Characterizing organic carbon sources in urban streams with fluorescence spectroscopy

How does land use impact sources of organic carbon to streams?

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Introduction

Dissolved organic carbon (DOC) is the most studied and most abundant form of organic matter in most aquatic ecosystems. It serves an important role in aquatic ecosystems, serving as a primary food source for organisms.

DOC also contributes to freshwater acidity, and form complexes with trace metals, creating water-soluble compounds that facilitate downstream transport and pollutant uptake by organisms. DOC may be produced autochthonously by microbial activity, or deposited allochthonously by terrestrial inputs.

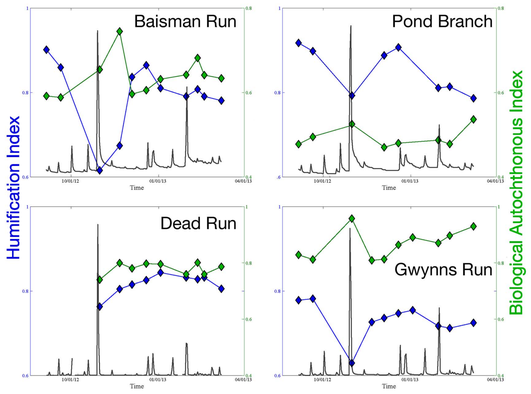
Due to complex chemical nature and heterogeneity of DOC, best characterized by bulk operational definitions rather than by chemical composition.

Hypotheses:

1) End-member sources of DOC can be differentiated via fluorescence spectroscopy
2) Urban streams will receive more urban DOC inputs, while forested streams will receive more forested DOC inputs

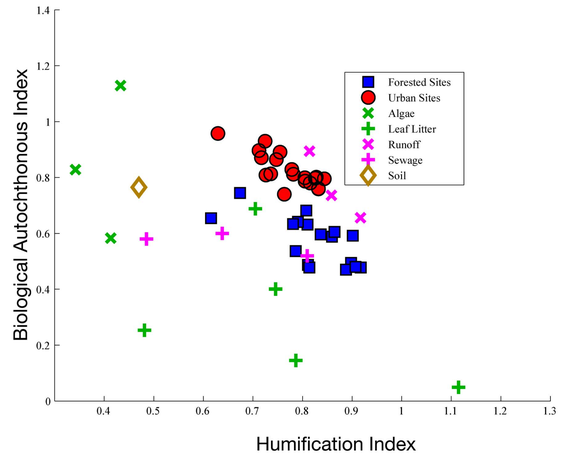
Methodology

- Characterize end-member sources of DOC to streams with fluorescence spectroscopy
  - Two urban sources: stormwater runoff, sewage
  - Two forested sources: decaying leaf litter, algae
- Compare end-member spectra to fluorescence data from four urban Baltimore streams:
  - Two urban: Dead Run, Gwynns Run
  - Two forested: Baisman Run, Pond Branch
- Use fluorescence indices and parallel factor analysis to characterize and compare DOC in end-member sources to stream inputs
- Seasonal sampling to account for temporal variation in streams and end-member sources



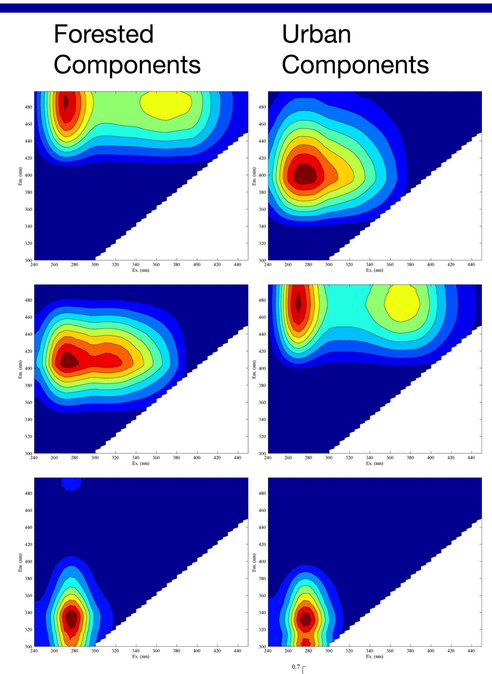
Fluorescence Indices:

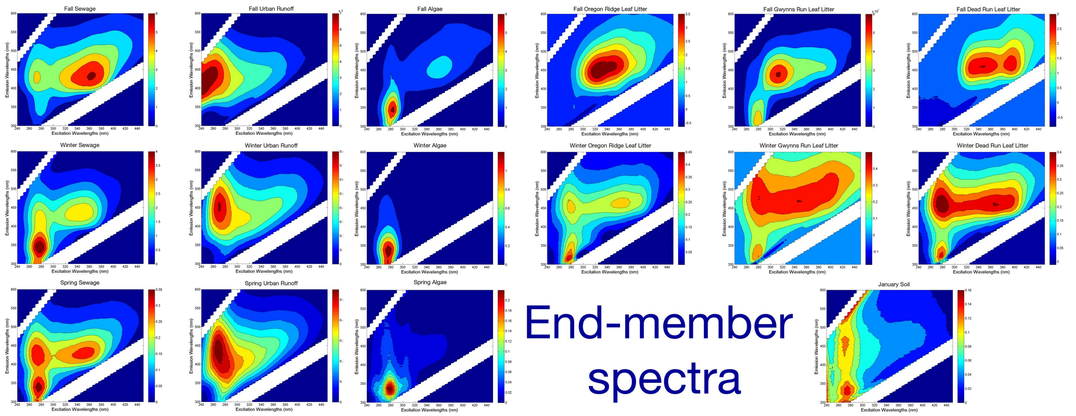
Humification Index (HIX) -
degree of carbon maturation, humification
Biological Autochthonous Index (BIX) -
degree of in-situ biological production



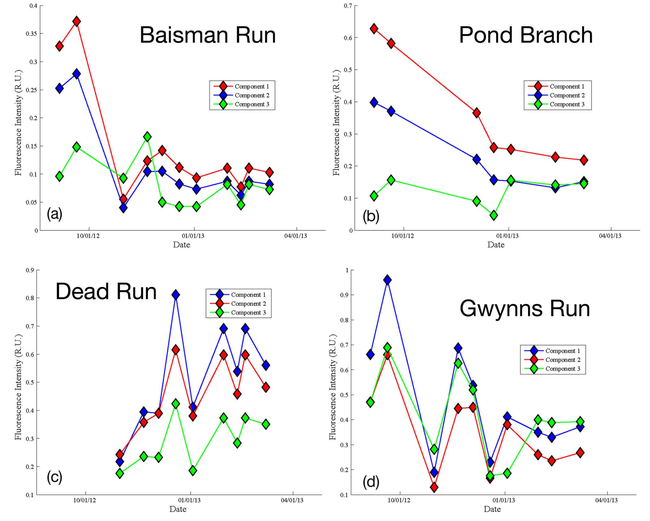
Parallel factor analysis

Extension of principal component analysis, identifies fluorescent compounds





End-member spectra



Conclusions

1) Natural and anthropogenic sources of DOC can be differentiated with fluorescence
2) Hydrological control on DOC sources - humified sources decrease with increased discharge, autochthonous production increases with discharge
3) Same three components identified in both forested and urban streams:
   Two terrestrial alloocthonous humic components, one autochthonous component