Large Precipitation Events in Northern Vermont Compared to Global Temperature Anomalies and Carbon Dioxide Concentrations

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Introduction

The goal of our study was to develop a large precipitation database for Northern Vermont. In a collaborative examination of northern tier weather data that included the stations in Burlington (1864-2014), Johnson (2000-2014), Morrisville (1962-2014), and St. Johnsbury (1894-2014). We analyzed data trends and correlations within the context of larger scale climate change. Through the process of creating the database, individual stations were examined more closely. The St. Johnsbury data was compared to global temperature anomalies and atmospheric carbon dioxide concentrations to establish a potential relationship to climate change.

Materials and Methods

Weather data was downloaded from the National Climatic Data Center (NCDC) in hourly format for each month of each year in the study period.
Microsoft Excel was used to reformat and organize data . Large precipitation events, per calendar day, were classified by a baseline of 0.8 inches of precipitation or greater. The number of events per month, year, decade, and the entire dataset were recorded, averaged, and normalized. Global temperature anomalies were retrieved from the NCDC data base and CO_2 concentrations are from Scripps CO_2 Data - Mauna Loa Observatory in Hawaii, United States. Both of these data sets were normalized and compared to the standardized large precipitation event numbers from the St. Johnsbury database.

Citations

All CO_2 information is from Scripps Mauna Loa CO_2 Data Summary (Monthly & Annual) June 4, 2015 at Scripps Institution of Oceanography in San Diego (La Jolla) California. Weather data retrieved from St. Johnsbury Fairbanks Museum and NOAA/NCDC.

Results

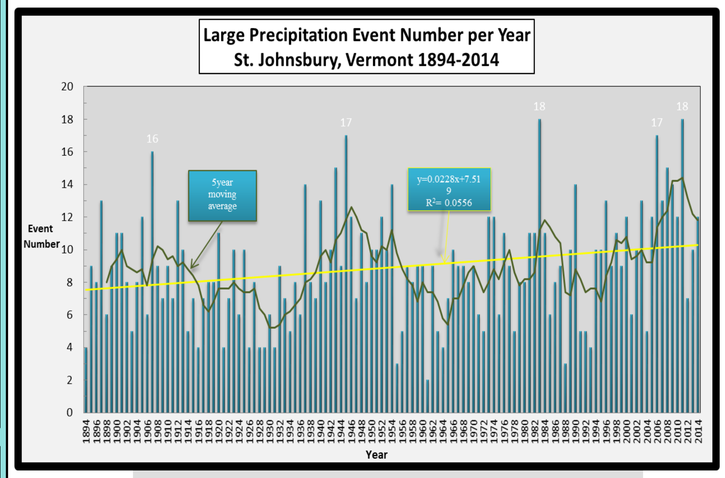

Figure 1. STJ precipitation amount by year 1894-2014.

Figure 1. shows large precipitation events (0.8 of precipitation or greater) through time, 1894-2014, in St. Johnsbury Vermont. This graph highlights a variability in the amount of events per year, as well as a slightly positive trend for the time period. There is an increase in the 5 year moving average and note that the last decade has higher event frequency.

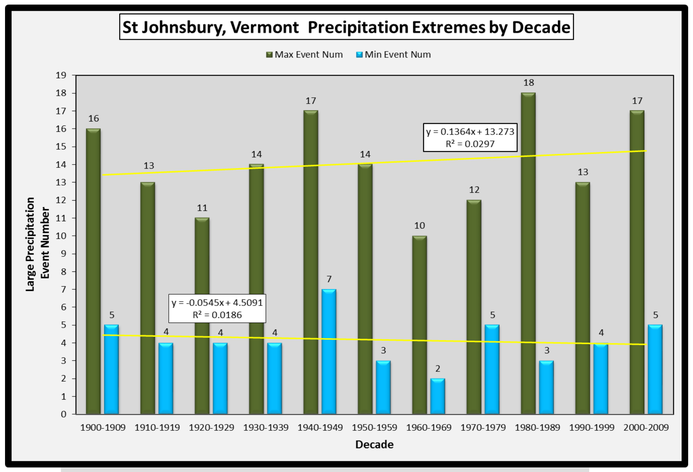

Figure 2. STJ precipitation extremes by decade 1900-2009.

Figure 2. shows large precipitation events by decade for St. Johnsbury, Vermont. The events are categorized by the least number of events in a year that decade, and the greatest. This graph highlights that the maximum event number per year is increasing as the decades increase. Drier years remain nearly the same, unlike wet years.

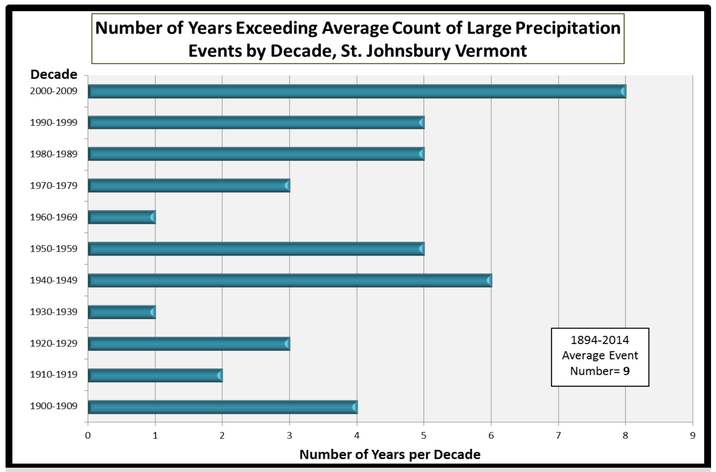

Figure 3. STJ precipitation by decade in number of events. Events in this scenario are calculated as more than the average amount for 1894-2014 by at least one event.

Figure 3. shows by decade a count of the number of years that event occurrence was at least one more than average. This graph highlights a clear positive trend through time in event number. Decades are experiencing more precipitation. 2000-2009 has had the most years with a significant number of large precipitation events

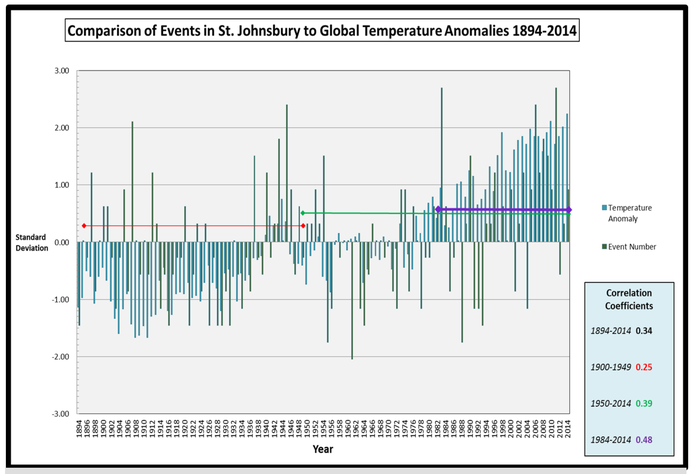

Figure 4. STJ precipitation event amount compared to carbon dioxide concentration by year 1894-2014.

Figure 4. shows standardized event number as compared to global temperature anomaly through time, 1894-2014, in St. Johnsbury, Vermont. This graph highlights that the strongest correlation is between 1984-2014 (0.48). Though the entire dataset reveals a positive correlation the correlation increases after 1950.

Conclusions

To corroborate the scientific consensus about climate change this data suggests a strong connection between increasing global temperatures and the increase of precipitation event frequency in St. Johnsbury, Vermont. With the defined event being a calendar day of 0.8 inches of precipitation or greater we notice that wet years and decades are becoming wetter. The trends that are strongest are for the most recent climatology for 1984-2014. This reinforces the observations that since 1950 temperatures increased and with that so has the number of precipitation events. To expand and define this relationship even further a dataset of carbon dioxide concentrations in the atmosphere was used for comparison. Knowing that there is a strong correlation between global temperature anomalies and CO_2 allows us to compare large precipitation events.

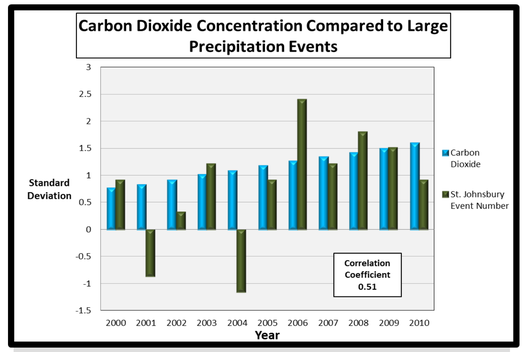

Figure 5. STJ precipitation event amount compared to carbon dioxide concentration by year 2000-2010.

The above graph is a depiction of standardized event numbers and carbon dioxide concentration in St. Johnsbury, Vermont for the decade 2000-2010. This is the decade with the strongest correlation. There is a positive correlation which indicates that as the amount of carbon dioxide in the atmosphere increases so will the frequency of large precipitation events in St. Johnsbury. This enables us to develop plans for future research to continue to link climate change on the larger scale to the northern tier of Vermont.

Acknowledgments

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