A Look at Land Use, Nutrient, Sediment Trends Among Stream Sites in the Winooski and Missisquoi Watersheds

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Background

The overarching goal of Vermont EPSCoR’s center on Research on Adaptation to Climate Change (RACC), is to address how climate change and land use will impact hydrological processes and nutrient transport over the landscape, and in turn, how this will effect Lake Champlain. To help understand some of these processes, RACC researchers installed seven automated samplers at stream sites within the Winooski and Missisquoi River watersheds. This poster provides an overview of the data obtained in 2012 and 2013 with a focus on the Hungerford Brook and Mad River sites.

Methods

• The stream sites were selected to pair samplers with existent USGS gaging stations for linking with flow and stage data.
• Samplers were typically installed at stream sites in early June, sampled throughout the season, and removed at the end of October.
• The site-specific sampling programs were provided by USGS and programmed to collect water samples in response to stage and rate of change, with the goal of capturing the full range of storm events.
• Total suspended solid samples were analyzed at St Michaels College.

Nutrient analysis was conducted at Johnson State College.

• Land use data was calculated in ArcGIS using existent LCLU data. Similar land use types were clustered together into three focus categories: forest, urban, or agricultural.

Results

Linear regression analysis (see Table 1) showed strong positive relationships between:

- TSS and discharge at all sites (R² values ranging between 0.30 and 0.68)
- TP and discharge at all sites, except Winooski R. at Montpellier (R² between 0.30 and 0.58)
- TP and TSS at all sites, except Winooski R. at Essex (R² between 0.39 and 0.85)
- TN and TSS at the Mad River, Missisquoi R. at N. Troy and Swanton (R² between 0.35 and 0.65)

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Trends in land use were observed by organizing R² values (see Table 1). It was found that:

- As urban area decreased, the TN vs. TSS relationship became stronger (from R² of 0.01 to 0.65)
- As urban area decreased, the TDN vs. discharge relationship became weaker (R² 0.36 to 0)
- As urban area decreased, the SRP vs. discharge relationship became weaker (R² 0.41 to 0.15)
- As total watershed area decreased, TSS vs. discharge relationship became weaker (R² 0.68 to 0.30)
- As total watershed area decreased, TDP vs. discharge relationship became stronger (R² 0.01 to 0.47)

Discussion

• Increasing stream flows would be expected to contribute to an increase in sediment and particulate phosphorus. This was observed in that TP, TSS, and discharge were strongly correlated among all sites. Also, this suggests that watershed wide land use and watershed size does not impact these relationships. It was not surprising that other relationships were weakly correlated, such as with nitrogen due to its high mobility in the environment.
• The highest nutrient values were found at Hungerford Brook, the most agriculturally dominated watershed in this study.
• It would be interesting to see if considering local land use (such as within a 30 ft or 100 ft buffer), would suggest anything further.
• It would be prudent to conduct a more detailed analysis, especially as more data is obtained, such as dividing the data by year, season, and even by pre/post storm event.
• It should be noted that this dataset is skewed to a higher range of values, due to the focus of sampling during storm events.

Acknowledgements

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