DEVELOPMENT OF A VISIBILTIY FORECASTING PRODUCT USING CANADA'S WILDFIRE SMOKE PREDICTION SYSTEM

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During the 2018 fire season, flights at several airports in Interior & West Kootenay BC and southern AB were cancelled or delayed as a result of low visibility conditions due to wildfire smoke. Within Environment & Climate Change Canada, the Canadian Meteorological Aviation Center provides aviation weather forecast services, which include visibility forecast, to Canadians. The ability to provide timely and reliable visibility forecast can be highly valuable, especially for firefighting efforts. This study uses air quality and meteorological forecast from Canada's Wildfire Smoke Prediction System (FireWork) to develop a 2D gridded hourly visibility product at 10 km over North America. The motivation for this project is to provide additional guidance for forecasters during wildfire events.

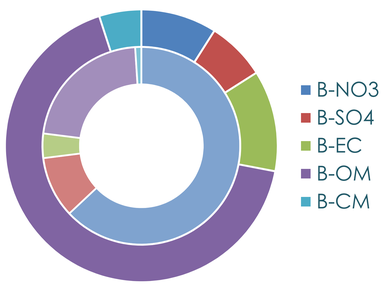
BACKGROUND

FireWork provides 48h forecast twice daily (0z/12z) from April to October at 10 km horizontal grid spacing.

Model outputs include:

- 1-hr $PM_{2.5}$ & NO_2 at the surface
- 2-bin speciated particulates
- Meteorology (RH, Temp, WS)

Visibility impairment is due to the scattering and absorption of particles and gases (both natural & anthropogenic). RH increases the scattering efficiency of hygroscopic PM species.



PM contributions to visual loss at YXX on a smoky day. Outer and inner circle represents observed & FireWork forecast, respectively.

Typical (left) vs smoke-impacted (right; 2018-08-16 07:30 PDT) view from Vancouver Harbour.

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METHODOLOGY

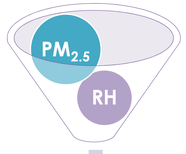
Hourly AQ & Met forecast from FireWork were used to derive the corresponding visibility forecast (SM) for all Canadian airports from 2016 to 2018. METAR visibility obs were used to assess model performance via a contingency approach.

Visibility Forecast

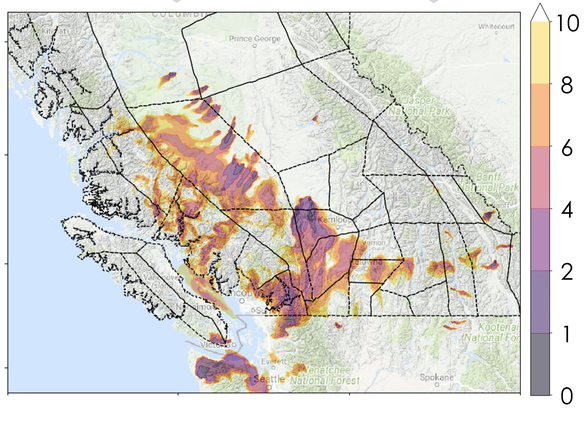
1. **Revised IMPROVE Algorithm**
   Pitchford et al. (2017)

OR

2. **Statistical Method**
   Generalized Additive Model (GAM)*
   Vis ~ s($PM_{2.5}$) + s(RH)



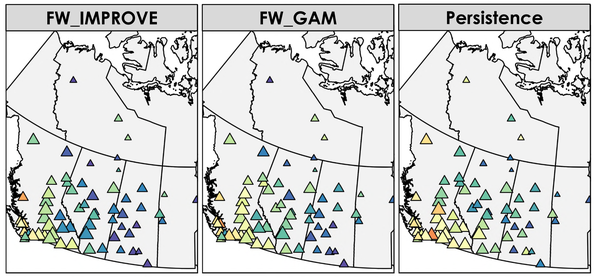
*Final model was developed using observed values from 7 BC coastal stations



Proposed 2D gridded hourly visibility forecast (SM) based on FireWork AQ & Met forecast.

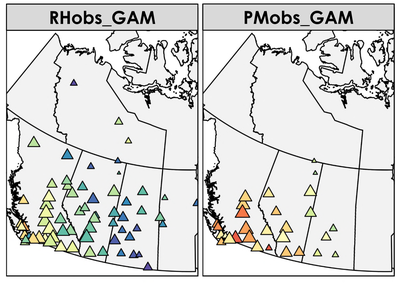
MODEL PERFORMANCE

ALL HOURS (< 6 SM; due to smoke/haze)



Critical Success Index in detecting hours < 6 SM for all Canadian Airports (2016 to 2018).

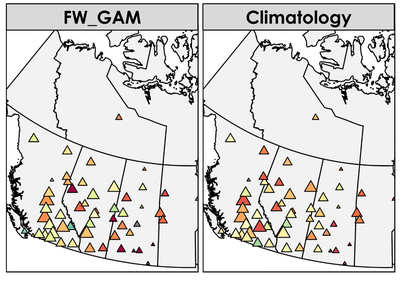
RH vs $PM_{2.5}$?



FireWork forecast were substituted with their respective obs values to gauge model sensitivity.

FW_GAM model performance is largely driven by the accuracy of FireWork $PM_{2.5}$ forecast.

DEPARTURE OF AN EVENT



FW_GAM & Climatology model (which assumes an 8h event duration) showed similar skills in detecting the departure of an event.

CONCLUSIONS

- Hourly visibility forecast can be reconstructed from FireWork AQ & Met forecast
- Proposed visibility product showed skills in detecting low visibility hours & departure of an event
- As FireWork $PM_{2.5}$ forecast improves, the proposed visibility product is expected to improve in tandem