Analyzing Monthly Rainfall and Rainfall Event Trends from 1950-2012 in Albany, NY and Schenectady, NY

Matthew Vetta

Department of Geography, University of Guelph, Guelph, ON

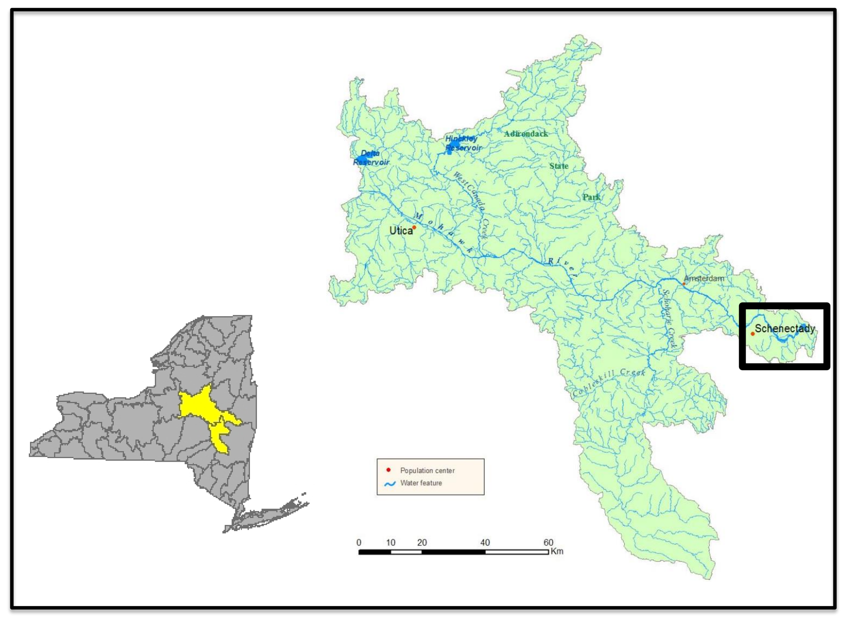
mvetta@uoguelph.ca

Extreme rainfall events cause serious events such as floods and slope failure, leading to damages. Areas experiencing frequent and intense rainfall events exhibit higher sediment yields in streams due to erosion and run-off associated with these events. Temporal and spatial variability in rainfall events on a global scale have led to studies focusing on determining trends in large-scale precipitation events using statistical analysis (Kunkel, 2003).

This study analyzed monthly rainfall totals and event trends for Albany, NY and Schenectady, NY with Mann-Kendall and Pearson Correlation.
The main objectives of this report are to:

- Acquire precipitation data from April 1950 to September 2012;
- Perform statistical trend analysis with Mann-Kendall, Seasonal Mann-Kendall and Pearson Regression tests; and
- Analyze the resulting trends.

Study Area



Rainfall during the late summer and fall in the Schenectady and Albany areas are heavily affected by north Atlantic storms, specifically hurricanes, as seen with Hurricanes Irene (2011) and Sandy (2012) and tropical storm Lee (2011). The variability in precipitation in this zone is affected by Lake Ontario and the increased elevation of the Adirondacks and Catskill Mountains to the west, north, and south (Godwin et al., 2003).

Figure 1. Map of the Mohawk River watersheds, highlighting Albany and Schenectady (NYSDEC, 2012)

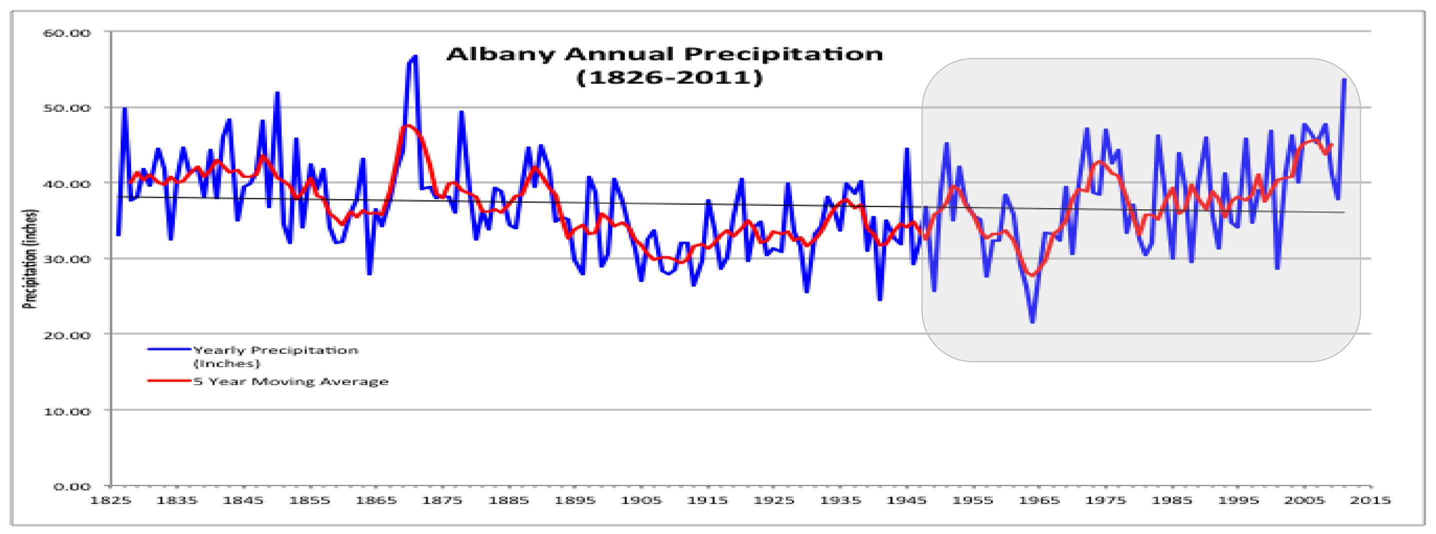


Figure 2. Yearly Albany data with the 5 year moving average. The grey box represents the time period, 1950-2012, examined using Mann-Kendall and Pearson Correlation. The examined time period provides includes a rainfall low period (1960s), a rainfall high period (1970s) and approximately 2 decades with a seemingly increasing trend (1990s-present)

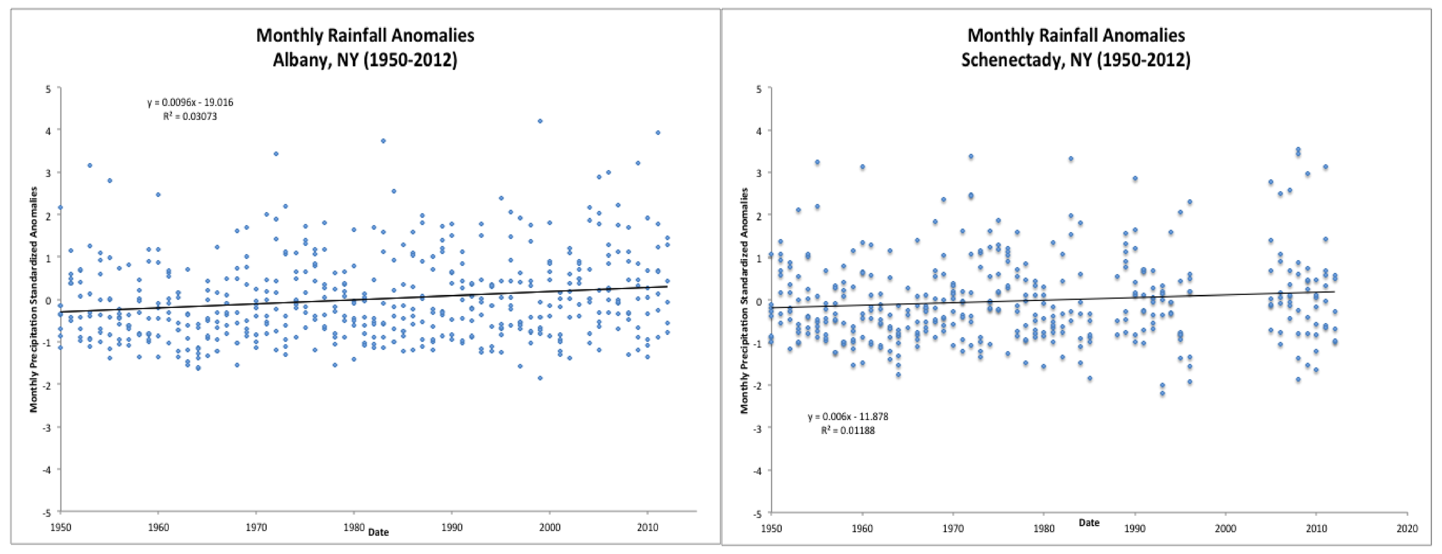


Figure 3. The results from the Pearson Correlation test on the monthly rainfall standardized anomalies for Albany (left) and Schenectady (right) show an increasing rainfall trend from 1950-2012. The Pearson r values calculated were 0.1753 and 0.1090 for Albany and Schenectady respectively.

Data

Data from April to November were examined because these are periods dominated by rainfall events rather than snowfall or other precipitation. Mann-Kendall (MK), Seasonal Mann-Kendall, and Pearson Regression tests were run. MK is a non-parametric rank-based method that is used to test for randomness against trends in climate and precipitation (Helsel and Hirsch, 2002). The MK test is hypothesis based, where the null hypothesis states there is no trend and the alternative rejects the null hypothesis. The Kendall's tau value computed from the MK test will generally be lower than traditional correlation values, which determines the relationship strength between the features (Helsel and Hirsch, 2002). The closer to 0, the stronger the relationship.

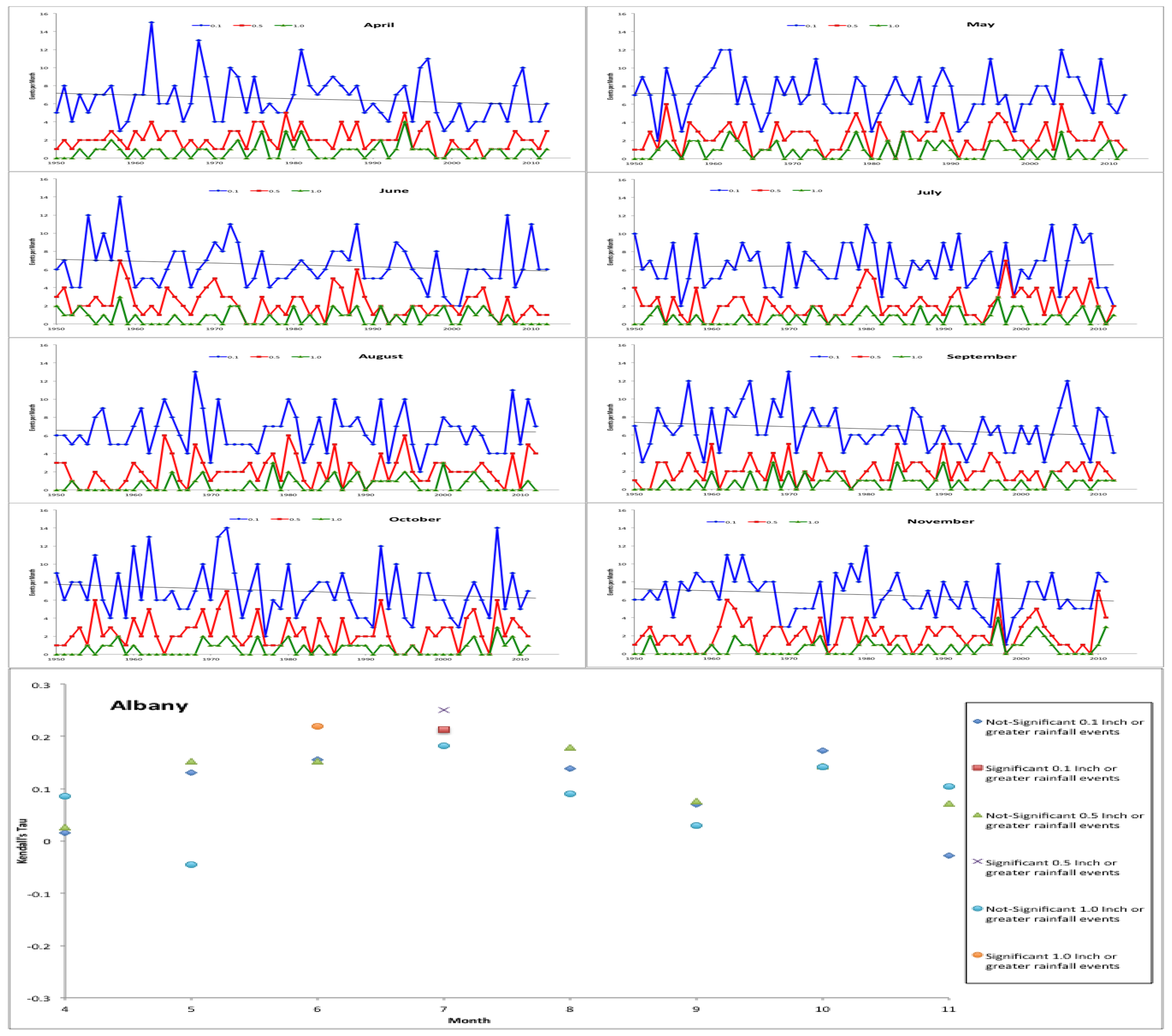


Figure 4. The top eight graphs represent rainfall events in Albany from 1950-2012. Blue lines represent 0.1 inch or greater events, red lines are 0.5 inch or greater events, and green lines represent 1.0 inch or greater events. The bottom graph represents the statistically significant or not significant rainfall event trends identified by the MK test. The results show that only June and July have statistically significant increases in rainfall events. However, overall the MK results show that rainfall and rainfall events for these defined sizes over this 62 year period are statistically increasing. This is most likely dominated by steadily increasing rainfall over the past couple decades as seen in figure 2.

Figure 5. The top eight graphs represent rainfall events in Schenectady from 1950-2012. Blue lines represent 0.1 inch or greater events, red lines are 0.5 inch or greater events, and green lines represent 1.0 inch or greater events. The bottom graph represents the statistically significant or not significant rainfall event trends identified by the MK test. The results show that only October have statistically significant increases in rainfall events. However, overall the MK results show that rainfall and rainfall events for these defined sizes over this 62 year period are statistically increasing. This is most likely dominated by steadily increasing rainfall over the past couple decades as seen in figure 2.

Discussion

- Statistically significant increasing trends for monthly rainfall and events. greater than 0.1 inch, 0.5 inch, and 1.0 inch events for Albany and Schenectady.
- Significant increasing trends in monthly rainfall from 1950-2012 for Albany in June, July, and October.
- Schenectady only had significantly increasing trends in October.
- Albany has significant increasing trend in 0.1 and 0.5 inch events during July, and 1.0 inch events in June.
- However, Schenectady only show significantly increasing trends in 0.1 and 0.5 inch events for October.

Future Work I

Future research may include statistical significant tests on the standardized anomalies, calculated Pearson Regression values, and on the standardized event totals. Also future work through applying dendrogeomorphological methods in the two study sites is able to examine the frequency occurrence rates for slope failure events in the area, thus providing a way to cross-reference slope failure and rainfall events.

Future Work II

Future research aims to evaluate slope instability along the Mohawk River at a fine spatial and temporal resolution with LiDAR imagery and dendrogeomorphological methods. To accomplish this, the following objectives will be explored:

- Create a fine spatial resolution LiDAR derived DEM to identify potential high sediment yield sources
- Estimate temporal variations in sediment yield associated with slope processes using dendrogeomorphological reconstruction
- Investigate the hydroclimatological factors contributing to sediment yield

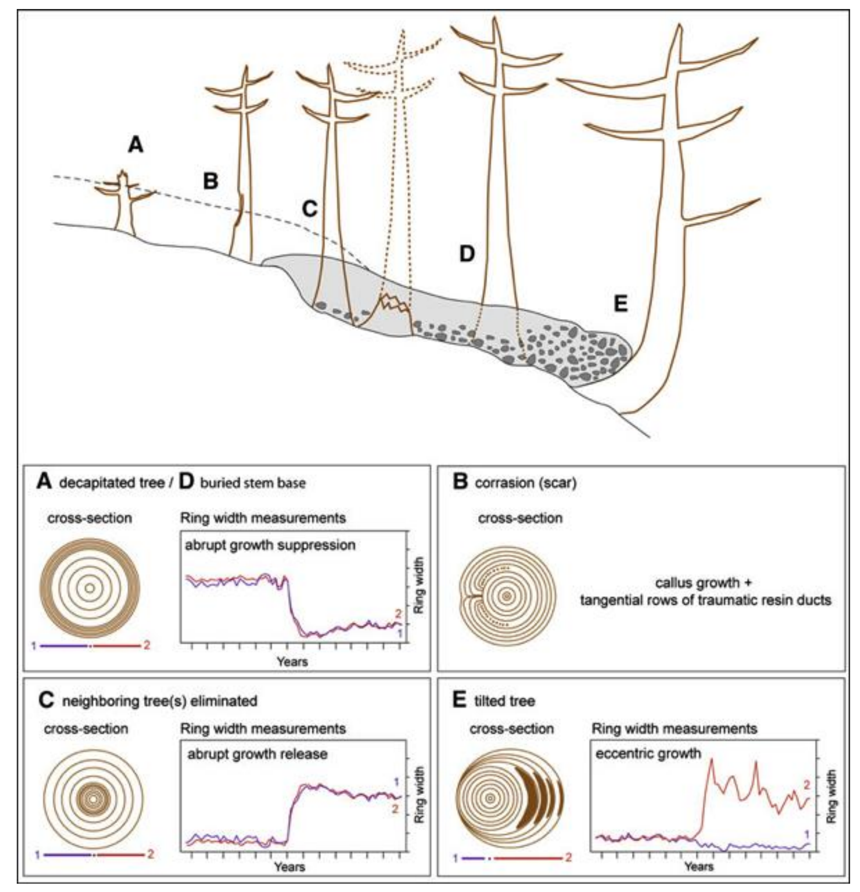


Figure 6. Examining tree ring series provides a method to date and determine geomorphic processes resulting in growth disturbances. Tree ring growth curves are graphed to highlight any growth disturbances.

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