

Appendix to Beaumont-Port Arthur Conceptual Model

- I. Introduction/Background
- II. Transport analyses from 2003
- III. VOC canister analyses
- IV. Baylor aircraft data analyses

I. Introduction/Background

In EPA's guidance document, *Draft Guidance on the Use of Models and other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS*, EPA recommends States assemble conceptual models that describe the scope of an area's ozone problem. Conceptual models should include readily available emissions, air quality, and meteorological data in order to provide both a quantitative and qualitative measure of the factors affecting ozone concentrations.

For the Beaumont/Port Arthur (BPA) ozone nonattainment area, the then-Texas Natural Resource Conservation Commission (TNRCC) contracted with the University of Texas at Austin and Environ Corporation to compile and analyze all available data into a conceptual model. This information is documented in a 2002 report entitled *Conceptual Model of Ozone Formation in the Beaumont/Port Arthur Ozone Non-Attainment Area*. Since that report was released, the now-Texas Commission on Environmental Quality (TCEQ) has conducted more analyses on BPA air quality and meteorological data and presents it here.

II. Transport/background analyses

During 2003, TCEQ staff briefed BPA stakeholders on the results of analyses of ozone episodes occurring in south east Texas. The objective was to use additional analysis tools to evaluate 1-hour and 8-hour exceedances occurring in BPA from 1998-2002. This analysis included forward plume sequences, HYSPLIT backward trajectories, and 5-minute ozone time series. For this part of the conceptual model, the focus is on the definition and effects of background upon local BPA ozone concentrations.

Background ozone is perhaps the most difficult part of the 8-hour ozone problem to solve. EPA's default assumption is that "clean" air consists of 40 ppb ozone. Thus, under optimum conditions, an urban area can contribute up to 44 ppb prior to causing an exceedance of the 8-hour standard. However, as will be shown, background ambient concentrations of ozone during 8-hour ozone events are usually more than 40 ppb. In one instance, "background" ozone arriving at the Sabine Pass monitoring station from offshore was already greater than 85 ppb. In fact, for 28 consecutive hours, ozone arriving at Sabine Pass was greater than 80 ppb.

The majority of high ozone events in BPA can be attributed to recirculation of local emissions as well as transport of ozone and ozone precursors from the Houston/Galveston/Brazoria area. In addition, during high ozone events, background concentrations are generally high and contribute significantly to Beaumont ozone events. For TCEQ's analysis, background is defined as the lowest daily upstream maximum ozone concentration. Background sites will vary by day. Background concentrations have two components, a long-range regional scale transport plus the local emissions accumulation /carryover from previous day.

Land/sea breeze flow reversal is another important factor for many BPA ozone events. Complicating this is the daily rotation of the wind. Consequently, changes in land/sea breeze wind directions make it very difficult to differentiate between background concentrations and

the recirculation of local emissions. Transport cases with persistent straight line flow, e.g., the

Sabine Pass case mentioned above, are much easier to analyze.

Tools

In conducting this analysis, TCEQ evaluated 1-hour and 8-hour ozone data in BPA from 1998-2002. Over this period, there were 23 1-hour exceedances (>124 ppb) and 56 8-hour exceedances (>84 ppb). Two primary tools were used to assess air parcel movement: (1) back trajectories, using the NOAA HYbrid Single-Particle Lagrangian Integrated Trajectory (Hysplit) model and EDAS model fields for input and (2) a forward plume/puff sequence model that uses surface CAMS meteorological data for input. Since these tools use different inputs and methods, the results may not agree exactly, so a composite picture is developed.

Hysplit uses Eta Data Assimilation System (EDAS) fields, which are based on 40 km-spaced grid points. Therefore, these Hysplit analyses may be a good indicator of large scale (e.g. synoptic) flow, but may not be able to capture subtle meso- and micro-scale flows. Hysplit can show a general upstream pattern, but may not be the best possible tool for assessing source culpability.

The forward plume/puff sequence model, developed by Bryan Lambeth of TCEQ, uses surface winds from all the CAMS stations in the area, and weights them using a $1/r^2$ approach. The model releases a "puff" each hour from selected sources, and moves it downwind each hour based on each hour's winds. The model is typically run on a day by day basis, with particles/puffs being emitted starting at midnight and continuing forward until 10 pm or midnight of the following day. The puffs are connected to show the path of the plume over each hour. This approach does not grow or disperse the puffs, nor does it indicate the magnitude of the emissions. Each hour's set of plumes can be animated to show the forward movement of the plumes. The plume/puff sequence model also has limitations, namely, (1) since it is based upon surface winds, and some areas have no local monitors, the model interpolates data from distant sites, and measurement errors could be as much as ± 10 degrees; and (2) surface winds are not transport level winds - wind speeds increase with altitude and directions shift or shear with altitude. However, the animated hourly images suggest general source regions and transport patterns. One limitation of this tool is that it is dependent on surface meteorological stations. If the model moves parcels out in areas far removed from any stations (e.g. over the Gulf of Mexico), the uncertainty of the plume path is increased.

Time series of 5-minute ozone data were also reviewed. This process helped describe day-specific upwind stations, background ozone, plus local and transported contributions of ozone.

For high BPA ozone days that occurred during the 2000 Texas Air Quality Study, two more tools were available for episode analysis. These were the University of Houston/NOAA's Hysplit tool and the University of Alabama at Huntsville's lagrangian forward particle model. Both of these tools used 4 km MM5 wind fields generated by Dr John Nielsen-Gammon that focused on the Houston/Galveston and BPA areas. Both tools are available via the web at:

http://imaqs.uh.edu/traj_analysis/ (UH/NOAA Hysplit model)

<http://texaqnsstc.uah.edu/> (UAH lagrangian forward particle model)

Results of Analysis

Although the TCEQ's analysis looked at 23 1-hour exceedance days and 56 8-hour exceedance days, this report will provide examples of the various meteorological regimes affecting ozone in BPA. These are:

- Local (BPA only)
- Transport from Houston/Galveston
- Local plus Houston/Galveston
- Lake Charles
- Local plus Lake Charles
- Gulf on-shore flow.

To define "Local", TCEQ noted that local high ozone is often characterized by low or calm wind speeds. Since the measurement threshold of an airport anemometer is 3 knots or nautical miles/hour, anything less than 3 knots is a "calm". In general, high ozone usually occurs by 4 pm local standard time. Therefore, if a 10-hour back trajectory (4 pm back to 6 am) did not leave an imaginary circle of 30 nautical mile radius (3 knots * 10 hours = 30 nautical miles) about the monitor with the ozone exceedance, then the exceedance was considered "local". On the Hysplit graphics, TCEQ drew a 30 mile radius about the monitor with the highest ozone value for a given exceedance day. That monitor location was used as the origin of the Hysplit back trajectory for that day. Conversely, 4 pm - 6 am back trajectories that crossed the 30 mile circle were considered to be transported from an upwind source region. For our analyses, the transport source regions of interest were Houston/Galveston, and to a lesser extent, Lake Charles, Louisiana.

Maritime flow consists of cases where the wind flow comes in from the Gulf of Mexico and over the previous 10+ hours, does not seem to lead back to any sources on land. The source may be areas along the Gulf Coast in other states, such as Mississippi, or even further inland.

Combination cases (Local plus Houston/Galveston, Local plus Lake Charles) are much more difficult to identify. That is, one may look at a trajectory, a plume sequence, and an ozone time series and not be able to ascertain whether the exceedance was solely due to just local conditions, or local conditions superimposed upon some transported in high background.

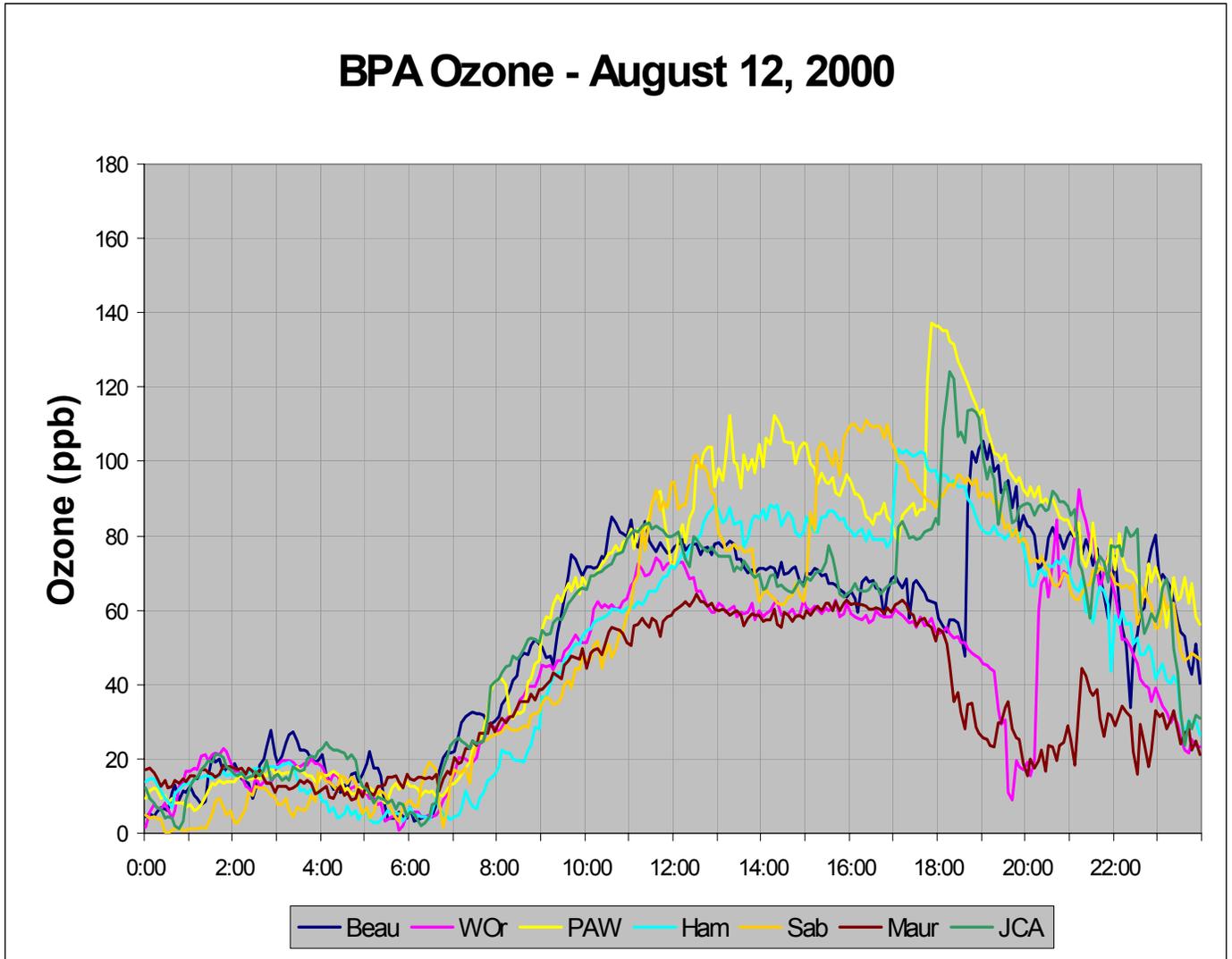
This report will provide example analyses for a locally-generated (BPA only) episode, an episode with transport from HGB, and one showing Gulf on-shore or maritime flow.

Local case - August 12, 2000

August 12, 2000 is an example of a locally-generated ozone exceedance (both 1-hour and 8-

hour). The 5 minute time series trace shows that background ozone on this day is approximately 60 ppb as measured at the Mauriceville station. See Figure II-1.

Figure II-1 Five minute ozone time series for August 12, 2000



“Spikes” in the ozone trace can be seen with all the ozone stations except for Mauriceville, indicating that the plume or parcel affecting each of the other stations’ ozone never reached Mauriceville. The highest 5-minute ozone measured on August 12 occurs at Port Arthur West (PAW) and reached approximately 135 ppb. The 1-hour daily maximum ozone was 126 ppb and was also measured at PAW.

Hysplit-based back trajectories show that the air parcels actually came from the south before

coming back from the north due to a weak frontal passage. Thus, BPA emissions came back over the area. Plume sequence images confirm that the winds in BPA appear to go out and come back upon the area, with no impact from either Houston/Galveston or Lake Charles. Therefore, **Figure II-2 Hysplit for August 12, 2000**

this is a locally-generated ozone exceedance. The August 12, 2000 Hysplit plot is Figure II-2 and the plume sequences are Figures II-3 and II-4.

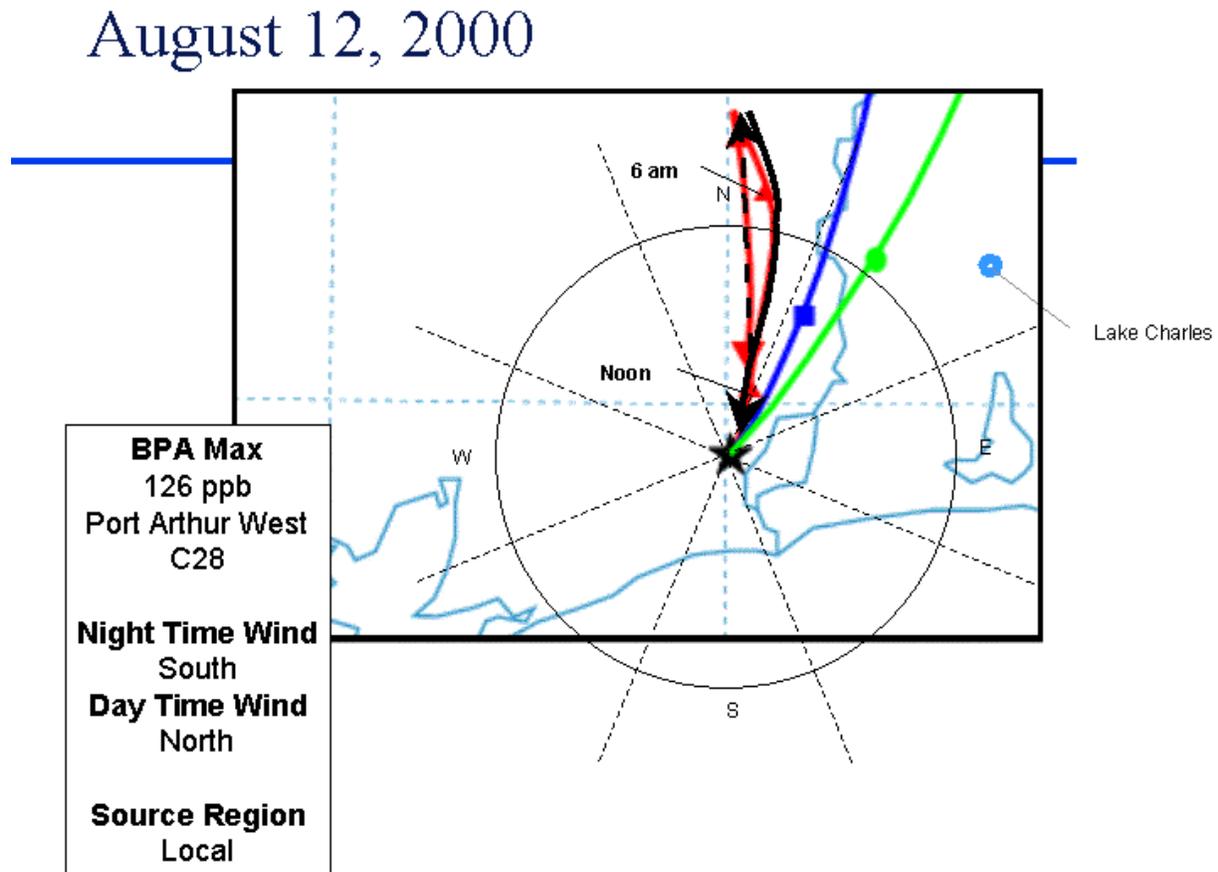


Figure II-3 Plume sequence for August 12, 2000 - 0800 CST

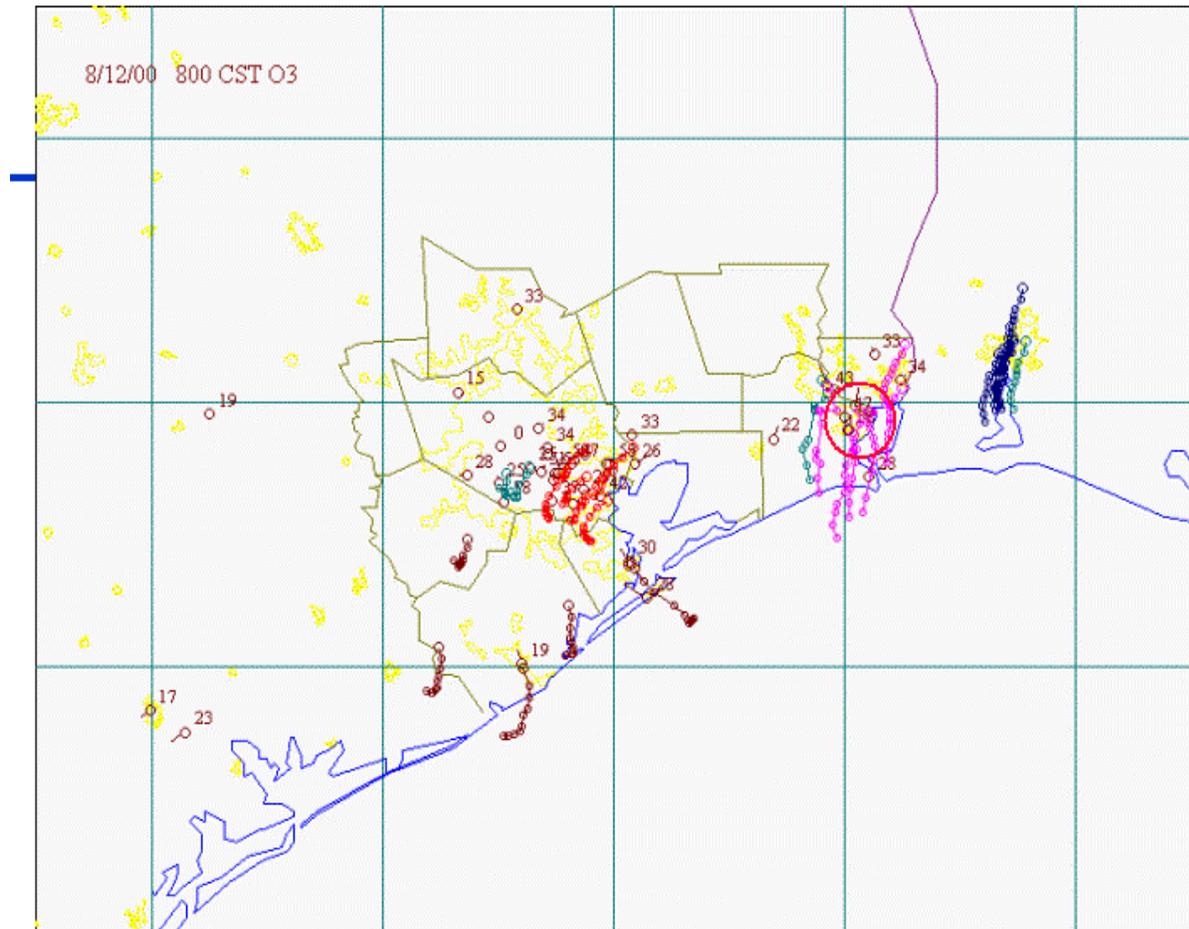
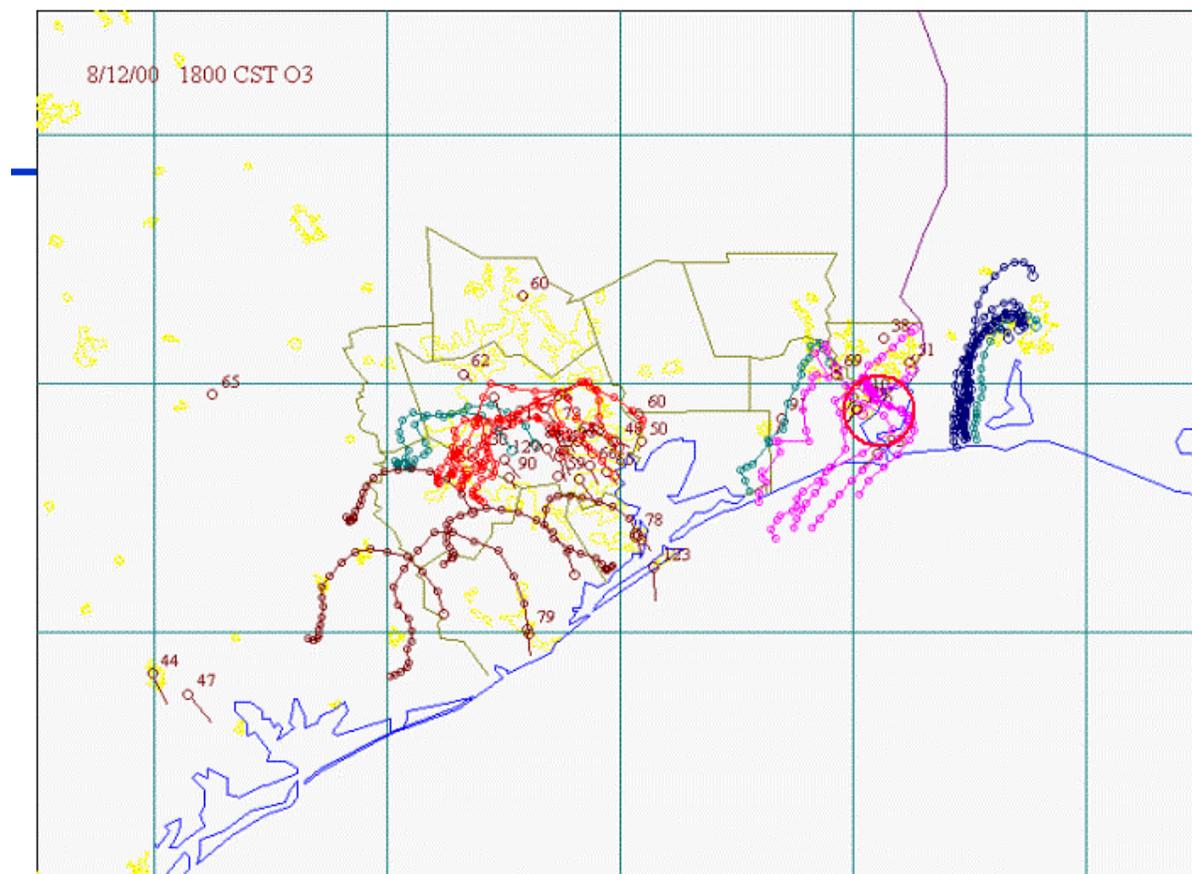


Figure II-4 Plume sequence August 12, 2000 1800 CST

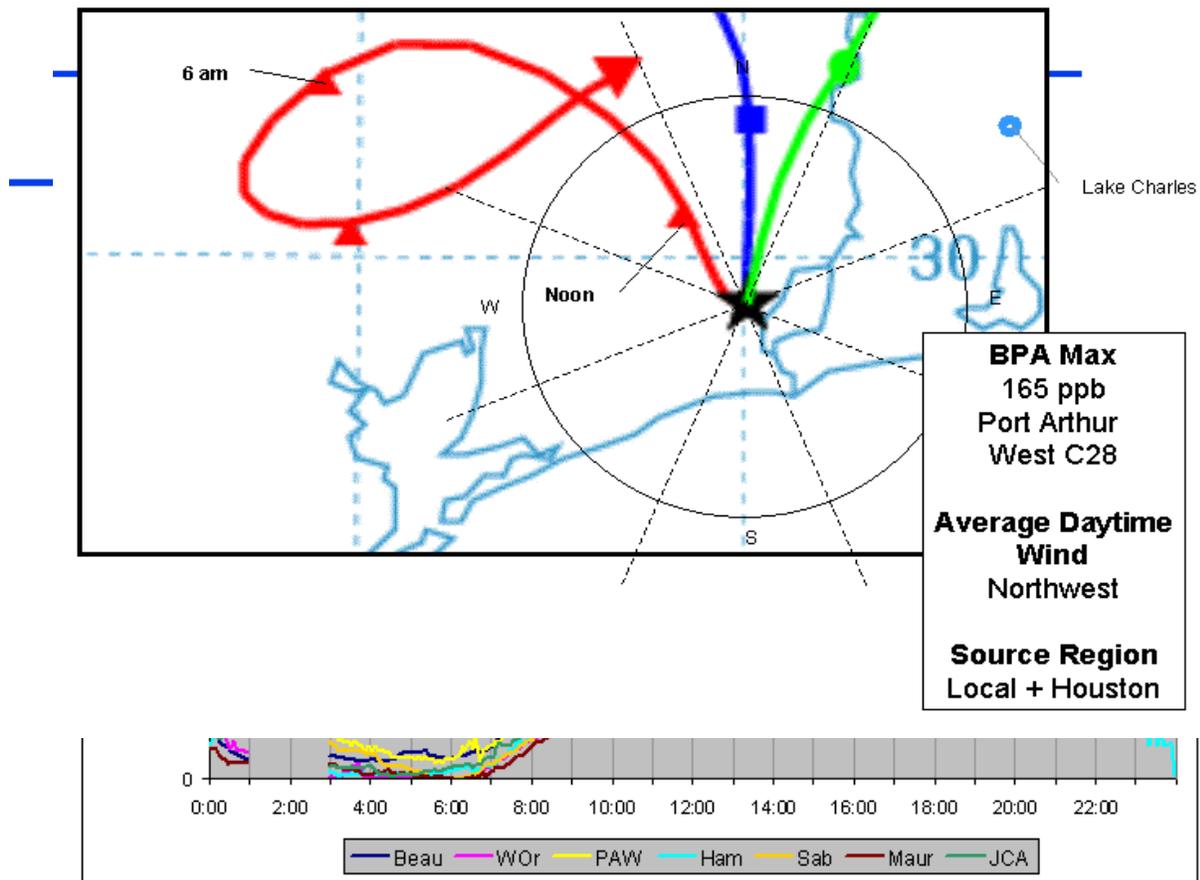
HGB transport - August 30, 2000



In a like manner, August 30, 2000 is considered a classic case of transport from HGB to BPA. The 5-minute ozone time series indicates that background ozone, as seen at Mauriceville is 56 ppb. (See Figure II-5) Again, “spikes” in the time series can be seen at all monitors, even at a somewhat lesser degree, at Mauriceville. As the spikes occur at different times at the stations, and indeed, the maximum ozone occurs well past the traditional ozone time of day peak, this is an indicator of ozone being transported into BPA.

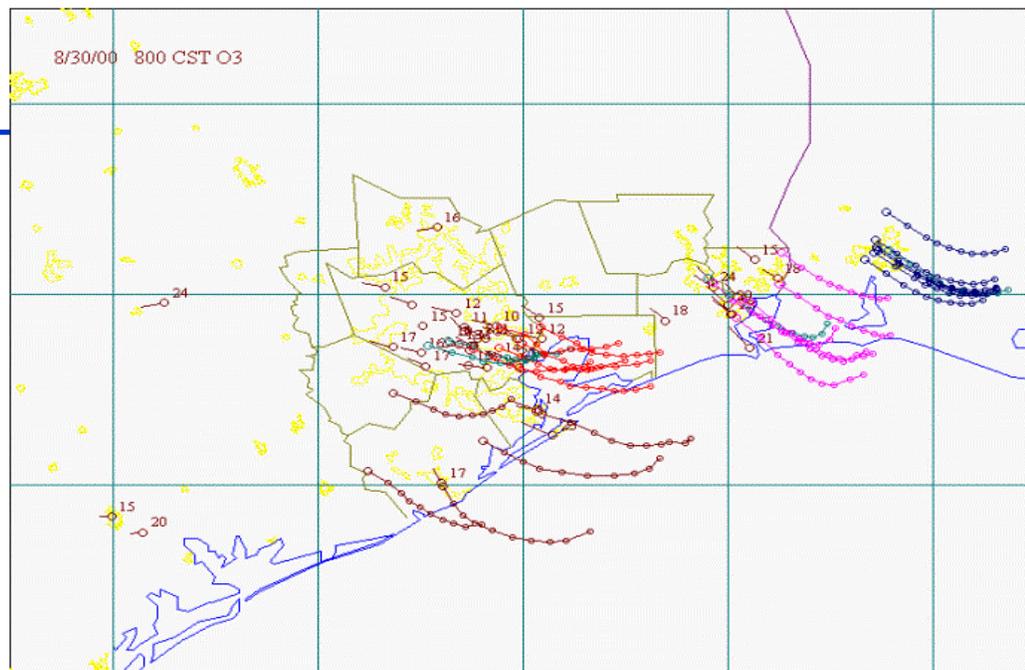
Figure II-5 5 minute ozone time series for August 30, 2000

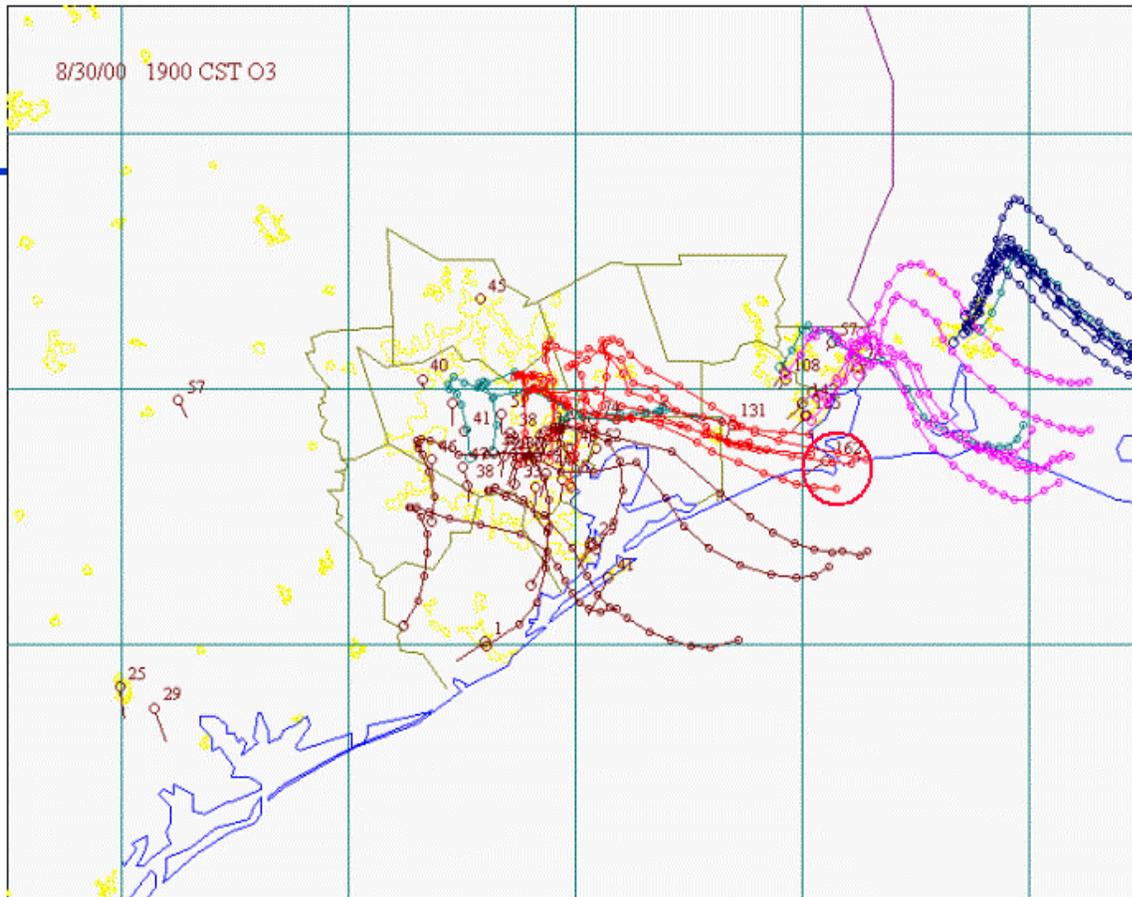
August 30, 2000



The Hysplit trajectory for August 30 shows (1) the parcel paths go outside the 30 mile radius circle and (2) the surface trajectory (100 meters - red line in Figure II-6) points back toward HGB. Plume sequences for this day show an obvious advection of ozone and precursors from HGB to BPA. The Hysplit plot is Figure II-6 and the plume sequence plots are Figure II-7 and II-8.

Figure II-6 Hysplit plot for August 30, 2000





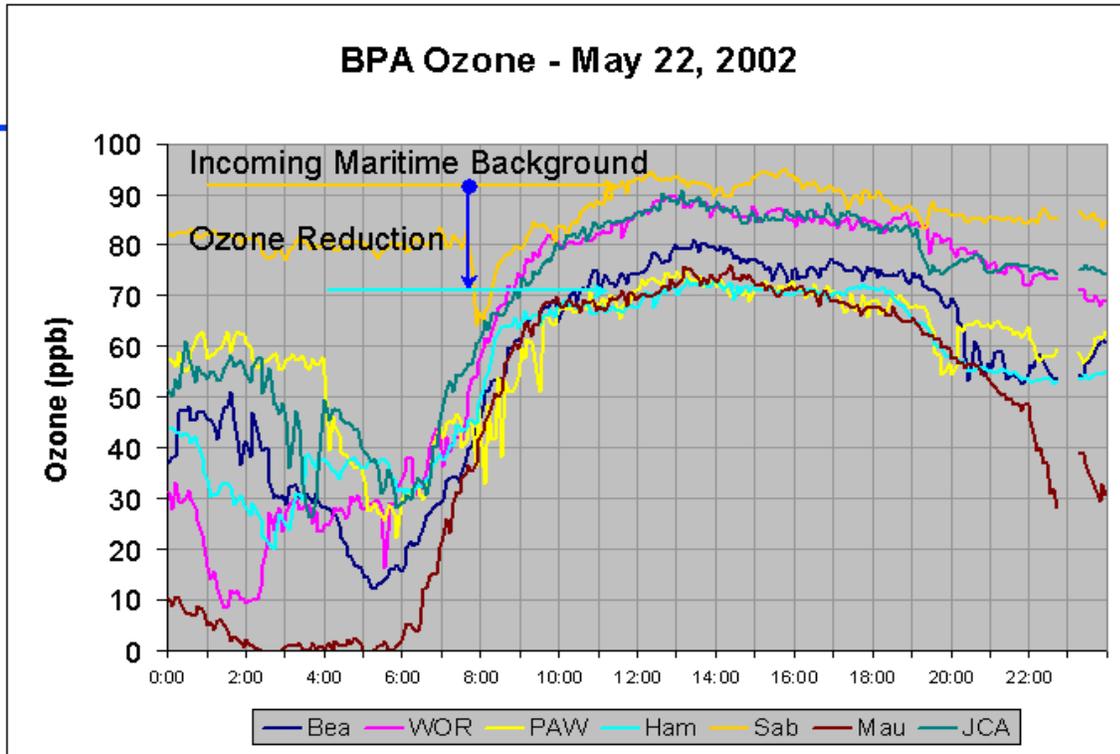
**Figure II-9
Plume**

sequence from August 30, 2000 1900 CST

Maritime - May 22, 2002

A maritime, Gulf on-shore flow is found in evaluating the May 22, 2002 BPA ozone event. A review of the 5-minute time series shows something not commonly seen on ozone time series (Figure II-10). Ozone rises at all stations uniformly around 6 am for all stations except Sabine Pass (Sab). Whereas the average 6 am ozone for the other 6 stations is around 25 ppb, Sabine Pass's ozone has been at 80 ppb since midnight. By 9 am, all stations are now registering ozone in the 70 to 90 ppb range. These concentrations stay at these levels for the next 11 hours. This is one indication that the incoming air is consistently affecting all stations in the same manner. See

Figure II-10 5 minute ozone time series for May 22, 2002



Hysplit analyses (Figure II-11) show that the parcels coming into Sabine Pass at 4 pm had only been out in the Gulf at 6 am, and possibly were near Mobile, Alabama on the morning of the previous day. Over this entire time period and fetch, the parcel did not appear to spend any time over what one might consider an urbanized or industrialized area. Plume sequences show that the winds came in off of the Gulf persistently and moved the BPA local emissions on into Texas. There was no recirculation or other mesoscale meteorological event observed that is typically associated with elevated ozone. (Plume sequences are Figures II-12 and II-13.)

Figure II-11 Hysplit plot for May 22, 2002

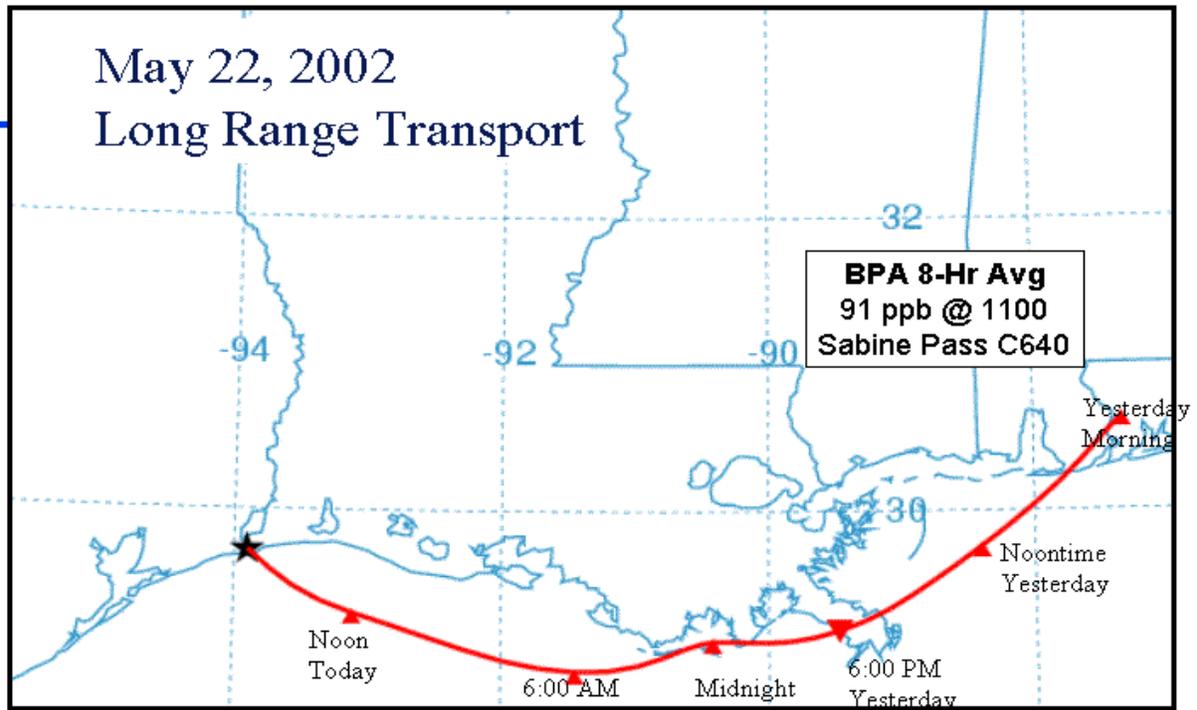


Figure II-12 Plume sequence for May 22, 2002 0800 CST

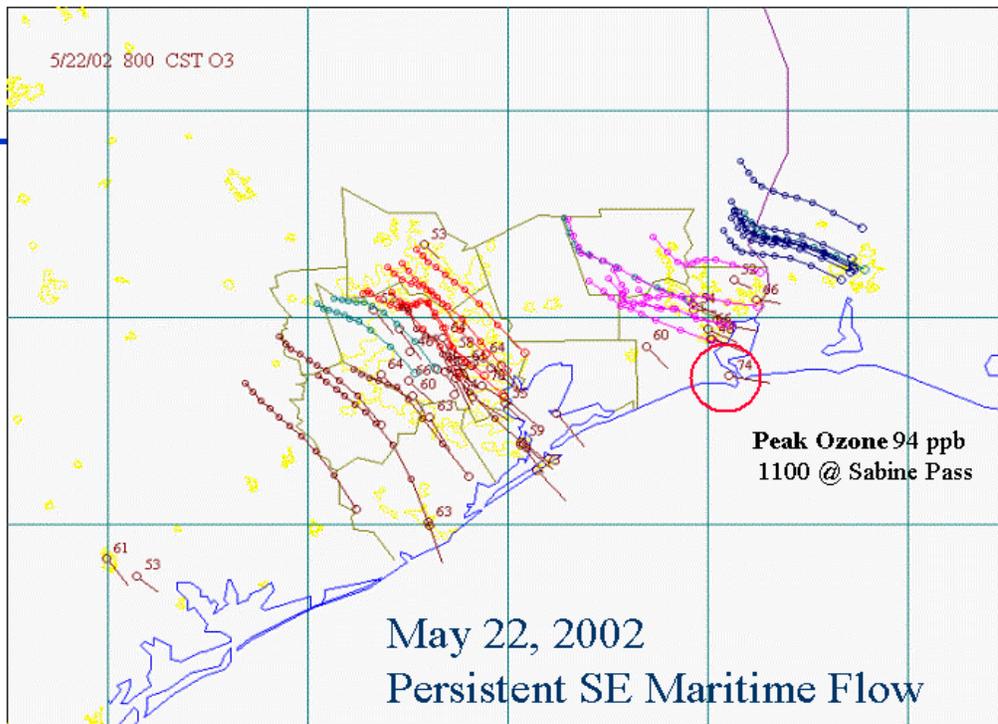
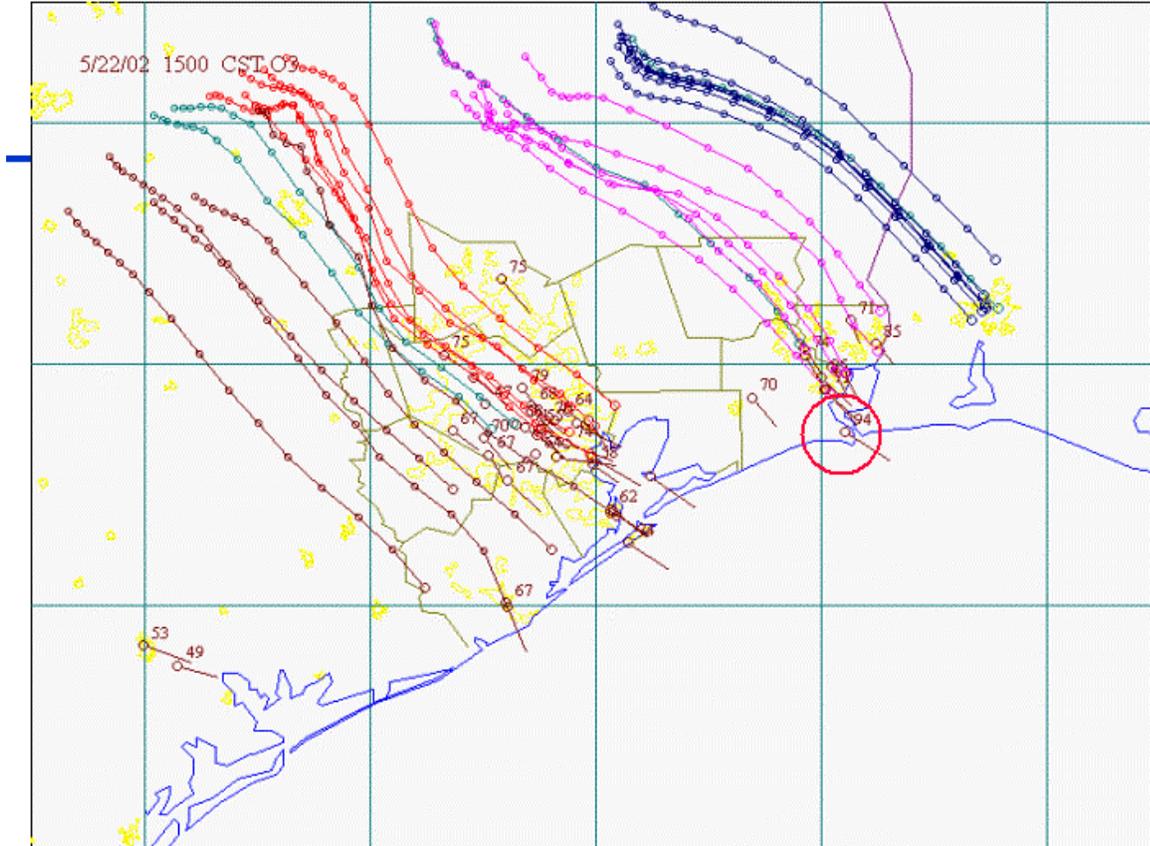


Figure II-13 Plume sequence for May 22, 2002 1500 CST



In summary, the 1-hour and 8-hour exceedance analyzed can be categorized as shown in Tables

II-1 and II-2

Table II-1 Classification of BPA area 1-hour ozone exceedances 1998-2002

Source region	# of cases	Percentage
Local (BPA)	6	28.5%
HGB transport	5	21.7
Local + HGB	5	21.7
Maritime	2	8.7
Lake Charles	1	4.3
BPA + other out of state	1	4.3
Other regional/out of state	3	13.0
	23	100%

Table II-2 Classification of BPA area 8-hour ozone exceedances 1998-2002

Source region	# of cases	Percentage
Local (BPA)	31	55%
HGB transport	10	18
Local + HGB	2	4
Maritime	3	5
Lake Charles	5	9
Local + Lake Charles	5	9
	56	100%

III. Cannister analyses

Analysis of canister data for the Beaumont-Port Arthur Area

This project analyzes the canister data collected at Beaumont-Port Arthur (BPA) Area to answer two questions:

- Which compounds are most important in the formation of ozone in the BPA areas?

- Whether or not the contribution of certain compound groups to total reactivity has increased or diminished over the last five years ?

Canister data is collected at seven TCEQ and six SETRPC (South East Texas Regional Planning Commission) canister monitors in the Beaumont-Port Arthur area. Three of the BPA SETRPC monitors are located near TCEQ monitors and share the same name. All of the samples collected at these sites are 24-hour samples collected in canisters; the TCEQ monitors collect new samples every six days and the SETRPC monitors collect new data every twelve days. For this analysis, only the data collected between 1997 and 2001 was used. Figure III-1 shows the TCEQ canister site locations.

Compound groups

The compounds collected at each monitor were grouped according to structural similarity in order to reduce the number of categories on the graphs used to analyze the data. Twelve of the compounds measured at the monitors had already been identified as contributors to high ozone by previous VOC analysis. These twelve compounds are ethylene, propylene, 1,3-butadiene, isoprene, styrene, toluene, 1-pentene, isopentane, n-butane, 1-butene, m & p-xylene, and 1,2,4-trimethylbenzene; each of these compounds was included with the proper group or was put into its own group. Since different compound concentrations were measured at the TCEQ and SETRPC monitors, the grouping of compounds was slightly different for each set of monitors. The names of the groups along with the compounds included in each group for each set of monitors are given in an attachment Table III-1.

MIR Reactivity

Each of the compounds measured in the canisters reacts with other compounds in the air to form ozone at different rates and in different amounts. For this reason, reactivity values, rather than pure concentration data, were used to weight the contribution to total ozone formation in favor of compounds that have the potential to form large quantities of ozone quickly. There are two types of reactivity scales that can be used to assign ozone formation potential to a given VOC compound; these scales are OH reactivity and maximum incremental reactivity (MIR). The OH reactivity scale is used to give an idea of how fast a compound will begin participating in reactions to form ozone; the MIR scale is used to give an idea of how much ozone a compound can form. For this analysis, only the MIR scale was used (Carter, 2002). The MIR value for each of the compounds measured in the canisters was calculated by multiplying the compound's concentration in ppbV by an MIR conversion factor, which consists of the MIR constant multiplied by the ratio of the molecular weight of the VOC to the molecular weight of ozone. The total reactivity for each group of compounds was found by summing the reactivities of all of the compounds falling within that group.

Approach

One group of samples that were of particular interest were the samples with high reactivity. The method used to identify high reactivity days involved calculating the total MIR for each sample by summing the group reactivities and finding the 90th percentile of the total reactivity for all of the samples at a given monitor. All of the samples with a total reactivity higher than the 90th percentile were separated from the rest of the data and the median reactivity for each compound group was calculated. These median values were used to create pie charts that compared the

contribution to high reactivity of all of the compound groups for a given monitor.

In order to determine whether or not the contribution of certain compound groups to total reactivity had increased or diminished at a given monitor over the time period used in this analysis, stacked bar charts were created using the median reactivity for each compound group over an entire year at that monitor. All of the samples collected within a year, not just the samples with high reactivity, were used to find the median values. Each bar represents one year in the time span and the reactivity groups are represented by the colored bands.

Summary and results

The first part of the analysis involved using high reactivity samples to determine the compounds that make the largest contributions to total reactivity in those high reactivity samples. Figures III-2a - III-14b show the 90th percentile of the total MIR(Maximum Incremental Reactivity) for each monitor. The top four contributors to reactivity for each of the TCEQ and SETRPC sites are summarized in Table III-2; in some cases where several compounds tie for fourth place, only the top three compounds are given.

Table III-2. Top four compounds contributing to high reactivity at BPA monitors

Site Name	Compound	%	Compound	%	Compound	%	Compound	%
Beaumont C2	Ethylene	19	Propylene	13	Pentanes	10		
Port Arthur C28	Ethylene	23	Butanes	17	Pentanes	12	Butenes	11
Groves	Butanes	31	Pentanes	17	Butenes	13	Pentenes	10
Port Neches	Butadiene	57	Butenes	13	Ethylene	7	Propylene	6
City Service	Propylene	33	Pentanes	15	Ethylene	14	Butanes	9
Carroll Street	Propylene	16	Butenes	15	Ethylene	12	Pentanes	11
West Orange	Ethylene	22	Pentenes	12	Pentanes	11	Butanes	10
Airport*	Ethylene	31	Pentanes	16	Propylene	9	Butanes	8
Beaumont*	Xylenes	19	Pentanes	17	Ethylene	16	Toluene	8
Cove School*	Ethylene	52	Propylene	8	Alkanes	7	Pentanes	5
Mauriceville*	Xylenes	23	Ethylene	16	Isoprene	11	Pentanes	7
Port Neches*	Butadiene	58	Ethylene	9	Propylene	6		
West Orange*	Ethylene	62	Propylene	7	Butadiene	4	Alkanes	4

*. SERTPC sites.

For over half of the samples in BPA, either propylene or ethylene is the top contributor to reactivity, and 8 of the 13 monitors contain both propylene and ethylene in the top four

compounds. Butadiene was the largest fraction of the reactivity at Port Neches for both the TCEQ and the SETRPC sites. The compound group xylenes was a large contributor to the total reactivity at Beaumont and Mauriceville. Butanes, butenes, pentanes, and pentenes were also significant contributors to high reactivity at several of the sites.

The second part of the analysis used the median reactivity changes to examine trends in each compound group. Figures b1-b13 show stacked bar chart by each site. Overall, a gradual decline in total reactivity can be seen at most of the monitor sites in BPA area. This decrease in overall median reactivity indicates a decrease in concentrations of certain compounds from 1997 to 2001.

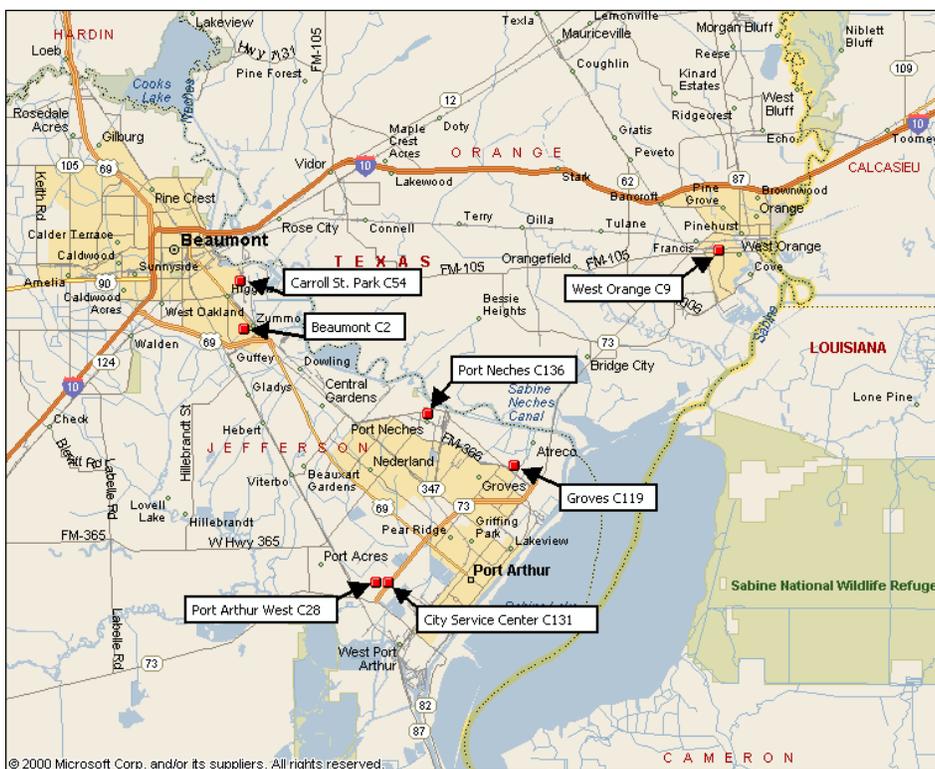


Figure III-1 Beaumont-Port Arthur area TCEQ monitors

Table III-1. Compound Groups

Group Name	TCEQ Compounds	SETRPC Compounds
Ethylene	Ethylene	Ethylene
Propylene	Propylene	Propylene
Butadiene	1,3-Butadiene	1,3-Butadiene
Isoprene	Isoprene	Isoprene
Styrene	Styrene	Styrene
Toluene	Toluene	Toluene
MTBE	MTBE	MTBE
Butenes	1-Butene; c-2-Butene; t-2-Butene	1-Butene
Pentenes	1-Pentene; 2-Methyl-2-Butene; 3-Methyl-1-Butene; c-2-Pentene; t-2-Pentene	1-Pentene
Large Alkenes	1-Hexene-2-Methyl-1-Pentene; 1-Heptene; 2-Methyl-1-Pentene; 4-Methyl-1-Pentene; c-2-Hexene; t-2-Hexene	1-Hexene-2-Methyl-1-Pentene; 1-Octene

C2C3	Ethane; Propane; Acetylene	Ethane; Propane
Butanes	n-Butane; Isobutane	n-Butane
Pentanes	Isopentane; n-Pentane	Isopentane; n-Pentane
Alkanes	2-2-4-Trimethylpentane; 3-Methylpentane; n-Octane; n-Decane; n-Hexane; 2,4-Dimethylpentane; 2-Methylheptane; 2-Methylhexane; 3-Methylheptane; 2-Methylpentane_Isohexane; n-Heptane; 3-Methylhexane; n-Nonane; n-Undecane; 2,3-Dimethylpentane; 2,3-Dimethylbutane; 2,3,4-Trimethylpentane; 2,2-Dimethylbutane_Neohexane	2-2-4-Trimethylpentane; 3-Methylpentane; n-Octane; n-Decane; n-Hexane; Isohexane
Xylenes	o-Xylene; p-Xylene + m_Xylene	o-Xylene; p-Xylene + m_Xylene
Aromatics	Benzene; Ethylbenzene; Isopropylbenzene; m-Diethylbenzene; n-Propylbenzene	Benzene; Cumene; Naphthalene; t-Butylbenzene
Trimethylbenzenes	1,2,3-Trimethylbenzene; 1,2,4-Trimethylbenzene; 1,3,5- Trimethylbenzene	1,2,4-Trimethylbenzene
Ethyltoluenes	m-Ethyltoluene; o-Ethyltoluene; p-Ethyltoluene	
Cyclos	Cyclohexane; Methylcyclohexane; Methylcyclopentane; Cyclopentane; Cyclopentene	Cyclohexane; Methylcyclohexane
Halogenates	1,2-Dichloroethane; Carbon Tetrachloride; Chlorobenzene; Chloroform; Chloroprene; Trichlorofluoromethane; Vinyl Chloride; Methylene Chloride; Trichloroethylene; Trichlorofluoromethane; 2-Chloropentane; Bromomethane; cis-1,3-Dichloropropylene; 1,1-Dichloroethane; 1,1-Dichloroethylene; 1,2-Dibromoethane; 1,2-Dichloropropane; trans-1,3-Dichloropropylene; 1,1,2,2-Tetrachloroethane; 1,1,2-Trichloroethane; Tetrachloroethylene_Perchloroethylene	1,1,1-Trichloroethane; 1,2-Dichloroethane; Carbon Tetrachloride; Chlorobenzene; Chloroform; Trichlorofluoromethane; Methylene Chloride; Trichloroethylene; Vinyl Chloride; 1,1,1-Trichloroethane; Trichlorofluoromethane
Monoterpenes	a-Pinene; b-Pinene	a-Pinene; b-Pinene

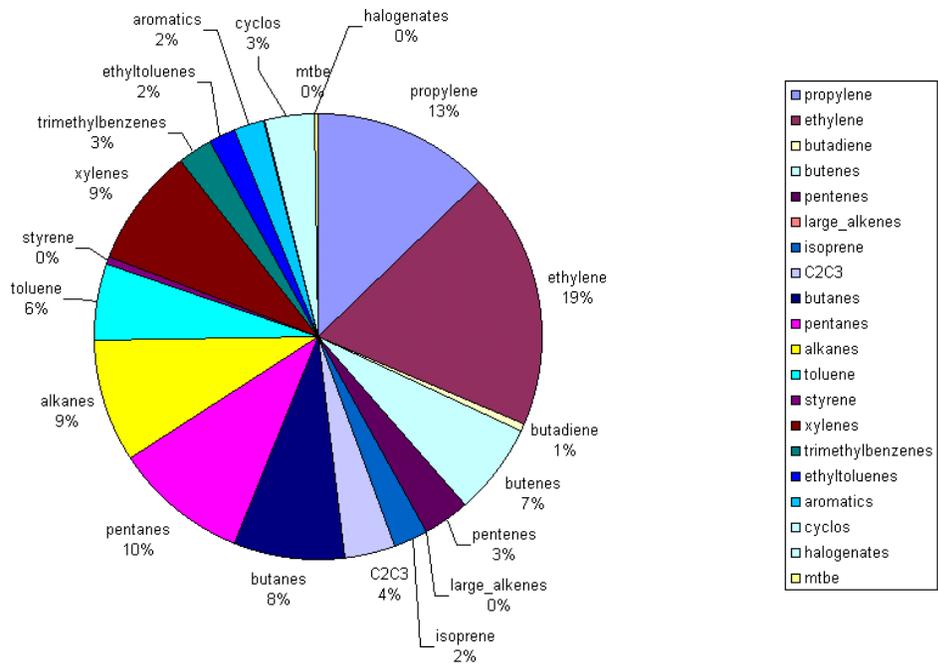


Figure III-2a Median reactivity for high reactivity days at Beaumont C2/C112

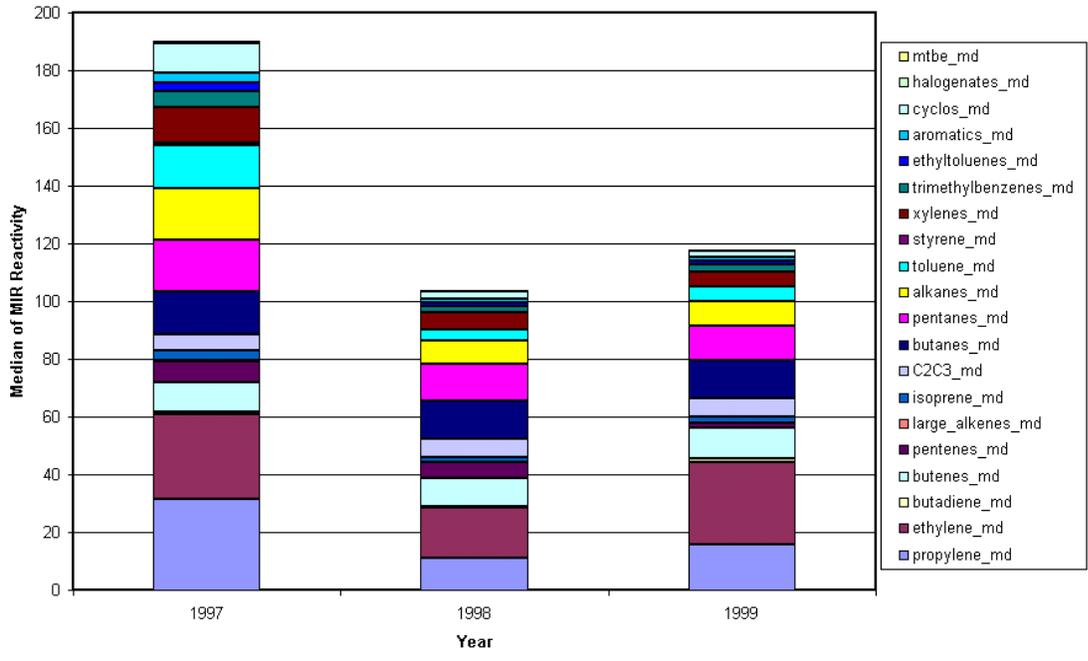


Figure III-2b Median reactivity by year at Beaumont C2/C112

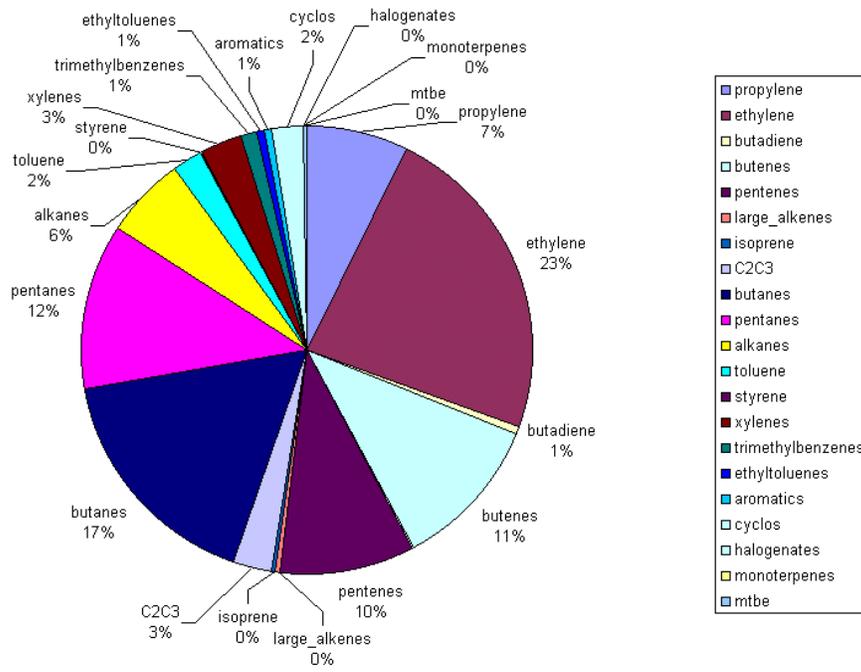


Figure III-3a. Median reactivity for high reactivity days at Port Arthur West C28/C128

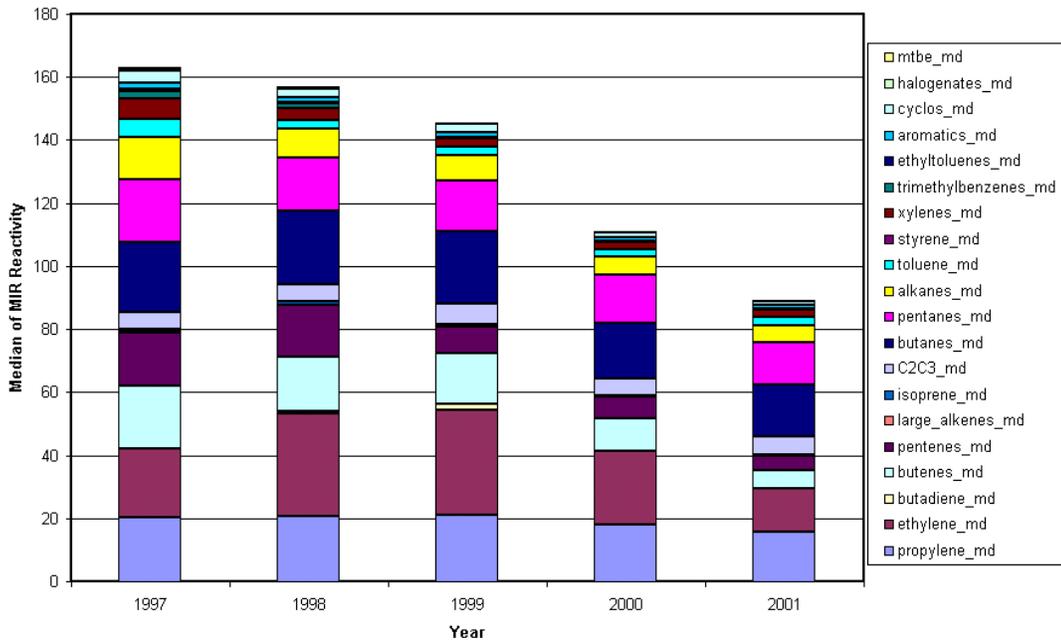


Figure III-3b. Median reactivity by year at Port Arthur West C28/C128

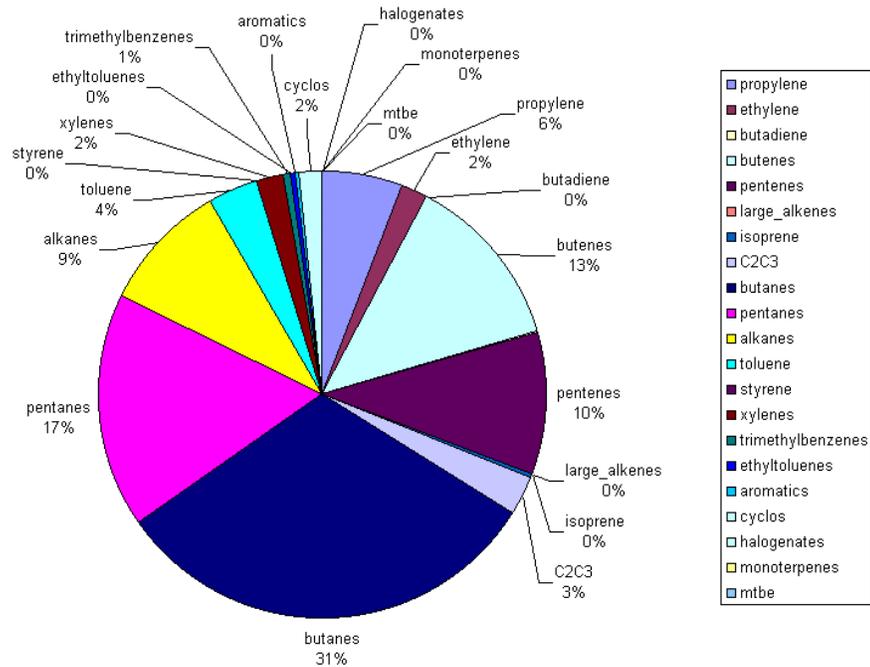


Figure III - 4a. Median reactivity for high reactivity days at Groves C119

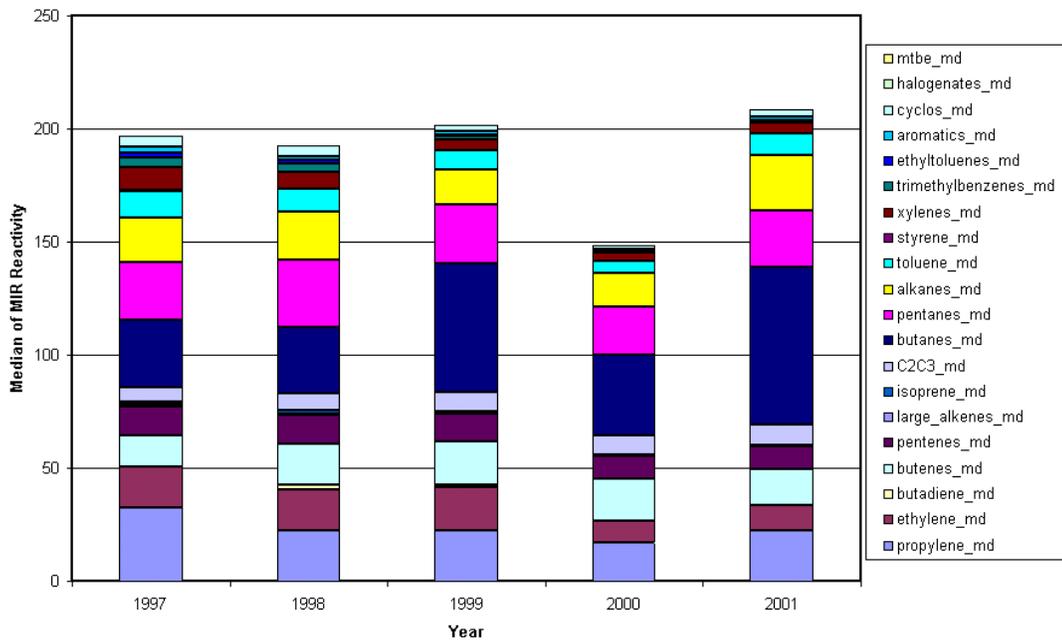


Figure III-3b Median reactivity by year at Groves C119

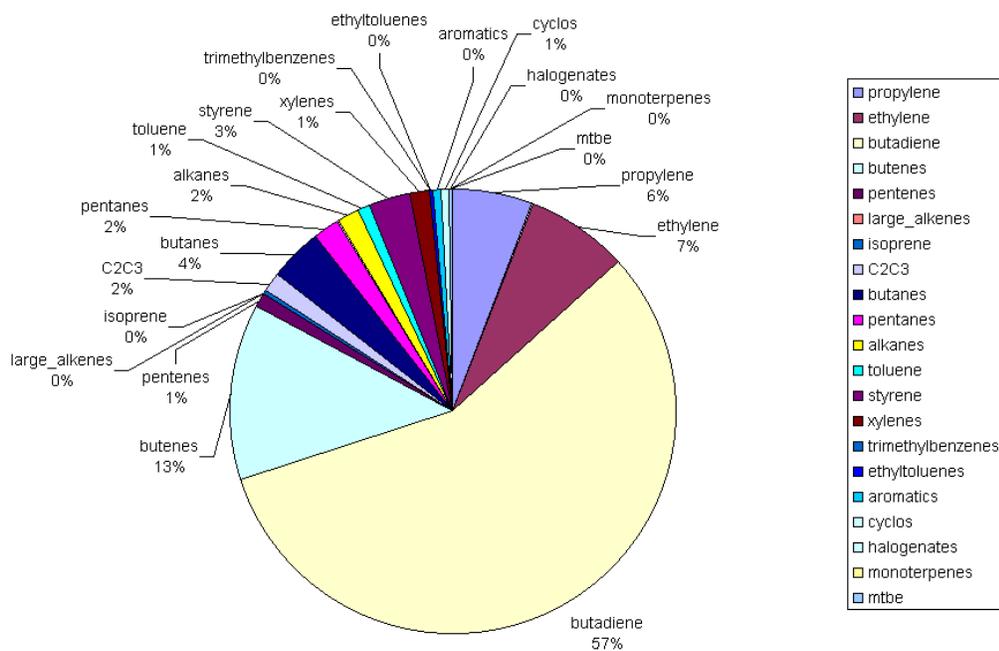


Figure III-5a Median reactivity for high reactivity days at Port Neches C136

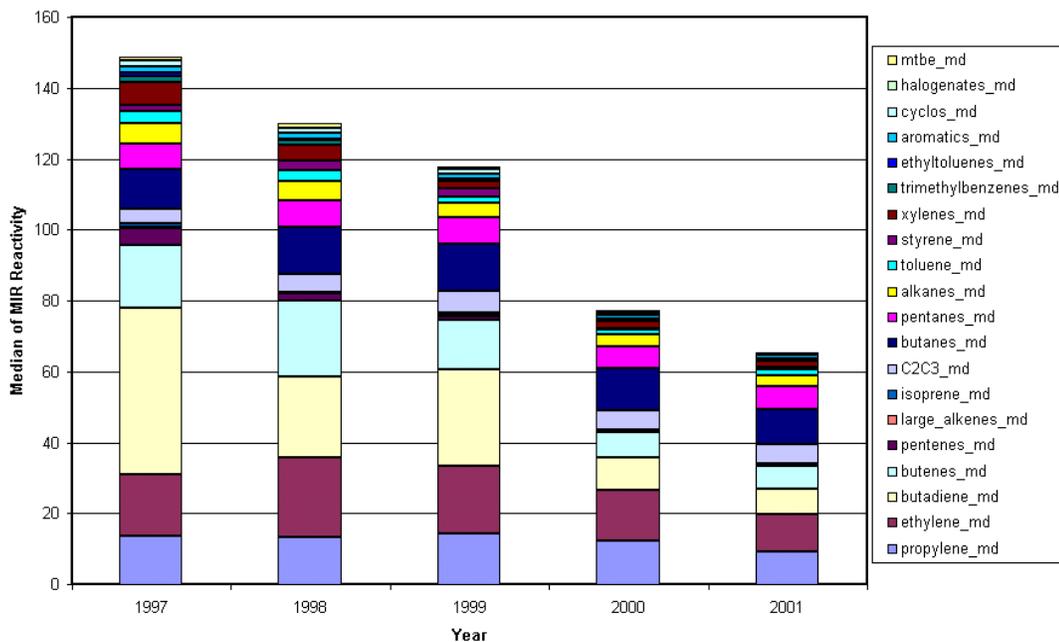


Figure III-5b Median reactivity by year at Port Neches C136

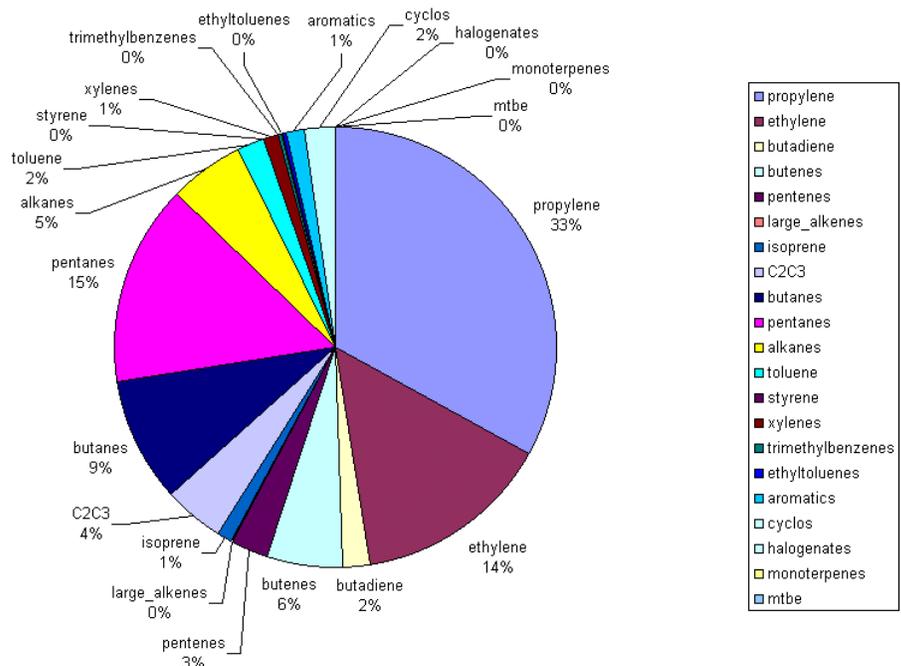


Figure III-6a Median reactivity for high reactivity days at City Service Center C131

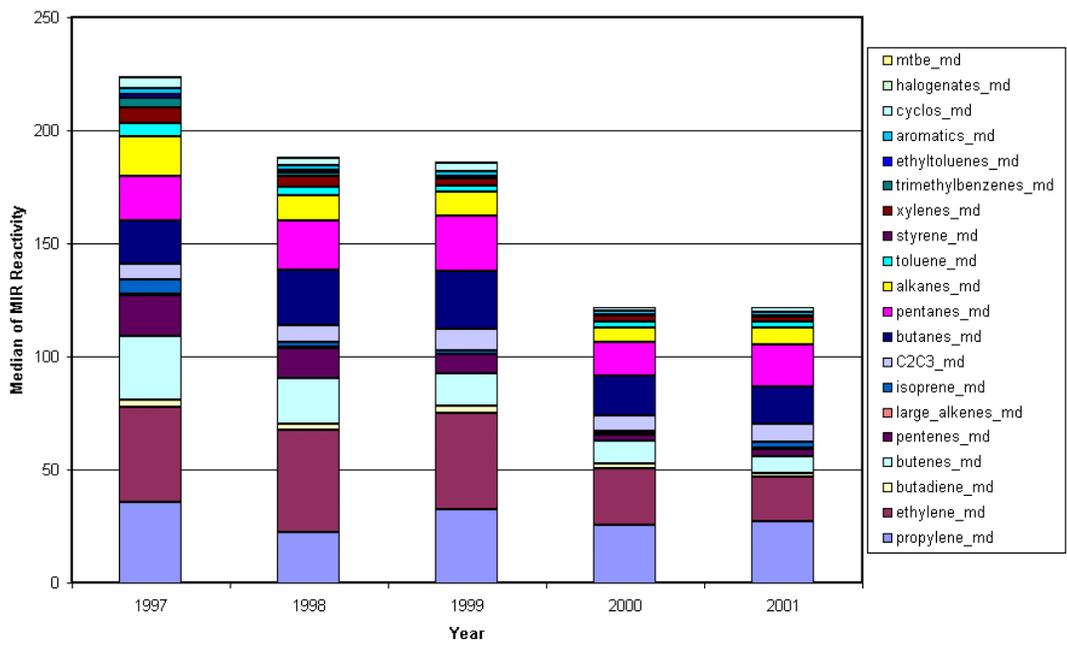


Figure III-6b Median reactivity by year at City Service Center C131

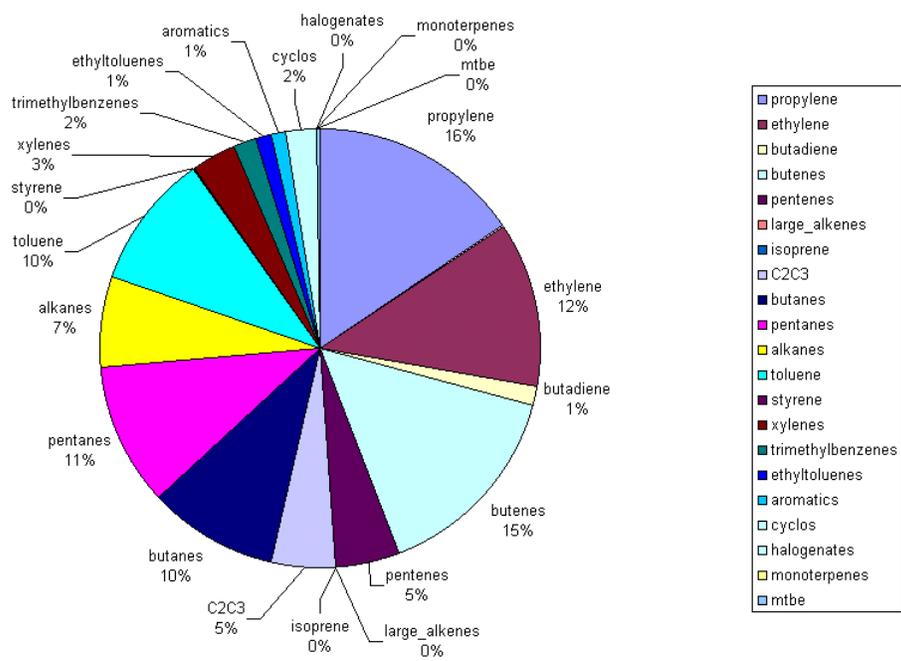


Figure III-7a Median reactivity for high reactivity days at Carroll St. Park C54/C130

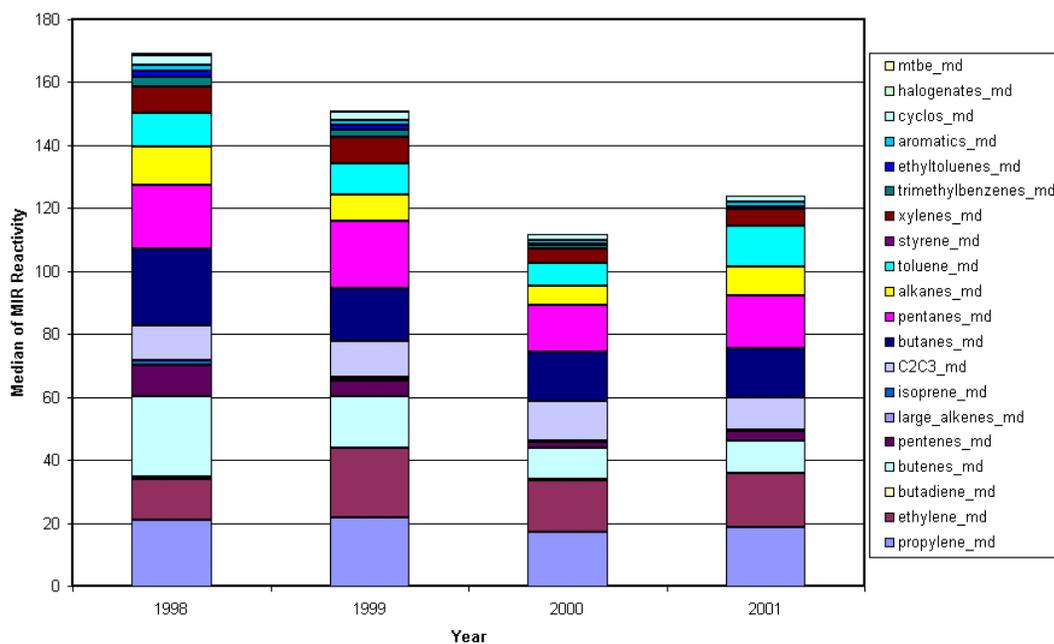


Figure III-7b Median reactivity by year at Carroll St. Park C54/C130

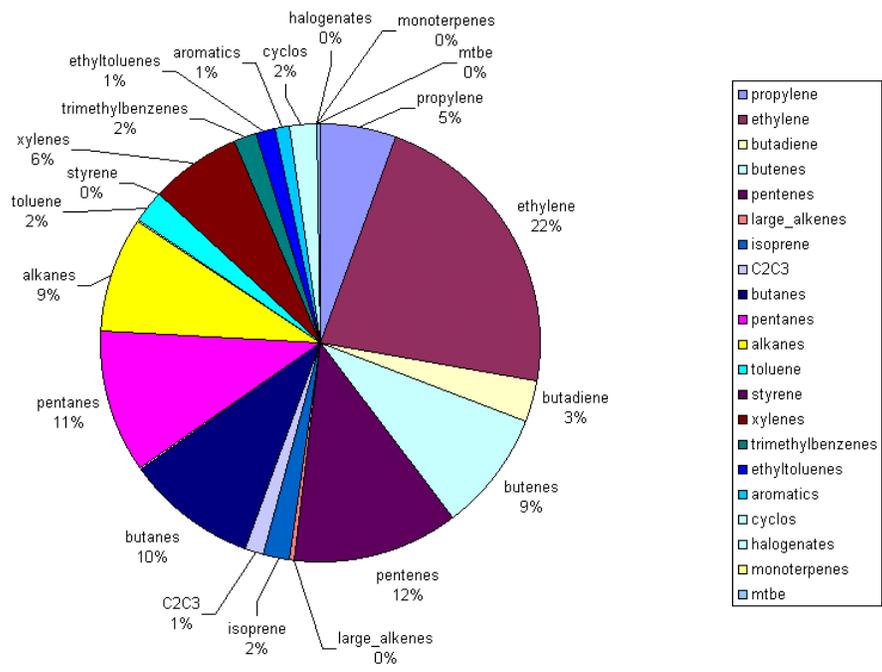


Figure III 8a Median reactivity at West Orange C9/C141

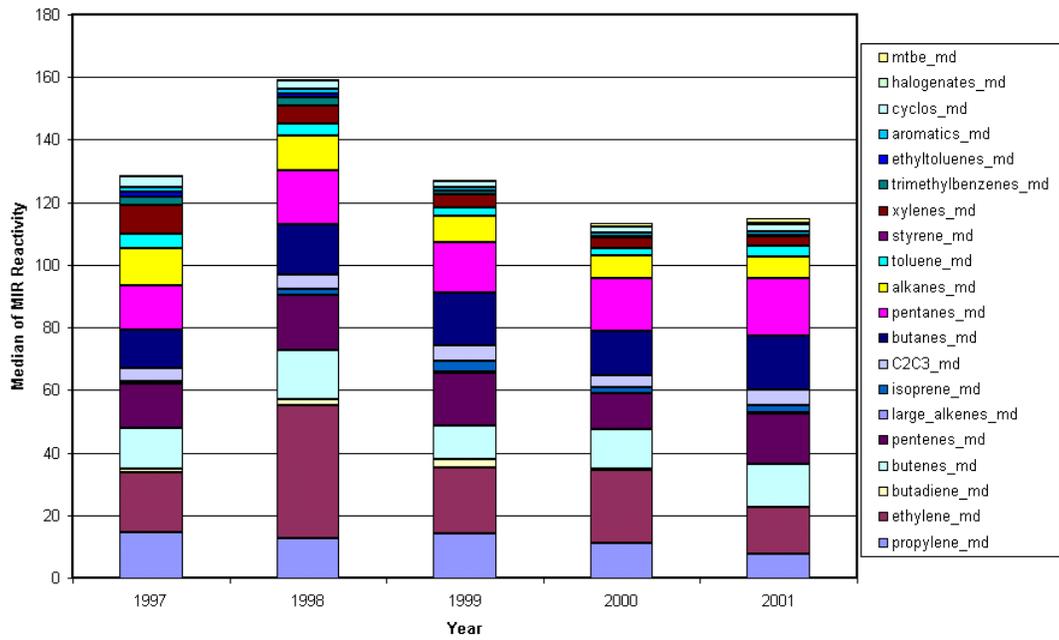


Figure III-8b Median reactivity by year at West Orange C9/C141

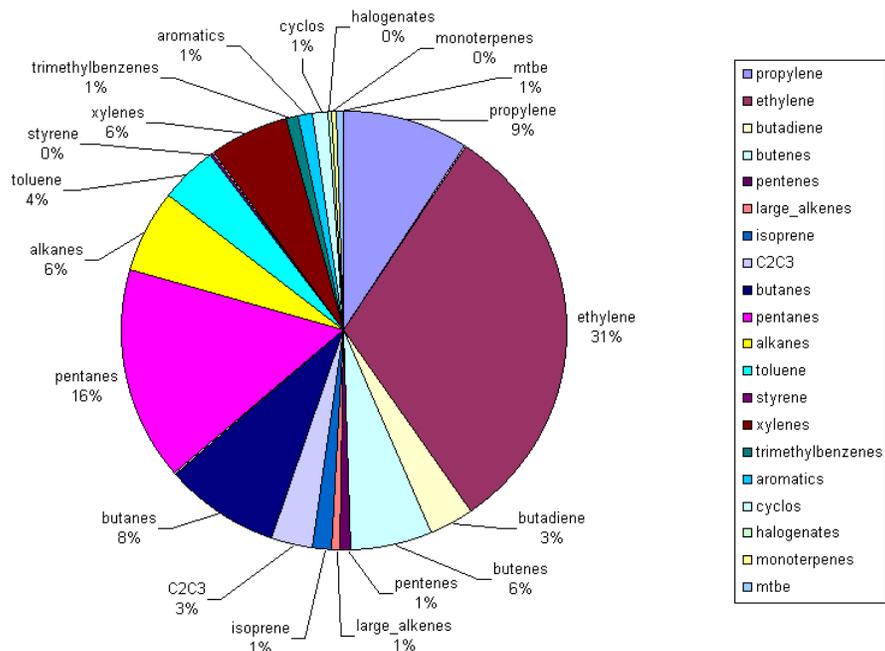


Figure III-9a Median reactivity for high reactivity days at Airport (SETRPC)

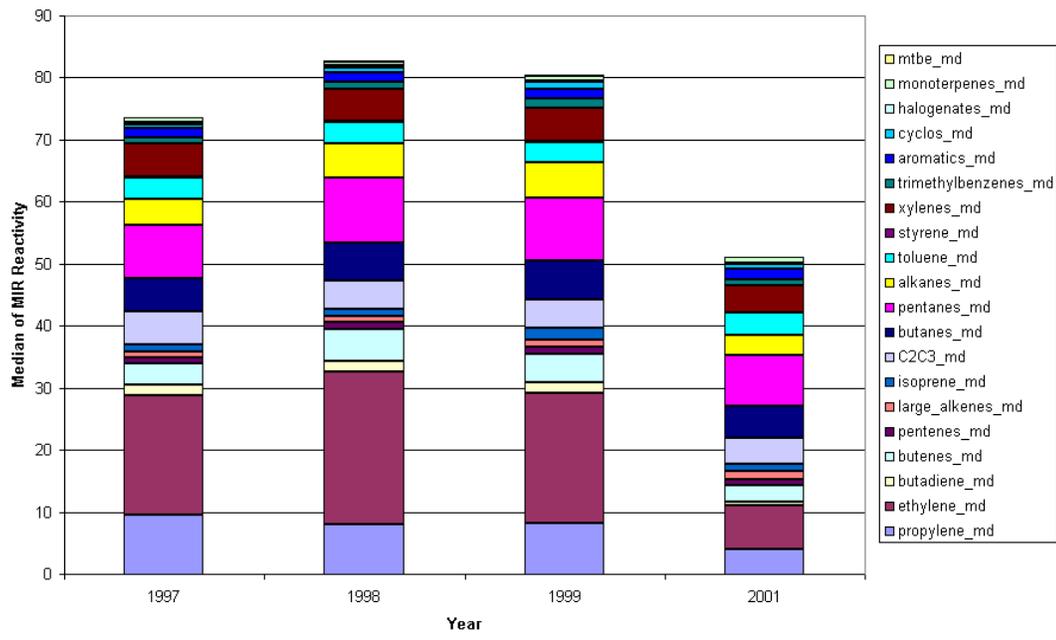


Figure III-9b Median reactivity by year at Airport (SETRPC)

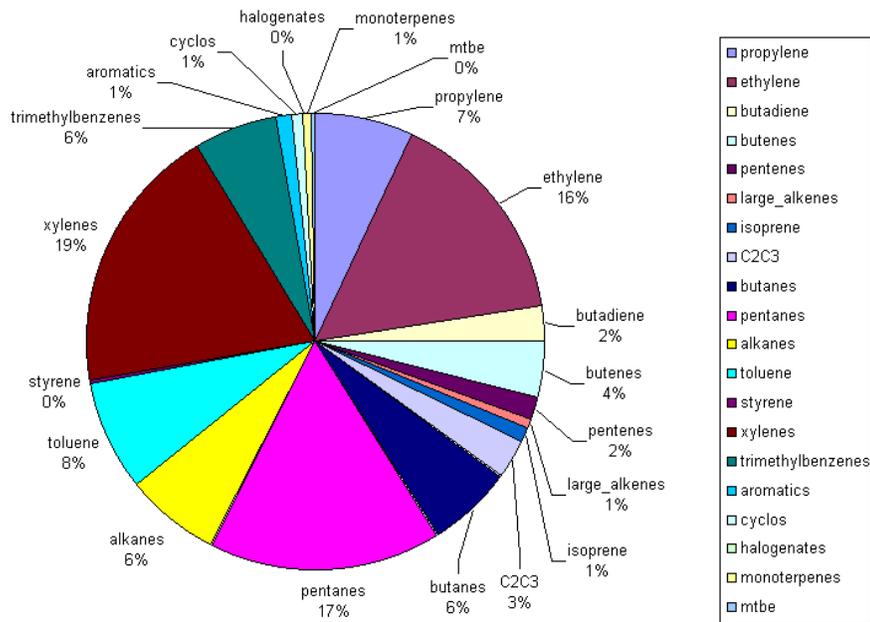


Figure III-10a Median reactivity for high reactivity days at Beaumont (SETRPC)

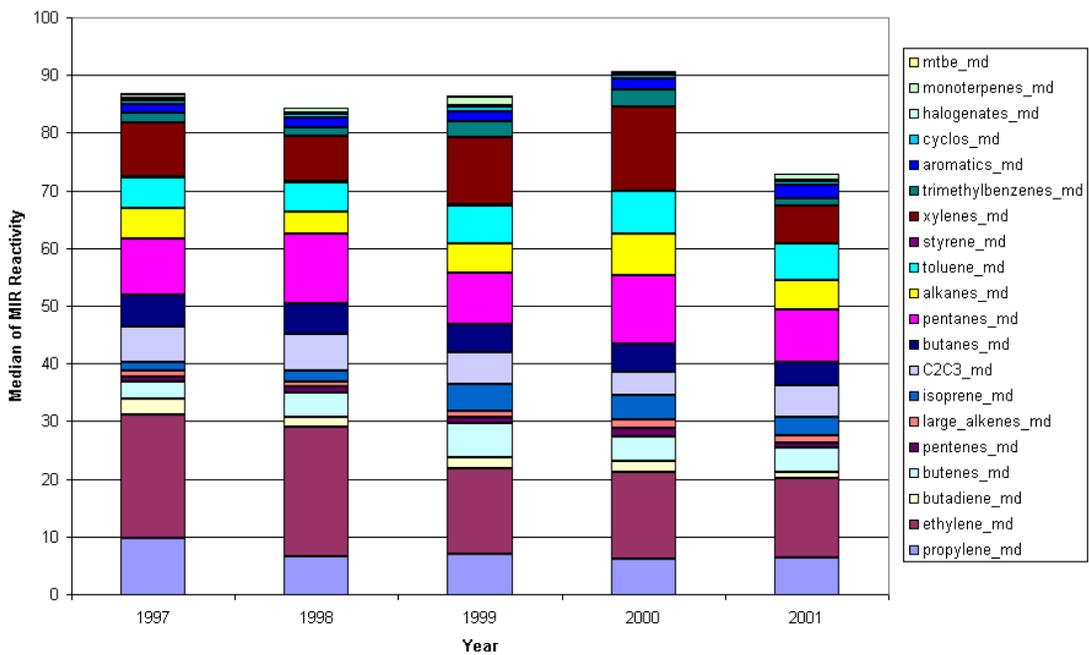


Figure III-10b Median reactivity by year at Beaumont (SETRPC)

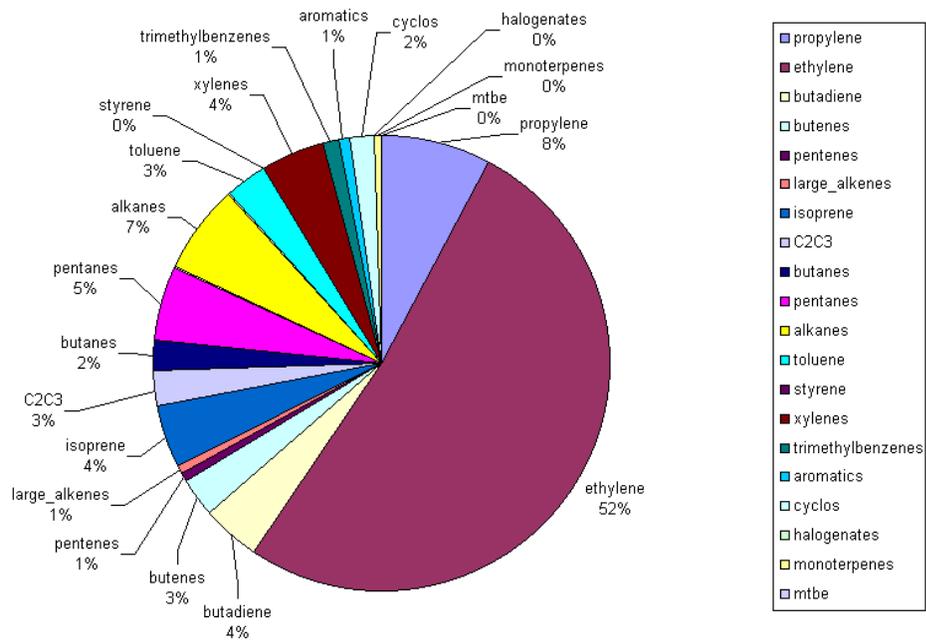


Figure III-11a Median reactivity for high reactivity days at Cove School (SETRPC)

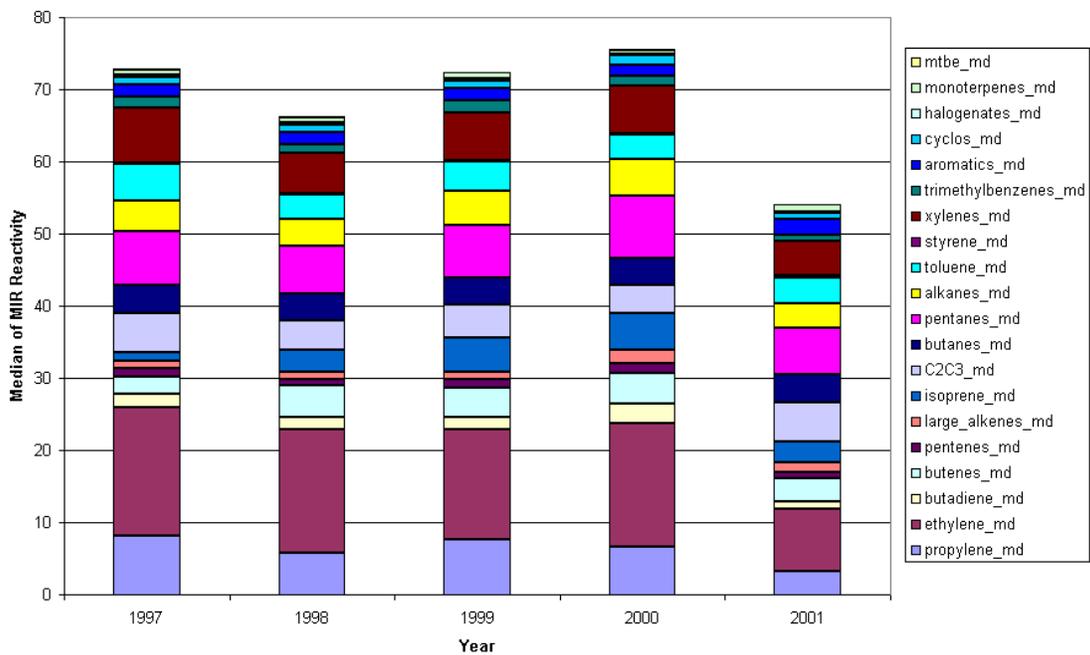


Figure III-11b Median reactivity by year at Cove School (SETRPC)

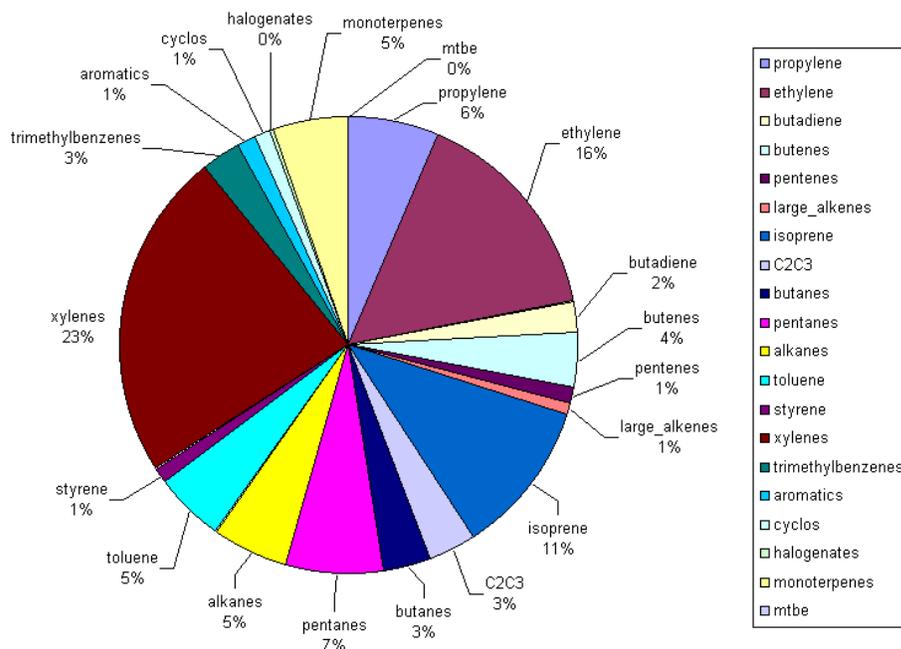


Figure III-12a Median reactivity for high reactivity days at Mauriceville (SETRPC)

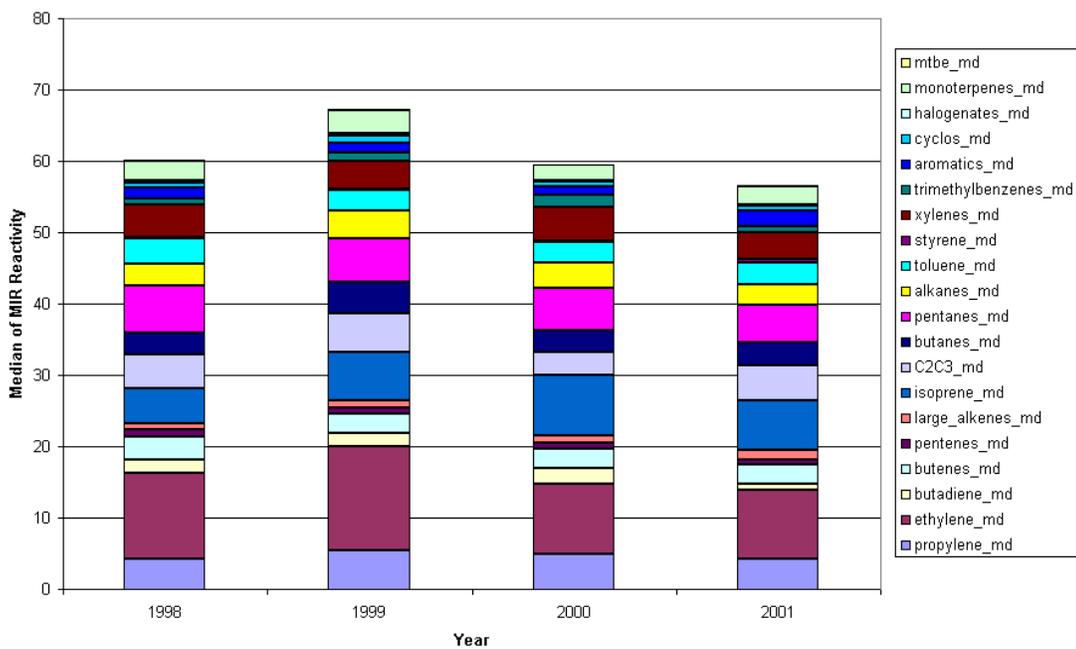


Figure III-12b Median reactivity by year at Mauriceville (SETRPC)

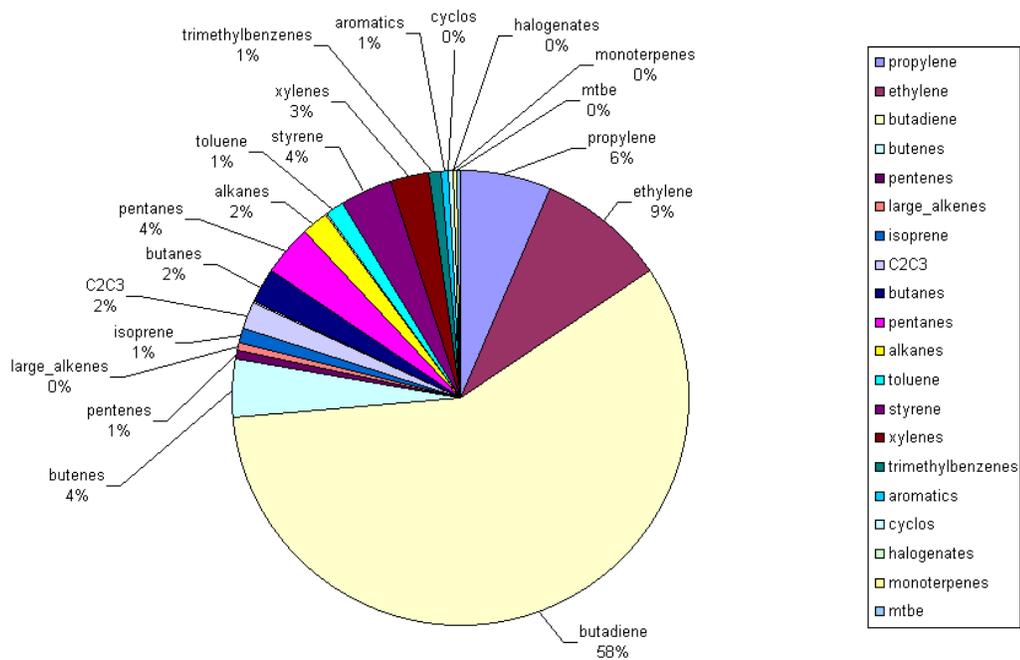


Figure III-13a Median reactivity for high reactivity days at Port Neches (SETRPC)

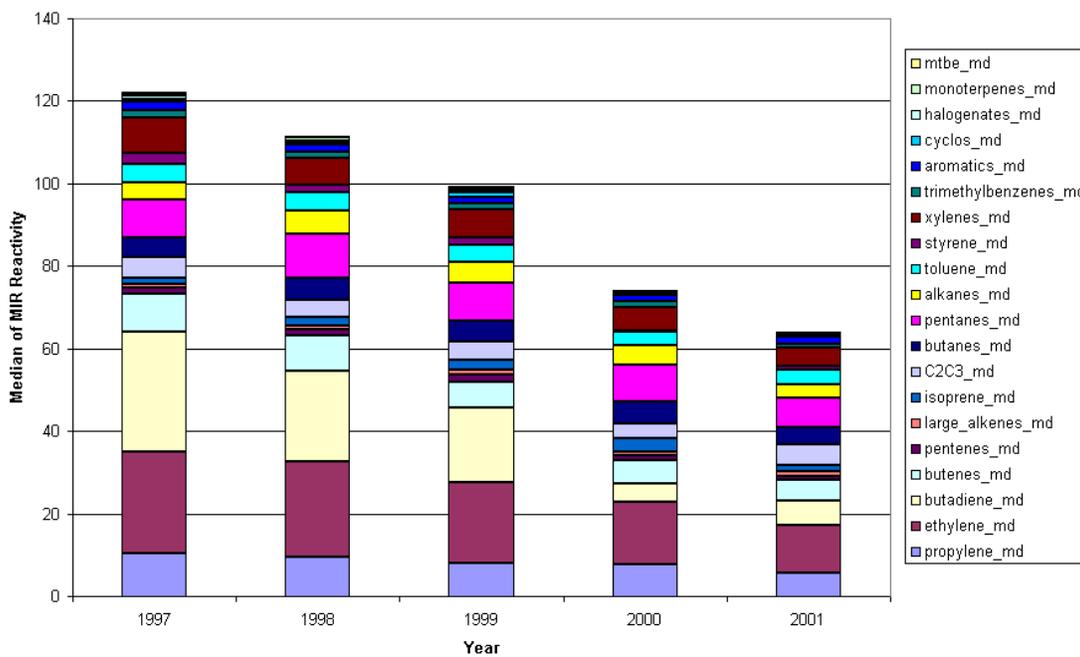


Figure III-13b Median reactivity by year at Port Neches (SETRPC)

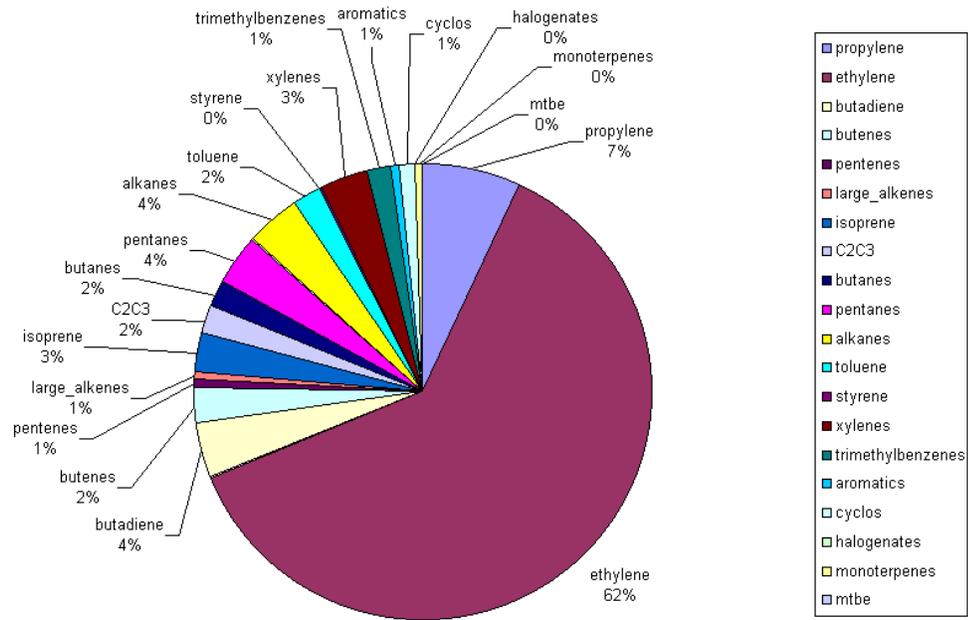
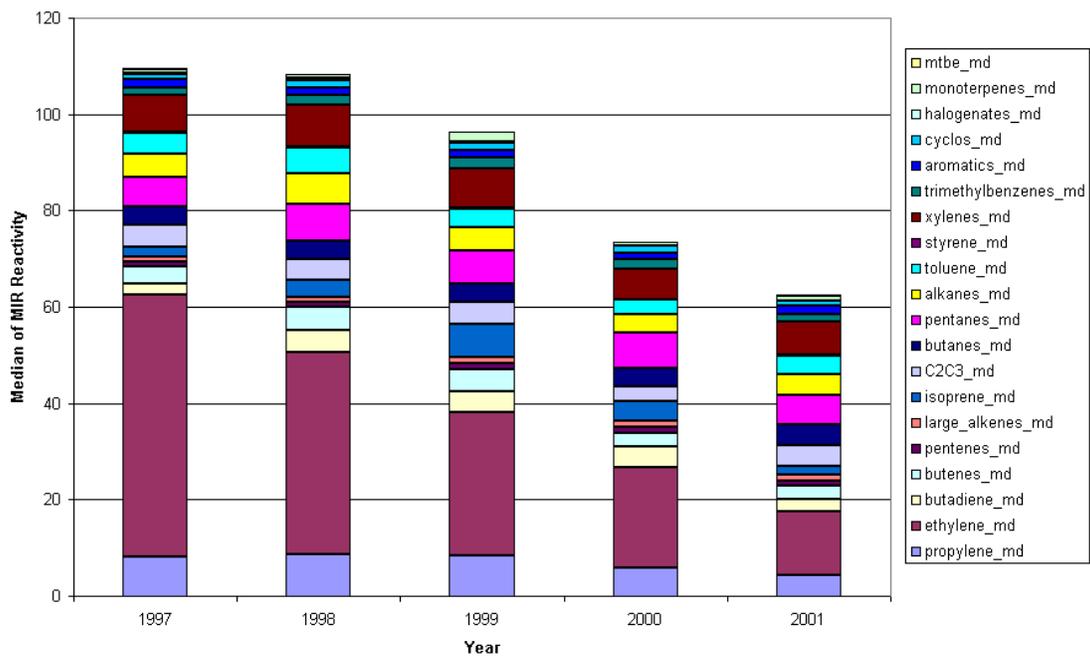


Figure III-14a Median reactivity for high reactivity days at West Orange (SETRPC)



IV Figure III-14b Median reactivity by year at West Orange (SETRPC)

Aircraft data analyses

Eighteen flights in the Beaumont-Port Arthur (BPA) area have been conducted by TCEQ contracted aircraft since 2001. Thirteen of these 18 flights were completed in the fall of 2003 and have yet to be analyzed. Fourteen of the flights were designed to study the emissions from the industrial point sources. Two flights looked at overall BPA emissions and resulting plumes along with some point source emissions sampling. The other two flights were developed to research the transport of pollutants in and out of Beaumont-Port Arthur to and from both Houston and Lake Charles, Louisiana. 82 hydrocarbon canisters have been taken in the BPA area to study the VOC make-up of the area. 56 of the canisters were taken during the fall 2003 campaign and that data is not yet available.

Data from 2001 through early 2003 have been analyzed, specifically for verification of the point source VOC emissions inventory. The rapid alkene detector (RAD) was onboard the contracted aircraft during most flights and was utilized to compare observed concentration to reported emissions data. The RAD is a chemiluminescent instrument that reacts terminal alkenes with ozone to produce photons of light that are converted to a concentration value. To improve the measurement of the terminal alkenes, the flight days took place during non-ozone season months when reaction of these compounds with other atmospheric constituents would be slower. The flight paths were developed to fly close downwind to industrial sources that emit substantial amounts of terminal alkenes. The observed concentrations were then compared to the annual reported VOC emissions inventory to determine if a discrepancy existed. Preliminary results showed that the VOC emissions inventory for the BPA area was underreported, similar to the Houston VOC emissions inventory.

As stated before, two flights studied the main plume from BPA to understand the areas ozone production characteristics. September 25, 2001 was a misty, cool day (75 °F) with background ozone concentrations of approximately 45 ppb aloft under north-northeast flow. The aircraft followed ozone and NO_y south into the Gulf of Mexico and recorded peak ozone over 60 ppb, a 15 ppb gain over background values. Substantial NO_y concentrations (over 10 ppb) and some terminal alkenes were also measured coincident with the ozone. September 13, 2002 had similar wind conditions but was sunny and about 90 °F. Background ozone concentrations were about 70 ppb but the peak ozone measured downwind of BPA over the Gulf was above 130 ppb, indicating that BPA produced about 60 ppb of ozone. The RAD wasn't onboard this flight but NO_y concentrations were near 20 ppb showing significant amounts of precursors were downwind capable of creating ozone. More flights during the ozone season may better characterize BPA's ozone production potential.

The data collected in the fall of 2003 should yield important information about the air quality around the Beaumont-Port Arthur area. The data includes flights dedicated to understanding the emissions of area point sources. Flights were also devised to study the regional transport of pollutants into and out of the area. As more data is collected and evaluated, the BPA conceptual model will be periodically updated.

