Appendix Q. Expanded Analyses of Day of the Week/Weekday Versus Weekend Trends for Measured Air Contaminant Concentrations and Individual Measured Concentration Trends including Correlating Contaminants

Analyses of Day of the Week and Weekday Versus Weekend Trends for Measured Air Contaminant Concentrations.

With only a maximum of 61 data points per monitor over the course of this one year study, this limits the number of data points for each day of the week at each monitor to nine or less. Therefore, the variability in the concentrations due to meteorological differences with a reduced number of data points could make trends harder to visualize. To both increase the number of data points for each day of the week and again to try and limit the influence of wind directionality as much as possible, the sites were combined together and the mean average concentration was calculated over all four sites for each day of the week (Figure Q.1). However, while the data is not presented, each monitoring location was also analyzed individually to ensure that no observations were overlooked by using only the pooled data.

As discussed previously, monitored benzene concentrations are apparently most influenced by the wind direction transporting the emissions from the largest local source of benzene to the monitors. Because the GIBI and BTRS sites have the two highest benzene concentrations and their concentrations also fluctuate in a similar fashion due to the orientation of both with respect to the largest local benzene source (thus doubling the influence on the combined sites concentration with the varied wind directionality), the weekly concentration variations are driven primarily by the similar trends seen at these two monitors (individual monitoring site day of the week trends data not shown). The benzene combined mean concentrations are the highest on Wednesdays and Thursdays (Figure Q.1), but the wind roses for those days indicate potential reasons that the concentrations are elevated these two days (Figure Q.2). The wind patterns for Wednesdays indicate that the percentage of winds from the southwest and south, southwest combined (the direction of the two monitors with the most influential concentrations, GIBI and BTRS, with respect to the largest local benzene source) is the second highest out of all the days of the week. The combined winds from these two degree sectors for Thursdays is only the middle of the range but there are additional winds in the direction of the other two monitors (SPWT and BISP) and their concentrations are also elevated substantially this day of the week. In addition, the percentage of calms is the highest out of all the days, again indicating the influence of wind speeds in dispersing the contaminants. The lower combined mean concentrations on Mondays seems to be an anomaly because this day of the week has the highest percentage of winds from the southwest and south, southwest combined (the direction of the GIBI and BTRS monitors with respect to the largest local benzene source) and the second highest percentage of calm winds. Although 1,3-butadiene appears to track similarly to benzene in response to the changes in wind direction with respect to the orientation of the largest local benzene source and the monitors, 1,3-butadiene does show an elevated combined mean concentration on Mondays, as well as, also having the highest combined mean concentrations on Wednesdays and Thursdays.

The combined mean acrolein concentration was lower on Saturday and Sunday and the combined mean toluene concentration showed an even more substantial decrease on Saturday and Sunday, after both showed a build-up of concentrations throughout the week (Figure Q.1). Both of these contaminants are emitted by mobile sources so this could be due to the higher amount of traffic on the area highways and roads Monday through Friday (with this being an area with a high concentration of industry and smaller businesses) which decreases over the weekend. The combined mean acetaldehyde concentrations for the days of the week indicate the potential for a similar trend, but to a lesser extent and with Wednesdays and Sundays being out of line with the other days of the week. However, reviewing the individual monitoring sites reveals that all four of them follow virtually the same patterns with only a few minor exceptions indicating that this trend is independent of the influences of wind directionality (data not shown). Acetaldehyde is also emitted by mobile sources so the reasoning for this trend provided above could be the case for this contaminant as well. A similar pattern was seen with the concentration of particulate matter less than 2.5 micrometers ($PM_{2.5}$) seen in various cities including New York City in response to the mobile source influence over the course of the week (DeGaetano and Doherty 2004, Lough et al. 2006). However, there may be sources of toluene or of acetaldehyde and acrolein, which are products of incomplete combustion, which are operating only during the weekdays but not on the weekend and could contribute to this observed trend. With the seven day a week operation of the largest local benzene source resulting in similar benzene concentrations on the weekend as compared to the weekdays and the decrease in toluene concentrations over the weekends, the benzene/toluene ratios for Saturdays and Sundays are elevated from that of the weekdays.

The combined mean carbon tetrachloride concentrations do not vary very much at all from one day to the next (Figure Q.1). The combined mean carbon disulfide concentrations do not show any indications of a meaningful trend over the days of the week but are elevated on Wednesdays and Fridays. Again, the combination of wind directionality and percentage of calm winds apparently influenced the elevated concentrations observed (Figure Q.2). At the SPWT monitor, which is closest to the largest carbon disulfide source in the area and has the highest concentration of all four monitors, the combined mean concentration for Wednesdays was elevated (data not shown) with the second highest percentage of winds from the southwest quadrant (the direction of the monitor with respect to the largest source). The next highest combined mean carbon disulfide concentration day at the individual monitoring sites was Friday at the BISP monitor which resulted from the second highest percentage of winds from the northeast quadrant (the direction of the monitor with respect to the largest source) and the third highest percentage of calm winds. Additionally, the combined mean carbon disulfide concentrations for Wednesdays and Fridays were in the top three at both the BTRS and GIBI monitors with the wind roses again indicating an influence from both directionality (combinations of winds and resultant vector from the south to southwest direction towards the largest source in the area) and percentage of calm winds (third highest on Fridays). The combined mean formaldehyde concentrations do not show any indications of a meaningful day of the week trend.

Following up on the day of the week analyses, the all sites combined mean concentration for all the weekdays together versus all the weekend days together were compared (Figure Q.3). By pooling all the weekdays and the two weekend days together, the combined wind patterns

became more similar to each other, as compared to, those for the individual days of the week (Figure Q.4). The combined monitoring sites again allowed for the influences of the wind directionality to be reduced. There was a higher percentage of calm winds for the combined weekdays (4.64%) then there was for the combined weekend days (1.23%) which could have contributed to the observed increases in the contaminant combined mean concentrations. The results of this analysis indicated that the following contaminants had the largest increase in combined mean weekday concentration as compared to the combined mean weekend concentration: Toluene at 38%, 1,3-butadiene at 32%, Acrolein at 16%, and Acetaldehyde at 15%. The weekday and weekend concentrations for formaldehyde, benzene, carbon tetrachloride, and carbon disulfide showed very little difference to one another with the largest difference being only 6%. While it has been noted that there are indications of similarities between the concentration trends of benzene and 1,3-butadiene, here a difference is seen. It appears that the much higher concentrations of benzene, arising from the influences of the largest local benzene source, mask most of the influences from the mobile source or smaller local point source emissions. Whereas, the much lower emissions of 1,3-butadiene from the largest local benzene source allow for the influences of mobile source and/or other point sources operating only during the weekdays to be observed, similar to that discussed above for toluene, acrolein, and acetaldehyde. With very little weekday to weekend differences in average benzene concentration, along with the substantial decrease in average toluene concentration on the weekends as compared to the weekdays, the benzene/toluene ratio increases by 34% on the weekends versus the weekdays.

Analyses of the Individual Measured Concentration Trends and Similarly Correlating Air Contaminants.

To further indicate similarities or differences in the concentration trends between the different contaminants at the same monitoring site or between the different monitoring sites for the same contaminants, individual data points for all of the monitoring days were analyzed using line graphs. The benzene line graphs of the individual data points at all four monitors indicate that the two monitors that are in the same direction with respect to the largest local benzene source, GIBI and BTRS, track very similarly to one another (Figure Q.5). However, the overall trend lines for the GIBI and BTRS monitors differ, for the most part, from those for the SPWT and BISP monitors. This graph is presented using the log scale in order to observe the trends for all four monitors because of the large differences in the relative benzene concentrations measured at each site. These relationships provide additional indications that the benzene concentrations are driven more by the wind directionality with respect to local sources, as opposed to regional transport which would result in similar trends for all four monitors. There are situations where all four monitors do show similar trends for benzene on particular days during which another factor or factors appear to additionally be exerting an influence(s) on the resulting concentration. Reviewing the wind roses for these isolated days indicates that the wind speeds, in addition to the wind direction, appear to be playing a role in the measured concentrations (data not shown). For example, three days where the benzene concentrations were elevated at all four monitors, 4/24/08, 9/21/07, and 11/2/07, had calm winds percentages of 12.5%, 8.33%, and 4.17%, whereas, three days where the benzene concentrations were depressed at all four monitors, 1/7/08, 3/31/08, and 5/30/08, all have calm winds percentages of 0% in addition to having wind directionality that did not directly line the largest local benzene source up with any of the

monitors. The calm winds percentage of 4.17% on 11/2/07 is somewhat lower than the other two days with high benzene concentrations at all four monitors, but reviewing the wind rose reveals that the winds are primarily in the lowest wind speed range with no wind speeds higher than the second lowest wind speeds range and the wind directionality indicates shifting winds throughout the day in most directions. As one could imagine, having shifting low speed winds from a wide variety of directions would result in a more stagnant mass of air that would not allow the contaminants, including benzene, to disperse into the upper atmosphere and/or out of the area.

The carbon tetrachloride line graphs of the individual data points at all four monitors indicate that they all track very similarly to one another (Figure Q.6). In addition, even with the substantially smaller range of the concentration scale, one can see how the carbon tetrachloride concentration had much less temporal variation than benzene did. Both of these suggest that this contaminant's concentrations are driven primarily by regional transport of the pollutant into the area. The acrolein line graphs of the individual data points at the monitors indicate that there are only isolated occasions where all four monitors have similar concentration trends and, while the GIBI and BTRS monitors track together at times, this is much less apparent then with benzene (Figure Q.7). This might arise from the presence of more numerous sources of acrolein in the industrial area and the lower overall difference between the amount of emissions coming from the largest industrial area sources and from the variety of other sources in the area. Therefore, the wind directionality variations result in a different mix of acrolein emissions, from the variety of sources, influencing each of the monitors from different degree sectors at varied percentages. However, there are some large sources of acrolein (which is a product of incomplete combustion) nearby in the industrial area, including the largest local benzene source. Therefore, there are situations where the meteorological conditions would be expected to result in similar trends being observed at the GIBI and the BTRS monitors, as they are lined up with respect to the industrial area and this source. Acrolein is very unstable with a half life in the range of 8 to 19 hours and quickly reacts with other products in the atmosphere. Concurrently, photochemical reactions occur in the atmosphere producing secondary acrolein from precursor chemicals (such as 1,3-butadiene). Further indicating that the largest local benzene source is only one of many acrolein sources in the area, or that the instability resulting in rapid destruction and/or secondary formation is occurring, is the lack of overall similarities of the trendlines for both benzene and acrolein at either the GIBI or the BTRS monitors (Figures Q.8-9). In contrast, the trendline for 1,3-butadiene compared to benzene at both the BTRS site, and especially, the GIBI site are very similar. These graphs are presented in log scale in order to observe the trends for all three contaminants because of the large differences in the relative concentrations for each contaminant. There are instances when all four monitors show similar acrolein concentration trends, indicating that another influencing factor(s) in addition to wind directionality is potentially exerting its effects (Figure Q.7), and the wind speed seems to provide an explanation (data not shown). On both 7/5/07 and 4/18/08, the acrolein concentrations were elevated at all four monitors and the percentage of calm winds were 12.5% and 20.83%, respectively. In contrast, the acrolein concentrations were reduced at all four monitors on both 1/1/08 and 1/19/08 and the percentage of calm winds were 0% on both of these days.

The 1,3-butadiene line graphs of the individual data points at the monitors indicate that the GIBI and BTRS monitors have similar trends and, while they do not track together as closely as benzene, they are more similar than the acrolein concentration trendlines for these two monitors

(Figure Q.10). This indicates that the lower overall emissions of 1,3-butadiene from the largest local benzene source, as compared to those of benzene, allow for the additional smaller sources of 1,3-butadiene to exert their influences on the measured concentrations or that the increased reactivity of 1,3-butadiene (half-life of roughly 1 to 9 hours) results in the differences in the trends observed between these two monitors. This graph is presented using the log scale, again in order to observe the trends for all four monitors because of the large differences in the relative concentrations measured at each site. To see how certain contaminants compare to one another at the same monitor location, the GIBI monitor was used because it is the closest to the industrial area and the largest local benzene source. As stated previously, the trendlines of the benzene and 1,3-butadiene concentrations are similar but, while the trendline for acrolein shows some similarities to these other two contaminants, overall it tracks much less closely with either benzene and 1,3-butadiene as these two contaminants track with respect to one another (Figure Q.9). Next, the individual trendlines of the benzene concentrations were compared to the concentrations of toluene, m,p-xylene, o-xylene, and the benzene/toluene ratio at the GIBI monitor (Figure Q.11). The two xylenes tracked almost identically with one another and toluene was very similar to the xylenes but with some subtle differences and a few isolated variations. As all these contaminants are emitted by the largest local benzene source, the benzene trendline does show many similarities to these other three contaminants. However, the lower emissions and, subsequently, overall concentration levels of toluene and the xylenes result in the influences from other emissions (such as mobile sources) being greater overall, thus leading to additional differences between these three contaminants and benzene. The substantially higher concentrations of benzene as compared to toluene cause the benzene/toluene ratio to primarily be influenced by, and therefore track closely with, the benzene concentrations. This graph is presented in log scale, again because of the large differences in the relative concentrations/ratio.

The formaldehyde and acetaldehyde line graphs of the individual data points at the monitors indicate that all four track very similarly to one another (Figures Q.12-13). This was not expected because with a half-life of only around one day or less, as opposed to over 50 years like that of carbon tetrachloride, it was unexpected that these two contaminants were acting like a regional background air pollutant drifting over the study area and causing similar trends to be observed at all four monitors simultaneously. However, because both of these contaminants (being the smallest two carbonyls) can be formed secondarily in the atmosphere by photochemical reactions breaking down larger hydrocarbon molecules, it was thought that potentially a higher percentage of calm winds would allow the time necessary for the precursor chemicals to remain in the area and undergo the chemical transformations to these smaller compounds. This is supported by the previous discussion of the different concentrations resulting from lower versus higher average wind speed days which showed that formaldehyde had the second largest percentage increase during the lowest average wind speed days as compared to the highest average wind speed days at 240% and acetaldehyde had the third largest percentage increase at 76%.

The GIBI monitor was again used to investigate if formaldehyde and acetaldehyde have similar trendlines, as they can both be formed through the secondary atmospheric chemical breakdown reactions. With only a few minor exceptions, formaldehyde and acetaldehyde do track together indicating that their measured concentrations are due to the same processes (Figure Q.14). The trendline for the carbonyls was then compared with those for the various other products of

incomplete combustion and mobile source contaminants at the GIBI monitor in order to see how they matched up with one another (Figure Q.15). Only one of the xylenes (o-xylene) and one of the carbonyls (formaldehyde) was included due to the similarity with the other closely related contaminant (m,p-xylene and acetaldehyde, respectively), and 1,3-butadiene was also not included because of how closely it tracked with benzene. There appeared to be some agreement between formaldehyde and certain contaminants at certain times, but overall there was not a strong correlation between formaldehyde and these other incomplete combustion/mobile source contaminants.

Because of the similarities between formaldehyde and acetaldehyde with respect to one another and across all four monitoring sites, to investigate the theory of secondary formation of these two contaminants from atmospheric precursors, the concentrations of both formaldehyde and acetaldehyde over the four different sites were combined into one trendline. Then, whether or not any correlation existed between the measured concentrations and either the average wind speeds or an additional variable involved in the secondary formation of these compounds through atmospheric chemical reactions, insolation, was investigated. Insolation is the intensity of the sun's rays penetrating through the atmosphere. The overall solar intensity is primarily driven by the angle of the sun's rays with respect to the Earth's atmosphere and depends both on the time of year and the latitude (however, other variables such as cloud cover also affect the amount of insolation on any given day). The insolation differences throughout the year due to the angle of the solar radiation is the major influence in the seasonal temperature trends (shorter term wind patterns and short-term insolation variations both cause fluctuations around the general seasonal temperature trend, however). The time of the year was the only gauge of insolation available and, as expected, it showed a close relationship with the general temperature trends. Therefore, because only the direct measurement of temperature was available, it was used to represent insolation. A relationship between these two carbonyls and temperature or season is supported by the previous discussion of the different concentrations resulting from lower versus higher average temperature days and the monthly trends/seasonality analyses. Recall that the formaldehyde showed the largest percentage increase during the highest average temperature days, as compared to, the lowest average temperature days at 325% and acetaldehyde showed an almost 50% increase. Additionally, the monthly trends for both of these carbonyls indicated a relationship of increasing concentrations with increasing temperatures, which was further supported by the percentage increases for the summer months versus the winter months, where formaldehyde had the largest increase at 300% and acetaldehyde was also among those with the highest percentage increases at 39%.

Reviewing the line graph of the individual monitoring days for the all sites formaldehyde and acetaldehyde combined concentration indicated that this trendline had correlations with both average temperature and average wind speeds. The long-term trend for the combined concentrations over the full year followed the annual temperature trendline (Figure Q.16). The highest concentrations were generally seen at the beginning of the study period when the temperatures were also the highest, followed by a marked decrease in concentrations in late November to early December when the temperatures also dropped and both stayed lower until March when the temperatures began to steadily rise again along with the combined concentrations. There was also some agreement between the short-term changes in average temperature and combined carbonyls concentration. However, the overall lack of similarities in

the short-term combined concentration and temperature trendline fluctuations indicates that another factor, such as the wind speeds, was the primary influence driving the shorter term trends (e.g. daily), whereas, the temperature/insolation drives the general, longer term trends. The short term/daily trendline does indeed indicate a reverse correlation with average wind speeds (Figure Q.17). While there are instances where this inverse relationship breaks down indicating that there is another factor influencing the measured concentration to a greater degree at that time, very regularly when the average wind speeds are low or decrease, the combined concentration is high or increases and vice versa. Evidence of this inverse relationship between the two trendlines can even be observed during the winter months when the least amount of overall atmospheric secondary formation is occurring. There are cases when this relationship breaks down but most of these instances could be explained by influences of the short-term temperature fluctuations. For example, on 9/27/07, 10/3/07, 10/21/07, 11/8/07, 11/26/07, 12/8/07, 4/6/08, and 6/17/08 when the combined concentration and the average wind speed did not show the inverse trend, the temperature that day showed a direct relationship with the combined concentration potentially explaining the pattern for the resulting measured concentration.

After discovering this relationship with these two carbonyls, whether or not similar relationships could be observed for other contaminants was investigated. Acrolein was investigated first because of the previous indications that both temperature and wind speeds are influencing factors for the concentrations measured. The average acrolein concentration was 51% higher with the lowest average wind speed days as compared to the highest, and acrolein showed the strongest monthly trend of a direct correlation between average temperature and concentration. The percentage increase in acrolein concentration from the winter months to the summer months was the third highest at 58%, and percentage increase over the highest average temperature days as compared to the lowest average temperature days was among the highest at 78%. As described earlier, the individual acrolein trendlines for the four different monitors, while showing some similarities between the two monitors that are in the same general direction with respect to the industrial area (GIBI and BTRS), indicated not only much more variability between these two monitors, but also, fewer instances where all four monitors showed similar trends. Again, this increased variability in the line graph of the individual monitoring days potentially arises because of the numerous widespread sources of acrolein, along with, the lower relative emissions from the largest industrial area sources and the instability/reactivity of acrolein. Therefore, acrolein is being produced by both emissions from a wide variety of sources and by secondary formation through atmospheric photochemical reactions while, at the same time, acrolein is being reduced by reacting with other products in the air. This results in increased temporal and spatial variability in acrolein concentrations.

Once again, to investigate the general effects of average temperature and wind speed and to reduce the overall influences from wind direction, the acrolein concentrations from all four monitors were pooled together into one trendline. The comparison of this mean pooled acrolein trendline and the average temperature indicated that the concentration not only followed the general longer term temperature trend over the course of the year (similar to the carbonyls), but also that it was influenced by the shorter term variations in temperature as well (Figure Q.18). The comparison between the mean pooled acrolein concentration and average wind speed indicated, however, that the short-term inverse correlation between these two variables also apparently existed (Figure Q.19). The times when either one of these inter-relationships broke

down, it appeared as though the other independent variable was exerting a greater influence on the acrolein concentration, causing it to break from agreement with the less influential variable on that particular day. For example, on, 8/4/07, 9/15/07, 11/26/07, and 2/12/08 the combined acrolein concentration went up even though the average temperature dropped, but the average wind speed dropped dramatically that day indicating that it was the more influential factor. The opposite also held true, in that, when the combined acrolein concentration decreased even though the average temperature increased, the average wind speed for that day was substantially increased (e.g. 7/11/07, 7/29/07, 10/3/07, and 2/18/08). A similar situation was observed when the inter-relationship with the other independent variable, average wind speed, was investigated. For example, on, 8/28/07, 10/21/07, 11/14/07, 1/7/08, and 6/23/08 the combined acrolein concentration went up even though the average wind speed also went up but looking at the average temperature shows that it increased dramatically that day. The opposite again also held true, in that, when the combined acrolein concentration decreased even though the average wind speed also decreased, the average temperature for that day was lower (e.g. 7/17/07, 8/22/07, 10/15/07, 11/2/07, 11/20/07, 1/13/07, 2/24/08, 3/31/08, 4/12/08, 4/30/08, and 6/17/08). The temperature fluctuations appear to exert a greater influence on the resulting acrolein concentrations measured (as compared to the wind speed variations) because, when these two variables were exerting opposing influences, the concentration trendline more often followed the temperature fluctuations. Only a few anomalies were found when either the combined acrolein concentration decreased even though both the average temperature increased and the average wind speed decreased (3/31/08), or the combined acrolein concentration increased even though both the average temperature decreased and the average wind speed increased (9/3/07, 3/25/08, and 6/11/08).
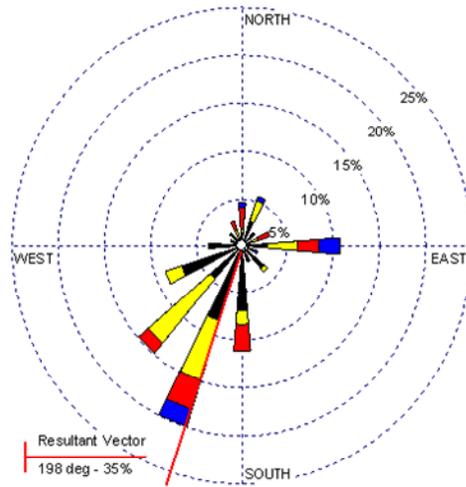
The combined sites concentration trendlines for carbon tetrachloride does not indicate a correlation with either average temperature (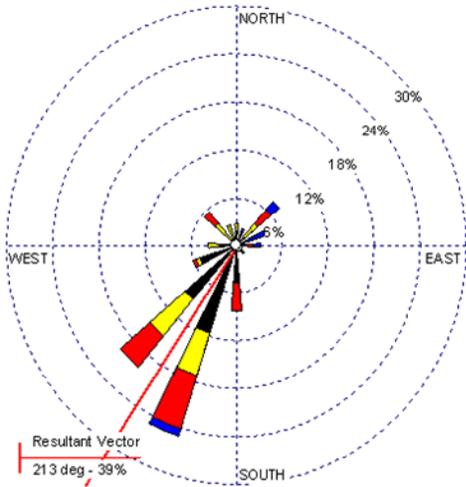long or short-term) or average wind speed (Figures Q.20-21). The combined benzene concentration and the combined sites benzene/toluene ratio, which is driven primarily by the benzene concentrations, do not indicate strong correlations with either average temperature (long or short-term) or average wind speed (Figures Q.22-25). This is further support that wind direction appears to be the factor exerting the largest influence on the resulting benzene concentration measured. The combined sites concentration trendlines for 1,3-butadiene, tracking similarly to benzene, also does not indicate a strong correlation with either average temperature (long or short-term) or average wind speed (Figures Q.26-27). However, there are a few instances where the benzene and 1,3-butadiene concentrations differ and it appears that the 1,3-butadiene concentration is at least partially driven by the average wind speed (e.g. 10/21/07 and 10/27/07). Previous results indicated that the largest local benzene source was primarily contributing the airborne concentration of these contaminants, but that benzene emissions are substantially higher than those of 1,3-butadiene. The lower emissions of 1,3-butadiene is believed to allow the influences from other variables to be exerted to a greater extent, whereas, the higher emissions of benzene appear to mask most of these other influences. The combined sites concentration trendlines for toluene and total xylenes, being very similar, both potentially indicate only a weak correlation with average temperature (both long and short-term) and a moderate inverse correlation with average wind speed, although slightly less of a correlation for toluene (Figures Q.28-31). The similarities and differences between the combined total xylenes/combined toluene concentration and the combined benzene concentration potentially indicate that, similar to the relationship between benzene and 1,3-butadiene, the

largest local benzene source is a predominant source but that there are additional sources in the area (e.g. mobile sources and additional stationary sources) and the measured concentrations are influenced by other factors in addition to wind directionality. However, the larger relative emissions of benzene from the largest local benzene source likely masks almost all of the other influences besides wind direction with respect to the orientation of the largest local benzene source and monitor(s). Whereas, the smaller relative emissions of 1,3-butadiene, xylenes, and toluene from the this same local point source allows for influences from the other variables (e.g. temperature and wind speed), as well as, from the other local sources (via different wind directionality impacts at the monitors) exerted on the measured concentrations to be observed.

The combined sites concentration trendline for carbon disulfide does not indicate a consistent strong correlation with either average temperature (long or short-term) or average wind speed (Figures Q.32-33).
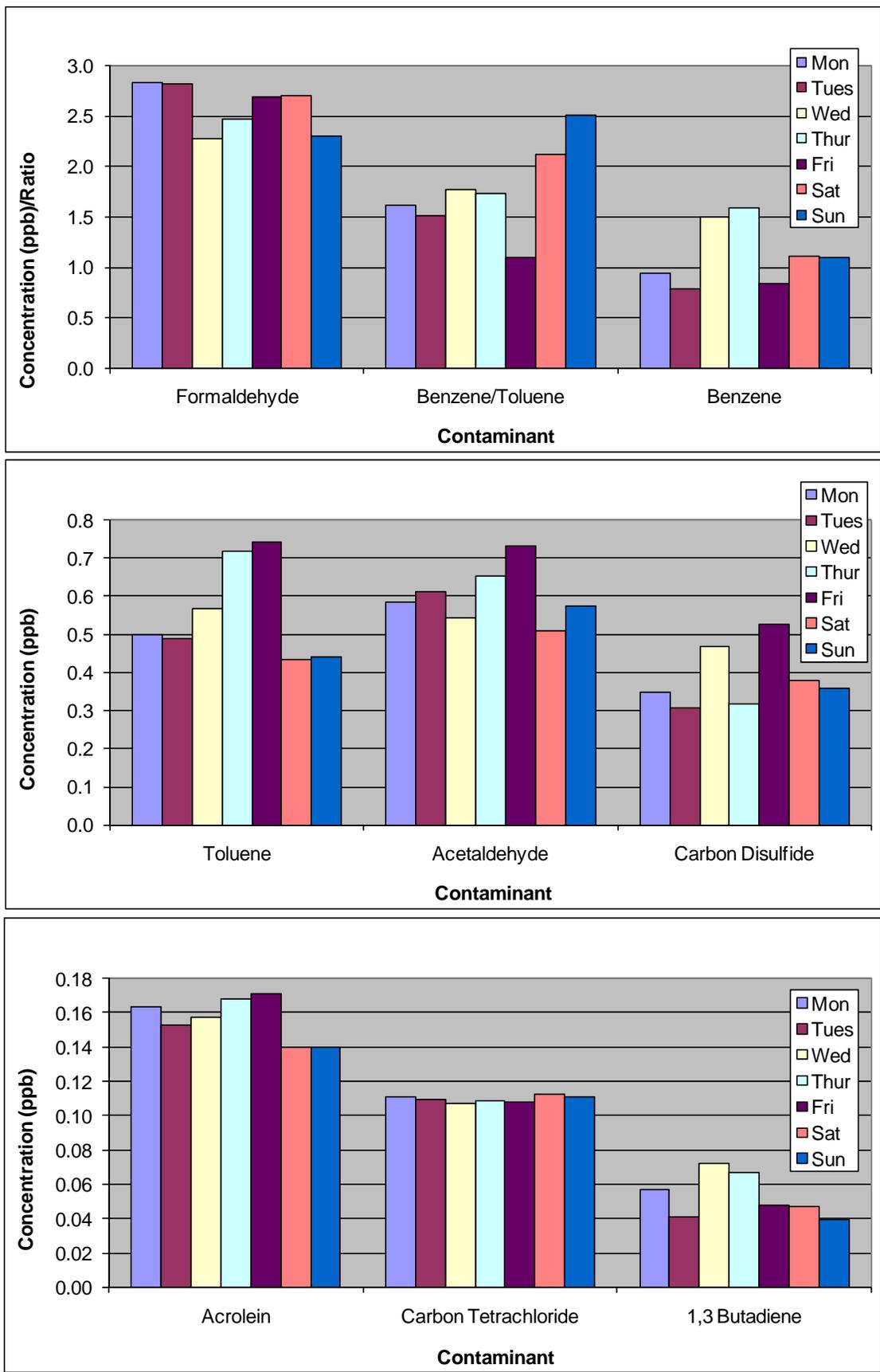
Figure Q.1. Combined Sites Concentrations of Air Contaminants for the Different Days of the Week.

Combined Mondays Wind

WIND SPEED (Knots)
>= 22
17 - 21
11 - 17
7 - 11
4 - 7
1 - 4
Calms: 6.02%

Resultant Vector
210 deg - 42%

Combined Tuesdays Wind

WIND SPEED (Knots)
>= 22
17 - 21
11 - 17
7 - 11
4 - 7
1 - 4
Calms: 2.31%

Resultant Vector
198 deg - 35%
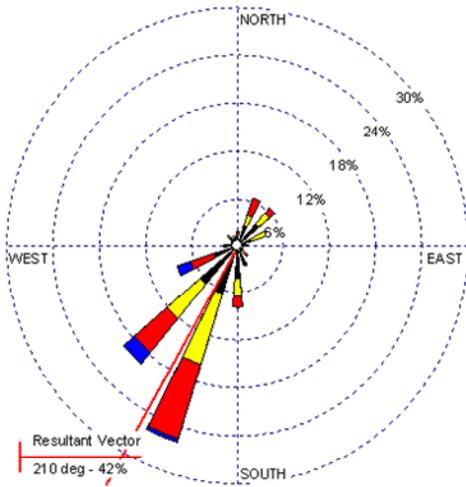
Combined Wednesdays Wind

WIND SPEED (Knots)
>= 22
17 - 21
11 - 17
7 - 11
4 - 7
1 - 4
Calms: 3.24%

Resultant Vector
213 deg - 39%
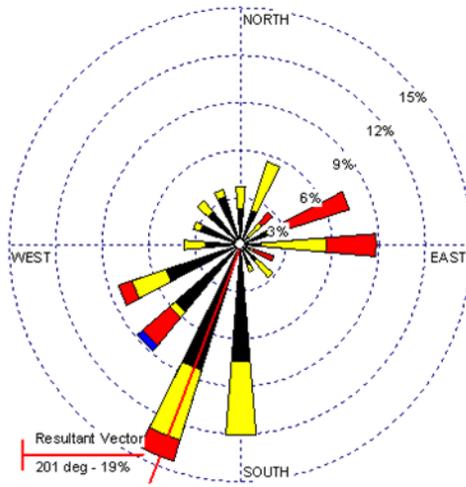
Combined Thursdays Wind

WIND SPEED (Knots)
>= 22
17 - 21
11 - 17
7 - 11
4 - 7
1 - 4
Calms: 6.94%

Resultant Vector
201 deg - 19%
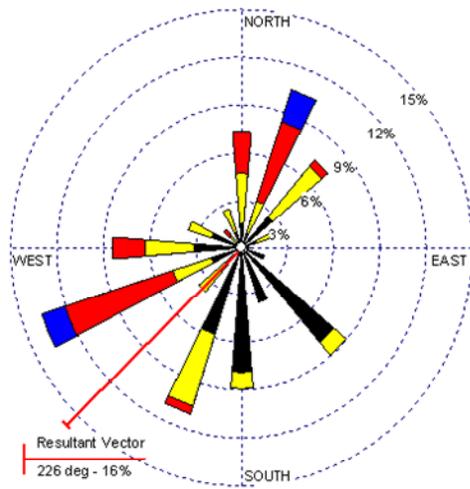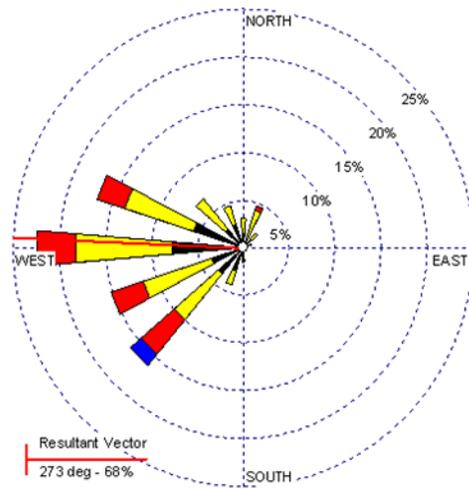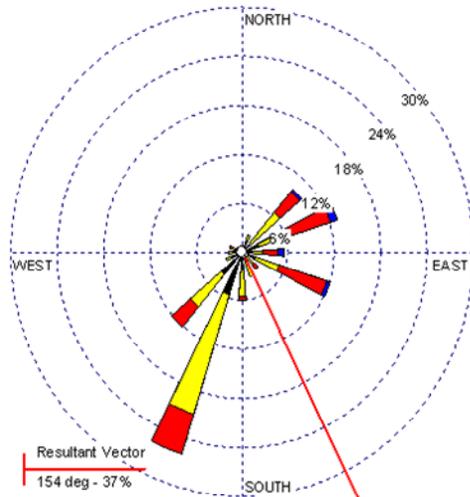
Figure Q.2. Wind Roses for the Different Days of the Week Combined.
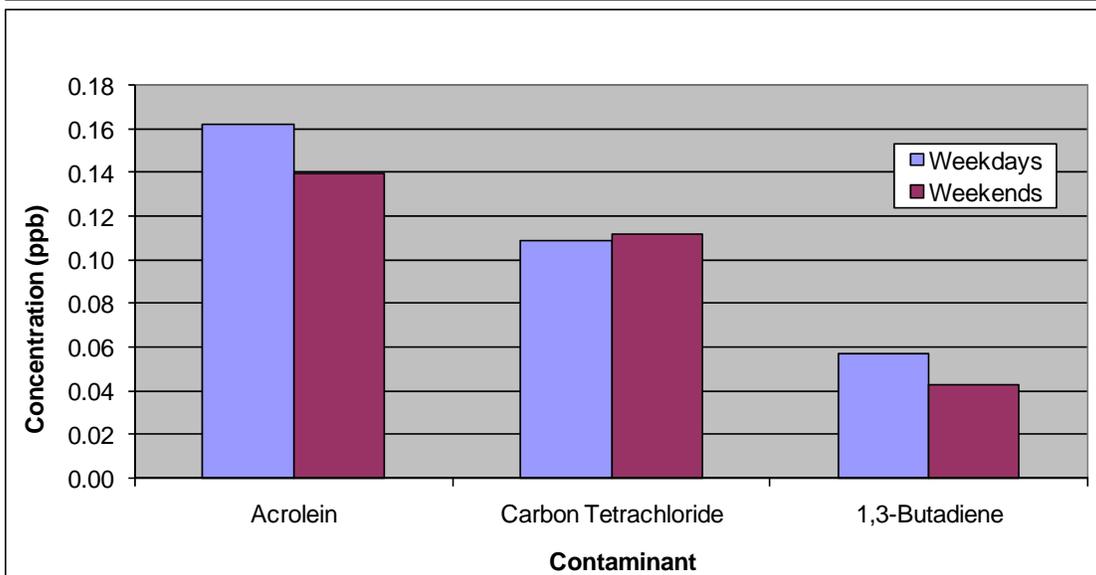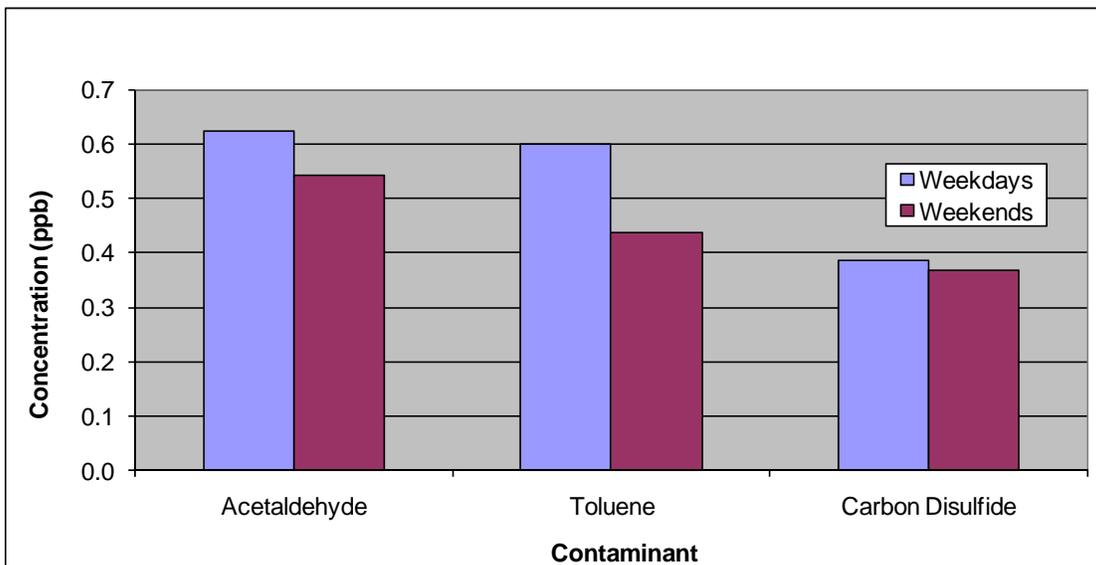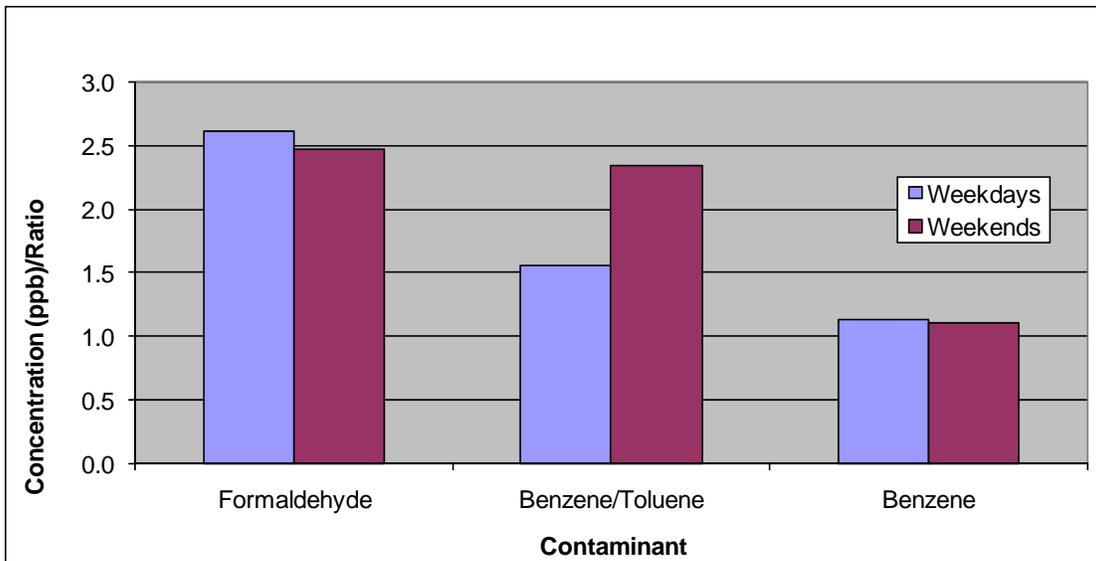
Figure Q.3. Average Air Contaminant Concentrations during the Weekdays versus the Weekends.
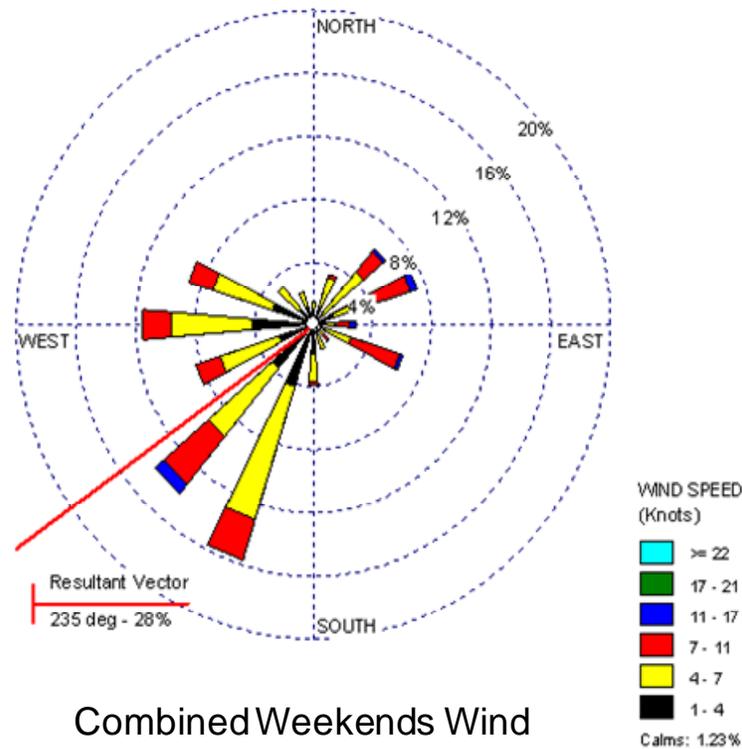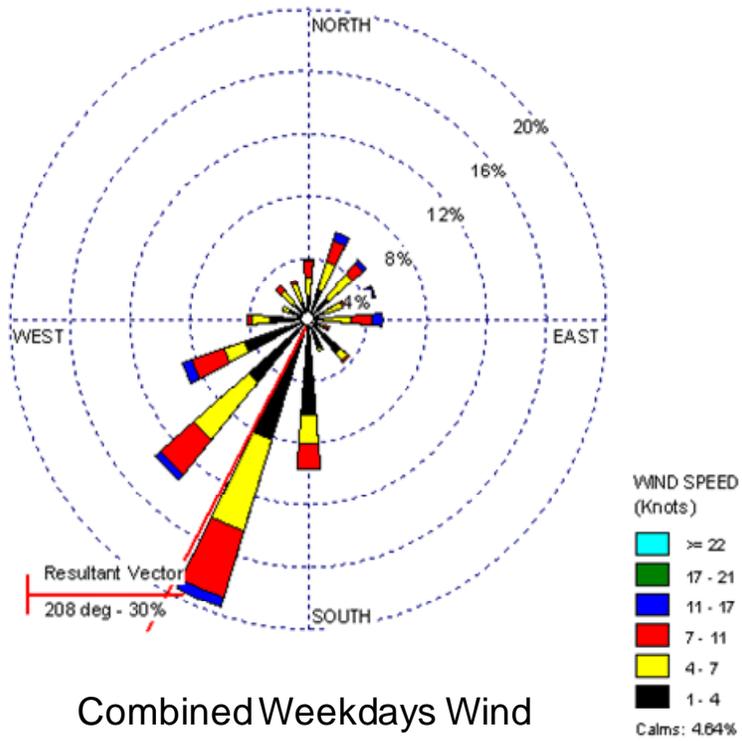
Figure Q.4. Wind Roses for the Weekdays and Weekends Combined.
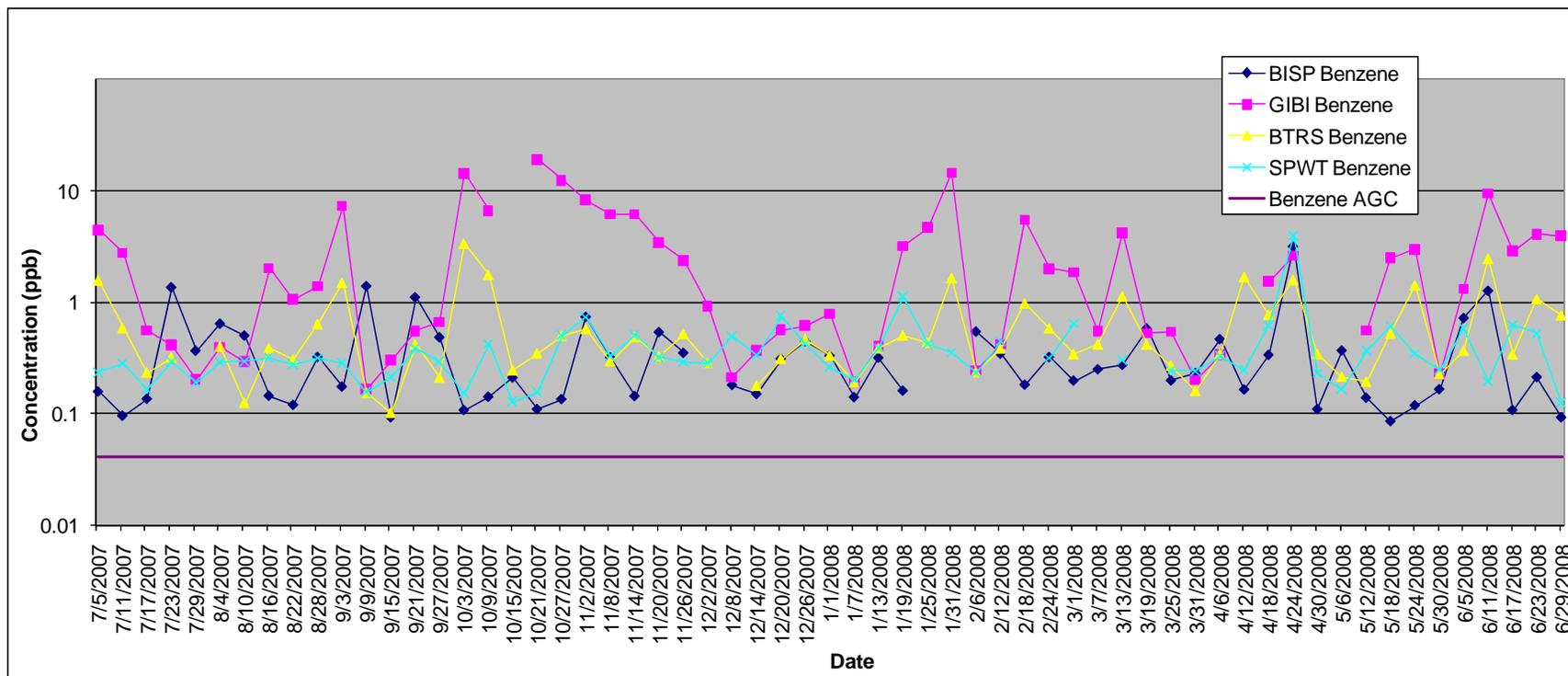
Figure Q.5. Individual Data Points of the Daily Benzene Concentrations for all Four Monitoring Sites in Log Scale. The concentrations are presented using the logarithmic scale because the GIBI monitor had several concentrations which were substantially higher than the others resulting in line graphs when the normal scale was used where observing how the trendlines tracked in relation to one another was not as easy to see.
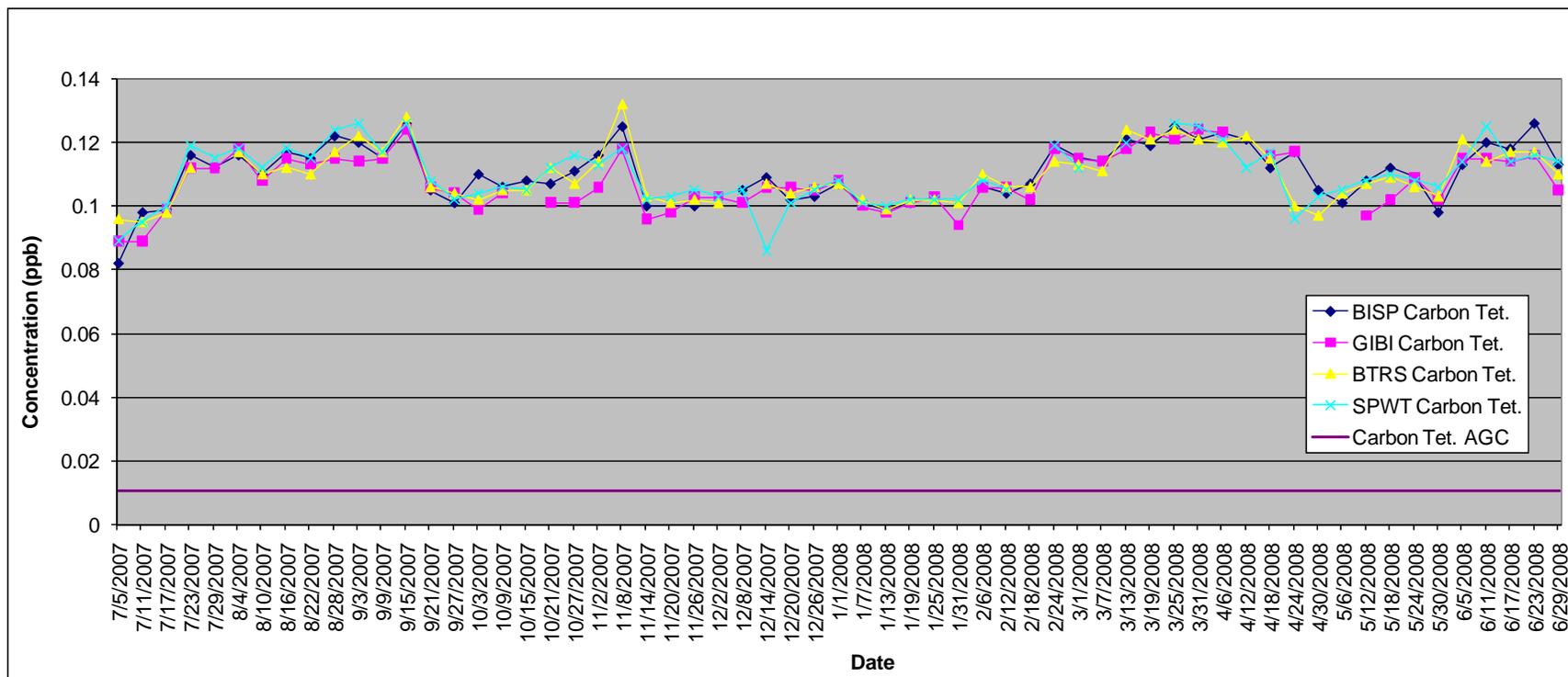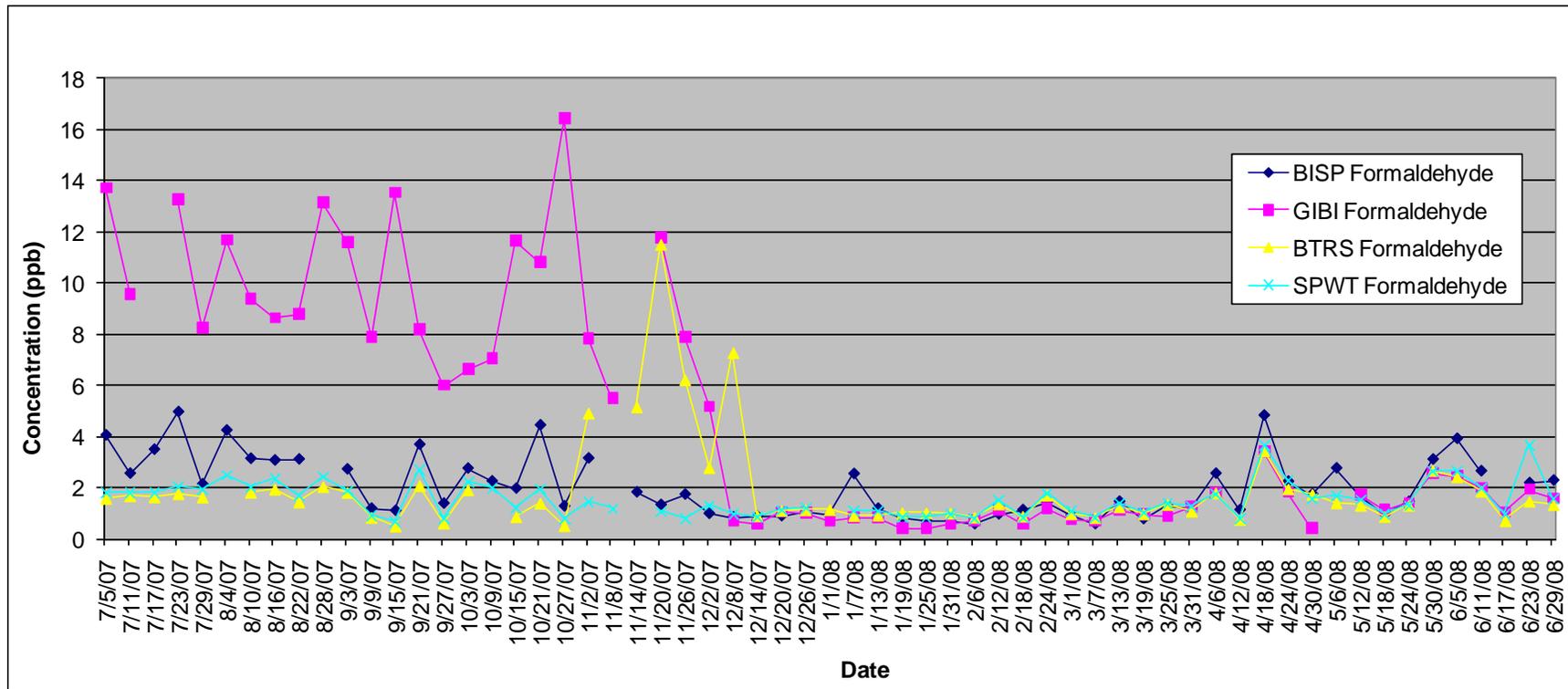
Figure Q.6. Individual Data Points of the Daily Carbon Tetrachloride Concentrations for all Four Monitoring Sites.
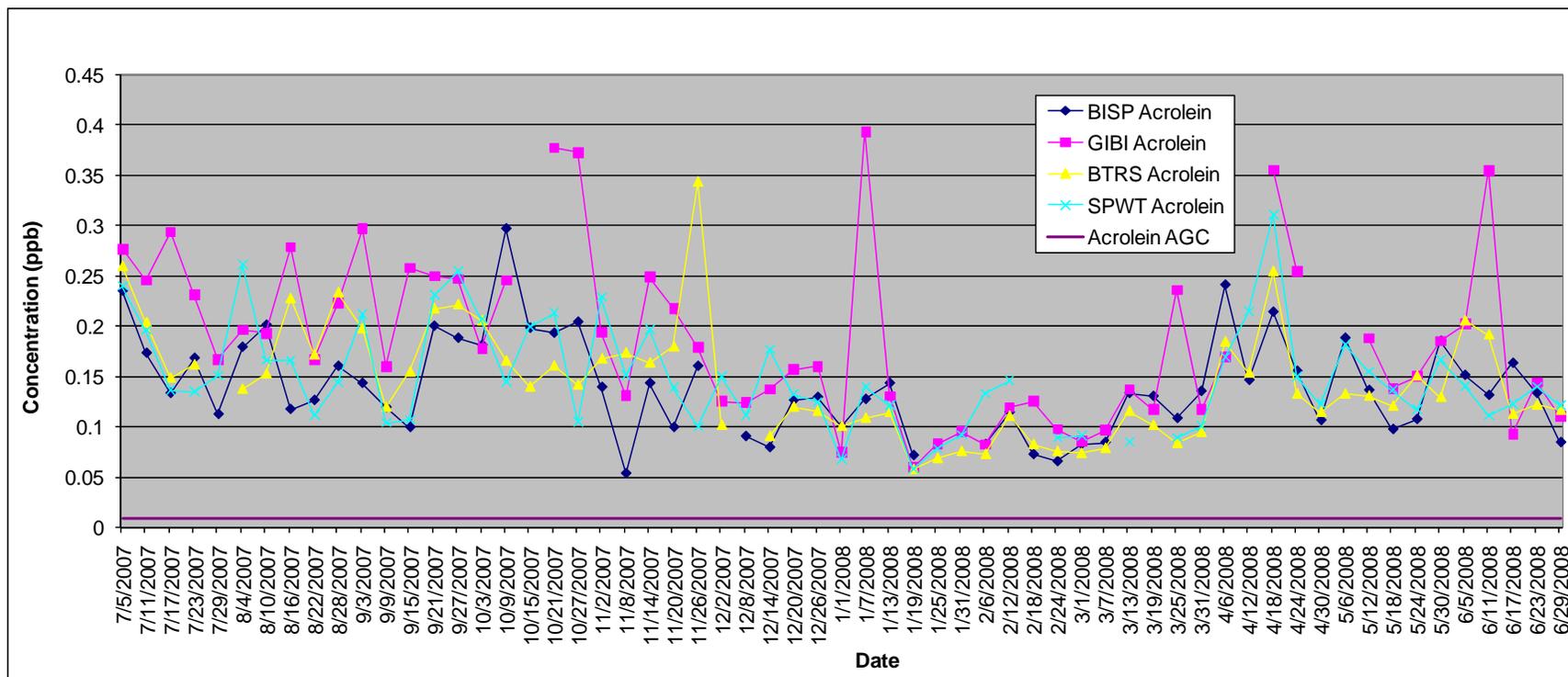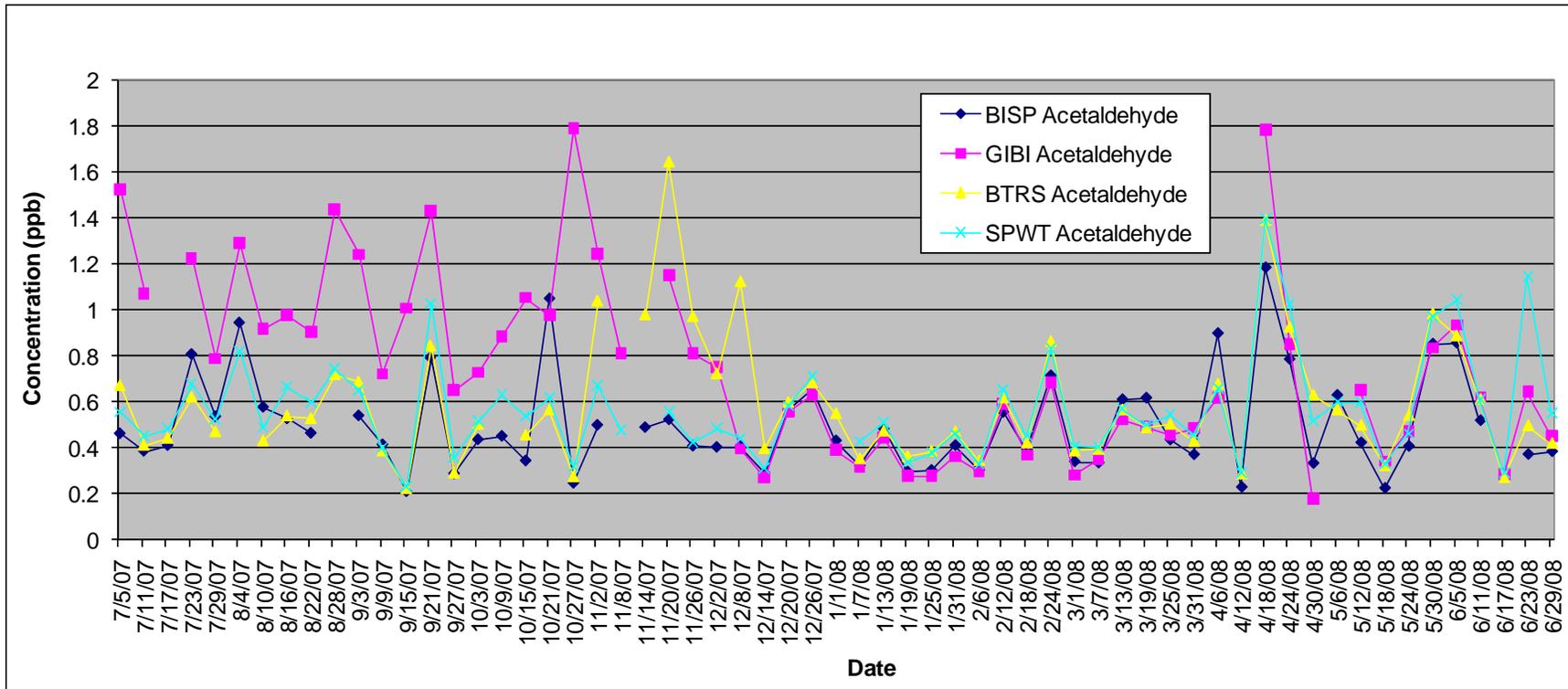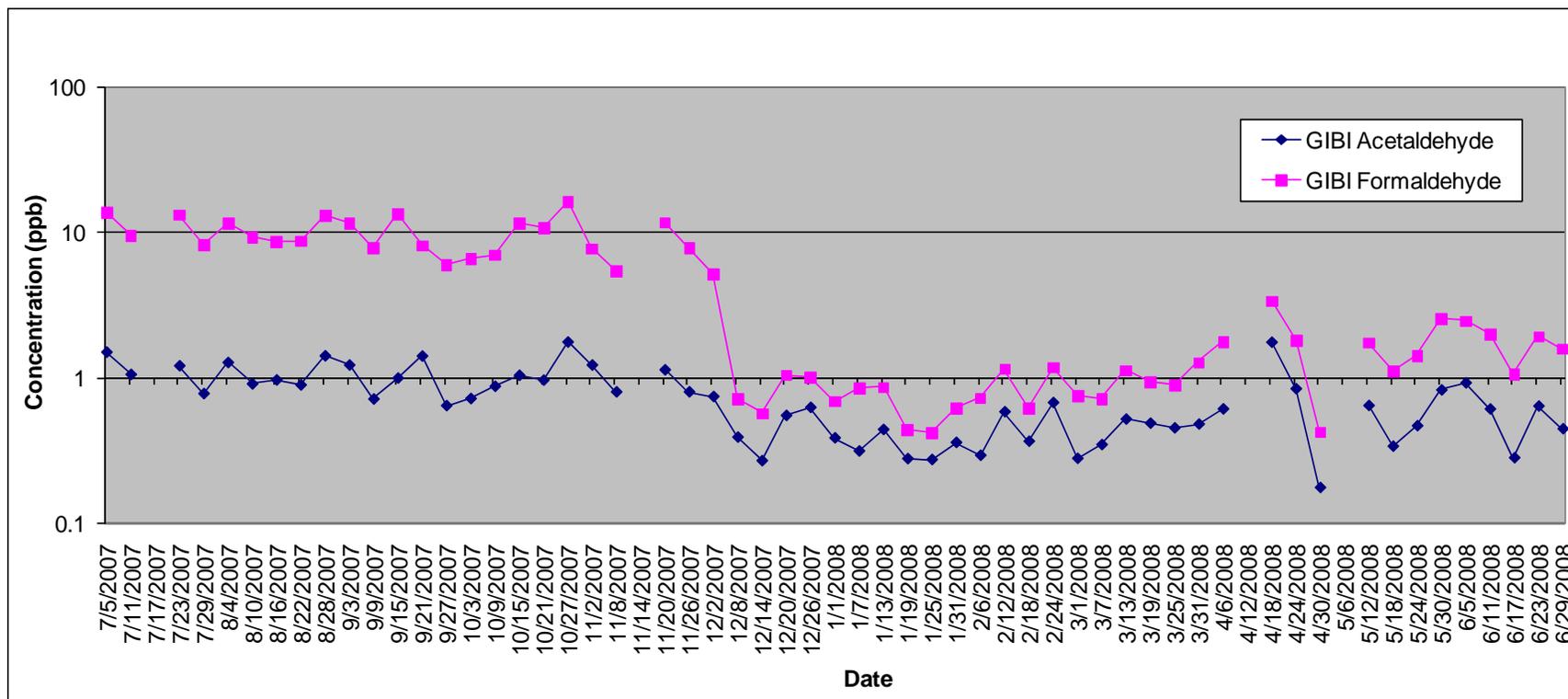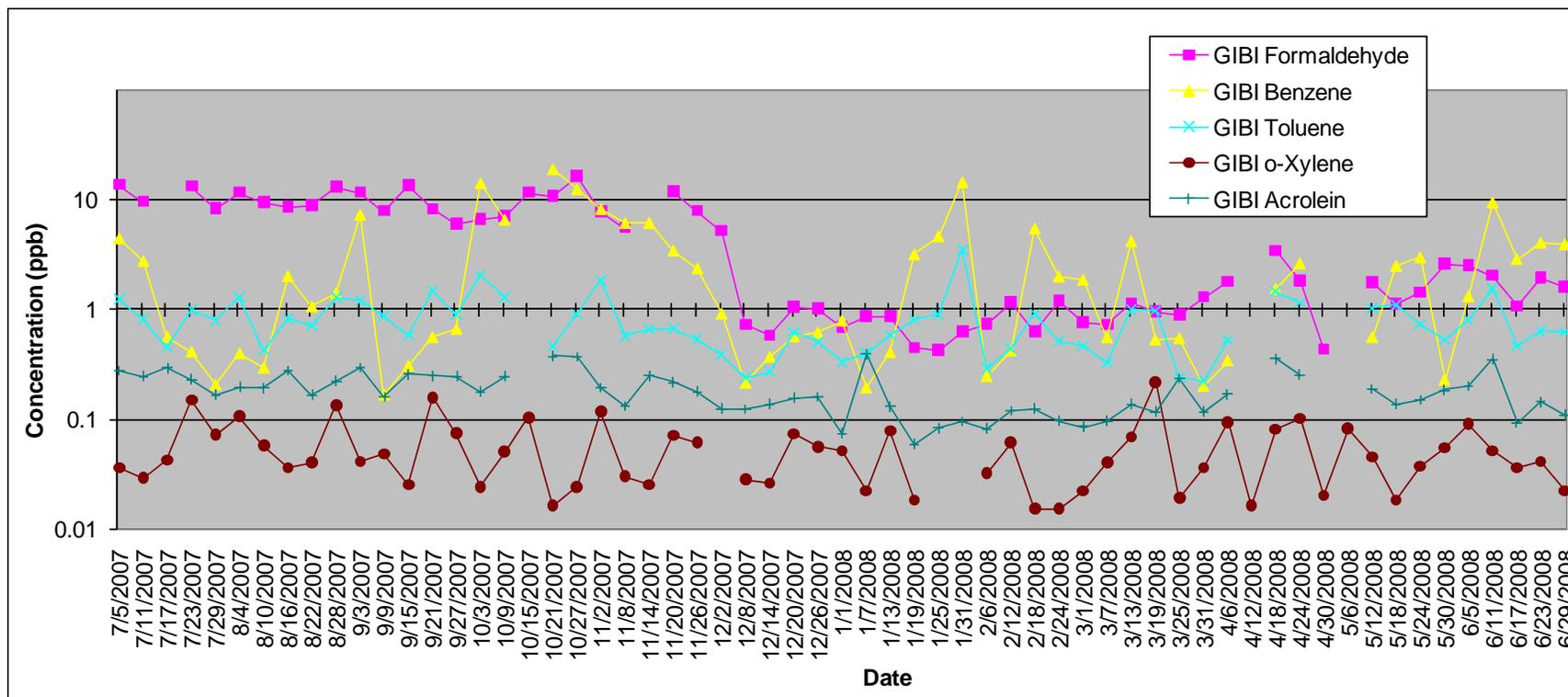
Figure Q.7. Individual Data Points of the Daily Acrolein Concentrations for all Four Monitoring Sites.
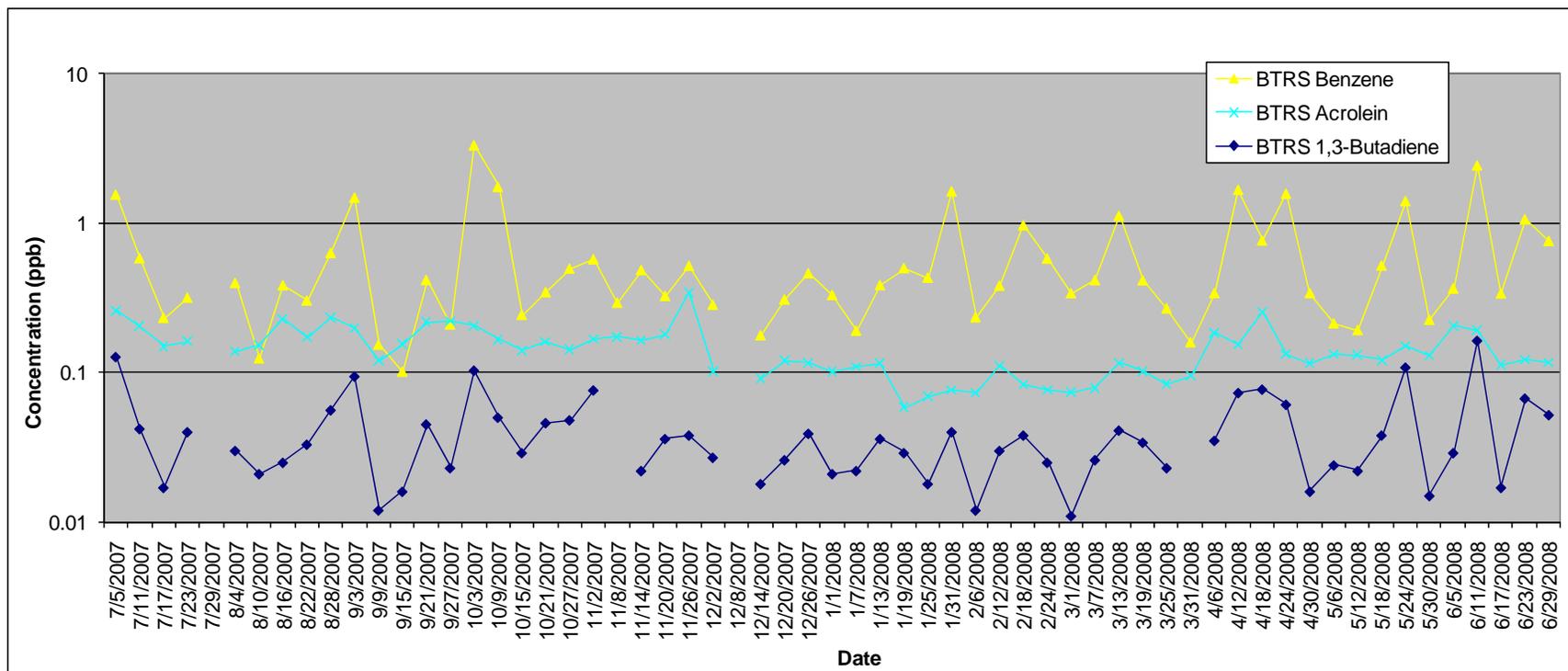
Figure Q.8. Comparisons between the Individual Data Point Trendlines of the Daily Concentrations for Acrolein, Benzene, and 1,3-Butadiene at the BTRS Monitor in Log Scale. The concentrations are presented using the logarithmic scale because of the substantial differences between the concentration range for benzene as compared to that of 1,3-butadiene resulting in line graphs when the normal scale was used where observing how the trendlines tracked in relation to one another was not as easy to see.
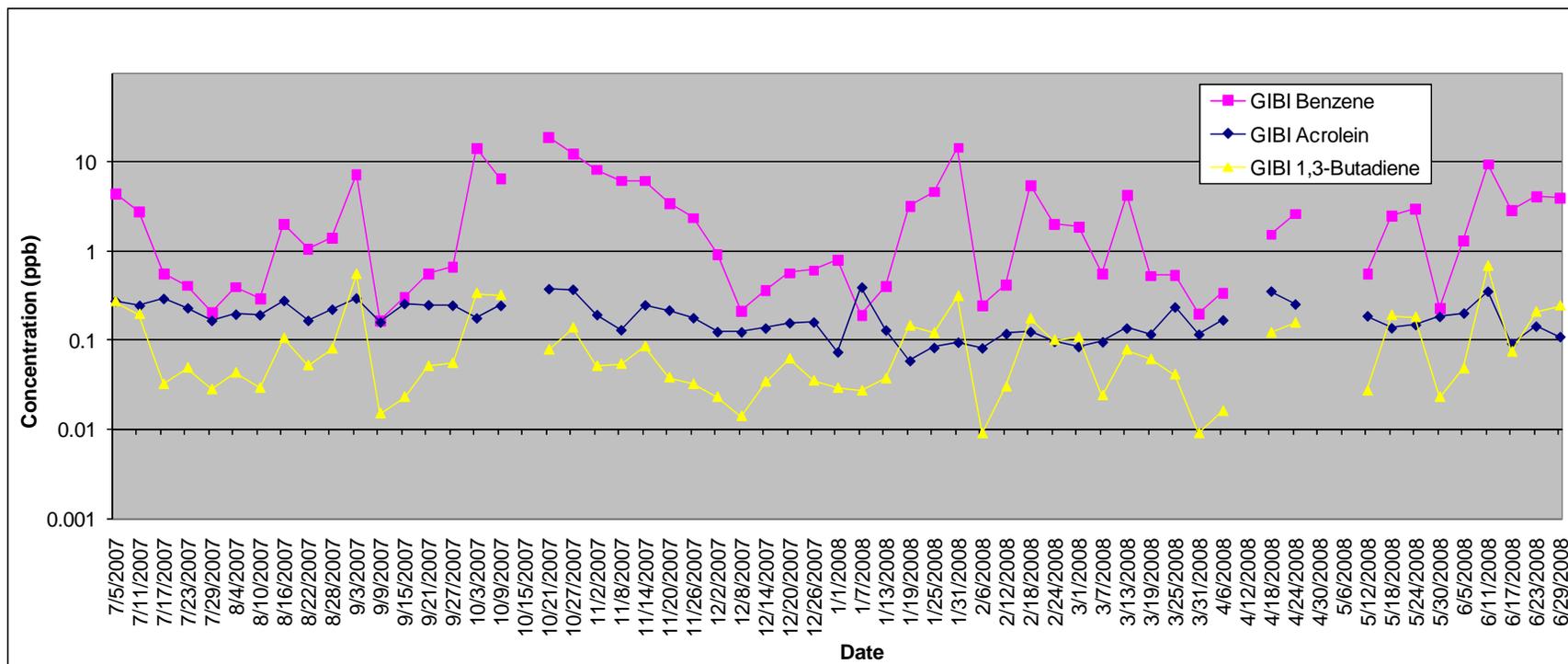
Figure Q.9. Comparisons between the Individual Data Point Trendlines of the Daily Concentrations for Acrolein, Benzene, and 1,3-Butadiene at the GIBI Monitor in Log Scale. The concentrations are presented using the logarithmic scale because of the substantial differences between the concentration range for benzene as compared to that of 1,3-butadiene resulting in line graphs when the normal scale was used where observing how the trendlines tracked in relation to one another was not as easy to see.
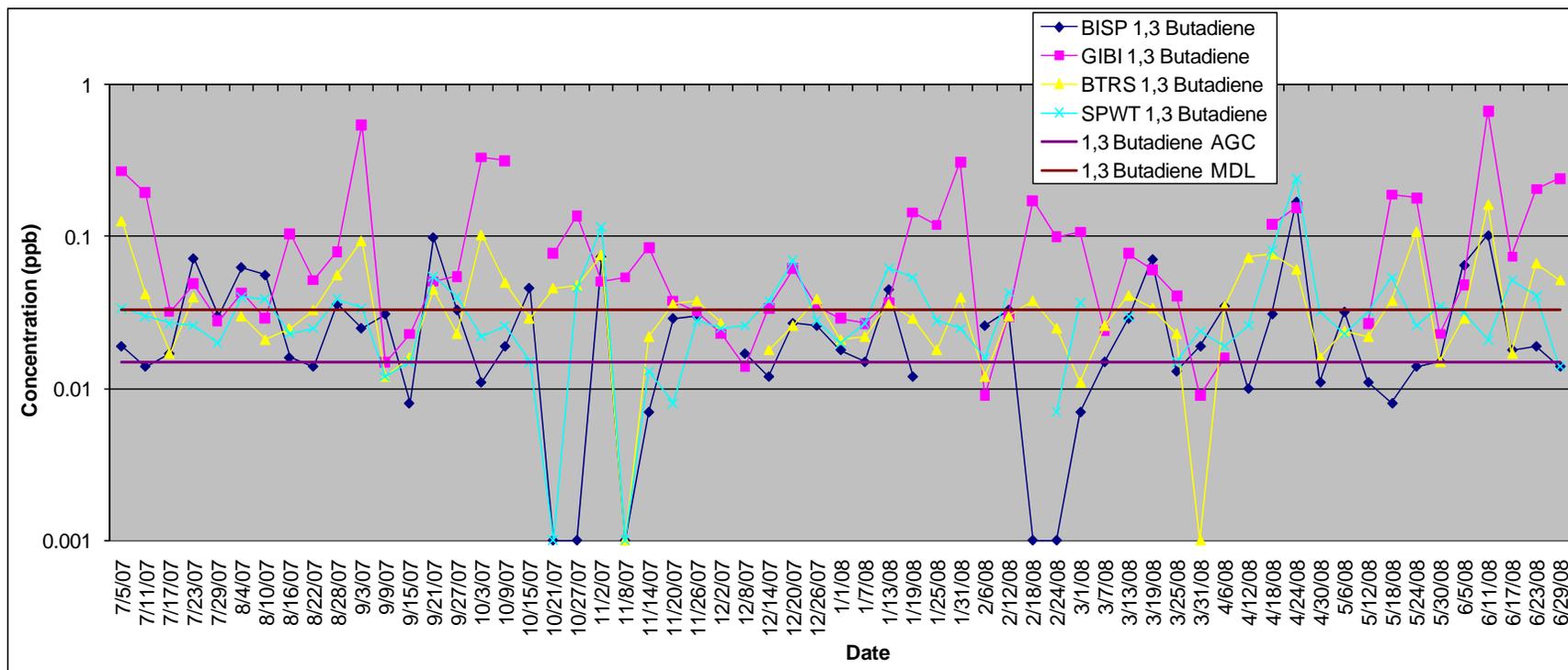
**Figure Q.10.** Individual Data Points of the Daily 1,3-Butadiene Concentrations for all Four Monitoring Sites in Log Scale. The concentrations are presented using the logarithmic scale because the GIBI monitor had several concentrations which were substantially higher than the others resulting in line graphs when the normal scale was used where observing how the trendlines tracked in relation to one another was not as easy to see.
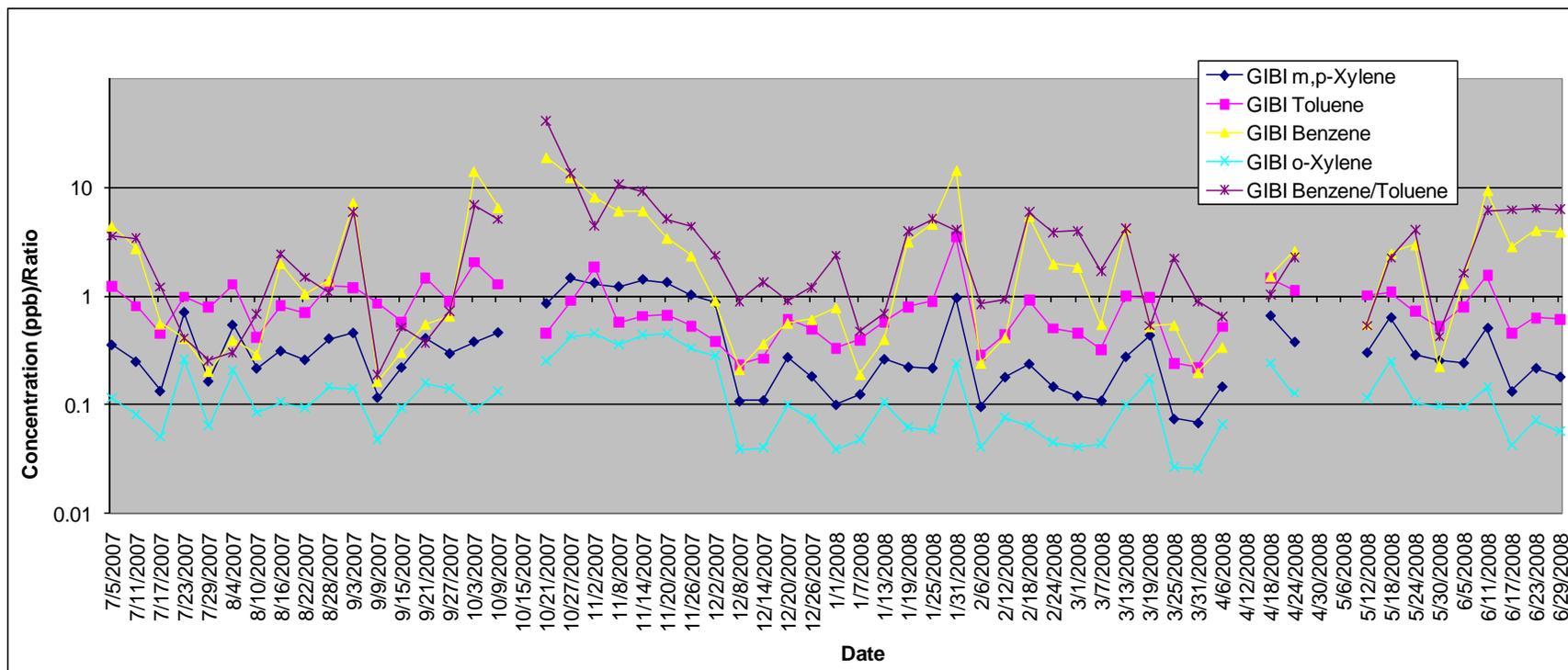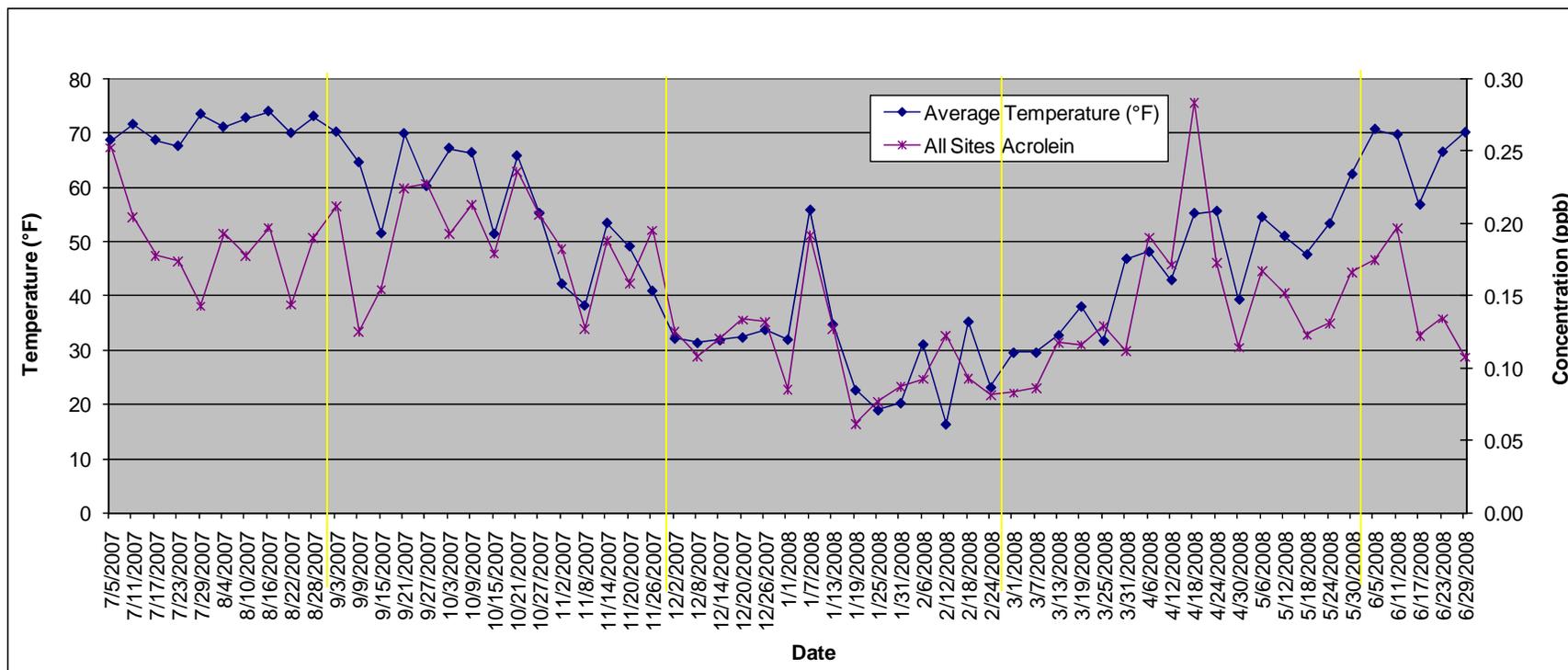
Figure Q.11. Comparisons between the Individual Data Point Trendlines of the Daily Concentrations for m,p-Xylene, Toluene, Benzene, and o-Xylene, along with the Daily Benzene/Toluene Ratios at the GIBI Monitor in Log Scale. The concentrations are presented using the logarithmic scale because of the substantial differences between the concentration range for benzene as compared to that of o-xylene resulting in line graphs when the normal scale was used where observing how the trendlines tracked in relation to one another was not as easy to see.

Figure Q.12. Individual Data Points of the Daily Formaldehyde Concentrations for all Four Monitoring Sites.

Figure Q.13. Individual Data Points of the Daily Acetaldehyde Concentrations for all Four Monitoring Sites.

Figure Q.14. Comparisons between the Individual Data Point Trendlines of the Daily Concentrations for Acetaldehyde and Formaldehyde at the GIBI Monitor in Log Scale. The concentrations are presented using the logarithmic scale because of the substantial differences between the concentration range for formaldehyde as compared to that of acetaldehyde resulting in line graphs when the normal scale was used where observing how the trendlines tracked in relation to one another was not as easy to see.

Figure Q.15. Comparisons between the Individual Data Point Trendlines of the Daily Concentrations for Formaldehyde, Benzene, Toluene, o-Xylene, and Acrolein at the GIBI Monitor in Log Scale. The concentrations are presented using the logarithmic scale because of the substantial differences between the concentration range for formaldehyde and benzene as compared to that of o-xylene resulting in line graphs when the normal scale was used where observing how the trendlines tracked in relation to one another was not as easy to see.
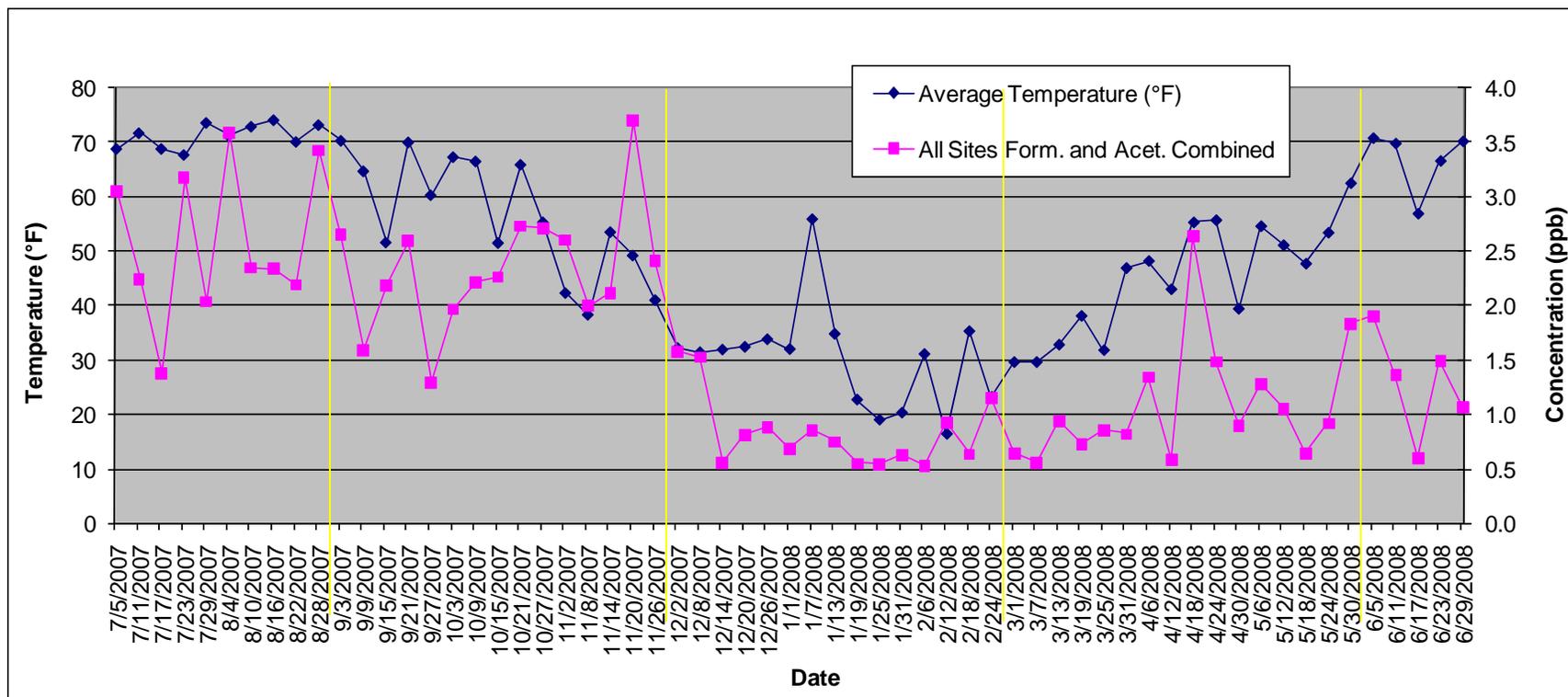
Figure Q.16. Comparisons between the Combined Formaldehyde and Acetaldehyde Daily Average Concentrations for All Four Monitoring Sites Together and the Short-Term and Long-Term Average Temperature Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both temperature (°F) and concentration (ppb).
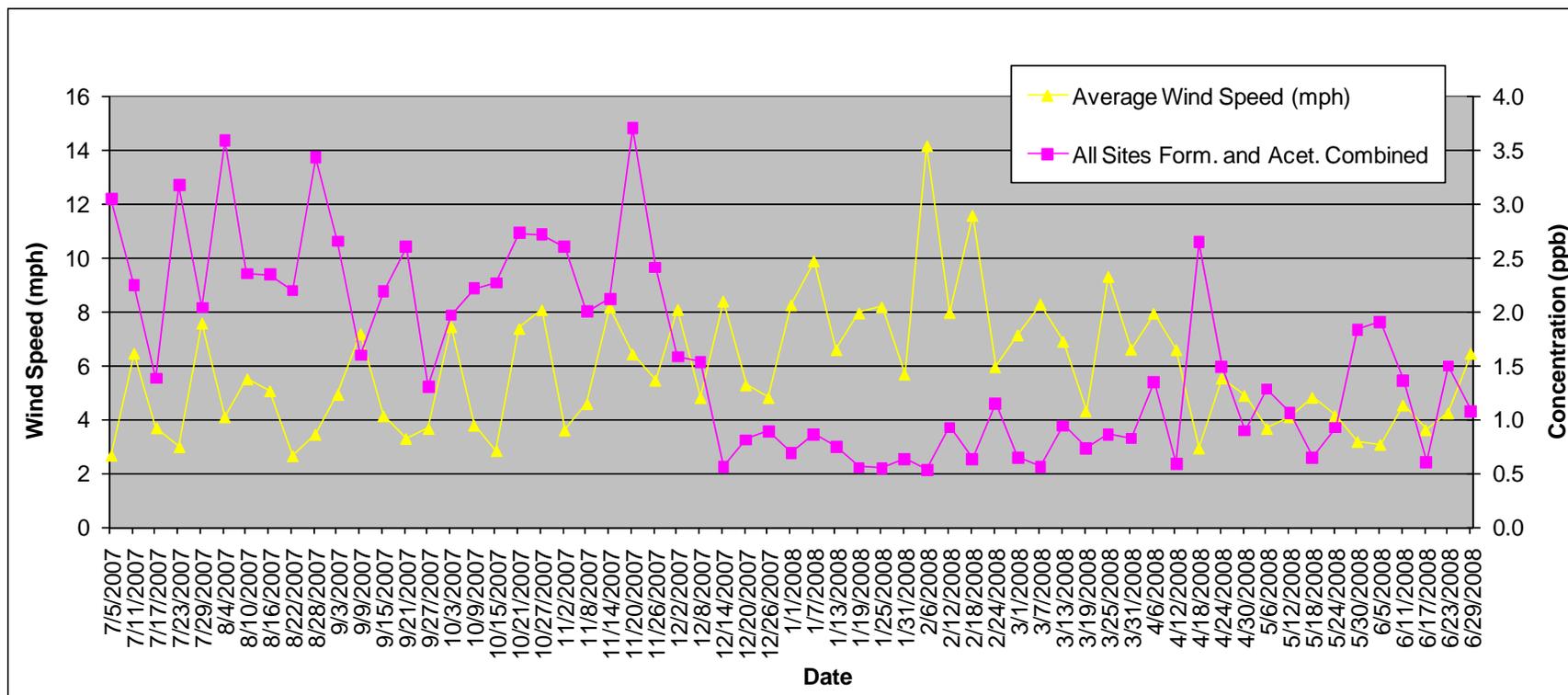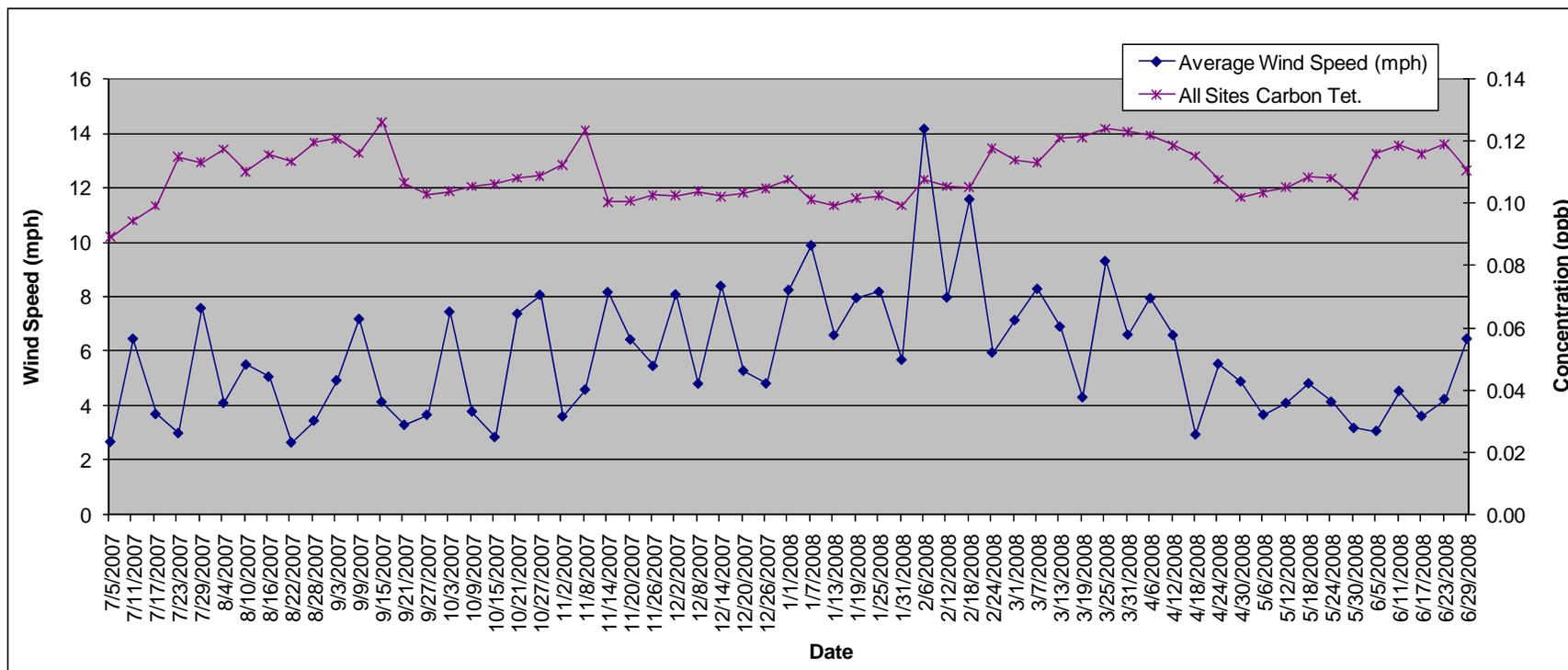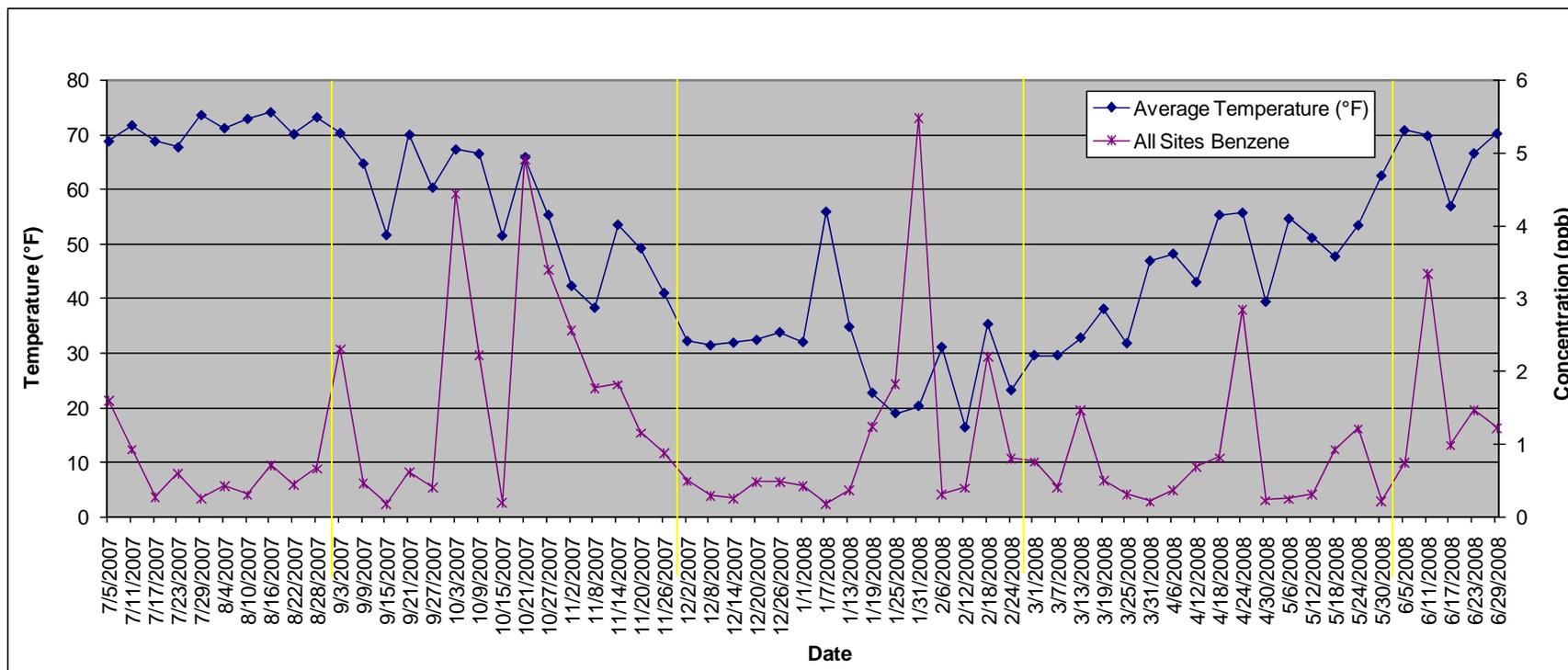
Figure Q.17. Comparisons between the Combined Formaldehyde and Acetaldehyde Daily Average Concentrations for All Four Monitoring Sites Together and the Average Wind Speed Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both wind speed (mph) and concentration (ppb).
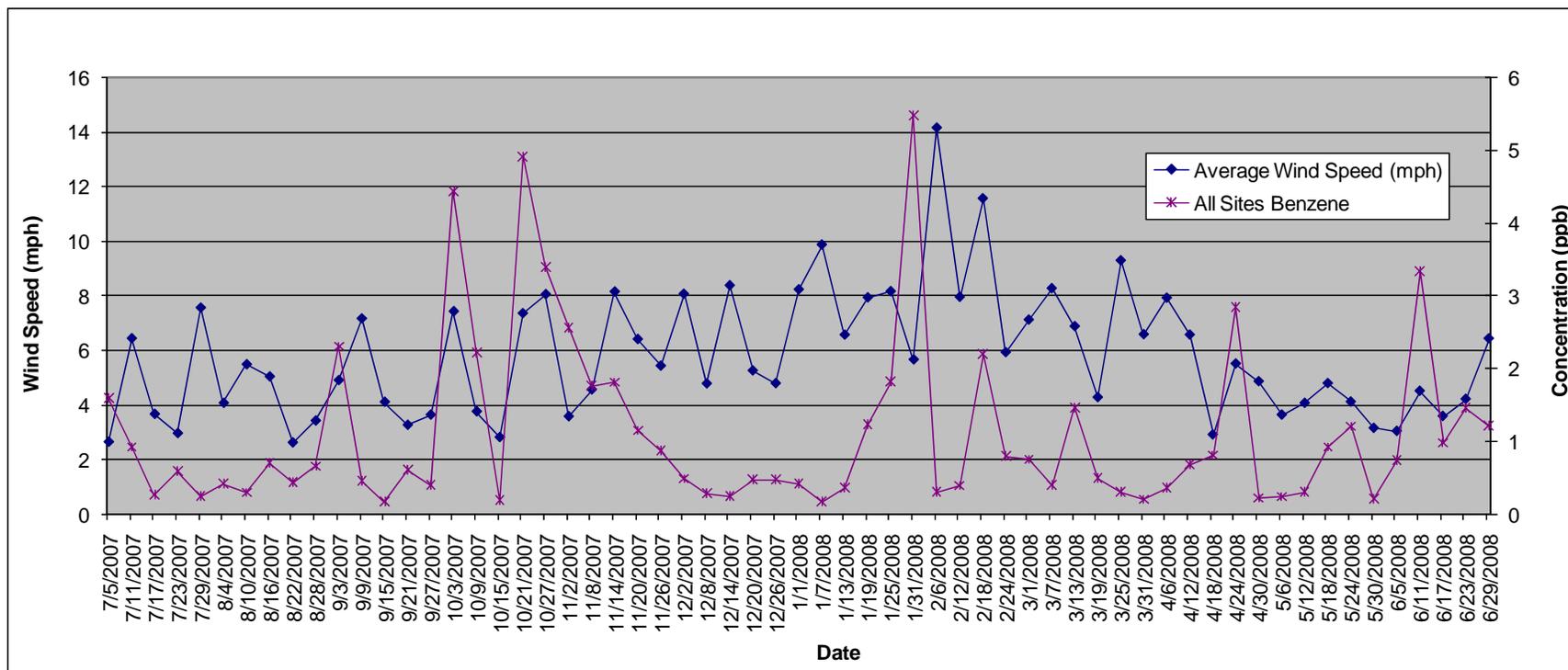
Figure Q.18. Comparisons between the Acrolein Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Short-Term and Long-Term Average Temperature Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both temperature (°F) and concentration (ppb).
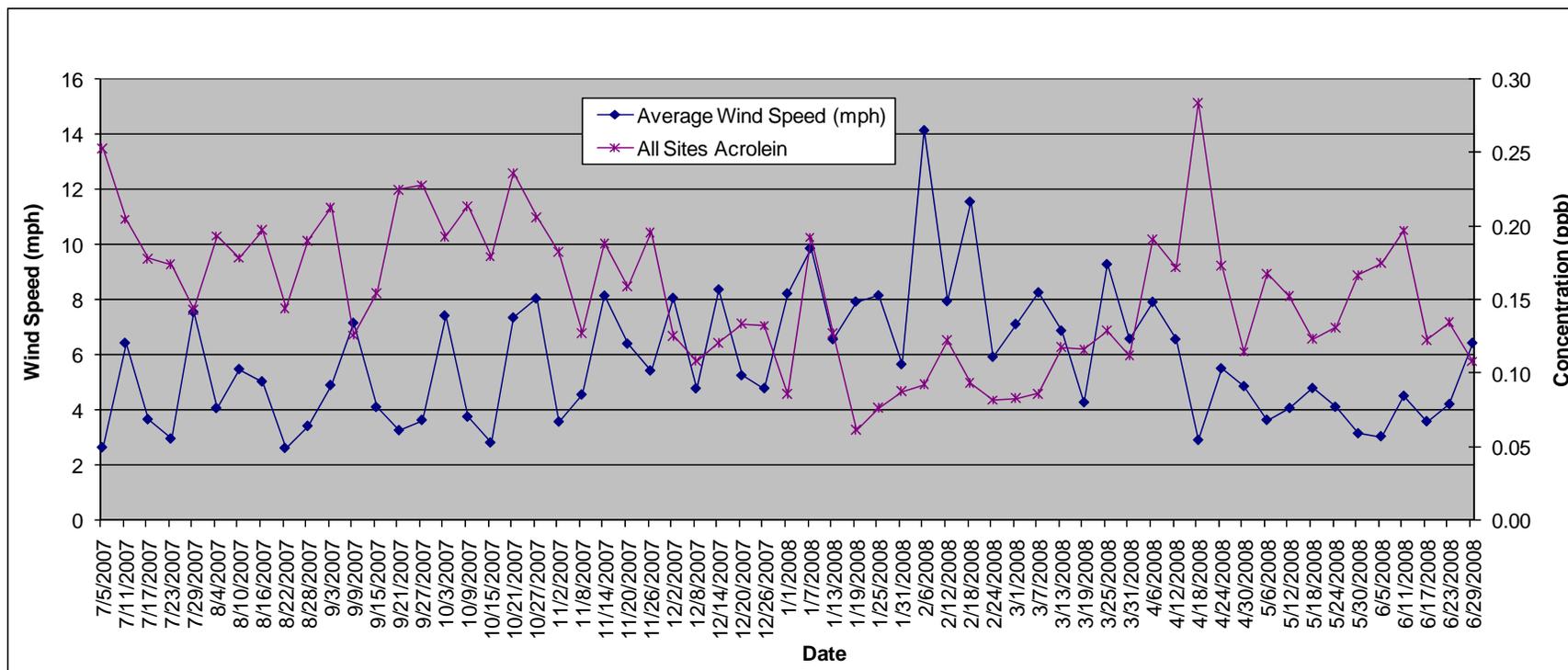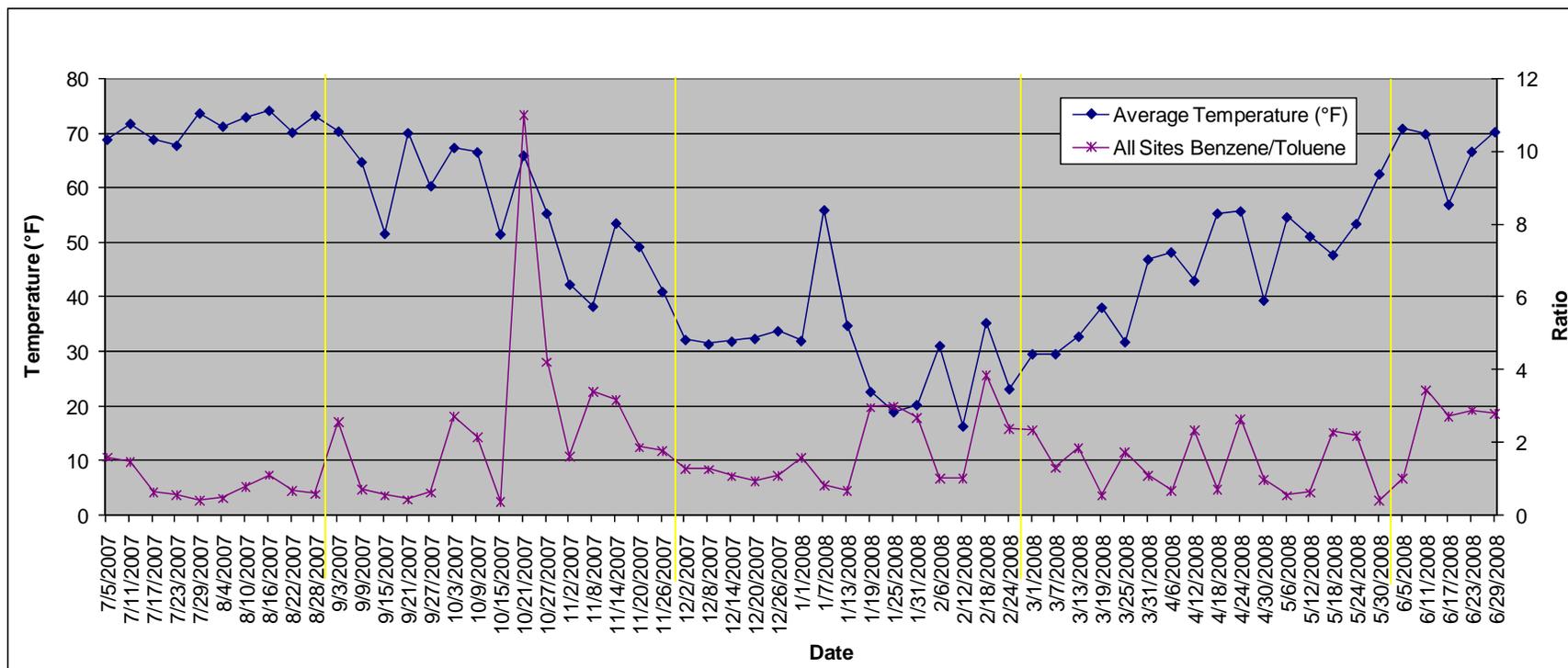
Figure Q.19. Comparisons between the Acrolein Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Average Wind Speed Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both wind speed (mph) and concentration (ppb).
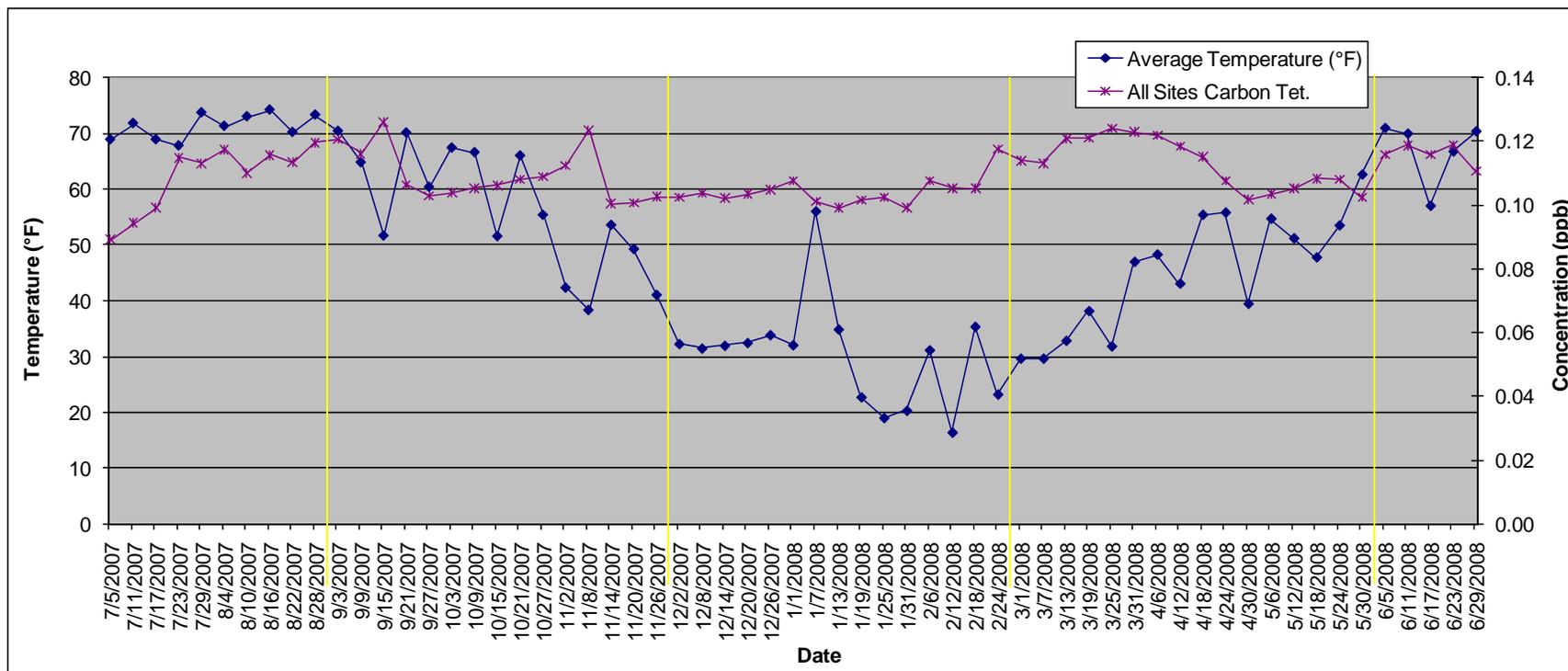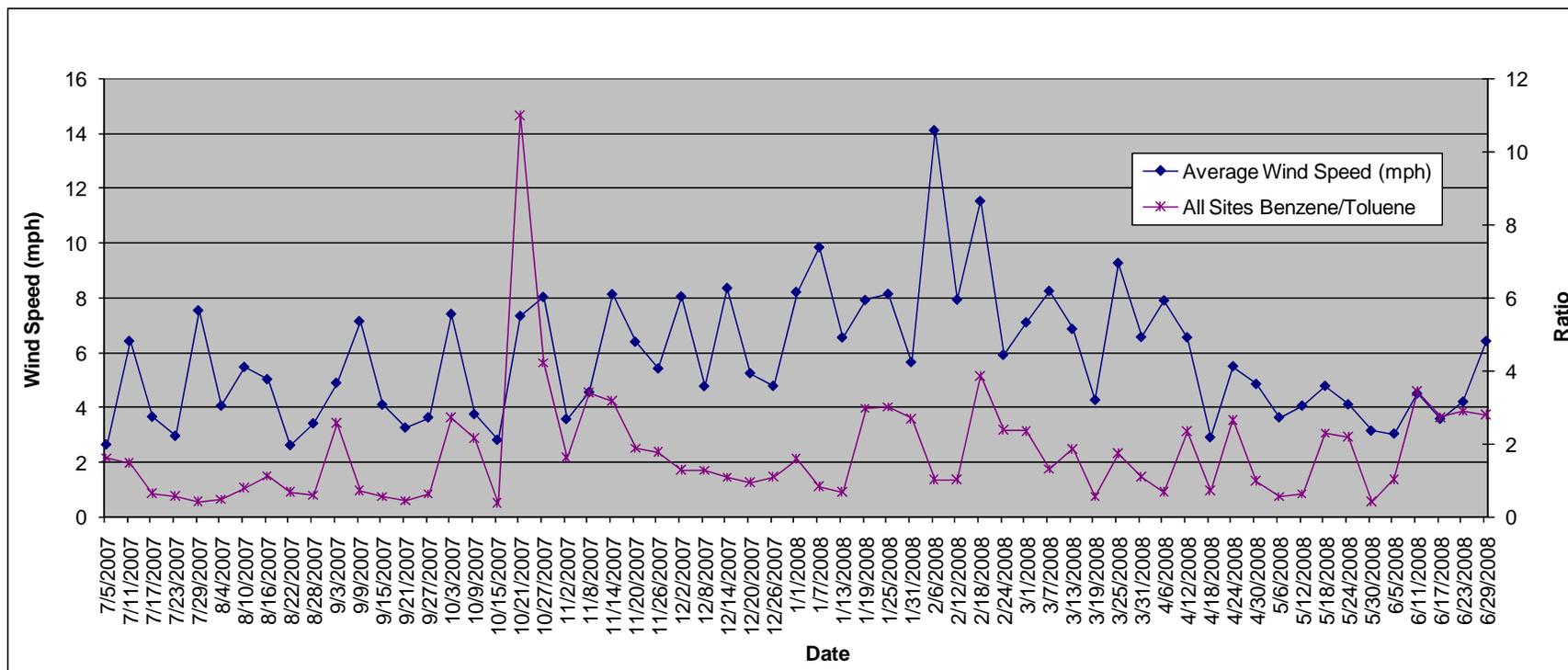
Figure Q.20. Comparisons between the Carbon Tetrachloride Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Short-Term and Long-Term Average Temperature Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both temperature (°F) and concentration (ppb).
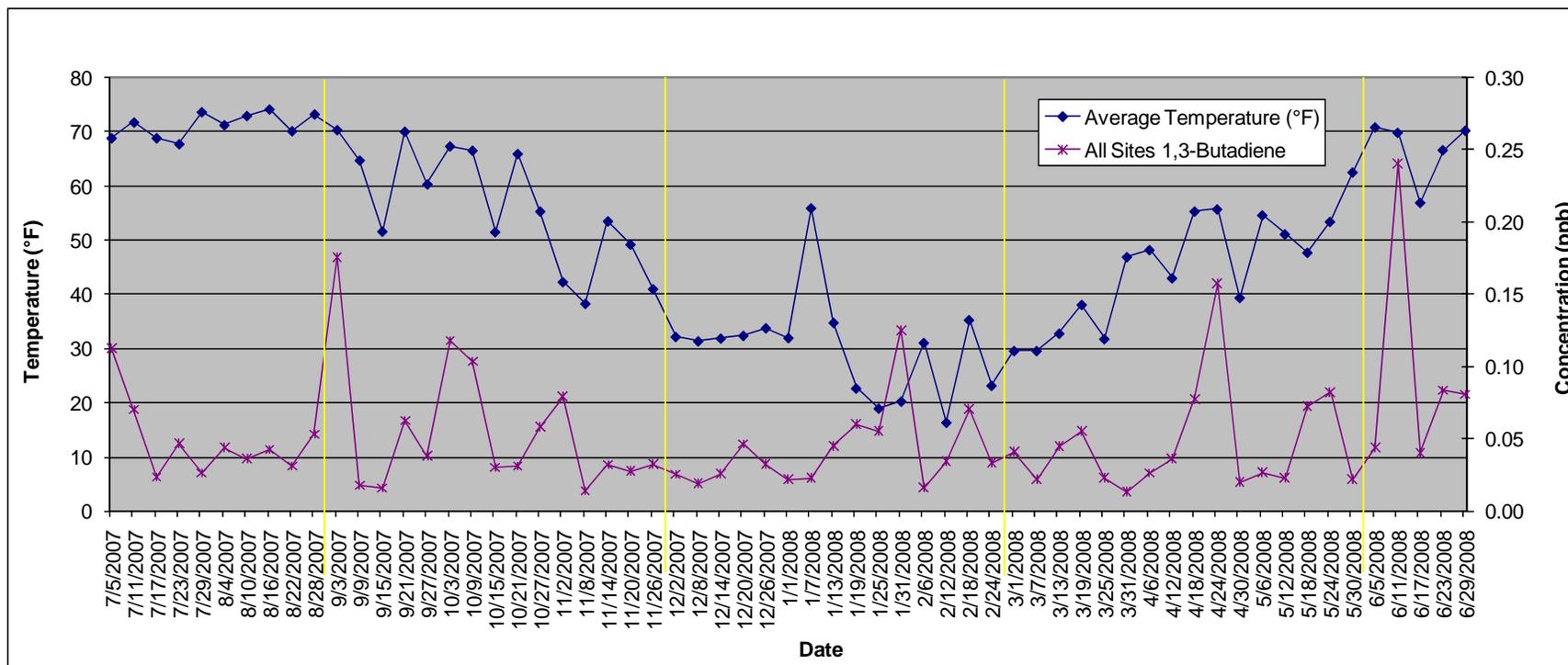
Figure Q.21. Comparisons between the Carbon Tetrachloride Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Average Wind Speed Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both wind speed (mph) and concentration (ppb).

Figure Q.22. Comparisons between the Benzene Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Short-Term and Long-Term Average Temperature Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both temperature (°F) and concentration (ppb).

Figure Q.23. Comparisons between the Benzene Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Average Wind Speed Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both wind speed (mph) and concentration (ppb).
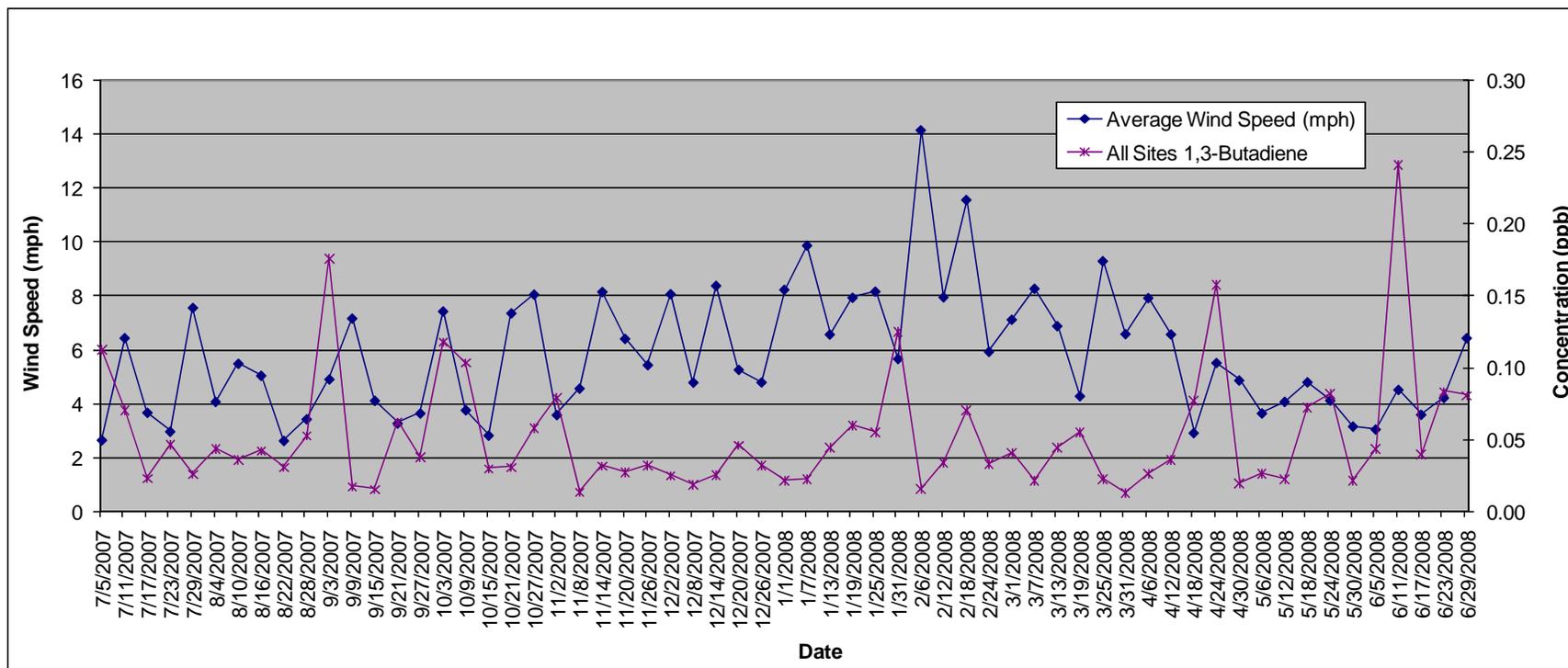
Figure Q.24. Comparisons between the Benzene/Toluene Combined Daily Average Ratios for All Four Monitoring Sites Together and the Short-Term and Long-Term Average Temperature Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both temperature (°F) and concentration (ppb).
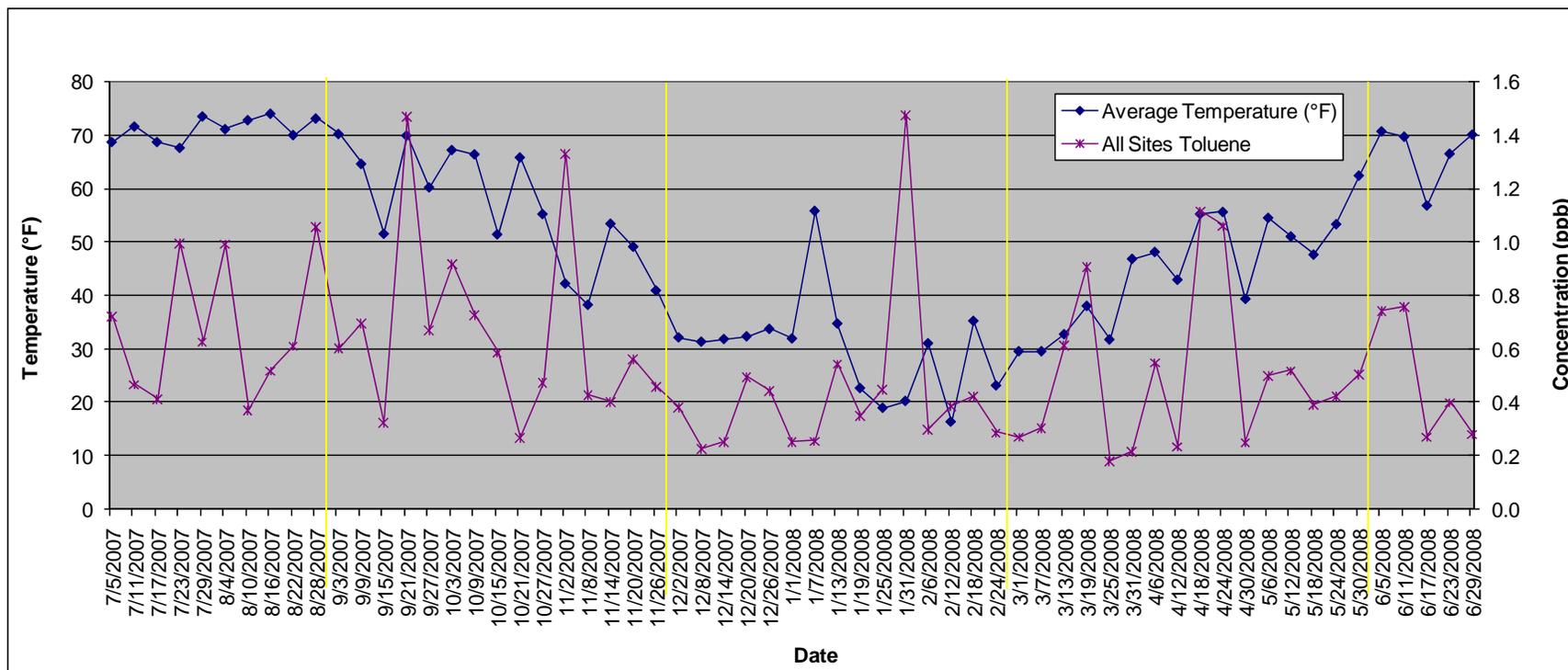
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Figure Q.25. Comparisons between the Benzene/Toluene Combined Daily Average Ratios for All Four Monitoring Sites Together and the Average Wind Speed Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both wind speed (mph) and concentration (ppb).
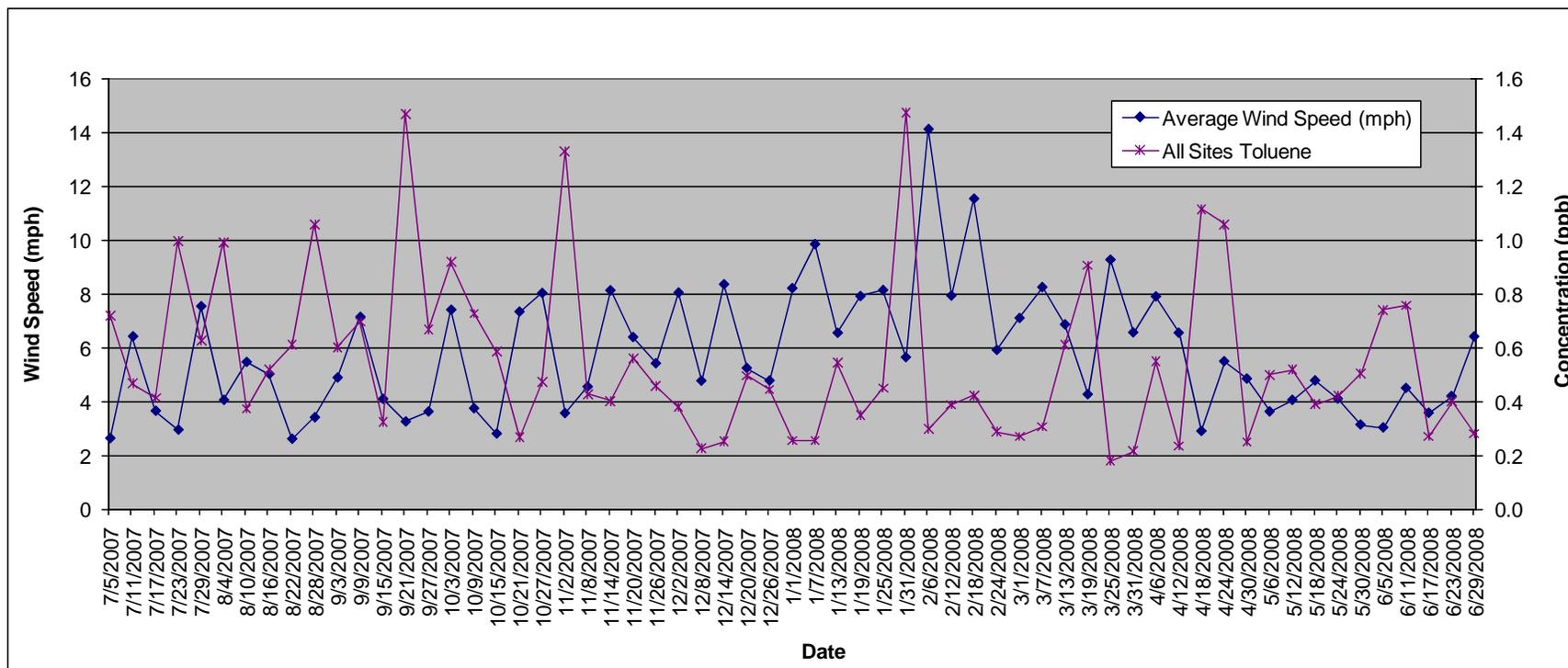
Figure Q.26. Comparisons between the 1,3-Butadiene Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Short-Term and Long-Term Average Temperature Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both temperature (°F) and concentration (ppb).
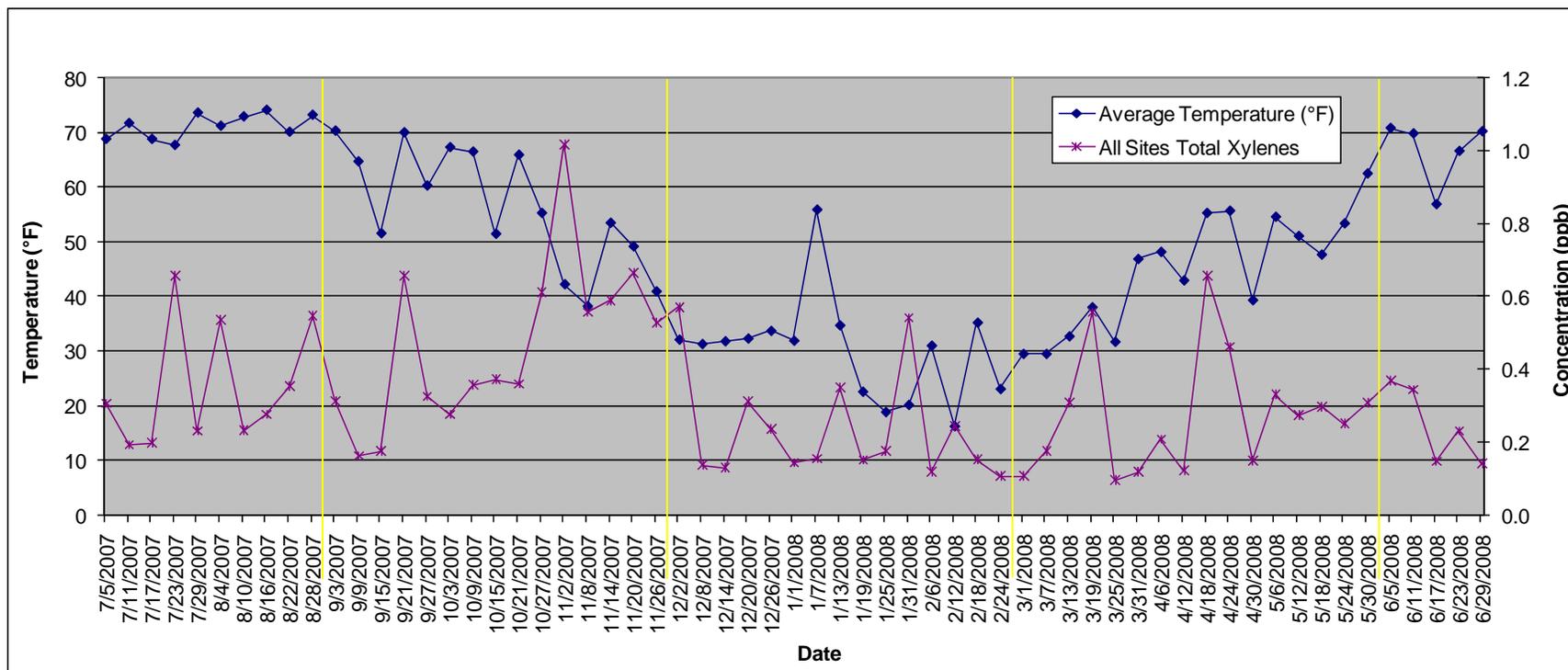
Figure Q.27. Comparisons between the 1,3-Butadiene Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Average Wind Speed Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both wind speed (mph) and concentration (ppb).
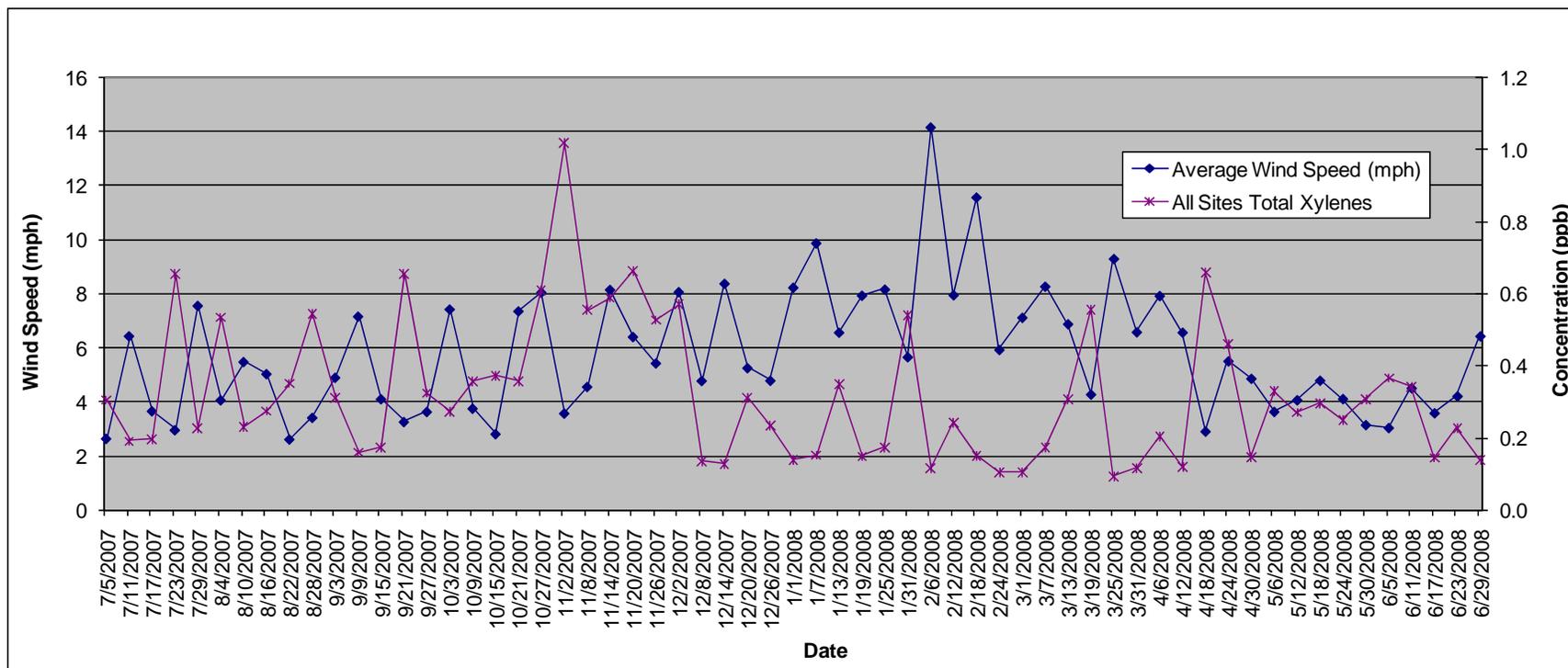
Figure Q.28. Comparisons between the Toluene Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Short-Term and Long-Term Average Temperature Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both temperature (°F) and concentration (ppb).
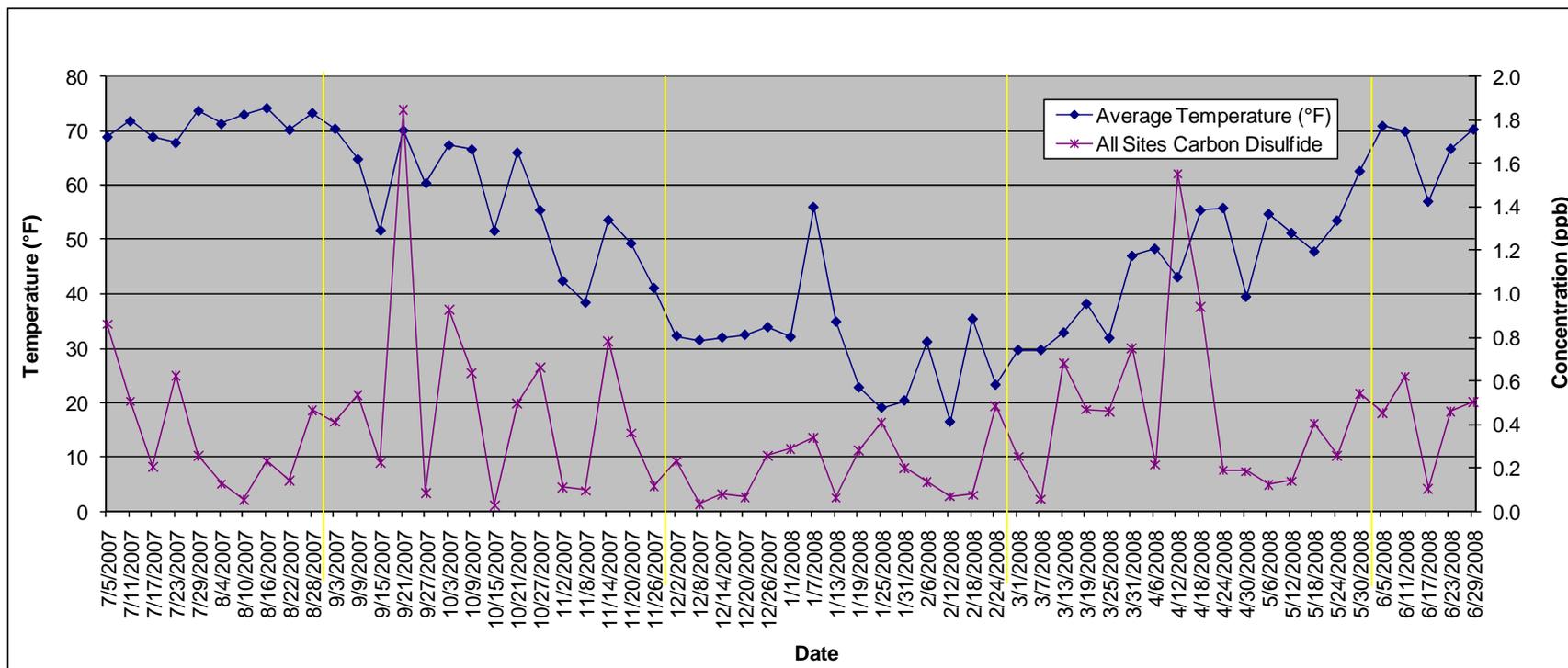
Figure Q.29. Comparisons between the Toluene Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Average Wind Speed Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both wind speed (mph) and concentration (ppb).
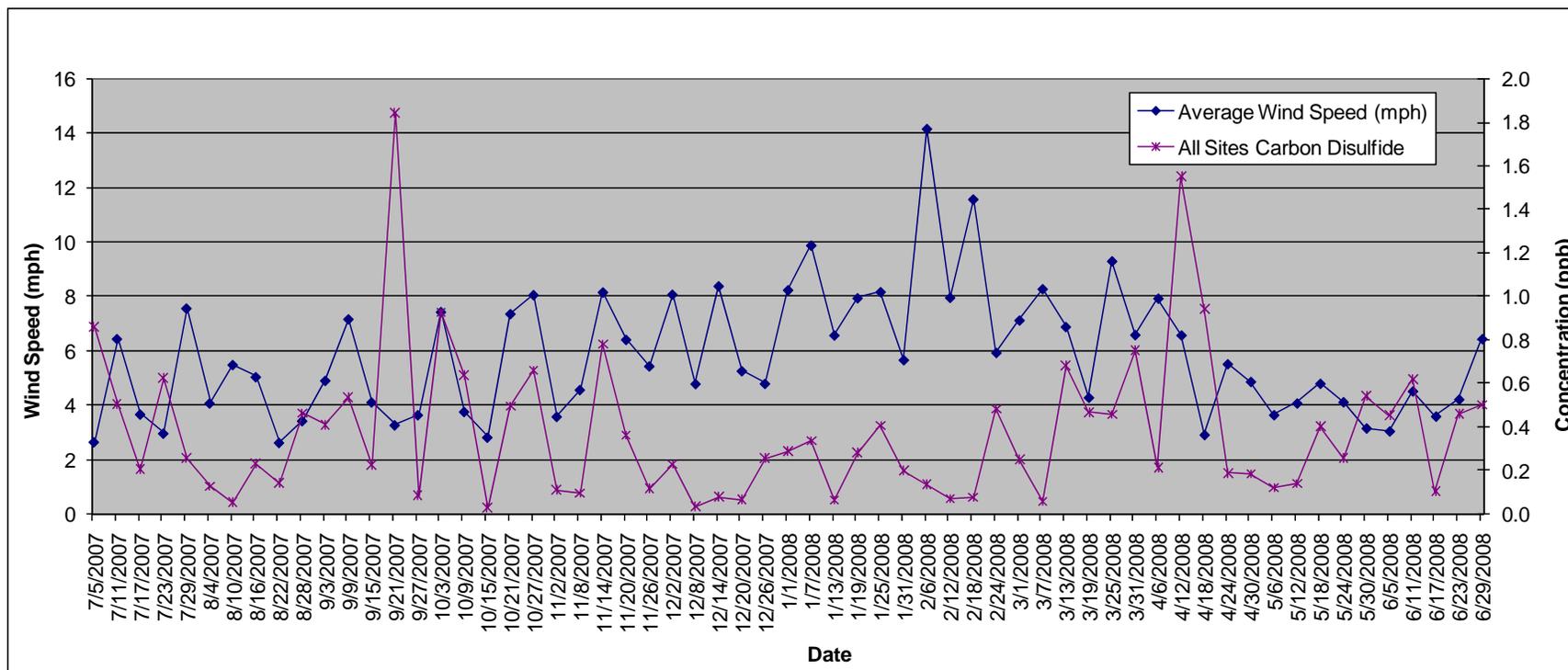
Figure Q.30. Comparisons between the Total Xylenes Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Short-Term and Long-Term Average Temperature Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both temperature (°F) and concentration (ppb).

Figure Q.31. Comparisons between the Total Xylenes Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Average Wind Speed Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both wind speed (mph) and concentration (ppb).

Figure Q.32. Comparisons between the Carbon Disulfide Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Short-Term and Long-Term Average Temperature Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both temperature (°F) and concentration (ppb).

Figure Q.33. Comparisons between the Carbon Disulfide Combined Daily Average Concentrations for All Four Monitoring Sites Together and the Average Wind Speed Fluctuations measured at the BISP Meteorological Station on the Monitoring Days over the Study Period Year. Please note that there are two Y-axes allowing separate scales for both wind speed (mph) and concentration (ppb).