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Vector Wind Velocity, Speed, and Mode Summaries for the Southeastern U.S. (U)

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Executive Summary

This report presents wind speed and direction summaries for a wide area of the Southeastern United States (including EPA Region 4) and portions of the Ohio and Mississippi River Valleys in a monthly time series format that is further broken down for eight hours of the day (01:00, 04:00, 07:00, 10:00, 13:00, 16:00, 19:00, 22:00 EST). The data used for these summaries were obtained from the International Station Meteorological Climate Summary (FCCA, 1996), a publicly available source of tabular data from weather stations around the world distributed through the National Climatic Data Center (NCDC). The advantage of examining the data in the form presented in this report is that it is far easier to examine and understand regional and diurnal weather patterns than would be possible with the tabular data in its original format.

The winds presented here can be viewed online in any of three formats through an Internet link. The first format is the traditional wind rose (as used in our earlier reports for 13 stations in the Southeast, c.f., Weber, Buckley, and Parker (2002) and Weber, Buckley, and Kurzeja (2003)). The second format is the mode, or most frequent wind direction sector from the wind rose plots (i.e., the longest "petal" from the individual station roses). Finally, the third format depicted is the average wind vector. The average wind vector was determined by extracting the wind speed and direction for each of the 16 sectors from a station's wind record and then summing components of these vectors for the month and time of observation. Each station was then plotted on a sequence of maps for the Southeastern U.S. using ArcView software. These maps form a time series in 3-hour increments showing changes in vector wind speed and direction for each month of the year. The complete set of color figures are too numerous to be included in this report, but may be accessed by contacting one of the authors.

I. Introduction/Data Processing

This report is a continuation of previous work on wind rose depictions for the Southeastern U.S. that the authors and others completed for a more limited geographical area. A main difference between the previous reports and this work is that the area analyzed and plotted extends west to Fort Smith, Arkansas; north to Columbus, Ohio; and south to Key West, Florida. Thus, we can now examine wind roses for the western side of the Appalachians, the Gulf Coast, and the Mississippi and Ohio River Valleys, in addition to the region of the Southeastern U.S. shown in the earlier work.

Some 58 National Weather Service (NWS) stations in the Southeastern U.S. were selected for analysis. These stations are listed in Table 1 along with the location, latitude, longitude, elevation, and period of record as recorded on the FCCA data disk. The stations with an asterisk (*) in Table 1 have wind rose statistics recorded in the Central Standard Time (CST) zone. All the remaining stations report have their data recorded in Eastern Standard Time (EST). The reason that some of the stations in Table 1 appear to be out of their normal time zone is due to an early reporting convention established by the National Climatic Data Center.

The wind data from the frequency tables contained on the FCCA disk are frequency of occurrence of six wind speed ranges, along with the mean (scalar) speed in each of 16 wind direction sectors for each 3-hour period. Traditional wind roses figures can be constructed from these tables by drawing wind rose "petals" whose lengths represent the frequency of occurrence of the wind for these sixteen sectors. The petals are segmented with colors to represent wind speed bins proportional to the frequency of occurrence of six wind speed range bins.

The vector averages are different from the traditional wind roses in that all the information in the tables is reduced to one vector or petal of the rose. This petal represents the net effect of the wind blowing for that particular 3-hr time period during the month being examined. The vector average is determined by taking the scalar average speed for each direction sector (of 16) and projecting its components along east-west and north-south axes. Then, the magnitude (or speed) of the vector average is found by summing the components (weighted by the frequency of occurrence) and taking the square root of the sum of the squares of the components. Finally, to account for the percentage of calm winds and to scale the results for plotting, the following formulae were used,

$$S = \left(1 - {P_{CALM}}/{100}\right)\sqrt{{U_{Tot}}^2 + {V_{Tot}}^2}$$

and

$$S_{SCALED} = \frac{S}{10},$$

where P_{CALM} is the percentage of calms reported for the station for the particular month and time of day, U_{Tot} and V_{Tot} are the sums of the vector components (as described above), and S is the average magnitude of the vector wind. This method accounts for the calm (or zero) wind speeds by reducing the speed according to the fraction of calm winds. The quantity S_{SCALED} is the scaled value of the wind to accommodate plotting the wind roses with the ArcView software in the layout provided. The average vector speed is then assigned a bin and color-coded according to (0-2, 2-4, etc. knots).

The vector's average direction angle is found by finding the inverse tangent of the ratio of the summed north-south and east-west components. The average wind direction angle is then used to determine the appropriate 22.5 degree sector among the 16 possibilities of the full circle. This process is repeated for each of the eight time periods of the day and 12 months of the year for the years of record at each station. The average vector for each station is then plotted on a background map with the aid of ArcView GIS software.

II. Wind Plots

The average wind vector plots are made with ArcView software with our previously established choices of colors for the "petals" corresponding to particular wind speed ranges. The wind directions are assigned as usual to one of the sixteen compass sector ranges to represent the direction from which the wind blows (Table 2).

No blues or blacks were visible among the complete set of plots for the 12 months and eight hours of the day, so the average vector for all 58 stations in each case was less than (or at most) 10.5 knots for all of the 16 compass sectors N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW and NNW (22.5 degrees in each sector).

The average wind vector can be interpreted as the net airflow at the given time of day for a particular station. For example, if the wind tables showed only two directions, north and south, and these winds occurred with equal frequency and wind speed classes, the net air flow would be zero and the wind vector would be zero. On the other hand, if the frequency of occurrence of one of the two directions in this example dominates the other, the net flow (vector) would lie in that direction. In our plots there were a few cases where the net flow was approximately zero, i.e., essentially a dot on the plot. Normally when a station's traditional wind rose is predominately from a group of contiguous sectors, the average wind vector will be from that sector. But this is not necessarily always the case, since sectors with larger speeds can offset sectors with low speeds. A reason for examining the mean vector wind is that more often these vectors show spatially coherent patterns and sensible time evolution than can be seen with modes or traditional wind roses.

The wind mode is a more straightforward interpretation than the net vector. It is merely the longest "petal" of the wind rose, meaning it is the most frequent wind direction sector at a given station. The color of the petal for the wind mode in the plots was fixed to be red. The length of the petal corresponds to the frequency of occurrence of that wind direction from the original wind rose, i.e. the larger the frequency of occurrence of winds from a particular compass sector, the longer the petal will be.

Traditional wind roses have proved to be valuable in the past giving forecasters useful, added insight for difficult wind forecasts, especially where National Weather Service models disagree or where predicted wind speed is light.

III. Discussion of Results

A. Examples of Plots

Since each combination of month and time of day can be plotted in one figure, we have a total of 12 months × 8 periods of the day × 3 types of plots (traditional rose, mode, vector average), or 288 figures. This number is too large to include and discuss in this report; instead, we elected to make the complete collection of figures available on the Internet and to discuss a few examples, leaving readers to examine the complete set of figures as time permits.

We begin with an example of the vector average wind roses shown for April, 16:00 EST (reporting time) in Fig. 1. This figure shows the existence of sea breeze conditions along the Gulf of Mexico and Florida's east coast, with southwest to west-southwest flow in most inland areas, and stronger net transport in and near the Appalachians.

Figure 2 shows the mode plot for the same month and time of day as Fig. 1. Figure 2 indicates some inland directed modes along the coasts and mainly northerly directed modes along the Mississippi River Valley. Major flow features can be seen around the Appalachians, but differences from the vector average exist. For example, note that AGS, AHN, and ATL most frequently experience west-northwest winds while the vector average is west-southwest. This may be due to the frequent occurrence of west-northwest winds at night that has been noted even on SRS Area Towers (C. Hunter, personal communication). The west-southwest winds in the vector average may be due to pre-frontal conditions during which winds tend to be stronger in this geographical area, especially in the spring time.

B. Complete results

We now describe the results from our analysis of all of the months and times of day. For convenience, we break up the discussion into eight periods of the day and six regions. The regions are defined in Table 3 and shown in Fig. 3.

Table 4 shows summaries of the wind vector plots for the sub-regions in Table 3. Each 3-hour time period and sub-region was assigned an overall wind direction from among the 16 compass sectors for each month. Three special categories (SLB = sea breeze, meaning there is no predominant direction for all stations, but there is flow from sea to land or land to sea in all cases; CF = coastal following, meaning there is no predominant direction, but each vector seems to be following the coastal contour; and MX = mixed; meaning there is no predominant direction and no spatial coherance) were assigned. Table 5 contains similar information as gathered for the mode of each station.

The summaries in Tables 4 and 5 were accomplished by examining the plots and subjectively determining the overall wind direction for each sub-region. The reader may find it easier to follow the changes in wind direction with plots than by examining tables.

Figures 4 to 15 show time variations in wind vector averages and modes for each sub-region.

Figure 4 shows the time evolution of vector winds for the East Coast stations. The winds between 01:00 and 13:00 LST for these stations show a northwesterly flow in the winter months (probably due to extratropical cyclones) that gradually turns southwesterly by August (probably due to the Bermuda high-pressure system). The winds in September show a mixed result, but by October they have returned to northerly in the morning hours or northeasterly in the afternoon then northwesterly in the morning in November and December. Figure 5 illustrates the corresponding time evolution of the mode for the East Coast stations. The winds between 01:00 and 07:00 LST for these stations show a southwesterly flow in the spring months. The winds in September and October become northeasterly due to the high-pressure system that is often over the Ohio Valley or the Appalachians in the fall.

The time evolution of vector winds for the Piedmont Stations is shown in Fig. 6. The daytime (between 07:00-16:00) winds show west or northwesterly flow in the winter months that gradually turn southwesterly by July. The winds in August show a mixed result (breakdown of this regime) but by September the winds have become NNE, then northerly in October. The nighttime (17:00-00:00) winds show a progression by month from westerly to southwesterly to south then southeast in August, followed by a relatively sudden change to northeasterly in September. The primary forcing causing this change is the Bermuda high-pressure system in summer being replaced by the Ohio-Appalachians high pressure system in autumn, and extratropical cyclones in winter. The corresponding modes (Fig. 7) are mostly mixed except that they demonstrate either southwesterly flow between 01:00 and 13:00 LST or northeasterly flow from 04:00 to 19:00 LST in September and November.

Figures 8 and 9 show the time evolution of vector winds and mode for the Appalachian stations. Since these stations are dramatically terrain influenced the predominant summary is mixed. However, during the afternoon (13:00 – 19:00 LST) there is a fairly constant westerly component to the vector average winds. The shift to northeast in September is not as universal for these stations as it is for the Piedmont. The early morning and evening vector average winds are mostly northwesterly in the winter months. Again the mixed mode in nearly every time period implies the dramatic influence of terrain.

The time variation in vector winds for the Mississippi Valley stations is indicated in Fig. 10. These stations seem to show a predominant southerly flow for the spring and summer months during all times of day. This may be due to a thermal low over the continental U.S. in the summertime or due to the circulation pattern in the western portion of the Bermuda high pressure system. At nighttime in the late fall and winter the flow becomes easterly over this section of the country, probably again due to the high-pressure system over the Ohio Valley and Appalachians. Time-variations in mode (Fig. 11) show that whenever the stations are not categorized as mixed, they seem to be dominated by southerly flow for all months and times of day.

Figure 12 shows the time evolution of vector winds for the Ohio Valley stations. These stations are rather unique in that they show no northeasterly net vectors. The predominant mode is west, southwest, or south, with only three occurrences of winds from the southeast. During midday the flow is predominantly southwesterly throughout the year. This is probably due migratory low-pressure systems moving in from the Midwest to the Ohio Valley. The corresponding mode variations shown in Fig. 13 indicate none coming from the northeast. The predominant mode is southwest or south with no occurrences of southeast. At midday the predominant southwesterly modes persist except in winter.

Finally, Gulf Coast station time variations in vector averaged winds are shown in Fig. 14. The daytime winds (13:00 – 19:00 LST) show sea breezes during the spring and summer months. In fall and winter the flow is more likely to be from the northeast, whereas summer's flow at 01:00 LST is from the southeast. For the modes (Fig. 15), the daytime winds after 13:00 LST are sea breezes during the spring and summer months. In the morning hours during fall the flow is more likely to be from the northeast.

IV. Conclusions/Future Work

The wind statistics are presented in three forms that can be accessed on the Internet. The URLs are available from the authors. There are three groups of plots; first, traditional wind roses; second, the mode or the direction sector with the largest frequency of occurrence; third, the net wind vector, a single vector representing the net flow at a particular station during the month and 3-hr time period specified.

The winds are controlled by semi-permanent pressure systems off the Southeast Coast and inland as well. The Bermuda high influences the winds in the spring and summer periods. The high-pressure system over the Ohio Valley and/or Appalachians controls the winds during fall, and migratory low-pressure systems from the Midwest influence the flow during summer for stations in the Ohio Valley. The land-sea breeze circulation affects the coastal stations along the East and Gulf Coasts.

More work should be done to exploit the predictive capabilities of these results. For example, by determining the net flow for a group of stations in a sub-region, one might be able at any given time of the year to determine if a net vector wind or transport of heat had been achieved. If so, then the climatic average might be expected. If a region were above or below its average net flow, then higher or lower flow from the excess/deficient direction sectors might be expected.

References

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List of Tables

Table 1. National Weather Service stations selected for analysis.

Station	City	State	LAT (º min)-N	LON (º min)-W	Elevation (ft)	Period of Record
AGS	AUGUSTA	GA	33 22	81 58	148	1949-1995
AHN	ATHENS	GA	33 57	83 19	802	1955-1995
AQQ	APALACHACOLA	FL	33 39	84 26	20	1945-1995
ATL	ATLANTA	GA	29 44	85 02	1010	1948-1992
AVL	ASHEVILLE	NC	35 26	82 33	2140	1948-1995
BHM	BIRMINGHAM	AL	33 34	86 45	620	1948-1995
BNA*	NASHVILLE	TN	36 07	86 41	580	1948-1995
BTR*	BATON ROUGE	LA	30 32	91 08	64	1948-1995
CAE	COLUMBIA	SC	33 57	81 07	213	1948-1995
CHA	CHATTANOOGA	TN	35 02	85 12	692	1948-1995
CHS	CHARLESTON	SC	32 54	80 02	41	1945-1995
CLT	CHARLOTTE	NC	35 13	80 56	700	1948-1995
CMH	COLUMBUS	OH	40 00	82 53	812	1948 1995
CRW	CHARLESTON	WV	38 22	81 36	1015	1949-1995
CSG	COLUMBUS	GA	32 31	84 57	449	1948-1995
CVG	COVINGTON	KY	39 04	84 40	869	1948-1995
DAB	DAYTONA	FL	29 11	81 03	29	1948-1995
EKN	ELKINS	WV	38 53	79 51	1981	1948-1995
EVV	EVANSVILLE	IN	38 03	87 32	380	1948-1995
EYW	KEY WEST	FL	24 33	81 45	4	1948-1995
FMY	FORT MEYERS	FL	26 35	81 52	15	1948-1995
FSM*	FORT SMITH	AR	35 20	94 22	449	1948-1995
GNV	GAINESVILLE	FL	29 41	82 16	138	1984-1995
GPT*	GULFPORT	MS	30 24	89 04	30	1948-1993
GSO	GREENSBORO	NC	36 05	79 57	886	1948-1995
HSV	HUNTSVILLE	AL	34 39	86 46	624	1958-1995
ILM	WILMINGTON	NC	34 16	77 54	72	1948-1995
JAN*	JACKSON	MS	32 19	90 05	330	1963-1995
JAX	JACKSONVILLE	FL	30 30	81 42	26	1948-1995
JKL	JACKSON	KY	37 36	81 19	1355	1981-1995
LCH*	LAKE CHARLES	LA	30 07	93 13	9	1961-1995
LEX	LEXINGTON	KY	31 02	84 36	966	1948-1995
LIT*	LITTLE ROCK	AR	34 44	92 14	257	1948-1995
MCN	MACON	GA	32 42	83 39	354	1948-1995
MCO	ORLANDO	FL	28 26	81 20	91	1974-1995
MEI*	MERIDIAN	MS	32 20	88 45	294	1948-1995
MEM	MEMPHIS	TN	35 03	90 00	265	1948-1995
MGM	MONTGOMERY	AL	32 18	86 24	221	1948-1995
MIA	MIAMI	FL	25 48	80 18	12	1948-1995
MOB	MOBILE	AL	30 41	88 15	211	1948-1995
MSY*	NEW ORLEANS	LA	29 59	90 15	4	1948-1995
ORF	NORFOLK	VA	36 54	76 12	22	1948-1995
PAH	PADUCAH	KY	37 04	88 46	410	1949-1995
PBI	WEST PALM	FL	26 41	80 07	18	1948-1995
PNS	PENSACOLA	FL	30 28	87 12	112	1948-1995
RDU	RALEIGH-DURHAM	NC	35 52	78 47	376	1950-1995
RIC	RICHMOND	VA	37 30	77 20	164	1948-1995
ROA	ROANOKE	VA	37 19	79 98	1149	1948-1995
SAV	SAVANNAH	GA	32 08	81 12	46	1950-1995
SDF	LOUISVILLE	KY	38 11	85 44	477	1948-1995
SHV*	SHREVEPORT	LA	32 28	93 49	254	1948-1995
STL*	ST LOUIS	MO	38 45	90 22	535	1945-1995
TLH	TALLAHASSEE	FL	30 23	84 22	55	1948-1995
TPA	TAMPA	FL	27 58	82 32	19	1948-1995
TRI	BRISTOL	TN	36 29	82 24	1525	1948-1995
TUP*	TUPELO	MS	34 16	88 46	325	1983-1995
TYS	KNOXVILLE	TN	35 48	84 00	949	1948 1995
VRB	VERO BEACH	FL	27 39	80 25	23	1949-1995

**Indicates station with wind statistics recorded in Central Standard Time (CST).*

Table 2. Speed range and color-code for vector wind rose figures.

Speed range (knots)	Color
0 < Speed ≤ 3.5	Red
3.5 < Speed ≤ 6.5	Green
6.5 < Speed ≤ 10.5	Maroon
10.5 < Speed ≤ 16.5	Blue
16.5 < Speed ≤ 21.5	Black

Table 3. Southeastern U.S. sub-regions used for discussion of diurnal wind variations.

Num	Sub-Region	Stations included
1	Southeast Coast	CHS, DAB, EYW, GNV, ILM, JAX, MCO, MIA, ORF, PBI, SAV, VRB
2	Piedmont	AGS, AHN, ATL, CAE, CLT, CSG, GSO, MCN, MGM, RDU, RIC
3	Appalachians	AVL, BHM, BNA, CHA, CRW, EKN, HSV, ROA, TRI, TYS
4	Mississippi Valley	FSM, JAN, LIT, MEI, MEM, PAH, SHV, STL, TUP
5	Ohio Valley	CHM, CVG, EVV, JKL, LEX, SDF
6	Gulf Coast	AQQ, BTR, FMY, GPT, LCH, MOB, MSY, PNS, TLH, TPA

Table 4. Diurnal wind summaries for the vector average by sub-region of the Southeastern U. S. (16 compass points: N, NNE, …, NNW; MX implies mixed results, SLB implies sea/land breeze, and CF implies winds following the coastal contour).

01 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	NW	WNW	WSW	SW	SSW	SSW	SW	SW	MX	N	NW	NW
Piedmont	W	WNW	W	SW	SSW	SSW	SSW	MX	NE	N	WNW	WNW
Appalachians	WNW	NW	W	MX	MX	MX	MX	MX	MX	MX	MX	NW
Miss. Val.	MX	MX	S	S	SSE	SSE	S	SE	ESE	MX	MX	MX
Ohio Val.	W	WNW	W	SW	S	S	S	SSE	SE	MX	SW	WSW
Gulf Coast	NNE	NE	SE	SE	SSE	SE	MX	MX	ENE	NE	NE	ENE

04 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	NW	NW	W	W	WSW	SW	SW	MX	MX	N	NNW	NW
Piedmont	NW	WNW	W	WSW	MX	MX	SW	MX	NNE	N	NW	WNW
Appalachians	NW	NW	WNW	MX	MX	MX	MX	MX	MX	MX	NW	NW
Miss. Val.	MX	MX	MX	S	SSE	SSE	S	SSE	MX	MX	MX	MX
Ohio Val.	WSW	WNW	W	SW	S	SSW	SSW	MX	MX	MX	SW	WSW
Gulf Coast	NNE	NNE	MX	MX	MX	MX	MX	MX	NE	NE	NE	NE

07 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	NW	NW	WNW	W	MX	W	WSW	MX	MX	N	NW	NW
Piedmont	WNW	NW	WNW	W	MX	MX	SW	MX	NNE	N	NW	WNW
Appalachians	NW	NW	NW	MX	MX	MX	MX	MX	MX	NNE	NW	NW
Miss. Val.	MX	MX	MX	S	SSE	S	S	SSW	E	MX	MX	MX
Ohio Val.	W	WNW	W	SW	S	S	SSW	SSE	MX	MX	SW	WSW
Gulf Coast	NNE	NNE	ENE	E	E	MX	MX	NE	NE	NE	NE	NE

10 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	NW	NW	WNW	W	MX	MX	MX	MX	NE	NNE	MX	MX
Piedmont	NW	NW	WNW	W	W	W	SW	NNE	NE	NNE	NNW	NW
Appalachians	NW	NW	W	W	MX	MX	MX	MX	MX	MX	NW	NW
Miss. Val.	MX	MX	S	SSW	S	SW	SW	MX	E	MX	MX	MX
Ohio Val.	WSW	WSW	SW	SW	SW	SW	SW	SW	SSW	SW	SW	SW
Gulf Coast	NE	NE	E	SE	SE	SSE	MX	MX	ENE	ENE	ENE	ENE

13 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	NW	MX	MX	MX	MX	SLB	SLB	SLB	ENE	NE	MX	MX
Piedmont	W	W	W	WSW	WSW	WSW	SW	MX	NE	NNE	W	W
Appalachians	W	W	WSW	WSW	W	W	W	W	MX	NW	W	W
Miss. Val.	W	W	SW	S	S	S	WSW	MX	MX	MX	MX	MX
Ohio Val.	WSW	WSW	WSW	WSW	WSW	SW	WSW	WSW	WSW	WSW	WSW	WSW
Gulf Coast	NE	MX	SLB	SLB	SLB	SLB	SLB	SLB	ESE	ENE	ENE	ENE

16 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	MX	MX	MX	SLB	SLB	SLB	SLB	SLB	SLB	NE	MX	MX
Piedmont	W	W	W	WSW	WSW	MX	SW	MX	NE	NNE	W	W
Appalachians	W	W	WSW	WSW	W	W	WSW	WNW	MX	MX	W	W
Miss. Val.	WNW	WNW	WSW	SSW	S	S	SW	MX	NE	MX	MX	MX
Ohio Val.	WSW	W	WSW	WSW	WSW	WSW	WSW	W	WSW	WSW	WSW	WSW
Gulf Coast	MX	MX	SLB	SLB	SLB	SLB	SLB	SLB	MX	MX	MX	MX

19 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	MX	MX	MX	SLB	SLB	SLB	SLB	SLB	SLB	NE	MX	MX
Piedmont	W	W	WSW	SW	S	SSE	S	SE	ESE	NNE	NW	NW
Appalachians	WNW	WNW	W	WSW	W	W	WSW	MX	MX	NNW	NW	WNW
Miss. Val.	MX	N	MX	S	SSE	SSE	S	MX	ENE	E	ESE	E
Ohio Val.	WSW	W	W	WSW	WSW	SW	SW	MX	MX	MX	SW	WSW
Gulf Coast	MX	MX	SLB	SLB	SLB	SLB	SLB	SLB	NE	NE	NE	MX

22 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	MX	MX	CF	CF	CF	CF	CF	MX	NE	NNE	MX	MX
Piedmont	W	W	WSW	SSW	S	SSE	S	SE	ENE	NE	WNW	WNW
Appalachians	WNW	NW	W	WSW	MX	MX	MX	MX	NE	N	WNW	WNW
Miss. Val.	MX	E	SSE	SSE	SE	SE	SSE	SE	E	E	ESE	ESE
Ohio Val.	WSW	W	MX	SW	S	S	S	MX	MX	MX	SW	WSW
Gulf Coast	NE	MX	MX	MX	MX	MX	MX	MX	ENE	NE	NE	NE

Table 5. Diurnal wind summaries for the mode by sub-region of the Southeastern U.S. (16 compass points, N, NNE, … NNW; MX = mixed results, SLB = sea/land breeze; and CF = winds following the coastal contour).

01 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	MX	MX	MX	MX	SW	SW	SW	SW	MX	NNE	CF	NW
Piedmont	MX	MX	MX	MX	MX	MX	SSW	MX	MX	MX	MX	MX
Appalachians	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX
Miss. Val.	MX	MX	MX	S	S	S	S	MX	MX	MX	S	S
Ohio Val.	MX	MX	MX	MX	MX	S	SSW	MX	MX	MX	MX	MX
Gulf Coast	SLB	SLB	MX	MX	MX	MX	MX	MX	MX	NE	SLB	SLB

04 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	MX	MX	MX	SW	SW	SW	SW	MX	MX	NNE	CF	MX
Piedmont	MX	MX	MX	MX	MX	MX	SW	MX	NE	NE	MX	MX
Appalachians	MX	MX	MX	MX	MX	MX	MX	MX	NE	MX	MX	MX
Miss. Val.	MX	MX	S	S	S	S	SSW	MX	MX	MX	MX	S
Ohio Val.	MX	MX	MX	MX	MX	S	SSW	MX	MX	MX	MX	MX
Gulf Coast	SLB	SLB	MX	MX	MX	MX	MX	MX	NE	NE	SLB	SLB

07 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	MX	MX	MX	SW	WSW	WSW	WSW	MX	MX	CF	CF	MX
Piedmont	MX	MX	MX	MX	MX	MX	SW	MX	NE	NE	MX	MX
Appalachians	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX
Miss. Val.	N	MX	MX	S	MX	S	SSW	MX	MX	MX	S	S
Ohio Val.	MX	MX	MX	MX	S	S	SSW	MX	MX	MX	S	S
Gulf Coast	SLB	SLB	MX	MX	MX	MX	MX	MX	NE	NE	NE	MX

10 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	MX	CF	MX	MX	MX	MX	MX	MX	NE	NE	CF	CF
Piedmont	MX	MX	MX	MX	MX	SW	SW	MX	NE	NE	MX	MX
Appalachians	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX
Miss. Val.	MX	MX	S	S	S	SSW	MX	MX	MX	MX	S	S
Ohio Val.	MX	MX	SSW	SSW	SW	SW	SW	SW	MX	SSW	SSW	SSW
Gulf Coast	MX	MX	MX	MX	MX	MX	MX	MX	ENE	ENE	MX	MX

13 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	MX	MX	MX	MX	MX	SLB	MX	SLB	ENE	NE	MX	MX
Piedmont	MX	MX	MX	MX	SW	SW	SW	MX	NE	NE	MX	MX
Appalachians	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX
Miss. Val.	MX	MX	S	S	S	SSW	SSW	MX	MX	MX	MX	MX
Ohio Val.	MX	MX	MX	SW	SW	SW	SW	SW	SW	SW	SW	SW
Gulf Coast	MX	MX	SLB	SLB	SLB	SLB	MX	MX	MX	MX	MX	MX

16 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	MX	MX	MX	SLB	SLB	SLB	SLB	SLB	SLB	MX	MX	MX
Piedmont	MX	MX	MX	MX	MX	MX	MX	MX	NE	NE	MX	MX
Appalachians	MX	MX	MX	MX	MX	W	MX	MX	MX	MX	MX	MX
Miss. Val.	MX	MX	MX	S	S	S	MX	MX	N	MX	MX	S
Ohio Val.	MX	MX	MX	WSW	SW	SW	SW	SW	MX	MX	MX	MX
Gulf Coast	MX	MX	SLB	SLB	SLB	SLB	SLB	SLB	SLB	MX	MX	MX

19 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	MX	CF	CF	SLB	SLB	SLB	SLB	SLB	SLB	NE	MX	MX
Piedmont	MX	MX	MX	MX	MX	MX	MX	MX	NE	NE	MX	MX
Appalachians	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX
Miss. Val.	MX	MX	MX	S	SSE	SSE	S	MX	N	MX	MX	MX
Ohio Val.	MX	MX	MX	MX	SSW	SW	SW	MX	MX	MX	MX	MX
Gulf Coast	MX	MX	SLB	SLB	SLB	SLB	SLB	MX	MX	MX	MX	MX

22 LST	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
East Coast	MX	MX	MX	CF	CF	CF	CF	MX	NE	NNE	MX	MX
Piedmont	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX
Appalachians	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX
Miss. Val.	MX	MX	S	S	S	S	S	MX	MX	MX	S	S
Ohio Val.	MX	MX	MX	MX	S	S	S	MX	S	S	S	S
Gulf Coast	SLB	MX	MX	MX	MX	MX	MX	MX	MX	MX	MX	SLB

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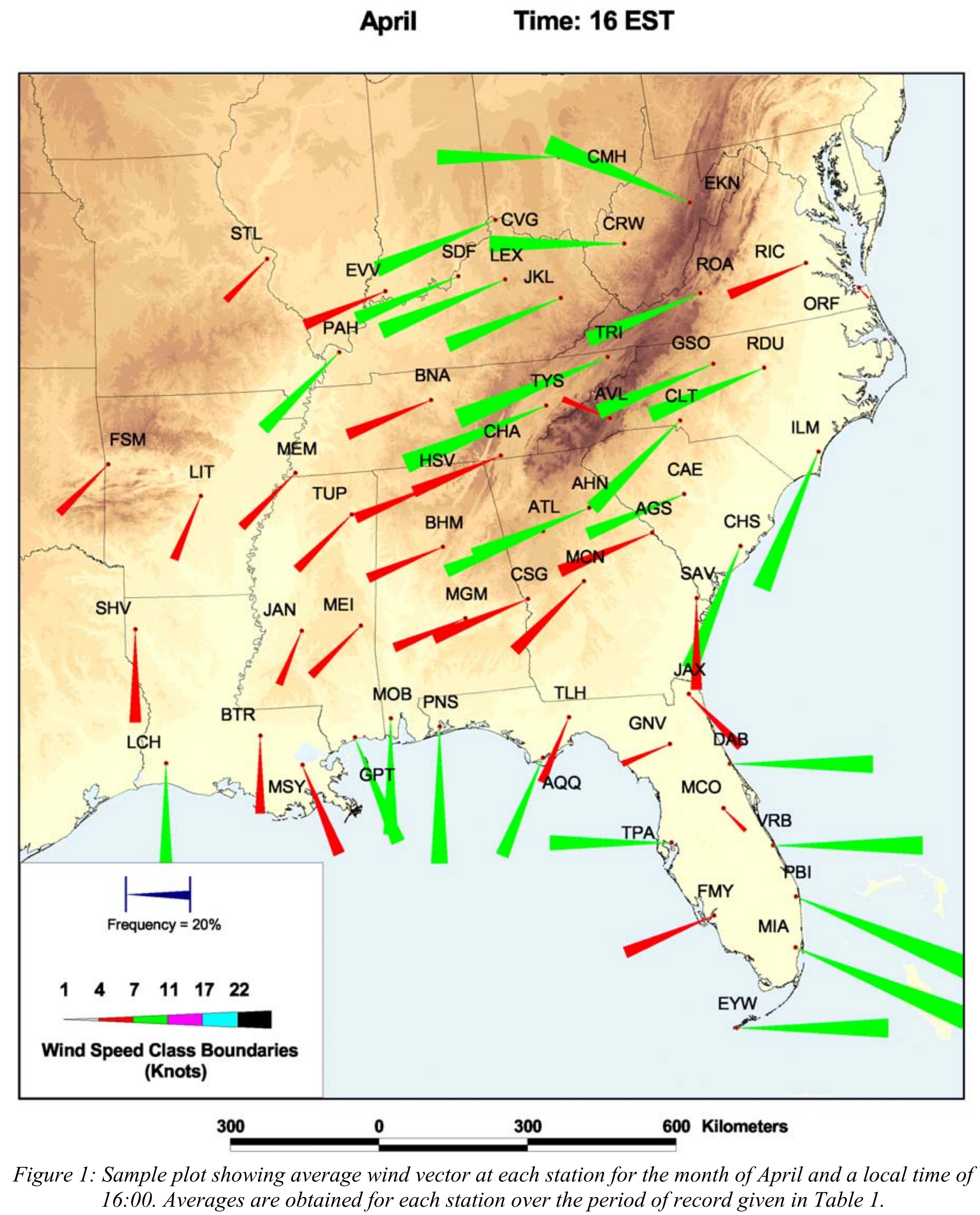

Figure 1: Sample plot showing average wind vector at each station for the month of April and a local time of 16:00. Averages are obtained for each station over the period of record given in Table 1.

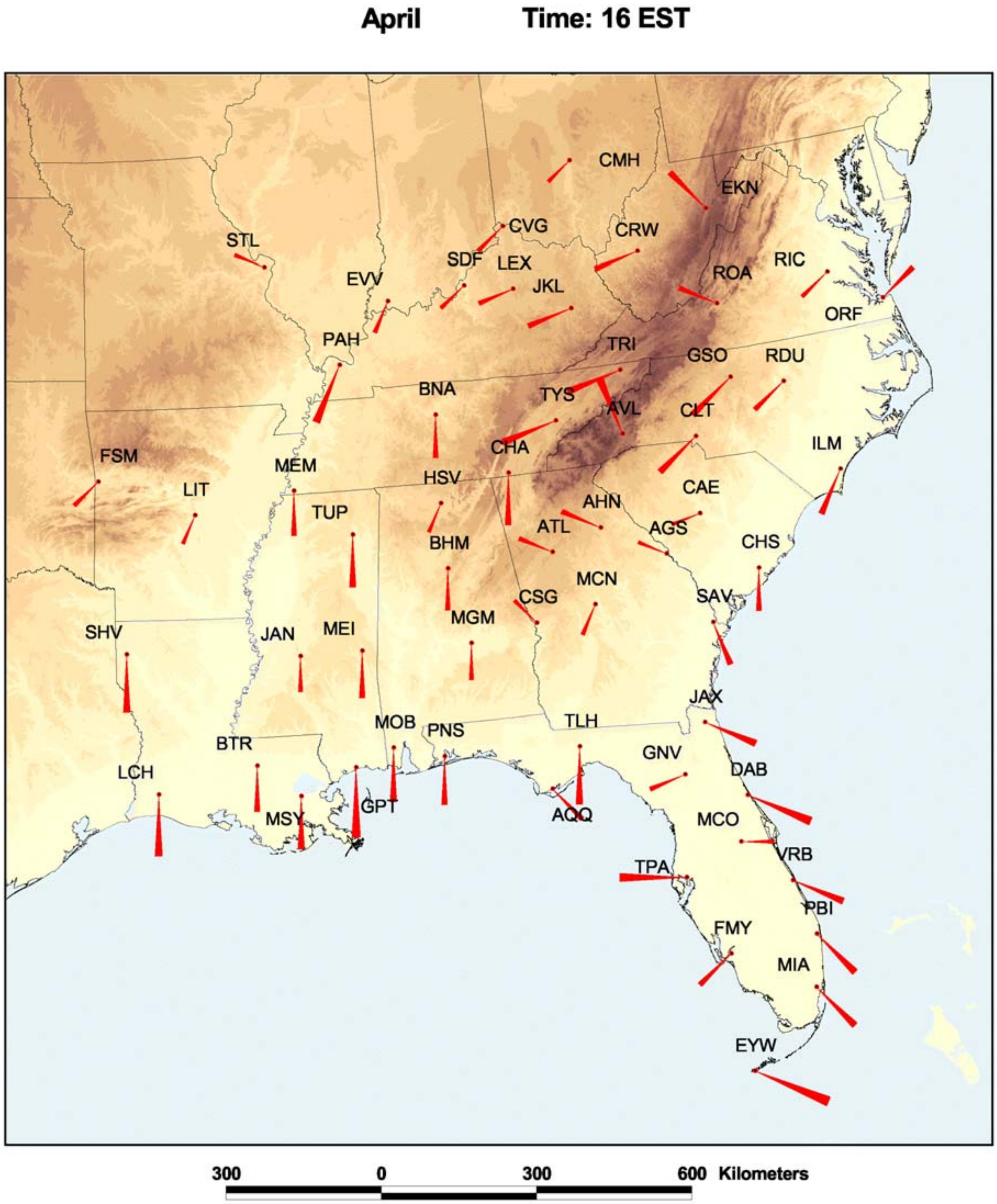

Figure 2: Sample plot showing the mode at each station for the month of April and a local time of 16:00. Modes are obtained for each station over the period of record given in Table 1.

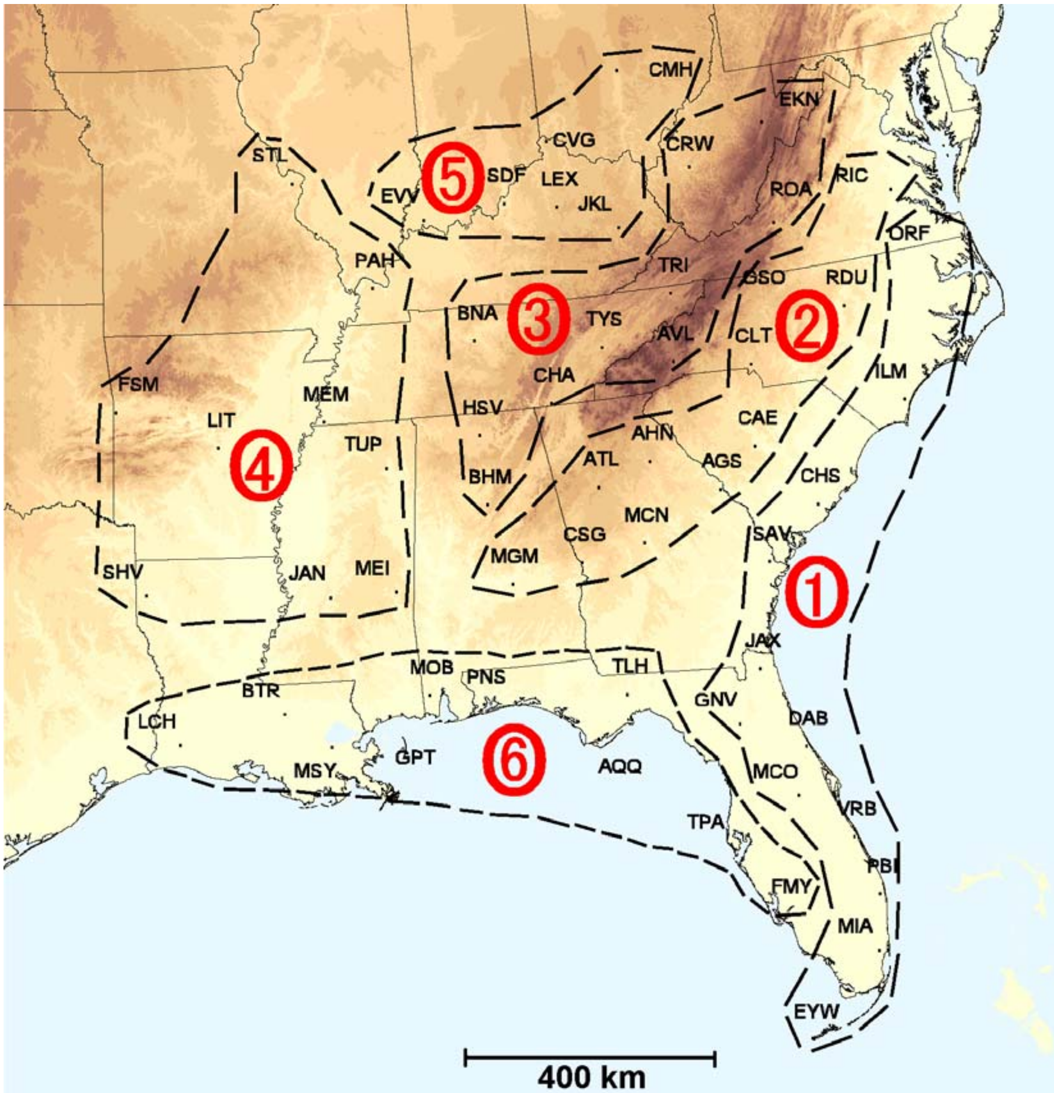

Figure 3: Sub-regions of the Southeastern U.S. for the purpose of discussion.

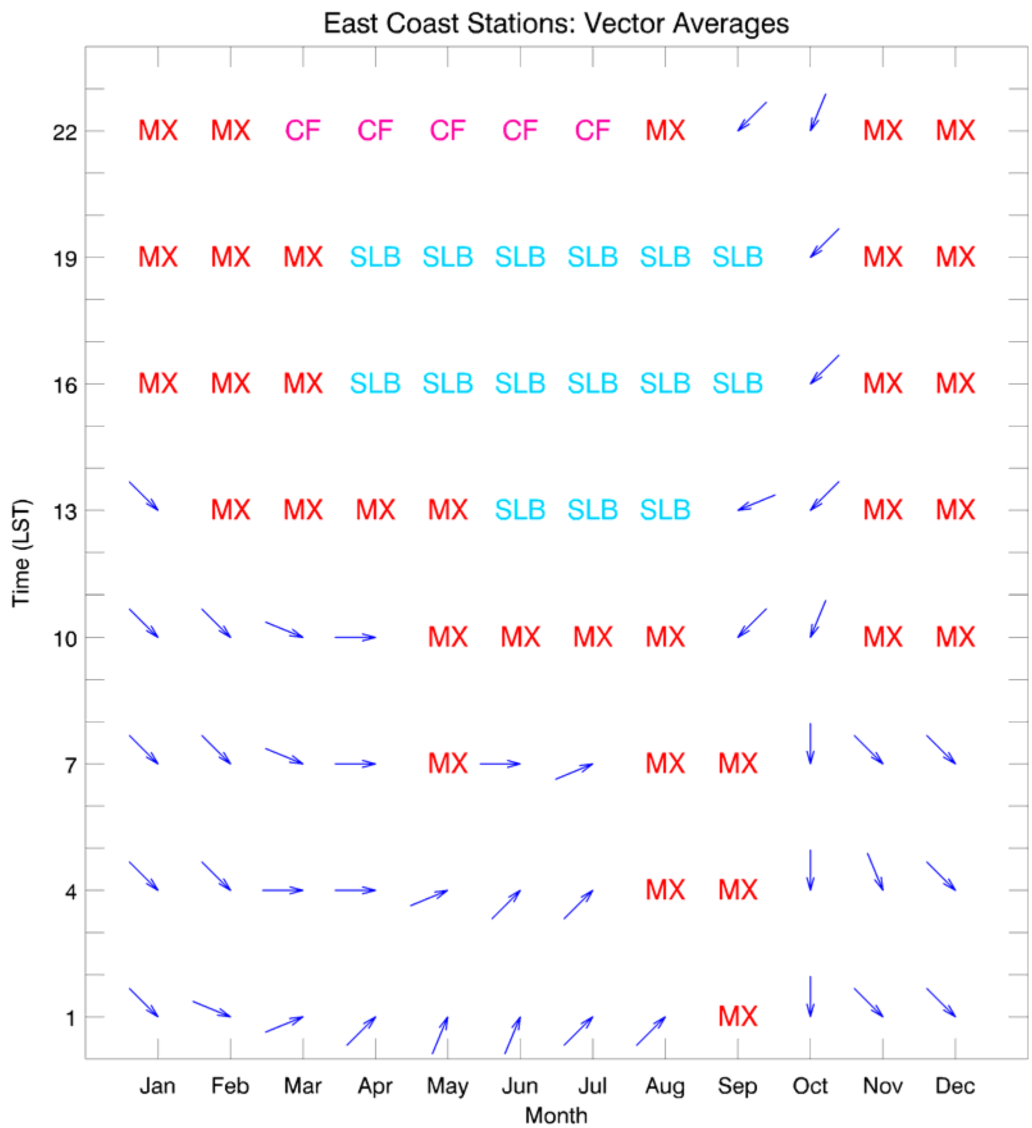

Figure 4: Variation of vector averages with month and time of day for the East Coast sub-region.

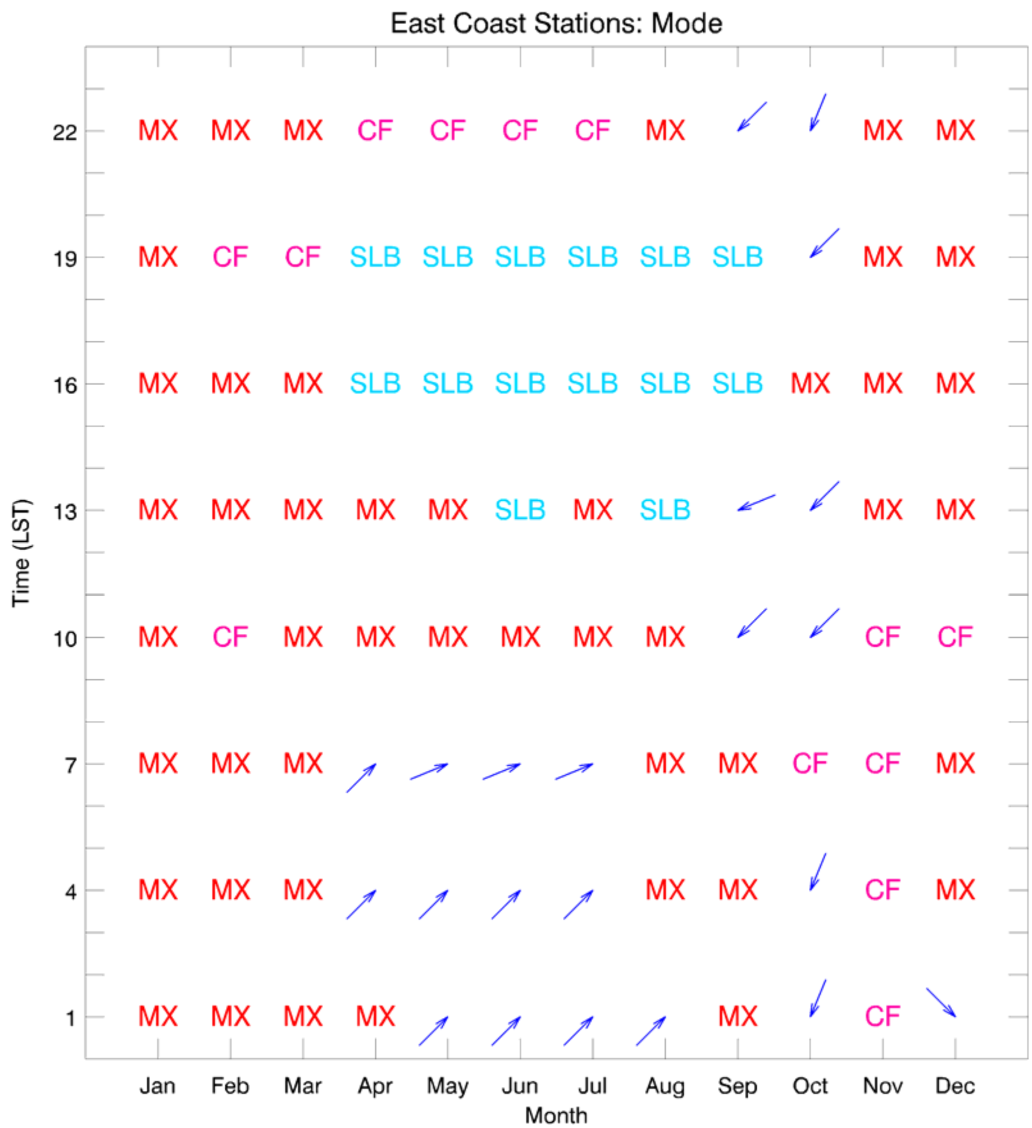

Figure 5: Variation of mode with month and time of day for the East Coast sub-region.

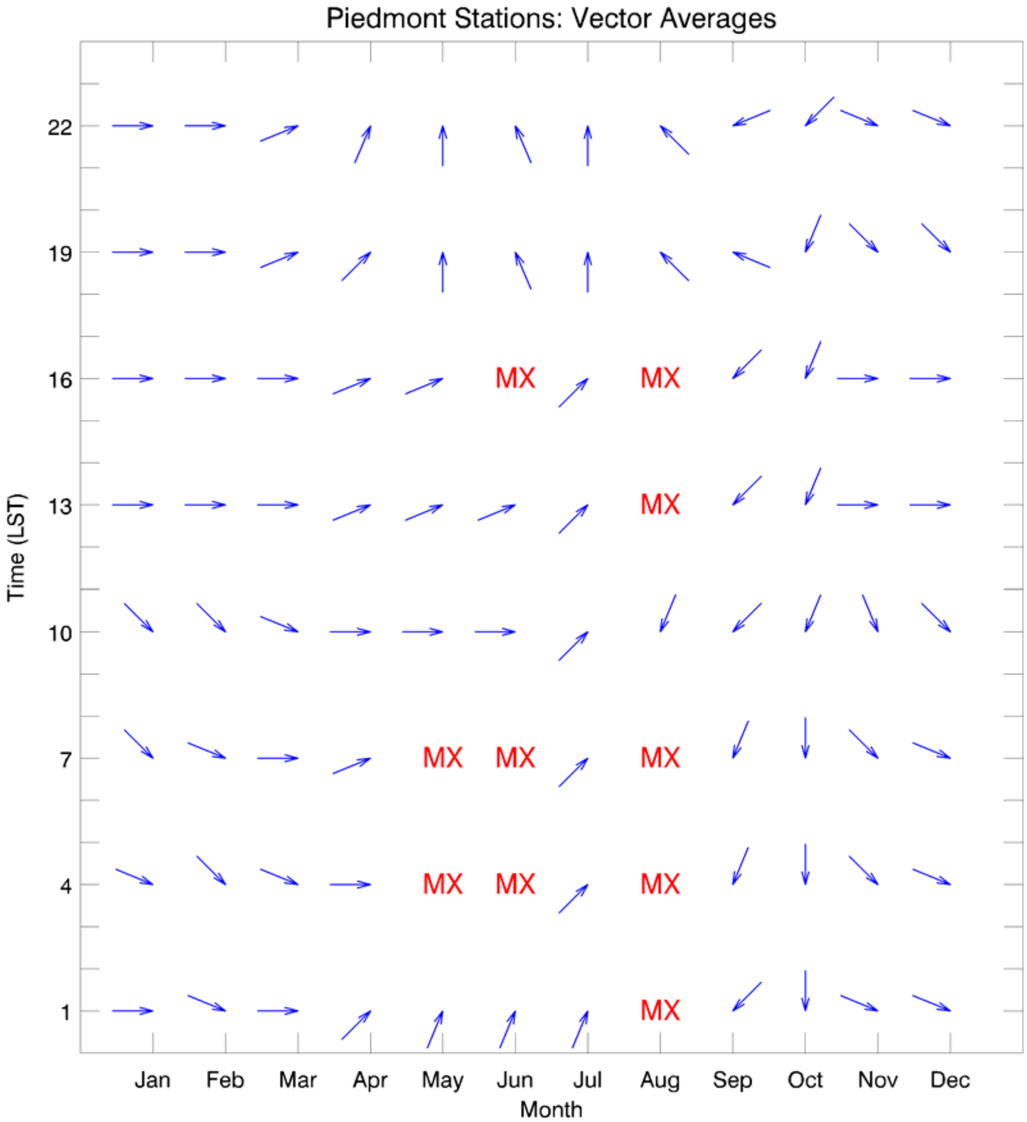

Figure 6: Variation of vector averages with month and time of day for the Piedmont sub-region.

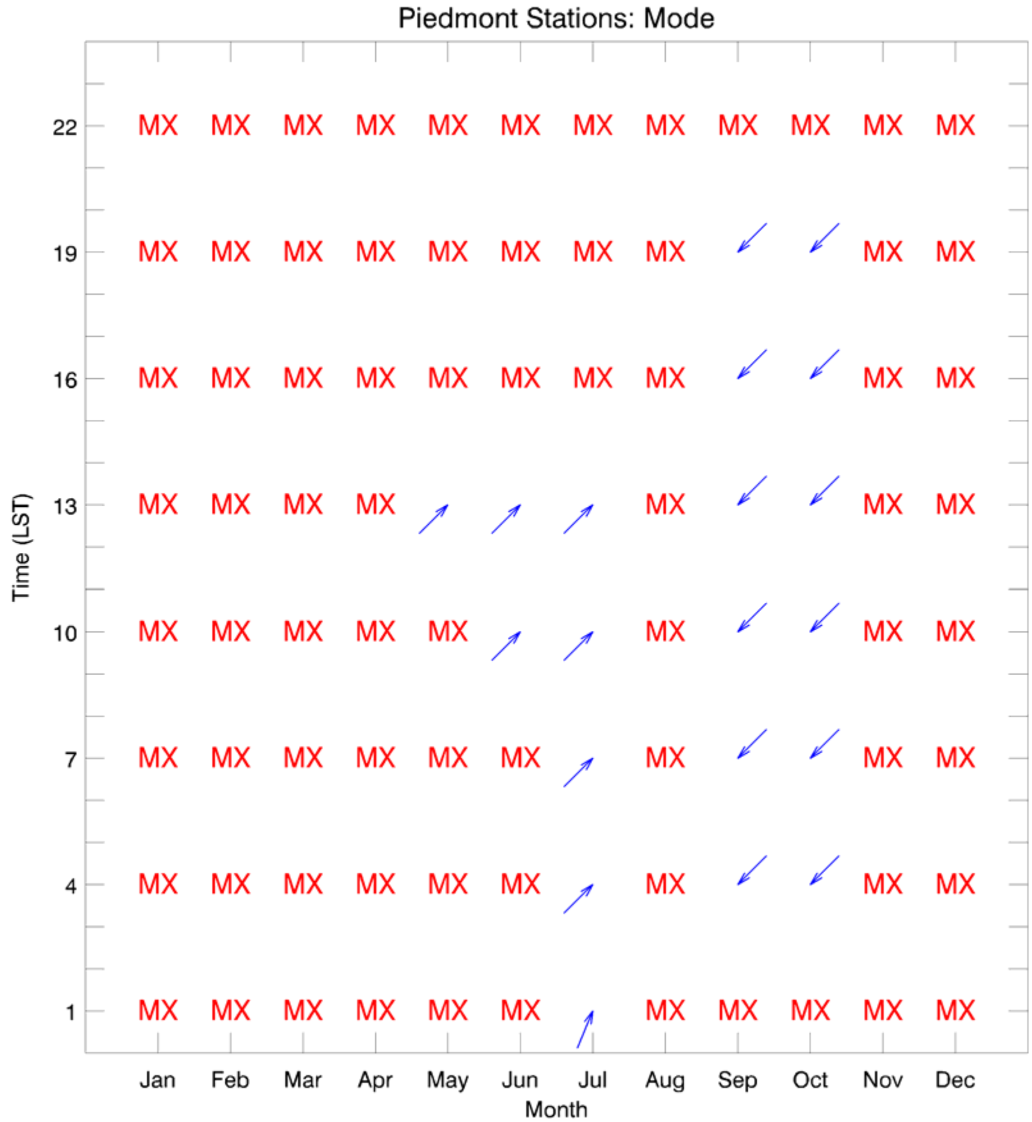

Figure 7: Variation of mode with month and time of day for the Piedmont sub-region.

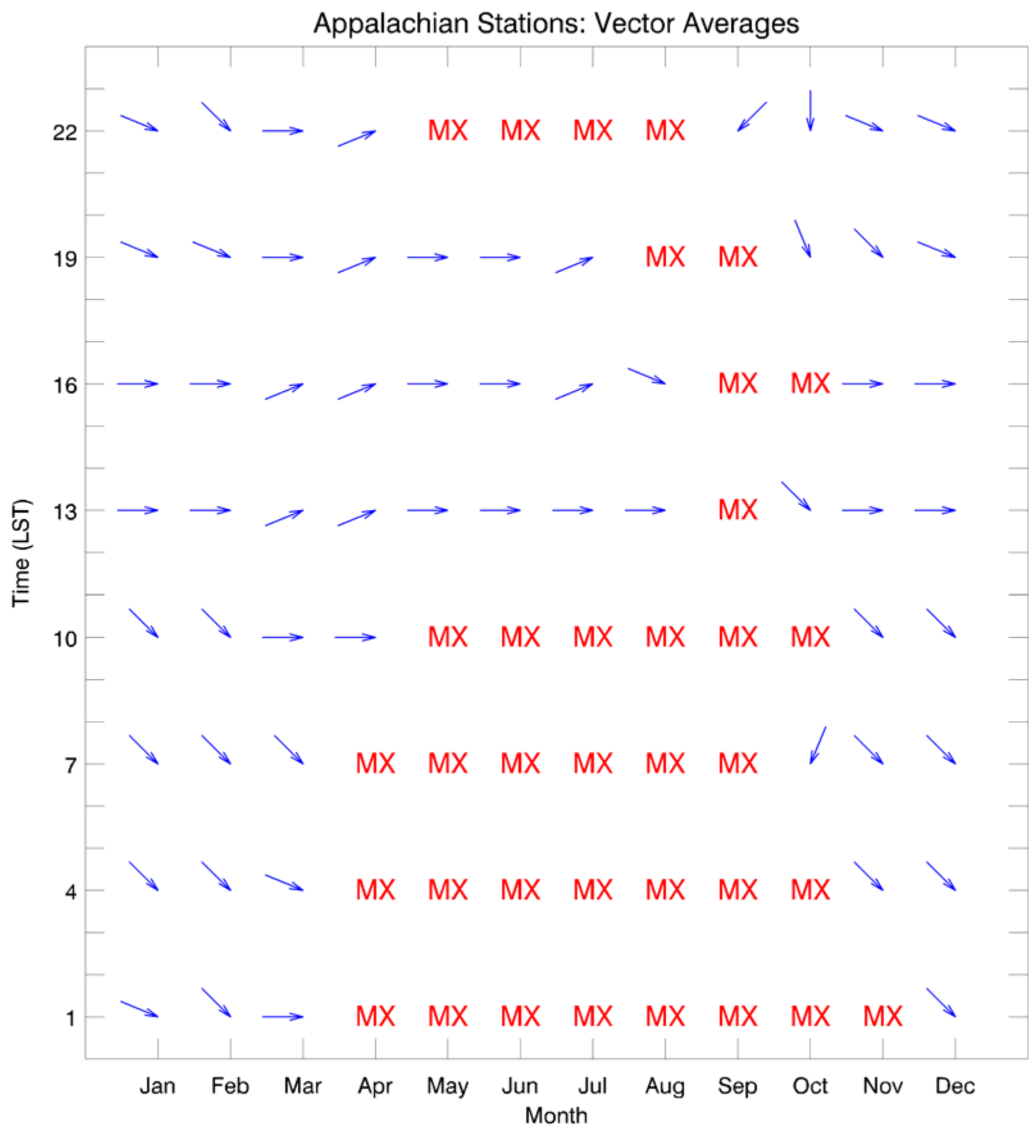

Figure 8: Variation of vector averages with month and time of day for the Appalachian sub-region.

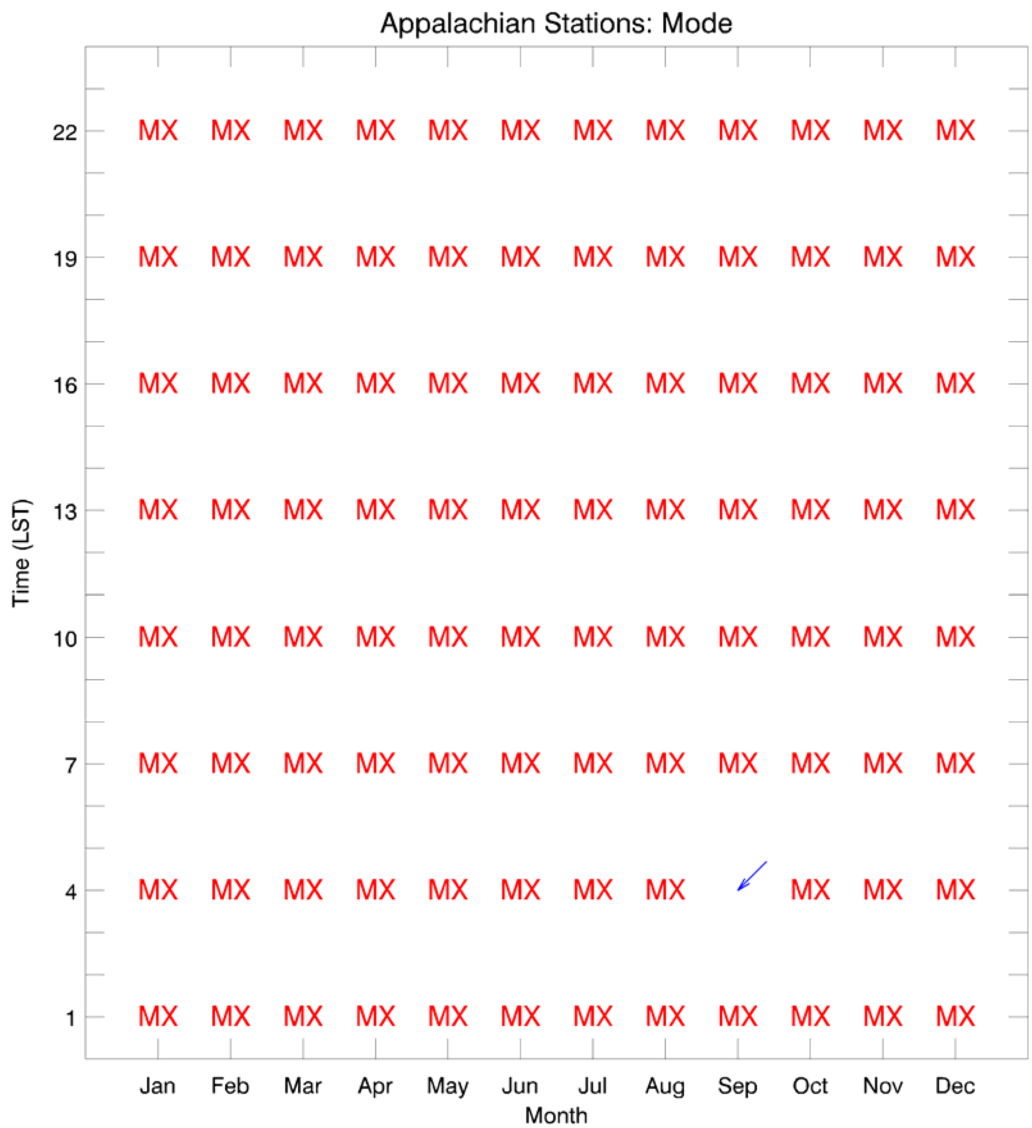

Figure 9: Variation of mode with month and time of day for the Appalachian sub-region.

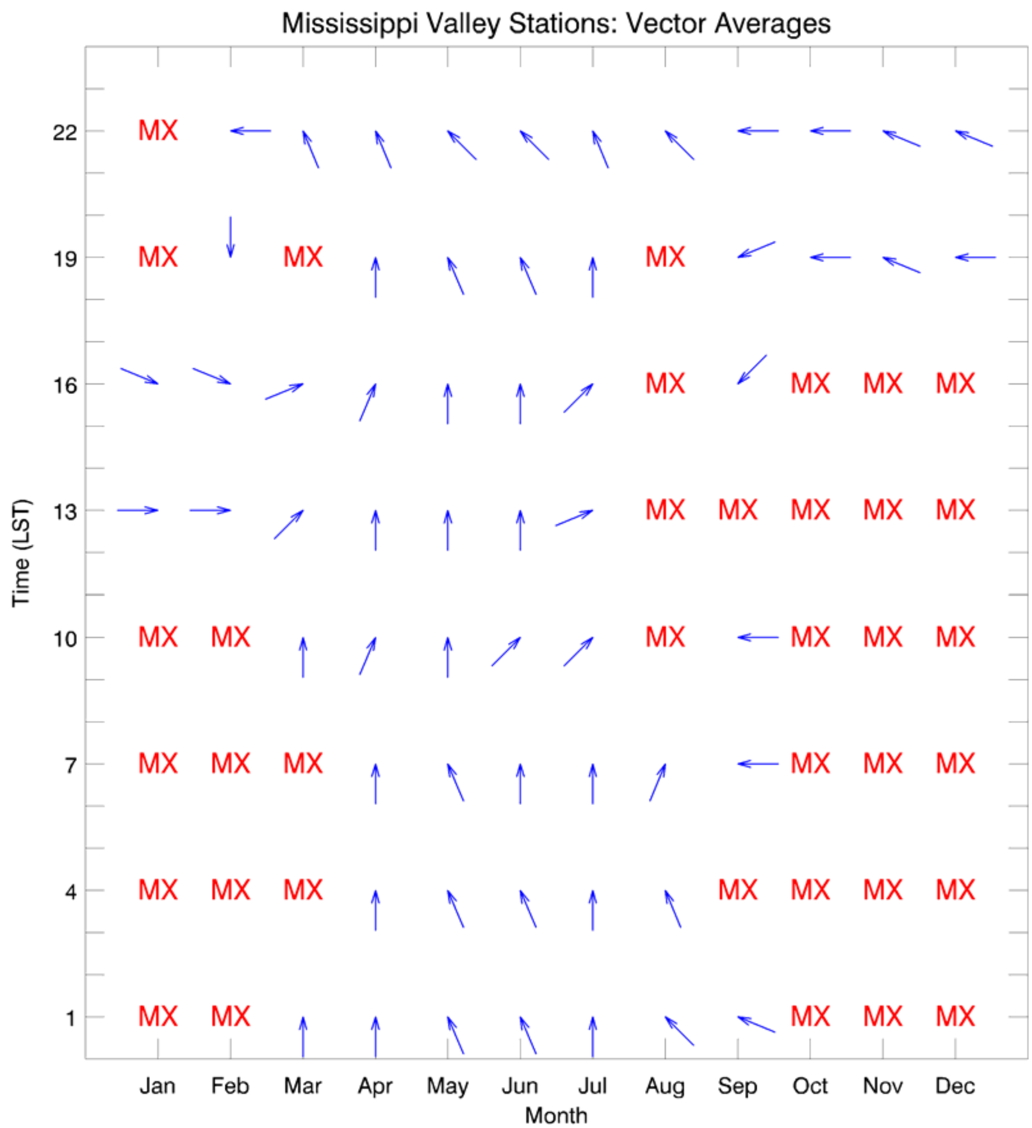

Figure 10: Variation of vector averages with month and time of day for the Mississippi Valley sub-region.

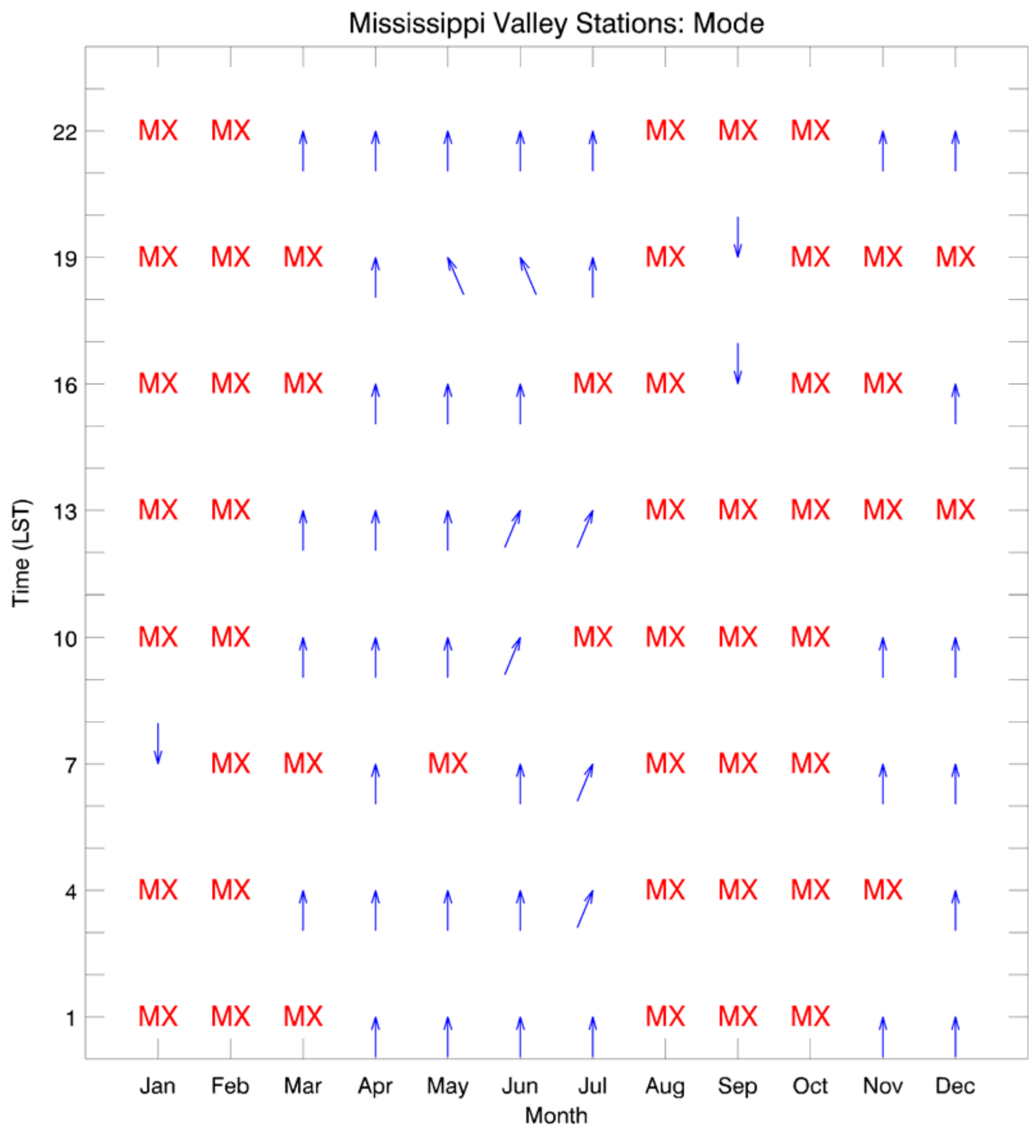

Figure 11: Variation of mode with month and time of day for the Mississippi Valley sub-region.

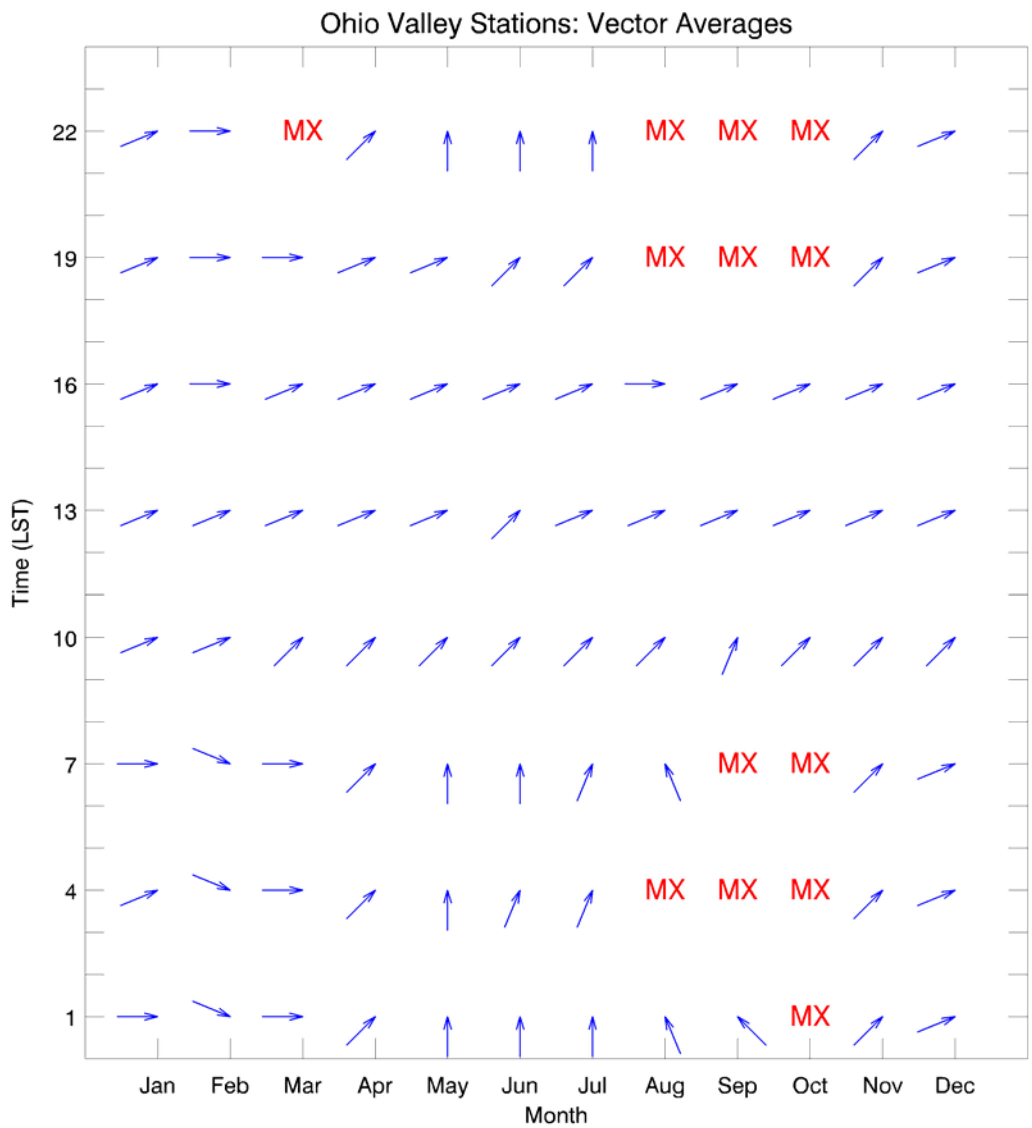

Figure 12: Variation of vector averages with month and time of day for the Ohio Valley sub-region.

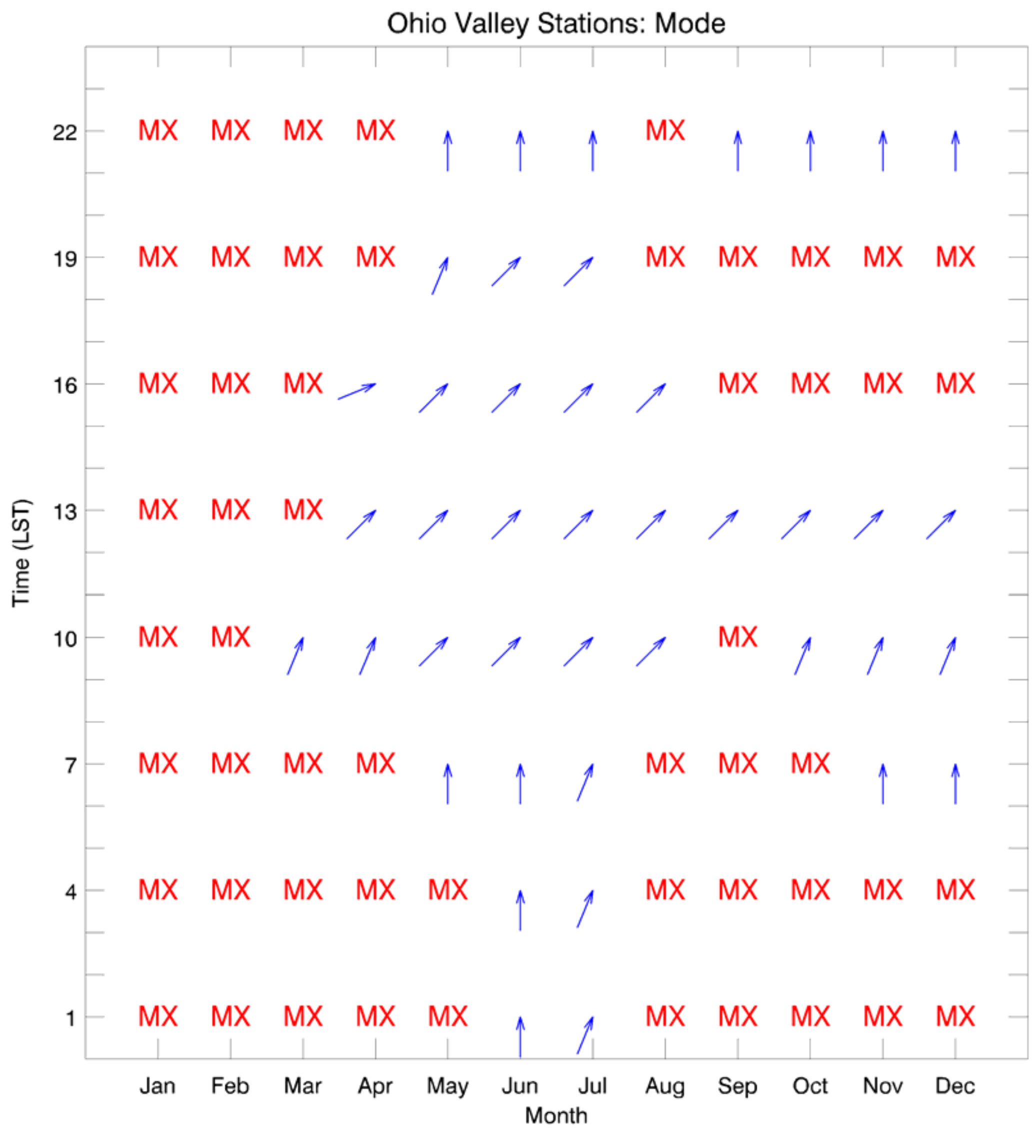

Figure 13: Variation of mode with month and time of day for the Ohio Valley sub-region.

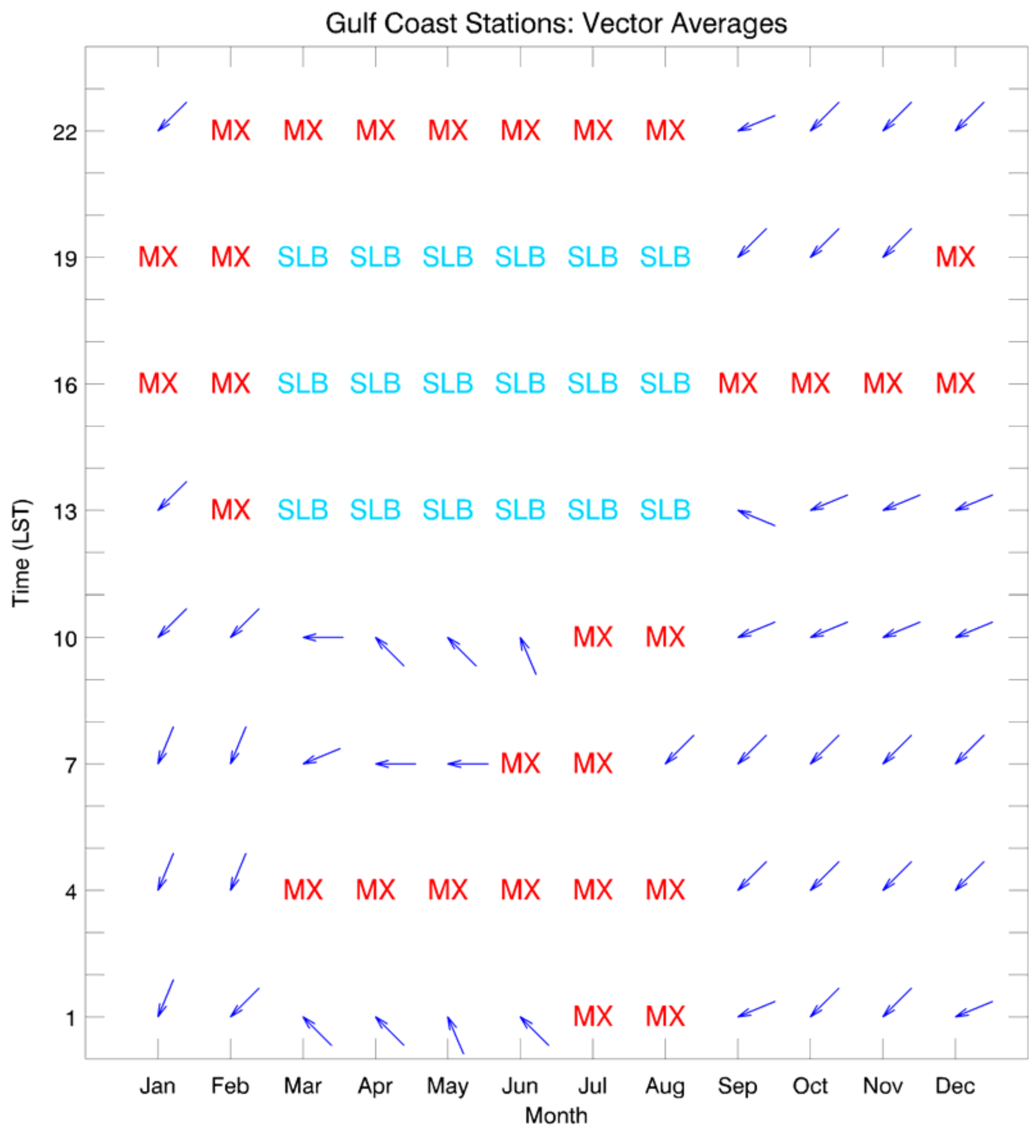

Figure 14: Variation of vector averages with month and time of day for the Gulf Coast sub-region.

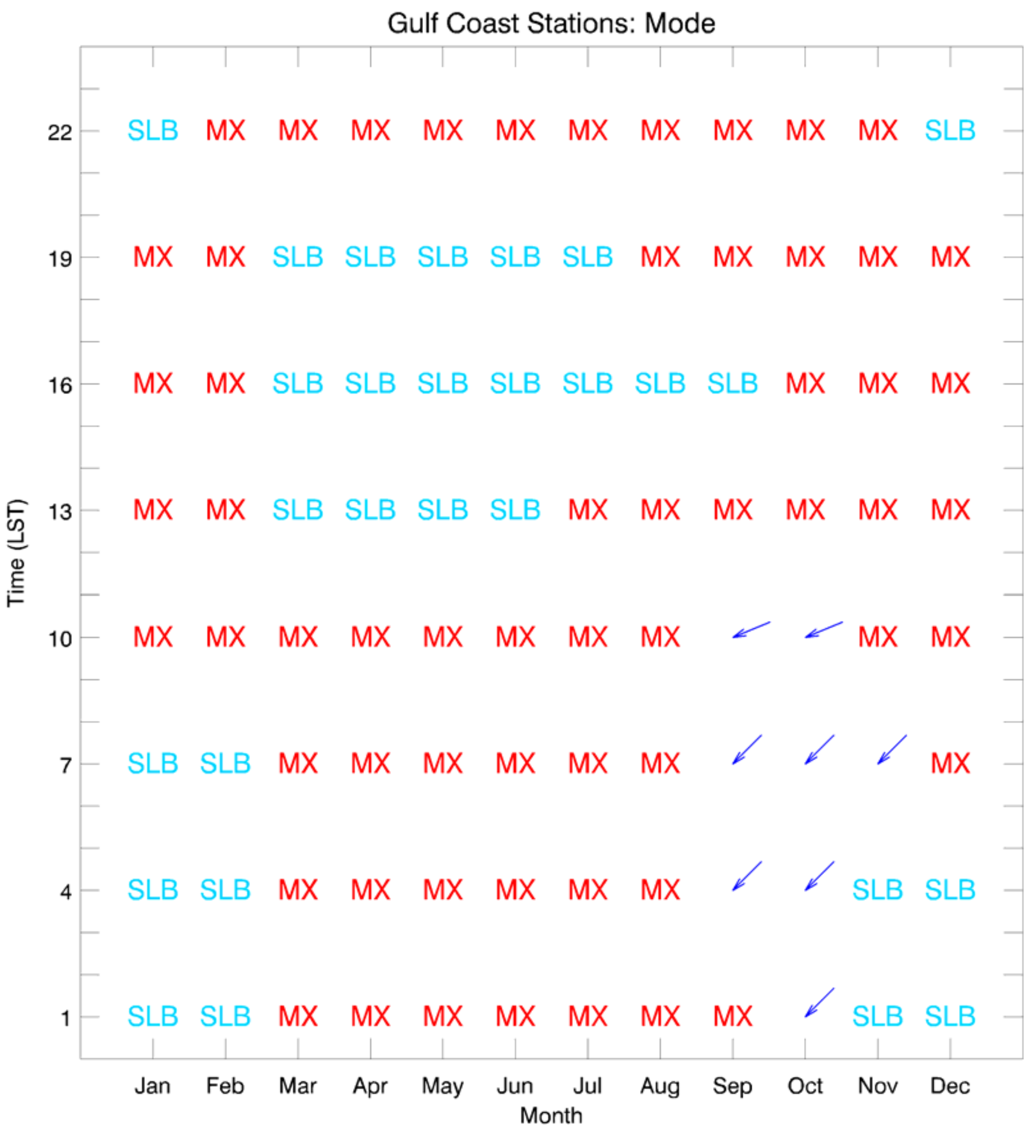

Figure 15: Variation of mode with month and time of day for the Gulf Coast sub-region.