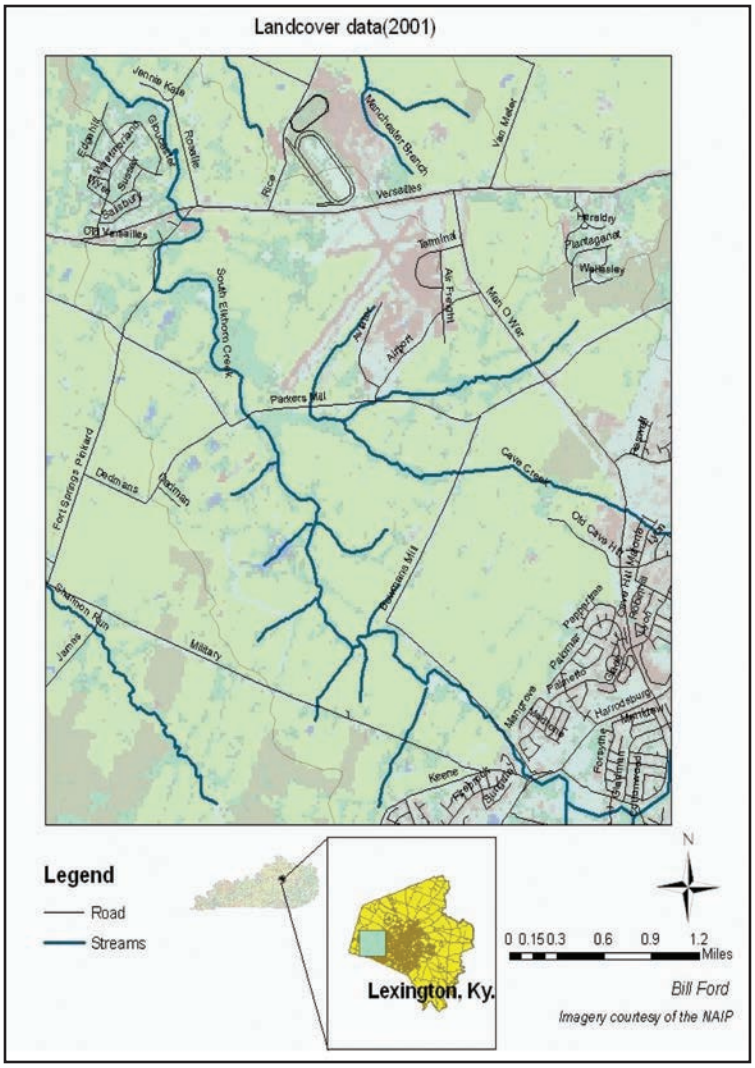
Methods

Point samples were taken from two sites using in-situ sediment trap tubes, which collect an integrated sediment sample over a period of a week. A Teledyne ISCO device was used to accrue suspended sediment samples over the duration of storm events. Elemental analysis was conducted using an isotope ratio mass spectrometer (IRMS). Since the sediment transport in the lowland watershed was not uniform, carbon flux of sediment yield was calculated by use of Hans Albert Einstein's equations for flow sediment yield:

$$q_{ss} = \int_{a}^{D} Cudz \quad S_y = \int_{0}^{T} Q_s dt$$

Study Site

The upper South Elkhorn watershed is a lowland mixed land use watershed which originates in the southwestern corner of Lexington, Kentucky. The dominant land uses are mixed residential and commercial urban in the upstream portion, and low density horse farm agriculture in the downstream portion. One sample site is in the "Urban" portion; the other is in the "Agricultural". The agricultural site is located at the outlet of the watershed; the urban site is located upstream of the agricultural site.



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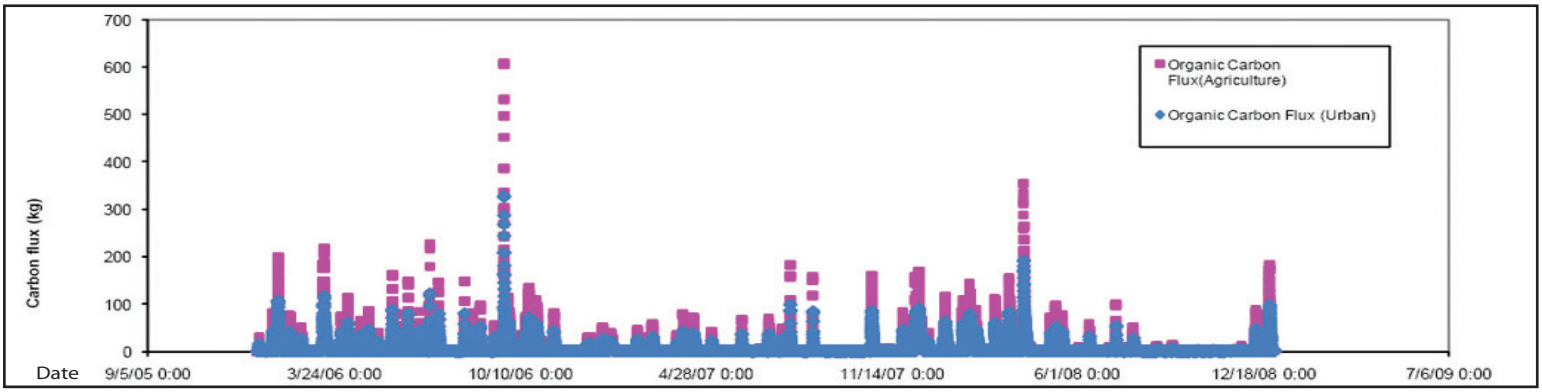
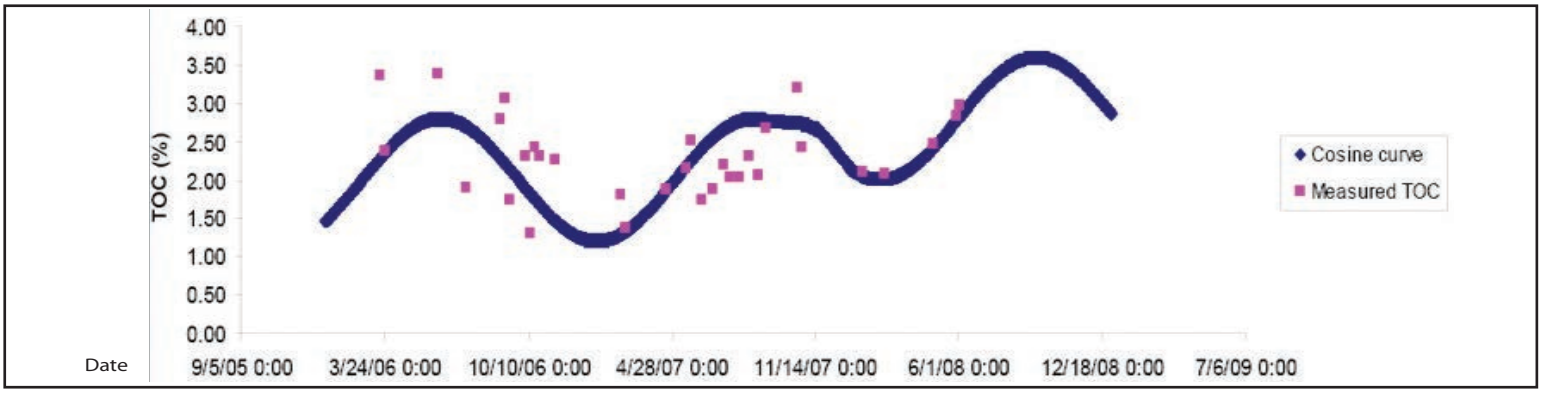
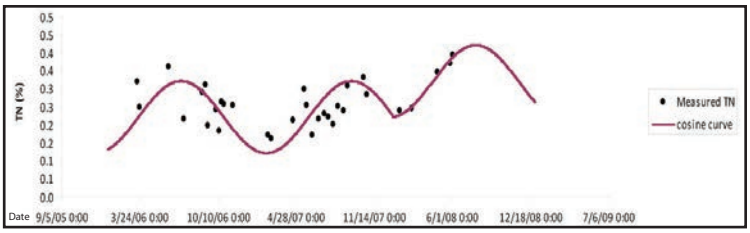
Results



Although sediment yields were much higher at the outlet of the agricultural site, higher TOC values at the urban site closed the gap in carbon flux.



TOC and TN vary from season to season due to microbial processes in-stream.



Site	Sediment Yield (kg)	OC flux (kg)	Nitrogen flux (kg)	Average Measured TOC (%)	Average Measure TN (%)	Area of watershed at site(km^2)
Agriculture	7,195,628.3	150,533.6	17,105.3	2.31	0.26	61.8
Urban	2,837,991.8	80,960.7	8,562.8	3.15	0.33	32.8

Graph depicts concentration and flow with respect to time over the duration of a hydrologic event.

Conclusions

Because of the area draining at each site, TOC was much higher at the outlet of streams. However, the higher TOC percentage at the urbanized site helped to close the gap. Seasonal trends were found to be present for TOC and TN at the agricultural site because of microbial processes taking place in-stream. The significance of the TN flux proved to be much less than the TOC flux, providing approximately one-tenth of the yield of organic carbon.

Future Analysis

Further research is needed to compare the carbon flux data from the stream with carbon flux data from the soil. Eventually, Kentucky's contribution to the global carbon cycle could be anticipated by future extrapolation of carbon data to the Bluegrass Region.

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