Hixon Center for Urban Ecology

Student Research Fellows

Impact of Storm Events and Urbanization on Drinking Water Quality

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Problem Investigated

Rapidly changing climate and urbanization of watersheds are altering the transport dynamics of freshwater and dissolved organic matter. Considering the fact that precipitation events play a dominant role in controlling the quantity and quality of water, and urban watersheds export more polluted water with higher concentration of dissolved substances, it is imperative to improve our understanding of how precipitation intensity, land cover change, and seasonality affect our drinking water quality. I investigated dissolved organic matter transport and formation potential of disinfection by-products (DBP) in two contrasting watersheds during 11 storm events. The key questions that I ask through this study are: 1. How do precipitation events impact dissolved organic carbon transport in a forested and an urban watershed? 2. Does urbanization of watersheds contribute to higher formation potential of DBP, a known carcinogen? 3. How will increasing precipitation intensity affect DBP formation?

Background

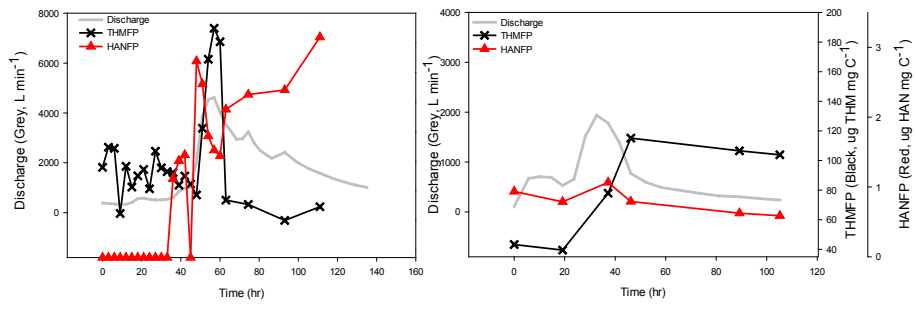
- Freshwater systems export dissolved organic carbon to provide energy and nutrient for aquatic ecosystems.
- Export of dissolved organic carbon (DOC) is heavily controlled by precipitation events
- Dissolved organic carbon could form harmful disinfection by-products when chlorinated for drinking water treatment.
- Urban watersheds export much higher concentration of DOC, yet our dependence on such watersheds for drinking water source will inevitably increase.

Methods

- Esopus Creek in New York and Still River in Connecticut were chosen to represent pristine forested watersheds and urbanized watersheds.
- Over 200 samples were collected from the two streams during 11 precipitation events, and analyzed for dissolved organic carbon, total nitrogen, dissolved organic nitrogen, and disinfection by-product formation potential. Hurricane Irene, in particular was closely examined to assess the impact of extreme events on dissolved organic matter transport.
- Chemical analysis data were coupled with stream discharge data to produce an annual DOC/DON budget.

Left: Esopus Creek in Catskill Mountain in late spring. *Right:* Same location right after Hurricane Irene.

Left: Time-series samples of stream water collected during Hurricane Irene.



Change in DBP formation potential during precipitation events (*Left:* Forested watershed, *Right:* Urban watershed

Conclusions

- The urban watershed exhibits completely different DOC export dynamics from its forested counterpart, and shows higher concentration of DOC, DON, and DBP formation potential.
- Samples collected during peak discharge showed higher concentration of DOC, SUVA, and DBP formation potential, indicating that precipitation events not only control the quantity of organic matter but also its composition.
- Hurricane Irene was the biggest precipitation event in history for Catskill Mountain and exported unprecedented amount of organic carbon that equals roughly 45% of annual DOC flux.
- Future climate change is expected to increase the storm intensity for Northeast, thus altering the temporal and compositional pattern of dissolved organic carbon transport. Coupled with increasing dependence on urban watersheds, such change will inevitably affect the formation potential of harmful disinfection by-products.

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