INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
We make Indiana a cleaner, healthier place to live.

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December 6, 2004

Steve Rothblatt
Office of Air and Radiation
U.S. Environmental Protection Agency, Region V
77 West Jackson Boulevard
Chicago, Illinois 60604

Re: PM2.5 Nonattainment Designations

Dear Mr. Rothblatt:

On December 2, 2004, I and others from the Indiana Department of Environmental Management, discussed with members of your staff USEPA's upcoming decision on PM2.5 attainment and nonattainment designations, with particular attention on counties in southwestern Indiana. This letter provides additional data and analysis for your consideration.

We understand that USEPA is evaluating whether to consider data from the first three quarters of 2004 in addition to the 2001-2003 annual averages as a further indicator of whether air quality in a given area meets the PM2.5 health standard. We strongly urge USEPA to take these data into account, as it is clear that utility and other clean air reduction programs implemented in recent years are resulting in cleaner air in several Indiana regions. Recognizing that progress now, through either an attainment or unclassifiable designation, will avoid unnecessary imposition of requirements on counties where air quality meets health standards and emissions are not contributing to nonattainment downwind. And, given the likelihood that these areas will attain the standard once 2004 data are fully quality assured, it does not make sense to designate these areas in December, only to begin a public process of redesignation several months later.

One of the areas where monitoring data show a downward trend, and where 2004 data to date strongly suggest that the 2002-2004 annual average will show compliance with the health standard is Evansville. The data show not only that air quality is meeting the standard in the Evansville area, but also that emissions from Vanderburgh County are not contributing to high PM2.5 values in Dubois County. Enclosed with this letter is further information on this issue for your consideration that supports the following conclusions:

- Wind rose analysis shows that on those days where values are particularly high, driving up the annual average, winds are generally not from the south/southwest (i.e. Evansville) direction;
- On days with high values, PM2.5 concentrations at the Jasper monitor do not appear to increase relative to other sites when the wind is directly from Vanderburgh County;
- The Jasper monitor shares the same regional background as all other sites;
- Local influences such as nearby highway and emissions from local industry are possible causes of differences in Jasper values relative to other sites;
- Power plant emissions, which are clearly a substantial contributor to regional values, are just as high in surrounding counties relative to Vanderburgh County.

Indiana is fully committed to improving air quality for all Hoosiers. Regardless of the outcome of the nonattainment designations, there are clean air measures on the way, but not yet implemented, that will continue to improve air quality across our state. We strongly urge USEPA to consider all the data presented, including this most recent information, prior to making these critical policy determinations. If you or your staff have questions about the information in this letter or the nonattainment determinations, please contact me at 317-232-8222 or Ken Ritter at 317-233-5682.

Very truly yours,

Janet G. McCabe
Assistant Commissioner

Enclosure
cc: Cheryl Newton
Jay Bortzer
John Summerhays
Joanne Alexandrovich
Dona Bergman

Analysis of impact of Evansville Urban Area on Dubois County $PM_{2.5}$ Concentrations

Summary

The Jasper, Indiana monitoring site, in Dubois County, currently has a design value exceeding the $PM_{2.5}$ National Ambient Air Quality Standard (NAAQS). Jasper is located approximately 45 miles northeast of Evansville. Because the Evansville (Vanderburgh County) design value from 2001 - 2003 also exceeded the NAAQS, that area is also being considered for nonattainment designation. However, it appears that 2004 data will drive the design value below the NAAQS in Vanderburgh County. Discussions have recently centered around whether or not EPA should proceed with a nonattainment designation of Vanderburgh County (and other Evansville Urban Area counties) because of its possible impact on the Dubois County monitor value.

The Dubois County monitor is one of three non-urban $PM_{2.5}$ sites operated by IDEM in southwest Indiana. Additional sites are in Knox and Spencer Counties. In addition, there is an Interagency Monitoring of Protected Visual Environments (IMPROVE) site operated at Livonia in Washington County. The site in Spencer County is in Dale, approximately 15 miles due south of Jasper, almost on the southern Dubois County border. There is a map of the monitoring locations on the following page.

The Dubois County site has consistently averaged higher than any other non-urban sites in southwest Indiana. Table 1 shows these differences from 2001 - 2003.

Table 1 Design values for southwestern Indiana $PM_{2.5}$ sites

County	2001	2002	2003
Dubois	16.54	16.34	15.72
Knox	13.39	14.20	13.96
Spencer	14.52	14.06	14.63
Livonia	13.30	12.26	12.30

In attempting to determine why Dubois County has had higher values, several analyses have been performed. Regionally, there are significant amounts of emissions from large utilities in southwestern Indiana, as well as utilities in southern Illinois and Kentucky. There are a significant number of wood furniture manufacturers located in the Jasper area. Many of these burn scrap wood in boilers. Emissions from these sources are not large annually, but wood is generally burned when supplies accumulate. These sources could impact the monitoring site on certain days, but this has not been clearly established. Emissions from heavy-duty diesel trucks and other traffic along US 231, a major north-south highway which passes several hundred yards west of the site, may also be impacting monitored values, but data to quantify such an impact are not available. Therefore, an analysis of meteorological data and monitoring values at nearby sites was performed.

The following conclusions about Dubois County data were reached based upon this analysis:

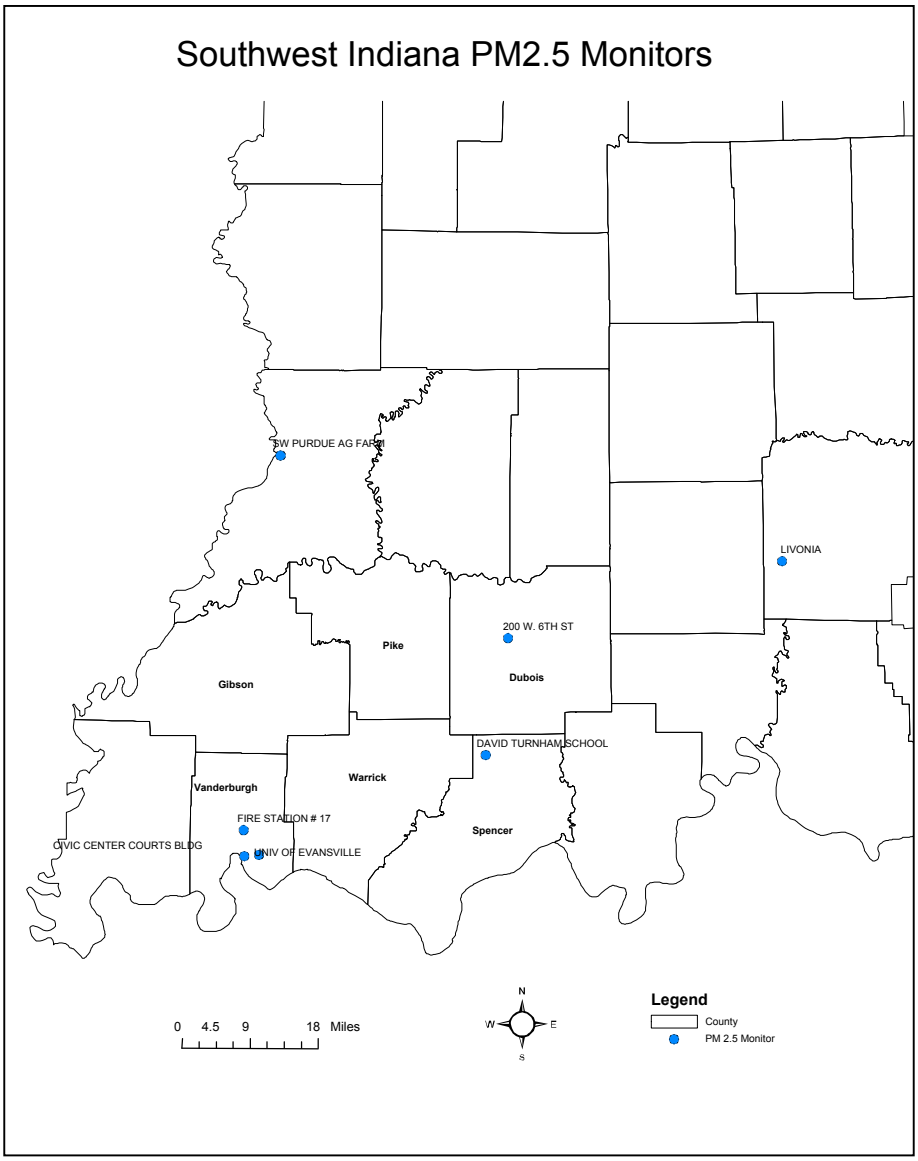
1. Average wind directions for the 2002 - 2003 time period were primarily from the south and southwest.

2. Background levels at the other sites were all 12 - 14 ug/m^3 for an annual average.

3. Wind directions from days with high $PM_{2.5}$ values at Dubois County are seldom from Vanderburgh County. An analysis of wind direction on days with the highest values, e.g. over 20 ug/m^3, at the Jasper site in Dubois County showed that the wind direction seldom was from the south or southwest (origin of Vanderburgh County).

4. <u>On days with high values at Dubois County, the other sites are usually high also</u>. This analysis also showed that generally when one non-urban site in southwest Indiana was over 20 ug/m^3, the others were also. On these days, these sites were seldom impacted by an air mass that moved over the Evansville area. On days in which Evansville was directly upwind of Dubois County, the Dubois values were relatively the same as the other sites not impacted by Evansville. For the Dubois County site, the mass for the days with values above 20 ug/m^3 contributed about 3 ug/m^3 to the annual average.

5. <u>$PM_{2.5}$ values for this area are greatly impacted by regional transport.</u> Speciated data are not available from sites operated by IDEM. However, the Livonia IMPROVE site and others in the general area show that sulfate is the predominate portion of the sample, followed by organic carbon. This indicates emissions from regional transport sources, such as utilities, is a major contributor to concentrations in the area. For Vanderburgh County, SO2 emissions for the past three years have averaged less than 40 tons per year. Reducing these emissions to zero would likely have little to no impact on Dubois County.



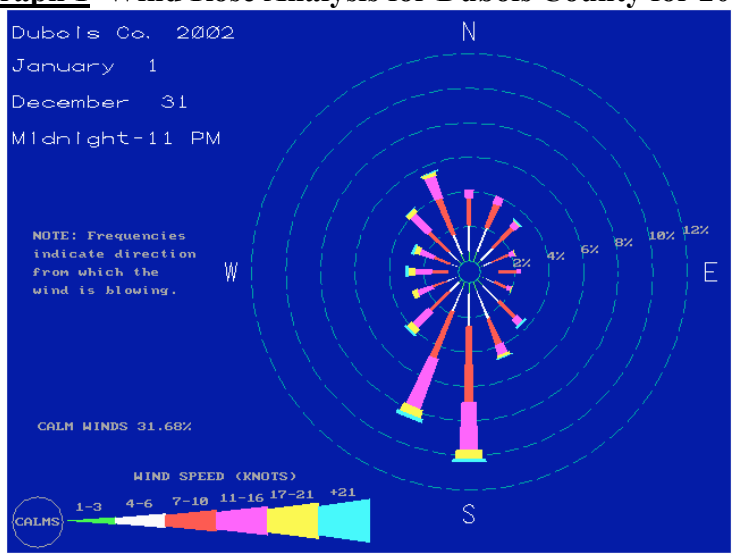
Detailed Analysis

Data Used for Analysis

Information was gathered through the Indiana climate page on the Purdue Applied Meteorology Group - Department of Agronomy website http://shadow.agry.purdue.edu/sc.hly-geog.html. Southern Purdue Agricultural Research Center in Dubois, Dubois County was selected.

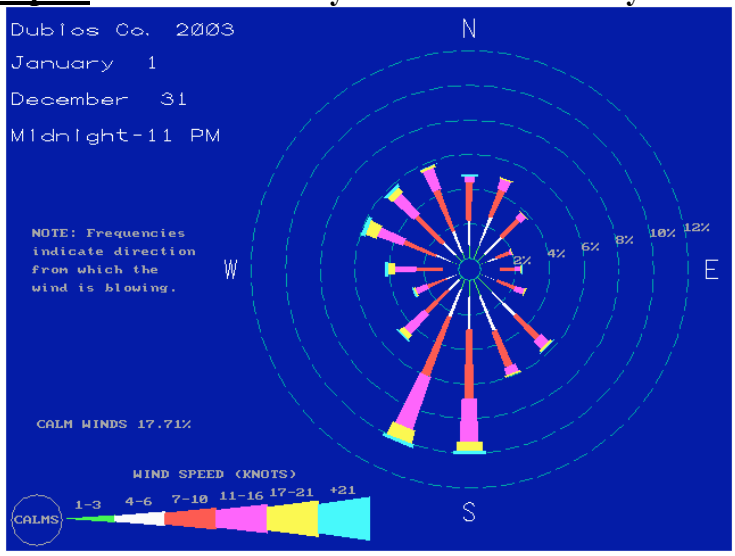
Graph 1 shows the wind rose from Dubois County for 2002. The wind blows most frequently from the south, south-southwest, north-northwest, south-southeast, southwest and northwest.

Graph 1 Wind Rose Analysis for Dubois County for 2002



Graph 2 shows the wind rose from Dubois County for 2003. The wind blows most frequently from the south-southwest, south, south-southeast, west-northwest, northwest, southeast and north-northwest.

Graph 2 Wind Rose Analysis for Dubois County for 2003



Analysis of data values 20 ug/m3 and over

An analysis was performed to determine if high values were associated with different wind directions. IDEM had made wind roses for 2002 and 2003 high days earlier, so these were used for the analysis. The days used for this analysis are in Table 2.

Table 2

2002						2003					
	Dubois	Knox	Spencer	Livonia	Wind Direction		Dubois	Knox	Spencer	Livonia	Wind Direction
1/2/2002	21.6	13.2	20.2		NW - NE	1/30/2003	38.2	27.2		23.9	NE-S
1/20/2002	20.6	15.6	18.6	15.2	SE-S	2/26/2003	29.1	24.0	22.4	16.8	NE-S
3/18/2002	23.9	18.0		18.3	N-NE	3/1/2003	52.9	49.8		29.6	NW
6/4/2002	24.7			28.0	S-SW	3/7/2003	18.1	21.6		11.5	SE-SW
6/10/2002	21.9	21.9		18.9	SE-S	3/13/2003	50.0	29.3		22.3	NW-SE
6/19/2002	28.2	28.3	27.8		SE-S	4/18/2003	30.2	28.3		23.5	SW-NW
6/22/2002	31.6	38.6		32.0	E-SE	6/17/2003	25.1	27.7		22.0	NW-NE
6/25/2002	20.8	15.5	20.5	14.3	SE-SW	6/23/2003	16.4	24.2		20.2	SE
7/1/2002	27.2	25.3	27.2	27.2	N*	6/29/2003	21.4	22.1		17.7	SE-SW
7/4/2002	33.9	35.9		27.8	NE*	7/2/2003	21.4	34.4	24.7	18.2	NW
7/10/2002	22.0	19.9		18.0	NE*	7/5/2003	20.8	18.6		24.2	SW
7/13/2002	29.4	28.7	26.5	24.4	NE*	7/14/2003	22.0	25.7	22.9	22.1	SE
7/16/2002	43.1	43.8		33.7	SE*	7/20/2003	38.0	29.0		35.3	S-SW
7/22/2002	23.5			23.9		7/26/2003	24.6	22.0	24.8	25.6	S-SW
7/25/2002	20.3	21.4	25.3	15.7	NE-SE*	8/1/2003	31.4	26.4	27.9	27.3	SW
7/31/2002	23.3	18.9	26.7			8/13/2003	38.0	33.9	34.6	37.2	NE-SE
8/3/2002	45.6				SE*	8/16/2003	26.0	21.9		27.0	NW
8/12/2002	24.5	24.0	24.3	22.6	SE-SE*	8/19/2003	24.4	22.7		24.0	N-SE
8/21/2002	25.1	26.2		22.0	SE-S	8/22/2003	25.7	25.7		22.1	S-SW
8/27/2002	23.8			20.3	N-NE	8/25/2003	31.6	27.8	31.0	31.6	SW
8/30/2002	25.5		22.3	19.9	NE-E	8/28/2003	21.7	18.6		20.4	S-SW
9/2/2002	21.3			21.1	SE-SW	9/12/2003	39.5	37.9	38.1	32.2	SE
9/8/2002	36.3			31.0	SE-SW	9/18/2003	20.5	19.7	20.0	21.2	NE
9/17/2002	27.8	24.7	28.4	22.0	SE	9/21/2003	20.8	17.4		22.8	NE-SE
9/29/2002	21.7	25.2	20.6	19.9	E-SE	10/9/2003	24.2	28.5		18.3	SE
11/28/2002	20.4		18.2	13.7	SW	11/11/2003	22.0	22.4	18.9	16.6	SW
12/7/2002	31.5			19.7	S-SW						
12/10/2002	25.0		21.5	16.2	NE						

*Wind directions taken from Evansville NWS site. See the attachments for a complete set of wind roses for Dubois and Evansville meteorological sites. Data from the two sites are comparable so Evansville data was substituted where Dubois County data was unavailable.

$PM_{2.5}$ data used for the Livonia site is from http://vista.cira.colostate.edu/improve/. This sampler uses a different protocol than the FRM sites, but results are similar. The Dubois, Knox, and Livonia sites operate on a 1 in 3 day schedule, while Spencer County is 1 in 6 days. Therefore, the analysis was done on a 1 in 6 day schedule so that data would be comparable.

This analysis showed:

- When Dubois County site was high, generally, so also were the other non-urban sites, indicating a regional contribution to the samples
- The days with values over 20 ug/m^3 contributed nearly 3 ug/m3 to the annual average. This was calculated by the following method:
    1. summing the values of the 28 days for 2002, sum = 744.5, 26 days for 2003 = 734
    2. calculating the baseline of 15 ug/m^3 for those days; 28 x 15 = 420 for 2002, 26 x 15=390 for 2003
    3. subtracting the baseline from the sum of the values; 744.5 - 420 = 324.5, 734 - 390 = 344
    4. dividing each by 122 sample days for an entire year; 324.5/122=2.66 for 2002, 2.82 for 2003

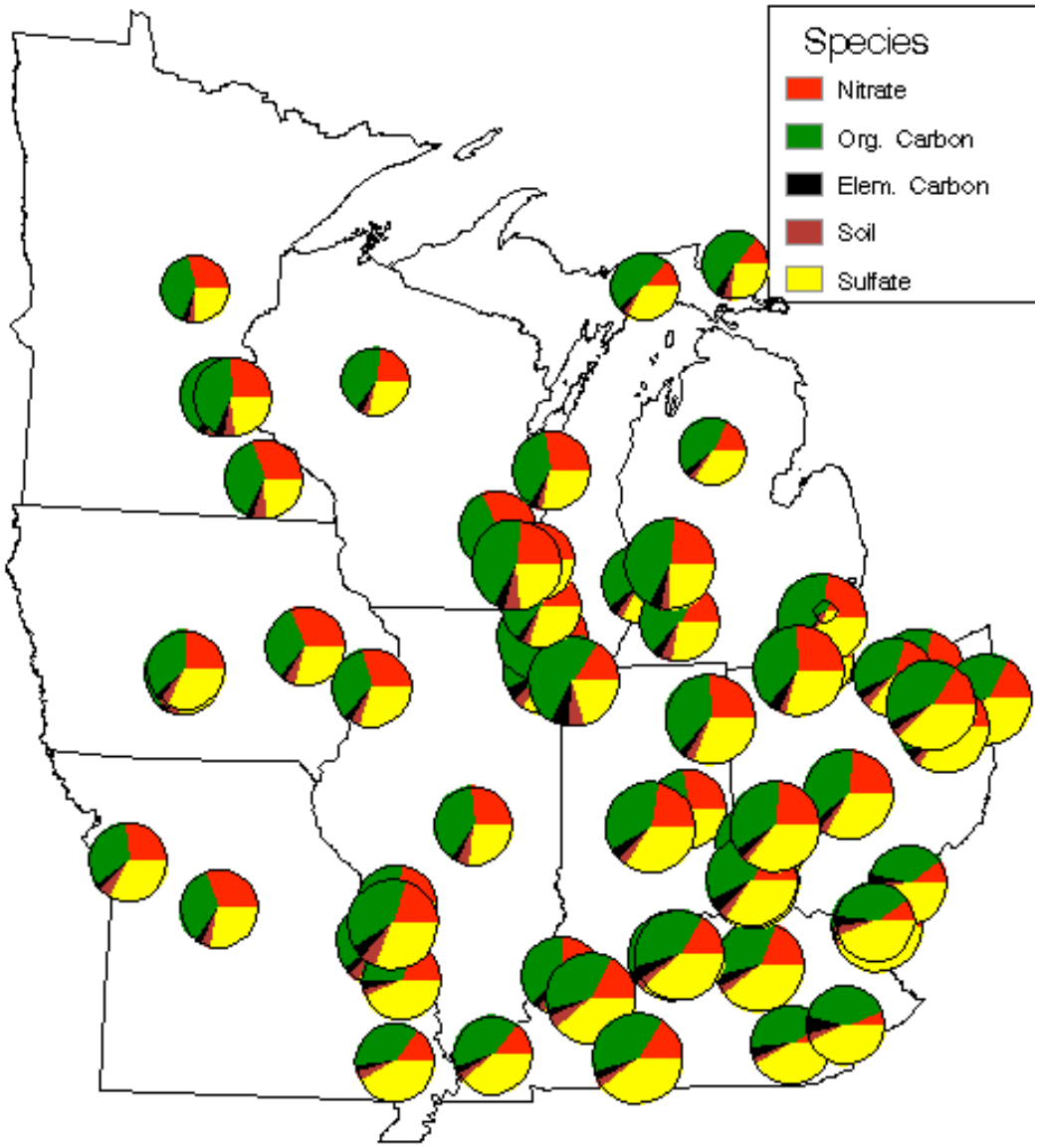
When these values are removed from the 2001 - 2003 design value of 16.2 ug/m^3 for Dubois County, it can be seen that the value would be well below the NAAQS of 15 ug/m^3. While an impact from Vanderburgh County could be included in the background concentrations, clearly there is a regional component that needs to be examined. Available data does not show that high values are more likely to occur at the Jasper site when the air mass is from the Evansville area.

Speciation information

No speciated data is available for Dubois County. However, it is available for Livonia and several other sites in the area. The map below shows the results. Sulfates are a major component of the sample in this area, impacted greatly by the regional transport of emissions from large utilities. In this area, most pie charts look similar. While Evansville emissions could impact Dubois County, the point source emissions from Vanderburgh County have averaged under 40 tons/year from 2001 - 2003. See the attachments for the inventory spreadsheet. Reducing these emissions to zero will not likely solve the attainment problems in Dubois County. Several of the counties in the area have large utilities. Addressing their regional impact through the NOx SIP Call and the Clean Air Interstate Rule will provide a better means of achieving attainment in this area. Another source of emissions impacting the samples could be mobile source emissions. These emissions are also properly addressed by a regional process, which EPA has already started with heavy duty diesel engine and diesel fuel rules, for both on- and off-road vehicles.

Annual Average Species Contribution to Fine

Data from EPA Speciation Network, July 2002—June 2003

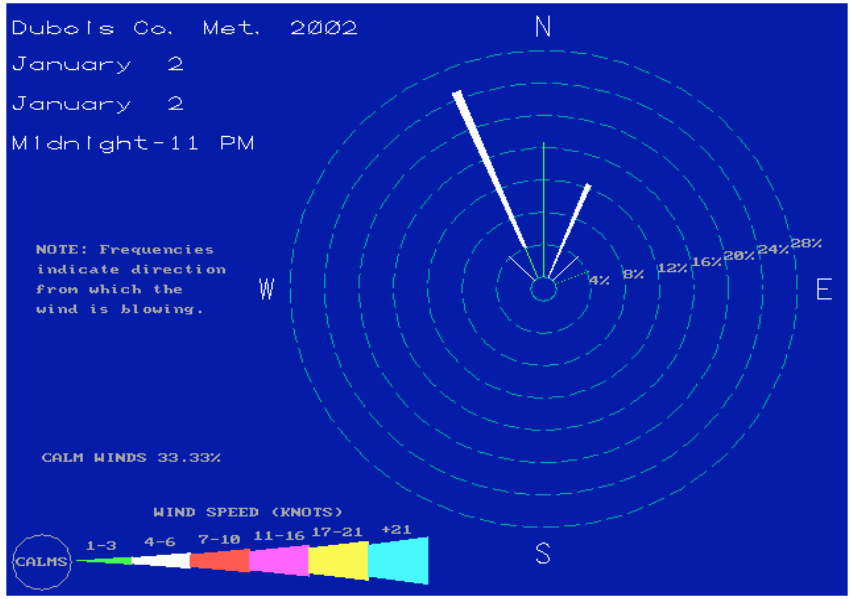


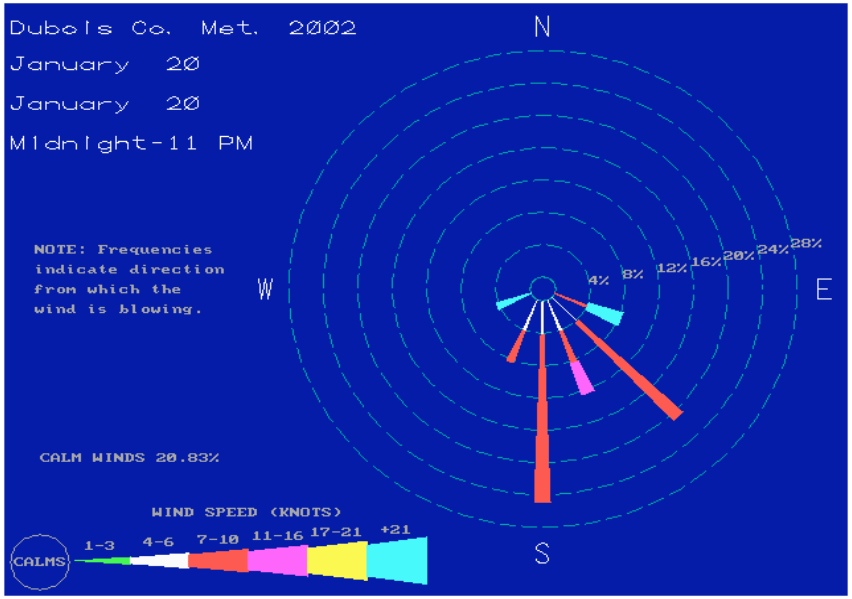
Attachments to Dubois County Analysis

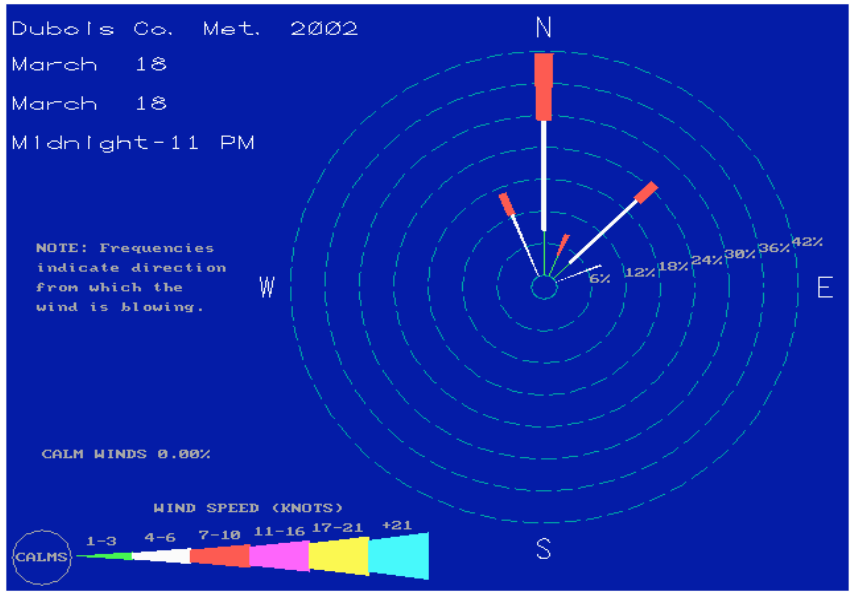
Dubois County Wind Roses, 2002
Dubois County Wind Roses, 2003
Evansville Wind Roses, 2002
Evansville Wind Roses, 2003
Vanderburgh County SO2 Emissions Inventory

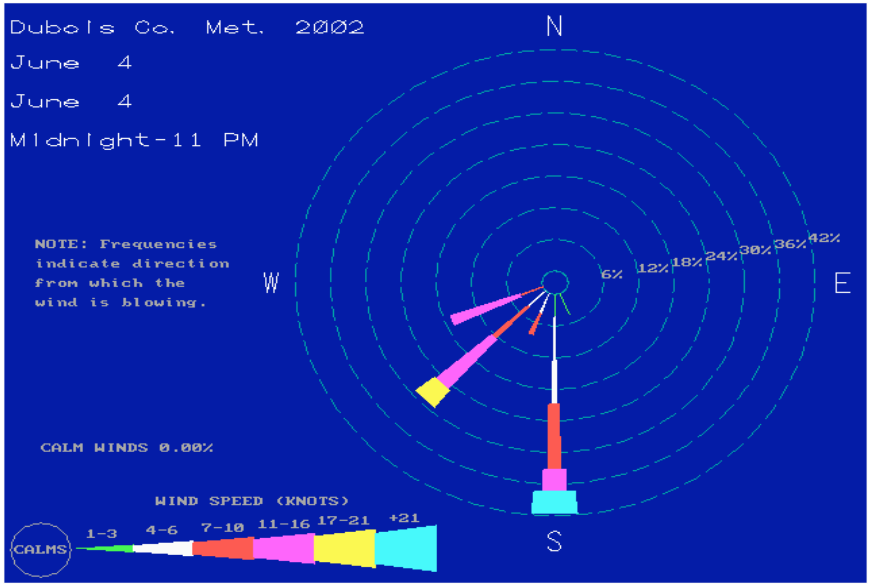
Dubois County Wind Rose Analysis - 2002

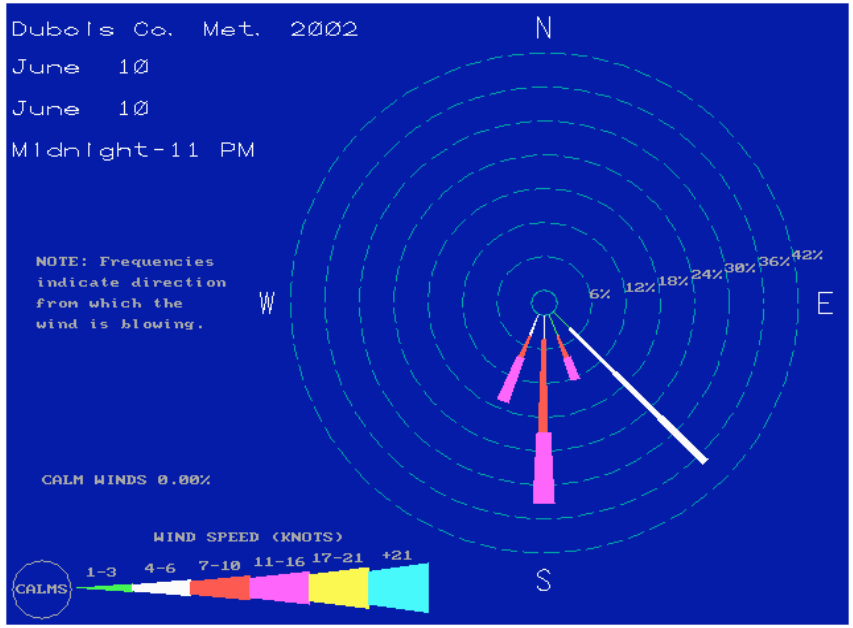
Wind Speed and Wind Direction on Days where PM2.5 readings were ≥ 20 ug/m3

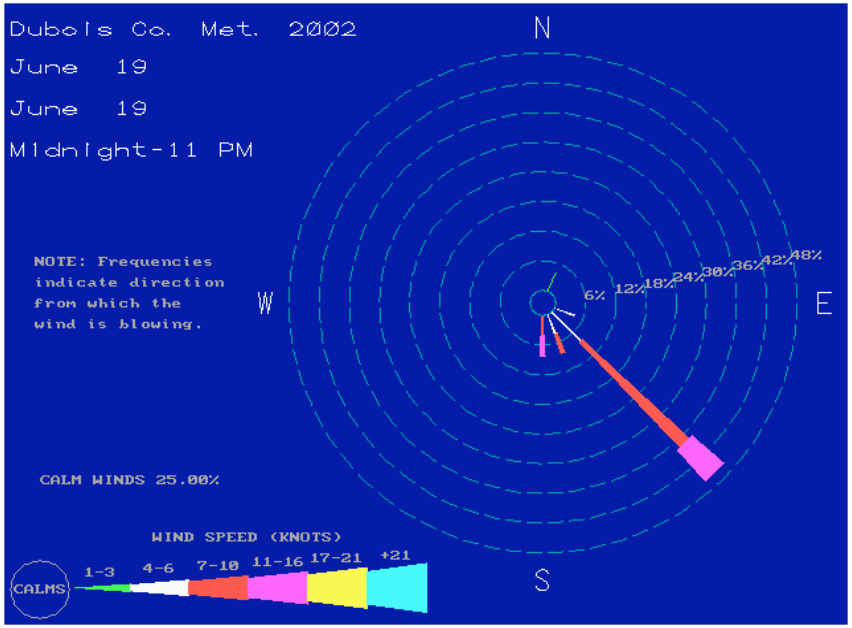


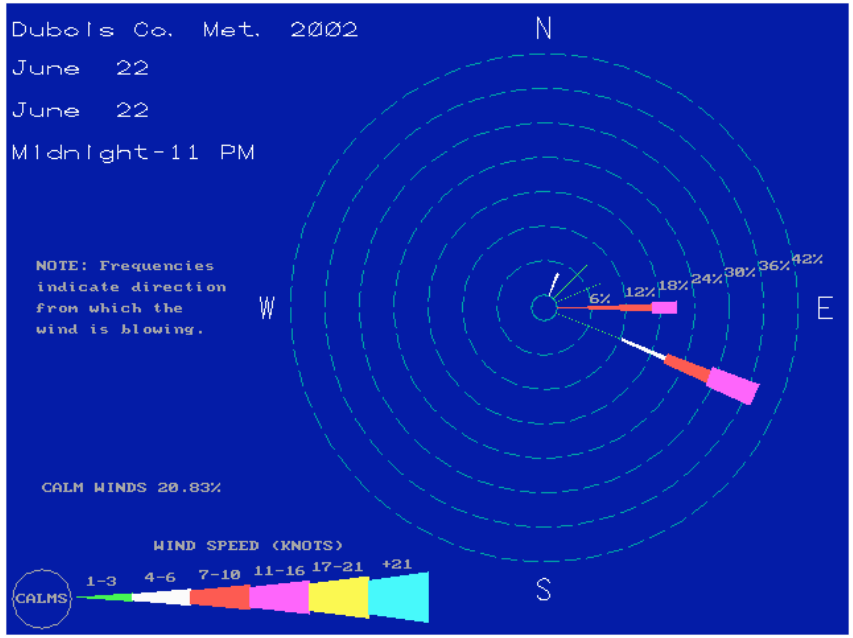


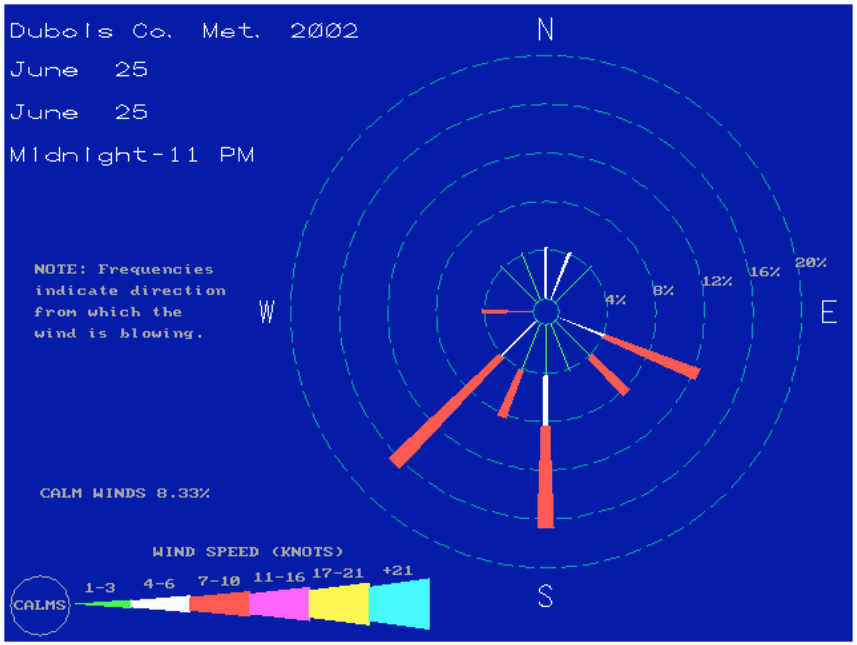


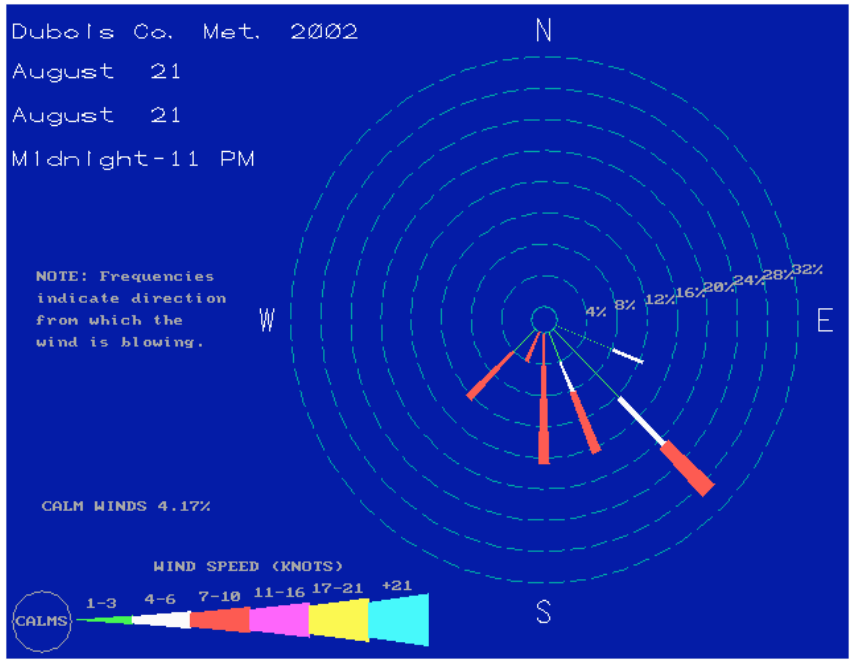


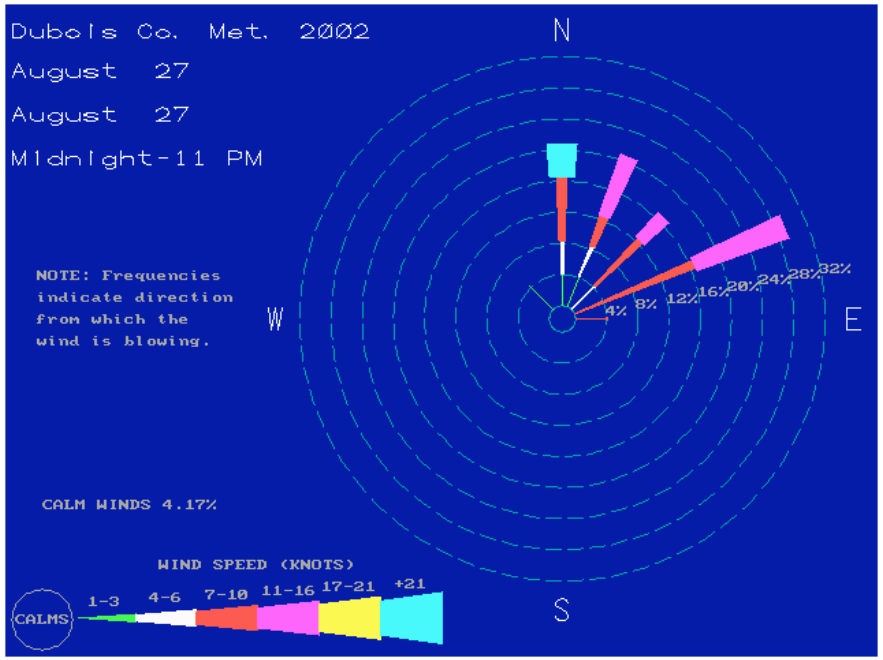

Dubois Co. Met. 2002
June 10
June 10
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 0.00%
N
W
E
S
6%
12%
18%
24%
30%
36%
42%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

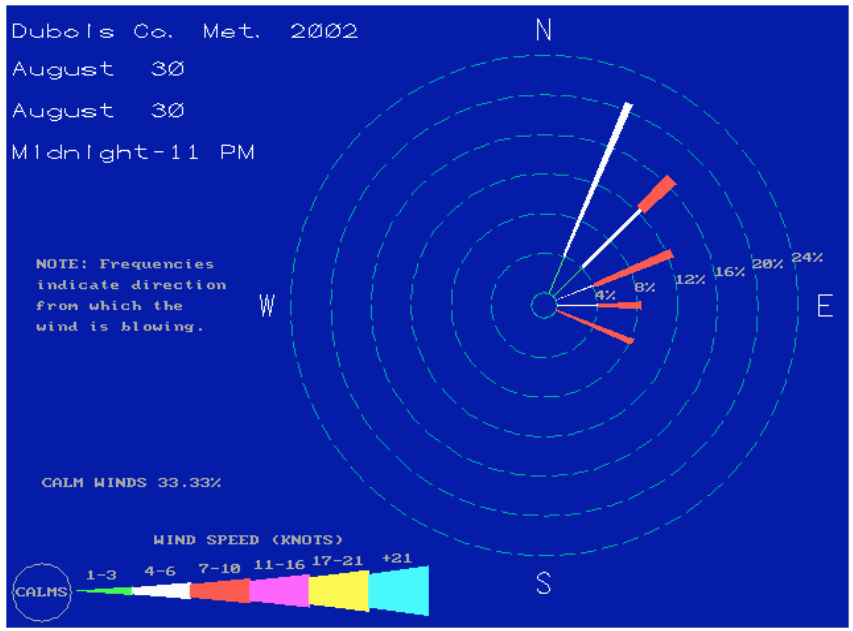

Dubois Co. Met. 2002
June 19
June 19
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 25.00%
N
W
E
S
6%
12%
18%
24%
30%
36%
42%
48%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Dubois Co. Met. 2002
June 22
June 22
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 20.83%
N
W
E
S
6%
12%
18%
24%
30%
36%
42%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Dubois Co. Met. 2002
June 25
June 25
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 8.33%
N
W
E
S
4%
8%
12%
16%
20%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Dubois Co. Met. 2002
August 21
August 21
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 4.17%
N
W
E
S
4% 8% 12% 16% 20% 24% 28% 32%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Dubois Co. Met. 2002
August 27
August 27
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 4.17%
N
W
E
S
4% 8% 12% 16% 20% 24% 28% 32%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Dubois Co. Met. 2002
August 30
August 30
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 33.33%
N
W
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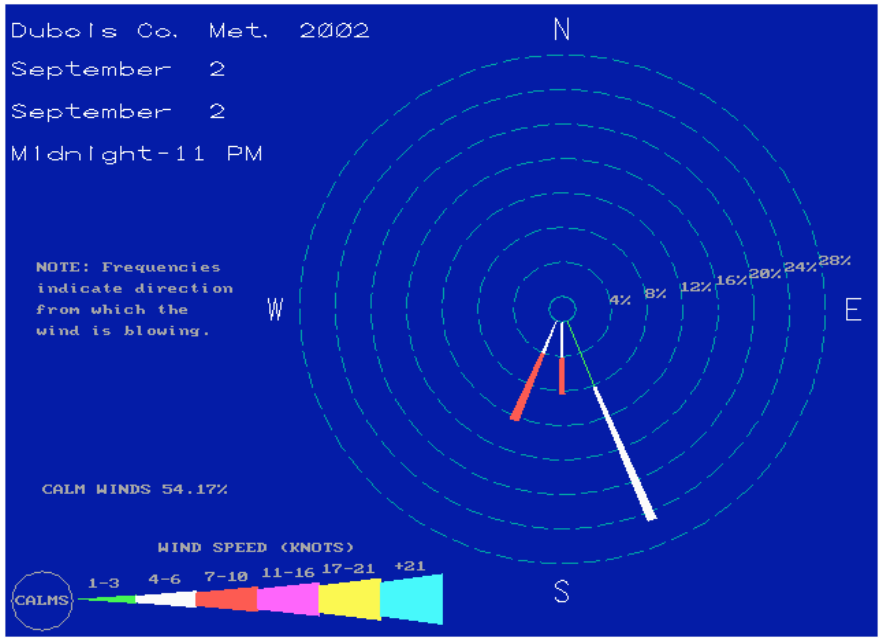
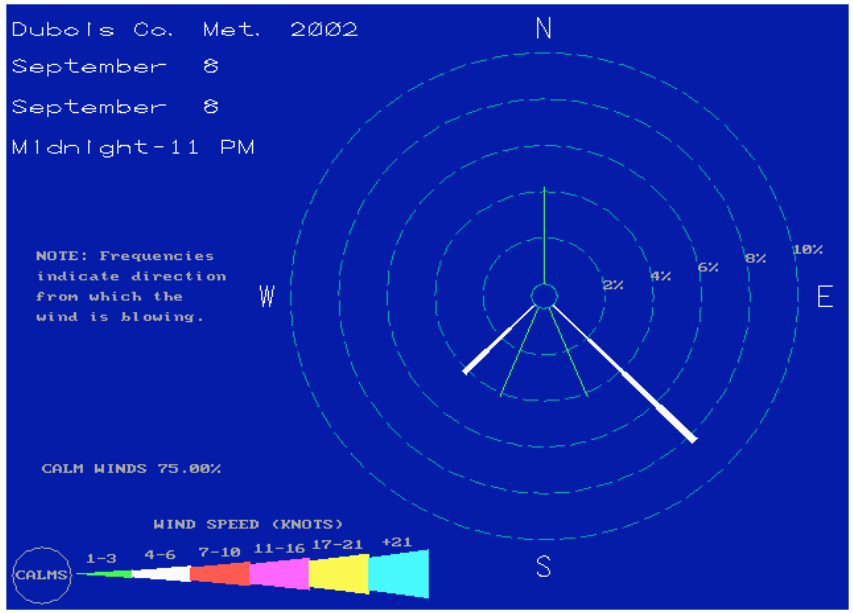
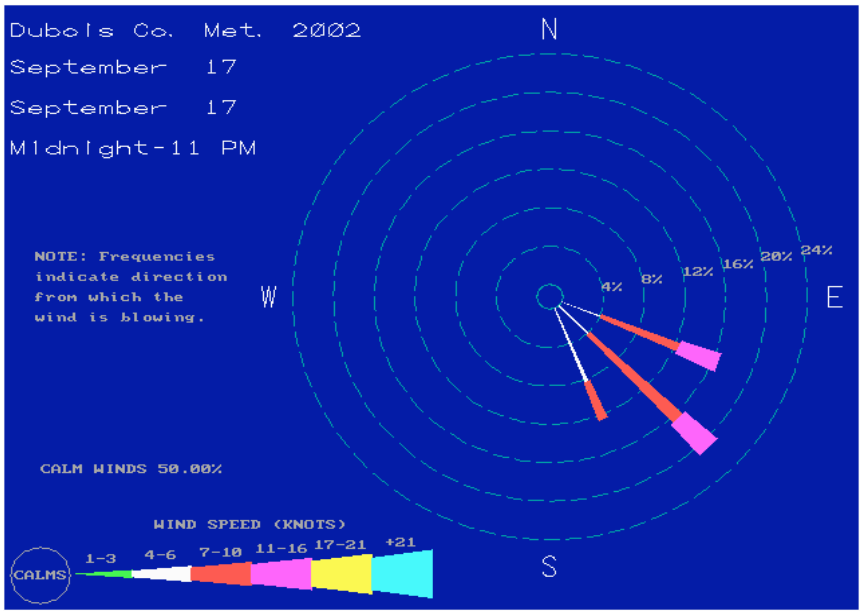
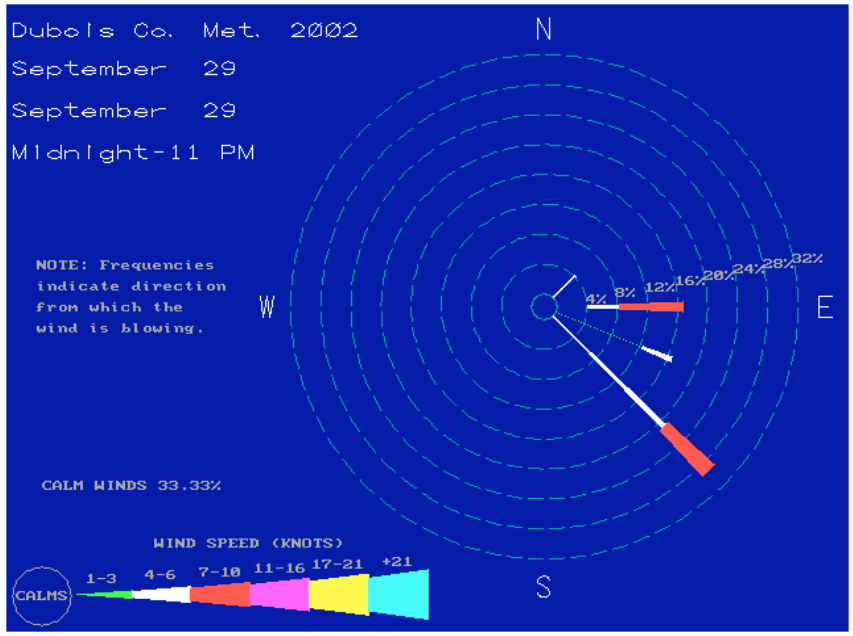
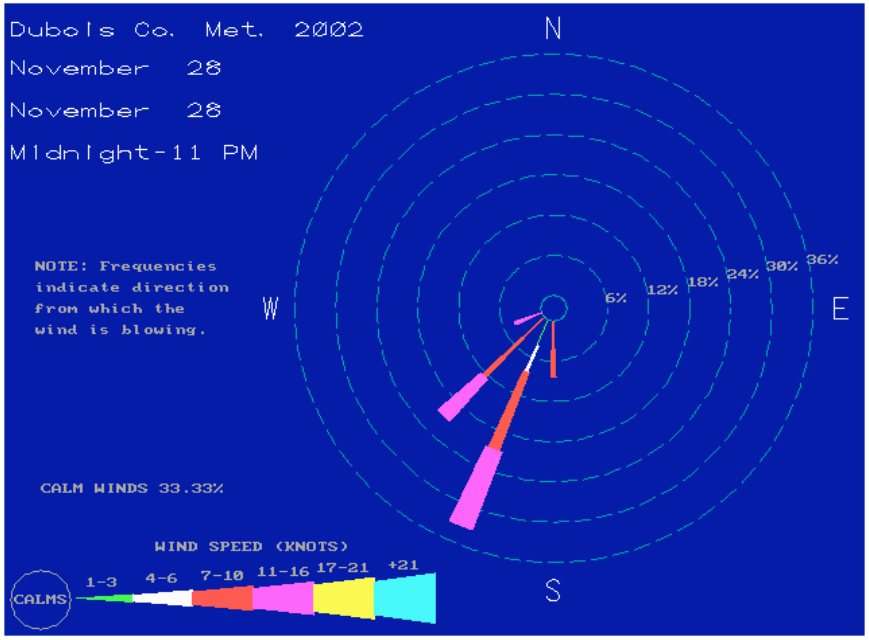
S
4% 8% 12% 16% 20% 24%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

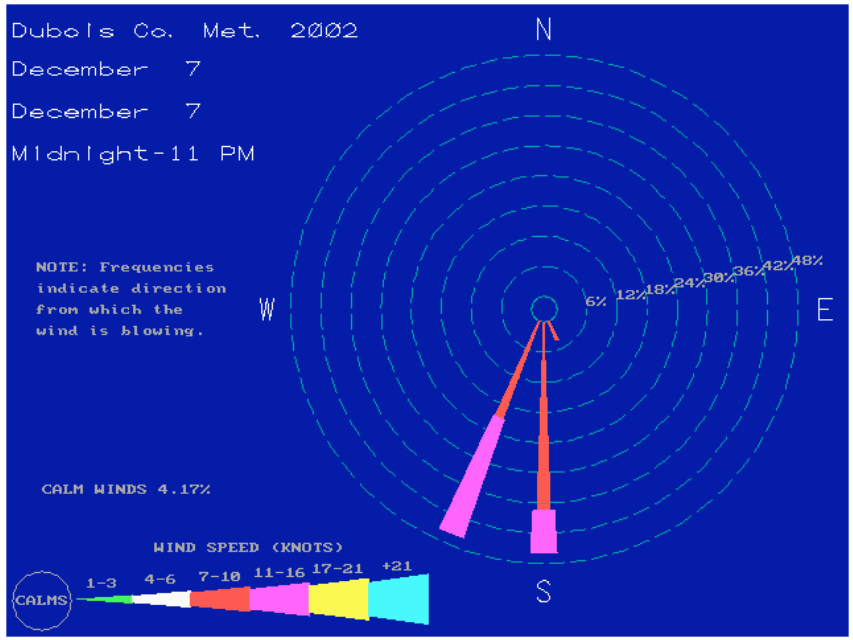

Dubois Co. Met. 2002
September 2
September 2
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 54.17%
N
W
E
S
4% 8% 12% 16% 20% 24% 28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

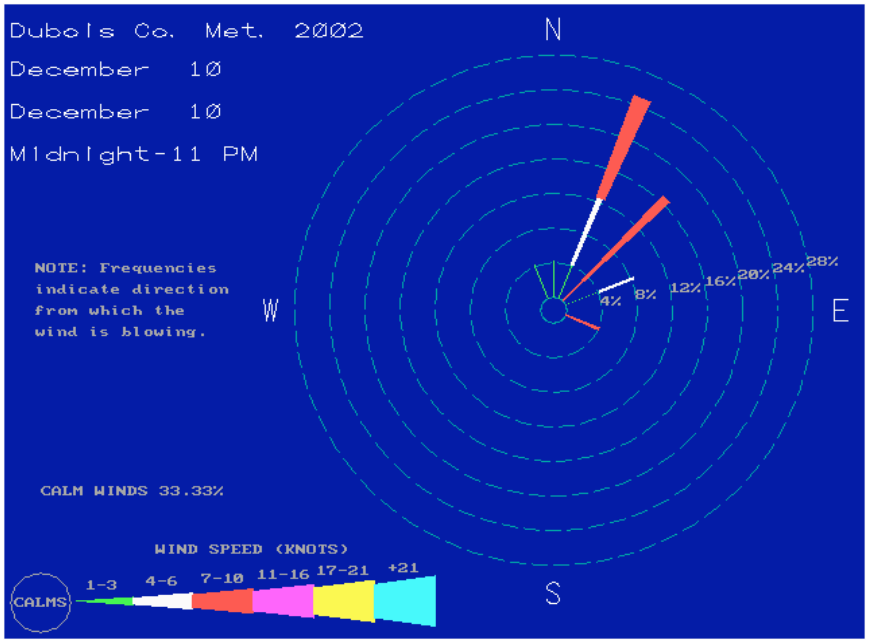

Dubois Co. Met. 2002
September 8
September 8
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 75.00%
N
W
E
S
2%
4%
6%
8%
10%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

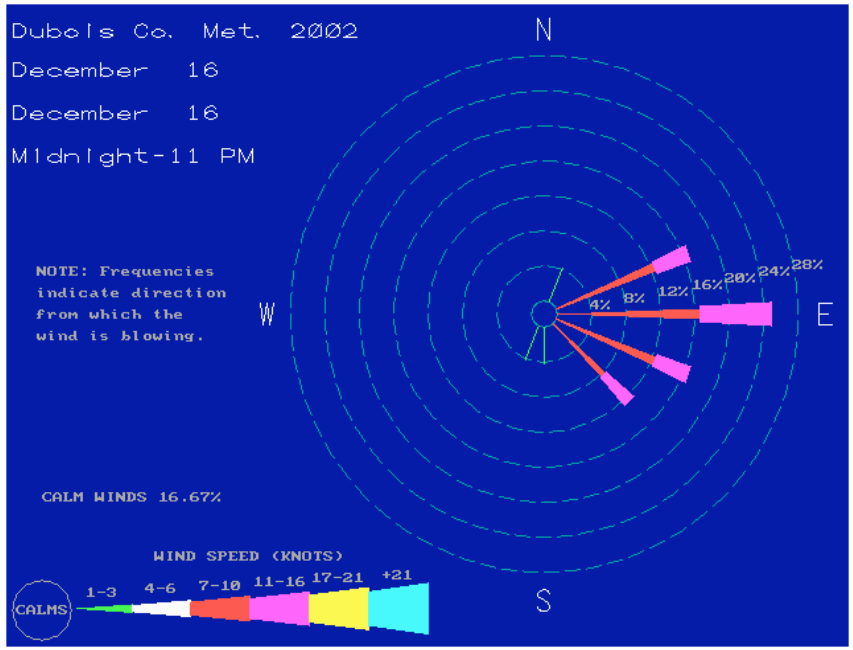

Dubois Co. Met. 2002
September 17
September 17
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 50.00%
N
W
E
S
4%
8%
12%
16%
20%
24%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Dubois Co. Met. 2002
September 29
September 29
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 33.33%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
32%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Dubois Co. Met. 2002
November 28
November 28
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 33.33%
N
W
E
S
6%
12%
18%
24%
30%
36%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

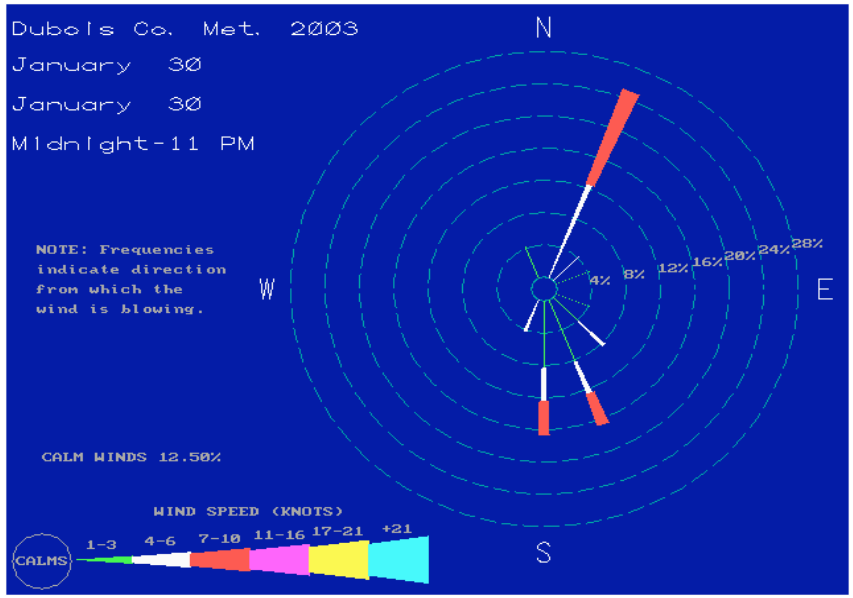

Dubois Co. Met. 2002
December 7
December 7
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 4.17%
N
W
E
S
6% 12% 18% 24% 30% 36% 42% 48%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

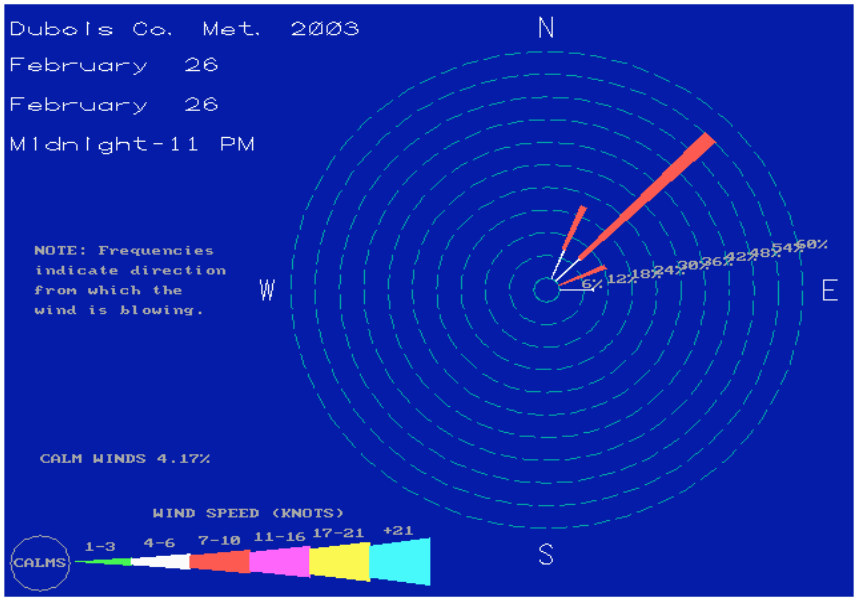

Dubois Co. Met. 2002
December 10
December 10
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 33.33%
N
W
E
S
4% 8% 12% 16% 20% 24% 28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

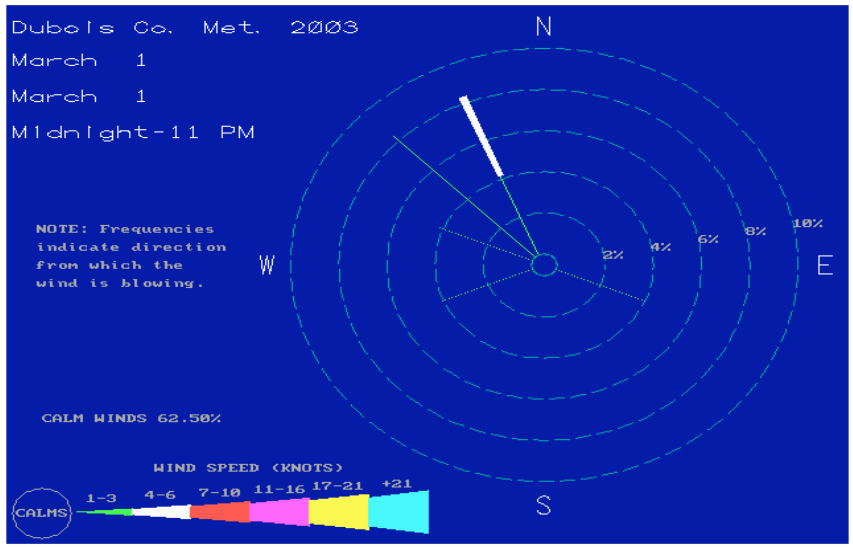

Dubois Co. Met. 2002
December 16
December 16
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 16.67%
N
W
E
S
4% 8% 12% 16% 20% 24% 28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

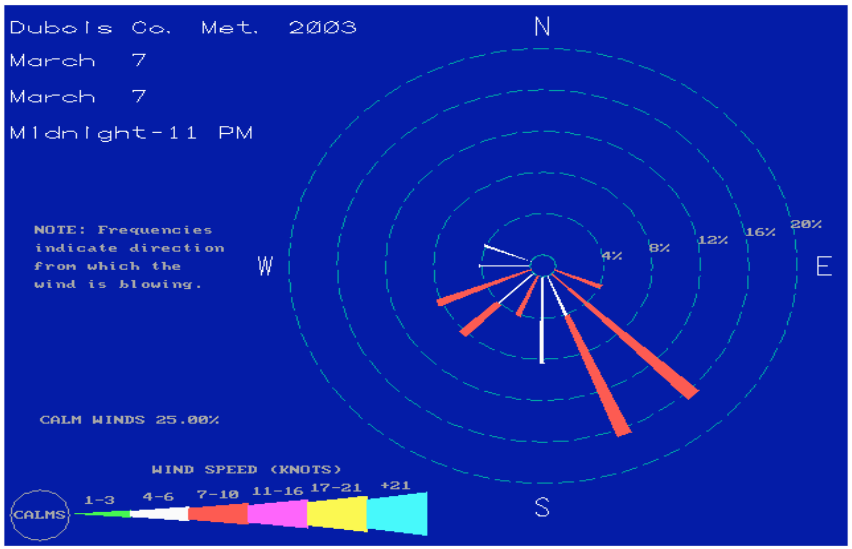
Dubois County Wind Rose Analysis - 2003

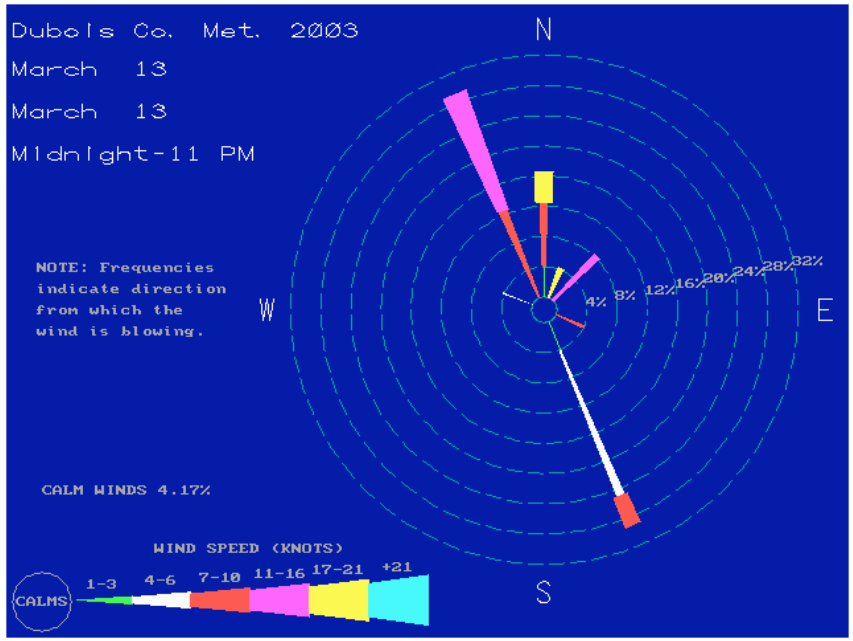
Wind Speed and Wind Direction on Days where PM2.5 readings were ≥ 20 ug/m3

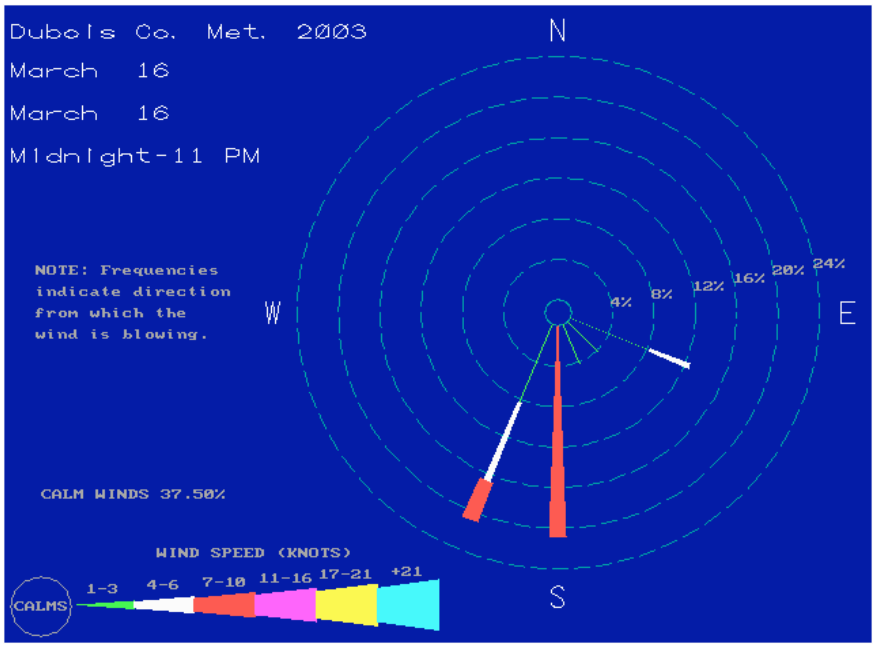


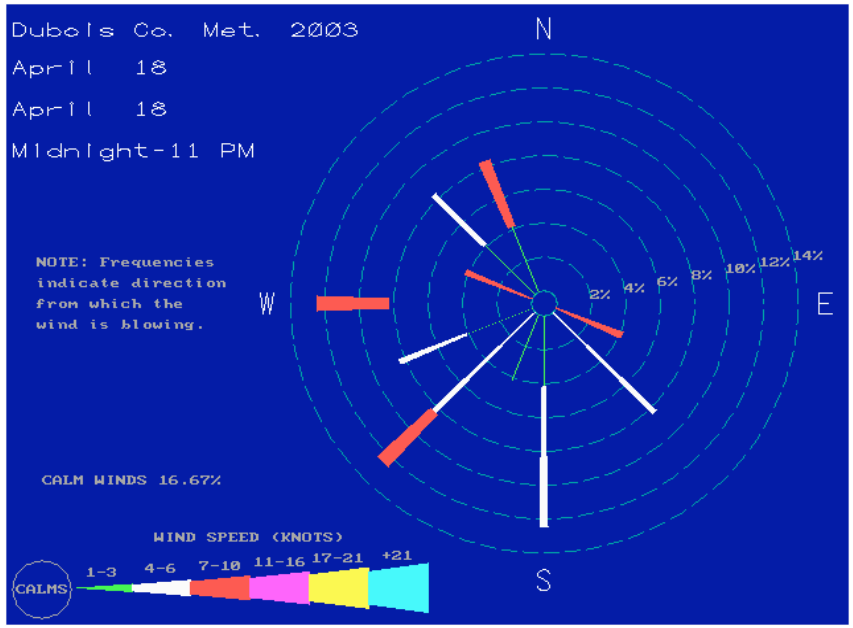


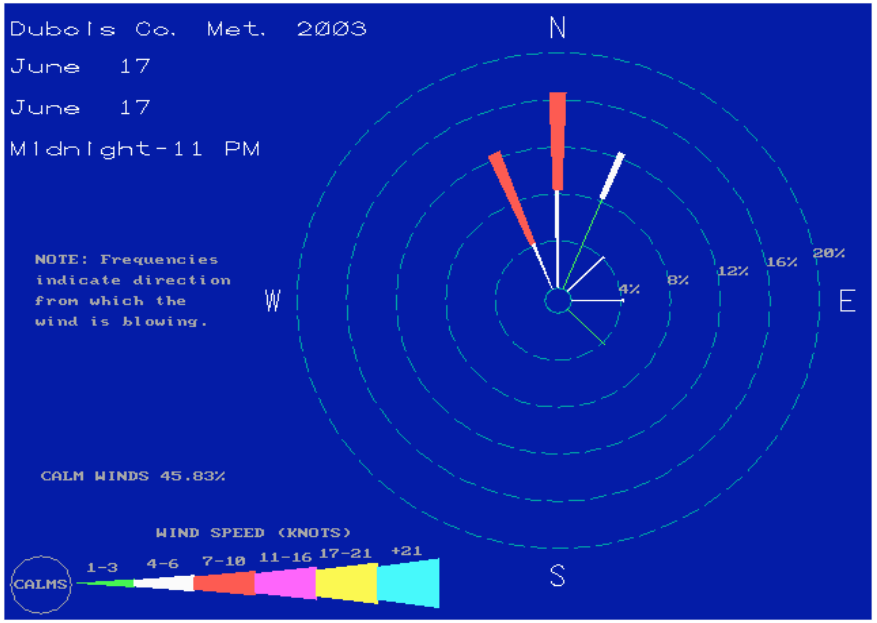


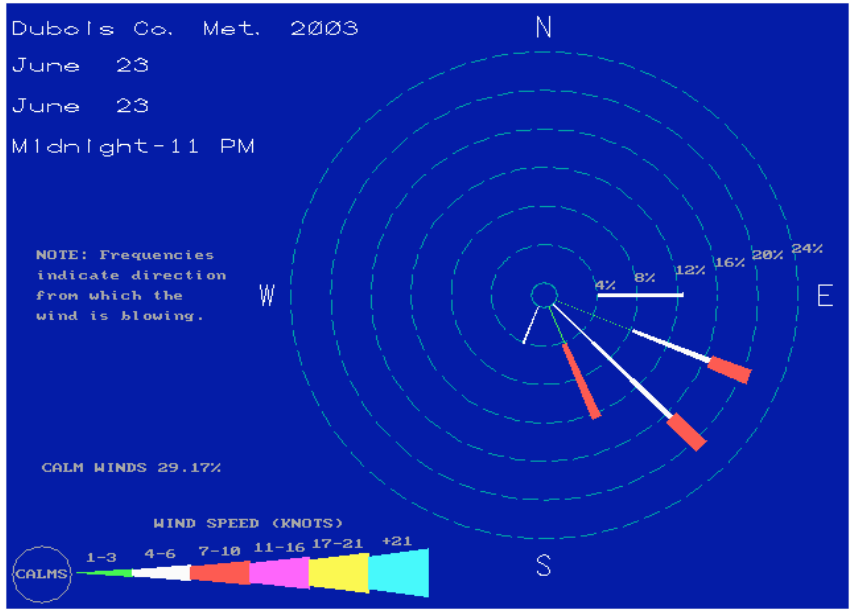


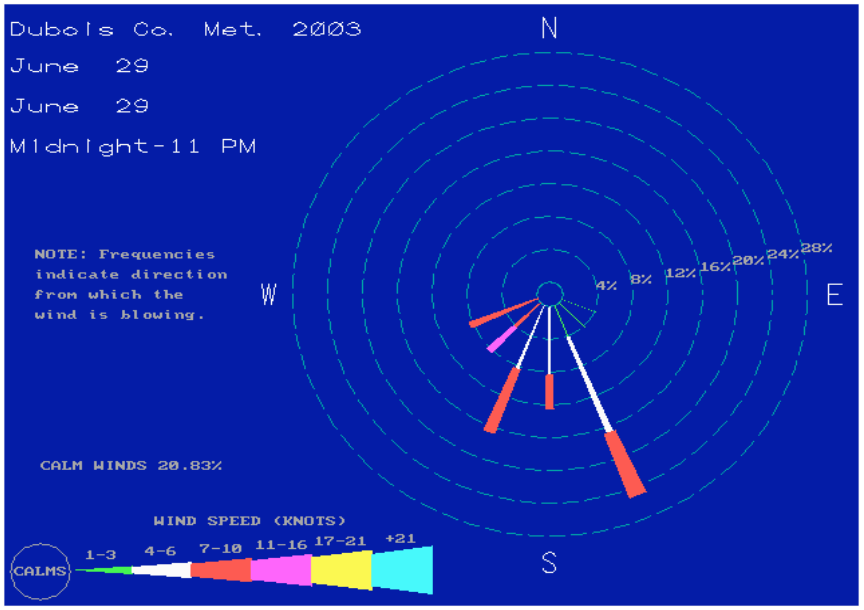

Dubois Co. Met. 2003
March 13
March 13
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 4.17%
N
W
E
S
4% 8% 12% 16% 20% 24% 28% 32%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

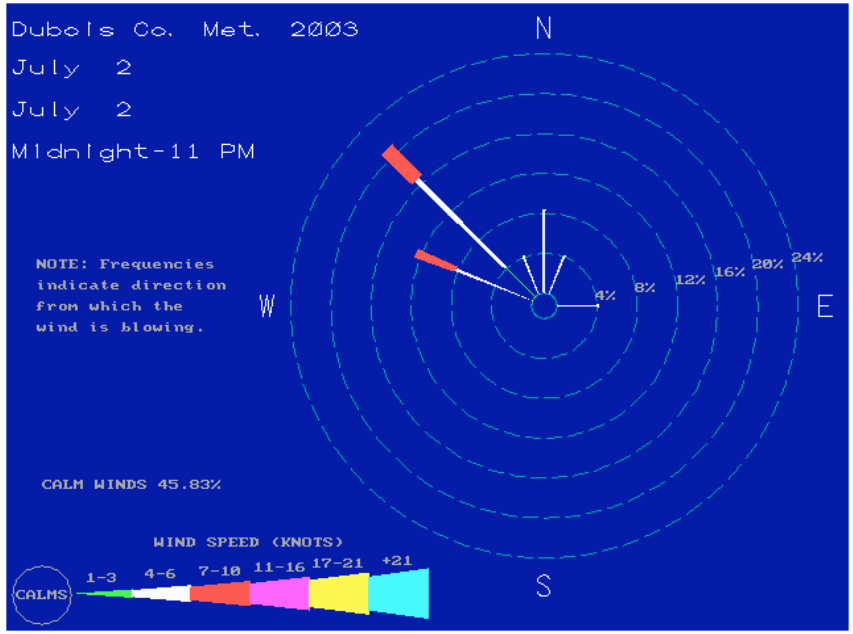

Dubois Co. Met. 2003
March 16
March 16
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 37.50%
N
W
E
S
4% 8% 12% 16% 20% 24%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

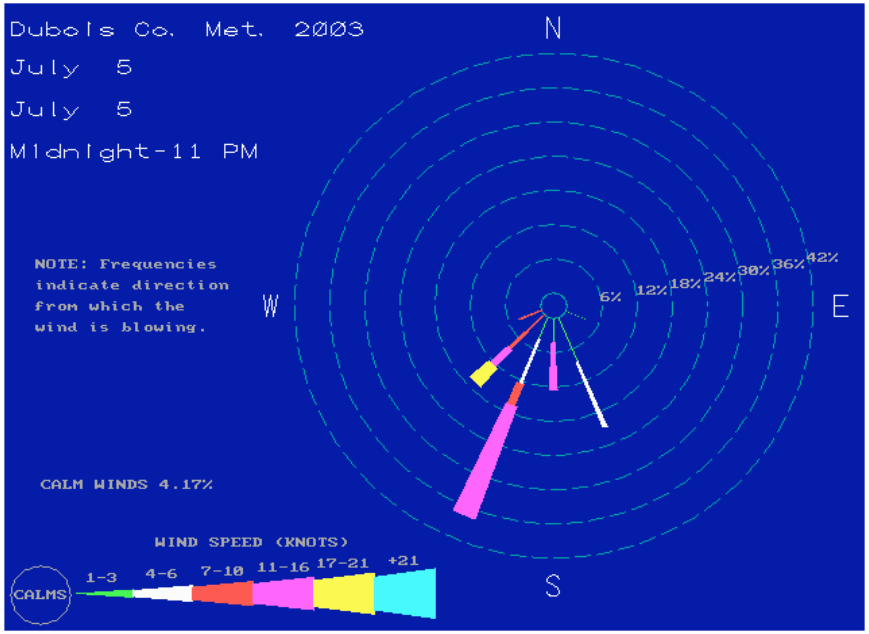

Dubois Co. Met. 2003
April 18
April 18
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 16.67%
N
W
E
S
2% 4% 6% 8% 10% 12% 14%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

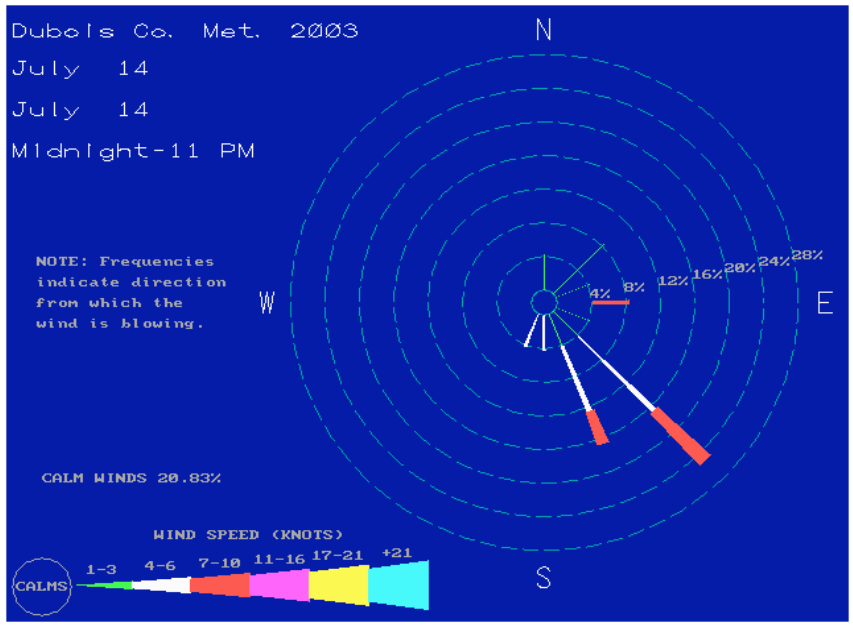

Dubois Co. Met. 2003
June 17
June 17
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 45.83%
N
W
E
S
4% 8% 12% 16% 20%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

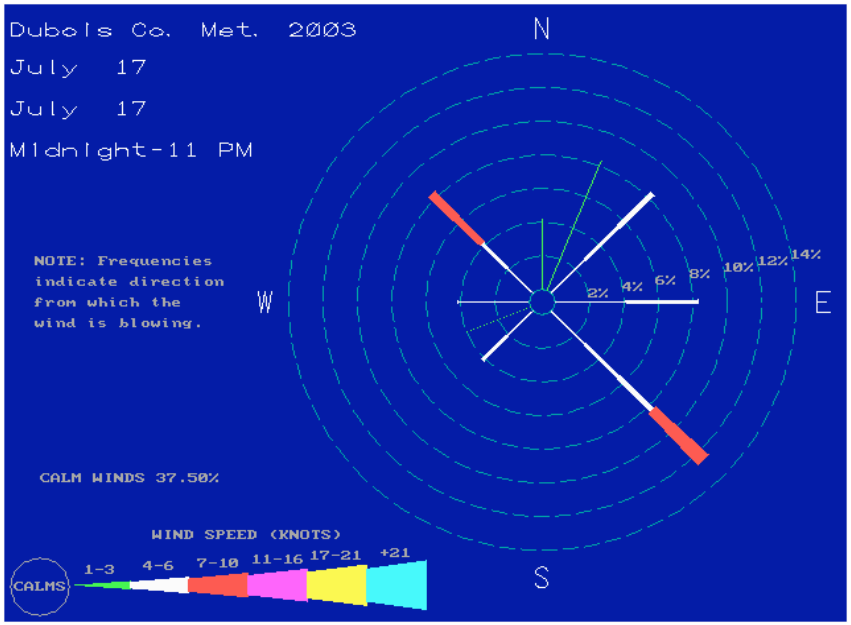

Dubois Co. Met. 2003
June 23
June 23
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 29.17%
N
W
E
S
4% 8% 12% 16% 20% 24%
WIND SPEED (KNOTS)
CALMS 1-3 4-6 7-10 11-16 17-21 +21

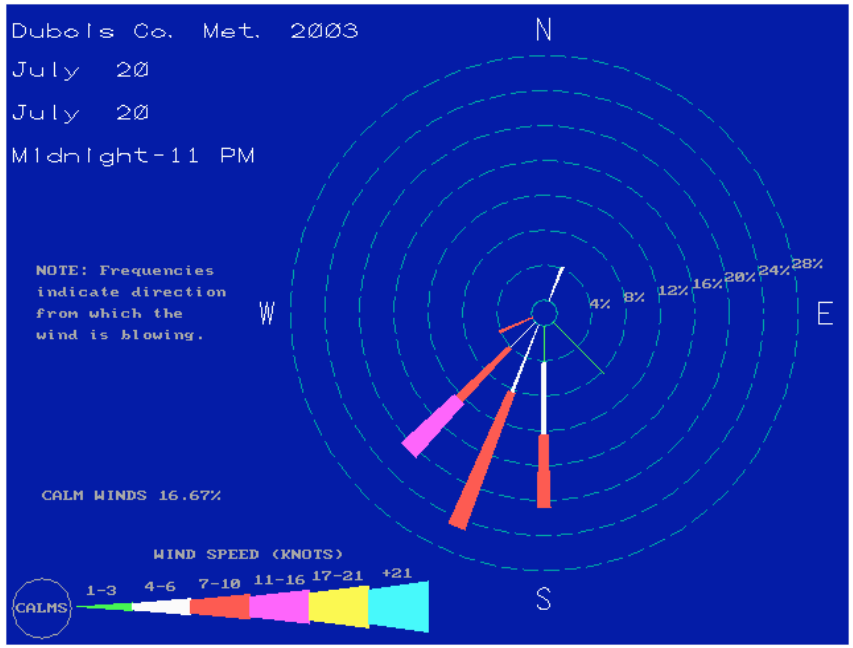

Dubois Co. Met. 2003
June 29
June 29
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 20.83%
N
W
E
S
4% 8% 12% 16% 20% 24% 28%
WIND SPEED (KNOTS)
CALMS 1-3 4-6 7-10 11-16 17-21 +21

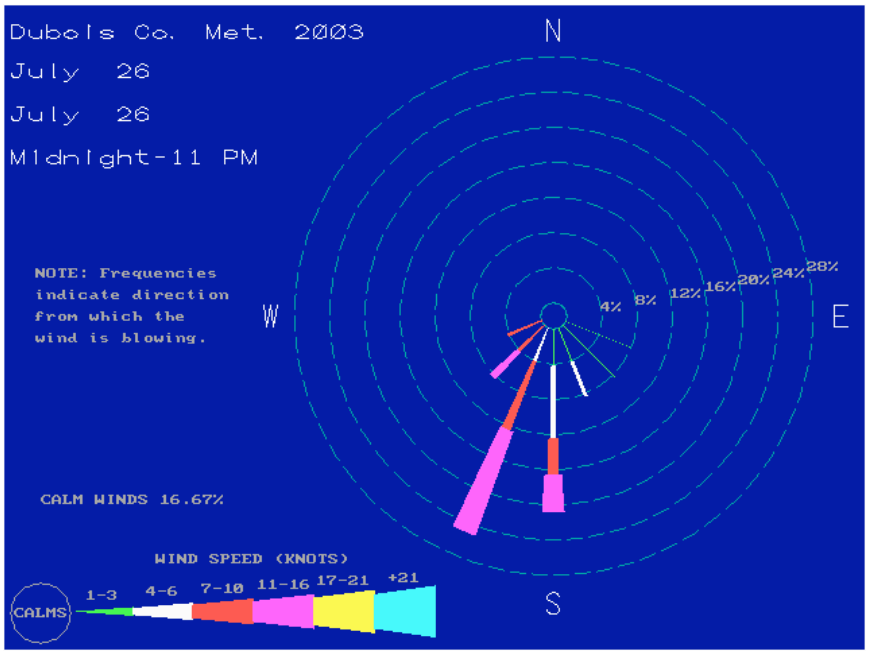

Dubois Co. Met. 2003
July 2
July 2
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 45.83%
N
W
E
S
4% 8% 12% 16% 20% 24%
WIND SPEED (KNOTS)
CALMS 1-3 4-6 7-10 11-16 17-21 +21

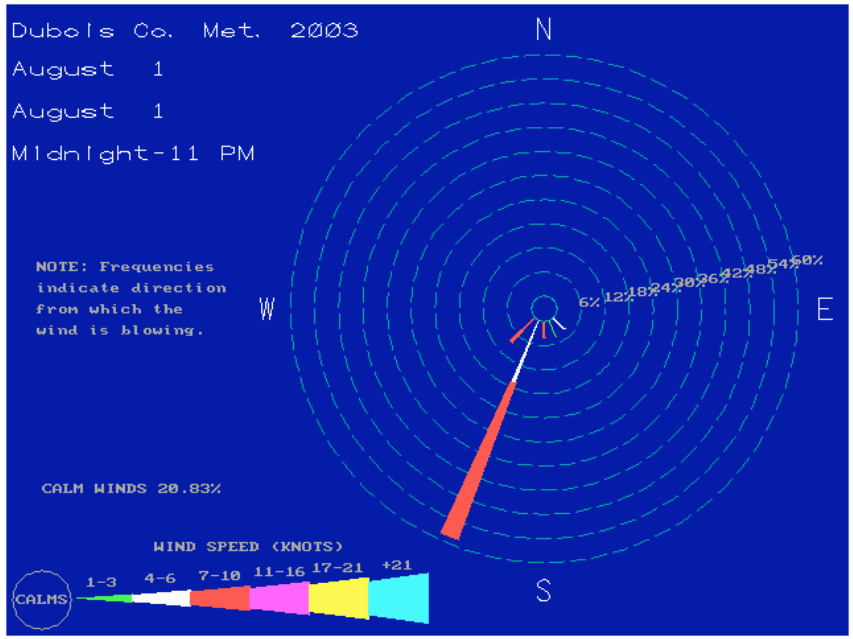

Dubois Co. Met. 2003
July 5
July 5
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 4.17%
N
W
E
S
6% 12% 18% 24% 30% 36% 42%
WIND SPEED (KNOTS)
CALMS 1-3 4-6 7-10 11-16 17-21 +21

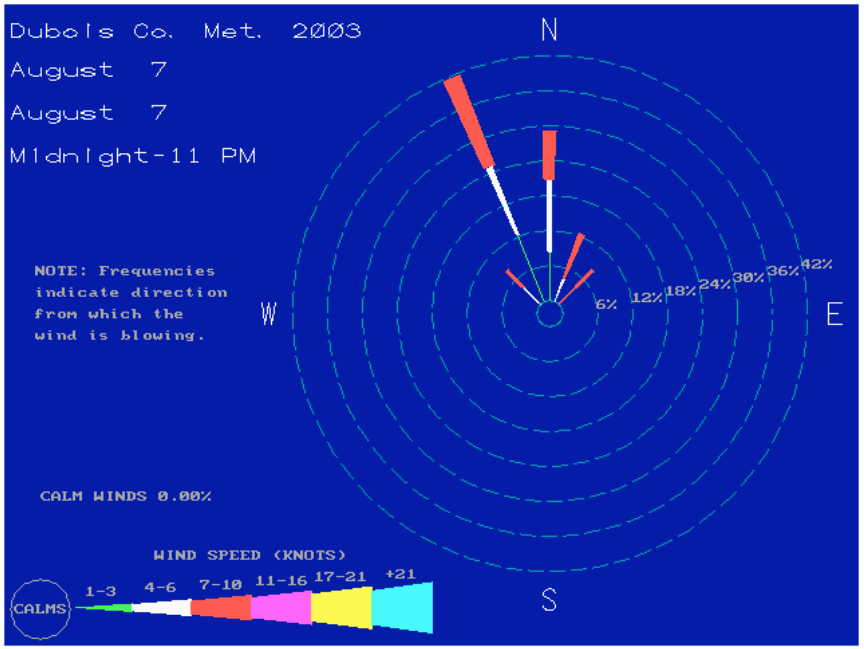

Dubois Co. Met. 2003
July 14
July 14
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 20.83%
N
W
E
S
4% 8% 12% 16% 20% 24% 28%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

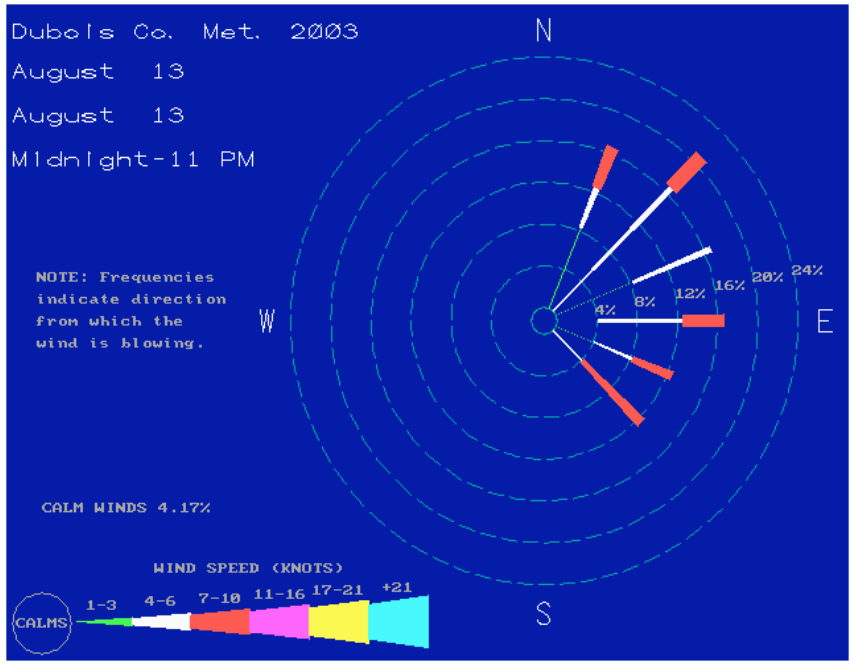

Dubois Co. Met. 2003
July 17
July 17
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 37.50%
N
W
E
S
2% 4% 6% 8% 10% 12% 14%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

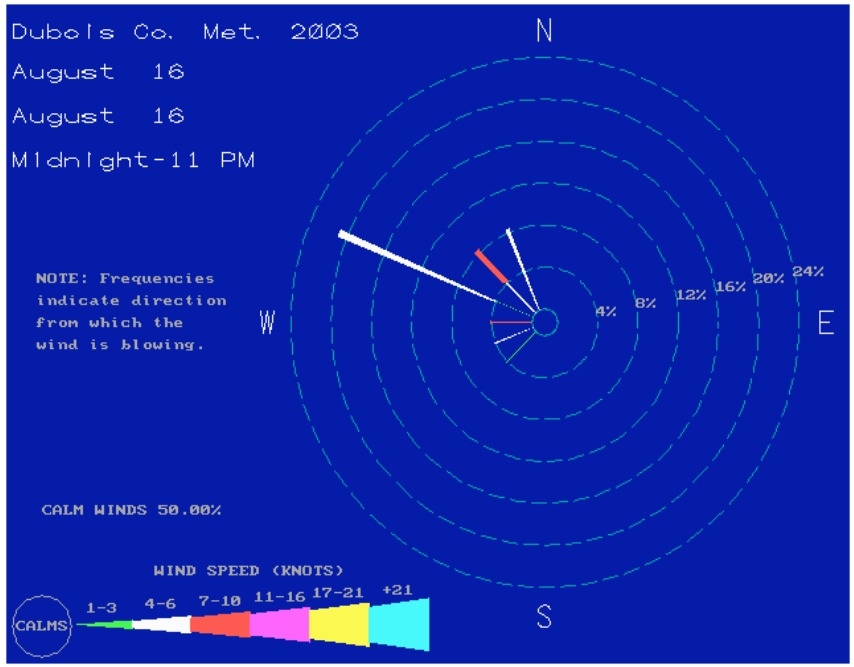

Dubois Co. Met. 2003
July 20
July 20
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 16.67%
N
W
E
S
4% 8% 12% 16% 20% 24% 28%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

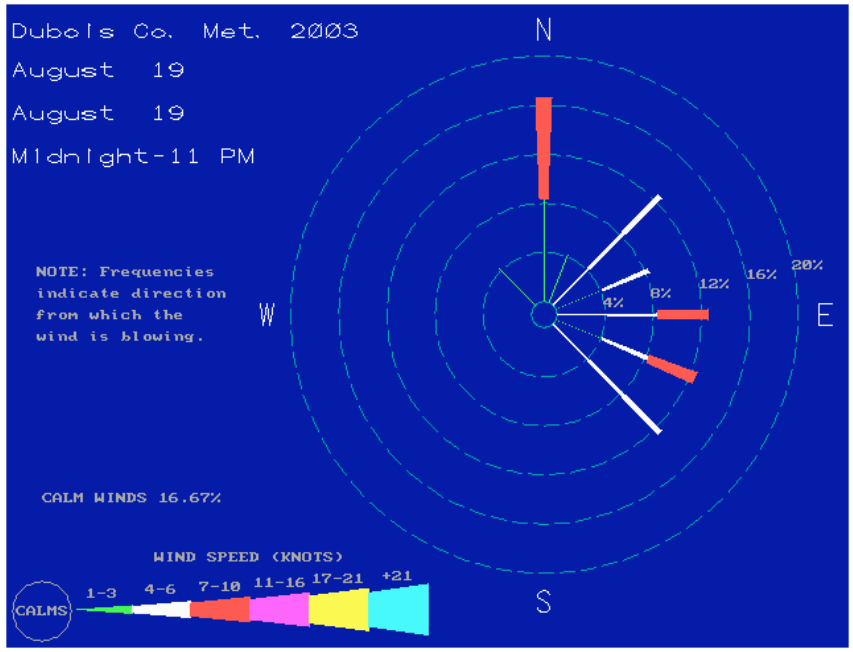

Dubois Co. Met. 2003
July 26
July 26
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 16.67%
N
W
E
S
4% 8% 12% 16% 20% 24% 28%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

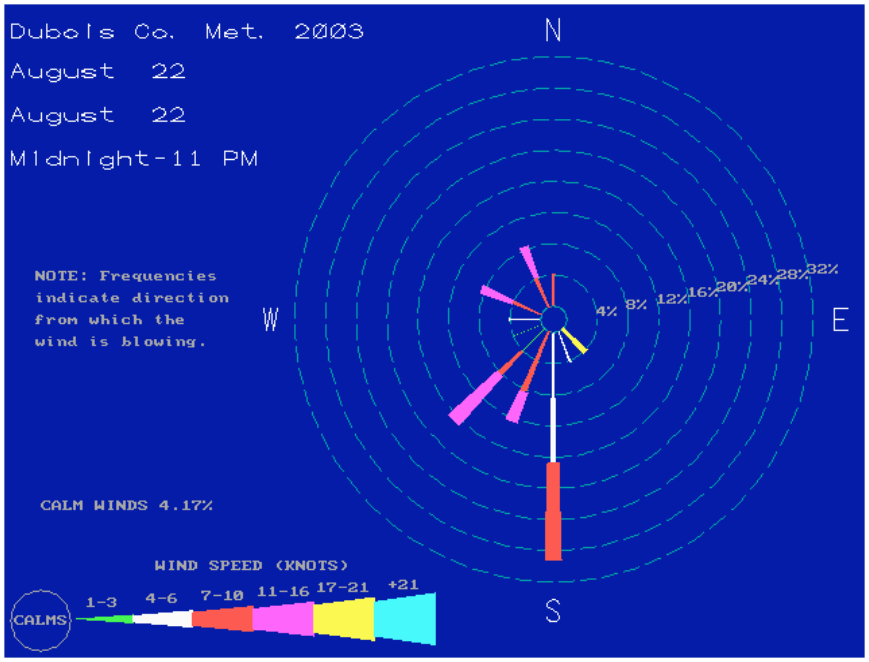

Dubois Co. Met. 2003
August 1
August 1
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 20.83%
N
W
E
S
6% 12% 18% 24% 30% 36% 42% 48% 54% 60%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

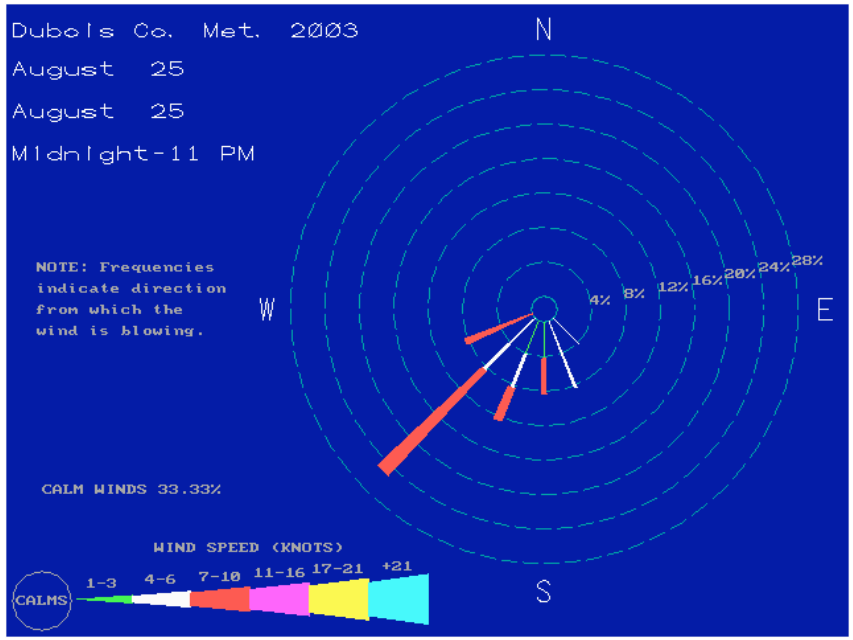

Dubois Co. Met. 2003
August 7
August 7
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 0.00%
N
W
E
S
6% 12% 18% 24% 30% 36% 42%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

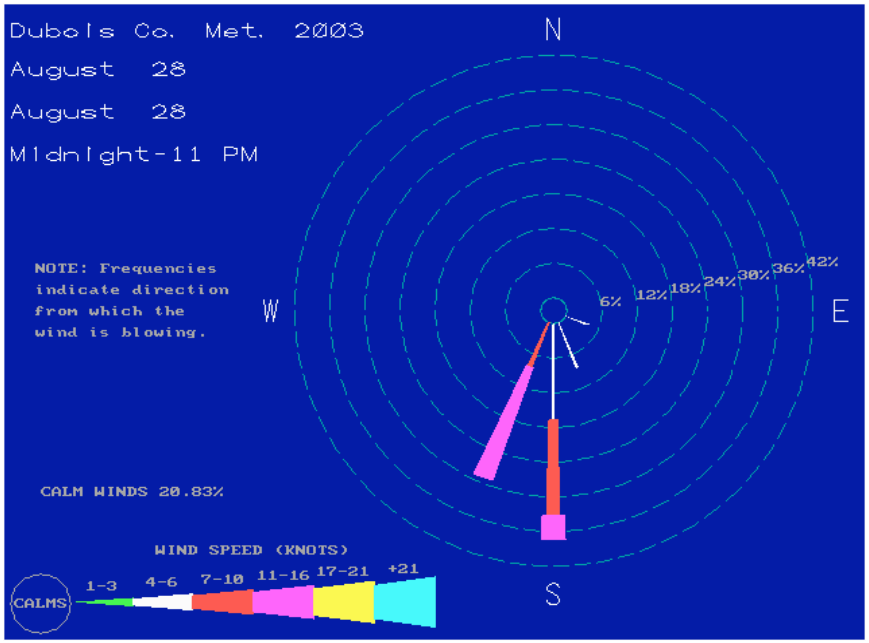

Dubois Co. Met. 2003
August 13
August 13
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 4.17%
N
W
E
S
4% 8% 12% 16% 20% 24%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

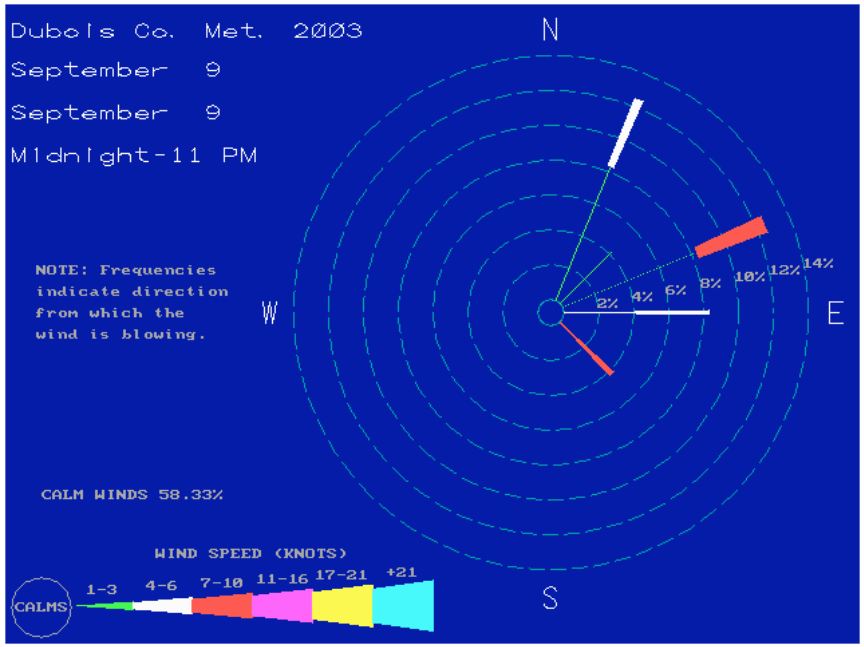

Dubois Co. Met. 2003
August 16
August 16
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 50.00%
N
W
E
S
4% 8% 12% 16% 20% 24%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

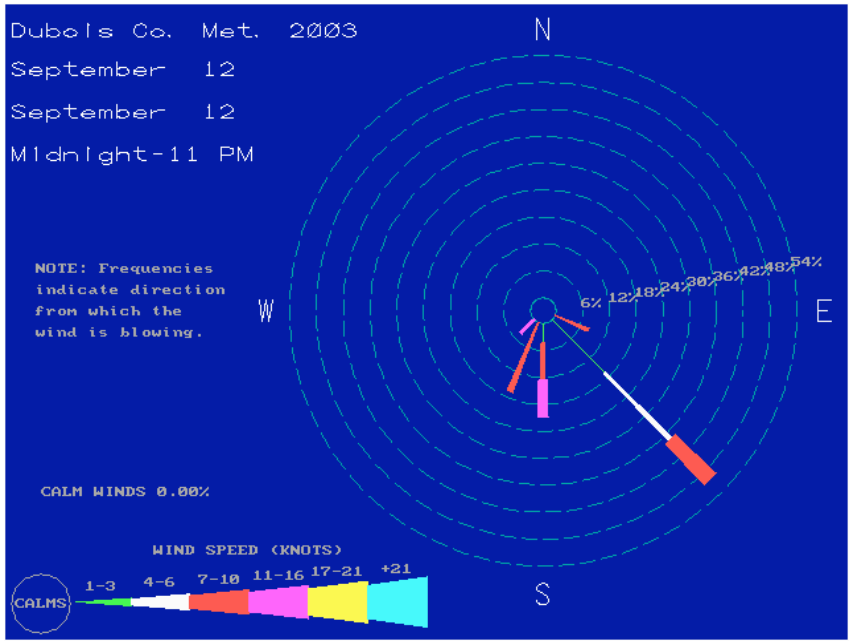

Dubois Co. Met. 2003
August 19
August 19
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 16.67%
N
W
E
S
4%
8%
12%
16%
20%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

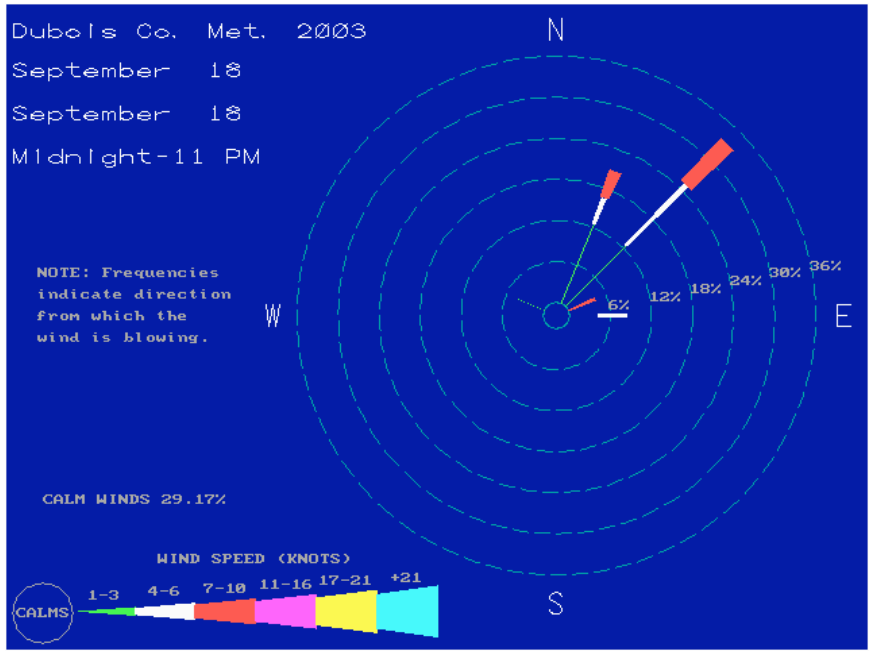

Dubois Co. Met. 2003
August 22
August 22
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 4.17%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
32%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

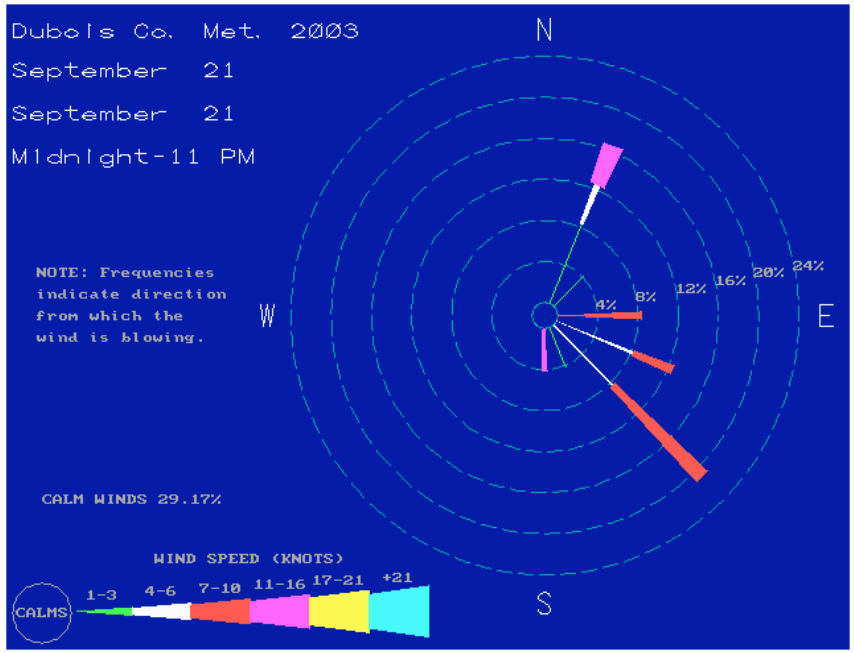

Dubois Co. Met. 2003
August 25
August 25
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 33.33%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

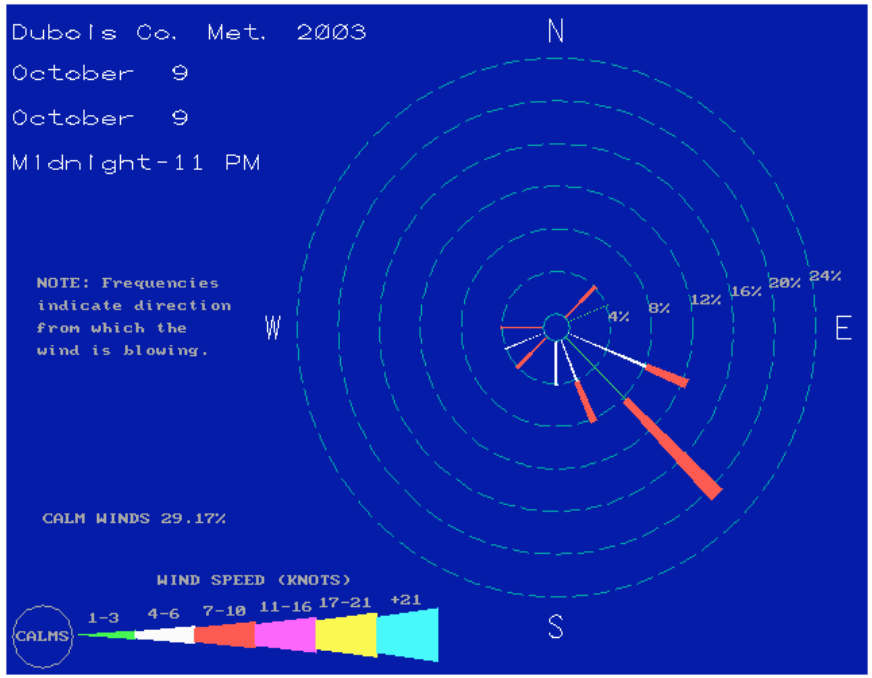

Dubois Co. Met. 2003
August 28
August 28
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 20.83%
N
W
E
S
6%
12%
18%
24%
30%
36%
42%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

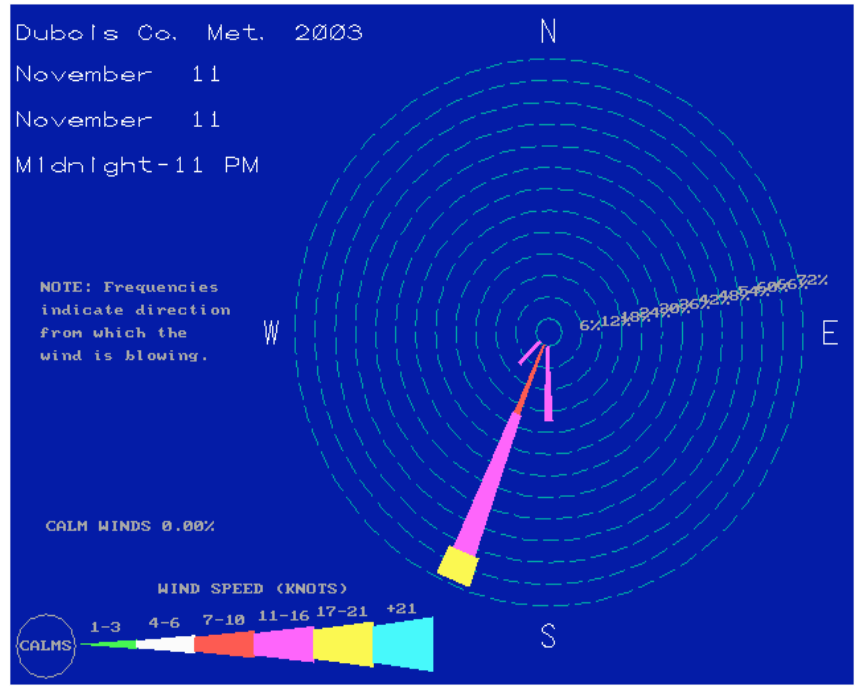

Dubois Co. Met. 2003
September 9
September 9
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 58.33%
N
W
E
S
2% 4% 6% 8% 10% 12% 14%
WIND SPEED (KNOTS)
CALMS 1-3 4-6 7-10 11-16 17-21 +21


Dubois Co. Met. 2003
September 12
September 12
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 0.00%
N
W
E
S
6% 12% 18% 24% 30% 36% 42% 48% 54%
WIND SPEED (KNOTS)
CALMS 1-3 4-6 7-10 11-16 17-21 +21


Dubois Co. Met. 2003
September 18
September 18
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 29.17%
N
W
E
S
6% 12% 18% 24% 30% 36%
WIND SPEED (KNOTS)
CALMS 1-3 4-6 7-10 11-16 17-21 +21

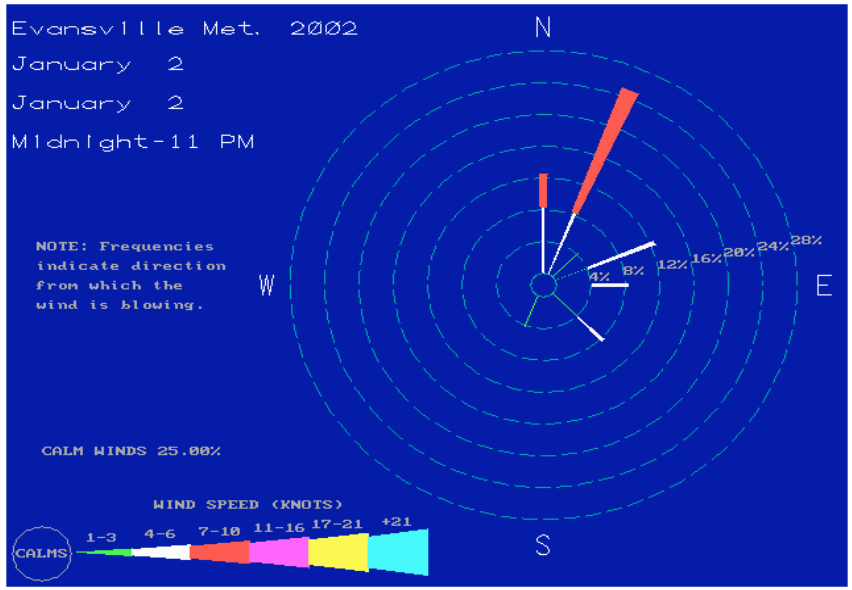

Dubois Co. Met. 2003
September 21
September 21
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 29.17%
N
W
E
S
4% 8% 12% 16% 20% 24%
WIND SPEED (KNOTS)
CALMS 1-3 4-6 7-10 11-16 17-21 +21

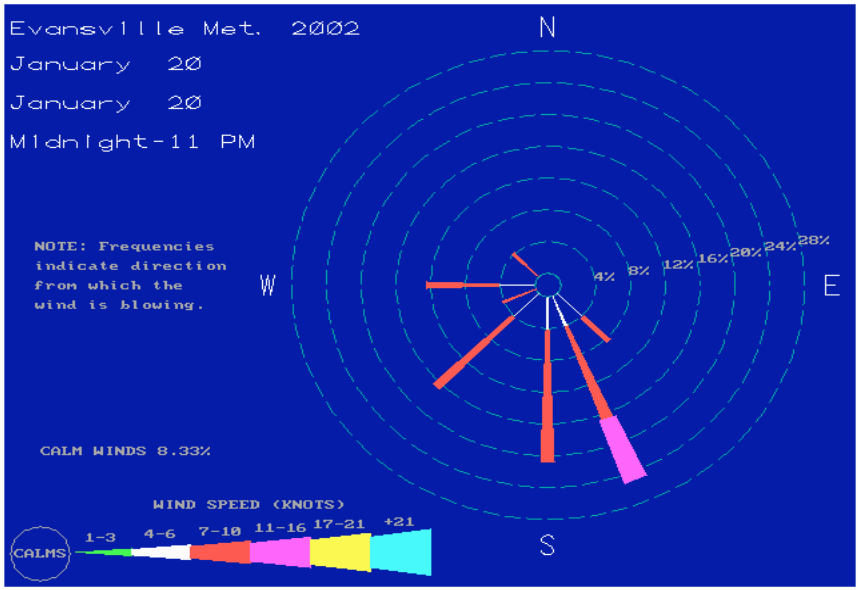

Dubois Co. Met. 2003
October 9
October 9
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 29.17%
N
W
E
S
4%
8%
12%
16%
20%
24%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

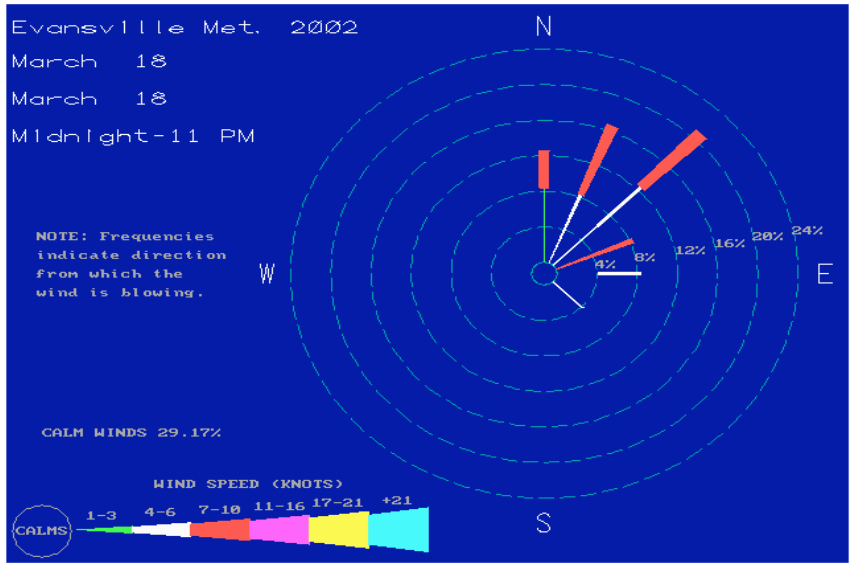

Dubois Co. Met. 2003
November 11
November 11
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 0.00%
N
W
E
S
6%
12%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

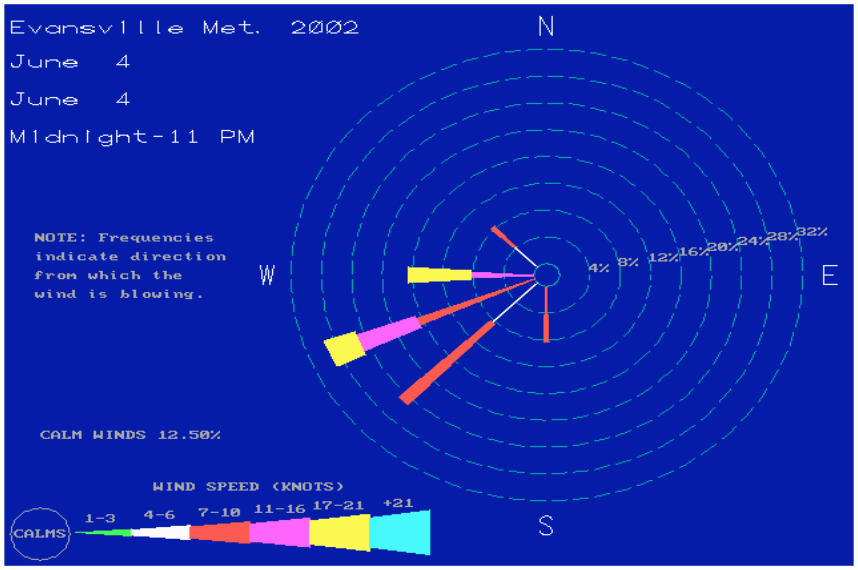
Evansville Wind Rose Analysis - 2002

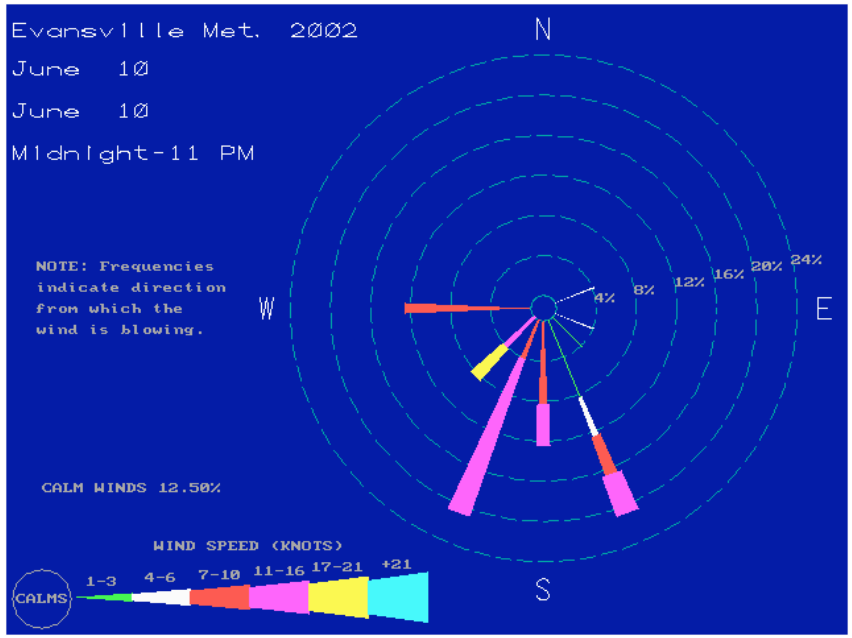
Wind Speed and Wind Direction on Days where PM2.5 readings were ≥ 20 ug/m3

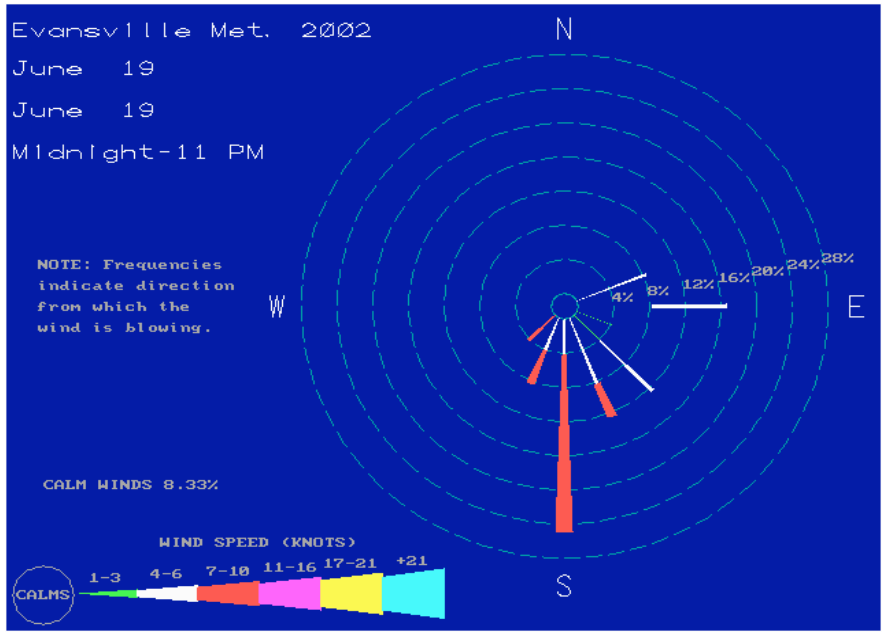


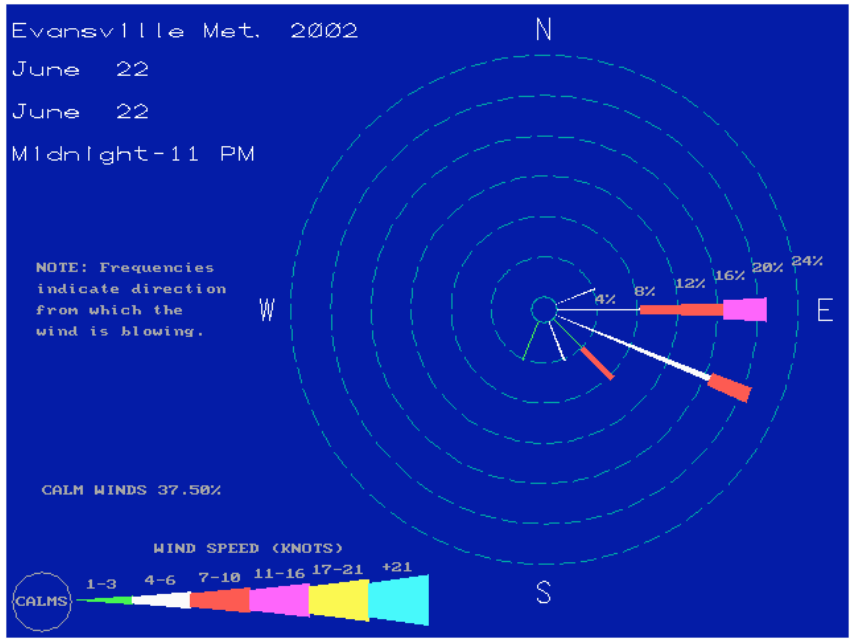


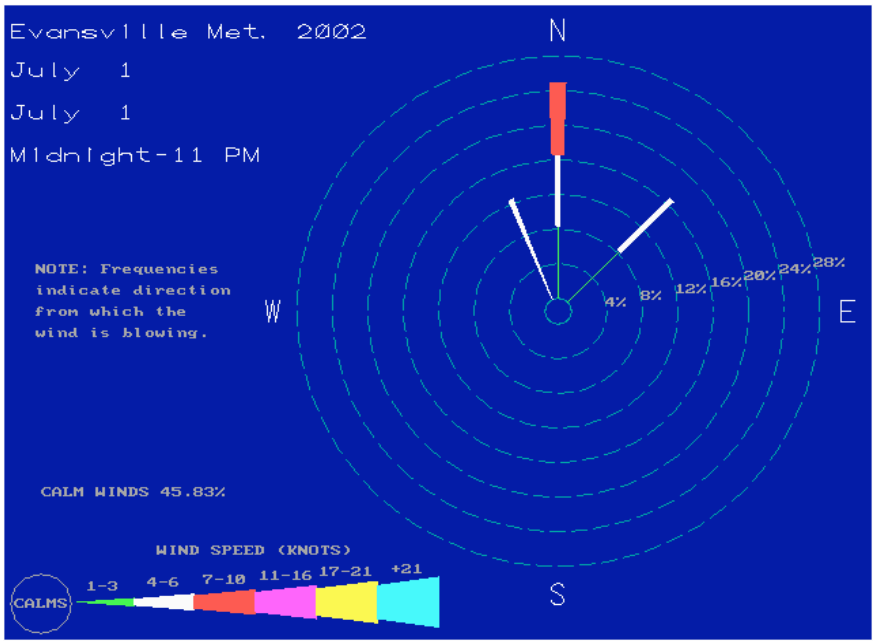


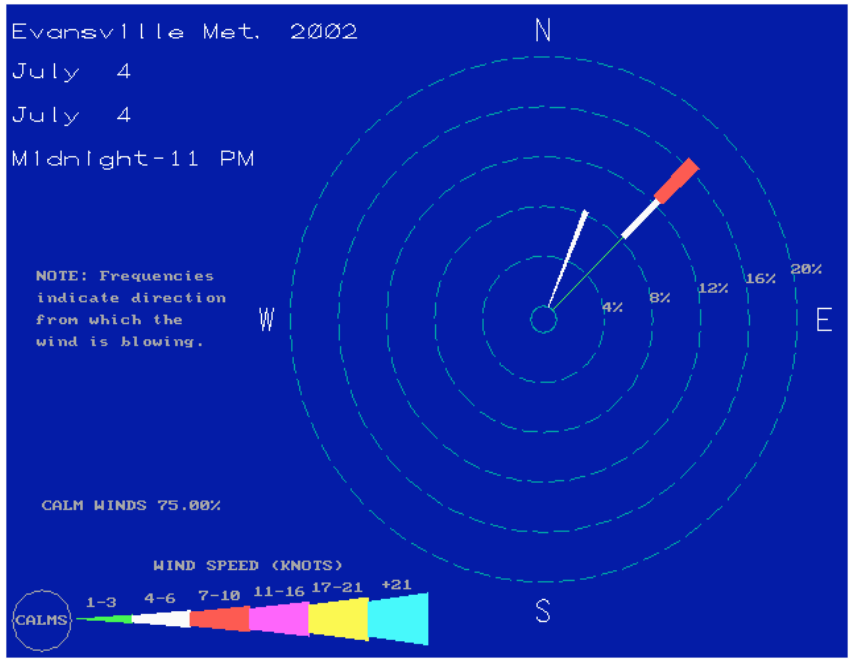


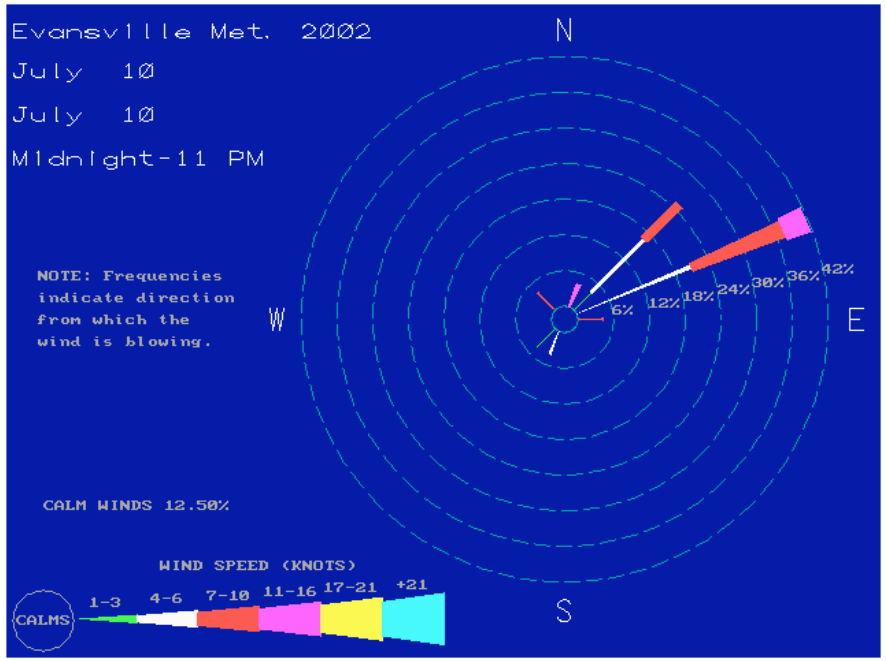

Evansville Met. 2002
June 10
June 10
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 12.50%
N
W
E
S
4%
8%
12%
16%
20%
24%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

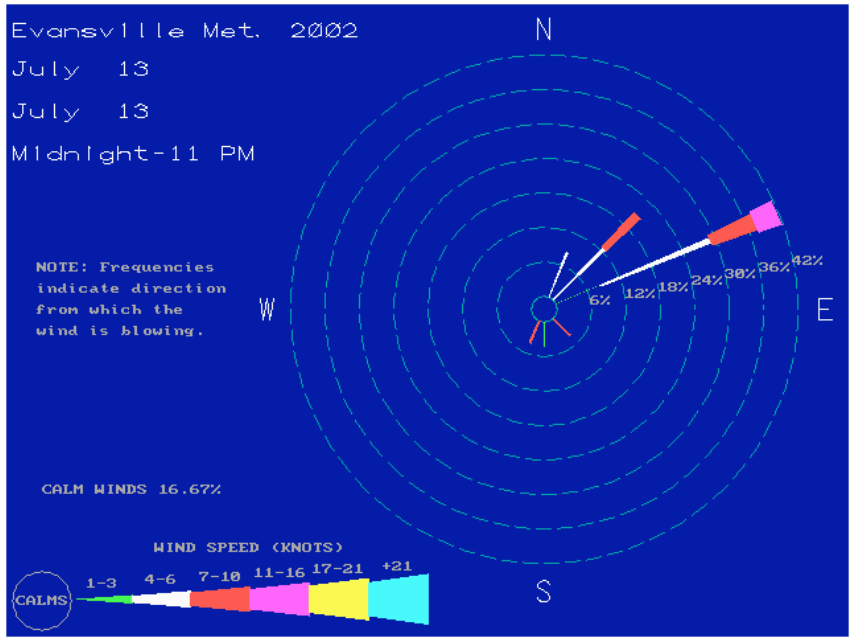

Evansville Met. 2002
June 19
June 19
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 8.33%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

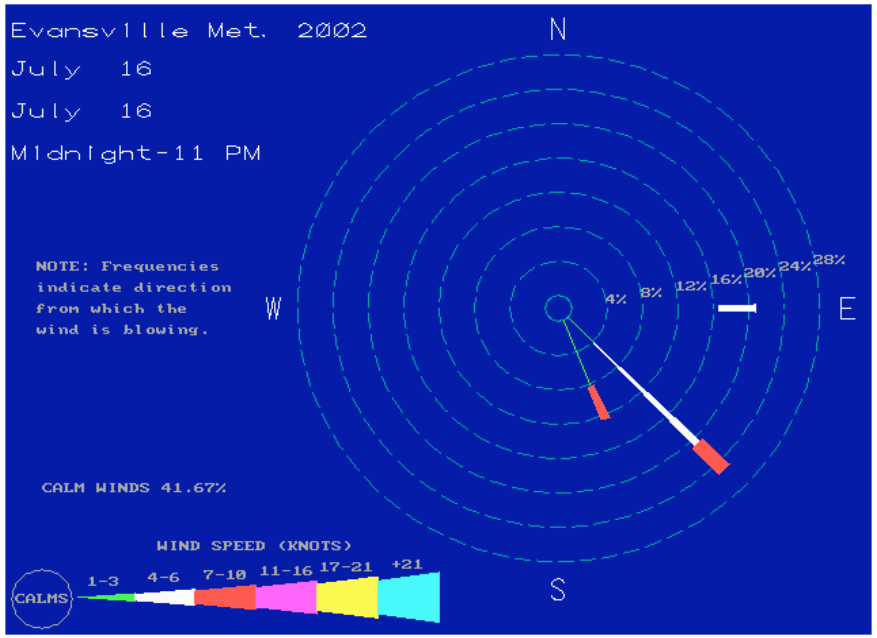

Evansville Met. 2002
June 22
June 22
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 37.50%
N
W
E
S
4%
8%
12%
16%
20%
24%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

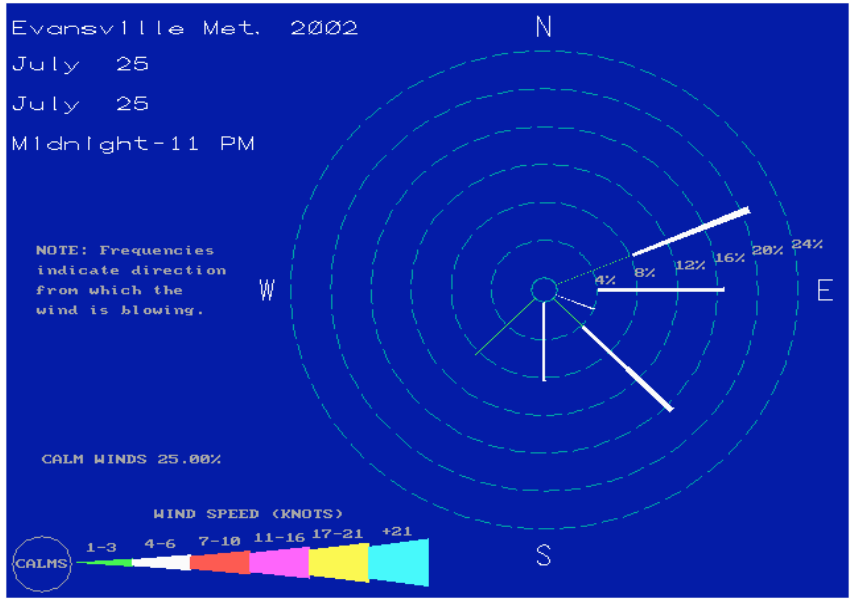

Evansville Met. 2002
July 1
July 1
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 45.83%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

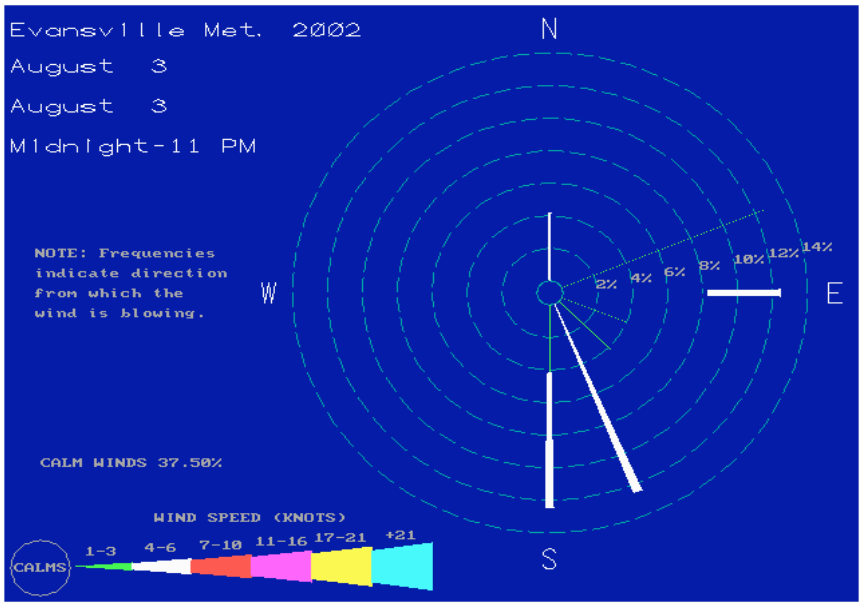

Evansville Met. 2002
July 4
July 4
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 75.00%
N
W
E
S
4%
8%
12%
16%
20%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

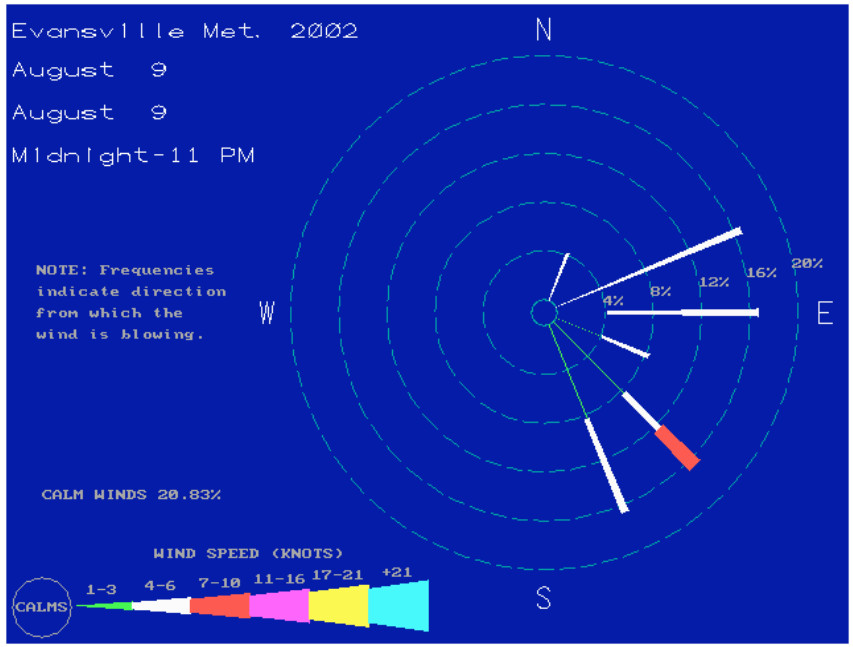

Evansville Met. 2002
July 10
July 10
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 12.50%
N
W
E
S
6%
12%
18%
24%
30%
36%
42%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

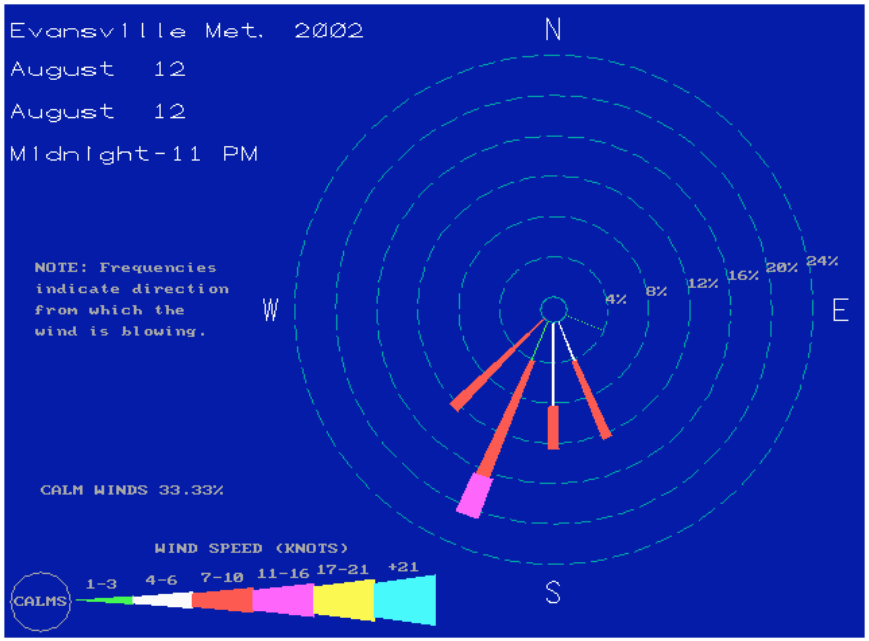

Evansville Met. 2002
July 13
July 13
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 16.67%
N
W
E
S
6%
12%
18%
24%
30%
36%
42%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

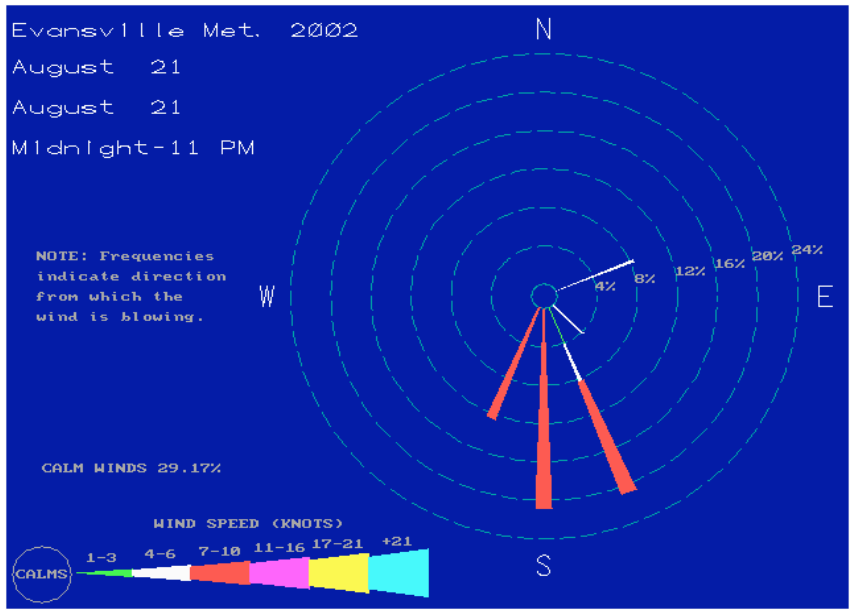

Evansville Met. 2002
July 16
July 16
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 41.67%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

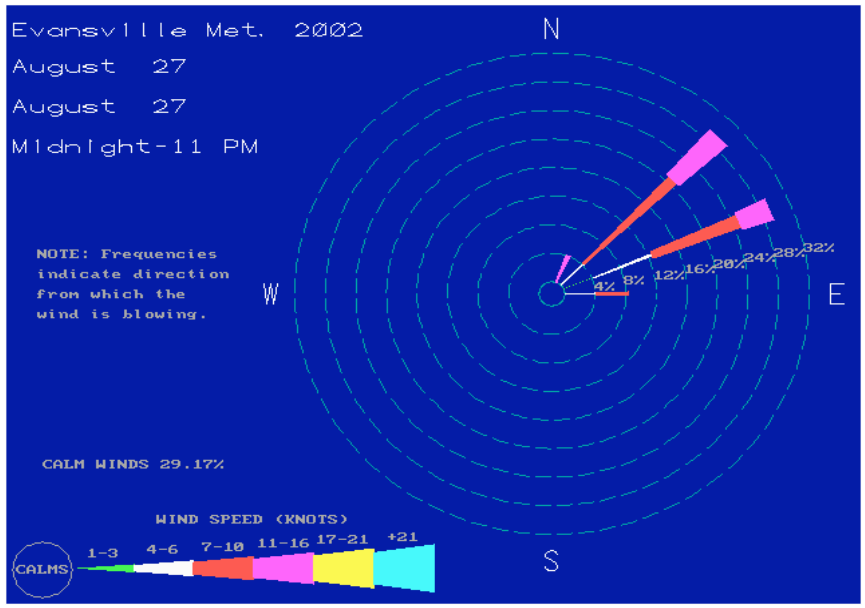

Evansville Met. 2002
July 25
July 25
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 25.00%
N
W
E
S
4%
8%
12%
16%
20%
24%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

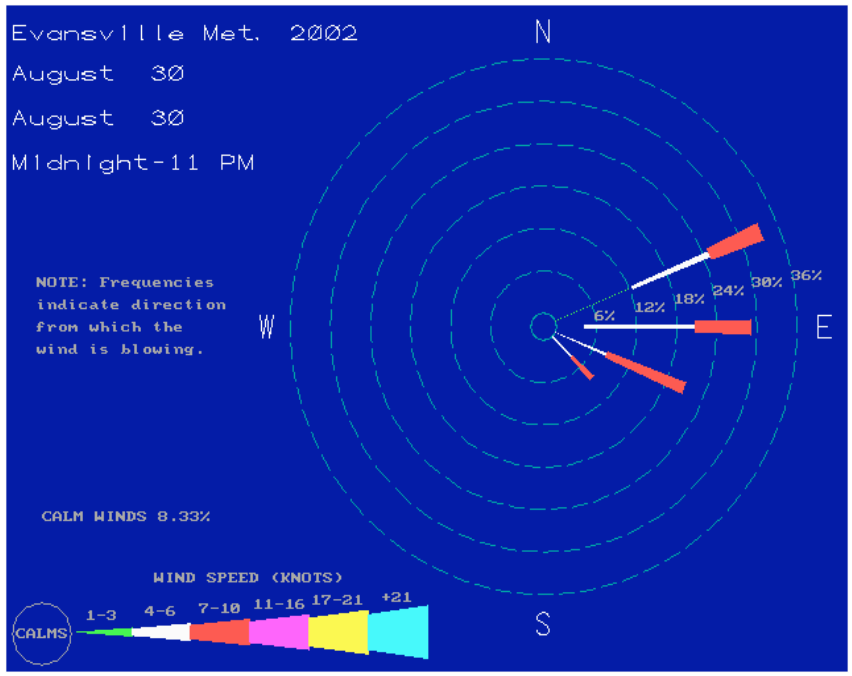

Evansville Met. 2002
August 3
August 3
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 37.50%
N
W
E
S
2%
4%
6%
8%
10%
12%
14%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

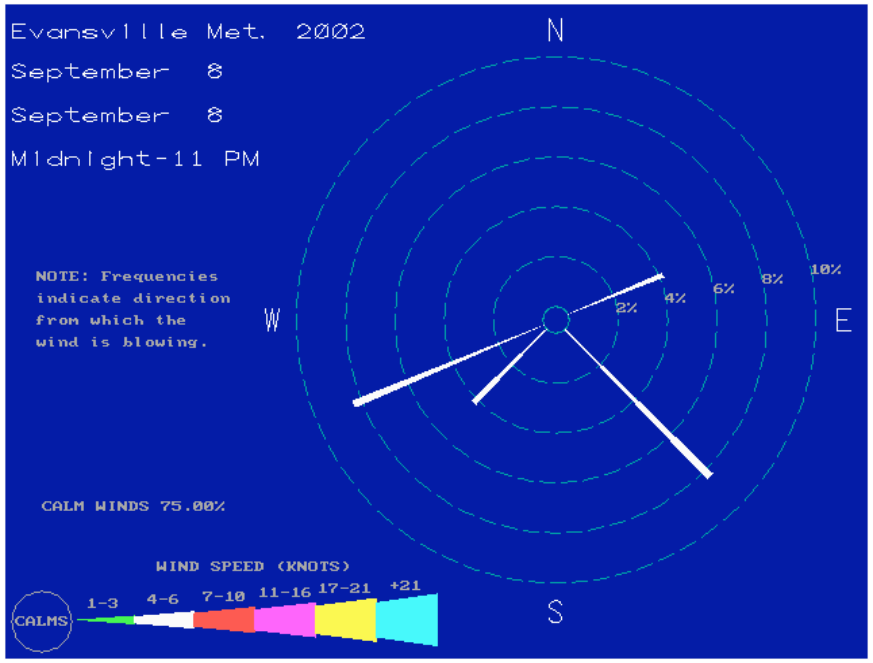

Evansville Met. 2002
August 9
August 9
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 20.83%
N
W
E
S
4%
8%
12%
16%
20%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

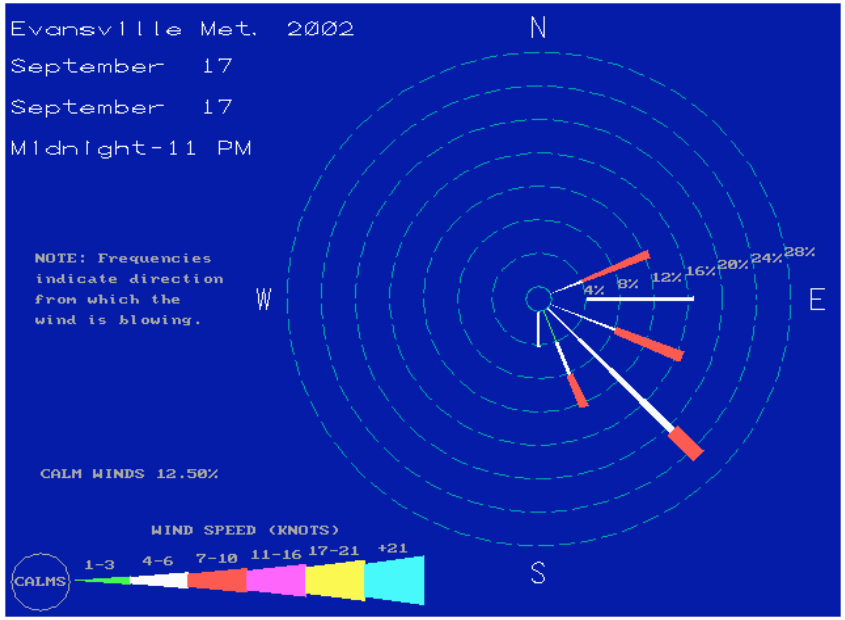

Evansville Met. 2002
August 12
August 12
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 33.33%
N
W
E
S
4%
8%
12%
16%
20%
24%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

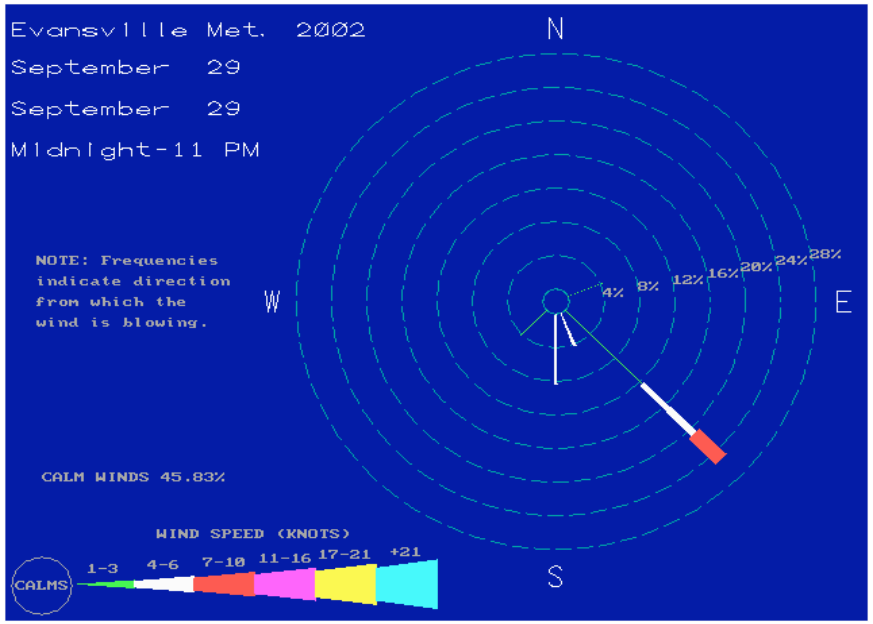

Evansville Met. 2002
August 21
August 21
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 29.17%
N
W
E
S
4%
8%
12%
16%
20%
24%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

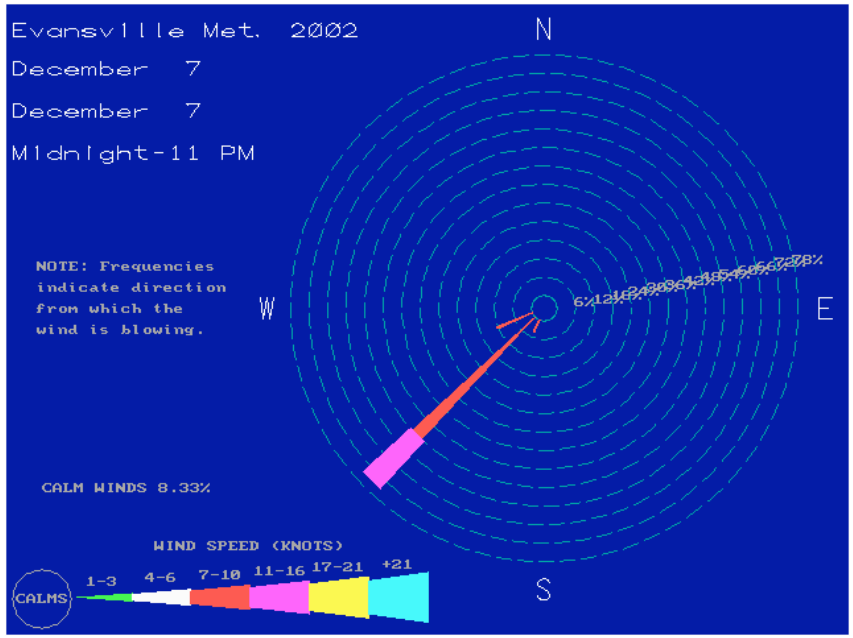

Evansville Met. 2002
August 27
August 27
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 29.17%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
32%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

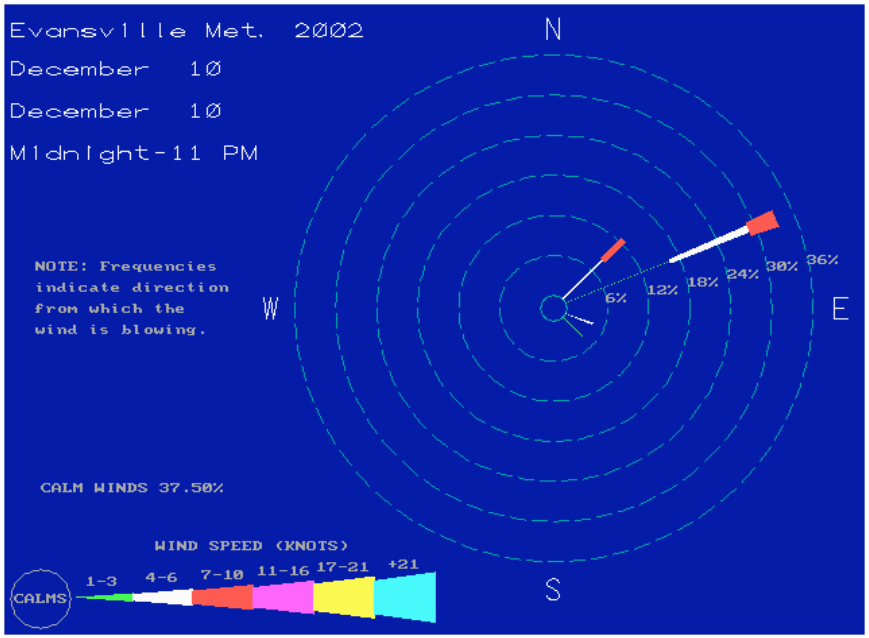

Evansville Met. 2002
August 30
August 30
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 8.33%
N
W
E
S
6%
12%
18%
24%
30%
36%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

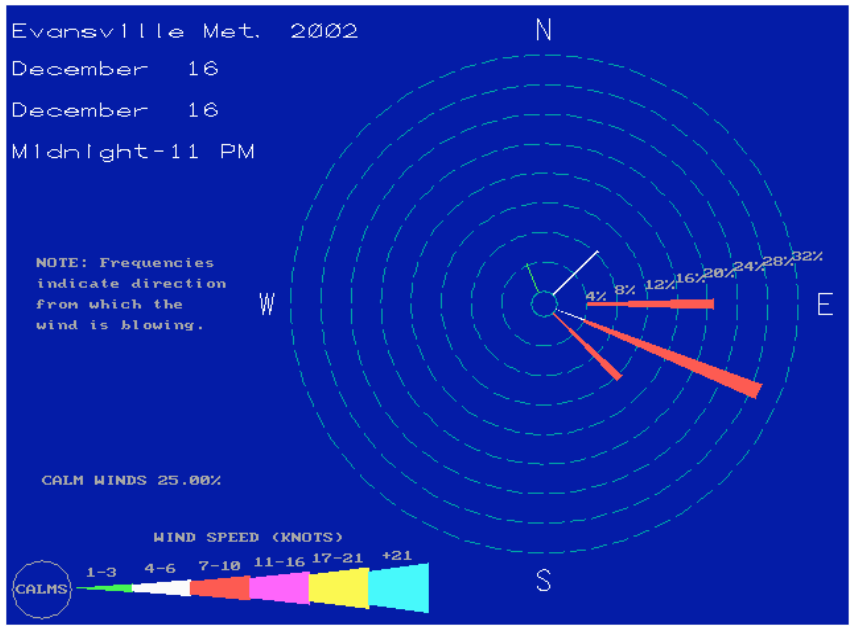

Evansville Met. 2002
September 8
September 8
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 75.00%
N
W
E
S
2%
4%
6%
8%
10%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Evansville Met. 2002
September 17
September 17
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 12.50%
N
W
E
S
4% 8% 12% 16% 20% 24% 28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Evansville Met. 2002
September 29
September 29
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 45.83%
N
W
E
S
4% 8% 12% 16% 20% 24% 28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

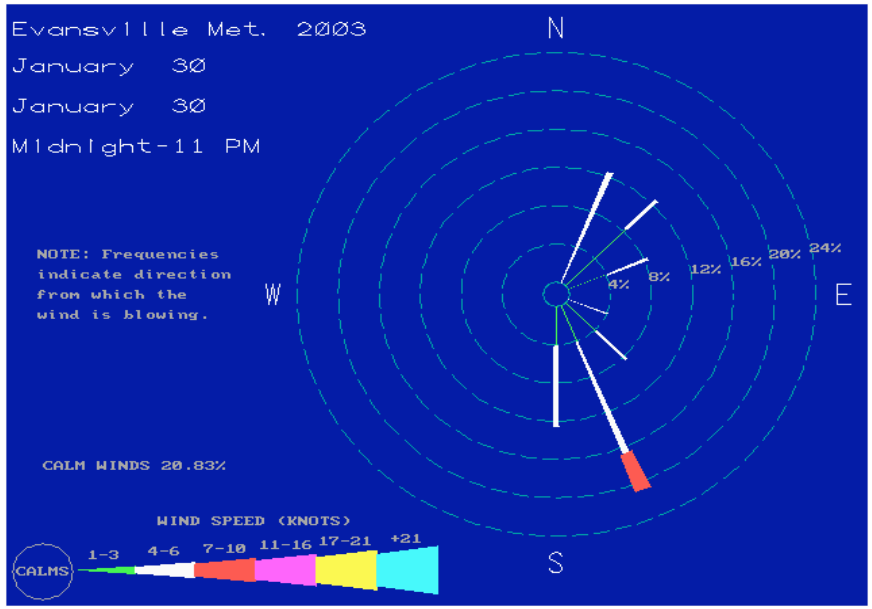

Evansville Met. 2002
December 7
December 7
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 8.33%
N
W
E
S
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

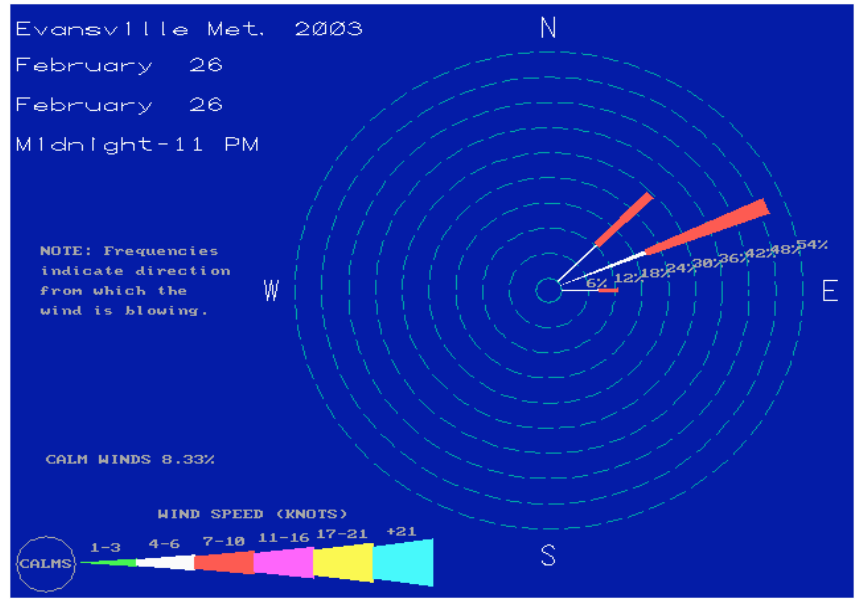

Evansville Met. 2002
December 10
December 10
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 37.50%
N
W
E
S
6% 12% 18% 24% 30% 36%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

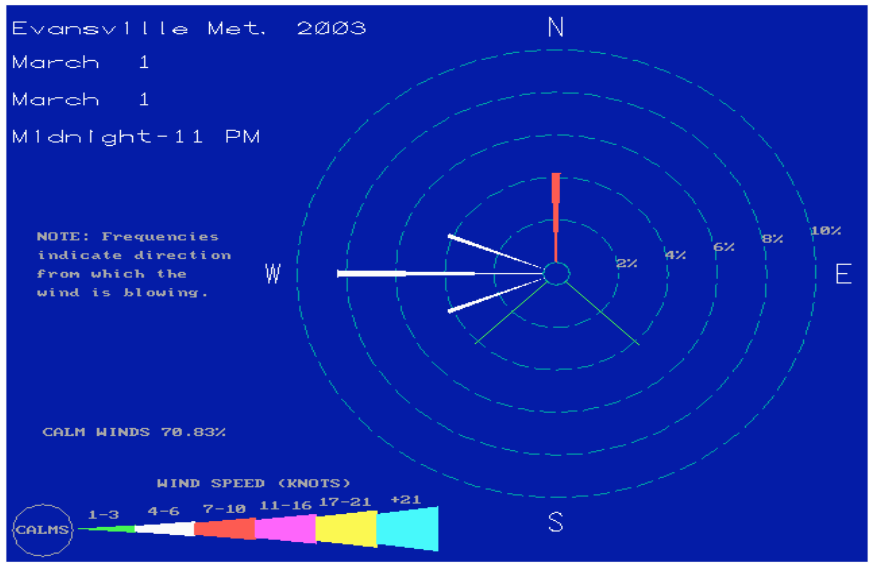

Evansville Met. 2002
December 16
December 16
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 25.00%
N
E
S
W
4%
8%
12%
16%
20%
24%
28%
32%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

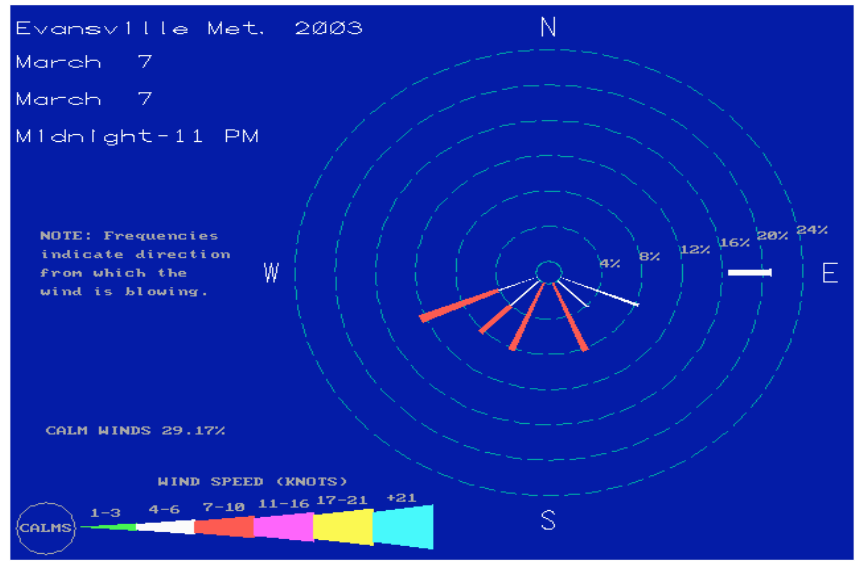
Evansville Wind Rose Analysis - 2003

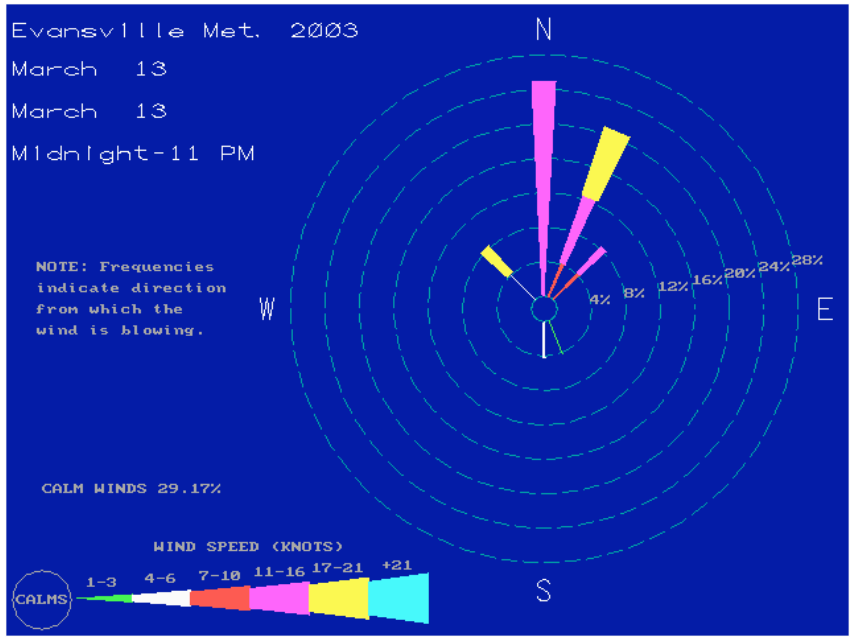
Wind Speed and Wind Direction on Days where PM2.5 readings were ≥ 20 ug/m3

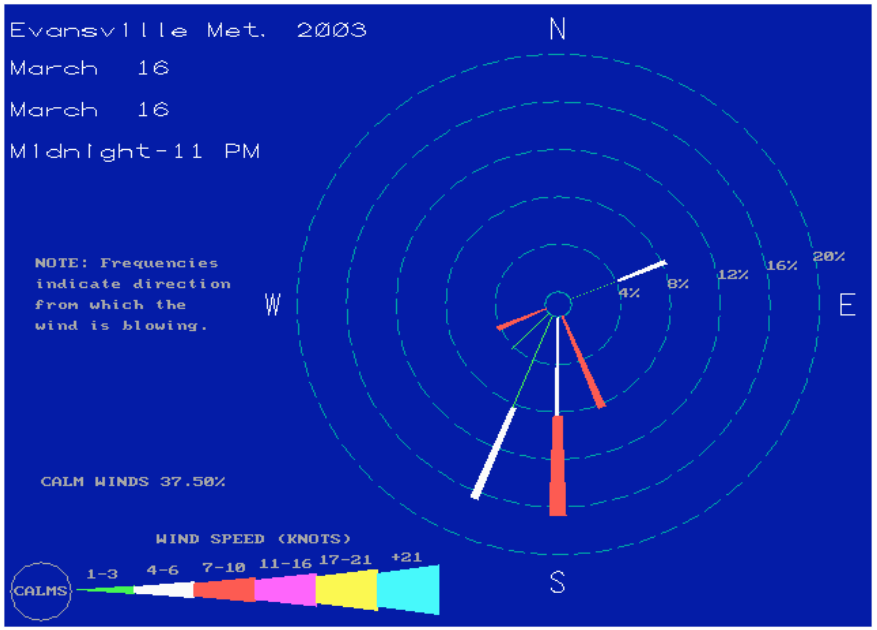


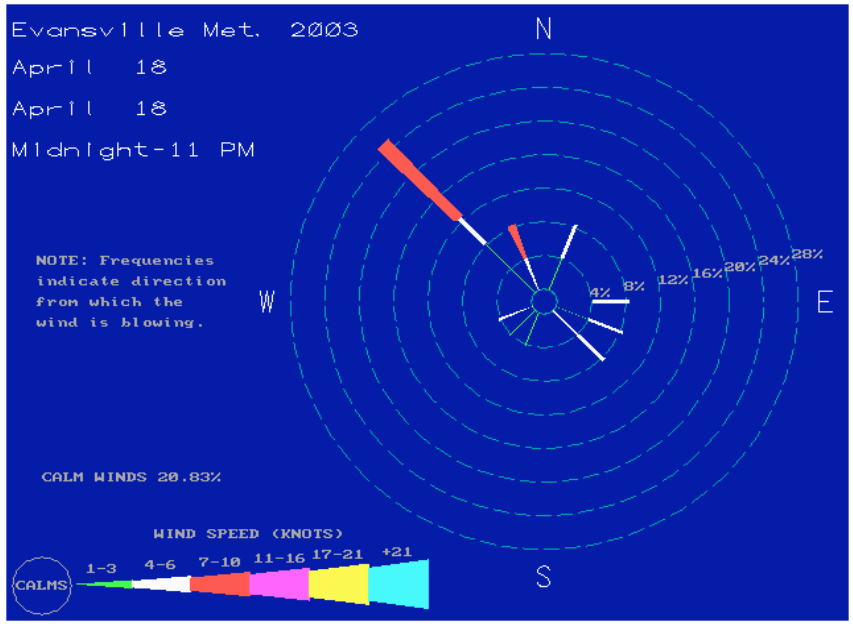


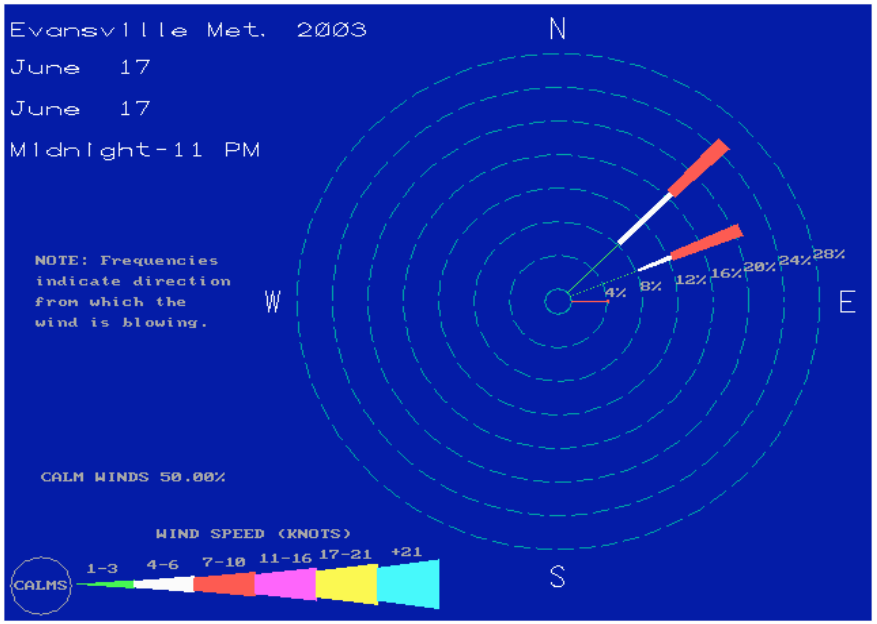


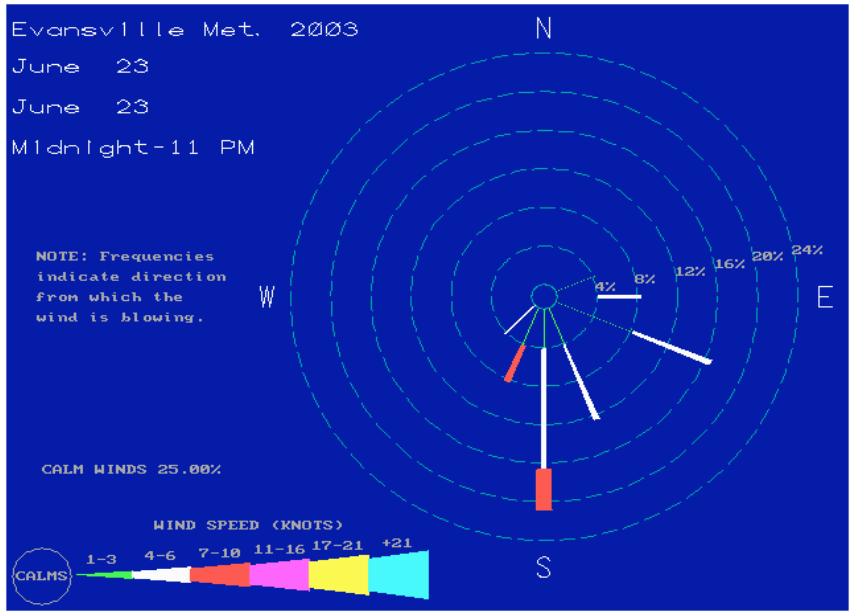


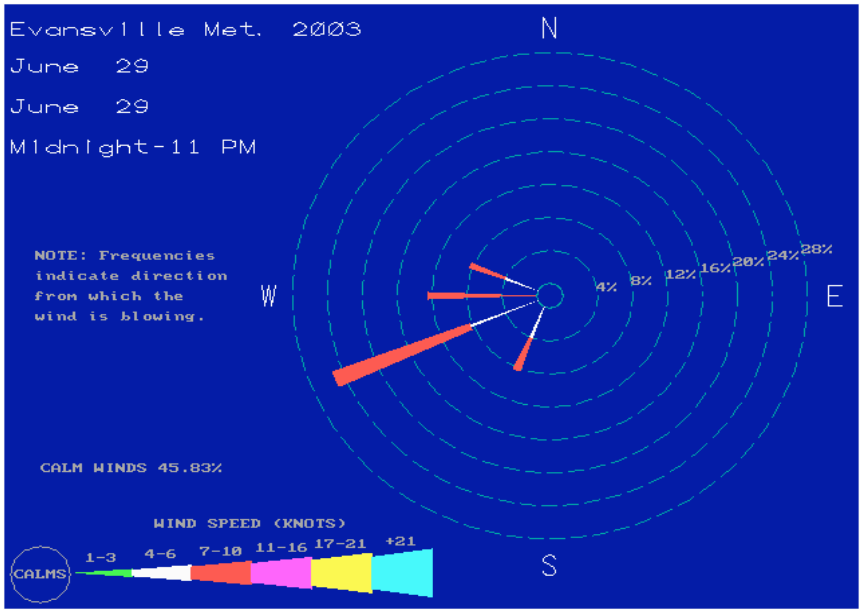

Evansville Met. 2003
March 13
March 13
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 29.17%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

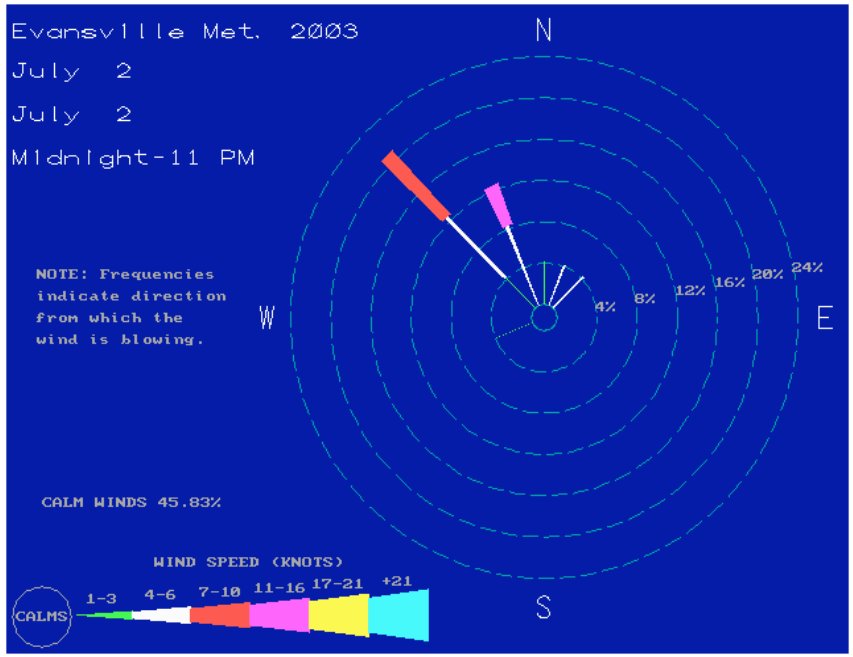

Evansville Met. 2003
March 16
March 16
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 37.50%
N
W
E
S
4%
8%
12%
16%
20%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

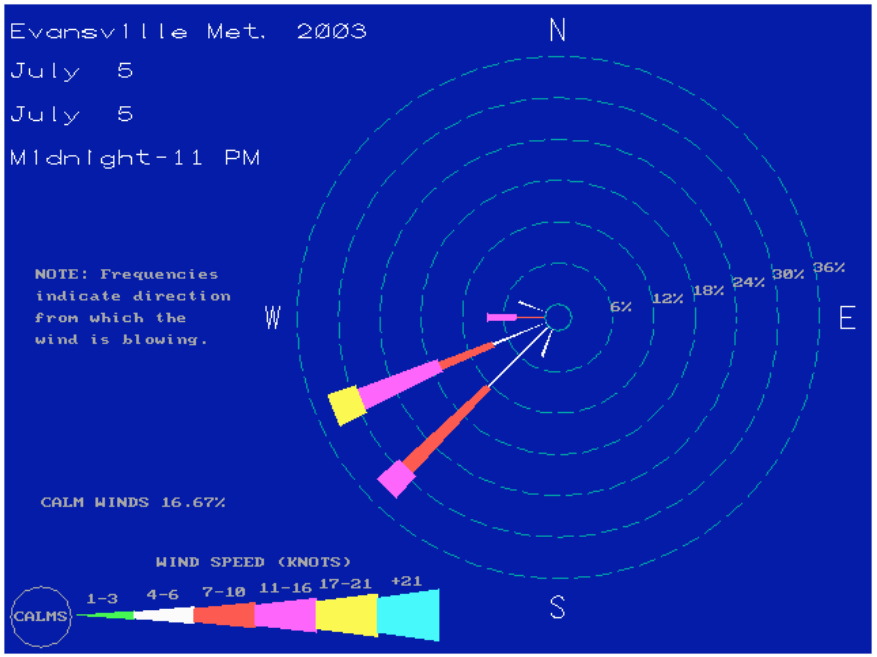

Evansville Met. 2003
April 18
April 18
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 20.83%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

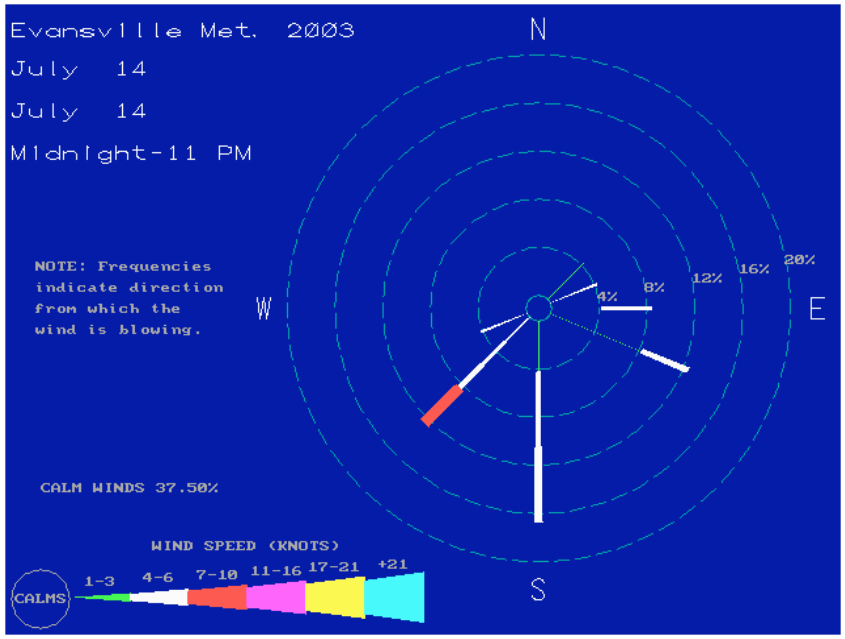

Evansville Met. 2003
June 17
June 17
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 50.00%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

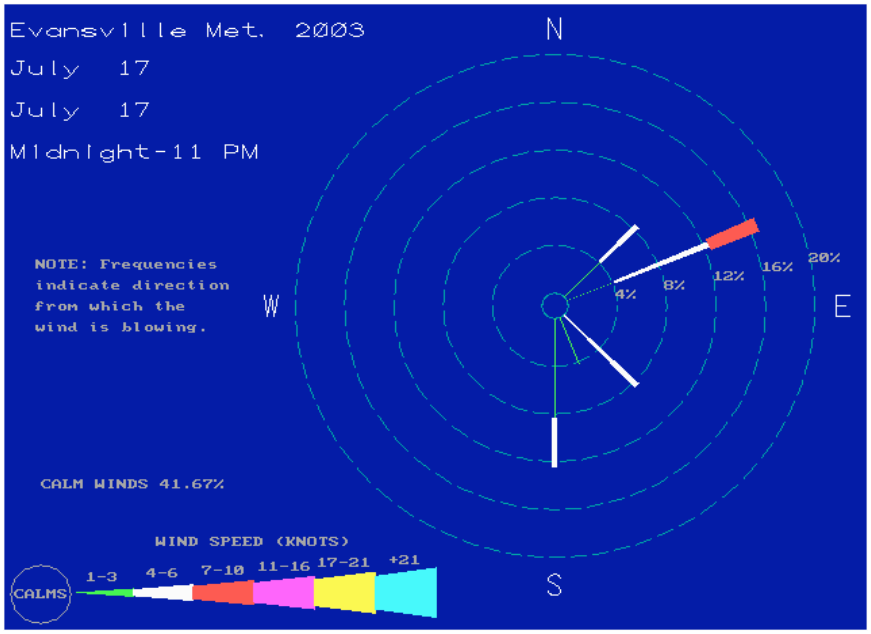

Evansville Met. 2003
June 23
June 23
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 25.00%
N
W
E
S
4% 8% 12% 16% 20% 24%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

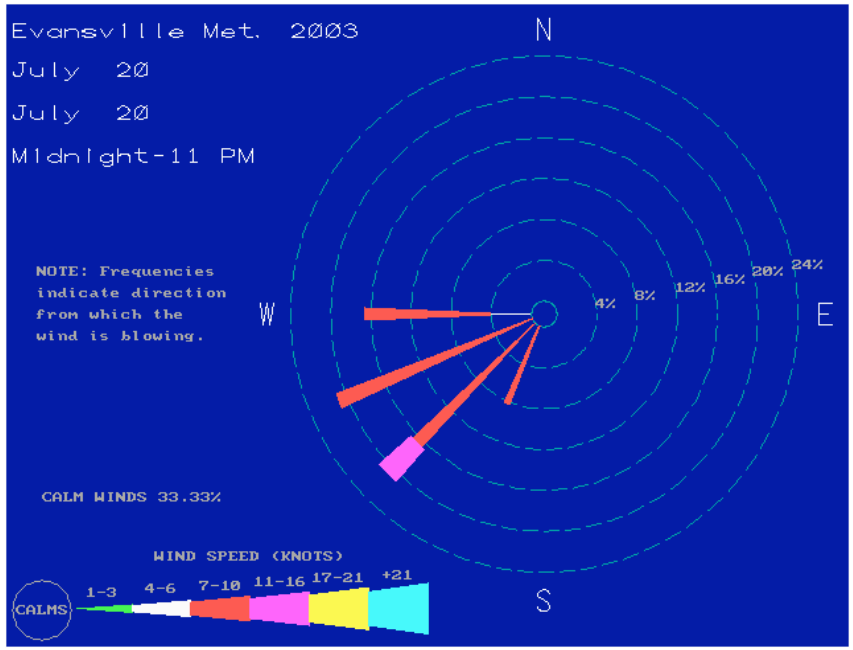

Evansville Met. 2003
June 29
June 29
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 45.83%
N
W
E
S
4% 8% 12% 16% 20% 24% 28%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

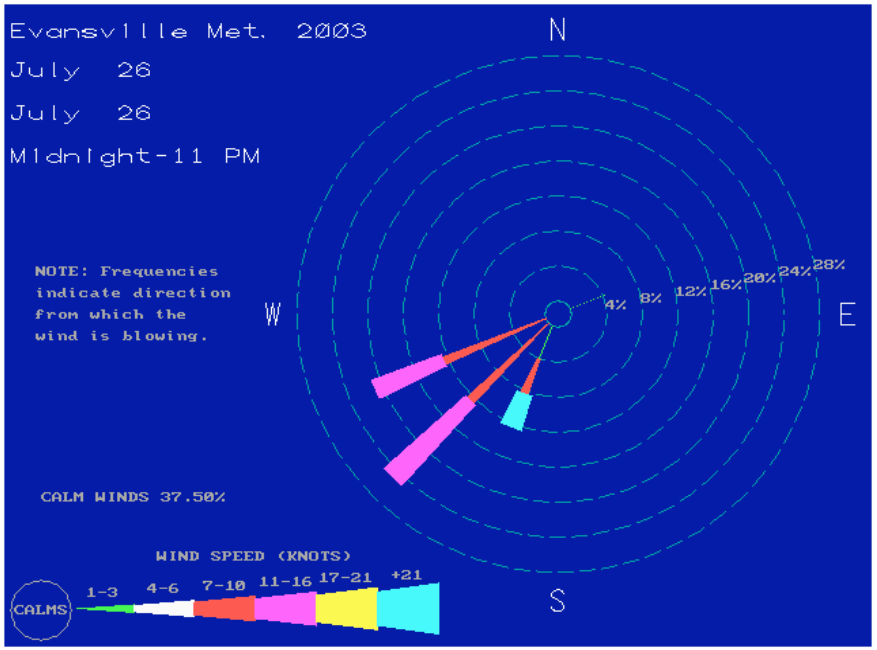

Evansville Met. 2003
July 2
July 2
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 45.83%
N
W
E
S
4% 8% 12% 16% 20% 24%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

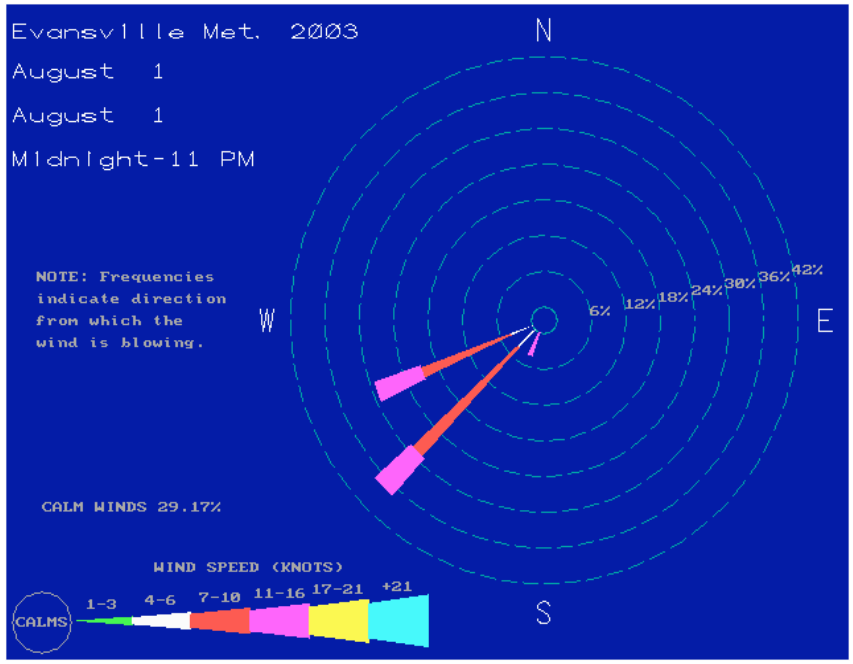

Evansville Met. 2003
July 5
July 5
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 16.67%
N
W
E
S
6% 12% 18% 24% 30% 36%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

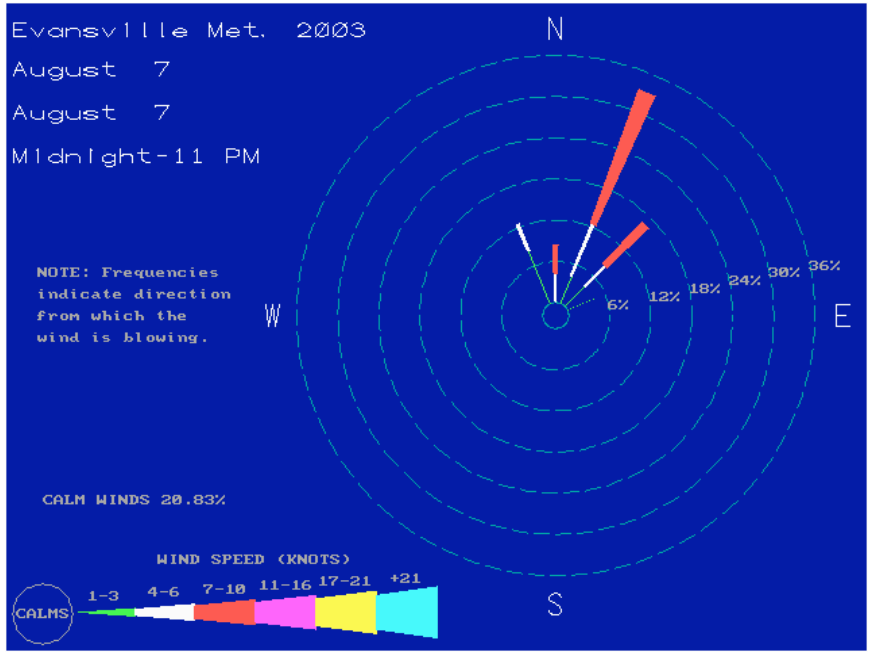

Evansville Met. 2003
July 14
July 14
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 37.50%
N
W
E
S
4%
8%
12%
16%
20%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

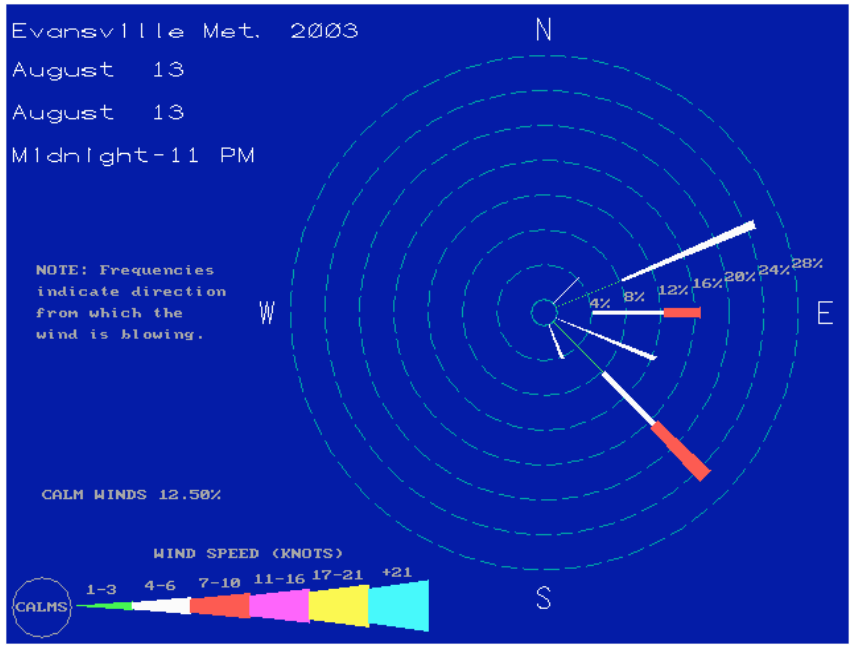

Evansville Met. 2003
July 17
July 17
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 41.67%
N
W
E
S
4%
8%
12%
16%
20%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

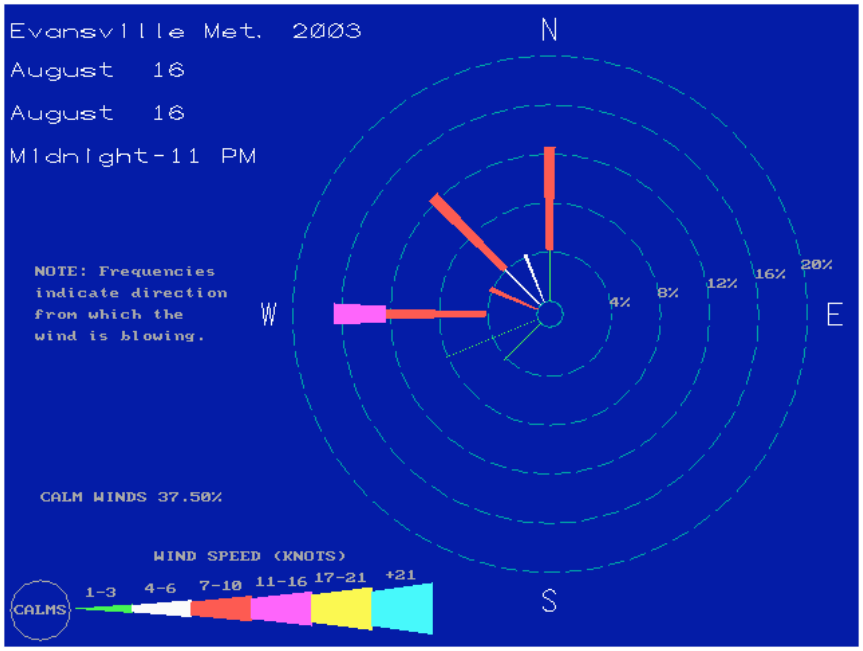

Evansville Met. 2003
July 20
July 20
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 33.33%
N
W
E
S
4%
8%
12%
16%
20%
24%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

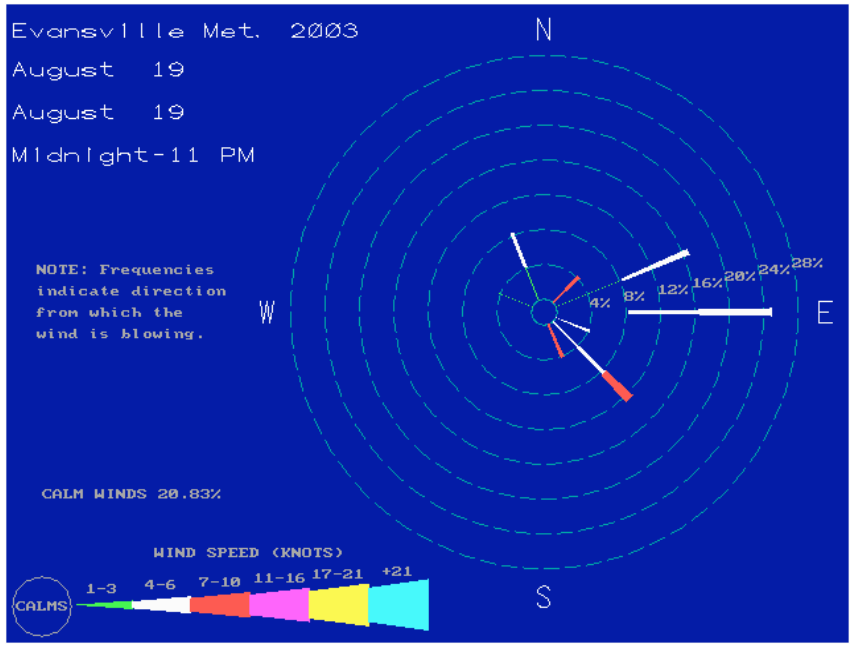

Evansville Met. 2003
July 26
July 26
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 37.50%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

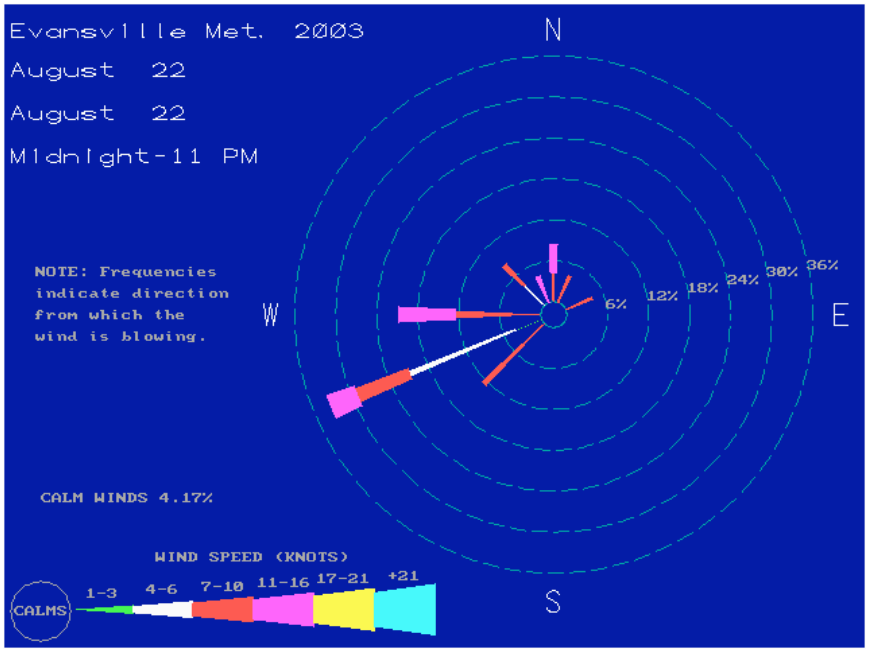

Evansville Met. 2003
August 1
August 1
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 29.17%
N
W
E
S
6% 12% 18% 24% 30% 36% 42%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

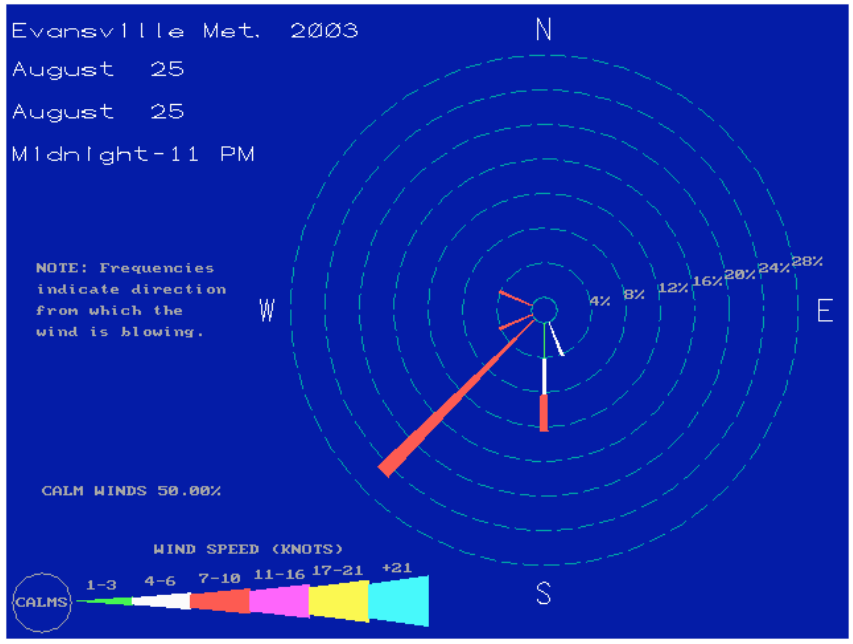

Evansville Met. 2003
August 7
August 7
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 20.83%
N
W
E
S
6% 12% 18% 24% 30% 36%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

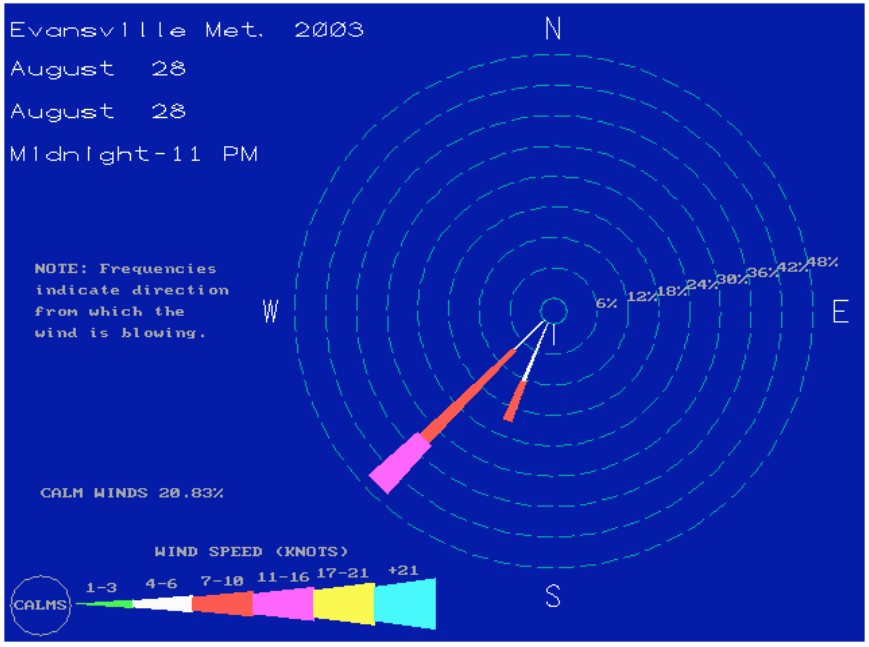

Evansville Met. 2003
August 13
August 13
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 12.50%
N
W
E
S
4% 8% 12% 16% 20% 24% 28%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

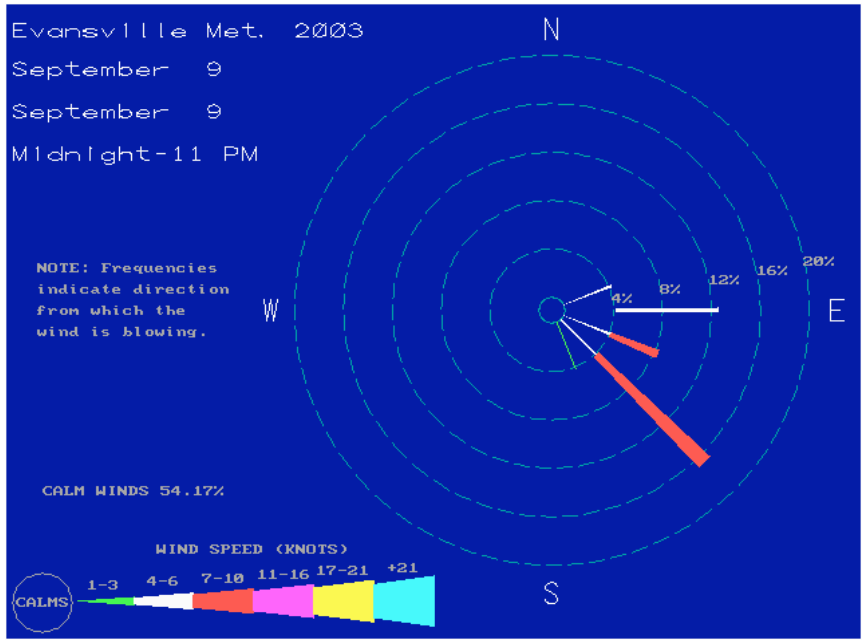

Evansville Met. 2003
August 16
August 16
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 37.50%
N
W
E
S
4% 8% 12% 16% 20%
WIND SPEED (KNOTS)
CALMS
1-3 4-6 7-10 11-16 17-21 +21

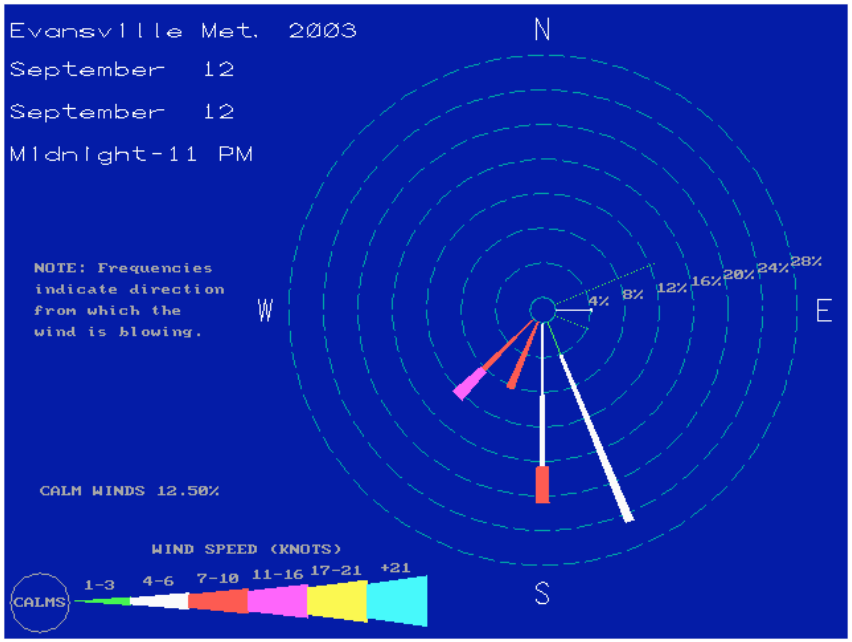

Evansville Met. 2003
August 19
August 19
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 20.83%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

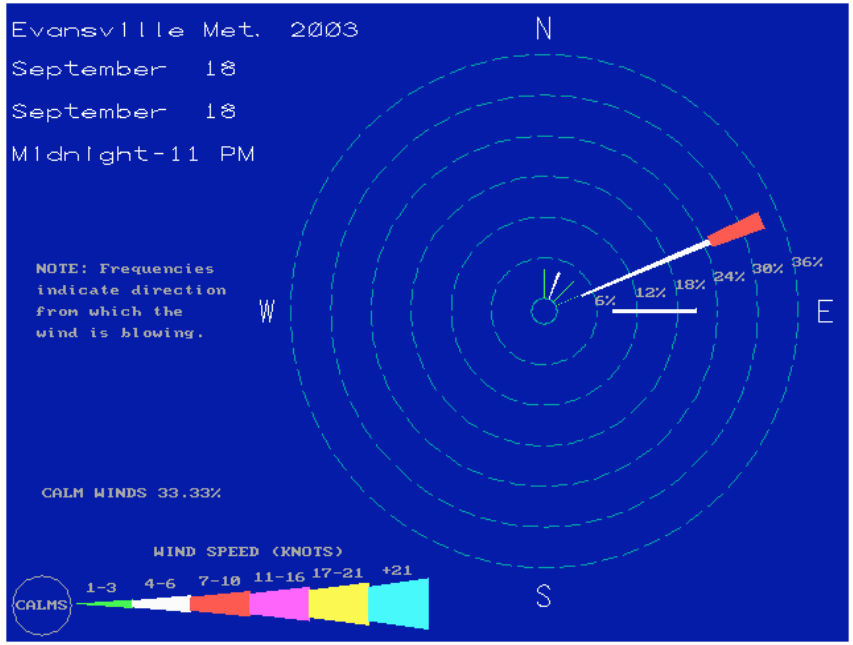

Evansville Met. 2003
August 22
August 22
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 4.17%
N
W
E
S
6%
12%
18%
24%
30%
36%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

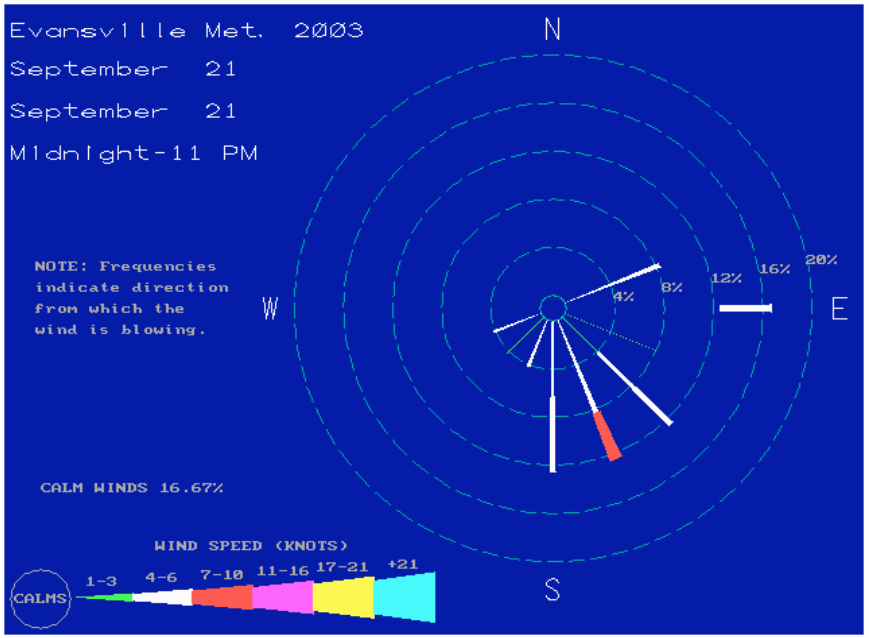

Evansville Met. 2003
August 25
August 25
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 50.00%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

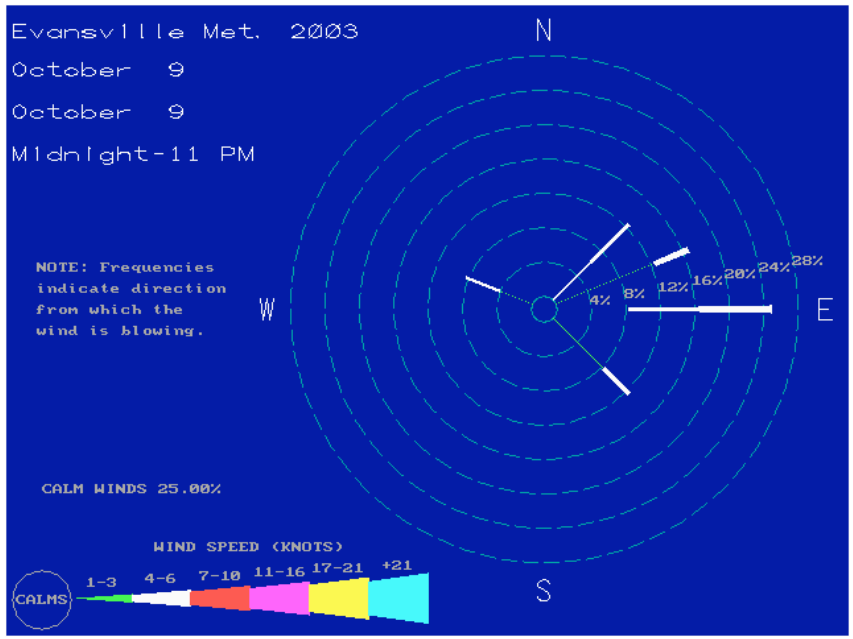

Evansville Met. 2003
August 28
August 28
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 20.83%
N
W
E
S
6%
12%
18%
24%
30%
36%
42%
48%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

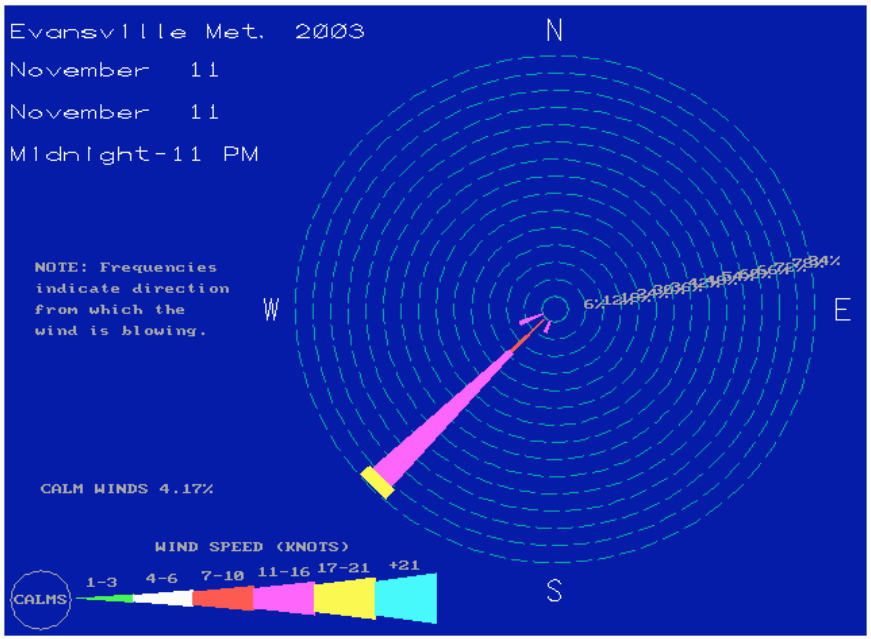

Evansville Met. 2003
September 9
September 9
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 54.17%
N
W
E
S
4%
8%
12%
16%
20%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Evansville Met. 2003
September 12
September 12
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 12.50%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Evansville Met. 2003
September 18
September 18
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 33.33%
N
W
E
S
6%
12%
18%
24%
30%
36%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Evansville Met. 2003
September 21
September 21
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 16.67%
N
W
E
S
4%
8%
12%
16%
20%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Evansville Met. 2003
October 9
October 9
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 25.00%
N
W
E
S
4%
8%
12%
16%
20%
24%
28%
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21


Evansville Met. 2003
November 11
November 11
Midnight-11 PM
NOTE: Frequencies indicate direction from which the wind is blowing.
CALM WINDS 4.17%
N
W
E
S
WIND SPEED (KNOTS)
CALMS
1-3
4-6
7-10
11-16
17-21
+21

Vanderburgh County SO2 sources, tons per year

Facility ID	Facility Name	2000	2001	2002	2003
00001	SIGECO - OHIO RIVER	1.0	0.9	1.2	0.2
00003	WHITE CAP, LLC	0.0	0.0	0.1	0.1
00005	EVANSVILLE STATE HOSPITAL		0.0	0.0	
00007	HAHN EQUIPMENT CO.	0.0	0.0		
00009	HOOSIER STAMPING & MFG. CORP	0.0	0.0	0.0	
00011	BOOTZ MFG CO	0.0	0.0	0.0	0.0
00013	KOCH ORIGINALS	0.0	0.0	0.0	
00014	GEO KOCH SONS INC	0.0	0.0	0.0	
00015	MEAD JOHNSON AND COMPANY	3.0	8.2	0.3	3.5
00017	GUARDIAN AUTOMOTIVE TRIM, INC.	0.0	0.1	0.0	
00018	RED SPOT PAINT & VARNISH CO., INC.	0.0	0.0	0.0	
00020	A ASPHALT CO. INC.	1.8	1.2	1.0	
00022	WHIRLPOOL CORP	0.2	0.3	0.2	1.2
00026	INLAND PAPERBOARD AND PACKAGING, INC.	0.0	0.0	0.0	
00029	DEACONESS HOSPITAL	0.5	11.8	0.1	
00036	KARGES FURNITURE CO., INC.	0.0	0.0	0.0	
00040	HARTFORD BAKERY INC.	0.0	0.0	0.0	0.0
00041	ST. MARY'S MEDICAL CENTER	0.0	0.0	0.0	
00045	EVANSVILLE METAL PROD	0.0	0.0	0.0	
00064	UNIV OF EVANSVILLE	0.5	0.1	0.0	
00067	GENERAL ELECTRIC I&RS	0.0	0.0	0.0	
00069	ST. MARY'S MEDICAL CENTER-WELBORN	0.1	0.0	0.0	
00070	FAULTLESS CASTER CORP	0.0	0.0	0.0	
00071	INTRAMETCO PROCESSING INC.	2.0	2.1	3.4	
00078	ROBUR CORPORATION	0.0	0.0	0.0	
00081	INDIANA TUBE CORP.	0.0	0.0	0.0	
00084	SIGECO - BERGDOLT ROAD - NEGT	0.1	0.1	0.0	0.0
00087	OBRYAN BARREL CO., INC.	0.0	1.2	1.0	
00094	PPG INDUSTRIES, INC. WKS #28	0.0	0.0	0.0	
00095	INDUSTRIAL CONTRACTORS, INC. METAL FAB	0.0	0.0	0.0	
00096	FLANDERS ELECTRIC MOTOR SERVICE	0.0	0.0	0.0	
00107	AZTECA MILLING, L.P.	0.1	0.1	0.1	
00112	AMERIQUAL FOODS, INC.	0.0	0.0	0.0	
00114	BFI WASTE SYSTEMS OF NORTH AMERICA, INC.	5.7	5.7	6.9	6.9
00115	MASTER MANUFACTURING CO., INC.	0.0	0.0	0.0	
00116	KRIEGER & RAGSDALE CO., INC.	0.0	0.0	0.0	
00123	J. TROCKMAN & SONS, INC.	0.0	0.0		
00129	KERRY INGREDIENTS	0.0	0.0	0.0	
00139	FLANDERS ELECTRIC MOTOR SERVICE			0.0	
00147	UNIVERSITY OF SOUTHERN INDIANA	0.0	0.0	0.0	
00148	UNISEAL, INC.; PLANT #2	0.0	0.0	0.0	
00156	SKY CYLINDER TESTING, INC.		0.0	0.0	
00163	COLLIS,INC.			0.0	
00165	DECORING SUPPLIES & EQUIPMENT, INC.			0.0	
00888	BRAKE SUPPLY		0.0	0.0	
03146	JERRY DAVID ASPHALT	4.6	5.2	5.2	
03408	J.H.RUDOLPH & CO	0.0	0.0	0.0	
	Totals	**19.9**	**37.4**	**19.8**	**12.0**