Assessment of Near 0°C Temperature and Precipitation Characteristics across Canada

Eva Mekis¹, Ronald Stewart², Barrie Bonsal³, Bohdan Kochtubajda⁴ and Julie Theriault⁵

1 - Environment and Climate Change Canada, Toronto; 2- University of Manitoba, Winnipeg; 3 - Environment and Climate Change Canada, Saskatoon; 4 - Environment and Climate Change Canada, Edmonton; 5 - University of Quebec at Montreal, Montreal
Hourly Temperature Distribution

Winnipeg
1953 - 2012
Rationale and Objective

Surprisingly, relatively little analysis has been conducted on this issue from a broad perspective, including over Canada.

So, our objective is:

To develop a Canada-wide perspective on near 0°C conditions with a particular focus on its associated precipitation.
Datasets

Surface:
Environment and Climate Change Canada hourly reporting stations
Dry bulb temperature, moisture, precipitation occurrence/type

Issues:
Period of record
Manual versus automatic observations
Site location changes
Merging information from nearby sites
Precipitation measurement

Datasets:
For ‘climatology’ 1981-2015 with at least 25 years of data
343 hourly reporting stations and 227 with weather type information
Average Annual Number of Days with near 0°C Conditions

Period: 1981 – 2015, minimum 25 years

\[-2°C \leq T \leq 2°C\]
Average Annual Period of Time Near 0°C (h)

Period: 1981 – 2015, minimum 25 years

-2°C ≤ T ≤ 2°C
Average Annual Number of Events near $0^\circ C$

Period: 1981 – 2015, minimum 25 years

$-2^\circ C \leq T \leq 2^\circ C$

Event - a period with continuous temperatures within the temperature threshold boundaries
Maximum Duration of Events near 0°C (h)

Period: 1981 – 2015, minimum 25 years

\[-2°C ≤ T ≤ 2°C\]
Average Annual Precipitation Hours near 0°C:
based of 12 weather type hourly observations

-2°C ≤ T ≤ 2°C

<table>
<thead>
<tr>
<th>Code</th>
<th>Weather Type</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>86</td>
<td>Rain (R)</td>
<td>[0 1 2 3]</td>
</tr>
<tr>
<td>87</td>
<td>Rain Showers (RW)</td>
<td>[0 1 2 3]</td>
</tr>
<tr>
<td>88</td>
<td>Drizzle (L)</td>
<td>[0 1 2 3]</td>
</tr>
<tr>
<td>89</td>
<td>Freezing Rain (ZR)</td>
<td>[0 1 2 3]</td>
</tr>
<tr>
<td>90</td>
<td>Freezing Drizzle (ZL)</td>
<td>[0 1 2 3]</td>
</tr>
<tr>
<td>91</td>
<td>Snow (S)</td>
<td>[0 1 2 3]</td>
</tr>
<tr>
<td>92</td>
<td>Snow Grains (SG)</td>
<td>[0 1 2 3]</td>
</tr>
<tr>
<td>93</td>
<td>Ice Crystals (IC)</td>
<td>[0 1 2 3]</td>
</tr>
<tr>
<td>94</td>
<td>Ice Pellets (IP)</td>
<td>[0 1 2 3]</td>
</tr>
<tr>
<td>95</td>
<td>Ice Pellet Showers (IPW)</td>
<td>[0 1 2 3]</td>
</tr>
<tr>
<td>96</td>
<td>Snow Showers (SW)</td>
<td>[0 1 2 3]</td>
</tr>
<tr>
<td>97</td>
<td>Snow Pellets (SP)</td>
<td>[0 1 2 3]</td>
</tr>
</tbody>
</table>

Hours
- 0 to 70
- 70 to 140
- 140 to 210
- 210 to 280
- 280 to 350
- 350 to 420
- 420 to 490
- 490 to 560
- 560 to 630
- 630 to 700
Fraction of Near 0°C Conditions with Precipitation (%)

Period: 1981 – 2015, minimum 25 years

-2°C ≤ T ≤ 2°C

<table>
<thead>
<tr>
<th>Code</th>
<th>Type</th>
<th>Code</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>86</td>
<td>Rain (R)</td>
<td>88</td>
<td>Drizzle (L)</td>
</tr>
<tr>
<td>87</td>
<td>Rain Showers (RW)</td>
<td>89</td>
<td>Freezing Rain (ZR)</td>
</tr>
<tr>
<td>90</td>
<td>Freezing Drizzle (ZL)</td>
<td>91</td>
<td>Snow (S)</td>
</tr>
<tr>
<td>92</td>
<td>Snow Grains (SG)</td>
<td>93</td>
<td>Ice Crystals (IC)</td>
</tr>
<tr>
<td>94</td>
<td>Ice Pellets (IP)</td>
<td>95</td>
<td>Ice Pellet Showers (IPW)</td>
</tr>
<tr>
<td>96</td>
<td>Snow Showers (SW)</td>
<td>97</td>
<td>Snow Pellets (SP)</td>
</tr>
</tbody>
</table>

Percentage
- X: 0 to 5
- Yellow: 5 to 10
- Orange: 10 to 15
- Red: 15 to 20
- Maroon: 20 to 25
- Purple: 25 to 30
- Blue: 30 to 35
- Dark Blue: 35 to 40
- Dark Cyan: 40 to 45
- Black: 45 to 50
Fraction of Near 0°C Conditions with Freezing Rain (%)

Period: 1981 – 2015, minimum 25 years

\[-2°C \leq T \leq 2°C\]
Fractional Occurrence of Precipitation Types

-2°C ≤ T ≤ 2°C
Winnipeg

Temperature $\leq \pm 2^\circ$C:

- Occurrences
- Top 5% in duration
- Precipitation
Temperatures Near 0°C

Winnipeg

-2°C \leq T \leq 2°C

Number of Events

Number of Days

Maximum Duration (h)

And: No significant increase in freezing rain
Concluding Remarks

An assessment of critical near 0°C conditions across Canada is being carried out: important for freeze/thaw, hazards

Several points can be made:

The country is characterized by highly variable near 0°C features occurrences, events, duration, patterns

Associated precipitation is often critical but highly variable occurrences, types, patterns

Future conditions need to be better addressed build on solid foundation