Memorandum

Subject: Update on CAMx Modeling for the Pinedale Anticline Record of Decision
To: John Zachariassen, BLM
From: Gail Tonnesen, AECOM
Date: August 3, 2010

AECOM is performing CAMx modeling for the period April 1 through September 30, 2006 to support the Anticline Record of Decision (ROD). The primary focus of the modeling effort is ozone, however, we are including fine particulate matter in the simulation. The objective of the project is to use the same model configuration and input data that was previously developed as part of Continental Divide-Creston (CDC) Environmental Impact Statement study. Because we are using the same model configuration and input data sets as used in the CDC study, we expect the results to be essentially identical to the CDC CAMx modeling. However, we were not able to obtain all model emissions input data sets for the coarse 36 km grid, so we developed emissions for those source categories that were not provided. In addition, we processes emissions using SMOKE for the 4, 12 and 36 km grids, and it is possible that there may be small differences in the CAMx results as a results of developing new emissions data and processing emissions on a linux cluster that uses different operating system from that used in the CDC study. Nonetheless, we expect the model predicted ozone concentrations and the ozone model performance to be essentially identical to that found in the CDC study.

We have completed the development of error and bias metrics for the Anticline modeling and have developed a set of spatial plots comparing our CAMx ozone results to observations for the modeling period. We developed time-series plots, scatter plots, and tables of bias and error for individual monitoring sites for monthly averages. While we cannot directly compare these results to 3-month averages that were presented in the CDC study, the results seem to be consistent with the error and bias metrics reported in that study. Table 1 shows tabulated error and bias metrics calculated as a monthly average for each monitoring site in the 4-km domain.

We also found that on certain days, most notably mid April, the CAMx simulated ozone concentrations included a large contribution to ozone transported from the top lateral boundary concentrations that were derived from the GEOSCHEM model. This resulted in large over predictions for ozone in Utah and Colorado during April 18-20. Figure 1 shows the modeled and observed ozone concentrations on the 12 km for this period. Figure 2 shows that there was an area on the northern boundary with ozone concentrations greater than 700 ppb during this period.

We contacted ENVIRON to discuss this unexpected result and verified that they had the same result in the CDC modeling. ENVIRON has since developed a revised set of GEOSCHEM boundary conditions using lower ozone concentrations in the top layers. ENVIRON also verified that there was an observed stratospheric ozone event during mid April, 2006, so it is likely that a large component of the transported ozone is real, although the transport might have been over predicted in some regions. As shown in Figure 2, the model performed reasonably well for the Anticline region during this period, so

reducing the ozone boundary conditions might not improve ozone performance for the Anticline. We are continuing to compare our model performance results with those presented in the CDC study and expect will complete the model performance evaluation report shortly.

Table 1. Ozone error and bias metrics calculated as monthly averages for the 4-km grid for Air Quality Systems monitoring sites.

Station	Stats	April 04k	May 04k	June 04k	July 04k	August 04k	Sept 04k
56_035_0098	Fraction_Bias(%)	-21.8	-13.3	-17.1	-12.5	-11.3	-4.5
	Fraction_GErr(%)	23.1	13.8	18.5	13.9	13.9	10.4
	Norm_Mean_Bias(%)	-18.8	-12.2	-15.7	-11.3	-9.8	-4.0
	Norm_Mean_Err(%)	20.1	12.8	16.9	12.5	12.9	10.1
	Mean_Norm_Bias(%)	-18.4	-12.0	-15.2	-11.1	-10.0	-3.7
	Mean_Norm_GErr(%)	19.7	12.5	16.7	12.6	12.9	10.1
56_035_0099	Fraction_Bias(%)	-7.3	-14.1	-17.3	-10.5	-8.0	-4.2
	Fraction_GErr(%)	10.5	14.4	19.3	13.9	11.6	9.8
	Norm_Mean_Bias(%)	-6.7	-13.0	-16.3	-9.9	-6.8	-4.1
	Norm_Mean_Err(%)	10.0	13.2	17.8	12.9	10.9	9.4
	Mean_Norm_Bias(%)	-6.5	-12.8	-15.3	-9.1	-7.2	-3.5
	Mean_Norm_GErr(%)	9.9	13.0	17.5	13.1	10.9	9.6
56_035_0100	Fraction_Bias(%)	-9.5	-13.8	-15.1	-13.0	-0.8	-0.3
	Fraction_GErr(%)	12.0	14.3	15.3	13.4	12.9	9.3
	Norm_Mean_Bias(%)	-8.5	-12.8	-14.1	-11.8	0.0	-0.1
	Norm_Mean_Err(%)	11.2	13.2	14.2	12.2	12.6	9.2
	Mean_Norm_Bias(%)	-8.5	-12.4	-13.7	-11.8	0.5	0.4
	Mean_Norm_GErr(%)	11.2	13.0	13.9	12.2	13.3	9.6
56_037_0200	Fraction_Bias(%)	-2.8	-5.2	-9.3	11.5	12.0	19.4
	Fraction_GErr(%)	7.6	10.1	10.3	14.1	12.4	19.4
	Norm_Mean_Bias(%)	-2.3	-4.6	-9.0	13.3	13.2	21.6
	Norm_Mean_Err(%)	7.1	9.6	9.8	15.8	13.6	21.6
	Mean_Norm_Bias(%)	-2.4	-4.4	-8.6	13.2	13.2	21.8
	Mean_Norm_GErr(%)	7.3	9.7	9.5	15.6	13.6	21.8
56_037_0898	Fraction_Bias(%)		-3.9	-9.5	-11.4	-7.3	0.1
	Fraction_GErr(%)		7.8	11.1	11.9	9.7	8.9
	Norm_Mean_Bias(%)		-3.4	-9.0	-10.1	-6.7	0.4
	Norm_Mean_Err(%)		7.4	10.6	10.7	8.9	8.8
	Mean_Norm_Bias(%)		-3.4	-8.6	-10.3	-6.7	0.8
	Mean_Norm_GErr(%)		7.4	10.3	10.8	9.1	9.0

Table 2. Ozone error and bias metrics calculated as monthly averages for the 4-km grid for CASTNet monitoring sites.

Station	Stats	April 04k	May 04k	June 04k	July 04k	August 04k	Sept 04k
CNT169	Fraction_Bias(%)	-9.7	-7.9	-4.6	0.4	-2.2	7.7
	Fraction_GErr(%)	11.4	14.5	9.1	8.1	8.8	8.6
	Norm_Mean_Bias(%)	-8.7	-6.6	-4.5	0.7	-1.9	8.1
	Norm_Mean_Err(%)	10.5	13.9	9.0	8.1	9.0	9.0
	Mean_Norm_Bias(%)	-8.8	-6.5	-4.0	0.9	-1.6	8.3
	Mean_Norm_GErr(%)	10.5	13.8	8.7	8.1	8.7	9.2
PND165	Fraction_Bias(%)	1.0	-1.5	-1.3	-3.1	1.0	5.5
	Fraction_GErr(%)	6.6	8.5	4.1	8.5	8.4	8.5
	Norm_Mean_Bias(%)	1.3	-1.3	-1.4	-2.7	1.7	5.9
	Norm_Mean_Err(%)	6.8	8.5	4.1	8.2	8.8	8.8
	Mean_Norm_Bias(%)	1.4	-0.9	-1.2	-2.6	1.6	6.3
	Mean_Norm_GErr(%)	6.7	8.4	4.0	8.2	8.6	9.2
	Num_Points	24	30	6	30	30	24

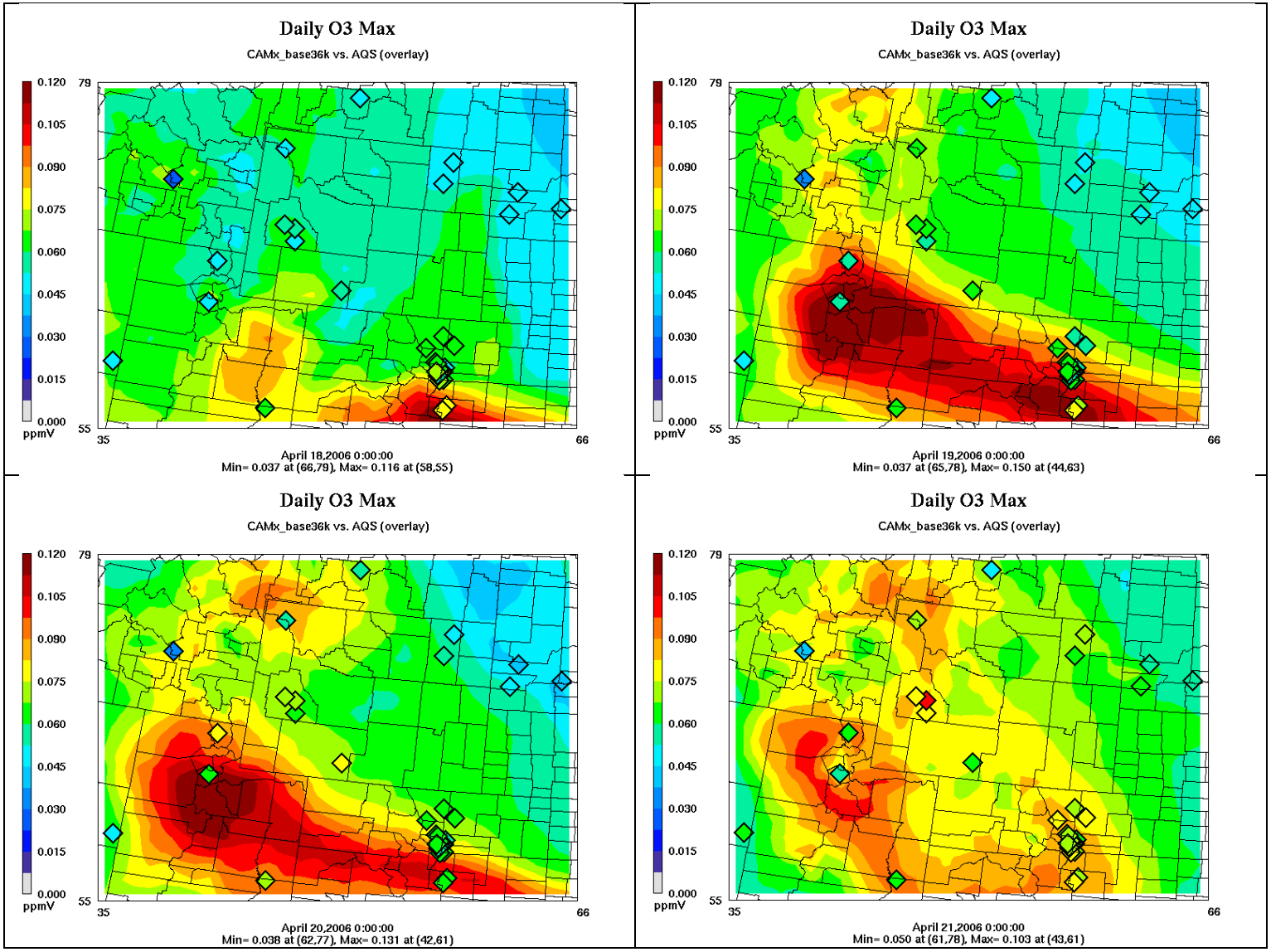

Figure 1. Spatial plots showing maximum 1-hour average observed and modeled ozone concentrations from April 18-21 on the 12-km grid.

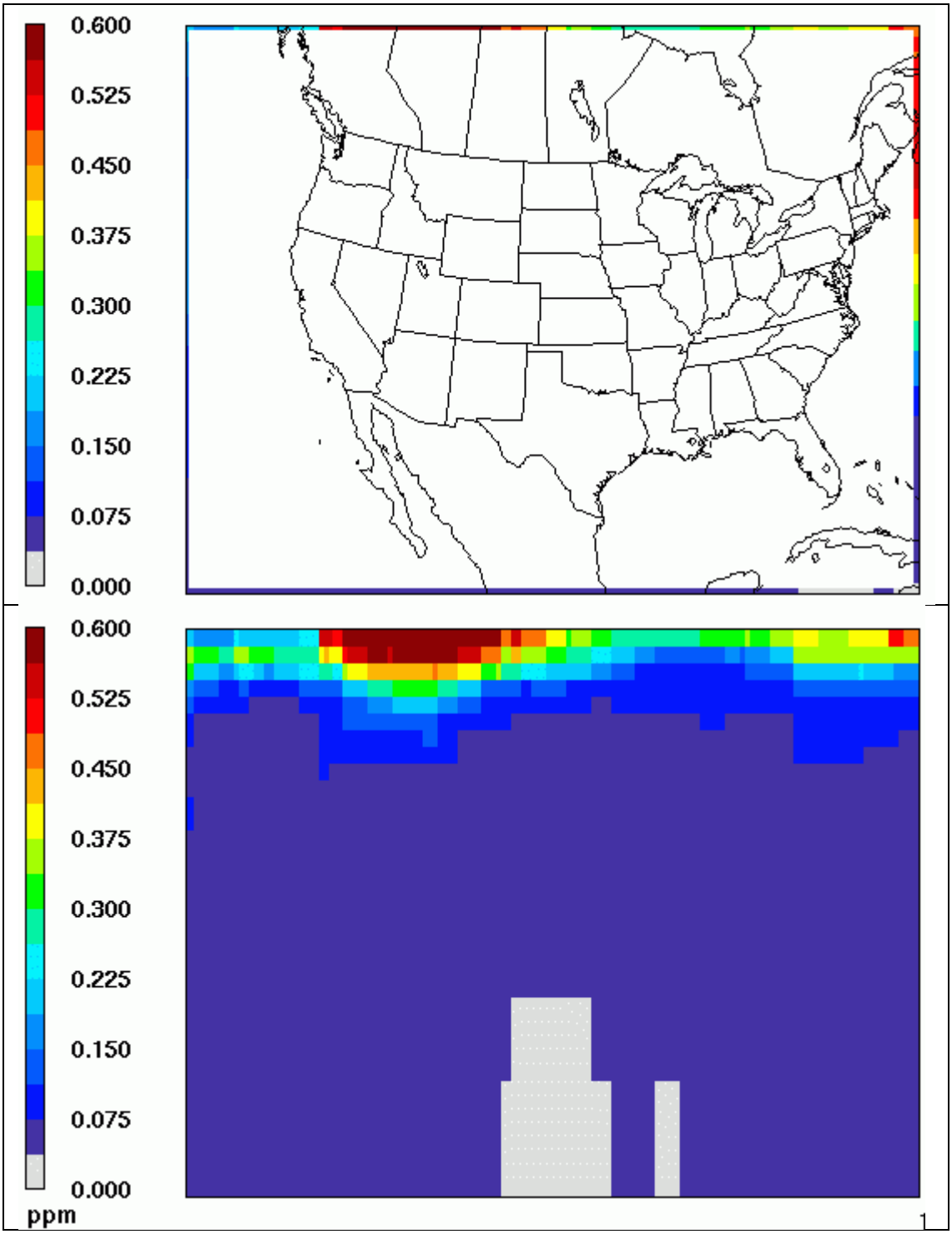

Figure 2. Boundary Conditions derived from GEOS-CHEM at 17:00 MST on April 17, 2006 for layer 34 (top) and for the vertical profile for the plane transecting the northern boundary (bottom).

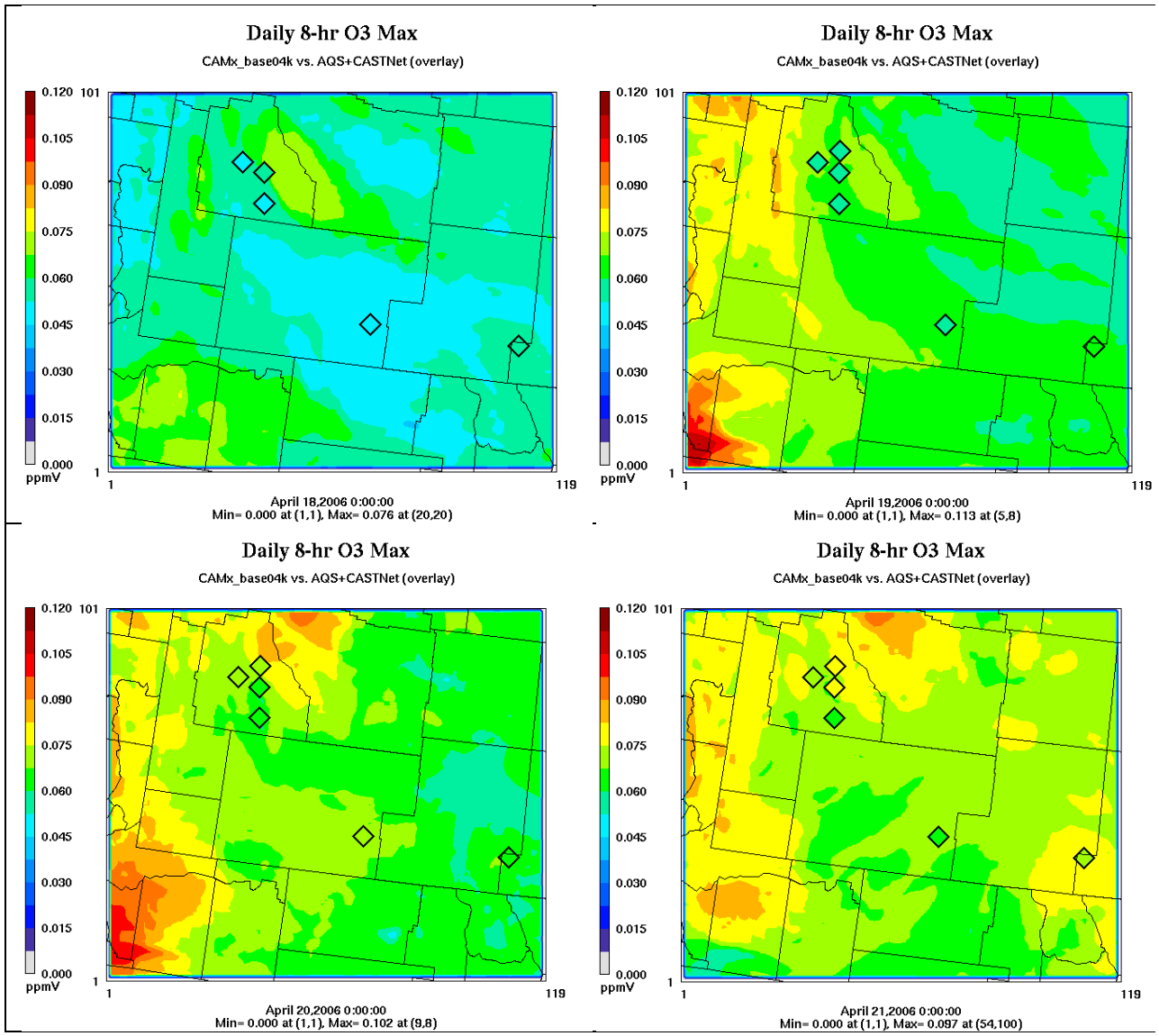

Figure 4-3. Spatial plots showing observed and modeled daily maximum 8-hour average ozone concentrations from April 18-21 on the 4 km grid.