Climatology of Blowing Snow in Canada and the United States

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Introduction

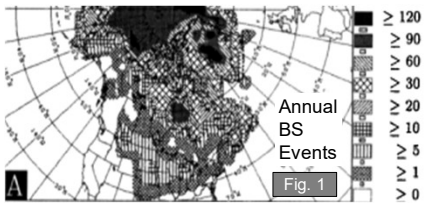


Fig. 1

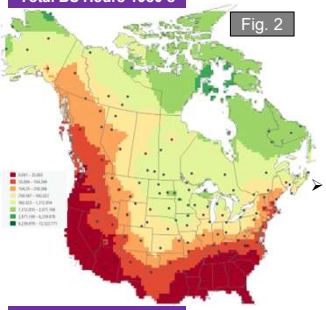
Blowing snow (BS) can make road travel very hazardous. Understanding where and when BS events are most common is important to mitigating weather related accidents. Few studies have looked at BS across North America. Dery and Yau (1999) used the European Centre for Medium-Range Weather Forecasts (ECMWF) Re-Analysis data for 1979-1993 to identify BS conditions. **(Fig. 1)**. **This current study is the first to use observations to examine the spatial and temporal variations of BS occurrences across the United States and Canada.**

Methodology

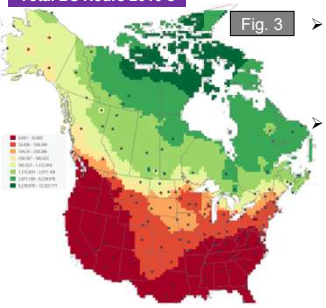
- Hourly surface weather observations from the Integrated Surface Database (ISD) from the National Center for Environmental Information (NCEI) were used from 133 stations around the US and Canada (shown on the following maps by the blue dots) across 40 cold seasons (October – April) during 1979/1980 through 2018/2019.
- Present Weather Codes and meteorological parameters of temperature, wind speed, and visibility were examined.
- Observed air temperature and the BS wind speed threshold (U_T) defined by Li and Pomeroy (1997) were used as a criteria to identify BS conditions for time periods following when stations converted from manual to automated surface weather observations since the present weather code would often be erroneously reported as blowing dust/sandstorm codes rather than blowing snow.
- Equation for the BS wind speed threshold, where T is air temperature (Celsius): $U_T = 9.43 + 0.18(T) + 0.0033(T)^2$

Results

Total BS Hours 1980's

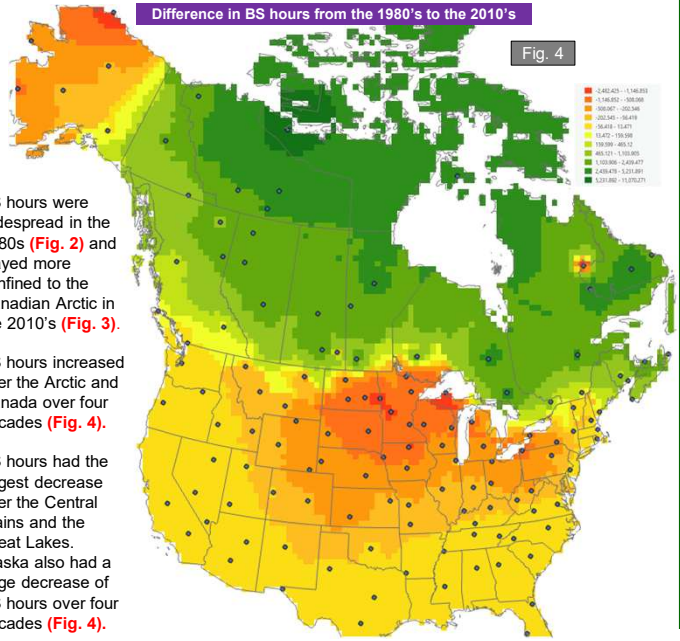

Fig. 2

Total BS Hours 2010's

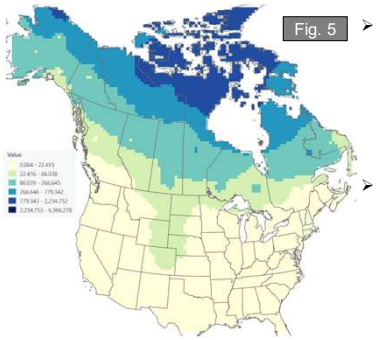

Fig. 3

- BS hours were widespread in the 1980s **(Fig. 2)** and stayed more confined to the Canadian Arctic in the 2010's **(Fig. 3)**.
- BS hours increased over the Arctic and Canada over four decades **(Fig. 4)**.
- BS hours had the largest decrease over the Central Plains and the Great Lakes. Alaska also had a large decrease of BS hours over four decades **(Fig. 4)**.

Difference in BS hours from the 1980's to the 2010's

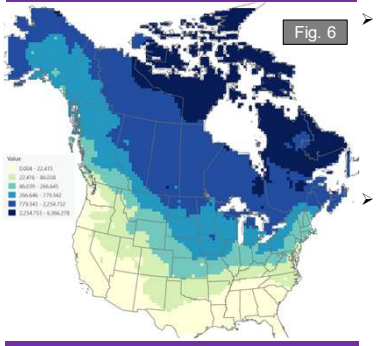

Fig. 4

October total BS hours: 40 cold seasons


Fig. 5

- October has had the fewest BS hours over 40 cold seasons. Most occurred in Canada and Alaska **(Fig. 5)**.
- January has had the most BS hours over 40 cold seasons, with BS frequent in the Upper Central Plains and Great Lakes **(Fig. 6)**.

January total BS hours: 40 cold seasons


Fig. 6

- Most frequently, BS hours were in the Arctic north of the Hudson Bay with about 830 hours per cold season **(Fig. 7)**.
- BS was frequent in the Upper Midwest, Central Plains, and Great Lakes with about 20 hours per cold season **(Fig. 7)**.

Total BS hours: 40 cold seasons

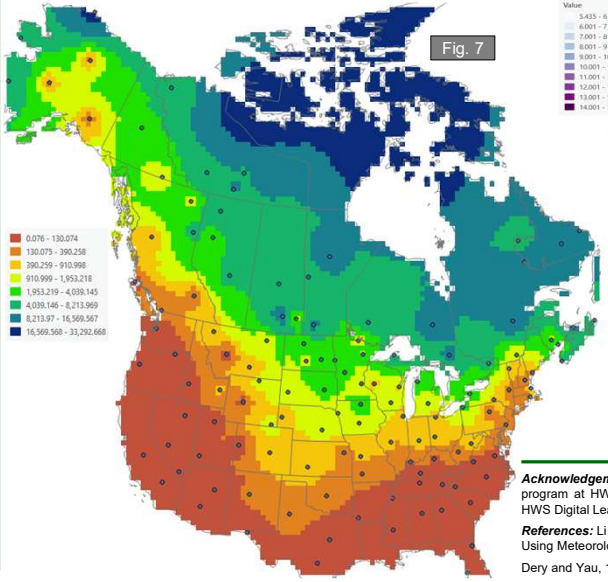
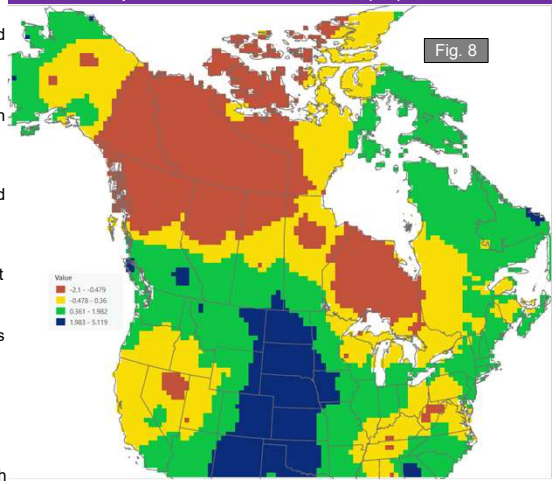
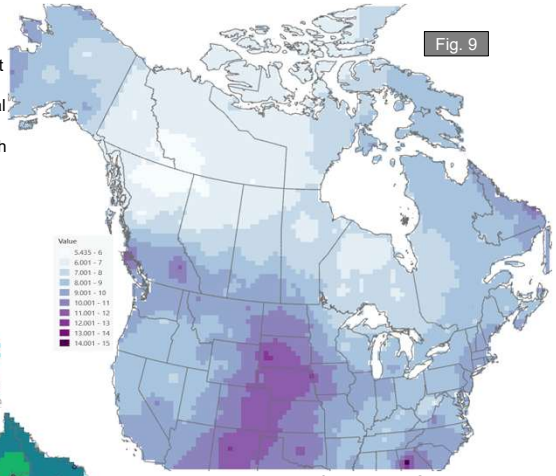


Fig. 7

Mean wind speed difference from BS threshold (m/s): 40 cold seasons


Fig. 8

Mean wind speed (m/s) during BS hours: 40 cold seasons


Fig. 9

- Mean wind speeds with faster than BS threshold wind speeds during BS hours typically occurred over the Central Great Plains **(Fig. 8)**.
- The mean wind speeds were slower than BS threshold wind speed during BS hours across most of Canada, especially south of the Hudson Bay and Western Provinces/Territories **(Fig. 8)**.
- The fastest mean wind speeds during BS hours occurred in coastal locations and the Great Plains of the US **(Fig. 9)**

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References: Li and Pomeroy, 1997: Estimates of Threshold Wind Speeds for Snow Transport Using Meteorological Data. JAMC, 36, 205-213

Dery and Yau, 1999: Climatology of Winter-Type Weather Events. JGR, 104, 16,657-16,672