Comparison of precipitation change estimates across the U.S. - Canadian border

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Rationale and Objectives

• There is a strong spatial and temporal
  inhomogeneity in precipitation information across the U.S. - Canadian border due to different observational practices and gauge designs.
• Furthermore, during the past 100 years there were instrumental (and methodological) change biases that introduce false trends, “jumps” and other
  non-meteorological “signals” in observational data.

During the past several decades, there were reports of significant changes in precipitation frequency and duration of prolonged no-rain periods in the northern regions of the United States and Southern Canada (Groisman et al., 2005, Groisman and Knight 2007, 2008).

Data and their problems

Study area along the U.S. Canadian border

Long-term meteorological stations available in each sector of the U.S.-Canadian border area

Changes in total number of days with snowfall per year are shown for average over North America. The trend is corrected for changes in station network, changes in precipitation measurement equipment and temperature measurement methods, changes in urbanization and land-use changes and changes in climate. The initial analysis of the data was done by NCDC (1998) and distributed by them as part of the Global Historical Climatology Network (GHCN) (Rogers and Kennett 1986).

Comparison of rainfall with other precipitation measurement datasets shows no significant changes over the area of interest. The changes in daily precipitation over the area along the U.S.-Canadian border are shown in the right panel. The changes are not statistically significant.

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Results

Annual number of days across the US Canadian border (28.5° lat) with precipitation above 0.21 mm (left) and above 2.31 mm (right)

Annual precipitation along the US-Canadian border ± 2° lat.

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Summary

• We assessed the changes in characteristics of precipitation within 2.5° latitude NIS of the USA – Canadian border during the past century using the long instrumentally homogeneous time series at national networks. Across the border, we compared the time series for total precipitation, seasonal counts of days with precipitation, and intense and extreme precipitation.
• Significant inhomogeneities were found on the lower end of the precipitation distribution in both countries and the thresholds after which we can reliably analyze time series of precipitation totals and “days with sizable precipitation” (i.e., days with precipitation above these thresholds) were estimated.
• Only a threshold of 2.3 mm is sufficient to eliminate spurious trends in precipitation frequency in southern Canada while the elimination of the lowest non-zero bin in the precipitation reports (0.254 mm) is sufficient to assess precipitation frequency trends over the northern USA after the 1940s.
• For heavy precipitation characteristics, no homogeneity issues were found. Here, increases of the annual number of days in the upper 10th percentile of the daily events vary from 12% (Canada) to 13% (USA) per century.