Prince George Air Quality Emissions and Modelling (2014-2016)

Summary

Background

UNBC Researchers Dr. Peter Jackson and Brayden Nilsen have used emission inventory and meteorological data from 2014 - 2016 to update the previous (2005) micro-emission inventory and modelling system for the Prince George airshed. The work focuses on respirable particulate matter including $PM_{10,}$ $PM_{2.5}$, and particulates that form through secondary processes from sulphur dioxide and oxides of nitrogen. Particulate matter is an important contaminant in the Prince George airshed given its known impacts on health.

Dr. Jackson and Mr. Nilsen studied a 40km by 40km area covering the city of Prince George, which they broke down into neighbourhoods/areas. The project was completed with the use of four main technological components:

- Micro Emissions Inventory (MEI)
- Meteorological model (CALMET) updated to represent 2016 conditions
- Dispersion model (CALPUFF)
- Custom web-based scenario simulation tool (AirQuest)

The study was conducted with financial support from the City of Prince George, the Prince George Air Improvement Roundtable, and Northern Health. The BC Ministry of the Environment and Climate Change Strategy and Environment and Climate Change Canada provided in-kind technical support. An earlier version of the report was reviewed by a team consisting of members from the aforementioned organizations as well as the BC Centre for Disease Control, the Regional District of Fraser-Fort George, and Sinclar Group Forest Products Ltd

Micro Emissions Inventory (MEI)

Researchers updated the MEI to represent Prince George's 2016 emissions and concluded that industrial sector emissions have changed the most since the previous (2005) report:

- $PM_{2.5}$ emissions have decreased by 40%
- SO_2 emissions have decreased by 24%

In this study, several updates were made to the emissions categories used in the 2005 report:

- Researchers improved the method used to model PM from road dust as this category was unrealistically high in the 2005 report
- A category for fugitive dust was added
- Open burning (small 2005 contribution) was removed because it is now prohibited under Bylaw

It should also be noted that rail and residential wood burning emissions were not updated due to lack of recent emissions information. Rail emissions are likely underrepresented due to the terminal expansion and increased rail activities that are unaccounted for in the micro-emission inventory.

CALPUFF

CALPUFF's modelled pollution concentrations generally matched observations gathered at monitoring stations. Researchers reported the following:

- Major PM_{10} sources include commercial and road dust, and are highest in the spring and summer in the Bowl and at the BCR industrial site.
- The most dominant $PM_{2.5}$ source is heating (wood burning) in the fall and winter, but major sources also include road dust, commercial dust, and industry.
- The most dominant sources of $PM_{2.5}$, in the spring and summer are road and commercial dust.
- Modelled $PM_{2.5}$ averages at the BCR Industrial Site, in the Bowl, and in the Hart tended to exceed the provincial 1-year annual average objective of $8ugm^{-3}$.
- Overall SO_2 emissions are usually low. Major sources include industry, on-road mobile, and rail. The highest concentrations occur at BCR Site, in the Hart near the Heavy Industry Site, and in the Bowl.
- The largest source of NO_x emissions is on-road mobile, with little variation between seasons. Concentrations are highest in the Bowl, and at the BCR Site.

Conclusion

$PM_{2.5}$ is the main pollutant of concern. In most neighbourhoods the main sources are background levels, dust, wood burning, and industry.

- Wood burning dominates ambient concentrations of $PM_{2.5}$ in the winter
- Dust dominates ambient concentrations of $PM_{2.5}$ in the summer
- Ambient $PM_{2.5}$ levels from industry are consistent throughout the year

Limitations of the study include:

- Modelled PM concentrations were lower than observed when winds were from the north to east at Plaza 400 due. These differences may be due to underestimated emissions from sources in the heavy industrial areas and rail.
- Modelled PM levels were higher than observed at Plaza 400 when winds were from the southwest. The difference is likely due to overestimated emissions from wood heating.

Follow up and Future Work

Currently, AirQuest is being updated to incorporate new model data. Future work on this system should focus on the refinement of the MEI, specifically around rail, industry, and on-road mobile sources of NO_x