Appendix 8G

Emission Processing for OTC 2009 OTW/OTB 12km CMAQ Simulations

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Overview

The OTC 2009 OTW/OTB emission modeling was conducted at the Virginia Department of Environmental Quality (DEQ). The modeling followed and retained the framework of the previous (original) OTC 2002/2009 emission modeling done by the New York State Department of Environmental Conservation (NYSDEC). Several changes and corrections had been made throughout the entire modeling period. Virginia DEQ was in close contact with NYSDEC which provided many premerged netCDF files for inclusion in the merging process to obtain final SMOKE outputs for CMAQ simulations.

Emissions for all source categories were processed by SMOKE2.1. The SMOKE programs downloaded from Community Modeling and Analysis System (CMAS) website have been compiled for LINUX system and ready for usage. If existing compiled codes returned errors, such as in the case of large MCIP files, compiled versions provided by NYSDEC and available at Ozone Research Center's (ORC) ftp sites were used instead.

Data Sources

The majority of raw input data files were provided to DEQ by Greg Stella of AlpineGeophysics through its ftp site at alpinegeophysics.com. Different versions of 2009 SMOKE emission modeling have been conducted over the years by AlpineGeophysics. The version of input data files used for OTC 2009 OTW/OTB emission modeling was labeled as BaseG of the AlpineGeophysics.

In some source categories, primarily in MANEVU and Canada regions, several changes and corrections in emissions were made at various stage of SMOKE modeling, causing the outputs using AlpineGeophysics files to be discarded. SMOKE modeling of those categories (described below) was performed by NYSDEC which made netCDF outputs available at Ozone Research Center's ftp site at ozoneresearch.org. In such cases, DEQ used the premerged netCDF files directly for final merging.

SMOKE Processing

The OTC 12km regional and urban scale modeling domain encompasses four RPOs: VISTAS, MANEVU, CENRAP, and MRPO. Part of Canada also falls in the modeling domain.

The OTC 2009 OTW/OTB emissions were processed roughly on a month-by-month and RPO-by-RPO basis. SMOKE modeling was conducted for each month for each of the four individual RPOs as well as for Canada (completed by NYSDEC), except for mobile source category, which was done by two sub-RPOs: one for MANEVU and the other for the combination of VISTAS, CENRAP, and MRPO. A separate SMOKE ASSIGNS file was created for each RPO and/or source category. The episode length in the ASSIGNS files varies from one month to the entire year.

Five major emission source categories (listed below) were included in the OTC 2009 OTW/OTB SMOKE modeling. Sub-categories were lumped into the major categories here for presentation purpose but were treated as separate categories in processing. For example, low-level wildfire was treated as area source, whereas high-level wildfire was modeled as point source. In addition, point source category was further divided into EGU and non-EGU. Minor sources such as non-fossil fuels and marine vassel were processed as well. Table 1 summarizes input files and other relevant information for each of the RPOs and Canada.

(1). Area (including low-level wildfire and NH_3);
(2). Nonroad (including marine vassel);
(3). Point (including EGU, Non-EGU, non-fossil fuels and wildfires);
(4). Mobile;
(5). Biogenic.

For VISTAS region (only), AlpineGeophysics has developed annual, daily, or hourly emissions data for EGU and high-level wildfire source categories. SMOKE run script parameters of DAY_SPECIFIC_YN and/or HOUR_SPECIFIC_YN were turned on (to Y) and month-specific temporal profiles of BaseG were applied to make sure those more detailed inventory files were used to override annual emissions.

Mobile source emissions were divided into two groups for processing. The original input file (mbinv_vistas_09g_vmt_12jun06.txt) provided by AlpineGeophysics contains VMT data for all four RPOs. The MANEVU portion was first removed from the original file and the revised file (otherRPOs.mb.vmt.emis) which contains VMT data for the remaining three RPOs (VISTAS, CENRAP, MRPO) was then used as the input inventory for processing. The MANEVU portion removed from the original file was processed separately on its own as another group.

MOBILE6 Processing

As described above, mobile source emissions for three RPOs — VISTAS, CENRAP, and MRPO — were grouped and processed together. To estimate vehicle emission factors in MOBILE6, temperature averaging of space and time were specified in input file of mvref_vistas_2009g_26aug06.txt as follows:

(1). Spatial averaging: temperatures were averaged over all counties that share a common reference county;

(2). Temporal averaging: temperatures were averaged over the duration of the episode, which in present case is one month.

The averaging described above is consistent with the original OTC 2002/2009 emission processing done by NYSDEC. DEQ also processed MANEVU portion of mobile source. However, due to the inconsistency of temporal profile and cross-reference file used between DEQ's run and the original 2002/2009 run by NYSDEC, those outputs were discarded. NYSDEC re-processed the MANEVU portion and provided netCDF files to DEQ for final merging. The re-processed MANEVU run by NYSDEC reflects updated mobile source information in New Jersey and Connecticut.

Speciations, Temporal and Spatial Allocations

For consistency, the OTC 2009 OTW/OTB input profiles for speciations, temporal, and spatial allocations remained the same as the original OTC 2002/2009 emission modeling done by NYSDEC, even though more up-to-date profiles (such as those marked with BaseG or later) were available at the AlpineGeophysics. No attempt was made to examine the effects of different versions of profiles on daily emissions.

Fugitive Dust Corrections

Fugitive dust emissions were corrected in SMOKE by two-step process. First, SMKINVEN and CNTLMAT were executed with two separate input files: (1) the original inventory file, and (2) a controlled matrix file of 2009 dust projection factors. A new inventory file containing adjusted emissions was created in SMKINVEN/CNTLMAT run. The new file was then used as the inventory input for regular SMOKE processing of SMKINVEN, SPCMAT, GRDMAT, TEMPORAL, LAYPOINT (for point source), and SMKMERGE. The source categories which went through this two-step process included non-EGU for VISTAS, MANEVU, CENRAP, and MRPO, and area sources for MANEVU and CENRAP.

Canadian and Biogenic Emissions

Canadian emissions of all four source categories (area, nonroad, point, mobile) and domain-wide biogenic emissions were processed by NYSDEC. Details on how emission modeling of these categories was conducted have been documented in "Emission Processing for the Revised 2002 OTC Regional and Urban 12 km Base Case Simulations" by NYSDEC. DEQ obtained premerged netCDF files for these source categories from ORC ftp site and used them directly for final merging.

Premerged netCDF Files

In December 2006, NYSDEC made further adjustments to ammonia and dust emissions of MRPO region and ran through SMOKE with the adjusted emissions. Three of MRPO's source categories were affected: area, nonroad, and NH_3. As a result, outputs generated by DEQ for the three affected MRPO's categories were discarded. Canadian emissions of all four source categories (area, nonroad, point and mobile) were also re-processed by NYSDEC with updated information. Seven newer versions, three for MRPO and four for Canada, of premerged netCDF files reflecting the adjustments were made available at ORC ftp site. The updated premerged netCDF files were used to replace earlier versions in the final merging process..

SMOKE Merging

A total of twenty-seven netCDF files were merged together to produce daily total emissions for use as inputs to CMAQ:

(1). Six for VISTAS (excluding mobile);
(2). Five for MANEVU (excluding mobile);
(3). Four for CENRAP (excluding mobile);
(4). Five for MRPO (excluding mobile);
(5). Two for mobile source emissions;
(6). Four for Canadian emissions;
(7). One for domain-wide biogenic emissions.

Table 1 lists the categories (indicated by sequential numbers) which were combined in the merging process.

BOTW Emissions

The differences between 2009 BOTW and 2009 OTW/OTB emissions lie in the area and non-EGU sources of MANEVU region where more controlled emissions are in effect for BOTW than for OTW/OTB. NYSDEC generated premerged netCDF files for BOTW run. To obtain 2009 OTC BOTW emissions, the two affected MANEVU source categories for OTW/OTB run were substituted and replaced by the new BOTW premerged files in the final merging process.

Table 1. 2009 OTW/OTB Emissions Processing Summary

	Category	Files	Files Source	Notes
		VISTAS		
(1)	**Area**	arinv_vistas_2009g_2453922_w_pmfac.txt	AlpineGeophysics	
(2)	**Nonroad**	nrinv_vistas_2009g_2453908.txt	AlpineGeophysics	
		marinv_vistas_2009g_2453972.txt	AlpineGeophysics	marine vessel emissions
(3)	**Non-EGU**	negu_ptinv_vistas_2009_baseg_2453957.txt	AlpineGeophysics	
(4)	**EGU**	egu_ptinv_vistas_2009_baseg_2453990.txt	AlpineGeophysics	annual emissions
		pthour_2009_baseg_mon_2453990.ems	AlpineGeophysics	hourly emissions, mon=may,jun,...
(5)	**Low Fire**	area_level_fires_vistas2002_baseg.ida	AlpineGeophysics	treated as area sources
(6)	**High Fire**	ptinv.plume.vistasbaseg09.num.ida	AlpineGeophysics	treated as point sources; annual data
		ptday.plume.vistasbaseg09.num.ida	AlpineGeophysics	daily data; num=1,2,...
		pthour.plume.vistasbaseg09.num.ida	AlpineGeophysics	hourly data; num=1,2,...
(7)	**Mobile**	otherRPOs.mb.vmt.emis	revised from AlpineG	contains VISTAS/CENRAP/MRPO
		MANEVU		
(8)	**Area**	MANEVU2009OTBAreaV3_1_woodburn.incl.IDA.txt	AlpineGeophysics	if BOTW, premerged netCDF for merging
(9)	**Nonroad**	2009MANEVUNRNIFV3_0_NonRoad_IDA.NJfix.txt	AlpineGeophysics	
(10)	**Non-EGU**	manevu2009noneguv3_0_point_ida.txt	AlpineGeophysics	if BOTW, premerged netCDF for merging
(11)	**EGU**	ptinv_egu_2009_manevu_10aug2006.txt	AlpineGeophysics	annual emissions
(12)	**Non-Fossile**	manevu_nonfossil_2009_19sept2006.txt	AlpineGeophysics	non-fossil fuel emissions
(13)	**Mobile**	netCDF file	NYSDEC	netCDF used for merging

Table 1. 2009 OTW/OTB Emissions Processing Summary (cont.)

	Category	Files	Files Source	Notes
		CENRAP		
(14)	**Area**	cenrap_area_burning_smoke_2009_input_ann_tx_neli_071905_2453959.txt	AlpineGeophysics	
		cenrap_area_misc_2009_smoke_input_ann_state_071905_2453959.txt	AlpineGeophysics	
		cenrap_area_misc_2009_smoke_output_nh3_annual_072805_rev_2453959.txt	AlpineGeophysics	
		arinv.cenrap_2009_09_xfact.ida.txt	AlpineGeophysics	
		cenrap_area_smoke_2009_output_nh3_annual_071905_rev_2453959.txt	AlpineGeophysics	
(15)	**Nonroad**	cenrap_nonroad_smoke_2009_output_annual_071305_rev.txt	AlpineGeophysics	
(16)	**Non-EGU**	ptinv_negu_cenrap2009_25aug2006.ida	AlpineGeophysics	
(17)	**EGU**	ptinv_egu_2009_cenrap_10aug2006.txt	AlpineGeophysics	annual emissions
	Mobile	otherRPOs.mb.vmt.emis	revised from AlpineG	VISTAS/CENRAP/MRPO
		MRPO		
(18)	**Area**	arinv_other_mrpok_2009_10aug2006.txt	AlpineGeophysics	dust correction; premerged netCDF
		dustinv_mrpo_basef4_2009_10nov05.ida	AlpineGeophysics	
(19)	**NH3**	nh3inv_2009_mrpok_ann_10aug2006.txt	AlpineGeophysics	dust correction; premerged netCDF
(20)	**Nonroad**	nrinv_mrpo_g_09_2453958_adj.txt	AlpineGeophysics	dust correction; premerged netCDF
		arinv_mar_mrpok_2009_7aug2006.txt	AlpineGeophysics	
(21)	**Non-EGU**	ptinv_negu_2009_mrpok_10aug2006.txt	AlpineGeophysics	
(22)	**EGU**	ptinv_egu_2009_mrpok_10aug2006.txt	AlpineGeophysics	annual emissions
	Mobile	otherRPOs.mb.vmt.emis	revised from AlpineG	VISTAS/CENRAP/MRPO

Table 1. 2009 OTW/OTB Emissions Processing Summary (cont.)

	Category	Files	Files Source	Notes
			CANADA	
(23)	**Area**	netCDF file	NYSDEC; downloaded from OTC ftp site	premerged netCDF for merging
(24)	**Nonroad**	netCDF file	NYSDEC; downloaded from OTC ftp site	premerged netCDF for merging
(25)	**Point**	netCDF file	NYSDEC; downloaded from OTC ftp site	premerged netCDF for merging
(26)	**Mobile**	netCDF file	NYSDEC; downloaded from OTC ftp site	premerged netCDF for merging
			BIOGENIC	
(27)	**biogenic**	netCDF file	NYSDEC; downloaded from OTC ftp site	domain-wide emissions; premerged netCDF for merging