Introduction

This is the fourth air quality report for the Northeast Air Zone. Annual air zone reporting is a commitment under the national Air Quality Management System (AQMS). This report describes achievement of the Canadian Ambient Air Quality Standards (CAAQS) for ground-level ozone (O_3) and fine particulates ($PM_{2.5}$), the associated management levels and recent actions to improve air quality. A province-wide summary can be found at: http://www.env.gov.bc.ca/soe/indicators/air/.

Background

The AQMS is the national approach to managing air quality in Canada. Under the AQMS, the CAAQS are developed to drive action to protect human health and the environment. Air zones are areas that exhibit similar air quality characteristics, issues and trends, and that form the basis for monitoring, reporting and taking action on air quality. The Northeast Air Zone (see Figure 1) is one of seven broad air zones across the province. Under the AQMS, progressively more rigorous actions are expected as air quality approaches or exceeds the CAAQS. The level of action is guided by the Air Zone Management Framework outlined in Table 1.

Figure 1. Northeast Air Zone.

Table 1. Air zone management framework for ground-level ozone and $PM_{2.5}$ defined based on 2015 CAAQS criteria.

Management Level	Objectives	Ozone	$PM_{2.5}$	
		8-hour (ppb)	Annual (µg/m³)	24-hour (µg/m³)
Red	Achieve CAAQS	>63	>10.0	>28
Orange	Prevent CAAQS Exceedance	>56 and ≤63	>6.4 and ≤10.0	>19 and ≤28
Yellow	Prevent Air Quality Deterioration	>50 and ≤56	>4.0 and ≤6.4	>10 and ≤19
Green	Keep Clean Areas Clean	≤50	≤4.0	≤10

Ozone Levels

Ozone monitoring at the Fort St. John Key Learning Centre was initiated in late 2014 and has been operated continuously since early 2015. Ozone monitoring in Taylor and Rolla began in 2016 and was discontinued in Rolla the following year. Based on data collected between 2016 and 2018, ozone concentrations at the three sites ranged from 50-51 ppb. These levels were below the national standard of 63 ppb.[1]

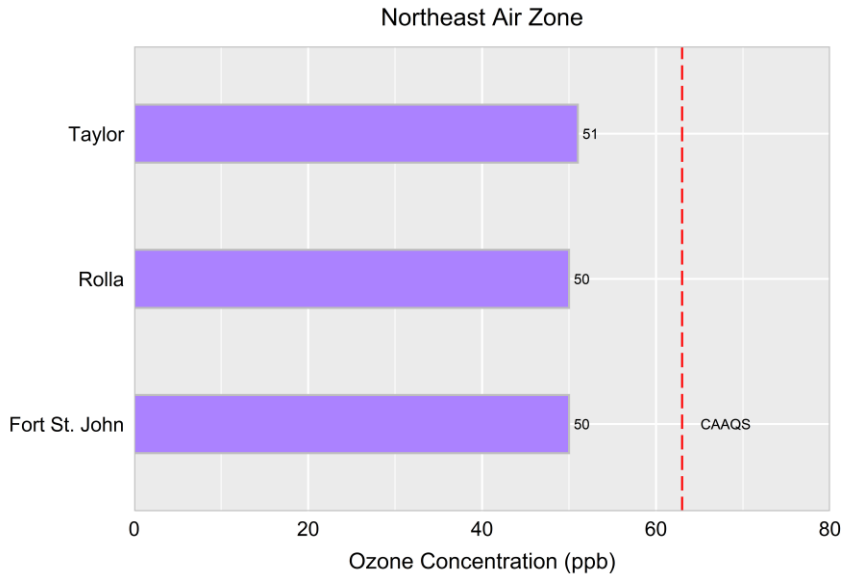


Figure 2. Ozone concentrations in the Northeast Air Zone, based on annual 4th highest daily 8-hour maxima, averaged over 2016-2018. Red dashed line identifies the CAAQS of 63 ppb.

Trends in annual ozone levels are shown in Figure 3.[2] Concentrations have remained well below the level of the national standard over the period of record.

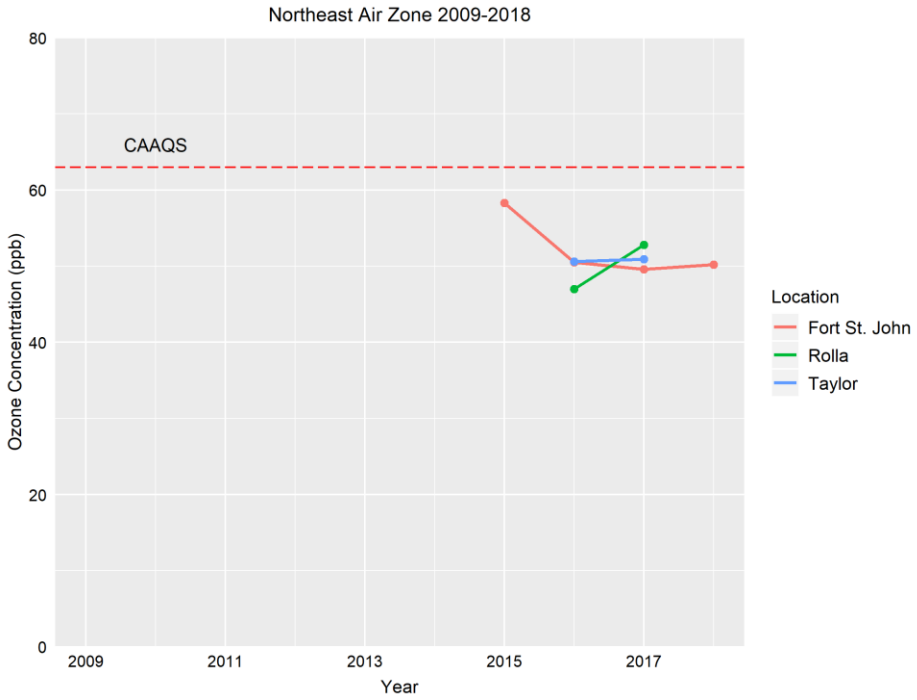


Figure 3. Annual trends in ozone concentrations (2009-2018), based on annual 4th highest daily 8-hour maxima for a single year. Red dashed line identifies CAAQS level of 63 ppb.

[1] Concentrations based on 4th highest daily 8-hour maximum, averaged over three years (2016-2018).
[2] Concentrations based on 4th highest daily 8-hour maximum, averaged over a single year.

$PM_{2.5}$ Levels

$PM_{2.5}$ refers to inhalable particles up to 2.5 micrometres in diameter. $PM_{2.5}$ monitoring was initiated in 2015 at the Fort St. John Key Learning Centre, and measurements are summarized in Figure 4. All measurements for this reporting period were based on the Federal Equivalent Method (FEM), which provides a more complete measure of $PM_{2.5}$ than the older TEOM instruments.

Between 2016 and 2018, three complete years of data were collected. A 24-hour average value of 28 µg/m^3 and an annual mean of 6.8 µg/m^3 were obtained,[3] indicating that $PM_{2.5}$ levels at this site did not exceed the national standards of 28 and 10 µg/m^3, respectively.

Trends in annual mean concentrations for 2016-2018 are shown Figure 5.[4]

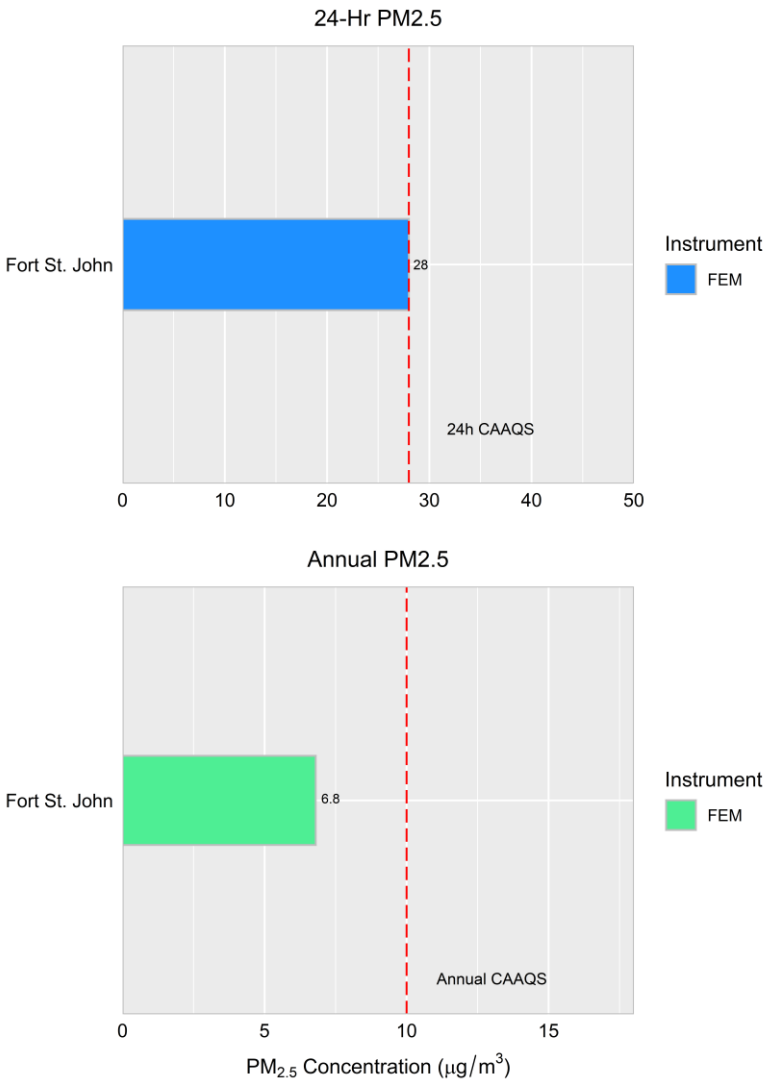


Figure 4. $PM_{2.5}$ concentrations in the Northeast Air Zone. Upper plot based on 24-hour concentration (annual 98th percentile, averaged over 2016-2018). Lower plot based on annual mean concentration (averaged over 2016-2018). The red dashed lines identify CAAQS of 28 µg/m^3 (upper plot) and 10 µg/m^3 (lower plot).

[3] The 24-hour concentration is based on the annual 98th percentile of 24-hour values, averaged over three years (2016-2018). The annual mean concentration is based on the annual average of 24-hour values, averaged over three years (2016-2018).

[4] Concentrations based on the annual average of 24-hour values over single year.

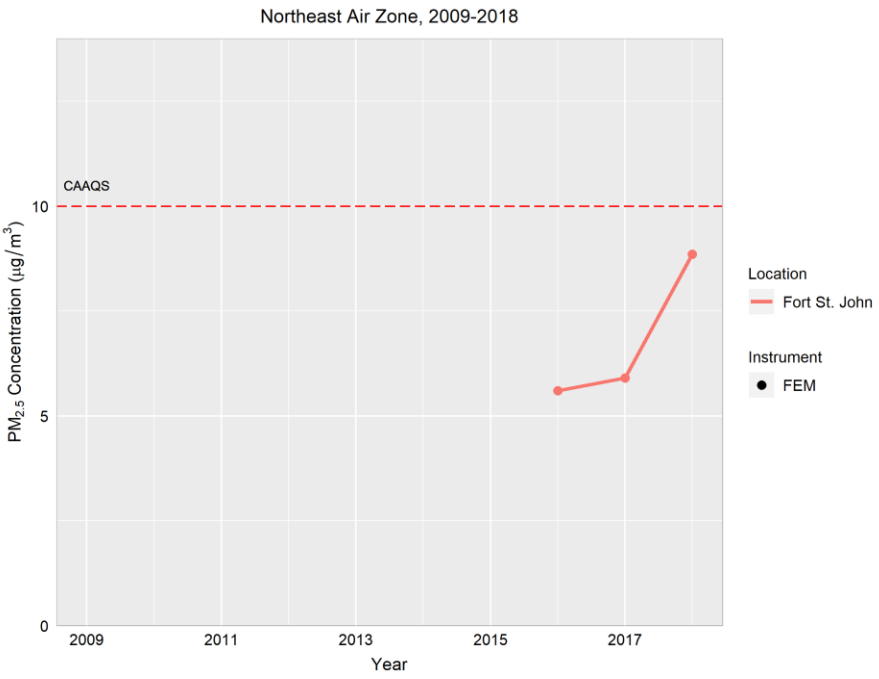


Figure 5. Trends in $PM_{2.5}$ concentrations (2009-2018), based on annual mean concentrations from a single year. The CAAQS value of 10 µg/m^3 is shown by the dashed line.

Air Zone Management Levels

Air zone management levels are assigned on the basis of the highest concentrations within an air zone, excluding contributions from transboundary flows (TF) and exceptional events (EE) such as wildfires. This is done so that long-term management strategies are not developed on the basis of events that are beyond local or provincial control.

In the Northeast Air Zone, wildfires are the primary contributor to TF/EE. The methodology for identifying wildfire-influenced data is provided in Appendix I.

Table 2 summarizes ozone concentrations as measured and after consideration of any TF/EE influences. Over the period of 2016-2018, no wildfire influences were identified. As management levels are primarily based on those sites with three complete years of data, the Northeast Air Zone is assigned a "green" management level based on ozone levels in Fort St. John. This indicates that any ozone-related actions should focus on keeping clean areas clean.

Table 3 summarizes both as-measured $PM_{2.5}$ concentrations and management levels once estimated wildfire influences have been removed. As discussed further in Appendix II, wildfire influences were identified, but the impact on management levels was small. The air zone is assigned a "yellow" management level for $PM_{2.5}$. This means that $PM_{2.5}$-related actions should focus on preventing air quality deterioration.

Table 2. Summary of ozone concentrations as measured and air zone management levels for the Northeast Air Zone (based on 2016-2018 data). Overall management level is preferentially based on site with highest management level and three compete years of data.

Location	No. Valid Years	4th Highest Daily 8-hour Maxima (ppb)		Air Zone Management Level
		As Measured	TF/EE Influences Removed	
Fort St. John-Key Learning Centre	3	50	50	**Goal: Keeping Clean Areas Clean**
Rolla	2	50	50	
Taylor-Lone Wolf Golf Course	2	51	51	

Table 3. Summary of $PM_{2.5}$ concentrations as measured and air zone management levels for the Northeast Air Zone (based on 2016-2018 data).

Location	Monitor Type	No. Valid Years	Daily Mean (98th Percentile)		Annual Mean		Air Zone Management Level
			As Measured	TF/EE Removed	As Measured	TF/EE Removed	
Fort St. John – Key Learning Centre	FEM	3	28	18	6.8	5.9	Goal: Prevent Air Quality Deterioration

Actions to Protect Air Quality

Air quality activities in the Northeast Air Zone have largely focussed on characterizing air quality in this region and identifying potential impacts from the oil and gas sector. As reported in the 2015-2017 air zone report, surveillance monitoring was conducted in a number of smaller communities that are closer to oil and gas production as part of the Northeast Air Quality Monitoring Project. Results from this study can be found in the "Northeast Air Quality Monitoring Report" (see: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/air/reports-pub/northeast_bc_air_quality_assessment_report.pdf).

A description of other activities underway in B.C. air zones can be found in the "Air Zone Management Response for British Columbia" (see: www.gov.bc.ca/bcairquality).

Appendix I – Approach to Identify Wildfire-influenced Data

Summertime air quality in British Columbia is periodically influenced by wildfire smoke – from local fires as well as long-range transport from outside of the province. The wildfire season in B.C. typically occurs between May and September, when warm and dry conditions prevail.

A myriad of different pollutants is emitted from wildfires, including $PM_{2.5}$ and gases that include nitrogen oxides and volatile organic compounds (VOCs) that can react in the atmosphere to form ground-level ozone and additional $PM_{2.5}$.

Given that smoke-affected areas may be extensive, and that smoke may linger for days before being fully dispersed from an airshed, the current analysis has focussed on those periods when wildfire smoke may have contributed to an exceedance of the CAAQS levels for $PM_{2.5}$ or ozone. Criteria used to flag and evaluate wildfire-influenced data included the following:

- 24-hour $PM_{2.5}$ concentrations in excess of the CAAQS level of 28 $\mu g/m^3$ and/or 8-hour daily maximum ozone levels in excess of the CAAQS level of 63 ppb between May and September,
- Wildfires of interest identified based on data from B.C. Wildfire Management Branch,
- Wildfire smoke advisories had been issued by the Ministry of Environment & Climate Change Strategy during the period of interest,
- NASA satellite images showing smoke impacts over the region, and
- Multiple monitoring sites in the area of concern showing elevated pollutant concentrations, suggesting a common regional source.

Appendix II – Wildfire-influenced Data in the Northeast Air Zone (2016-2018)

Ozone and $PM_{2.5}$ data from 2016-2018 for the Northeast Air Zone were evaluated based on the criteria set out in Appendix I for TF/EE influences. Wildfire-influenced $PM_{2.5}$ data are summarized in Table II-1. Supporting evidence included the following:

- Wildfires of note – either due to size or proximity to populated areas – are tracked by the BC Wildfire Service (see: https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary).
    - 2016 was below-average in terms of the amount of land burned (0.10 million hectares.
    - In contrast, 2017 (1.22 million hectares) and 2018 (1.35 million hectares ha) were record-breaking years.
    - Several large fires burned in the interior of B.C. during the summers of 2017 and 2018 (see Table II-1 for example). The smoke impacts due to these fires was at times widespread and affected air quality in B.C. and beyond.
- Days flagged as wildfire-influenced (Table II-2) coincided with Smoky Skies Bulletins issued by the Ministry of Environment and Climate Change Strategy.
- Satellite images from 2017 (see Figure II-1) and 2018 (see Figure II-2) provide additional information on both the number of wildfires and the spatial extent of wildfire smoke in and adjacent to the Northeast Air Zone on wildfire-influenced days.

Table II-1. Examples of notable wildfires in the central interior during 2018.[5]

Date Discovered	Size (ha)	Geographic Location	Description
2017-07-06	191,865	Elephant Hill	Large area spanning near Ashcroft to near B.C. Highway 24 at north end
2017-07-06	5,700	Gustafsen fire	Just west of 100 Mile House
~2017-07-07	545,151	Chilcotin Plateau	Complex of nearly 20 separate fires on Chilcotin Plateau
~2017-07-07	241,160	Hanceville Complex	Complex of fires around Hanceville, Riske Creek, Alexis Creek and surrounding areas
~2017-07-07	31,181	Central Cariboo Complex	Complex of fires around Williams Lake, Soda Creek and surrounding areas
~2017-07-07	33,018	West Chilcotin Complex	Complex of fires that included the 7,368 ha Precipice fire 52 km east of Bella Coola

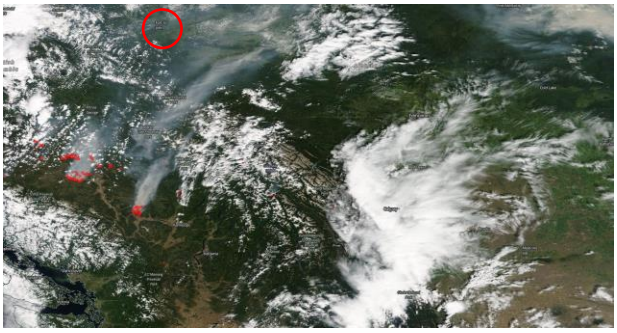
[5] https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary

Table II-1 continued

Date Discovered	Size (ha)	Geographic Location	Description
2018-07-27	92,412	Fraser Complex - Shovel Lake	6.7 km northwest of Endako; caused by equipment use
2018-07-30	20,813	Fraser Complex-Chutanli Lake	11 km northeast of Tatelkuz Lake; caused by equipment use
2018-07-30	10,2602	Fraser Complex-Tezzeron Lake	106 km northwest of Vanderhoof; lightning-caused
2018-07-31	79,394	Tweedsmuir Complex – Ramsey Creek	Tweedsmuir Provincial Park; lightning-caused
2018-08-01	21,381	Fraser Complex - Island Lake	Adjacent to Island Lake; lightning-caused
2018-08-01	44,817	Tweedsmuir Complex - Dean River	Tweedsmuir Provincial Park; lightning-caused
2018-08-01	12,322	Baezaeko Complex-Shag Creek	Lightning-caused
2018-08-01	8,278	Baezako Complex-Blackwater River	Lightning-caused
2018-08-01	13,433	Baezako Complex-North Baezaeko	South of Kluskoil Lake Park, 85 km west of Quesnel; lightning-caused
2018-08-03	60,631	Tweedsmuir Complex – Pondosy Bay	Tweedsmuir Provincial Park; lightning-caused

Table II-1 Wildfire-influenced $PM_{2.5}$ data from 2017 and 2018.

Location	Date	24-hr $PM_{2.5}$ ($\mu g/m^3$)	Smoky Skies Bulletin?
Fort St. John	2017-07-15	28.3	Y
Taylor-Lone Wolf Golf Centre	2017-07-15	29.0	Y
Fort St. John	2017-08-13	46.7	Y
Fort St. John	2017-09-07	49.4	Y
Fort St. John	2018-05-24	29.2	Y
Fort St. John	2018-08-07	28.1	Y
Fort St. John	2018-08-08	50.1	Y
Fort St. John	2018-08-09	116.5	Y
Fort St. John	2018-08-10	92.1	Y
Fort St. John	2018-08-14	44.4	Y
Fort St. John	2018-08-15	36.4	Y
Fort St. John	2018-08-16	67.9	Y
Fort St. John	2018-08-17	66.2	Y
Fort St. John	2018-08-21	102.6	Y
Fort St. John	2018-08-22	178.3	Y
Fort St. John	2018-08-24	57	Y
Fort St. John	2018-08-25	49.4	Y



a. NASA Worldview, Jul. 15, 2017

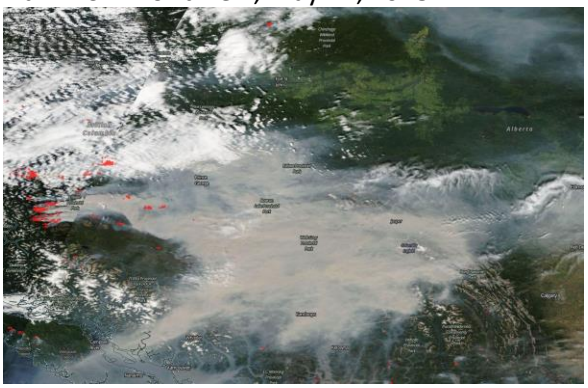
b. NASA Worldview, Aug. 13, 2017

c. NASA Worldview, Sep. 7, 2017

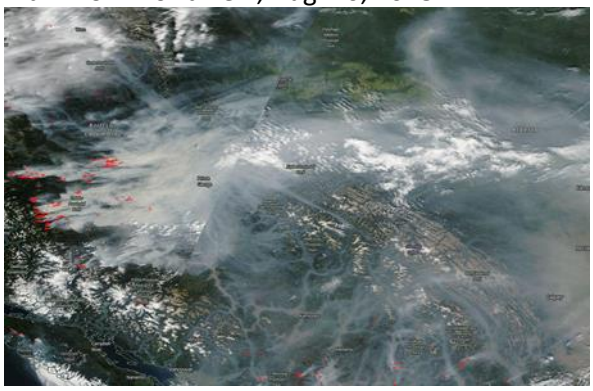
Figure II-1. Satellite images from Jul. 15, Aug. 13 and Sep. 7, 2017, showing wildfire smoke (grey plumes) over parts of B.C. including the northeast of the province. Small red dots indicate fires and thermal anomalies. Large red circle in Figure II-1(a) shows approximate location of Fort St. John. Source of images: NASA Worldview at: https://worldview.earthdata.nasa.gov/.

a. NASA Worldview, May 24, 2018

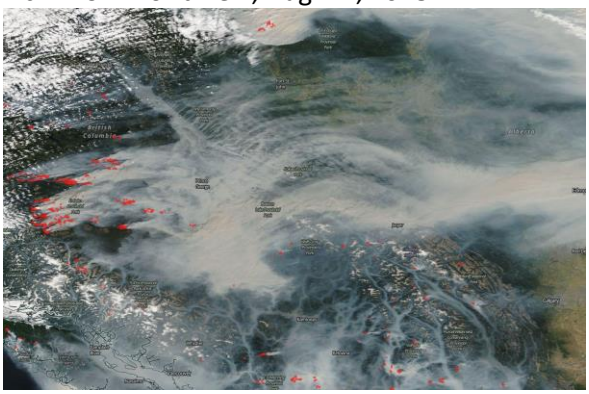
b. NASA Worldview, Aug. 10, 2018



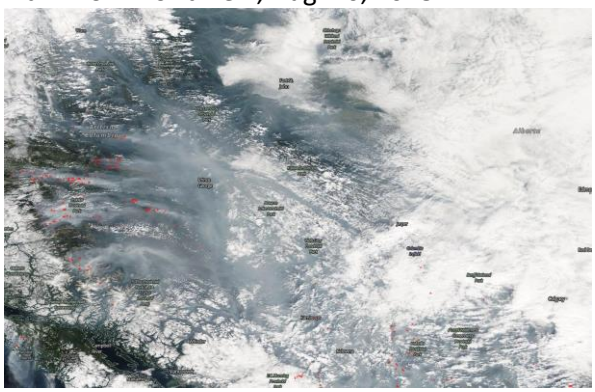
c. NASA Worldview, Aug. 14, 2018



d. NASA Worldview, Aug. 16, 2018



e. NASA Worldview, Aug. 21, 2018



f. NASA Worldview, Aug. 24, 2018

Figure II-2. Satellite images from May 24 and Aug. 10, 14, 16, 21 and 24, 2018, showing wildfire smoke (grey plumes) over parts of B.C. including the northeast of the province. Small red dots indicate fires and thermal anomalies. Large red circle in Figure II-2(a) shows approximate location of Fort St. John. Source of images: NASA Worldview at: https://worldview.earthdata.nasa.gov/.