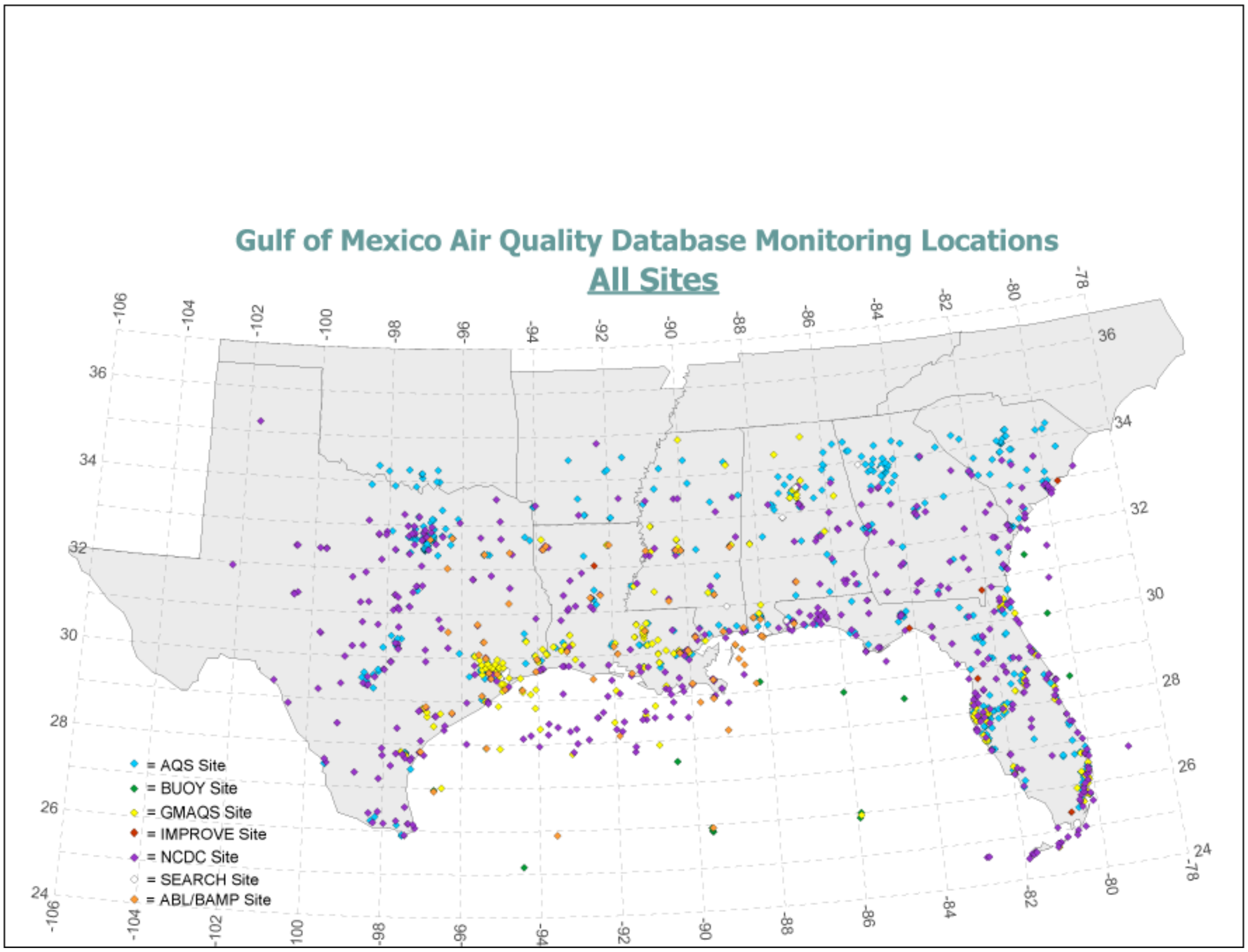
OCS Study
MMS 2009-058

Synthesis, Analysis, and Integration of Meteorological and Air Quality Data for the Gulf of Mexico Region

Volume IV: CART Analysis of Modeling Episode Days



MMS
U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

OCS Study
MMS 2009-058

Synthesis, Analysis, and Integration of Meteorological and Air Quality Data for the Gulf of Mexico Region

Volume IV: CART Analysis of Modeling Episodes Days

Authors

Sharon G. Douglas
A. Belle Hudischewskyj
Jay L. Haney

Prepared under MMS Contract
1435-01-06-CT-39773 (M06PC00013)
by
ICF International
101 Lucas Valley Road, Suite 260
San Rafael, CA 94903

Published by

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

New Orleans
December 2009

DISCLAIMER

REPORT AVAILABILITY

This report is available only in compact disc format from the Minerals Management Service, Gulf of Mexico OCS Region, at a charge of $15.00, by referencing OCS Study MMS 2009-058. The report may be downloaded from the MMS website through the Environmental Studies Program Information System (ESPIS). You will be able to obtain this report also from the National Technical Information Service in the near future. Here are the addresses. You may also inspect copies at selected Federal Depository Libraries.

Minerals Management Service
Gulf of Mexico OCS Region
Public Information Office (MS 5034)
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394
Telephone requests may be placed at
(504) 736-2519, 1-800-200-GULF, or
Rush Orders: 1-800-553-6847
Fax: (504) 736-2620

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161
Phone: (703) 605-6040
Fax: (703) 605-6900
Email: bookstore@ntis.gov

CITATION

Douglas, S.G., A.B. Hudischewskyj, and J.L. Haney. 2009. Synthesis, analysis and integration of meteorological and air quality data for the Gulf of Mexico region. Volume IV: CART analysis of modeling episode days. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2009-058. 30 pp.

ABOUT THE COVER

The graphic on the cover depicts the locations of the air quality and meteorological monitoring sites that are included in the Gulf of Mexico Air Quality Database (GMAQDB) tool.

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

1.0 INTRODUCTION

This report summarizes the combined analysis of photochemical modeling results and Classification and Regression Tree (CART) analysis results for selected areas along the Gulf Coast. The objective of this analysis was to use the Classification and Regression Tree (CART) results developed as part of the MMS-sponsored data synthesis study (Volume III of this report) to assess the frequency of occurrence of the conditions that lead to impacts of emissions from oil-and-gas-related sources located within the Outer Continental Shelf (OCS) region on 8-hour ozone concentrations at onshore locations, based on photochemical modeling results using the 2005 Gulfwide emission inventory (Haney et al., 2008).

In this analysis, the CART results were used to classify and assess the frequency of occurrence of the modeled days, based on the frequency of occurrence of similar days in the multi-year dataset. The frequency with which the impacts simulated by the photochemical model are expected to occur was then estimated – based on the frequency of the similar meteorological conditions. This analysis also examined whether significant impacts (that may make the difference between a non-exceedance day and an exceedance day) are expected to be more or less frequent with the new ozone standard, based on the frequency of occurrence of the meteorological conditions leading to these impacts.

1.1. OVERVIEW OF THE MMS DATA SYNTHESIS CART ANALYSIS FOR 8-HOUR OZONE

The CART analysis technique was used to examine the relationships between onshore and offshore meteorological conditions and ozone air quality in coastal non-attainment areas. The focus of this analysis was 8-hour average ozone. CART was specifically applied for the Houston/Galveston, Beaumont-Port Arthur, Lake Charles, Baton Rouge, New Orleans, Gulfport, Mobile and Pensacola areas. The Houston/Galveston area was divided into three subareas: Northwest Houston, Central Houston, and Southeast Houston/Galveston to accommodate differences in ozone concentrations and meteorological conditions across the area.

CART analysis (Brieman et al., 1984; Steinberg and Colla, 1997) is a statistical technique that can be used to "mine" and extract information from complex datasets. For air quality related analyses, the CART technique is used to segregate days with different values of an air quality parameter (the classification parameter) into different groups or bins and to provide information about the groupings. The input dataset is assumed to consist of a classification parameter (in this case pollutant concentration or another air quality related value) and a series of independent parameters that may be related to the classification parameter (typically a variety of meteorological input parameters). CART accomplishes the task of segregating the dataset through the development of a binary decision tree. At each split, the days are divided according to the value for one of the input parameters, in a way that best separates days with different values of a classification parameter. The end of a branch, called a bin, corresponds to a subset of days with predominantly one value for the classification parameter, characterized by input parameter ranges defined along the path to that bin.

The CART classification tree and the parameters and values used to divide the data into bins provide insight into the causal relationships between the independent parameters and the classification parameter, as well as the relative importance of the various independent parameters.

In the case of air quality, this translates to the relationships between meteorology and air quality related values, and the key parameters and combinations of parameters that lead to poor air quality. By segregating the data values into the classification bins, CART also provides information on the frequency of occurrence of the conditions associated with each bin.

For the MMS data synthesis study (Volume III of this report), CART was applied for the period 2000-2004. The classification parameter is daily maximum 8-hour average ozone. This was assigned a value of 1 through 5, such that each value corresponds to a different range of 8-hour ozone concentration. The concentration ranges are: less than 60 ppb, 60 to 75 ppb, 75 to 95 ppb, 95 to 115 ppb, and greater than or equal to 115 ppb. The remaining CART input parameters consist of meteorological and air quality parameters that characterize the conditions that are expected to influence ozone along the Gulf Coast and include: temperature (near the surface and aloft), relative humidity, wind speed and direction (near the surface and aloft), wind persistence, pressure, precipitation, stability, recirculation, cloud-cover, and prior-day regional ozone concentrations. These are described in detail in the data analysis report.

The CART results are also summarized in the data analysis report. CART "classification accuracy" ranges from approximately 76 to 89 percent and refers to the percentage of days that were assigned to the correct classes (that is, correctly placed into bins with ranges corresponding to their observed values). Based on this good classification accuracy, the resulting classification trees provide a good basis for the frequency assessment.

1.2. OVERVIEW OF THE MMS OCS IMPACTS MODELING STUDY

This analysis makes use of the results of a photochemical modeling study (Haney et al., 2008) that was conducted to evaluate the impacts of offshore emissions on simulated offshore and onshore ozone air quality. Precursor emissions from offshore oil–and-gas-related sources operating in 2005 in the Western and Central OCS Gulf of Mexico planning areas were used in the modeling. Emissions were based on the 2005 Gulfwide emission inventory (GWEI), as developed by the Eastern Research Group (ERG, 2007). The modeling analysis utilized existing modeling databases originally developed for the Gulf Coast Ozone Study (GCOS) (Douglas et. al., 2001 and 2005), and modeling was conducted for one multi-day simulation period: 1-8 August 1999. The modeling results show that emissions from offshore sources affect ozone concentrations in the coastal areas of Louisiana, Mississippi, Alabama, and Florida during this simulation period.

The modeling analysis included a series of emission-reduction and contribution analysis simulations using the Variable-Grid Urban Airshed Model (UAM-V5) and the Oxidant and Precursor Tagging Methodology (OPTM). These simulations were performed to quantify onshore ozone impacts from offshore sources. An emission-reduction simulation involving the omission of all oil-and-gas-related offshore sources was conducted. The results indicate that, for this particular modeling episode, the onshore impacts from all offshore oil-and-gas-related sources are small, with maximum onshore impacts of about 10 ppb. Examination of modeled impacts at coastal monitoring sites in Louisiana, Mississippi, Alabama, and Florida indicates that the OCS emissions contribute to exceedances of the prior (85 ppb) and current (75 ppb) National Ambient Air Quality Standards (NAAQS) for a few of the simulation days.

In addition to the emission reduction simulations, two simulations were conducted using the OPTM feature of UAM-V5, which allows one to tag and track the contributions from specific source categories or regions to simulated ozone concentrations in the modeling domain. The results of these simulations indicate that, for this particular modeling episode, the maximum OPTM-derived contributions at the onshore sites of interest range from less than 1 to approximately 9 ppb. Analysis of the offshore ozone concentrations shows that, for volatile organic carbon (VOC) emissions, platform sources are the major contributors to the simulated 8-hour ozone concentrations in the offshore area. For oxides of nitrogen (NO_x) emissions, oil-and-gas-related non-platform sources followed by sources located in state waters and platform sources are the major contributors.

1.3. OVERVIEW OF OZONE AIR QUALITY IN THE GOM REGION

Ozone is an air quality concern for most (monitored) areas along the Gulf Coast. To provide perspective on the current 8-hour ozone issues in the GOM region and recent trends, Table 1 lists the maximum 8-hour ozone design values for sites within selected counties and parishes of interest for the four consecutive three-year periods ending in 2005 through 2008. The design value is defined as the three-year average of the fourth highest daily maximum 8-hour average ozone concentration in each of the three years. The design value is calculated for each site and then the maximum value over all sites within an area determines the design value for the area. The National Ambient Air Quality Standard (NAAQS) for 8-hour ozone requires the design value to be less than or equal to 75 parts per billion (ppb). Prior to March 2008 the NAAQS level was set to 85 ppb.

Table 1

Maximum 8-Hour Ozone Design Values (ppb) for the Three Consecutive Three-Year Periods Ending in 2005 through 2007 for Selected Areas Along the Gulf Coast..

Area (Counties/Parishes)	2003-2005 8-Hour Ozone Design Value (ppb)	2004-2006 8-Hour Ozone Design Value (ppb)	2005-2007 8-Hour Ozone Design Value (ppb)	2006-2008 8-Hour Ozone Design Value (ppb)
Houston/Galveston (Harris and Galveston Counties, TX)	103	103	96	91
Beaumont/Port Arthur (Jefferson and Orange Counties, TX)	88	85	83	81
Lake Charles (Calcasieu Parish, LA)	83	82	81	75
New Orleans (Orleans, Jefferson, St. Charles, and St. Bernard Parishes, LA)	84	82	83	79
Baton Rouge (East Baton Rouge, West Baton Rouge, Ascension, Iberville, and Livingston Parishes, LA)	96	91	89	83
Gulfport (Harrison County, MS)	83	83	83	81
Mobile (Mobile and Baldwin Counties, AL)	77	78	78	79
Pensacola (Escambia and Santa Rosa Counties, FL)	83	83	82	81

The calculated design values for the most recent periods are nearly all above the current 8-hour standard for all areas. The design values decrease with time for Houston/Galveston, Beaumont/Port Arthur, Lake Charles, New Orleans, and Baton Rouge and either decrease slightly or for stay about the same for the remaining coastal areas. Initial compliance with the new standard is being determined using data collected during the period 2006-2008.

The remainder of this report summarizes the methods used to combine the CART analysis and photochemical modeling information, and presents the results of the frequency of impact and attainment impact analyses.

2.0 METHODOLOGY

Assessment of the frequency of the model-derived impacts included three steps, as follows:

Step 1: Extract Meteorological Input Parameters from Model Input Files

To ensure consistency between the UAM-V5/OPTM modeling results and any information derived from CART, the meteorological input parameters for mapping the simulated days into the CART classification trees were obtained from the UAM-V5 ready meteorological input files. The input parameters include: temperature (near the surface and aloft), relative humidity, wind speed and direction (near the surface and aloft), wind persistence, pressure, precipitation, stability, recirculation, cloud-cover, and prior-day regional ozone concentrations. The input parameters are primarily a mix of hourly, multi-hour average, and daily maximum values. They also include several derived parameters (calculated using selected data). These are wind persistence, recirculation, and cloud cover. Wind persistence is defined as the 24-hour average vector wind speed divided by the 24-hour average scalar wind speed for a given surface wind location. Hourly values of surface wind speed and wind direction are used to calculate this derived parameter. Recirculation is calculated based on upper-air wind speed and direction and cloud cover is calculated based on upper-level humidity. A detail description of all of the input parameters can be found in Volume III of this report.

In this step of the analysis, hourly values of all of the data needed to calculate the CART input parameters (including the derived parameters) were extracted for each day from the UAM-V5 input files. The extracted "data" were then used to calculate the parameters needed to map the simulation days into the CART classification trees. Pressure and geopotential height for use in the CART classification/mapping (Step 2 below) were based on observed data rather than model input files, since there were no equivalent parameters in the model-ready files.

Step 2: Classify Modeled Days Using CART Results

For each area, each simulation day was mapped into a classification bin of the corresponding classification tree for that area. The mapping relies on an optional CART procedure in which any day that is characterized by a complete set of input parameters can be mapped into a classification bin based on the values of the parameters. For this exercise, the prior-day ozone concentrations were based on observed rather than simulated values. Classification accuracy was assessed, based on the observed ozone concentrations, and was found to be reasonable.

Step 3: Combine CART-based Classification and Frequency Information with Simulated OCS Impacts

Each CART bin contains a number of days (from the period 2000-2004) and the frequency of occurrence of the conditions associated with each bin was calculated as the number of days in the bin divided by the number of years included in the analysis (in this case, five). This frequency information was combined with the modeled OCS impacts as derived from the OPTM simulations to estimate the frequency of impact. A key assumption in this step was that the simulated OCS impacts for each simulation day could be applied to the other days in the classification bin.

Whether the simulated impact for each bin is large enough to cause 8-hour ozone concentrations for days within the bin that were less than the NAAQS to exceed the NAAQS was also explored. This was done three different ways: 1) based on the average observed 8-hour ozone concentration for simulation period days within the bin, 2) based on the average observed 8-hour ozone concentrations for all days within the bin, and 3) based on the day-specific observed ozone concentrations for all days within the bin. For each bin, the average simulated impact was calculated and compared to the average simulated 8-hour ozone value over all days in the bin. An inverse relative impact factor, defined as the ratio of the average simulated value over the difference between the average simulated value and the average impact (i.e., the ratio of the simulated concentration with OCS to the simulated concentration without OCS), was calculated. The maximum over the NO_x and VOC impacts from the OPTM simulations was used in this calculation. This is similar to the relative reduction factor (RRF) approach used by EPA in the 8-hour ozone attainment test (USEPA, 2007). The inverse relative impact factor was then applied to the reference 8-hour ozone concentrations (corresponding to the three approaches listed above). The result is the estimated observed 8-hour ozone concentration that would have occurred in the absence of OCS emissions. The concentrations both with and without the OCS contribution were then compared with the NAAQS.

For the first and second approaches, the frequency of occurrence of days within each bin was used as the basis for determining the number of exceedance days that can be attributed to OCS emissions. For the third approach, the estimated OCS impact was estimated for each day in the bin and the number of exceedance days both with and without OCS emissions impacts were simply counted. This exercise was completed using both the current 8-hour ozone NAAQS (75 ppb) and the prior NAAQS (85 ppb). Note that the third approach is tied to the daily maximum 8-hour ozone concentration for each day in each bin that is considered. Thus a possible outcome is that there are no days with concentrations close enough to 75 ppb to be affected, but that there are days with concentrations close enough to 85 ppb to be affected (and visa versa).

These steps were applied and the assessment was conducted for each area of interest including: Northwest Houston, Central Houston, Southeast Houston/Galveston, Beaumont/Port Arthur, Lake Charles, New Orleans, Baton Rouge, Gulfport, Mobile, and Pensacola. The results are presented in the next section.

3.0 RESULTS

The impact frequency analysis results for each area are presented in this section, approximately from west to east. Only the non-start up days for the simulation period (3-8 August) are considered in this analysis.

3.1. NORTHWEST HOUSTON

The simulation days represent two of the CART bins for Northwest Houston (Bins 29 and 34). Five of the six simulation days are classified in Bin 29 and one of the days is in Bin 34. The frequency of occurrence of days within these bins is 5.2 and 5.4 times per year, respectively. For Bin 29, the average impact from OCS NO_x emissions on 8-hour ozone concentration in Northwest Houston is 1.29 ppb and the average ozone impact from OCS VOC emissions is 0.13 ppb. These impacts are expected to occur (on average) just over five times per year. For Bin 34, the average impact from OCS NO_x emissions on 8-hour ozone concentration in Northwest Houston is 0 ppb and the average impact from OCS VOC emissions is 0 ppb. These conditions are also expected to occur (on average) over five times per year.

If the bins are weighted according to the number of days within each bin, Bin 29 represents 49 percent and Bin 34 represents 51 percent of the days represented by the simulation period. If it is assumed that the distribution of impacts for the simulation period is similar to that for the ozone season, the estimated distribution of contributions can be calculated as displayed in Figure 1. Three ranges of contribution are used, and are set to less than 0.5, 0.5 to 5, and greater than 5 ppb. These are larger than needed for the Northwest Houston area, but are used here so that the plots for all areas are consistent.

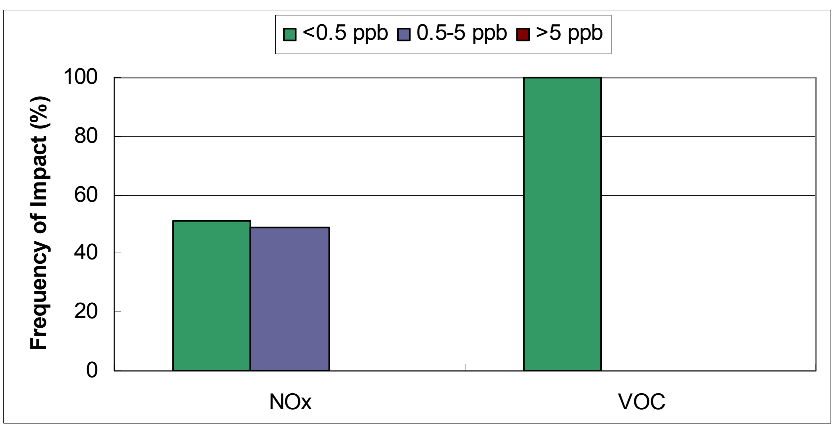


Figure 1. Estimated distribution of contributions from OCS sources to daily maximum 8-hour ozone concentrations for a typical ozone season: Northwest Houston.

Figure 1 indicates that OCS NO_x impacts are expected to be less than 0.5 ppb on about 51 percent of the days and in the range of 0.5 to 5 ppb on about 49 percent of the days in a typical ozone season. The VOC impacts are expected to be less than 0.5 ppb on all days.

The simulated average impacts for each bin were then used to examine whether the impacts might affect the number of exceedance days for the area. This was done three different ways: 1) based on the average observed 8-hour ozone concentration for simulation period days within the bin, 2) based on the average observed 8-hour ozone concentrations for all days within the bin, and 3) based on the day-specific observed ozone concentrations for all days within the bin. Together the three approaches provide a range of impact analysis results.

The impact adjustment factors range from 1.000 to 1.015 for this area. The results for the three different approaches are as follows:

- Using the average observed values for the simulated days in each bin as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Thus, for a typical year, no exceedances are attributed to the OCS emissions using this approach.

- Using the average observed values within the bins as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Again no exceedances are attributed to the OCS emissions.

- Using the day-specific ozone concentrations for all days in the bin as the reference concentrations, it is estimated that, for a typical year, two exceedances of the 75 ppb ozone standard and no exceedances of the 85 ppb ozone standard are attributable to the OCS emission impacts. Figure 2 compares the observed and estimated daily maximum 8-hour ozone concentrations for days within the represented classification bins for the with- and without-OCS scenarios, respectively.

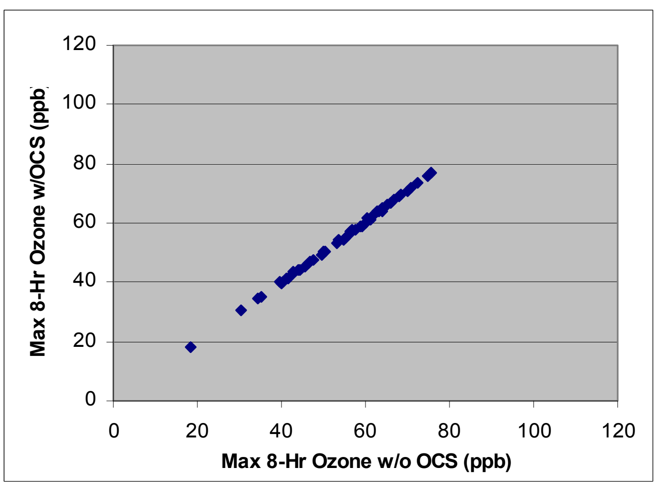


Figure 2. Comparison of observed (with OCS) and estimated (without OCS) daily maximum 8-hour ozone concentrations for CART bins 29 and 34 for 2000-2004: Northwest Houston.

In summary, based on data for 2000-2004, the number of exceedance days for Northwest Houston attributed to OCS emissions in a typical year ranges from 0 to 2 for the 75 ppb standard and is zero for the 85 ppb standard.

3.2. CENTRAL HOUSTON

The simulation days represent three CART bins for Central Houston (Bins 18, 23, and 33). Four of the six simulation days are classified in Bin 18 and one day each is in Bins 23 and 33. The frequency of occurrence of days within these bins is 2.8, 2.4, and 11 times per year, respectively. For Bin 18, the average impact from OCS NO_x emissions on 8-hour ozone concentration in Central Houston is 1.32 ppb and the average impact from OCS VOC emissions is 0.14 ppb. These impacts are expected to occur (on average) about three times per year. For Bin 23, the average impact from OCS NO_x emissions on 8-hour ozone concentration in Central Houston is 0.50 ppb and the average impact from OCS VOC emissions is 0.30 ppb. These conditions are expected to occur (on average) over two times per year. For Bin 33, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 0.10 ppb and the average impact from OCS VOC emissions is 0.03 ppb. These conditions are expected to occur (on average) eleven times per year.

If the bins are weighted according to the number of days within each bin, Bin 18 represents 17 percent, Bin 23 represents 15 percent, and Bin 33 represents 68 percent of the days represented by the simulation days. If it is assumed that the distribution of impacts for the simulation period is similar to that for the ozone season, the estimated distribution of contributions can be calculated as displayed in Figure 3. Three ranges of contribution are used, and are set to less than 0.5, 0.5 to 5, and greater than 5 ppb.

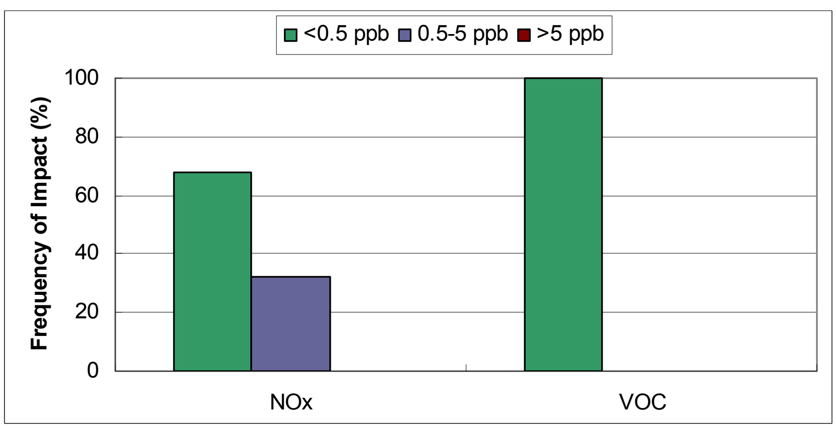


Figure 3. Estimated distribution of contributions from OCS sources to daily maximum 8-hour ozone concentrations for a typical ozone season: Central Houston.

Figure 3 indicates that OCS NO_x impacts are expected to be less than 0.5 ppb on about 68 percent of the days and in the range of 0.5 to 5 ppb on about 32 percent of the days in a typical ozone season. The VOC impacts are expected to be less than 0.5 ppb on all days.

The simulated average impacts for each bin were then used to examine whether the impacts might affect the number of exceedance days for the area. The three approaches described earlier in the report provide the following range of impact analysis results.

The impact adjustment factors range from 1.001 to 1.015 for this area. The results for the three different approaches are as follows:

- Using the average observed values for the simulated days in each bin as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Thus, for a typical year, no exceedances are attributed to the OCS emissions using this approach.

- Using the average observed values within the bins as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Again no exceedances are attributed to the OCS emissions.

- Using the day-specific ozone concentrations for all days in the bin as the reference concentrations, it is estimated that, for a typical year, no exceedances of the 75 ppb ozone standard and 0.8 exceedances of the 85 ppb ozone standard are attributable to the OCS emission impacts. As noted in the previous section, this metric is tied to the daily maximum 8-hour ozone concentration and indicates that there were no days with concentrations close enough to 75 ppb to be affected, but that there are days with concentrations close enough to 85 ppb to be affected. Figure 4 compares the observed and estimated daily maximum 8-hour ozone concentrations for days within the represented classification bins for the with- and without-OCS scenarios, respectively.

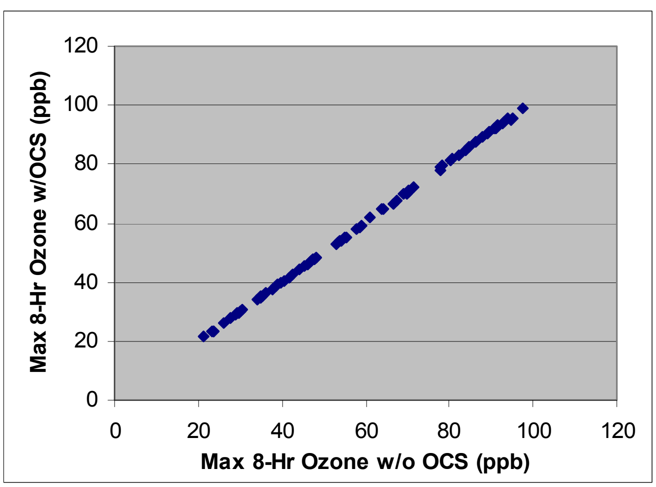


Figure 4. Comparison of observed (eith OCS) and estimated (without OCS) daily maximum 8-hour ozone concentrations for CART bins 18, 23, and 33 for 2000-2004: Central Houston.

In summary, based on data for 2000-2004, the number of exceedance days for Central Houston attributed to OCS emissions in a typical year is zero for the 75 ppb standard and ranges from 0 to 0.8 for the 85 ppb standard.

3.3. SOUTHEAST HOUSTON/GALVESTON

The simulation days represent four CART bins for Southeast Houston/Galveston (Bins 19, 25, 28, and 34). Bins 19 and 25 each have two days and Bins 23 and 34 each have one day. The frequency of occurrence of days within these bins is 5.8, 12.2, 4.6, and 0.2 times per year, respectively. For Bin 19, the average impact from OCS NO_x emissions on 8-hour ozone concentration in Southeast Houston/Galveston is 3.49 ppb and the average impact from OCS VOC emissions is 0.17 ppb. These impacts are expected to occur (on average) about six times per year. For Bin 25, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 9.31 ppb and the average impact from OCS VOC emissions is 0.31 ppb. These conditions are expected to occur (on average) more than 12 times per year. For Bin 28, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 0.16 ppb and the average impact from OCS VOC emissions is 0.0 ppb. These conditions are expected to occur (on average) more than four times per year. For Bin 34, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 3.50 ppb and the average impact from OCS VOC emissions is 0.84 ppb. These conditions are expected to occur (on average) more than four times per year.

If the bins are weighted according to the number of days within each bin, Bin 19 represents 25 percent, Bin 25 represents 54 percent, Bin 28 represents 20 percent, and Bin 34 represents one percent of the days represented by the simulation days. If it is assumed that the distribution of impacts for the simulation period is similar to that for the ozone season, the estimated distribution of contributions can be calculated as displayed in Figure 5. Three ranges of contribution are used, and are set to less than 0.5, 0.5 to 5, and greater than 5 ppb.

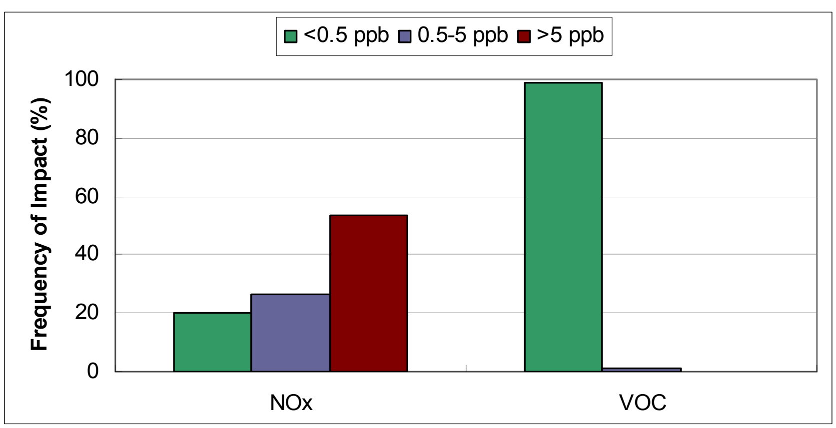


Figure 5. Estimated distribution of contributions from OCS sources to daily maximum 8-hour ozone concentrations for a typical ozone season: Southeast Houston/Galveston.

Figure 5 indicates that OCS NO_x impacts are expected to be less than 0.5 ppb on about 20 percent of the days, in the range of 0.5 to 5 ppb on about 26 percent of the days, and greater than

5 ppb on about 54 percent of the days in a typical ozone season. The VOC impacts are expected to be less than 0.5 ppb on nearly all days (99 percent).

The simulated average impacts for each bin were then used to examine whether the impacts might affect the number of exceedance days for the area. The three approaches described earlier in the report provide the following range of impact analysis results.

The impact adjustment factors range from 1.002 to 1.032 for this area. The results for the three different approaches are as follows:

- Using the average observed values for the simulated days in each bin as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Thus, for a typical year, no exceedances are attributed to the OCS emissions using this approach.

- Using the average observed values within the bins as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Again no exceedances are attributed to the OCS emissions.

- Using the day-specific ozone concentrations for all days in the bin as the reference concentrations, it is estimated that, for a typical year, 0.5 exceedances of the 75 ppb ozone standard and 1 exceedance of the 85 ppb ozone standard are attributable to the OCS emission impacts. Figure 6 compares the observed and estimated daily maximum 8-hour ozone concentrations for days within the represented classification bins for the with- and without-OCS scenarios, respectively.

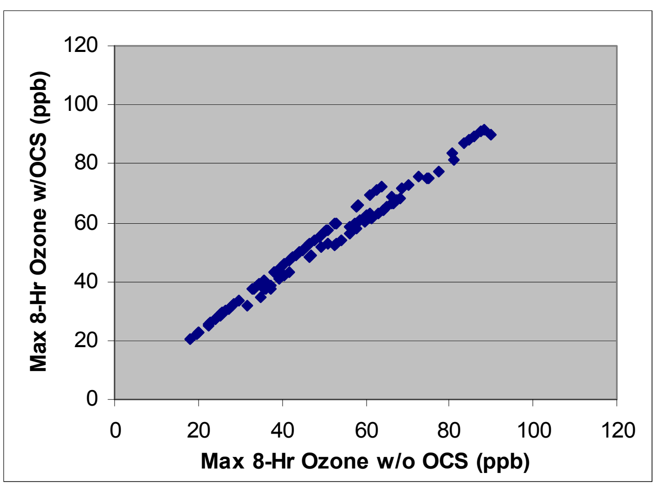


Figure 6. Comparison of observed (with OCS) and estimated (without OCS) daily maximum 8-hour ozone concentrations for CART bins 19, 25, 28, and 34 for 2000-2004: Southeast Houston/Galveston.

Although the simulated impacts are large for some days, these are primarily not days with concentrations near the exceedance thresholds.

In summary, based on data for 2000-2004, the number of exceedance days for Southeast Houston/Galveston attributed to OCS emissions in a typical year ranges from 0 to 0.5 for the 75 ppb standard and from 0 to 1 for the 85 ppb standard.

3.4. BEAUMONT/PORT ARTHUR

The simulation days represent four CART bins for Beaumont/Port Arthur (Bins 2, 9, 14, and 23). Bins 2, 9, and 23 are each represented by one simulation day and Bin 14 is represented by three days. The frequency of occurrence of days within these bins is 20.4 (Bin 2), 0.6 (Bin 9), 10.4 (Bin 14) and 1.2 (Bin 23) times per year. For Bin 2, the average impact from OCS NO_x emissions on 8-hour ozone concentration in the Beaumont/Port Arthur area is 0.09 ppb and the average impact from OCS VOC emissions is 0.07 ppb. These impacts are expected to occur (on average) about 20 times per year. For Bin 9, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 0.36 ppb and the average impact from OCS VOC emissions is 0.05 ppb. These conditions are expected to occur (on average) less than once per year. For Bin 14, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 1.08 ppb and the average impact from OCS VOC emissions is 0.11ppb. These conditions are expected to occur (on average) more than ten times per year. For Bin 23, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 7.02 ppb and the average impact from OCS VOC emissions is 0.77 ppb. These conditions are expected to occur (on average) slightly more than once per year.

If the bins are weighted according to the number of days within each bin, Bin 2 represents 62 percent, Bin 9 represents two percent, Bin 14 represents 32 percent, and Bin 23 represents four percent of the days represented by the simulation days. If it is assumed that the distribution of impacts for the simulation period is similar to that for the ozone season, the estimated distribution of contributions can be calculated as displayed in Figure 7. Three ranges of contribution are used: less than 0.5, 0.5 to 5, and greater than 5 ppb.

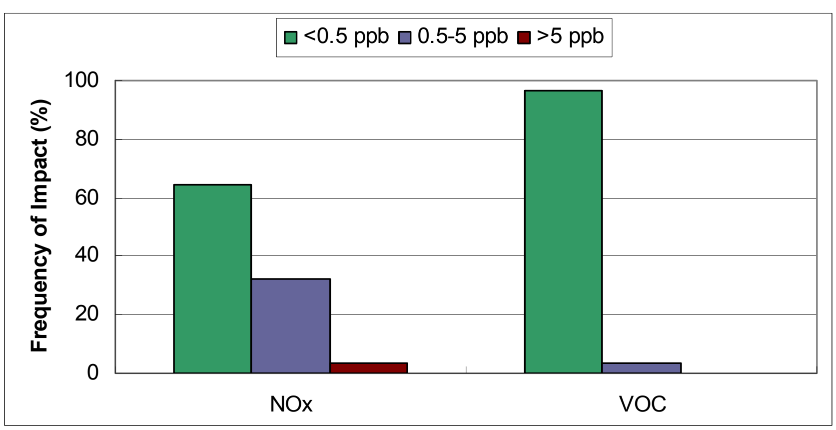


Figure 7. Estimated distribution of contributions from OCS sources to daily maximum 8-hour ozone concentrations for a typical ozone season: Beaumont/Port Arthur.

Figure 7 indicates that OCS NO_x impacts are expected to be less than 0.5 ppb on about 64 percent of the days, in the range of 0.5 to 5 ppb on 34 percent of the days, and greater than 5 ppb on 4 percent of the days in a typical ozone season. The VOC impacts are expected to be less than 0.5 ppb on about 96 percent of the days and between 0.5 and 5 ppb on 4 percent of the days.

The simulated average impacts for each bin were then used to examine whether the impacts might affect the number of exceedance days for the area. The three approaches described earlier in the report provide the following range of impact analysis results.

The impact adjustment factors range from 1.001 to 1.098 for this area. The results for the three different approaches are as follows:

- Using the average observed values for the simulated days in each bin as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Thus, for a typical year, no exceedances are attributed to the OCS emissions using this approach.

- Using the average observed values within the bins as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. No exceedances are attributed to OCS emissions.

- Using the day-specific ozone concentrations for all days in the bin as the reference concentrations, it is estimated that, for a typical year, no exceedances of the 75 ppb ozone standard and less than one exceedance (0.4 exceedances) of the 85 ppb ozone standard are attributable to the OCS emission impacts. Figure 8 compares the observed and estimated daily maximum 8-hour ozone concentrations for days within the represented classification bins for the with- and without-OCS scenarios, respectively.

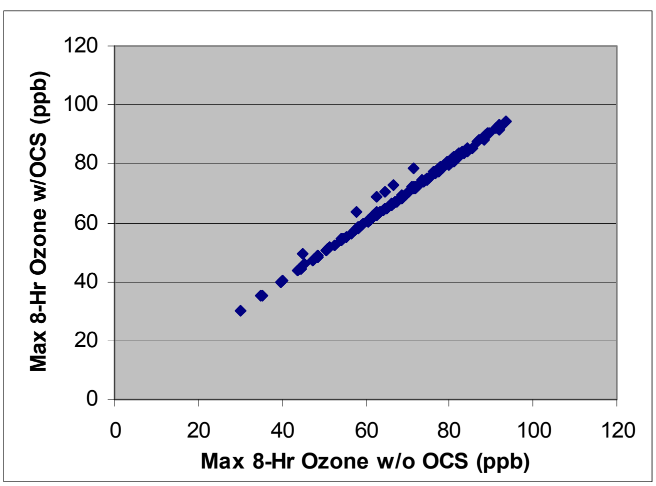


Figure 8. Comparison of observed (with OCS) and estimated (without OCS) daily maximum 8-hour ozone concentrations for CART bins 2, 9, 14, and 23 for 2000-2004: Beaumont/Port Arthur.

Although the simulated impacts are large for some days, these are primarily not days with concentrations near the exceedance thresholds.

Based on data for 2000-2004, the number of exceedances for Beaumont/Port Arthur attributed to OCS emissions in a typical year is 0 for the 75 ppb standard and 0 to 0.4 for the 85 ppb standard.

3.5. LAKE CHARLES

The simulation days represent four CART bins for Lake Charles (Bins 3, 6, 9, 10, 12, and 14). Each bin is represented by one simulation day. The frequency of occurrence of days within these bins is 123.4, 1.6, 1.4, 0.8, 9.6, and 0.6 times per year, respectively. For Bin 3, the average impact from OCS NO_x emissions on 8-hour ozone concentration in the Lake Charles area is 0 ppb and the average impact from OCS VOC emissions is also 0 ppb. These conditions are expected to occur (on average) about 123 times per year. For Bin 6, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 0.04 ppb and the average impact from OCS VOC emissions is 0.04 ppb. These conditions are expected to occur (on average) fewer than two times per year. For Bin 9, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 0.09 ppb and the average impact from OCS VOC emissions is 0.08 ppb. These conditions are also expected to occur (on average) less than twice per year. For Bin 10, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 0.03 ppb and the average impact from OCS VOC emissions is 0.03 ppb. These conditions are expected to occur (on average) less than once per year. For Bin 12, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 2.27 ppb and the average impact from OCS VOC emissions is 0.41 ppb. These conditions are expected to occur (on average) about ten times per year. For Bin 14, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 6.09 ppb and the average impact from OCS VOC emissions is 0.33 ppb. These conditions are expected to occur (on average) less than once per year.

If the bins are weighted according to the number of days within each bin, Bin 3 represents 90 percent, Bins 6, 9 and 10 each represent one percent, Bin 12 represents 7 percent, and Bin 14 represents less than one percent of the days represented by the simulation days. If the distribution of impacts for the simulation period is similar to that for the ozone season, the estimated distribution of contributions is displayed in Figure 9.

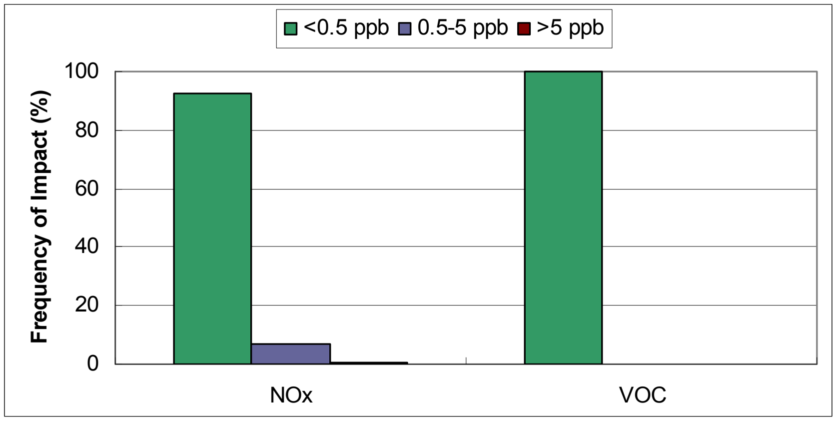


Figure 9. Estimated distribution of contributions from OCS sources to daily maximum 8-hour ozone concentrations for a typical ozone season: Lake Charles.

Figure 9 indicates that OCS NO_x impacts are expected to be less than 0.5 ppb on about 93 percent of the days, in the range of 0.5 to 5 ppb on about 7 percent of the days, and greater than 5 ppb on less than one percent of the days in a typical ozone season. The VOC impacts are expected to be less than 0.5 ppb on all days.

The simulated average impacts for each bin were then used to examine whether the impacts might affect the number of exceedance days for the area. The three approaches described earlier in the report provide the following range of impact analysis results.

The impact adjustment factors range from 1.0 to 1.077 for this area. The results for the three different approaches are as follows:

- Using the average observed values for the simulated days in each bin as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Thus, for a typical year, no exceedances are attributed to the OCS emissions using this approach.

- Using the average observed values within the bins as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Again no exceedances are attributed to the OCS emissions.

- Using the day-specific ozone concentrations for all days in the bin as the reference concentrations, it is estimated that, for a typical year, no exceedances of the 75 ppb ozone or the 85 ppb ozone standard are attributable to the OCS emission impacts. Figure 10 compares the observed and estimated daily maximum 8-hour ozone concentrations for days within the represented classification bins for the with- and without-OCS scenarios, respectively.

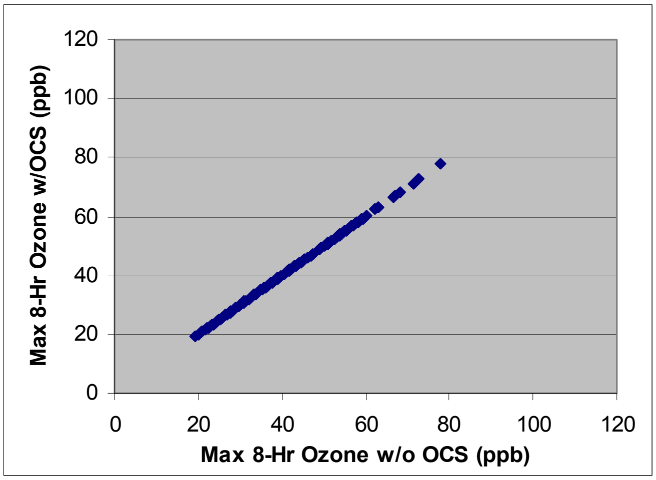


Figure 10. Comparison of observed (with OCS) and estimated (without OCS) daily maximum 8-hour ozone concentrations for CART bins 3, 6, 9, 10, 12, and 14 for 2000-2004: Lake Charles.

In summary, based on data for 2000-2004, the number of exceedance days for Lake Charles attributed to OCS emissions in a typical year is 0 for both the 75 ppb and 85 ppb standards.

3.6. NEW ORLEANS

The simulation days represent three CART bins for New Orleans (Bins 18, 24, and 33). One of the six simulation days is classified in Bin 18, four are classified in Bin 24, and one is in Bin 33. The frequency of occurrence of days within these bins is 1.2, 1, and 1.6 times per year, respectively. Thus, not many days are represented for this area. For Bin 18, the average impact from OCS NO_x emissions on 8-hour ozone concentration in New Orleans is 0.11 ppb and the average impact from OCS VOC emissions is also 0.11 ppb. These impacts are expected to occur (on average) about once per year. For Bin 24, the average impact from OCS NO_x emissions on 8-hour ozone concentration in New Orleans is 0.62 ppb and the average impact from OCS VOC emissions is 0.20 ppb. These conditions are expected to occur (on average) once per year. For Bin 33, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 7.37 ppb and the average impact from OCS VOC emissions is 2.53 ppb. These conditions are expected to occur (on average) less than two times per year.

If the bins are weighted according to the number of days within each bin, Bin 18 represents 32 percent, Bin 24 represents 26 percent, and Bin 33 represents 42 percent of the days represented by the simulation period. If it is assumed that the distribution of impacts for the simulation period is similar to that for the ozone season, the estimated distribution of contributions can be calculated as displayed in Figure 11. Three ranges of contribution are used, and are set to less than 0.5, 0.5 to 5, and greater than 5 ppb.

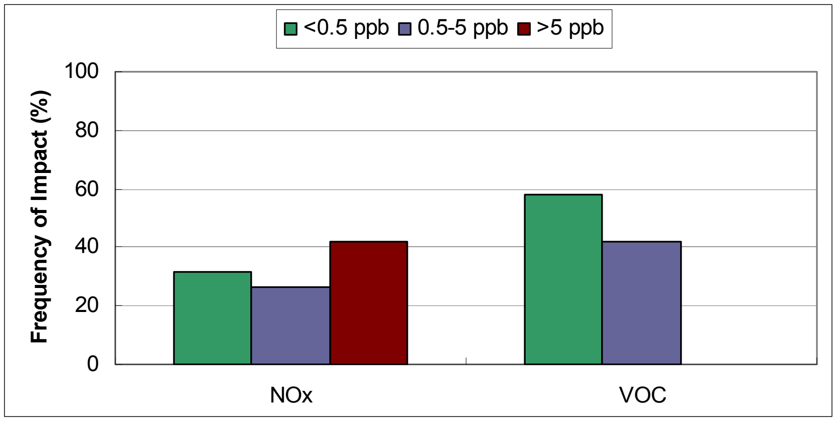


Figure 11. Estimated distribution of contributions from OCS sources to daily maximum 8-hour ozone concentrations for a typical ozone season: New Orleans.

Figure 11 indicates that OCS NO_x impacts are expected to be less than 0.5 ppb on about 32 percent of the days, in the range of 0.5 to 5 ppb on about 26 percent of the days, and greater than 5 ppb on about 42 percent of the days in a typical ozone season. The VOC impacts are expected to be less than 0.5 ppb on about 58 percent of the days and in the range of 0.5 to 5 ppb on about 42 percent of the days. The results for New Orleans may be unreliable due to the small number of days represented by the simulation period. There is no easy way to quantify this, however.

The simulated average impacts for each bin were then used to examine whether the impacts might affect the number of exceedance days for the area. The three approaches described earlier in the report provide the following range of impact analysis results.

The impact adjustment factors range from 1.001 to 1.093 for this area. The results for the three different approaches are as follows:

- Using the average observed values for the simulated days in each bin as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Thus, for a typical year, no exceedances are attributed to the OCS emissions using this approach.

- Using the average observed values within the bins as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Again no exceedances are attributed to the OCS emissions.

- Using the day-specific ozone concentrations for all days in the bin as the reference concentrations, it is estimated that, for a typical year, no exceedances of either the 75 or 85 ppb ozone standard are attributable to the OCS emission impacts. Figure 12 compares the observed and estimated daily maximum 8-hour ozone concentrations for days within the represented classification bins for the with- and without-OCS scenarios, respectively.

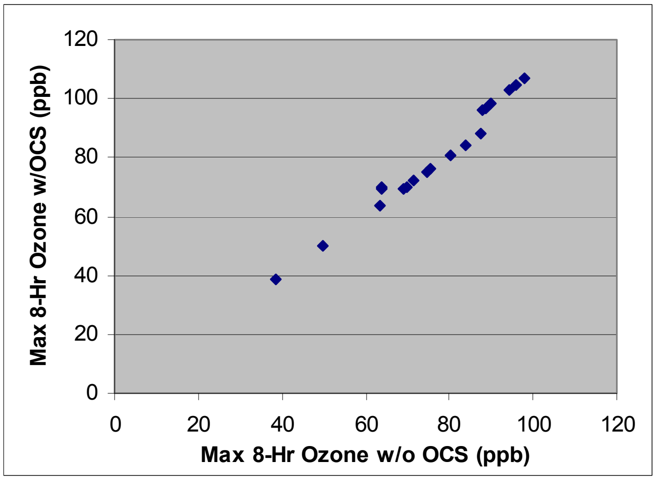


Figure 12. Comparison of observed (with OCS) and estimated (without OCS) daily maximum 8-hour ozone concentrations for CART bins 18, 24, and 33 for 2000-2004: New Orleans.

Although some of the impacts are large, they are associated with base ozone concentrations that are above the exceedance thresholds. In summary, based on data for 2000-2004, the number of exceedance days for New Orleans attributed to OCS emissions in a typical year is zero for both the 75 ppb and 85 ppb standards.

3.7. BATON ROUGE

The simulation days represent four CART bins for Baton Rouge (Bins 13, 27, 30, and 34). Bins 13 and 30 are each represented by two simulation days and Bins 27 and 34 are each represented by one day. The frequency of occurrence of days within these bins is 2.8 (Bin 13), 16.6 (Bin 27), 2.8 (Bin 30) and 9.8 (Bin 34) times per year. For Bin 13, the average impact from OCS NO_x emissions on 8-hour ozone concentration in the Baton Rouge area is 0.43 ppb and the average impact from OCS VOC emissions is 0.07 ppb. These impacts are expected to occur (on average) about three times per year. For Bin 27, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 0.01 ppb and the average impact from OCS VOC emissions is 0.01 ppb. These conditions are expected to occur (on average) more than 16 times per year. For Bin 30, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 0.09 ppb and the average impact from OCS VOC emissions is 0.08 ppb. These conditions are expected to occur (on average) approximately three times per year. For Bin 34, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 4.73 ppb and the average impact from OCS VOC emissions is 1.18 ppb. These conditions are expected to occur (on average) about 10 times per year.

If the bins are weighted according to the number of days within each bin, Bin 13 represents nine percent, Bin 27 represents 52 percent, Bin 30 represents 9 percent, and Bin 34 represents 31 percent of the days represented by the simulation days. If it is assumed that the distribution of impacts for the simulation period is similar to that for the ozone season, the estimated distribution of contributions can be calculated as displayed in Figure 13. Three ranges of contribution are used: less than 0.5, 0.5 to 5, and greater than 5 ppb.

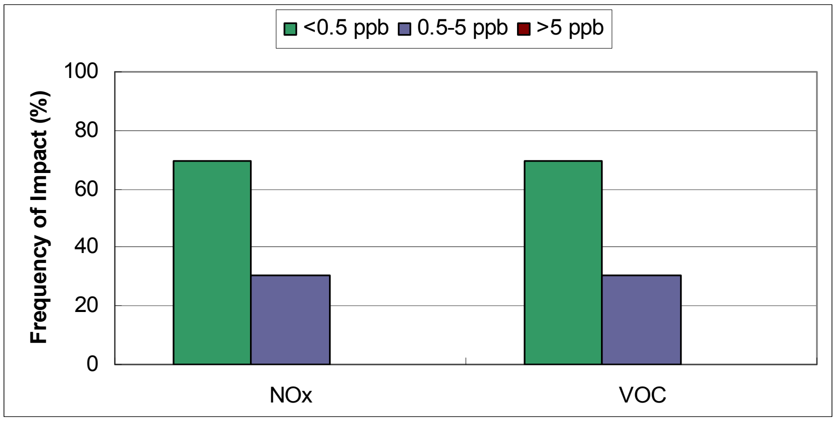


Figure 13. Estimated distribution of contributions from OCS sources to daily maximum 8-hour ozone concentrations for a typical ozone season: Baton Rouge.

Figure 13 indicates that OCS NO_x impacts are expected to be less than 0.5 ppb on about 69 percent of the days and in the range of 0.5 to 5 ppb on about 31 percent of the days in a typical ozone season. The VOC impacts are also expected to be less than 0.5 ppb on approximately 69 percent of the days and between 0.5 and 5 ppb on about 31 percent of the days.

The simulated average impacts for each bin were then used to examine whether the impacts might affect the number of exceedance days for the area. The three approaches described earlier in the report provide the following range of impact analysis results.

The impact adjustment factors range from 1.001 to 1.058 for this area. The results for the three different approaches are as follows:

- Using the average observed values for the simulated days in each bin as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Thus, for a typical year, no exceedances are attributed to the OCS emissions using this approach.

- Using the average observed values within the bins as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Again no exceedances are attributed to the OCS emissions.

- Using the day-specific ozone concentrations for all days in the bin as the reference concentrations, it is estimated that, for a typical year, 1.2 exceedances of the 75 ppb ozone standard and 0.4 exceedances of the 85 ppb ozone standard are attributable to the OCS emission impacts. Figure 14 compares the observed and estimated daily maximum

8-hour ozone concentrations for days within the represented classification bins for the with- and without-OCS scenarios, respectively.

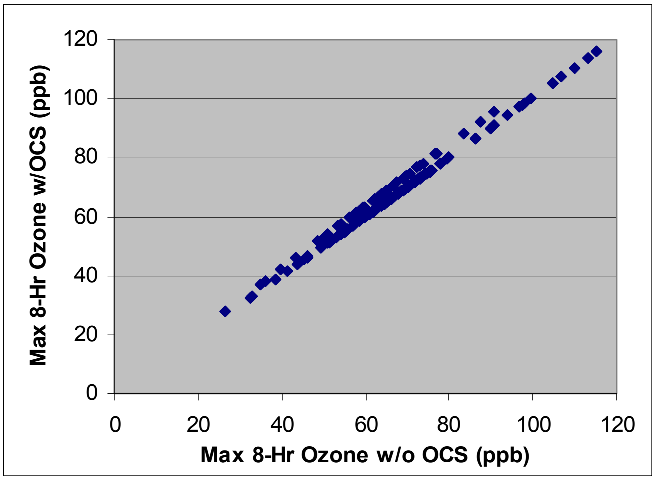


Figure 14. Comparison of observed (with OCS) and estimated (without OCS) daily maximum 8-hour ozone concentrations for CART bins 13, 27, 30, and 34 for 2000-2004: Baton Rouge.

In summary, based on data for 2000-2004, the number of exceedance days for Baton Rouge attributed to OCS emissions in a typical year ranges from 0 to 1.2 for the 75 ppb standard and from 0 to 0.4 for the 85 ppb standard.

3.8. GULFPORT

The simulation days represent three CART bins for Gulfport (Bins 18, 31, and 32). Two of the six simulation days are classified in Bin 18, one is classified in Bin 31, and three are in Bin 32. The frequency of occurrence of days within these bins is 5.6, 1, and 2.6 times per year, respectively. For Bin 18, the average impact from OCS NO_x emissions on 8-hour ozone concentration in the Gulfport area is 0.07 ppb and the average impact from OCS VOC emissions is also 0.41 ppb. These impacts are expected to occur (on average) more than five times per year. For Bin 31, the average impact from OCS NO_x emissions on 8-hour ozone concentration in Gulfport is 0.0 ppb and the average impact from OCS VOC emissions is 0.0 ppb. These conditions are expected to occur (on average) once per year. For Bin 32, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 3.63 ppb and the average impact from OCS VOC emissions is 0.15 ppb. These conditions are expected to occur (on average) less than three times per year.

If the bins are weighted according to the number of days within each bin, Bin 18 represents 61 percent, Bin 31 represents 11 percent, and Bin 32 represents 28 percent of the days represented by the simulation period. If it is assumed that the distribution of impacts for the simulation period is similar to that for the ozone season, the estimated distribution of contributions can be calculated as displayed in Figure 15. Three ranges of contribution are used, and are set to less than 0.5, 0.5 to 5, and greater than 5 ppb.

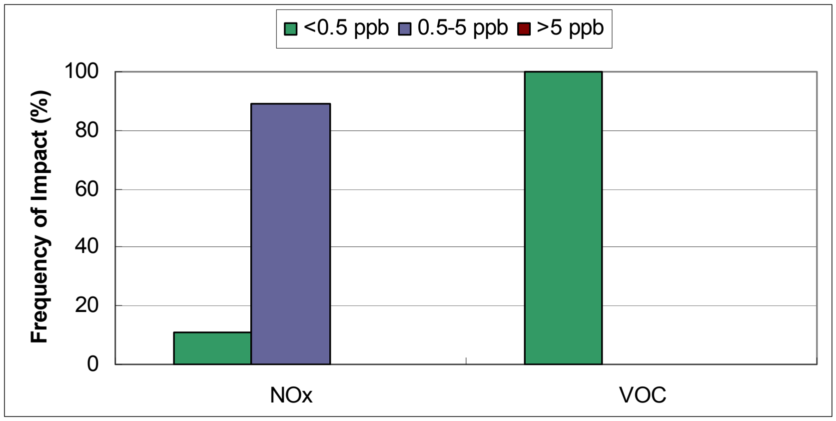


Figure 15. Estimated distribution of contributions from OCS sources to daily maximum 8-hour ozone concentrations for a typical ozone season: Gulfport.

Figure 15 indicates that OCS NO_x impacts are expected to be less than 0.5 ppb on about 11 percent of the days and in the range of 0.5 to 5 ppb on about 89 percent of the days in a typical ozone season. The VOC impacts expected to be less than 0.5 ppb on all days.

The simulated average impacts for each bin were then used to examine whether the impacts might affect the number of exceedance days for the area. The three approaches described earlier in the report provide the following range of impact analysis results.

The impact adjustment factors range from 1.001 to 1.038 for this area. The results for the three different approaches are as follows:

- Using the average observed values for the simulated days in each bin as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Thus, for a typical year, no exceedances are attributed to the OCS emissions using this approach.

- Using the average observed values within the bins as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Again no exceedances are attributed to the OCS emissions.

- Using the day-specific ozone concentrations for all days in the bin as the reference concentrations, it is estimated that, for a typical year, 1.3 exceedances of the 75 ppb standard and no exceedances of the 85 ppb ozone standard are attributable to the OCS emission impacts. Figure 16 compares the observed and estimated daily maximum 8-hour ozone concentrations for days within the represented classification bins for the with- and without-OCS scenarios, respectively.

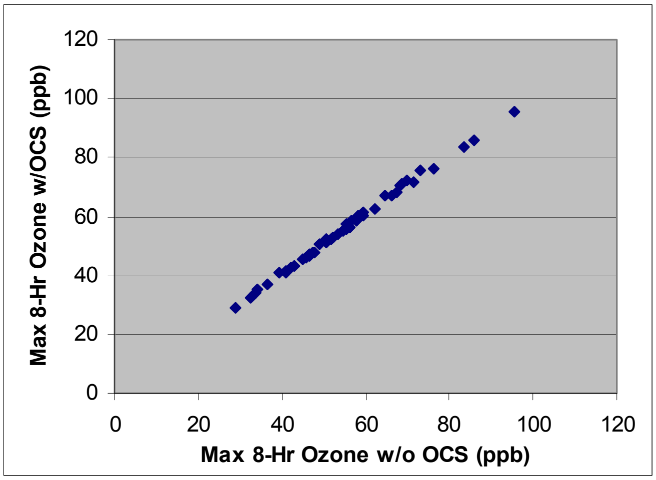


Figure 16. Comparison of observed (with OCS) and estimated (without OCS) daily maximum 8-hour ozone concentrations for CART bins 18, 31, and 32 for 2000-2004: Gulfport.

In summary, based on data for 2000-2004, the number of exceedance days for Gulfport attributed to OCS emissions in a typical year ranges from zero to 1.3 for the 75 ppb standard and is zero for the 85 ppb standard.

3.9. MOBILE

The simulation days represent three CART bins for Mobile (Bins 20, 27, and 29). One of the six simulation days is classified in Bin 20, four are classified in Bin 27, and one is in Bin 29. The frequency of occurrence of days within these bins is 21.4, 0.4, and 1.6 times per year, respectively. For Bin 20, the average impact from OCS NO_x emissions on 8-hour ozone concentration in Mobile is 1.50 ppb and the average impact from OCS VOC emissions is also 0.42 ppb. These impacts are expected to occur (on average) more than 21 times per year. For Bin 27, the average impact from OCS NO_x emissions on 8-hour ozone concentration in Mobile is 1.27 ppb and the average impact from OCS VOC emissions is 0.46 ppb. These conditions are expected to occur (on average) less than once per year. For Bin 29, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 0.0 ppb and the average impact from OCS VOC emissions is 0.0 ppb. These conditions are expected to occur (on average) less than twice per year.

If the bins are weighted according to the number of days within each bin, Bin 20 represents 91 percent, Bin 27 represents 2 percent, and Bin 29 represents 7 percent of the days represented by the simulation period. If it is assumed that the distribution of impacts for the simulation period is similar to that for the ozone season, the estimated distribution of contributions can be calculated as displayed in Figure 17. Three ranges of contribution are used, and are set to less than 0.5, 0.5 to 5, and greater than 5 ppb.

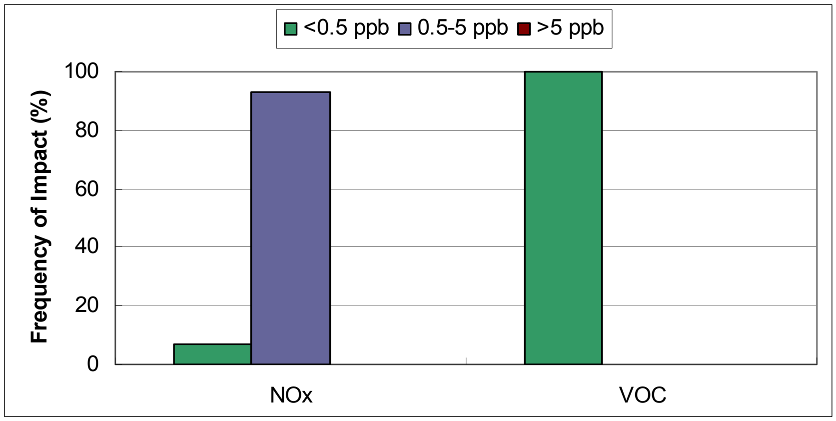


Figure 17. Estimated distribution of contributions from OCS sources to daily maximum 8-hour ozone concentrations for a typical ozone season: Mobile.

Figure 17 indicates that OCS NO_x impacts are expected to be less than 0.5 ppb on about 7 percent of the days and in the range of 0.5 to 5 ppb on about 93 percent of the days in a typical ozone season. The VOC impacts expected to be less than 0.5 ppb on all days.

The simulated average impacts for each bin were then used to examine whether the impacts might affect the number of exceedance days for the area. The three approaches described earlier in the report provide the following range of impact analysis results.

The impact adjustment factors range from 1.001 to 1.022 for this area. The results for the three different approaches are as follows:

- Using the average observed values for the simulated days in each bin as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Thus, for a typical year, no exceedances are attributed to the OCS emissions using this approach.

- Using the average observed values within the bins as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Again no exceedances are attributed to the OCS emissions.

- Using the day-specific ozone concentrations for all days in the bin as the reference concentrations, it is estimated that, for a typical year, no exceedances of either the 75 ppb standard or the 85 ppb ozone standard are attributable to the OCS emission impacts. Figure 18 compares the observed and estimated daily maximum 8-hour ozone concentrations for days within the represented classification bins for the with- and without-OCS scenarios, respectively.

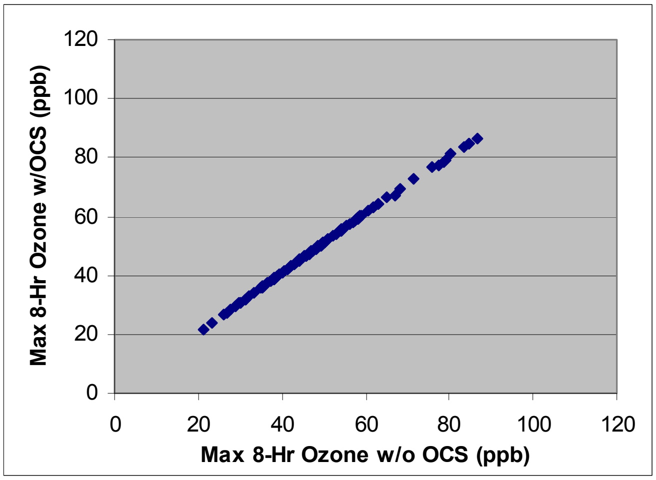


Figure 18. Comparison of observed (with OCS) and estimated (without OCS) daily maximum 8-hour ozone concentrations for CART bins 20, 27, and 29 for 2000-2004: Mobile.

In summary, based on data for 2000-2004, the number of exceedance days for Mobile attributed to OCS emissions in a typical year is zero for both the 75 ppb and 85 ppb standards.

3.10. PENSACOLA

The simulation days represent four CART bins for Pensacola (Bins 24, 27, 31, and 32). Bins 24, 27, and 31 are each represented by one simulation day and Bin 32 is represented by three days. The frequency of occurrence of days within these bins is 2 (Bin 27), 0.6 (Bin 27), 2 (Bin 31) and 7.2 (Bin 32) times per year. For Bin 24, the average impact from OCS NO_x emissions on 8-hour ozone concentration in the Pensacola area is 0.48 ppb and the average impact from OCS VOC emissions is 0.04 ppb. These impacts are expected to occur (on average) twice per year. For Bin 27, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 5.48 ppb and the average impact from OCS VOC emissions is 1.22 ppb. These conditions are expected to occur (on average) less than once per year. For Bin 31, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 0.66 ppb and the average impact from OCS VOC emissions is 0.01 ppb. These conditions are expected to occur (on average) approximately two times per year. For Bin 34, the average impact from OCS NO_x emissions on 8-hour ozone concentration is 0.48 ppb and the average impact from OCS VOC emissions is 0.06 ppb. These conditions are expected to occur (on average) about seven times per year.

If the bins are weighted according to the number of days within each bin, Bin 24 represents 17 percent, Bin 27 represents five percent, Bin 31 represents 17 percent, and Bin 32 represents 61 percent of the days represented by the simulation days. If it is assumed that the distribution of impacts for the simulation period is similar to that for the ozone season, the estimated distribution of contributions can be calculated as displayed in Figure 19. Three ranges of contribution are used: less than 0.5, 0.5 to 5, and greater than 5 ppb.

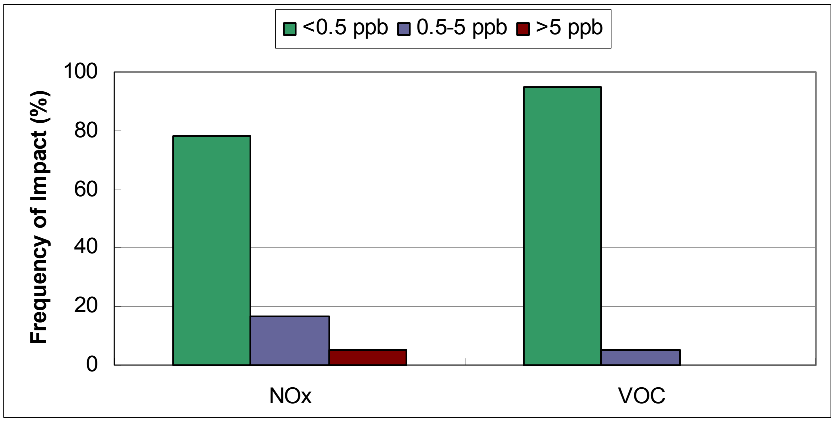


Figure 19. Estimated distribution of contributions from OCS sources to daily maximum 8-hour ozone concentrations for a typical ozone season: Pensacola.

Figure 19 indicates that OCS NO_x impacts are expected to be less than 0.5 ppb on about 78 percent of the days, in the range of 0.5 to 5 ppb on about 17 percent of the days, and greater than 5 ppb on five percent of the days in a typical ozone season. The VOC impacts are also expected to be less than 0.5 ppb on approximately 95 percent of the days and between 0.5 and 5 ppb on about 5 percent of the days.

The simulated average impacts for each bin were then used to examine whether the impacts might affect the number of exceedance days for the area. The three approaches described earlier in the report provide the following range of impact analysis results.

The impact adjustment factors range from 1.005 to 1.098 for this area. The results for the three different approaches are as follows:

- Using the average observed values for the simulated days in each bin as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Thus, for a typical year, no exceedances are attributed to the OCS emissions using this approach.

- Using the average observed values within the bins as the reference concentrations, the number of exceedance days is the same for the with- and without-OCS emissions scenarios for both the 75 and 85 ppb ozone standards. Again no exceedances are attributed to the OCS emissions.

- Using the day-specific ozone concentrations for all days in the bin as the reference concentrations, it is estimated that, for a typical year, 0.2 exceedances of the 75 ppb ozone standard and no exceedances of the 85 ppb ozone standard are attributable to the OCS emission impacts. Figure 20 compares the observed and estimated daily maximum 8-hour ozone concentrations for days within the represented classification bins for the with- and without-OCS scenarios, respectively.

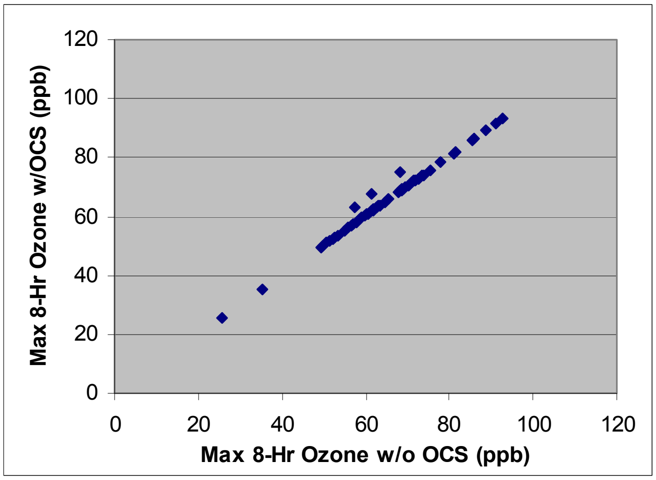


Figure 20. Comparison of observed (with OCS) and estimated (without OCS) daily maximum 8-hour ozone concentrations for CART bins 24, 27, 31, and 32 for 2000-2004: Pensacola.

Although the simulated impacts are large for some days, these are primarily not days with concentrations near the exceedance thresholds.

In summary, based on data for 2000-2004, the number of exceedance days for Pensacola attributed to OCS emissions in a typical year ranges from zero to 0.2 for the 75 ppb standard and is zero for the 85 ppb standard.

4.0 SUMMARY OF FINDINGS AND RECOMMENDATIONS FOR FURTHER STUDY

The objective of this analysis was to use the CART results developed as part of the MMS-sponsored data synthesis study together with photochemical modeling results to assess the frequency of occurrence of the conditions that lead to impacts of emissions from oil-and-gas-related sources located within the OCS region on 8-hour ozone concentrations at selected onshore locations.

The CART results were used to classify and assess the frequency of occurrence of the modeled days, based on the frequency of occurrence of similar days in the multi-year dataset. The simulated impacts for the modeled days were tabulated and frequency with which the impacts are expected to occur was calculated. The distribution of impacts among the modeled days, weighted according to the frequency of occurrence of the meteorological conditions represented by these days, was further assumed to represent the distribution of impacts for a typical ozone season. For the majority of areas, the OCS impacts on 8-hour average ozone (for both NO_x and VOC emissions) are expected to be less than 0.5 ppb on the majority of days. Greater ozone impacts from NOx emissions, between 0.5 and 5 ppb, are estimated for more than 25 percent of the days in a typical year for Northwest Houston, Central Houston, Galveston, Beaumont/Port Arthur, New Orleans, and Baton Rouge and for more than 50 percent of the days in a typical year for Gulfport and Mobile. Even greater ozone impacts from NO_x emissions of more than 5 ppb are estimated for 54 percent of the days in a typical year for Galveston and for 42 percent of the days for New Orleans. Higher VOC impacts are estimated for a significant number of days for only one area - New Orleans (42 percent). The results for New Orleans, however, are likely the least reliable because only a few days (in a typical year) are represented by the simulation period.

The simulation-based frequency-weighted daily average impact for each area is summarized in Table 2. This table also includes the total number of days represented by the simulation days in a typical ozone season, based on the number of days per year in the CART bins represented by the simulation days. The greater the number of days, the more confidence one may have in the results.

Table 2

Simulation-Based Frequency-Weighted Daily Average Impact and Number of Typical-Ozone-Season Days Represented by the Simulation Days.

Area	# of Days Represented for a Typical Ozone Season	Weighted Average NOx Contribution (ppb)	Weighted Average VOC Contribution (ppb)
Northwest Houston	10.6	0.63	0.06
Central Houston	16.2	0.52	0.09
Southeast Houston/Galveston	22.8	5.93	0.22
Beaumont/Port Arthur	32.6	0.67	0.11
Lake Charles	137.4	0.19	0.03
New Orleans	3.8	3.30	1.15
Baton Rouge	32	1.50	0.38
Gulfport	9.2	1.45	0.29
Mobile	23.4	1.39	0.38
Pensacola	11.8	0.76	0.11

Considering all areas, the average estimated daily impact of OCS NO_x emissions is 1.63 ppb and the average daily impact of OCS VOC emissions is 0.22 ppb.

This analysis also examined whether the impacts might affect the number of exceedance days for each area as well as whether significant impacts (that may make the difference between a non-exceedance day and an exceedance day) are expected to be more or less frequent with the new ozone standard. Among the ten areas, the number of exceedance days attributed to OCS emissions in a typical year ranges from zero to two for the 75 ppb 8-hour ozone standard and from zero to one for the 85 ppb standard. Considering all areas, the average number of 75 ppb exceedance days for which the OCS contribution increases the daily maximum 8-hour ozone concentration to a value that is above the threshold is 0.52 days per year. The average number of 85 ppb exceedance days for which the OCS contribution increases the daily maximum 8-hour ozone concentration to a value that is above the threshold is 0.26 days per year.

Incorporating the results from additional modeling episode periods, especially seasonal or annual periods, would greatly improve the estimates of both the magnitude and frequency of the impact of OCS emissions on onshore 8-hour ozone concentrations.

5.0 REFERENCES

Brieman, L., J.H. Friedman, R.A. Olshen, and C.J. Stone. 1984. Classification and regression trees. Belmont, California: Wadsworth. 358 pp.

Douglas, S.G., Y. Wei, A.B. Hudischewskyj, A.R. Alvarez, R.S. Beizaie, and J.L. Haney. 2001. Gulf Coast Ozone Study (GCOS) modeling analysis. Phase II: Methods and results. Prepared for the Southeast States Air Resources Managers (SESARM) and the Gulf Coast Ozone Study Operations Committee by ICF International, San Rafael, CA (01-049). 412 pp.

Douglas, S.G., J.L. Haney, Y. Wei, B. Wang, and S. Beckmann. 2005. Gulf Coast Ozone Study (GCOS) Modeling Analysis. Phase III: Additional future-year assessments. Prepared for the Southeast States Air Resources Managers (SESARM) and the Gulf Coast Ozone Study Operations Committee, by ICF International, San Rafael, CA (05-025). 245 pp.

Eastern Research Group (ERG). 2007. Year 2005 Gulfwide emission inventory study. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2007-067. 149 pp.

Haney, J.L., Y. Wei, T.C. Myers, and S.G. Douglas. 2008. An assessment of on-shore air quality impacts for the Eastern Gulf Coast (Louisiana to Florida) using the 2005 Gulfwide emissions inventory. Prepared for the U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, by ICF International, San Rafael, CA (08-127). 69 pp.

Steinberg, D., and P. Colla. 1997. CART – classification and regression trees. San Diego, CA: Salford Systems. 168 pp.

U.S. Environmental Protection Agency (USEPA). 2007. Guidance on the use of models and other analyses for demonstrating attainment of air quality goals for ozone, PM2.5, and regional haze. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. EPA-454/B-07-002. 252 pp.

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.