March 7, 2019

SPECIFICATION SHEET: OTHPT

Description: Canadian and Mexican point source emissions, for simulating 2016 air quality

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1. EXECUTIVE SUMMARY

Canadian and Mexican point source emissions are processed in the othpt sector using inventories provided by Environment and Climate Change Canada (ECCC) for year 2015, and a projection of Mexico emissions from 2008 to 2016. This sector includes all point source emissions in Canada and Mexico, except for ag land breaking PM emissions in Canada (othptdust sector). Temporal profiles are provided by ECCC. Base year inventories were processed with the Sparse Matrix Operating Kernel Emissions (SMOKE) modeling system version 4.6. SMOKE creates emissions in a format that can be input into air quality models. National and province/state-level emission summaries for key pollutants are provided.

2. INTRODUCTION

This document details the approach and data sources to be used for developing 2016 emissions for the Canadian and Mexican point source (othpt, or other point) sector. This sector includes all point source emissions in Canada and Mexico, except for ag land breaking PM emissions in Canada, which require afdust-style reductions and are in the othpt sector.

Canadian emissions for this sector are provided by ECCC for the year 2015 and are used directly (i.e. without projecting) for 2016 modeling. In Canada, the othpt sector includes the following inventories:

- Agricultural emissions from livestock (NH3 and VOC) and fertilizer (NH3), which are now represented as point sources rather than area sources in Canada
- Aircraft emissions, including landing and take-off (LTO)
- Upstream oil and gas (UOG)
- Other point source emissions (EGUs and various nonEGU point sources)
- CMV C3 emissions, extracted from the area source marine inventory and converted to point format

In Mexico, the othpt sector includes a point source inventory for year 2016, and a CMV port inventory for year 2014.

The othpt sector includes 732 SCCs. To help manage the size of this document, a full table of SCCs is not included here.

3. INVENTORY DEVELOPMENT METHODS

Canada

ECCC provided the Canadian point source emissions inventory for 2015 in a format that is close to, but not exactly, FF10. Some columns that are unused by SMOKE contained metadata that needed to be reformatted or moved prior to importing the data into EPA's Emissions Modeling Framework (EMF), due to restrictions on variables types imposed by the FF10 format (e.g. character values in numeric fields). Also, accented characters needed to be removed from facility names to facilitate importing the data into EMF. Finally, point source IDs such as the unit_id and rel_point_id were added to the inventory where necessary, since these IDs are required by SMOKE.

Emissions for year 2015 were used directly for year 2016 modeling in beta platform. The ag and aircraft inventories are monthly, and the other Canada inventories in othpt are annual. The Canada point inventories are census-division-level.

Detailed documentation of the ECCC emissions inventories for 2015 is provided in the following document: *A18031_2015_Canadian_CAC_EmissionsInventoryPackage_version1.docx*
The othpt sector includes eight Canadian point inventories that were provided directly by ECCC: three ag inventories (animal_NH3, animal_VOC, fertilizer_NH3); point_airport_LTO; Upstream Oil and Gas (UOG); and three inventories covering other point sources according to pollutant (CB6 species, total VOC, and all pollutants except VOC).

The othpt sector also includes a point inventory representing Canadian CMV C3 emissions. ECCC provided all CMV emissions as an area source inventory. To support application of plume rise to Canadian C3 emissions, the area source C3 emissions were converted to point format, using shapefiles provided by ECCC for marine sources to allocate the sources to specific coordinates, and moved to the othpt sector. Underway and port emissions were plotted using separate shapefiles. To prevent a double count with this sector, the cmv_c3 sector does not include any emissions in Canadian federal waters, on-shore or off-shore.

In Canada, different pollutants were sometimes assigned to different point source IDs even though they originate from the same source. Whenever PM10 and PM2.5 emissions from the same source were assigned to different point source IDs, SMOKE treats the PM10 and PM2.5 emissions as coming from separate sources, causing an error in the PMC calculation within SMOKE. To fix this error, we changed the process IDs for many PM2.5 records so that they matched the process IDs for PM10. Occasionally we had to change the unit IDs for the same reason.

Information regarding the pre-speciated VOC point source inventory in Canada is provided in Section 4, Chemical Speciation.

Mexico

The othpt sector includes two Mexico inventories. One of the inventories is a general point source inventory. This inventory is based on projections of a 2008 inventory. The inventory was originally projected to years 2014 and 2018 by ERG. For 2016 beta platform, emissions values from those two years were averaged (interpolated) to 2016.

The second Mexico point source inventory is a CMV inventory, which includes emissions from a few ports in Mexico, but not including any underway emissions. This inventory is only available

for the year 2014, so no projections or interpolations to 2016 were performed; instead, year 2014 emissions were used directly. Because this inventory includes no underway emissions, it does not double-count CMV emissions in Mexico federal waters from the cmv_c3 sector.

4. ANCILLARY DATA

Spatial Allocation

Spatial allocation of othpt emissions to the national 36km and 12km domains used for air quality modeling is accomplished using latitude and longitude coordinates from the inventories.

Temporal Allocation

Othpt sector inventories are temporalized to hourly using month-of-year, day-of-week, and hour-of-day temporal profiles. The Canadian ag and aircraft inventories are monthly and do not have month-of-year temporalization applied. ECCC provided temporal profiles and an SCC cross-reference. The Canadian temporal profiles used in beta platform differ from those provided by ECCC in the following ways:

- ECCC provided temporal profiles and cross-references in a format used by older versions of SMOKE (3.5 and earlier). We converted their profiles and cross-reference to the format used by SMOKE 4.6.
- ECCC's cross-reference included an overall default profile (SCC=000000000) to be used when specific SCCs were not included in the cross-reference. As a standard practice, we do not include an overall default profile in our temporal cross-reference, so we removed that assignment and filled in missing SCCs, with profiles assigned to those for similar SCCs as needed.

Mexico sources use the same temporal profiles as Canada.

Reports summarizing total emissions according to the monthly, day-of-week, and hour-of-day temporal profile assignments are included in the emissions modeling workgroup reports package at the state and county level.

Chemical Speciation

One of the Canadian point source inventories includes pre-speciated VOC emissions for the CB6 mechanism. However, this inventory did not include all species needed for the CB6 mechaism for CMAQ; specifically, CH4, SOAALK, NAPH, and XYLMN were missing. For the NAPH species, naphthalene emissions from a supplemental HAP inventory provided by ECCC were used. Then, XYL was converted to XYLMN by subtracting NAPH. Finally, CH4 and SOAALK were speciated from total VOC (also provided by ECCC) using traditional speciation profiles by SCC.

In addition to the pre-speciated VOC inventory, ECCC also provided a total inventory VOC (VOC_INV) inventory for the same point sources. These VOC_INV emissions are passed through SMOKE with species name VOC_INV only and are not speciated. Including VOC_INV in the model-ready emissions helps with generation of post-SMOKE reports or plots of total VOC emissions.

There are also other sources in Canada, such as oil and gas, for which we do not have pre-speciated VOC emissions and for which we apply VOC speciation within SMOKE.

Otherwise, the othpt sector includes speciation of PM2.5 and VOC emissions using the same profiles and SCC cross-references as in the US. Other than the pre-speciated VOC emissions in Canada, there is no HAP integration in this sector.

Reports summarizing total PM2.5 and VOC emissions according to speciation profile are included in the emissions modeling workgroup reports package at the state and county level.

5. Emissions Projection Methods

Future year projections for the 2016 beta platform have not yet been finalized at the time this was written.

6. Emissions Processing Requirements

Othpt emissions are processed for air quality modeling using the Sparse Matrix Operator Kernel Emissions (SMOKE[1]) modeling system. As with all point source sectors, this is typically handled with two separate scripts, or "jobs": one which processes time-independent, or "onetime", programs (Smkinven, Spcmat, Grdmat, Smkreport, Elevpoint), and one which processes time-dependent programs (Temporal, Smkmerge). Since some of the point source inventories are monthly, the onetime step is run once for every month.

The othpt sector is processed through SMOKE using a PELVCONFIG file that classifies all emissions as "elevated". This means all of the othpt sector emissions are output to an inline point source file for input to CMAQ and are subject to plume rise, even though some of these sources will end up being low-level sources based on plume rise calculations. A 2-D gridded emissions file for othpt is not generated, nor are any othpt sector emissions merged into the model-ready 2-D gridded emissions.

[1] http://www.smoke-model.org/index.cfm

7. EMISSIONS SUMMARIES

National and state totals by pollutant for the beta platform cases are provided here, and some example plots. Additional onroad mobile plots and maps are available online through the LADCO website[2] and the Intermountain West Data Warehouse[3].

The case descriptions are as follows:

2011en, 2023en, 2028el = Final 2011, 2023, and 2028 cases from the 2011v6.3 platform

2014fd = 2014NEIv2 and 2014 NATA

2016fe = 2016 alpha platform (grown from 2014NEIv2)

2016ff = 2016 beta platform

Table 1. Comparison of Canada national total annual CAPS othpt emissions (tons/yr)

Pollutant	2011en	2014fd	2016fe	2016ff	2023en	2028el
CO	1,405,817	1,405,817	1,479,048	1,338,471	1,697,818	1,322,367
NH3	19,240	19,240	20,712	522,334	25,401	20,978
NOX	833,998	833,998	799,283	1,049,857	811,424	938,876
PM10	133,709	133,709	112,210	156,809	121,884	163,330
PM2.5	57,660	57,660	56,881	61,707	64,236	67,998
SO2	1,235,619	1,235,619	1,107,046	1,126,873	903,591	1,233,069
VOC	963,504	963,504	979,770	990,109	1,026,119	513,761

Table 2. Comparison of Mexico national total annual CAPS othpt emissions (tons/yr)

Pollutant	2011en	2014fd	2016fe	2016ff	2023en	2028el
CO	683,482	801,953	870,711	870,711	928,414	1,005,161
NH3	32,773	33,978	36,587	36,587	45,251	51,916
NOX	651,521	1,041,307	1,041,004	1,041,004	775,506	868,360
PM10	241,496	277,304	285,497	285,497	304,874	348,528
PM2.5	168,144	200,851	205,461	205,461	210,851	240,645
SO2	2,276,770	2,341,533	2,286,086	2,286,086	2,105,867	2,181,839
VOC	303,905	332,800	356,270	356,270	427,730	496,080

Table 3. Comparison of province total annual NOx othpt emissions (tons/yr)

Province	2011en	2014fd	2016fe	2016ff	2023en	2028el
Alberta	489,584	489,584	447,382	510,293	421,837	575,981
British Columbia	86,375	86,375	102,308	157,831	140,438	89,526
Manitoba	3,590	3,590	3,755	4,327	4,250	3,822

[2] https://www.ladco.org/technical/modeling-results/2016-inventory-collaborative/

[3] http://views.cira.colostate.edu/iwdw/eibrowser2016

Province	2011en	2014fd	2016fe	2016ff	2023en	2028el
NW Territories	9,497	9,497	10,882	12,639	15,040	9,107
New Brunswick	15,790	15,790	16,127	15,638	17,138	16,804
Newfoundland	15,449	15,449	14,747	43,653	17,288	23,646
Nova Scotia	23,948	23,948	22,255	52,741	17,174	25,181
Nunavut	3,154	3,154	815	9,739	1,110	5,588
Ontario	76,441	76,441	72,529	86,561	77,106	72,773
Prince Edward Island	269	269	261	619	234	321
Quebec	39,911	39,911	41,623	88,267	42,254	50,554
Saskatchewan	69,971	69,971	66,578	67,385	57,526	65,439
Yukon	18	18	20	163	27	135

Table 4. Comparison of state total annual NOx othpt emissions (tons/yr)

State	2011en	2014fd	2016fe	2016ff	2023en	2028el
Aguascalientes	987	1,046	1,115	1,115	1,407	1,657
Baja Calif	14,498	51,617	57,007	57,007	32,455	36,145
Baja Calif Sur	8,899	30,995	26,952	26,952	2,582	2,740
Campeche	35,616	107,621	109,753	109,753	41,077	43,559
Chiapas	5,503	5,736	6,107	6,107	7,500	8,690
Chihuahua	11,989	11,839	12,807	12,807	13,663	15,396
Coahuila	217,689	260,400	233,909	233,909	218,533	239,177
Colima	15,921	39,088	40,154	40,154	7,294	6,261
Distrito Federal	2,582	2,727	2,964	2,964	3,853	4,536
Durango	6,988	6,653	7,231	7,231	7,371	8,167
Guanajuato	9,566	8,940	9,767	9,767	12,567	14,143
Guerrero	14,706	18,006	16,289	16,289	14,270	15,052
Hidalgo	35,641	36,580	38,735	38,735	50,270	57,900
Jalisco	7,403	7,841	8,366	8,366	10,547	12,415
Mexico	17,656	18,613	23,400	23,400	35,567	42,073
Michoacan	4,966	18,673	19,026	19,026	6,938	8,150
Morelos	4,249	4,504	4,806	4,806	6,064	7,142
Nayarit	375	399	426	426	538	631
Nuevo Leon	41,887	45,445	48,758	48,758	57,573	67,018
Oaxaca	10,928	33,165	34,158	34,158	13,944	14,946
Puebla	7,360	7,740	8,397	8,397	11,104	13,054
Queretaro	9,793	11,964	12,953	12,953	22,762	28,917
Quintana Roo	616	16,310	16,163	16,163	388	432
San Luis Potosi	22,263	22,661	25,636	25,636	33,743	37,848
Sinaloa	10,982	23,914	20,023	20,023	2,049	2,450
Sonora	14,581	24,938	25,361	25,361	18,526	20,768
Tabasco	23,255	38,740	40,317	40,317	29,986	33,749
Tamaulipas	34,020	67,274	69,921	69,921	42,968	48,354
Tlaxcala	962	1,019	1,140	1,140	1,531	1,806
Veracruz	48,607	98,705	101,302	101,302	56,892	61,418
Yucatan	11,020	18,142	18,049	18,049	11,529	13,747

State	2011en	2014fd	2016fe	2016ff	2023en	2028el
Zacatecas	11	12	12	12	15	18

Table 5. Comparison of province total annual SO2 othpt emissions (tons/yr)

Province	2011en	2014fd	2016fe	2016ff	2023en	2028el
Alberta	341,784	341,784	286,947	271,989	266,675	397,763
British Columbia	71,232	71,232	84,143	62,802	121,567	72,876
Manitoba	175,367	175,367	134,557	169,249	12,128	150,628
NW Territories	713	713	673	988	553	228
New Brunswick	21,768	21,768	21,746	23,221	21,681	25,405
Newfoundland	23,320	23,320	19,278	21,528	18,105	29,199
Nova Scotia	81,235	81,235	72,089	69,648	44,652	77,531
Nunavut	12	12	13	2,484	17	128
Ontario	286,280	286,280	249,695	273,618	171,985	224,069
Prince Edward Island	253	253	225	165	141	859
Quebec	119,561	119,561	130,632	120,629	160,187	137,299
Saskatchewan	114,092	114,092	107,043	110,516	85,895	117,038
Yukon	3	3	3	38	4	47

Table 6. Comparison of state total annual SO2 othpt emissions (tons/yr)

State	2011en	2014fd	2016fe	2016ff	2023en	2028el
Aguascalientes	2,126	2,254	2,405	2,405	3,034	3,573
Baja Calif	6,544	25,584	26,051	26,051	9,312	10,939
Baja Calif Sur	23,287	32,009	22,362	22,362	1,258	1,478
Campeche	597,041	602,321	640,701	640,701	680,281	710,130
Chiapas	64,007	67,876	72,430	72,430	91,338	107,575
Chihuahua	26,614	16,536	19,391	19,391	10,357	6,101
Coahuila	259,191	307,877	279,080	279,080	266,372	293,265
Colima	120,897	73,727	81,724	81,724	32,885	17,649
Distrito Federal	815	862	919	919	1,166	1,372
Durango	23,453	16,985	19,303	19,303	14,845	13,374
Guanajuato	45,221	37,023	40,646	40,646	41,309	40,820
Guerrero	136,218	158,113	141,750	141,750	130,119	135,900
Hidalgo	235,959	233,150	196,831	196,831	184,420	194,849
Jalisco	28,016	29,691	31,684	31,684	39,974	47,078
Mexico	7,594	7,736	8,403	8,403	10,985	12,801
Michoacan	15,236	22,308	23,385	23,385	20,150	23,491
Morelos	11,889	12,600	13,446	13,446	16,968	19,985
Nayarit	335	355	379	379	478	563
Nuevo Leon	37,296	35,410	40,357	40,357	48,160	51,357
Oaxaca	120,767	130,599	142,578	142,578	146,499	149,424
Puebla	5,322	5,621	6,004	6,004	7,675	9,029
Queretaro	5,211	5,525	5,896	5,896	7,447	8,773

State	2011en	2014fd	2016fe	2016ff	2023en	2028el
Quintana Roo	688	8,853	8,589	8,589	178	169
San Luis Potosi	77,709	60,398	70,544	70,544	69,928	66,068
Sinaloa	106,500	103,052	63,463	63,463	14,453	17,401
Sonora	75,235	73,211	45,469	45,469	10,868	13,062
Tabasco	16,234	24,919	26,039	26,039	22,532	26,279
Tamaulipas	48,001	57,551	63,957	63,957	49,954	49,670
Tlaxcala	1,706	1,807	1,929	1,929	2,436	2,869
Veracruz	159,311	168,060	171,215	171,215	154,777	134,612
Yucatan	18,345	19,517	19,154	19,154	15,704	12,181
Zacatecas	3	3	3	3	4	5