Evaluation of the new OPM winter model

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* OPM: outage prediction model
The OPM operational system:

Approaching storm

Selection of temporal window and storm type

Rain/wind

- Low impact
- Extreme or Tropical
  - Moderate impact

Thunderstorm

Winter

* OPM: outage prediction model
Winter storms

When wintry precipitation occurs, there are three main factors responsible for outages:

- Strong winds and gusts.
- Snow and ice accretion.
- Leaves on trees.

When these factors combine together, catastrophic events can occur.

Damaged power line (left) and trouble spots (right) during the 2011 nor’easter.
Winter storms: what we know

- Linear trend of mean outages per grid cell for snow density between 50 and 105 kg/m³.

- Spike of outages between 105 and 130 kg/m³, peaking at 115 kg/m³: heavy, wet snow.

- Increase of outages for freezing rain above 20 mm.

Cerrai et al., 2020a
The OPM winter model has been operational in CT since early 2018;
Updated in 2020 for CT, included EMA, WMA, and NH;
A new version is available in Nov. 2021.
New OPM winter model: Version 2021

Highlights

- 188 historical winter storms (2005-2021)
  Newly added 30+ storms to the database since the last model version

- Two machine learning methods
  Random Forest (RF)
  Gradient Boosting Machine (GBM)

- Model optimization (final product of the winter model)
  Combine and optimize the RF and GBM methods

- Improvements
  Winter model v2021 versus Winter model v2020
  The current model employed in the operational system
OPM winter models: version 2020 versus version 2021

Winer model v2020

predicted # of trouble spots vs Actual # of trouble spots

Winer model v2021

predicted # of trouble spots vs Actual # of trouble spots

<table>
<thead>
<tr>
<th>Territory</th>
<th>APE q50</th>
<th>MAPE</th>
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</thead>
<tbody>
<tr>
<td>All territories</td>
<td>66%</td>
<td>157%</td>
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<tr>
<td>CT</td>
<td>78%</td>
<td>255%</td>
</tr>
<tr>
<td>EMA</td>
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<td>200%</td>
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<tr>
<td>NH</td>
<td>45%</td>
<td>90%</td>
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<tr>
<td>WMA</td>
<td>64%</td>
<td>130%</td>
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<table>
<thead>
<tr>
<th>Territory</th>
<th>APE q50</th>
<th>MAPE</th>
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<tbody>
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<td>84%</td>
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<tr>
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<td>77%</td>
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APE q50: median absolute percentage error
MAPE: mean absolute percentage error
Summary

- With updating the winter storm database and the model optimization approach, the new winter model outperforms the current one.

Future work

- Continue to collect new winter storms for model updating.
- Improve the classification method for winter precipitation.
- Improve the weather prediction for winter storms.