Appendix C

Air Quality Modeling to Determine the Impacts of OGV Clean Fuel Regulations and Potential Shipping Routes on South Coast Air Basin Air Quality and Public Health

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Air Quality Modeling to Determine the Impacts of OGV Clean Fuel Regulations and Potential Shipping Routes on South Coast Air Basin Air Quality and Public Health

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I. Introduction

A regional air quality model was used to simulate ozone (O_3) and fine particulate matter (PM2.5) concentrations within a Southern California modeling domain for six scenarios of ocean-going vessel (OGV) emissions. The six emission scenarios varied based on:

- shipping activity levels within transit routes;
- potential regulatory zone configurations around the transit routes; and
- fuel types used within the regulatory zones.

Detailed information on the emission inventories used can be found in the Emissions Inventory section. Also, Attachment C-2 provides a detailed spatial summary of the OGV emission inputs used for modeling.

The model-simulated impact of different OGV activity, transit routes, and corresponding fuel use on inland air quality and public health was estimated by analyzing the model-simulated concentration differences between each scenario and baseline conditions.

II. Model Application

Model Configuration

To simulate gaseous and PM2.5 concentrations, the Community Multi-scale Air Quality (CMAQ) model version 4.6 was exercised for the year 2005 (http://www.cmaq-model.org/). The CMAQ model was developed by the U.S. EPA, and has been used by ARB in previous regional air quality modeling analyses. The year 2005 was selected because it was also used as the base year for the South Coast Air Quality Management District's (SCAQMD) PM2.5 State Implementation Plan (SIP) development (SCAQMD, 2007).

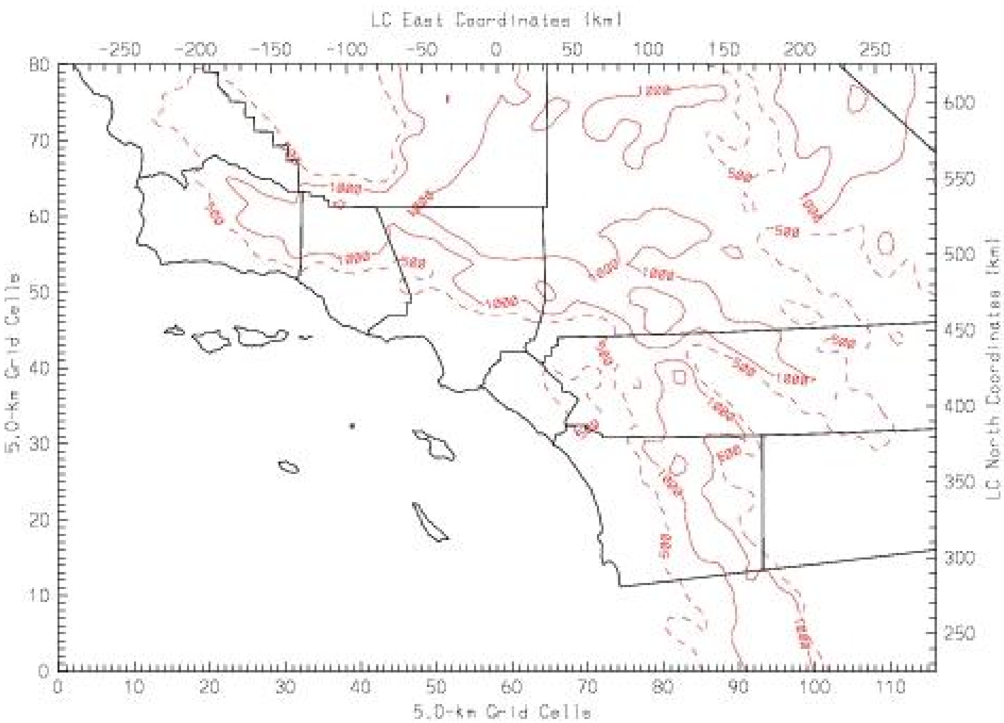
For the analysis described herein, the Carbon Bond V (CB05) gas-phase chemical mechanism and the AERO4 aerosol modules are used. Within the CMAQ model, particulate matter is grouped into three log-normal modes that correspond to the ultrafine (aerodynamic diameter (D_p) < 0.1 μm), fine (0.1 μm < D_p < 2.5 μm), and coarse (D_p > 2.5 μm) particles sizes. Concentrations of PM2.5 are assumed to be the sum of all simulated particulate matter concentrations with D_p less than 2.5 μm.

Domain Setup

The modeling system utilizes a domain comprised of a three-dimensional grid cell structure. The modeling domain covers the South Coast Air Basin (SCAB) with 116 by 80 horizontal grid cells with sides 5 km in length (Figure C-1). The vertical structure of the air quality modeling domain was determined by the layer structure of the meteorological model. In this analysis, there are nine vertical layers extending to the top of the meteorological domain. The lowest eight layers extend to approximately 5 kilometers above the surface.

The meteorological input fields required by the air quality model were generated using the MM5 prognostic meteorological model (Grell *et al.*, 1994). The MM5 model is recommended by the U.S. EPA (EPA, 2007) for air quality modeling applications and has been used for preparing ozone and PM SIP analyses in Central and Southern California. The MM5 model was used to generate hourly meteorological fields for the year 2005 (the utilized fields were produced by the South Coast AQMD and used for their air quality management plan). The Meteorology-Chemistry Interface Processor (MCIP) version 3.2, which is part of the CMAQ software package, was used to generate model-ready meteorological inputs for the CMAQ model from the MM5 output files (http://www.cmascenter.org).

Figure C-1. The Southern California Ozone Study (SCOS) Modeling Domain Showing Terrain Contours



Initial and Boundary Conditions

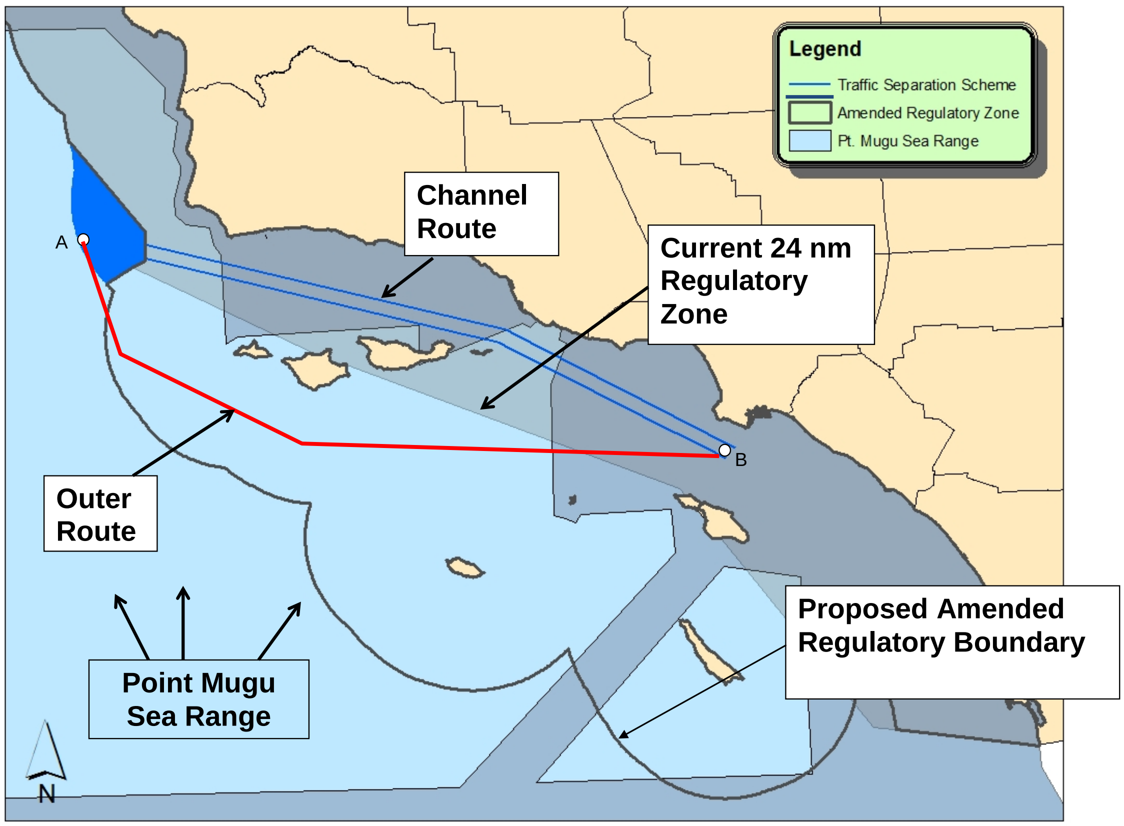
The boundary and initial gaseous and PM concentrations required for the air quality simulations were based on the U.S. EPA definition of "clean air" (EPA, 1991). Since the area of concern, the Santa Barbara Shipping Channel and Point Mugu Sea Range, is near the center of the simulation domain, as shown in Figure 1, the impact of boundary conditions (BC) should be minimal. Each simulation included a 10-day spin-up period to minimize the influence of the initial conditions.

Emissions Inventory

Emissions for all sources (e.g. stationary, area-wide, off-road, on-road, biogenic, and OGV) in the modeling domain are considered in the CMAQ air quality model simulations, since the model takes into account the chemical interactions of all pollutants in the airshed on the production of pollutants of interest (ozone, total PM2.5, PM2.5 nitrates, and PM2.5 sulfates). For non-OGV emissions, the year 2005 emissions inventory that is used in this modeling analysis is based on the same California Emissions Inventory Forecast System (CEFS) version (1.06) of ARB's Emissions Inventory as was used by the SCAQMD in the preparation of their PM2.5 SIP.

A brief description of emissions for all 6 OGV simulation scenarios is provided below and in Table C-1. Figure C-2 provides a graphical depiction of the key vessel transit routes used in the modeling scenarios.

Figure C-2: Vessel Traffic Routes by the Channel Islands in Southern California



MS1: No OGV Clean Fuel Regulation, vessels in pre-regulation traffic patterns and use pre-rule fuels, primarily HFO

In this scenario, the vessel traffic pattern was based on actual pre-rule vessel routes in the SCOS domain. Under this scenario, the vast majority of all the non-tanker vessels transiting north and southbound in the Santa Barbara Channel region used the existing traffic separation scheme inside the channel (Channel Route). It was assumed that all the vessels used dirty fuel (heavy fuel oil (HFO) at 2.5% S) at pre-regulation levels.

MS2: OGV Clean Fuel Regulation implemented, vessels in pre-regulation traffic patterns

In this scenario, the vessel traffic pattern is the same as that in MS1. It was assumed that all the vessels within the channel (and all other traffic within the 24 nm regulatory zone in the SCOS domain) used compliant clean distillate fuel (MGO at 0.1% S). It was assumed that all vessel activity outside the 24 nm regulatory zone in the SCOS domain used dirty fuel (HFO at 2.5% sulfur).

MS6: **OGV Clean Fuel Regulation implemented, vessels in Outer Route pattern using clean fuel. OGV Clean Fuel Regulation implemented, 100% of vessels transit outside the Santa Barbara Channel and use marine distillate fuels**

This scenario was included to address the request by the Santa Barbara Air Quality Management District concerning the comparisons between using clean fuel in the Channel Route compared to using clean fuel in the Outer Route. In this scenario, 100% of the vessel traffic within the Santa Barbara Channel was relocated to the route outside the channel (Outer Route). It was assumed that all the relocated vessel traffic used compliant clean distillate fuel although the route was outside the regulatory zone. All other OGV traffic within the SCOS domain had the same routing and fuel type as Scenario MS2.

MS1A: Vessels only subject to North American ECA Phase 1 requirements. ARB rule is forgone. Vessels in pre-regulation traffic patterns.

This scenario represents the condition where the ARB rule is forgone and air quality benefits depend solely on the North American Emission Control Area (ECA) 2012 Phase 1 requirements (assuming HFO fuel type at 1% sulfur). The vessel traffic pattern was based on actual pre-rule vessel routes.

MS5: OGV Clean Fuel Regulation implemented, 50%[1] of the vessels transit outside the Santa Barbara Channel and use HFO

This scenario reflects the current situation. 50% of the vessel traffic visiting the Ports of Los Angeles and Long Beach was relocated to the Outer Route. It was assumed that all the relocated vessel traffic used dirty fuel, as they were outside the regulatory zone. All other traffic within the 24 nm regulatory zone in the SCOS domain used clean fuel. All OGV traffic outside the 24 nm zone in the SCOS domain used dirty fuel.

MS4ws: OGV Clean Fuel Regulation implemented with proposed regulatory boundary change. Vessels in pre-regulation traffic patterns and all vessels within the proposed amended regulatory zone, including those in the Outer Route, use clean fuel

This scenario reflects what we anticipate will happen if the proposed regulatory boundary change is implemented. Under this scenario, the vast majority of all the non-tanker vessels transiting north and southbound in the Santa Barbara Channel region used the existing traffic separation scheme inside Channel Route. All vessels within the amended clean fuel zone used compliant clean distillate fuel (MGO at 0.1% S). Since the “window” is primarily outside the modeling domain, the emissions that occurred outside the SCOS domain were

[1] 50 percent of the vessel traffic visiting the Ports of LA and LB corresponds to about 75% of the total vessel traffic that historically uses the Santa Barbara Channel.

placed in grid cells inside the “window” to capture any impact that the window may have on the on-shore concentrations.

The ‘baseline’ OGV emissions inventory for year 2005 (scenario MS1) is version v2-3f of ARB’s OGV inventory. This is a pre-regulatory 2005 inventory, where there is no OGV Clean Fuel Regulation in place. Emission scenario MS2 represents the anticipated emissions inventory from the original rule and was produced by making adjustments to the baseline inventory (MS1), where clean fuel is required for shipping activities within 24nm of the California coastline. .

It is assumed that ships transiting outside the regulatory boundary (i.e. requiring clean fuels) in the three scenarios emit pollutants at the same rate and at the same speed as they would travel inside of the regulatory zone without vessel speed restrictions or fuel sulfur restrictions.

Emission inputs of specific chemical species are required for modeling. These inputs are produced by applying the latest ARB speciation profiles (i.e. species fractions) to the scenario-specific TOG and PM emission estimates. In 2010, OGV PM speciation profiles were updated to reflect the most recent information. These profiles (Attachment C-1) were developed based on a series of tests conducted on OGV main engines (ME) and auxiliary engines (AE) operating on HFO and MDO with various sulfur contents (0.1% to 2.5%).

The gridded OGV emissions inventory was developed for a large statewide domain comprised of 4 km-by-4 km grid cells. For use in air quality modeling, these statewide OGV emissions were mapped into the smaller, Southern California domain for which meteorological inputs were readily available (described in the previous section). The air quality modeling domain has a different grid cell structure (5 km-by-5 km grid cells) and a different map projection than the domain on which the OGV emissions are produced (UTM versus Lambert Conformal, respectively).

A comparison of speciated, daily-averaged emission rates between OGV emissions for each of the six scenarios and the total emissions for the South Coast Air Basin is shown in Table C-2. The emissions in Table C-2 are summarized from the Southern California modeling domain (i.e. these totals reflect the emissions used in modeling).

Attachment C-2 provides illustrations of the emission differences among scenarios. These tabulated emission estimates are summarized from the OGV emission inventory on the large statewide domain prior to converting the information to modeling domain. Because of the differences in grid cell size and map projection along the boundaries of the region summarized, the summaries in Table C-2 and Attachment C-2 differ slightly.

OGV emissions are treated as an area-wide emission source, thus all of the OGV emissions are limited to the surface layer. The impact of OGV emission height on air quality model performance is considered to be negligible, as was discussed previously in appendix E-2 of the OGV Fuel Rule Initial Statement of Reasons (ARB, 2008).

Table C-1. Summary of the Modeling Scenarios.

Scenario ID #	Scenario[3,4]	SB Channel Route Status	Rule Status[2]	ECA Status
MS1	**Baseline**	**Channel Route- (most Vessels using Channel Route)**	No rule	No ECA
MS2	**With rule**	**Channel Route- (most Vessels using Channel Route)**	With rule	No ECA
MS6	**SB 100% ships moved outside channel using clean fuel**	**100 percent of vessels using Outer Route**	using clean fuel for ships moved to outside channel	No ECA
MS1A	**Baseline**	**Channel Route- (most Vessels using Channel Route)**	No rule	With ECA at 1% Sulfur
MS4ws	**Amended Zone with Window**	**Channel Route- (most Vessels using Channel Route)**	With rule	No ECA
MS5	**With rule and 75% ships moved outside SB channel**	**Current Traffic Pattern (50% of Vessels using Outer Route)[5]**	With rule	No ECA

Table Notes:
1) In scenario MS1A, it is assumed under the ECA Phase 1, vessels use HFO fuel with 1% sulfur
2) Rule is assuming 0.1% distillate fuel
3) The 2005 emissions inventory used in the modeling analysis was generated using the ARB Emissions Inventory Forecast System and was consistent with that used by the SCAQMD in the preparation of their PM2.5 SIP
4) Inventory version v2-3f
5) 50 percent of the vessel traffic visiting the Ports of LA and LB corresponds to about 75% of the total vessel traffic that historically uses the Santa Barbara Channel

Table C-3. Comparison Between OGV Emissions for Each Scenario and Total Emissions from all Sources in the South Coast Air Basin.

Emission species	OGV Emissions (Tons/Day)						
	MS1	MS2	MS6	MS1A	MS4ws	MS5	SCAB Total Emission* (Tons/day)
NO_x	118.2	114.1	114.4	118.8	109.8	110.5	1205.6
SO_x	89	15.8	24	36.3	10.9	35.5	157.2
VOC	4.4	4.9	4.8	5	4.8	4.4	2463.6
PM2.5 SO_4	3.6	0.7	1	0.6	0.5	1.6	20.7
PM2.5 EC	0.1	0.1	0.1	0.4	0.1	0.1	19.6
Other PM2.5	7.4	2.6	3.2	7.2	1.9	3.8	197.5

*Total emission in South Coast Air Basin was calculated based on scenario MS1, which includes shipping emissions in scenario MS1 and all non-shipping emissions

III. Simulation Results

The CMAQ air quality model was run for calendar year 2005 for each scenario. Hourly gaseous and aerosol concentrations for each grid cell within the domain were calculated. The results from each simulation were used to calculate, by grid cell, the annual maximum 8-hour ozone (O3) concentration, and the annual average concentrations of PM2.5 total, PM2.5 sulfate (SO4), and PM2.5 nitrate (NO_3).

The difference in gaseous and particulate concentrations between the baseline scenario (MS1) and each of the other scenarios is used to illustrate the impact of each scenario on baseline air quality (i.e. where the baseline represents pre-clean-fuel-regulation conditions). Figures C-3 to C-7 provide a summary of the modeling results in the form of the percentage change in annual averaged PM2.5 concentration and annual maximum 8-hour Ozone concentration from the baseline scenario (MS1).

Air quality model performance was discussed previously in appendix E-2 of the OGV Fuel Rule Initial Statement of Reasons. (ARB, 2008)

Effects on PM2.5 Air Quality and Premature Cardiopulmonary Mortality

For annual average PM2.5 concentrations, all the scenarios show significant decreases in PM2.5 compared to the no-rule baseline MS1 (right panels in Figures C-3 through C-7). In addition, there are no on-shore areas of increased PM2.5 concentrations within the modeling domain for any of the scenarios. For all of the scenarios, the decreases in PM2.5 are the greatest around the Ports of Los Angeles and Long Beach and along the coastal regions. Although all scenarios show decreases in PM2.5, some of the scenarios, such as MS6 and MS4ws have large reductions over a wider geographic area.

To evaluate the public health impacts of the changes in PM2.5 concentrations, the model-simulated PM2.5 results were used to estimate impacts on annual cardiopulmonary mortality avoided for each scenario. The differences between the non-cancer health impacts for the scenario compared to the Baseline (MS1) provide a relative quantification of the public health impacts of each scenario. The results are summarized below in Table C-4.

Premature deaths from cardiopulmonary causes associated with exposure to PM2.5 were estimated using an approach based on a peer-reviewed methodology developed by the U.S. Environmental Protection Agency (EPA, 2010). Details of the approach and the key assumptions underlying it are described in Attachment C-3. Further details are supplied in a recent ARB staff report. (ARB, 2010)

To estimate premature deaths, staff developed population exposure estimates using the model-predicted concentrations of directly emitted diesel PM (primary diesel PM) and secondary PM within each modeling grid cell. The number of annual cases of death from cardiopulmonary causes associated with exposure to the PM2.5 was then estimated using a function relating PM2.5 exposure, the population affected, and the baseline incidence rates to cardiopulmonary mortality. Following the U.S. EPA's methodology, the PM2.5-mortality function used was from a recent, comprehensive nationwide study on the health effects of PM2.5 (Krewski et al., 2009). The populations within each grid cell were determined from U.S. Census Bureau year 2000 census data, projected to 2005. Mortality incidence rates were computed from California individual death records for 2005.

TableC-4: Annual Cardiopulmonary Mortality Compared to No Rule Baseline Scenario

Scenario Comparison	Description	Annual Cardiopulmonary Mortality		
		Low	**Mean**	**High**
MS2 vs MS1	**Impacts of OGV Clean Fuel Regulation as originally anticipated when adopted-vessels continue to use the Channel Route and use clean fuels with in the 24 nm regulatory zone**	540	700	850
MS6 vs MS1	**Impacts if vessels use Outer Route and all use clean fuels**	580	740	910
MS1A vs MS1	**Impacts if only ECA Phase 1 ECA implemented, no ARB OGV Clean Fuel Regulation**	280	360	440
MS4ws vs MS1	**Impacts of proposed amendments – vessels return to pre-regulation traffic patterns and all vessels in the expanded regulatory zone use clean fuels**	560	710	870
MS5 vs MS1	**Current Situation – 75% of vessels that historically used Channel Route use Outer Route and HFO**	500	650	790

As can be seen in Table C-4, there is considerable uncertainty associated with the methodology to estimate annual cardiopulmonary mortality, on the order of $\pm$ 25 percent. In all cases, the uncertainties for the scenarios overlap with each other and this needs to be taken into consideration when interpreting the values. However, comparing the mean values is helpful in providing a qualitative or directional indication of the relative differences between the impacts of the various scenarios such as:

- The cardiopulmonary premature deaths avoided are significant for all scenarios, greater than 350 premature deaths avoided annually for all scenarios.
- When comparing the impacts of vessels in the Channel Route using clean fuel and vessels in the Outer Route using HFO there is a small difference in the mean values (700 vs. 650) with the Outer Route having a slightly lower mean value. (MS2 vs. MS1) and (MS5 vs. MS1)
- Having vessels that use the Outer Route use the cleaner marine distillate fuels results in a small increase in the cardiopulmonary premature deaths avoided mean values (740 vs. 650) relative to not having them use the cleaner fuel. Comparison between (MS6 vs. MS1) and (MS5 vs. MS1)
- The OGV Clean Fuel Regulation is providing significant public health benefits prior to 2015 that are above and beyond what would be provided if only the North American ECA was implemented (650, 700 or 710 vs. 360) See comparison between (MS5, MS2 or MS4ws vs. MS1) and (MS1A vs. MS1)
- The proposed amendments to the OGV Clean Fuel Regulation will provide similar public health benefits to those anticipated when the regulation was

initially adopted (710 vs. 700). See comparison between (MS4ws vs. MS1) and (MS2 vs. MS1)

Ozone Air Quality

For most of the scenarios, there is very little difference in on-shore ozone concentrations relative to the baseline. As illustrated in the left panel of Figures 2 through 6, for the scenarios that do show ozone concentration changes in the figures, the differences are relatively small (+/-5%).

Attachment C-4 provides a summary of model-simulated percent changes in ozone concentrations applied to site-specific, 2005 ozone design values. Percentage changes from the modeling are calculated two ways: from the grid cell containing a specific monitoring station as well as for the 9 grid cells immediately surrounding the monitoring station. This information provides a scenario- and site-specific estimate of percentage change to ozone and how the respective level of changes might impact 2005 health-based ozone attainment levels (ARB does not currently estimate mortality impacts based on ozone). As with the small percent changes in the modeling results, the impact on design value concentrations is very minor.

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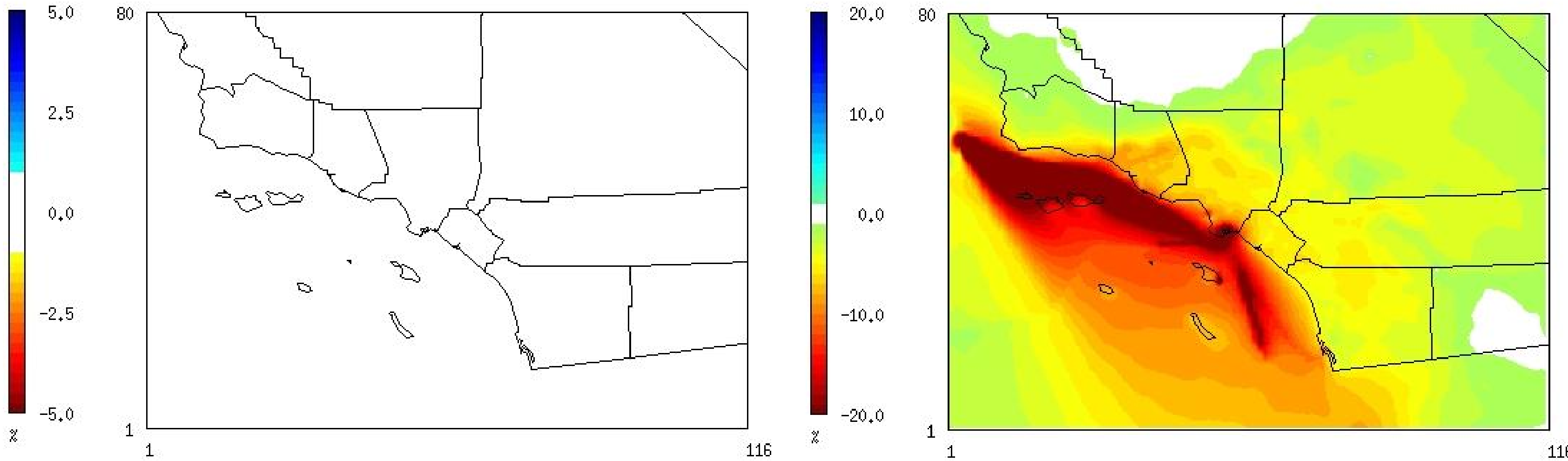

Figure C-3 (MS2 vs. MS1) The figures above illustrate model-simulated air quality benefits in the form of percentage decrease (i.e. a negative value is a decrease) in annual maximum 8-hour O3 concentrations (left) and annual average $PM_{2.5}$ concentrations (right). Only changes >1% and <-1% are shown in the plots.

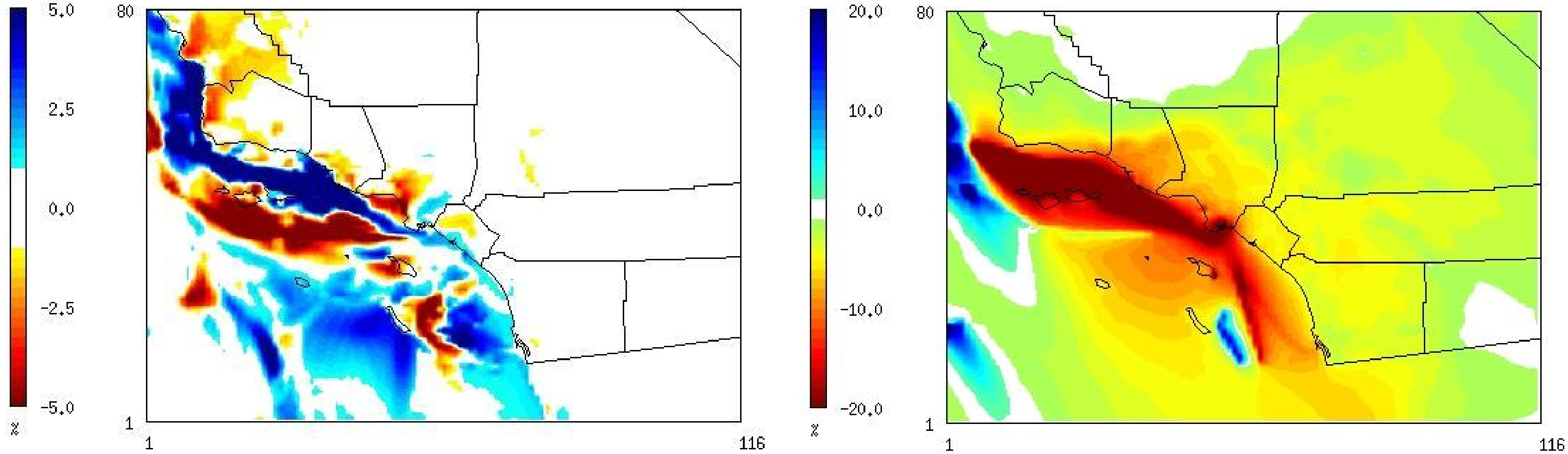

Figure C-4 (MS6 vs. MS1) The figures above illustrate model-simulated air quality benefits in the form of percentage decrease (i.e. a negative value is a decrease) in annual maximum 8-hour O3 concentrations (left) and annual average $PM_{2.5}$ concentrations (right). Only changes >1% and <-1% are shown in the plots.

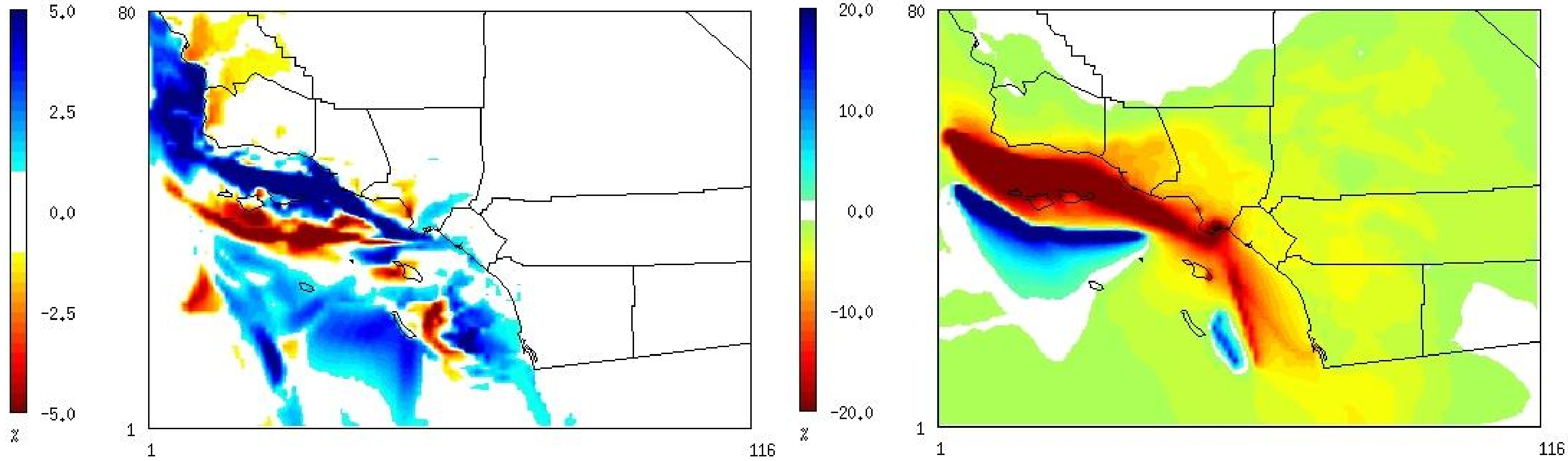

Figure C-5 (MS5 vs. MS1) The figures above illustrate model-simulated air quality benefits in the form of percentage decrease (i.e. a negative value is a decrease) in annual maximum 8-hour O3 concentrations (left) and annual average $PM_{2.5}$ concentrations (right). Only changes >1% and <-1% are shown in the plots.

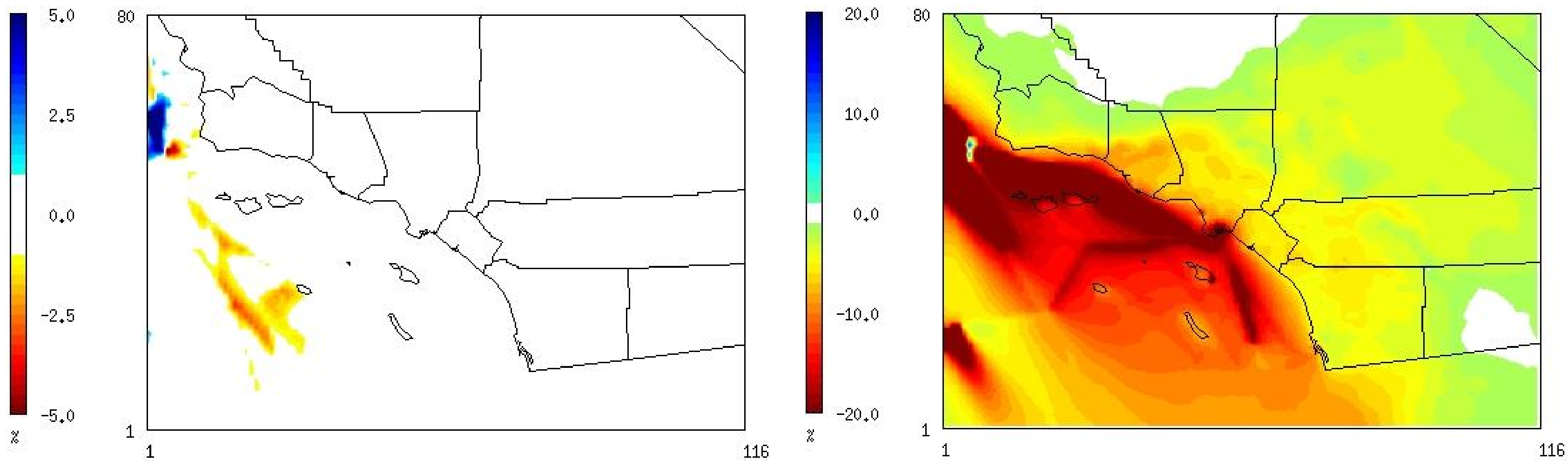

Figure C-6 (MS4ws vs. MS1) The figures above illustrate model-simulated air quality benefits in the form of percentage decrease (i.e. a negative value is a decrease) in annual maximum 8-hour O3 concentrations (left) and annual average $PM_{2.5}$ concentrations (right). Only changes >1% and <-1% are shown in the plots.

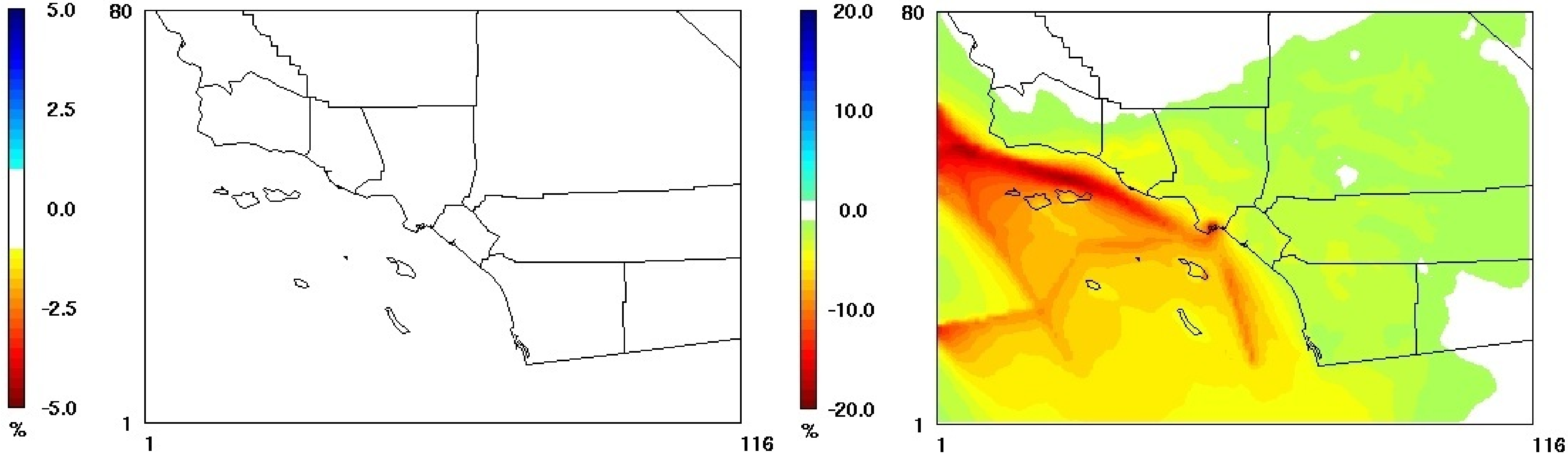

Figure C-7 (MS1A vs. MS1) The figures above illustrate model-simulated air quality benefits in the form of percentage decrease (i.e. a negative value is a decrease) in annual maximum 8-hour O3 concentrations (left) and annual average $PM_{2.5}$ concentrations (right). Only changes >1% and <-1% are shown in the plots.

Attachment C-1. Ocean-going Vessel (OGV) PM Speciation Profile Preparation

Background

PM speciation profiles 119 *(Marine Vessel-Liquid Fuel)* and 425 *(Diesel Vehicle Exhaust)*[1] were used for HFO (Heavy Fuel Oil) and MDO (Marine Diesel Oil) in the 2008 air quality modeling analysis because no updated OGV exhaust source testing data were available for creating speciation profiles at the time. A summary of these two profiles is as follows:

Table 1. PM Profiles 119 and 425 Used for 2008 Modeling Analysis

Size Fraction (by weight)	$PM_{2.5}$/TPM	PM_{10}/TPM
PM 119	0.937	0.96
PM 425	0.92	1.0

Weight Fraction (of PM mass)	$PM_{2.5}$				PM_{10}			
	EC	OC	SO_4^{2-}	others	EC	OC	SO_4^{2-}	others
PM 119	0.04	0	0.15	0.81	0.04	0	0.15	0.81
PM 425	0.264	0.694	0.0186	0.0235	0.261	0.689	0.0174	0.0328

In 2010, four new OGV PM speciation profiles were developed based on a series of newly conducted OGV exhaust source tests [2-5]. These profiles were prepared for OGV main engine (ME) and auxiliary engine (AE) operating on HFO, MDO, and blended fuel, with various sulfur contents (0.1% to 2.5%), which were involved in the air quality modeling scenarios. The four profiles include:

Profile Number	Profile Name
PM 1191	Ocean-Going Vessel Exhaust--HFO (2.5% Sulfur)
PM 1192	Ocean-Going Vessel Exhaust--HFO (1.0% Sulfur)
PM 1193	Ocean-Going Vessel Exhaust-- Blend (1.0% Sulfur)
PM 4251	Ocean-Going Vessel Exhaust-- MDO (0.1% Sulfur)

Methodology

- *PM 1191: Ocean-Going Vessel Exhaust--HFO (2.5% Sulfur)*

This profile was obtained by averaging the weight fractions of EC, OC and SO_4^{2-} in total PM mass from 18 source tests [2-5] of ME or AE running with HFO having sulfur contents ranging from 2.05% to 3.8%. Because the source tests were limited, it was assumed that the PM exhaust emitted from ME and AE have the same speciation composition for the same fuel. For each test, the weight fractions of EC, OC and SO_4^{2-} were calculated by dividing the emission factors of these species by the emission factor of the total PM mass.

Table 2. PM Profile 1191

HFO	Emission Factor (g/kW-hr)				Weight Fraction (of PM mass)		
	PM Mass	EC	OC	$H_2SO_4{\cdot}6.5H_2O$	EC	OC	SO_4^{2-}
2.5% S	1.501 *(±0.881)*[*]	0.015 *(±0.011)*	0.244 *(±0.112)*	1.080 *(±0.635)*	0.013 *(±0.012)*	0.212 *(±0.119)*	0.335 (±0.076)

[*] Average value (±*standard deviation)*

- *PM 1192: Ocean-Going Vessel Exhaust--HFO (1.0% Sulfur)*

The emission factors of EC and OC for OGV running with 1.0% sulfur HFO were assumed to be the same as those for OGV running with 2.5% sulfur HFO, which were calculated based on the 18 source tests mentioned previously. The emission factor of SO_4^{2-} was estimated by multiplying the fuel consumption rate (195 g/kW-hr)[6], fuel sulfur content (1.0%), conversion rate of fuel sulfur to SO_4^{2-} (3%)[6], and molecular weight ratio of SO_4^{2-} to sulfur. The weight fractions of EC, OC and SO_4^{2-} were then calculated from the emission factors.

Table 3. PM Profile 1192

HFO	Emission Factor (g/kW-hr)				Weight Fraction (of PM mass)		
	PM Mass	EC	OC	SO_4^{2-}	EC	OC	SO_4^{2-}
1.0% S	1.10[6]	0.015	0.244	0.176	0.014	0.222	0.160

- *PM 4251: Ocean-Going Vessel Exhaust-- MDO (0.1% Sulfur)*

This profile was obtained by averaging the weight fractions of EC, OC and SO_4^{2-} in total PM mass from 10 source tests [2, 3, 5] of ME or AE running with MDO with sulfur contents ranging from 0.05% to 0.2%. For each test, the weight fractions of EC, OC and SO_4^{2-}

were calculated by dividing the emission factors of these species by the emission factor of the total PM mass.

Table 4. PM Profile 4251

MDO	Emission Factor (g/kW-hr)				Weight Fraction (of PM mass)		
	PM Mass	EC	OC	$H_2SO_4 \cdot 6.5H2O$	EC	OC	SO_4^{2-}
0.1% S	0.338 *(±0.177)*	0.020 *(±0.019)*	0.111 *(±0.438)*	0.042 *(±0.014)*	0.052 *(±0.037)*	0.522 *(±0.114)*	0.080 *(±0.068)*

* Average value (±*standard deviation)*

- *PM 1193: Ocean-Going Vessel Exhaust--Blend (1.0% Sulfur)*

The emission factors of EC and OC for OGV running with 1.0% sulfur blend fuel were assumed to be the average values of those for HFO (2.5% S) and MDO (0.1% S). The emission factor of SO_4^{2-} was estimated by multiplying the fuel consumption rate (190 g/kW-hr)[6], fuel sulfur content (1.0%), conversion rate of fuel sulfur to SO_4^{2-} (3%) [6]**,** and molecular weight ratio of SO_4^{2-} to sulfur. The weight fractions of EC, OC and SO_4^{2-} were then calculated from the known emission factors.

Table 5. PM Profile 1193

Blend	Emission Factor (g/kW-hr)				Weight Fraction (of PM mass)		
	PM Mass	EC	OC	SO_4^{2-}	EC	OC	SO_4^{2-}
1.0% S	0.80[6]	0.018	0.213	0.171	0.023	0.266	0.214

Summary

It should be noted that all of the source tests cited in this work were conducted for $PM_{2.5}$ only, and it was assumed that same speciation profiles can be used for PM_{10} and TPM for the same fuel. It was also assumed that PM 1191 and PM1192 have the same $PM_{2.5}$ and PM_{10} size fractions as PM 119; PM 4251 and PM 1193 have the same $PM_{2.5}$ and PM_{10} size fractions as PM 425. The size fractions, speciation profiles and factors used to convert profiles PM 119 and PM 425 to the updated profiles are summarized in the following tables.

Table 6. Size Fraction Summary of New OGV Profiles

Size Fraction (by weight)	$PM_{2.5}$/TPM	PM_{10}/TPM
PM 1191	0.937	0.96

PM 1192	0.937	0.96
PM 1193	0.92	1.0
PM 4251	0.92	1.0

Table 7. Speciation Summary of New OGV Profiles

Weigh Fraction (of PM mass)	$PM_{2.5}$ Fraction				PM_{10} Fraction			
	EC	OC	SO_4^{2-}	others	EC	OC	SO_4^{2-}	others
PM 1191	0.013	0.212	0.335	0.440	0.013	0.212	0.335	0.440
PM 1192	0.014	0.222	0.160	0.604	0.014	0.222	0.160	0.604
PM 1193	0.023	0.266	0.214	0.497	0.023	0.266	0.214	0.497
PM 4251	0.052	0.522	0.080	0.346	0.052	0.522	0.080	0.346

Table 8. Conversion Factors Used to Create New OGV Profiles from Old Profiles

Conversion Factor	$PM_{2.5}$ Fraction				PM_{10} Fraction			
	EC	OC	SO_4^{2-}	others	EC	OC	SO_4^{2-}	others
PM 1191/ PM 119	0.33		2.23	0.54	0.33		2.23	0.54
PM 1192/ PM 119	0.35		1.07	0.75	0.35		1.07	0.75
PM 1193/ PM 119	0.58		1.43	0.61	0.58		1.43	0.61
PM 4251/PM 425	0.20	0.75	4.29	14.74	0.20	0.76	4.59	10.56

*Note: there is no OC in PM 119, so no conversion factor can apply.

References for Appendix C Attachment C-1:

1. *California Air Resources Board Main Speciation Profiles*. California Air Resources Board: 2008; http://www.arb.ca.gov/ei/speciate/speciate.htm. Accessed July 7, 2010.

2. Miller, J. W.; Nigam, A.; Welch, W. A.; Cocker, D. R. *Measurement of Criteria and Greenhouse Gas Emissions from Auxiliary Engines on Ocean-Going Vessels Operating on Heavy Fuel Oil and Marine Diesel Oil*; Californa Air Resources Board: 2009.

3. Miller, J. W.; Agrawal, H.; Welch, W. A. *Criteria Emissions from the Main Propulsion Engine of a Post-Panamax Class Container Vessel Using Distillate and Residual Fuels*; California Air Resources Board: 2009.

4. Miller, J. W.; Agrawal, H.; Welch, W. A. *Measurement of Emissions from the Main Propulsion Engine (MAN B&W 11K90MC-C) on a Panamax Class Container Ship.*; Califorina Air Resources Board: 2009.

5. Jayaram, V.; Miller, J. W.; Nigam, A.; Welch, W. A. *Effect of Selective Catalytic Reduction Unit on Emissions from an Auxiliary Engine on an Ocean-Going Vessel*; California Air Resources Board: 2009.

6. Soriano, B. L.; Milkey, P.; Alexis, A.; Di, P.; Du, S.; Lu, J.; Hand, R.; Houghton, M.; Komlenic, M.; Suer, C.; Williams, L.; Zuo, Y.-P. *Initial Statement of Reasons for Proposed Rulemaking: Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessel within California Waters and 24 Nautical Miles of the California Baseline*; California Air Resources Board: Sacramento, CA, June 2008.

Attachment C-2. Ocean-going Vessel (OGV) Gridded Emissions Inventory

The following plots show the spatial allocation of emissions in tons for NOx, PM25, and SOx by scenario. The accompanying tables give emission totals in tons for the entire domain (Total) and indicated sub-regions. *SCOS* refers to the SCOS domain only, *24nm* refers to the region within 24nm of the coastline, *SCOS 24nm* is the portion of the 24nm zone within the SCOS domain, and *SB Box* is an arbitrary region used to estimate emissions directly offshore of Santa Barbara County. Figure 1b visually identifies the sub-regions

Figure 1. NOx, PM25, and SOx emissions for Scenario MS1

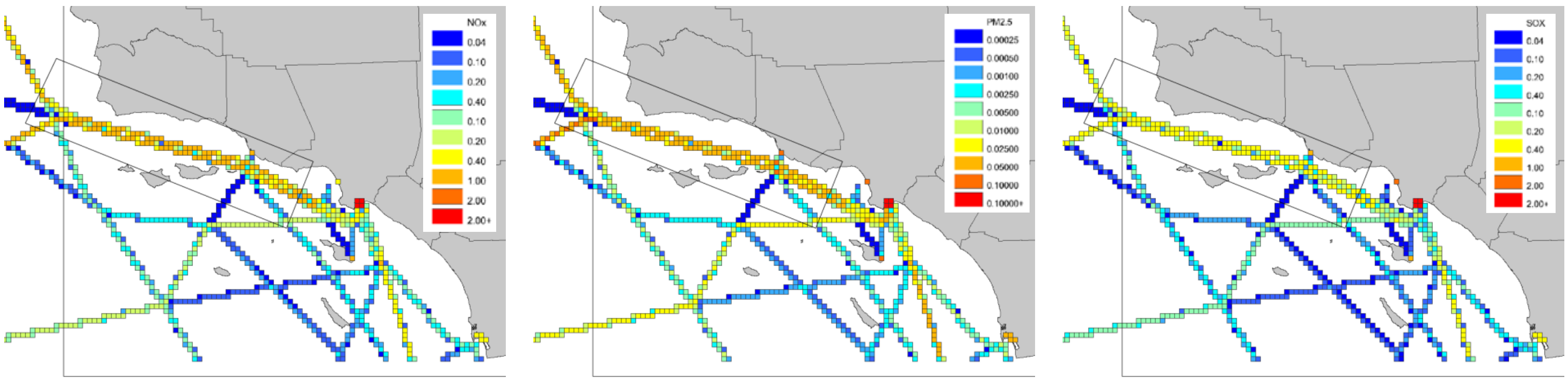

Table 1. Scenario MS1 NOx, PM25, and SOx emission totals by region

MS1	NOx	SOx	PM2.5
Total	297.1	202.2	26.1
SCOS	118.8	88.7	10.9
24nm	169.4	124.9	15.4
SCOS 24nm	99.3	76.7	9.2
SB Box	63.2	38.5	5.3

Figure 1b.

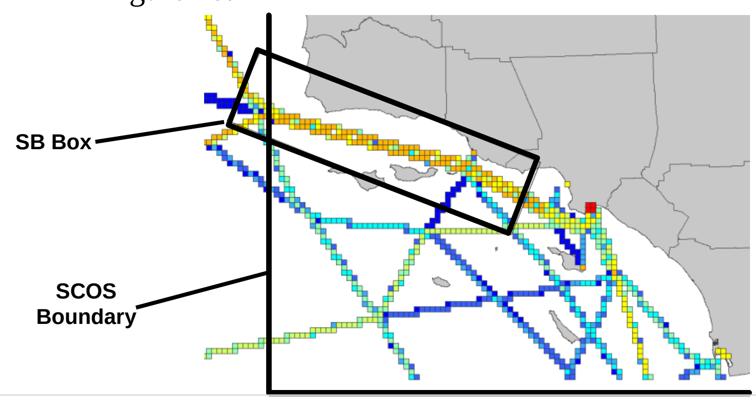

Figure 2. NOx, PM25, and SOx emissions for Scenario MS2

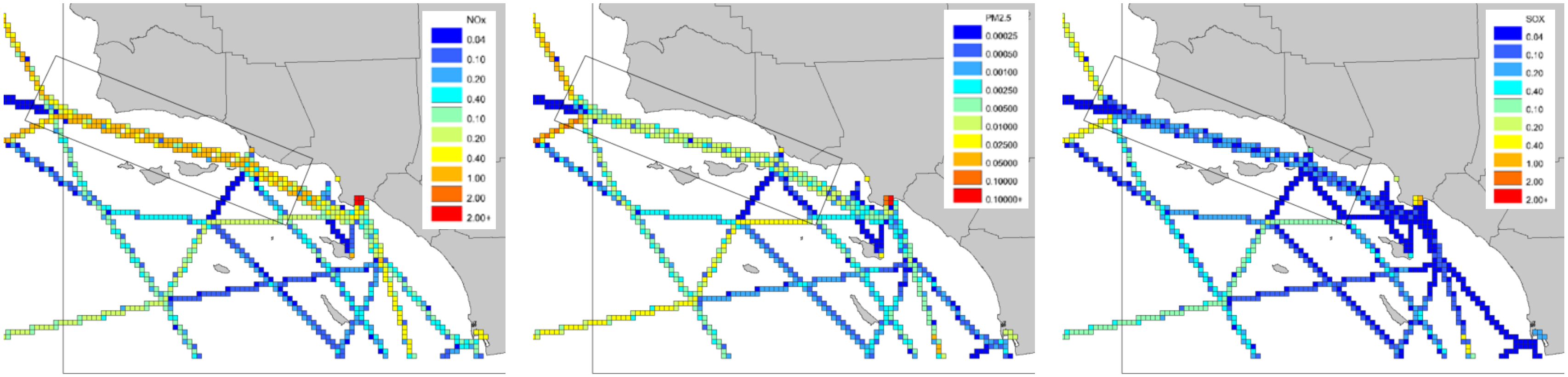

Table 2. Scenario MS2 NOx, PM25, and SOx emission totals by domain and differences from Scenario MS1

MS2	NOx	SOx	PM2.5
Total	289.0	83.0	12.8
SCOS	114.1	15.7	3.1
24nm	161.3	5.7	2.5
SCOS 24nm	94.6	3.7	1.5
SB Box	60.2	3.0	1.0

MS2 - MS1	NOx	SOx	PM2.5
Total	-8.1	-119.2	-13.3
SCOS	-4.7	-73.0	-7.7
24nm	-8.1	-119.2	-12.8
SCOS 24nm	-4.7	-73.0	-7.7
SB Box	-3.0	-35.5	-4.3

Figure 3. NOx, PM25, and SOx emissions for Scenario MS5

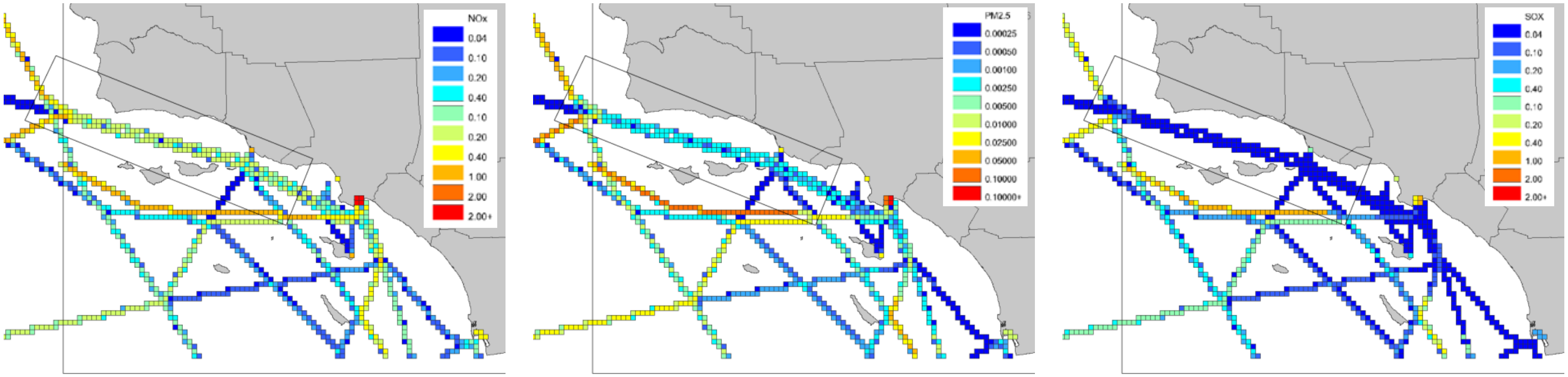

Table 3. Scenario MS5 NOx, PM25, and SOx emission totals by domain and differences from Scenario MS1 and Scenario MS2

MS5	NOx	SOx	PM2.5
Total	285.5	102.6	15.7
SCOS	110.6	35.2	5.5
24nm	124.4	4.9	2.1
SCOS 24nm	57.7	2.9	1.1
SB Box	27.8	3.1	0.7

MS5 - MS1	NOx	SOx	PM2.5
Total	-11.6	-99.6	-10.4
SCOS	-8.2	-53.5	-5.3
24nm	-45.0	-120.0	-13.3
SCOS 24nm	-41.6	-73.8	-8.2
SB Box	-35.4	-35.4	0.7

MS5 - MS2	NOx	SOx	PM2.5
Total	-3.5	19.5	2.8
SCOS	-3.5	19.5	2.4
24nm	-36.9	-0.8	-0.4
SCOS 24nm	-36.9	-0.8	-0.5
SB Box	-32.4	0.1	-0.3

Figure 4. NOx, PM25, and SOx emissions for Scenario MS6

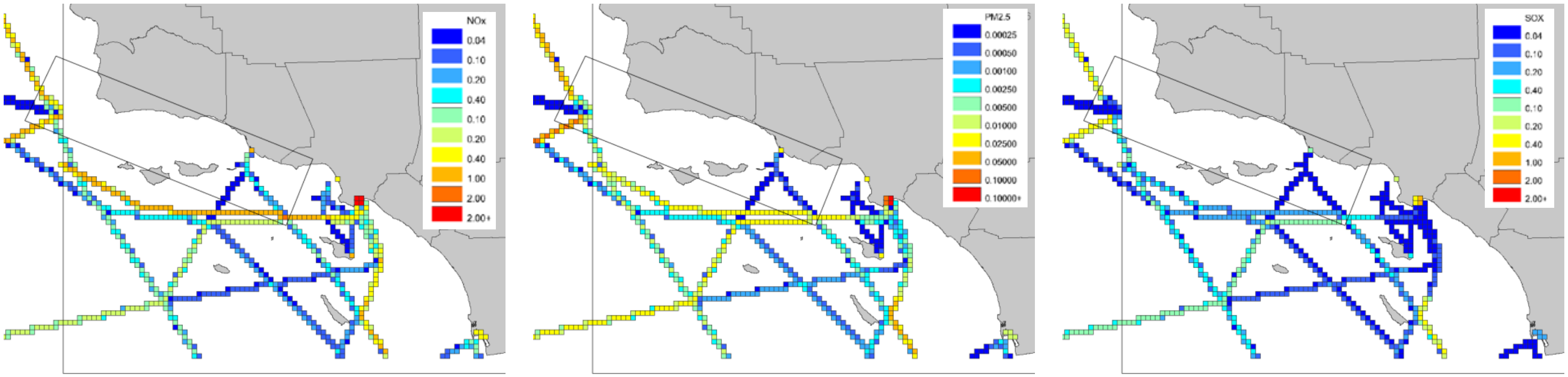

Table 4. Scenario MS6 NOx, PM25, and SOx emission totals by domain and differences from Scenario MS1 and Scenario MS2

MS6	NOx	SOx	PM2.5
Total	280.2	85.6	13.6
SCOS	114.5	23.8	4.2
24nm	110.0	4.6	1.9
SCOS 24nm	46.9	4.7	1.1
SB Box	14.8	2.0	0.4

MS6 - MS1	NOx	SOx	PM2.5
Total	-17.0	-116.6	-12.5
SCOS	-4.3	-64.9	-6.6
24nm	-59.4	-120.3	-13.5
SCOS 24nm	-52.4	-72.0	-8.1
SB Box	-48.4	-36.5	0.4

MS6 - MS2	NOx	SOx	PM2.5
Total	-8.8	2.6	0.8
SCOS	0.4	8.1	1.1
24nm	-51.3	-1.1	-0.6
SCOS 24nm	-47.7	1.1	-0.4
SB Box	-45.5	-1.0	-0.6

Figure 5. NOx, PM25, and SOx emissions for Scenario MS4ws

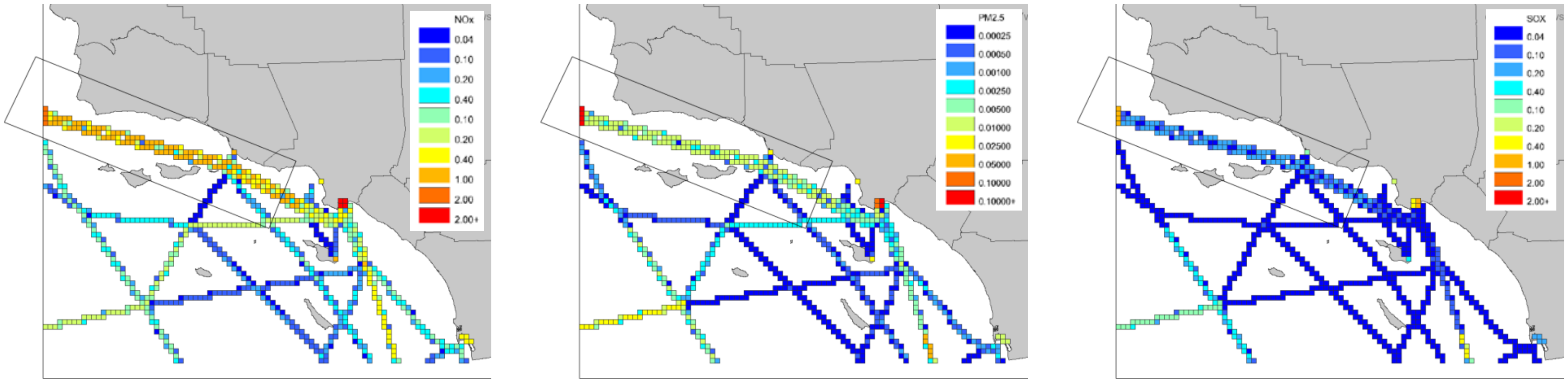

Table 5. Scenario 17ws NOx, PM25, and SOx emission totals by domain and differences from Scenario MS1 and Scenario MS2

MS4ws	NOx	SOx	PM2.5
Total	284.4	74.3	12.3
SCOS	109.8	10.9	2.6
24nm	163.0	9.1	3.1
SCOS 24nm	96.3	7.1	2.0
SB Box	59.1	4.3	1.2

MS4ws - MS1	NOx	SOx	PM2.5
Total	-12.7	-127.9	-13.8
SCOS	-9.0	-77.8	-8.2
24nm	-6.4	-115.8	-12.3
SCOS 24nm	-3.0	-69.6	-7.2
SB Box	-4.1	-34.2	0.4

MS4ws - MS2	NOx	SOx	PM2.5
Total	-4.6	-8.7	-0.5
SCOS	-4.3	-4.8	-0.5
24nm	1.7	3.4	0.6
SCOS 24nm	1.7	3.4	0.5
SB Box	-1.1	1.3	0.2

Figure 6. NOx, PM25, and SOx emissions for Scenario MS1A

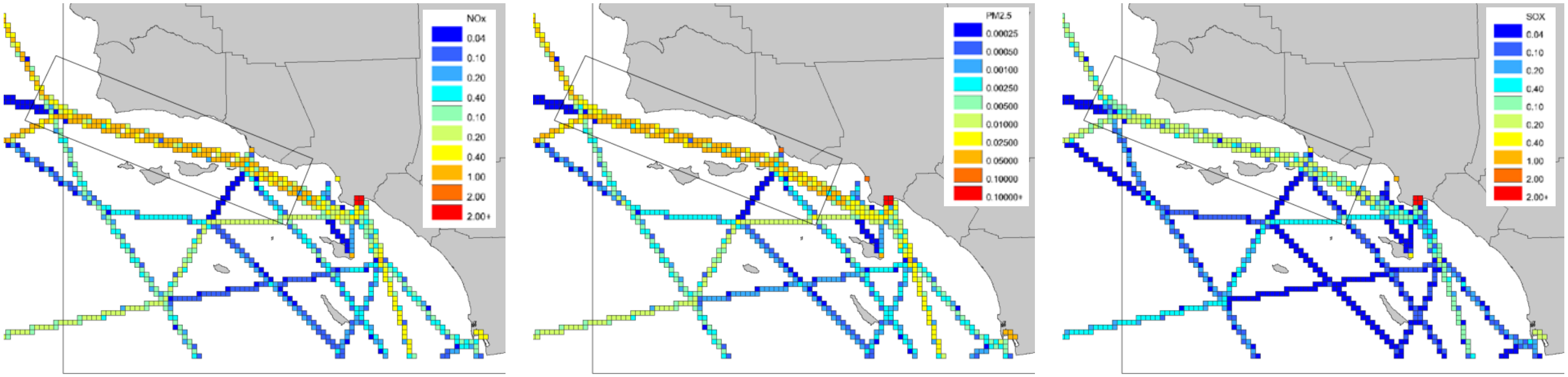

Table 6. Scenario MS1A NOx, PM25, and SOx emission totals by domain and differences from Scenario MS1 and Scenario MS2

MS1A	NOx	SOx	PM2.5
Total	297.1	81.7	19.1
SCOS	118.8	36.0	8.0
24nm	169.4	50.7	11.3
SCOS 24nm	99.3	31.2	6.8
SB Box	63.2	15.5	3.9

MS1A - MS1	NOx	SOx	PM2.5
Total	0.0	-120.5	-7.0
SCOS	0.0	-52.7	-2.9
24nm	0.0	-74.2	-4.1
SCOS 24nm	0.0	-45.5	-2.4
SB Box	0.0	-23.1	3.5

MS1A - MS2	NOx	SOx	PM2.5
Total	8.1	-1.3	6.3
SCOS	4.7	20.3	4.9
24nm	8.1	45.0	8.7
SCOS 24nm	4.7	27.5	5.2
SB Box	3.0	12.5	2.9

Attachment C-3: Health Benefits Associated with Reductions in PM Emissions from the OGV Regulation

Overview

The estimate of the number of PM2.5-associated premature deaths is based on a peer-reviewed methodology developed by the U.S. Environmental Protection Agency (U.S. EPA, 2010). Calculation of this estimate requires information on the concentration of PM2.5, the population exposed, the baseline incidence rates, and a concentration-response function relating changes in PM2.5 exposure to changes in mortality incidence. This information is available as part of the rulemaking package and can be found at the following link: http://www.arb.ca.gov/ports/marinevess/ogv/ogv1085.htm.

Estimating population exposure to PM2.5

PM2.5 concentrations were estimated for a domain covering southern California using the Community Multi-scale Air Quality model as described in this appendix. Primary and secondary PM2.5 concentrations were modeled for five scenarios of OGV emission controls, and a baseline scenario representing no emission controls.

Population at the Census Tract Level

Age-resolved population data at the census tract level, for the 2000 Census, were obtained from the United States Census Bureau (Census Bureau). These were projected to 2005 using age-resolved county population projections from the California Department of Finance (CDOF).

Age-specific population growth factors for each county, for each year, were computed from the CDOF projections by dividing each county population for 2005 by the county population for the year 2000. Since each census tract lies entirely in a county, these growth factors were applied to each census tract in the county, each age group separately. Population was projected for ten-year age groups 25-34 through 75-84, and for age 85 and older.

This method of projection reflects growth in overall county population, but does not model changes in population distribution within counties, such as expansion of urban areas into surrounding rural land.

Baseline Cardiopulmonary Mortality Incidence Rate

Baseline cardiopulmonary mortality incidence rates vary by age bracket. Incidence was estimated separately for ten-year age groups 25-34 through 75-84, and age 85 and older. Baseline incidence rates were estimated at the county level from individual death records for the year 2005, obtained from the California Department of Public Health (CDPH). Cardiopulmonary mortality was defined as ICD9 codes 161-187 and 192-214.

The county of residence of the decedent was generally not recorded. However, the Federal Information Processing Standards (FIPS) city code and the ZIP code were usually recorded. The FIPS city code unambiguously identifies the county, but was sometimes invalid, unrecorded, or recorded as “unknown”. When the FIPS code was not available it was sometimes possible to identify the county from the ZIP code, but ZIP codes can overlap multiple counties. In cases where 90% or more of the area of the decedent's zip code lay entirely within a county, the death was assigned to that county. A handful of records included invalid dates. The breakdown of records was as follows:

County identified by FIPS code	231,181	96.6%
County identified by ZIP code	4,196	1.8%
Unidentified or invalid data	3,851	1.6%

Because the county could not be determined for 1.6% of the records, the incidence is slightly underestimated. No adjustment was made to compensate for excluded records.

Concentration-Response Function

The concentration-response (C-R) function used in this analysis is from U.S. EPA Quantitative Health Risk Assessment (EPA, 2010). In their assessment, the U.S. EPA used the C-R function from a recent comprehensive epidemiological study of the health effects of PM2.5 (Krewski et al., 2009).

U.S. EPA chose Krewski et al. (2009) for quantifying PM2.5-related mortality from long-term PM2.5 exposure for several reasons. First, the cohort includes both men and women, and enrollment was not dependent on underlying health status. It includes data from cities from across the U.S. PM2.5 exposure was based on monitored data collected over two time periods (1979-1983 and 1999-2000); the effect estimates were presented both for each time period and as an average. The study was validated through extensive reanalysis that demonstrated the results to be robust. Extensive exploratory analysis of potential individual and ecologic covariates was conducted, and the results were adjusted for all covariates that influenced the model fit. Finally, spatial autocorrelation was evaluated and adjusted for in the ecologic covariates.

The C-R function employed in this analysis was the one developed for the 1999-2000 time period.

Aggregating results to county, air basin and state

To aggregate results from census tracts to larger geographical subdivisions such as counties or air basins, we used a GIS technique called areal interpolation. Areal interpolation is a procedure for translating spatial data from one set of geographical subdivisions to another when the boundaries do not exactly overlap. Numerous variants of the technique exist, but for the purpose of this analysis the simplest form, which uses area of polygon intersection, was employed (Goodchild and Lam, 1980; Flowerdew and Green, 1994).

The precision of areal interpolation based on area of intersection depends on the relative size of the geographical subdivisions and the homogeneity of the spatial distribution of the quantity being apportioned. In urban areas, where census tracts are small and population is distributed more evenly, areal interpolation to larger subdivisions such as air basins yields relatively precise estimates. In rural areas where the population is distributed unevenly over large census tracts, estimates are less precise.

Based on our analysis, we estimated the average numbers of cases per year for each of the six scenarios. The results of this analysis are provided in Table C-3-1 below.

Table C-3-1: Annual Cardiopulmonary Mortality Compared to No-rule Baseline Scenario

Scenario	Annual Cardiopulmonary Mortality		
	Low	**Mean**	**High**
MS2 vs MS1	540	700	850
MS6 vs MS1	580	740	910
MS1A vs MS1	280	360	440
MS4ws vs MS1	560	710	870
MS5 vs MS1	500	650	790

Attachment C-4. Ocean-going Vessel (OGV) Model-Adjusted 8 Hour Ozone Design Values

Background

The following tables show estimates of the potential effects of OGV scenarios on 2005 8-hr ozone design values for ozone montoring stations located in the domain. The tables include the original, observation-based design values ($DV_{current}$) and the model- adjusted design values ($DV_{adjusted}$). The model-adjusted DVs are calculated by applying the model-simulated percent difference calculated in the grid cell(s) containing or surrounding the monitoring station to the current DVs (where the percent difference is calculated between the specified modeling scenario and the baseline case, Scenario MS1). For example:

$$\text{Current DV} * (\text{Modeled Ozone}_{MS2} - \text{Modeled Ozone}_{MS1}) / \text{Modeled Ozone}_{MS1} = \text{Adjusted DV}$$

Model-adjusted DVs are provided for two cases: 1) for the single grid cell containing the monitoring site; and 2) the min, max and average for the 9-cells surrounding the monitoring site, including the cell within which the site is located.

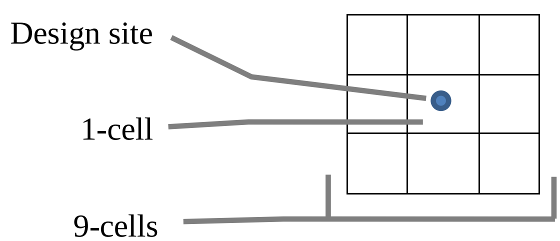

Table C-4-1. Current DVs ("Obs") and Adjusted DVs based on Modeled Percent Differences MS2 vs. MS1

Ozone (ppm)			MS2 vs MS1		Model Adjusted			
					1-Cell	9-Cell		
County	Basin	SiteID	Site Name	Obs	Adj	Min	Ave	Max
Imperial	SS	2551	El Centro-9th Street	0.084	0.084	0.084	0.084	0.084
	SS	2997	Calexico-Grant Street	0.069	0.069	0.069	0.069	0.069
	SS	3135	Calexico-Ethel Street	0.071	0.071	0.071	0.071	0.071
	SS	3143	Westmorland-W 1st Street	0.079	0.079	0.079	0.079	0.079
	SS	3173	Calexico-East	0.075	0.075	0.075	0.075	0.075
	SS	3186	Niland-English Road	0.072	0.072	0.072	0.072	0.072
Kern	SJV	2312	Edison	0.097	0.097	0.097	0.097	0.097
	SJV	2772	Oildale-3311 Manor Street	0.096	0.096	0.096	0.096	0.096
	SJV	2919	Maricopa-Stanislaus Street	0.091	0.091	0.091	0.091	0.091
	SJV	2941	Arvin-Bear Mountain Blvd	0.113	0.113	0.113	0.113	0.113
	SJV	2981	Shafter-Walker Street	0.090	0.090	0.090	0.090	0.090
	MD	3121	Mojave-923 Poole Street	0.090	0.090	0.090	0.090	0.090
	SJV	3145	Bakersfield-Golden State Highway	0.090	0.090	0.090	0.090	0.090
	SJV	3146	Bakersfield-5558 California Avenue	0.097	0.097	0.097	0.097	0.097
Los Angeles	SC	2160	Pasadena-S Wilson Avenue	0.093	0.093	0.093	0.093	0.093
	SC	2166	Pico Rivera	0.070	0.070	0.070	0.070	0.070
	SC	2420	Reseda	0.106	0.106	0.106	0.106	0.106
	SC	2429	North Long Beach	0.064	0.064	0.064	0.064	0.064
	SC	2484	Azusa	0.094	0.094	0.094	0.094	0.094
	SC	2492	Burbank-W Palm Avenue	0.089	0.089	0.089	0.089	0.089
	SC	2494	West Los Angeles-VA Hospital	0.078	0.078	0.078	0.078	0.078
	SC	2583	Lynwood	0.061	0.061	0.061	0.061	0.061
	SC	2849	Glendora-Laurel	0.105	0.105	0.105	0.105	0.105
	SC	2898	Pomona	0.100	0.100	0.100	0.100	0.100
	SC	2899	Los Angeles-North Main Street	0.076	0.076	0.076	0.076	0.076
	SC	3502	Santa Clarita	0.120	0.120	0.120	0.120	0.120
	MD	3658	Lancaster-43301 Division Street	0.098	0.098	0.098	0.098	0.098
Orange	SC	2249	La Habra	0.073	0.073	0.073	0.073	0.073
	SC	2937	Costa Mesa-Mesa Verde Drive	0.073	0.073	0.073	0.073	0.073
	SC	3265	Mission Viejo-26081 Via Pera	0.086	0.086	0.086	0.086	0.086
	SC	3674	Anaheim-Pampas Lane	0.081	0.081	0.081	0.081	0.081
Riverside	SS	2199	Palm Springs-Fire Station	0.104	0.104	0.104	0.104	0.104
	SC	2525	Perris	0.098	0.098	0.098	0.098	0.098
	SC	2596	Riverside-Rubidoux	0.112	0.112	0.112	0.112	0.112
	SS	2878	Indio-Jackson Street	0.095	0.095	0.095	0.095	0.095
	SC	2943	Lake Elsinore-W Flint Street	0.104	0.104	0.104	0.104	0.104
	SC	3168	Banning Airport	0.119	0.119	0.119	0.119	0.119

San Bernardino	SC	2077	Redlands-Dearborn	0.123	0.123	0.123	0.123	0.123
	SC	2221	San Bernardino-4th Street	0.116	0.116	0.116	0.116	0.116
	SC	2266	Fontana-Arrow Highway	0.118	0.118	0.118	0.118	0.118
	SC	2485	Upland	0.106	0.106	0.106	0.106	0.106
	SC	2499	Crestline	0.127	0.127	0.127	0.127	0.127
	MD	2650	Hesperia-Olive Street	0.104	0.104	0.104	0.104	0.104
	MD	2830	Phelan-Beekley Road and Phelan Road	0.100	0.100	0.100	0.100	0.100
	MD	2923	Barstow	0.085	0.085	0.085	0.085	0.085
	MD	3124	Twentynine Palms-Adobe Road #2	0.085	0.085	0.085	0.085	0.085
	MD	3152	Joshua Tree-National Monument	0.105	0.105	0.105	0.105	0.105
	MD	3500	Victorville-14306 Park Avenue	0.094	0.094	0.094	0.094	0.094
San Diego	SD	2040	San Diego-Overland Avenue	0.074	0.074	0.074	0.074	0.074
	SD	2263	Escondido-E Valley Parkway	0.073	0.073	0.073	0.073	0.073
	SD	2327	El Cajon-Redwood Avenue	0.070	0.070	0.070	0.070	0.070
	SD	2368	Del Mar-Mira Costa College	0.070	0.070	0.070	0.070	0.070
	SD	2460	Alpine-Victoria Drive	0.086	0.086	0.086	0.086	0.086
	SD	2589	Chula Vista	0.064	0.064	0.064	0.064	0.064
	SD	2933	Otay Mesa-Paseo International	0.065	0.065	0.065	0.065	0.065
	SD	2964	San Diego-12th Avenue	0.060	0.060	0.060	0.060	0.060
	SD	3198	Camp Pendleton	0.076	0.076	0.076	0.076	0.076
San Luis Obispo	SCC	2321	Morro Bay	0.056	0.056	0.056	0.056	0.056
	SCC	2671	Grover City-Lesage Drive	0.058	0.058	0.058	0.058	0.058
	SCC	2709	San Luis Obispo-Marsh Street	0.057	0.057	0.057	0.057	0.057
	SCC	2955	Paso Robles-Santa Fe Avenue	0.071	0.071	0.071	0.071	0.071
	SCC	2965	Atascadero-Lewis Avenue	0.068	0.068	0.068	0.068	0.068
	SCC	3251	Nipomo-Regional Park	0.064	0.064	0.064	0.064	0.064
Santa Barbara	SCC	2008	El Capitan Beach	0.067	0.067	0.067	0.067	0.067
	SCC	2360	Lompoc-S H Street	0.056	0.056	0.056	0.056	0.056
	SCC	2593	Santa Ynez-Airport Road	0.068	0.068	0.068	0.068	0.068
	SCC	2954	Gaviota-GTC Site B	0.060	0.060	0.060	0.060	0.060
	SCC	2957	Paradise Road-Los Padres National Forest	0.078	0.078	0.078	0.078	0.078
	SCC	2992	Lompoc-HSandP	0.070	0.070	0.070	0.070	0.070
	SCC	3003	Carpinteria-Gobernador Road	0.064	0.064	0.064	0.064	0.064
	SCC	3023	Vandenberg Air Force Base-STS Power	0.069	0.069	0.069	0.069	0.069
	SCC	3101	Las Flores Canyon #1	0.074	0.074	0.074	0.074	0.074
	SCC	3153	Goleta-Fairview	0.064	0.064	0.064	0.064	0.064
	SCC	3486	Santa Maria-906 S Broadway	0.053	0.053	0.053	0.053	0.053
	SCC	3665	Santa Barbara-700 East Canon Perdido	0.064	0.064	0.064	0.064	0.064
Ventura	SCC	2088	Ventura-Emma Wood State Beach	0.068	0.068	0.068	0.068	0.068
	SCC	2880	Simi Valley-Cochran Street	0.091	0.091	0.091	0.091	0.091
	SCC	2984	Thousand Oaks-Moorpark Road	0.083	0.083	0.083	0.083	0.083
	SCC	2991	El Rio-Rio Mesa School #2	0.066	0.066	0.066	0.066	0.066
	SCC	3172	Ojai-Ojai Avenue	0.090	0.090	0.090	0.090	0.090
	SCC	3505	Piru-3301 Pacific Avenue	0.087	0.087	0.087	0.087	0.087

Table C-4-2. Current DVs ("Obs") and Adjusted DVs based on Modeled Percent Differences MS5 vs. MS1

Ozone (ppm)			MS5 vs MS1		Model Adjusted			
					1-Cell	9-Cell		
County	Basin	SiteID	Site Name	Obs	Adj	Min	Ave	Max
Imperial	SS	2551	El Centro-9th Street	0.084	0.084	0.084	0.084	0.084
	SS	2997	Calexico-Grant Street	0.069	0.069	0.069	0.069	0.069
	SS	3135	Calexico-Ethel Street	0.071	0.071	0.071	0.071	0.071
	SS	3143	Westmorland-W 1st Street	0.079	0.079	0.079	0.079	0.079
	SS	3173	Calexico-East	0.075	0.075	0.075	0.075	0.075
	SS	3186	Niland-English Road	0.072	0.072	0.072	0.072	0.072
Kern	SJV	2312	Edison	0.097	0.097	0.097	0.097	0.097
	SJV	2772	Oildale-3311 Manor Street	0.096	0.096	0.096	0.096	0.096
	SJV	2919	Maricopa-Stanislaus Street	0.091	0.091	0.091	0.091	0.091
	SJV	2941	Arvin-Bear Mountain Blvd	0.113	0.113	0.113	0.113	0.113
	SJV	2981	Shafter-Walker Street	0.090	0.090	0.090	0.090	0.090
	MD	3121	Mojave-923 Poole Street	0.090	0.090	0.090	0.090	0.090
	SJV	3145	Bakersfield-Golden State Highway	0.090	0.090	0.090	0.090	0.090
	SJV	3146	Bakersfield-5558 California Avenue	0.097	0.097	0.097	0.097	0.097
Los Angeles	SC	2160	Pasadena-S Wilson Avenue	0.093	0.093	0.093	0.093	0.093
	SC	2166	Pico Rivera	0.070	0.071	0.070	0.071	0.071
	SC	2420	Reseda	0.106	0.105	0.104	0.105	0.106
	SC	2429	North Long Beach	0.064	0.065	0.064	0.065	0.065
	SC	2484	Azusa	0.094	0.095	0.094	0.095	0.095
	SC	2492	Burbank-W Palm Avenue	0.089	0.088	0.088	0.088	0.089
	SC	2494	West Los Angeles-VA Hospital	0.078	0.077	0.076	0.077	0.078
	SC	2583	Lynwood	0.061	0.062	0.061	0.062	0.062
	SC	2849	Glendora-Laurel	0.105	0.106	0.105	0.106	0.106
	SC	2898	Pomona	0.100	0.101	0.101	0.101	0.101
	SC	2899	Los Angeles-North Main Street	0.076	0.076	0.075	0.076	0.076
	SC	3502	Santa Clarita	0.120	0.120	0.120	0.120	0.120
	MD	3658	Lancaster-43301 Division Street	0.098	0.098	0.098	0.098	0.098
Orange	SC	2249	La Habra	0.073	0.074	0.073	0.074	0.074
	SC	2937	Costa Mesa-Mesa Verde Drive	0.073	0.074	0.073	0.074	0.074
	SC	3265	Mission Viejo-26081 Via Pera	0.086	0.086	0.085	0.086	0.087
	SC	3674	Anaheim-Pampas Lane	0.081	0.081	0.080	0.081	0.081
Riverside	SS	2199	Palm Springs-Fire Station	0.104	0.104	0.104	0.104	0.104
	SC	2525	Perris	0.098	0.098	0.098	0.098	0.098
	SC	2596	Riverside-Rubidoux	0.112	0.112	0.112	0.112	0.113
	SS	2878	Indio-Jackson Street	0.095	0.095	0.095	0.095	0.095
	SC	2943	Lake Elsinore-W Flint Street	0.104	0.104	0.104	0.104	0.104
	SC	3168	Banning Airport	0.119	0.119	0.118	0.119	0.120

San Bernardino	SC	2077	Redlands-Dearborn	0.123	0.123	0.123	0.123	0.123
	SC	2221	San Bernardino-4th Street	0.116	0.116	0.116	0.116	0.117
	SC	2266	Fontana-Arrow Highway	0.118	0.119	0.119	0.119	0.119
	SC	2485	Upland	0.106	0.107	0.107	0.107	0.107
	SC	2499	Crestline	0.127	0.127	0.127	0.127	0.127
	MD	2650	Hesperia-Olive Street	0.104	0.104	0.104	0.104	0.104
	MD	2830	Phelan-Beekley Road and Phelan Road	0.100	0.100	0.100	0.100	0.100
	MD	2923	Barstow	0.085	0.085	0.085	0.085	0.085
	MD	3124	Twentynine Palms-Adobe Road #2	0.085	0.085	0.085	0.085	0.085
	MD	3152	Joshua Tree-National Monument	0.105	0.105	0.105	0.105	0.105
	MD	3500	Victorville-14306 Park Avenue	0.094	0.094	0.094	0.094	0.094
San Diego	SD	2040	San Diego-Overland Avenue	0.074	0.074	0.074	0.074	0.074
	SD	2263	Escondido-E Valley Parkway	0.073	0.073	0.073	0.073	0.073
	SD	2327	El Cajon-Redwood Avenue	0.070	0.070	0.070	0.070	0.070
	SD	2368	Del Mar-Mira Costa College	0.070	0.071	0.070	0.070	0.071
	SD	2460	Alpine-Victoria Drive	0.086	0.086	0.086	0.086	0.086
	SD	2589	Chula Vista	0.064	0.064	0.063	0.064	0.064
	SD	2933	Otay Mesa-Paseo International	0.065	0.065	0.065	0.065	0.065
	SD	2964	San Diego-12th Avenue	0.060	0.060	0.060	0.060	0.060
	SD	3198	Camp Pendleton	0.076	0.076	0.076	0.076	0.077
San Luis Obispo	SCC	2321	Morro Bay	0.056	0.056	0.055	0.056	0.057
	SCC	2671	Grover City-Lesage Drive	0.058	0.059	0.057	0.059	0.061
	SCC	2709	San Luis Obispo-Marsh Street	0.057	0.056	0.055	0.056	0.056
	SCC	2955	Paso Robles-Santa Fe Avenue	0.071	0.070	0.069	0.070	0.071
	SCC	2965	Atascadero-Lewis Avenue	0.068	0.067	0.067	0.067	0.067
	SCC	3251	Nipomo-Regional Park	0.064	0.064	0.063	0.063	0.064
Santa Barbara	SCC	2008	El Capitan Beach	0.067	0.066	0.066	0.067	0.068
	SCC	2360	Lompoc-S H Street	0.056	0.056	0.054	0.055	0.056
	SCC	2593	Santa Ynez-Airport Road	0.068	0.068	0.067	0.068	0.068
	SCC	2954	Gaviota-GTC Site B	0.060	0.060	0.060	0.060	0.060
	SCC	2957	Paradise Road-Los Padres National Forest	0.078	0.077	0.077	0.078	0.078
	SCC	2992	Lompoc-HSandP	0.070	0.069	0.068	0.069	0.070
	SCC	3003	Carpinteria-Gobernador Road	0.064	0.064	0.064	0.065	0.066
	SCC	3023	Vandenberg Air Force Base-STS Power	0.069	0.071	0.067	0.070	0.072
	SCC	3101	Las Flores Canyon #1	0.074	0.073	0.073	0.073	0.074
	SCC	3153	Goleta-Fairview	0.064	0.064	0.064	0.064	0.064
	SCC	3486	Santa Maria-906 S Broadway	0.053	0.052	0.052	0.052	0.053
	SCC	3665	Santa Barbara-700 East Canon Perdido	0.064	0.064	0.064	0.064	0.065
Ventura	SCC	2088	Ventura-Emma Wood State Beach	0.068	0.069	0.067	0.070	0.074
	SCC	2880	Simi Valley-Cochran Street	0.091	0.091	0.091	0.091	0.092
	SCC	2984	Thousand Oaks-Moorpark Road	0.083	0.083	0.083	0.083	0.083
	SCC	2991	El Rio-Rio Mesa School #2	0.066	0.066	0.065	0.066	0.068
	SCC	3172	Ojai-Ojai Avenue	0.090	0.090	0.088	0.090	0.090
	SCC	3505	Piru-3301 Pacific Avenue	0.087	0.087	0.087	0.087	0.087

Table C-4-3 Current DVs ("Obs") and Adjusted DVs based on Modeled Percent Differences MS6 vs. MS1

Ozone (ppm)			MS6 vs MS1		Model Adjusted			
					1-Cell	9-Cell		
County	Basin	SiteID	Site Name	Obs	Adj	Min	Ave	Max
Imperial	SS	2551	El Centro-9th Street	0.084	0.084	0.084	0.084	0.084
	SS	2997	Calexico-Grant Street	0.069	0.069	0.069	0.069	0.069
	SS	3135	Calexico-Ethel Street	0.071	0.071	0.071	0.071	0.071
	SS	3143	Westmorland-W 1st Street	0.079	0.079	0.079	0.079	0.079
	SS	3173	Calexico-East	0.075	0.075	0.075	0.075	0.075
	SS	3186	Niland-English Road	0.072	0.072	0.072	0.072	0.072
Kern	SJV	2312	Edison	0.097	0.097	0.097	0.097	0.097
	SJV	2772	Oildale-3311 Manor Street	0.096	0.096	0.096	0.096	0.096
	SJV	2919	Maricopa-Stanislaus Street	0.091	0.091	0.091	0.091	0.091
	SJV	2941	Arvin-Bear Mountain Blvd	0.113	0.113	0.113	0.113	0.113
	SJV	2981	Shafter-Walker Street	0.090	0.090	0.090	0.090	0.090
	MD	3121	Mojave-923 Poole Street	0.090	0.090	0.090	0.090	0.090
	SJV	3145	Bakersfield-Golden State Highway	0.090	0.090	0.090	0.090	0.090
	SJV	3146	Bakersfield-5558 California Avenue	0.097	0.097	0.097	0.097	0.097
Los Angeles	SC	2160	Pasadena-S Wilson Avenue	0.093	0.092	0.092	0.092	0.092
	SC	2166	Pico Rivera	0.070	0.070	0.070	0.071	0.071
	SC	2420	Reseda	0.106	0.104	0.103	0.105	0.106
	SC	2429	North Long Beach	0.064	0.064	0.064	0.065	0.065
	SC	2484	Azusa	0.094	0.094	0.094	0.094	0.095
	SC	2492	Burbank-W Palm Avenue	0.089	0.088	0.087	0.088	0.089
	SC	2494	West Los Angeles-VA Hospital	0.078	0.076	0.075	0.076	0.077
	SC	2583	Lynwood	0.061	0.062	0.061	0.062	0.062
	SC	2849	Glendora-Laurel	0.105	0.105	0.105	0.105	0.106
	SC	2898	Pomona	0.100	0.101	0.101	0.101	0.101
	SC	2899	Los Angeles-North Main Street	0.076	0.075	0.074	0.075	0.076
	SC	3502	Santa Clarita	0.120	0.120	0.120	0.120	0.120
	MD	3658	Lancaster-43301 Division Street	0.098	0.098	0.097	0.098	0.098
Orange	SC	2249	La Habra	0.073	0.074	0.073	0.073	0.074
	SC	2937	Costa Mesa-Mesa Verde Drive	0.073	0.074	0.072	0.073	0.074
	SC	3265	Mission Viejo-26081 Via Pera	0.086	0.085	0.085	0.086	0.087
	SC	3674	Anaheim-Pampas Lane	0.081	0.080	0.080	0.080	0.081
Riverside	SS	2199	Palm Springs-Fire Station	0.104	0.104	0.104	0.104	0.104
	SC	2525	Perris	0.098	0.098	0.098	0.098	0.098
	SC	2596	Riverside-Rubidoux	0.112	0.112	0.112	0.112	0.113
	SS	2878	Indio-Jackson Street	0.095	0.095	0.095	0.095	0.095
	SC	2943	Lake Elsinore-W Flint Street	0.104	0.104	0.104	0.104	0.104
	SC	3168	Banning Airport	0.119	0.119	0.118	0.119	0.120

San Bernardino	SC	2077	Redlands-Dearborn	0.123	0.123	0.123	0.123	0.123
	SC	2221	San Bernardino-4th Street	0.116	0.116	0.116	0.116	0.117
	SC	2266	Fontana-Arrow Highway	0.118	0.119	0.119	0.119	0.119
	SC	2485	Upland	0.106	0.106	0.106	0.107	0.107
	SC	2499	Crestline	0.127	0.127	0.127	0.127	0.127
	MD	2650	Hesperia-Olive Street	0.104	0.104	0.104	0.104	0.104
	MD	2830	Phelan-Beekley Road and Phelan Road	0.100	0.100	0.100	0.100	0.100
	MD	2923	Barstow	0.085	0.085	0.085	0.085	0.085
	MD	3124	Twentynine Palms-Adobe Road #2	0.085	0.085	0.085	0.085	0.085
	MD	3152	Joshua Tree-National Monument	0.105	0.104	0.104	0.104	0.104
	MD	3500	Victorville-14306 Park Avenue	0.094	0.094	0.094	0.094	0.094
San Diego	SD	2040	San Diego-Overland Avenue	0.074	0.074	0.074	0.074	0.074
	SD	2263	Escondido-E Valley Parkway	0.073	0.073	0.073	0.073	0.073
	SD	2327	El Cajon-Redwood Avenue	0.070	0.070	0.069	0.070	0.070
	SD	2368	Del Mar-Mira Costa College	0.070	0.071	0.069	0.070	0.071
	SD	2460	Alpine-Victoria Drive	0.086	0.086	0.086	0.086	0.086
	SD	2589	Chula Vista	0.064	0.064	0.063	0.064	0.064
	SD	2933	Otay Mesa-Paseo International	0.065	0.065	0.065	0.065	0.065
	SD	2964	San Diego-12th Avenue	0.060	0.060	0.060	0.060	0.060
	SD	3198	Camp Pendleton	0.076	0.076	0.076	0.076	0.077
San Luis Obispo	SCC	2321	Morro Bay	0.056	0.056	0.055	0.056	0.057
	SCC	2671	Grover City-Lesage Drive	0.058	0.059	0.057	0.059	0.062
	SCC	2709	San Luis Obispo-Marsh Street	0.057	0.055	0.055	0.055	0.056
	SCC	2955	Paso Robles-Santa Fe Avenue	0.071	0.070	0.069	0.070	0.071
	SCC	2965	Atascadero-Lewis Avenue	0.068	0.066	0.066	0.066	0.067
	SCC	3251	Nipomo-Regional Park	0.064	0.063	0.063	0.063	0.064
Santa Barbara	SCC	2008	El Capitan Beach	0.067	0.066	0.066	0.066	0.067
	SCC	2360	Lompoc-S H Street	0.056	0.055	0.054	0.055	0.056
	SCC	2593	Santa Ynez-Airport Road	0.068	0.068	0.067	0.068	0.068
	SCC	2954	Gaviota-GTC Site B	0.060	0.060	0.059	0.059	0.060
	SCC	2957	Paradise Road-Los Padres National Forest	0.078	0.077	0.076	0.077	0.078
	SCC	2992	Lompoc-HSandP	0.070	0.068	0.068	0.068	0.069
	SCC	3003	Carpinteria-Gobernador Road	0.064	0.064	0.064	0.064	0.066
	SCC	3023	Vandenberg Air Force Base-STS Power	0.069	0.073	0.066	0.071	0.074
	SCC	3101	Las Flores Canyon #1	0.074	0.073	0.073	0.073	0.074
	SCC	3153	Goleta-Fairview	0.064	0.064	0.063	0.064	0.065
	SCC	3486	Santa Maria-906 S Broadway	0.053	0.052	0.051	0.052	0.053
	SCC	3665	Santa Barbara-700 East Canon Perdido	0.064	0.064	0.064	0.064	0.064
Ventura	SCC	2088	Ventura-Emma Wood State Beach	0.068	0.069	0.067	0.070	0.074
	SCC	2880	Simi Valley-Cochran Street	0.091	0.091	0.091	0.091	0.092
	SCC	2984	Thousand Oaks-Moorpark Road	0.083	0.082	0.082	0.083	0.083
	SCC	2991	El Rio-Rio Mesa School #2	0.066	0.066	0.064	0.065	0.068
	SCC	3172	Ojai-Ojai Avenue	0.090	0.090	0.088	0.089	0.090
	SCC	3505	Piru-3301 Pacific Avenue	0.087	0.087	0.087	0.087	0.087

Table C-4-4. Current DVs ("Obs") and Adjusted DVs based on Modeled Percent Differences MS4ws vs. MS1

Ozone (ppm)			MS4ws vs MS1		Model Adjusted			
					1-Cell	9-Cell		
County	Basin	SiteID	Site Name	Obs	Adj	Min	Ave	Max
Imperial	SS	2551	El Centro-9th Street	0.084	0.084	0.084	0.084	0.084
	SS	2997	Calexico-Grant Street	0.069	0.069	0.069	0.069	0.069
	SS	3135	Calexico-Ethel Street	0.071	0.071	0.071	0.071	0.071
	SS	3143	Westmorland-W 1st Street	0.079	0.079	0.079	0.079	0.079
	SS	3173	Calexico-East	0.075	0.075	0.075	0.075	0.075
	SS	3186	Niland-English Road	0.072	0.072	0.072	0.072	0.072
Kern	SJV	2312	Edison	0.097	0.097	0.097	0.097	0.097
	SJV	2772	Oildale-3311 Manor Street	0.096	0.096	0.096	0.096	0.096
	SJV	2919	Maricopa-Stanislaus Street	0.091	0.091	0.091	0.091	0.091
	SJV	2941	Arvin-Bear Mountain Blvd	0.113	0.113	0.113	0.113	0.113
	SJV	2981	Shafter-Walker Street	0.090	0.090	0.090	0.090	0.090
	MD	3121	Mojave-923 Poole Street	0.090	0.090	0.090	0.090	0.090
	SJV	3145	Bakersfield-Golden State Highway	0.090	0.090	0.090	0.090	0.090
	SJV	3146	Bakersfield-5558 California Avenue	0.097	0.097	0.097	0.097	0.097
Los Angeles	SC	2160	Pasadena-S Wilson Avenue	0.093	0.093	0.093	0.093	0.093
	SC	2166	Pico Rivera	0.070	0.070	0.070	0.070	0.070
	SC	2420	Reseda	0.106	0.106	0.106	0.106	0.106
	SC	2429	North Long Beach	0.064	0.064	0.064	0.064	0.064
	SC	2484	Azusa	0.094	0.094	0.094	0.094	0.094
	SC	2492	Burbank-W Palm Avenue	0.089	0.089	0.089	0.089	0.089
	SC	2494	West Los Angeles-VA Hospital	0.078	0.078	0.078	0.078	0.078
	SC	2583	Lynwood	0.061	0.061	0.061	0.061	0.061
	SC	2849	Glendora-Laurel	0.105	0.105	0.105	0.105	0.105
	SC	2898	Pomona	0.100	0.100	0.100	0.100	0.100
	SC	2899	Los Angeles-North Main Street	0.076	0.076	0.076	0.076	0.076
	SC	3502	Santa Clarita	0.120	0.120	0.120	0.120	0.120
	MD	3658	Lancaster-43301 Division Street	0.098	0.098	0.098	0.098	0.098
Orange	SC	2249	La Habra	0.073	0.073	0.073	0.073	0.073
	SC	2937	Costa Mesa-Mesa Verde Drive	0.073	0.073	0.073	0.073	0.073
	SC	3265	Mission Viejo-26081 Via Pera	0.086	0.086	0.086	0.086	0.086
	SC	3674	Anaheim-Pampas Lane	0.081	0.081	0.081	0.081	0.081
Riverside	SS	2199	Palm Springs-Fire Station	0.104	0.104	0.104	0.104	0.104
	SC	2525	Perris	0.098	0.098	0.098	0.098	0.098
	SC	2596	Riverside-Rubidoux	0.112	0.112	0.112	0.112	0.112
	SS	2878	Indio-Jackson Street	0.095	0.095	0.095	0.095	0.095
	SC	2943	Lake Elsinore-W Flint Street	0.104	0.104	0.104	0.104	0.104
	SC	3168	Banning Airport	0.119	0.119	0.119	0.119	0.119

San Bernardino	SC	2077	Redlands-Dearborn	0.123	0.123	0.123	0.123	0.123
	SC	2221	San Bernardino-4th Street	0.116	0.116	0.116	0.116	0.116
	SC	2266	Fontana-Arrow Highway	0.118	0.118	0.118	0.118	0.118
	SC	2485	Upland	0.106	0.106	0.106	0.106	0.106
	SC	2499	Crestline	0.127	0.127	0.127	0.127	0.127
	MD	2650	Hesperia-Olive Street	0.104	0.104	0.104	0.104	0.104
	MD	2830	Phelan-Beekley Road and Phelan Road	0.100	0.100	0.100	0.100	0.100
	MD	2923	Barstow	0.085	0.085	0.085	0.085	0.085
	MD	3124	Twentynine Palms-Adobe Road #2	0.085	0.085	0.085	0.085	0.085
	MD	3152	Joshua Tree-National Monument	0.105	0.105	0.105	0.105	0.105
	MD	3500	Victorville-14306 Park Avenue	0.094	0.094	0.094	0.094	0.094
San Diego	SD	2040	San Diego-Overland Avenue	0.074	0.074	0.074	0.074	0.074
	SD	2263	Escondido-E Valley Parkway	0.073	0.073	0.073	0.073	0.073
	SD	2327	El Cajon-Redwood Avenue	0.070	0.070	0.070	0.070	0.070
	SD	2368	Del Mar-Mira Costa College	0.070	0.070	0.070	0.070	0.070
	SD	2460	Alpine-Victoria Drive	0.086	0.086	0.086	0.086	0.086
	SD	2589	Chula Vista	0.064	0.064	0.064	0.064	0.064
	SD	2933	Otay Mesa-Paseo International	0.065	0.065	0.065	0.065	0.065
	SD	2964	San Diego-12th Avenue	0.060	0.060	0.060	0.060	0.060
	SD	3198	Camp Pendleton	0.076	0.076	0.076	0.076	0.076
San Luis Obispo	SCC	2321	Morro Bay	0.056	0.056	0.056	0.056	0.056
	SCC	2671	Grover City-Lesage Drive	0.058	0.058	0.058	0.058	0.058
	SCC	2709	San Luis Obispo-Marsh Street	0.057	0.057	0.057	0.057	0.057
	SCC	2955	Paso Robles-Santa Fe Avenue	0.071	0.071	0.071	0.071	0.071
	SCC	2965	Atascadero-Lewis Avenue	0.068	0.068	0.068	0.068	0.068
	SCC	3251	Nipomo-Regional Park	0.064	0.064	0.064	0.064	0.064
Santa Barbara	SCC	2008	El Capitan Beach	0.067	0.067	0.067	0.067	0.067
	SCC	2360	Lompoc-S H Street	0.056	0.056	0.056	0.056	0.056
	SCC	2593	Santa Ynez-Airport Road	0.068	0.068	0.068	0.068	0.068
	SCC	2954	Gaviota-GTC Site B	0.060	0.060	0.060	0.060	0.060
	SCC	2957	Paradise Road-Los Padres National Forest	0.078	0.078	0.078	0.078	0.078
	SCC	2992	Lompoc-HSandP	0.070	0.070	0.070	0.070	0.070
	SCC	3003	Carpinteria-Gobernador Road	0.064	0.064	0.064	0.064	0.064
	SCC	3023	Vandenberg Air Force Base-STS Power	0.069	0.068	0.068	0.068	0.069
	SCC	3101	Las Flores Canyon #1	0.074	0.074	0.074	0.074	0.074
	SCC	3153	Goleta-Fairview	0.064	0.064	0.064	0.064	0.064
	SCC	3486	Santa Maria-906 S Broadway	0.053	0.053	0.053	0.053	0.053
	SCC	3665	Santa Barbara-700 East Canon Perdido	0.064	0.064	0.064	0.064	0.064
Ventura	SCC	2088	Ventura-Emma Wood State Beach	0.068	0.068	0.068	0.068	0.068
	SCC	2880	Simi Valley-Cochran Street	0.091	0.091	0.091	0.091	0.091
	SCC	2984	Thousand Oaks-Moorpark Road	0.083	0.083	0.083	0.083	0.083
	SCC	2991	El Rio-Rio Mesa School #2	0.066	0.066	0.066	0.066	0.066
	SCC	3172	Ojai-Ojai Avenue	0.090	0.090	0.090	0.090	0.090
	SCC	3505	Piru-3301 Pacific Avenue	0.087	0.087	0.087	0.087	0.087

Table C-4-5. Current DVs ("Obs") and Adjusted DVs based on Modeled Percent Differences MS1A vs. MS1

Ozone (ppm)			MS1A vs MS1		Model Adjusted			
					1-Cell	9-Cell		
County	Basin	SiteID	Site Name	Obs	Adj	Min	Ave	Max
Imperial	SS	2551	El Centro-9th Street	0.084	0.084	0.084	0.084	0.084
	SS	2997	Calexico-Grant Street	0.069	0.069	0.069	0.069	0.069
	SS	3135	Calexico-Ethel Street	0.071	0.071	0.071	0.071	0.071
	SS	3143	Westmorland-W 1st Street	0.079	0.079	0.079	0.079	0.079
	SS	3173	Calexico-East	0.075	0.075	0.075	0.075	0.075
	SS	3186	Niland-English Road	0.072	0.072	0.072	0.072	0.072
Kern	SJV	2312	Edison	0.097	0.097	0.097	0.097	0.097
	SJV	2772	Oildale-3311 Manor Street	0.096	0.096	0.096	0.096	0.096
	SJV	2919	Maricopa-Stanislaus Street	0.091	0.091	0.091	0.091	0.091
	SJV	2941	Arvin-Bear Mountain Blvd	0.113	0.113	0.113	0.113	0.113
	SJV	2981	Shafter-Walker Street	0.090	0.090	0.090	0.090	0.090
	MD	3121	Mojave-923 Poole Street	0.090	0.090	0.090	0.090	0.090
	SJV	3145	Bakersfield-Golden State Highway	0.090	0.090	0.090	0.090	0.090
	SJV	3146	Bakersfield-5558 California Avenue	0.097	0.097	0.097	0.097	0.097
Los Angeles	SC	2160	Pasadena-S Wilson Avenue	0.093	0.093	0.093	0.093	0.093
	SC	2166	Pico Rivera	0.070	0.070	0.070	0.070	0.070
	SC	2420	Reseda	0.106	0.106	0.106	0.106	0.106
	SC	2429	North Long Beach	0.064	0.064	0.064	0.064	0.064
	SC	2484	Azusa	0.094	0.094	0.094	0.094	0.094
	SC	2492	Burbank-W Palm Avenue	0.089	0.089	0.089	0.089	0.089
	SC	2494	West Los Angeles-VA Hospital	0.078	0.078	0.078	0.078	0.078
	SC	2583	Lynwood	0.061	0.061	0.061	0.061	0.061
	SC	2849	Glendora-Laurel	0.105	0.105	0.105	0.105	0.105
	SC	2898	Pomona	0.100	0.100	0.100	0.100	0.100
	SC	2899	Los Angeles-North Main Street	0.076	0.076	0.076	0.076	0.076
	SC	3502	Santa Clarita	0.120	0.120	0.120	0.120	0.120
	MD	3658	Lancaster-43301 Division Street	0.098	0.098	0.098	0.098	0.098
Orange	SC	2249	La Habra	0.073	0.073	0.073	0.073	0.073
	SC	2937	Costa Mesa-Mesa Verde Drive	0.073	0.073	0.073	0.073	0.073
	SC	3265	Mission Viejo-26081 Via Pera	0.086	0.086	0.086	0.086	0.086
	SC	3674	Anaheim-Pampas Lane	0.081	0.081	0.081	0.081	0.081
Riverside	SS	2199	Palm Springs-Fire Station	0.104	0.104	0.104	0.104	0.104
	SC	2525	Perris	0.098	0.098	0.098	0.098	0.098
	SC	2596	Riverside-Rubidoux	0.112	0.112	0.112	0.112	0.112
	SS	2878	Indio-Jackson Street	0.095	0.095	0.095	0.095	0.095
	SC	2943	Lake Elsinore-W Flint Street	0.104	0.104	0.104	0.104	0.104
	SC	3168	Banning Airport	0.119	0.119	0.119	0.119	0.119

San Bernardino	SC	2077	Redlands-Dearborn	0.123	0.123	0.123	0.123	0.123
	SC	2221	San Bernardino-4th Street	0.116	0.116	0.116	0.116	0.116
	SC	2266	Fontana-Arrow Highway	0.118	0.118	0.118	0.118	0.118
	SC	2485	Upland	0.106	0.106	0.106	0.106	0.106
	SC	2499	Crestline	0.127	0.127	0.127	0.127	0.127
	MD	2650	Hesperia-Olive Street	0.104	0.104	0.104	0.104	0.104
	MD	2830	Phelan-Beekley Road and Phelan Road	0.100	0.100	0.100	0.100	0.100
	MD	2923	Barstow	0.085	0.085	0.085	0.085	0.085
	MD	3124	Twentynine Palms-Adobe Road #2	0.085	0.085	0.085	0.085	0.085
	MD	3152	Joshua Tree-National Monument	0.105	0.105	0.105	0.105	0.105
	MD	3500	Victorville-14306 Park Avenue	0.094	0.094	0.094	0.094	0.094
San Diego	SD	2040	San Diego-Overland Avenue	0.074	0.074	0.074	0.074	0.074
	SD	2263	Escondido-E Valley Parkway	0.073	0.073	0.073	0.073	0.073
	SD	2327	El Cajon-Redwood Avenue	0.070	0.070	0.070	0.070	0.070
	SD	2368	Del Mar-Mira Costa College	0.070	0.070	0.070	0.070	0.070
	SD	2460	Alpine-Victoria Drive	0.086	0.086	0.086	0.086	0.086
	SD	2589	Chula Vista	0.064	0.064	0.064	0.064	0.064
	SD	2933	Otay Mesa-Paseo International	0.065	0.065	0.065	0.065	0.065
	SD	2964	San Diego-12th Avenue	0.060	0.060	0.060	0.060	0.060
	SD	3198	Camp Pendleton	0.076	0.076	0.076	0.076	0.076
San Luis Obispo	SCC	2321	Morro Bay	0.056	0.056	0.056	0.056	0.056
	SCC	2671	Grover City-Lesage Drive	0.058	0.058	0.058	0.058	0.058
	SCC	2709	San Luis Obispo-Marsh Street	0.057	0.057	0.057	0.057	0.057
	SCC	2955	Paso Robles-Santa Fe Avenue	0.071	0.071	0.071	0.071	0.071
	SCC	2965	Atascadero-Lewis Avenue	0.068	0.068	0.068	0.068	0.068
	SCC	3251	Nipomo-Regional Park	0.064	0.064	0.064	0.064	0.064
Santa Barbara	SCC	2008	El Capitan Beach	0.067	0.067	0.067	0.067	0.067
	SCC	2360	Lompoc-S H Street	0.056	0.056	0.056	0.056	0.056
	SCC	2593	Santa Ynez-Airport Road	0.068	0.068	0.068	0.068	0.068
	SCC	2954	Gaviota-GTC Site B	0.060	0.060	0.060	0.060	0.060
	SCC	2957	Paradise Road-Los Padres National Forest	0.078	0.078	0.078	0.078	0.078
	SCC	2992	Lompoc-HSandP	0.070	0.070	0.070	0.070	0.070
	SCC	3003	Carpinteria-Gobernador Road	0.064	0.064	0.064	0.064	0.064
	SCC	3023	Vandenberg Air Force Base-STS Power	0.069	0.069	0.069	0.069	0.069
	SCC	3101	Las Flores Canyon #1	0.074	0.074	0.074	0.074	0.074
	SCC	3153	Goleta-Fairview	0.064	0.064	0.064	0.064	0.064
	SCC	3486	Santa Maria-906 S Broadway	0.053	0.053	0.053	0.053	0.053
	SCC	3665	Santa Barbara-700 East Canon Perdido	0.064	0.064	0.064	0.064	0.064
Ventura	SCC	2088	Ventura-Emma Wood State Beach	0.068	0.068	0.068	0.068	0.068
	SCC	2880	Simi Valley-Cochran Street	0.091	0.091	0.091	0.091	0.091
	SCC	2984	Thousand Oaks-Moorpark Road	0.083	0.083	0.083	0.083	0.083
	SCC	2991	El Rio-Rio Mesa School #2	0.066	0.066	0.066	0.066	0.066
	SCC	3172	Ojai-Ojai Avenue	0.090	0.090	0.090	0.090	0.090
	SCC	3505	Piru-3301 Pacific Avenue	0.087	0.087	0.087	0.087	0.087