

Temporal changes in dissolved organic carbon in Tempe Town Lake

Megan Kelly¹ and Hilairy Hartnett^{1,2}

1)Department of Chemistry and Biochemistry 2)School of Earth and Space Exploration Arizona State University Tempe, AZ 85287-1404

Introduction

-Dissolved Organic Carbon (DOC) is an important factor in an aquatic system's health.
-Sources and reactivity of DOC in urban aquatic systems are not well understood.



Background

Tempe Town Lake is a man-made lake created by two inflatable dams on the Salt River.

DOC concentrations vary seasonally:
-Highest DOC in winter during high flow¹
-Decreasing DOC in spring and summer period¹
-Spike in DOC during summer monsoon¹

Different DOC concentrations suggest that there are different organic compounds present in each season.¹



Work to date

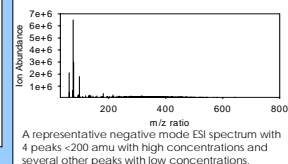
-Continued monitoring in Tempe Town Lake
-Have also begun studying Lake George, a small lake in downtown Saint Cloud, MN

Studying Lake George will allow for a comparison between an urban lake in an arid climate and one in a mesic climate.

-We have begun analyzing the suite of organic compounds present in Tempe Town Lake and how that suite changes over time.

To investigate other sources of carbon and processes occurring in the lake, (for example, photosynthesis, respiration, and photo oxidation) molecular-level information is necessary.¹

To examine the composition of the DOC, we use **electrospray ionization mass spectrometry (ESI-MS)**.



References

- Hartnett, H., and Brown, B., 2006. Organic Carbon Concentrations in Tempe Town Lake: biogeochemical and hydrologic processes. Poster, Central Arizona-Phoenix Long Term Ecological Research.
- Dass, C., 1997. High Performance Liquid Chromatography Electrospray Ionization Mass Spectrometry. In: Settle, F.A. (Ed.), Instrumental Techniques for Analytical Chemistry. Prentice Hall PTR, 647-664.
- Seitzinger, S., Hartnett, H., Lauck, R., Mazurek, M., Mingshi, T., Spyres, G., and Styles, R., 2005. Molecular-level chemical characterization and bioavailability of dissolved organic matter in stream water using electrospray-ionization mass spectrometry. Limnology and Oceanography: 50 (1) 1-12.



Filtration System



Electrospray Ionization Mass Spectrometer

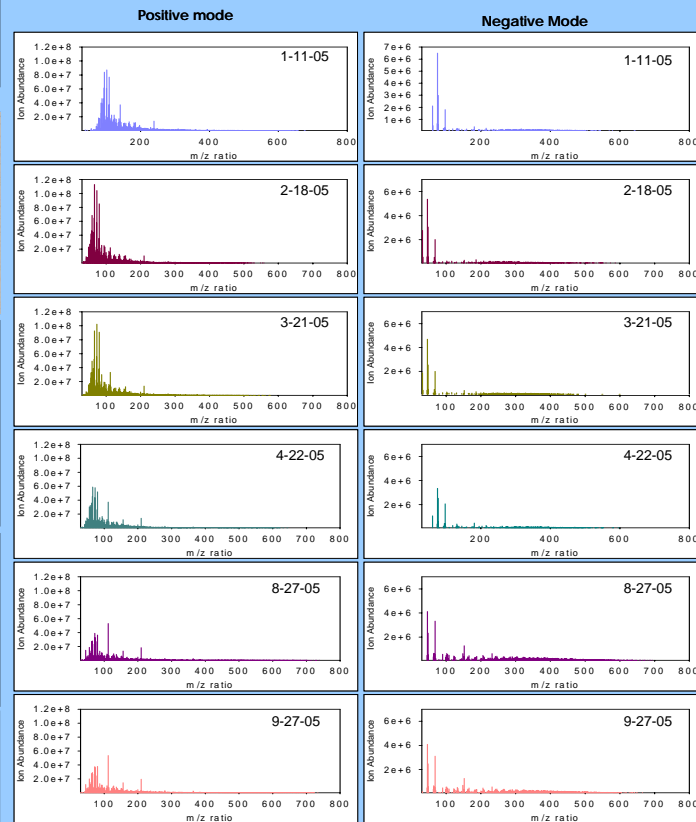
Methods

-Bimonthly sampling at Tempe Town Lake
•pH, conductivity, dissolved oxygen, and water temperature
-1 L of water filtered for ion chromatography, inductively coupled plasma mass spectrometry (ICP-MS), isotope analysis, Bulk DOC analysis, and ESI-MS.
-ESI-MS analysis completed for six samples from three seasons in 2005
•Detailed interpretation of positive mode

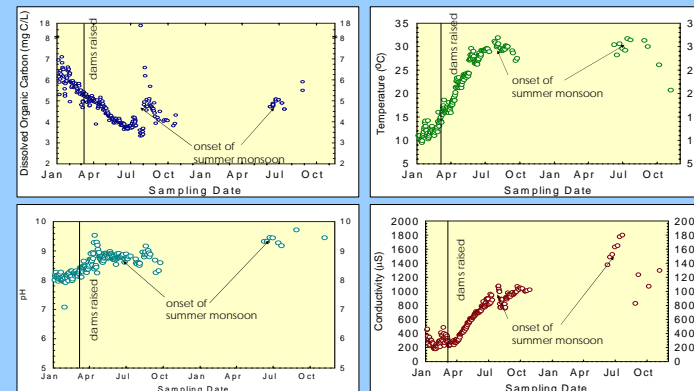
ESI-MS

-Singly ionizes polar compounds with minimal fragmentation²
-Peak height = abundance of compounds
-Mass-to-charge-ratio = molecular weight
-Positive and negative mode detection
•Positive mode shows compounds with basic functional groups such as -OH, -CH₃, -NH₂, -OCH₃, -O and -(CH₂)₂³
•Negative mode shows compounds with acidic functional groups like -NO₂, -COOH, -CN, and halides³.

Results Electro spray Ionization Mass Spectra



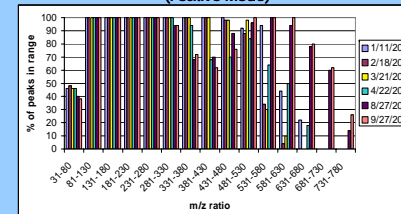
Results Water chemistry, 2005-2006



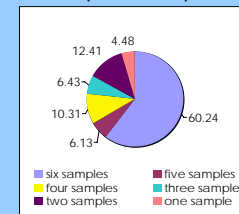
ESI-MS Sample Dates and Characteristics

Sampling Date	Temp (°C)	pH	Conductivity (uS)	DOC (mg C/L)
1/11/2005	10	8.169	315.7	6.2725
2/18/2005	11.7	8.035	365	5.7246
3/21/2005	16.3	8.473	273.5	5.1158
4/22/2005	23.4	9.045	474	4.8406
8/27/2005	30.1	8.925	923	4.5165
9/27/2005	-	-	1023	4.0886

Percentage of Peaks Present in a Molecular Weight Range (Positive Mode)



Percentage of Compounds Similar in All Samples (Positive Mode)



Summary

Bulk Results
-Temperatures were similar in summer 2005 and summer 2006.
-pH was higher in summer 2006 than in 2005.
-Conductivity in summer 2006 was higher than in summer 2005.
• Presumably due to a drier year with more evaporation.
-DOC was between 5 and 6 mg C/L in 2006.

ESI-MS Results

-Positive and negative spectra are clearly different.
-All samples contain compounds at every nominal mass from 81 - 280 amu.
-The most abundant compounds in all seasons are <150 amu.
-Spectra exhibit change over time, most notably between seasons.
-Samples from August and September exhibit the greatest diversity among samples, suggesting that different processes affect the lake during the monsoon season.

Future Plans

-Further ESI-MS interpretation of these six samples
-ESI-MS work on more samples to give higher temporal resolution
-Analysis of Lake George data for climate comparison
-Experiments to assess how different processes affect DOC composition in Tempe Town Lake

Further Information

Megan Kelly
megan.m.kelly@asu.edu, 320-282-5929

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