Final Report

AIR QUALITY MODELING ANALYSIS FOR THE DENVER EARLY ACTION OZONE COMPACT:

Ozone Source Apportionment Modeling for the Denver EAC

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EXECUTIVE SUMMARY

As part of the Denver 8-hour ozone Early Action Compact (EAC), photochemical modeling was performed for the June 5 through July 1, 2002 period and the Denver Front Range Region using the Comprehensive Air-quality Model with extensions (CAMx). The CAMx model was used to develop a Clean Air Action Plan for the Denver Metropolitan Area (DMA) (see: www.**raqc**.org/ozone/EAC/ozone-**eac**.htm). CAMx employs several "probing tools" that extract information from the photochemical model simulation that have a variety of uses from better understanding the inner workings of the model to assisting in the design of more optimal control strategies. One of the CAMx probing tools is the Ozone Source Apportionment Technology (OSAT) that uses an internal reactive tracer accounting system to identify the sources of ozone. The CAMx OSAT probing tool was applied to the Denver EAC June 2002 database to identify the source regions and categories that contributed to elevated ozone concentrations in the DMA and vicinity.

DEFINITION OF THE OZONE SOURCE APPORTIONMENT ANALYSIS

The CAMx Ozone Source Apportionment Technology (OSAT) Anthropogenic Precursor Culpability Assessment (APCA) ozone source apportionment technique was applied to the Denver EAC June 2002 episode to determine the source regions and categories that produced the estimated ozone concentrations in the CAMx simulation. To operate OSAT/APCA, the user must first define the source groups for which ozone source apportionment will be obtained. Source groups are defined by source regions and source categories. For the Denver EAC OSAT/APCA application, the CAMx modeling domain was divided up into 10 geographic source regions and 7 source categories. As initial concentrations (ICs) and boundary conditions (BCs) are always included as their own source groups, this results in 72 source groups for the Denver EAC ozone source apportionment modeling ($72 = 10 \times 7 + 2$).

Source Regions

The 10 geographic source regions used in the source apportionment modeling are as follows (see Figure ES-1):

1. Seven County Denver Metropolitan Area (DMA)
2. Weld County
3. Elbert County
4. Morgan County
5. Larimer County
6. El Paso County
7. Northern Colorado
8. Southern Colorado
9. Central US (States east of Colorado)
10. Western US (States west of Colorado)

Source Categories

The seven source categories for which ozone source apportionment was obtained for each source region above for areas follows:

1. Biogenic Emissions
2. On-Road Mobile Sources
3. Non-Road Mobile Sources
4. Colorado Low-Level Oil and Gas Sources
5. Colorado Elevated Oil and Gas Point Sources
6. Remainder Low-Level Anthropogenic Sources
7. Elevated Point Sources

Description of OSAT/APCA

OSAT and APCA are two types of ozone source apportionment probing tools available in CAMx. Both techniques use reactive tracers to represent VOC and NOx emissions from user-selected source groups that operate in parallel to the host model (CAMx). At each time step and grid cell, ozone formed in the host model is allocated to source groups based on the relative contribution of each source group's limiting precursor (either VOC or NOx). The ozone reactive tracer associated with each source group is then transported, dispersed, deposited and chemical destroyed following the processes in the host model. The differences between OSAT and APCA are described below.

Ozone Source Apportionment Technology (OSAT)

OSAT provides information about the relationships between ozone concentrations and sources of precursors in the form of ozone source apportionments. Source apportionment means that the sum of the source contributions adds up to exactly 100% of the total ozone and so all of the ozone is accounted for. OSAT attributes ozone among all of the potential sources of ozone in the simulation, namely emissions, boundary conditions (BCs) and initial conditions (ICs). Ozone formation from VOC and NOx precursors is tracked separately. The emissions contributions can be broken down by geographic area and/or source category. OSAT apportions ozone formation based solely on what precursors were present when the ozone is formed. OSAT determines whether ozone formation is NOx or VOC limited in each grid cell at each time step, and attributes ozone production according to the relative contributions of the limiting precursor (VOC or NOx) from different sources present at that time. The precursors are tracked using a reactive tracer (tagged species) approach. Likewise, the ozone contributions are tracked using a reactive tracer approach and separate tracers are used to track ozone formation attributed to NOx (O3N tracers) and VOC (O3V tracers).

Because ozone formation chemistry is a non-linear process, there is no unique way of apportioning ozone back to precursor sources. The OSAT approach to source apportionment is to attribute ozone formation among the precursors that were present when the ozone was formed. There are two schemes for doing this called OSAT and APCA (Anthropogenic Precursor

Culpability Assessment). For the Denver 8-hour ozone EAC analysis, the APCA ozone source apportionment technique was utilized.

Anthropogenic Precursor Culpability Assessment (APCA)

Applications of OSAT to the Eastern US consistently identify biogenic emissions as a major contributor to ozone formation. This is not surprising as biogenic VOC emissions are very reactive and dominate regional VOC emissions in the Eastern US, but this finding is not "policy relevant" for designing anthropogenic emissions ozone control plans. The APCA methodology was developed from OSAT to address this issue. APCA stands for Anthropogenic Precursor Culpability Assessment, and differs from OSAT in recognizing that certain emission groups are not controllable (i.e., biogenic emissions) and that apportioning ozone production to these emissions does not provide control strategy relevant information. To address this, in situations where OSAT attributes ozone formation to a non-controllable source category when it was due to the interaction of ozone precursors from a non-controllable (i.e., biogenic) and controllable emissions source, APCA re-directs the ozone attribution to the controllable precursor. In practice, biogenic emissions are the uncontrollable source category and APCA only attributes ozone production to biogenic emissions when ozone formation is due to the interaction of biogenic VOC with biogenic NOx. When ozone formation is due to biogenic VOC interacting with anthropogenic NOx under VOC-limited conditions (where OSAT would attribute ozone production to biogenic VOCs), APCA directs the attribution to the anthropogenic NOx precursors present. The result of using APCA instead of OSAT is that more ozone formation is attributed to anthropogenic NOx sources and little ozone formation is attributed to biogenic sources. APCA is not called a "source apportionment" technique because it expresses biases as to which sources should be implicated (i.e., those that are controllable), hence it is referred to as a "culpability assessment."

One cautionary note regarding ozone source apportionment should be made. As ozone formation is highly nonlinear, ozone source apportionment is not unique. Furthermore, ozone source apportionment changes as controls are implemented, thus it is not quantitatively prognostic. However, when used in a qualitative fashion OSAT/APCA is a powerful tool that can provide information on many source-receptor relationships that would take 100s of standard model runs to obtain.

Emissions Scenario

The 2007 Three Control Strategy emissions scenario (cntl4 a2 version) as reported by Morris and co-workers (2004b) was used for the OSAT/APCA simulation. This simulation included 8.1 RVP with 40% ethanol penetration, Flash VOC and RICE control measures. It should be noted that the control factors used in the 8.1 RVP control measure were found to be in error. However, the emissions are close to the current 2007 Base Case and Control Strategies that are being analyzed for the Denver EAC (Morris et al., 2004c). As the ozone source apportionment is used to get a broad brush of source regions/categories contributions, rather than detailed refined quantitative contributions, the RVP control factor error will have minimal effect on the ozone source apportionment.

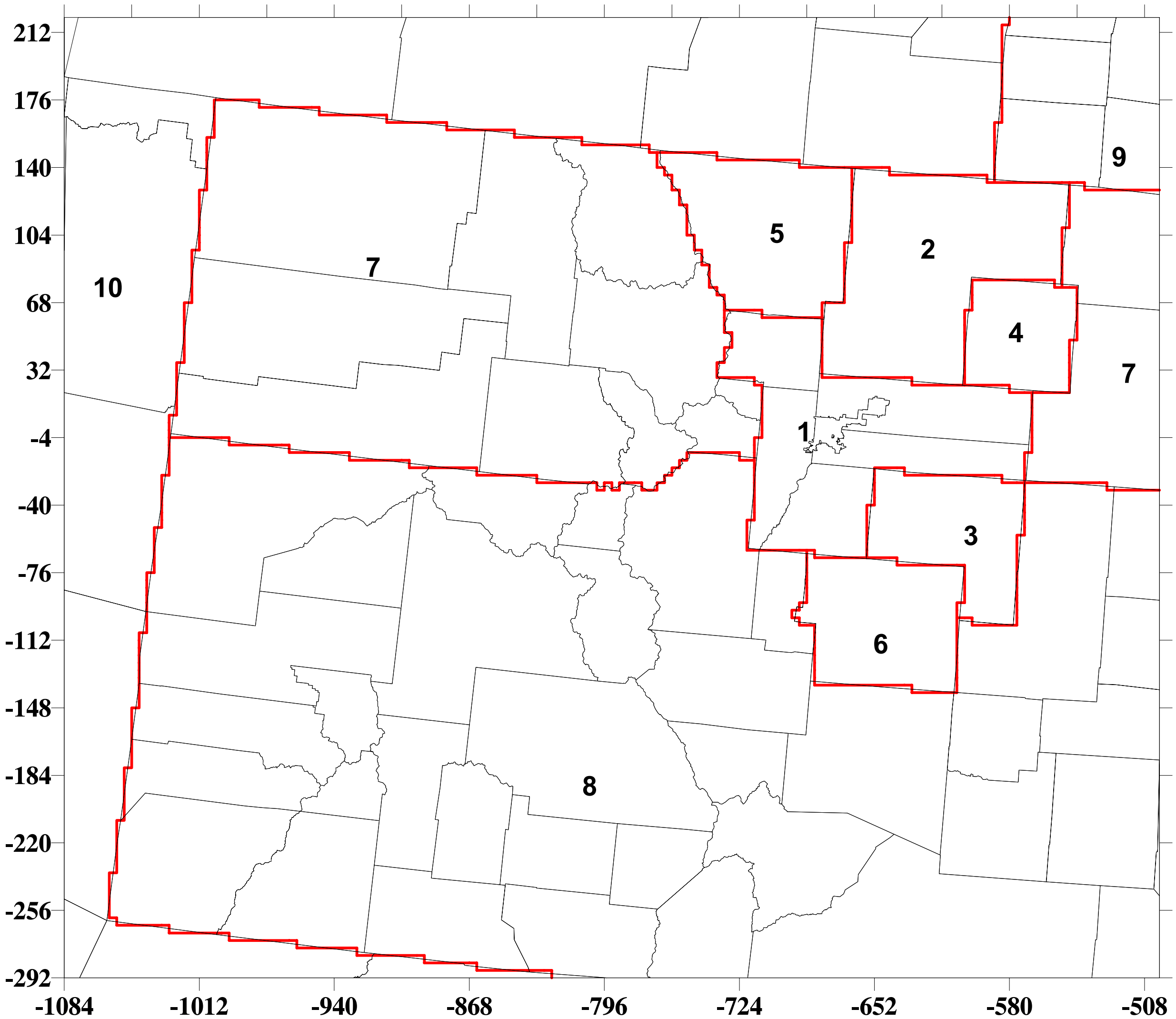

Figure ES-1. OSAT/APCA source region definitions for the 4-km domain used in the Denver EAC modeling.

OZONE SOURCE APPORTIONMENT MODELNG RESULTS

Table ES-1 summarizes the percent contribution and ozone contribution of the different source regions to the average of the peak 8-hour ozone concentrations near each ozone monitor across the days used in the ozone attainment demonstration test. The average contributions for the four ozone monitors located in the DMA area (Rocky Flats, NREL, Highland and Chatfield) are very similar. Boundary Conditions (BCs) always contribute the most (57%-59%) followed by sources in the DMA (27%-29%). Weld County is the next most important nearby Colorado County (1%-3%), with all other local Counties contributing 0%-3%. Other states in the US contribute 9%-10%.

The contributions of source regions to the peak 8-hour ozone concentrations at Rocky Mountain National Park (RMNP) are similar to the DMA monitors, only with less contribution from the

DMA (20% versus ~28%) and more contribution from Weld County (6% versus ~2%). Fort Collins exhibits a slightly different ozone contribution with much less contribution from the DMA (3%) and higher contributions from Weld (7%) and Larimer (10%) counties.

A common theme at all ozone monitors is that a majority of the peak 8-hour ozone is due to ozone transport. Sources from outside of Colorado contribute 66%-68% of the peak 8-hour ozone concentrations at monitors in and near the DMA. At the RMNP and Fort Collins monitors, ozone transport from outside of Colorado contributes, respectively, 70% and 78% of the peak 8-houirn ozone concentrations.

Table ES-1a. Percent contribution of source regions to the multi-day average of peak 8-hour ozone concentrations near each ozone monitor on high ozone days.

Source Region	Rocky Flats	NREL	Highland	Chatfield	RMNP	Fort Collins
BCs	58	57	58	57	59	61
DMA	26	29	27	28	20	3
Weld Co.	3	1	2	2	6	7
Elbert Co.	0	0	0	0	0	0
Morgan Co.	0	0	0	0	0	0
Larimer Co.	1	1	1	1	2	10
El Paso Co.	1	1	0	0	0	0
Other CO	3	2	2	3	2	2
Other USA	9	9	10	9	11	17

Table ES-1b. Ozone contribution (ppb) of source regions to the multi-day average of peak 8-hour ozone concentrations near each ozone monitor on high ozone days.

Source Region	Rocky Flats	NREL	Highland	Chatfield	RMNP	Fort Collins
BCs	43	44	43	43	44	43
DMA	20	22	20	22	15	2
Weld Co.	2	1	1	1	4	5
Elbert Co.	0	0	0	0	0	0
Morgan Co.	0	0	0	0	0	0
Larimer Co.	1	0	0	0	2	8
El Paso Co.	1	1	0	0	0	0
Other CO	2	2	2	2	2	1
Other USA	6	7	7	7	8	12

Contributions at the Rocky Flats Monitor

As seen in Table ES-1, the ozone contributions at the key ozone monitors in and around the DMA are fairly similar. Thus, below we discuss in more detail the ozone contributions at the Rocky Flats monitor that has the highest 8-hour ozone Design Value.

Figure ES-2 display the ozone source apportionment results for the highest daily maximum 8-hour ozone concentrations near the Rocky Flats monitor averaged across the four days, that are used in the 2007 8-hour ozone Design Value projections. The largest contributor to the daily maximum 8-hour ozone concentrations near the Rocky Flats monitor is Boundary Conditions (BCs) that contributes 43 ppb (58%) of the ozone to the peak 8-hour ozone concentrations near the Rocky Flats monitor averaged across the four key modeling days used in the attainment demonstration modeling. This is not surprising as a 40 ppb ozone boundary condition was specified along the boundaries of the modeling domain with about 1 ppb of NOx and 15-35 ppbC of VOCs. It appears that the destruction of the ozone BC due to deposition and chemistry is compensated for by ozone formation from the NOx and VOC BCs so that in the Denver area BCs still contributes approximately 40 ppb.

The next most important source region after the BCs is emissions from the Denver Metropolitan Area (DMA). Emissions from the DMA contribute 20 ppb (26%) to the average of the highest daily maximum 8-hour ozone concentrations near Rocky Flats. The ozone source apportionment is consistent across all days that on-road mobile sources in the DMA contribute the most, followed by non-road mobile sources, elevated point sources, and other low-level anthropogenic emissions. The contributions of biogenic and oil and gas emissions in the DMA are < 1 ppb combined. If we define transport as the amount of ozone coming from non-DMA counties, then the contribution of ozone transport to the highest daily maximum 8-hour ozone concentrations near Rocky Flats is 74%.

The contribution of Weld County is the next highest contributing source region after the DMA, with a 4-day average contribution of 2.5%, compared to 58% for the BCs and 26% for the DMA. Within Weld County, on-road mobile sources contribute the most to the total Weld County contribution (0.6 ppb/32%) followed by non-road sources (0.4 ppb/21%) and then oil and gas emissions (0.3 ppb/16%) and elevated point sources (0.3 ppb/16%).

The ozone source apportionment modeling results help explain why the modeling results are so stiff when controls are applied to sources in the DMA. With ozone transport contributing almost ¾ of the ozone, DMA+Weld County sources only have about a quarter of the 8-hour ozone concentration that can be affected by controls in the DMA.

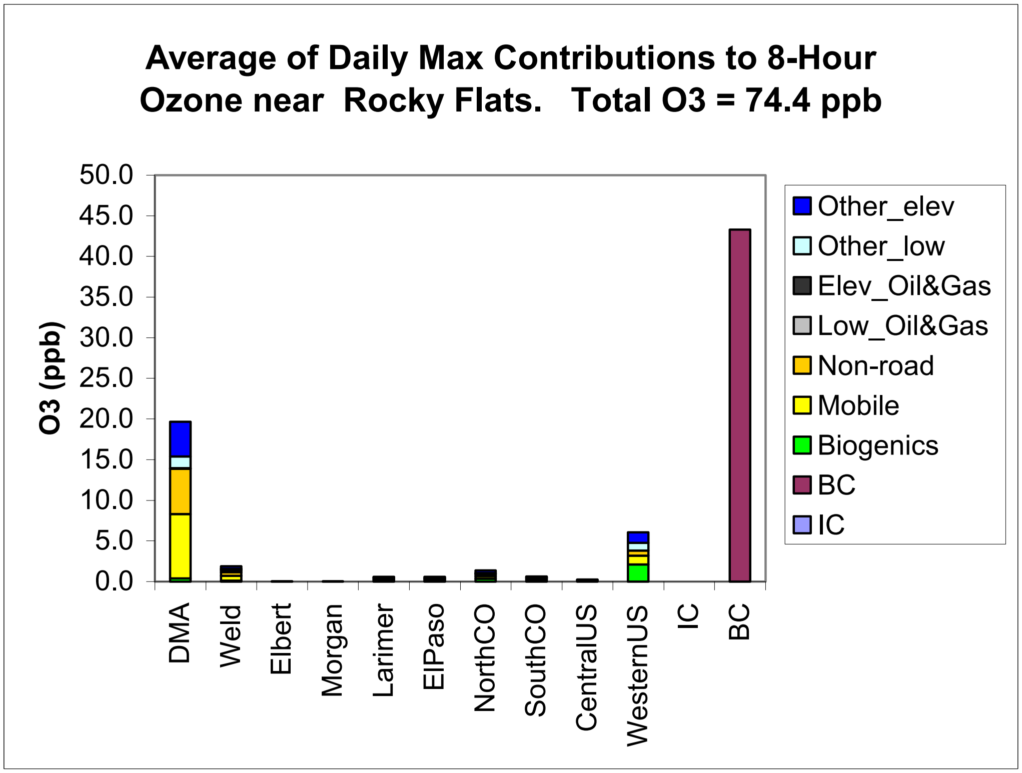

Figure ES-2. Contribution of source regions and source categories to the 4-day average of the highest daily maximum 8-hour ozone concentrations near the Rocky Flats monitor.

CONCLUSIONS

The ozone source apportionment modeling for the Denver June 2002 ozone episode using the Anthropogenic Precursor Culpability Assessment (APCA) estimates that a majority, approximately 75%, of the modeled peak 8-hour ozone concentrations for the June 2002 episode comes from outside of the Denver Metropolitan Area (DMA). This explains why, in part, the modeled peak 8-hour ozone concentrations are so stiff in response to local emission controls in the DMA.

In terms of local source contributions, emissions from the DMA contribute the most to elevated 8-hour ozone concentrations in the vicinity of the key ozone monitors of Rocky Flats, NREL, Chatfield and Highland. Within the DMA, the on-road mobile source category contributes the most followed by the non-road mobile source category and then elevated point sources. Of the counties surrounding the DMA, it appears that Weld County contributes the most, especially to the key Rocky Flats and NREL monitors, followed by Larimer County. The other Colorado Counties surrounding the DMA (i.e., Elbert, Morgan, and El Paso) have smaller contributions, although El Paso County did have larger contributions to the key DMA monitors south of Denver County (i.e., Chatfield and Highland) on some days. The contributions of source regions to the peak 8-hour ozone concentrations at Rocky Mountain National Park (RMNP) are similar to the DMA monitors, only with less contribution from the DMA (20% versus ~28%) and more contribution from Weld County (6% versus ~2%). Fort Collins exhibits a slightly different ozone contribution than monitors in the DMA with much less contribution from the DMA (3%) and higher contributions from Weld (7%) and Larimer (10%) counties.

1. INTRODUCTION

This report describes 2007 ozone source apportionment modeling carried out as part of the Denver-Northern Front Range 8-hour ozone Early Action Compact Study (Denver EAC Study). The purpose of the ozone source apportionment modeling is to identify the source regions and source categories that contribute most to elevated 8-hour ozone concentrations in the Denver region and, in particular, at the key ozone monitors of Rocky Flats, NREL, Chatfield, Highland and Rocky Mountain National Park where high 8-hour ozone concentrations are observed.

The procedures used in the Denver EAC photochemical modeling are described in detail in the modeling protocol (Tesche et al., 2003a). Meteorological modeling performed to develop meteorological inputs for the Comprehensive Air-quality Model with extensions (CAMx) photochemical grid model and the June-July 2002 modeling period is described by McNally and co-workers (2003). The preparation of the emissions inputs for the Denver EAC modeling is described in Mansell and Dinh (2003a,b,c). The 2002 Base Case modeling and model performance evaluation is described by Morris and co-workers (2003), the preliminary 2007 modeling analysis performed in December 2003 is given in Morris et al., (2004a), the revised 2007 emissions reductions sensitivity modeling is provided in Morris et al., (2004b) and the 2007 control strategy modeling results is presented in Morris et al., (2004c).

DEFINITION OF THE OZONE SOURCE APPORTIONMENT

The Comprehensive Air-quality Model with extensions (CAMx) photochemical grid model (www.camx.com) used in the Denver EAC modeling includes several "probing tools" that can extract additional information on ozone source/receptor relationships, sensitivity and processes that led to the estimated ozone concentrations (ENVIRON, 2003; Yarwood et al., 2003). One of the probing tools is the Ozone Source Apportionment Technology (OSAT) that uses reactive tracers to determine the source regions and categories that produced the estimated ozone concentrations in a CAMx simulation. To operate OSAT, the user must first define the source groups for which ozone source apportionment will be obtained. Source groups are defined by source regions and source categories. Because the computer run time and memory requirements depend on the number of source groups specified, they must be kept down to a reasonable number (typically 25 – 100).

For the Denver EAC OSAT application, the CAMx modeling domain was divided up into 10 geographic source regions and 7 source categories. As initial concentrations (ICs) and boundary conditions (BCs) are always included as their own source groups, this results in 72 source groups for the Denver EAC ozone source apportionment modeling ($72 = 10 \times 7 + 2$).

Source Regions

The 10 geographic source regions used in the source apportionment modeling are shown in Figure 1-1 and are as follows:

1. Seven County Denver Metropolitan Area (DMA)
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6. Remainder Low-Level Anthropogenic Sources
7. Elevated Point Sources

Probing Tools in CAMx

Several "probing tools" are available in CAMx to provide additional diagnostic and sensitivity information for an ozone simulation. The probing tools can be used to answer questions such as:

- Which emissions cause high ozone?
- How will ozone levels respond to emission changes?
- How important are the initial and boundary conditions?
- What are the influences of different model processes (chemistry, deposition, etc.) on ozone levels at a specific location?

The probing tools can provide information for ozone precursors as well as ozone. Some of these questions can be answered using traditional diagnostic and sensitivity analysis techniques (i.e., changing a model input and measuring the change in model output) but the probing tools are much more efficient and can provide a more complete picture. There are two main applications of the information provided by probing tools:

- Improving model performance: Comprehensive sensitivity and diagnostic information will provide greater understanding of how a model is working, increase the likelihood that model performance problems will be identified, and provide direction for how to correct model performance problems.

- Guiding design of control strategies: Understanding in detail what sources contribute to high ozone and/or how ozone will respond to emission reductions enables the selection of more equitable and efficient control strategies.

The probing tools that are available have differing capabilities and uses as discussed below.

Ozone Source Apportionment Technology (OSAT)

OSAT provides information about the relationships between ozone concentrations and sources of precursors in the form of ozone source apportionments. Source apportionment means that the sum of the source contributions adds up to exactly 100% of the total ozone and so all of the ozone is accounted for. OSAT attributes ozone among all of the potential sources of ozone in the simulation, namely emissions, boundary conditions (BCs) and initial conditions (ICs). Ozone formation from VOC and NOx precursors is tracked separately. The emissions contributions can be broken down by geographic area and/or source category. The OSAT methods are described in the CAMx User's Guide (ENVIRON, 2004) and Dunker et al. (2002b).

OSAT apportions ozone formation based solely on what precursors were present when the ozone is formed. OSAT determines whether ozone formation is NOx or VOC limited in each grid cell at each time step, and attributes ozone production according to the relative contributions of the limiting precursor (VOC or NOx) from different sources present at that time. The precursors are tracked using a reactive tracer (tagged species) approach. Likewise, the ozone contributions are tracked using a reactive tracer approach and separate tracers are used to track ozone formation attributed to NOx (O3N tracers) and VOC (O3V tracers).

Because ozone formation chemistry is a non-linear process, there is no unique way of apportioning ozone back to precursor sources. The OSAT approach to source apportionment is to attribute ozone formation among the precursors that were present when the ozone was formed. There are two schemes for doing this called OSAT and APCA (Anthropogenic Precursor Culpability Assessment). For the Denver 8-hour ozone EAC analysis, the APCA ozone source apportionment technique was utilized.

Anthropogenic Precursor Culpability Assessment (APCA)

Applications of OSAT to the Eastern US consistently identify biogenic emissions as a major contributor to ozone formation. This is not surprising as biogenic VOC emissions are very reactive and dominate regional VOC emissions in the Eastern US, but this finding is not "policy relevant" for designing anthropogenic emissions ozone control plans. The APCA methodology was developed from OSAT to address this issue. APCA stands for Anthropogenic Precursor Culpability Assessment, and differs from OSAT in recognizing that certain emission groups are not controllable (i.e., biogenic emissions) and that apportioning ozone production to these emissions does not provide control strategy relevant information. To address this, in situations where OSAT attributes ozone formation to a non-controllable source category when it was due to the interaction of ozone precursors from a non-controllable (i.e., biogenic) and controllable emissions source, APCA re-directs the ozone attribution to the controllable precursor. In practice, biogenic emissions are the uncontrollable source category and APCA only attributes ozone production to biogenic emissions when ozone formation is due to the interaction of biogenic VOC with biogenic NOx. When ozone formation is due to biogenic VOC interacting with anthropogenic NOx under VOC-limited conditions (where OSAT would attribute ozone production to biogenic VOCs), APCA directs the attribution to the anthropogenic NOx precursors present. The result of using APCA instead of OSAT is that more ozone formation is attributed to anthropogenic NOx sources and little ozone formation is attributed to biogenic sources. APCA is not called a "source apportionment" technique because it expresses biases as to which sources should be implicated (i.e., those that are controllable), hence it is referred to as a "culpability assessment."

One cautionary note regarding ozone source apportionment should be made. As ozone formation is highly nonlinear, ozone source apportionment is not unique. Furthermore, ozone source apportionment changes as controls are implemented, thus it is not quantitatively prognostic. However, when used in a qualitative fashion OSAT/APCA is a powerful tool that can provide information on many source-receptor relationships that would take 100s of standard model runs to obtain.

Emissions Scenario

The 2007 Three Control Strategy emissions scenario (cntl4 a2 version) as reported by Morris and co-workers (2004b) was used for the OSAT/APCA simulation. This simulation included 8.1 RVP with 40% ethanol penetration, Flash VOC and RICE control measures. It should be noted that the control factors used in the 8.1 RVP control measure were found to be in error. However, the emissions are close to the current 2007 Base Case and Control Strategies that are being analyzed for the Denver EAC (Morris et al., 2004c). As the ozone source apportionment is used to get a broad brush of source regions/categories contributions, rather than detailed refined quantitative contributions, the RVP control factor error will have minimal effect on the ozone source apportionment.

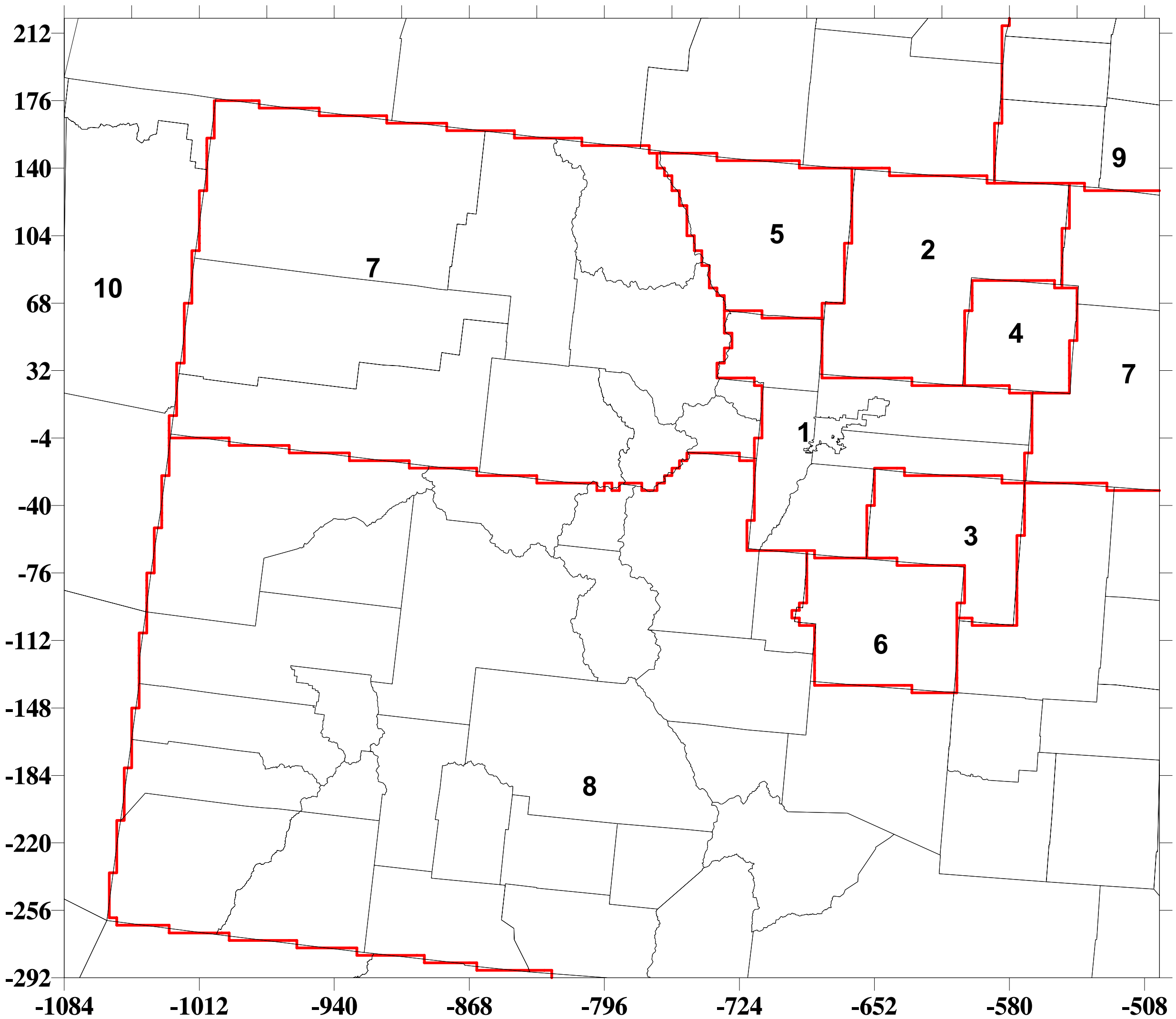


Figure 1-1a. OSAT/APCA source region definitions for the 4-km domain used in the Denver EAC modeling.

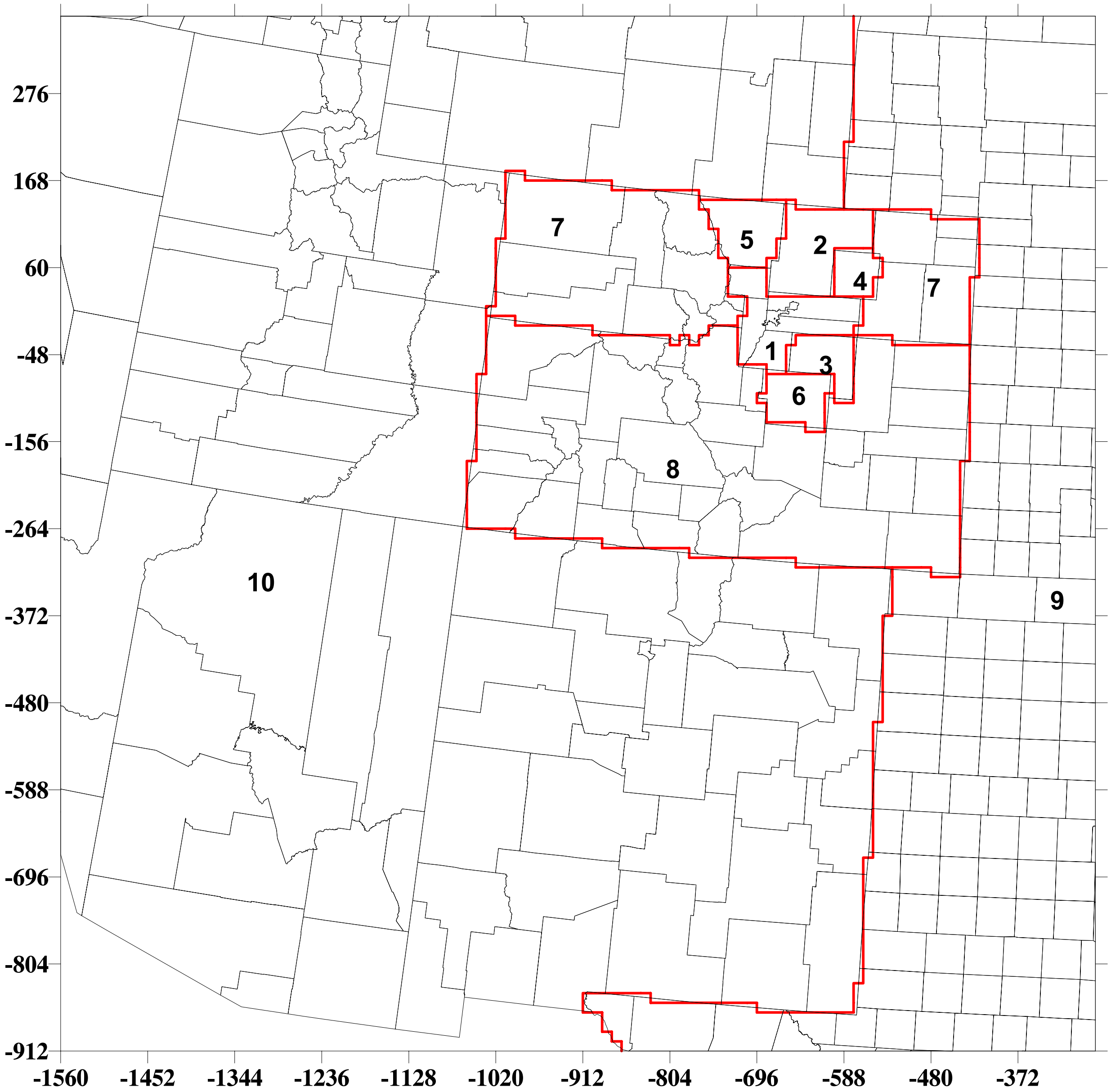


Figure 1-1b. OSAT/APCA source region definitions for the 12-km domain used in the Denver EAC modeling.

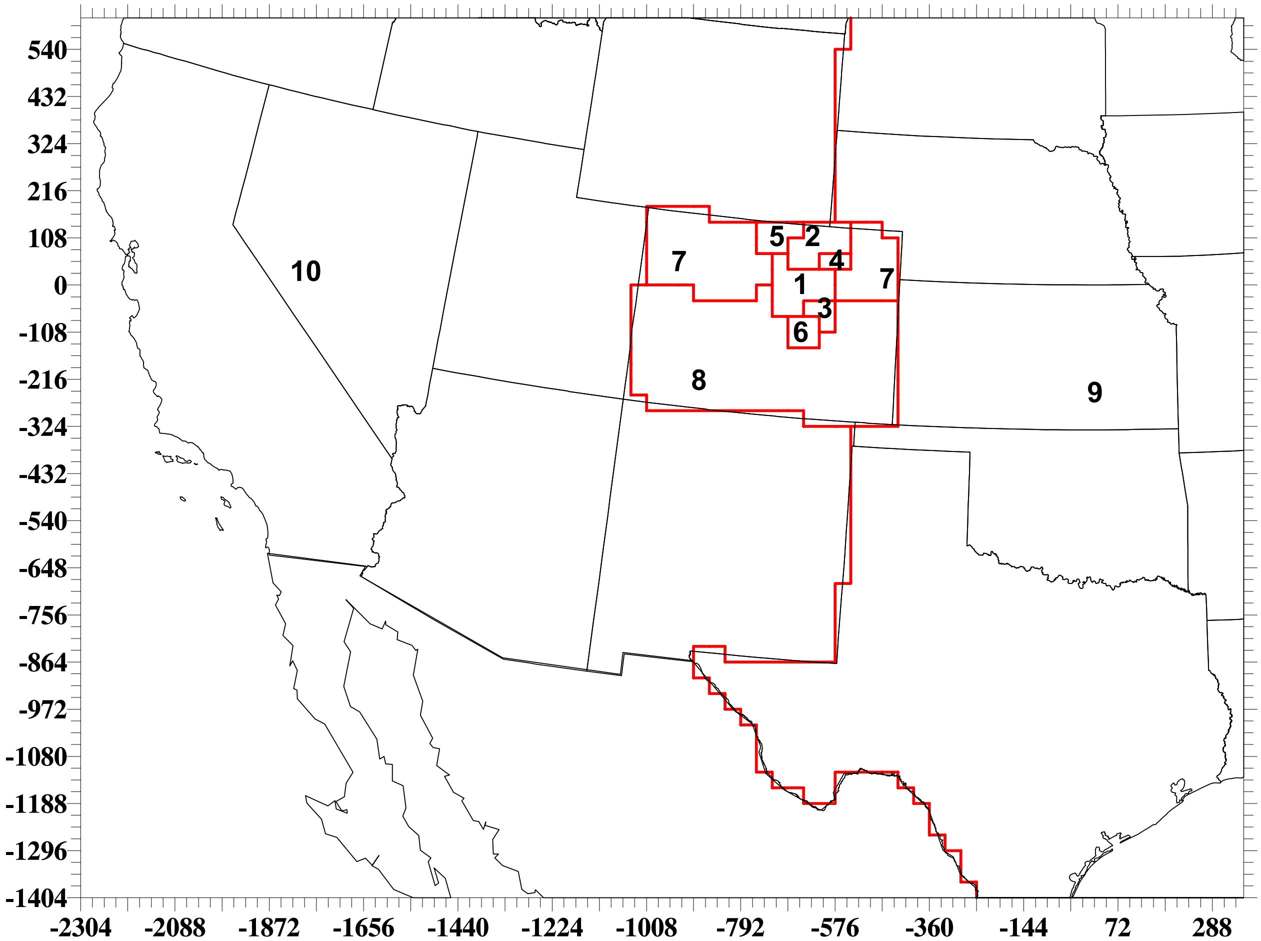


Figure 1-1c. OSAT/APCA source region definitions for the 36-km domain used in the Denver EAC modeling.

2. OZONE SOURCE APPORTIONMENT MODELING RESULTS AT KEY OZONE MONITORS ON KEY MODELING DAYS

The CAMx modeling results for the June 2002 episode were used to project future-year 8-hour ozone Design Values as part of the 8-hour ozone attainment demonstration in the Denver Clean Air Action Plan (CCAQC, 2004; Morris et al., 2004c). The base year (2002) base case and future-year (2007) CAMx modeling results were used to project future-year ozone Design Values following EPA's procedures (EPA, 1999). These procedures use the modeling results near an ozone monitor in a relative fashion on high modeled ozone days to scale current year observed ozone Design Values and project future-year ozone Design Values. Thus, the CAMx APCA ozone source apportionment modeling results were processed for the highest daily maximum 8-hour ozone concentrations near the key ozone monitors in the vicinity of the Denver Metropolitan Area (DMA) that are used in the modeled ozone attainment demonstration test.

The APCA ozone source apportionment modeling was performed for an interim 2007 Three Control Strategy emission scenario that included the following control measures:

- 8.1 psi RVP gasoline with a 40% ethanol market penetration;
- Weld County Flash emissions controls; and
- Controls on Reciprocating Internal Combustion Engines (RICE).

As noted in Section 1, the control factors for the RVP control measure were in error and did not represent as much control as would be expected. Thus, for Denver Metropolitan Area (DMA) mobile sources the VOC and CO emissions are closer to the 2007 Base Case that used a 9 psi RVP than an 8.1 psi RVP scenario. However, as the APCA source apportionment modeling results are used in a general fashion to estimate the relative contributions of different source regions and categories to elevated ozone in the DMA and vicinity, the choice of which of the 2007 emission scenarios to use in the ozone source apportionment modeling that have small emission differences is not very important.

OZONE SOURCE APPORTIONMENT AT ROCKY FLATS

Figure 2-1 display the ozone source apportionment results for the highest daily maximum 8-hour ozone concentrations near the Rocky Flats monitor for the four days, and averaged across the four days, that are used in the 2007 8-hour ozone Design Value projections (see Morris et al., 2004c). The same results are provided in a tabular format in Table A-1 in Appendix A. The largest contributor to the daily maximum 8-hour ozone concentrations near the Rocky Flats monitor is Boundary Conditions (BCs) that contributes 42-45 ppb (52%-61%) of the ozone to the peak 8-hour ozone concentrations near the Rocky Flats monitor on the four key modeling days used in the attainment demonstration modeling. This is not surprising as a 40 ppb ozone boundary condition was specified along the boundaries of the modeling domain with about 1 ppb of NOx and 15-35 ppbC of VOCs. It appears that the destruction of the ozone BC due to deposition and chemistry is compensated for by ozone formation from the NOx and VOC BCs so that in the Denver area BCs still contributes approximately 40 ppb. Note that BCs refer to the

assume concentrations along the lateral boundaries of the 36 km modeling domain (see Figure 1-1c) and the assumed concentrations aloft above the model top (~6.5 km AGL).
The next most important source region after the BCs is emissions from the Denver Metropolitan Area (DMA). Emissions from the DMA contribute 16 to 26 ppb (23-31%) to the highest daily maximum 8-hour ozone concentrations near Rocky Flats. The ozone source apportionment is consistent across all days that on-road mobile sources in the DMA contribute the most, followed by non-road mobile sources, elevated point sources, and other low-level anthropogenic emissions. The contributions of biogenic and oil and gas emissions in the DMA are < 1 ppb combined. If we define transport as the amount of ozone coming from non-DMA counties, then the contribution of ozone transport to the highest daily maximum 8-hour ozone concentrations near Rocky Flats is 69-77%.

The contribution of Weld County is the next highest contributing source region after the DMA, with a 4-day average contribution of 2.5%, compared to 58% for the BCs and 26% for the DMA. Within Weld County, on-road mobile sources contribute the most to the total Weld County contribution (0.6 ppb/32%) followed by non-road sources (0.4 ppb/21%) and then oil and gas emissions (0.3 ppb/16%) and elevated point sources (0.3 ppb/16%).

The ozone source apportionment modeling results help explain why the modeling results are so stiff when controls are applied to sources in the DMA. With ozone transport contributing approximately ~75% of the ozone, DMA+Weld County sources only have ~25% of the 8-hour ozone concentration that can be affected by controls in the DMA.

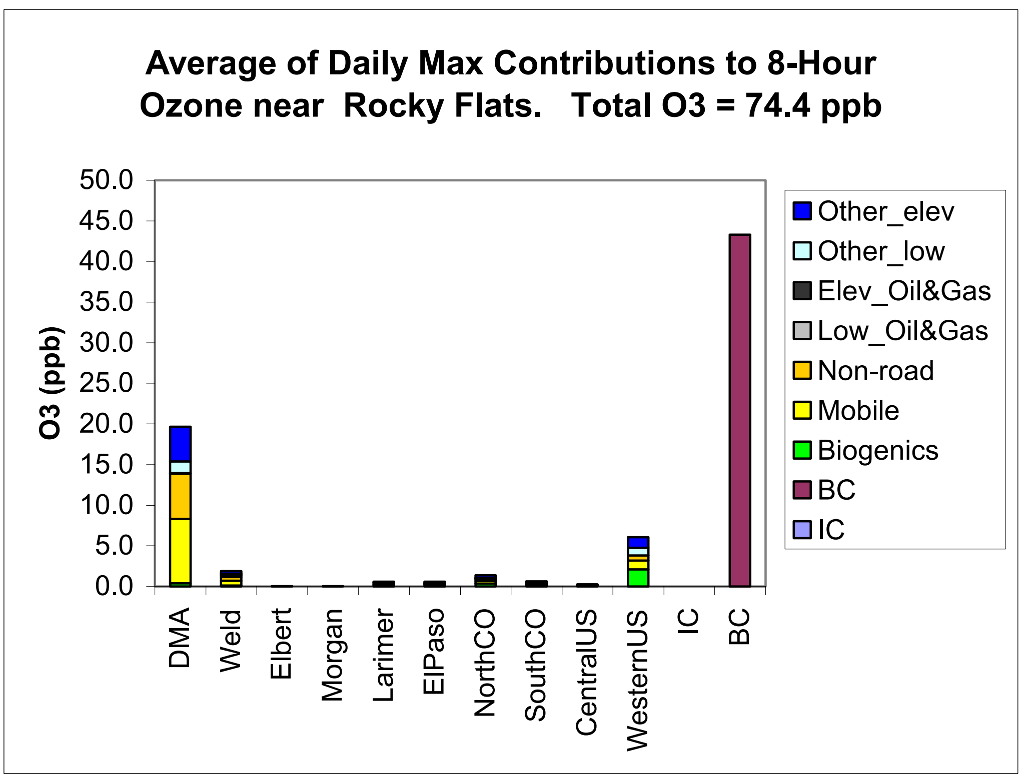


Figure 2-1a. Contribution of source regions and source categories to the 4-day average of the highest daily maximum 8-hour ozone concentrations near the Rocky Flats monitor.

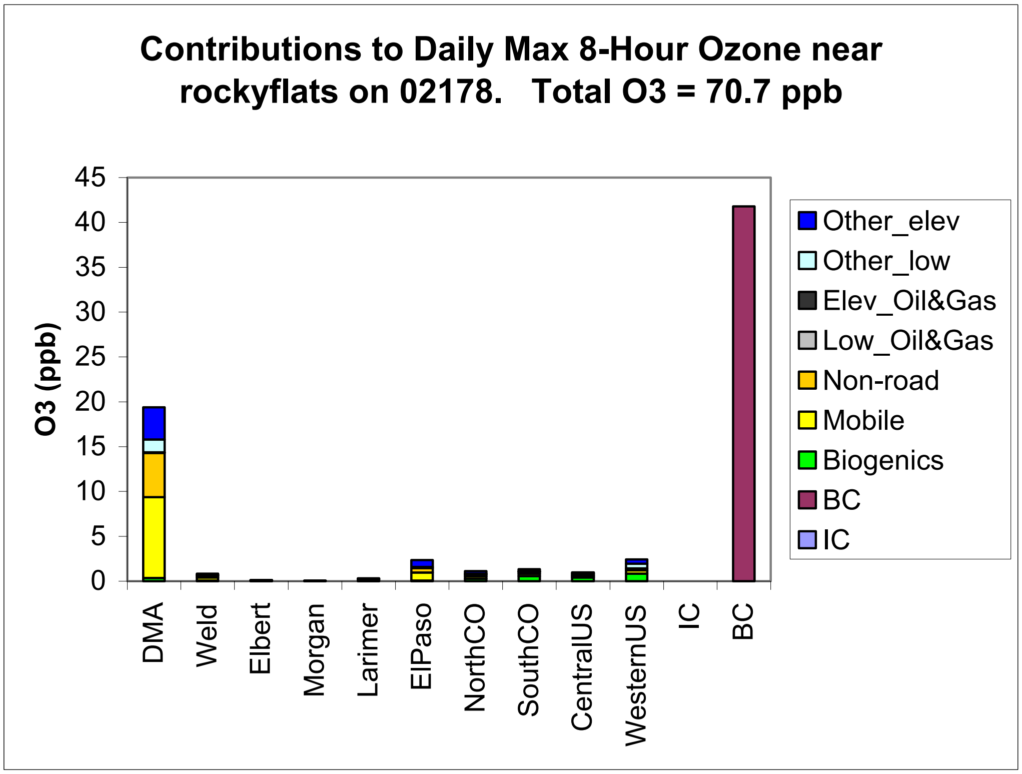


Figure 2-1b. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Rocky Flats monitor on June 27, 2002.

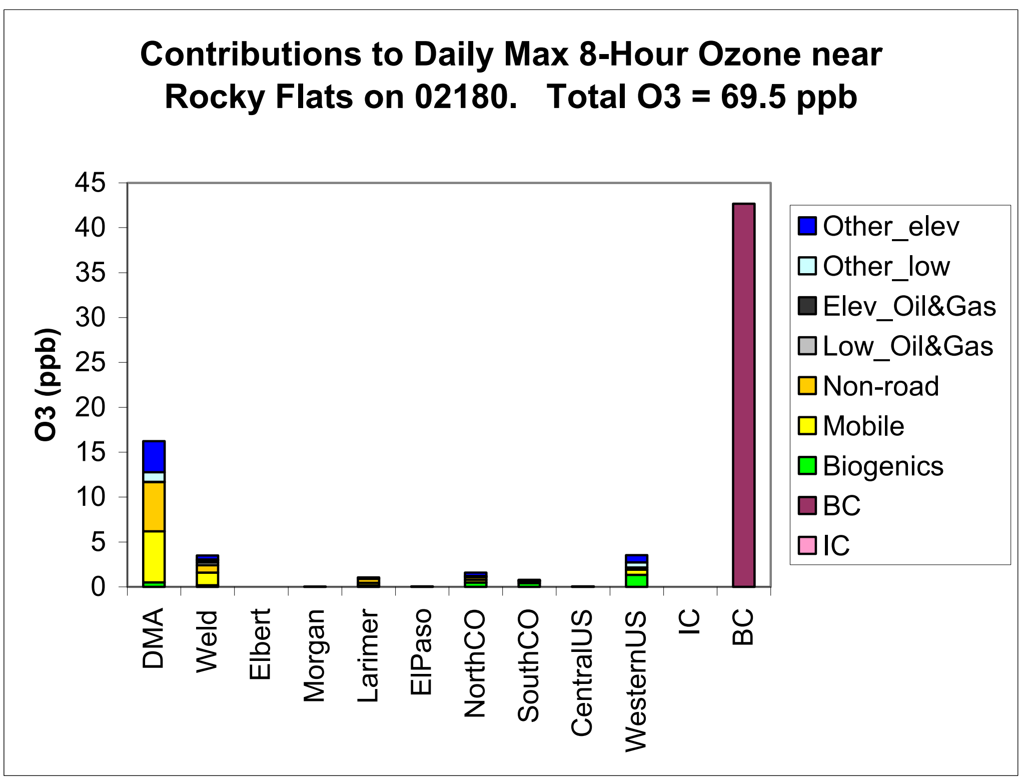


Figure 2-1c. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Rocky Flats monitor on June 29, 2002.

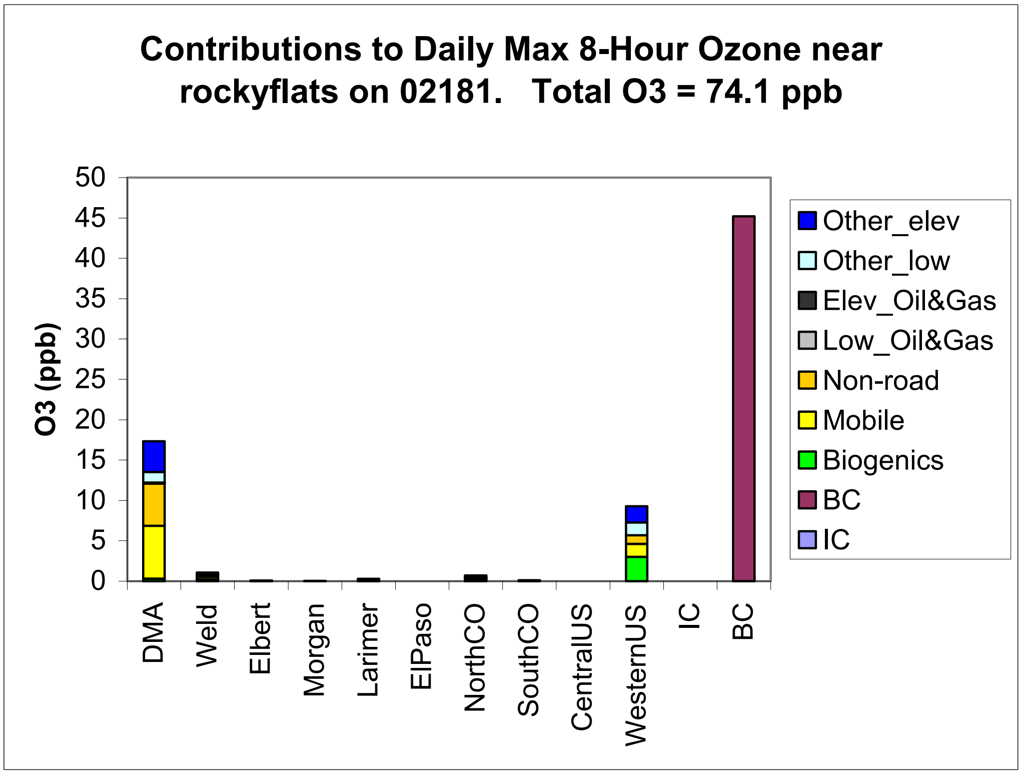


Figure 2-1d. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Rocky Flats monitor on June 30, 2002.

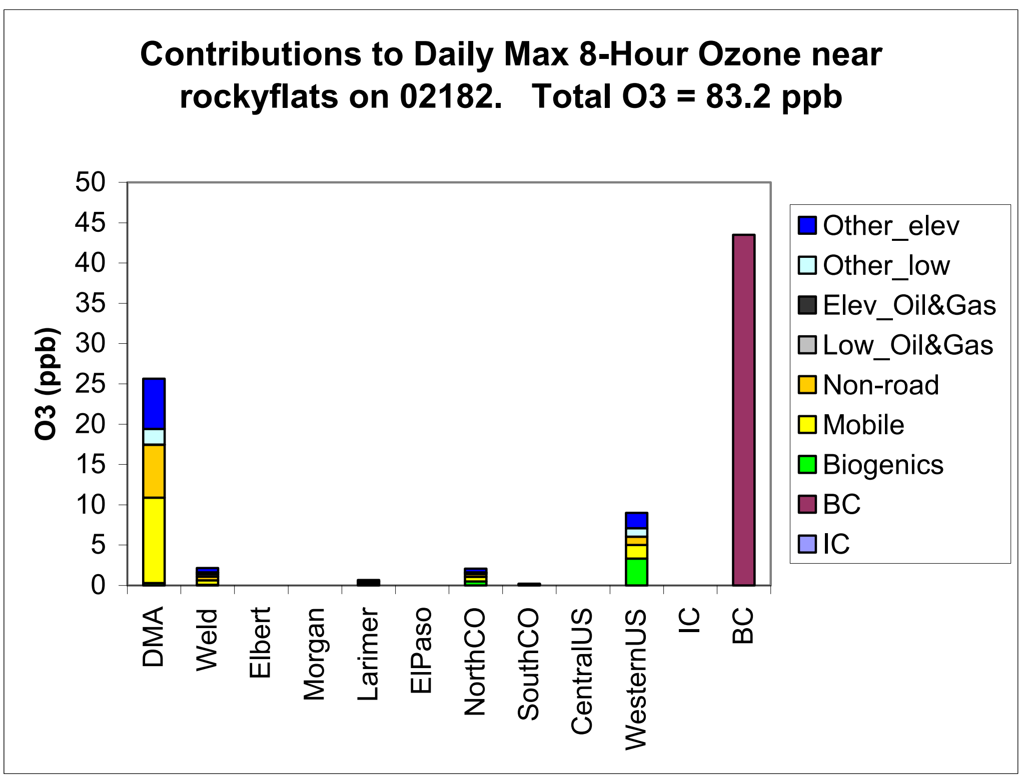


Figure 2-1e. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Rocky Flats monitor on July 1, 2002.

OZONE SOURCE APPORTIONMENT AT NREL

Figure 2-2 displays the APCA ozone source apportionment modeling results for the three days, and averaged across the three days, used to project 2007 8-hour ozone Design Values for the NREL monitor. Details on these ozone contributions are provided in Table A-2 in Appendix A. As seen for Rocky Flats, BCs contribute the most (42-45 ppb) to elevated 8-hour ozone near the NREL monitor; BCs contribute a majority of the ozone (52% - 61%) to the peak 8-hour ozone value. The second most important source region is the DMA that contributes 22 ppb (29%) to the three-day average of the peak 8-hour ozone concentration near the NREL monitor. On-road mobile sources are the most important category in the DMA followed by non-road mobile sources. Although the contributions of other Colorado Counties to the peak 8-hour ozone concentrations near the NREL monitor varies day-to-day, they are much less important than the ozone due to the DMA and BCs.

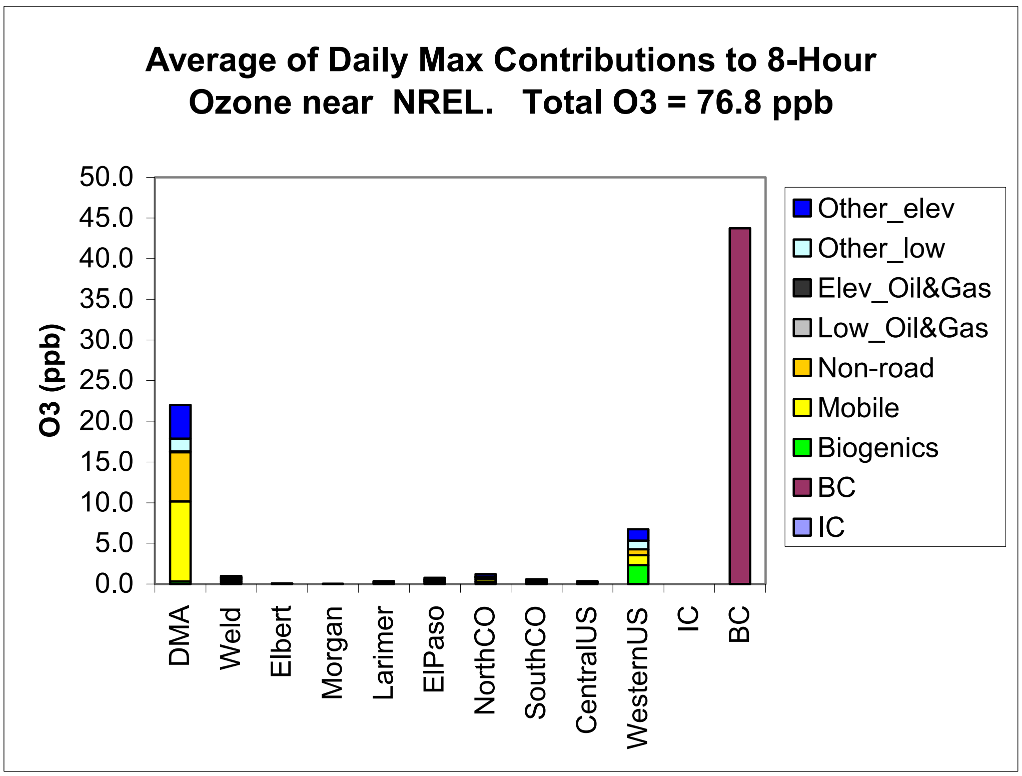


Figure 2-2a. Contribution of source regions and source categories to the 3-day average of the highest daily maximum 8-hour ozone concentrations near the NREL monitor.

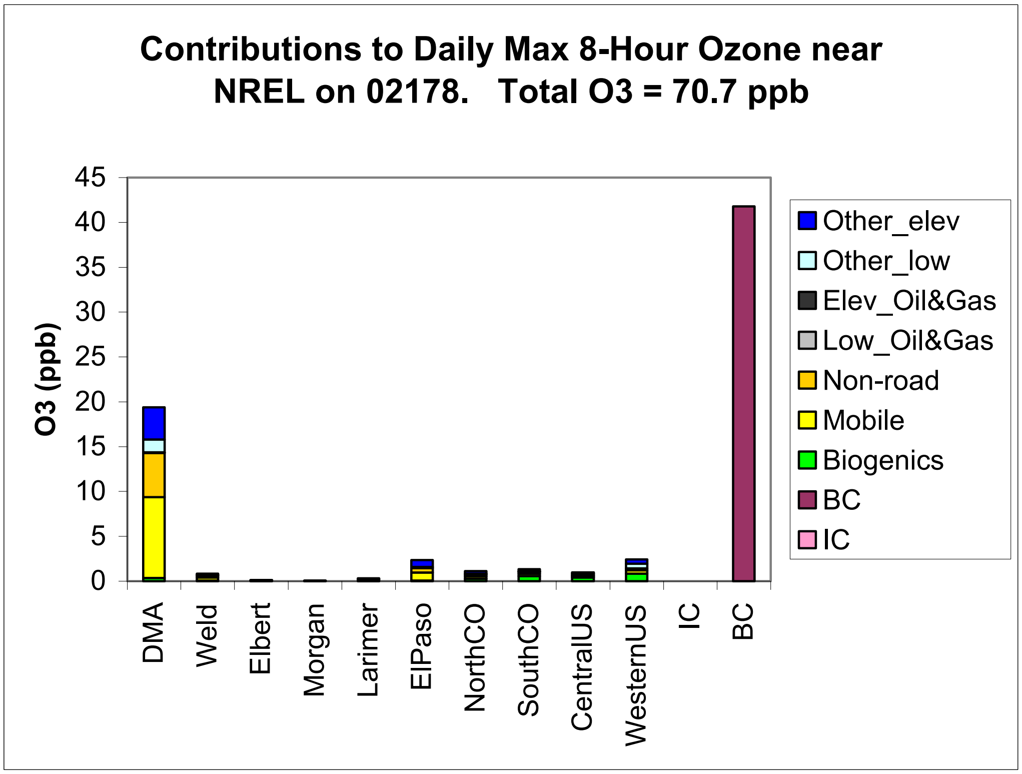


Figure 2-2b. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the NREL monitor on June 27, 2002.

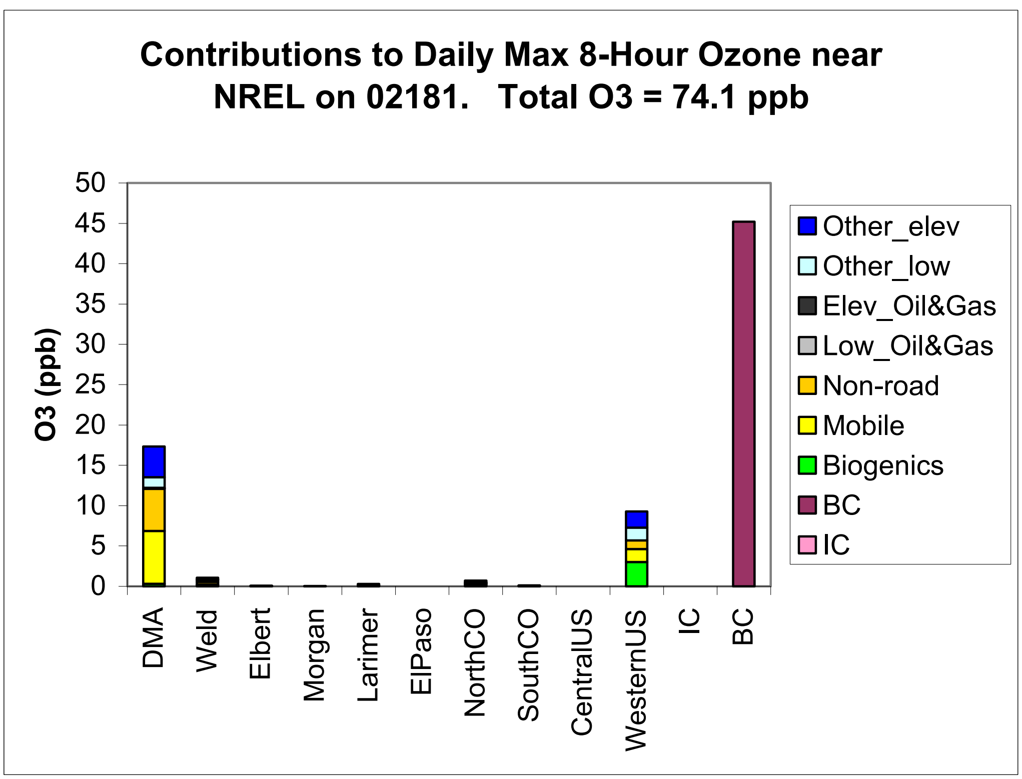


Figure 2-2c. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the NREL monitor on June 30, 2002.

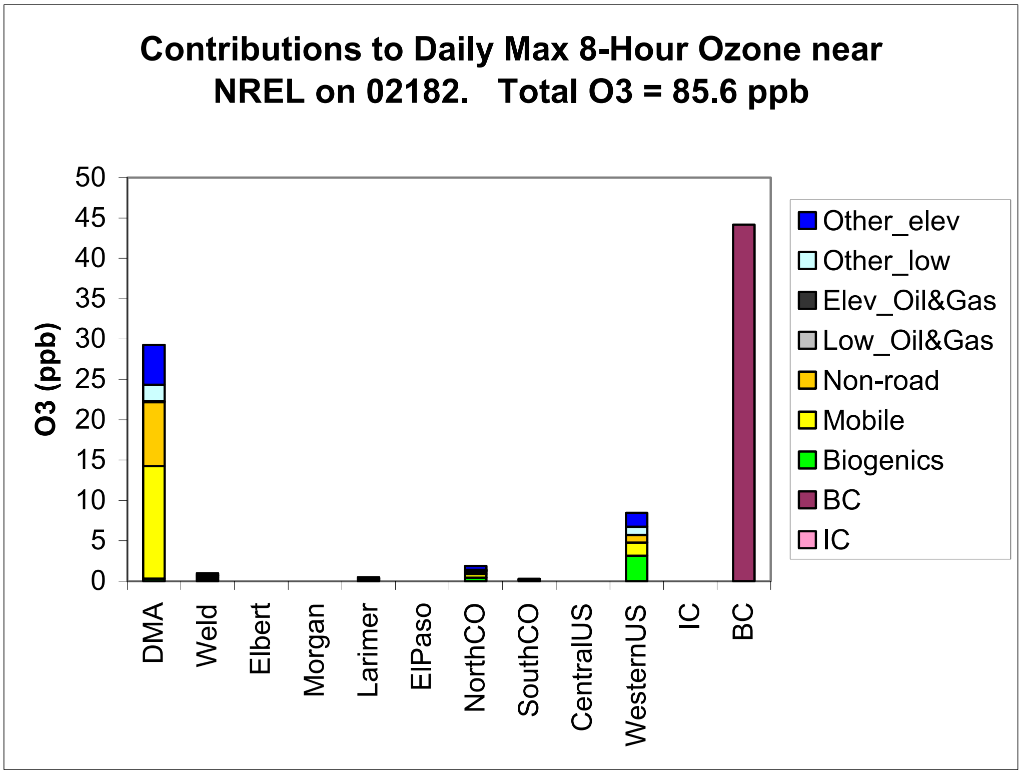


Figure 2-2d. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the NREL monitor on July 1, 2002.

OZONE SOURCE APPORTIONMENT AT HIGHLAND

The ozone source apportionment modeling results at the Highland ozone monitor are shown in Figure 2-3 and Table A-3. The results for the Highland monitor are similar to those at the Rocky Flats and NREL monitor, although some minor changes in the contributions are seen due to the location of the Highland monitor that is to the south of the DMA compared to NREL to the west and Rocky Flats to the northwest. But the basic results are the same with BCs contributing by far the most (> 50%) followed by the DMA with the remainder of the Colorado Counties being minor contributors.

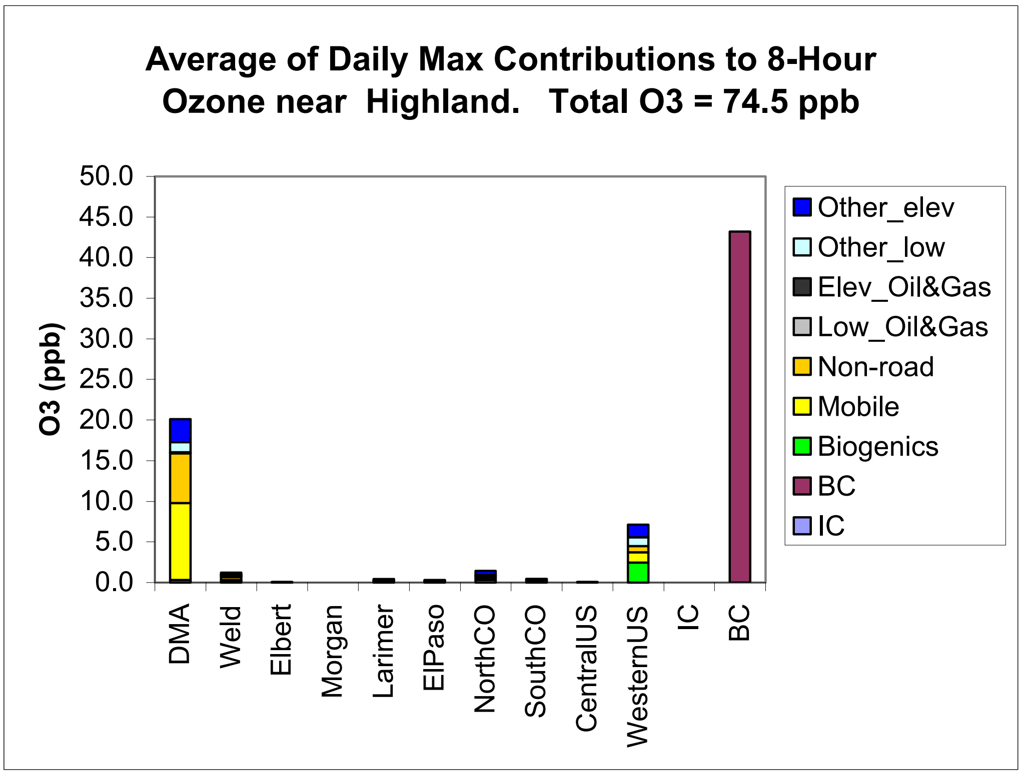


Figure 2-3a. Contribution of source regions and source categories to the 3-day average of the highest daily maximum 8-hour ozone concentrations near the Highland monitor.

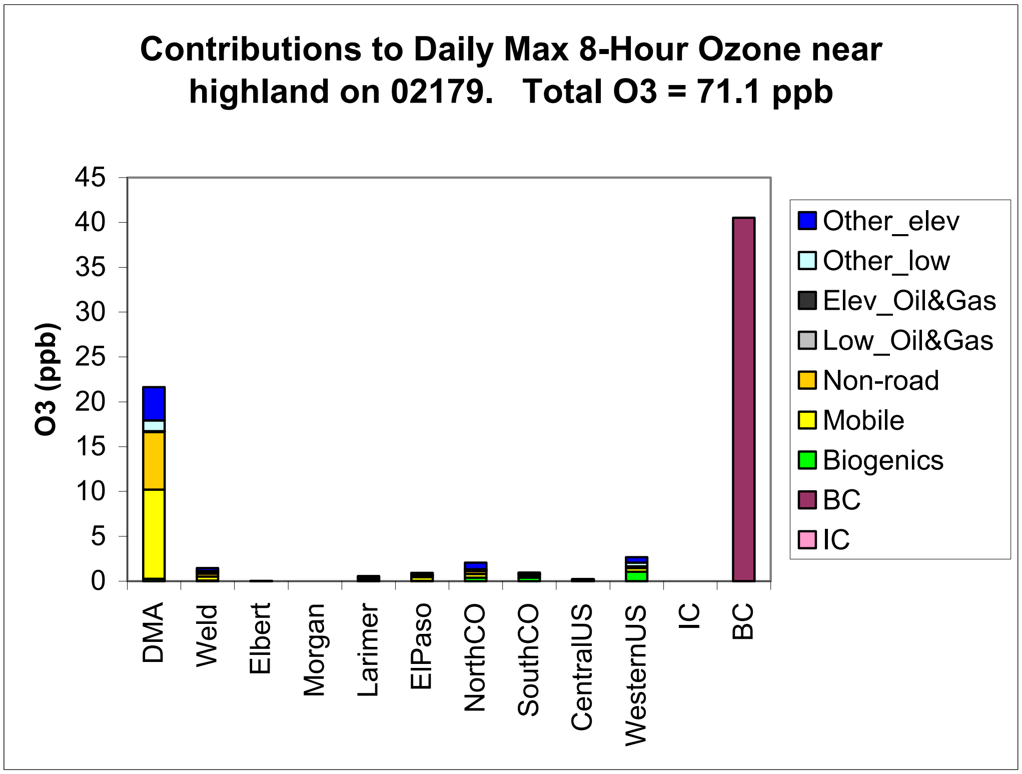


Figure 2-3b. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Highland monitor on June 28, 2002.

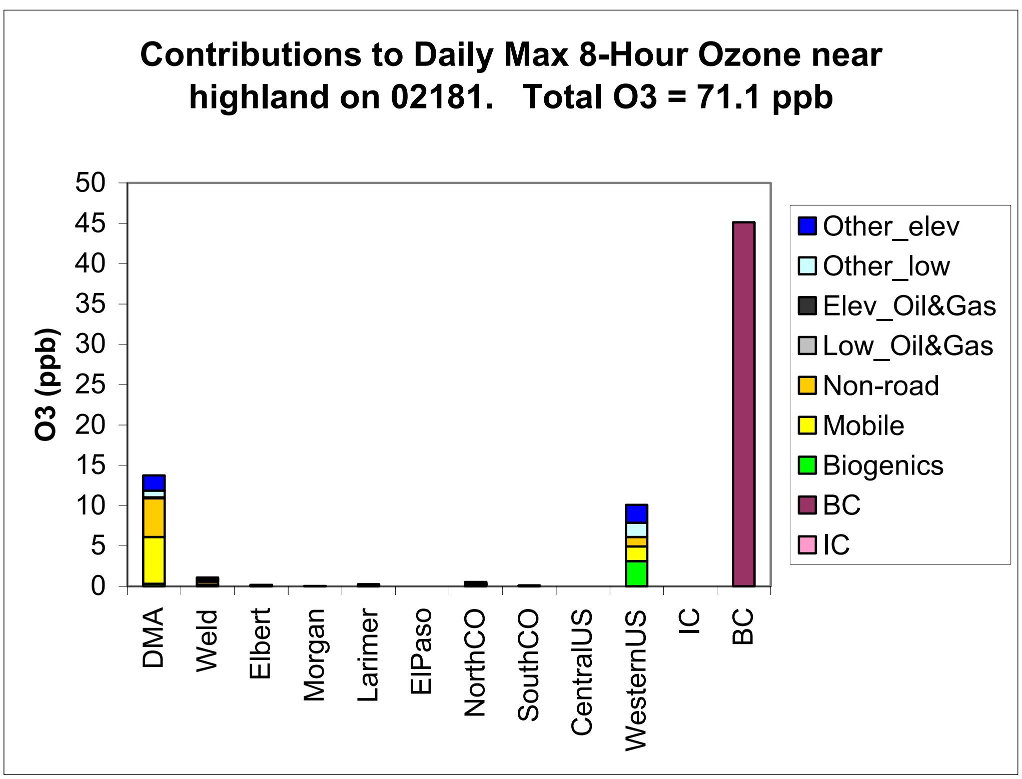


Figure 2-3c. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Highland monitor on June 30, 2002.

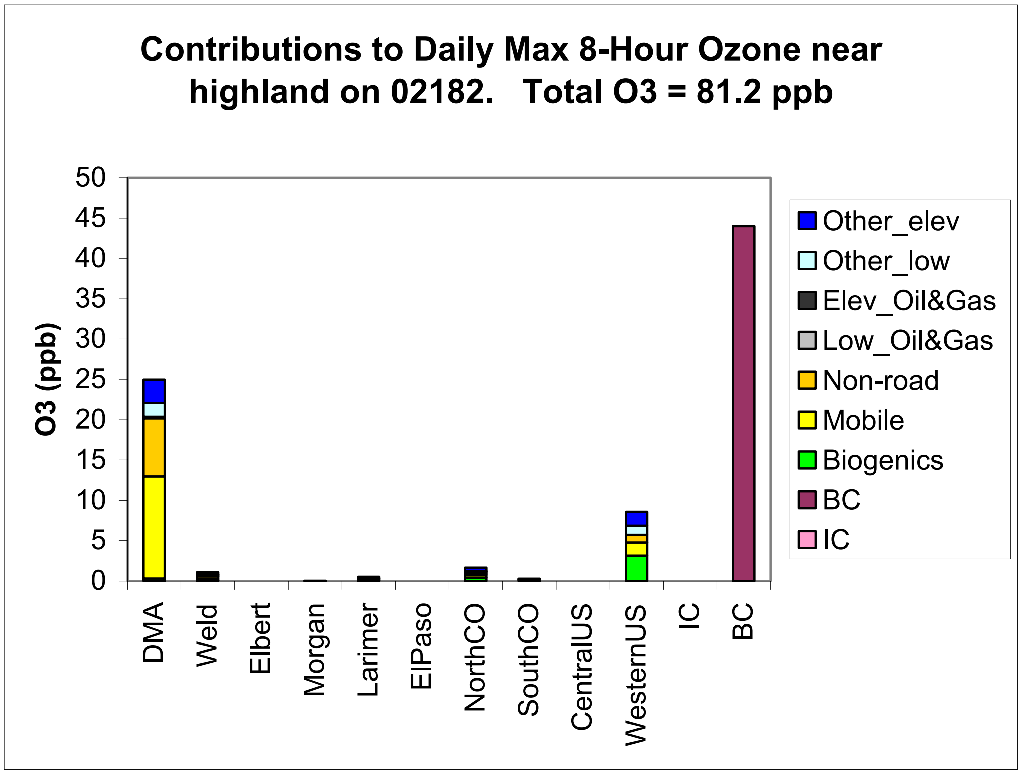


Figure 2-3d. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Highland monitor on July 1, 2002.

OZONE SOURCE APPORTIONMENT AT CHATFIELD

Due to the close proximity of the Chatfield and Highland ozone monitors, the ozone source apportionment modeling results for Chatfield (Figure 2-4 and Table A-4) are almost identical to those for Highland (Figure 2-3 and Table A-3) discussed above.

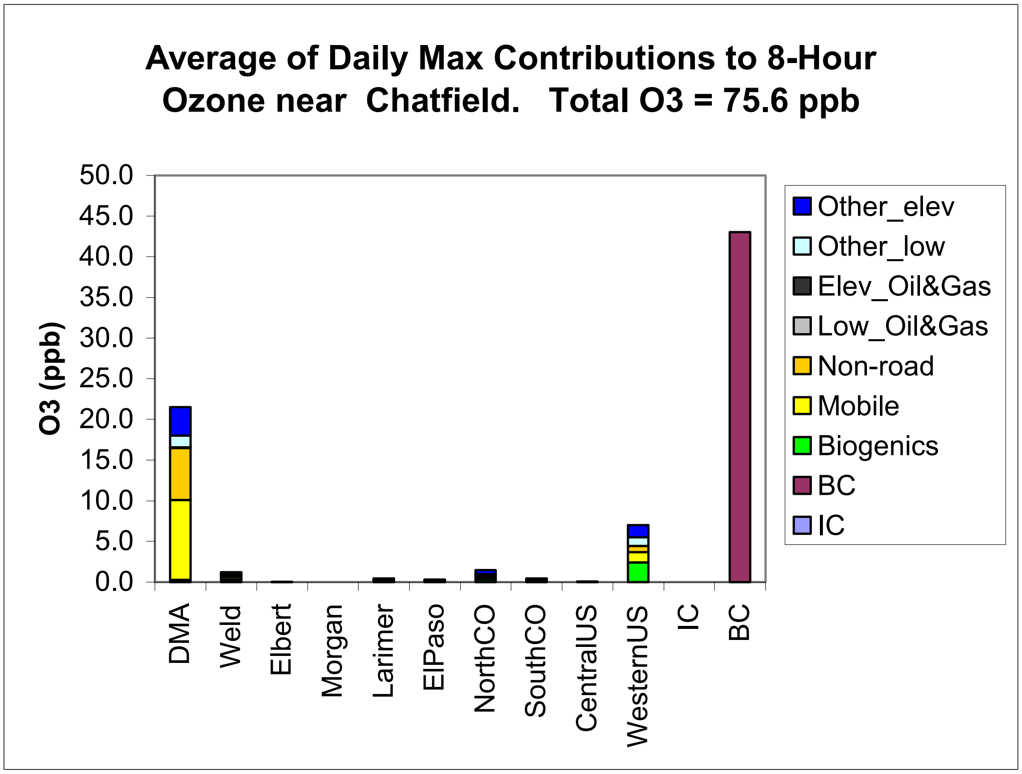


Figure 2-4a. Contribution of source regions and source categories to the 3-day average of the highest daily maximum 8-hour ozone concentrations near the Chatfield monitor.

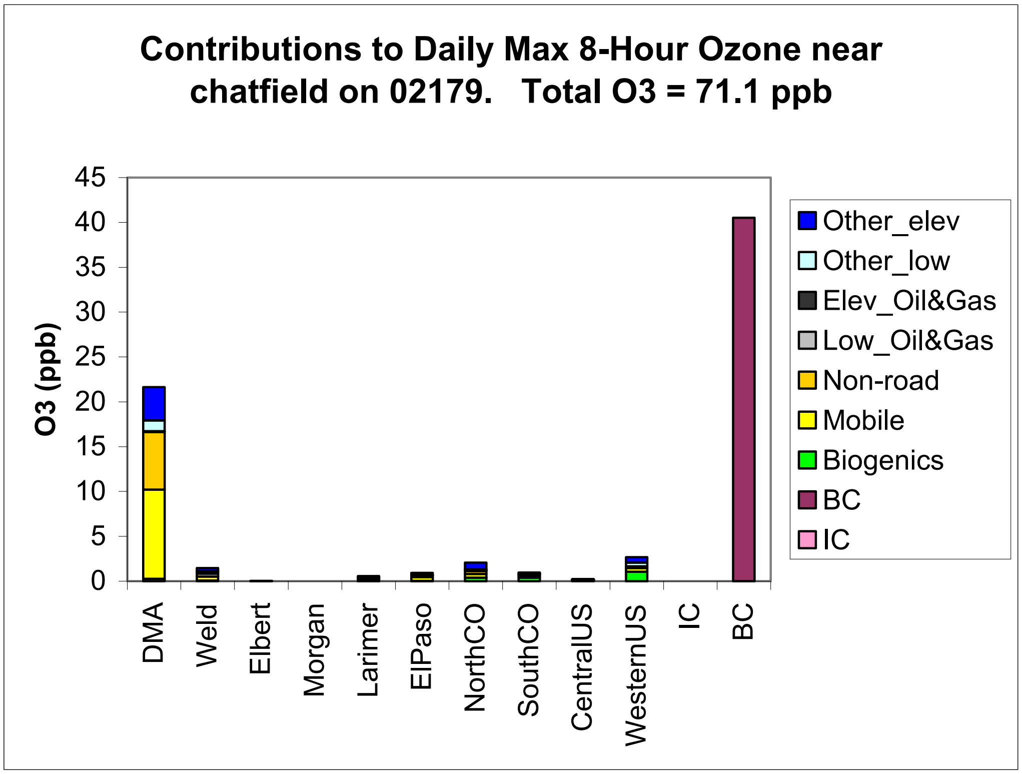


Figure 2-4b. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Chatfield monitor on June 28, 2002.

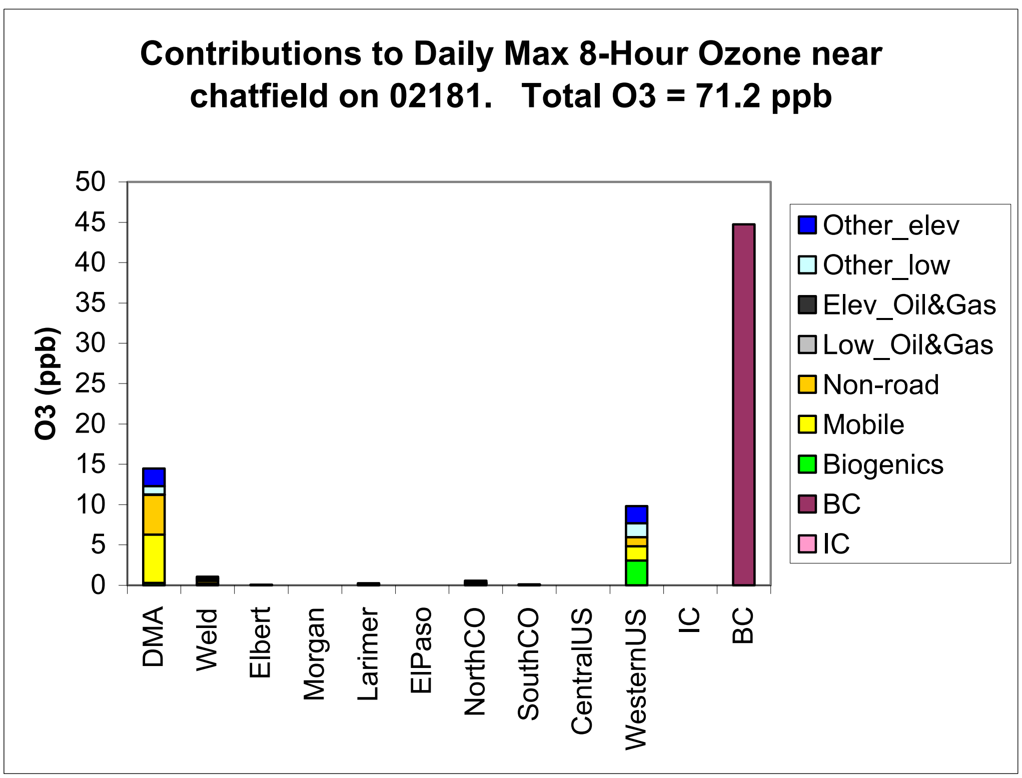


Figure 2-4c. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Chatfield monitor on June 30, 2002.

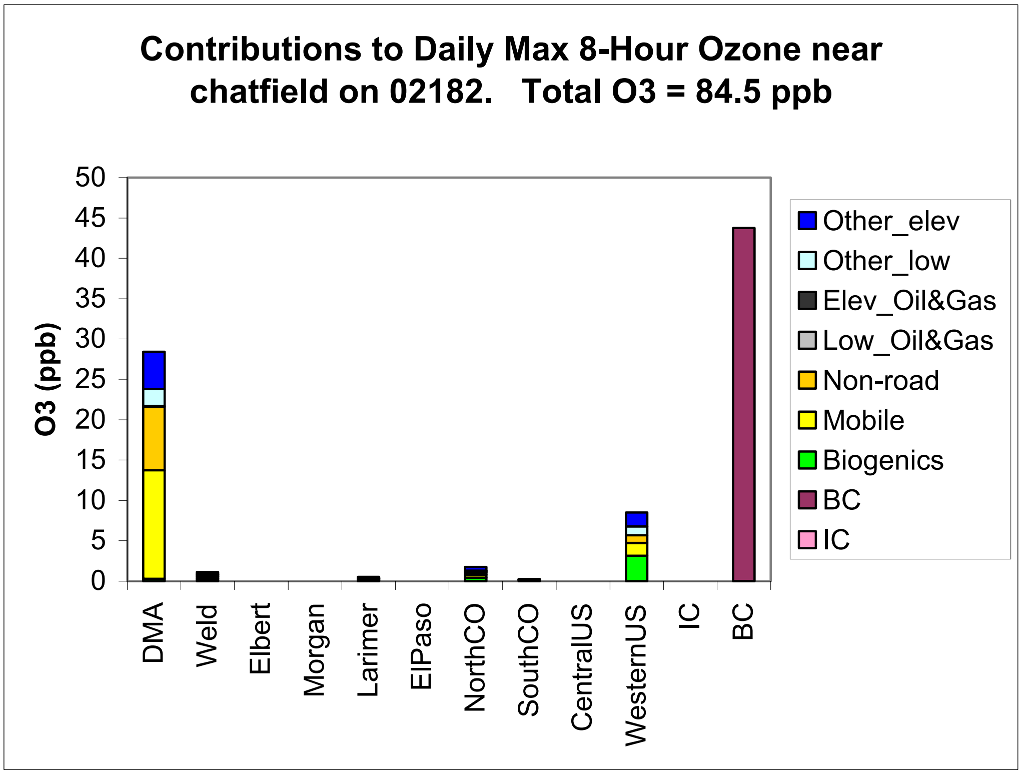


Figure 2-4d. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Chatfield monitor on July 1, 2002.

OZONE SOURCE APPORTIONMENT AT ROCKY MOUNTAIN NATIONAL PARK

The ozone source apportionment modeling results for the Rocky Mountain National Park (RMNP) monitor is different than seen for the other monitors due to the fact that it lies approximately 80 km to the northwest of the DMA, compared to the other monitors that all lie within 25 km of the DMA. Although BCs are again by far the largest contributor (> 50%) to the 8-hour ozone peaks near the RMNP monitor, the contribution of the DMA is less at RMNP than the other monitors, but it is still the second most important source region. The contributions of Weld County (6 ppb) to 8-hour ozone at RMNP is approximately 3 times greater than at the monitors closer to the DMA (2 ppb), although Weld County still contributes less than the DMA (20 ppb).

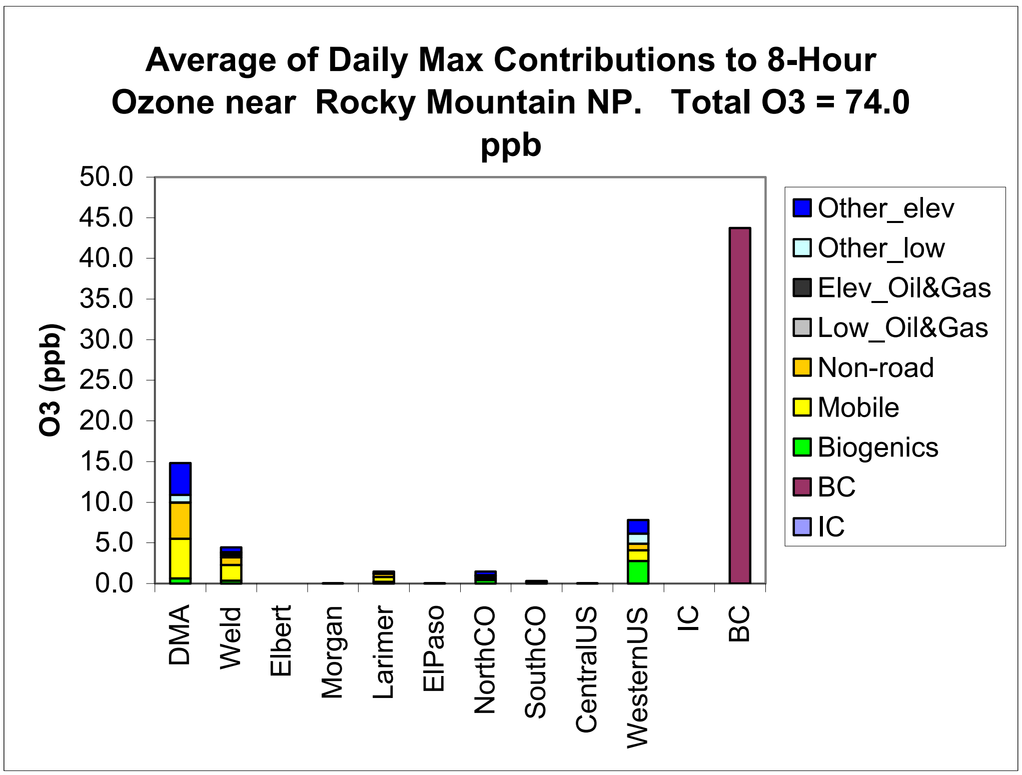


Figure 2-5a. Contribution of source regions and source categories to the 3-day average of the highest daily maximum 8-hour ozone concentrations near the Rocky Mountains National Park monitor.

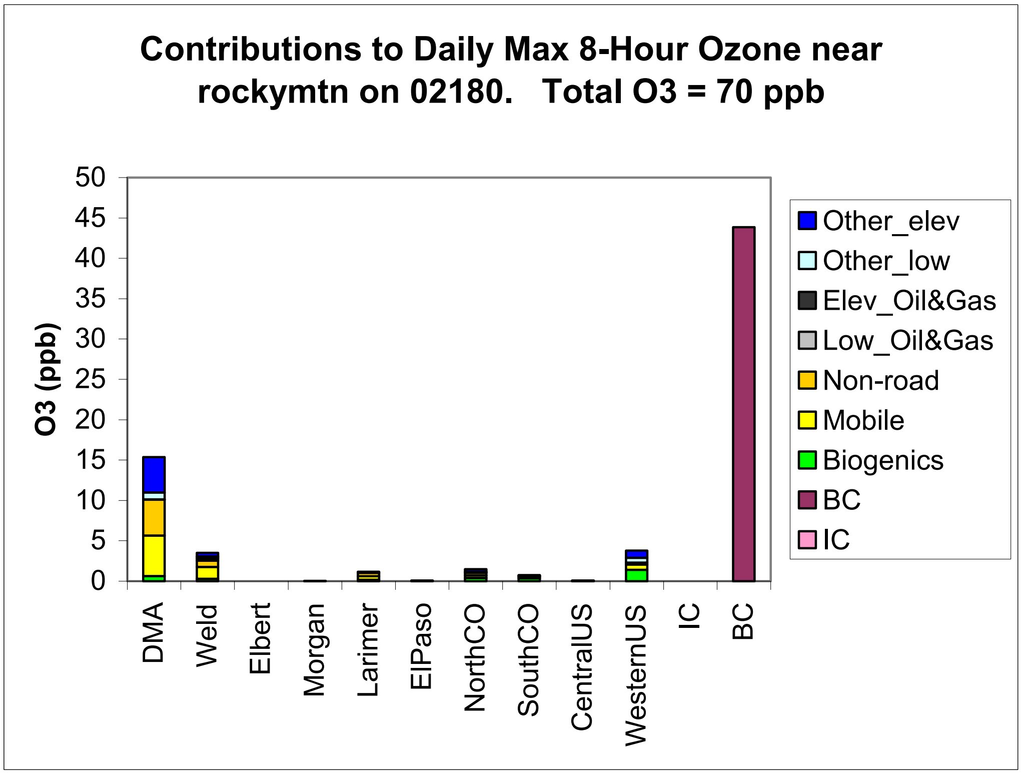


Figure 2-5b. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Rocky Mountains National Park monitor on June 29, 2002.

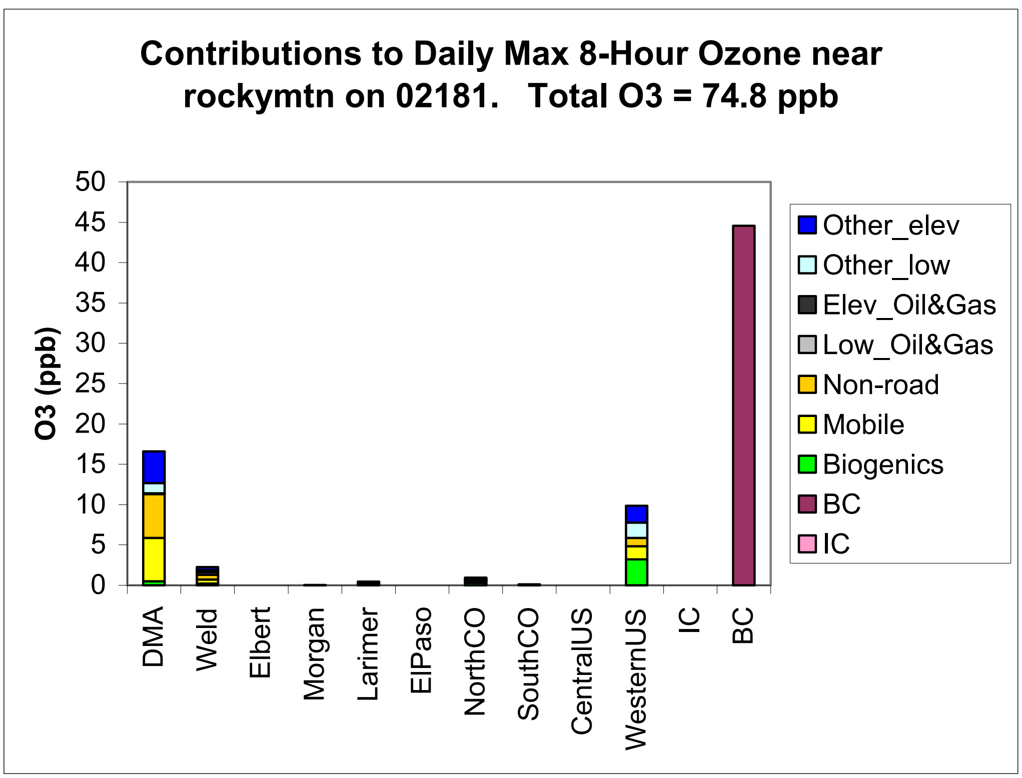


Figure 2-5c. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Rocky Mountains National Park monitor on June 30, 2002.

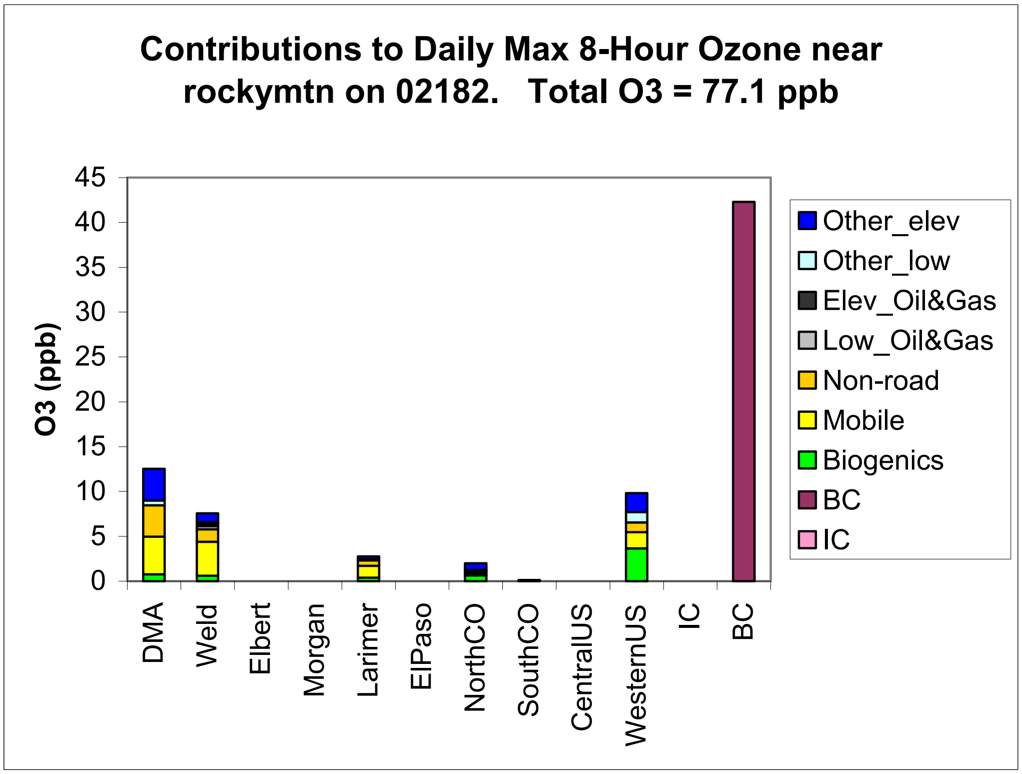


Figure 2-5d. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Rocky Mountains National Park monitor on July 1, 2002.

OZONE SOURCE APPORTIONMENT AT FORT COLLINS

The Fort Collins monitor is located approximately 85 km to the north of the DMA in Larimer County, Colorado. Although BCs are still the largest (> 50%) contributor to 8-hour ozone at Fort Collins, there are larger contributions from both Larimer and Weld Counties than from the DMA. On some days, Larimer County contributes more than Weld County (e.g., July 1, 2002), whereas on others the reverse is true (June 30, 2002).

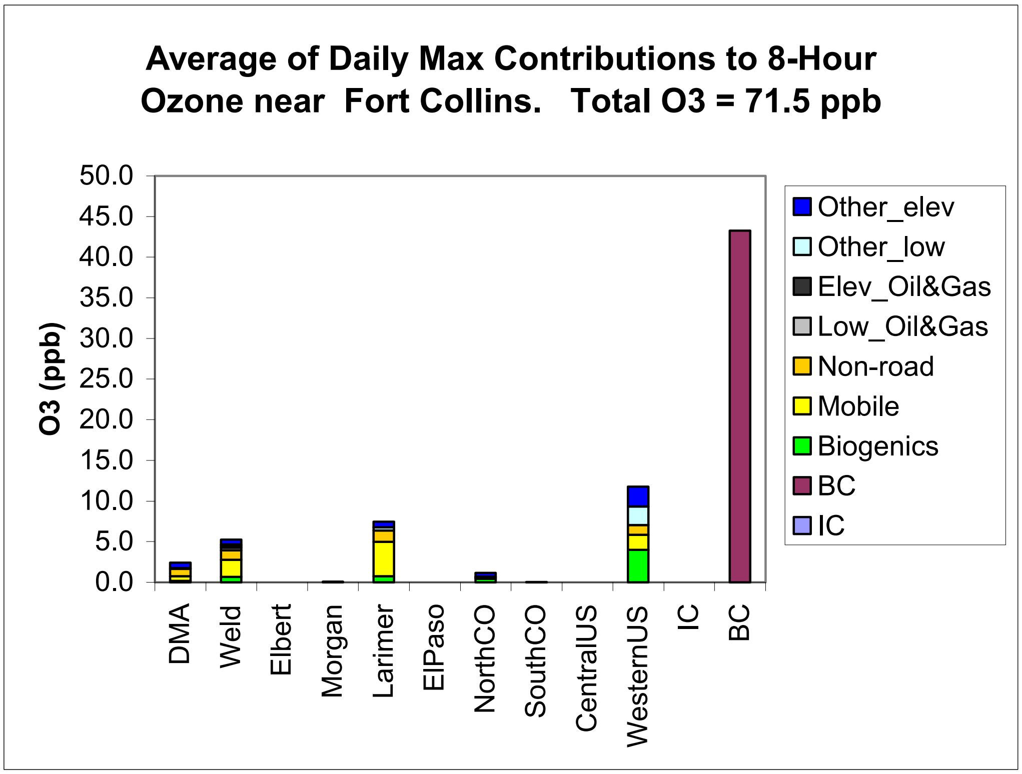


Figure 2-6a. Contribution of source regions and source categories to the 2-day average of the highest daily maximum 8-hour ozone concentrations near the Fort Collins monitor.

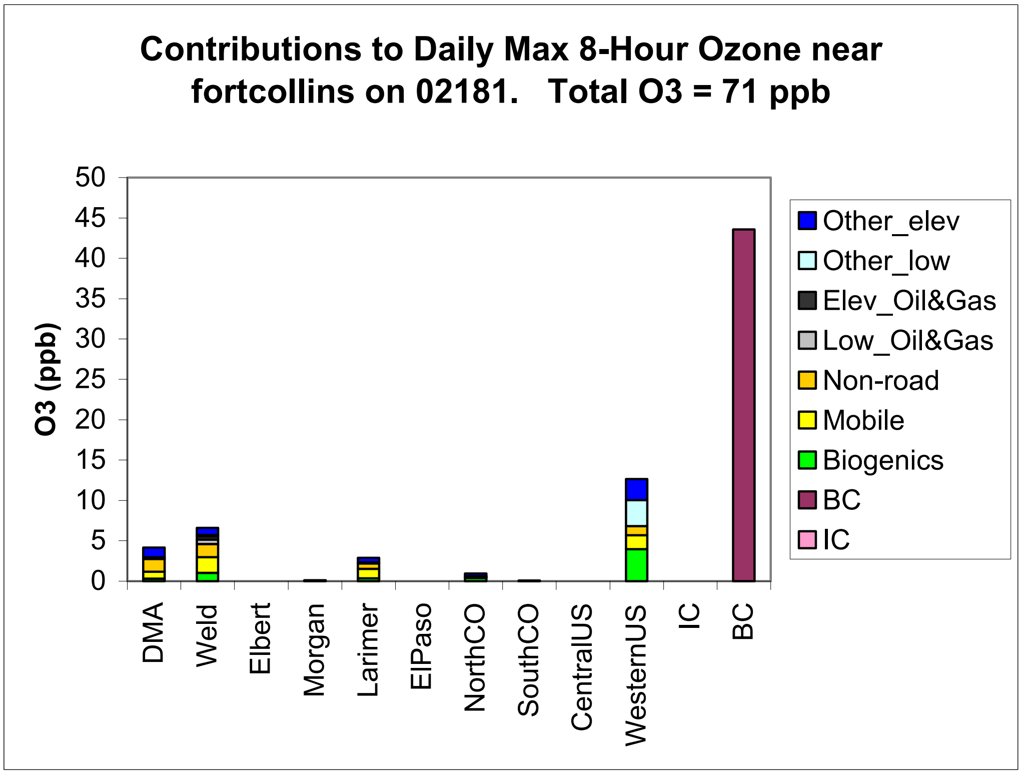


Figure 2-6b. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Fort Collins monitor on June 30, 2002.

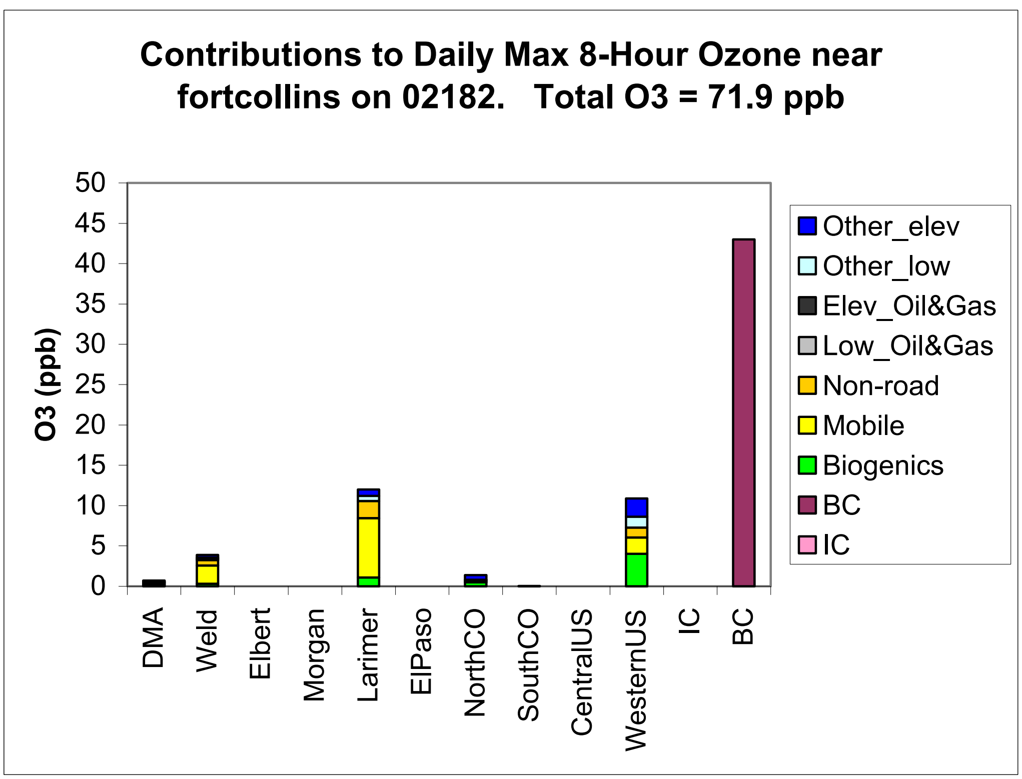


Figure 2-6c. Contributions of source regions and source categories to the highest daily maximum 8-hour ozone concentration near the Fort Collins monitor on July 1, 2002.

SUMMARY OF OZONE SOURCE APPORTIONMENT

Table 2-1 summarizes the percent and ozone contribution of the different source regions to the average of the peak 8-hour ozone concentrations near each ozone monitor across the days used in the ozone attainment demonstration test. The average contributions for the four ozone monitors located in the DMA area (Rocky Flats, NREL, Highland and Chatfield) are very similar. BCs contribute the most (57%-59%) followed by sources in the DMA (27%-29%). Weld County is the next most important nearby Colorado County (1%-3%), with all other local Counties contributing 0%-3%. Other states in the US contribute 9%-10%.

The contributions of source regions to the peak 8-hour ozone concentrations at RMNP are similar to the DMA monitors, only with less contribution from the DMA (20% versus ~28%) and more contribution from Weld County (6% versus ~2%). Fort Collins exhibits a slightly different ozone contribution with much less contribution from the DMA (3%) and higher contributions from Weld (7%) and Larimer (10%) counties.

A common theme at all ozone monitors is that a majority of the peak 8-hour ozone is due to ozone transport. Sources from outside of Colorado contribute 66%-68% of the peak 8-hour ozone concentrations at monitors in and near the DMA. At the RMNP and Fort Collins monitors ozone transport from outside of Colorado contributes, respectively, 70% and 78% of the peak 8-houirn ozone concentrations.

Table 2-1a. Percent contribution of source regions to the multi-day average of peak 8-hour ozone concentrations near each ozone monitor on high ozone days.

Source Region	Rocky Flats	NREL	Highland	Chatfield	RMNP	Fort Collins
BCs	58	57	58	57	59	61
DMA	26	29	27	28	20	3
Weld Co.	3	1	2	2	6	7
Elbert Co.	0	0	0	0	0	0
Morgan Co.	0	0	0	0	0	0
Larimer Co.	1	1	1	1	2	10
El Paso Co.	1	1	0	0	0	0
Other CO	3	2	2	3	2	2
Other USA	9	9	10	9	11	17

Table 2-1b. Ozone contribution (ppb) of source regions to the multi-day average of peak 8-hour ozone concentrations near each ozone monitor on high ozone days.

Source Region	Rocky Flats	NREL	Highland	Chatfield	RMNP	Fort Collins
BCs	43	44	43	43	44	43
DMA	20	22	20	22	15	2
Weld Co.	2	1	1	1	4	5
Elbert Co.	0	0	0	0	0	0
Morgan Co.	0	0	0	0	0	0
Larimer Co.	1	0	0	0	2	8
El Paso Co.	1	1	0	0	0	0
Other CO	2	2	2	2	2	1
Other USA	6	7	7	7	8	12

3. 8-HOUR OZONE SPATIAL IMPACTS OF COLORADO COUNTIES

In this section we discuss the spatial extent of the 8-hour ozone impacts due to emissions from Counties in Colorado. Separate ozone source apportionment was obtained for the following Colorado Counties:

- Denver Metropolitan Area (DMA) that includes the counties of Adams, Arapahoe, Broomfield, Boulder, Denver, Douglas and Jefferson;
- Weld County;
- Elbert County;
- Morgan County;
- Larimer County; and
- El Paso County.

On April 15, 2004, EPA designated the 7 county DMA as well as portions of Weld (Greeley) and Larimer (Fort Collins) Counties as a "Basic" 8-hour nonattainment area. However, because Denver has entered into an Early Action Compact (EAC), the designation is deferred until 2007.

Figures 3-1 through 3-6 display the spatial extent of the 8-hour ozone concentrations that occur between 10am and 6pm local time (the time when the daily maximum 8-hour ozone typically occur) on June 27, 2002 through July 1, 2002 due to all emissions (anthropogenic and biogenic) from the DMA and Weld, Elbert, Morgan, Larimer and El Paso Counties, respectively. Note that the scale for the ozone contributions plots due to emissions from the DMA is a factor of 2 greater (maximum of 20 ppb) than the scale used for the other counties (maximum of 10 ppb).

DENVER METROPOLITAN AREA

The Denver Metropolitan Area (DMA) consists of seven counties (Adams, Arapahoe, Broomfield, Boulder, Denver, Douglas and Jefferson) with a combined area of approximately 4,530 mi^2 and a population of approximately 2.4 million people. This results in a population density of approximately 540 people per square mile.

Figure 3-1 displays the contributions of emissions from the DMA to daytime 8-hour ozone concentrations on June 27 through July 1, 2002 for the 2007 Three Control Strategy emissions scenario. The highest ozone impacts due to emissions from the DMA are mainly within the DMA including the key ozone monitors of Rocky Flats, NREL, Chatfield and Highland. The spatial extent of the highest ozone due to DMA emissions varies by day: on June 27 highest ozone occurs to the northeast of Denver County; on June 28 highest ozone occurs to the south, southeast and east of Denver County; on June 29 highest ozone occurs to the south, east and north of Denver County; on June 30 the highest ozone occurs to the west and northwest of Denver County; and on July 1 the highest ozone occurs to the west of the DMA. July 1, 2002 is the day in which emissions from the DMA produce the highest 8-hour ozone concentrations with a peak value of 29 ppb and 8-hour ozone contributions in excess of 15 ppb occurring across most of Jefferson County and up into Boulder and down into Douglas Counties. On other days the peak 8-hour ozone concentration is typically around 20 ppb.

WELD COUNTY

Weld County has a population of approximately 181,000 people with an area of approximately 4,500 mi^2 resulting in a population density of approximately 45 people per square mile, over 10 times lower than the DMA. However, much of the emissions exist in southern Weld County closer to the DMA and the key DMA ozone monitors. Figure 3-2 displays the spatial extent of the 8-hour ozone concentrations due to emissions from Weld County. The maximum 8-hour ozone concentration due to emissions from Weld County range from 6-13 ppb and the highest values occur in southwestern Weld County that spill over into eastern Boulder and southeastern Larimer Counties. Weld County appears to contribute to ozone concentrations at the Rocky Flats and South Boulder ozone monitors on most days.

ELBERT COUNTY

Elbert County lies to the immediate southeast of the DMA and has a population of a little under 20,000 people and a population density of approximately 10 people per square mile. As seen in Figure 3-3, it contributes small amounts of ozone usually to the east of the DMA that is almost always less than 1 ppb. It's estimated ozone contributions at the key ozone monitors of Rocky Flats, NREL, Chatfield and Highland are likely immeasurable on most days.

MORGAN COUNTY

Morgan County lies to the northeast of the DMA immediately east of Weld County. It has a population of approximately 27,000 people, an area of approximately 1,300 mi^2 for a population density of approximately 20 people per square mile. As seen in Figure 3-4, on June 27-29 the 8-hour ozone impact due emissions from Morgan County resides to the northeast of the DMA and affects the Weld County ozone monitor that currently does not violate the 8-hour ozone standard. On June 30 and July 1, the ozone impact due to Morgan County travel further south impacting the eastern portion of the DMA, but does not contribute to the key ozone monitors to the south (Chatfield and Highland) and west (Rocky Flats and NREL) of the DMA. The maximum 8-hour ozone contribution due to emissions from Morgan County ranges from 2 to 9 ppb and tend to occur in Morgan or Weld Counties.

LARIMER COUNTY

The 8-hour ozone impacts due to emissions from Larimer County are shown in Figure 3-5. Larimer County has a population, area and population density of approximately 251,000 people, 2,600 mi^2 and 97 people per mi^2. The ozone footprint due to emissions from Larimer County frequently include the key Rock Flats monitor on all days as well as the NREL, Chatfield, Rocky

Mountain National Park and other key monitors on many days. The maximum 8-hour ozone contribution ranges from 4 to 12 ppb and always occurs within Larimer County.

EL PASO COUNTY

El Paso County lies to the south of the DMA and includes the city of Colorado Springs. It has a population of approximately 517,000 people and a population density of 243 people per square mile, which is about half of the DMA. The ozone contribution due to emissions from El Paso County on the DMA varies day-to-day. On June 27 and 28 southerly winds result in El Paso County ozone contributions in the DMA, particular at the Chatfield and Highland monitors on June 27. However, on June 29-30 and July 1, the ozone impacts due to El Paso County in the DMA appear to be nonexistent. The maximum ozone impact due to El Paso County emissions range from 7 to 16 ppb and tend to occur south of the DMA, except on June 27 when a 7 ppb 8-hour ozone maximum occurs in Douglas County in the DMA.

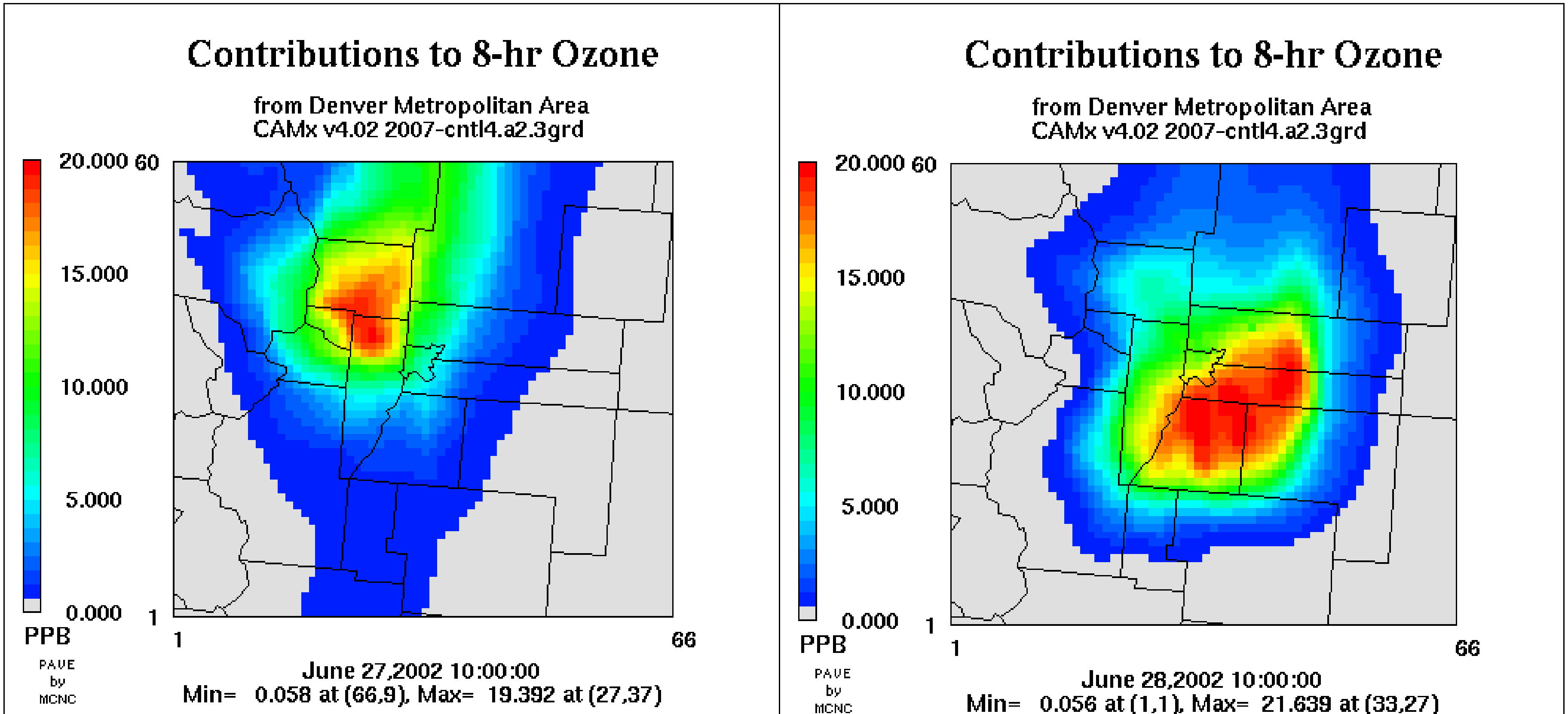


Figure 3-1a. Contributions of the Denver Metropolitan Area (DMA) to 10am to 6pm 8-hour ozone concentrations on June 27 (right) and June 28 (right), 2002.

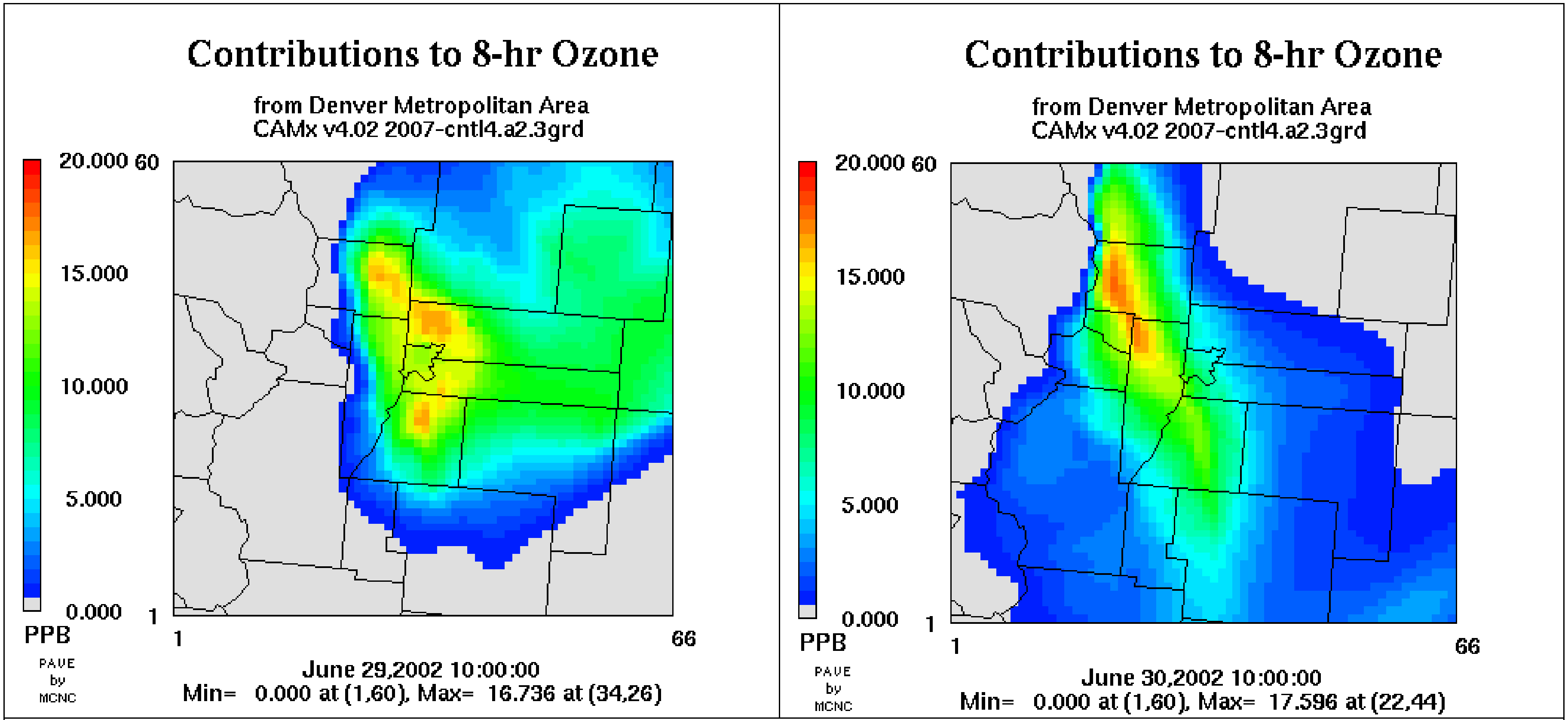


Figure 3-1b. Contributions of the Denver Metropolitan Area (DMA) to 10am to 6pm 8-hour ozone concentrations on June 29 (right) and June 30 (right), 2002.

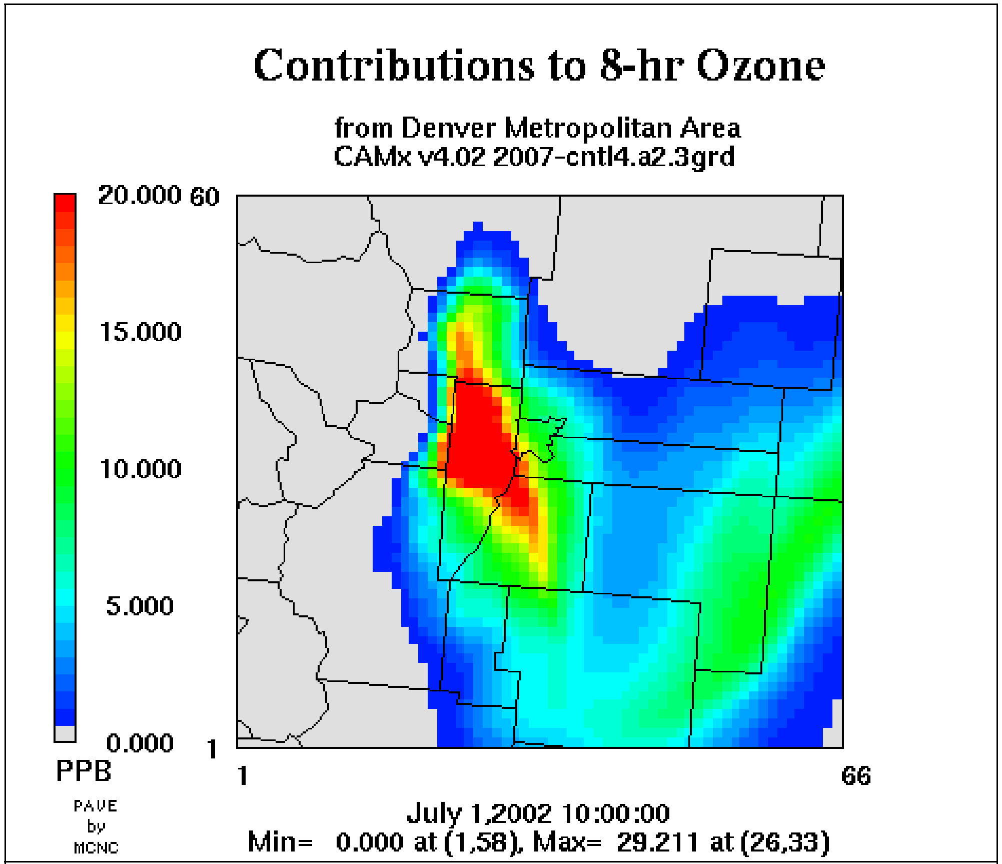


Figure 3-1c. Contributions of the Denver Metropolitan Area (DMA) to 10am to 6pm 8-hour ozone concentrations on July 1, 2002.

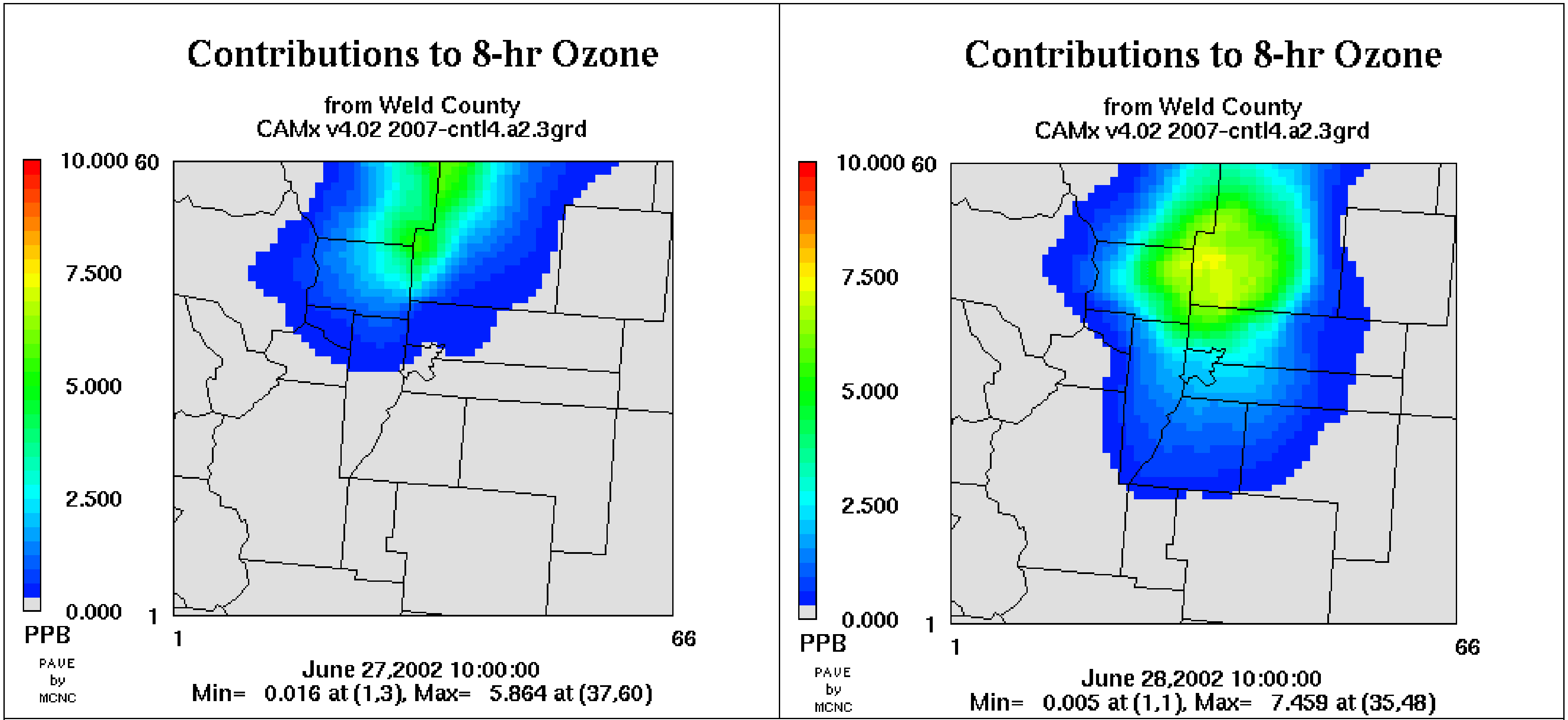


Figure 3-2a. Contributions of Weld County to 10am to 6pm 8-hour ozone concentrations on June 27 (right) and June 28 (right), 2002.

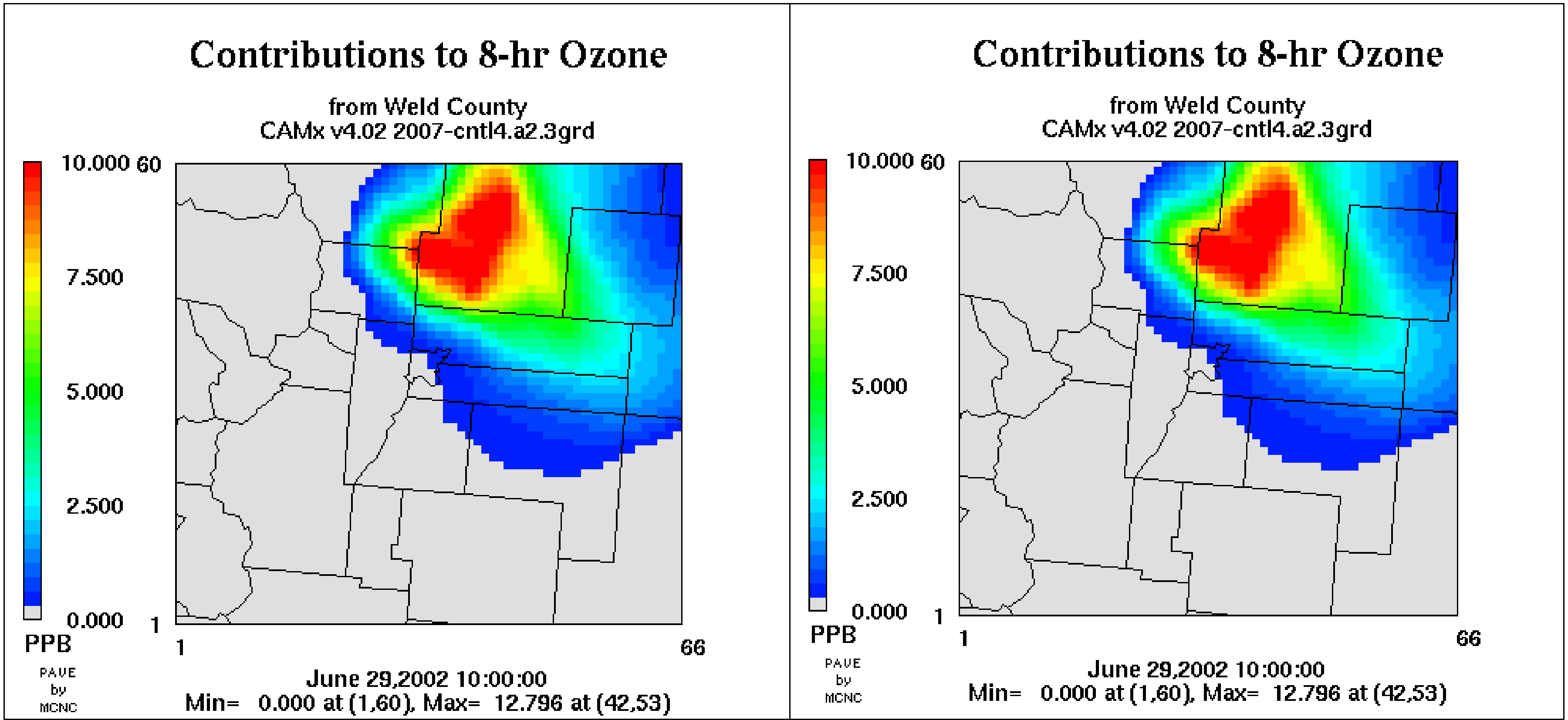


Figure 3-2b. Contributions of Weld County to 10am to 6pm 8-hour ozone concentrations on June 29 (right) and June 30 (right), 2002.

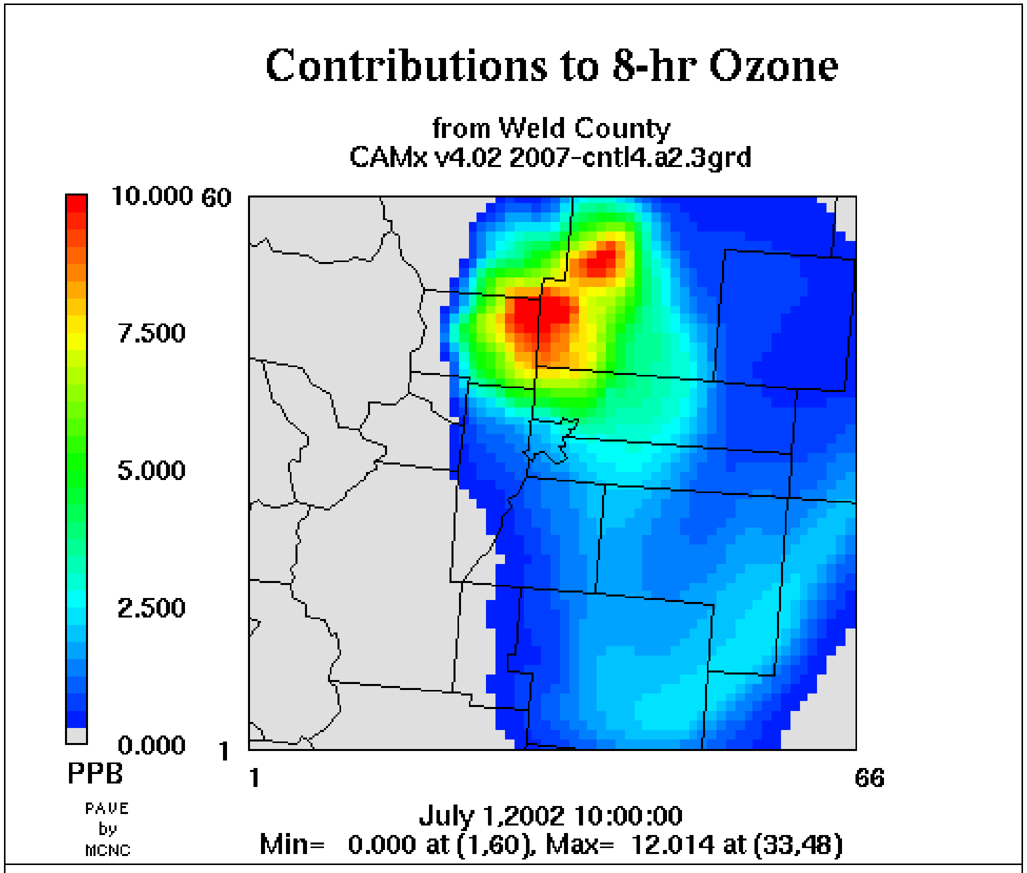


Figure 3-2c. Contributions of Weld County to 10am to 6pm 8-hour ozone concentrations on July 1, 2002.

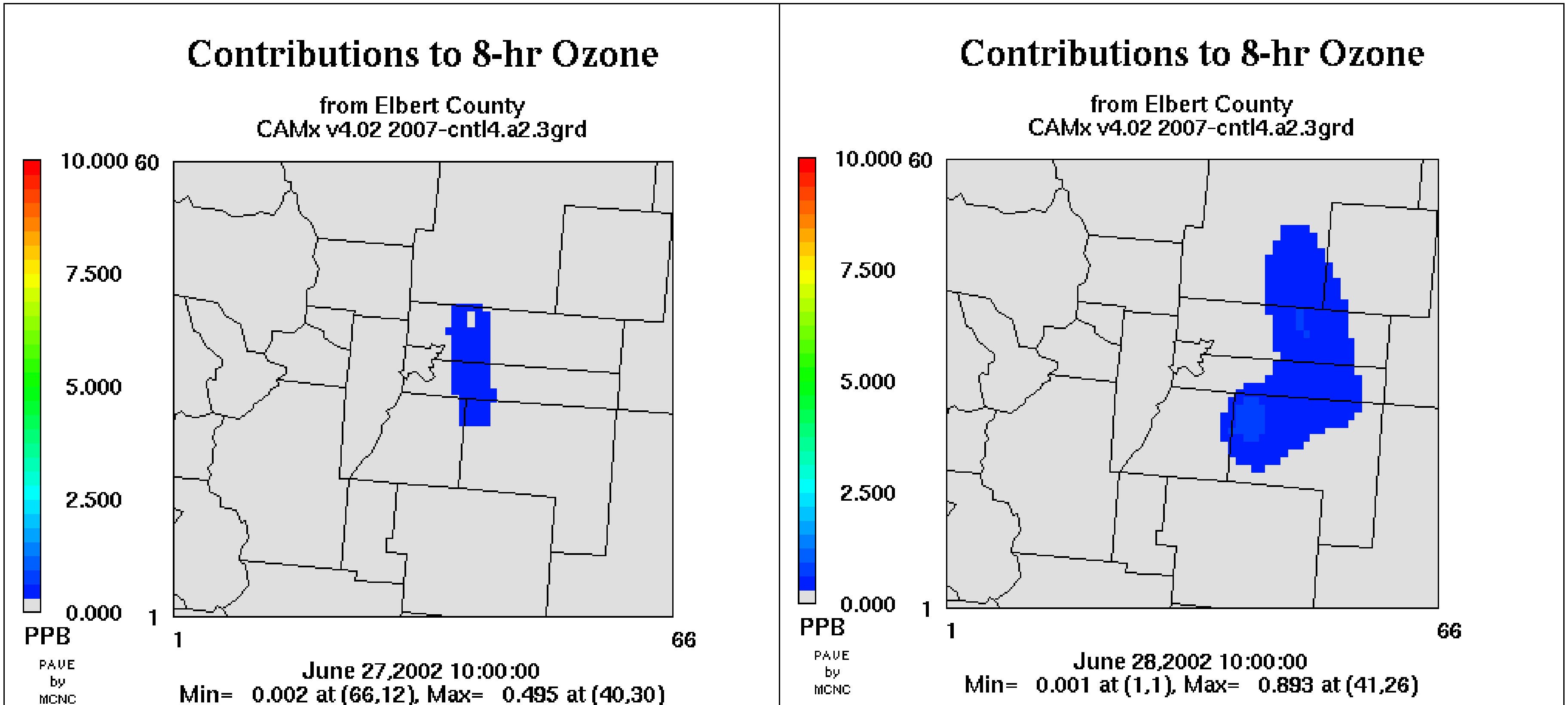


Figure 3-3a. Contributions of Elbert County to 10am to 6pm 8-hour ozone concentrations on June 27 (right) and June 28 (right), 2002.

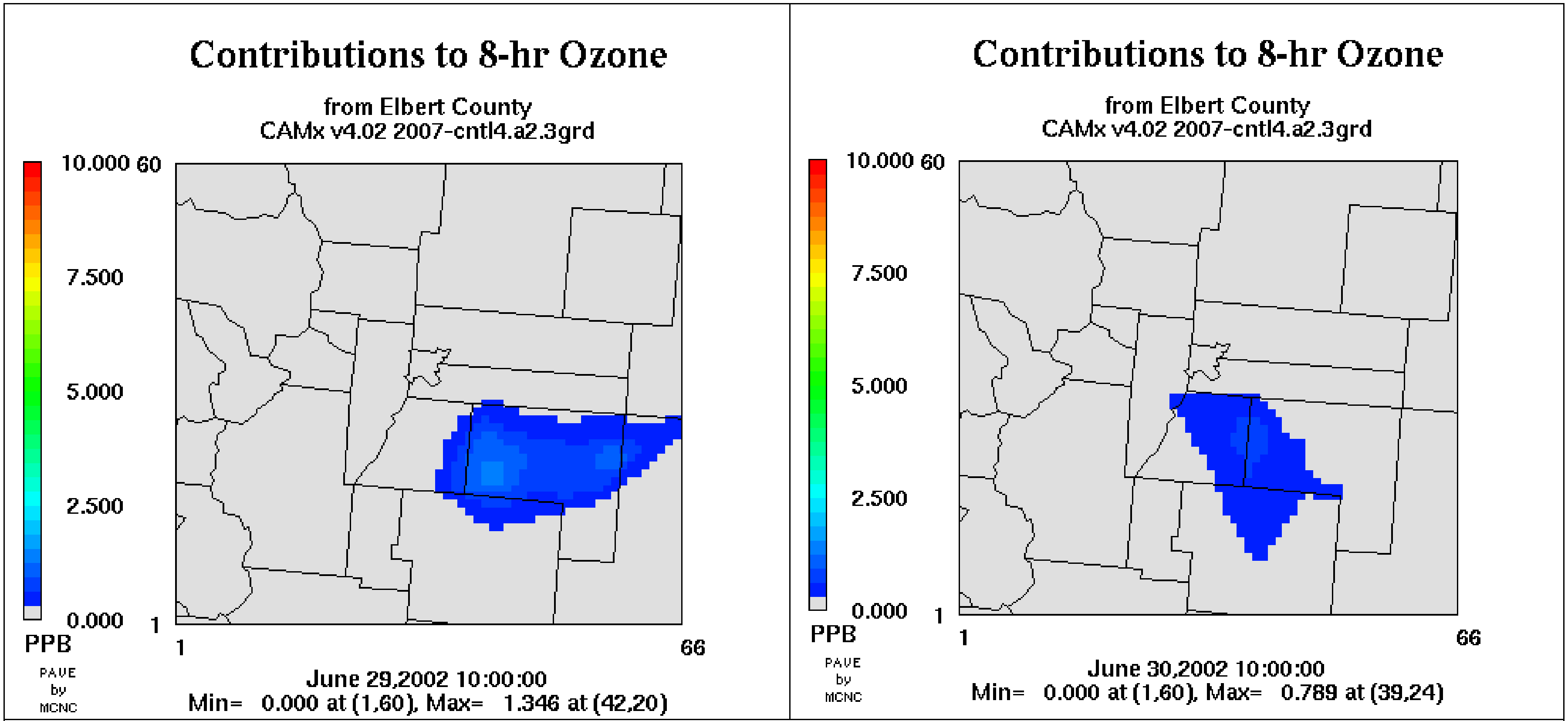


Figure 3-3b. Contributions of Elbert County to 10am to 6pm 8-hour ozone concentrations on June 29 (right) and June 30 (right), 2002.

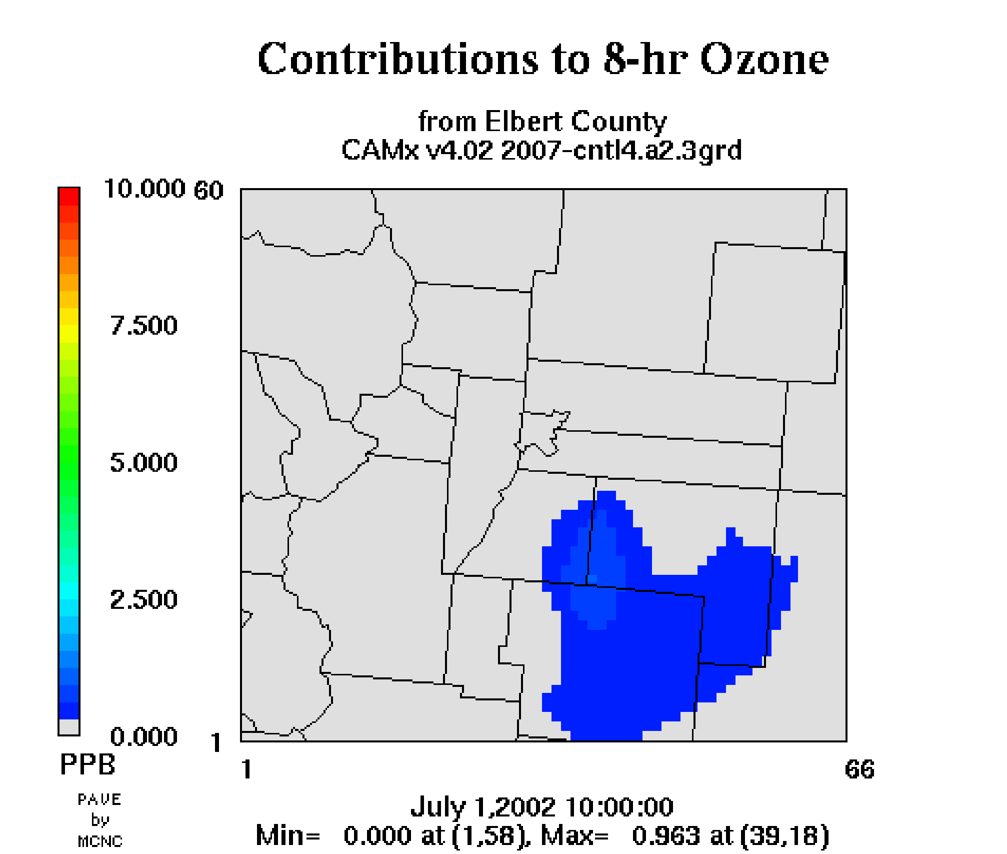


Figure 3-3c. Contributions of Elbert County to 10am to 6pm 8-hour ozone concentrations on July 1, 2002.

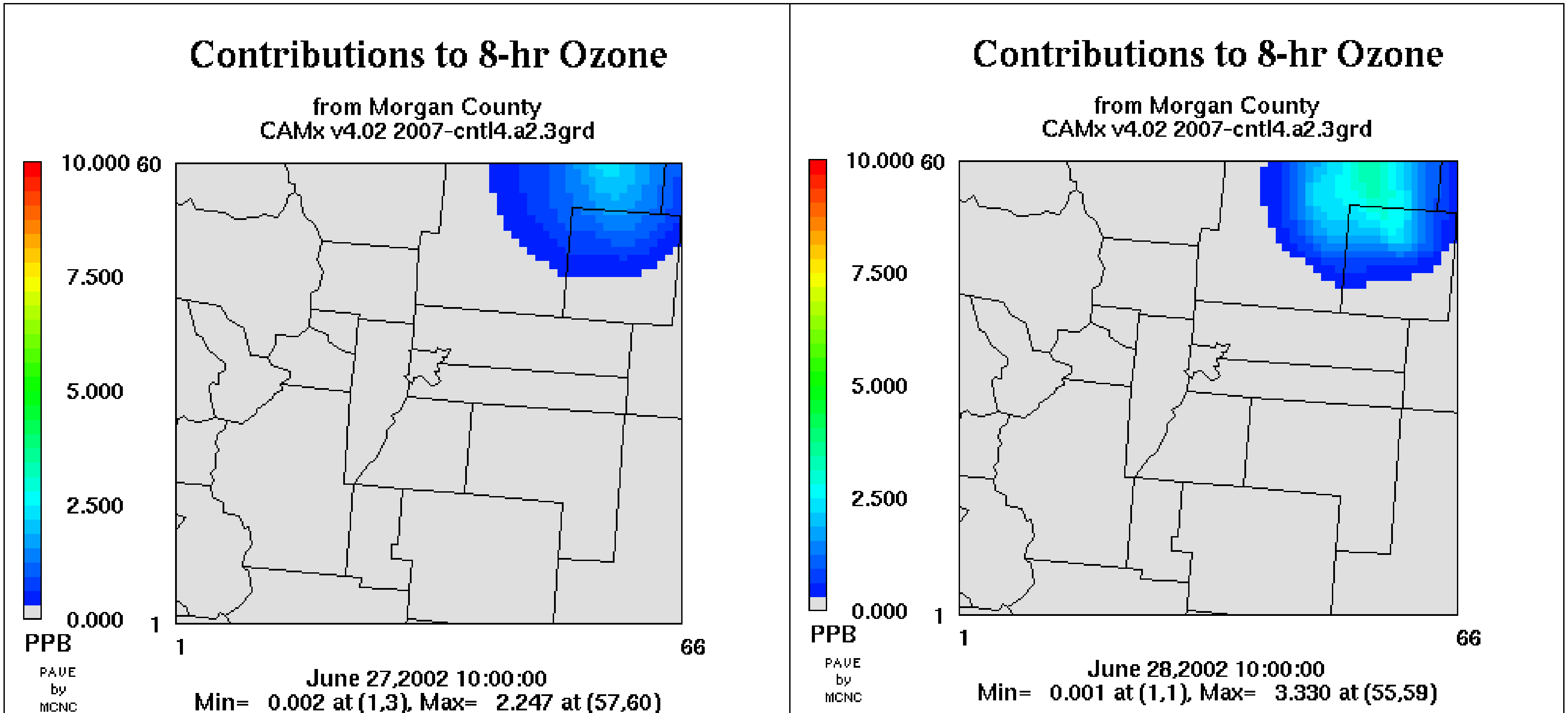
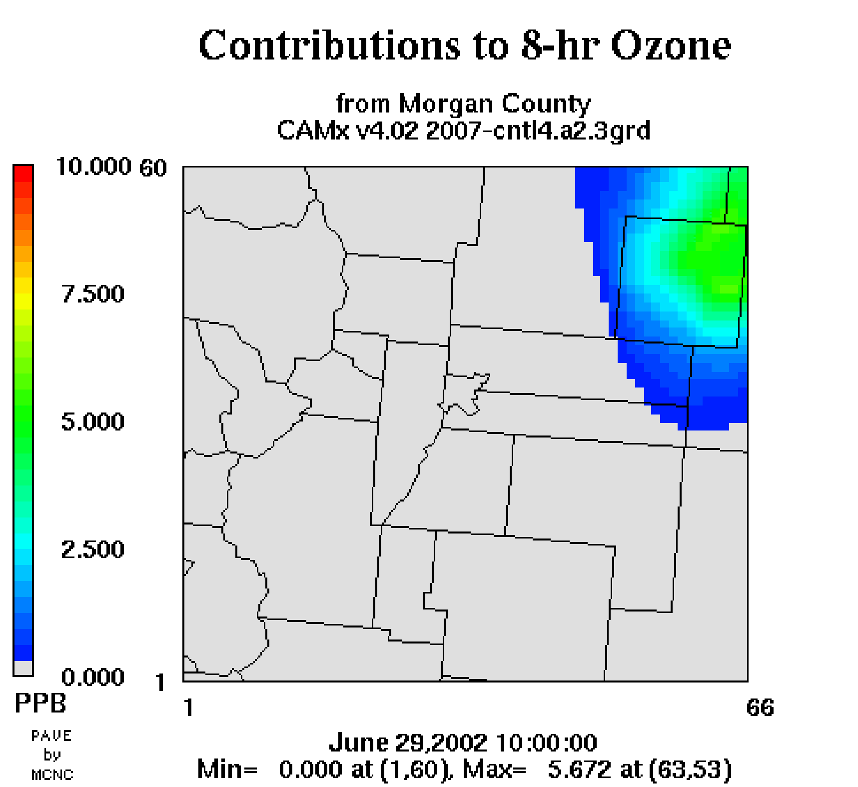


Figure 3-4a. Contributions of Morgan County to 10am to 6pm 8-hour ozone concentrations on June 27 (right) and June 28 (right), 2002.



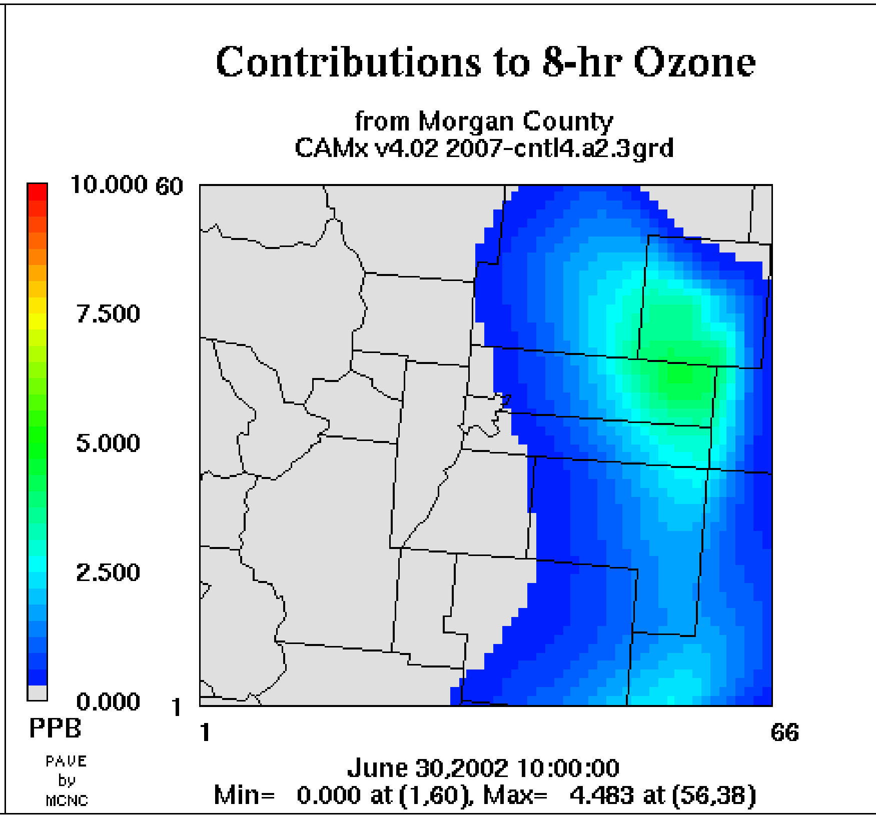


Figure 3-4b. Contributions of Morgan County to 10am to 6pm 8-hour ozone concentrations on June 29 (right) and June 30 (right), 2002.

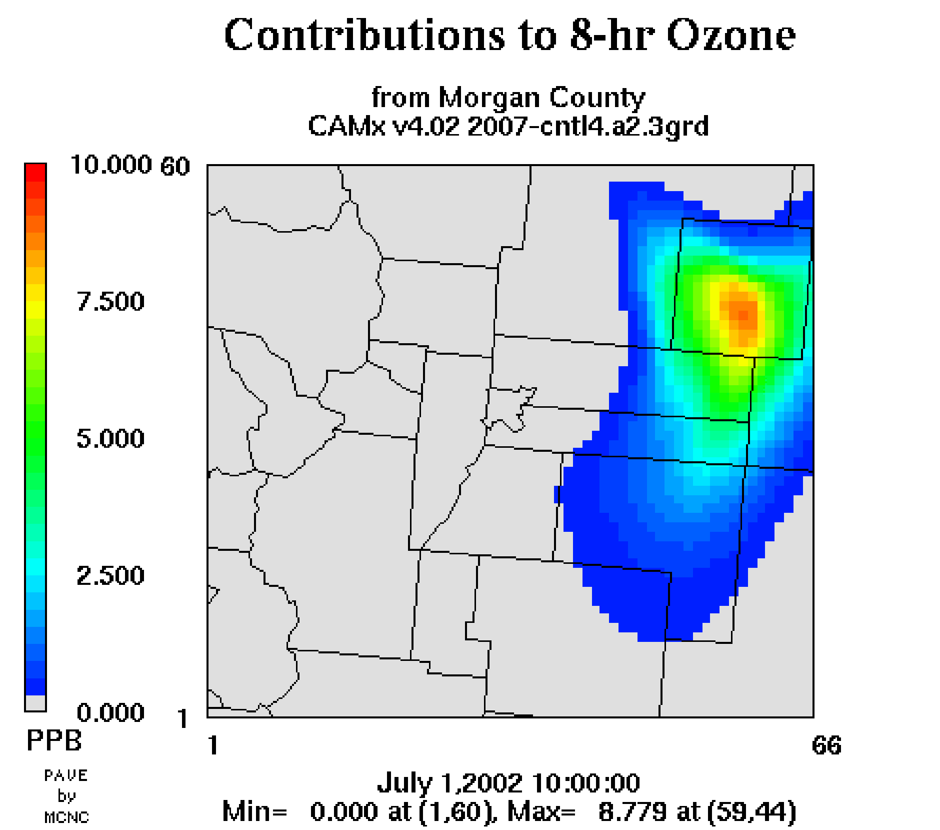


Figure 3-4c. Contributions of Morgan County to 10am to 6pm 8-hour ozone concentrations on July 1, 2002.

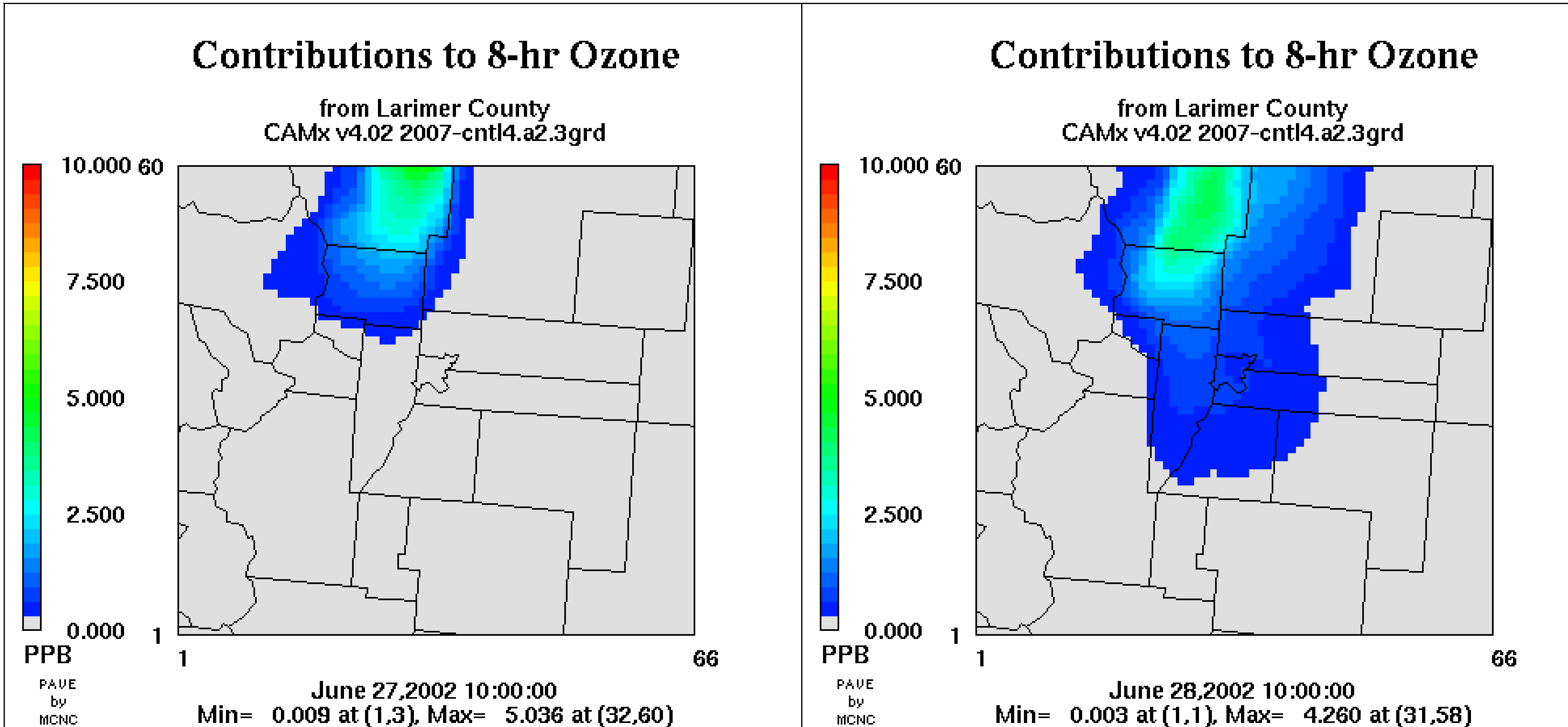


Figure 3-5a. Contributions of Larimer County to 10am to 6pm 8-hour ozone concentrations on June 27 (right) and June 28 (right), 2002.

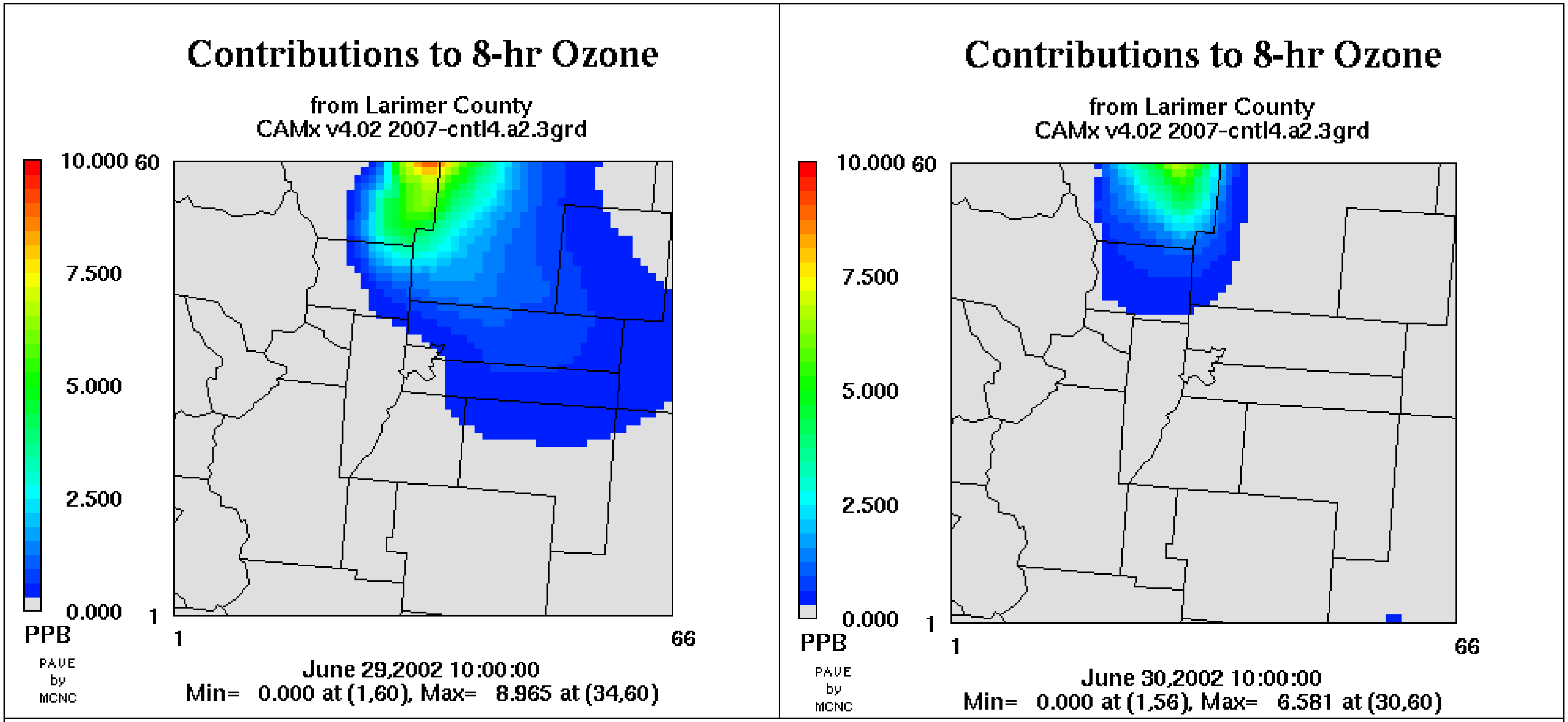


Figure 3-5b. Contributions of Larimer County to 10am to 6pm 8-hour ozone concentrations on June 29 (right) and June 30 (right), 2002.

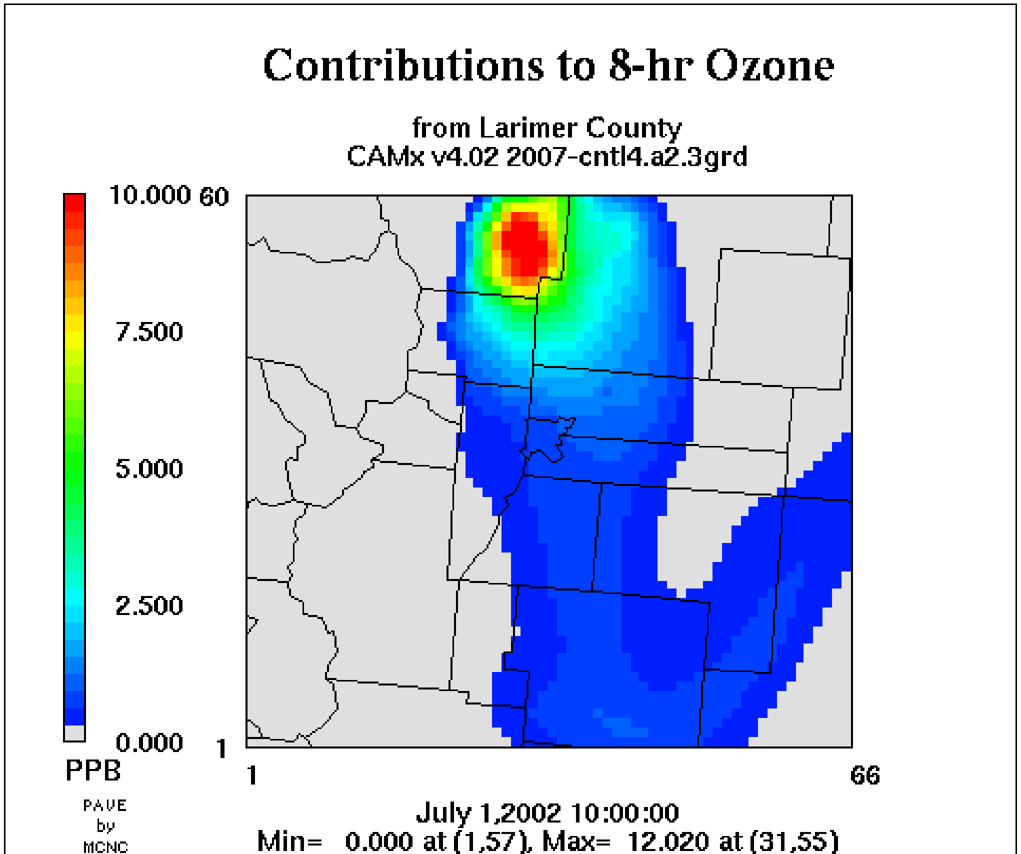


Figure 3-5c. Contributions of Larimer County to 10am to 6pm 8-hour ozone concentrations on July 1, 2002.

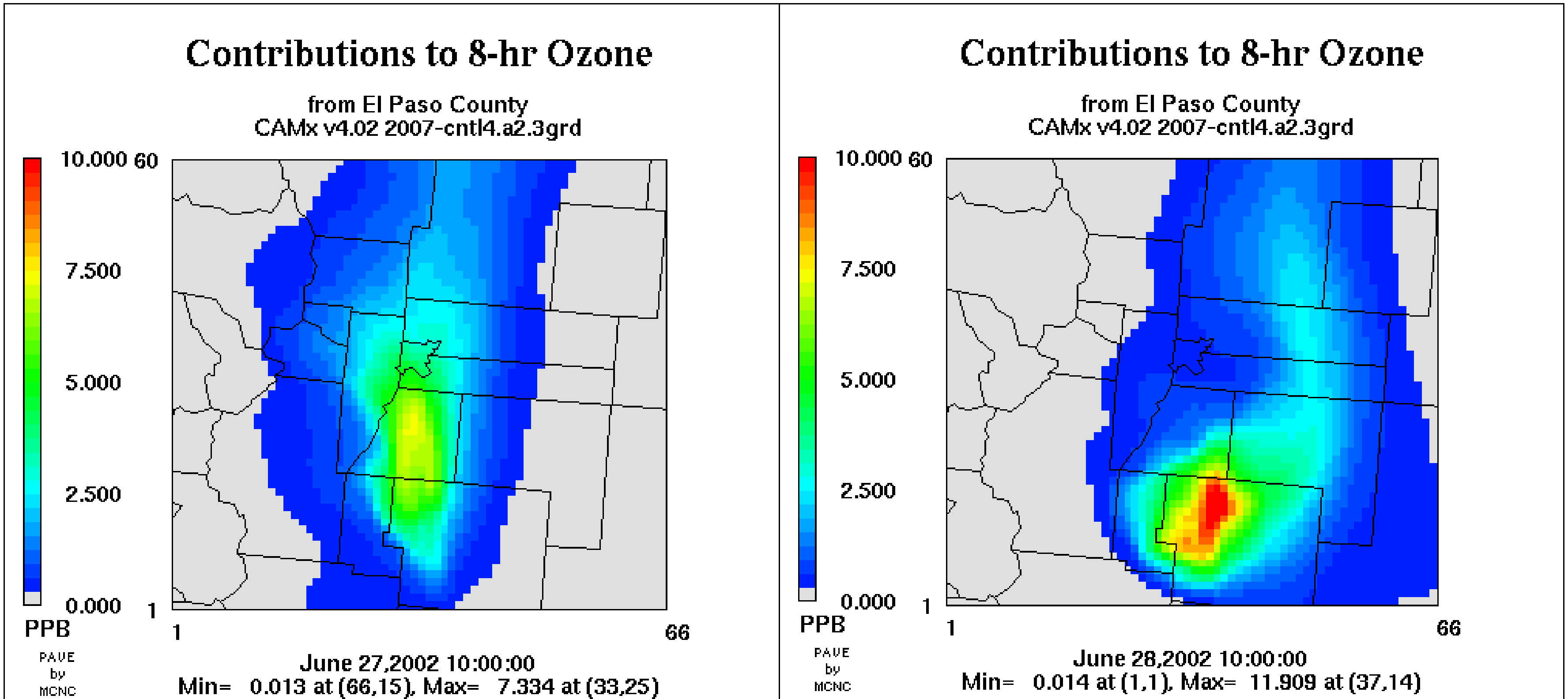


Figure 3-6a. Contributions of El Paso County to 10am to 6pm 8-hour ozone concentrations on June 27 (right) and June 28 (right), 2002.

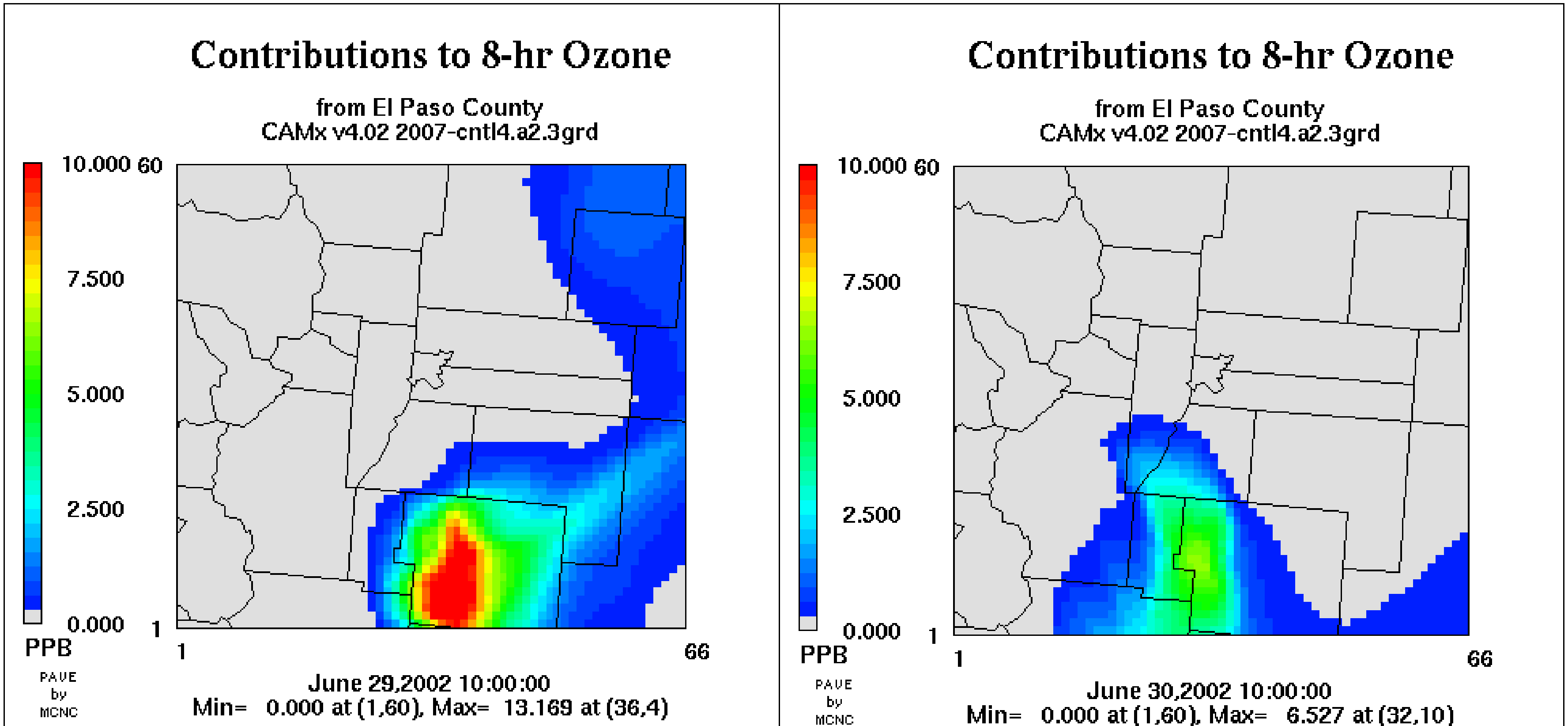


Figure 3-6b. Contributions of El Paso County to 10am to 6pm 8-hour ozone concentrations on June 29 (right) and June 30 (right), 2002.

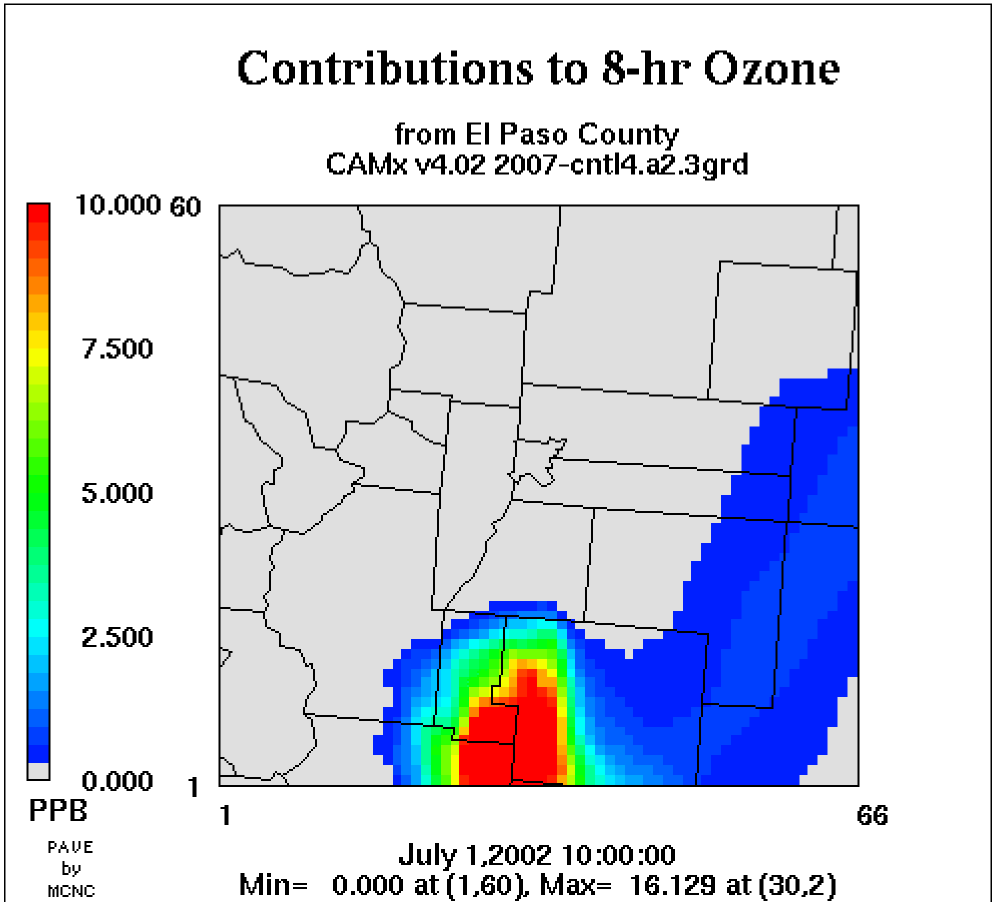


Figure 3-6c. Contributions of El Paso County to 10am to 6pm 8-hour ozone concentrations on July 1, 2002.

4. CONCLUSIONS AND RECOMMENDATIONS

The ozone source apportionment modeling for the Denver June 2002 ozone episode using the Anthropogenic Precursor Culpability Assessment (APCA) estimates that a majority, approximately 75%, of the modeled peak 8-hour ozone concentrations for the June 2002 episode comes from outside of the Denver Metropolitan Area (DMA). This explains why, in part, the modeled peak 8-hour ozone concentrations are so stiff in response to local emission controls in the DMA (Morris et al., 2004c).

In terms of local source contributions, emissions from the DMA contribute the most to elevated 8-hour ozone concentrations in the vicinity of the key ozone monitors of Rocky Flats, NREL, Chatfield and Highland. Within the DMA, the on-road mobile source category contributes the most followed by the non-road mobile source category and then elevated point sources. Of the counties surrounding the DMA, it appears that Weld County contributes the most, especially to the key Rocky Flats and NREL monitors, followed by Larimer County. The other Colorado Counties surrounding the DMA (i.e., Elbert, Morgan, and El Paso) have smaller contributions, although El Paso County did have larger contributions to the key DMA monitors south of Denver County (i.e., Chatfield and Highland) on some days.

One issue that was not addressed in the APCA ozone source apportionment modeling was the contributions of biogenic emissions. Further, the APCA source apportionment technique also does not provide information on VOC-limited versus NOx-limited ozone formation. The APCA source apportionment technique is designed to provide information relevant for anthropogenic emissions ozone culpability and for designing emission control strategies for reducing ozone concentrations. As emission control strategies target anthropogenic emissions, the APCA source apportionment technique has a bias toward assigning ozone to controllable anthropogenic emissions over uncontrollable biogenic emissions. Thus, ozone formed is only assigned to biogenic emissions when it is due to biogenic VOC emissions interacting with biogenic NOx emissions. Because APCA expresses a preference for assigning ozone formed to controllable over uncontrollable emissions, it is referred as an ozone culpability assessment rather than an ozone source apportionment. The Ozone Source Apportionment Technology (OSAT) ozone source apportionment technique in CAMx is a true ozone source apportionment technique that does not contain such a preference toward anthropogenic emissions. When ozone is formed under VOC-limited conditions due to the interactions of biogenic VOCs with anthropogenic NOx, whereas OSAT would assign the ozone formed to the biogenic VOCs, APCA assigns it to the anthropogenic NOx. The APCA version of the CAMx ozone source apportionment probing tool was used in the Denver analysis because it provides more control strategy relevant information and is the version used to assign ozone culpability, such as in the EPA NOx SIP Call (EPA, 1998a,b) and recently proposed Interstate Air Quality Rule (IAQR) (EPA, 2004a,b).

Although the APCA ozone source apportionment technique provides the most control strategy relevant ozone source apportionment results, we see advantages in also using the OSAT ozone source apportionment approach that can provide two additional pieces of information not provided by the APCA technique that would be valuable information:

1. Information on the contribution of biogenic emissions to elevated 8-hour ozone concentrations in the DMA and vicinity; and

2. Information on the spatial areas and level of ozone formation that is more VOC-limited versus NOx-limited.

Because the ENVIRON and Alpine Geophysics modeling teams are already set up to run and process the CAMx APCA ozone source apportionment modeling results, it would be quick and highly efficient to run and process the OSAT source apportionment as well.

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Appendix A

APCA Ozone Source Apportionment Modeling Results for the 2007 Three Control Strategy (RVP, Flash and RICE) Emissions Scenario for Estimated 8-hour Ozone Concentrations at Key Ozone Monitors

Rocky Flats
NREL
Highland
Chatfield
Rocky Mountains National Park
Fort Collins

Table A-1a. Ozone source apportionment for the average of four days highest daily maximum 8-hour ozone concentration near the Rocky Flats monitor for the 2007 Three Control Strategy emissions scenario.

Runname	2007-cntl4.a2									
Receptor	Rocky Flats									
Dates	4 day average									
Peak O3	74.4									
	IC	BC	Biogenics	Mobile	Non-road	Low_Oil&Gas	Elev_Oil&Gas	Other_low	Other_elev	Total
DMA			0.4	7.9	5.5	0.0	0.0	1.4	4.3	19.6
Weld			0.1	0.6	0.4	0.2	0.1	0.1	0.3	1.9
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.1	0.2	0.2	0.0	0.0	0.0	0.1	0.6
ElPaso			0.0	0.2	0.1	0.0	0.0	0.0	0.2	0.6
NorthCO			0.4	0.3	0.2	0.1	0.0	0.0	0.3	1.4
SouthCO			0.3	0.1	0.1	0.0	0.0	0.0	0.1	0.6
CentralUS			0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3
WesternUS			2.1	1.1	0.6	0.0	0.0	0.9	1.3	6.1
IC	0.0									0.0
BC		43.3								43.3
Total	0.0	43.3	3.5	10.5	7.3	0.3	0.2	2.6	6.6	74.4

Table A-1b. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Rocky Flats monitor on June 27, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**Rocky Flats**									
Juldate	**2178**									
Peak O3	**70.7**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**	**Total**
DMA			0.4	9.0	4.9	0.1	0.0	1.4	3.6	19.4
Weld			0.1	0.3	0.2	0.1	0.1	0.0	0.1	0.8
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Larimer			0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.3
ElPaso			0.1	0.9	0.5	0.0	0.0	0.1	0.8	2.3
NorthCO			0.3	0.3	0.2	0.0	0.0	0.0	0.3	1.1
SouthCO			0.6	0.2	0.2	0.0	0.0	0.0	0.2	1.3
CentralUS			0.4	0.1	0.1	0.0	0.0	0.2	0.1	1.0
WesternUS			0.8	0.4	0.2	0.0	0.0	0.5	0.5	2.4
IC	0.0									0.0
BC		41.8								41.8
Total	0.0	41.8	2.7	11.4	6.5	0.2	0.1	2.4	5.6	70.7

Table A-1c. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Rocky Flats monitor on June 29, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**Rocky Flats**									
Juldate	**2180**									
Peak O3	**69.5**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**	**Total**
DMA			0.5	5.7	5.5	0.0	0.0	1.1	3.4	16.2
Weld			0.2	1.4	0.8	0.3	0.2	0.1	0.5	3.5
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.2	0.3	0.4	0.0	0.0	0.1	0.1	1.1
ElPaso			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
NorthCO			0.5	0.3	0.3	0.1	0.0	0.0	0.4	1.6
SouthCO			0.4	0.1	0.1	0.0	0.0	0.0	0.1	0.8
CentralUS			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
WesternUS			1.3	0.6	0.3	0.0	0.0	0.6	0.8	3.5
IC	0.0									0.0
BC		42.7								42.7
Total	0.0	42.7	3.1	8.4	7.4	0.4	0.3	1.9	5.3	69.5

Table A-1d. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Rocky Flats monitor on June 30, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**										
Receptor	**Rocky Flats**										
Juldate	**2181**										
Peak O3	**74.1**										
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**	**Total**
DMA			0.3	6.5	5.2	0.1	0.1	1.3	3.8	17.3
Weld			0.1	0.1	0.3	0.2	0.1	0.0	0.2	1.1
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.3
ElPaso			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NorthCO			0.2	0.1	0.1	0.0	0.0	0.0	0.2	0.7
SouthCO			0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
CentralUS			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WesternUS			3.0	1.6	1.0	0.0	0.0	1.6	2.0	9.3
IC	0.0									0.0
BC		45.2								45.2
Total	0.0	45.2	3.7	8.5	6.8	0.3	0.2	3.0	6.4	74.1

Table A-1e. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Rocky Flats monitor on July 1, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	2007-cntl4.a2									
Receptor	Rocky Flats									
Juldate	2182									
Peak O3	83.2									
	IC	BC	Biogenics	Mobile	Non-road	Low_Oil&Gas	Elev_Oil&Gas	Other_low	Other_elev	Total
DMA			0.3	10.6	6.6	0.0	0.0	1.9	6.2	25.6
Weld			0.1	0.6	0.5	0.3	0.2	0.1	0.5	2.1
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.1	0.2	0.2	0.0	0.0	0.1	0.2	0.7
ElPaso			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NorthCO			0.5	0.6	0.4	0.1	0.1	0.0	0.5	2.1
SouthCO			0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2
CentralUS			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WesternUS			3.3	1.7	1.0	0.0	0.0	1.1	1.9	9.0
IC	0.0									0.0
BC		43.5								43.5
Total	0.0	43.5	4.4	13.6	8.6	0.4	0.2	3.2	9.3	83.2

Table A-2a. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the NREL monitor for 3-Day Average and the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**NREL**									
Juldate	**3-Day Avg**									
Peak O3	**76.8**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**	**Total**
DMA			0.3	9.8	6.0	0.1	0.1	1.6	4.1	22.0
Weld			0.1	0.2	0.3	0.1	0.1	0.0	0.2	1.0
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.4
ElPaso			0.0	0.3	0.2	0.0	0.0	0.0	0.3	0.8
NorthCO			0.3	0.3	0.2	0.1	0.0	0.0	0.3	1.2
SouthCO			0.2	0.1	0.1	0.0	0.0	0.0	0.1	0.6
CentralUS			0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.3
WesternUS			2.3	1.2	0.7	0.0	0.0	1.1	1.4	6.7
IC	0.0									0.0
BC		43.7								43.7
Total	0.0	43.7	3.5	12.1	7.6	0.3	0.2	2.8	6.5	76.8

Table A-2b. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the NREL monitor on June 27, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**NREL**									
Juldate	**2178**									
Peak obs	**70.7**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**
DMA			0.4	9.0	4.9	0.1	0.0	1.4	3.6
Weld			0.1	0.3	0.2	0.1	0.1	0.0	0.1
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.0	0.1	0.1	0.0	0.0	0.0	0.0
El Paso			0.1	0.9	0.5	0.0	0.0	0.1	0.8
North CO			0.3	0.3	0.2	0.0	0.0	0.0	0.3
South CO			0.6	0.2	0.2	0.0	0.0	0.0	0.2
Central US			0.4	0.1	0.1	0.0	0.0	0.2	0.1
Western US			0.8	0.4	0.2	0.0	0.0	0.5	0.5
IC	0.0								
BC		41.8							

Table A-2c. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the NREL monitor on June 30, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**								
Receptor	**NREL**								
Juldate	**2181**								
Peak obs	**74.1**								
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**
DMA			0.3	6.5	5.2	0.1	0.1	1.3	3.8
Weld			0.1	0.1	0.3	0.2	0.1	0.0	0.2
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.0	0.0	0.1	0.0	0.0	0.0	0.1
El Paso			0.0	0.0	0.0	0.0	0.0	0.0	0.0
North CO			0.2	0.1	0.1	0.0	0.0	0.0	0.2
South CO			0.1	0.0	0.0	0.0	0.0	0.0	0.0
Central US			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Western US			3.0	1.6	1.0	0.0	0.0	1.6	2.0
IC	0.0								
BC		45.2							

Table A-2d. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the NREL monitor on July 1, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**NREL**									
Juldate	**2182**									
Peak obs	**85.6**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**
DMA			0.3	13.9	7.9	0.1	0.1	2.0	4.9
Weld			0.1	0.2	0.3	0.2	0.1	0.0	0.2
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.1	0.1	0.1	0.0	0.0	0.0	0.1
El Paso			0.0	0.0	0.0	0.0	0.0	0.0	0.0
North CO			0.4	0.5	0.3	0.1	0.1	0.0	0.5
South CO			0.1	0.1	0.1	0.0	0.0	0.0	0.0
Central US			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Western US			3.1	1.6	1.0	0.0	0.0	1.0	1.8
IC	0.0								
BC		44.2							

Table A-3a. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Highland monitor for 3-Day Average and the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**Highland**									
Juldate	**3-Day Avg**									
Peak O3	**74.4**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**	**Total**
DMA			0.3	9.5	6.2	0.1	0.1	1.2	2.8	20.1
Weld			0.1	0.2	0.3	0.2	0.1	0.0	0.2	1.2
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.4
ElPaso			0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.3
NorthCO			0.3	0.3	0.2	0.1	0.1	0.0	0.5	1.4
SouthCO			0.2	0.1	0.1	0.0	0.0	0.0	0.1	0.4
CentralUS			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
WesternUS			2.4	1.3	0.8	0.0	0.0	1.1	1.5	7.1
IC	0.0									0.0
BC		43.2								43.2
Total	0.0	43.2	3.5	11.6	7.8	0.3	0.2	2.5	5.3	74.4

Table A-3b. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Highland monitor on June 28, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**Highland**									
Juldate	**2179.0**									
Peak obs	**71.1**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**
DMA			0.3	10.0	6.4	0.1	0.1	1.2	3.7
Weld			0.1	0.4	0.3	0.1	0.1	0.1	0.3
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.1	0.2	0.2	0.0	0.0	0.0	0.1
El Paso			0.0	0.4	0.2	0.0	0.0	0.0	0.3
North CO			0.4	0.4	0.3	0.1	0.1	0.0	0.7
South CO			0.4	0.2	0.2	0.0	0.0	0.0	0.1
Central US			0.1	0.0	0.0	0.0	0.0	0.0	0.0
Western US			1.1	0.4	0.2	0.0	0.0	0.4	0.6
IC	0.0								
BC		40.5							

Table A-3c. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Highland monitor on June 30, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**Highland**									
Juldate	**2181**									
Peak obs	**71.1**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**
DMA			0.3	5.8	4.8	0.1	0.1	0.9	1.9
Weld			0.1	0.1	0.3	0.2	0.1	0.0	0.2
Elbert			0.0	0.1	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.0	0.0	0.1	0.0	0.0	0.0	0.1
El Paso			0.0	0.0	0.0	0.0	0.0	0.0	0.0
North CO			0.2	0.1	0.0	0.0	0.0	0.0	0.2
South CO			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Central US			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Western US			3.1	1.8	1.2	0.0	0.0	1.8	2.2
IC	0.0								
BC		45.1							

Table A-3d. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Highland monitor on July 1, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	2007-cntl4.a2									
Receptor	Highland									
Juldate	2182									
Peak obs	81.2									
	IC	BC	Biogenics	Mobile	Non-road	Low_Oil&Gas	Elev_Oil&Gas	Other_low	Other_elev
DMA			0.3	12.6	7.2	0.1	0.1	1.7	2.9
Weld			0.1	0.2	0.3	0.2	0.1	0.1	0.2
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.1	0.1	0.1	0.0	0.0	0.0	0.2
El Paso			0.0	0.0	0.0	0.0	0.0	0.0	0.0
North CO			0.4	0.3	0.2	0.1	0.1	0.0	0.5
South CO			0.1	0.1	0.1	0.0	0.0	0.0	0.0
Central US			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Western US			3.2	1.6	1.0	0.0	0.0	1.1	1.8
IC	0.0								
BC		44.0							

Table A-4a. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Chatfield monitor for 3-Day Average and the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**Chatfield**									
Juldate	**3-Day Avg**									
Peak O3	**75.6**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**	**Total**
DMA			0.3	9.8	6.4	0.1	0.1	1.4	3.5	21.5
Weld			0.1	0.3	0.3	0.2	0.1	0.0	0.3	1.2
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.4
ElPaso			0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.3
NorthCO			0.3	0.3	0.2	0.1	0.1	0.0	0.5	1.5
SouthCO			0.2	0.1	0.1	0.0	0.0	0.0	0.1	0.4
CentralUS			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
WesternUS			2.4	1.3	0.8	0.0	0.0	1.1	1.5	7.0
IC	0.0									0.0
BC		43.0								43.0
Total	0.0	43.0	3.4	12.0	8.0	0.3	0.2	2.6	6.0	75.5

Table A-4b. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Chatfield monitor on June 28, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**Chatfield**									
Juldate	**2179**									
Peak obs	**71.1**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**
DMA			0.3	10.0	6.4	0.1	0.1	1.2	3.7
Weld			0.1	0.4	0.3	0.1	0.1	0.1	0.3
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.1	0.2	0.2	0.0	0.0	0.0	0.1
El Paso			0.0	0.4	0.2	0.0	0.0	0.0	0.3
North CO			0.4	0.4	0.3	0.1	0.1	0.0	0.7
South CO			0.4	0.2	0.2	0.0	0.0	0.0	0.1
Central US			0.1	0.0	0.0	0.0	0.0	0.0	0.0
Western US			1.1	0.4	0.2	0.0	0.0	0.4	0.6
IC	0.0								
BC		40.5							

Table A-4c. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Chatfield monitor on June 30, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**								
Receptor	**Chatfield**								
Juldate	**2181**								
Peak obs	**71.2**								
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**
DMA			0.3	6.0	4.9	0.1	0.1	1.0	2.2
Weld			0.1	0.1	0.3	0.2	0.1	0.0	0.2
Elbert			0.0	0.1	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.0	0.0	0.1	0.0	0.0	0.0	0.1
El Paso			0.0	0.0	0.0	0.0	0.0	0.0	0.0
North CO			0.2	0.1	0.1	0.0	0.0	0.0	0.2
South CO			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Central US			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Western US			3.1	1.8	1.1	0.0	0.0	1.7	2.1
IC	0.0								
BC		44.8							

Table A-4d. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Chatfield monitor on July 1, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**								
Receptor	**Chatfield**								
Juldate	**2182**								
Peak obs	**84.5**								
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**
DMA			0.3	13.5	7.8	0.1	0.1	2.1	4.6
Weld			0.1	0.2	0.3	0.2	0.1	0.1	0.3
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.1	0.1	0.1	0.0	0.0	0.0	0.2
El Paso			0.0	0.0	0.0	0.0	0.0	0.0	0.0
North CO			0.4	0.4	0.3	0.1	0.1	0.0	0.5
South CO			0.1	0.1	0.1	0.0	0.0	0.0	0.0
Central US			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Western US			3.1	1.6	1.0	0.0	0.0	1.1	1.8
IC	0.0								
BC		43.8							

Table A-5a. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Rocky Mountains National Park monitor for 3-Day Average and the 2007 Three Control Strategy emissions scenario.

Runname	2007-cntl4.a2									
Receptor	RMNP									
Juldate	3-Day Avg									
Peak O3	74.0									
	IC	BC	Biogenics	Mobile	Non-road	Low_Oil&Gas	Elev_Oil&Gas	Other_low	Other_elev	Total
DMA			0.6	4.9	4.5	0.0	0.0	0.9	3.9	14.8
Weld			0.4	1.9	0.9	0.3	0.2	0.1	0.6	4.4
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.2	0.6	0.4	0.0	0.0	0.1	0.2	1.5
ElPaso			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NorthCO			0.4	0.2	0.2	0.1	0.0	0.0	0.5	1.5
SouthCO			0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.3
CentralUS			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WesternUS			2.8	1.4	0.8	0.0	0.0	1.2	1.7	7.8
IC	0.0									0.0
BC		43.7								43.7
Total	0.0	43.7	4.6	9.0	6.9	0.4	0.3	2.3	6.9	74.1

Table A-5b. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Rocky Mountains National Park monitor on June 29, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**								
Receptor	**RMNP**								
Juldate	**2180**								
Peak obs	**70.0**								
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**
DMA			0.6	5.0	4.4	0.0	0.0	0.9	4.4
Weld			0.3	1.5	0.8	0.3	0.2	0.1	0.4
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.2	0.4	0.4	0.0	0.0	0.1	0.1
El Paso			0.0	0.0	0.0	0.0	0.0	0.0	0.0
North CO			0.4	0.3	0.3	0.1	0.0	0.0	0.3
South CO			0.4	0.1	0.1	0.0	0.0	0.0	0.1
Central US			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Western US			1.4	0.6	0.3	0.0	0.0	0.6	0.9
IC	0.0								
BC		43.8							

Table A-5c. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Rocky Mountains National Park monitor on June 30, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**RMNP**									
Juldate	**2181**									
Peak obs	**74.8**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**
DMA			0.5	5.4	5.5	0.1	0.0	1.3	3.9
Weld			0.2	0.5	0.6	0.3	0.2	0.1	0.4
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.1	0.1	0.1	0.0	0.0	0.0	0.2
El Paso			0.0	0.0	0.0	0.0	0.0	0.0	0.0
North CO			0.3	0.3	0.1	0.0	0.0	0.0	0.3
South CO			0.1	0.0	0.0	0.0	0.0	0.0	0.0
Central US			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Western US			3.2	1.6	1.0	0.0	0.0	1.9	2.1
IC	0.0								
BC		44.6							

Table A-5d. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Rocky Mountains National Park monitor on July 1, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**RMNP**									
Juldate	**2182**									
Peak obs	**77.1**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**
DMA			0.8	4.2	3.5	0.0	0.0	0.5	3.5
Weld			0.6	3.8	1.4	0.3	0.3	0.2	1.0
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			0.4	1.3	0.6	0.0	0.0	0.2	0.3
El Paso			0.0	0.0	0.0	0.0	0.0	0.0	0.0
North CO			0.6	0.1	0.3	0.1	0.1	0.0	0.8
South CO			0.1	0.0	0.0	0.0	0.0	0.0	0.0
Central US			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Western US			3.7	1.8	1.1	0.0	0.0	1.2	2.1
IC	0.0								
BC		42.3							

Table A-6a. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Fort Collins monitor for 2-Day Average and the 2007 Three Control Strategy emissions scenario.

Runname	2007-cntl4.a2									
Receptor	Ft. Collins									
Juldate	2-Day Avg									
Peak O3	71.5									
	IC	BC	Biogenics	Mobile	Non-road	Low_Oil&Gas	Elev_Oil&Gas	Other_low	Other_elev	Total
DMA			0.2	0.6	0.9	0.0	0.0	0.1	0.7	2.4
Weld			0.7	2.1	1.2	0.4	0.2	0.2	0.6	5.2
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Larimer			0.7	4.3	1.4	0.0	0.0	0.4	0.7	7.5
ElPaso			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NorthCO			0.4	0.1	0.1	0.1	0.0	0.0	0.5	1.2
SouthCO			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
CentralUS			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WesternUS			4.0	1.9	1.2	0.0	0.0	2.3	2.4	11.8
IC	0.0									0.0
BC		43.3								43.3
Total	0.0	43.3	6.1	8.8	4.8	0.4	0.3	2.9	4.9	71.5

Table A-6b. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Fort Collins monitor on June 30, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**									
Receptor	**Ft. Collins**									
Juldate	**2181**									
Peak obs	**71.0**									
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**	
DMA			0.3	0.9	1.6	0.0	0.0	0.2	1.2	
Weld			1.0	1.9	1.7	0.6	0.4	0.2	0.9	
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Morgan			0.1	0.0	0.0	0.0	0.0	0.0	0.0	
Larimer			0.4	1.2	0.7	0.0	0.0	0.2	0.6	
El Paso			0.0	0.0	0.0	0.0	0.0	0.0	0.0	
North CO			0.4	0.1	0.1	0.0	0.0	0.0	0.4	
South CO			0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Central US			0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Western US			3.9	1.7	1.1	0.0	0.0	3.2	2.6	
IC	0.0									
BC		43.6								

Table A-6c. Ozone source apportionment for the highest daily maximum 8-hour ozone concentration near the Fort Collins monitor on July 1, 2002 for the 2007 Three Control Strategy emissions scenario.

Runname	**2007-cntl4.a2**								
Receptor	**Ft. Collins**								
Juldate	**2182**								
Peak obs	**71.9**								
	IC	**BC**	**Biogenics**	**Mobile**	**Non-road**	**Low_Oil&Gas**	**Elev_Oil&Gas**	**Other_low**	**Other_elev**
DMA			0.1	0.2	0.2	0.0	0.0	0.0	0.2
Weld			0.3	2.3	0.7	0.1	0.1	0.1	0.3
Elbert			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Morgan			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larimer			1.1	7.4	2.1	0.0	0.0	0.6	0.8
El Paso			0.0	0.0	0.0	0.0	0.0	0.0	0.0
North CO			0.5	0.1	0.1	0.1	0.1	0.0	0.6
South CO			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Central US			0.0	0.0	0.0	0.0	0.0	0.0	0.0
Western US			4.0	2.0	1.2	0.0	0.0	1.4	2.3
IC	0.0								
BC		43.0							