Background

Long-term trends in nitrogen, carbon and pH contribute to water quality issues such as eutrophication, hypoxia, and acidification. However, less is known regarding their dynamics over day and night cycles related to whole stream metabolism. Most of the information on carbon, nitrogen and pH in streams comes from discrete grab samples rather than continuous samples taken throughout full diurnal cycles. Diurnal cycles in urban stream chemistry are driven by metabolic processes such as primary production (photosynthesis) and respiration (organic matter decomposition). Stream metabolism is affected by factors such as nutrient availability, temperature, and physical stream characteristics.

Hypothesis

Carbon quantity and form (organic carbon vs. inorganic carbon) show diurnal variations in an urban stream across seasons due to stream metabolism (evidence as changes in dissolved O2). H2: There is no diurnal variation in carbon and nitrogen in an urban stream across seasons.

Methods

Automated samplers, ISCOs, were used to collect water samples. Initially samples were to be collected every 30 minutes over 24 hours, the fall sample set was collected in this manner. To better visualize a diurnal cycle, two periods were collected for the winter sample set. Samples were collected to be analyzed with an Shimadzu TOC-L and a Shimadzu ICPE-9800. Samples were acidified in order to analyze concentrations of various elements (Figure 1) by the ICPE-9800. Site selected was the Northeast Branch of the Anacostia River (Figure 2) which is a USGS Water Data gauging station which also contains dissolved oxygen, specific conductance and pH.

Data was normalized by subtracting each elements mean and then dividing by the standard deviation. The majority of elements analyzed did not show any diurnal pattern. Most elements did demonstrate a diurnal cycle. The fall data set demonstrated a diurnal cycle for DOC and had sporadic elemental concentrations, which could be attributed to the delay in analysis. The spring data set also demonstrated a diurnal DOC signal.

Results

Dissolved oxygen can be compared to dissolved organic carbon. The concentrations have similar shapes with a lag time of two hours. Diurnal variations of organic carbon can vary as much as 20%. Dissolved inorganic carbon is also similar and exhibits a diurnal cycle. There are not many elements that exhibit a diurnal cycle. Manganese, iron and phosphorus are elements that exhibited a diurnal cycle which is because the elements are affected by stream metabolism. Changes in dissolved oxygen affects redox conditions and allows for an element such as Fe to be consumed. The lack of a diurnal cycle affirms that most elements in urban streams are not affected by stream metabolism and affected by some other factor such as weathering. This study showed that DIC and Si, K and Na, Ca and Mg each are linked and show similar patterns between each pair.

Conclusion

This study demonstrates for an urban stream that most elements do not exhibit a diurnal cycle. Diurnal cycles would indicate that that element would be included and influenced by stream metabolism. Manganese, iron and phosphorus are elements that exhibited a diurnal cycle which is because the elements are affected by stream metabolism. Changes in dissolved oxygen affects redox conditions and allows for an element such as Fe to be consumed. The lack of a diurnal cycle affirms that most elements in urban streams are not affected by stream metabolism and affected by some other factor such as weathering. This study showed that DIC and Si, K and Na, Ca and Mg each are linked and show similar patterns between each pair.