The Effect of Precipitation Events on River Ecosystems in Commercial, Residential, and Forested Predominant Landscapes

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Null Hypothesis: The predominant landscape on which precipitation events occur has no effect on a river's chemical and physical parameters.

Abstract:

Using statewide collaborative data collection protocols, the water quality of three streams: Little River, Bartlett Brook, and Indian Brook were compared. These streams have some similar attributes but differ in predominant surrounding landscapes: forested, commercial, and residential respectively. A data set showing the number of inches of precipitation on the day before water samples were collected by Rice Memorial HS, Colchester HS, and Peoples Academy HS, was compared to the concentrations of TSS, TN, and TP in each of the three streams. No significant trend is visible between the amount of precipitation one day previous to the data collection, and the nutrient levels in the water. Limited data points showed invalid trend lines. A strong correlation between concentrations of TSS and TP was evident.

Introduction:

During the EPSCoR summer program we learned that Phosphorus is fixed in soil, that streambank erosion contributes to half the TP in Lake Champlain, and that anoxic conditions release P from sediment. Rivers emptying phosphate-fixed sediment in Lake Champlain may produce a positive feedback loop that accelerates eutrophic conditions. To what end do predominate landscapes influence the levels of TSS, TP, and TN in its rivers after a precipitation event? And, how will our changing climate including more frequent and intense storm events influence nutrient levels in Lake Champlain? Is one landscape better than another in buffering nutrient loading in streams?

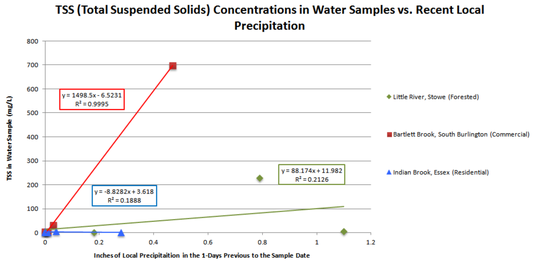
The Bartlett Brook runs through a predominantly *commercial* landscape, Indian Brook runs through a predominantly *residential* landscape, and Little River runs through a predominantly *forested* landscape. The purpose of our study was to compare how predominant surrounding landscapes affect water quality after precipitation events.

Methods and Materials:

- Biophysiochemical parameters were sampled per RACC protocol from mid July to mid October, 2013 by EPSCoR teams.
- Three replicate river water samples of total suspended solids (TSS) total nitrogen (TN), and phosphorus (TP), as well as one blank each for TP and TN were collected, stored on ice, and shipped to Saint Michael's College (SMC).
- Samples were analyzed for TSS, TN, and TSS at SMC Lab.
- RACC database was studied and it was found that Little River, Bartlett Brook, and Indian Brook were similar in characteristics save for predominant landscapes and that samples from these three stream sites were collected on similar days that correspond with storm events.
- CoCoRaHS, NOAA, and WeatherUnderground's measured rainfall data were used to find the inches of precipitation on the day before the sampling dates.
- Data sets were entered on an Excel spreadsheet in columns: date, TP, TN, TSS, and "Inches of Precipitation on the day before", and sorted according to precipitation from least to greatest.
- A linear best fit trendline was graphed in Excel.

Results:

Results suggest that there is not a statistical relationship between precipitation events and the concentration of TSS, TN, and TP, but we did find that, although TP and TSS did not correlate with precipitation events, TP and TSS did correlate with each other. In each river, TSS and TP data were nearly identical.

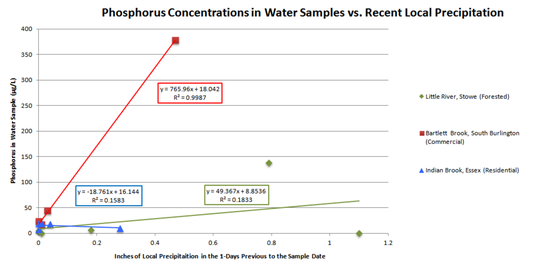


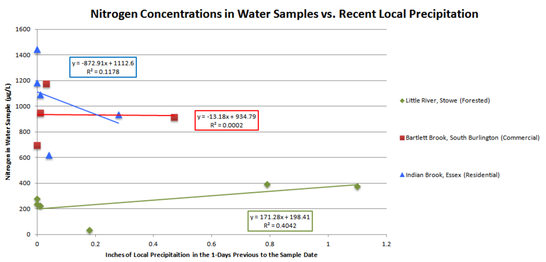
Discussion:

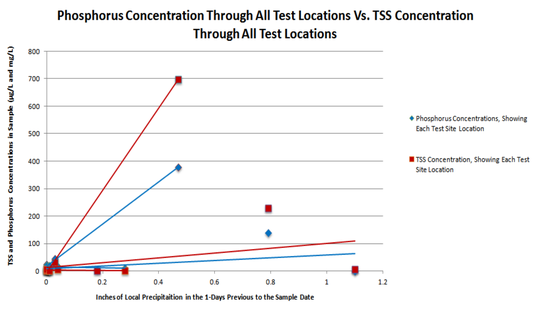
A trend line is most reliable when its R^2 value is at or near 1. Linear fit is significant when the R^2 value of the line is greater than 0.75. When an R^2 value approaches 1.0 the researcher needs to be sure that the sample size is adequate.

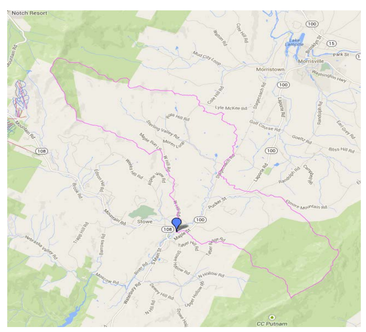
Since in each river, TSS and TP data were nearly identical, it is likely that the TSS is comprised mostly of sediment and that phosphorus is bound to this sediment (Barrow 2014). Sediment and Phosphorus inputs from our rivers into Lake Champlain will increase eutrophication. Vermont has made advancements in regulating phosphorus in detergents and wastewater treatment facilities but increased efforts to control erosion is paramount in light of increased storm intensity brought on by climate change.

Most (98%) N in the soil is in organic forms, either in plant and animal residues, not fixed to soil. Inorganic Nitrate ions do not bind to the soil solids because they carry negative charges. Inorganic ammonium $NH4^+$ does bind to soil but the amount is so small compared to P(Mosaic 2014). Perhaps because N is unrelated to sediment, it's presence in the stream does not correlate with TSS, TP, or erosion.

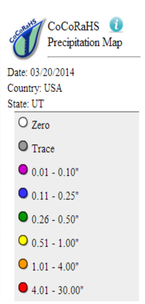


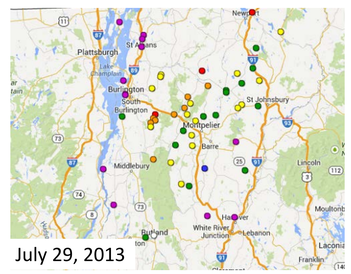


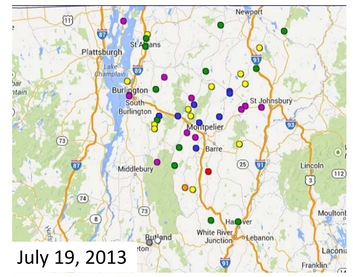


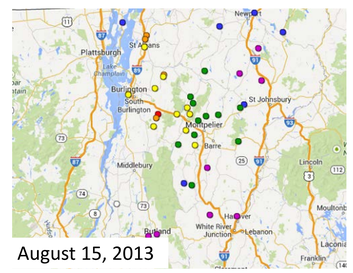


The Winooski River Watershed, of which the Little River lies within as indicated by the blue marker.









Figures 2-4: Precipitation maps noting levels of precipitation across northern Vermont on 3 dates pertaining to storm events used during data comparisons.

References:

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