A Proposed Method to Screen Source Impacts on Potential Background Monitors Using the ASOS Surface 1-Minute Dataset

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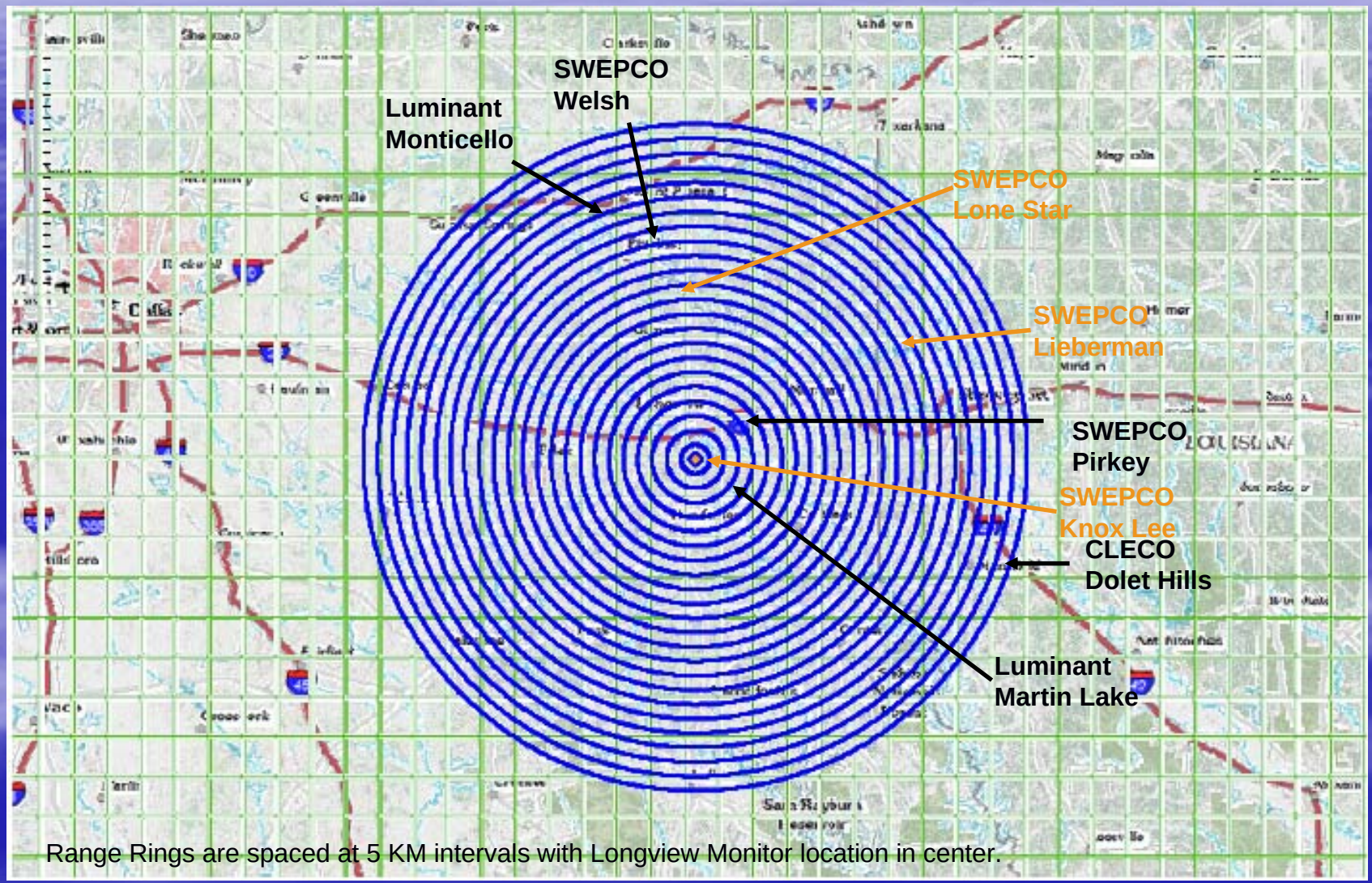
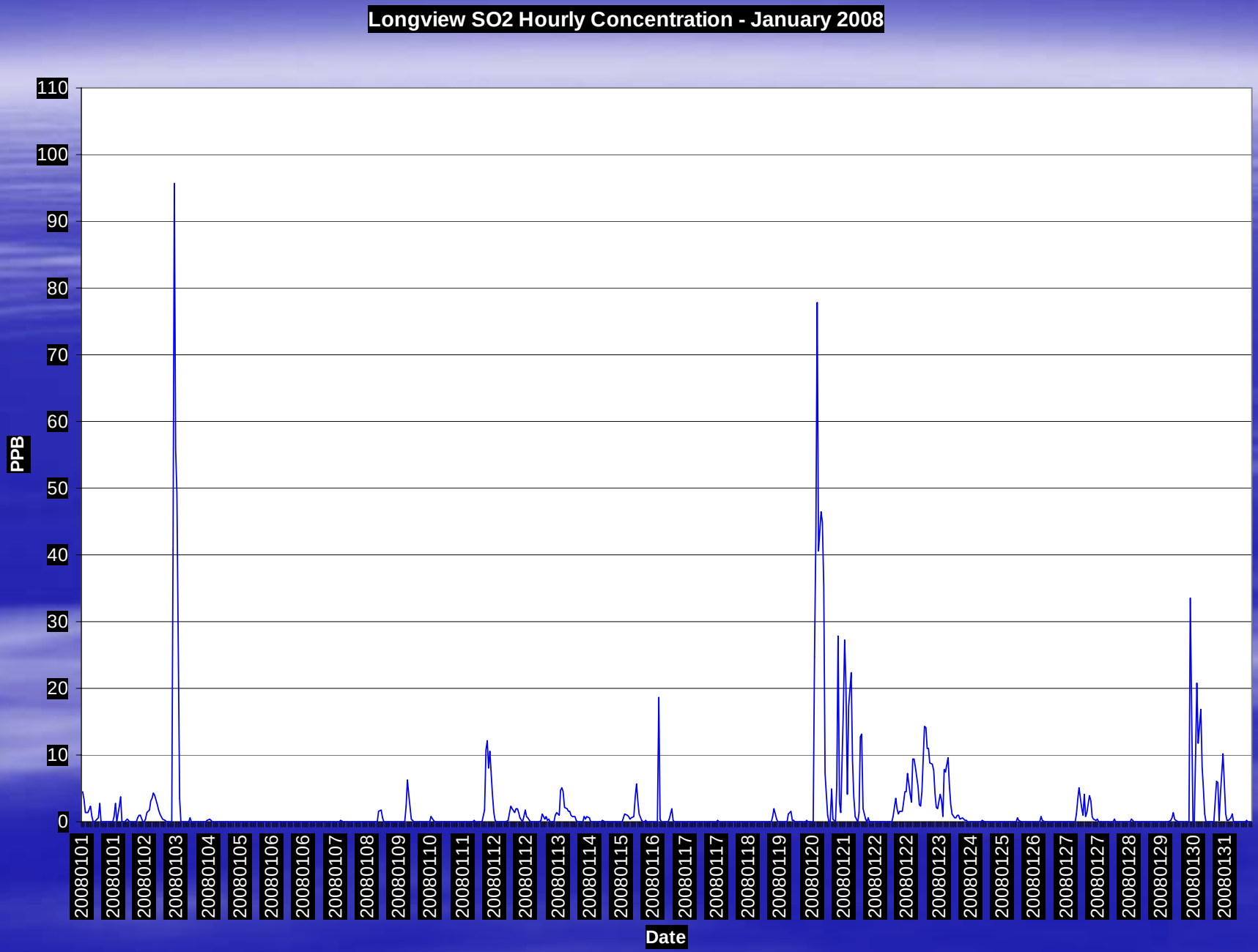
Background

- Looking for a background value for performing a one hour SO_2 analysis of power plants in the Longview, Texas area.
- 2008 – 2010 Design Value of Longview Monitor – 66 ppb
- Examined the hourly data from the Longview SO_2 Monitor and observed many hours of low values with periodic spikes to elevated values
- Conclusion - source impacts driving design value
- Therefore, it is not reasonable to use 66 ppb for a background value for this monitor

Sources Considered in the Analysis



Black denotes Coal fired facilities and orange denotes gas/oil fired facilities.


Longview SO2 Hourly Concentration - January 2008
PPB
110
100
90
80
70
60
50
40
30
20
10
0
20080101
20080101
20080102
20080103
20080104
20080105
20080106
20080106
20080107
20080108
20080109
20080110
20080111
20080112
20080112
20080113
20080114
20080115
20080116
20080117
20080117
20080118
20080119
20080120
20080121
20080122
20080122
20080123
20080124
20080125
20080126
20080127
20080127
20080128
20080129
20080130
20080131
Date

Initial Method

- Use a two hour average in the data analysis
- Select a threshold concentration value
- If wind direction was within +/- 15 Degrees of the direction of the source it was attributed to that source
- If the first condition was not met, look at the minimum and maximum wind directions the two hour period. If both fall within +/- 30 degrees of the direction of the source, it would be attributed to the source

Initial Method

- If the first two conditions do not satisfy a conclusion of attribution, then look at the one minute data from both hours to determine the number of minute values for which the wind was +/- 15 degrees of the source direction. If the number of minute values is greater than 10% or more for a higher concentration, then the hour can be attributed.
- If all of the above are not met, professional judgment or other more detailed analyses may be performed to justify attribution to a source.

Initial Results

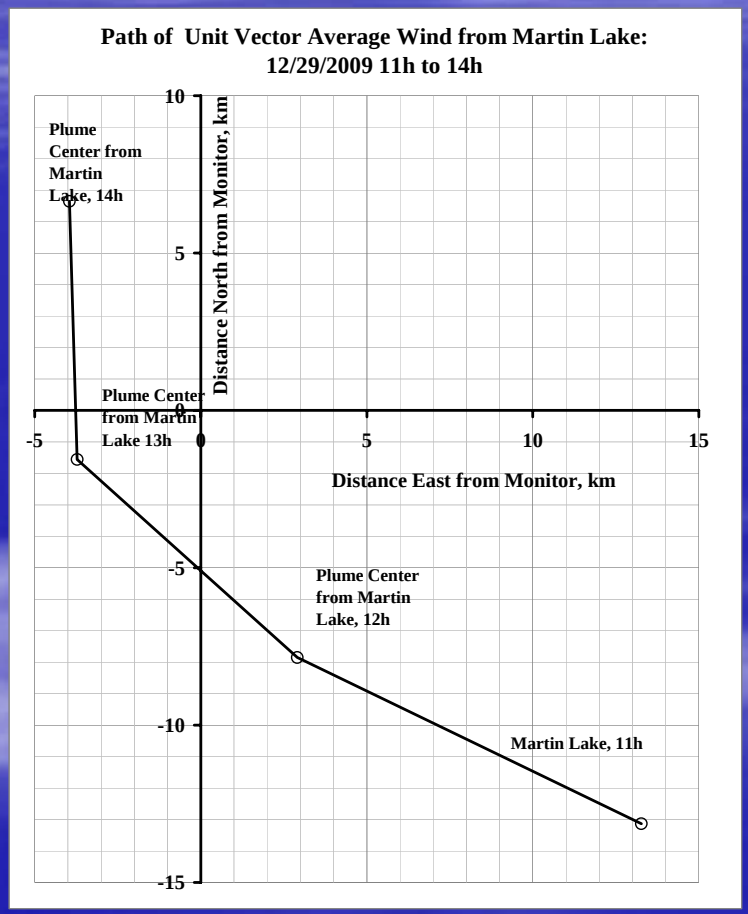
- Due to the volume of data that is involved in this analysis, computer programs are being developed to do the analysis.
- Initial results looked promising, but as we developed it, we found a few shortcomings.
- One value from 2009 was taken to a Step 4 analysis since Steps 1 – 3 would not clear it
  - This analysis demonstrated a shortcoming of using hourly based data and the capabilities of the methodology

Initial Results – Step 1 to Step 3 Analysis - Daily Max Basis

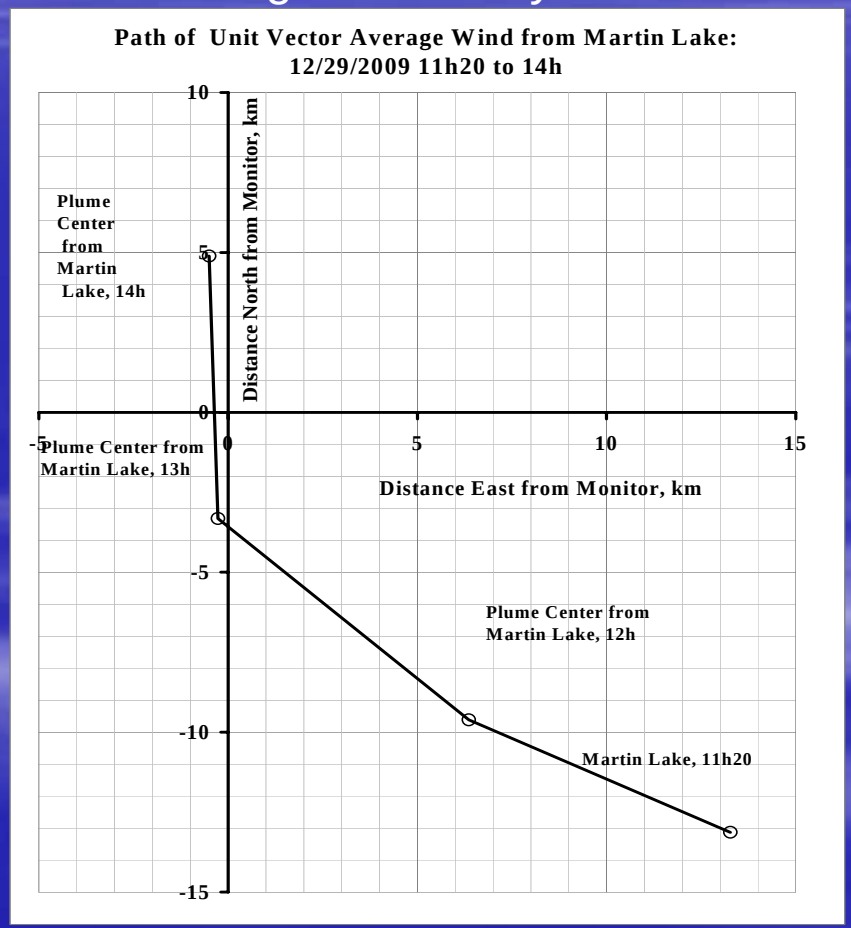
Data Set	99th Percentile SO_2 1-Hour Conc, ppb				Maximum SO_2 1-Hour Conc, ppb			
	2008	2009	2010	3 Year Avg	2008	2009	2010	3 Year Avg
No Upwind Sources	12.8	17.4	12.2	14	35.8	75.5	32.6	48
All Valid Conc's	65.3	55.6	76.4	66	95.7	75.5	83.1	85

Step 4 Analysis for 2009 Peak Value

Hourly Data Evaluation



Offsetting the Hour by 20 Minutes



Refinements to Method

- Only using a two hour average wind direction and speed may not be correct under all wind scenarios based on source location and wind speed
- Transport distance and travel time are important to the successful application of the methodology.
- In addition, this method considers percentile of hours in a source bin as well as simply the percentile of filtered daily high values in determining candidate background values.

Modified Analysis Accounting for Transit Time Up to 12 Hours

All Valid SO_2 Concentrations, ppb*	2008	2009	2010	3-Year Average
Maximum	95.7	75.5	83.1	85
99th Percentile of Hours	16.8	15.1	12.6	15
99th Percentile of Daily Maxima	65.3	55.6	76.4	66
SO_2 Concentrations (ppb) with No Upwind Sources**				
Maximum	21.6	21.7	32.6	25
99th Percentile of Hours	3.2	4.7	5.8	5
99th Percentile of Daily Maxima	8.9	8.9	15.4	11

* All valid monitored SO_2 concentrations (no alphabetic notations) with valid hourly average wind data for same hour.

** A source is upwind if average wind direction is within +/- 30 degrees of source direction (wind averaging period > transit time from source to monitor and < 12 hours)

Percentile Hour Values for 2008 and 2009
15 Degree Sector Analysis

2008

Source		Total Hours	Percentile SO_2 Concentration with Source Upwind, ppb											
Number	Name	Upwind	50	55	60	65	70	75	80	85	90	95	99	100
1	SWEPCO Lieberman	421	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.5	0.7	1.1	3.0	5.6
2	SWEPCO Pirkey	540	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.7	1.1	2.1	3.8	16.5
3	SWEPCO Knox Lee	562	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.8	1.6	5.1	23.2	65.3
4	CLECO Dolet Hill	392	0.2	0.3	0.4	0.5	0.7	1.2	1.8	3.4	7.4	17.5	44.1	77.8
5	Luminant Martin Lake	856	0.1	0.2	0.3	0.5	0.8	1.2	1.8	3.5	6.4	17.3	45.5	95.7
6	Luminant Monticello	562	0.3	0.5	0.6	0.7	1.2	1.6	2.4	3.5	4.6	6.6	9.6	14.4
7	SWEPCO Welsh	484	0.3	0.4	0.5	0.7	0.9	1.5	2.0	3.1	4.5	6.8	13.9	29.7
8	SWEPCO Lone Star	398	0.2	0.3	0.4	0.5	0.7	1.1	1.5	2.4	3.9	6.6	14.4	29.7
	No Upwind Sources	4,730	0.0	0.0	0.0	0.1	0.1	0.2	0.4	0.6	0.8	1.5	5.9	44.4

2009

Source		Total Hours	Percentile SO_2 Concentration with Source Upwind, ppb											
Number	Name	Upwind	50	55	60	65	70	75	80	85	90	95	99	100
1	SWEPCO Lieberman	560	0.8	0.8	0.9	1.0	1.1	1.2	1.4	1.7	2.1	2.6	5.9	26.8
2	SWEPCO Pirkey	674	0.9	1.0	1.0	1.1	1.2	1.4	1.6	1.8	2.2	3.0	6.7	15.4
3	SWEPCO Knox Lee	792	0.8	0.9	0.9	1.0	1.2	1.3	1.5	1.7	2.2	4.2	18.8	25.6
4	CLECO Dolet Hill	412	0.9	1.0	1.1	1.2	1.4	1.6	1.9	3.3	6.1	11.2	37.2	55.6
5	Luminant Martin Lake	942	0.8	0.9	1.0	1.2	1.3	1.6	2.1	3.1	5.6	15.0	41.9	75.5
6	Luminant Monticello	487	1.0	1.2	1.3	1.5	1.9	2.3	2.7	3.5	4.3	6.3	12.7	17.9
7	SWEPCO Welsh	440	0.9	1.0	1.1	1.3	1.6	2.0	2.5	3.2	4.4	6.3	12.7	17.9
8	SWEPCO Lone Star	413	0.7	0.8	0.9	1.1	1.2	1.4	1.8	2.3	3.1	5.2	8.1	19.0
	No Upwind Sources	4,637	0.6	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.7	2.4	6.5	44.4

Percentile Hour Values for 2010 15 Degree Sector Analysis

Source		Total Hours	Percentile SO_2 Concentration with Source Upwind, ppb											
Number	Name	Upwind	50	55	60	65	70	75	80	85	90	95	99	100
1	SWEPCO Lieberman	366	0.7	0.8	0.9	1.0	1.2	1.4	1.5	1.7	1.8	3.7	6.2	10.2
2	SWEPCO Pirkey	493	0.8	0.9	1.1	1.2	1.4	1.5	1.7	2.0	2.4	4.1	8.8	15.4
3	SWEPCO Knox Lee	566	0.9	1.0	1.1	1.2	1.4	1.5	1.8	2.1	2.7	4.5	20.8	26.9
4	CLECO Dolet Hill	221	1.6	1.8	2.1	2.3	2.6	3.2	4.2	5.5	7.7	14.2	35.2	47.6
5	Luminant Martin Lake	908	0.8	1.0	1.1	1.3	1.6	2.0	2.6	4.2	6.2	12.7	37.0	83.1
6	Luminant Monticello	586	1.2	1.4	1.6	1.9	2.3	2.8	3.2	3.6	4.4	6.3	10.7	16.5
7	SWEPCO Welsh	543	0.8	1.0	1.1	1.4	1.7	2.1	2.5	3.1	3.7	5.2	11.1	16.5
8	SWEPCO Lone Star	485	0.6	0.8	0.9	1.0	1.2	1.5	2.0	2.6	3.1	4.3	10.7	16.5
	No Upwind Sources	5,363	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.4	1.8	2.6	7.0	82.2

- The 2008 to 2010 three year average 99th percentile hour value where no source was determined to be upwind is 6.5 ppb
- If the Sector is opened up to 30 degrees the 99th percentile hour value is reduced to 4.6 ppb and the 100th Percentile is reduced to a peak of 32.6 ppb from 82.2.

Conclusions

- The use of the 6405 Dataset to source the meteorology for doing this type of exclusion analysis is viable.
- Transit times up to 12 hours should be considered to maximize the capture of source impacts on 1-hour monitored values
- If we are considering upwind sources with a long transit time, the angle between average wind direction and source direction should be increased to 30 degrees in order to allow for plume meander over a longer transit time

Conclusions

- A Step 4 analysis option should be available in the event there are hours that do not conform to the normal behaviors.
- If there are a large number of sources in similar directions, consideration should be given to grouping the sources instead of using individual sources.
- While performed for 1-hour SO2, this technique should work equally well for any pollutant with a 1-hour averaging time and possibly other short term averaging times.