Snowfall Forecasting challenges in the Great Lakes

NWS Gaylord
Mean Lake/Air Temperatures
(for Lake Michigan)

- Lake Effect Snow
- Stable Season
- Lake Effect Rain

°F

Month

J F M A M J J A S O N D

Air temperature
Lake temperature
How does lake effect snow form?
Lake effect snow on satellite
Snowfall forecast challenges
Challenge #1: Slight variations in wind direction
Challenge #1: Slight variations in wind direction
Challenge #2: Ice Cover
Average days of >90% ice cover
Northwest winds - No Ice cover
Northwest winds - Ice cover
Challenge #3: Snowflakes and temperatures
Temperatures aloft – the key

As temperatures aloft get colder, snowflakes become less dense. Less dense snowflakes may accumulate more quickly.

But as temperatures around 5000 feet fall below -20 degrees Celsius, snowfall intensity and accumulation drops off as snowflake size gets much smaller.
Dendrite Snowflake

Column Snowflake
Challenge #4: Elevation

During snow events, temperatures drop approximately 1 degree Fahrenheit for every 300 foot rise in elevation.

Alpena area = 600 ft MSL

Gaylord area = 1400 ft MSL
### December 20-21, 2012  Snowstorm

#### Gaylord Observations  Elevation 1400 feet

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature</th>
<th>Humidity</th>
<th>Precipitation</th>
<th>Wind Direction</th>
<th>Wind Speed</th>
<th>Wind Gust</th>
<th>Precipitation Type</th>
<th>Weather Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:53 AM</td>
<td>32.0 °F</td>
<td>92%</td>
<td>28.74 in</td>
<td>East</td>
<td>9.2 mph</td>
<td>20.7 mph</td>
<td>0.04 in</td>
<td>Fog, Snow</td>
</tr>
<tr>
<td>10:53 AM</td>
<td>30.9 °F</td>
<td>96%</td>
<td>28.71 in</td>
<td>East</td>
<td>10.4 mph</td>
<td>19.6 mph</td>
<td>0.07 in</td>
<td>Fog, Snow</td>
</tr>
<tr>
<td>11:53 AM</td>
<td>30.9 °F</td>
<td>96%</td>
<td>29.64 in</td>
<td>East</td>
<td>9.2 mph</td>
<td>25.3 mph</td>
<td>0.11 in</td>
<td>Fog, Snow</td>
</tr>
<tr>
<td>12:36 PM</td>
<td>30.2 °F</td>
<td>87%</td>
<td>29.52 in</td>
<td>East</td>
<td>12.7 mph</td>
<td>20.7 mph</td>
<td>0.04 in</td>
<td>Fog, Snow</td>
</tr>
<tr>
<td>1:31 PM</td>
<td>30.2 °F</td>
<td>93%</td>
<td>29.44 in</td>
<td>East</td>
<td>12.7 mph</td>
<td>24.2 mph</td>
<td>0.03 in</td>
<td>Fog, Snow</td>
</tr>
<tr>
<td>1:53 PM</td>
<td>30.9 °F</td>
<td>96%</td>
<td>28.43 in</td>
<td>East</td>
<td>17.3 mph</td>
<td>31.1 mph</td>
<td>0.05 in</td>
<td>Snow</td>
</tr>
</tbody>
</table>

#### Alpena Observations  Elevation 600 feet

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature</th>
<th>Humidity</th>
<th>Precipitation</th>
<th>Wind Direction</th>
<th>Wind Speed</th>
<th>Wind Gust</th>
<th>Precipitation Type</th>
<th>Weather Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:54 AM</td>
<td>35.1 °F</td>
<td>92%</td>
<td>29.80 in</td>
<td>ESE</td>
<td>18.4 mph</td>
<td>27.6 mph</td>
<td>0.00 in</td>
<td>Rain</td>
</tr>
<tr>
<td>11:11 AM</td>
<td>35.6 °F</td>
<td>93%</td>
<td>29.76 in</td>
<td>ESE</td>
<td>19.6 mph</td>
<td>33.4 mph</td>
<td>0.03 in</td>
<td>Rain, Snow</td>
</tr>
<tr>
<td>11:17 AM</td>
<td>33.8 °F</td>
<td>100%</td>
<td>29.76 in</td>
<td>ESE</td>
<td>18.4 mph</td>
<td>31.1 mph</td>
<td>0.05 in</td>
<td>Rain, Snow</td>
</tr>
<tr>
<td>11:38 AM</td>
<td>33.8 °F</td>
<td>93%</td>
<td>29.74 in</td>
<td>ESE</td>
<td>17.3 mph</td>
<td>31.1 mph</td>
<td>0.09 in</td>
<td>Snow</td>
</tr>
<tr>
<td>11:48 AM</td>
<td>33.8 °F</td>
<td>93%</td>
<td>29.73 in</td>
<td>ESE</td>
<td>16.1 mph</td>
<td>25.3 mph</td>
<td>0.12 in</td>
<td>Fog, Snow</td>
</tr>
<tr>
<td>11:54 AM</td>
<td>33.1 °F</td>
<td>93%</td>
<td>29.74 in</td>
<td>ESE</td>
<td>18.4 mph</td>
<td>27.6 mph</td>
<td>0.14 in</td>
<td>Fog, Snow</td>
</tr>
<tr>
<td>12:06 PM</td>
<td>33.8 °F</td>
<td>93%</td>
<td>29.70 in</td>
<td>ESE</td>
<td>18.4 mph</td>
<td>25.3 mph</td>
<td>0.03 in</td>
<td>Fog, Snow</td>
</tr>
<tr>
<td>12:22 PM</td>
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<td>29.68 in</td>
<td>East</td>
<td>12.7 mph</td>
<td>23.0 mph</td>
<td>0.04 in</td>
<td>Snow</td>
</tr>
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<td>12:26 PM</td>
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<td>29.67 in</td>
<td>East</td>
<td>12.7 mph</td>
<td>23.0 mph</td>
<td>0.04 in</td>
<td>Snow</td>
</tr>
<tr>
<td>12:47 PM</td>
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<td>29.65 in</td>
<td>East</td>
<td>18.4 mph</td>
<td>26.5 mph</td>
<td>0.04 in</td>
<td>Overcast</td>
</tr>
<tr>
<td>12:54 PM</td>
<td>35.1 °F</td>
<td>92%</td>
<td>29.66 in</td>
<td>East</td>
<td>17.3 mph</td>
<td>25.3 mph</td>
<td>0.04 in</td>
<td>Rain</td>
</tr>
</tbody>
</table>

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**Note:** The table includes temperature, humidity, precipitation, wind direction, wind speed, wind gust, precipitation type, and weather conditions for both Gaylord and Alpena, with observations taken at specific times throughout the day.
Challenge #5: Computer models
Why is storm track important?
Heaviest snow normally falls 150 to 200 miles to the left of the surface low track.
With all of these challenges... How do meteorologists put the forecast together?
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Creating a Forecast: Like putting a puzzle together

- Current observations
- Various computer models
- Pattern recognition
- Forecaster expert analysis and assessment
Questions???

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