UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Emissions, Monitoring, and Analysis Division
Office of Air Quality Planning and Standards
79 T.W. Alexander Drive, Research Triangle Park, North Carolina 27711

November 22, 2000

TECHNICAL MEMORANDUM

To: EPA Air Docket A-99-06

From: Eric Ginsburg, Senior Program Advisor
Emissions Monitoring and Analysis Division, OAQPS

Subject: Summary of Model-Adjusted Ambient Concentrations for Certain Levels of Ground-Level Ozone over Prolonged Periods

This memorandum summarizes the results of analyses of model-adjusted ozone air quality concentrations and the anticipated air quality impact of reductions in emissions expected to result from implementation of the heavy duty engine and vehicle standards and highway diesel fuel sulfur control requirements. Specifically, it provides information on the number of people estimated to live in metropolitan counties in which ozone monitors are predicted to repeatedly experience certain levels of ozone of potential concern over prolonged periods, i.e., 8-hours.

The focus for the analysis described in this memorandum on metropolitan areas reflects the substantially greater likelihood that heavy-duty vehicles contribute to the air quality concentrations reported, since they contribute a substantial fraction of ozone precursors in any metropolitan area. To provide a quantitative estimate of the number of people anticipated to reside in areas in which ozone concentrations are predicted to experience multiple days with 8-hour ozone in the range of 0.08 to 0.12 ppm and higher, we performed regional modeling for 6 different scenarios (1996 base, 2007 base, 2020 base and control, 2030 base and control) separately for the eastern and western regions of the United States, using the variable-grid Urban Airshed Model (UAM-V) and the meteorological inputs simulated for the Tier 2 rulemaking. UAM-V is a photochemical grid model that numerically simulates the effects of emissions, advection, diffusion, chemistry, and surface removal processes on pollutant concentrations within a three-dimensional grid. Emissions inputs to the model are described in Procedures for Developing Base Year and Future Year Mass and Modeling Inventories for the Heavy-Duty Diesel (HDD) Rulemaking, October, 2000, which was placed in the docket for this rulemaking. Other than the emissions inventory inputs, this ozone modeling followed the same protocol as was used for the final RIA for the Tier 2 Gasoline Sulfur rulemaking applications in 1999. Using this modeling, we derived relative reduction factors (RRF) from the relative change between 1996 base and future year concentrations predicted by the model for each of the future scenarios. These RRFs were then applied to the 1996 concentrations measured at appropriate ambient monitors to provide future air quality predictions calibrated by the monitoring data.

Our reason for considering this longer averaging period is that, irrespective of 1-hour air quality and the occurrences of exceedances of the level of the 1-hour NAAQS, the potential exists for exposures to levels of ozone for more prolonged periods which have been associated with a range of health effects, including lung function decrements, respiratory symptoms, and pulmonary inflammation. Our analysis relies on projected county-level population from the U.S. Department of Census for the period representing each year analyzed.

In our assessment of model performance, comparisons of base year model output data against ambient observations in the western U.S. indicated that the model was significantly underestimating (by 30-50 percent) the observed amounts of ozone. Given that model performance was degraded relative to both the performance of the model in the eastern U.S. (where biases were found to be within plus or minus 10 percent) and what is typically expected from such regional modeling applications, we determined that this application of the model should not be used in assessing future air quality or the impacts of the emissions control strategy in the west. For this reason, we have limited our application of RRFs to the monitors located in counties within in the eastern modeling domain.

For each of the counties analyzed, we determined the number of days for periods on which the highest model-adjusted 8-hour concentration at any monitor in the county was predicted, for example, to be between 0.08 and 0.12 ppm (after rounding from 3 decimal places). We then grouped the counties which had days with ozone in this range according to the number of days this was predicted to happen, and summed their projected populations. We repeated this for ozone ranges of 0.09 to 0.12 ppm, 0.10 to 0.12 ppm, 0.11 to 0.12 ppm and greater than or equal to 0.12 ppm. The results of this analysis are presented in the attached tables. For example, in the 2007 base case presented in Table A (i.e., before the application of emission reductions resulting from this rule), we estimated that 116 million, or 93% of the total population considered in this analysis, are predicted to live in areas with at least 2 days with model-adjusted 8-hour average concentrations of 0.08 ppm or higher. The number of people involved is predicted to diminish as the lower end of the concentration range increases or as the number of days predicted to experience such peak 8-hour average concentrations increases. The number of people predicted to live in areas with at least 2 days with model-adjusted 8-hour average concentrations of 0.08 ppm or higher is estimated to increase in the 2020 base case shown in Table B to 122 million people, although this is estimated to represent a smaller percentage (87%) of the total projected population considered in the analysis. However, both the number of people (139 million) and the relative percentage (91%) of the total population considered in the analysis is projected to grow in the 2030 base case (Table D).

cc: J. Anderson, ASD/OTAQ
R. Evans, ISEG/AQSSD
M. Horowitz, OGC
D. Kodjak, ASD/OTAQ
S. Napolitano, OTAQ
J. Hemby, AQTAG/EMAD
N. Possiel, AQMG/EMAD

Attachment

Table A
Base Scenario - 2007 Populations in Eastern Metropolitan Counties with Predicted Daily 8-Hour Ozone ≥ 0.080 ppm *

Number of days in 2007 with predicted peak 8-hour ozone in the ranges shown	2007 Population,(Millions)				
	0.080 - 0.119 ppm	0.090 - 0.119 ppm	0.100 - 0.119 ppm	0.110 - 0.119 ppm	>0.120 ppm
At least 2 days	116	90	45	15	8
At least 3 days	113	81	34	8	5
At least 4 days	111	73	25	6	4
At least 5 days	108	64	22	5	4
At least 6 days	104	54	11	5	4
At least 7 days	102	48	11	5	4
At least 8 days	99	44	8	5	4
At least 9 days	95	38	8	5	4
At least 10 days	92	36	7	5	4
At least 15 days	75	21	5	4	4
At least 20 days	54	13	4	4	0
At least 30 days	34	5	4	4	0
At least 40 days	25	5	4	0	0
At least 50 days	14	4	4	0	0
At least 60 days	7	4	0	0	0

* Total estimated 2007 population in eastern urban counties evaluated: 125 million
Eastern urban population (35 states & DC): 174 million
Urban population (lower 48 & DC): 231 million
Total estimated 2007 U.S. population (lower 48 & DC): 289 million

Table B
Base Scenario - 2020 Populations in Eastern Metropolitan Counties with Predicted Daily 8-Hour Ozone ≥ 0.080 ppm *

Number of days in 2020 with predicted peak 8-hour ozone in the ranges shown	2020 Population (Millions)				
	0.080 - 0.119 ppm	0.090 - 0.119 ppm	0.100 - 0.119 ppm	0.110 - 0.119 ppm	>0.120 ppm
At least 2 days	122	88	44	14	6
At least 3 days	116	74	35	9	4
At least 4 days	111	66	20	7	4
At least 5 days	109	56	18	6	4
At least 6 days	104	44	12	5	4
At least 7 days	102	43	10	4	4
At least 8 days	98	37	8	4	4
At least 9 days	95	33	8	4	4
At least 10 days	89	31	7	4	4
At least 15 days	67	15	6	4	4
At least 20 days	51	9	4	4	4
At least 30 days	35	4	4	4	0
At least 40 days	16	4	4	0	0
At least 50 days	10	4	4	0	0
At least 60 days	7	4	4	0	0

* Total estimated 2020 population in eastern urban counties evaluated: 140 million
Eastern urban population (35 states & DC): 193 million
Urban population (lower 48 & DC): 259 million
Total estimated 2020 U.S. population (lower 48 & DC): 321 million

Table C
Control Scenario - 2020 Populations in Eastern Metropolitan Counties with Predicted Daily 8-Hour Ozone ≥ 0.080 ppm *

Number of days in 2020 with predicted peak 8-hour ozone in the ranges shown	2020 Population (Millions)				
	0.080 - 0.119 ppm	0.090 - 0.119 ppm	0.100 - 0.119 ppm	0.110 - 0.119 ppm	>0.120 ppm
At least 2 days	111	76	34	12	5
At least 3 days	107	58	23	6	4
At least 4 days	102	48	16	6	4
At least 5 days	97	43	11	4	4
At least 6 days	92	35	10	4	4
At least 7 days	84	32	7	4	4
At least 8 days	77	31	6	4	4
At least 9 days	74	28	6	4	4
At least 10 days	70	24	5	4	4
At least 15 days	53	8	4	4	4
At least 20 days	39	6	4	4	4
At least 30 days	17	4	4	4	0
At least 40 days	11	4	4	0	0
At least 50 days	6	4	4	0	0
At least 60 days	4	4	4	0	0

* Total estimated 2020 population in eastern urban counties evaluated: 140 million
Eastern urban population (35 states & DC): 193 million
Urban population (lower 48 & DC): 259 million
Total estimated 2020 U.S. population (lower 48 & DC): 321 million

Table D
Base Scenario - 2030 Populations in Eastern Metropolitan Counties with Predicted Daily 8-Hour Ozone ≥ 0.080 ppm *

Number of days in 2030 with predicted peak 8-hour ozone in the ranges shown	2030 Population (Millions)				
	0.080 - 0.119 ppm	0.090 - 0.119 ppm	0.100 - 0.119 ppm	0.110 - 0.119 ppm	>0.120 ppm
At least 2 days	139	106	61	20	10
At least 3 days	136	93	41	10	5
At least 4 days	130	83	32	7	5
At least 5 days	126	73	27	7	5
At least 6 days	120	66	20	6	5
At least 7 days	118	55	15	6	5
At least 8 days	113	50	12	6	4
At least 9 days	110	47	11	6	4
At least 10 days	108	42	8	4	4
At least 15 days	86	27	7	4	4
At least 20 days	66	16	4	4	4
At least 30 days	42	8	4	4	0
At least 40 days	29	6	4	0	0
At least 50 days	17	4	4	0	0
At least 60 days	9	4	4	0	0

* Total estimated 2030 population in eastern urban counties evaluated: 152 million
Eastern urban population (35 states & DC): 209 million
Urban population (lower 48 & DC): 282 million
Total estimated 2030 U.S. population (lower 48 & DC): 346 million

Table E
Control Scenario - 2030 Populations in Eastern Metropolitan Counties with Predicted Daily 8-Hour Ozone ≥ 0.080 ppm *

Number of days in 2030 with predicted peak 8-hour ozone in the ranges shown	2030 Population (Millions)				
	0.080 - 0.119 ppm	0.090 - 0.119 ppm	0.100 - 0.119 ppm	0.110 - 0.119 ppm	>0.120 ppm
At least 2 days	125	89	47	13	6
At least 3 days	118	69	30	7	5
At least 4 days	114	57	20	6	5
At least 5 days	109	50	17	5	5
At least 6 days	105	48	14	5	5
At least 7 days	101	38	8	5	5
At least 8 days	93	36	8	5	4
At least 9 days	89	33	7	5	4
At least 10 days	85	33	7	4	4
At least 15 days	63	12	6	4	4
At least 20 days	53	8	4	4	4
At least 30 days	26	4	4	4	0
At least 40 days	13	4	4	0	0
At least 50 days	8	4	4	0	0
At least 60 days	6	4	4	0	0

* Total estimated 2030 population in eastern urban counties evaluated: 152 million
Eastern urban population (35 states & DC): 209 million
Urban population (lower 48 & DC): 282 million
Total estimated 2030 U.S. population (lower 48 & DC): 346 million