Aviation Climate Assessment Report

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June 2004

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Introduction

An integral component of the Aviation Traffic Support Team's assignment was the development of an aviation-based climatology. The intent of the climatology was to describe meteorological parameters and specific weather elements that have an impact on aviation and related operations. It was anticipated that the climatology could be used to help the team assess the spatial and temporal distribution of workload related to the defined significant weather elements. This report starts with an explanation of how the parameters to be studied were defined. A description of data sources used to develop the climatologies follows. Next, the methodology for computing both the climatologies and various summaries is explained. Finally, the relationship between weather and workload is addressed with results of the study concluding the report.

Project Overview

The initial task of this study was the determination of the elements, and their associated criteria, to be included in the climatologies. Several possibilities were considered. Previous climatological studies related to aviation generally assessed common standards of reference by calculating frequencies of occurrence for specific thresholds. For example, maps showing frequencies of ceilings below 3000 or 1000 feet, or visibilities below 5, 3, or 1 miles are available. However, these standard values have considerable variability in significance from airport to airport. Since an integral component of the climate study was to allow the team to attempt to assess workload, the decision was made to produce a climatology for which site-specific parameters were defined for each airport.

The FAA provided the team with a list of approximately 2000 airports, partitioned into categories according to air traffic – 31 large, 37 medium, and the remainder small. Discussion with a number of Center Weather Service Unit (CWSU) Meteorologists-in-Charge (MICs) suggested a significant amount of workload was determined by the size of the airport. In general, the workload at the large airports is impacted more than at medium airports, and weather contributes the most to the impact. The smallest airports do not contribute to a significant portion of the workload. En route weather is also a significant contribution to workload at the CWSU. Consequently, the decision was made to focus on studying weather elements at the 68 large and medium airports, and to supplement the study with additional, large-scale climatologies that would provide a more complete picture of the en route weather frequencies.

Determination of Significant Weather Elements

While weather is known to be an important component of the workload associated with aviation operations, the significance of weather factors exhibits substantial variability from airport to airport. Site-specific critical weather elements and their variability have not previously been documented. In order to define the list of critical weather elements, the MIC at each of the 21 CWSUs received a spreadsheet in which they could enter weather factors that impact air traffic flow at the large and medium airports within their area of responsibility. Weather Forecast Offices in Hawaii and Puerto Rico were asked to respond for the airports in their area of responsibility. Although some subjectivity was unavoidable, it was assumed that the CWSU meteorologists would have the experience and knowledge to know what the local FAA customers considered significant at these airports. The MICs coordinated with any customers they deemed appropriate, and determined the weather factors at each airport that change the air traffic flow and impact workload. Most MICs coordinated with a variety of local FAA sources including the TMU, ARTCC, TRACON, and Tower Chiefs.

The categories in the distributed spreadsheet were: wind, thunderstorms, ceilings, visibility, snow, freezing precipitation, turbulence, icing, and "other." The "other" category allowed the MICs to include impacts that did not fit under the assigned categories. In the end, it was not possible to quantify all impacts listed under the "other" category. However, this "other" category was used to note some weather and non-weather factors which impact workload but could not be covered by the climatological study.

The MIC spreadsheet input was used to determine the necessary parameters to be included in the climatologies. The climatologies were to include frequency calculations for wind, ceilings, visibility, thunderstorms, snow, and freezing precipitation. Of these six elements, frequencies for significant wind, ceilings and visibility were considered "airport specific" and would be calculated using the criteria, or specific thresholds, provided by the MICs.

Frequencies for thunderstorms and snow events were also determined to be airport specific, however, the MIC responses introduced too many variables to treat these elements in the same manner as wind, ceiling, and visibility. For example, characteristics of snow that were significant were extremely difficult to determine and depended on other factors, such as airport staffing availability. Responses included very qualitative descriptors such as "enough to cause problems," and "enough snow to wet runways." Thunderstorms were listed as a very significant impact, not only at the airport but also in the vicinity of the airport as well as en route. Finally, an assessment of icing and turbulence were listed as necessary components to study. The final list of parameters to be studied at each airport included: (1) significant wind, (2) significant ceilings, (3) significant visibility, (4) thunderstorms, (5) snow events, (6) Freezing precipitation events (including ice pellets), (7) turbulence, and (8) icing. Based on MIC input, information on the significant weather elements was compiled for 67 of the 68 airports.

The Categories of Significant Weather Elements

The CWSU MICs were polled to determine which factors contributed most to workload and airport impacts. The MICs were specifically asked to consider factors that change airport arrival and departure rates. Responses for 31 of the airports were received. The result of this survey is shown in Table 1. For the 31 airports represented, thunderstorms ranked first, followed by visibility, wind, ceilings, snow, freezing precipitation, icing, and turbulence.

Table 1. Rankings of Impact by Significant Weather Elements

Airport	Wind	Thunderstorms	Ceiling	Visibility	Snow	Freezing Precipitation	Turbulence	Icing
ORD	2	1	3	4	5	6	8	7
MDW	2	1	3	4	5	6	8	7
MKE	5.5	5.5	1	2	5.5	5.5	5.5	5.5
MCO	3	1	3	3	6.5	6.5	6.5	6.5
TPA	3	1	3	3	6.5	6.5	6.5	6.5
JAX	3	1	3	3	6.5	6.5	6.5	6.5
ANC	3	8	1	2	4	5	6	7
IAD	1	2	4	3	6	5	7.5	7.5
DCA	1	2	4	3	6	5	7.5	7.5
BWI	1	2	4	3	6	5	7.5	7.5
RDU	1	2	4	3	6	5	7.5	7.5
ORF	1	2	4	3	6	5	7.5	7.5
DEN +	2	1	3.5	3.5	7	8	5	6
DEN *	4	8	1.5	1.5	6	7	3	5
MCI	4.5	1	2	3	4.5	6	8	7
STL	4.5	1	2	3	4.5	6	8	7
MEM	4	1	5	6	2	3	7	8
BNA	4	1	6	5	2	3	7	8
EWR	4	1	2	3	5	6	7	8
JFK	4	1	2	3	5	6	7	8
LGA	4	1	2	3	5	6	7	8
PHL	4	1	2	3	5	6	7	8
LAX	3	2	4	1	8	7	6	5
SAN	3	2	4	1	8	7	6	5
SNA	3	2	4	1	8	7	6	5
BUR	3	2	4	1	8	7	6	5
ONT	3	2	4	1	8	7	6	5
LAS	3	1	4	2	8	7	6	5
BOS	5	1	4	3	2	7	8	6
BDL	5	1	4	3	2	7	8	6
PVD	5	1	4	3	2	7	8	6
MHT	5	1	4	3	2	7	8	6
Sum	**103.5**	**60.5**	**105**	**89**	**171**	**194**	**218.5**	**210.5**
Average Ranking	**3**	**1**	**4**	**2**	**5**	**6**	**8**	**7**

Note for Denver: + represents summer months and * winter months.

Based on the average sum of 144 for the eight weather elements, each was given an "impact score" equal to the average score divided by the individual weather element sum. Consequently, the weather impact scores included: Thunderstorms 2.38, Visibility 1.62, Wind 1.39, Ceilings 1.37, Snow 0.84, Freezing precipitation 0.74, Icing 0.68, and Turbulence 0.66. These impact scores were used to generate the composite rankings shown later in this report (Table 23).

Data Sources

Most of the parameters identified for the study are included in routine surface observations. Surface observations are available from the National Climatic Data Center (NCDC), however, no readily-available software was available to complete the necessary data manipulations. Additionally, field offices do not have the capability to download massive amounts of necessary data at high speed. Since NCDC produces a number of data sets available on CD-ROMs, they were considered for use in this study.

NCDC's International Station Meteorological Climate Summary (ISMCS) CD contains detailed climatological summaries for 2600 stations worldwide. Unfortunately, not all the airports identified by the FAA were included on the CD. And while the summaries were quite extensive, they did not included many of the site-specific thresholds identified by the MICs. In order to complete frequencies for the identified thresholds, hourly observations were deemed necessary. For most of the sites, hourly observations were available on NCDC's Solar and Meteorological Observing Network (SAMSON) CD. The SAMSON data covered the period from 1961 through 1990. For the 20 sites not included on the SAMSON CD, the Integrated Surface Hourly Observations (ISHO) were obtained from NCDC via download from their ftp site. For consistency, the ISHO data sets covered the same 30-year period (1961-1990.

Hourly observations that were not taken at the current hub location were used for the following three sites: Denver Stapleton Airport (DNR), Omaha Eppley Airport (OMA) and Austin Bergstrom Airport (AUS). Observations from Denver International Airport (DEN), Omaha WSFO (OVN) and Austin Mueller Municipal Airport (ATT) were substituted respectively. Availability of SAMSON data for the 1961-1990 timeframe was the major factor in using the alternate data sources for the three sites. For example, DNR was not in existence until after 1990.

Based on all of the input from the CWSU MICs, a program was developed to query all the variables from the surface-based observations, and calculate the frequencies of significant weather elements at the 68 large and medium airports identified by the FAA. Calculations of hourly, 3-hourly, daily, monthly, seasonal, and annual frequencies were made so that the team could determine the details of temporal distribution throughout the geographical area of consideration. As a quality control measure, the ISMCS climatological summaries were used to check initial output from the query program.

Supplemental sources to look at scales larger than immediate airports included pilot reports, sigmets, and airmet-based climatology produced by a meteorologist at the Aviation Weather Center (AWC), and thunderstorm frequencies determined using lightning data produced by the Statistical Modeling Group of the Meteorological Diagnostics Laboratory (MDL). The Statistical Modeling Group of MDL used 9 years of NLDN cloud-to-ground lighting observations for the years 1995 through 2003. The NLDN observations were limited to the CONUS. (Note: NLDN data was initially provided to MDL by the NASA Lightning Imaging Sensor (LIS) instrument team and the LIS data center via the Global Hydrology Resource Center (GHRC) located at the Global Hydrology and Climate Center (GHCC), Huntsville, Alabama through a license agreement with Global Atmospherics, Inc. (GAI). The data available from the GHRC are restricted to LIS science team collaborators and to NASA EOS and TRMM investigators. Finally, various icing and turbulence climatology studies performed at the National Center for Atmospheric Research (NCAR) in Boulder were also utilized. These are described in the methodology section.

Methodology

Information provided in the spreadsheets distributed to the MICs was compiled and studied, then used to determine how the climatology for each of the significant weather elements would be constructed. With the wide range of data sources necessary to complete the study, a variety of methods was employed.

Wind

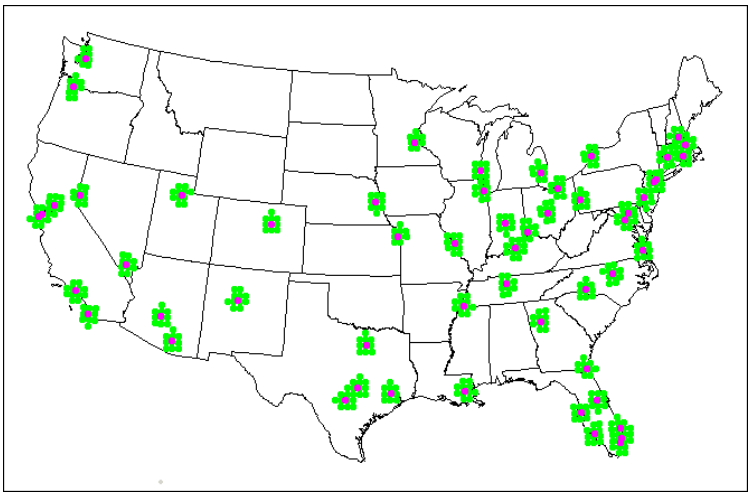
The MICs identified a number of wind regimes significant for each airport. Many of the entries were related to cross winds impacting runways, by either causing a change to alternate runways, or eliminating use of parallel runways, diminishing traffic flow. Other impacts were mainly due to tailwinds exceeding 8-10 mph manifesting operational changes, or wind speeds from any direction exceeding certain thresholds. Unless specific azimuths were provided, a vector perpendicular (crosswinds) or parallel (tailwinds) to the effected runway was used, plus or minus 30 degrees. The surface observations database was queried to obtain the frequencies of the specified wind criteria.

Thunderstorms

Frequency of thunderstorm occurrence was calculated for each airport using a query of observational data. However, thunderstorm occurrences outside the immediate airports are also very significant to air traffic flow and workload. For this reason, the MDL dataset of lightning relative frequencies were used to calculate thunderstorm frequencies within an approximate radius of 50 statute miles of each airport.

In the MDL data set, relative frequencies (RF) of lightning were computed for 40 km grid boxes described by the AWIPS212 Lambert Conformal Grid. The relative frequencies were computed for both 3-hourly periods and a 24-hour period (12-12 UTC) and expressed as percentages. For each grid, the number of events with at least one lightning strike was divided by the total number of cases, such that a 24-hour value of .75 indicated that at least one lightning strike was reported on 75% of the days for the given month. The number of lightning strikes, or associated thunderstorms, is not considered. If for a defined period there was at least one strike, the RF value was set to 1.

Using GIS software, both the gridded RF values and aviation station locations were plotted. For each station, a query was used to determine all grid boxes for which the center point was within 50 miles. Aviation stations (pink) and their associated "area" grid boxes (green) are illustrated here. Note that for areas with aviation stations in close proximity, (San Francisco, Los Angeles, Chicago, New York City, Dallas, Washington DC, Houston and Miami) only one set of grid boxes was necessary. For each station, the RF of each "area" grid box was averaged to result in a final "50 mile radius" RF value.



These calculations produced data that could be interpreted as "probabilities of experiencing at least one thunderstorm within 50 miles of an airport." In order to compare these RF values and station thunderstorm frequency values derived from surface hourly observations, three-hourly RF values were averaged and converted to an hourly value. While the three-hourly values are not always independent, this conversion permitted the values to be plotted alongside the station thunderstorm frequencies in the summary graphs.

The "station" frequencies are not equal to the "50 mile radius" frequencies. It was determined that complimenting station thunderstorm frequencies with 50-mile radius frequencies would be quite appropriate, since thunderstorms within this distance of most airports has an impact on operations and workload. For most airports, this range represents a distance that approximates the corner posts for the airport.

The surface-based thunderstorm observations represented a 30-year period. The nine-year lightning archive was not a subset of the surface-based period. There are limitations to both schemes. Station records are (although probably a very small factor) influenced by variability in human observations. Lightning data are influenced by detection efficiency, range limitations, trends in technology, and only reflect cloud-ground strokes.

Nevertheless, the findings were consistent with what was expected for all but a few locations. That is, one would expect to find the frequency of thunderstorms within a 50-mile airport radius to be greater than the frequency of thunderstorms at the airport. As expected, this ratio can vary substantially. For example, airports in a mountainous environment might experience far less thunderstorm activity than nearby mountains. Still, air traffic specialists and meteorologists have to "deal with" those thunderstorms that won't be represented in a surface-based, airport climatology. In some cases, round-off error using the lightning data actually produced frequencies that were slightly less than the surface-based data, but most of these cases involved near zero frequencies and were considered insignificant. For cases in which frequencies at the station were greater than zero but below 0.1 for any season, the lightning data values that were actually above zero but rounded to zero were set to 0.1.

Finally, maps of thunderstorm frequency and convective sigmet frequencies (from AWC) were produced to provide the team with another source of the climatological patterns of thunderstorms, and how these vary during 24-hour periods and seasonally.

Ceilings

The ceilings MICs identified as significant exhibited substantial variability from airport to airport. The greatest variability seemed to be related to the threshold for determining whether or not visual approaches could be made. Generally, visual approaches can be made for much lower ceilings in non-mountainous terrain. For example, when the ceiling drops below 7000 feet at Salt Lake City, discontinuance of visual approaches diminishes air traffic acceptance rates by nearly 40 percent. At Miami, visual approaches are usually possible with broken clouds as low as 3000 or 2500 feet. For each airport, the relative frequencies of the site-specific ceiling criteria were calculated using queries of the hourly surface observations database.

Visibility

The significance of marginal visibilities, such as 3-5 (or even 6) miles varies from airport to airport. Some areas (such as Phoenix and Oakland) have significant impacts due to slant range visibilities in this range, even at times when surface visibility may be 7 miles. There were no adequate data bases (including climatology of slant visibility or visibility aloft) to calculate these frequencies. Values of slant visibility provided by the MICs were used to calculate significant surface visibility frequencies. Some MICs provided high-resolution detail for low visibility minimums, including details for RVR values. RVR values were not available with the SAMSON. Consequently, for input that included RVR values less than 3000 feet, visibilities of less than ½ mile were used. Site-specific visibility criteria were calculated using queries of the hourly surface observations database.

Snow

Snowstorms certainly can have a major impact on air traffic and workload. There were too many variables for MICs to be able to get precise information to quantify how much snow in certain time periods would cause specific impacts. An initial study was made for frequencies in which snow was occurring with at least one inch of snow on the ground. However, there were gaps in the data set when snow depth was not reported. Additionally, some CWSU MICs reported that snow was a problem even with less than one inch accumulation. Consequently, the snow climatology was changed to a simple frequency of the occurrence of snow falling at the station.

Freezing Rain/Freezing Drizzle/Ice Pellets

All forms of freezing precipitation, included small amounts, have a major impact in aviation operations. Therefore, frequencies of occurrence were calculated without regard to accretion or accumulation. These frequencies were obtained through a query of the hourly surface observations database.

Turbulence

Except for low level wind shear, turbulence is a minor factor in creating workload or impacts at airports. To date, no high-resolution, high confidence climatology has been produced for turbulence. A study by Sharman et al (2002) focused on pilot reports and was based on reports of moderate or greater turbulence archived in pilot reports over a period of years. There are some caveats to be considered when using such data. First, as pointed out in these studies, results will be highly skewed according to flight route density. Second, some aviation centers actively solicit pilot reports more than others. The authors attempted to minimize the air traffic bias issue by calculating ratios of moderate or greater turbulence to total pilot reports, and calculated these ratios for nearly 800,000 pilot reports above 20,000 feet MSL. The results are shown in the supplemental maps section.

Using a different approach, Ellrod (2000) calculated expected turbulence from model data. In this study, which focused on mid-tropospheric clear air turbulence (CAT), calculated values of deformation and vertical wind shear for a large grid were used to determine areas for which turbulence would be expected. Given the differences in the studies, the results were fairly consistent with the previously cited pilot report studies. Besides a swath of high frequency turbulence across the Pacific north of Hawaii, Ellrod found that the area of greatest high-level CAT should be over the rugged terrain of the Southwest U.S. and eastward into the central U.S.

Finally, J. Slemmer (2004) of the Aviation Weather Center (AWC) produced a turbulence climatology based on frequencies of airmets due to high- and low-level turbulence. The sum of these frequencies produced a turbulence score. From the summed frequencies, values were extracted for each site and are listed in Table 12. Graphics depicting the

summed frequency and the high- and low-level contributions are included with the supplemental maps at the end of this report.

Icing

To this date, no high-resolution, high-confidence climatology for icing has been produced. Similar to turbulence, icing was listed as a minor factor in creating workload. Slemmer (2004) completed a climatology of icing based on airmet issuances. Several authors from NCAR have completed research inferring icing climatology from pilot reports (described in the RAP 2002 Annual Report). Fowler et al (2002) used an Integrated Icing Diagnosis Algorithm (IIDA) to determine the potential for in-flight icing conditions to exist, based on sounding data. The authors used this method to determine the percentage of soundings for which icing potential is expected to exist. Regardless of the choice of probability, the geographical patterns for icing potential are generally consistent. Temporal distribution is also consistent. For the CONUS, icing is predominantly a November-March phenomenon. However, farther north, icing becomes a greater factor at other times of the year.

Any pilot report-based icing climatology is flawed by the absence of systematic and spatially unbiased observations. There are inherent difficulties in assessing icing, including subjective judgment of ice accretion, the lack of negative icing pilot reports, and air traffic biases. Nevertheless, the results of studies using pilot reports seem to be consistent with studies of icing potential based on sounding diagnosis, especially over regions in which more significant icing is encountered.

For this project, a "composite icing score" was developed based on these studies. For the pilot report study, values were taken from the NCAR results and converted into categories. Categories were summed for each airport, and a composite icing score was calculated. These scores were compared to icing airmet frequencies provided by the AWC. This comparison yielded a correlation of +0.90, providing confidence in the consistency of all studies that were utilized. The frequencies of icing airmets provided by AWC were also placed into the summary table and summary map.

Variables not Quantified

Climatology for some of the variables MICs provided was not developed. These included frequencies of slant visibility, visibility aloft, temperatures aloft below certain thresholds, and low-level wind shear. Given time, slant and aloft visibility could be developed using pilot reports, but there would be significant biases inherent in this scheme. Threshold temperature (aloft) frequencies and low-level wind shear frequencies could be developed for each airport given the appropriate tools and data. Model assimilation tools that were offered did not have adequate resolution to perform an accurate assessment of low-level wind shear.

Relationship between Climatological Frequencies of Significant Weather Elements at Airports and Workload

Relating weather to workload is not a straightforward task. The relationship between the two is complex and is affected by a number of factors. The initial approach was to use the various results from the climatologies to assess workload associated with the airports. Certainly, these weather frequencies must be a significant component of the workload, but there are other non-weather factors, not addressed in this report, which must also be considered by the team. There is likely a stronger relationship between workload and significant weather frequencies at the large airports than at the medium airports.

Consider the case of two airports within the CWSU ZAB area of responsibility. Phoenix is listed as the nation's 5th busiest airport, while Albuquerque ranks 46th. Thunderstorms pose the greatest impact on airport operations and workload for the meteorologists. Albuquerque has a higher thunderstorm frequency than Phoenix. However, according to CWSU ZAB, the workload associated with thunderstorms in the Phoenix area far exceeds the workload associated with thunderstorms in the Albuquerque area.

Discussions with CWSU MICs suggested the large airports that are operating near capacity in fair weather , where runway supply and demand are approximately equal, are usually impacted greatly by small weather changes such as a few thunderstorms in the wrong place, or a wind shift. In contrast, at airports in which the difference between runway supply and demand is significantly greater than zero, greater changes in weather can occur without causing major changes in workload or an airport impact. The MICs suggested that most of the airport-related workload is directly associated with small differences between airport capacity and demand at the major airports. Input from the MICs also suggested the bulk of the workload is associated with between one quarter and one third of the 68 airports studied.

Because air traffic volume was repeatedly listed as an important contributor to impacts and workload, it was used in conjunction with frequencies of significant weather to produce "Significant Weather Factors." Summary tables were produced that list the rankings (by airport) of significant weather frequencies and the rankings (by airport) of Significant Weather Factors, in which frequencies are weighted according to air traffic.

Table 2 shows the ranking of airports according to total air traffic (2002 figures provided by the FAA). The air traffic factor is simply a multiple of the air traffic average for the 68 airports. The "weighted" tables are not intended to imply that there is a precise, direct relationship between air traffic, Significant Weather Frequencies, and workload, but are placed into this document to aid the team in their assessment.

Table 2. Rankings by Air Traffic

CY2002 Traffic Rank	Airport	Airport Name	Air Traffic Factor
1	ORD	Chicago O'Hare International	2.97
2	ATL	The William B Hartsfield Atlanta International	2.91
3	DFW	Dallas / Fort Worth International	2.47
4	LAX	Los Angeles International	1.99
5	PHX	Phoenix Sky Harbor International	1.89
6	DEN	Denver International	1.63
7	MSP	Minneapolis - St Paul International / Wold - Chamberlain /	1.62
8	CVG	Cincinnati / Northern Kentucky International	1.61
9	LAS	McCarran International	1.60
10	DTW	Detroit Metropolitan Wayne County	1.57
11	IAH	George Bush Intercontinental	1.53
12	PHL	Philadelphia International	1.42
13	CLT	Charlotte / Douglas International	1.41
15	EWR	Newark Liberty International	1.31
14	MIA	Miami International	1.31
16	MEM	Memphis International	1.28
17	SLC	Salt Lake City International	1.28
18	STL	Lambert - St Louis International	1.26
19	BOS	General Edward Lawrence Logan International	1.21
20	LGA	La Guardia	1.21
21	IAD	Washington Dulles International	1.17
22	PIT	Pittsburgh International	1.15
23	SNA	John Wayne - Orange County	1.14
24	SEA	Seattle - Tacoma International	1.13
25	OAK	Metropolitan Oakland International	1.09
26	SFO	San Francisco International	1.07
27	MDW	Chicago Midway International	1.05
28	HNL	Honolulu International	0.97
30	BWI	Baltimore - Washington International	0.96
29	MCO	Orlando International	0.96
32	JFK	John F Kennedy International	0.93
31	ANC	Ted Stevens Anchorage International	0.93

CY2002 Traffic Rank	Airport	Airport Name	Air Traffic Factor
33	FLL	Fort Lauderdale / Hollywood International	0.92
34	PDX	Portland International	0.85
35	SAT	San Antonio International	0.83
36	CLE	Cleveland - Hopkins International	0.82
37	DCA	Ronald Reagan Washington National	0.81
38	TUS	Tucson International	0.79
39	HOU	William P Hobby	0.78
40	DAL	Dallas Love Field	0.78
41	CMH	Port Columbus International	0.76
42	TPA	Tampa International	0.75
43	BNA	Nashville International	0.73
44	RDU	Raleigh - Durham International	0.71
45	AUS	Austin - Bergstrom International	0.71
46	ABQ	Albuquerque International Sunport	0.70
47	SJC	Norman Y. Mineta San Jose International	0.69
48	MKE	General Mitchell International	0.67
49	SAN	San Diego International	0.65
50	IND	Indianapolis International	0.65
51	SJU	Luis Munoz Marin International	0.64
52	PBI	Palm Beach International	0.63
53	BUR	Burbank - Glendale - Pasadena	0.57
54	SDF	Louisville International - Standiford Field	0.56
55	MCI	Kansas City International	0.54
56	SMF	Sacramento International	0.51
57	OGG	Kahului	0.48
58	ONT	Ontario International	0.47
59	MSY	Louis Armstrong New Orleans International	0.46
60	OMA	Eppley Airfield	0.45
61	RNO	Reno / Tahoe International	0.44
62	BDL	Bradley International	0.43
63	BUF	Buffalo Niagara International	0.43
64	PVD	Theodore Francis Green State	0.41
65	ORF	Norfolk International	0.39
66	JAX	Jacksonville International	0.39
67	MHT	Manchester	0.31
68	RSW	Southwest Florida International	0.24

Significant Weather Element Thresholds

In Table 3, the significant weather thresholds for which frequency calculations were performed for each airport are listed. These are the thresholds, or site-specific criteria, that were identified by the CWSU MICs, and for which the surface observations were queried. This table does not include the parameters for which standard values were queried for every airport. Recall that those parameters included snow events, freezing rain/drizzle/ice pellet events, thunderstorms, turbulence, and icing.

Table 3. Site-Specific Thresholds for Wind, Ceilings and Visibility

Airport ID	Wind	Ceiling	Visibility
ORD	>10kt any direction	<4500,<1000,<700	<7,<3,<2,<1/2
ATL	>10kt 240-300 >10kt 060-120	<4300,<3300,<300	<6,<3,<1,<1/2
DFW	>10kt 240-290 >10kt 070-110	<4000,<1000,<200	<6,<3,<1/2
LAX	>10kt 070-110	<3000,<1000,<500,<300	<7,<3,<1/2
PHX	>25kt 330-030 >25kt 150-210	<5000,<1000,<200	<5,<3
DEN	>8kt 330-030 >8kt 150-210 >20kt 260-280 >25kt 240-250 >25kt 290-300 >50kt any direction	<3500,<2000,<500,<200,<100	<6,<3,<1,<1/2<1/4
MSP	>20kt 020-060 >20kt 200-240	<4000,<700	<2,<1,<1/2
CVG	>27kt 240-300	<200	<1/2
LAS	>12kt 360-070 >15kt 300-330 >25kt 060-110	<9000,<5000,<200	<7,<3,<1/2
DTW	>25kt sustained or gusts 280-320 >25kt 280-320 >25kt 070-150	<5000,<600,<200,<100	<1, <1/2
IAH	>12kt 030-140 >25kt 330-030 >25kt 160-220	<2000,<400,<200	<6,<3,<1,<1/2
PHL	>10kt 140-200	<2300	<3,<1/2
CLT	>7kt 330-030 >7kt 150-210 >7kt 200-260 >7kt 020-080	<2100,<600,<300	<6,<3,<1,<1/2
MIA	>25kt 350-10 >25kt 170-190	<2500,<400,<300	<1

Airport ID	Wind	Ceiling	Visibility
EWR	>10kt 010-070 >10kt 190-250 >20kt 100-160 >20kt 280-340	<1500	<6
MEM	>20kt 150-210 >20kt 330-030 >8kt 150-210 >8kt 330-030	<5000,<900	<5,<2,<1/2
SLC	>25kt 220-280 >25kt 040-100 >7kt 130-190 >7kt 310-010	<7000,<3000,<300,<200,<100	<7,<3,<1/2,<1/4
STL	>=10kt 360-060 >=10kt 180-240	<5000,<1200,<900,<500,<300	<7,<5,<4,<1,<3/4,<1/2
BOS	>10kt any direction	<2500,<1000	<5,<3
LGA	>10kt 010-070 >10kt 190-250 >20kt 100-160 >20kt 280-340	<1000	<3
IAD	>25kt 280-320	<2000,<1000,<200	<5,<3,<1/4
PIT	>40kt 330-030 >40kt 150-210	<900,<500,<200,<100	<1,<3/4,<1/2
SNA	>10kt 160-220 >10kt 340-040	<500,<200	<1
SEA	>20kt any direction	<7000,<5000,<3500,<1500	<2
OAK	>10kt 120-150	<1700	<1/2
SFO	>20kt 240-300 >10kt 120-150	<4000,<1000	<5,<1/2
MDW	>10kt any direction	<400,<300	<1,<3/4
HNL	>3kt 170-350, >10kt 170-350	<2500,<2000,<700	<3,<1/2
MCO	>40kt 240-300 >40kt 060-120	<4000,<1000	<1/2
BWI	>10kt 190-250	<3000,<800	<3,<2,<1/4
ANC	>15kt any direction >8kt 120-180 >8kt 300-360	<2100,<1000,<200	<5,<3,<1,<1/2
JFK	>10kt 010-070 >10kt 190-250 >20kt 100-160 >20kt 280-340 >10kt 010-070	<1000	<3
FLL	>25kt 350-010 >25kt 170-190	<2500,<400,<300	<1
PDX	>8kt 160-240 >8kt 340-060 >25kt any direction	<3500	<1
SAT	None	<200	<1/2
CLE	>20kt 280-320	<500,<300,<200,<100	<7,<1,<1/2
DCA	>20kt 240-300 >10kt 150-210 with CIG<800 and/or VSBY < 1 ½	<800*, <200 *conditional with wind/vsby	< 1 ½*, <1/4 *conditional with wind/vsby

Airport ID	Wind	Ceiling	Visibility
TUS	>20kt crosswind only if alternate closed	<1000,<200	<4,<3
HOU	>10kt 280-340	<2000,<1000,<500,<200	<6,<3,<1,<1/2
DAL	>25kt	<3000,<1000,<200	<1,<1/2
CMH	>20kt 180-210 >30kt 240-300	<800, <200	<2, <1/2
TPA	>20kt 240-300 >20kt 060-120	None	<1/2
BNA	>15kt 270-340 >15kt 100-160	<5000,<200	<3/4,<1/2
RDU	>40kt any direction	<2300,<200	<5,<1/4
AUS	None	<200	<1/2
ABQ	>20kt crosswind only if alternate closed	<1000,<200	<4,<3
SJC	>5kt 150-210	<700	<1/2
MKE	None	<200	<1/2
SAN	>10kt 240-300 >10kt 060-120	<700,<400	<1/2
IND	>10kt 040-080 >10kt 200-260	<2200,<200	<3,<1/2
SJU	None identified	None identified	None identified
PBI	>25kt 350-010 >25kt 170-190	<2500,<500,<200	<1,<1/2
BUR	>10kt 050-110 >10kt 230-290	<5500,<200	<5*,<1 *conditional >10kt 050-110 or 230-290
SDF	>20kt 240-300	<200	<1/2
SMF	None	None	<1/2
OGG	>=5kt 120-280, >25kt any direction, >35kt 060-120	<3000,<2000	<5,<3
ONT	>10kt 050-110 >10kt 230-290	<200	<1,<1/2
MSY	>25kt 330-030 >25kt 160-220	<2000,<500,<200	<6,<3,<1,<1/2
OMA	None	<3200	<7
RNO	None	<1100	<4
BLD	>20kt any direction	<1000	<3
BUF	None	<500,<200	<1,<1/2
PVD	>20kt any direction	<2500,<1000	<3,<1/2
ORF	>20kt 130-150 >20kt 310-330	<200	<1/2
JAX	>20kt 330-030 >20kt 150-210	None	<1/2
MHT	>20kt any direction	<1000	<3
RSW	None	<1000	<1/2
MCI	>10kt 070-110 >10kt 250-310 >20kt sustained or gusts 070-110 or 250-310	<1000	<4,<3,<1,<1/2

Table 3 (cont.)

Results

Many of the results of this study are included in this report. In the first section, summary table rankings of the 68 airports for each of the significant weather elements (wind, thunderstorms, ceilings, visibilities, snow events, freezing rain/freezing drizzle/ice pellet events, turbulence and icing) are given. Tables 5-13 include rankings according to actual frequency of the weather elements identified by the CWSU MICs, as well as the Significant Weather Factor rankings (results weighted according to air traffic). Table 14 shows a composite ranking for all factors combined except turbulence and icing. Tables 15-22 rank the airports for each weather element according to air traffic as well as an impact score determined by the responses of the CWSU MICs (shown in Table 1). Finally, Table 23 shows the ranking of weighted (for air traffic and impact) factors, summed for all eight weather factors.

The summary tables are followed by maps of annual frequencies for each of the weather elements examined. These maps are intended to serve as a "quick-glance" spatial comparison of results. Next, seasonal frequency graphs for all elements, except turbulence and icing, for each airport are presented. Finally, supplemental graphics for turbulence and icing are included.

The team will also have access to more results via a web page that includes results shown in this report as well as graphics illustrating the temporal distribution of significant weather elements at each of the 68 airports.

Note that a standard (fixed) y-axis was not practical for the graphs shown in this report because of the large variability of frequencies encountered. The range of the y-axis on each graph was defined such that the largest of the frequencies to be shown has a value approximately 90 percent of the range. However, for graphs in which the largest frequency is less than one percent, the range of the y-axis is one percent. Table 4 shows the scheme that was used for scaling the y-axis.

Table 4. Graph Scale Scheme

Largest Frequency	Major Units
Zero to 1.5	0.2
>1.5 to 5.0	0.5
>5 to 10	1.0
>10 to 20	2.0
>20 to 35	4.0
>35 to 50	5.0
>50	10.0

Most of the graphs can be interpreted as showing the percent of time a significant weather element exists at an airport during a given three-month period. For example, a frequency of 5 percent for a significant wind during June through August indicates that,

climatologically, one should expect that particular wind to exist at the airport 5 percent of the time.

The graphic shown for thunderstorms shows both the station and 50 mile radius frequency of thunderstorms. The 50-mile radius values should be interpreted as the frequency of having a least one detected cloud to ground lightning strike within that radius. The supplemental graphics include (for airports in which lightning data were available) the seasonal daily probability of at least one detected lightning strike within a 50 mile radius of the airport.

Summary Tables

Table 5. Frequency Ranking and Significant Weather Factor Ranking for Wind

Rank	Site ID	Frequency		Rank	Site ID	Weighted Frequency
1	BOS	58.16		1	ORD	120.73
2	MDW	45.07		2	BOS	70.37
3	LGA	43.01		3	CLT	60.07
4	CLT	42.60		4	LGA	52.04
5	ORD	40.65		5	MDW	47.32
6	JFK	40.06		6	ATL	42.57
7	MEM	24.86		7	JFK	37.26
8	SNA	22.62		8	DEN	34.49
9	DEN	21.16		9	MEM	31.82
10	EWR	17.40		10	SNA	25.79
11	ONT	16.84		11	EWR	22.79
12	HNL	16.22		12	HNL	15.73
13	PDX	15.74		13	PDX	13.38
14	ATL	14.63		14	STL	12.63
15	OGG	11.35		15	DFW	8.87
16	STL	10.02		16	ONT	7.91
17	SAN	8.93		17	IAH	7.74
18	SJC	7.57		18	ANC	6.72
19	ANC	7.23		19	DTW	6.17
20	IND	6.58		20	SAN	5.80
21	BDL	6.10		21	SFO	5.55
22	MCI	5.33		22	OGG	5.45
23	SFO	5.19		23	SJC	5.22
24	IAH	5.06		24	LAS	4.88
25	HOU	4.87		25	BWI	4.41
26	BWI	4.59		26	PHL	4.35
27	DTW	3.93		27	IND	4.28
28	DFW	3.59		28	HOU	3.80
29	PHL	3.06		29	MCI	2.88
30	LAS	3.05		30	BDL	2.62

Rank	Site ID	Frequency		Rank	Site ID	Weighted Frequency
31	PVD	2.20		31	OAK	1.95
32	BNA	2.06		32	LAX	1.51
33	OAK	1.79		33	BNA	1.50
34	BUR	0.89		34	SEA	0.92
35	SEA	0.81		35	PVD	0.90
36	LAX	0.76		36	MSP	0.60
37	DCA	0.62		37	BUR	0.51
38	MHT	0.52		38	DCA	0.50
39	MSP	0.37		39	SLC	0.45
40	SLC	0.35		40	IAD	0.22
41	SDF	0.28		41	TPA	0.18
42	TPA	0.24		42	CLE	0.16
43	ORF	0.21		42	MHT	0.16
44	CLE	0.20		42	SDF	0.16
45	IAD	0.19		45	CMH	0.11
46	CMH	0.15		46	ORF	0.08
47	JAX	0.12		47	CVG	0.05
48	CVG	0.03		48	JAX	0.05
49	MSY	0.02		49	PHX	0.02
50	PHX	0.01		50	MIA	0.01
50	MIA	0.01		50	MSY	0.01
50	FLL	0.01		50	FLL	0.01
53	PIT	0		53	PIT	0.00
53	MCO	0		53	MCO	0.00
53	SAT	0		53	SAT	0.00
53	TUS	0		53	TUS	0.00
53	DAL	0		53	DAL	0.00
53	RDU	0		53	RDU	0.00
53	AUS	0		53	AUS	0.00
53	ABQ	0		53	ABQ	0.00
53	MKE	0		53	MKE	0.00
53	PBI	0		53	PBI	0.00
53	SMF	0		53	SMF	0.00
53	OMA	0		53	OMA	0.00
53	RNO	0		53	RNO	0.00
53	BUF	0		53	BUF	0.00
53	RSW	0		53	RSW	0.00
	SJU	N/A			SJU	N/A

Table 5 (cont.)

Table 6. Frequency Ranking and Significant Weather Factor Ranking for Thunderstorms (based on station data)

Rank	Site ID	Frequency		Rank	Site ID	Weighted Frequency
1	MCO	3.60		1	MCO	3.46
2	RSW	2.29		2	DFW	2.59
3	TPA	2.08		3	ATL	2.42
4	PBI	1.60		4	MIA	1.93
5	JAX	1.59		5	IAH	1.81
6	MIA	1.47		6	ORD	1.72
7	TUS	1.24		7	TPA	1.56
8	MCI	1.22		8	MEM	1.48
9	IAH	1.18		9	MSP	1.38
9	HOU	1.18		10	STL	1.23
11	MSY	1.17		11	DEN	1.19
12	MEM	1.16		12	CVG	1.06
13	OMA	1.07		13	PBI	1.01
14	DFW	1.05		14	TUS	0.98
15	BNA	1.03		15	SLC	0.95
16	FLL	0.99		16	HOU	0.92
17	STL	0.98		17	FLL	0.91
18	SDF	0.92		18	CLT	0.82
19	DAL	0.86		19	DTW	0.80
20	MSP	0.85		20	PHX	0.76
21	ATL	0.83		21	BNA	0.75
22	RDU	0.79		22	MDW	0.67
23	AUS	0.77		22	DAL	0.67
23	SJU	0.77		24	MCI	0.66
25	IND	0.75		25	JAX	0.62
26	SLC	0.74		26	PIT	0.60
27	DEN	0.73		27	RDU	0.56
28	CMH	0.67		28	PHL	0.55
29	CVG	0.66		28	RSW	0.55
30	MDW	0.64		28	AUS	0.55
30	SAT	0.64		31	MSY	0.54
32	MKE	0.60		32	SAT	0.53
33	ORD	0.58		33	SDF	0.52
33	CLT	0.58		34	CMH	0.51
35	ORF	0.57		35	SJU	0.49
36	ABQ	0.56		35	IND	0.49
37	PIT	0.52		37	OMA	0.48
38	DTW	0.51		37	IAD	0.48
39	CLE	0.48		39	EWR	0.45
40	BUF	0.45		40	LGA	0.41
41	DCA	0.43		41	MKE	0.40

Rank	Site ID	Frequency		Rank	Site ID	Weighted Frequency
42	IAD	0.41		42	CLE	0.39
43	PHX	0.40		42	ABQ	0.39
44	PHL	0.39		44	DCA	0.35
45	LGA	0.34		45	LAS	0.34
45	EWR	0.34		46	BWI	0.32
47	BWI	0.33		47	JFK	0.27
47	RNO	0.33		48	BOS	0.23
49	MHT	0.32		49	ORF	0.22
50	JFK	0.29		50	BUF	0.19
51	PVD	0.28		51	RNO	0.15
52	BDL	0.22		52	LAX	0.12
53	LAS	0.21		53	PVD	0.11
54	BOS	0.19		53	HNL	0.11
55	HNL	0.11		55	MHT	0.10
56	OGG	0.08		56	BDL	0.09
57	PDX	0.07		57	PDX	0.06
58	LAX	0.06		57	SNA	0.06
58	SMF	0.06		57	SEA	0.06
60	SEA	0.05		60	OGG	0.04
60	SNA	0.05		61	SMF	0.03
62	BUR	0.04		62	BUR	0.02
62	ONT	0.04		62	OAK	0.02
64	SJC	0.03		62	SFO	0.02
64	SAN	0.03		62	SJC	0.02
66	ANC	0.02		62	SAN	0.02
66	OAK	0.02		62	ONT	0.02
66	SFO	0.02		62	ANC	0.02

Table 6 (cont.)

Table 7. Frequency Ranking and Significant Weather Factor Ranking for Thunderstorms (based on lightning data within 50 miles of airport)

Rank	Site ID	Daily Prob.		Rank	Site ID	Weighted Factor
1	MIA	33.00		1	ATL	0.62
2	FLL	32.75		2	DFW	0.46
3	PBI	32.50		3	MIA	0.43
3	RSW	32.50		4	ORD	0.41
5	MCO	30.25		5	IAH	0.37
6	TPA	29.50		6	FLL	0.30
7	MSY	29.25		7	MCO	0.29
8	JAX	25.25		7	DEN	0.29
9	IAH	24.25		9	CVG	0.27
9	HOU	24.25		10	MEM	0.26
11	ATL	21.25		11	CLT	0.24
12	MEM	20.25		12	STL	0.22
13	ABQ	20.00		12	TPA	0.22
14	BNA	19.75		14	PHX	0.21
15	DFW	18.75		15	PBI	0.20
15	DAL	18.75		16	MSP	0.19
17	STL	17.75		16	HOU	0.19
17	DEN	17.75		18	DTW	0.18
19	CLT	17.25		19	SLC	0.16
19	AUS	17.25		19	PIT	0.16
21	TUS	17.00		21	DAL	0.15
21	SDF	17.00		21	PHL	0.15
23	MCI	16.75		23	MDW	0.14
24	CVG	16.50		24	BNA	0.14
25	IND	16.25		24	ABQ	0.14
26	SAT	15.50		24	LGA	0.14
27	RDU	15.25		27	MSY	0.13
28	CMH	15.00		27	TUS	0.13
29	OMA	14.75		27	SAT	0.13
30	ORD	13.75		30	EWR	0.12
30	MDW	13.75		30	LAS	0.12
32	PIT	13.50		30	IAD	0.12
33	ORF	13.25		30	AUS	0.12
34	CLE	12.75		34	CMH	0.11
35	SLC	12.50		34	BWI	0.11
36	DCA	12.00		34	RDU	0.11
37	MSP	11.75		34	IND	0.11
37	BWI	11.75		38	CLE	0.10
39	DTW	11.50		38	JAX	0.10
39	LGA	11.50		38	DCA	0.10
41	MKE	11.25		38	SDF	0.10

Rank	Site ID	Daily Prob.		Rank	Site ID	Weighted Factor
42	PHX	11.00		42	MCI	0.09
43	BUF	10.75		42	JFK	0.09
44	IAD	10.50		44	BOS	0.08
45	PHL	10.25		44	RSW	0.08
46	EWR	9.50		44	MKE	0.08
46	JFK	9.50		47	OMA	0.07
48	BDL	8.25		48	ORF	0.05
49	LAS	7.75		48	BUF	0.05
50	PVD	6.75		50	BDL	0.04
51	BOS	6.50		51	SEA	0.03
52	MHT	6.25		51	PVD	0.03
53	RNO	5.75		51	RNO	0.03
54	SEA	3.00		54	LAX	0.02
55	PDX	2.75		54	PDX	0.02
55	SMF	2.75		54	OAK	0.02
57	SAN	2.50		54	MHT	0.02
58	OAK	2.00		54	SAN	0.02
58	SJC	2.00		54	SFO	0.02
60	SFO	1.50		60	SNA	0.01
61	LAX	1.25		60	SMF	0.01
61	SNA	1.25		60	SJC	0.01
61	BUR	1.25		60	BUR	0.01
61	ONT	1.25		60	ONT	0.01
	SJU	N/A			SJU	N/A
	HNL	N/A			HNL	N/A
	OGG	N/A			OGG	N/A
	ANC	N/A			ANC	N/A

Table 7 (cont.)

Table 8. Frequency Ranking and Significant Weather Factor Ranking for Ceilings

Rank	Site ID	Frequency		Rank	Site ID	Weighted Frequency
1	SEA	50.13		1	ORD	87.91
2	DTW	34.54		2	ATL	73.07
3	ORD	29.60		3	SEA	56.65
4	STL	25.90		4	DTW	54.23
5	BNA	25.43		5	LAX	49.43
6	ATL	25.11		6	DFW	45.70
7	LAX	24.84		7	MSP	37.67
8	MEM	24.07		8	STL	32.63
9	SFO	23.85		9	MEM	30.81
10	MSP	23.25		10	IAH	25.69
11	PDX	22.79		11	SFO	25.52
12	BWI	22.67		12	SLC	25.47
13	BUR	21.64		13	BOS	23.53
14	PVD	21.37		14	CLT	21.98
15	SLC	19.90		15	BWI	21.76
16	BOS	19.45		16	PHL	20.87
17	OMA	19.13		17	PDX	19.37
18	DFW	18.50		18	OAK	18.97
19	IND	18.47		19	BNA	18.56
20	HOU	17.46		20	DEN	16.87
21	OAK	17.40		21	EWR	14.86
22	IAH	16.79		22	IAD	14.36
23	CLT	15.59		23	MCO	13.80
24	RDU	15.50		24	HOU	13.62
25	PHL	14.70		25	BUR	12.33
26	MCO	14.38		26	IND	12.01
27	IAD	12.27		27	MIA	11.08
28	MSY	12.19		28	RDU	11.01
29	MHT	12.02		29	LGA	10.43
30	EWR	11.34		30	PIT	9.63
31	DEN	10.35		31	ANC	8.88
32	ANC	9.55		32	PVD	8.76
33	JFK	9.24		33	OMA	8.61
34	BDL	8.90		34	JFK	8.59
35	LGA	8.62		35	LAS	8.53
36	MIA	8.46		36	FLL	7.07
37	PIT	8.37		37	MSY	5.61
38	FLL	7.68		38	PHX	4.52
39	MCI	7.27		39	CMH	4.25
40	PBI	5.60		40	MCI	3.93
41	CMH	5.59		41	BDL	3.83
42	LAS	5.33		42	MHT	3.73

Rank	Site ID	Frequency		Rank	Site ID	Weighted Frequency
43	OGG	4.68		43	HNL	3.67
44	BUF	4.43		44	PBI	3.53
45	SAN	4.12		45	SAN	2.68
46	HNL	3.78		46	SNA	2.54
47	CLE	2.86		47	CLE	2.35
48	PHX	2.39		48	OGG	2.25
49	SNA	2.23		49	CVG	2.00
50	MKE	2.13		50	BUF	1.90
51	SJC	2.08		51	MDW	1.59
52	AUS	1.90		52	SJC	1.44
53	ORF	1.85		53	MKE	1.43
54	SAT	1.67		54	SAT	1.39
55	MDW	1.51		55	AUS	1.35
56	RNO	1.38		56	ORF	0.72
57	CVG	1.24		57	DCA	0.67
58	DCA	0.83		58	RNO	0.61
59	ABQ	0.82		59	ABQ	0.57
60	ONT	0.77		60	ONT	0.36
61	SDF	0.31		61	SDF	0.17
62	TUS	0.19		62	TUS	0.15
63	TPA	0.00		63	TPA	0.00
63	JAX	0.00		63	JAX	0.00
63	DAL	0.00		63	DAL	0.00
63	SMF	0.00		63	SMF	0.00
63	RSW	0.00		63	RSW	0.00
	SJU	N/A			SJU	N/A

Table 8 (cont.)

Table 9. Frequency Ranking and Significant Weather Factor Ranking for Visibility

Rank	Site ID	Frequency		Rank	Site ID	Weighted Frequency
1	LAX	32.13		1	ORD	69.53
2	CLE	28.64		2	LAX	63.94
3	STL	24.47		3	ATL	43.68
4	ORD	23.41		4	STL	30.83
5	CLT	20.80		5	CLT	29.33
6	EWR	20.74		6	EWR	27.17
7	HOU	20.42		7	IAH	24.16
8	OMA	18.86		8	CLE	23.48
9	MSY	16.87		9	IAD	18.58
10	IAD	15.88		10	BOS	16.35
11	IAH	15.79		11	DFW	16.08
12	RDU	15.24		12	HOU	15.93
13	ATL	15.01		13	SLC	15.04
14	BOS	13.51		14	DEN	12.23
15	SLC	11.75		15	PHL	11.03
16	MHT	9.69		16	RDU	10.82
17	BWI	9.24		17	MEM	9.47
18	PVD	8.79		18	LGA	8.95
19	BDL	8.58		19	BWI	8.87
20	IND	7.99		20	OMA	8.49
21	PHL	7.77		21	MSY	7.76
22	DEN	7.50		22	SFO	7.63
23	MEM	7.40		23	JFK	6.37
23	LGA	7.40		24	IND	5.19
25	SFO	7.13		25	ANC	5.06
26	MCI	7.11		26	SEA	5.05
27	JFK	6.85		27	MSP	4.96
28	DFW	6.51		28	MCI	3.84
29	ANC	5.44		29	BDL	3.69
30	SEA	4.47		30	PVD	3.60
31	CMH	3.45		31	DTW	3.12
32	MSP	3.06		32	MHT	3.00
33	SMF	2.52		33	CMH	2.62
34	PDX	2.28		34	PIT	2.06
35	BUF	2.05		35	SNA	1.97
36	DTW	1.99		36	PDX	1.94
37	RNO	1.80		37	CVG	1.30
37	ONT	1.80		38	SMF	1.29
39	PIT	1.79		39	MCO	0.98
40	SNA	1.73		40	MDW	0.95
41	JAX	1.59		41	PHX	0.91
42	MKE	1.24		42	BUF	0.88

Rank	Site ID	Frequency		Rank	Site ID	Weighted Frequency
43	MCO	1.02		43	ONT	0.85
44	BNA	0.95		44	MKE	0.83
45	MDW	0.90		45	RNO	0.79
46	ORF	0.87		46	LAS	0.77
46	ABQ	0.87		47	BNA	0.69
48	BUR	0.85		48	OAK	0.63
49	CVG	0.81		49	SAT	0.62
50	AUS	0.77		49	JAX	0.62
51	TPA	0.76		51	ABQ	0.61
52	SAT	0.75		52	MIA	0.59
53	SAN	0.67		53	TPA	0.57
53	OGG	0.67		54	AUS	0.55
55	DCA	0.60		55	DCA	0.49
56	OAK	0.58		56	BUR	0.48
57	LAS	0.48		57	SAN	0.44
57	PHX	0.48		58	ORF	0.34
59	MIA	0.45		59	OGG	0.32
60	SJC	0.42		60	SJC	0.29
61	PBI	0.34		61	PBI	0.21
62	SDF	0.28		62	FLL	0.18
63	FLL	0.20		63	SDF	0.16
64	TUS	0.18		63	HNL	0.16
65	HNL	0.16		65	TUS	0.14
66	DAL	0		66	DAL	0.00
66	RSW	0		66	RSW	0.00
	SJU	N/A			SJU	N/A

Table 9 (cont.)

Table 10. Frequency Ranking and Significant Weather Factor Ranking for Snow

Rank	Site ID	Frequency		Rank	Site ID	Weighted Frequency
1	ANC	7.69		1	ORD	14.94
2	BUF	7.66		2	MSP	12.17
3	MSP	7.51		3	DEN	10.14
4	PVD	6.95		4	DTW	7.16
5	MKE	6.32		5	ANC	7.15
6	DEN	6.22		6	CVG	5.30
7	ORD	5.03		7	PIT	4.62
8	CLE	4.92		8	SLC	4.49
9	DTW	4.56		9	MDW	4.33
10	MDW	4.12		10	BOS	4.24
11	PIT	4.02		11	MKE	4.23
12	OMA	3.89		12	CLE	4.03
13	IND	3.83		13	BUF	3.29
14	MHT	3.64		14	STL	3.15
15	SLC	3.51		15	PVD	2.85
16	BOS	3.50		16	EWR	2.67
17	CVG	3.29		17	CMH	2.50
17	CMH	3.29		18	IND	2.49
19	BDL	3.06		19	PHL	2.40
20	MCI	2.80		20	LGA	2.36
21	STL	2.50		21	JFK	1.87
22	SDF	2.36		22	OMA	1.75
23	EWR	2.04		23	IAD	1.65
24	JFK	2.01		24	MCI	1.51
25	LGA	1.95		25	BWI	1.46
26	PHL	1.69		26	SDF	1.32
27	RNO	1.61		26	BDL	1.32
28	BWI	1.52		28	MHT	1.13
29	IAD	1.41		29	DCA	1.04
30	DCA	1.29		30	SEA	0.94
31	BNA	1.27		31	BNA	0.93
32	ABQ	0.91		32	DFW	0.91
33	SEA	0.83		33	MEM	0.82
34	ORF	0.73		34	ATL	0.79
35	MEM	0.64		35	RNO	0.71
36	RDU	0.55		36	ABQ	0.64
37	PDX	0.44		37	CLT	0.56
38	DAL	0.41		38	RDU	0.39
39	CLT	0.40		39	PDX	0.37
40	DFW	0.37		40	DAL	0.32
41	ATL	0.27		41	ORF	0.28
42	AUS	0.11		42	LAS	0.11

Rank	Site ID	Frequency		Rank	Site ID	Weighted Frequency
43	LAS	0.07		43	IAH	0.11
43	IAH	0.07		44	AUS	0.08
45	SAT	0.06		45	SAT	0.05
46	TUS	0.05		46	TUS	0.04
47	HOU	0.03		47	HOU	0.02
47	MSY	0.03		47	PHX	0.02
47	JAX	0.03		49	MSY	0.01
50	PHX	0.01		49	JAX	0.01
50	MCO	0.01		49	MCO	0.01
50	TPA	0.01		49	TPA	0.01
53	LAX	0		53	LAX	0.00
53	MIA	0		53	MIA	0.00
53	SNA	0		53	SNA	0.00
53	OAK	0		53	OAK	0.00
53	SFO	0		53	SFO	0.00
53	HNL	0		53	HNL	0.00
53	FLL	0		53	FLL	0.00
53	SJC	0		53	SJC	0.00
53	SAN	0		53	SAN	0.00
53	SJU	0		53	SJU	0.00
53	PBI	0		53	PBI	0.00
53	BUR	0		53	BUR	0.00
53	SMF	0		53	SMF	0.00
53	OGG	0		53	OGG	0.00
53	ONT	0		53	ONT	0.00
53	RSW	0		53	RSW	0.00

Table 10 (cont.)

Table 11. Frequency Ranking and Significant Weather Factor Ranking for Freezing Precipitation

Rank	Site ID	Frequency		Rank	Site ID	Weighted Frequency
1	BDL	0.84		1	ORD	1.04
2	MHT	0.64		2	MSP	0.91
3	PVD	0.58		3	ATL	0.81
4	MSP	0.56		4	DTW	0.71
5	BUF	0.53		5	IAD	0.60
6	OMA	0.51		6	DFW	0.59
6	IAD	0.51		6	EWR	0.59
6	MCI	0.51		8	BOS	0.56
9	BOS	0.46		9	CLT	0.55
9	IND	0.46		9	CVG	0.55
11	DTW	0.45		11	STL	0.54
11	EWR	0.45		12	LGA	0.52
13	STL	0.43		13	PHL	0.48
13	LGA	0.43		14	DEN	0.46
15	MKE	0.42		15	PIT	0.44
16	DCA	0.39		16	BDL	0.36
16	CLT	0.39		16	MEM	0.36
18	PIT	0.38		16	MDW	0.36
19	CLE	0.37		19	BWI	0.34
20	ANC	0.36		20	ANC	0.33
21	ORD	0.35		21	DCA	0.32
21	CMH	0.35		22	CLE	0.30
21	BWI	0.35		22	IND	0.30
24	CVG	0.34		24	JFK	0.29
24	MDW	0.34		25	MKE	0.28
24	PHL	0.34		25	MCI	0.28
27	JFK	0.31		27	CMH	0.27
28	RDU	0.30		28	PVD	0.24
28	DAL	0.30		29	DAL	0.23
30	DEN	0.28		29	OMA	0.23
30	MEM	0.28		29	BUF	0.23
30	ATL	0.28		32	RDU	0.21
33	SDF	0.27		33	MHT	0.20
34	BNA	0.24		33	PDX	0.20
34	DFW	0.24		35	IAH	0.18
36	PDX	0.23		35	BNA	0.18
37	AUS	0.20		37	SDF	0.15
38	SAT	0.13		38	AUS	0.14
39	IAH	0.12		39	SAT	0.11
39	HOU	0.12		40	HOU	0.09
41	ORF	0.11		41	ORF	0.04

Rank	Site ID	Frequency		Rank	Site ID	Weighted Frequency
42	SLC	0.03		42	SLC	0.04
42	SEA	0.03		43	SEA	0.03
42	RNO	0.03		44	OAK	0.02
45	JAX	0.02		45	RNO	0.01
45	OAK	0.02		45	JAX	0.01
47	ABQ	0.01		45	ABQ	0.01
47	MSY	0.01		45	BUR	0.01
47	BUR	0.01		49	MSY	0.00
48	LAS	0		49	LAS	0.00
48	TUS	0		49	TUS	0.00
48	PHX	0		49	PHX	0.00
48	MCO	0		49	MCO	0.00
48	TPA	0		49	TPA	0.00
48	LAX	0		49	LAX	0.00
48	MIA	0		49	MIA	0.00
48	SNA	0		49	SNA	0.00
48	SFO	0		49	SFO	0.00
48	HNL	0		49	HNL	0.00
48	FLL	0		49	FLL	0.00
48	SJC	0		49	SJC	0.00
48	SAN	0		49	SAN	0.00
48	SJU	0		49	SJU	0.00
48	PBI	0		49	PBI	0.00
48	SMF	0		49	SMF	0.00
48	OGG	0		49	OGG	0.00
48	ONT	0		49	ONT	0.00
48	RSW	0		49	RSW	0.00

Table 11 (cont.)

Table 12. Frequency Ranking and Significant Weather Factor Ranking for Turbulence

Rank	Site ID	Score		Rank	Site ID	Weighted Score
1	DEN	62		1	ORD	3.36
1	BDL	62		2	DEN	2.66
3	EWR	61		3	PHL	2.20
4	PHL	59		4	EWR	2.10
5	BOS	58		5	DFW	2.08
5	LGA	58		6	ATL	2.07
5	JFK	58		7	DTW	1.94
5	PVD	58		7	LAX	1.94
5	MHT	58		9	BOS	1.85
10	PIT	55		9	LGA	1.85
11	CMH	54		11	CVG	1.69
12	ABQ	52		12	PIT	1.66
13	BWI	50		13	LAS	1.60
14	IAD	49		14	STL	1.53
14	DCA	49		15	IAD	1.51
16	CLE	48		16	JFK	1.42
17	DTW	47		17	SLC	1.41
17	BUF	47		18	MSP	1.36
19	STL	46		19	PHX	1.34
20	PDX	44		20	SEA	1.28
21	ORD	43		21	BWI	1.26
21	MDW	43		22	CLT	1.22
21	SEA	43		23	MDW	1.19
24	ORF	42		24	SNA	1.11
24	SLC	42		25	CMH	1.08
26	IND	41		25	MEM	1.08
26	MKE	41		27	DCA	1.04
26	MCI	41		27	CLE	1.04
29	CVG	40		29	PDX	0.98
30	RDU	38		30	ABQ	0.96
30	SDF	38		31	IAH	0.85
30	RNO	38		32	MKE	0.72
30	LAS	38		33	RDU	0.71
34	BUR	37		34	BDL	0.70
34	LAX	37		34	IND	0.70
34	SNA	37		36	DAL	0.66
34	ONT	37		37	BNA	0.63
38	OMA	36		37	PVD	0.63
39	SMF	34		39	OAK	0.60
40	CLT	33		40	SFO	0.59
40	BNA	33		41	MCI	0.58

Rank	Site ID	Score		Rank	Site ID	Weighted Score
42	MSP	32		42	TUS	0.58
42	DFW	32		43	SDF	0.56
42	MEM	32		43	BUR	0.56
42	DAL	32		45	SAN	0.55
42	SAN	32		46	BUF	0.53
47	TUS	28		47	MHT	0.47
48	ATL	27		48	ONT	0.46
48	PHX	27		48	SMF	0.46
50	AUS	23		50	RNO	0.44
51	IAH	21		51	ORF	0.43
51	HOU	21		51	HOU	0.43
51	OAK	21		51	AUS	0.43
51	SFO	21		51	OMA	0.43
51	SJC	21		55	SAT	0.42
56	SAT	19		56	SJC	0.38
56	MSY	19		57	MSY	0.23
56	JAX	19		58	MCO	0.20
59	MCO	18		59	JAX	0.18
60	TPA	8		60	TPA	0.16
60	RSW	8		61	MIA	0.14
62	MIA	6		62	FLL	0.10
63	FLL	4		63	PBI	0.07
63	PBI	4		64	RSW	0.04
	SJU	N/A			SJU	N/A
	ANC	N/A			ANC	N/A
	HNL	N/A			HNL	N/A
	OGG	N/a			OGG	N/A

Table 12 (cont.)

Table 13. Frequency Ranking and Significant Weather Factor Ranking for Icing (based on airmet-sounding composite score)

Rank	Site ID	Score		Rank	Site ID	Weighted Score
1	SEA	15		1	ORD	44.55
1	PIT	15		2	ATL	26.19
1	PDX	15		3	DTW	23.55
1	BUF	15		4	MSP	21.06
1	CLE	15		5	DFW	19.76
1	ORD	15		6	CVG	19.32
1	MDW	15		7	PHL	18.46
1	DTW	15		8	PIT	17.25
1	ANC	15		9	SEA	16.95
10	CMH	14		10	DEN	16.30
10	MKE	14		11	MDW	15.75
12	MHT	13		12	BOS	14.52
12	PHL	13		13	LGA	14.52
12	MSP	13		14	EWR	14.41
12	IND	13		15	SLC	14.08
16	BDL	12		16	ANC	13.95
16	PVD	12		17	LAX	13.93
16	BOS	12		18	STL	13.86
16	LGA	12		19	PHX	13.23
16	JFK	12		20	LAS	12.80
16	CVG	12		21	PDX	12.75
16	SDF	12		22	CLE	12.30
23	EWR	11		23	IAD	11.70
23	BWI	11		24	MEM	11.52
23	SLC	11		25	CLT	11.28
23	STL	11		26	JFK	11.16
23	OMA	11		27	OAK	10.90
23	MCI	11		28	IAH	10.71
29	IAD	10		29	SFO	10.70
29	DCA	10		30	CMH	10.64
29	ORF	10		31	BWI	10.56
29	BNA	10		32	MKE	9.38
29	RNO	10		33	IND	8.45
29	DEN	10		34	DCA	8.10
29	OAK	10		35	SNA	7.98
29	SFO	10		36	BNA	7.30
37	ATL	9		37	SDF	6.72
37	SMF	9		38	MIA	6.55
37	MEM	9		39	BUF	6.45
40	CLT	8		40	DAL	6.24
40	RDU	8		41	MCI	5.94
40	DAL	8		42	RDU	5.68

Rank	Site ID	Score		Rank	Site ID	Weighted Score
40	ABQ	8		43	ABQ	5.60
40	DFW	8		44	TUS	5.53
40	LAS	8		45	HOU	5.46
46	SJC	7		46	BDL	5.16
46	AUS	7		47	SAT	4.98
46	IAH	7		48	AUS	4.97
46	TUS	7		49	OMA	4.95
46	HOU	7		50	PVD	4.92
46	LAX	7		51	SJC	4.83
46	SNA	7		52	FLL	4.60
46	BUR	7		53	SMF	4.59
46	ONT	7		54	SAN	4.55
46	MSY	7		55	RNO	4.40
46	PHX	7		56	MHT	4.03
46	SAN	7		57	BUR	3.99
58	SAT	6		58	ORF	3.90
58	JAX	6		59	MCO	3.84
60	MIA	5		60	ONT	3.29
60	FLL	5		61	MSY	3.22
60	PBI	5		62	PBI	3.15
63	MCO	4		63	TPA	3.00
63	TPA	4		64	HNL	2.91
63	RSW	4		65	JAX	2.34
66	HNL	3		66	SJU	1.28
67	OGG	2		67	RSW	0.96
67	SJU	2		67	OGG	0.96

Table 13 (Cont.)

Table 14. Composite Ranking for all Weather Elements except Icing and Turbulence (average air traffic weighted frequency)

Rank	Site ID	Average Weighted Frequency
1	ORD	48.63
2	ATL	27.08
3	BOS	18.54
4	LAX	18.42
5	CLT	17.80
6	DTW	13.68
7	STL	13.55
8	DFW	13.50
9	DEN	13.10
10	LGA	12.75
11	MEM	12.33
12	EWR	11.85
13	SEA	11.51
14	MSP	11.25
15	MDW	10.14
16	IAH	10.06
17	JFK	9.37
18	SLC	8.65
19	PHL	8.31
20	SFO	7.06
21	PDX	6.87
22	BWI	6.82
23	IAD	6.80
24	CLE	6.15
25	ANC	6.02
26	HOU	5.69
27	SNA	5.48
28	PIT	4.94
29	IND	4.74
30	OAK	4.64
31	BNA	4.27
32	CVG	4.23
33	RDU	4.10
34	LAS	3.92
35	OMA	3.50
36	HNL	3.22
37	MCO	3.16
38	PVD	3.06
39	CMH	2.99
40	MIA	2.88

Rank	Site ID	Average Weighted Frequency
41	PHX	2.78
42	MCI	2.72
43	BUR	2.48
44	MSY	2.45
45	BDL	2.44
46	MKE	2.37
47	SAN	1.93
48	BUF	1.85
49	FLL	1.82
50	ONT	1.78
51	MHT	1.76
52	SJC	1.69
53	DCA	1.64
54	SDF	1.31
55	OGG	1.29
56	PBI	1.13
57	ABQ	1.12
58	SAT	1.10
59	AUS	1.09
60	DAL	1.07
61	TUS	0.98
62	RNO	0.95
63	SMF	0.84
64	ORF	0.80
65	TPA	0.76
66	JAX	0.52
67	SJU+	0.25
68	RSW	0.22

Table 14 cont.)

+ Does not include wind, ceiling or visibility.

Table 15. Significant Wind Rankings Weighted by Weather Factor Impacts and Air Traffic (Significant wind frequency weighted for air traffic and impact factor)

Rank	Site ID	Weighted Wind Impact Factor
1	ORD	94.52
2	BOS	93.13
3	CLT	91.74
4	LGA	90.35
5	MDW	88.96
6	ATL	87.57
7	JFK	86.18
8	DEN	84.79
9	MEM	83.40
10	SNA	82.01
11	EWR	80.62
12	HNL	79.23
13	PDX	77.84
14	STL	76.45
15	DFW	75.06
16	ONT	73.67
17	IAH	72.28
18	ANC	70.89
19	DTW	69.50
20	SAN	68.11
21	SFO	66.72
22	OGG	65.33
23	SJC	63.94
24	LAS	62.55
25	BWI	61.16
26	PHL	59.77
27	IND	58.38
28	HOU	56.99
29	MCI	55.60
30	BDL	54.21
31	OAK	52.82
32	LAX	51.43
33	BNA	50.04
34	SEA	48.65
35	PVD	47.26
36	MSP	45.87
37	BUR	44.48
38	DCA	43.09
39	SLC	41.70

Rank	Site ID	Weighted Wind Impact Factor
40	IAD	40.31
41	TPA	38.92
42	CLE	37.53
42	MHT	37.53
42	SDF	37.53
45	CMH	33.36
46	ORF	31.97
47	CVG	30.58
47	JAX	30.58
49	PHX	27.80
50	MIA	26.41
50	MSY	26.41
50	FLL	26.41
53	PIT	22.24
53	RDU	22.24
53	OMA	22.24
53	MCO	22.24
53	MKE	22.24
53	BUF	22.24
53	PBI	22.24
53	ABQ	22.24
53	SAT	22.24
53	AUS	22.24
53	DAL	22.24
53	TUS	22.24
53	RNO	22.24
53	SMF	22.24
53	RSW	22.24
	SJU	N/A

Table 15 (cont.)

Table 16. Significant Thunderstorm Rankings Weighted by Weather Factor Impacts and Air Traffic (Station thunderstorm frequency weighted for air traffic and impact factor)

Rank	Site ID	Weighted Thunderstorm Impact Factor
1	MCO	161.84
2	DFW	159.46
3	ATL	157.08
4	MIA	154.70
5	IAH	152.32
6	ORD	149.94
7	TPA	147.56
8	MEM	145.18
9	MSP	142.80
10	STL	140.42
11	DEN	138.04
12	CVG	135.66
13	PBI	133.28
14	TUS	130.90
15	SLC	128.52
16	HOU	126.14
17	FLL	123.76
18	CLT	121.38
19	DTW	119.00
20	PHX	116.62
21	BNA	114.24
22	MDW	111.86
22	DAL	111.86
24	MCI	107.10
25	JAX	104.72
26	PIT	102.34
27	RDU	99.96
28	PHL	97.58
28	RSW	97.58
28	AUS	97.58
31	MSY	90.44
32	SAT	88.06
33	SDF	85.68
34	CMH	83.30
35	SJU	80.92
35	IND	80.92
37	OMA	76.16
37	IAD	76.16
39	EWR	71.40

Rank	Site ID	Weighted Thunderstorm Impact Factor
40	LGA	69.02
41	MKE	66.64
42	CLE	64.26
42	ABQ	64.26
44	DCA	59.50
45	LAS	57.12
46	BWI	54.74
47	JFK	52.36
48	BOS	49.98
49	ORF	47.60
50	BUF	45.22
51	RNO	42.84
52	LAX	40.46
53	PVD	38.08
53	HNL	38.08
55	MHT	33.32
56	BDL	30.94
57	PDX	28.56
57	SNA	28.56
57	SEA	28.56
60	OGG	21.42
61	SMF	19.04
62	BUR	16.66
62	OAK	16.66
62	SFO	16.66
62	SJC	16.66
62	SAN	16.66
62	ONT	16.66
62	ANC	16.66

Table 16 (cont.)

Table 17. Significant Ceiling Rankings Weighted by Weather Factor Impacts and Air Traffic (Significant ceiling frequency weighted for air traffic and impact factor)

Rank	Site ID	Weighted Ceiling Impact Factor
1	ORD	93.16
2	ATL	91.79
3	SEA	90.42
4	DTW	89.05
5	LAX	87.68
6	DFW	86.31
7	MSP	84.94
8	STL	83.57
9	MEM	82.20
10	IAH	80.83
11	SFO	79.46
12	SLC	78.09
13	BOS	76.72
14	CLT	75.35
15	BWI	73.98
16	PHL	72.61
17	PDX	71.24
18	OAK	69.87
19	BNA	68.50
20	DEN	67.13
21	EWR	65.76
22	IAD	64.39
23	MCO	63.02
24	HOU	61.65
25	BUR	60.28
26	IND	58.91
27	MIA	57.54
28	RDU	56.17
29	LGA	54.80
30	PIT	53.43
31	ANC	52.06
32	PVD	50.69
33	OMA	49.32
34	JFK	47.95
35	LAS	46.58
36	FLL	45.21
37	MSY	43.84
38	PHX	42.47
39	CMH	41.10
40	MCI	39.73

Rank	Site ID	Weighted Ceiling Impact Factor
41	BDL	38.36
42	MHT	36.99
43	HNL	35.62
44	PBI	34.25
45	SAN	32.88
46	SNA	31.51
47	CLE	30.14
48	OGG	28.77
49	CVG	27.40
50	BUF	26.03
51	MDW	24.66
52	SJC	23.29
53	MKE	21.92
54	SAT	20.55
55	AUS	19.18
56	ORF	17.81
57	DCA	16.44
58	RNO	15.07
59	ABQ	13.70
60	ONT	12.33
61	SDF	10.96
62	TUS	9.59
63	TPA	8.22
63	DAL	8.22
63	JAX	8.22
63	RSW	8.22
63	SMF	8.22
	SJU	N/A

Table 17 (cont.)

Table 18. Significant Visibility Rankings Weighted by Weather Factor Impacts and Air Traffic (Significant visibility frequency weighted for air traffic and impact factor)

Rank	Site ID	Weighted Visibility Impact Factor
1	ORD	110.16
2	LAX	108.54
3	ATL	106.92
4	STL	105.30
5	CLT	103.68
6	EWR	102.06
7	IAH	100.44
8	CLE	98.82
9	IAD	97.20
10	BOS	95.58
11	DFW	93.96
12	HOU	92.34
13	SLC	90.72
14	DEN	89.10
15	PHL	87.48
16	RDU	85.86
17	MEM	84.24
18	LGA	82.62
19	BWI	81.00
20	OMA	79.38
21	MSY	77.76
22	SFO	76.14
23	JFK	74.52
24	IND	72.90
25	ANC	71.28
26	SEA	69.66
27	MSP	68.04
28	MCI	66.42
29	BDL	64.80
30	PVD	63.18
31	DTW	61.56
32	MHT	59.94
33	CMH	58.32
34	PIT	56.70
35	SNA	55.08
36	PDX	53.46
37	CVG	51.84
38	SMF	50.22
39	MCO	48.60
40	MDW	46.98

Rank	Site ID	Weighted Visibility Impact Factor
41	PHX	45.36
42	BUF	43.74
43	ONT	42.12
44	MKE	40.50
45	RNO	38.88
46	LAS	37.26
47	BNA	35.64
48	OAK	34.02
49	SAT	32.40
49	JAX	32.40
51	ABQ	29.16
52	MIA	27.54
53	TPA	25.92
54	AUS	24.30
55	DCA	22.68
56	BUR	21.06
57	SAN	19.44
58	ORF	17.82
59	OGG	16.20
60	SJC	14.58
61	PBI	12.96
62	FLL	11.34
63	SDF	9.72
63	HNL	9.72
65	TUS	6.48
66	DAL	4.86
66	RSW	4.86
	SJU	N/A

Table 18 (cont.)

Table 19. Snow Event Rankings Weighted by Weather Factor Impacts and Air Traffic (Snow event frequency weighted for air traffic and impact factor)

Rank	Site ID	Weighted Snow Event Impact Factor
1	ORD	57.12
2	MSP	56.28
3	DEN	55.44
4	DTW	54.60
5	ANC	53.76
6	CVG	52.92
7	PIT	52.08
8	SLC	51.24
9	MDW	50.40
10	BOS	49.56
11	MKE	48.72
12	CLE	47.88
13	BUF	47.04
14	STL	46.20
15	PVD	45.36
16	EWR	44.52
17	CMH	43.68
18	IND	42.84
19	PHL	42.00
20	LGA	41.16
21	OMA	40.32
22	IAD	39.48
23	JFK	38.64
24	MCI	37.80
25	BWI	36.96
26	SDF	36.12
26	BDL	36.12
28	MHT	34.44
29	DCA	33.60
30	SEA	32.76
31	BNA	31.92
32	DFW	31.08
33	MEM	30.24
34	ATL	29.40
35	RNO	28.56
36	ABQ	27.72
37	CLT	26.88
38	RDU	26.04
39	PDX	25.20

Rank	Site ID	Weighted Snow Event Impact Factor
40	DAL	24.36
41	ORF	23.52
42	LAS	22.68
42	IAH	22.68
44	AUS	21.00
45	SAT	20.16
46	TUS	19.32
47	HOU	18.48
47	PHX	18.48
49	MSY	16.80
49	JAX	16.80
49	MCO	16.80
49	TPA	16.80
53	LAX	13.44
53	SFO	13.44
53	SNA	13.44
53	SMF	13.44
53	ONT	13.44
53	OAK	13.44
53	MIA	13.44
53	BUR	13.44
53	SAN	13.44
53	OGG	13.44
53	SJC	13.44
53	PBI	13.44
53	FLL	13.44
53	HNL	13.44
53	RSW	13.44
53	SJU	13.44

Table 19 (cont.)

Table 20. Freezing Precipitation Event Rankings Weighted by Weather Factor Impacts and Air Traffic (Freezing rain/drizzle/ice pellet frequency weighted for air traffic and impact factor)

Rank	Site ID	Weighted Freezing Precipitation Impact Factor
1	ORD	50.32
2	MSP	49.58
3	ATL	48.84
4	DTW	48.10
5	IAD	47.36
6	DFW	46.62
6	EWR	46.62
8	BOS	45.14
9	CLT	44.40
9	CVG	44.40
11	STL	42.92
12	LGA	42.18
13	PHL	41.44
14	DEN	40.70
15	PIT	39.96
16	BDL	39.22
16	MEM	39.22
16	MDW	39.22
19	BWI	37.00
20	ANC	36.26
21	JFK	35.52
22	DCA	35.52
23	CLE	34.04
23	IND	34.04
25	MKE	32.56
25	MCI	32.56
27	CMH	31.08
28	PVD	30.34
29	DAL	29.60
29	OMA	29.60
29	BUF	29.60
32	RDU	27.38
33	MHT	26.64
33	PDX	26.64
35	IAH	25.16
35	BNA	25.16
37	SDF	23.68
38	AUS	22.94
39	SAT	22.20

Rank	Site ID	Weighted Freezing Precipitation Impact Factor
40	HOU	21.46
41	ORF	20.72
41	SLC	20.72
43	SEA	19.24
44	OAK	18.50
45	RNO	17.76
45	JAX	17.76
45	ABQ	17.76
45	BUR	17.76
49	MSY	14.80
49	LAX	14.80
49	SFO	14.80
49	SNA	14.80
49	SMF	14.80
49	MCO	14.80
49	PHX	14.80
49	ONT	14.80
49	LAS	14.80
49	MIA	14.80
49	TPA	14.80
49	SAN	14.80
49	OGG	14.80
49	SJC	14.80
49	PBI	14.80
49	FLL	14.80
49	HNL	14.80
49	TUS	14.80
49	RSW	14.80
49	SJU	14.80

Table 20 (cont.)

Table 21. Turbulence Rankings Weighted by Weather Factor Impacts and Air Traffic (Turbulence frequency weighted for air traffic and impact factor)

Rank	Site ID	Weighted Turbulence Impact Factor
1	ORD	42.24
2	DEN	41.58
3	PHL	40.92
4	EWR	40.26
5	DFW	39.60
6	ATL	38.94
7	DTW	38.28
7	LAX	38.28
9	BOS	36.96
9	LGA	36.96
11	CVG	35.64
12	PIT	34.98
13	LAS	34.32
14	STL	33.66
15	IAD	33.00
16	JFK	32.34
17	SLC	31.68
18	MSP	31.02
19	PHX	30.36
20	SEA	29.70
21	BWI	29.04
22	CLT	28.38
23	MDW	27.72
24	SNA	27.06
25	CMH	26.40
25	MEM	26.40
27	DCA	25.08
27	CLE	25.08
29	PDX	23.76
30	ABQ	23.10
31	IAH	22.44
32	MKE	21.78
33	RDU	21.12
34	BDL	20.46
34	IND	20.46
36	DAL	19.14
37	BNA	18.48
37	PVD	18.48
39	OAK	17.16

Rank	Site ID	Weighted Turbulence Impact Factor
40	SFO	16.50
41	MCI	15.84
41	TUS	15.84
43	SDF	14.52
43	BUR	14.52
45	SAN	13.20
46	BUF	12.54
47	MHT	11.88
48	ONT	11.22
48	SMF	11.22
50	RNO	9.90
51	HOU	9.24
51	ORF	9.24
51	AUS	9.24
51	OMA	9.24
55	SAT	6.60
56	SJC	5.94
57	MSY	5.28
58	MCO	4.62
59	JAX	3.96
60	TPA	3.30
61	MIA	2.64
62	FLL	1.98
63	PBI	1.32
64	RSW	0.66
N/A	ANC	
N/A	OGG	
N/A	HNL	
N/A	SJU	

Table 21 (cont.)

Table 22. Icing Rankings Weighted by Weather Factor Impacts and Air Traffic (Icing frequency weighted for air traffic and impact factor)

Rank	Site ID	Weighted Icing Impact Factor
1	ORD	46.24
2	ATL	45.56
3	DTW	44.88
4	MSP	44.20
5	DFW	43.52
6	CVG	42.84
7	PHL	42.16
8	PIT	41.48
9	SEA	40.80
10	DEN	40.12
11	MDW	39.44
12	BOS	38.76
12	LGA	38.76
14	EWR	37.40
15	SLC	36.72
16	ANC	36.04
17	LAX	35.36
18	STL	34.68
19	PHX	34.00
20	LAS	33.32
21	PDX	32.64
22	CLE	31.96
23	IAD	31.28
24	MEM	30.60
25	CLT	29.92
26	JFK	29.24
27	OAK	28.56
28	IAH	27.88
29	SFO	27.20
30	CMH	26.52
31	BWI	25.84
32	MKE	25.16
33	IND	24.48
34	DCA	23.80
35	SNA	23.12
36	BNA	22.44
37	SDF	21.76
38	MIA	21.08
39	BUF	20.40
40	DAL	19.72

Rank	Site ID	Weighted Icing Impact Factor
41	MCI	19.04
42	RDU	18.36
43	ABQ	17.68
44	TUS	17.00
45	HOU	16.32
46	BDL	15.64
47	SAT	14.96
48	AUS	14.28
49	OMA	13.60
50	PVD	12.92
51	SJC	12.24
52	FLL	11.56
53	SMF	10.88
54	SAN	10.20
55	RNO	9.52
56	MHT	8.84
57	BUR	8.16
58	ORF	7.48
59	MCO	6.80
60	ONT	6.12
61	MSY	5.44
62	PBI	4.76
63	TPA	4.08
64	HNL	3.40
65	JAX	2.72
66	SJU	2.04
67	RSW	1.36
67	OGG	1.36

Table 22 (cont.)

Table 23. Ranking of Summed Weighted Frequencies (by impact and air traffic)

Rank	Site ID	Summed Weighted Impact Factor
1	ORD	643.70
2	ATL	606.10
3	DFW	575.61
4	STL	563.20
5	DEN	556.90
6	DTW	524.97
7	MSP	522.73
8	CLT	521.73
9	MEM	521.48
10	IAH	504.03
11	EWR	488.64
12	BOS	485.83
13	PHL	483.96
14	SLC	479.39
15	LGA	455.85
16	MDW	429.24
17	IAD	429.18
18	CVG	421.28
19	PIT	403.21
20	HOU	402.62
21	BWI	399.72
22	JFK	396.75
23	IND	392.93
24	LAX	389.99
25	MCI	374.09
26	CLE	369.71
27	BNA	366.42
28	SEA	359.79
29	RDU	357.13
30	CMH	343.76
31	PDX	339.34
32	MCO	338.72
33	ANC*	336.95
34	PHX	329.89
35	OMA	319.86
36	MIA	318.15
37	SFO	310.92
38	LAS	308.63
39	PVD	306.31
40	BDL	299.75

Rank	Site ID	Summed Weighted Impact Factor
41	MSY	280.77
42	MKE	279.52
43	SNA	275.58
44	DCA	259.71
45	TPA	259.60
46	OAK	251.03
47	MHT	249.58
48	FLL	248.50
49	BUF	246.81
50	DAL	240.00
51	SDF	239.97
52	PBI	237.05
53	TUS	236.17
54	AUS	230.76
55	SAT	227.17
56	JAX	217.16
57	ABQ	215.62
58	BUR	196.36
59	HNL*	194.29
60	ONT	190.36
61	SAN	188.73
62	RNO	184.77
63	ORF	176.16
64	SJC	164.89
65	RSW	163.16
66	OGG*	161.32
67	SMF	150.06
68	SJU*+	146.52

Table 23 (cont.)

***** Does not include turbulence.

+ Does not include turbulence, wind, ceilings or visibility

Summary Maps for Annual Frequencies

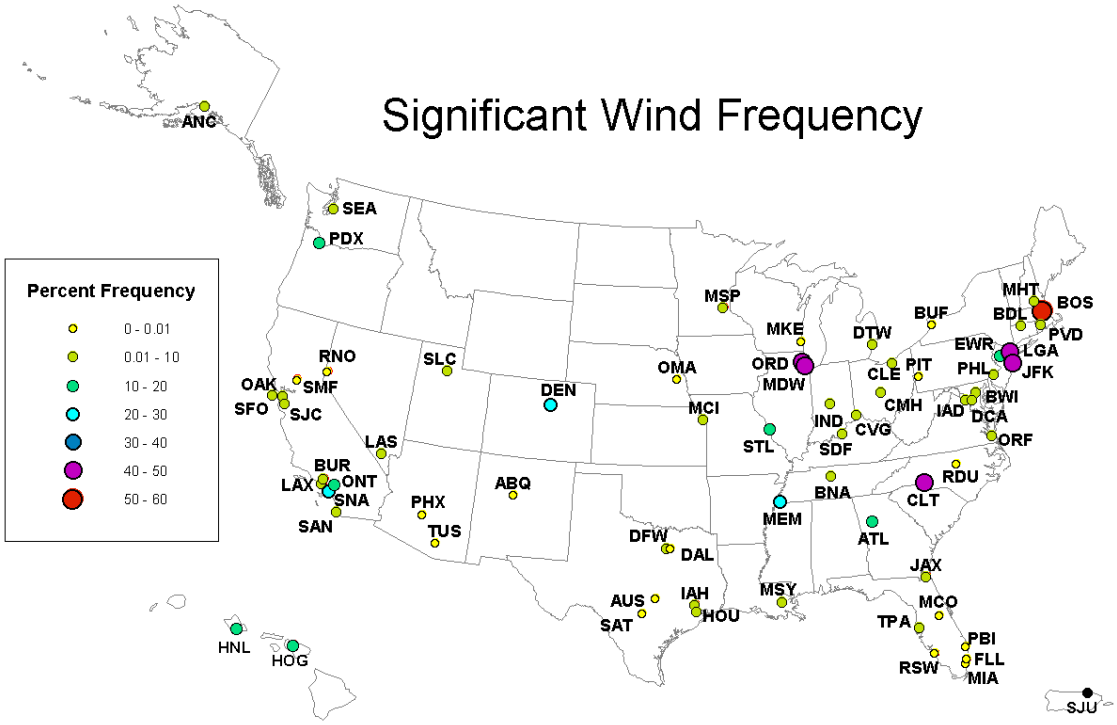


Figure 1. Annual Average Percent Frequency of Significant Wind 1961-1990

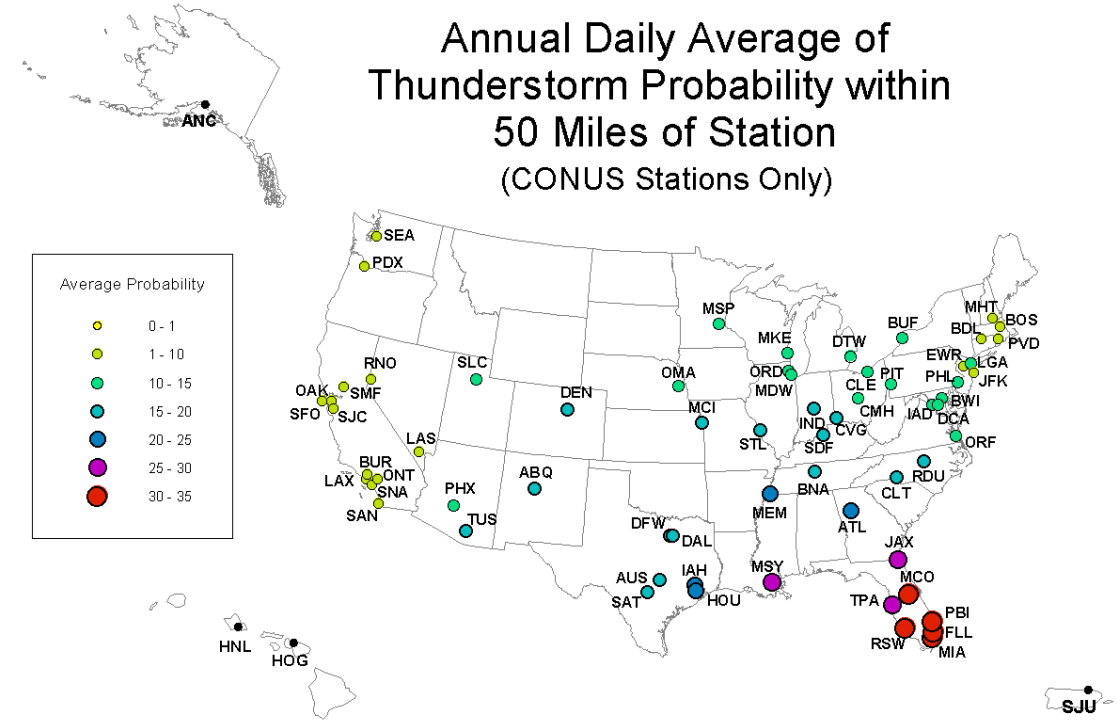


Figure 2. Annual Average Probability of Thunderstorms (Lightning) within 50 Miles of Station 1995-2003

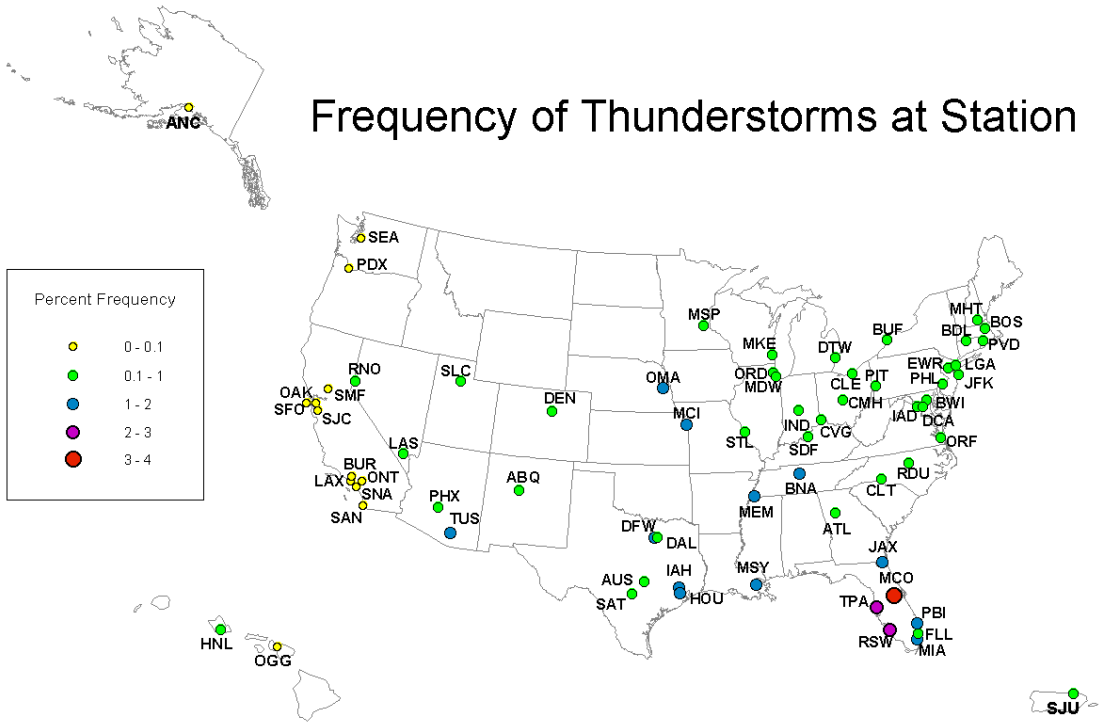


Figure 3. Annual Average Percent Frequency of Thunderstorms at a Station 1961-1990

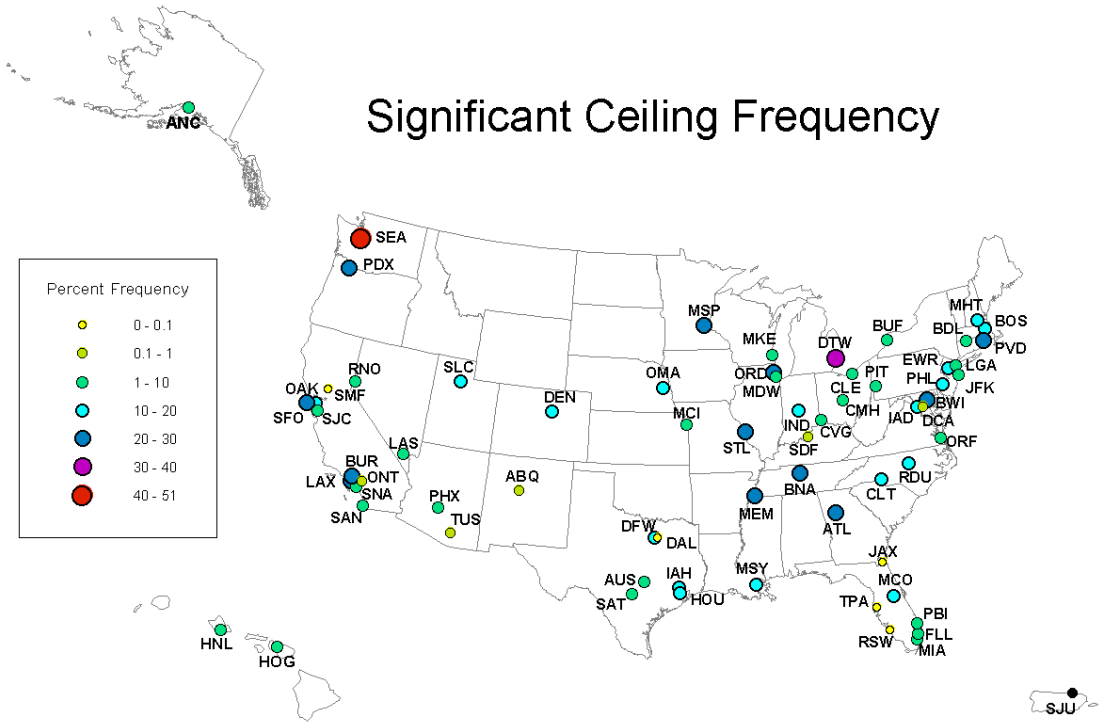


Figure 4. Annual Average Percent Frequency of Significant Ceilings 1961-1990

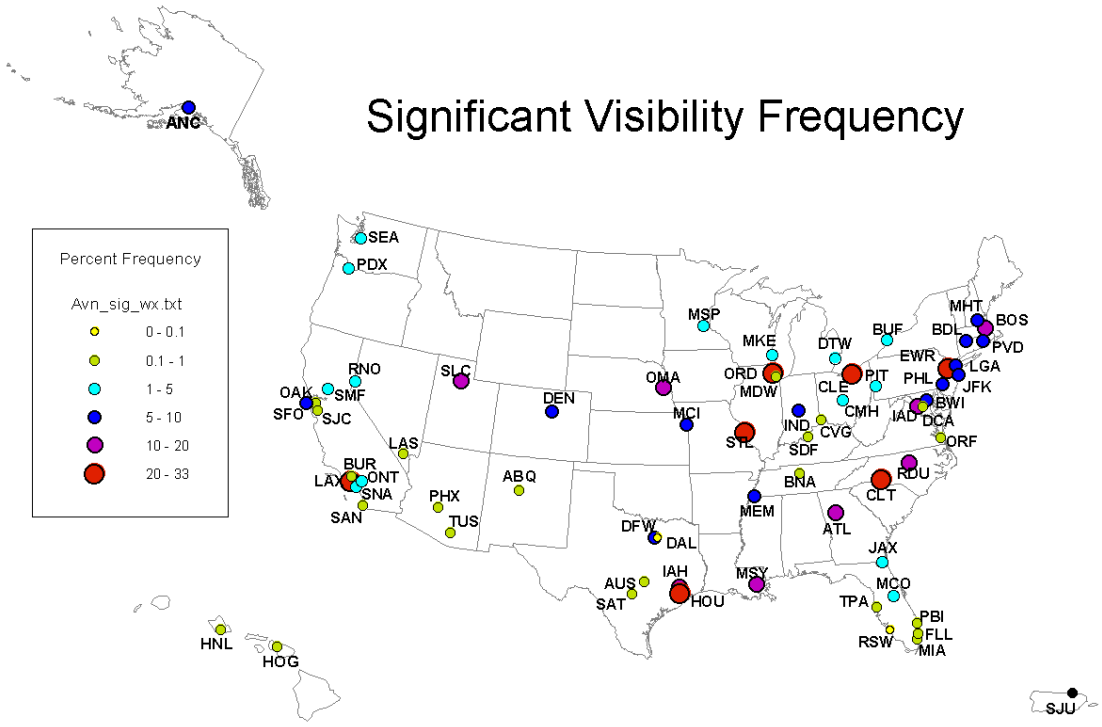


Figure 5. Annual Average Percent Frequency of Significant Visibility 1961-1990

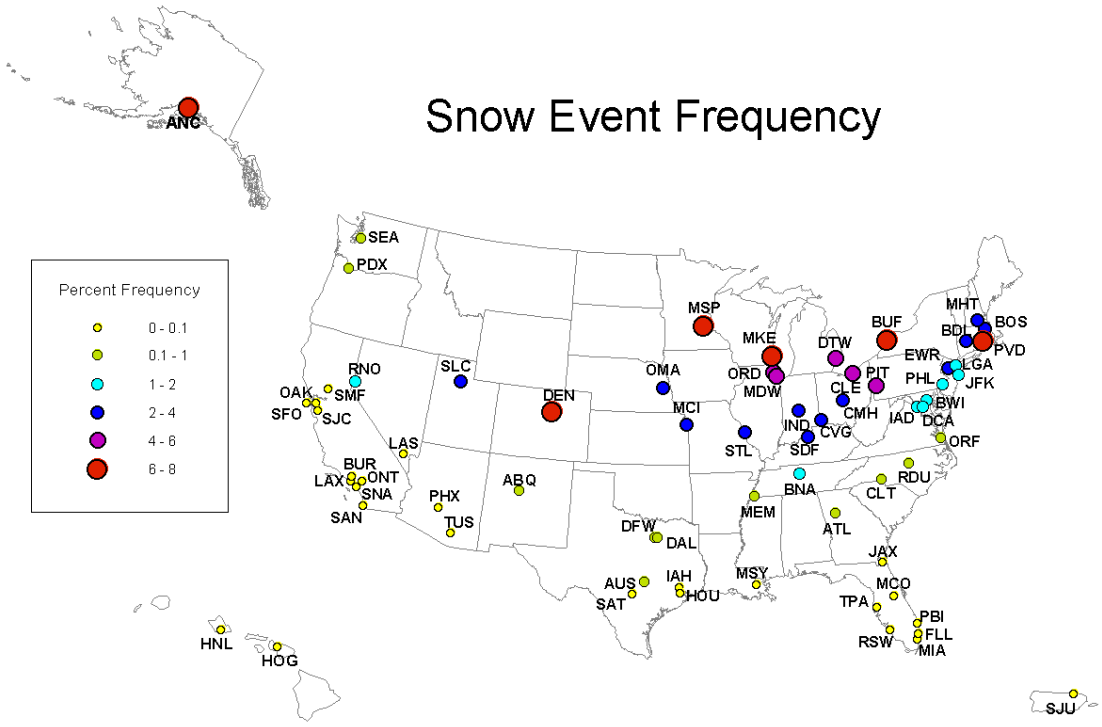


Figure 6. Annual Average Percent Frequency of Snow at Station 1961-1990

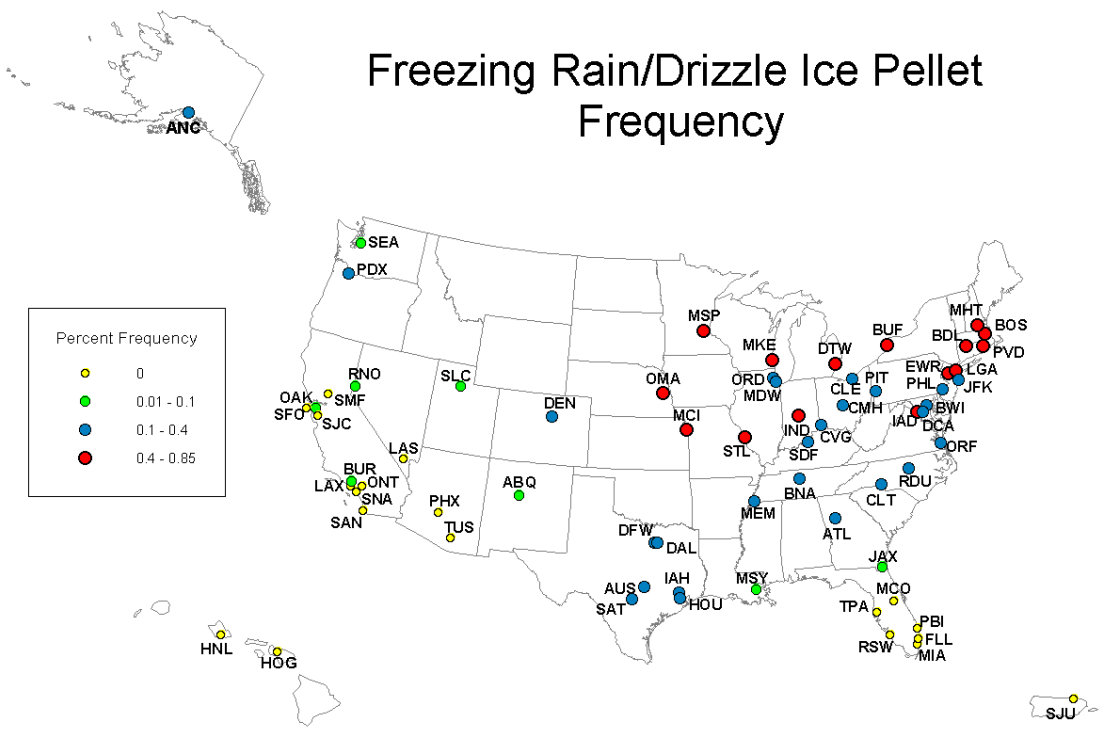


Figure 7. Annual Average Percent Frequency of Freezing Precipitation 1961-1990

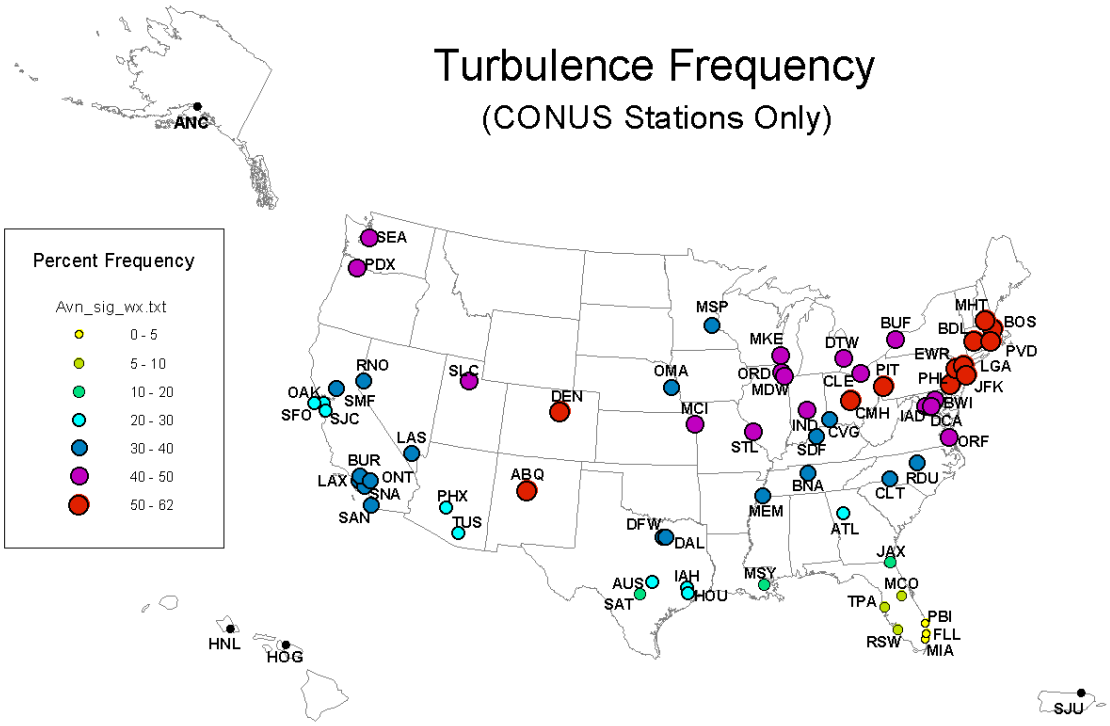


Figure 8. Average Annual Percent Frequency of Turbulence

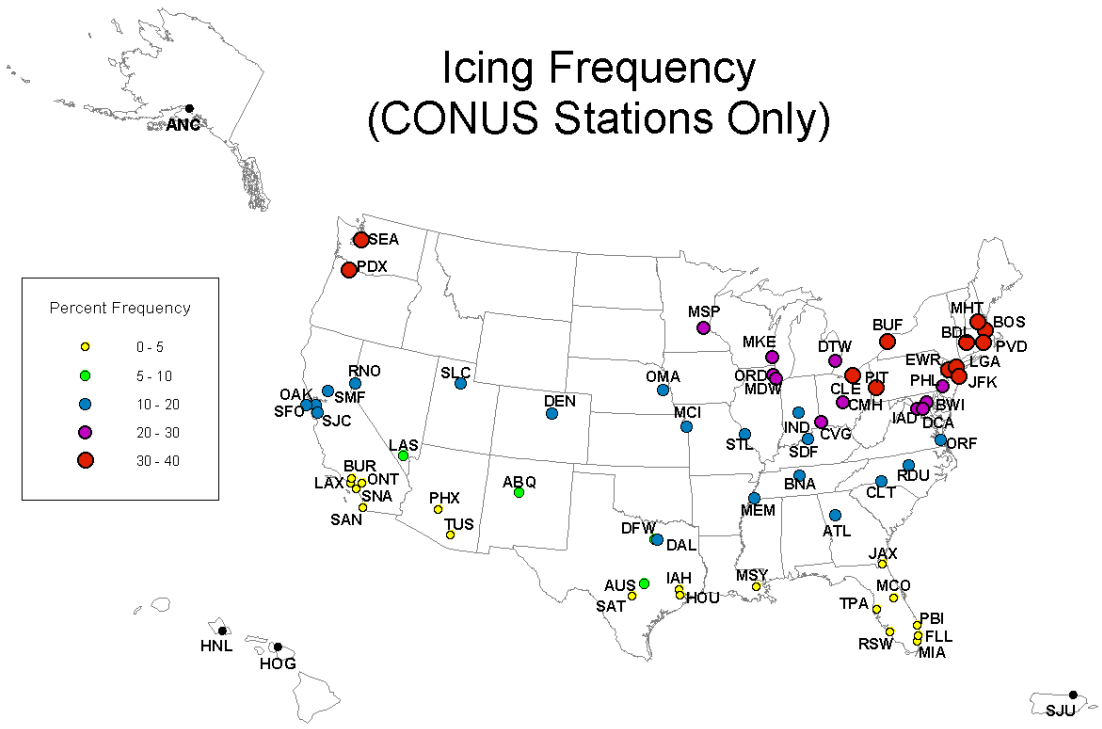


Figure 9. Average Annual Percent Frequency of Icing

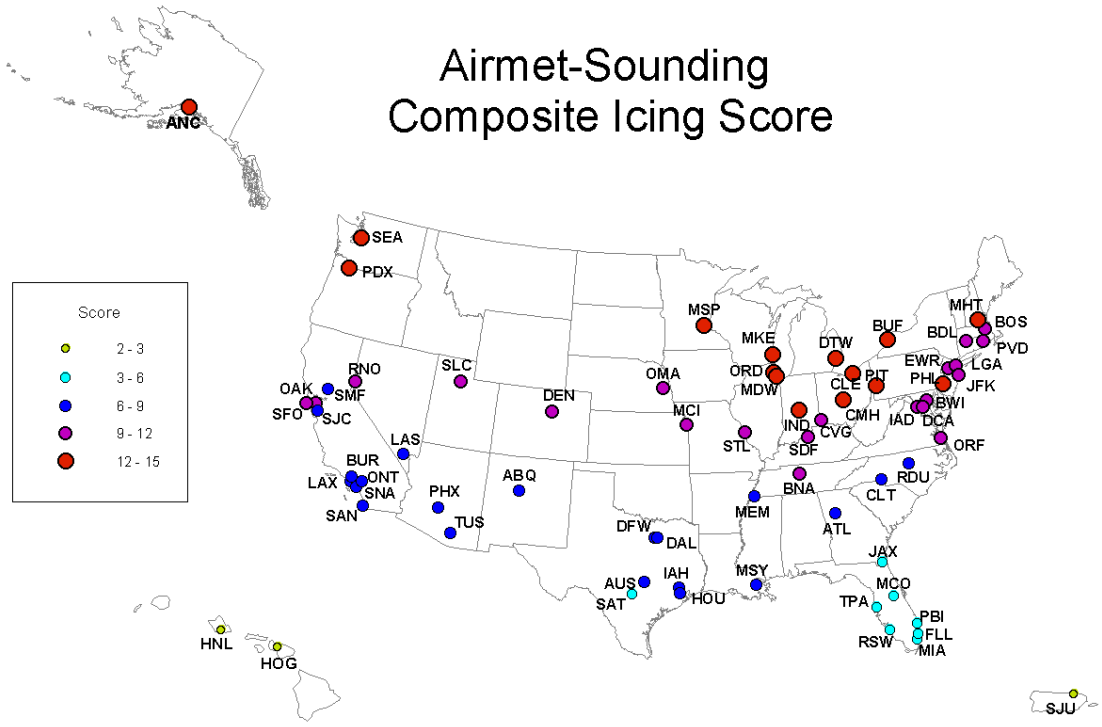
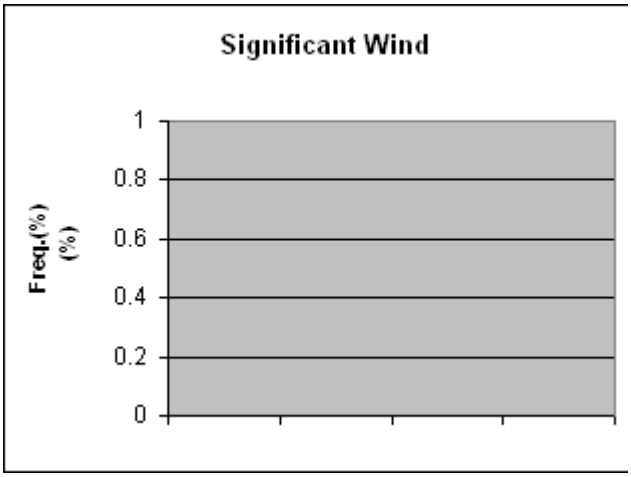
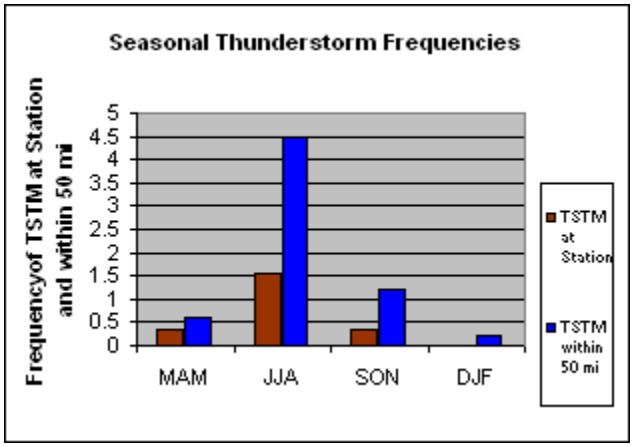


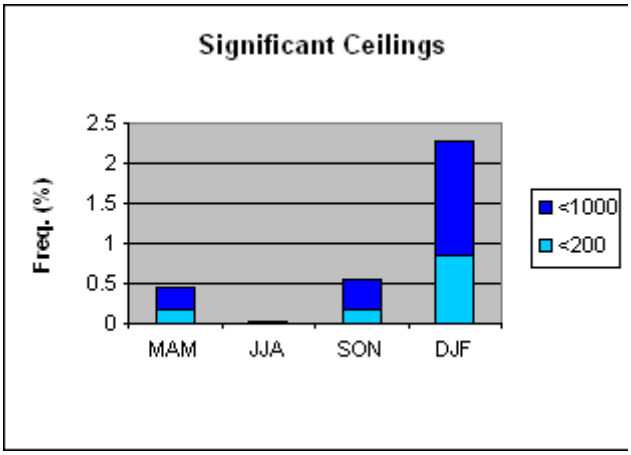
Figure 10. Airmet-Sounding Composite Icing Score

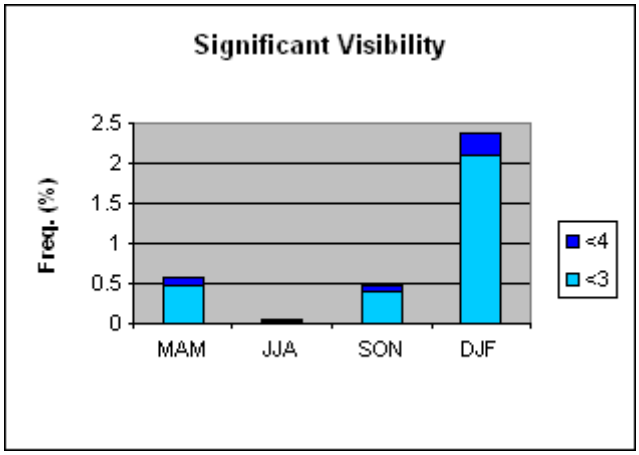
Seasonal Significant Weather Frequencies by Airport

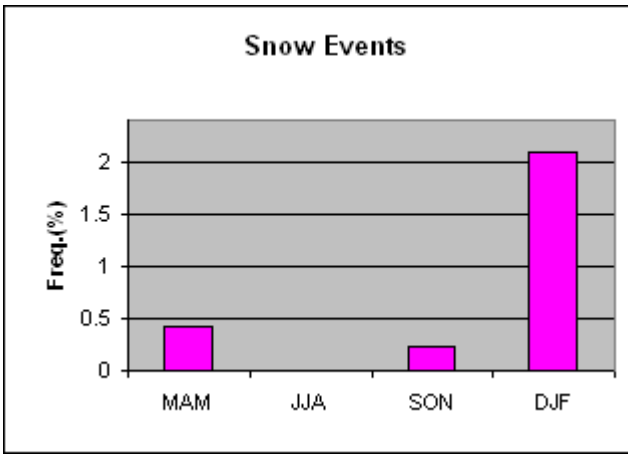
Albuquerque International Sunport – ABQ

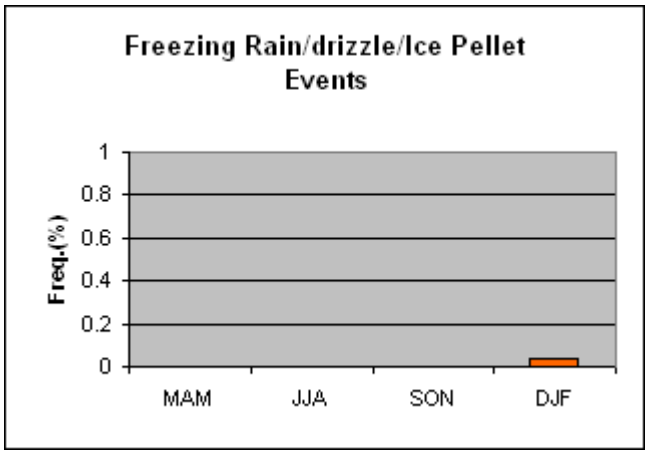












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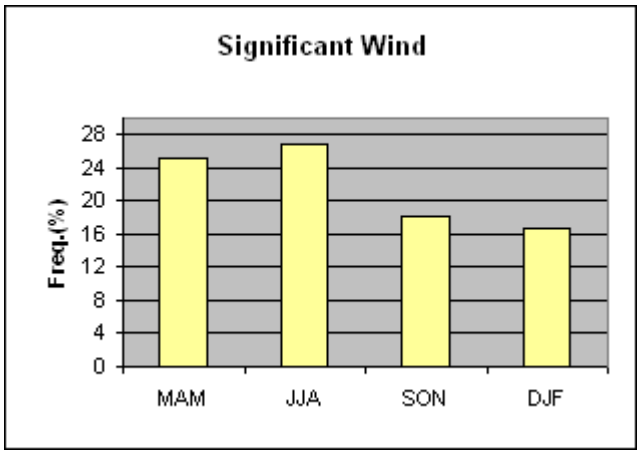
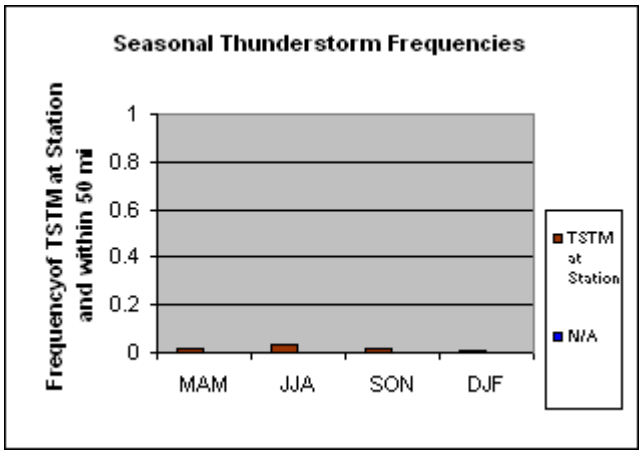
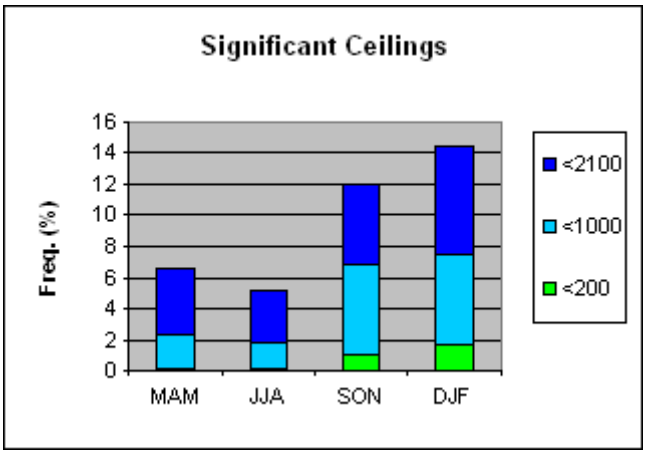
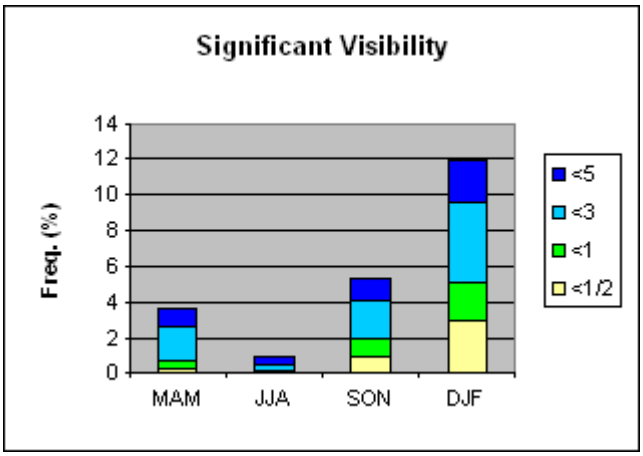
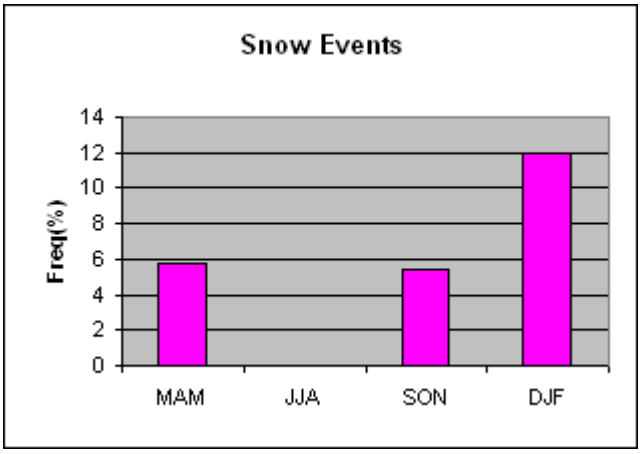
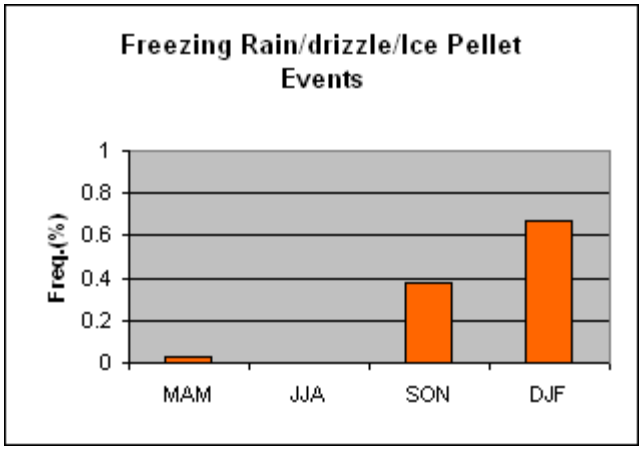




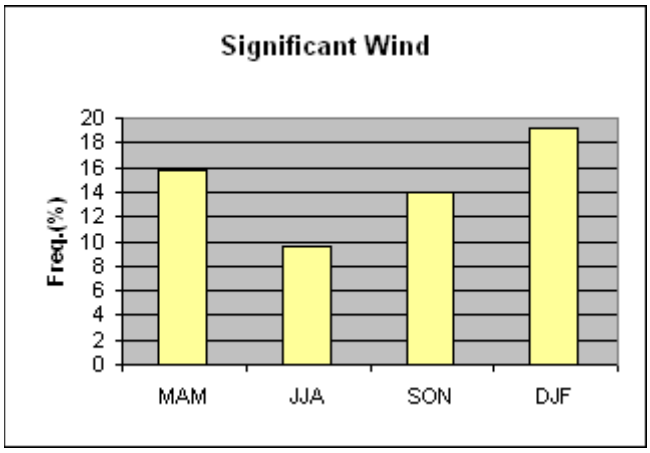


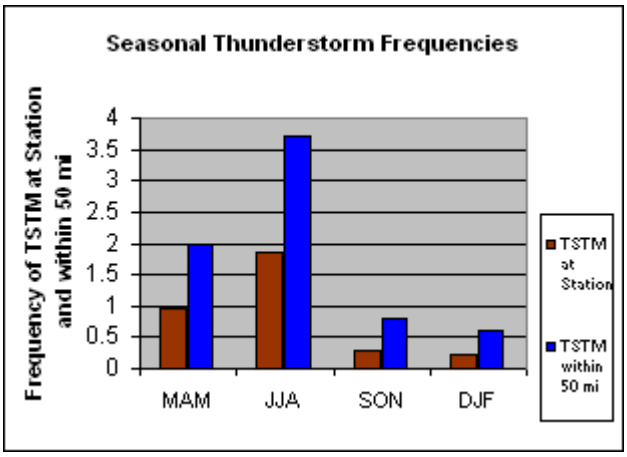


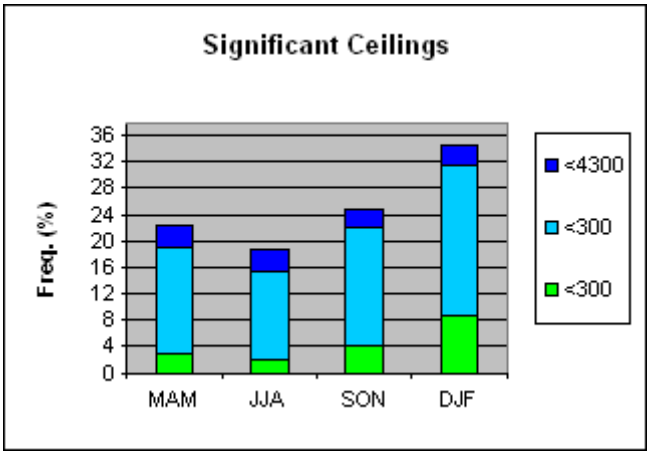


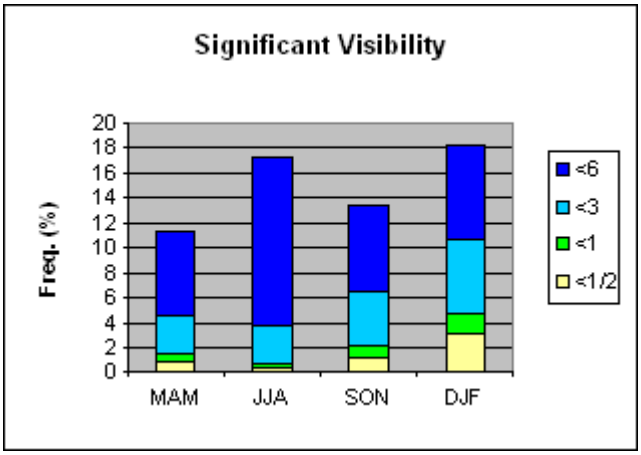


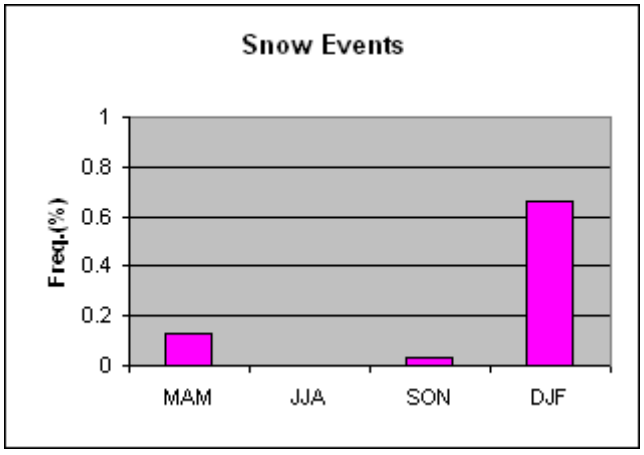
Atlanta – Hartsfield Atlanta International –ATL

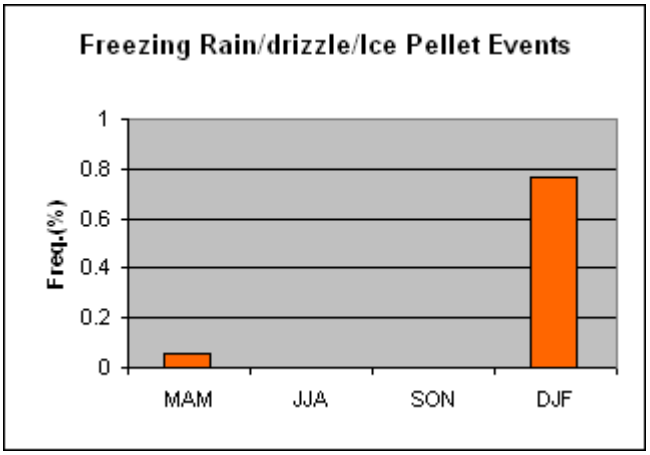




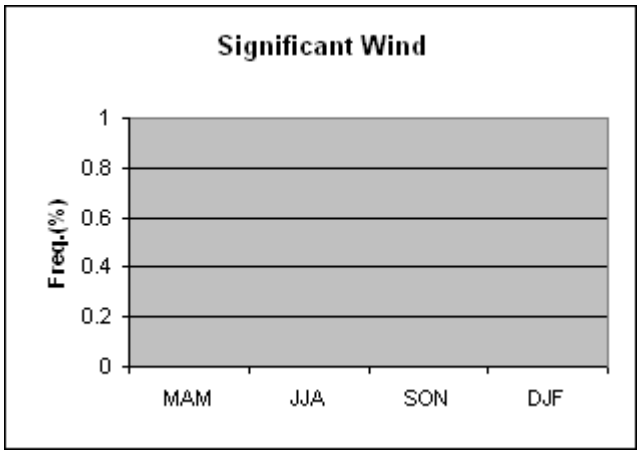


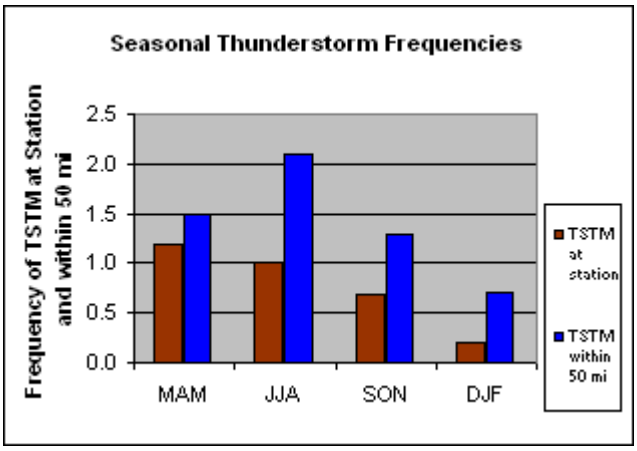


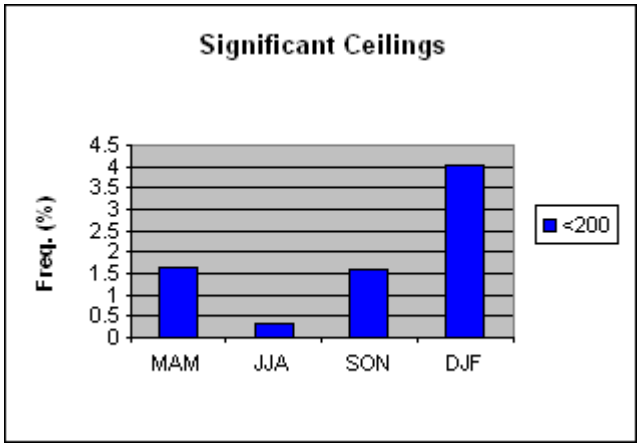


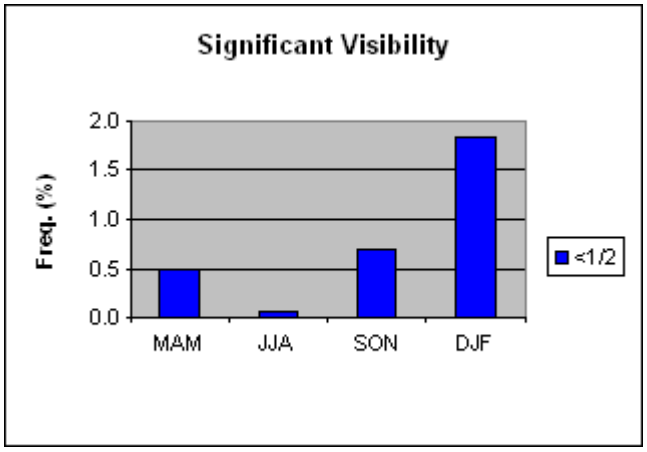


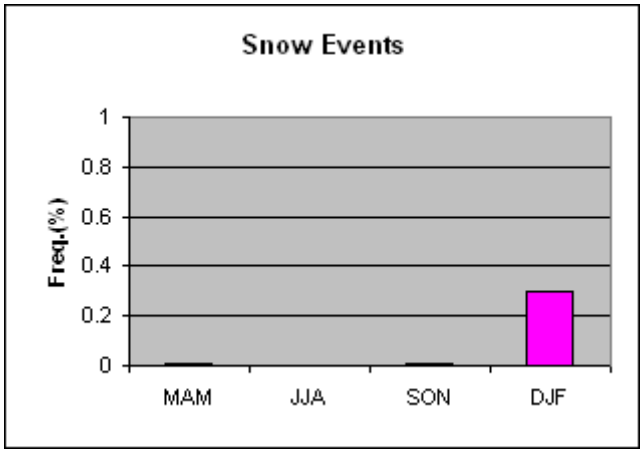
Austin – Bergstrom International – AUS

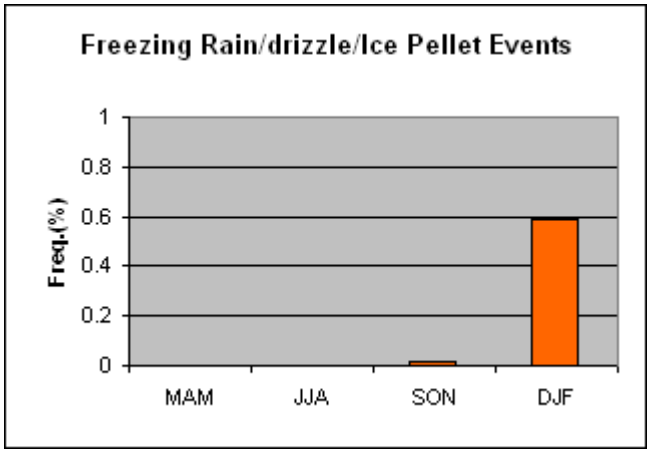




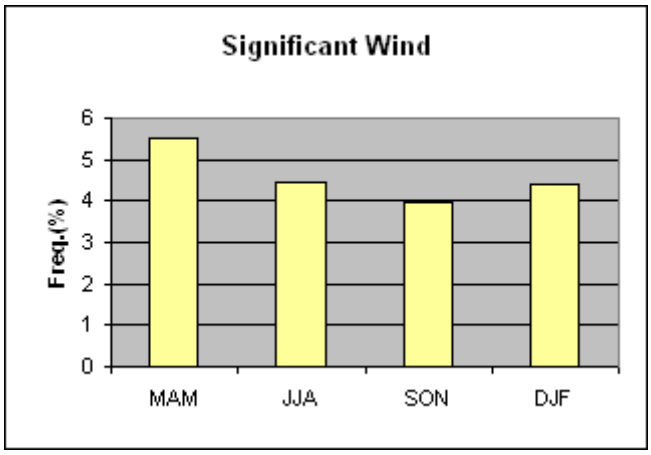


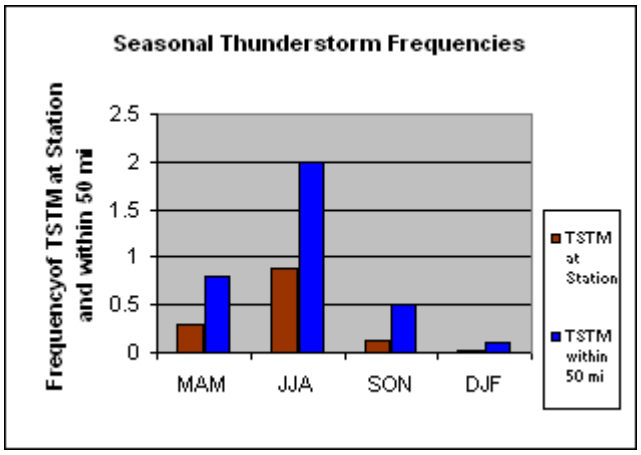


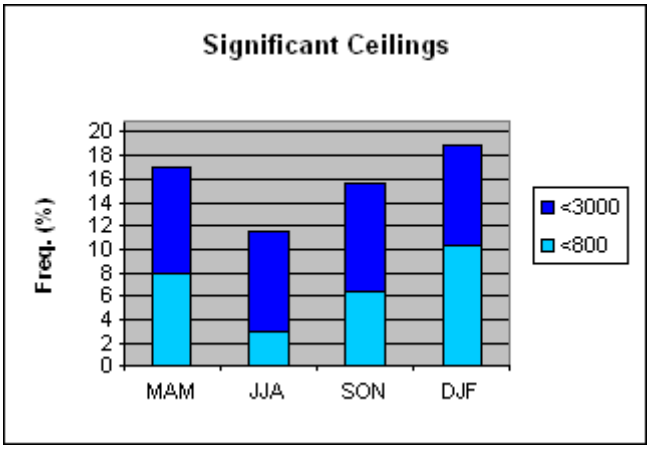


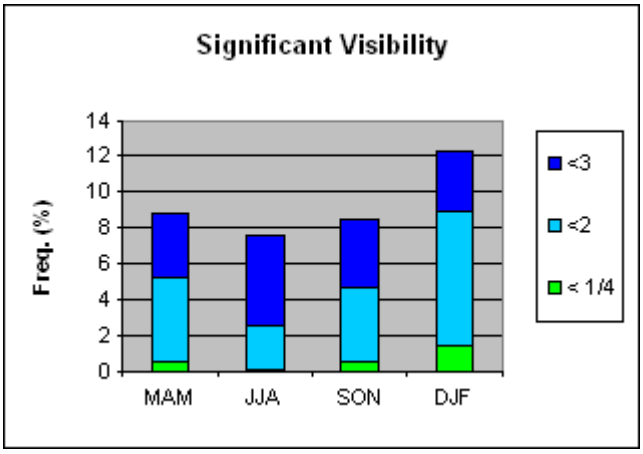


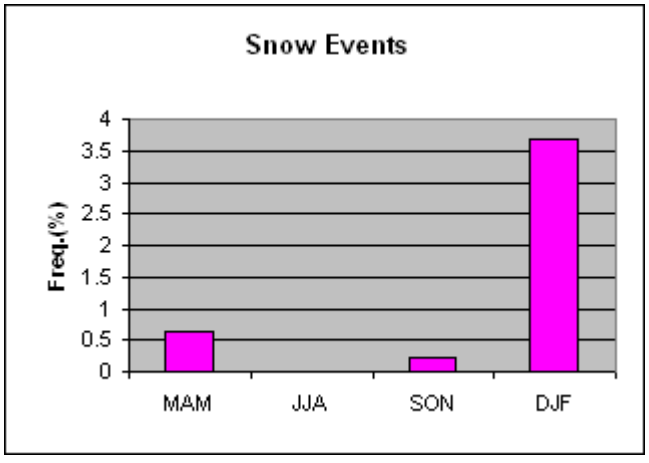
Baltimore-Washington International - BWI

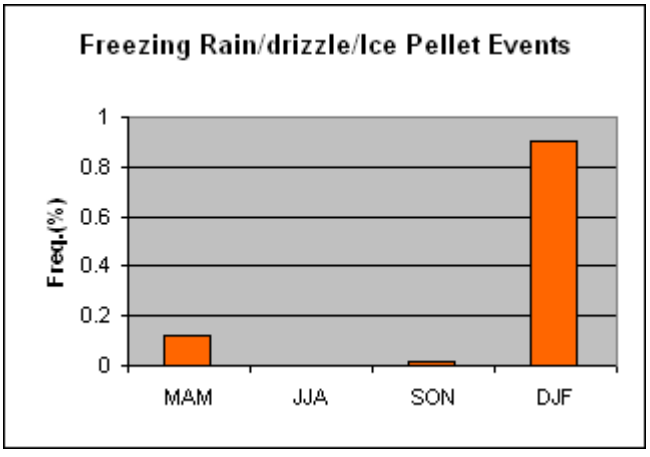




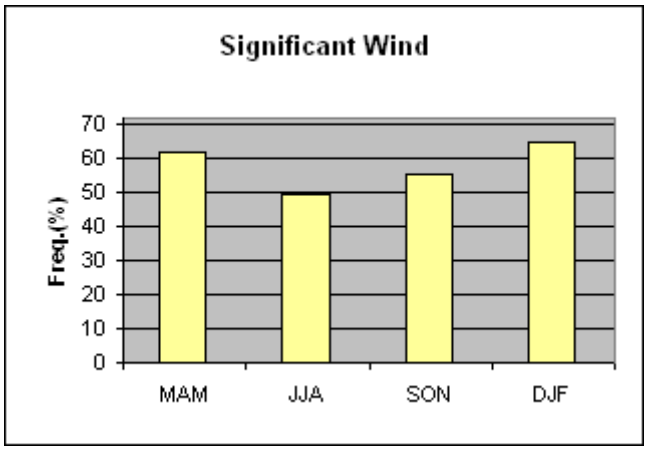


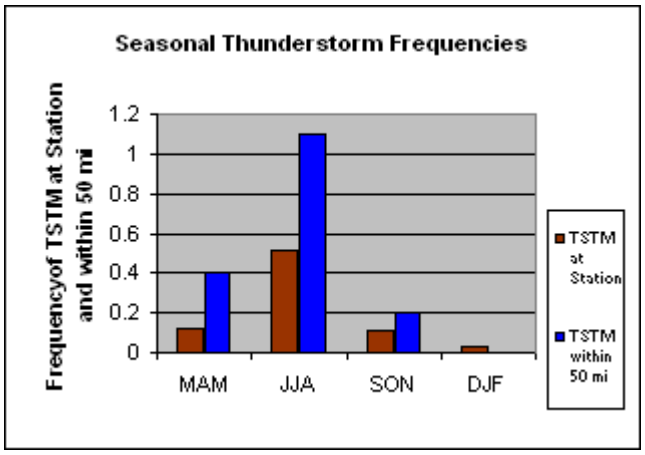


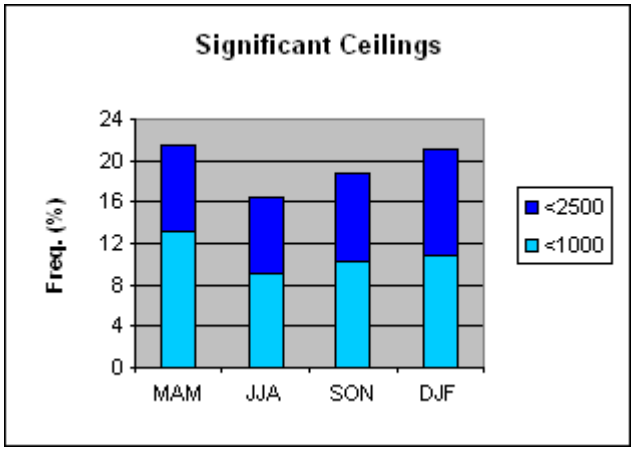


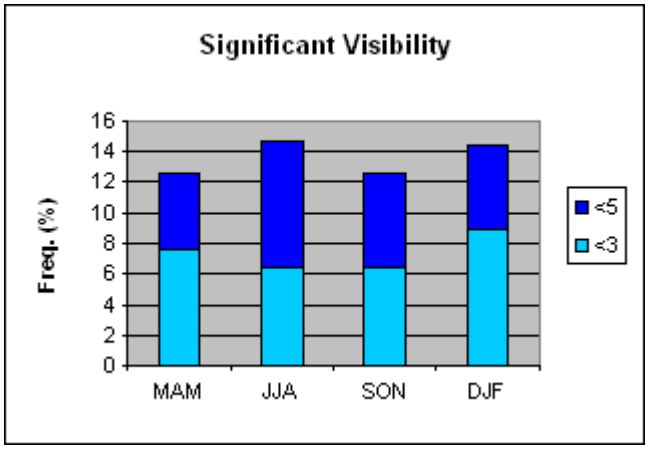


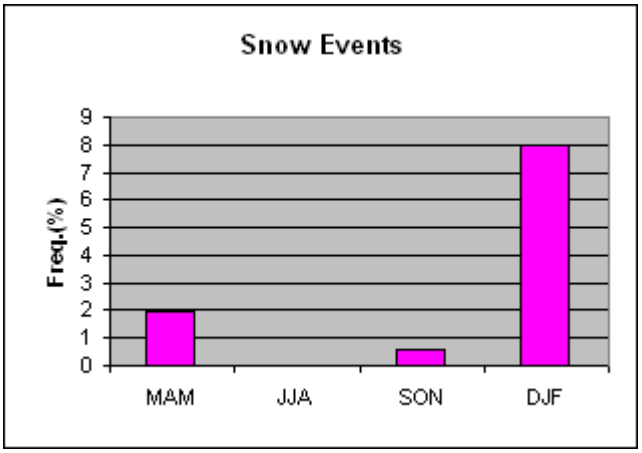
Boston – Logan International - BOS

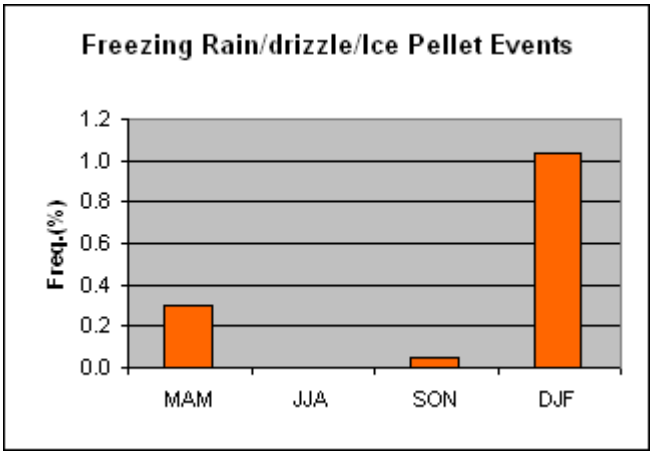




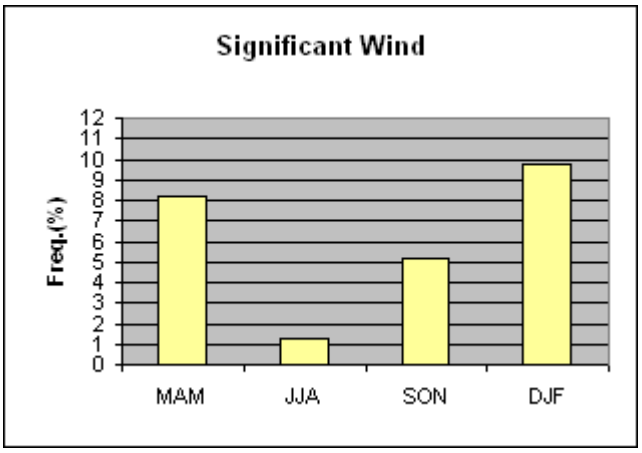


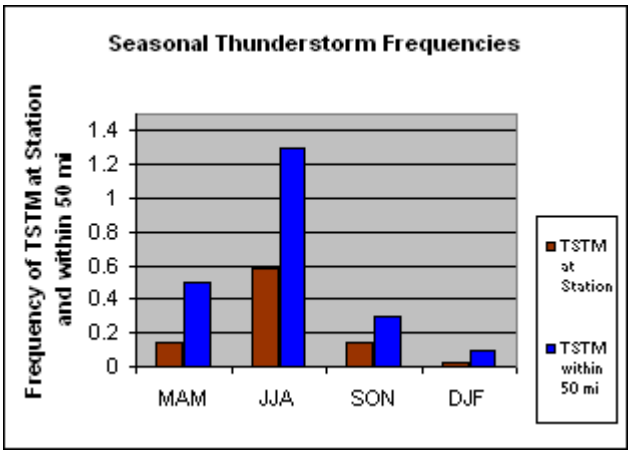


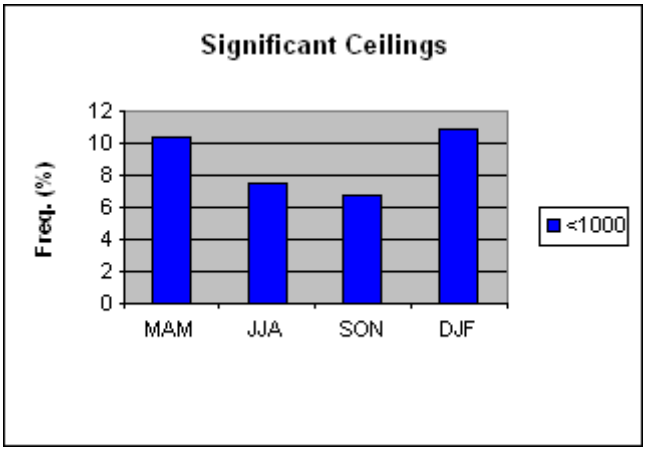


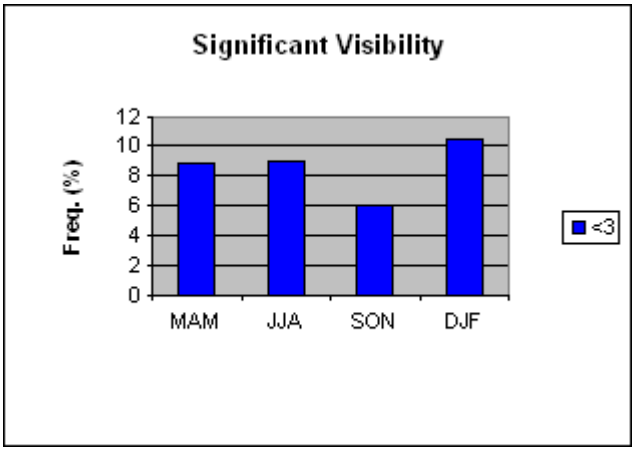


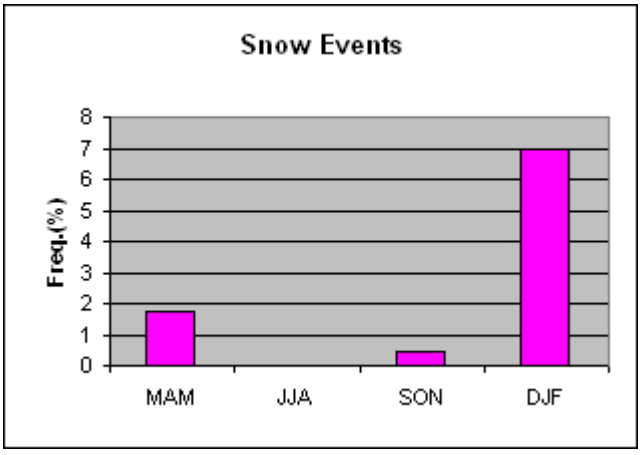
Bradley International – Winsor Locks - BDL

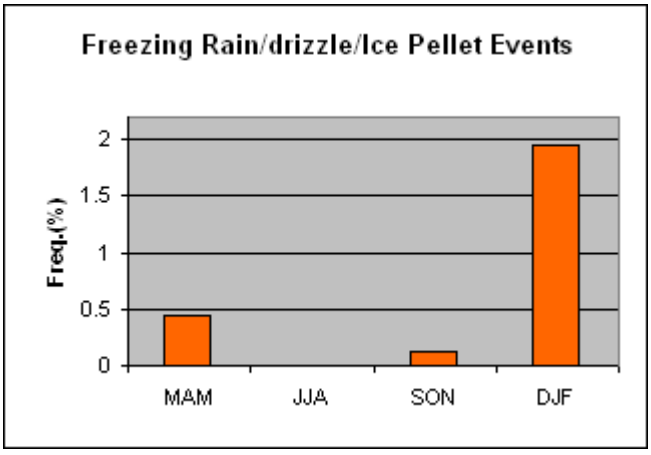




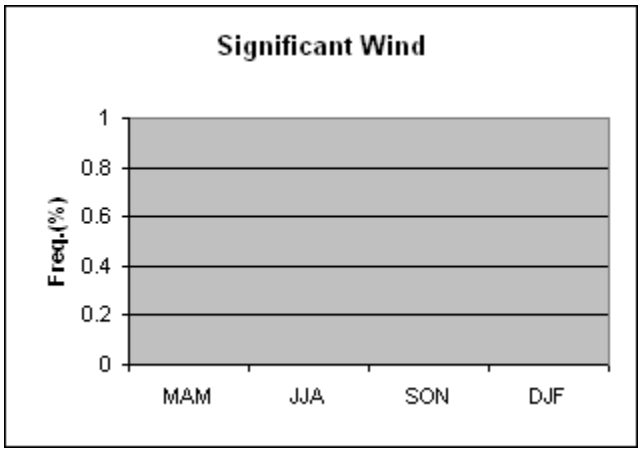


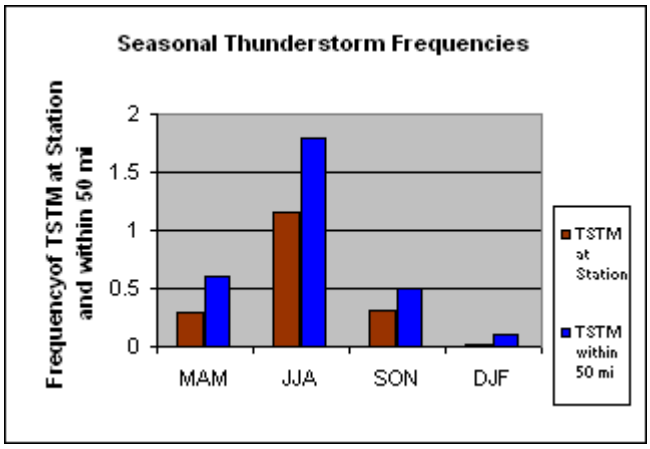


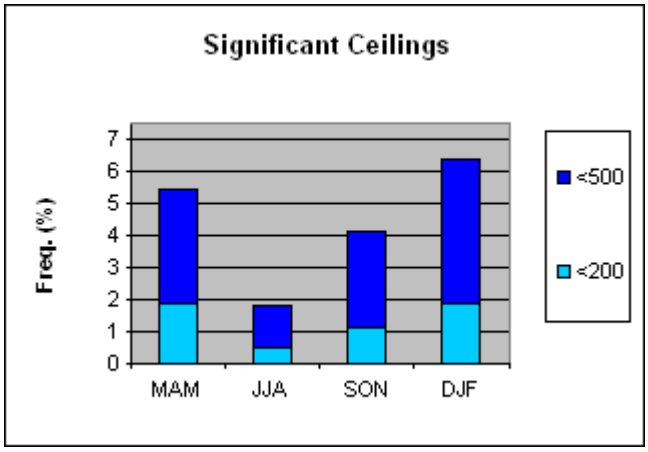


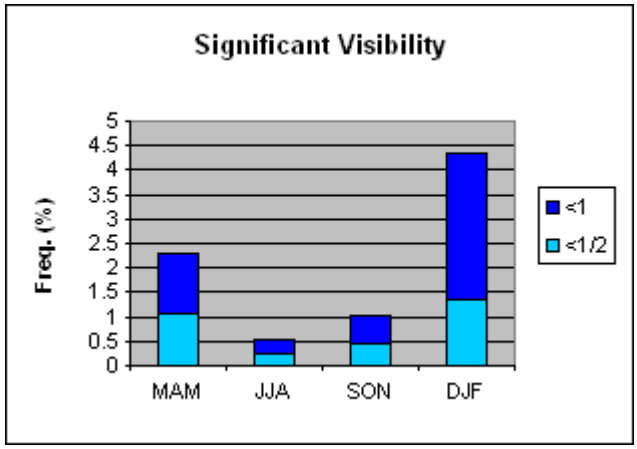


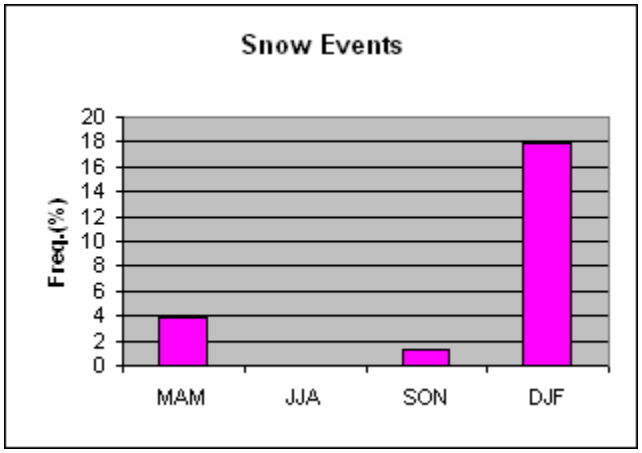
Buffalo Niagara International – BUF

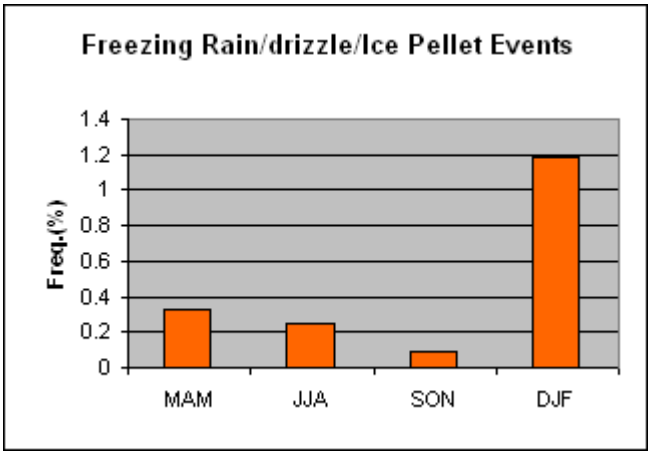




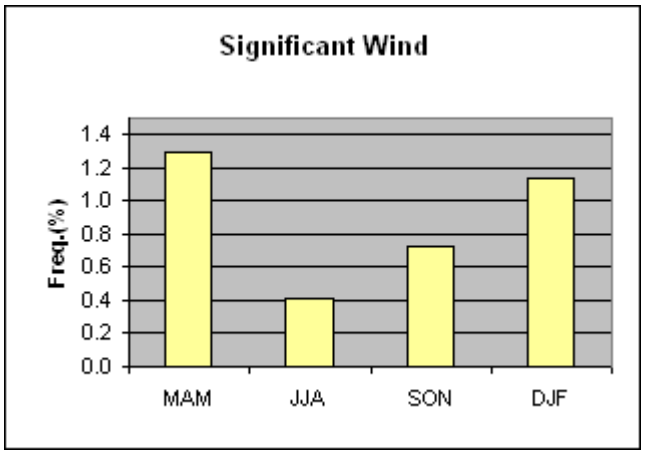


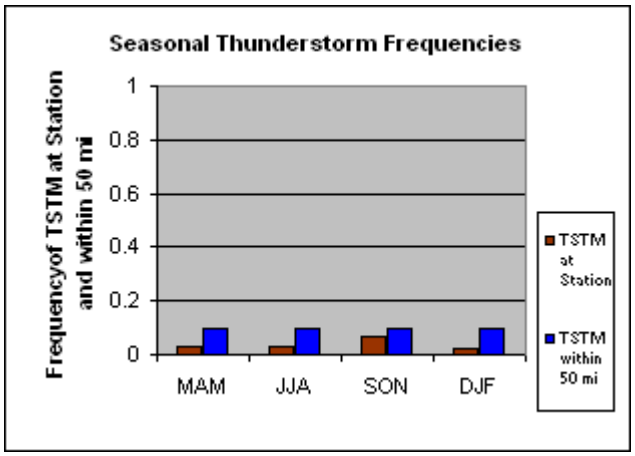


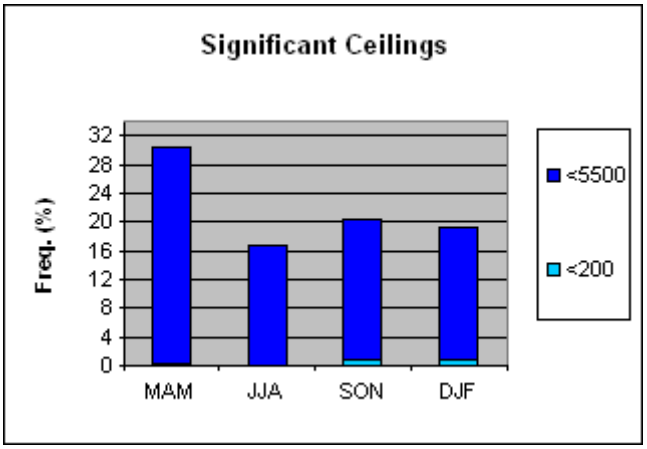


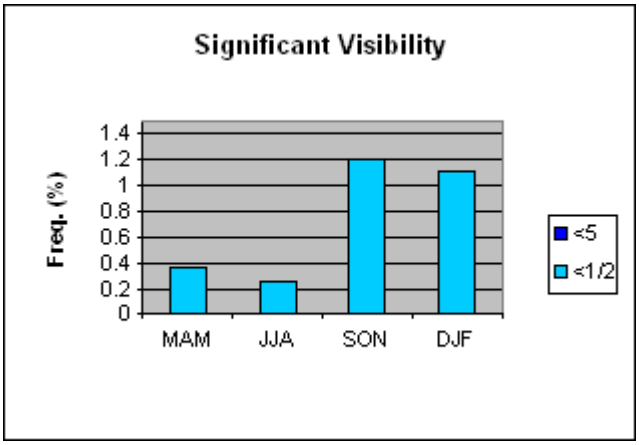


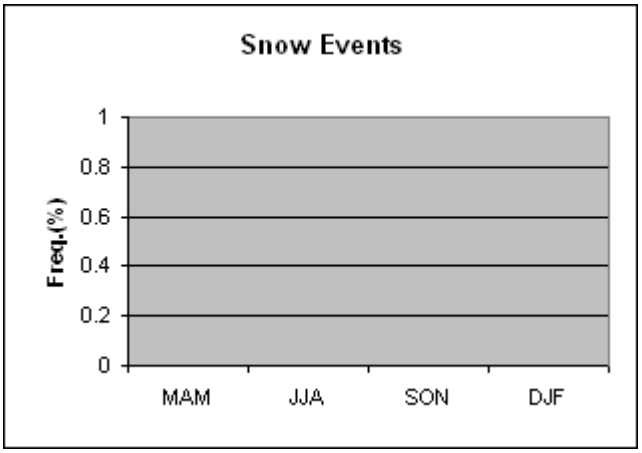
Burbank-Glendale-Pasadena – BUR

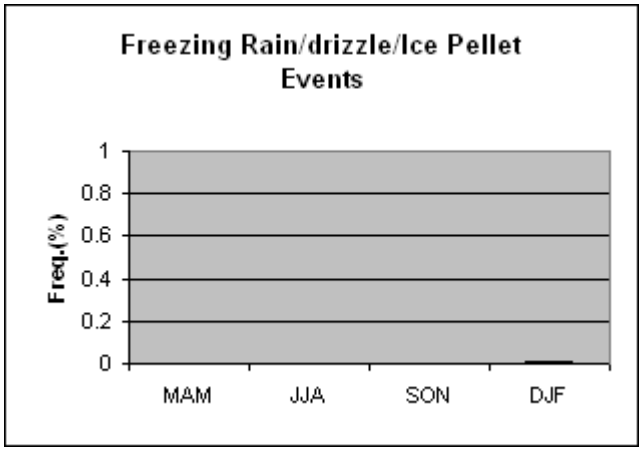




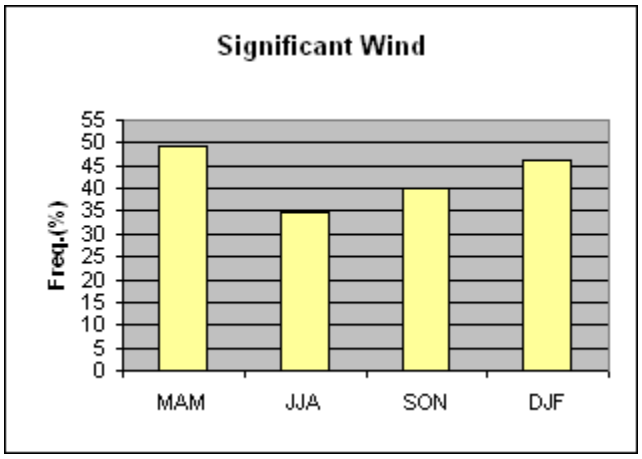


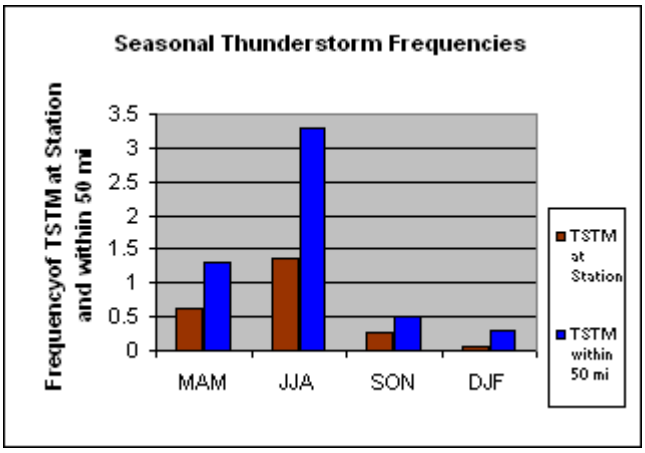


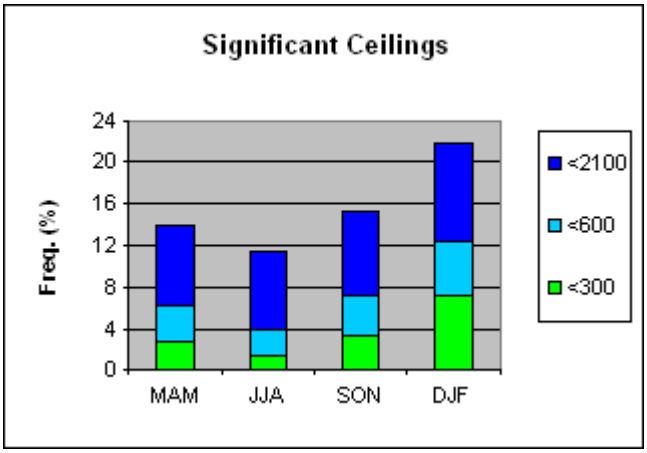


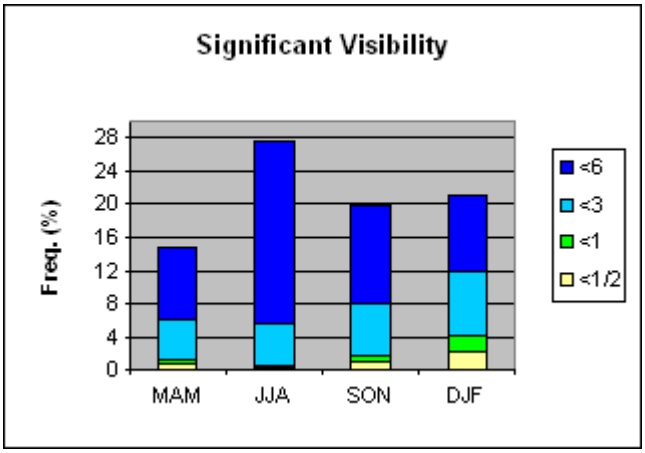


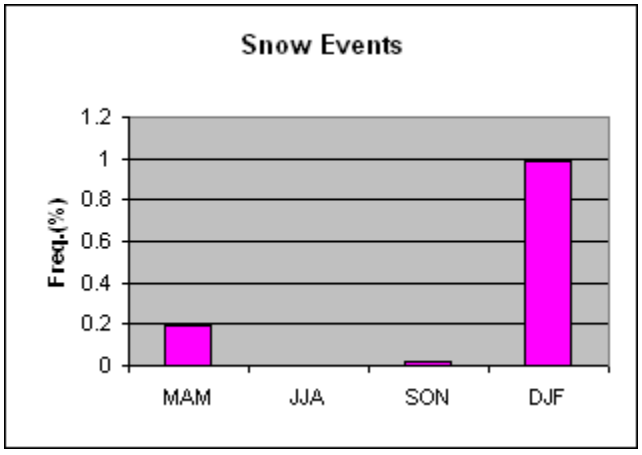
Charlotte-Douglas International – CLT

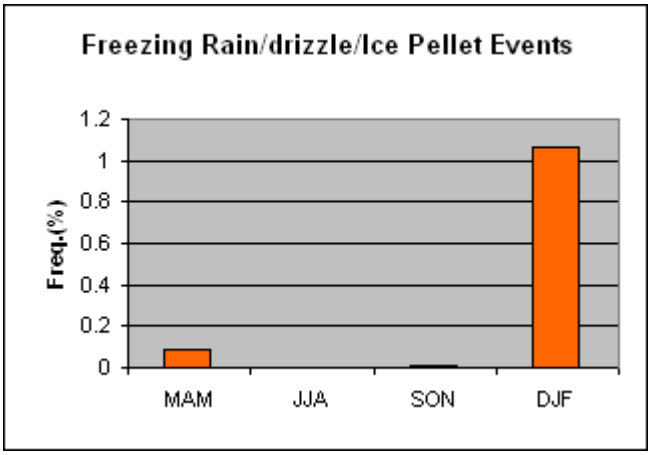




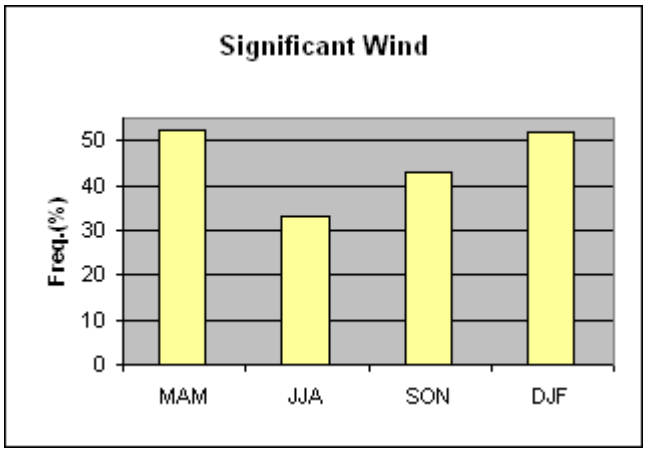


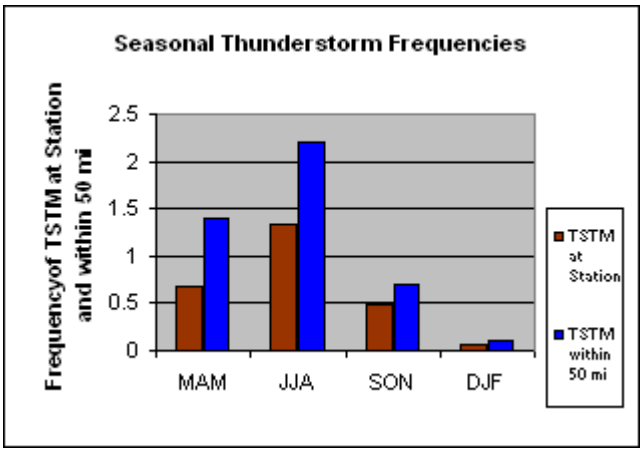


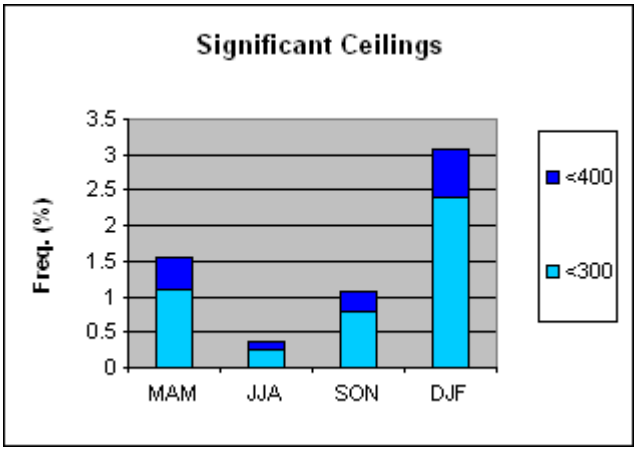


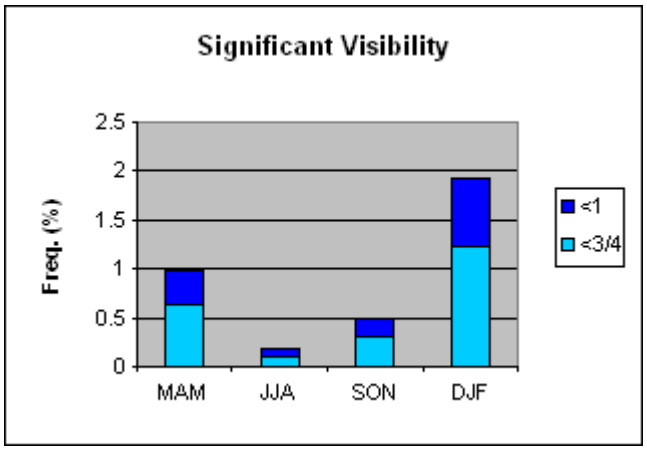


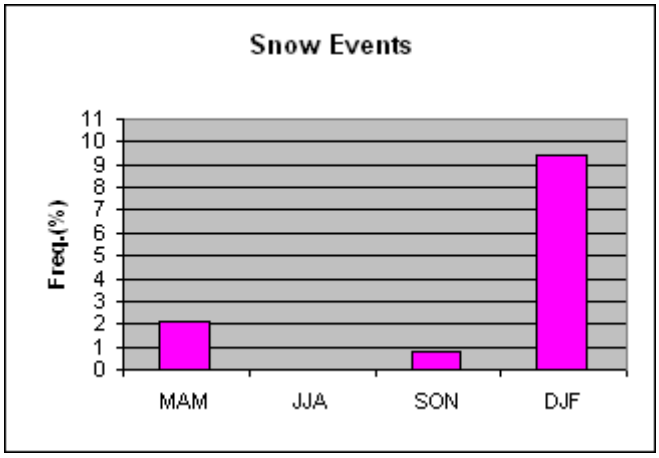
Chicago-Midway International – MDW

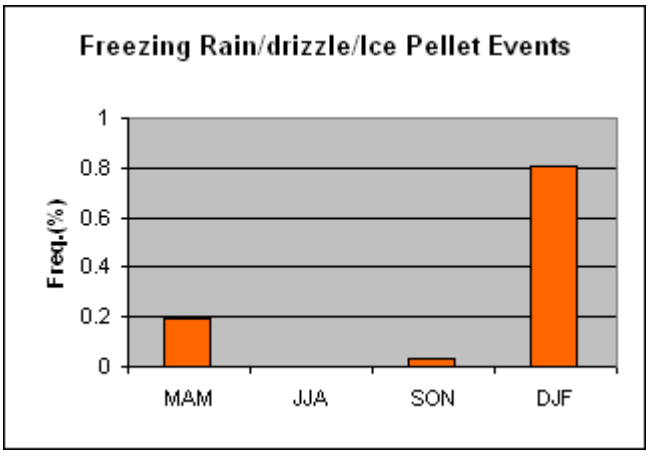




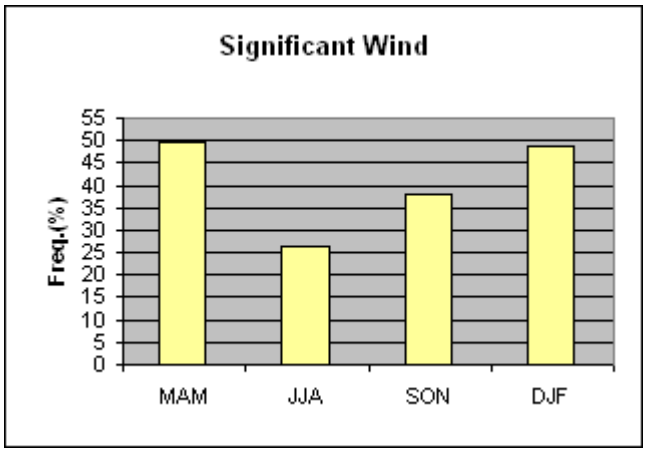


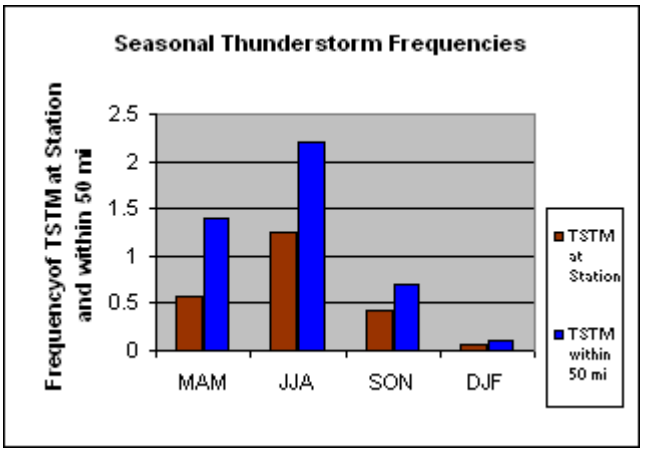


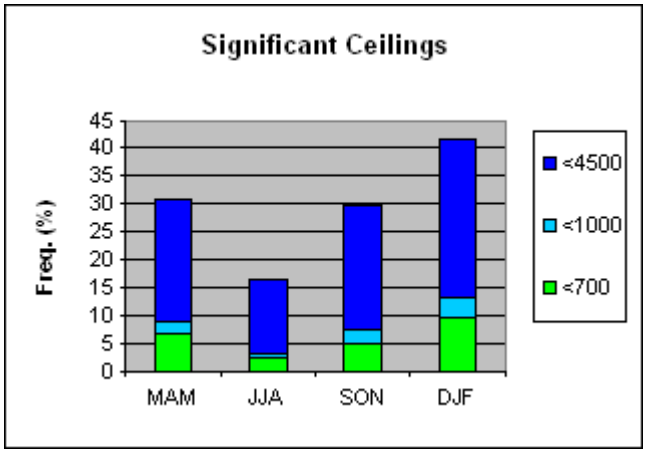


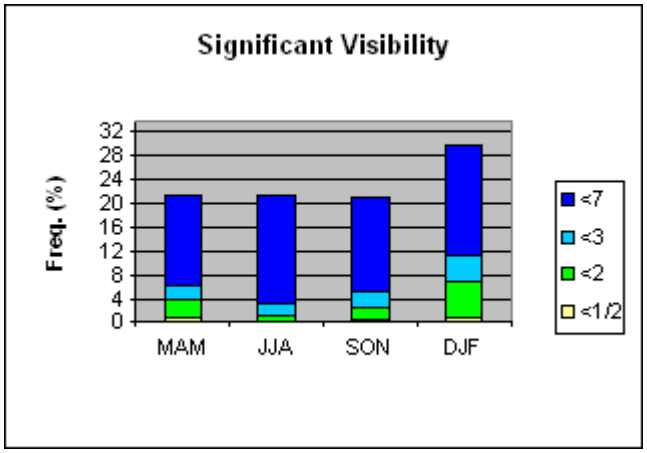


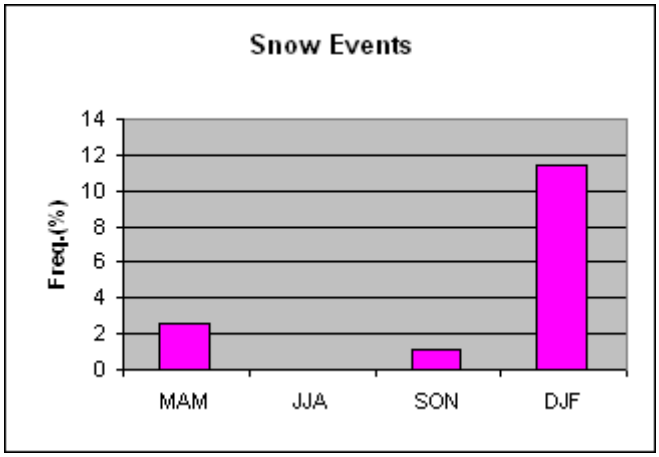
Chicago-O'Hare International – ORD

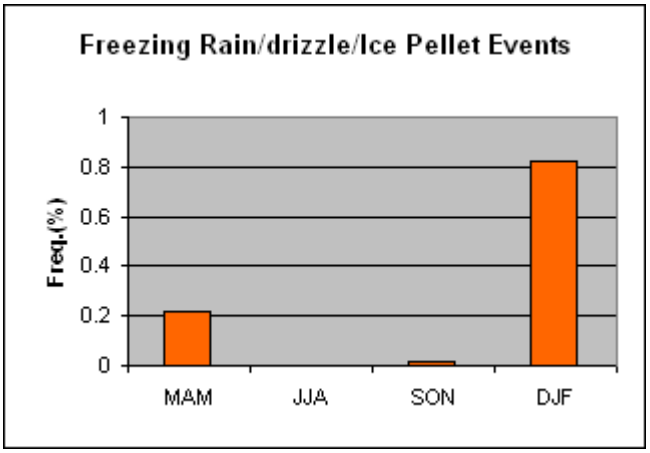




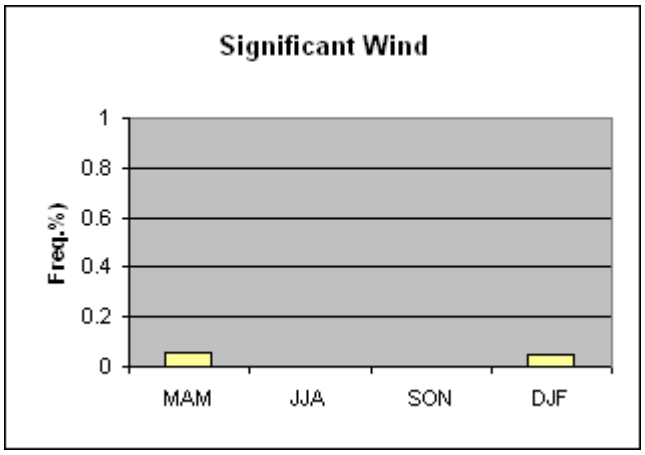


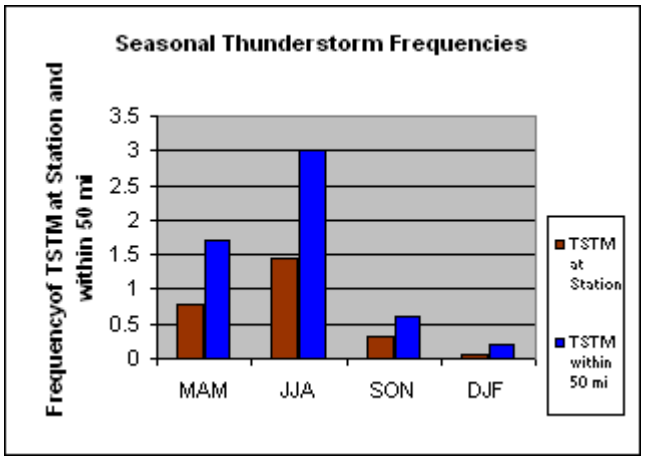


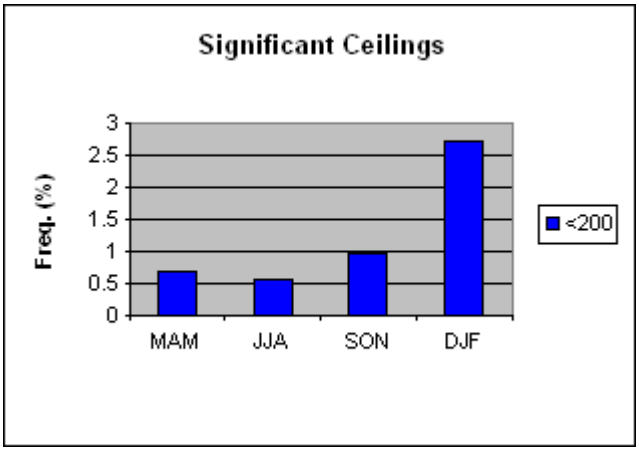


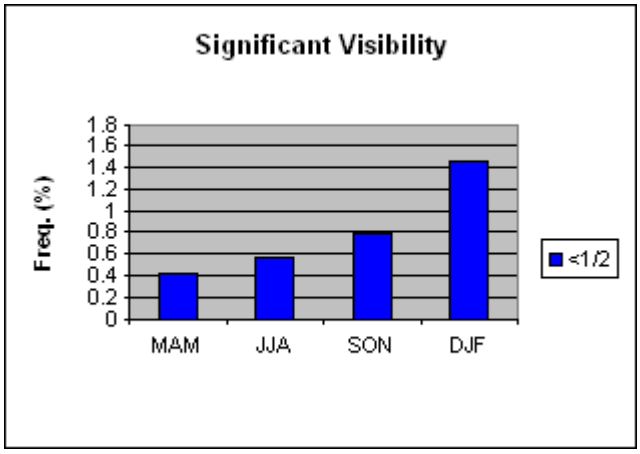


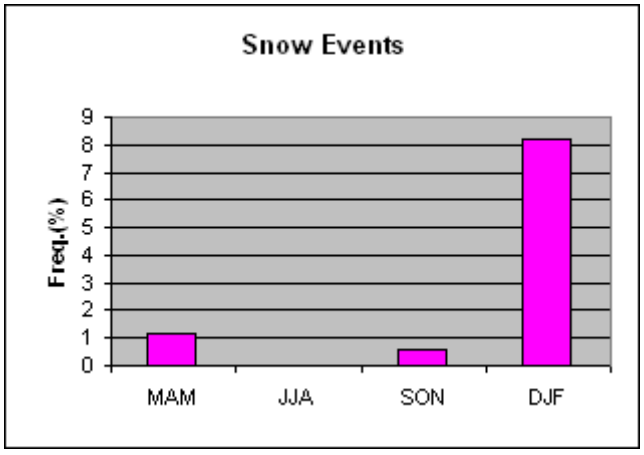
Cincinnati-Northern Kentucky International Covington – CVG

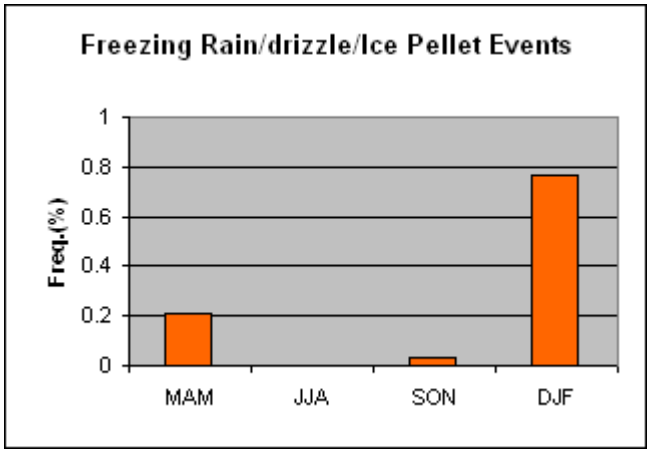




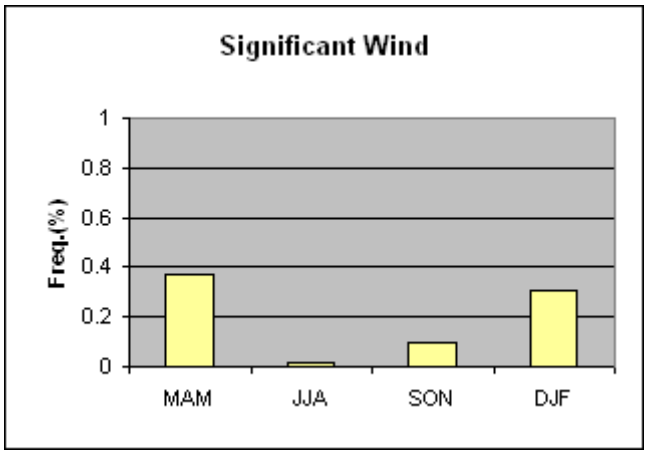


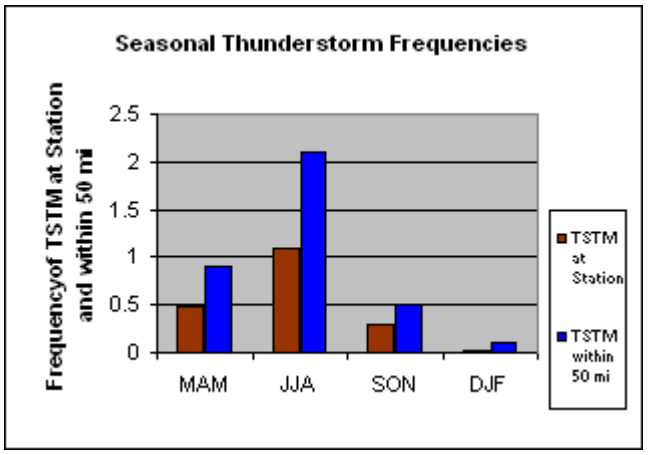


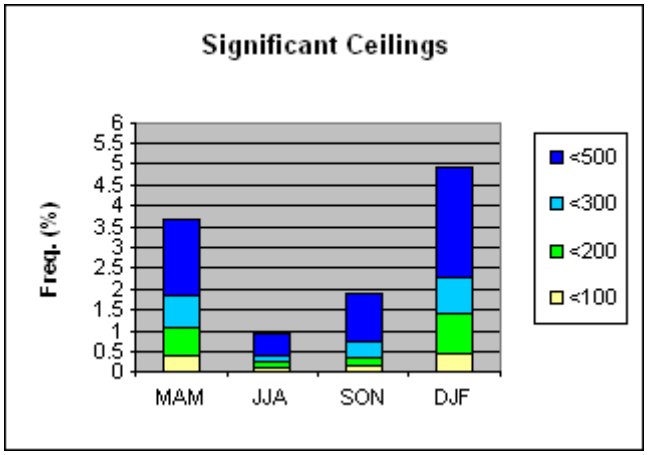


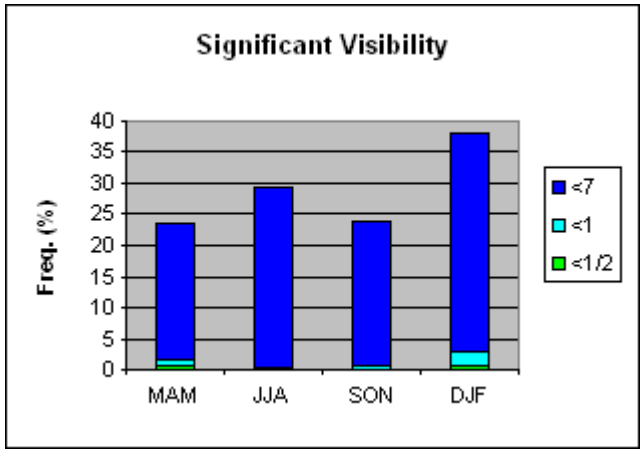


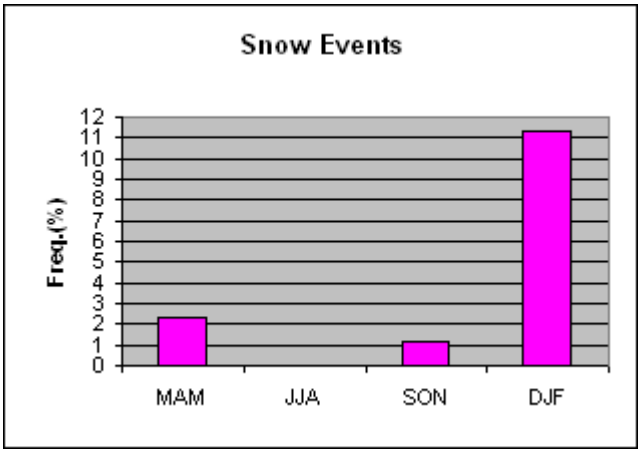
Cleveland-Hopkins International – CLE

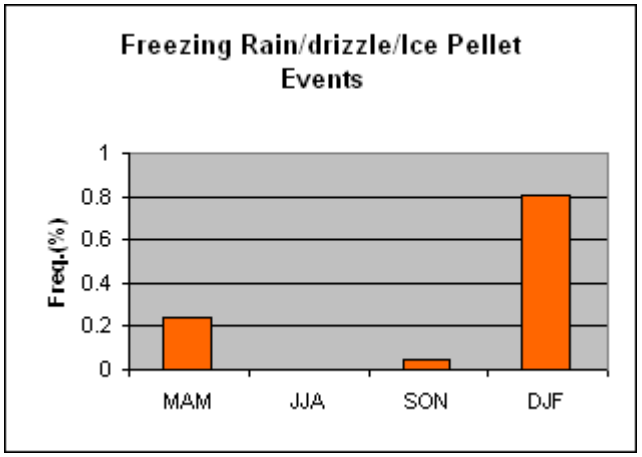




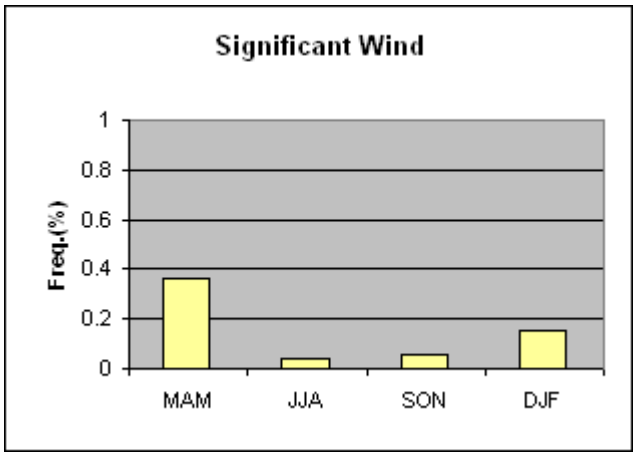


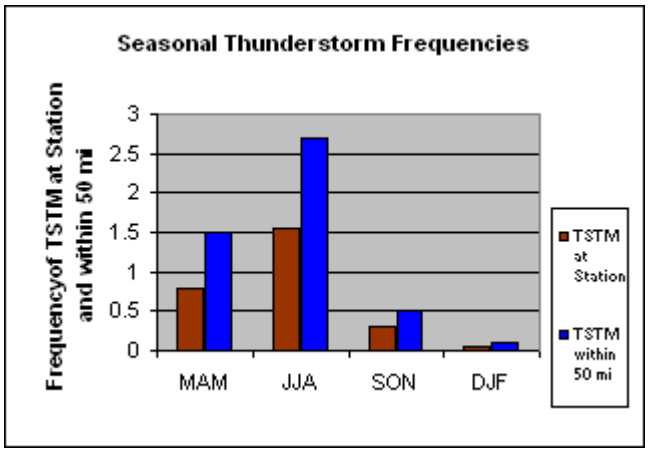


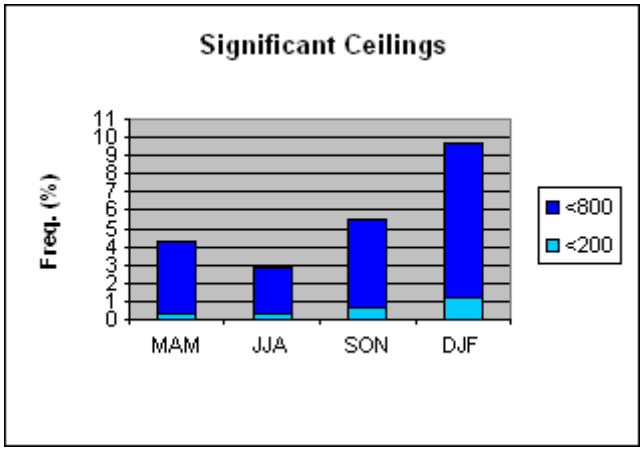


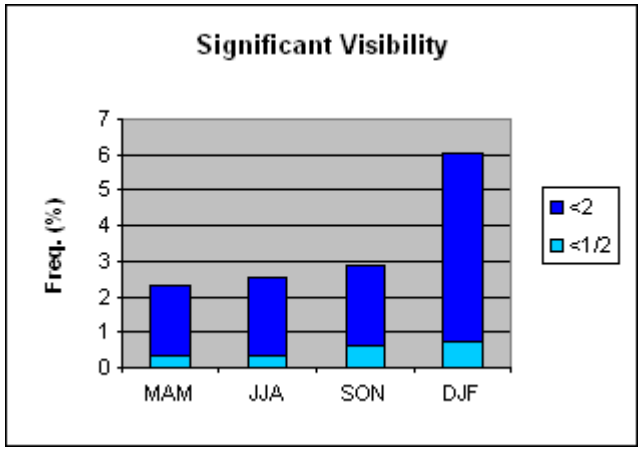


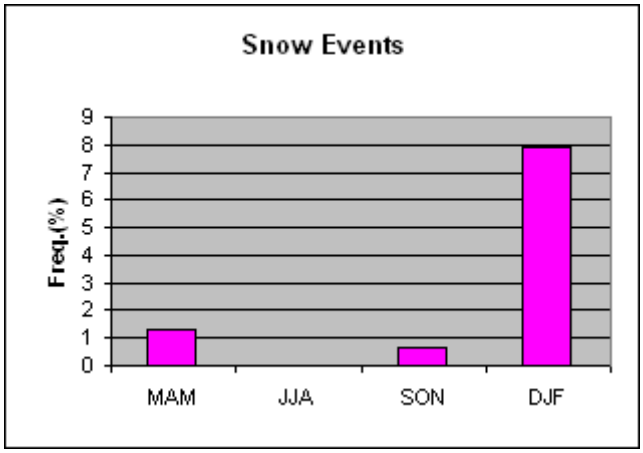
Columbus-Port Columbus International – CMH

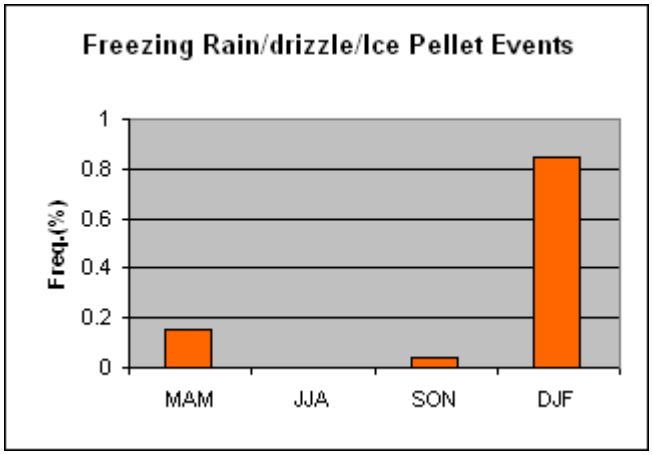




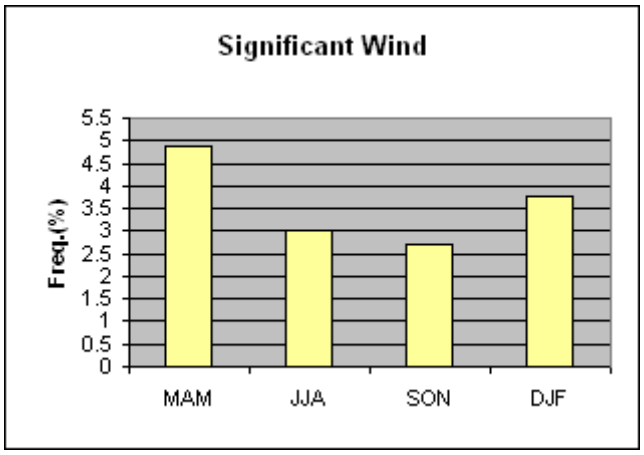


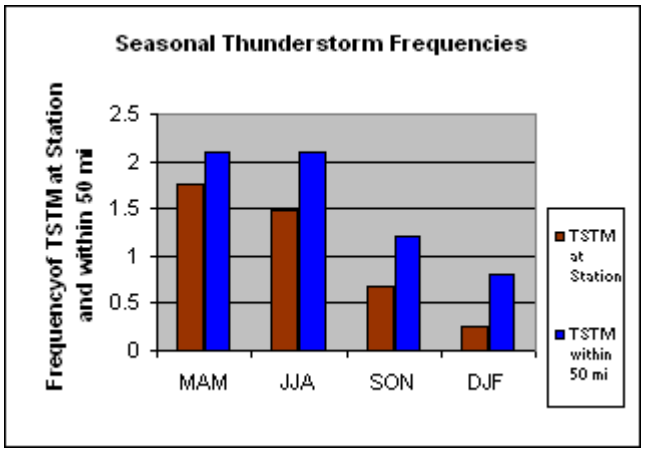


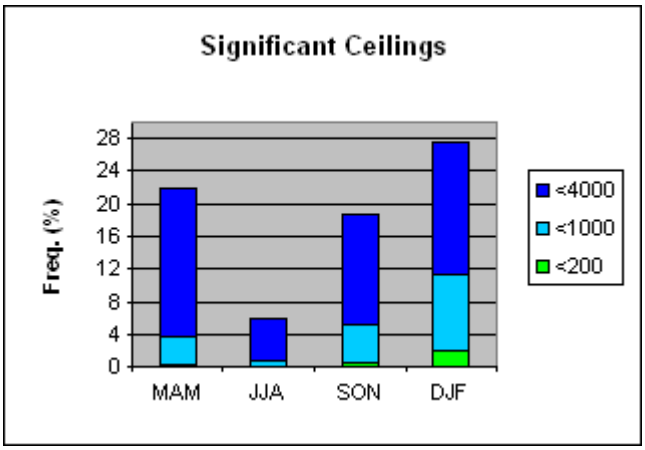


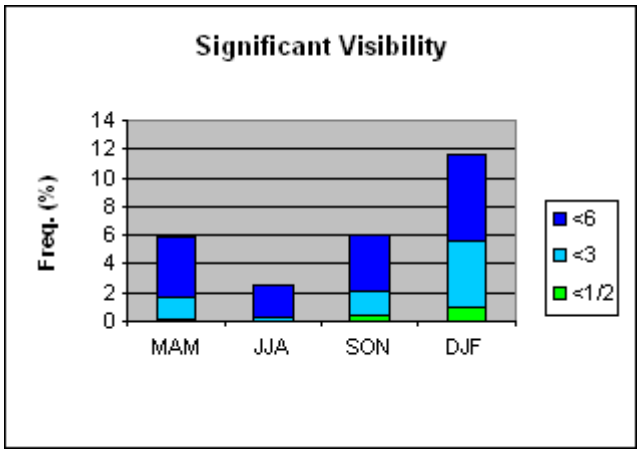


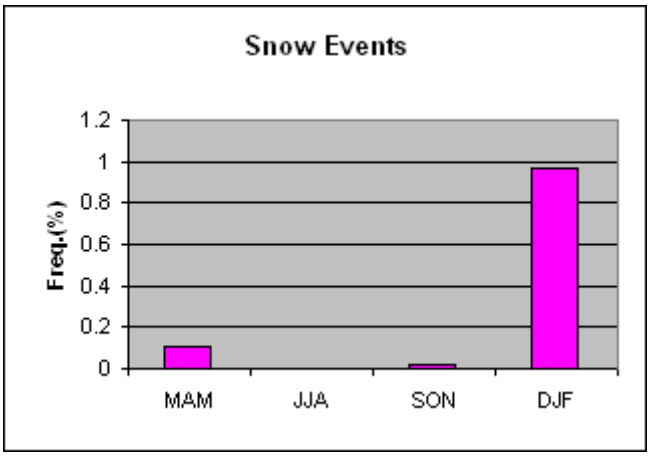
Dallas-Ft.Worth International - DFW

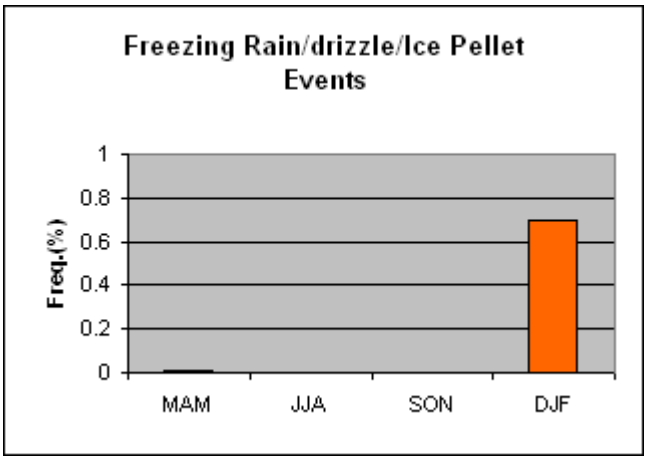




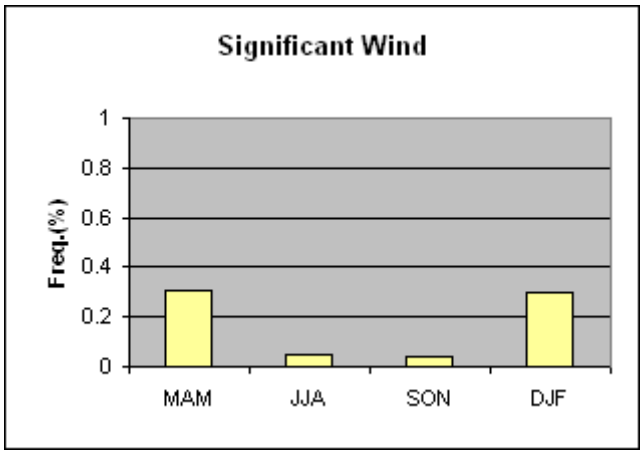


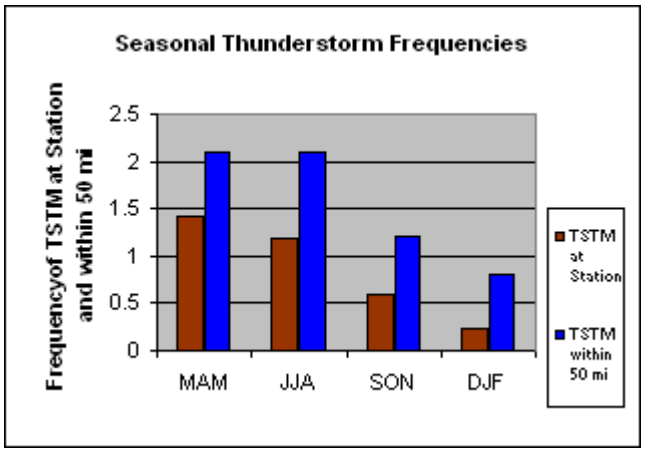


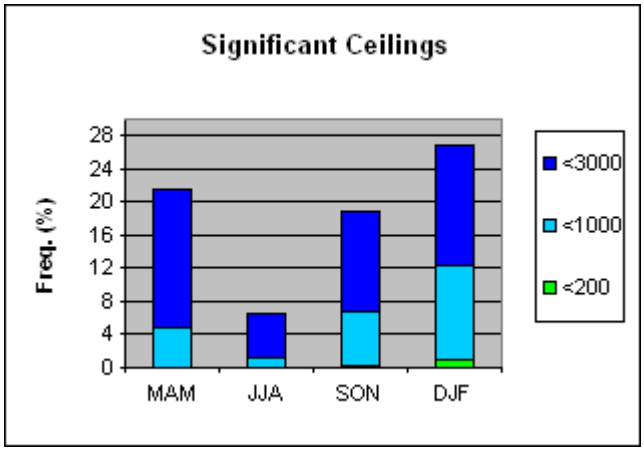


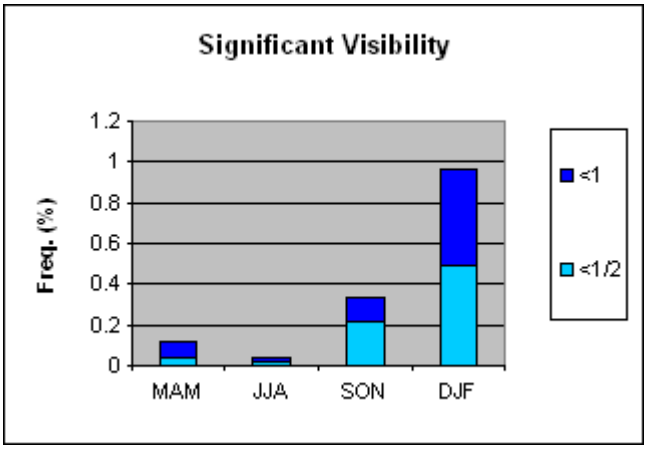


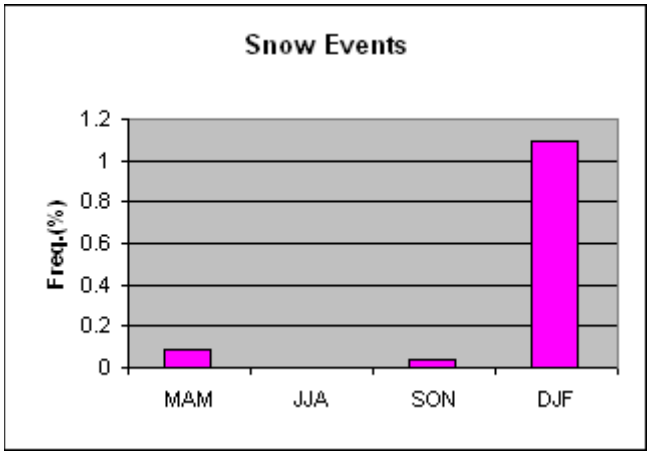
Dallas Love Field – DAL

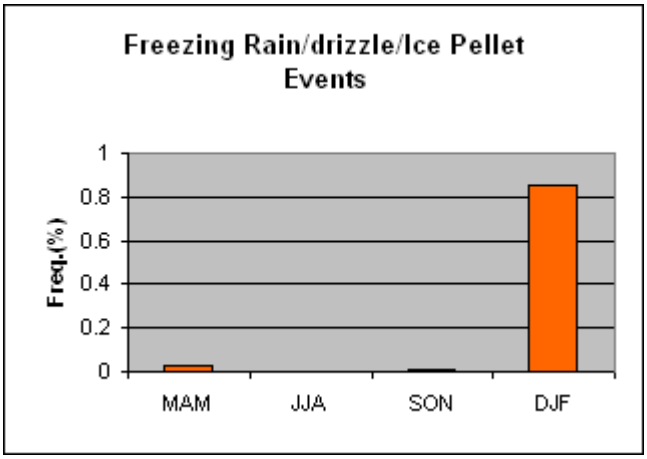




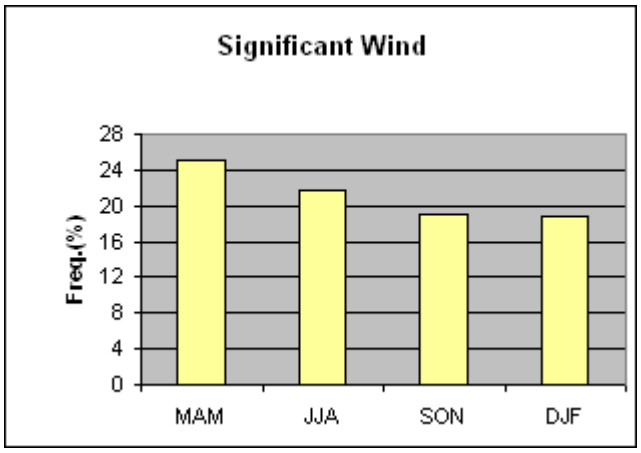


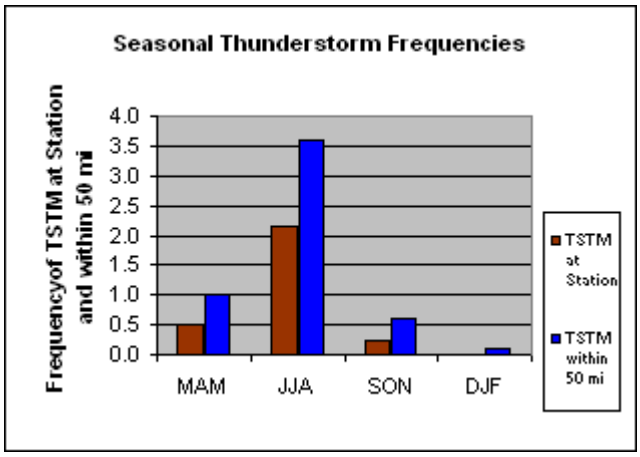


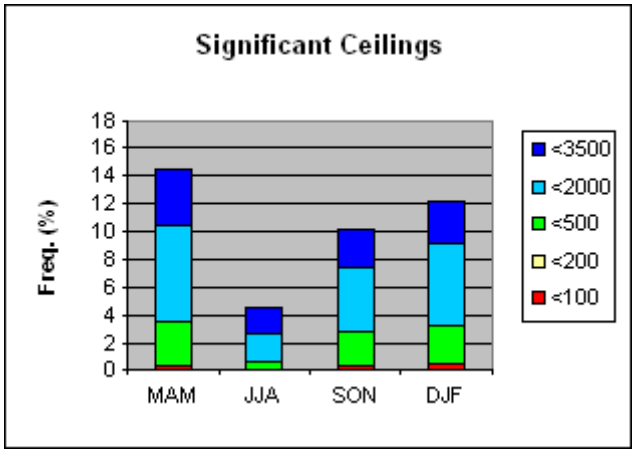


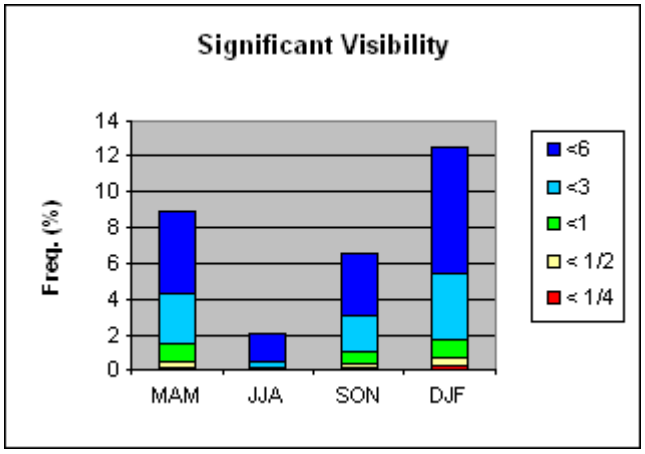


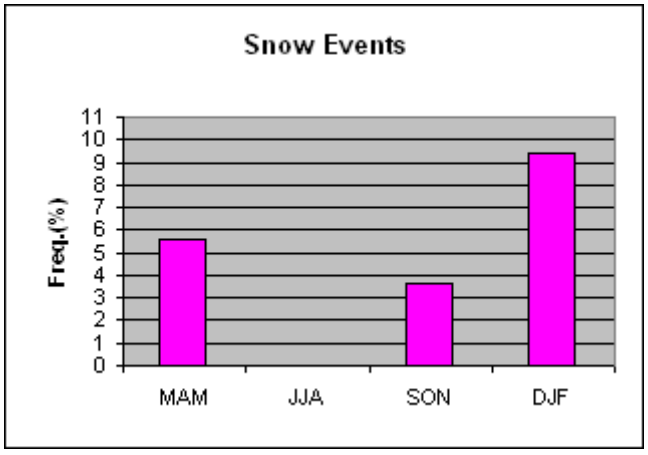
Denver International – DEN

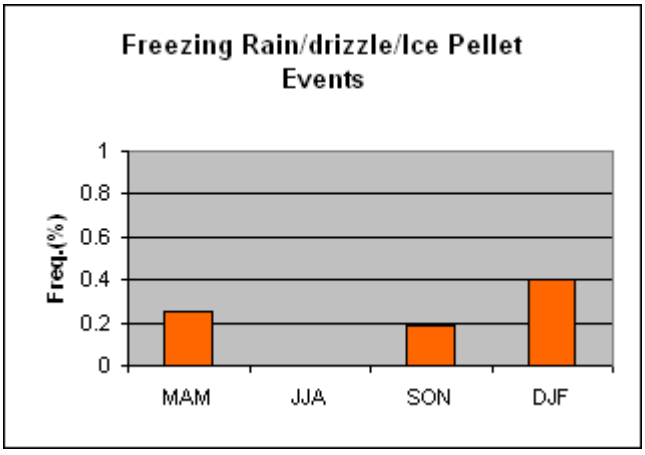




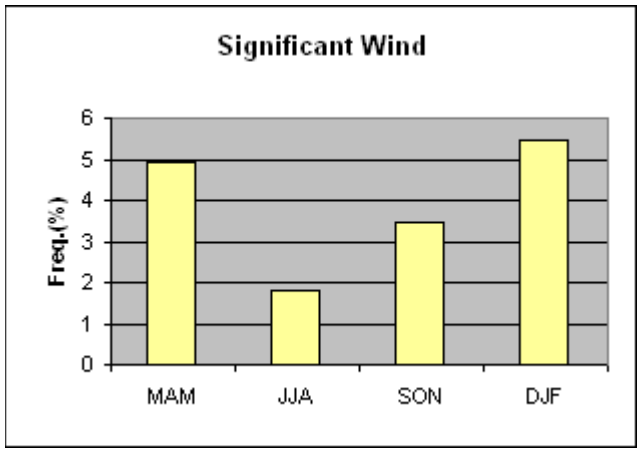


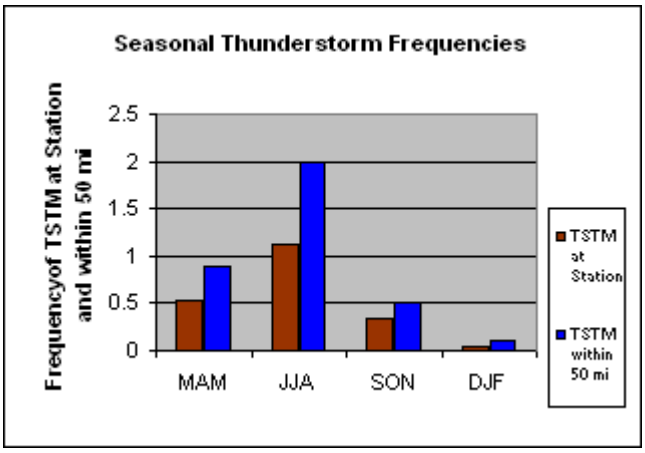


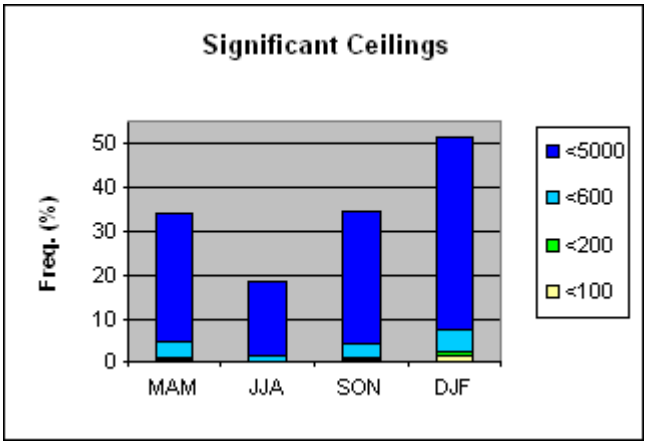


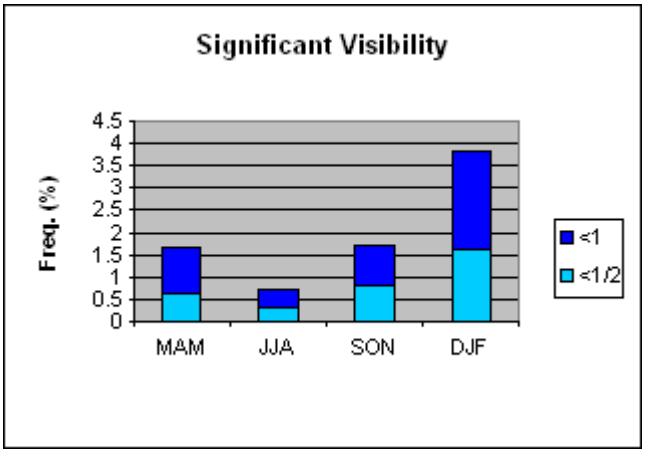


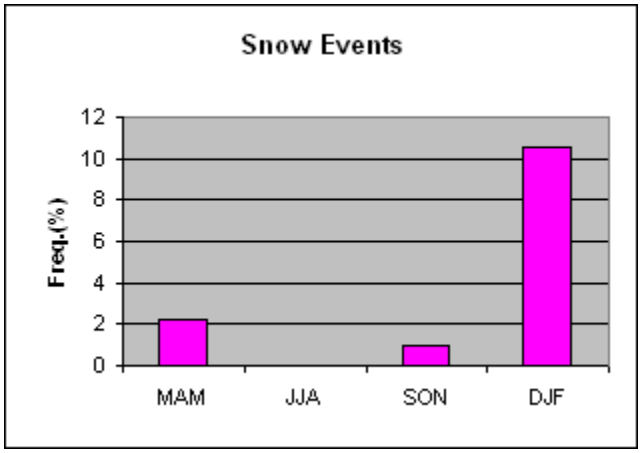
Detroit Metropolitan Wayne County– DTW

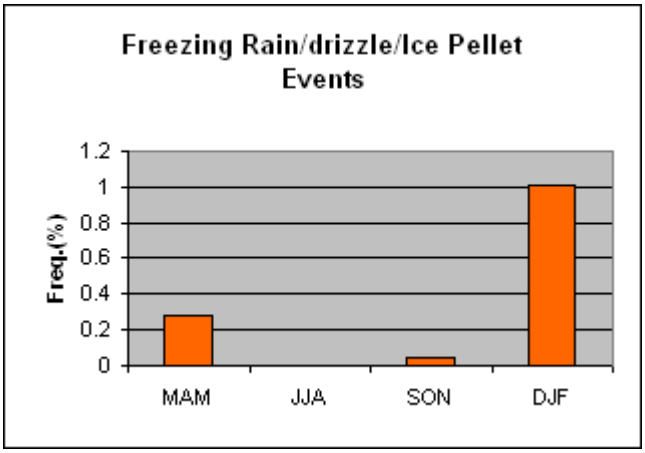




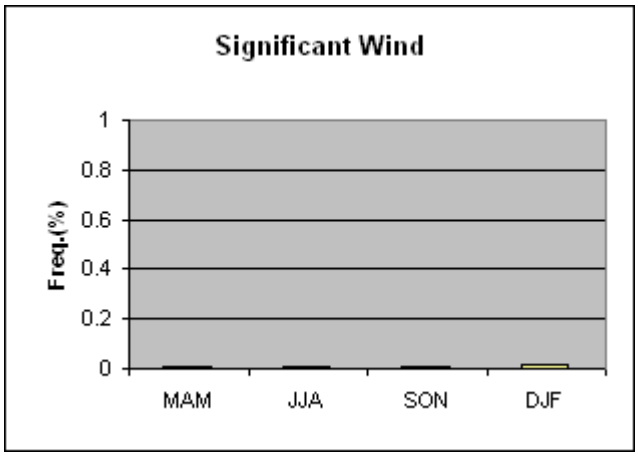


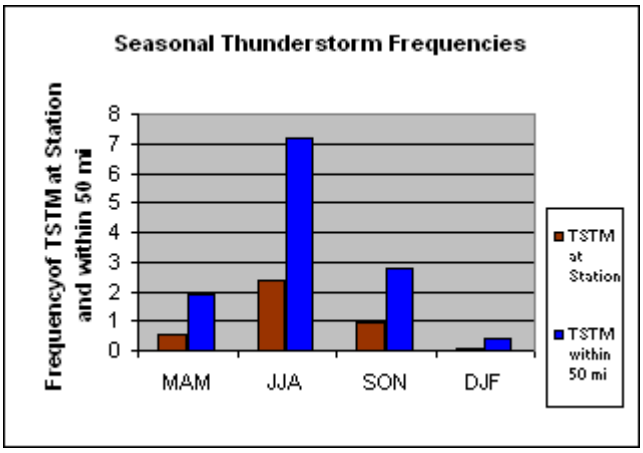


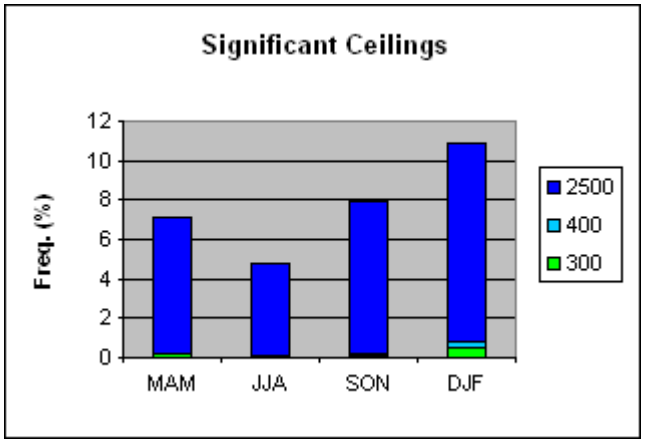


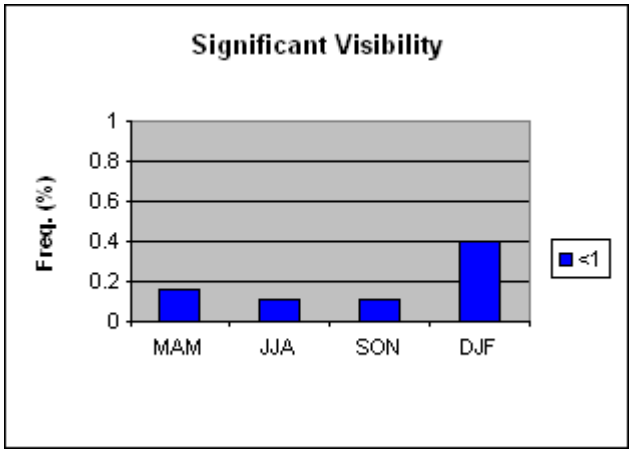


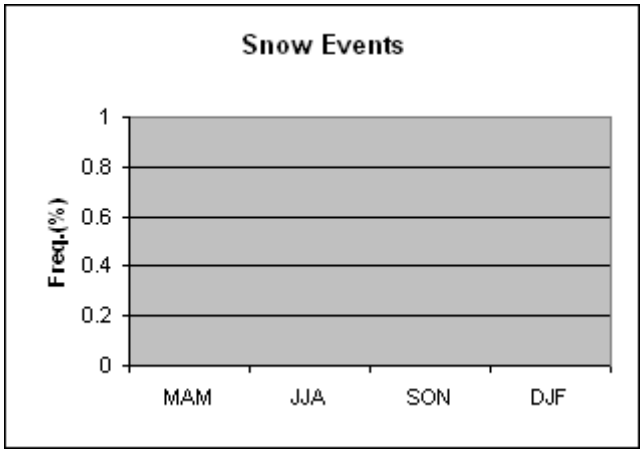
Fort Lauderdale Hollywood International – FLL

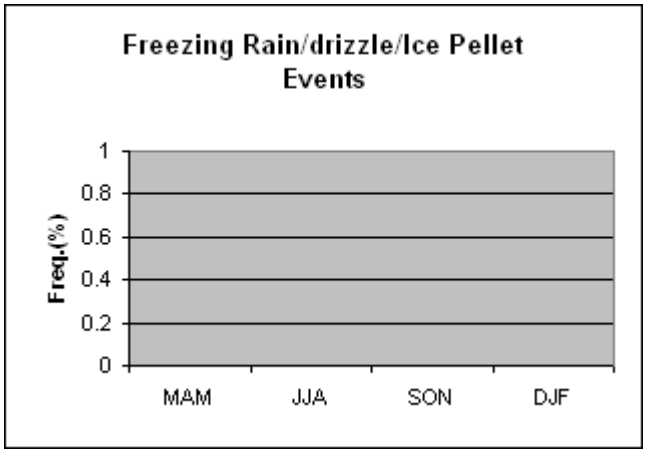




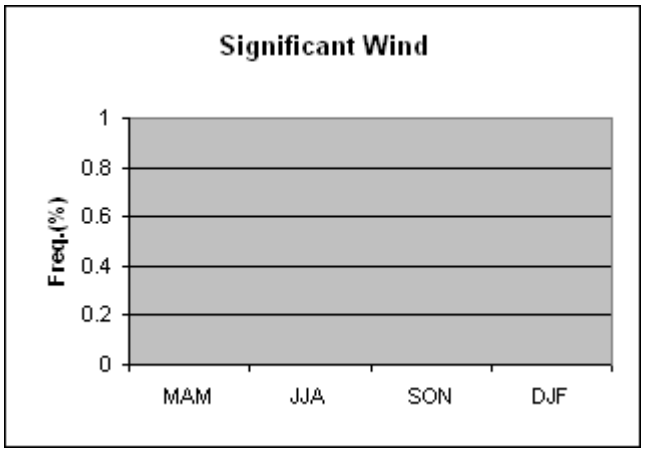


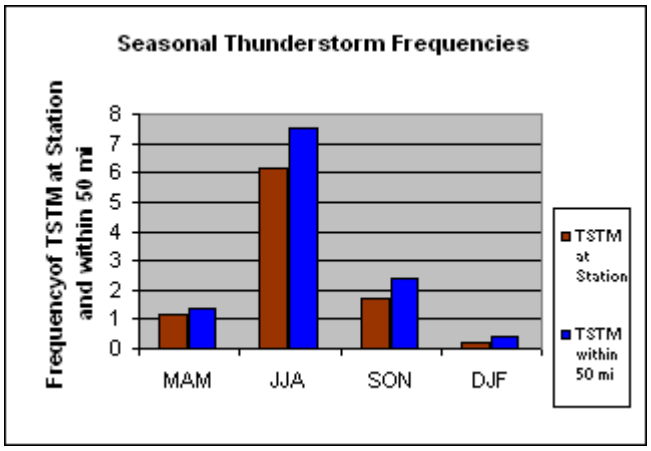


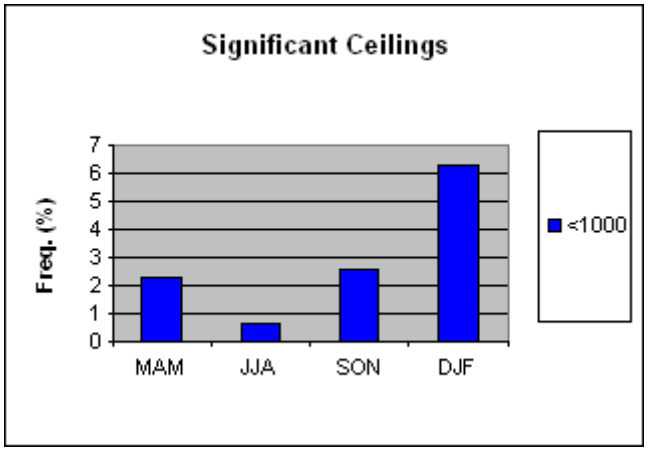


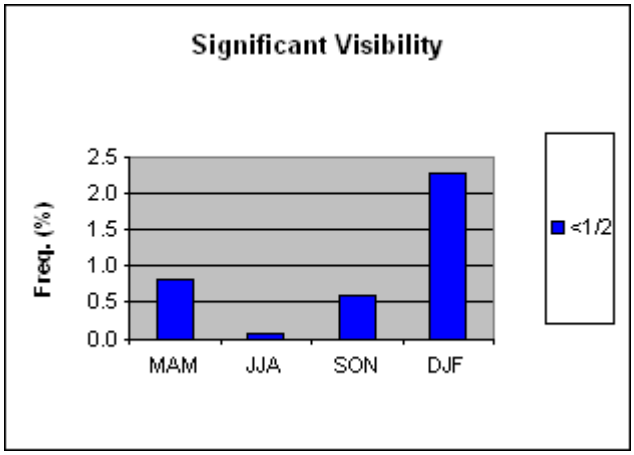


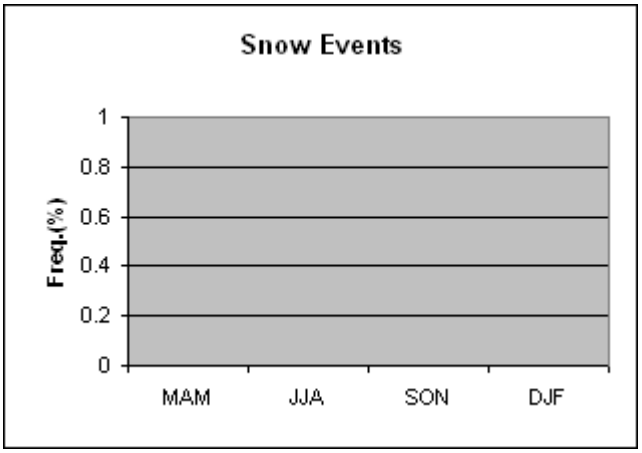
Fort Myers Southwest Florida International – RSW

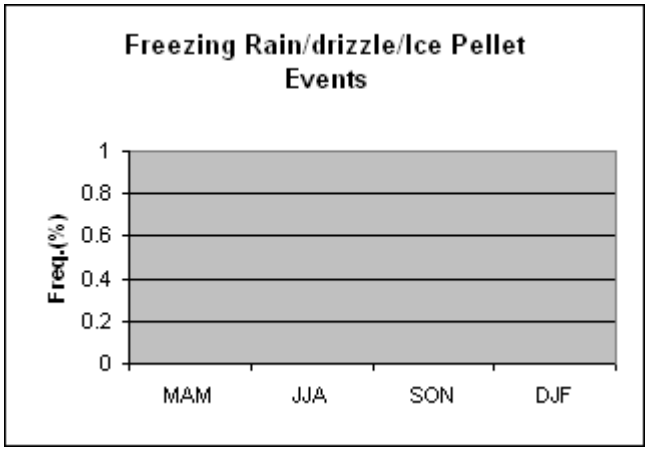




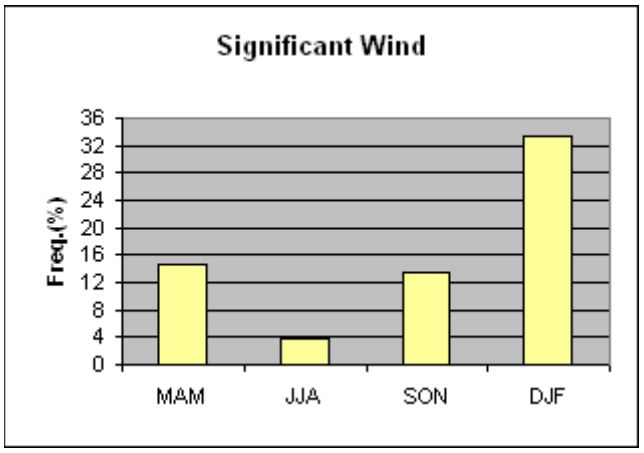


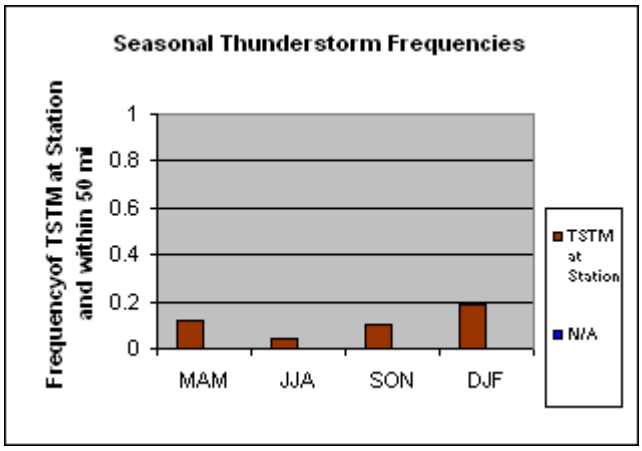


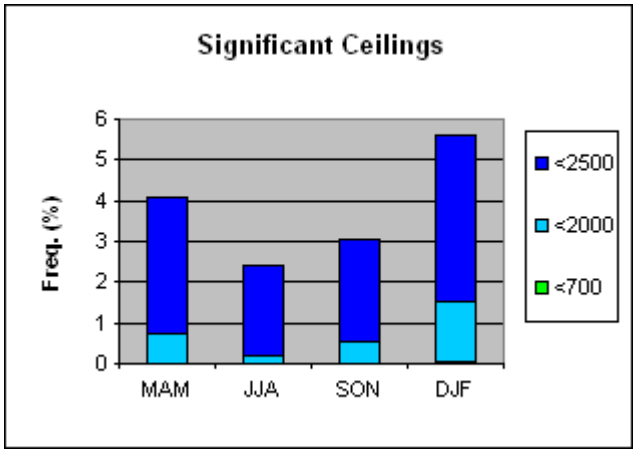


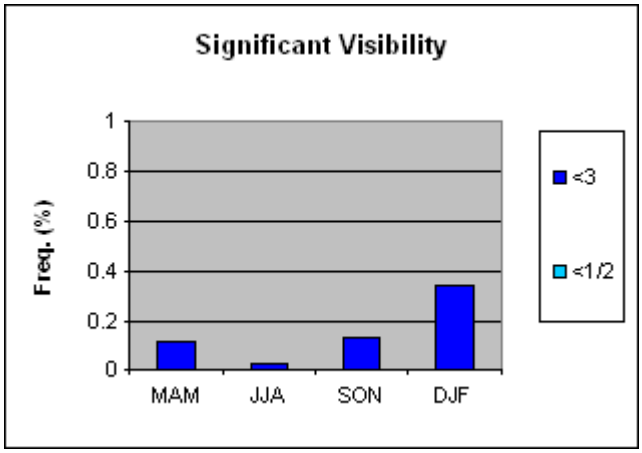


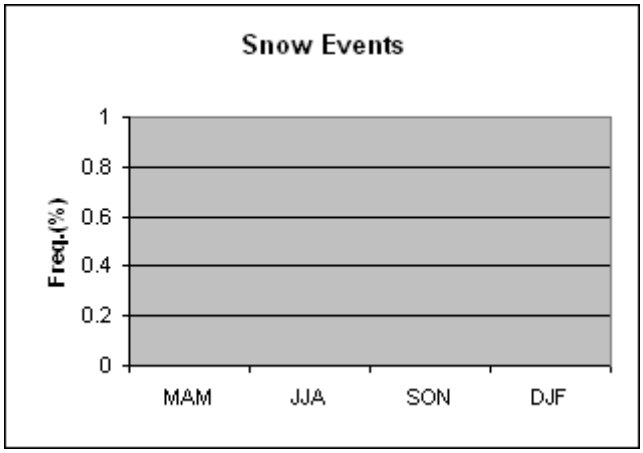
Honolulu International – HNL

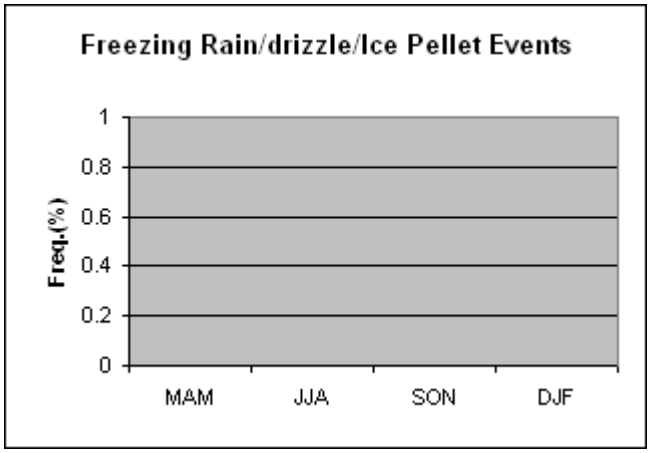




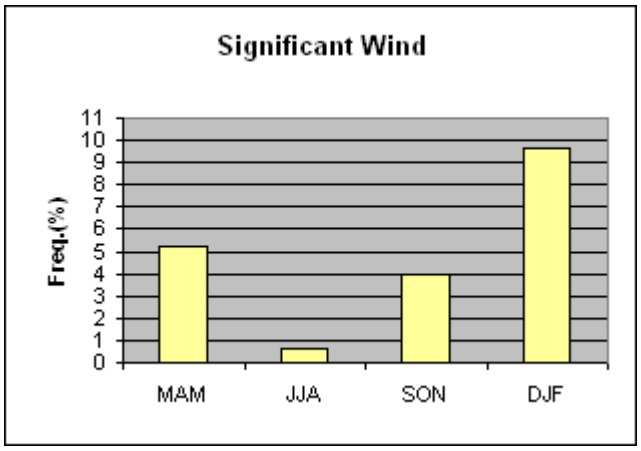


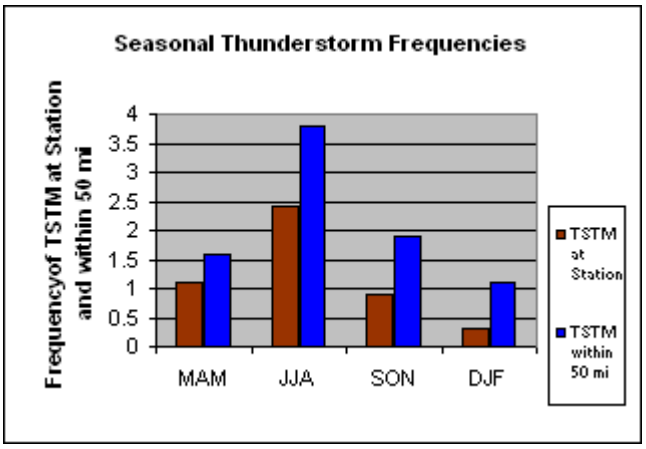


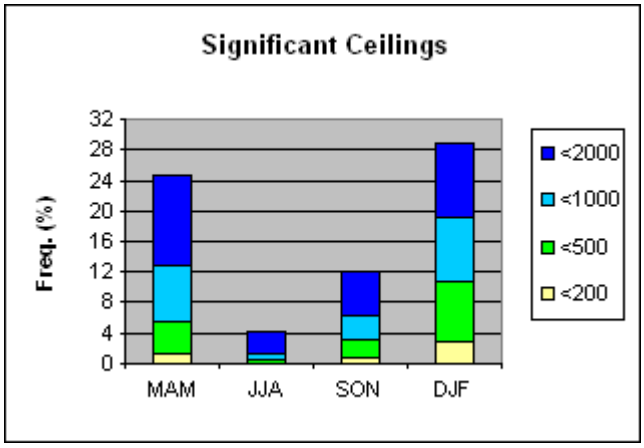


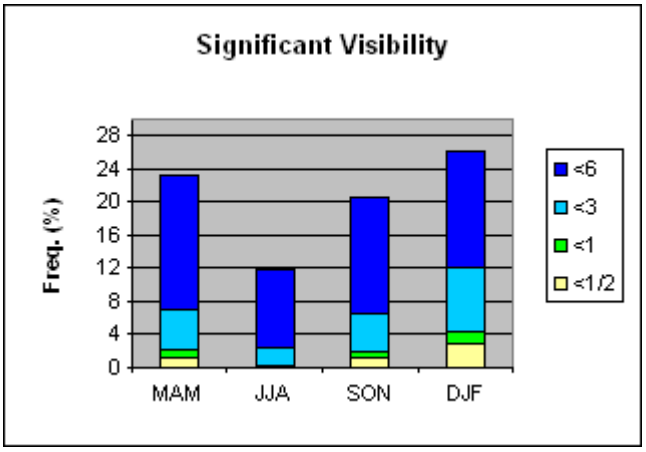


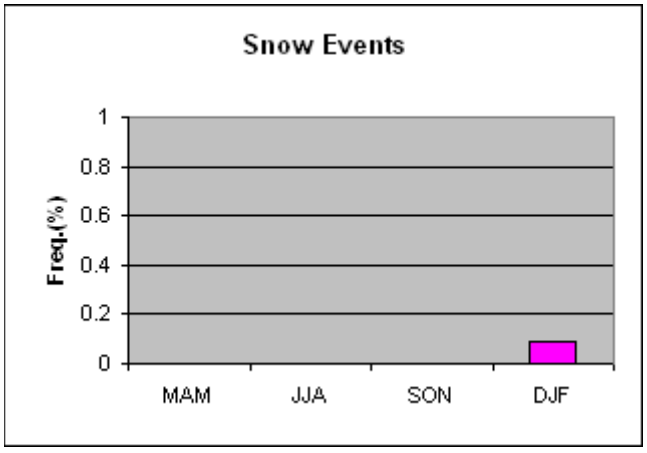
Houston Hobby – HOU

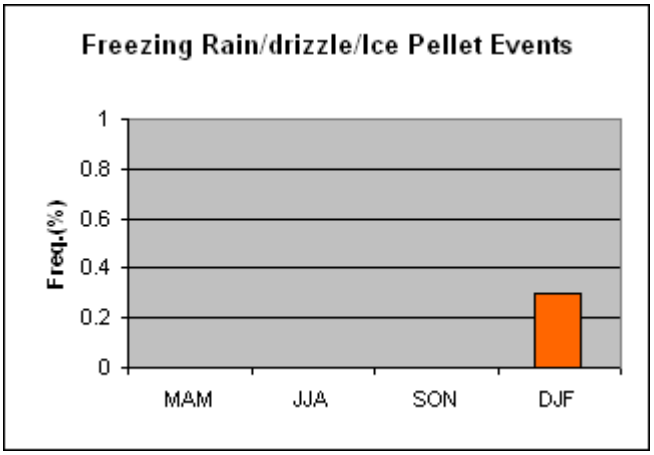




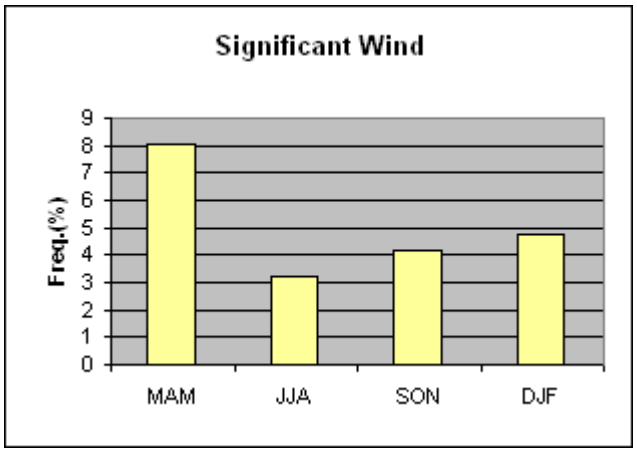


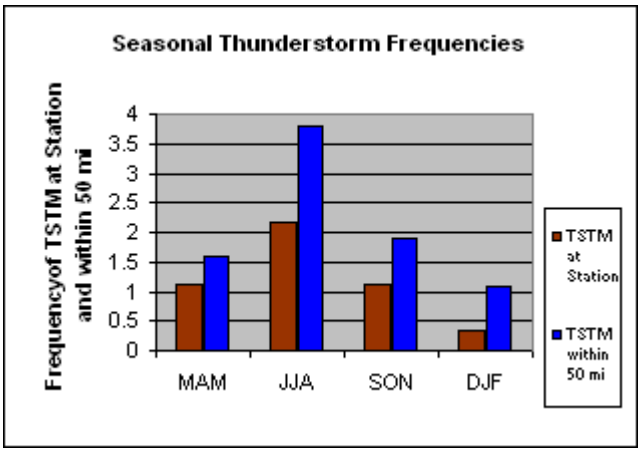


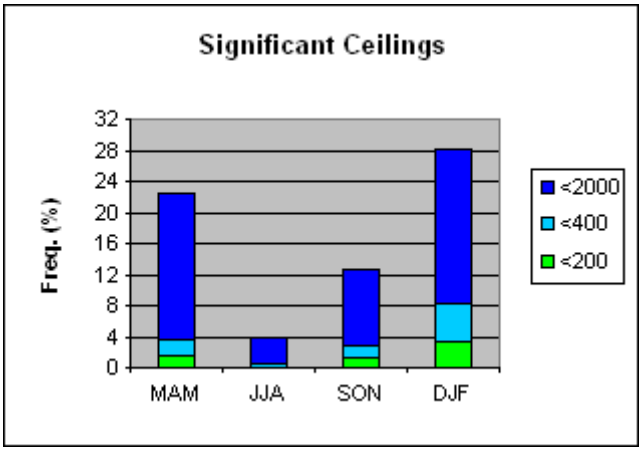


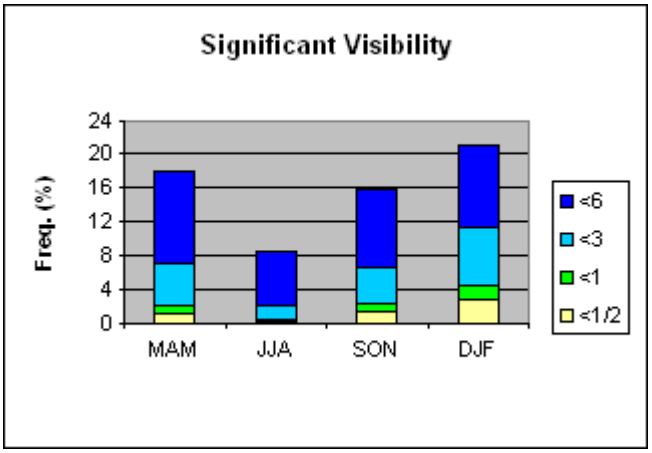


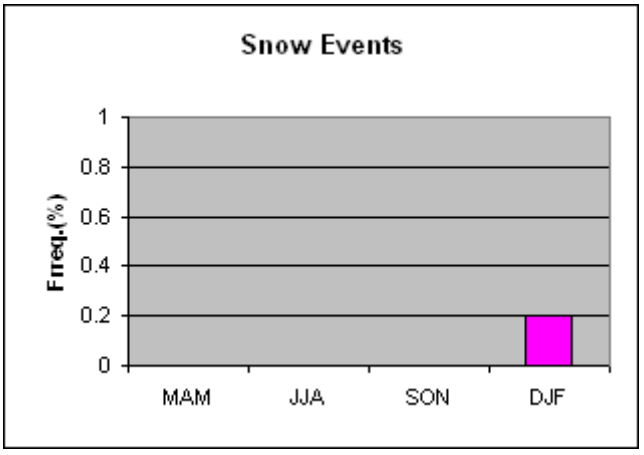
Houston George Bush Intercontinental – IAH

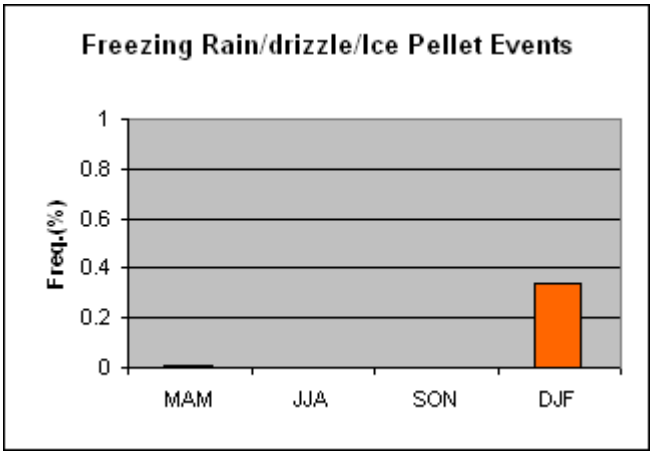




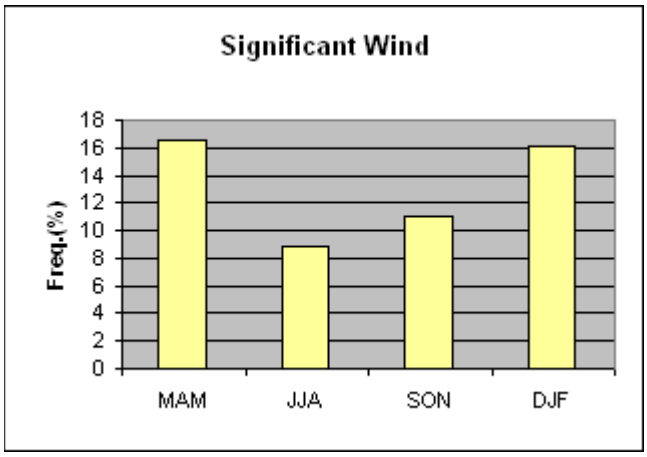


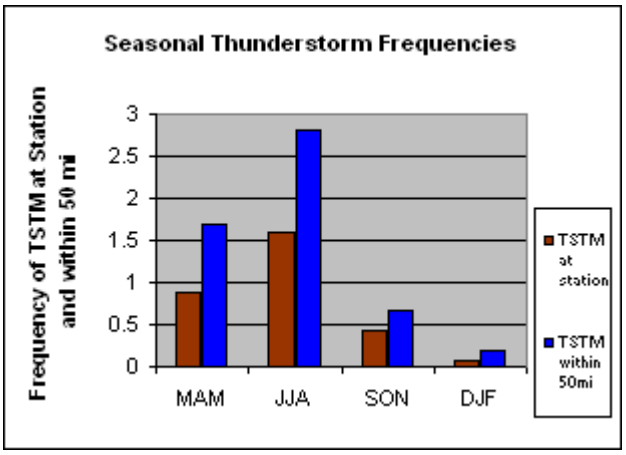


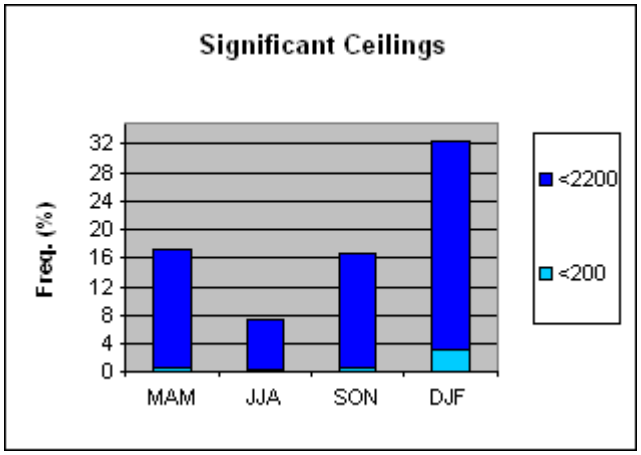


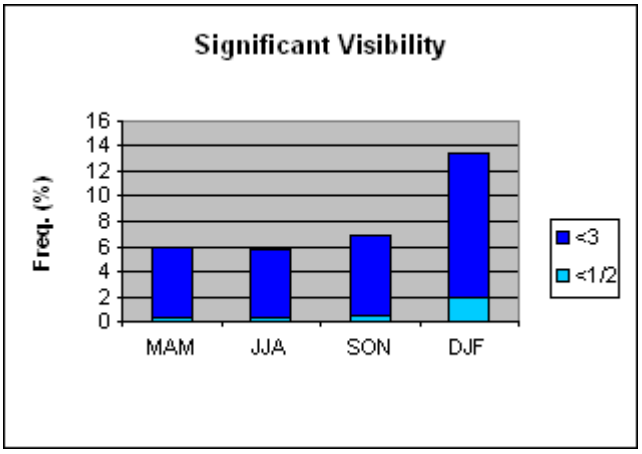


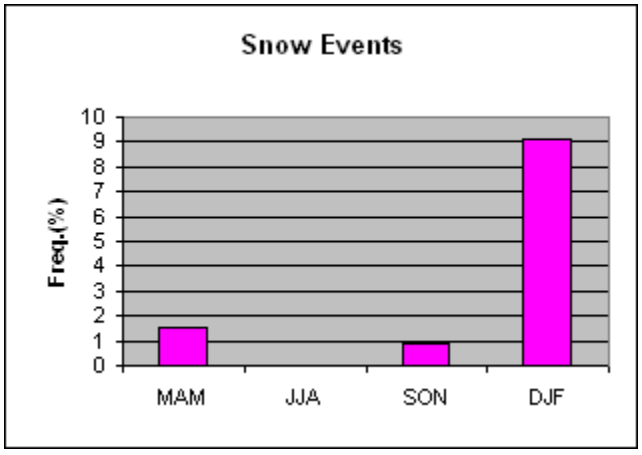
Indianapolis International – IND

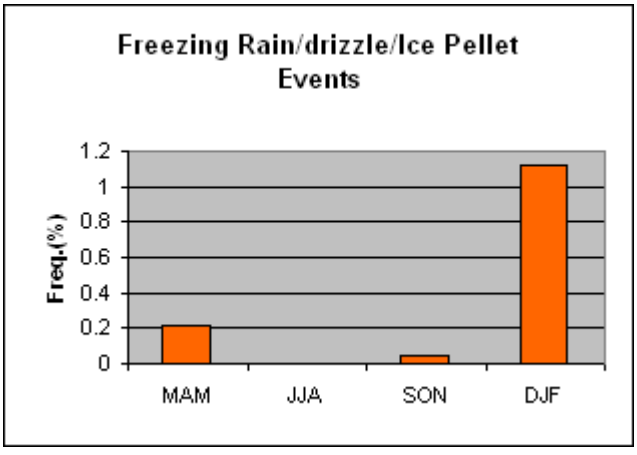




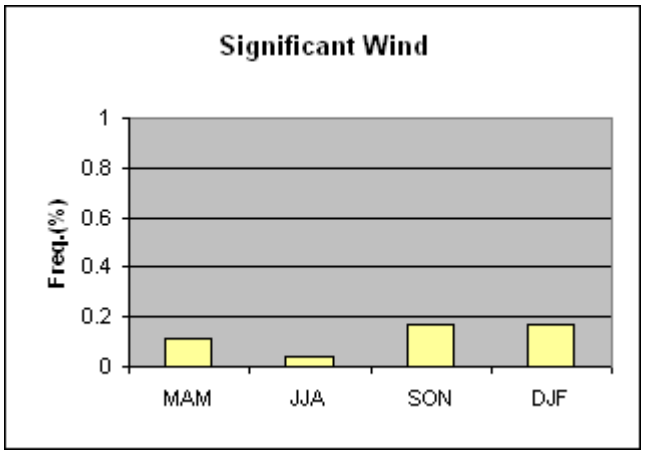


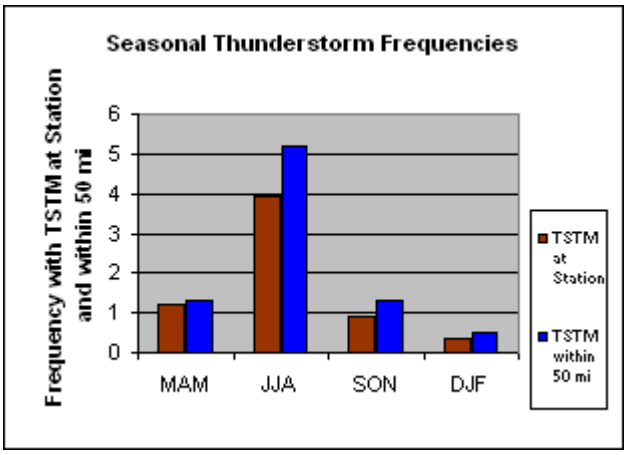


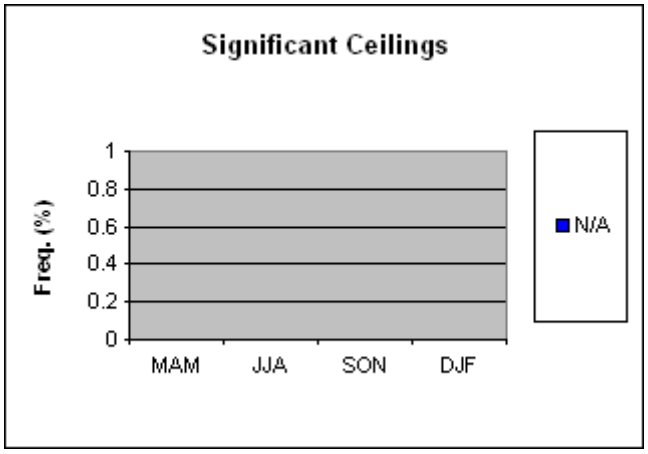


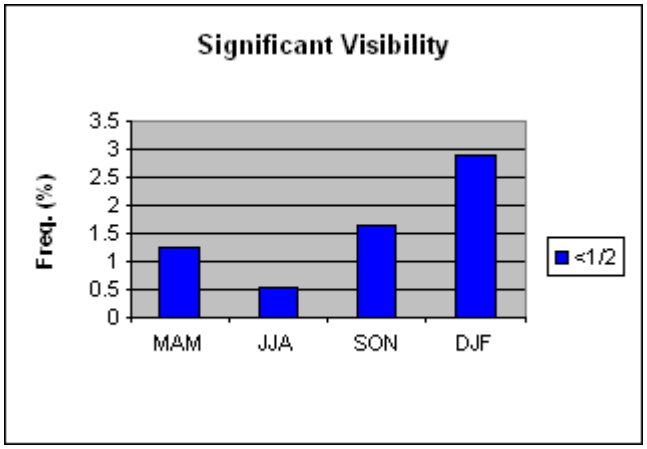


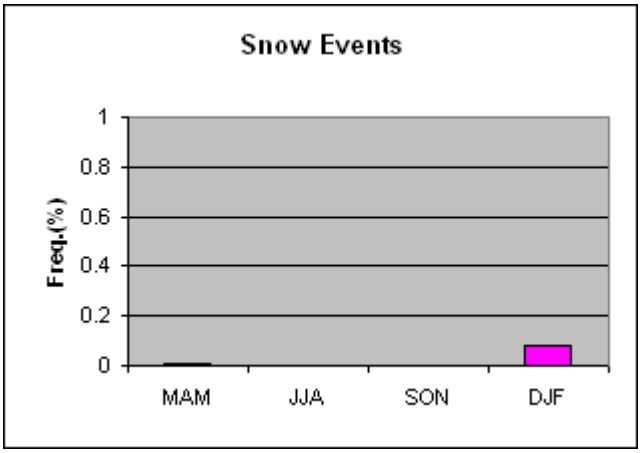
Jacksonville International – JAX

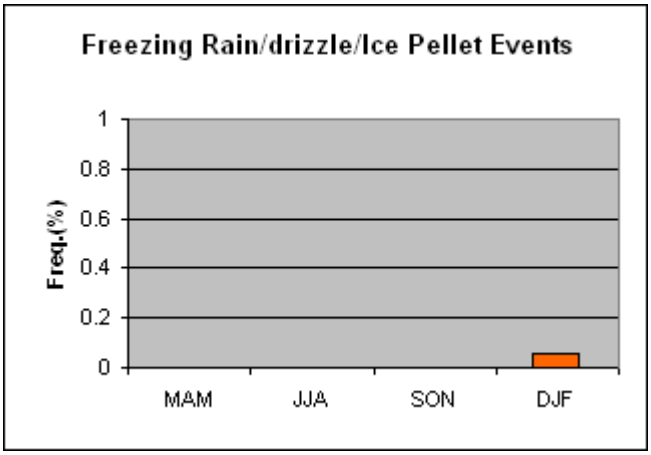




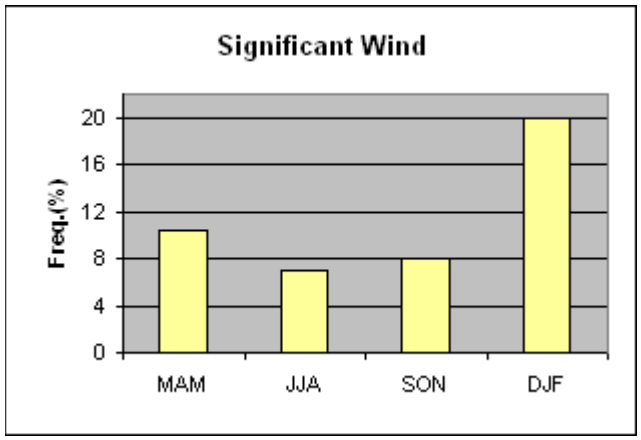


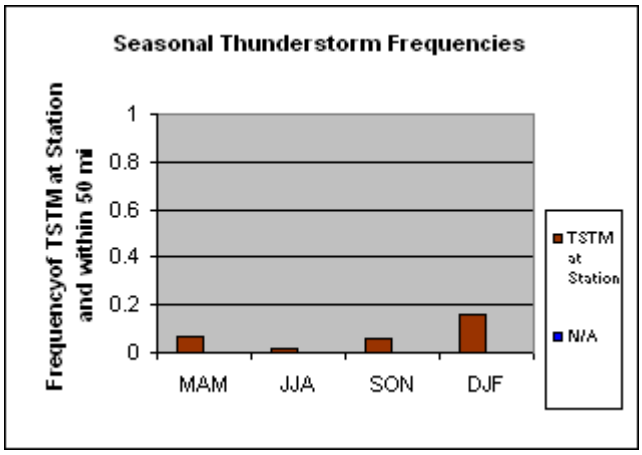


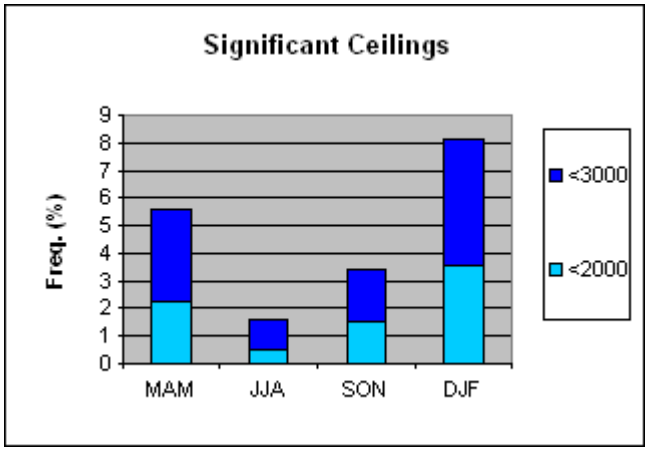


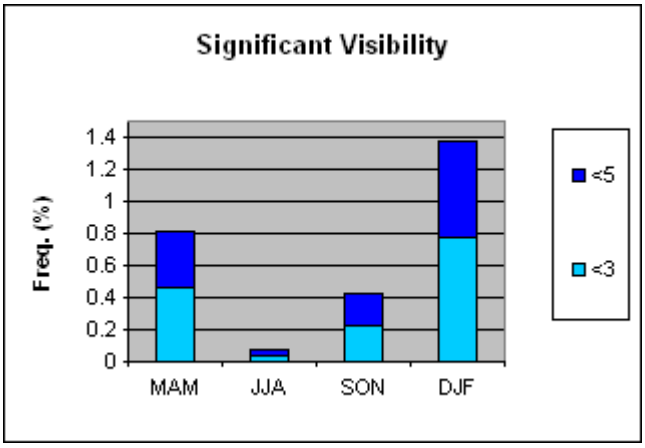


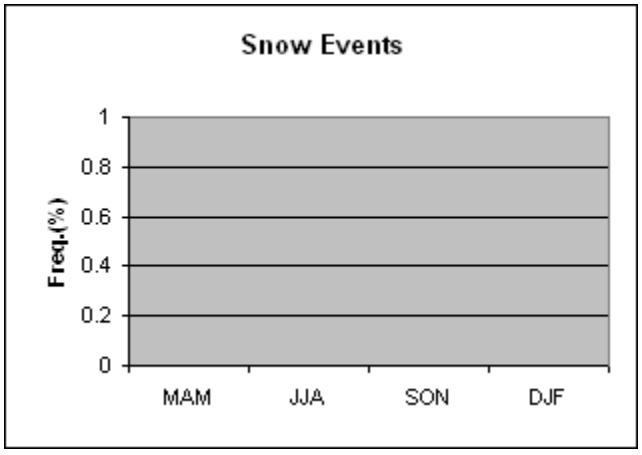
Kahului – OGG (HOG)

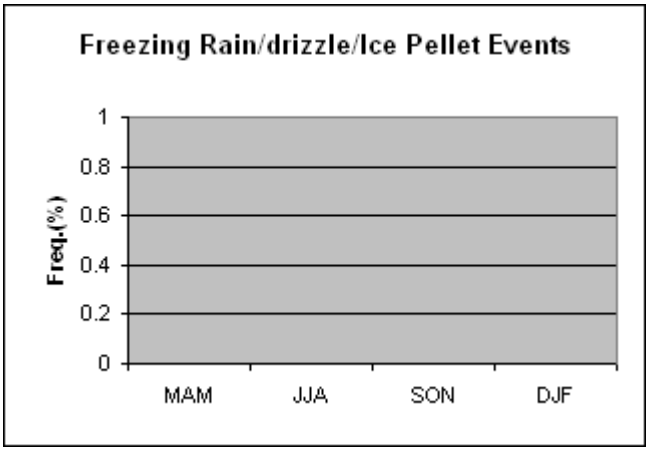




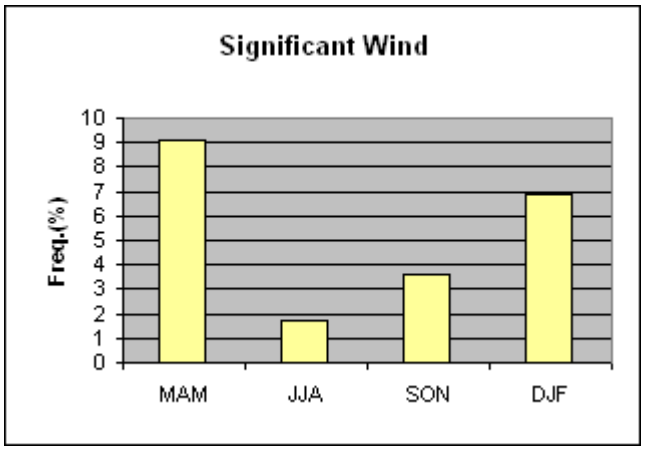


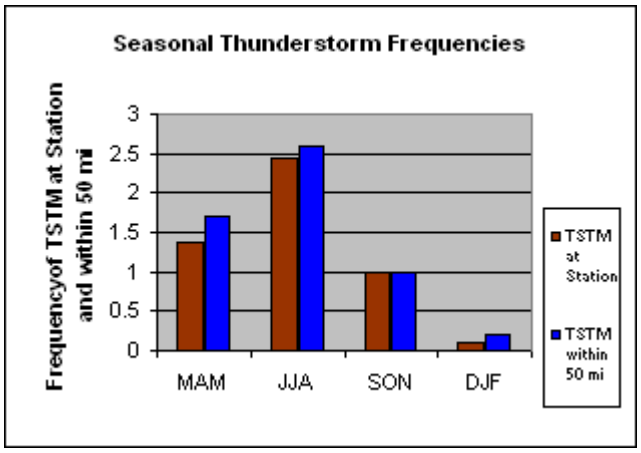


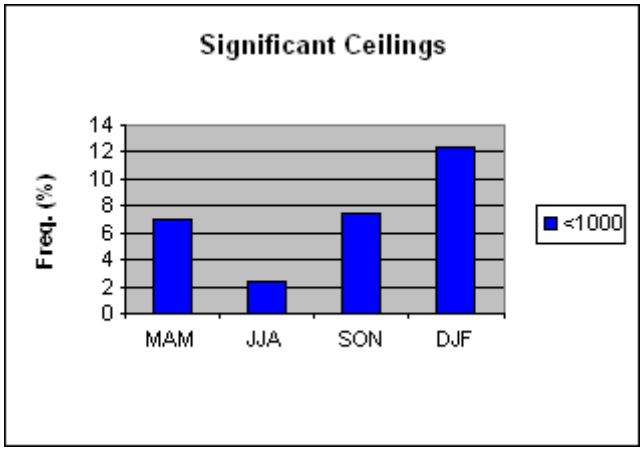


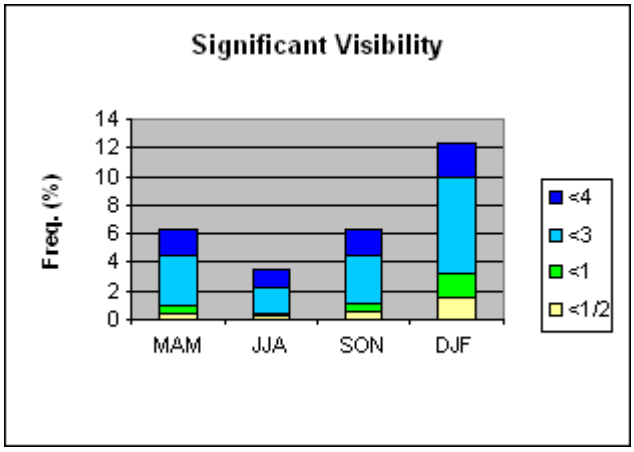


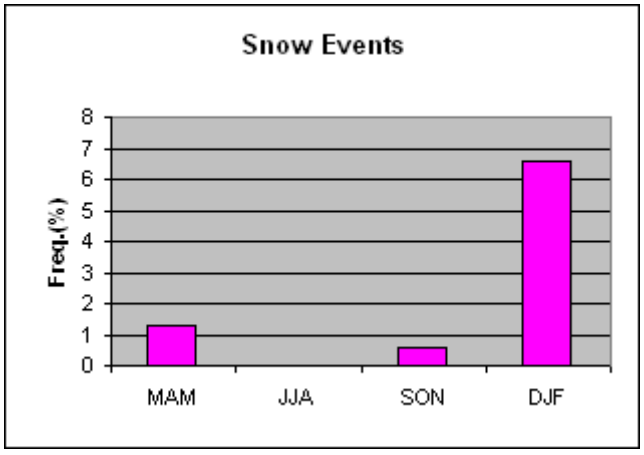
Kansas City International - MCI

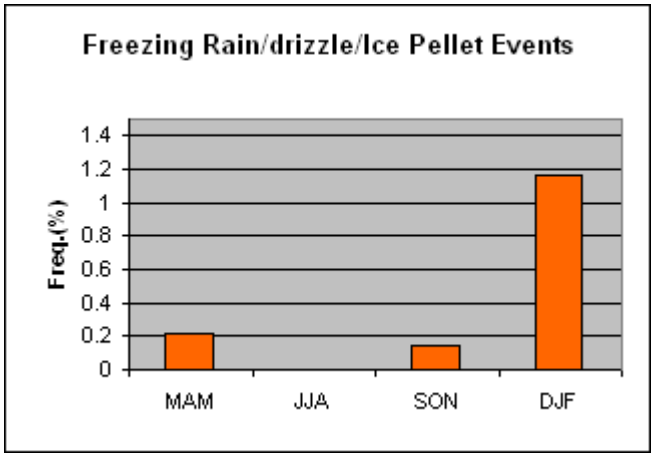




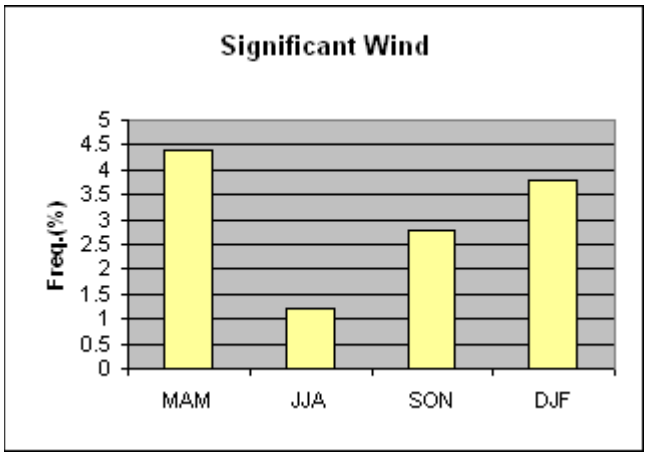


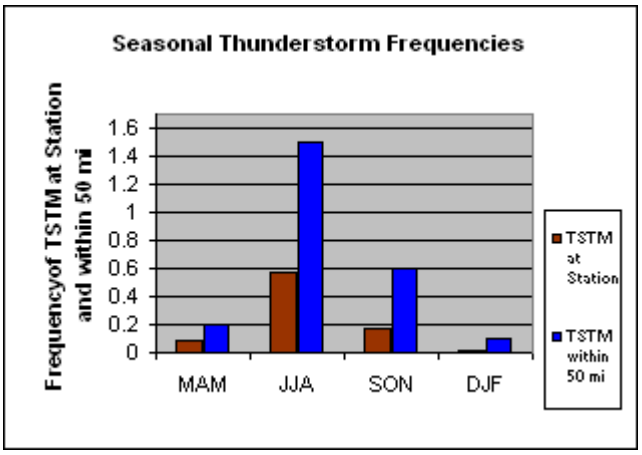


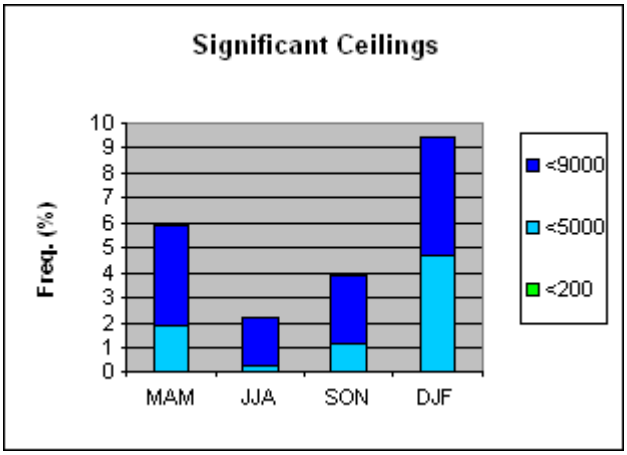


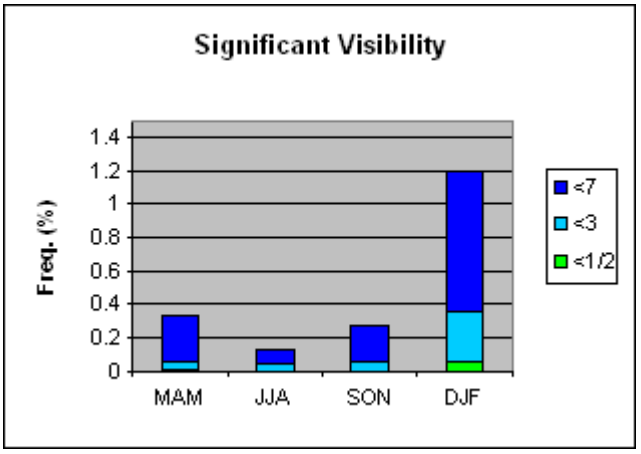


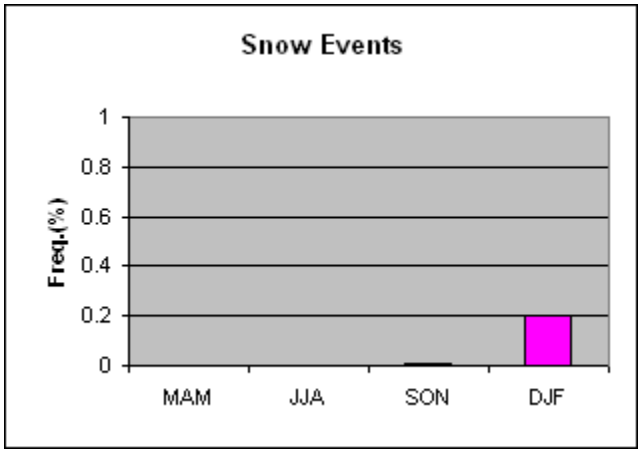
Las Vegas McCarran International – LAS

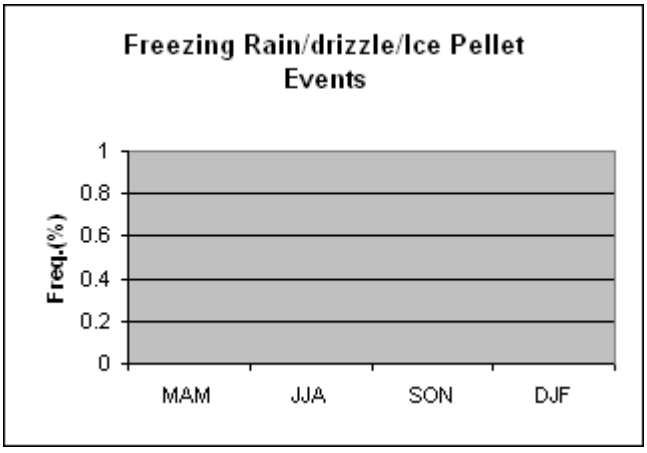




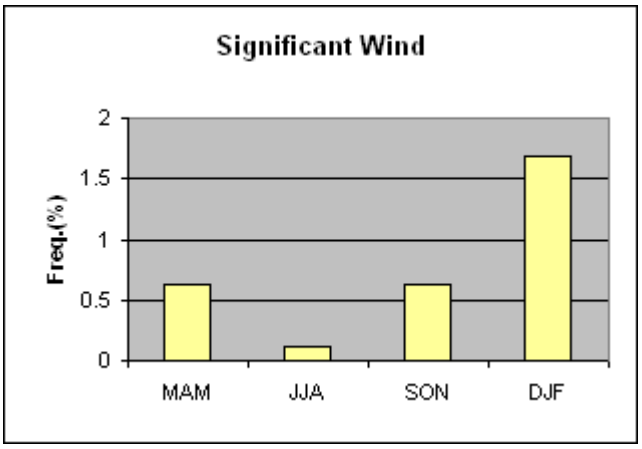


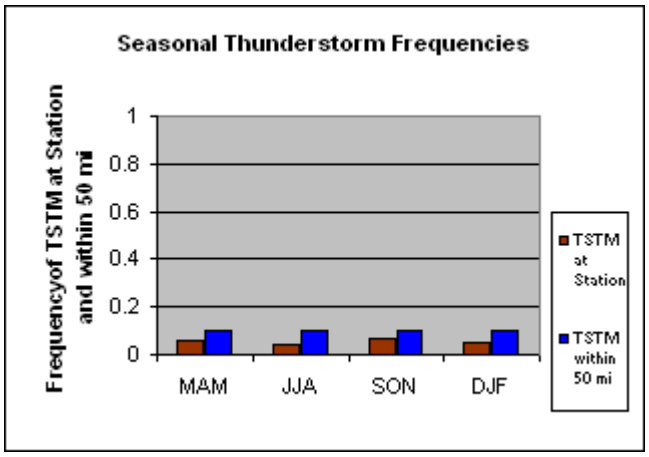


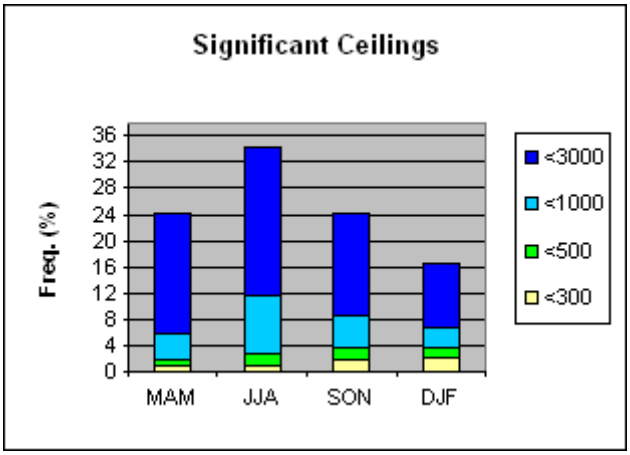


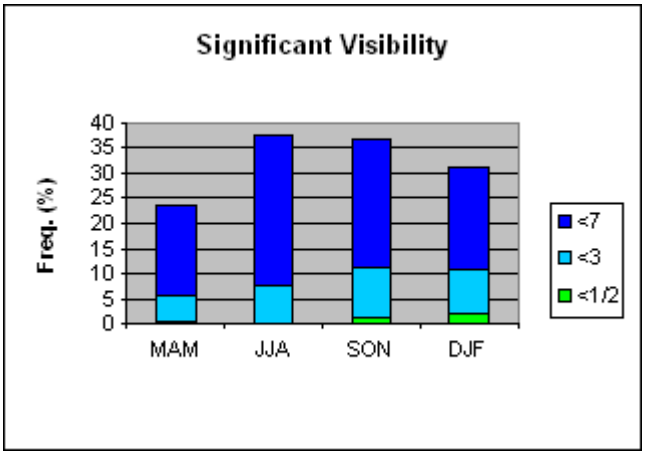


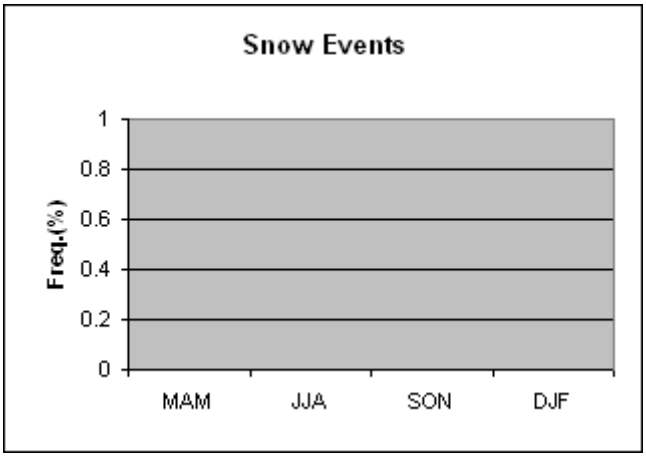
Los Angeles International – LAX

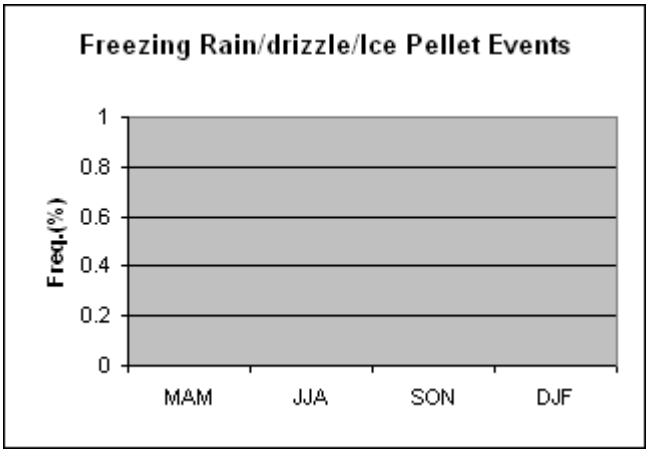




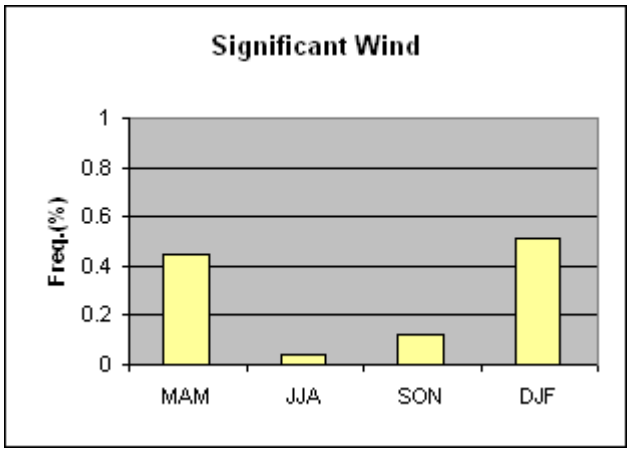


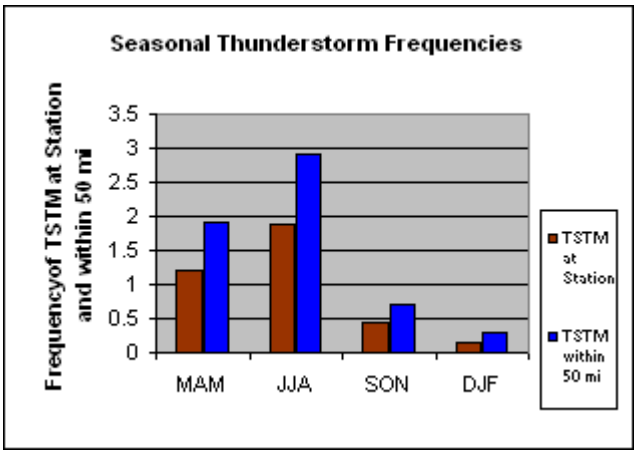


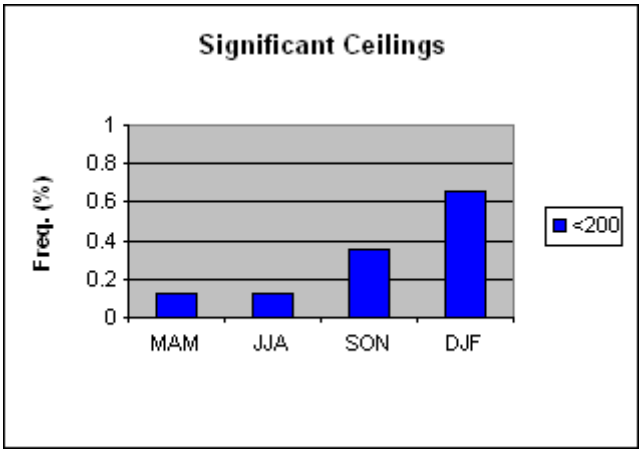


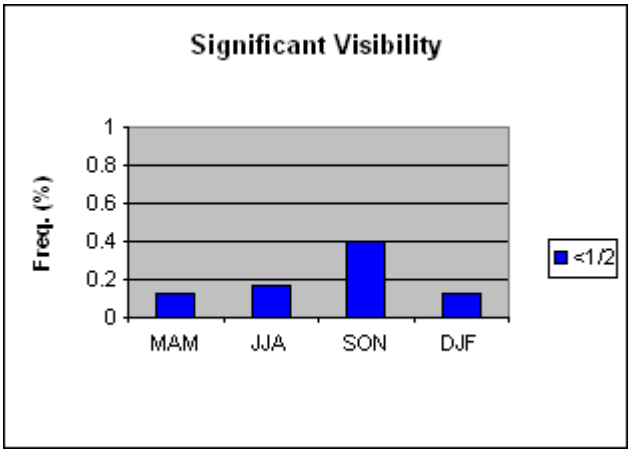


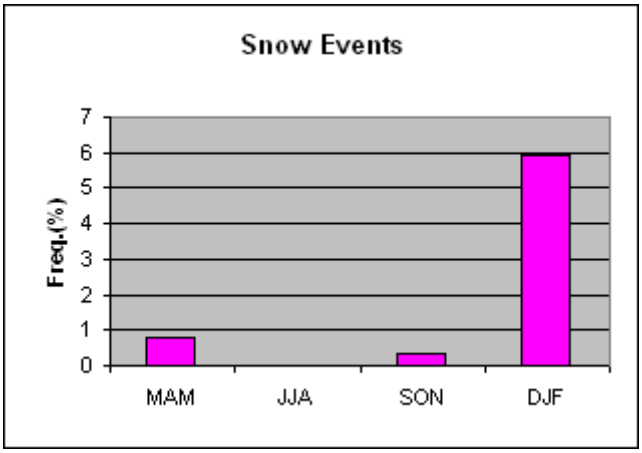
Louisville International Standiford Field – SDF

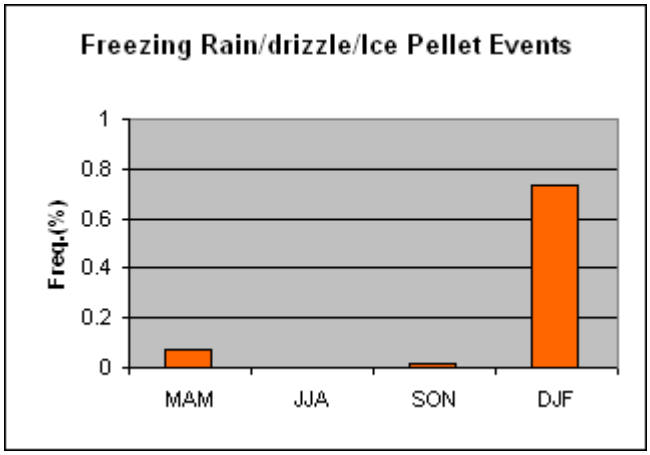




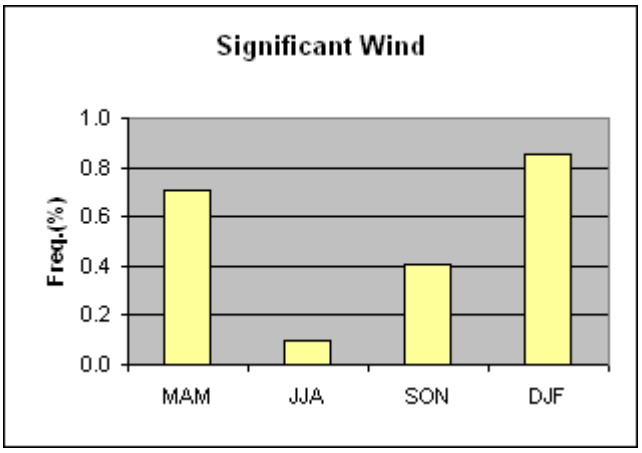


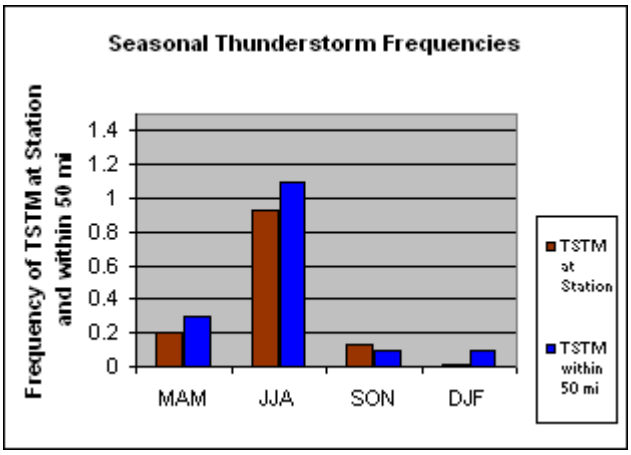


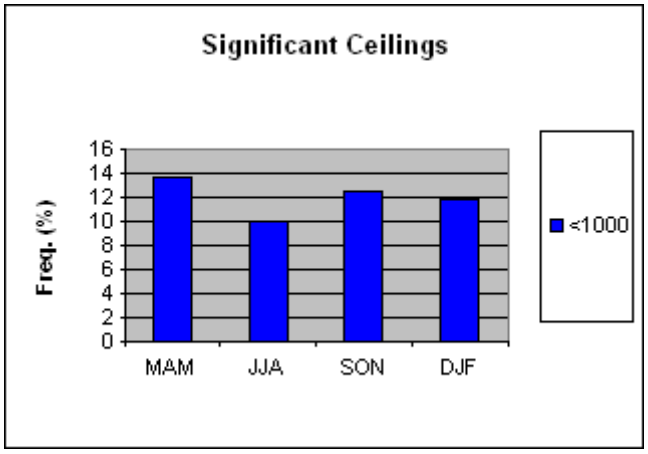


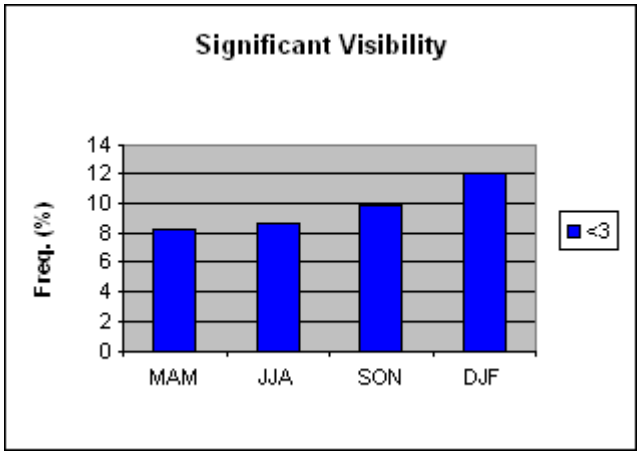


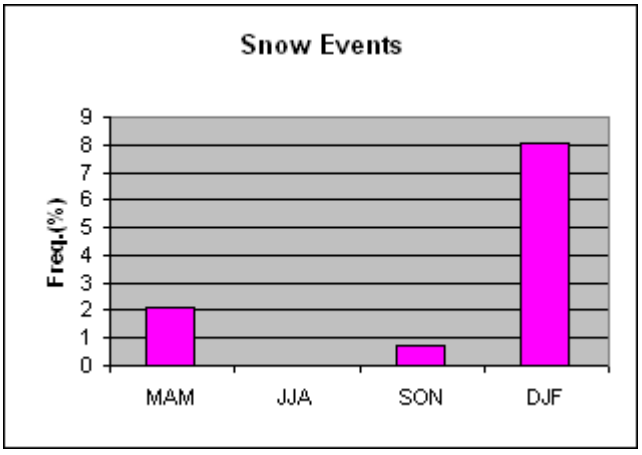
Manchester – MHT

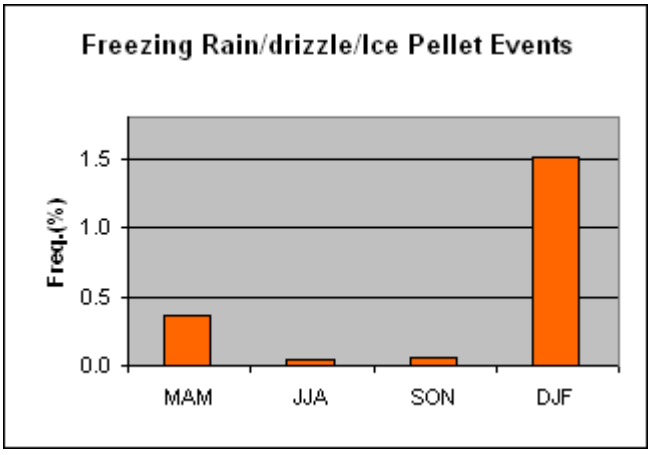




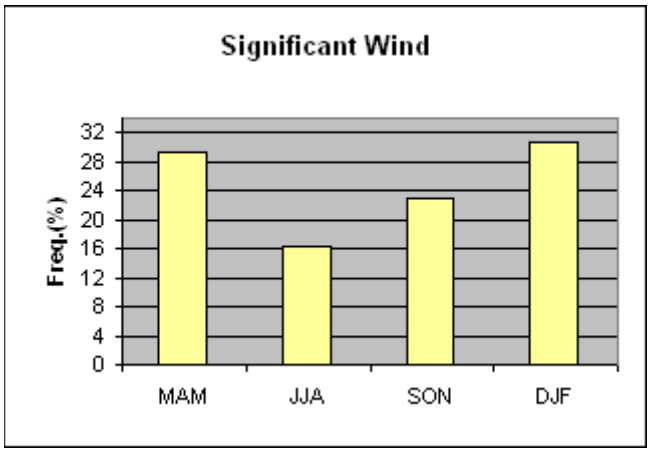


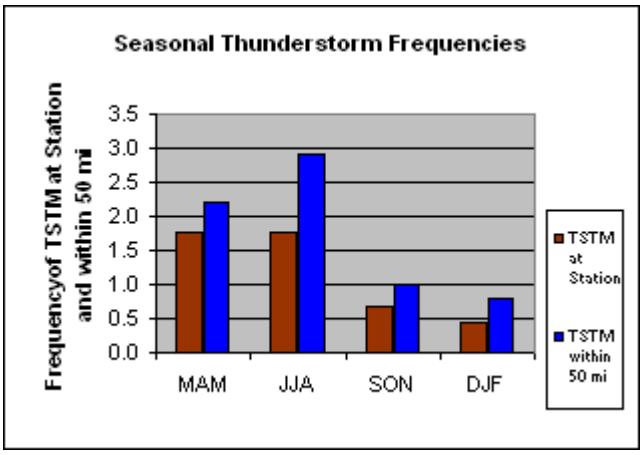


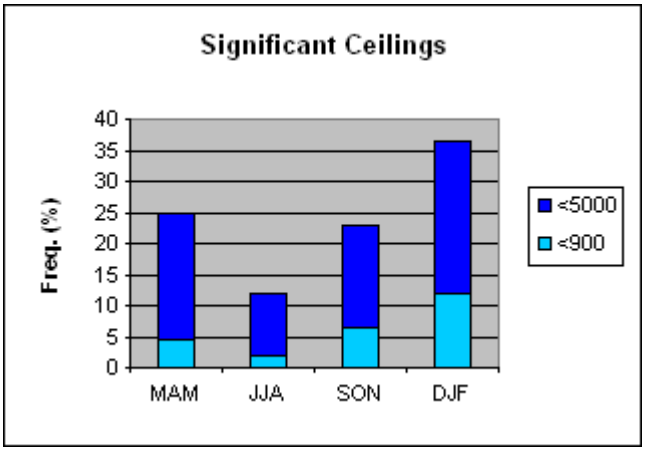


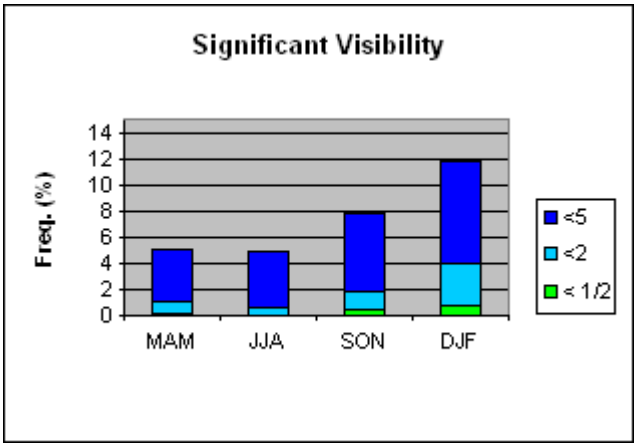


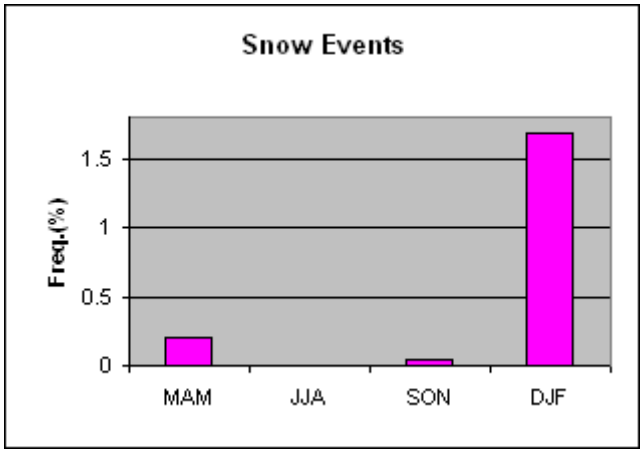
Memphis International – MEM

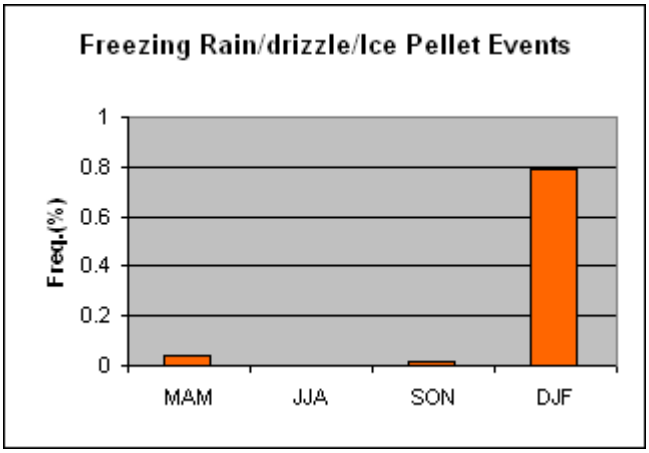




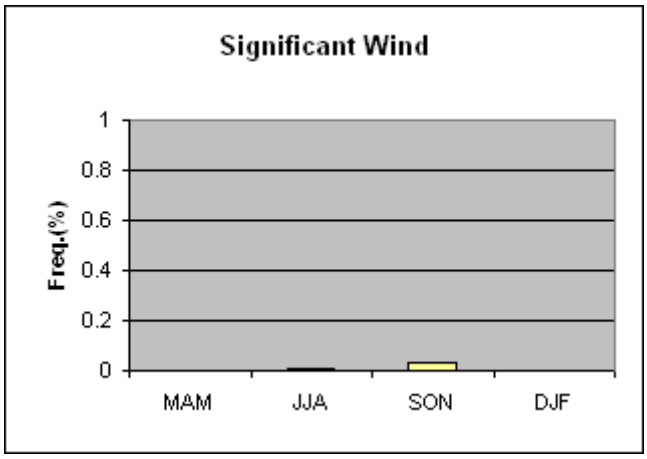


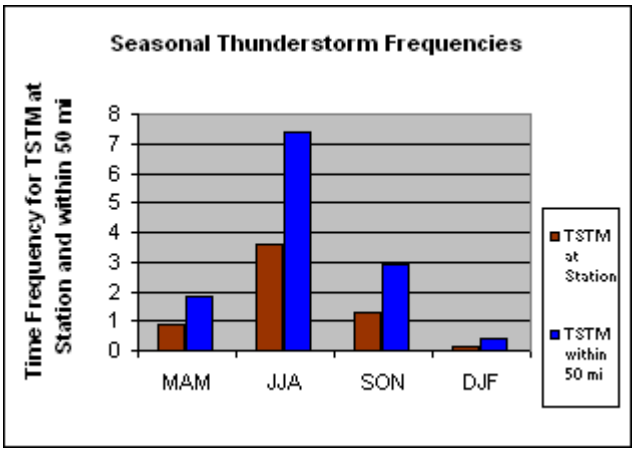


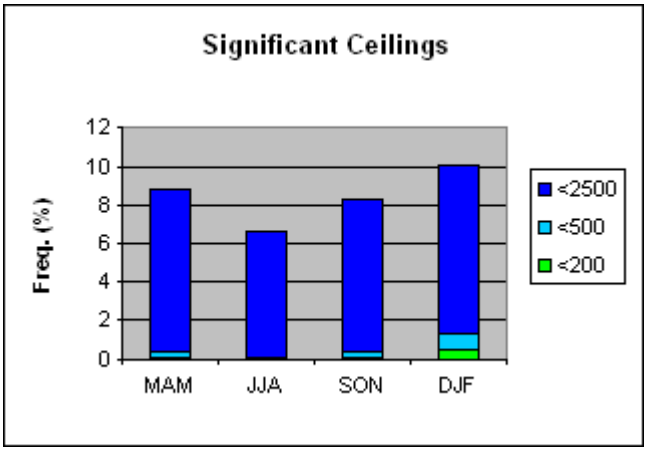


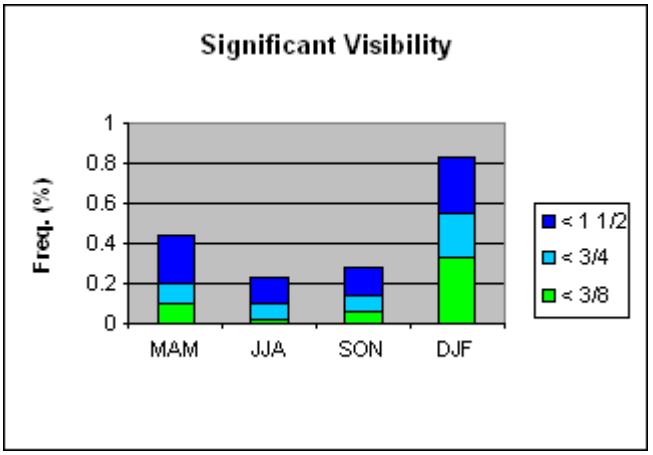


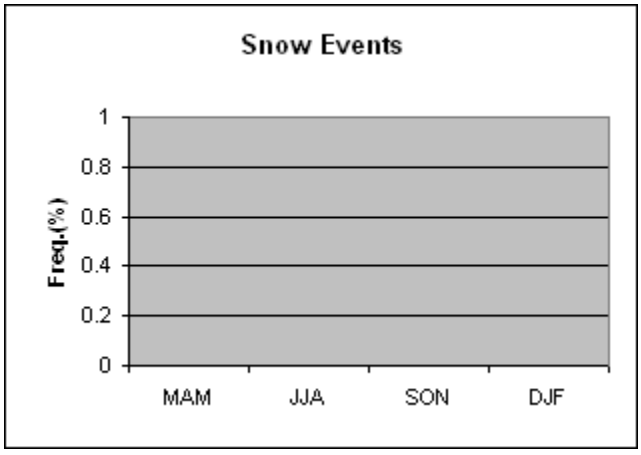
Miami International – MIA

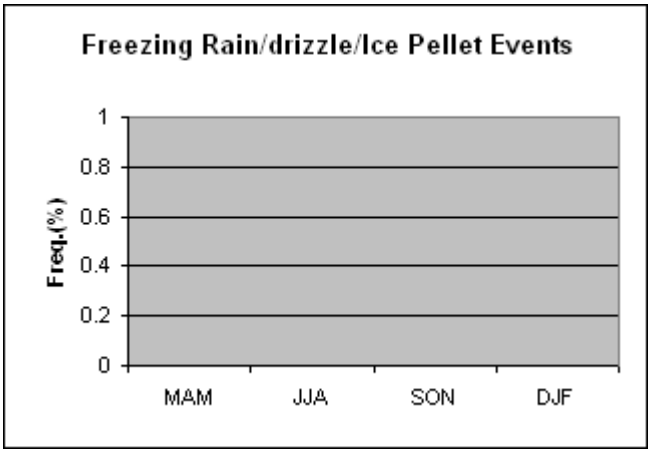




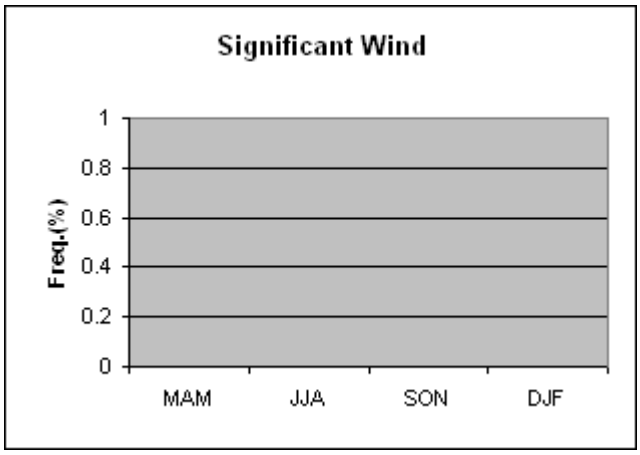


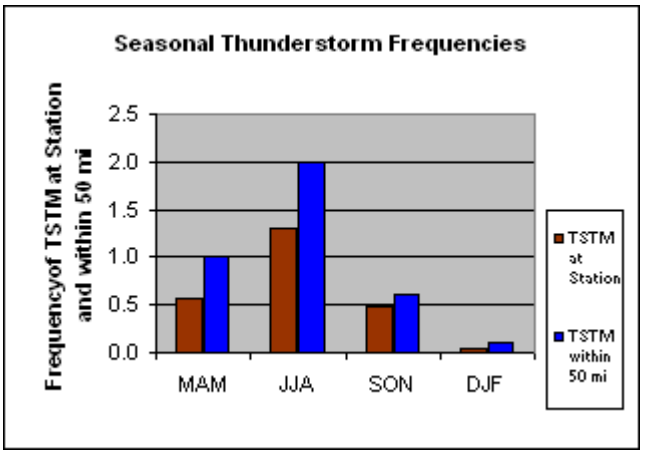


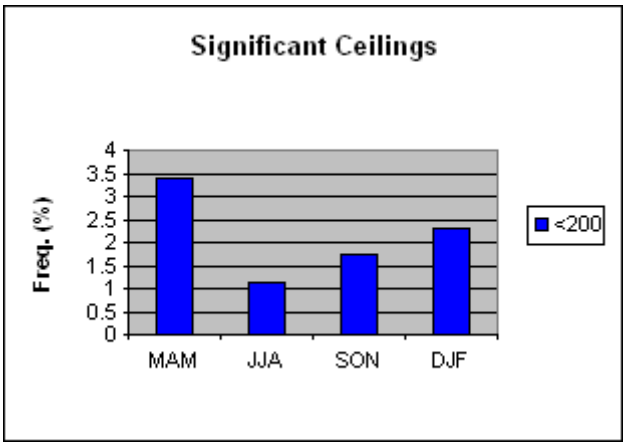


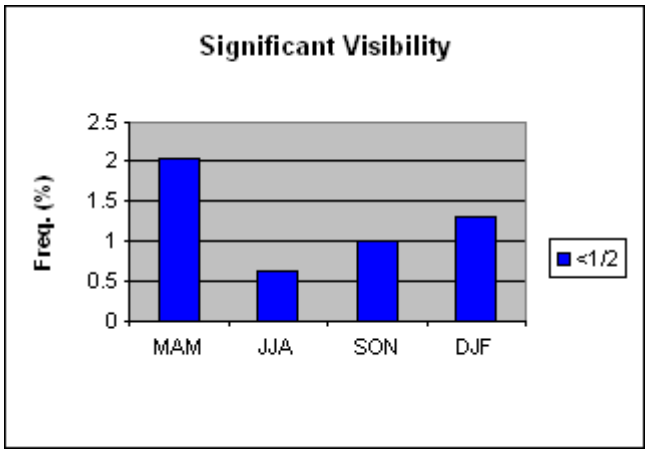


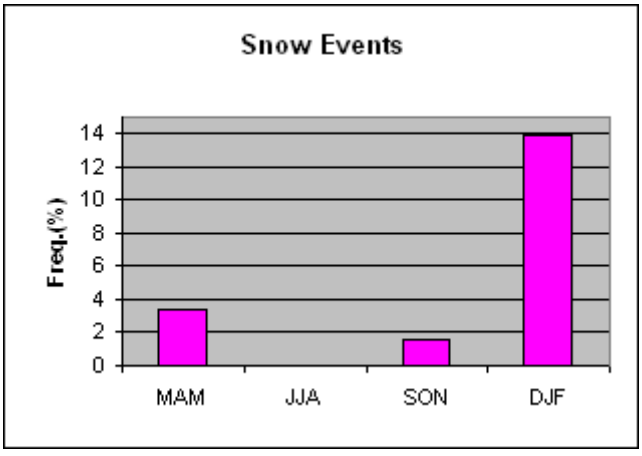
Milwaukee General Mitchell International - MKE

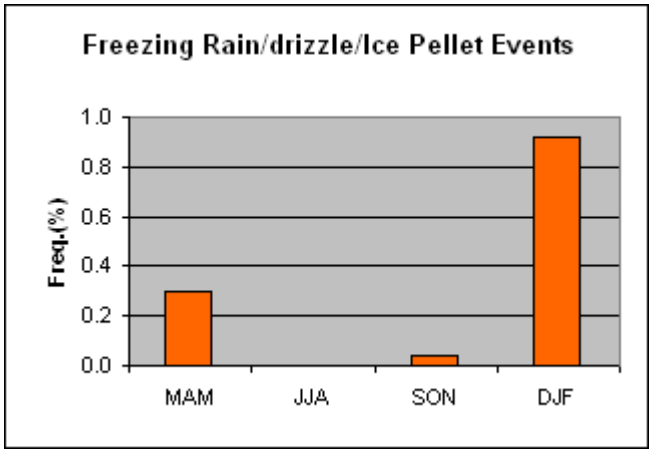




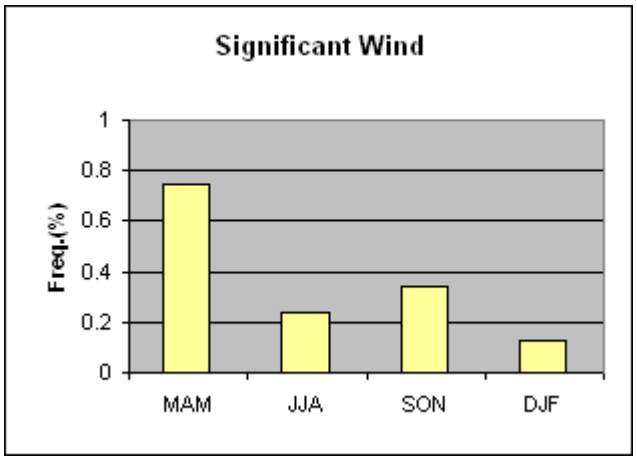


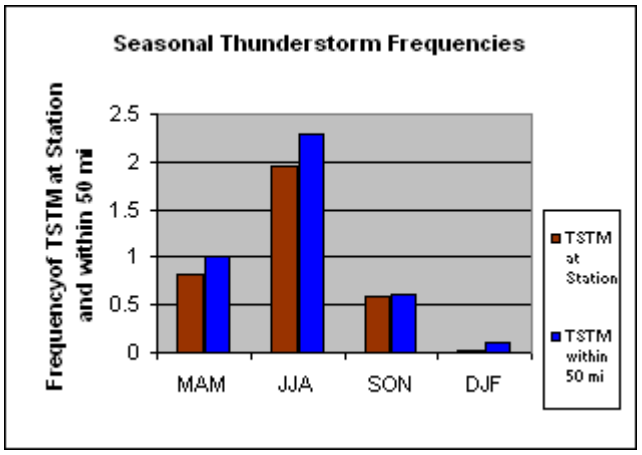


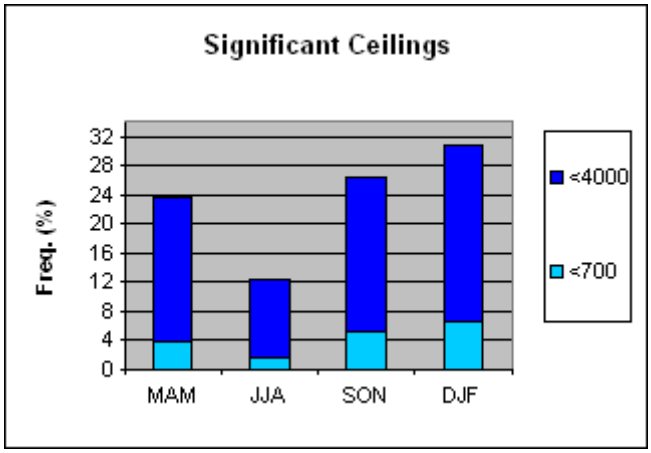


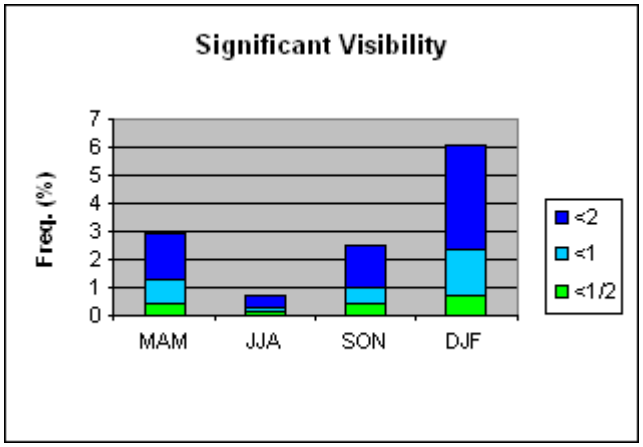


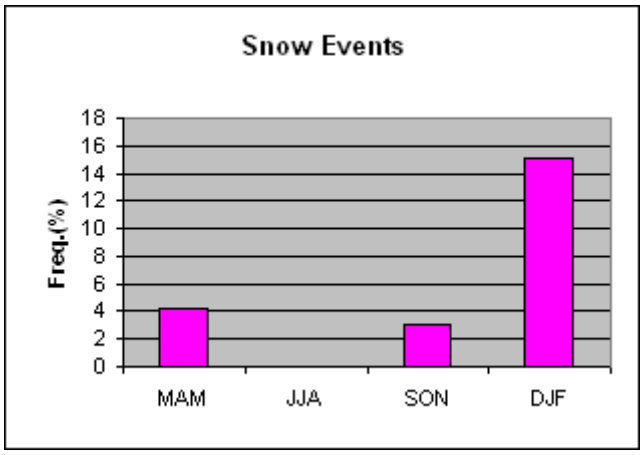
Minneapolis-St. Paul International – MSP

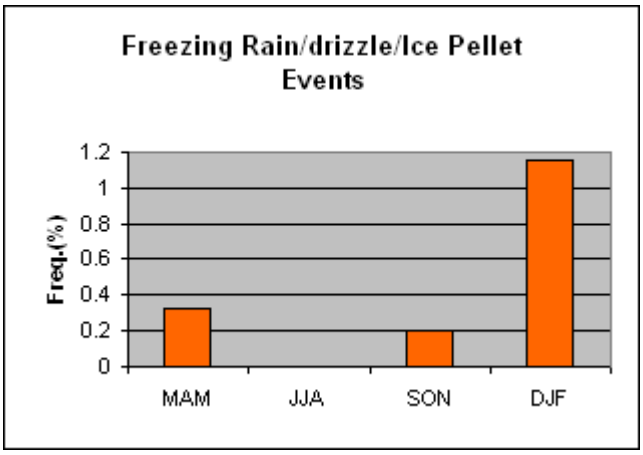




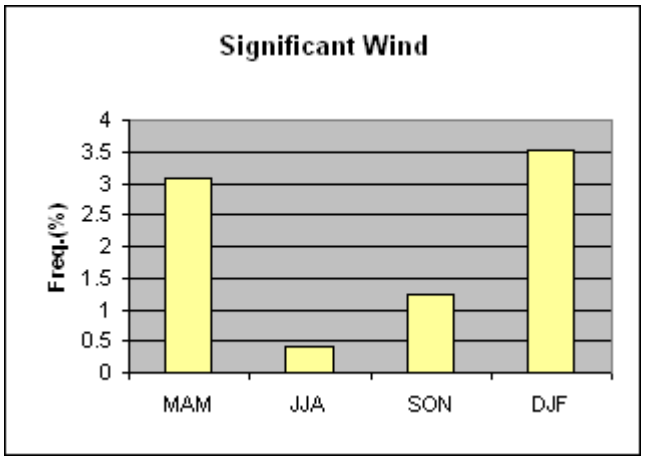


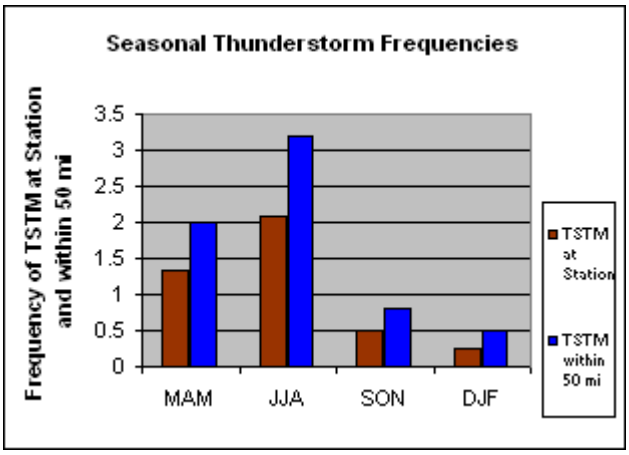


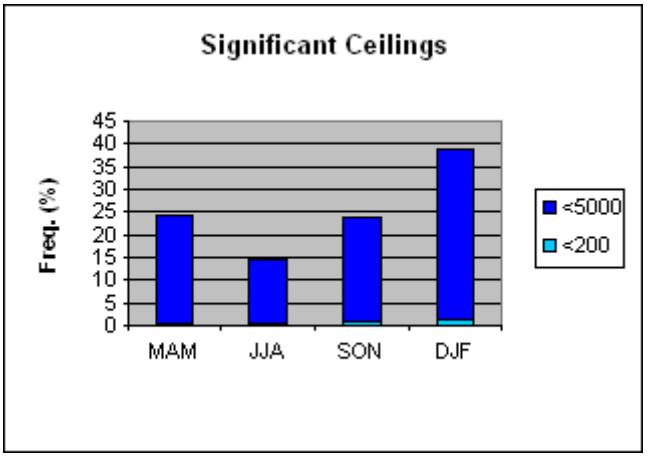


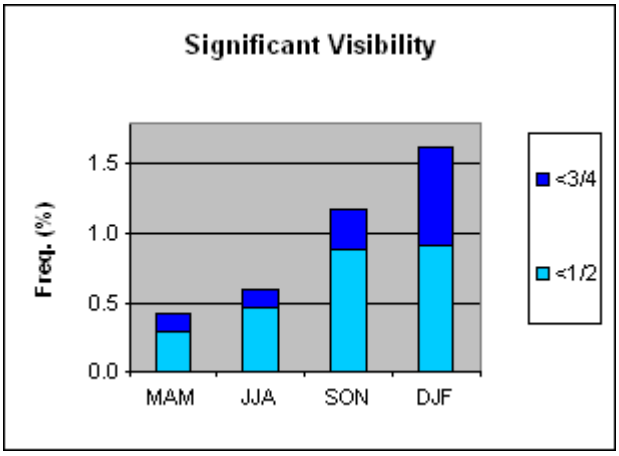


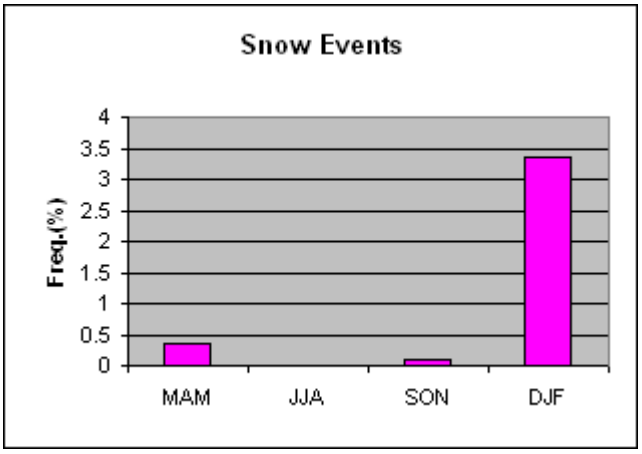
Nashville International – BNA

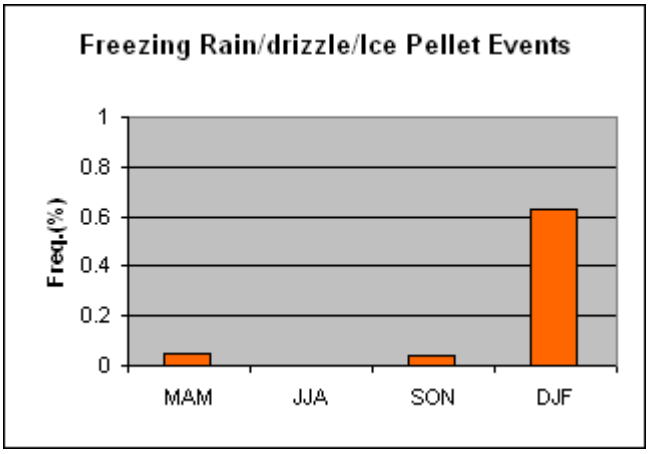




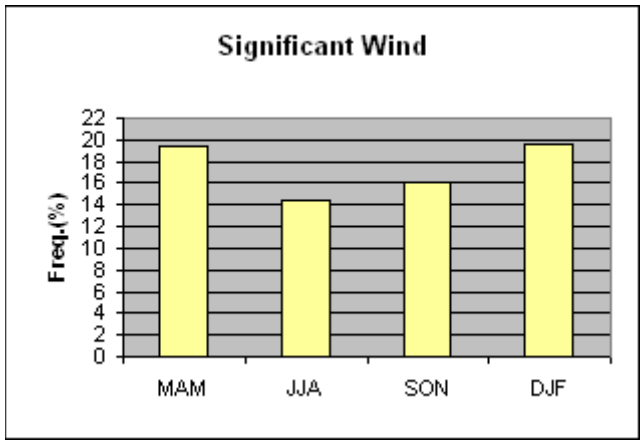


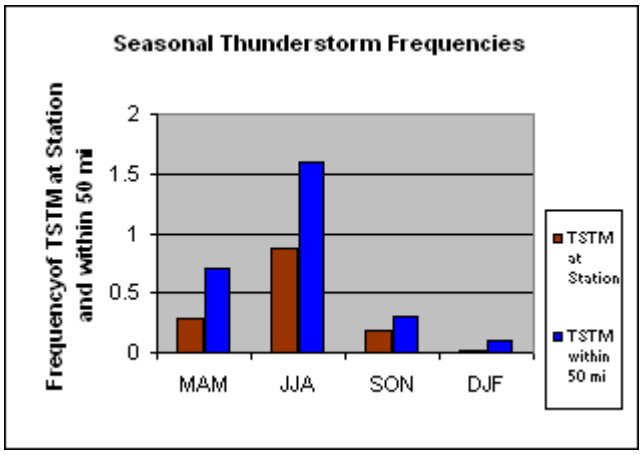


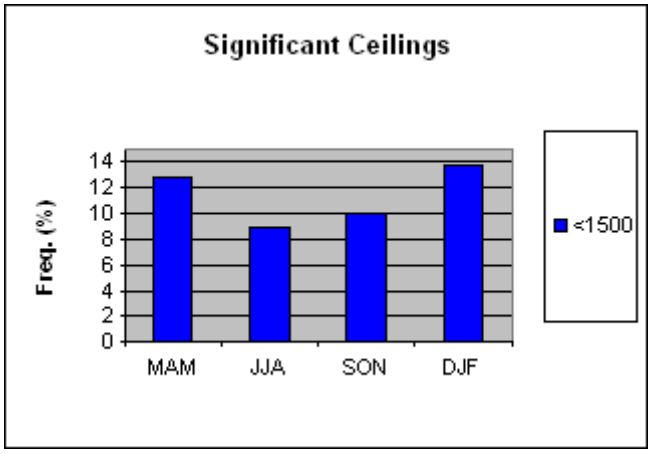


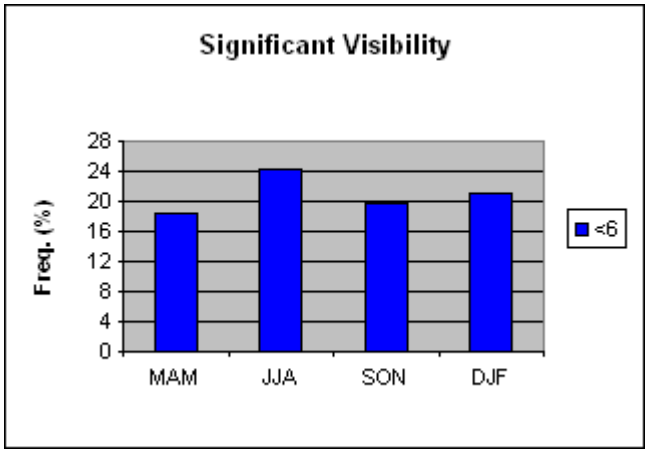


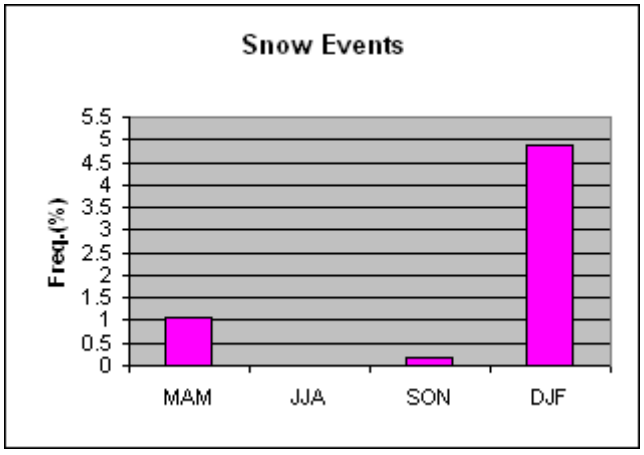
Newark Liberty International – EWR

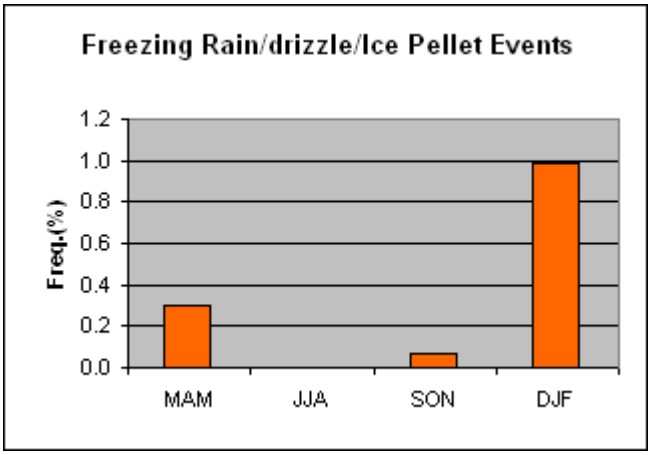




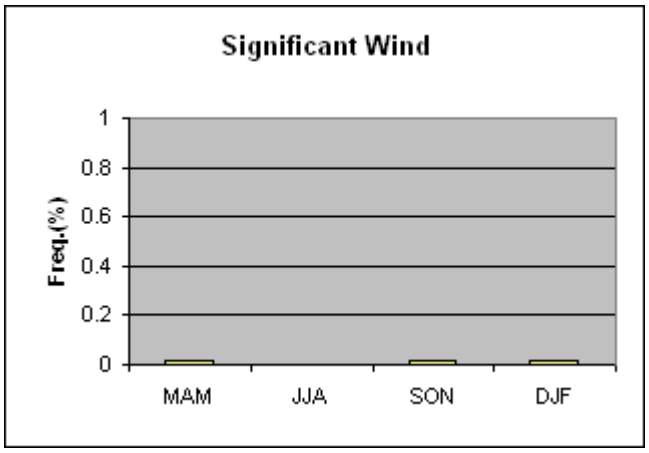


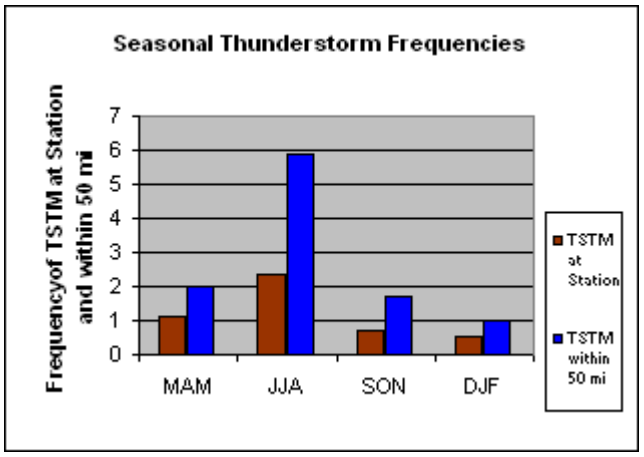


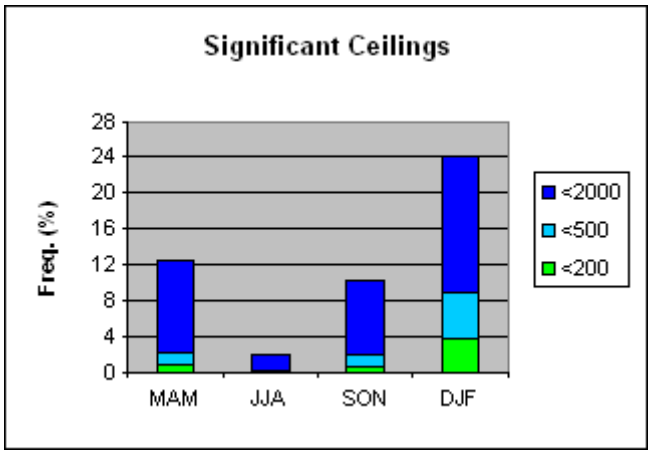


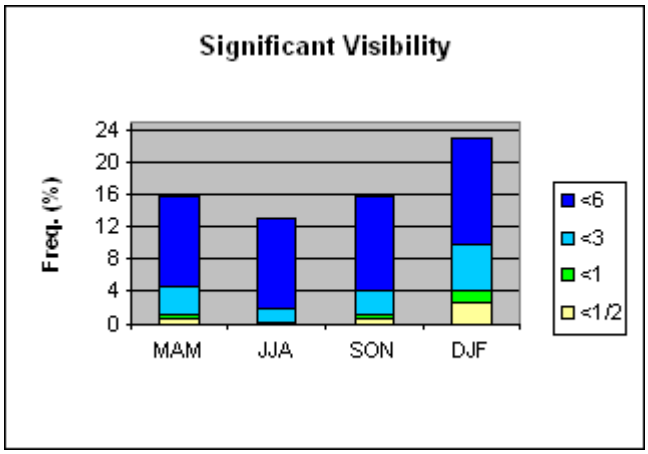


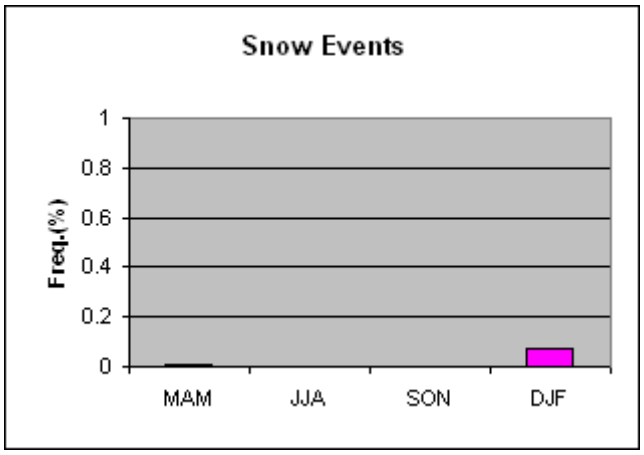
New Orleans Louis Armstrong International – MSY

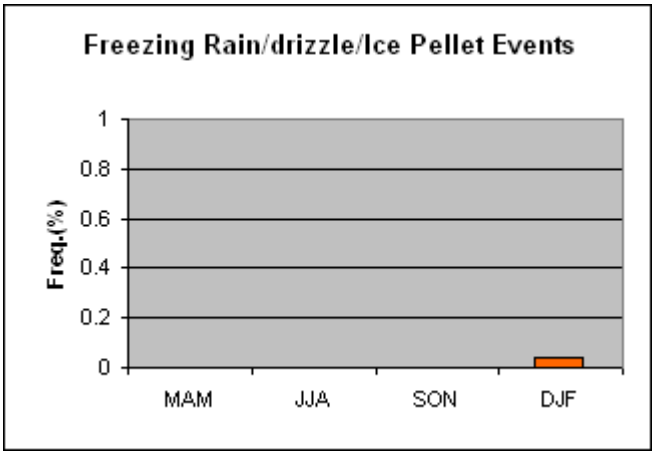




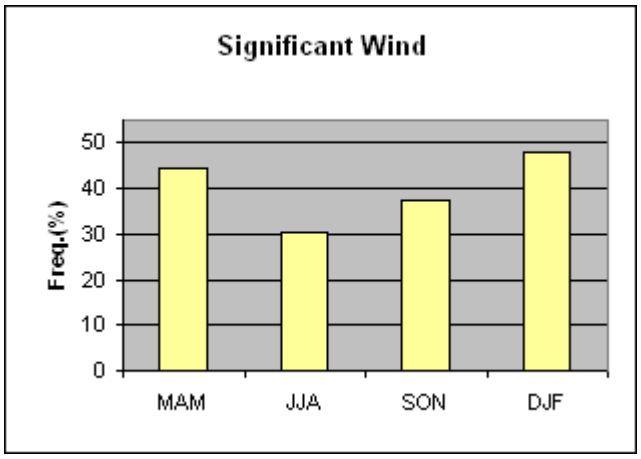


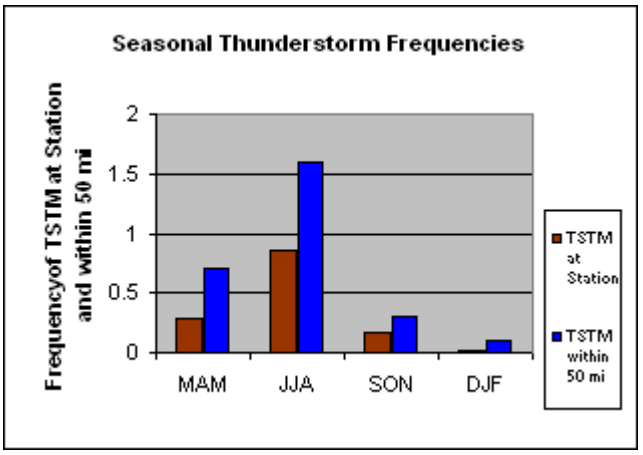


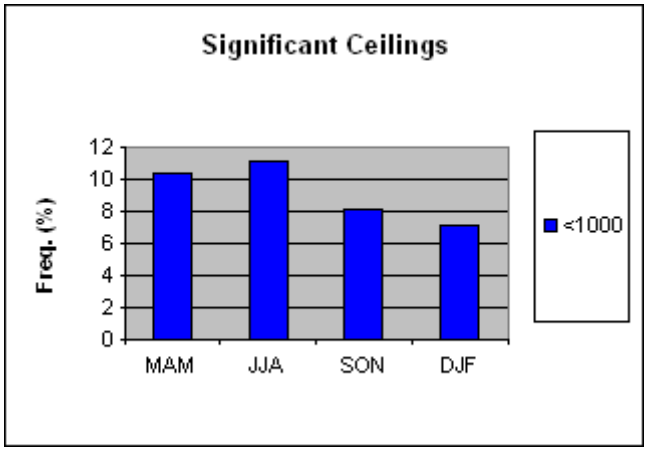


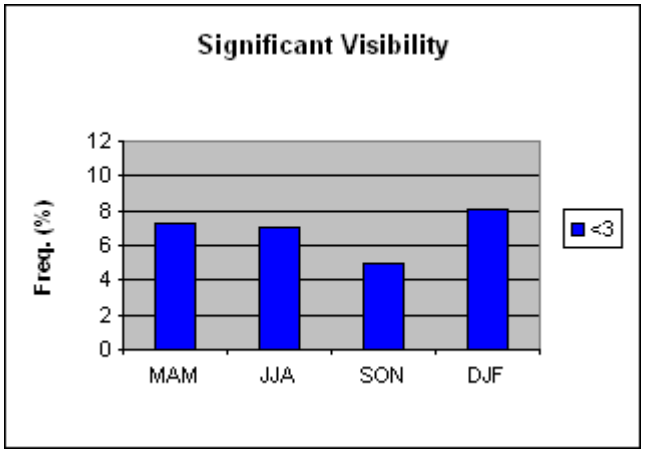


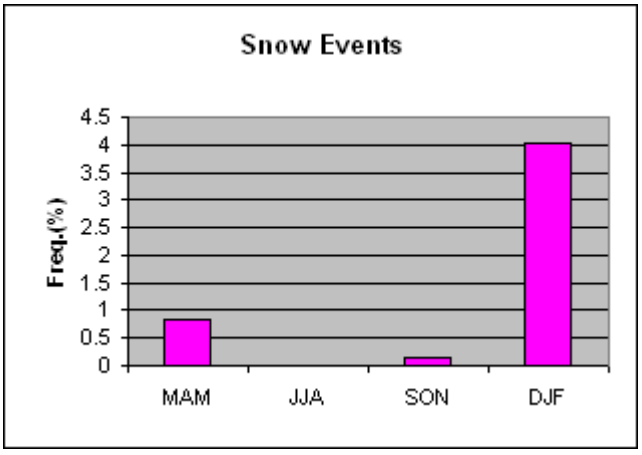
New York John F. Kennedy International – JFK

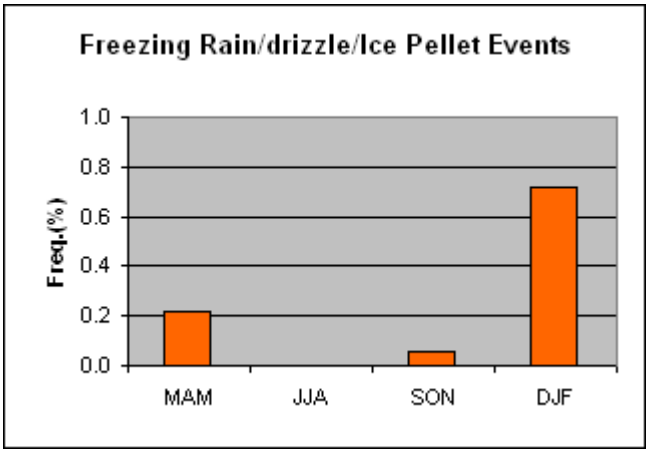




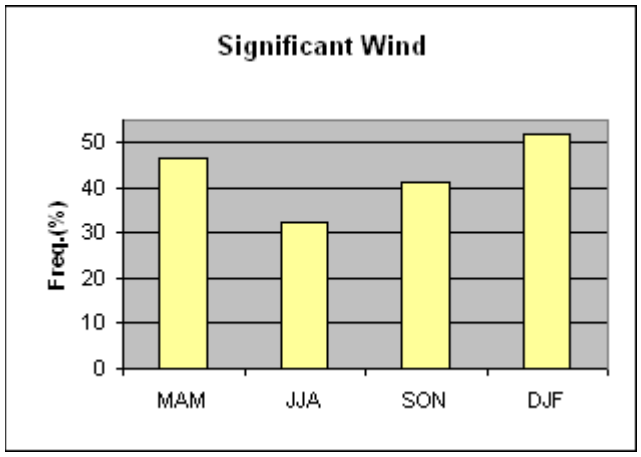


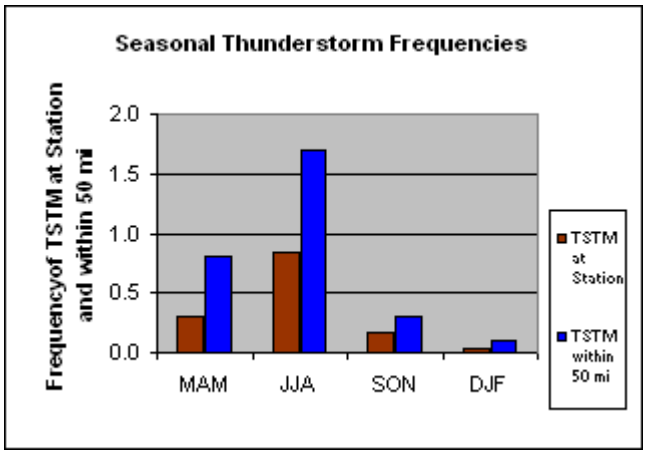


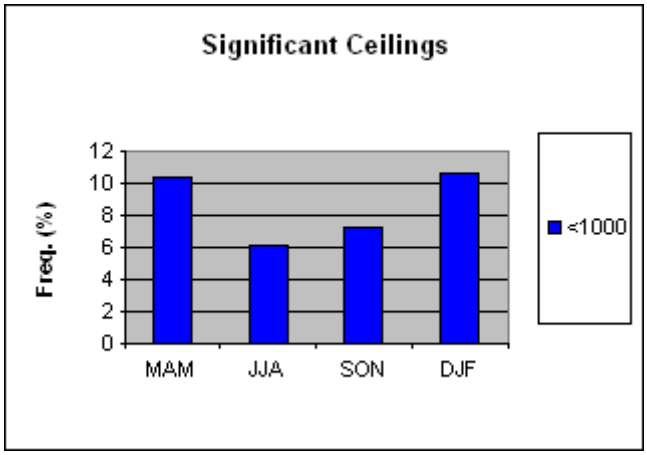


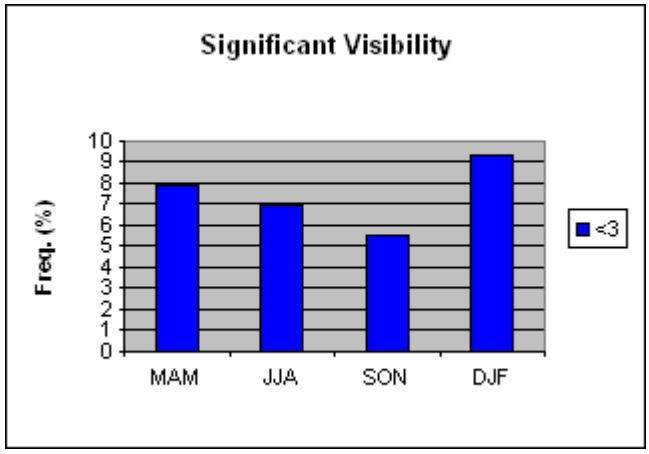


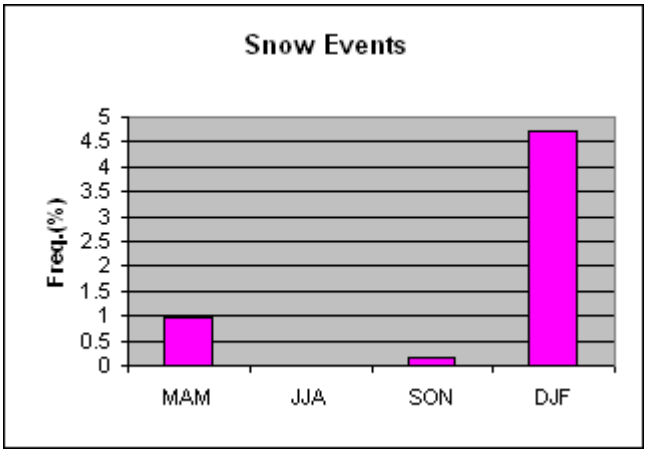
New York La Guardia – LGA

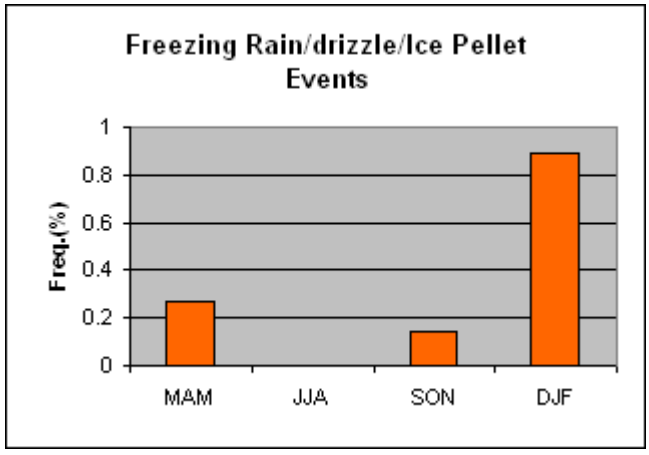




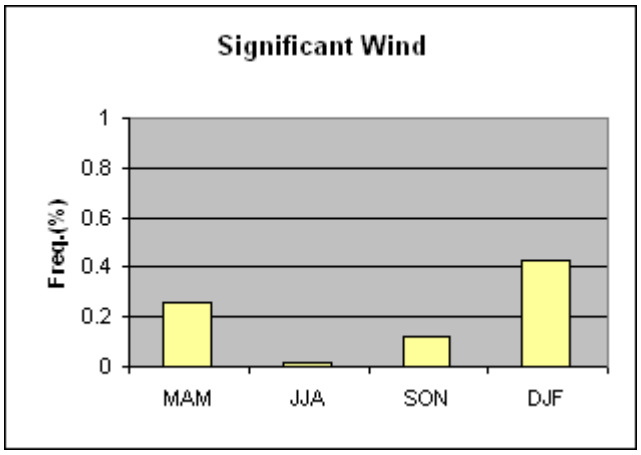


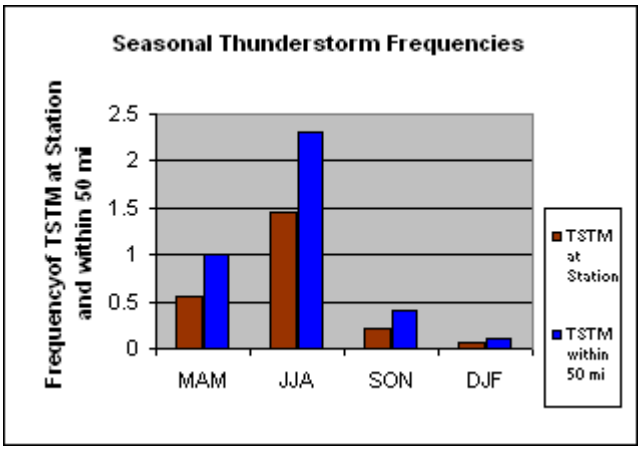


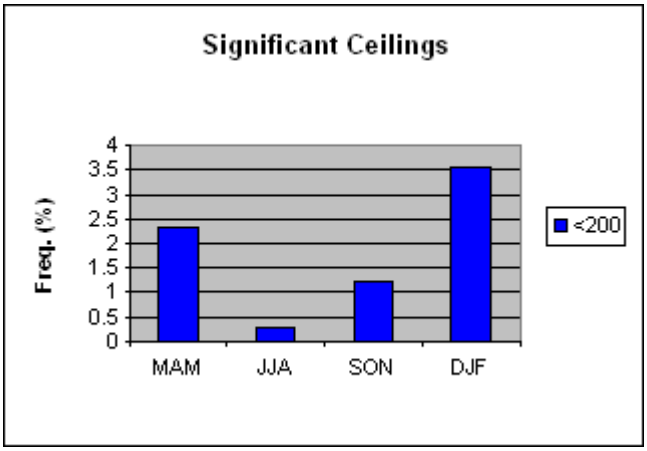


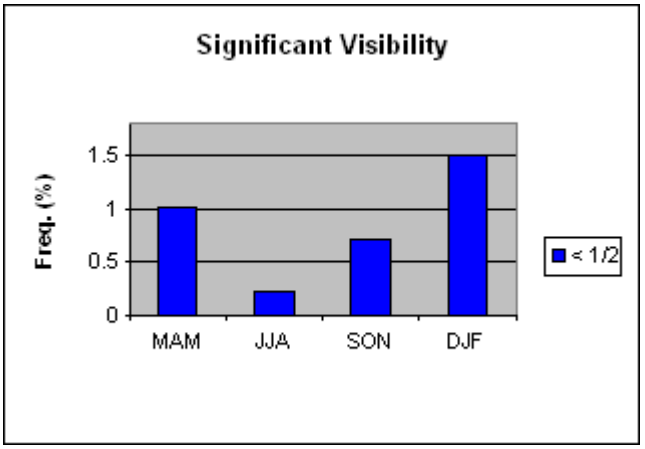


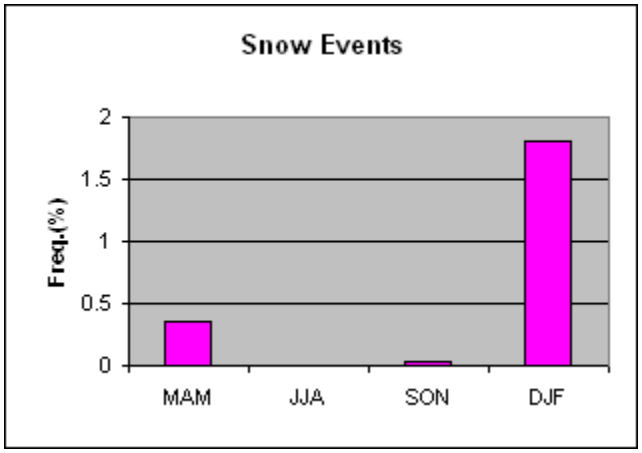
Norfolk International - ORF

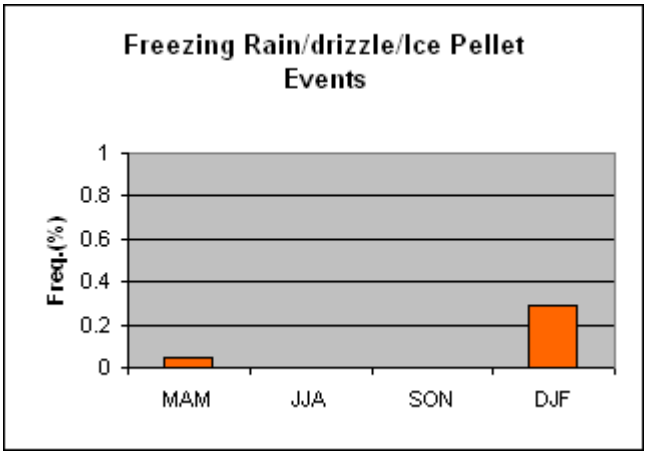




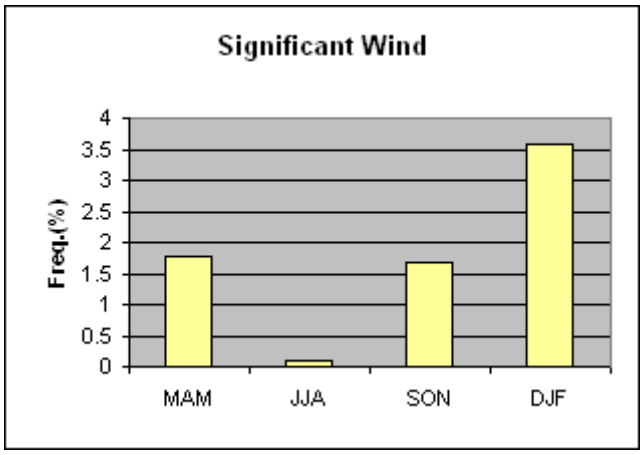


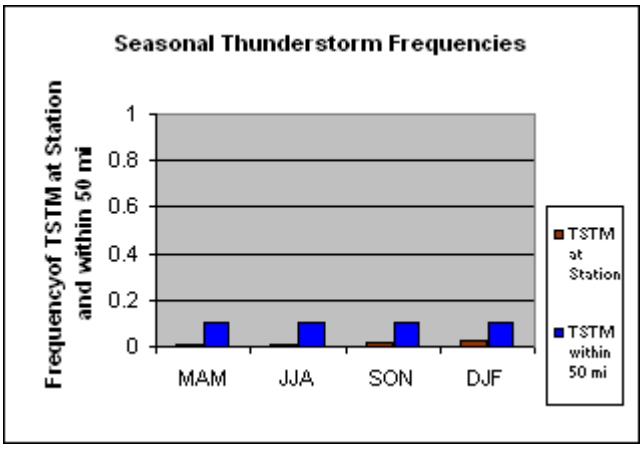


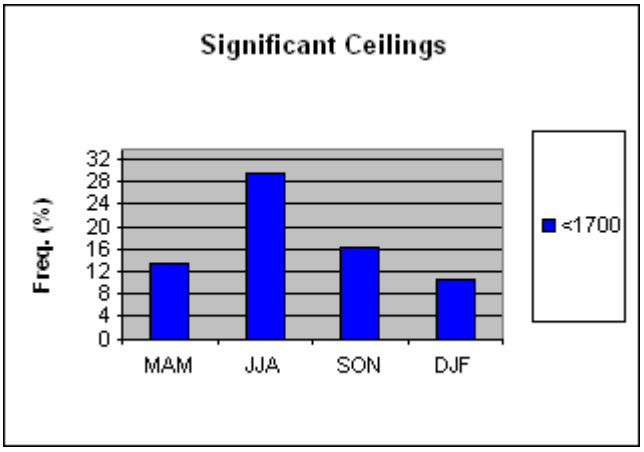


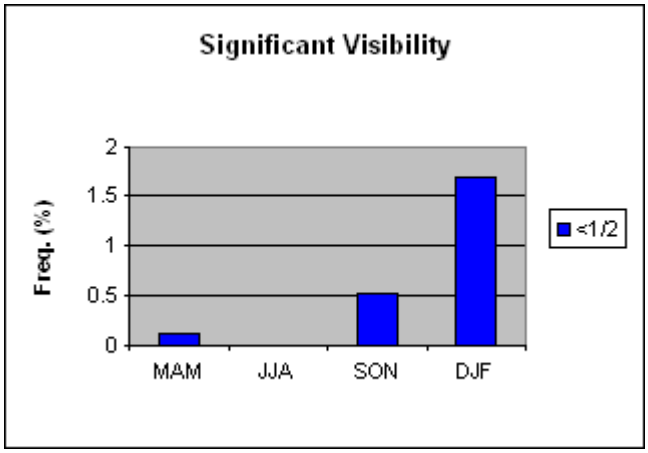


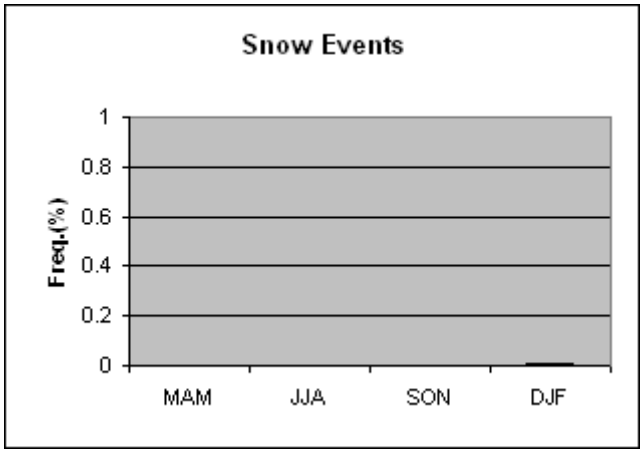
Oakland – Metropolitan Oakland International - OAK

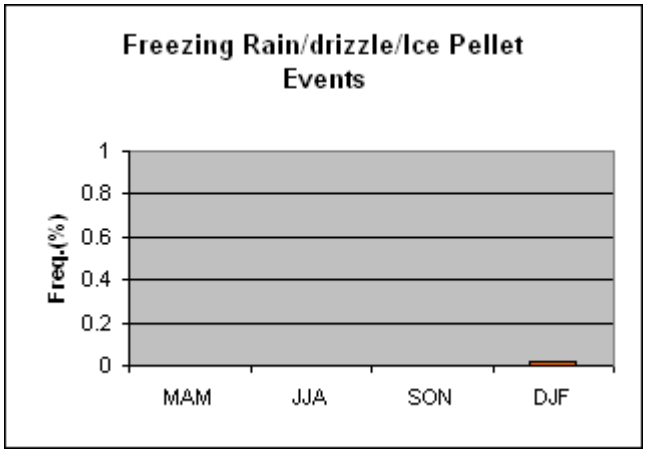




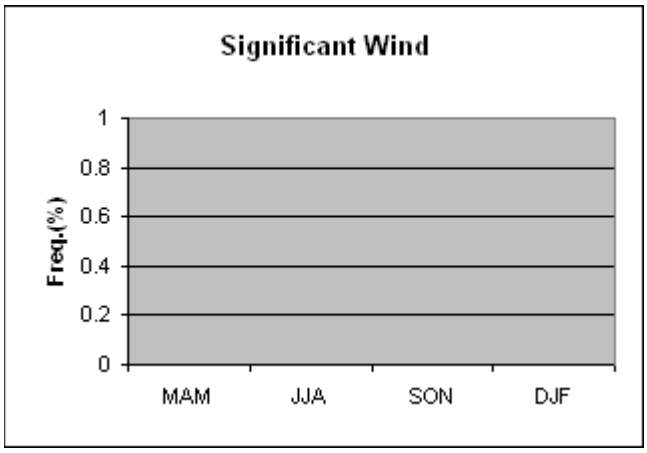


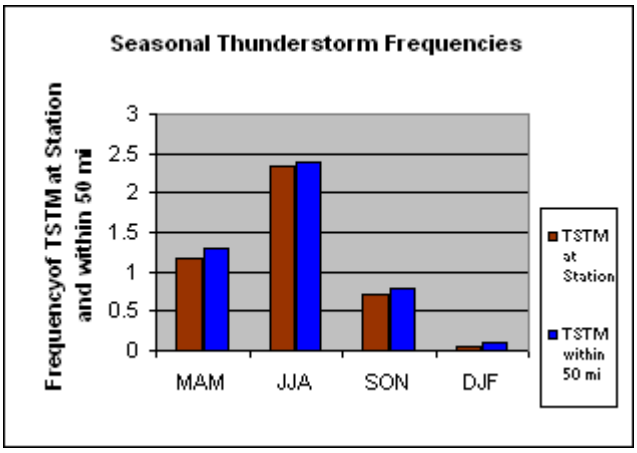


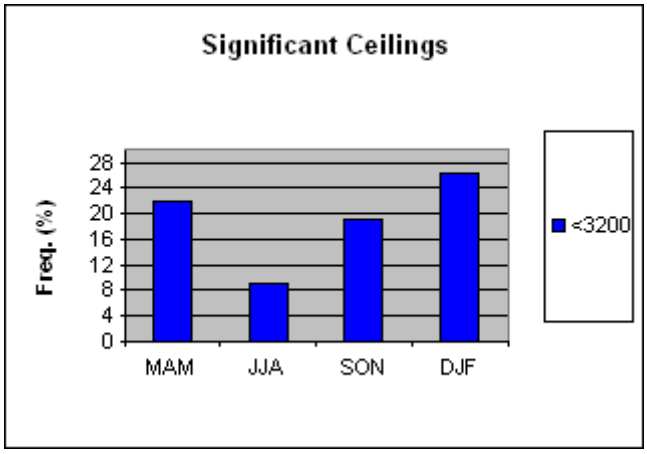


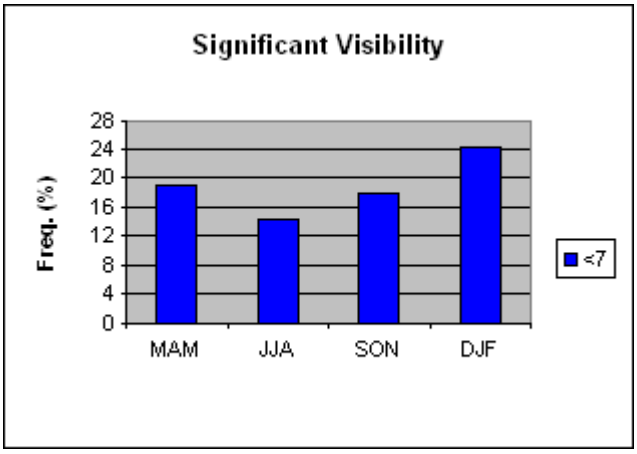


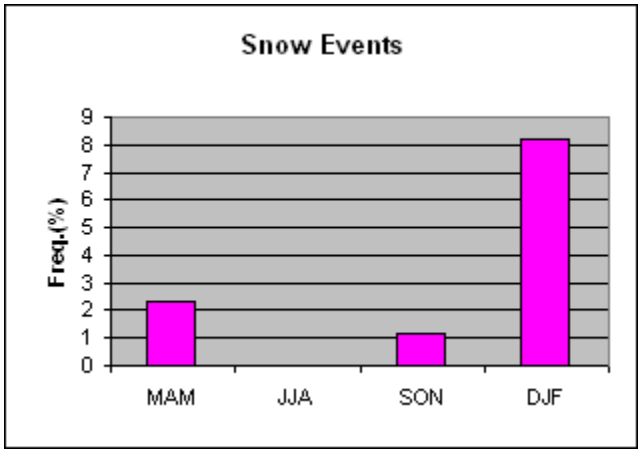
Omaha – Eppley Airfield - OMA

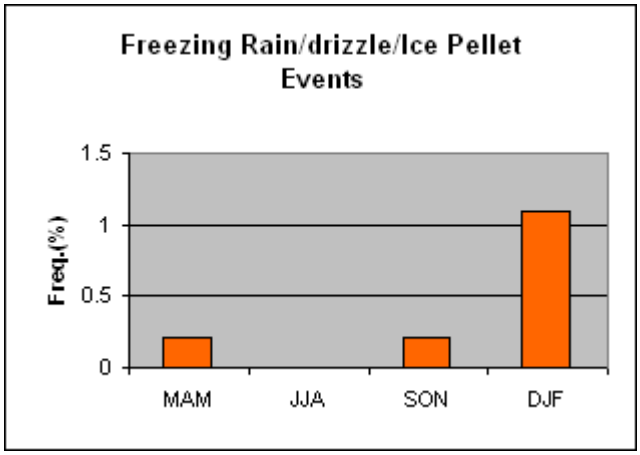




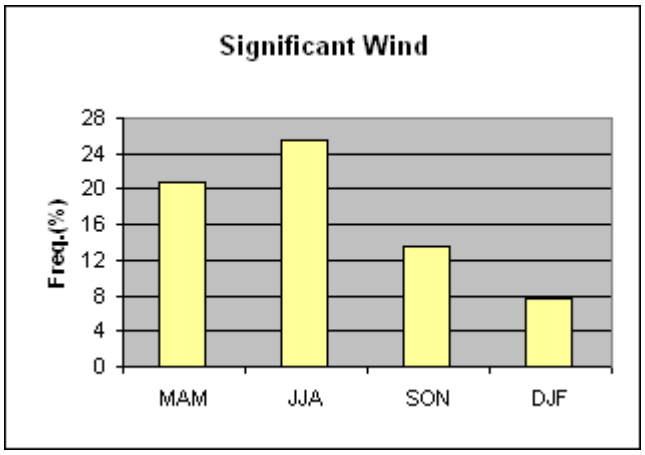


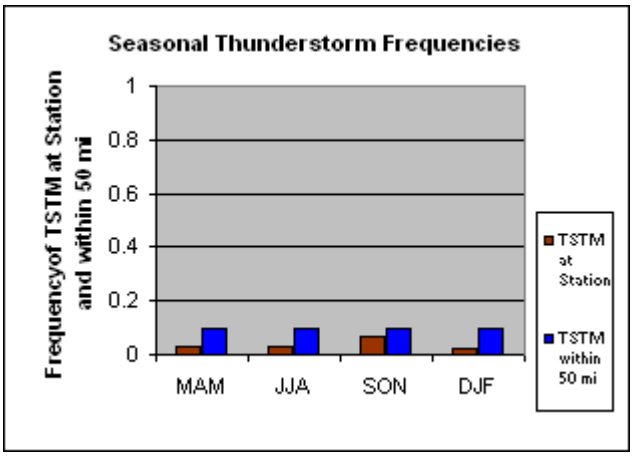


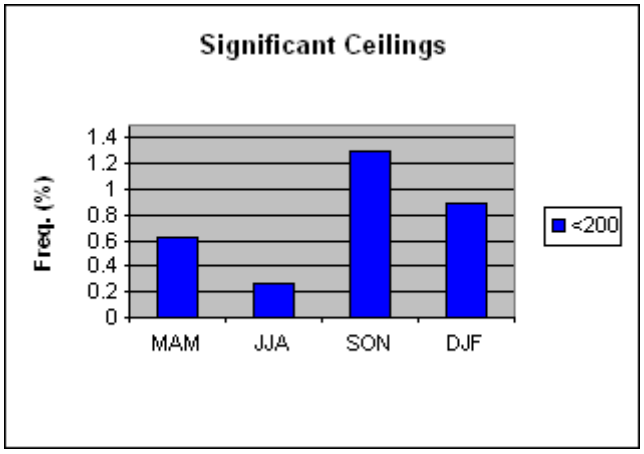


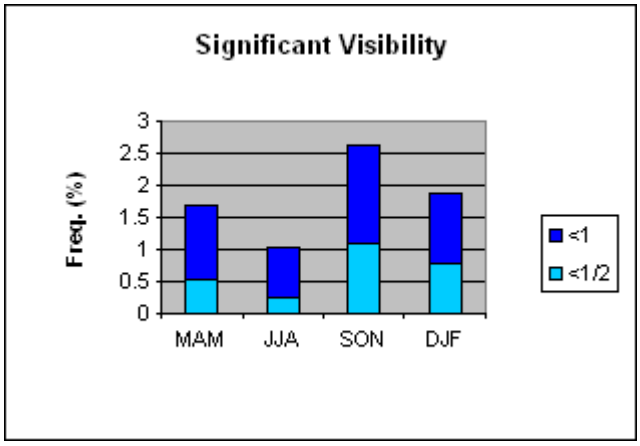


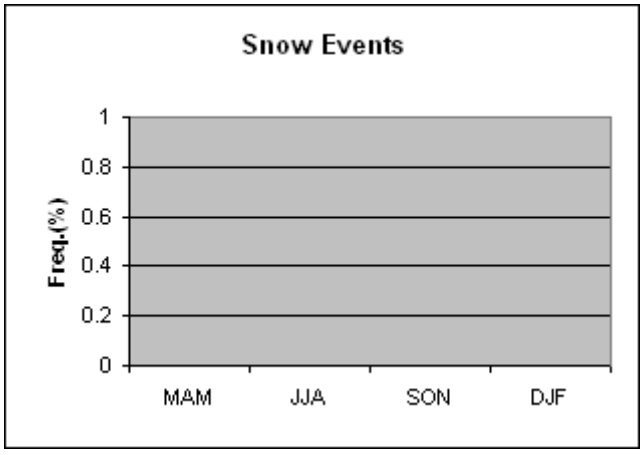
Ontario International – ONT

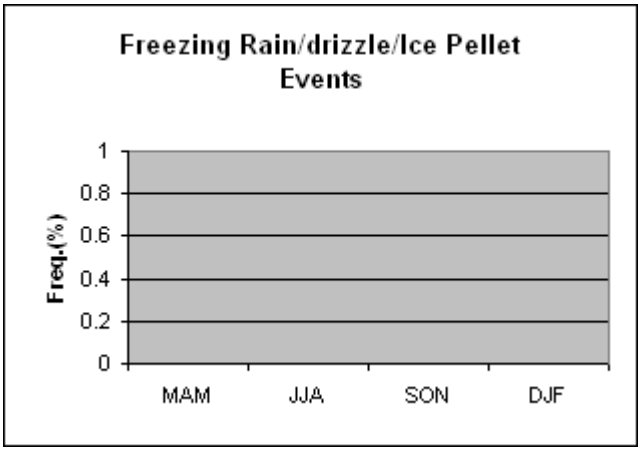




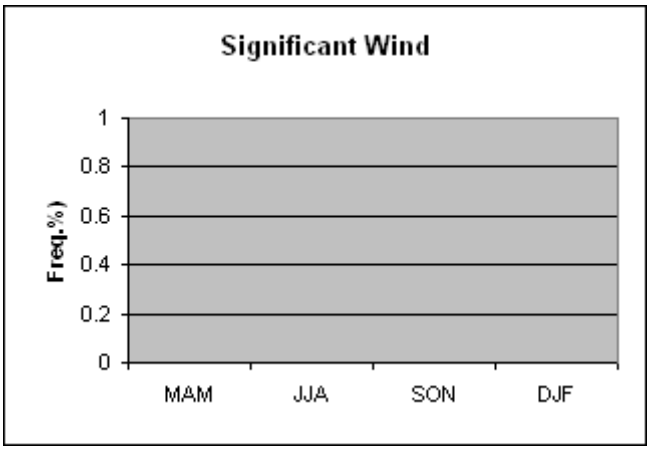


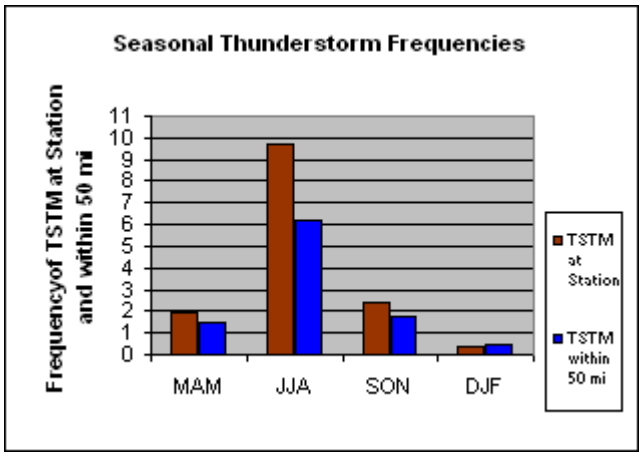


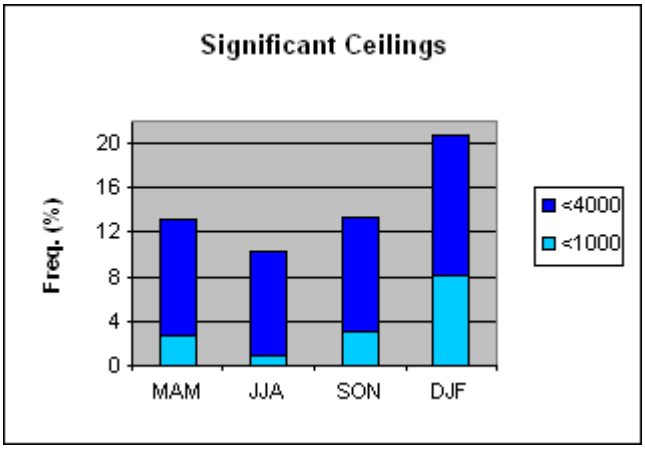


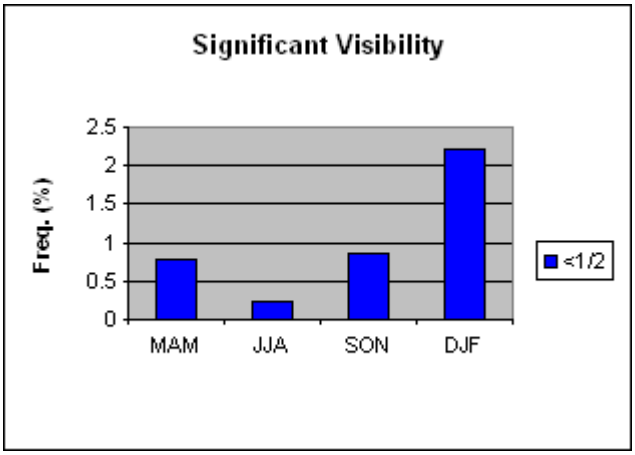


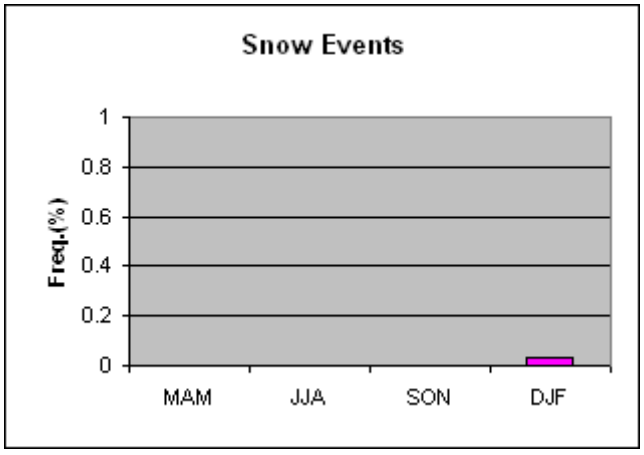
Orlando International – MCO

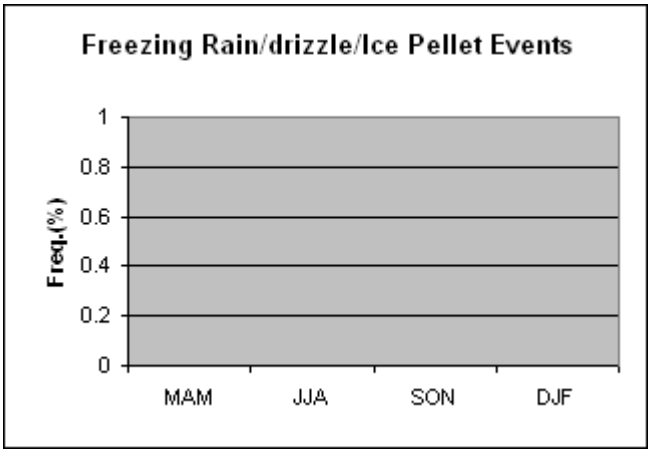




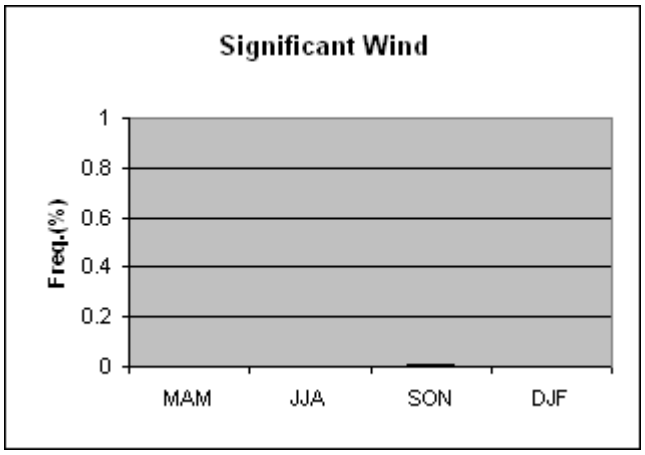


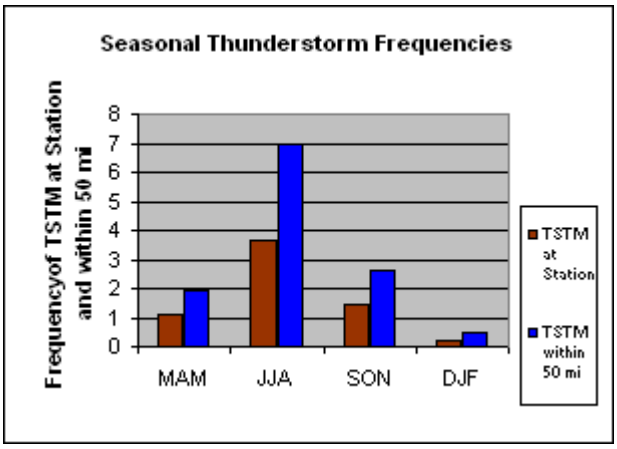


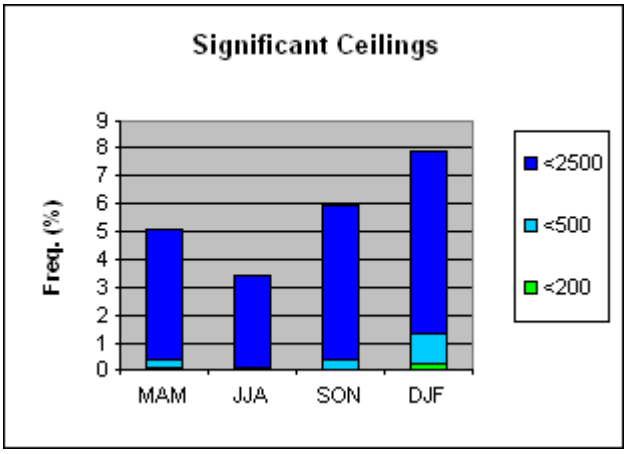


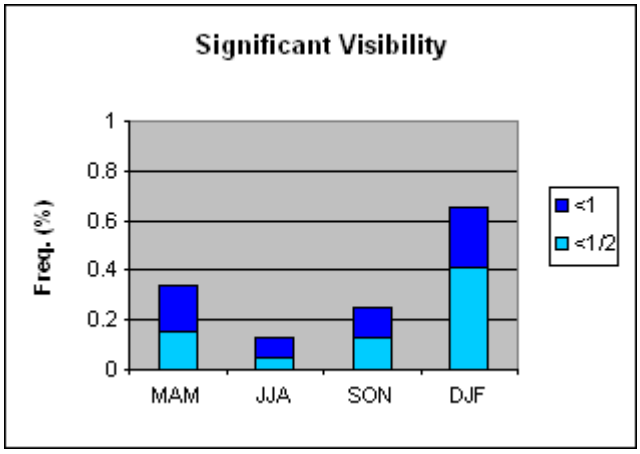


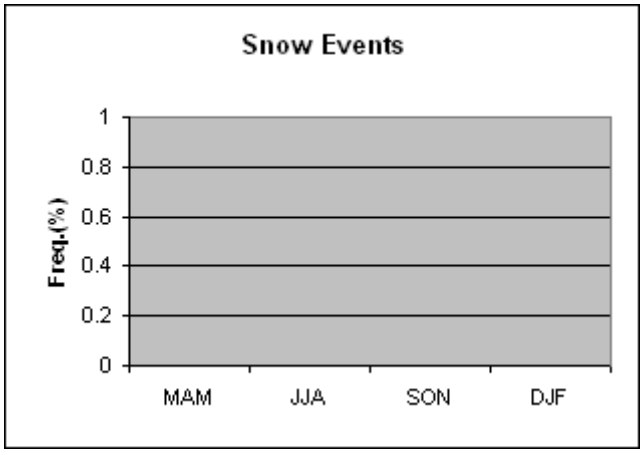
Palm Beach International – PBI

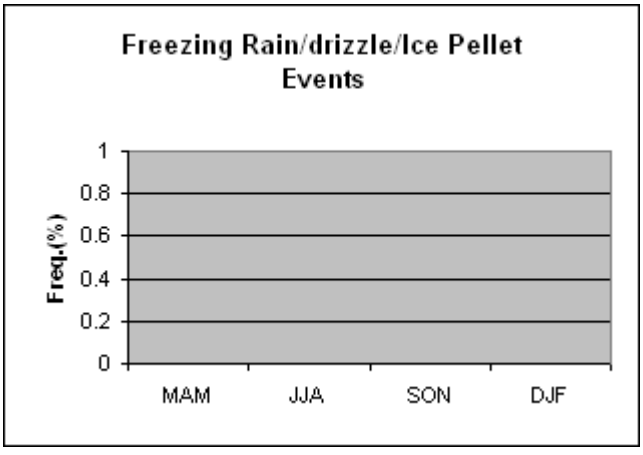




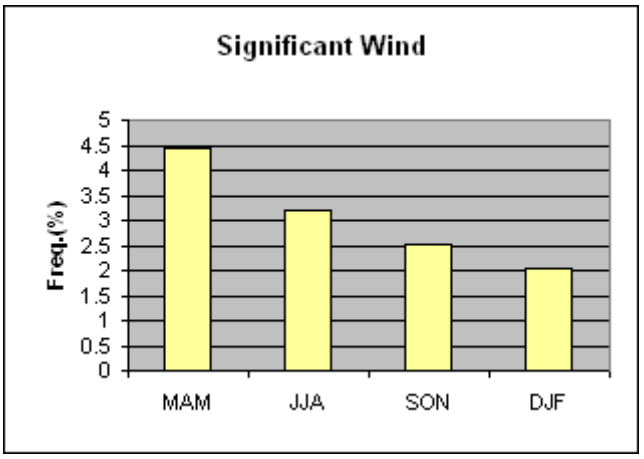


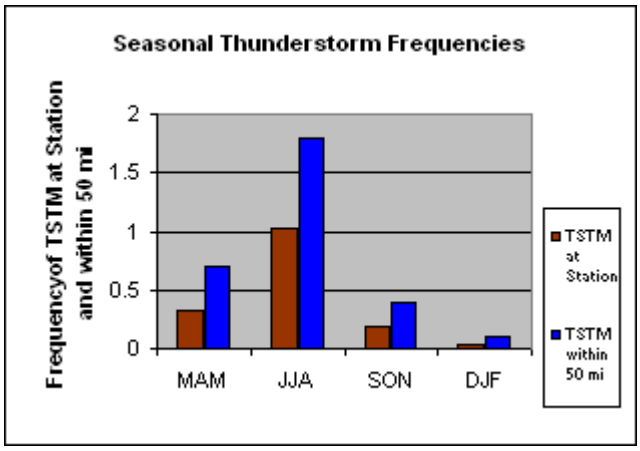


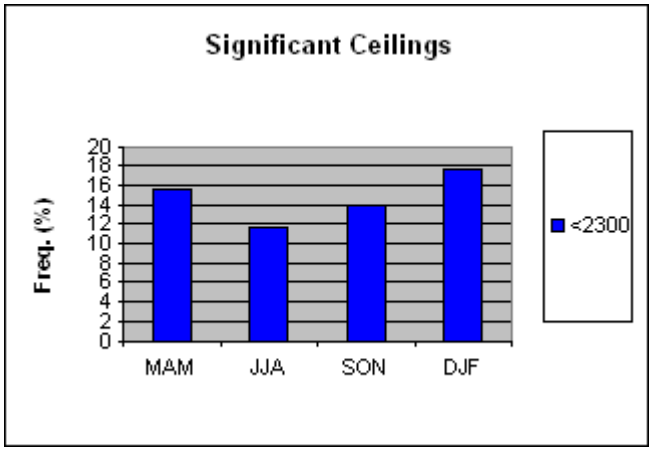


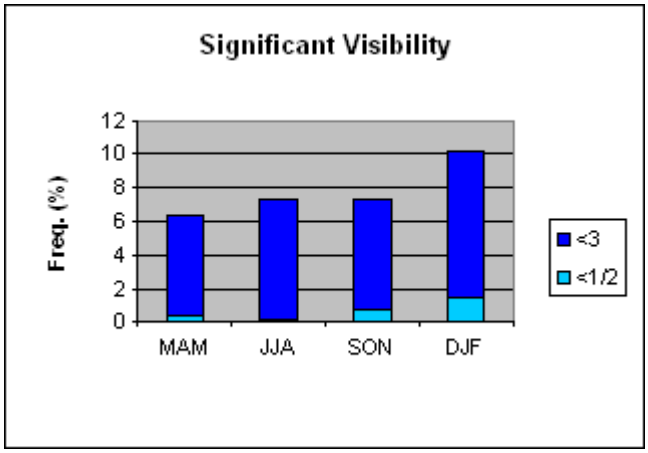


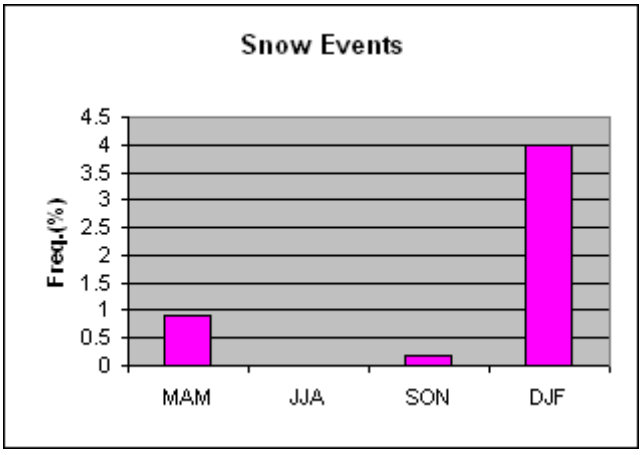
Philadelphia International - PHL

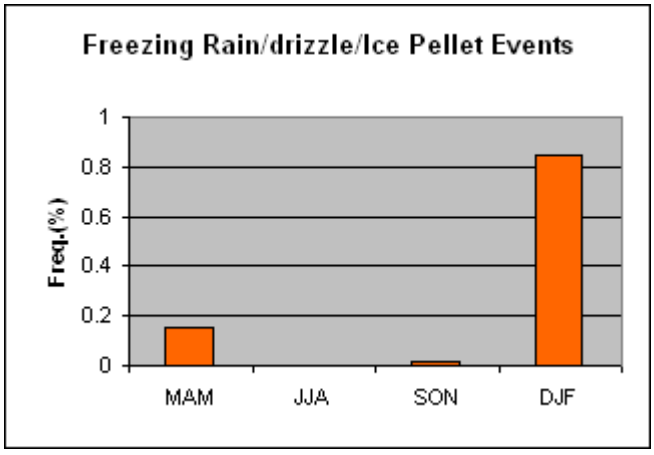




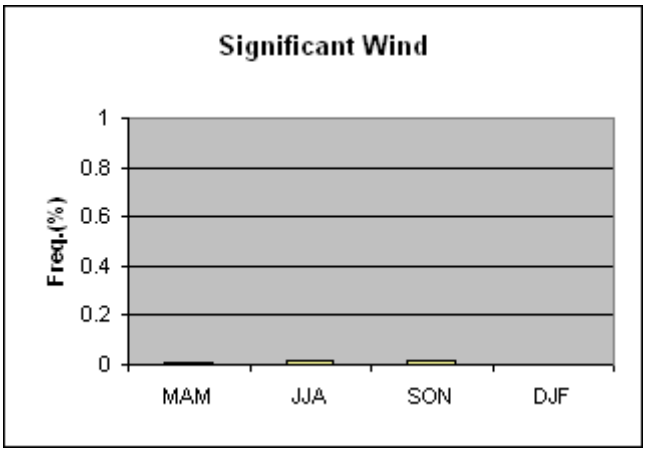


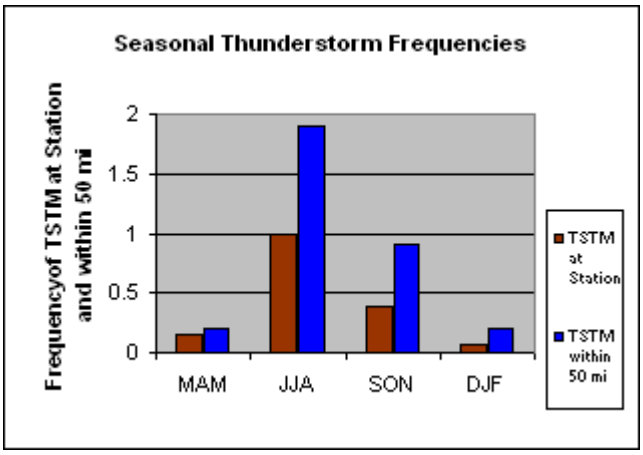


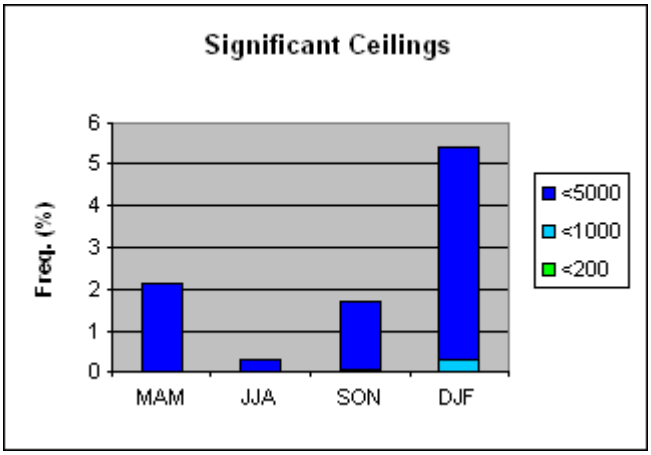


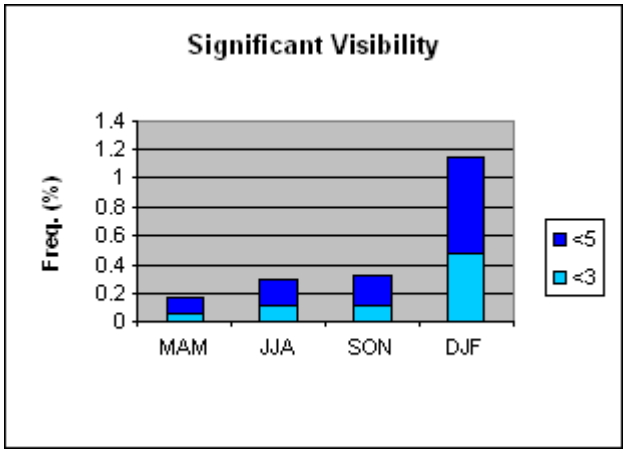


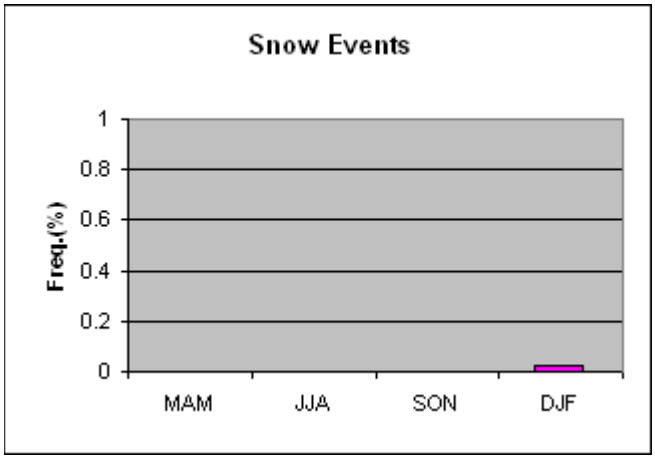
Phoenix – Sky Harbor International - PHX

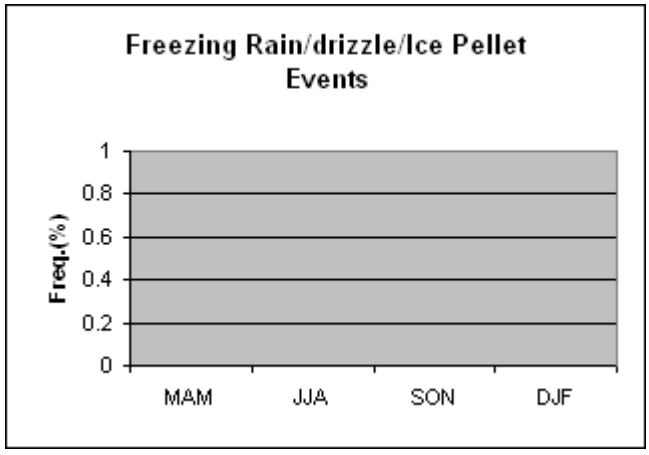




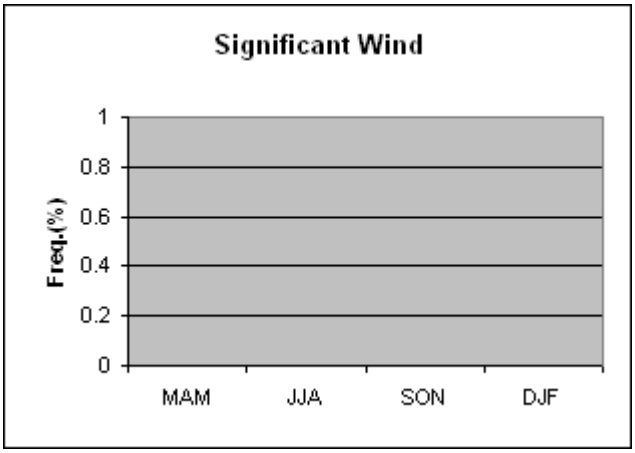


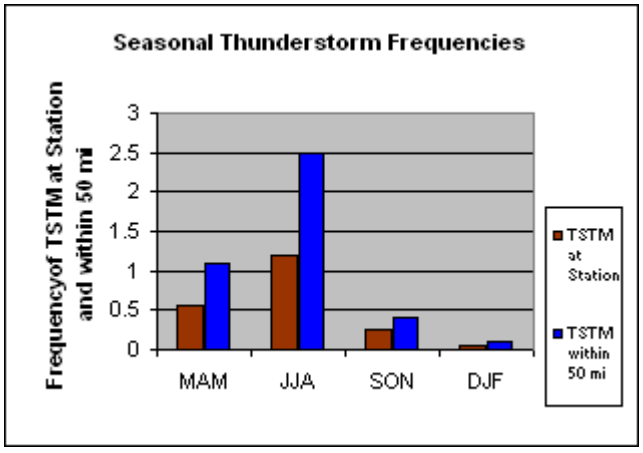


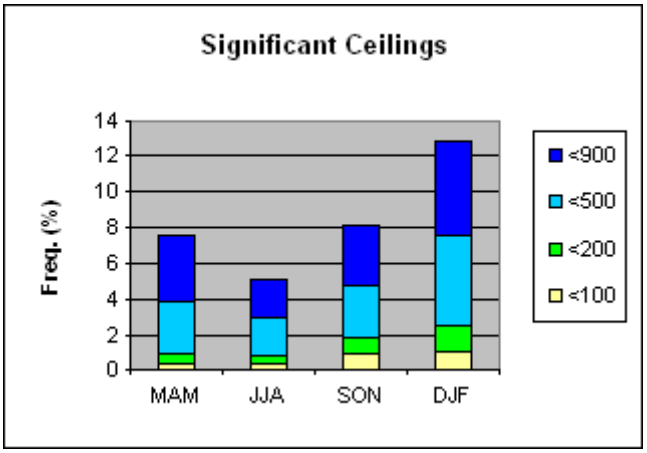


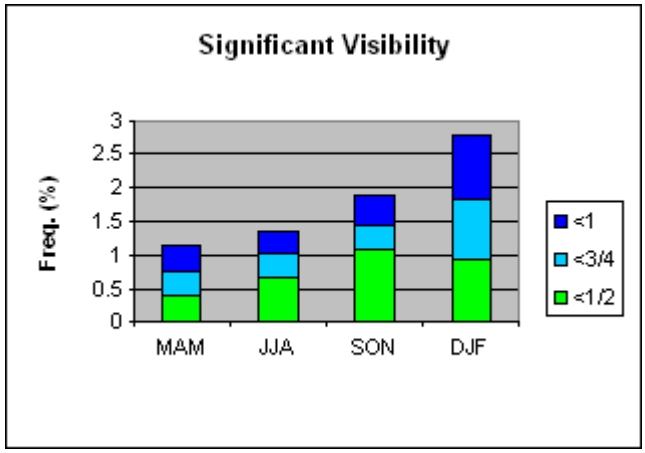


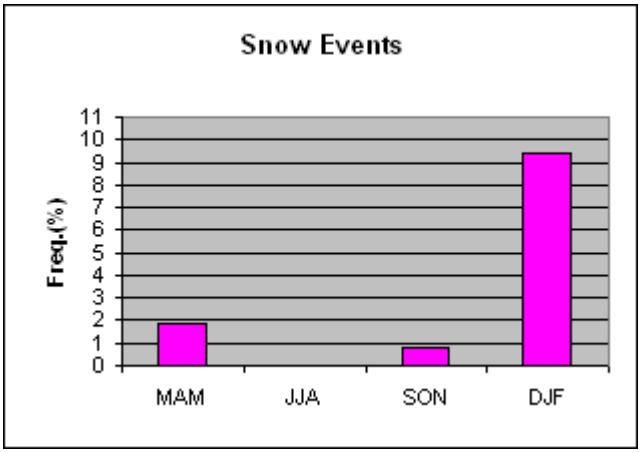
Pittsburg International – PIT

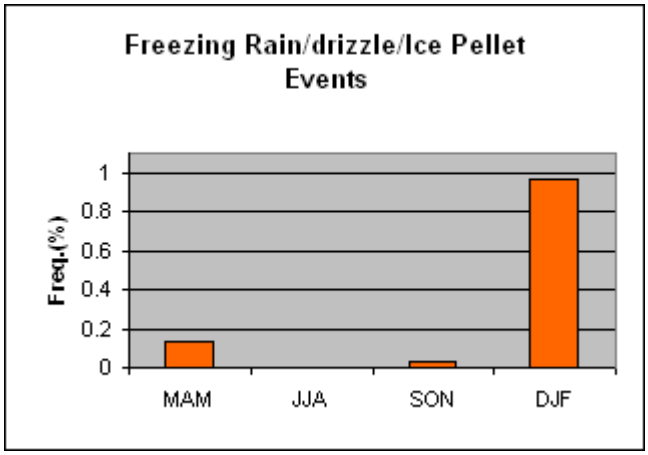




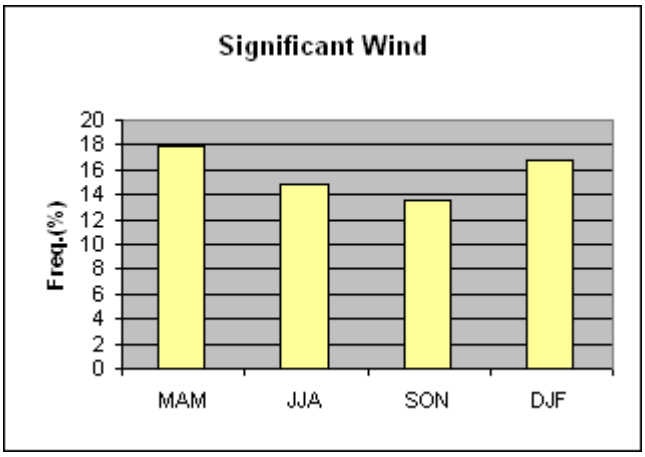


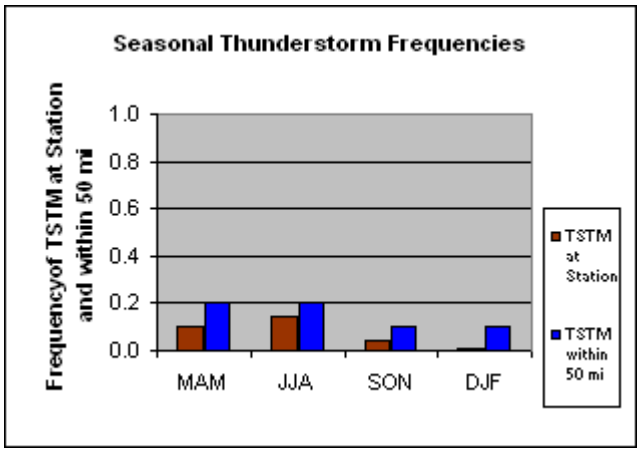


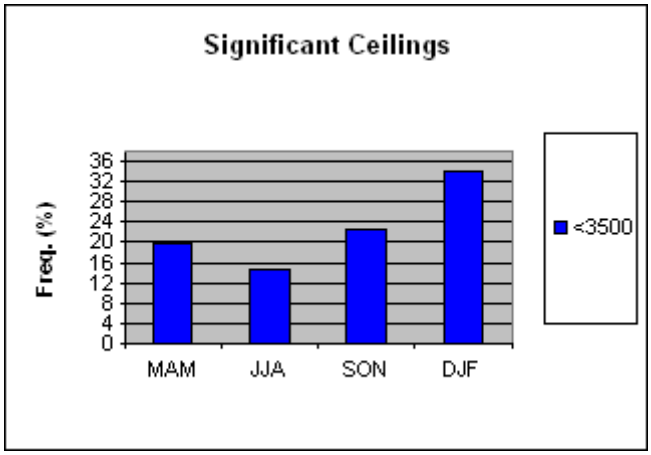


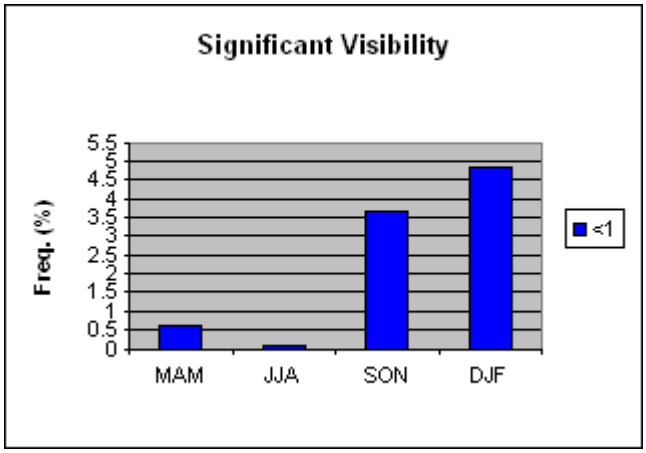


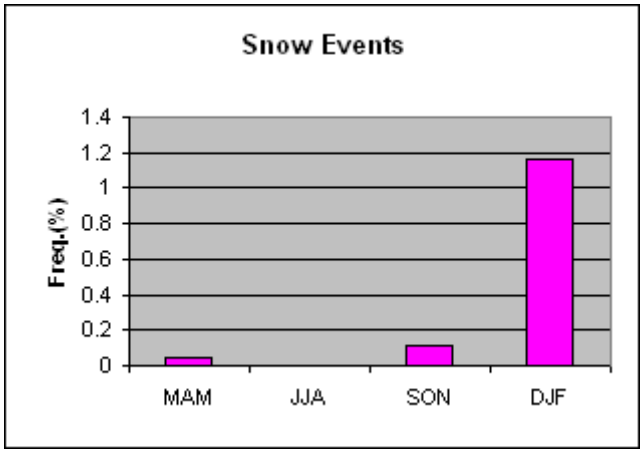
Portland International – PDX

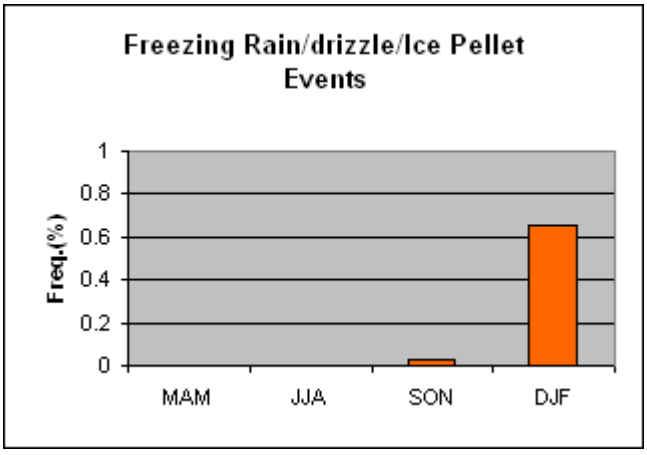




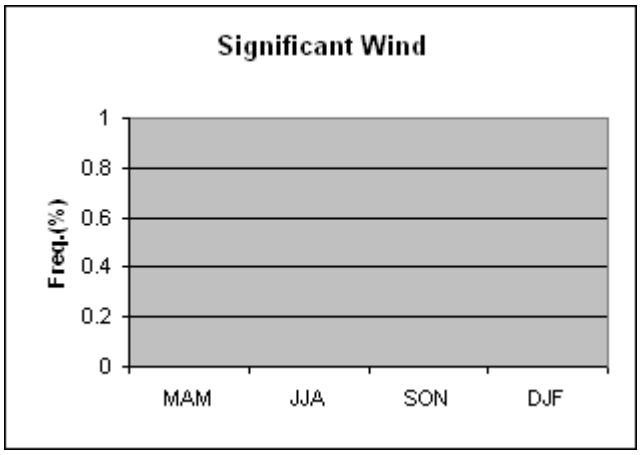


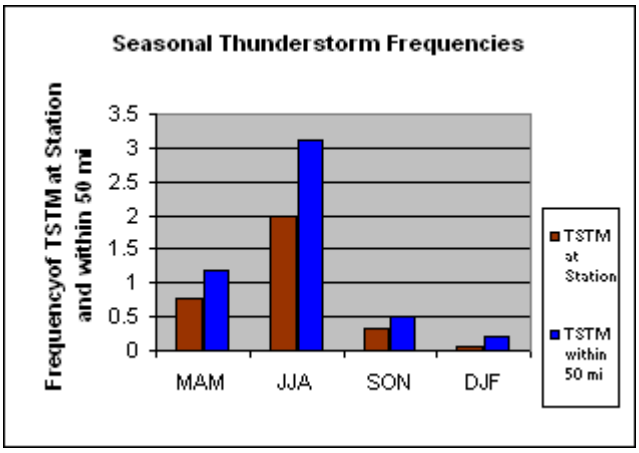


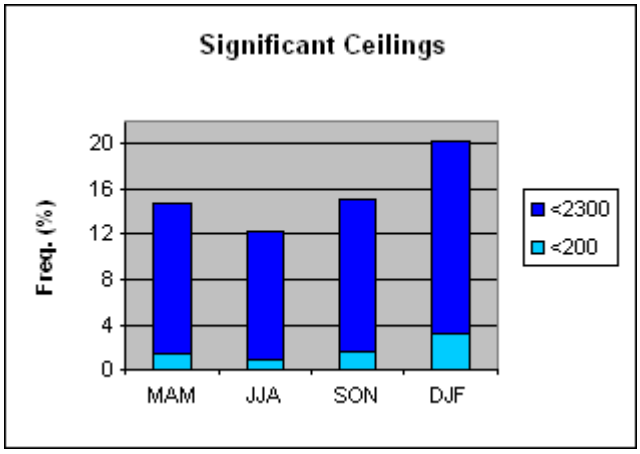


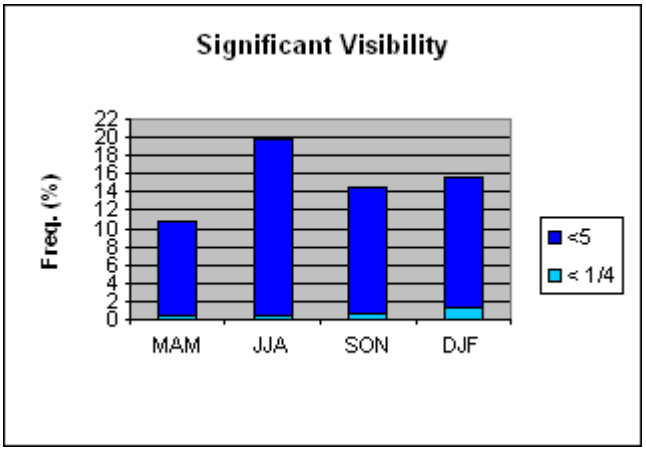


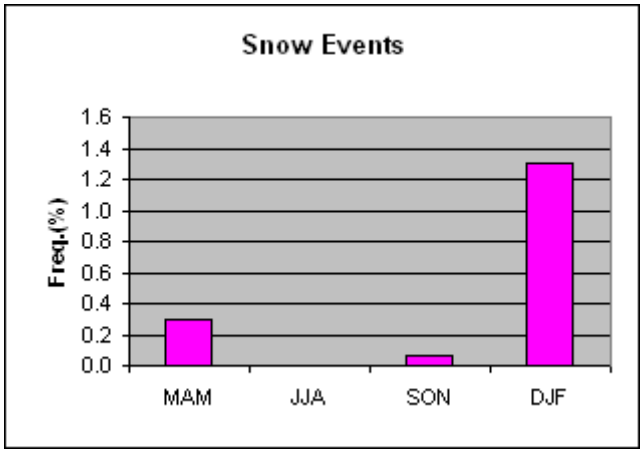
Raleigh-Durham International – RDU

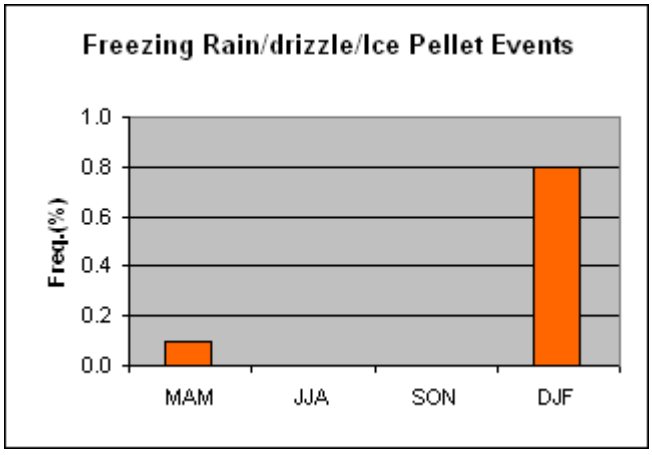




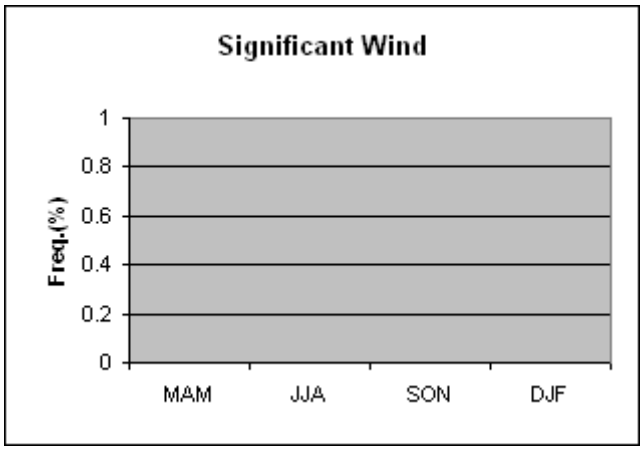


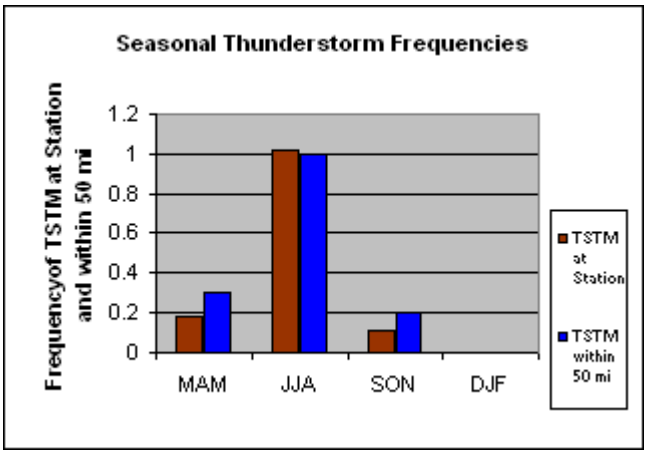


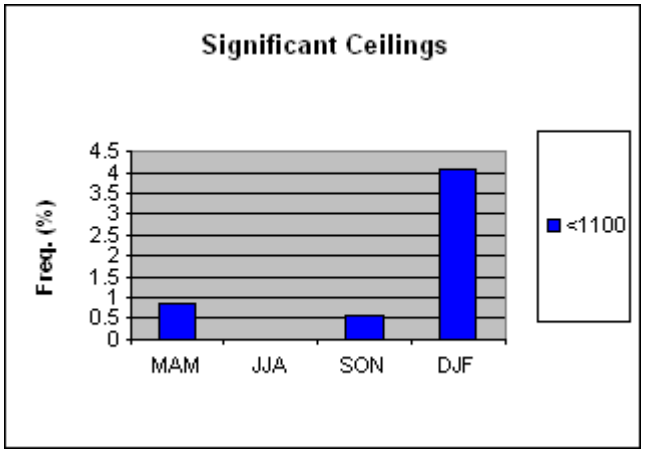


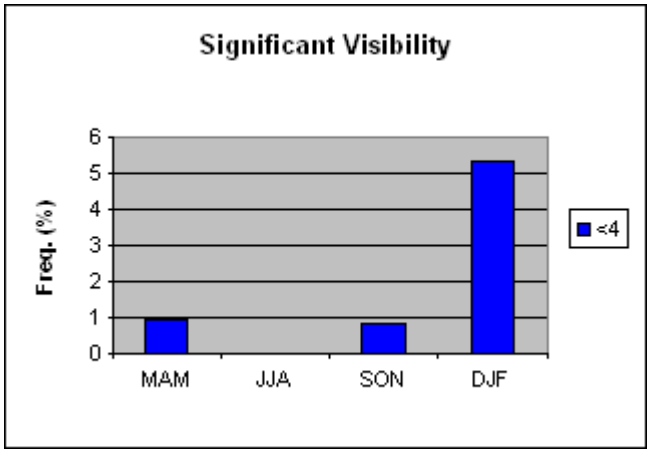


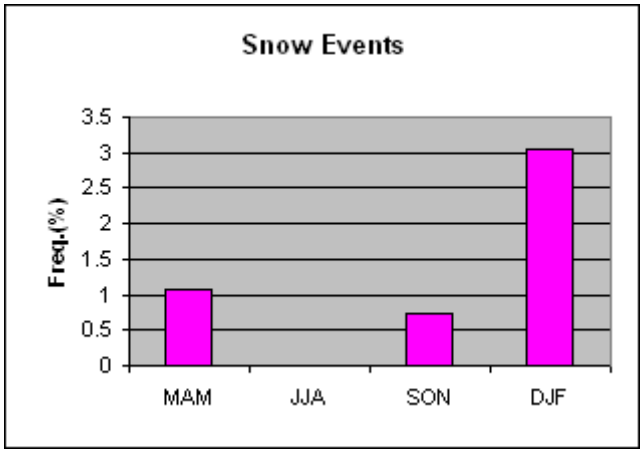
Reno-Tahoe International – RNO

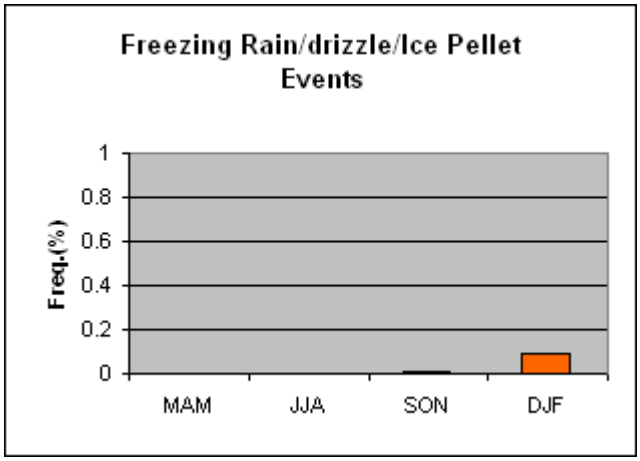




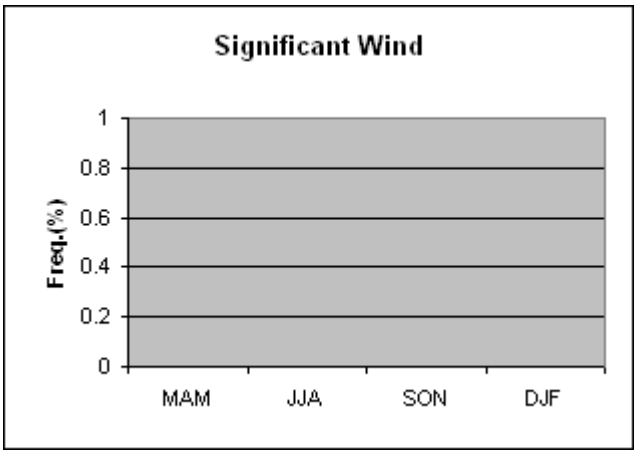


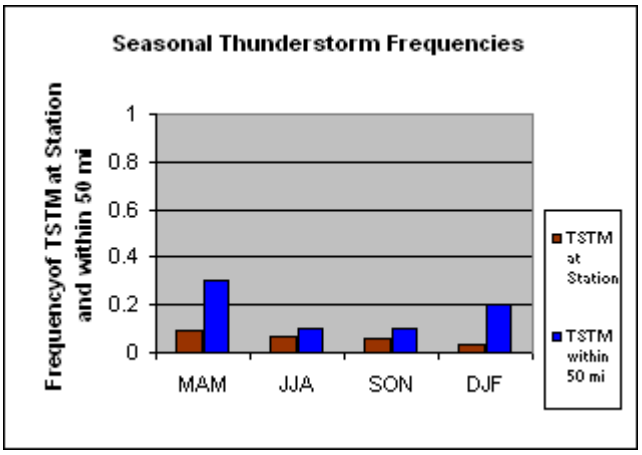


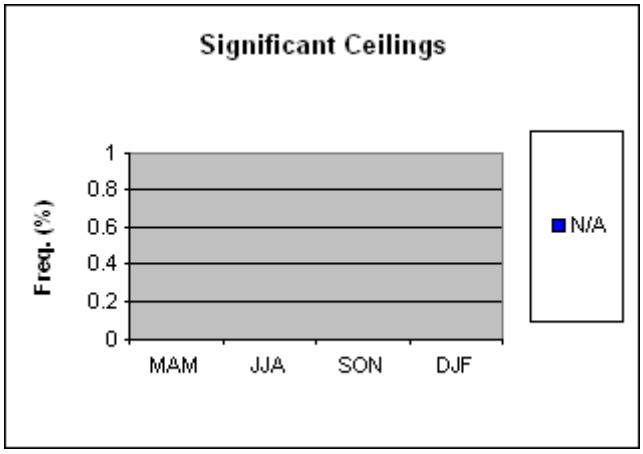


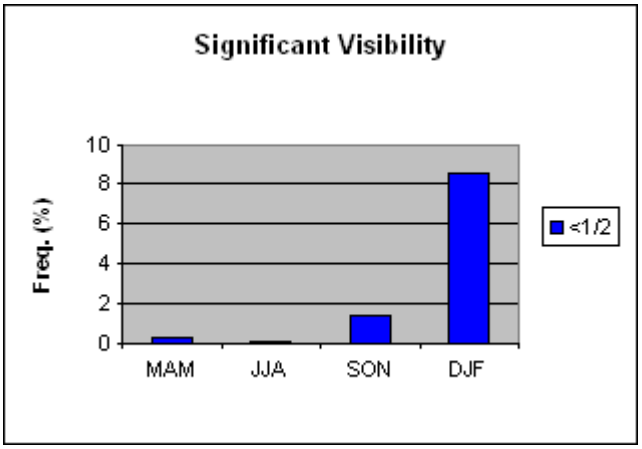


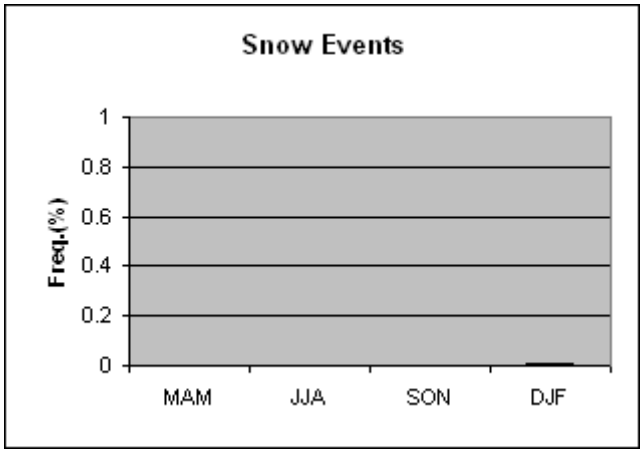
Sacramento International – SMF

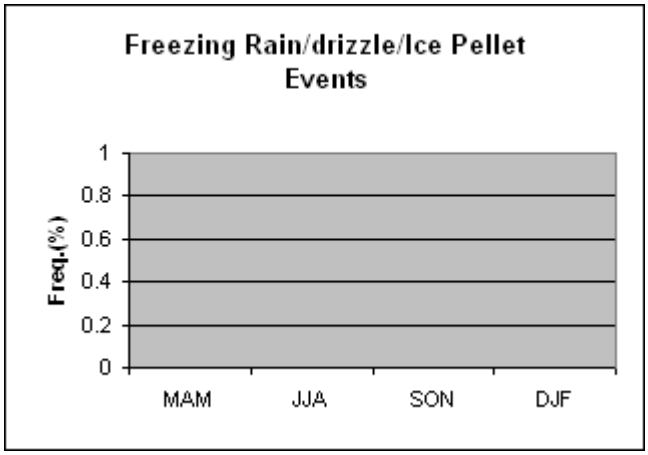




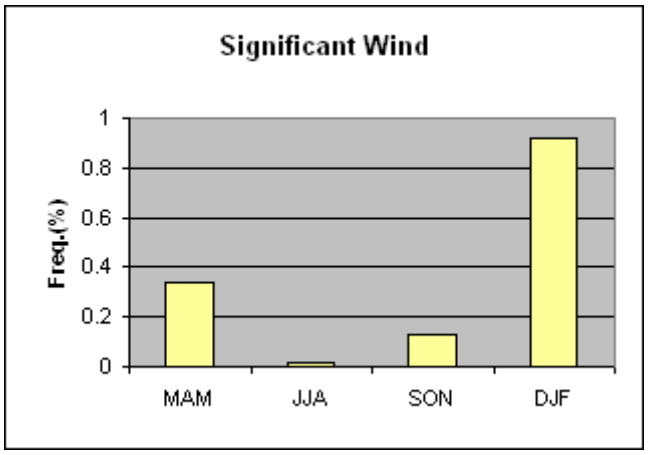


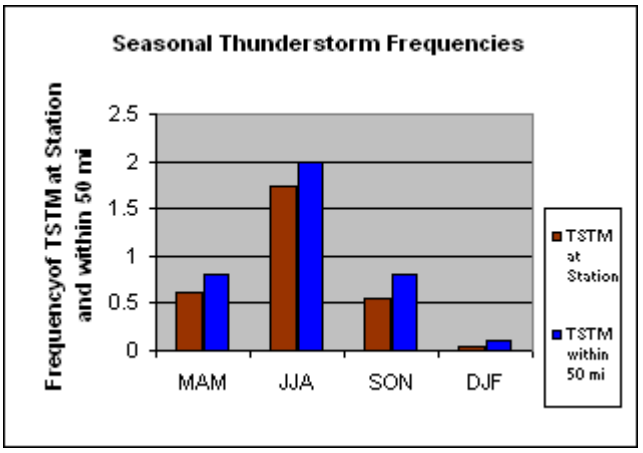


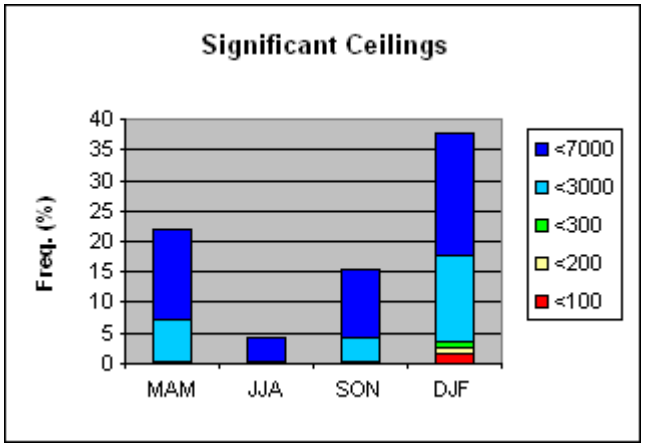


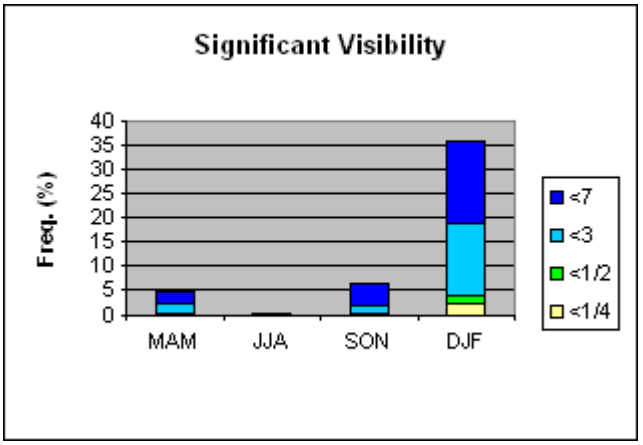


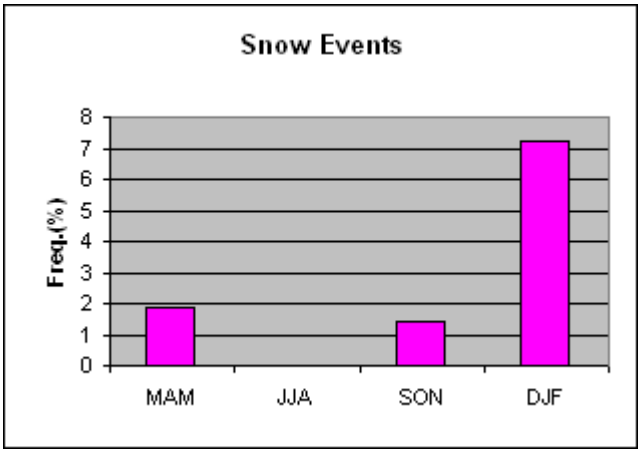
Salt Lake City International – SLC

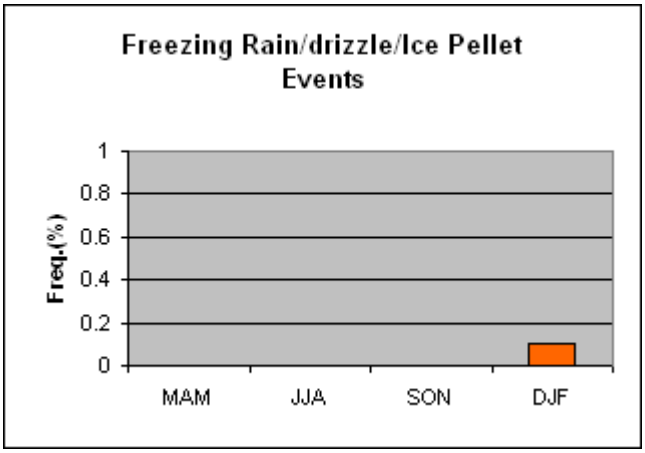




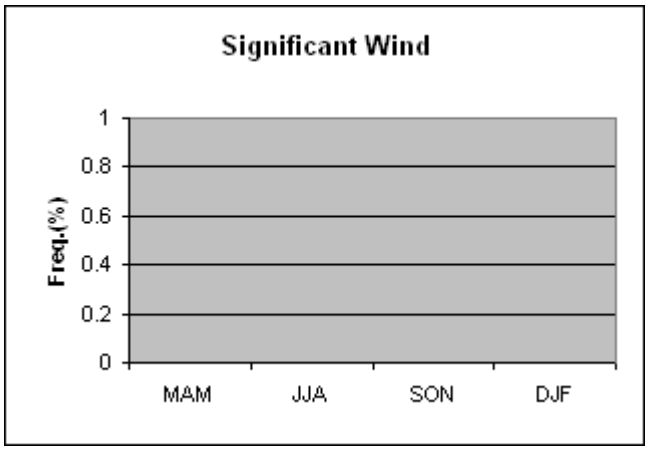


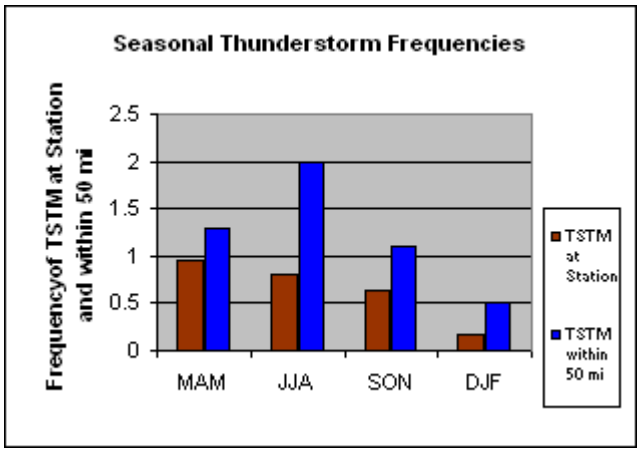


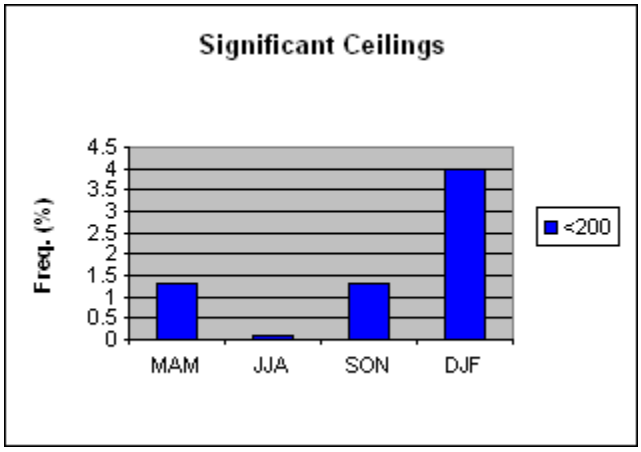


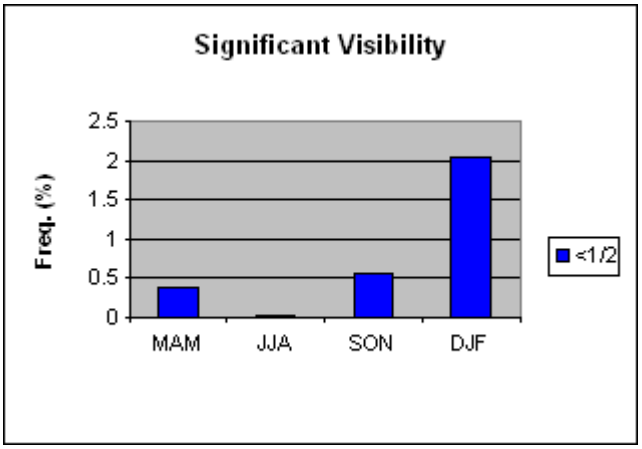


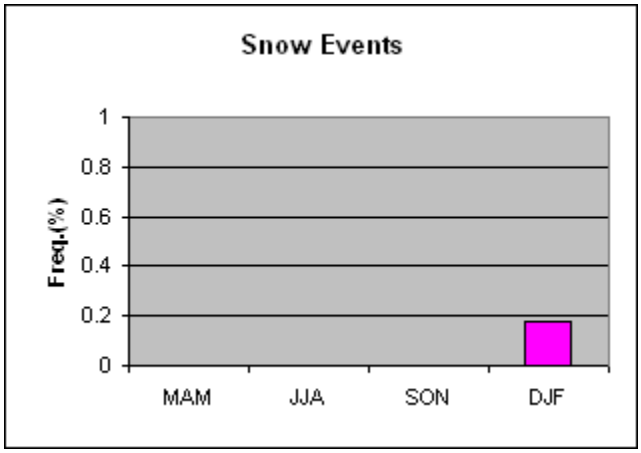
San Antonio International – SAT

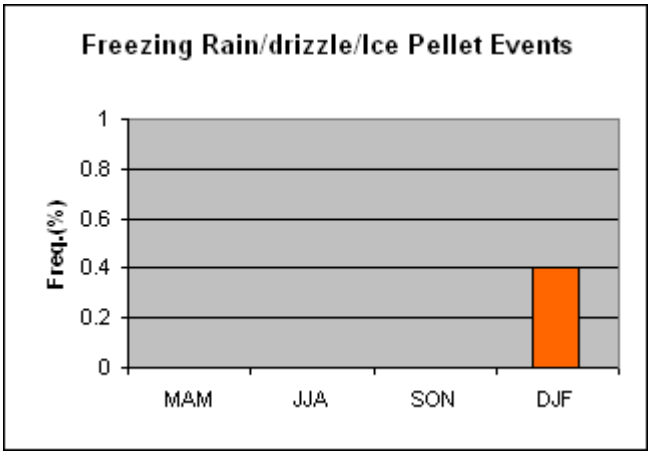




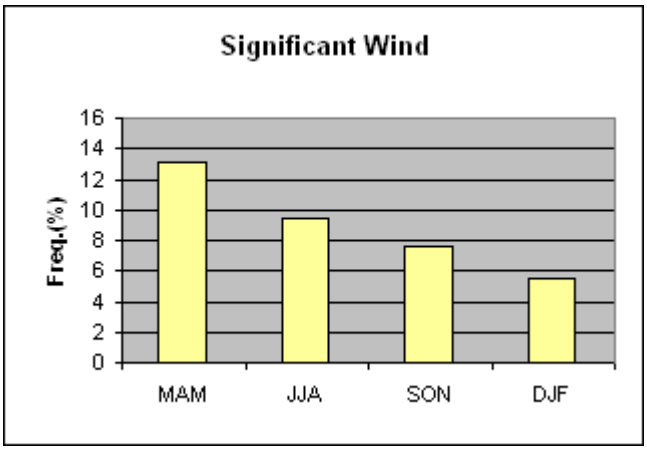


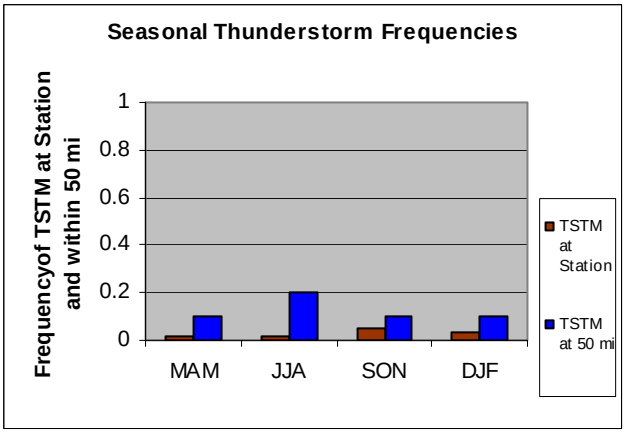


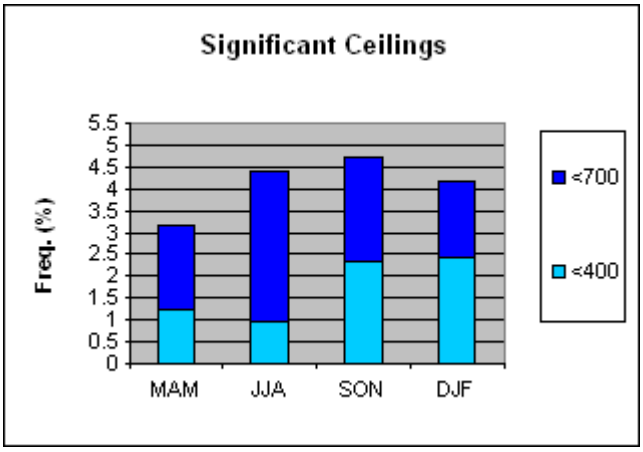


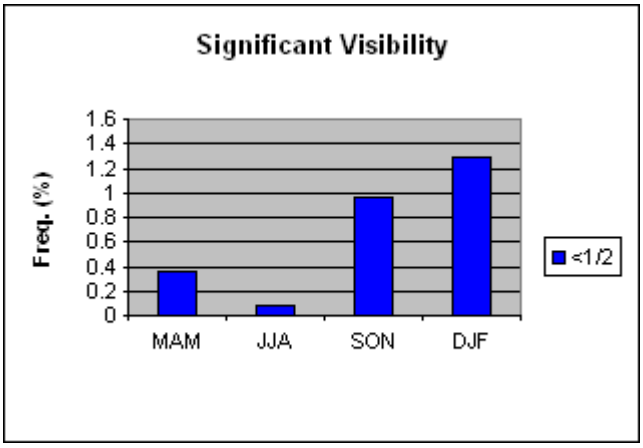


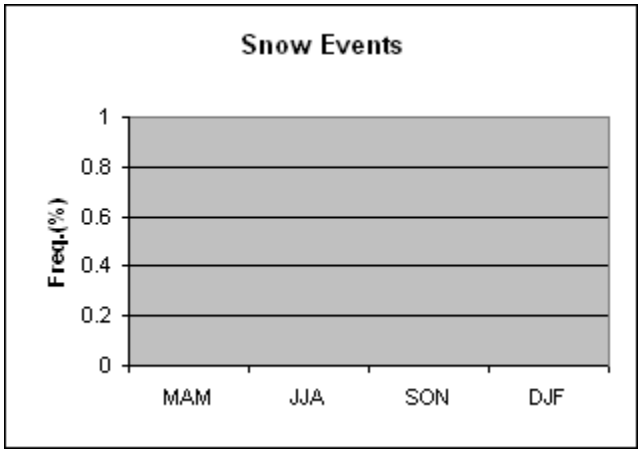
San Diego International – SAN

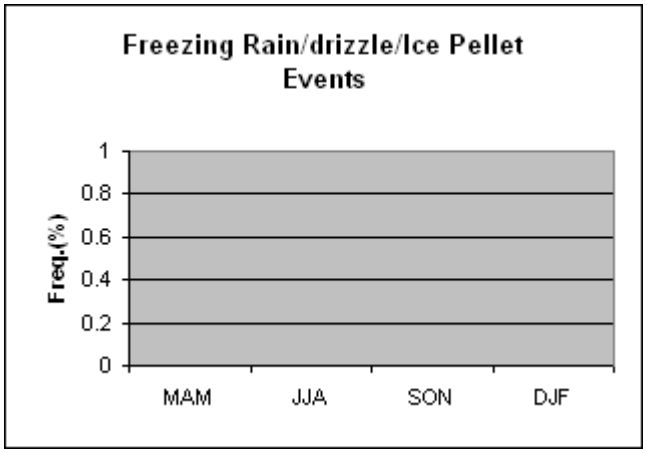




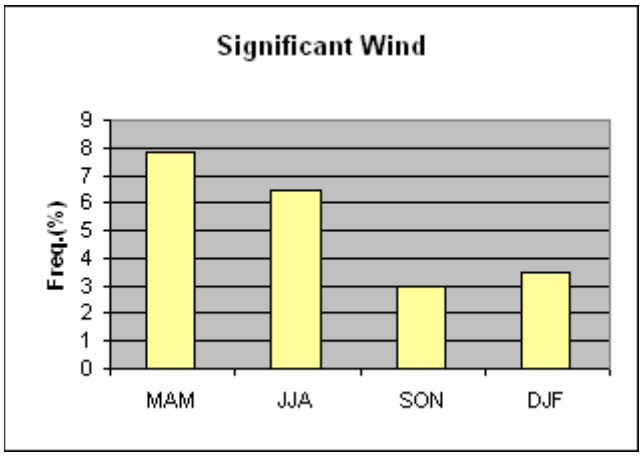


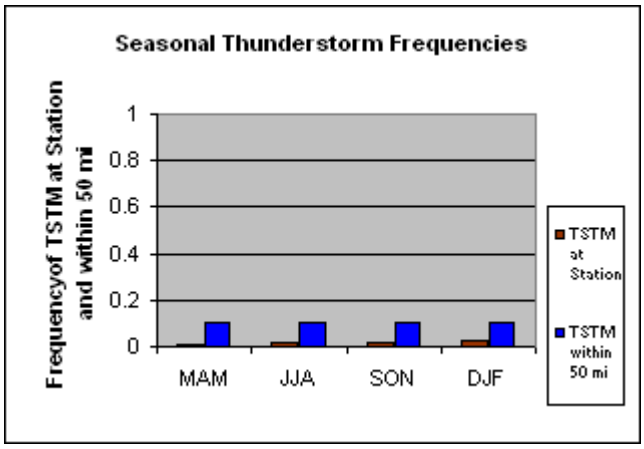


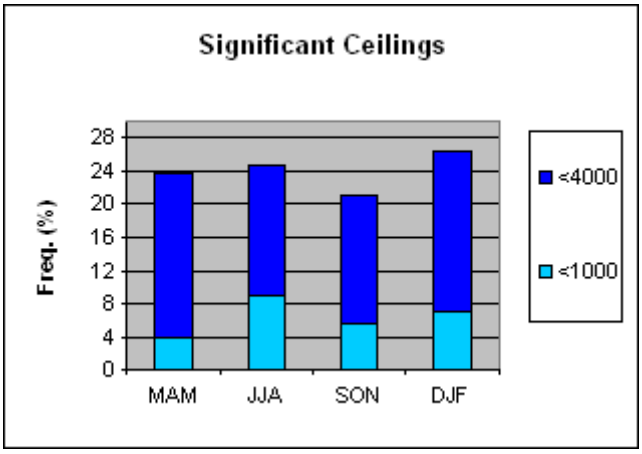


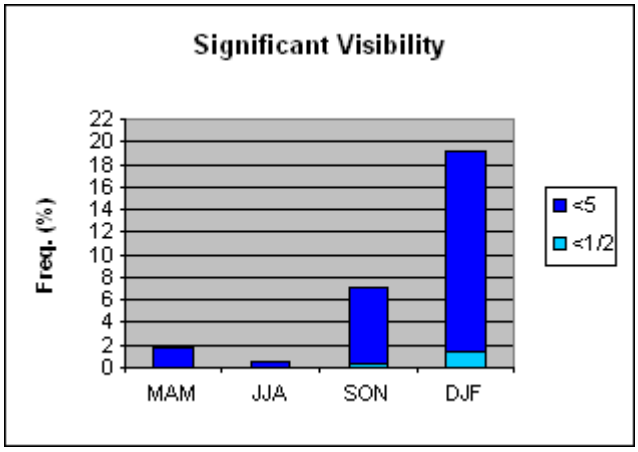


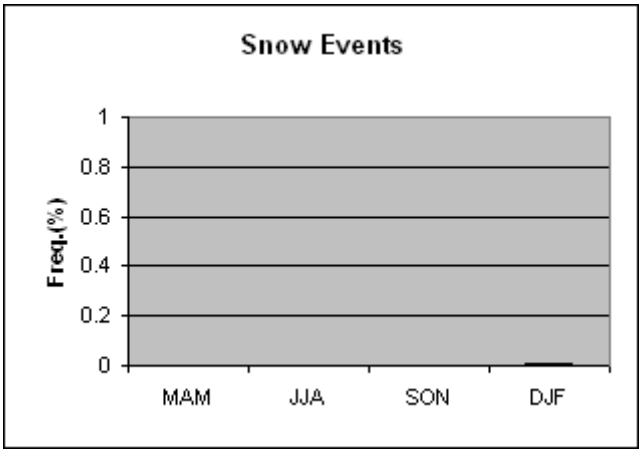
San Francisco International – SFO

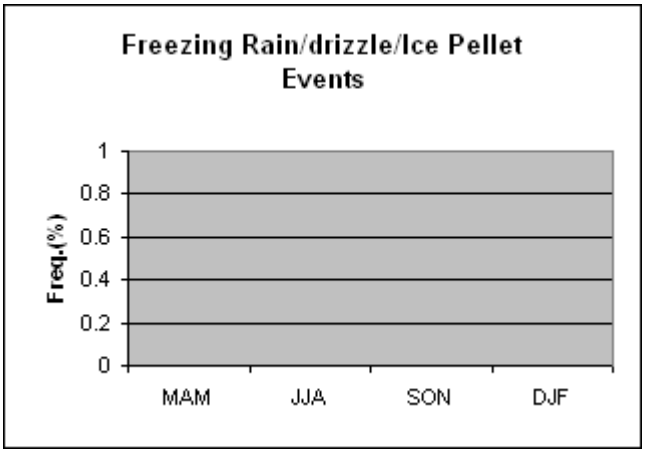




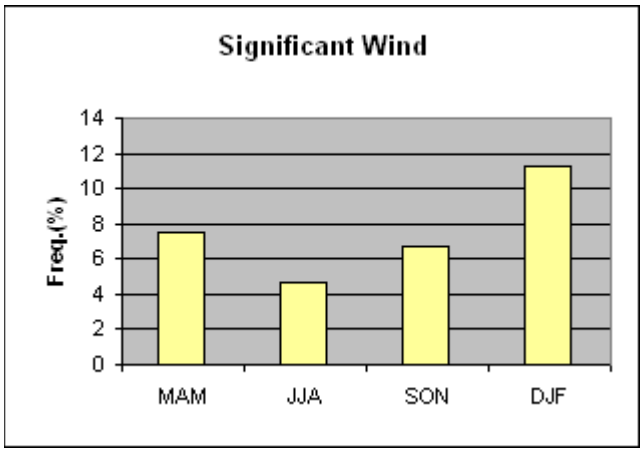


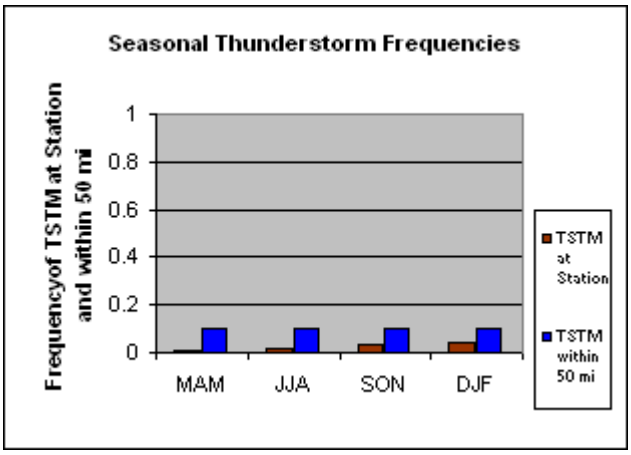


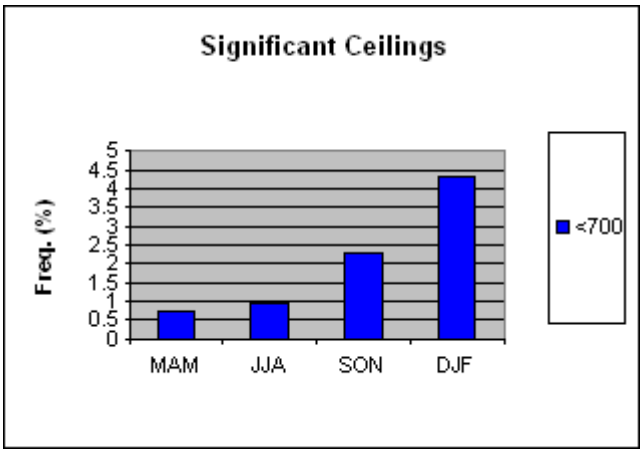


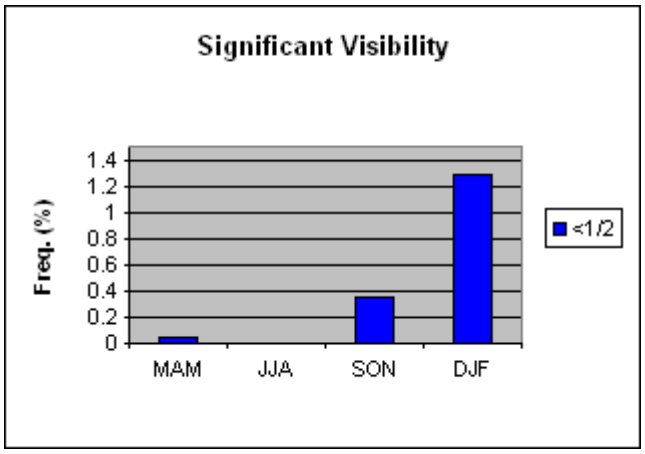


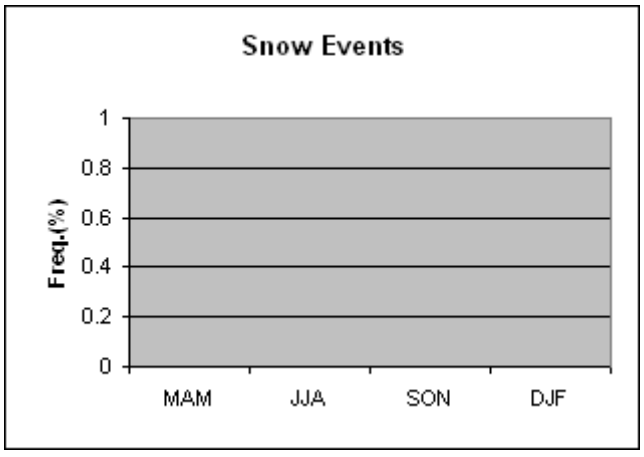
Santa Jose International – SJC

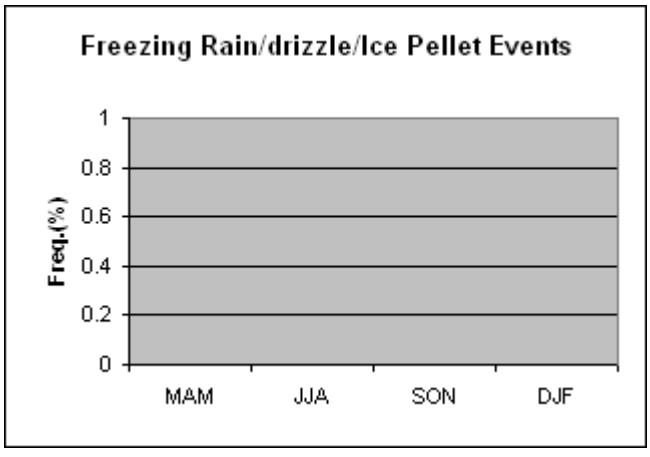




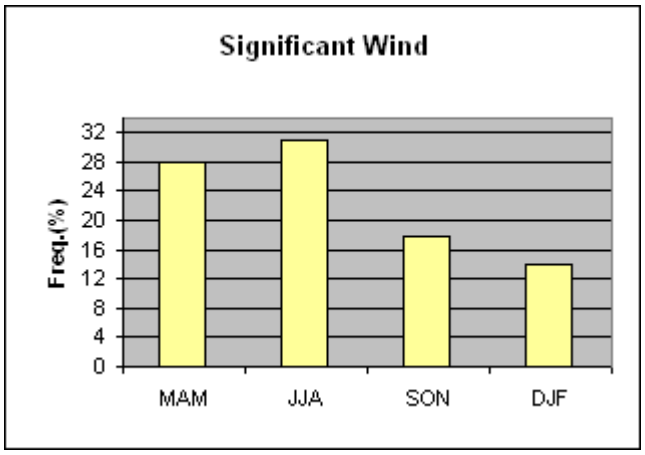


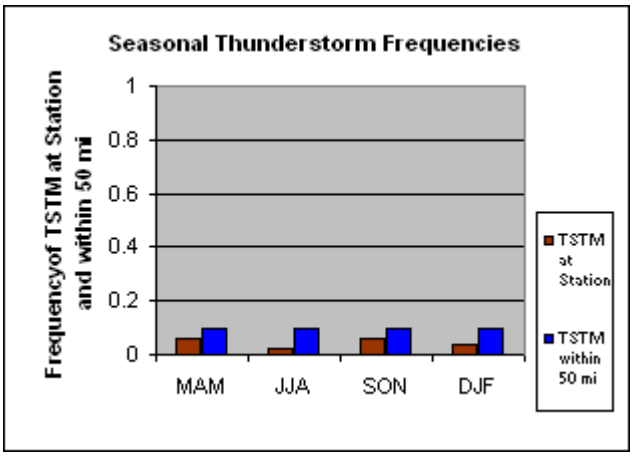


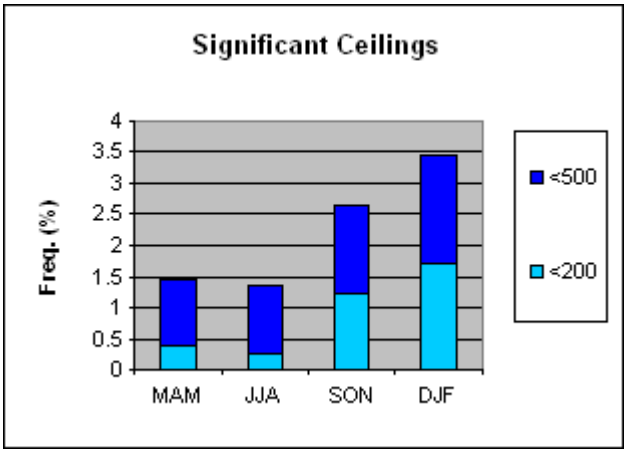


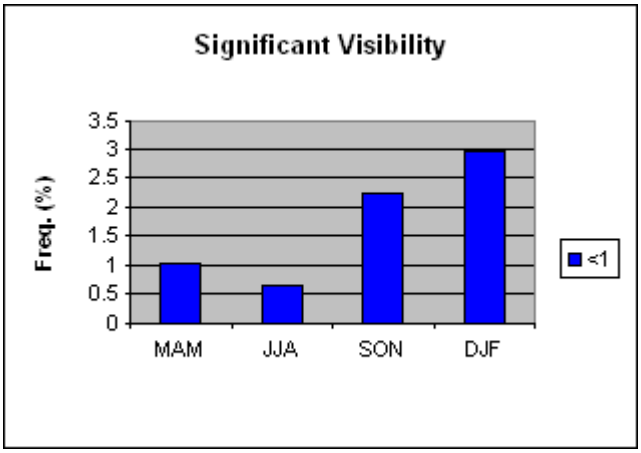


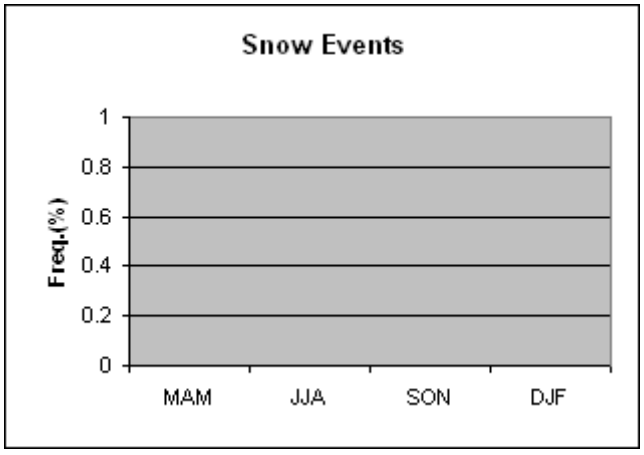
Santa Ana – John Wayne – Orange County – SNA

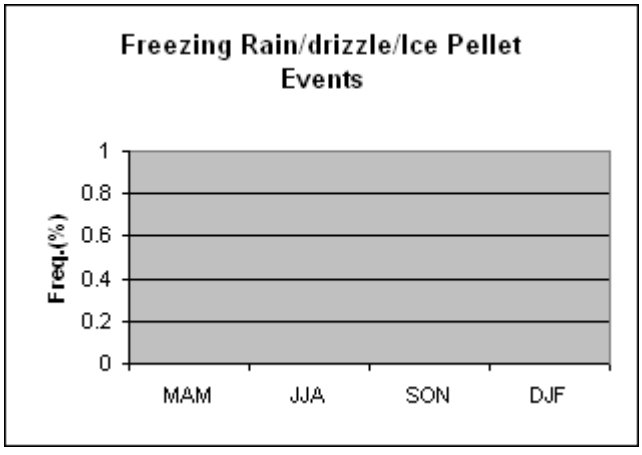




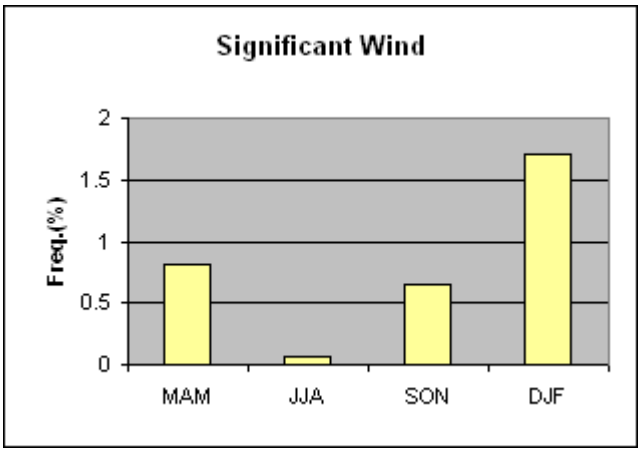


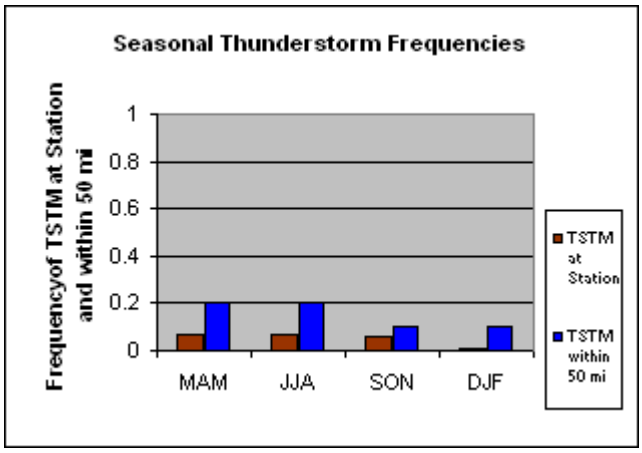


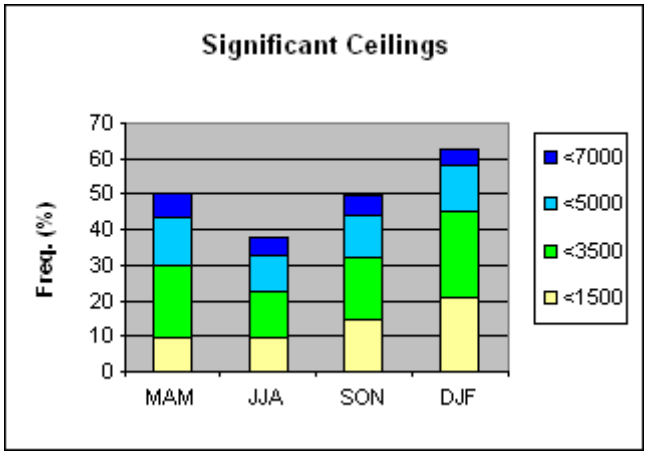


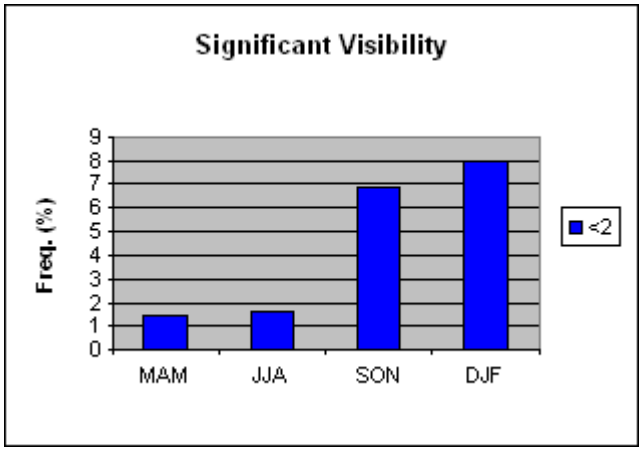


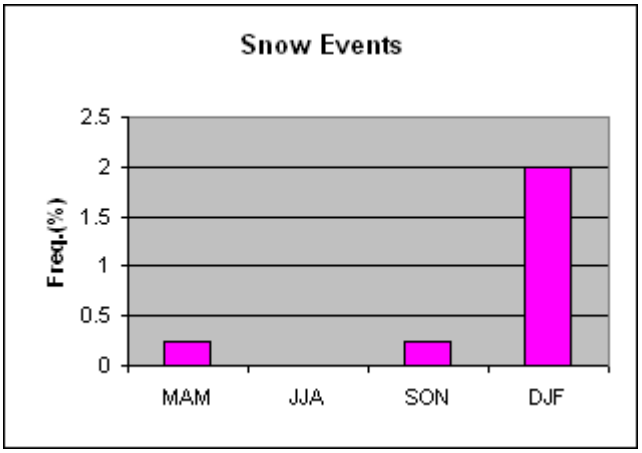
Seattle-Tacoma International – SEA

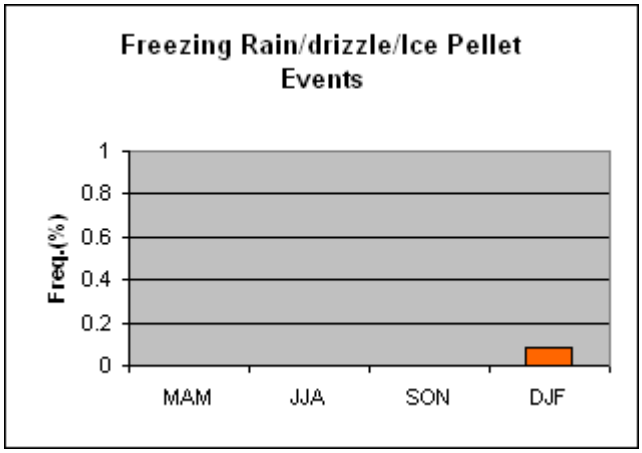




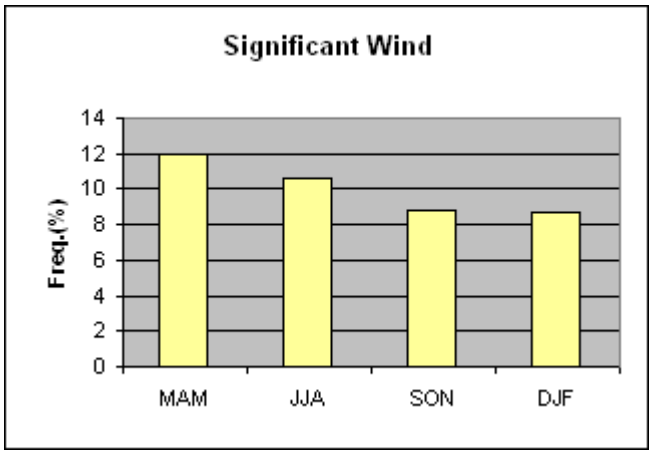


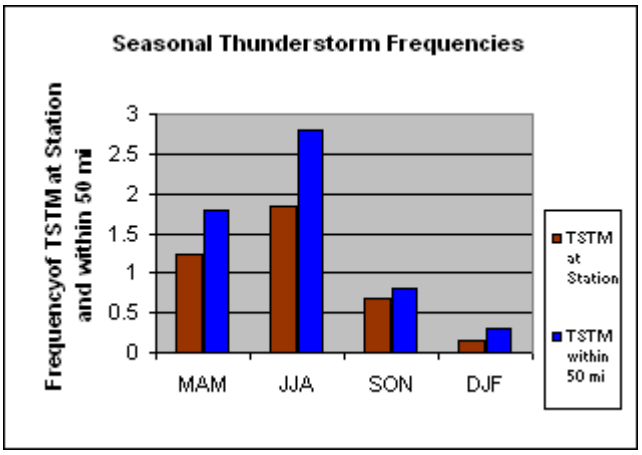


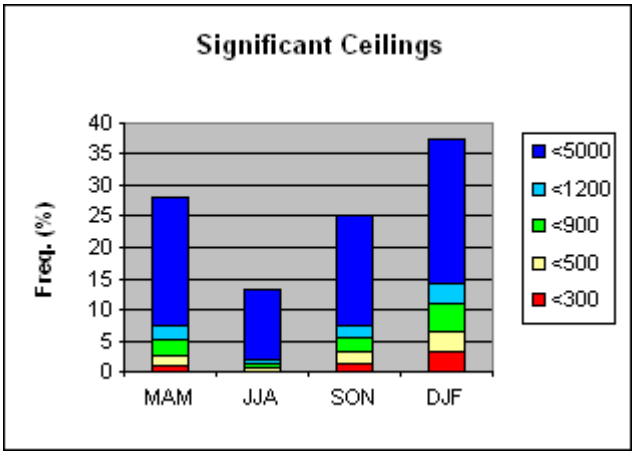


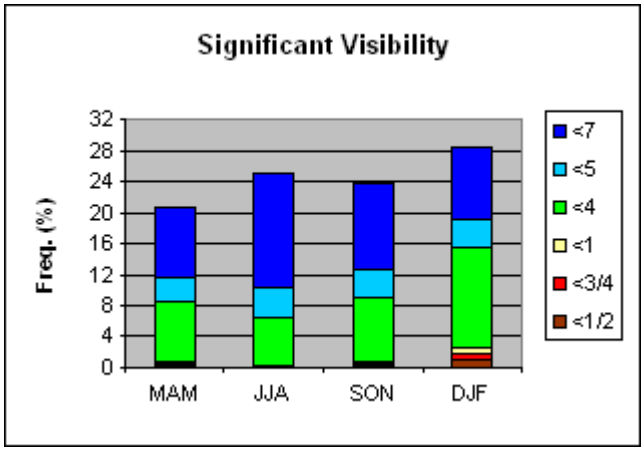


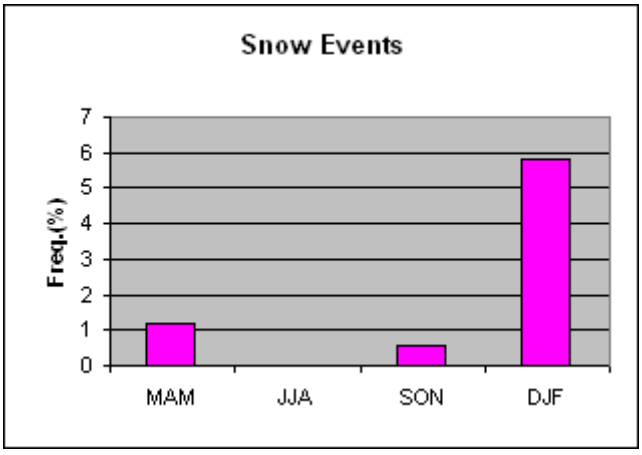
St. Louis – Lambert St. Louis International – STL

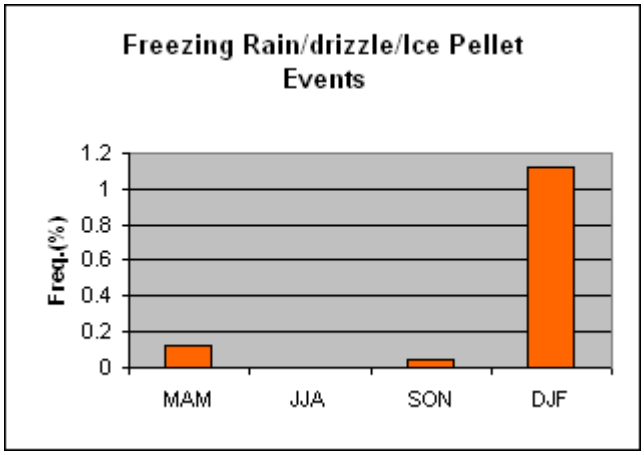




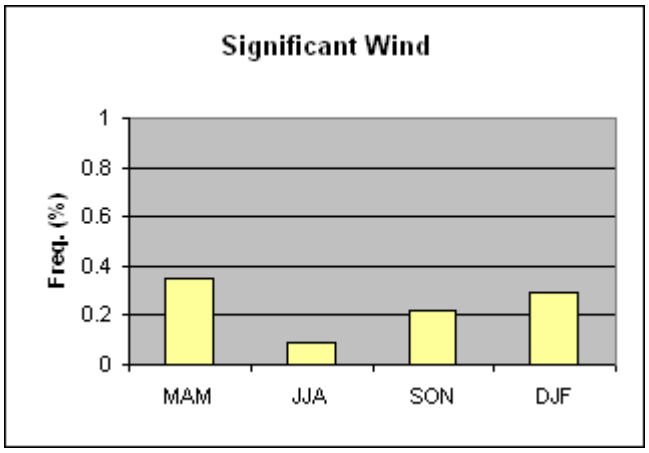


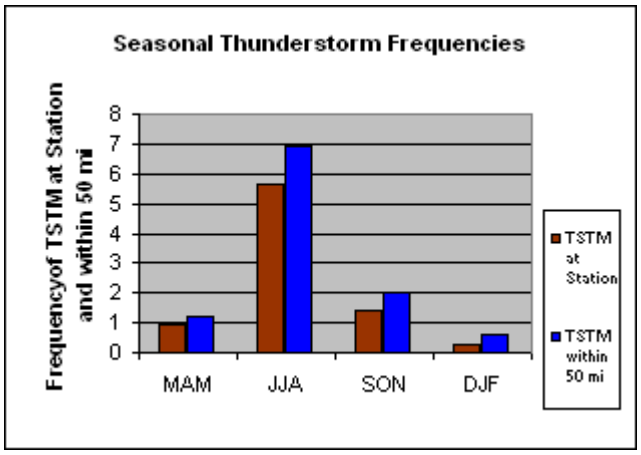


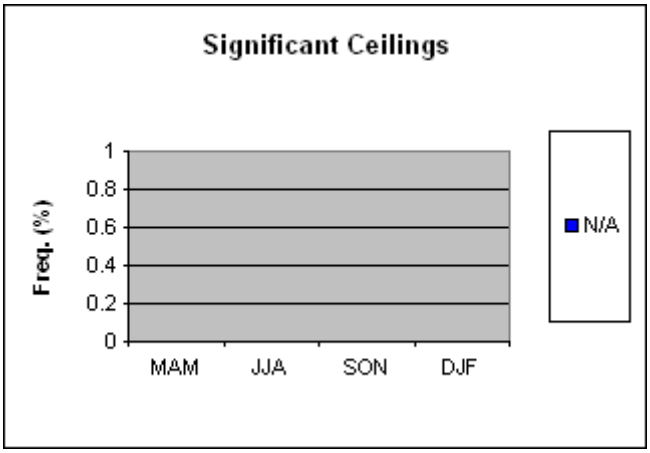


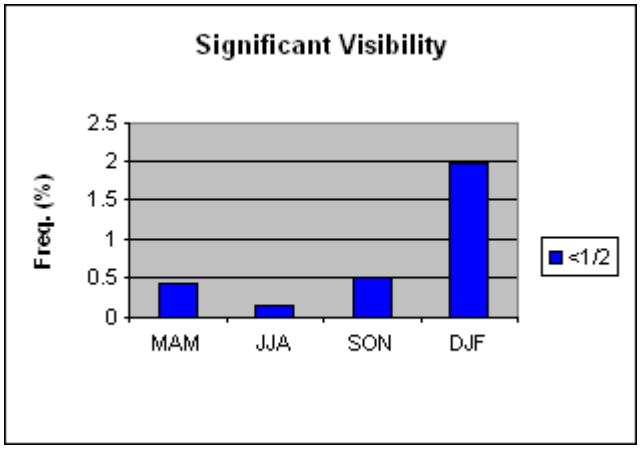


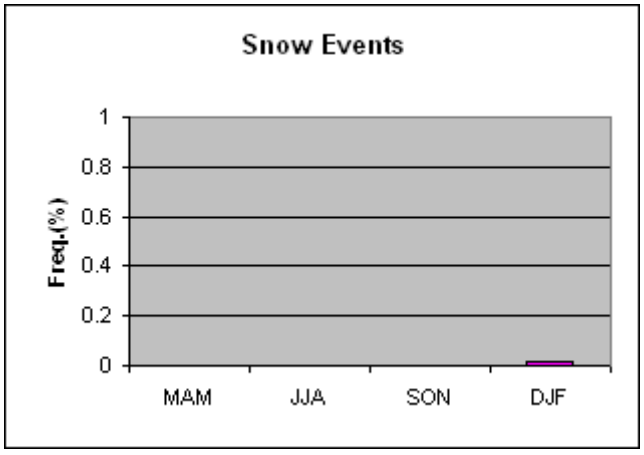
Tampa International – TPA

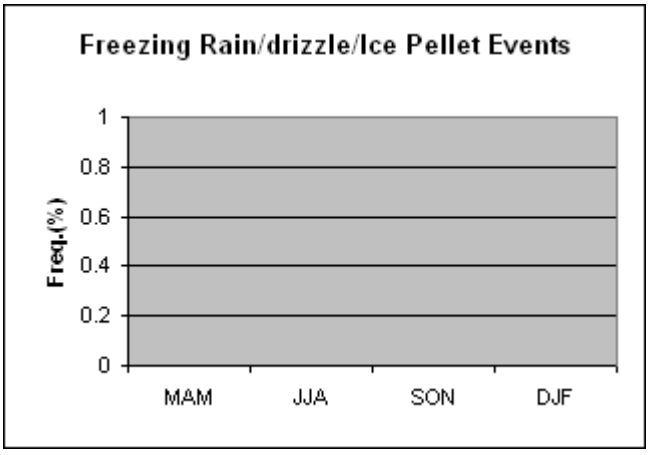




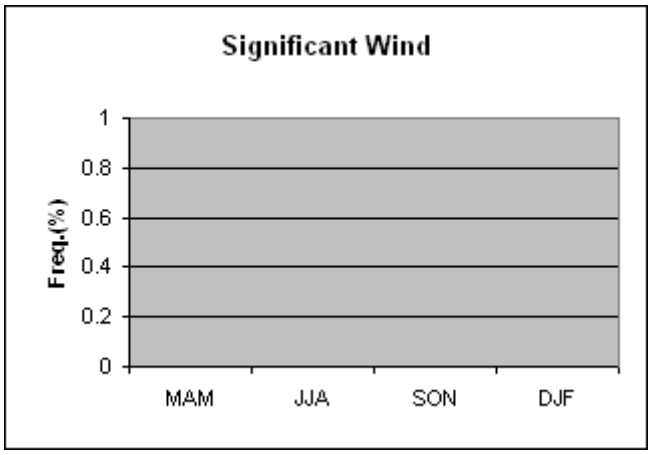


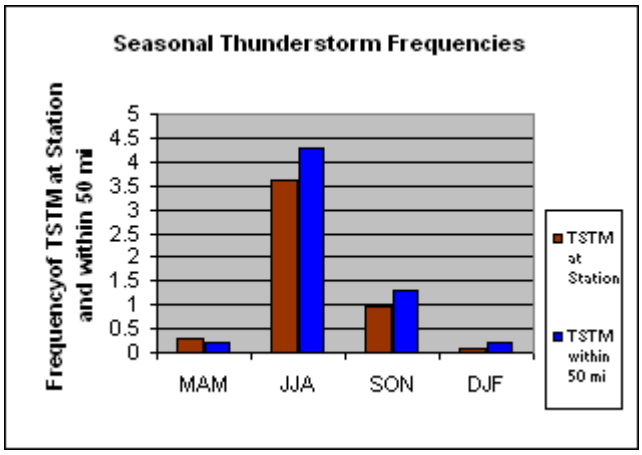


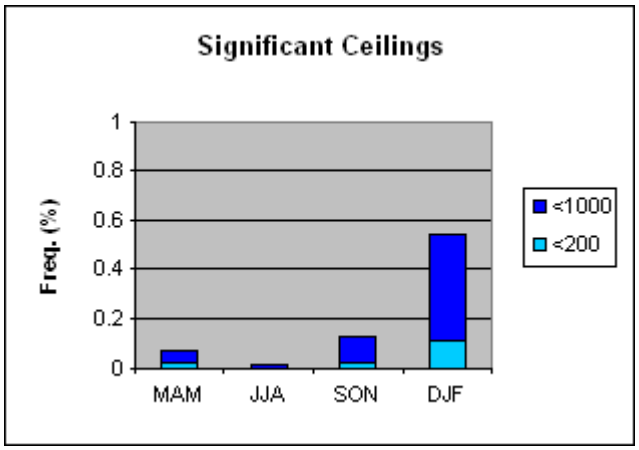


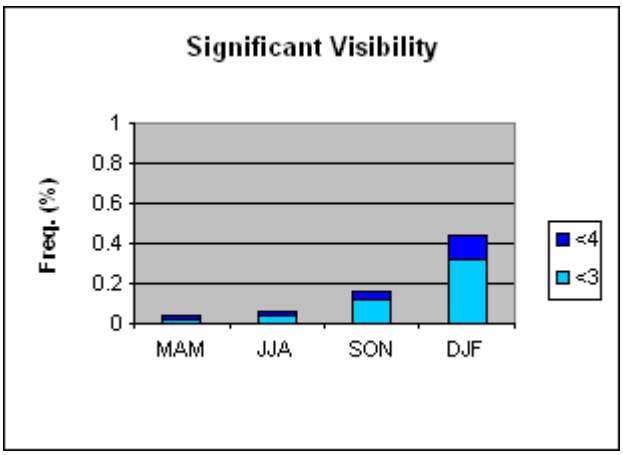


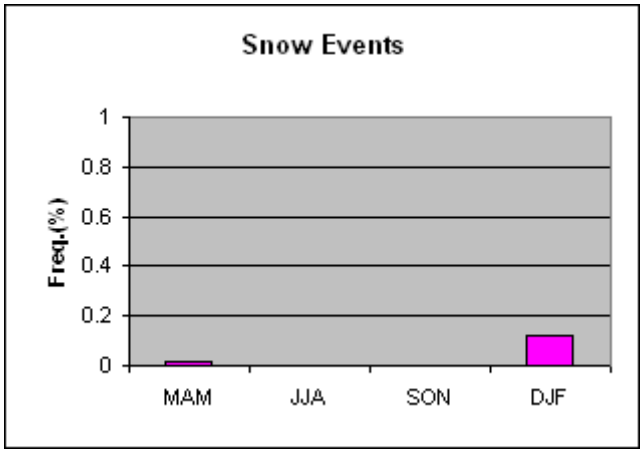
Tucson International – TUS

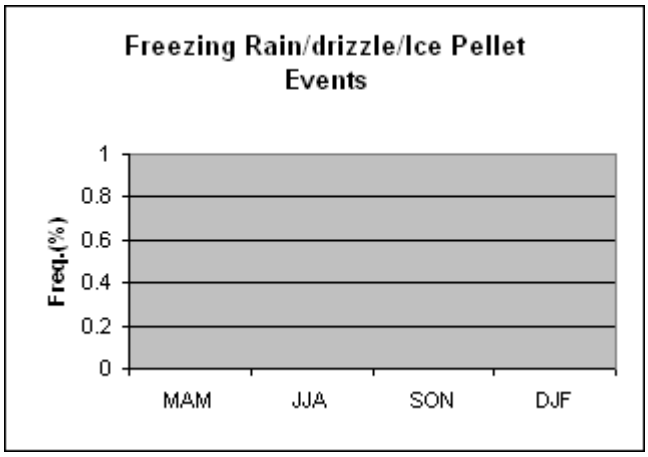




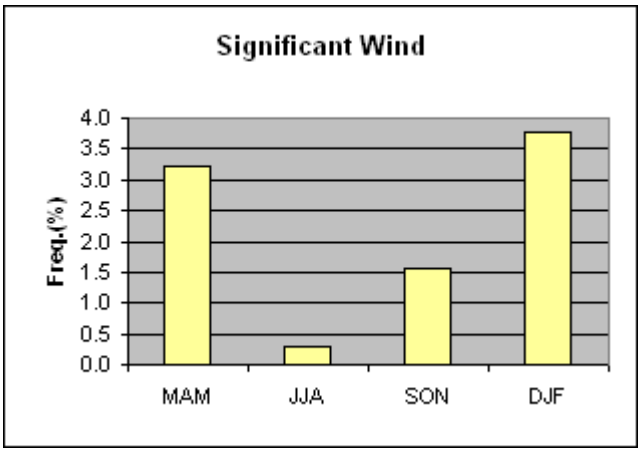


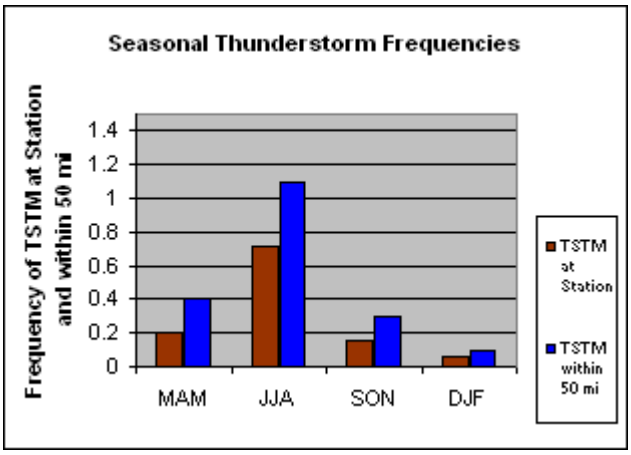


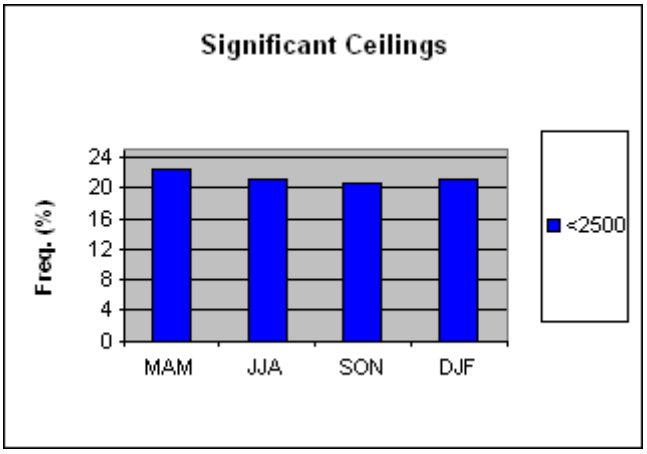


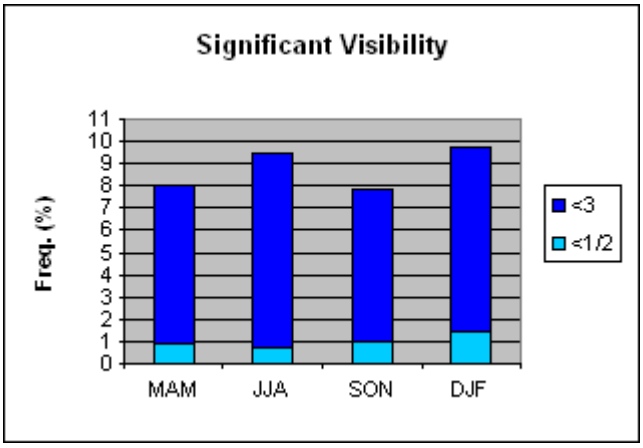


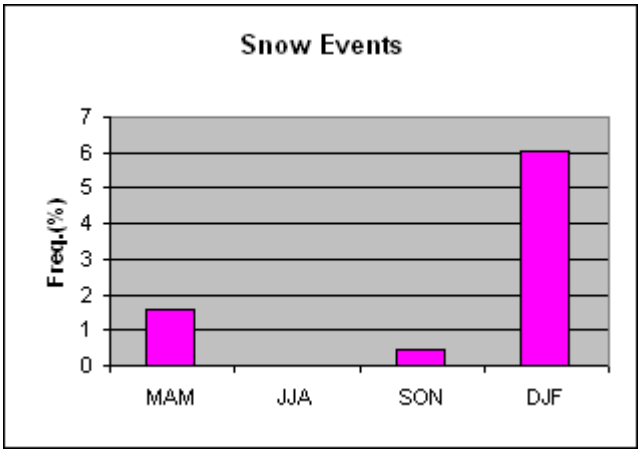
Warwick – Theodore Francis Green State – PVD

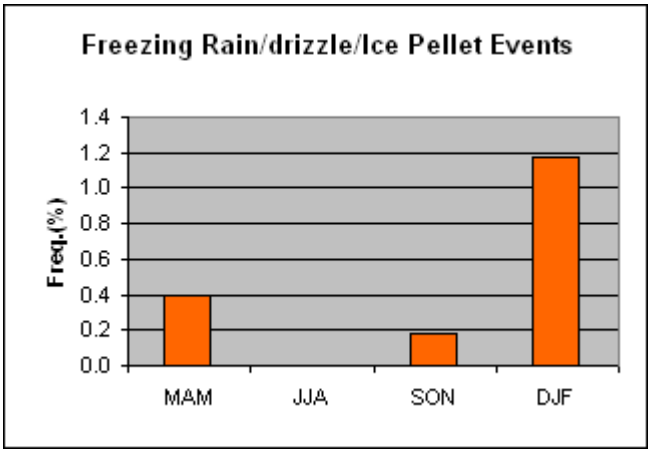




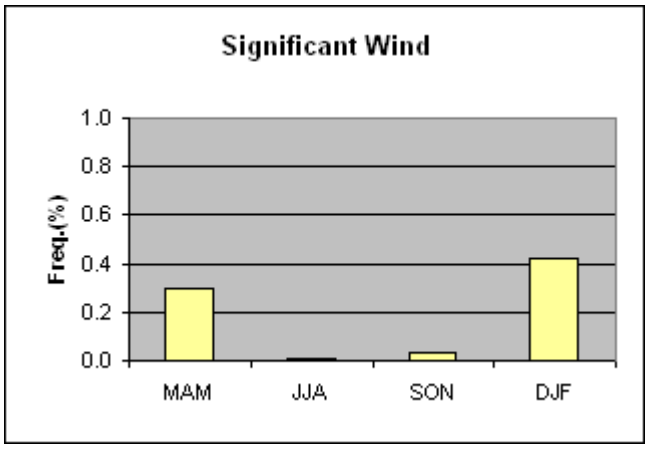


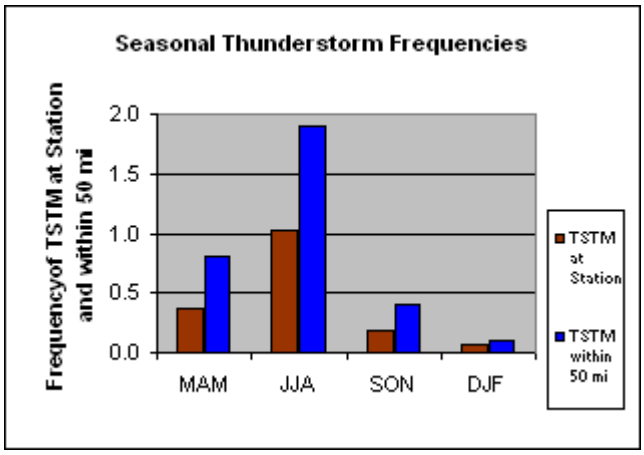


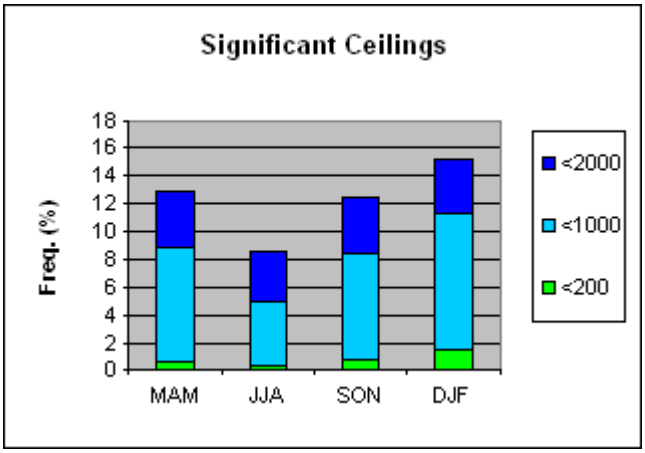


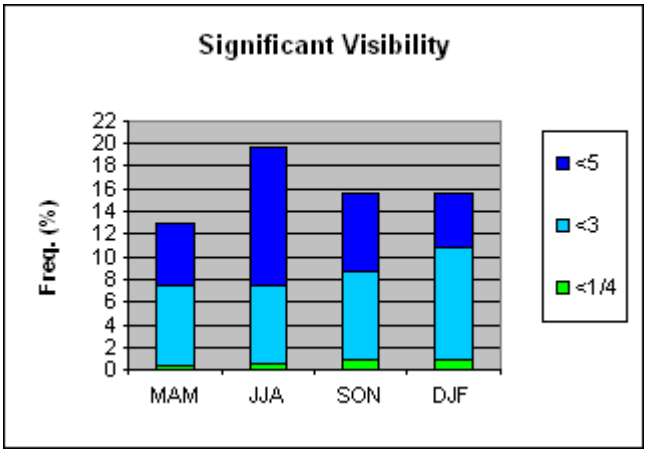


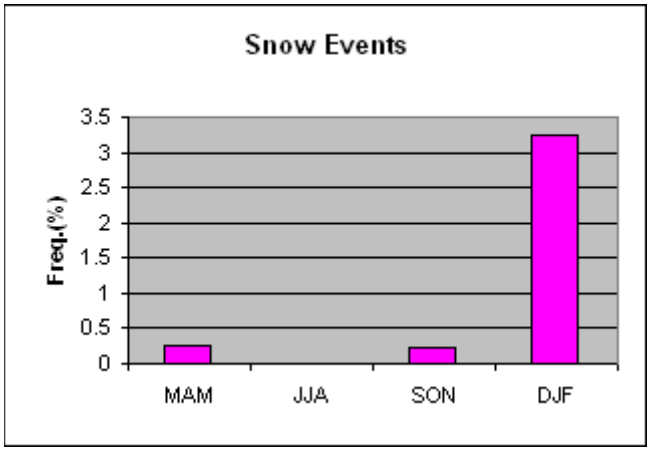
Washington-Dulles International – IAD

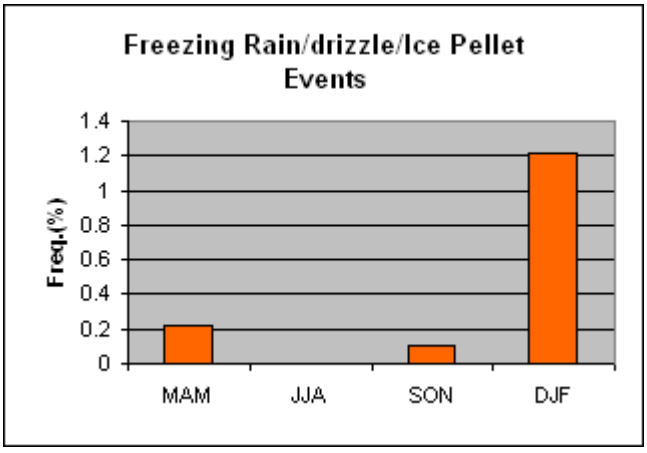




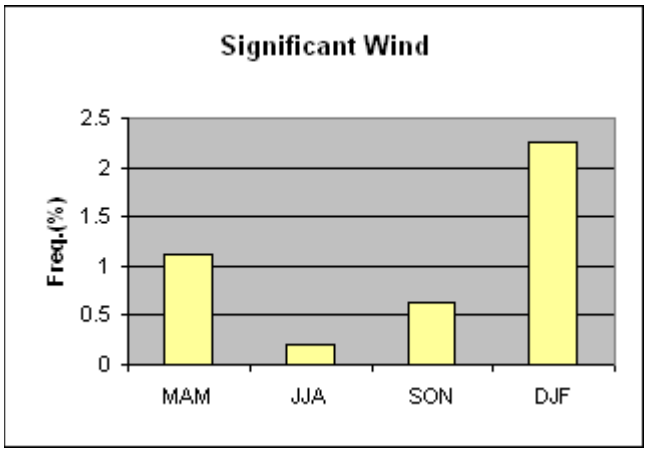


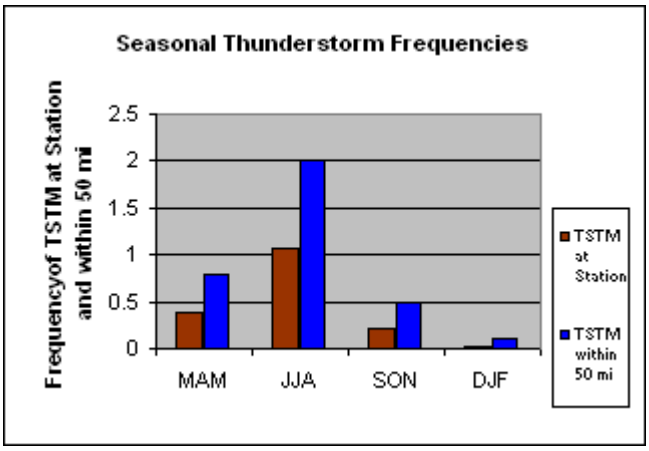


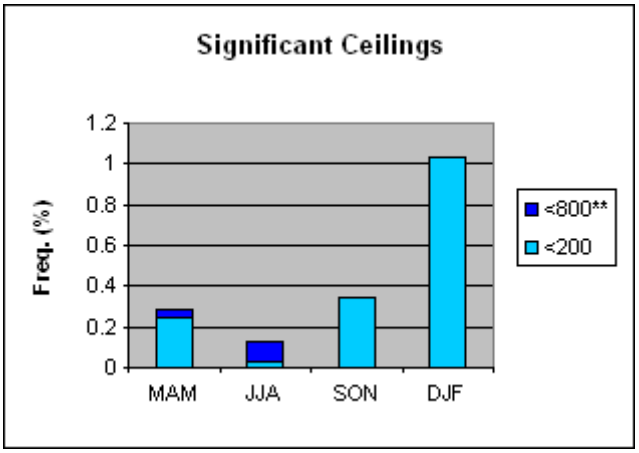


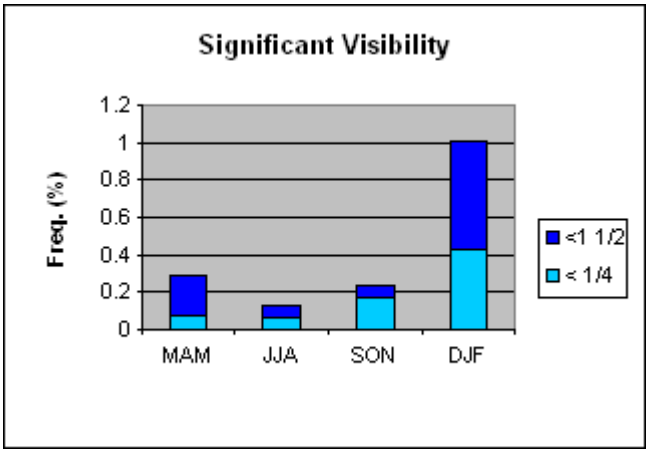


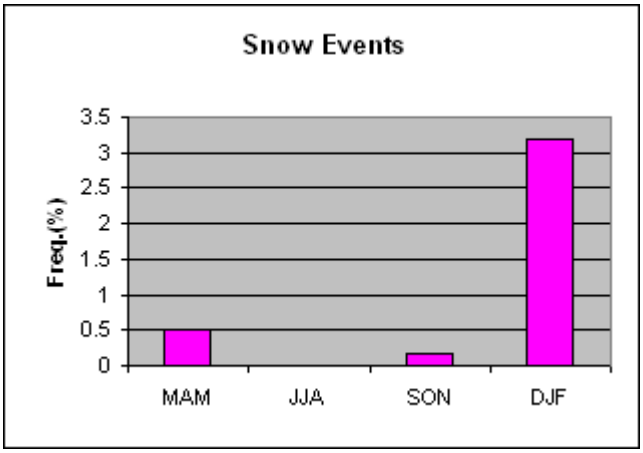
Washington National – Ronald Reagan - DCA

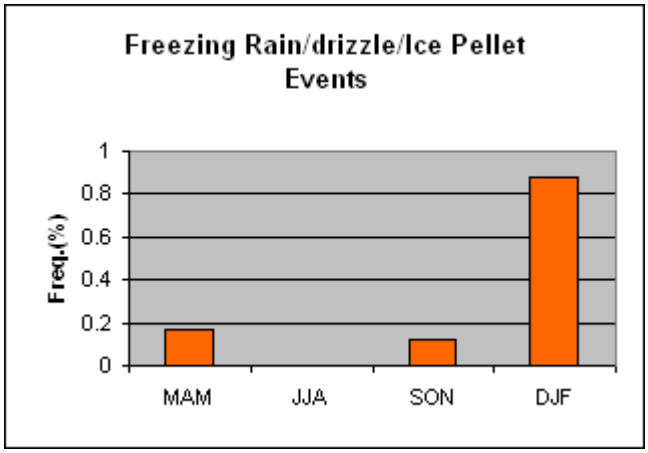










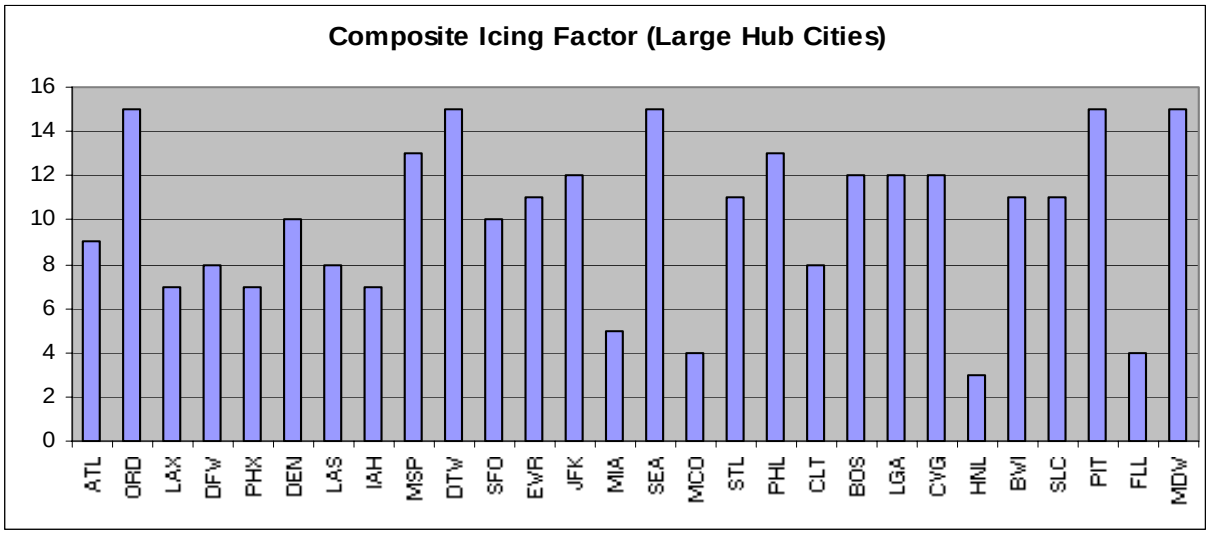


Supplemental Graphics

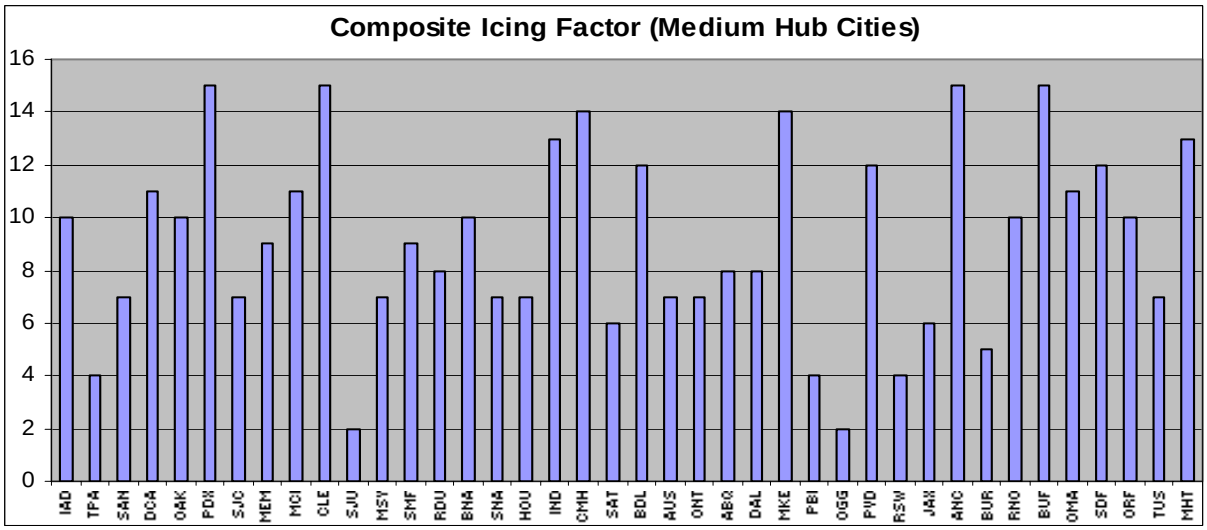
Some supplemental graphics are included in this section. For a complete set of AWC graphics, download the PowerPoint™ presentation from the web site.

Icing Scores

Icing Scores Based on Sounding Diagnosis and Airmet Climatology



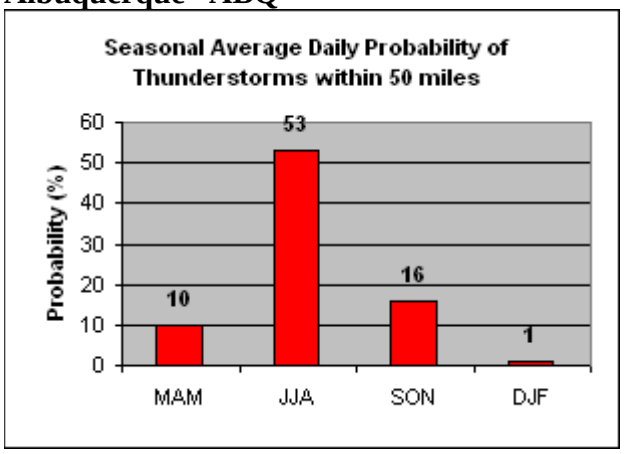
Icing Scores Based on Sounding Diagnosis and Airmet Climatology



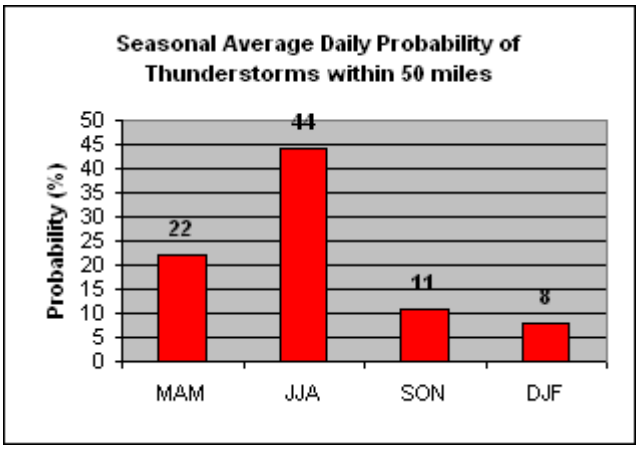
Thunderstorm Daily Probabilities by Season

(Probability of having at least one thunderstorm within a 50-mile radius of the airport)

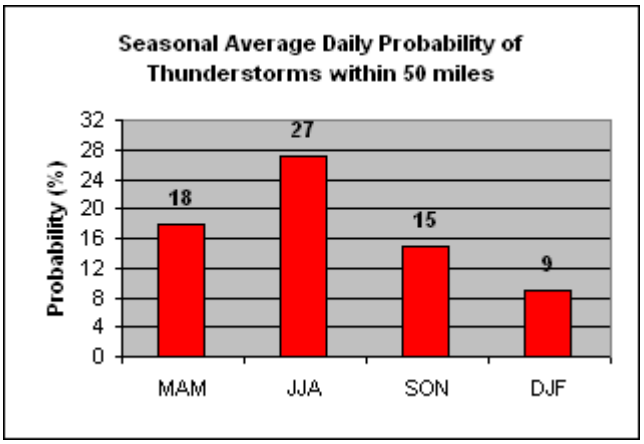
Albuquerque –ABQ



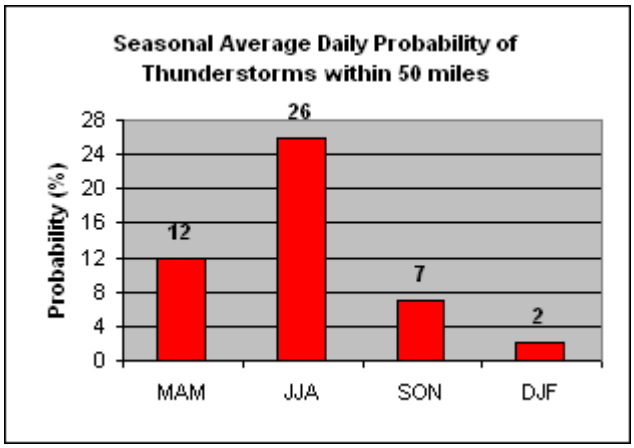
Atlanta - ATL



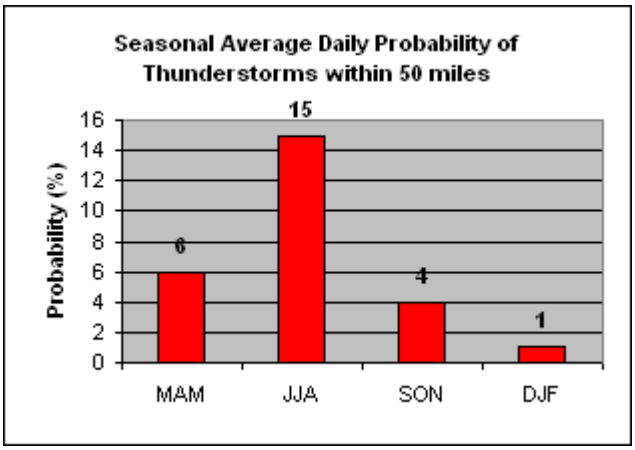
Austin – AUS



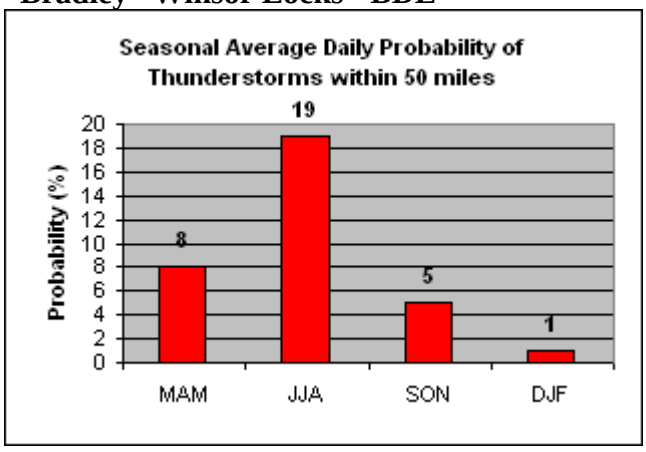
Baltimore - BWI



Boston – BOS



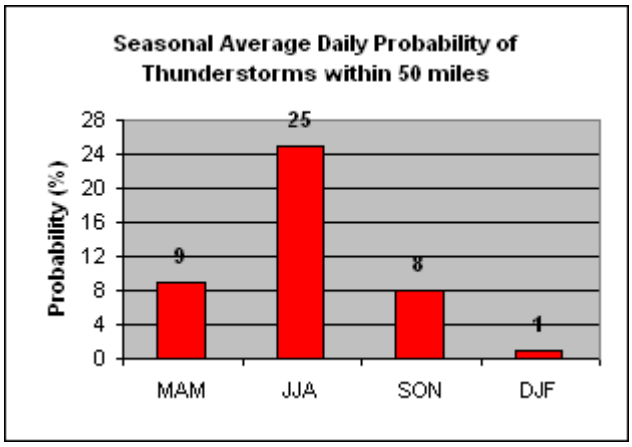
Bradley –Winsor Locks - BDL



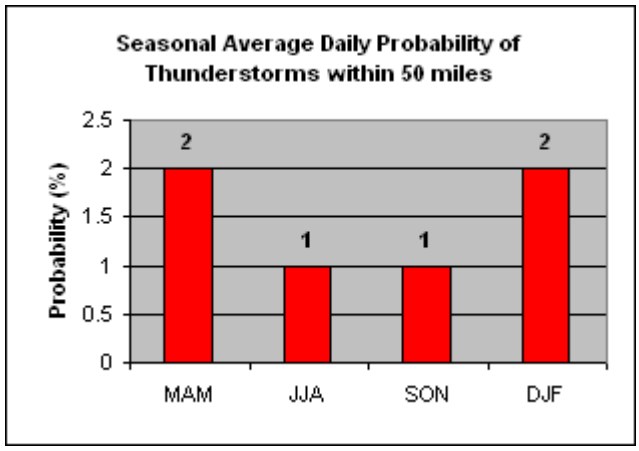
Thunderstorm Daily Probabilities by Season

(Probability of having at least one thunderstorm within a 50-mile radius of the airport

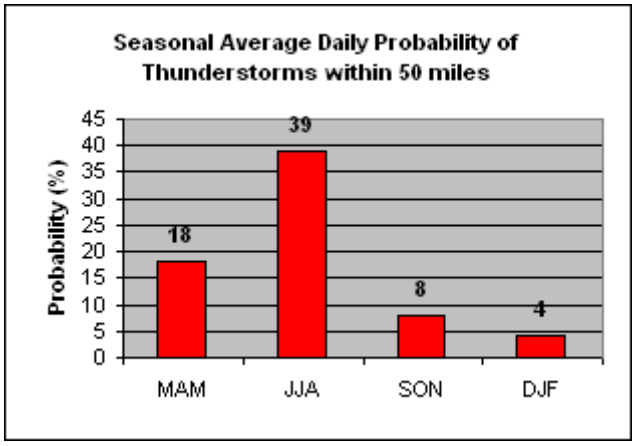
Buffalo – BUF



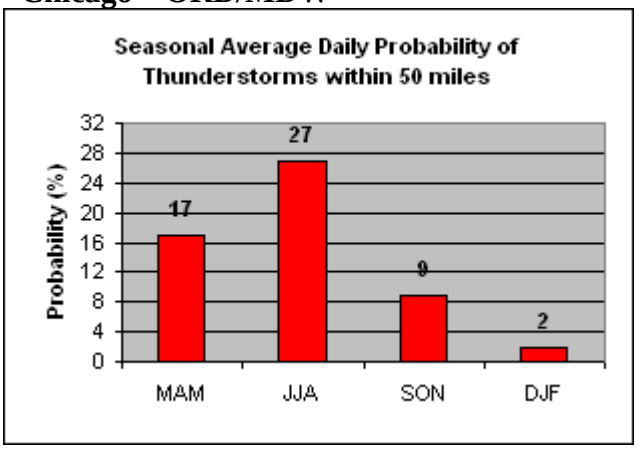
Burbank - BUR



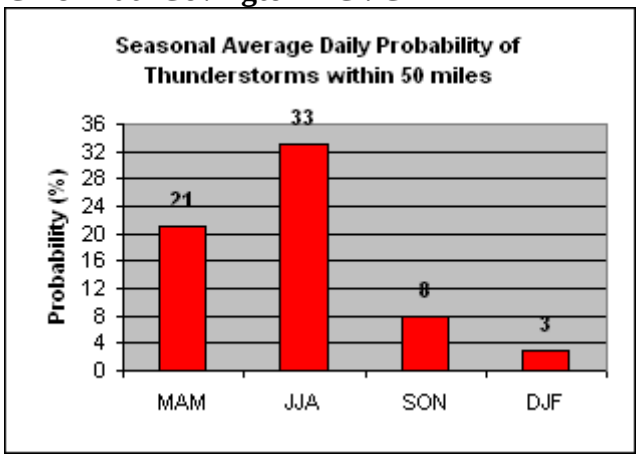
Charlotte – CLT



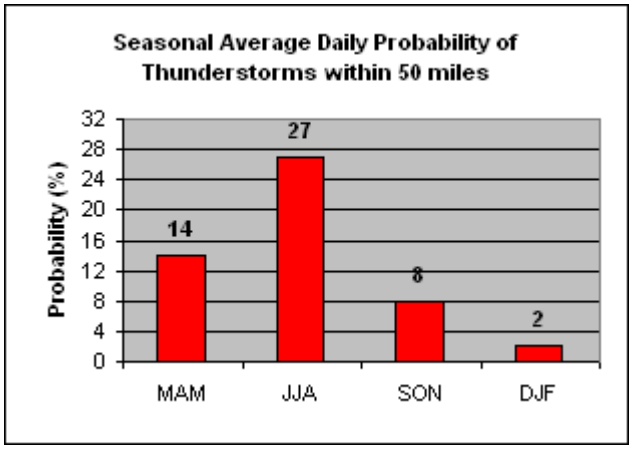
Chicago – ORD/MDW



Cincinnati-Covington – CVG



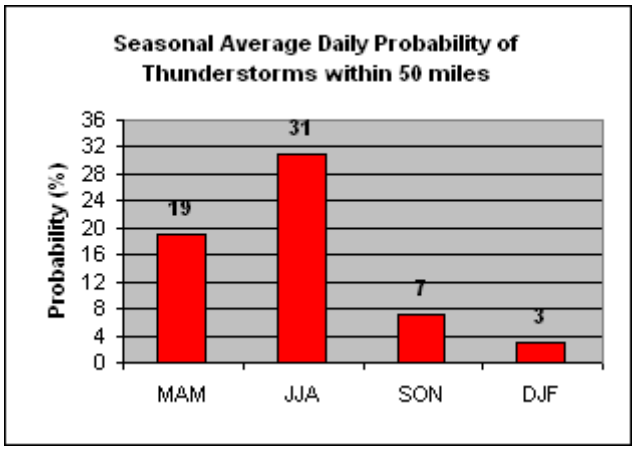
Cleveland - CLE



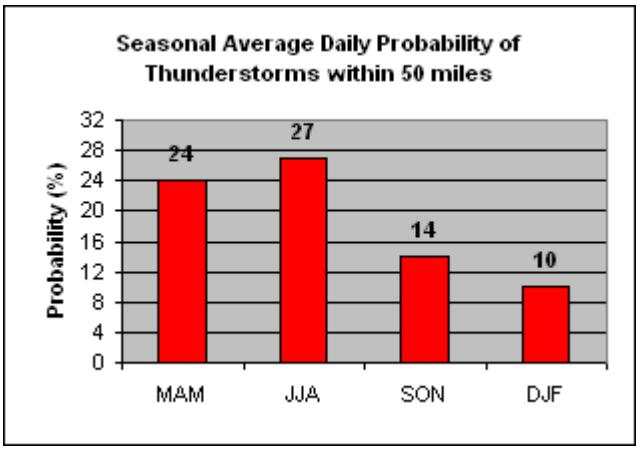
Thunderstorm Daily Probabilities by Season

(Probability of having at least one thunderstorm within a 50-mile radius of the airport)

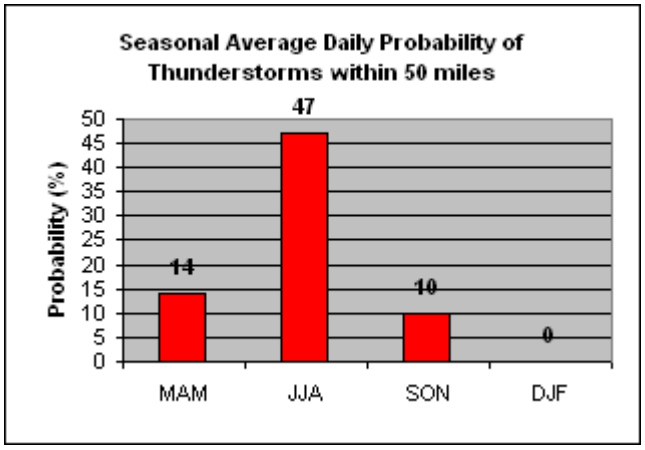
Columbus CMH



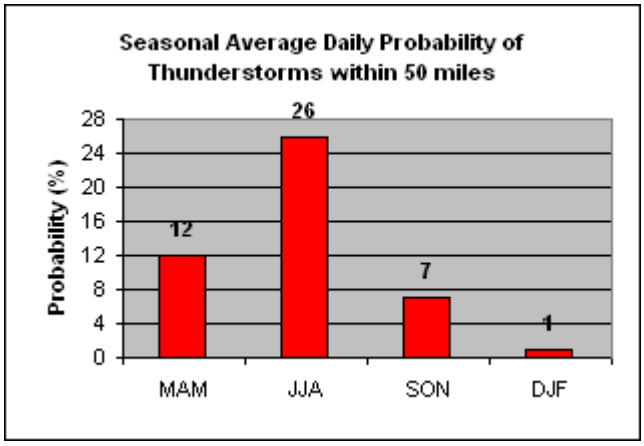
Dallas- Fort Worth –DFW/DAL



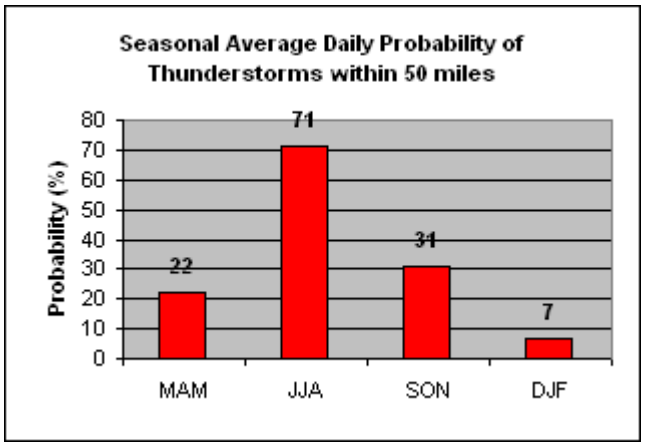
Denver – DEN



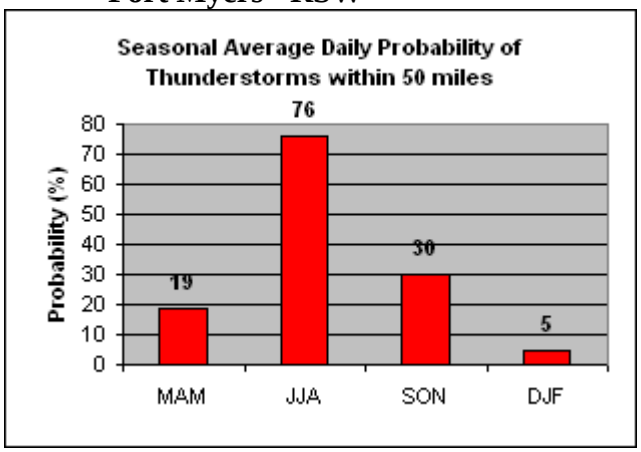
Detroit - DTW



Fort Lauderdale - FLL



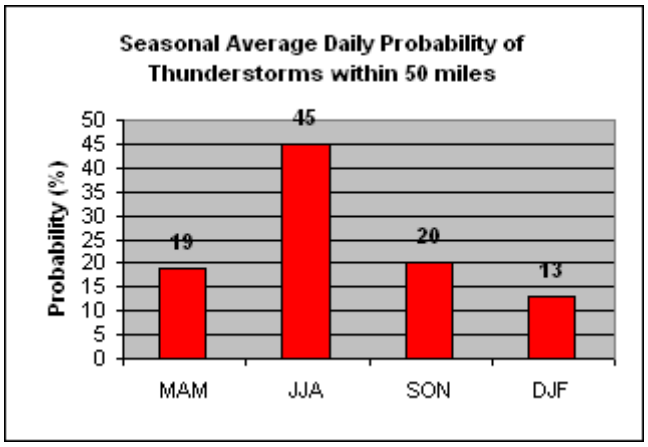
Fort Myers - RSW



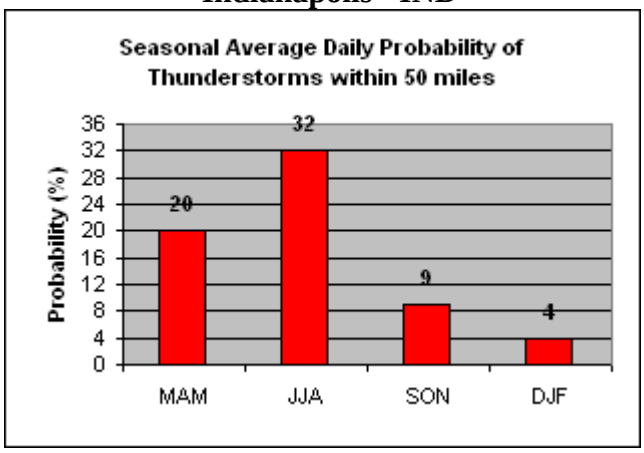
Thunderstorm Daily Probabilities by Season

(Probability of having at least one thunderstorm within a 50-mile radius of the airport)

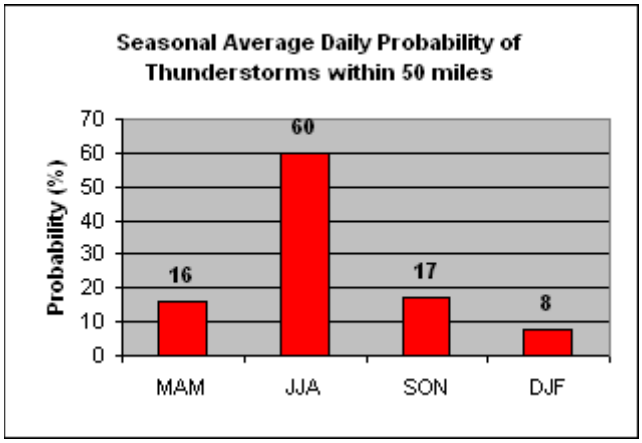
Houston – IAH/HOU



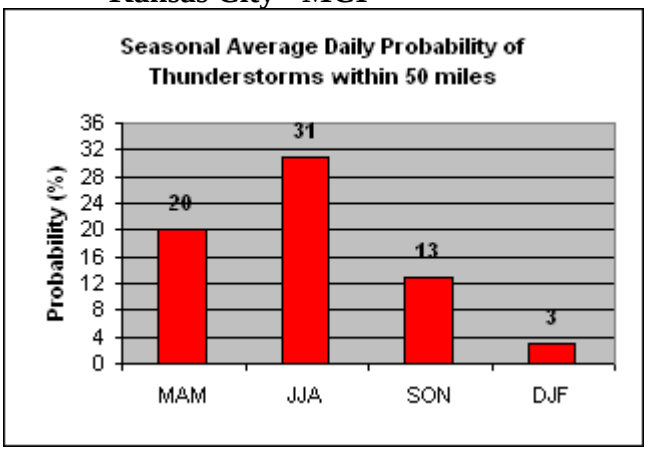
Indianapolis - IND



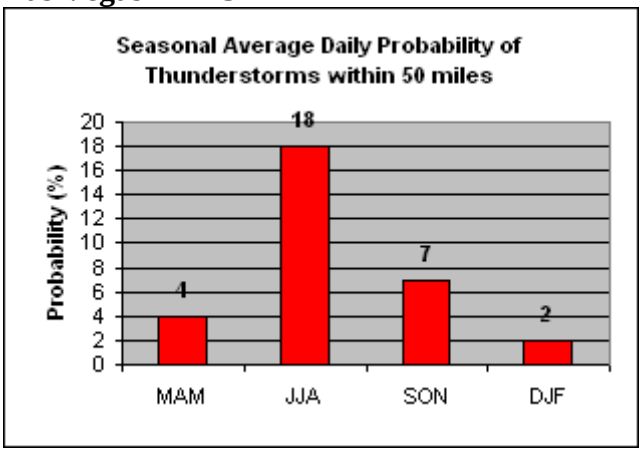
Jacksonville – JAX



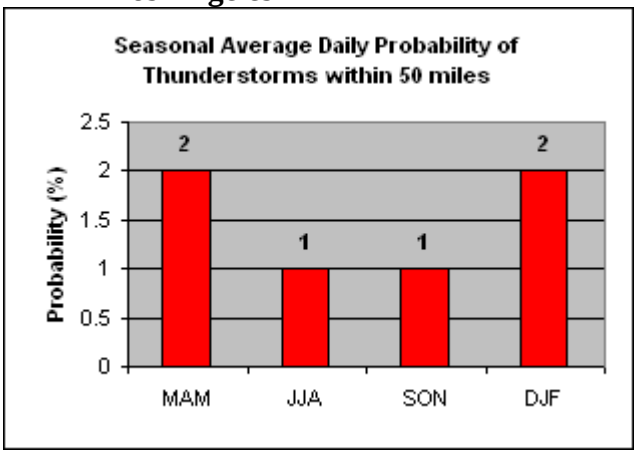
Kansas City - MCI



Las Vegas – LAS



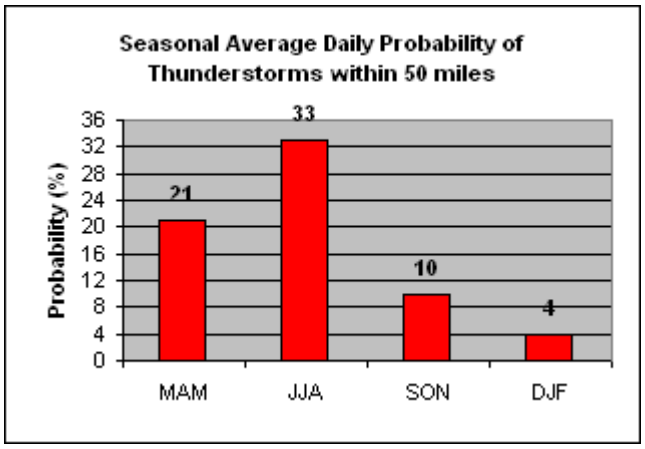
Los Angeles - LAX



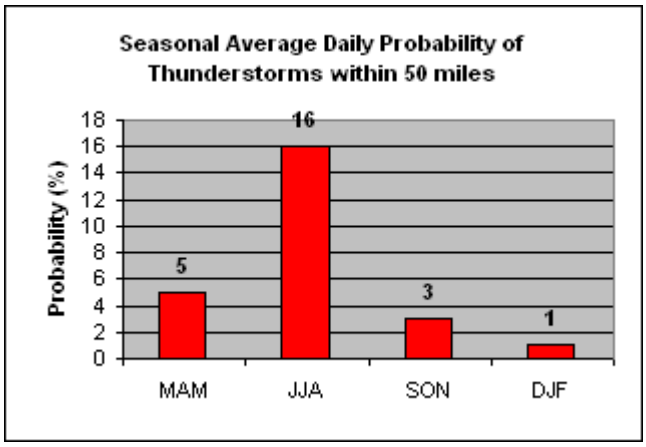
Thunderstorm Daily Probabilities by Season

(Probability of having at least one thunderstorm within a 50-mile radius of the airport)

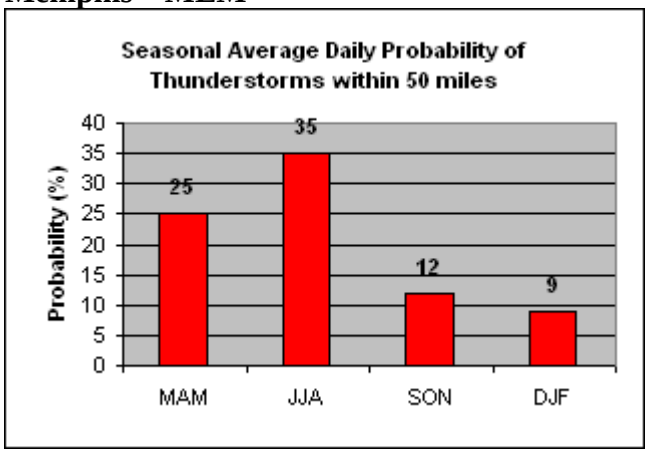
Louisville – SDF



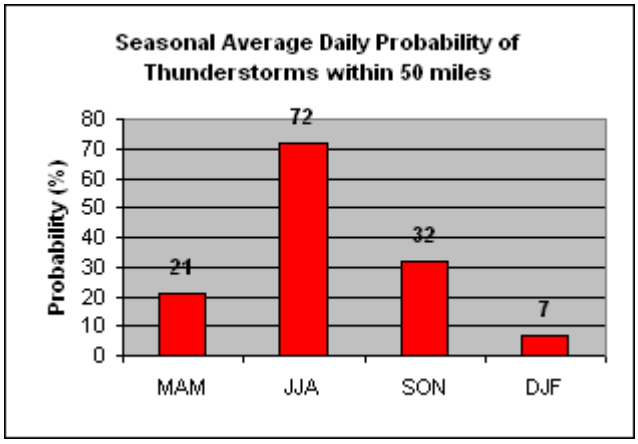
Manchester - MHT



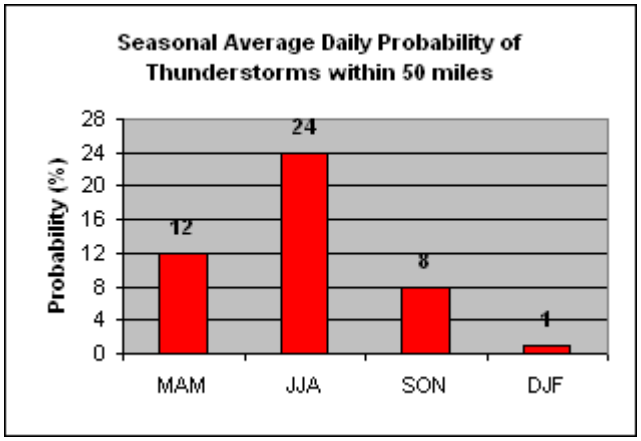
Memphis – MEM



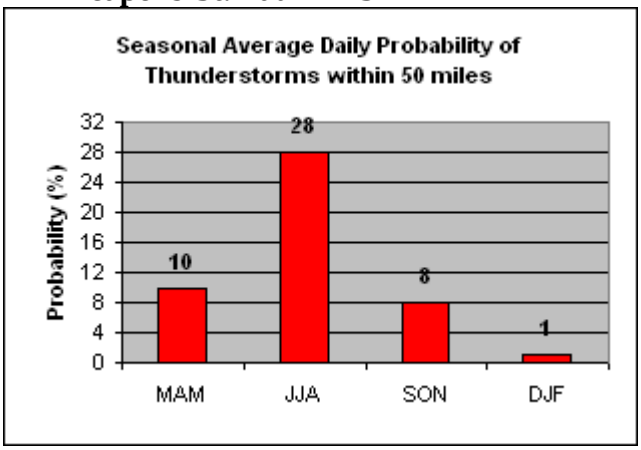
Miami - MIA



Milwaukee – MKE



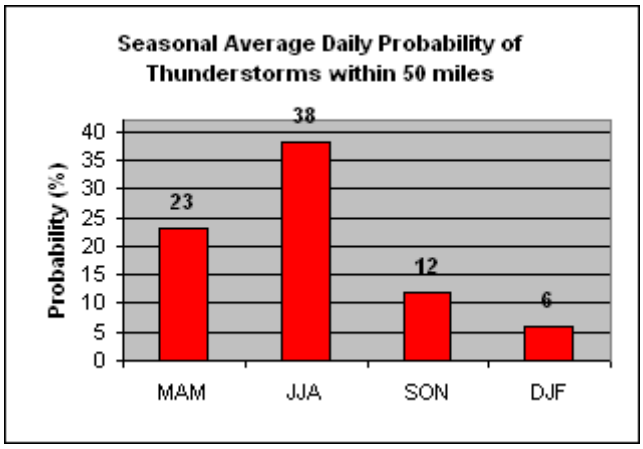
Minneapolis-St. Paul - MSP



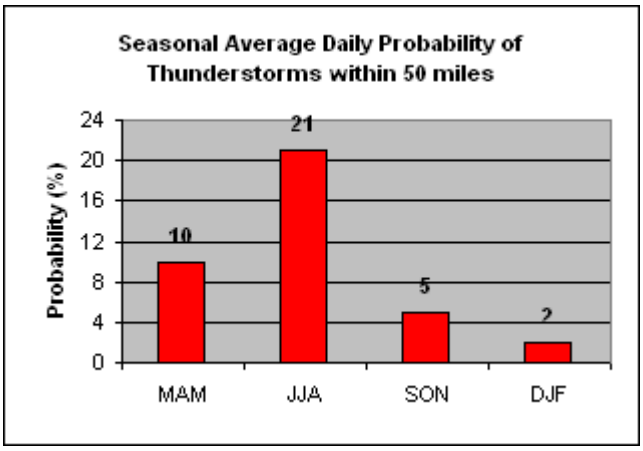
Thunderstorm Daily Probabilities by Season

(Probability of having at least one thunderstorm within a 50-mile radius of the airport)

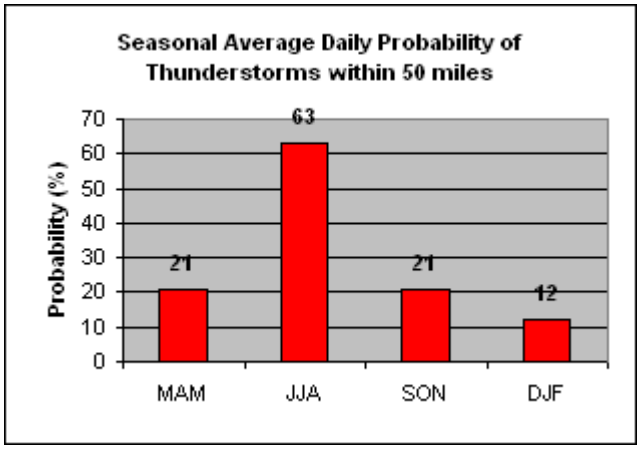
Nashville – BNA



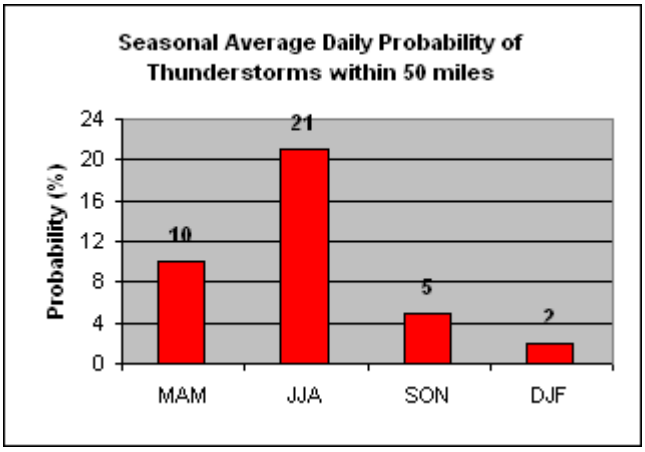
Newark – EWR



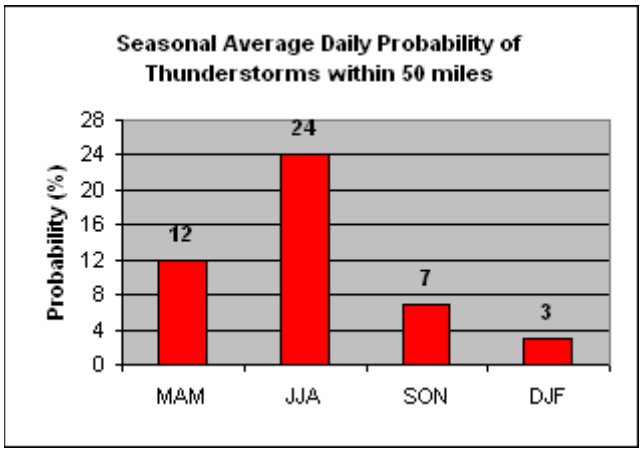
New Orleans – MSY



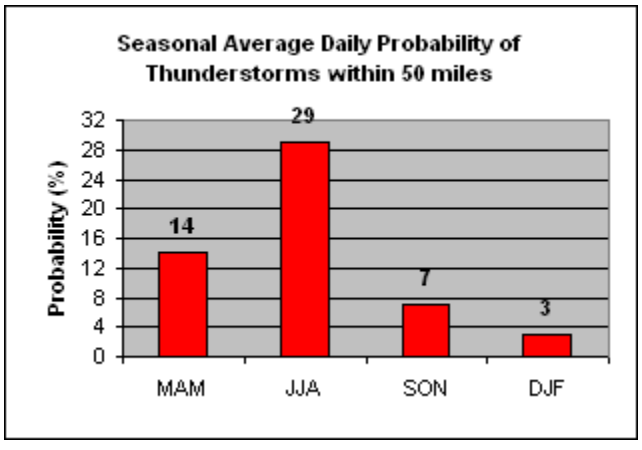
New York - JFK



New York – LGA



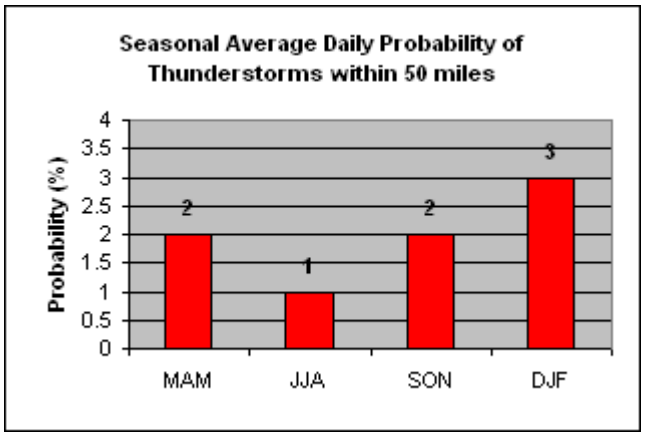
Norfolk – ORF



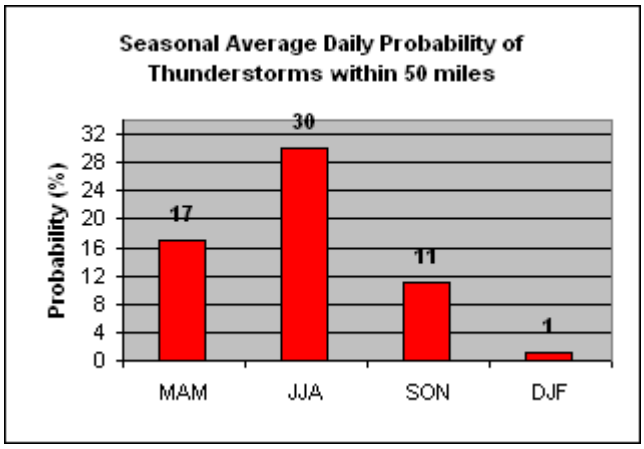
Thunderstorm Daily Probabilities by Season

(Probability of having at least one thunderstorm within a 50-mile radius of the airport)

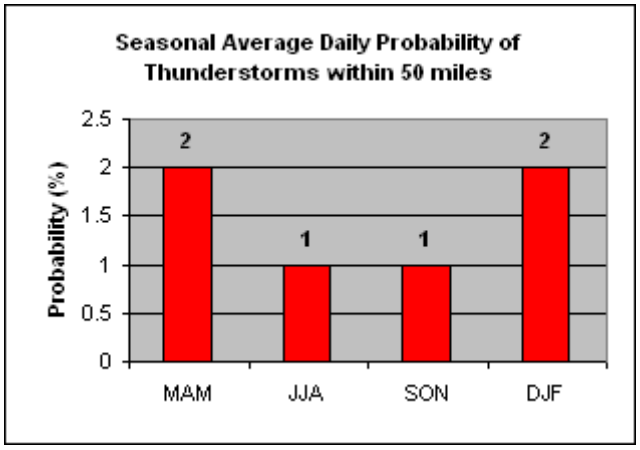
Oakland – OAK



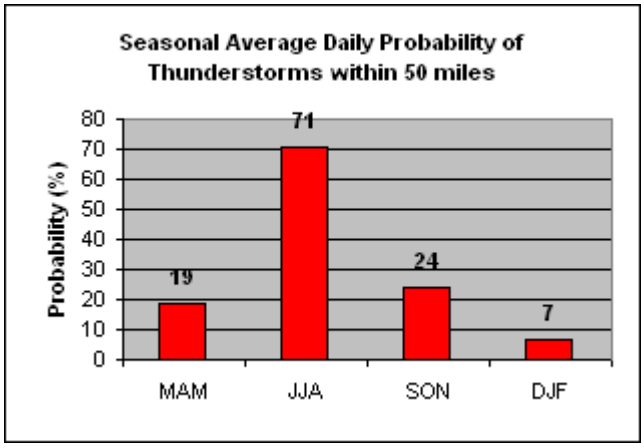
Omaha – OMA



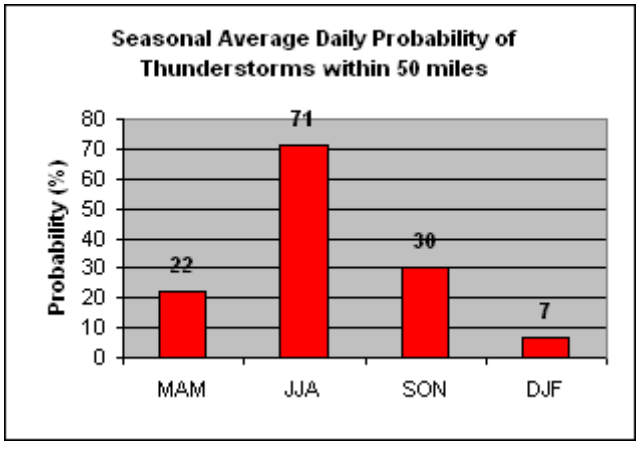
Ontario – ONT



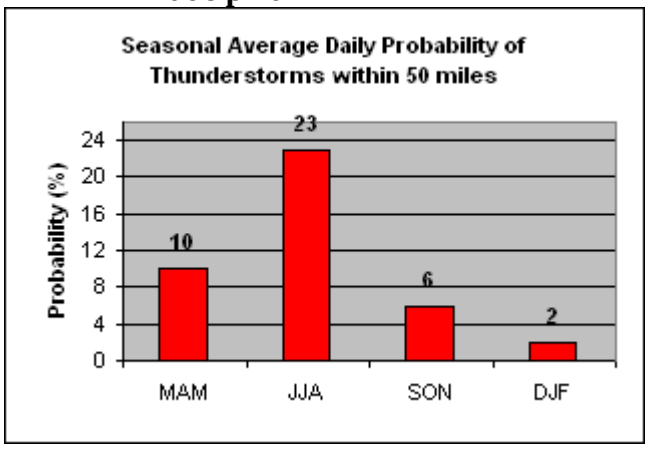
Orlando – MCO



Palm Beach – PBI



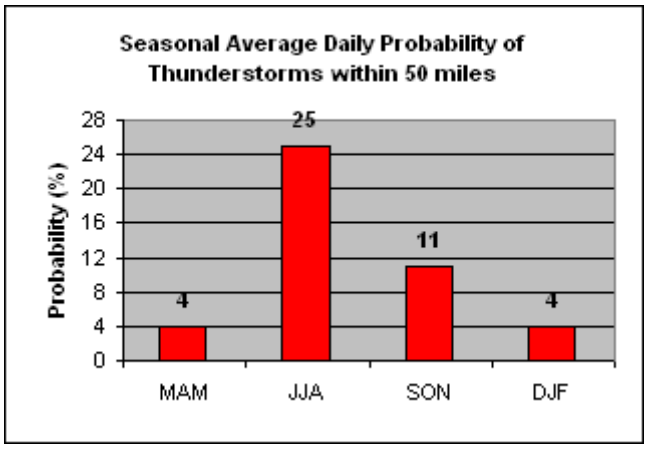
Philadelphia – PHL



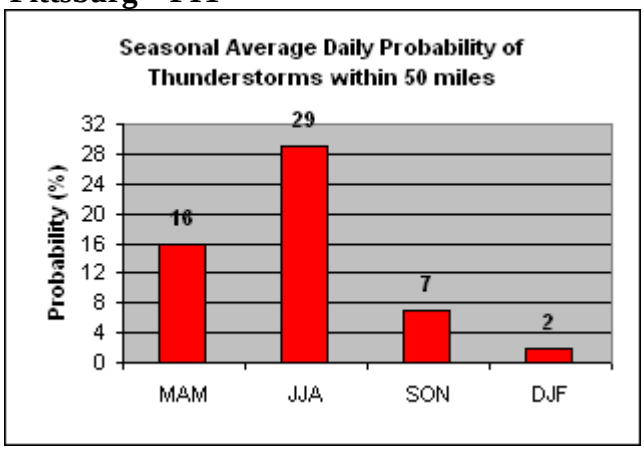
Thunderstorm Daily Probabilities by Season

(Probability of having at least one thunderstorm within a 50-mile radius of the airport)

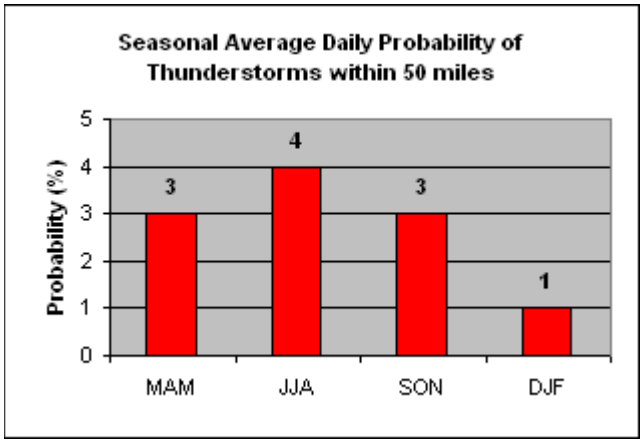
Phoenix – PHX



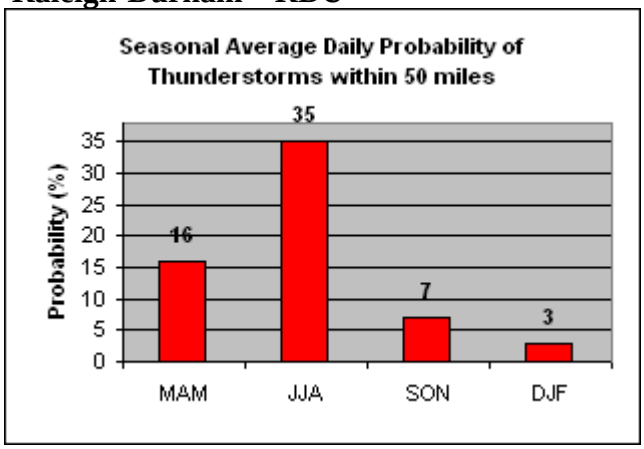
Pittsburg – PIT



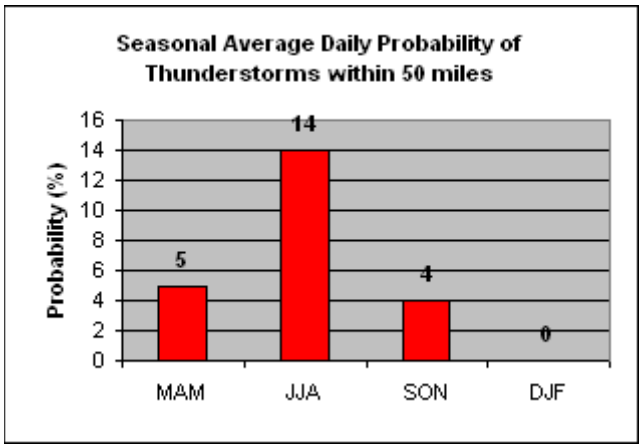
Portland – PDX



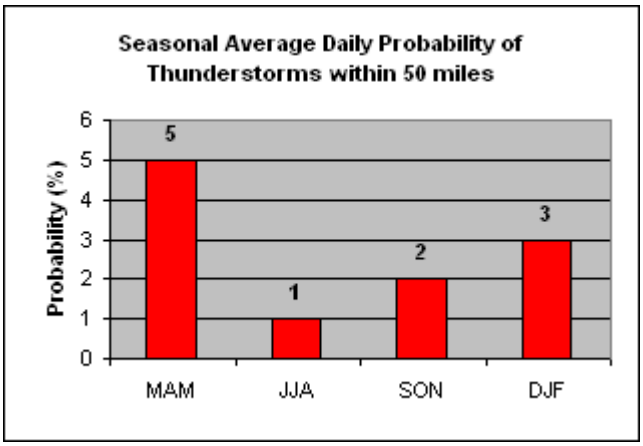
Raleigh-Durham – RDU



Reno – RNO



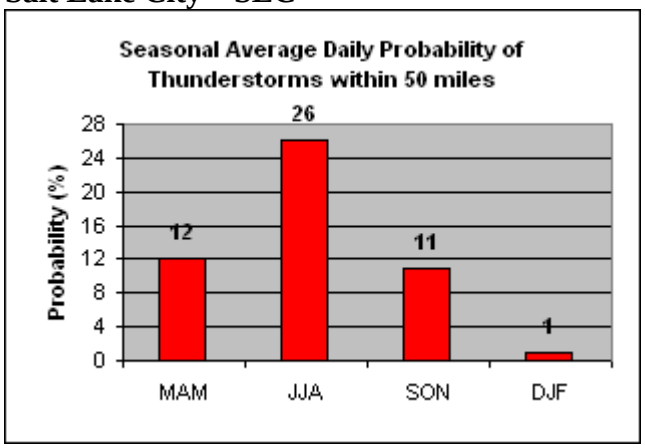
Sacramento – SMF



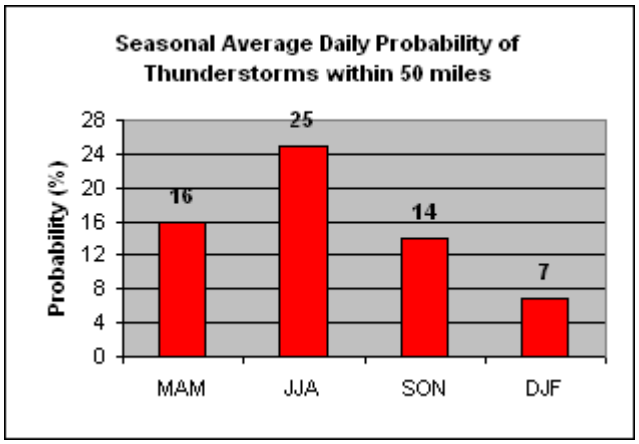
Thunderstorm Daily Probabilities by Season

(Probability of having at least one thunderstorm within a 50-mile radius of the airport)

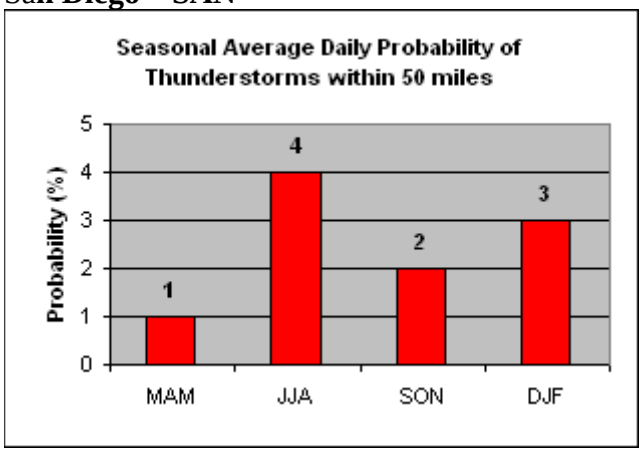
Salt Lake City – SLC



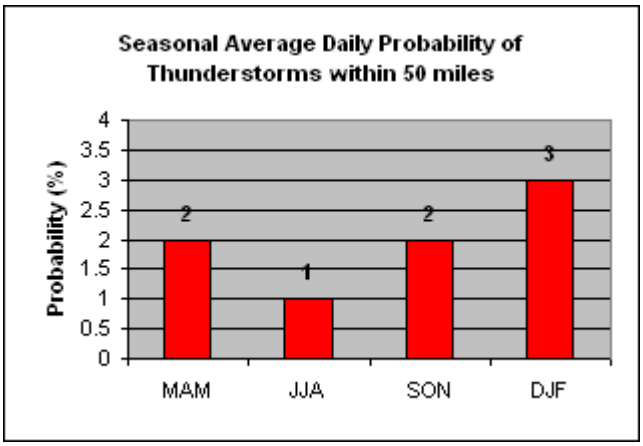
San Antonio – SAT



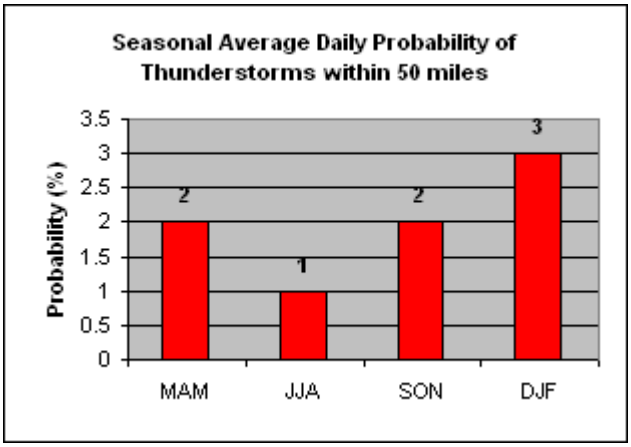
San Diego – SAN



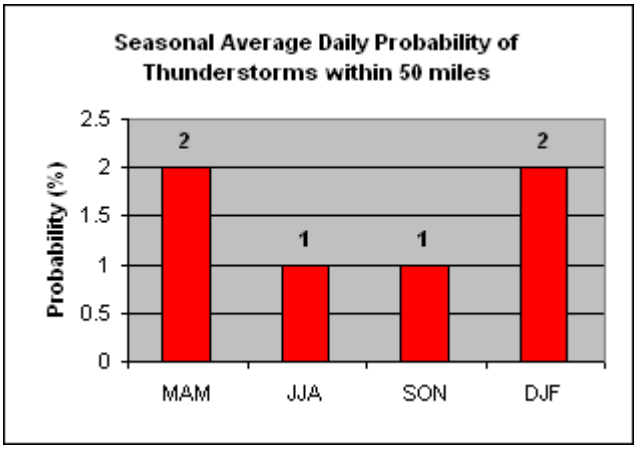
San Francisco – SFO



San Jose – SJC



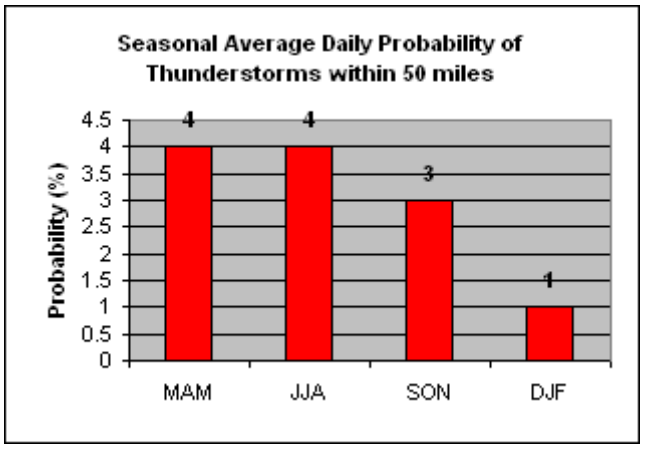
Santa Ana – SNA



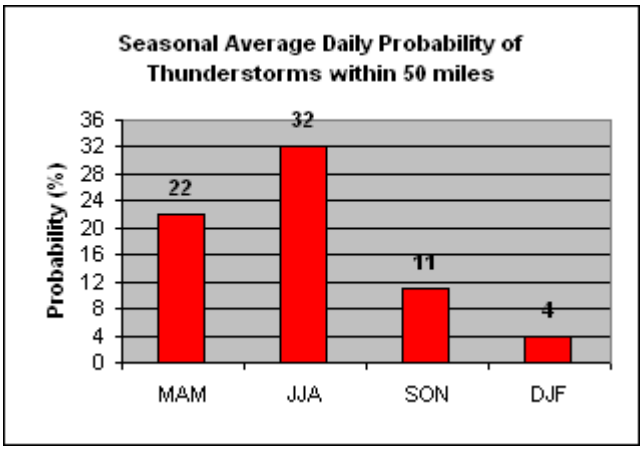
Thunderstorm Daily Probabilities by Season

(Probability of having at least one thunderstorm within a 50-mile radius of the airport)

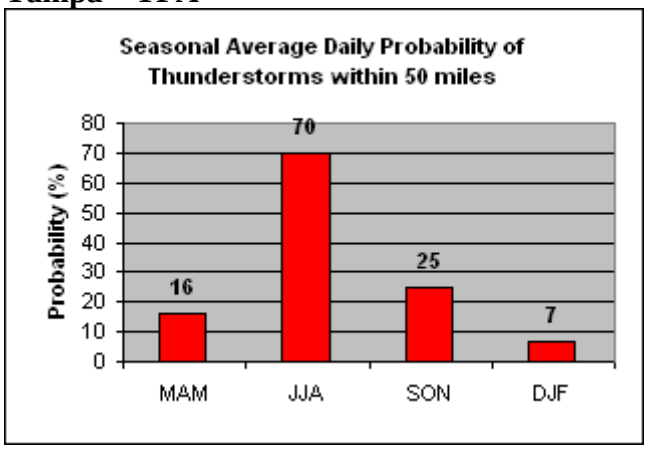
Seattle – SEA



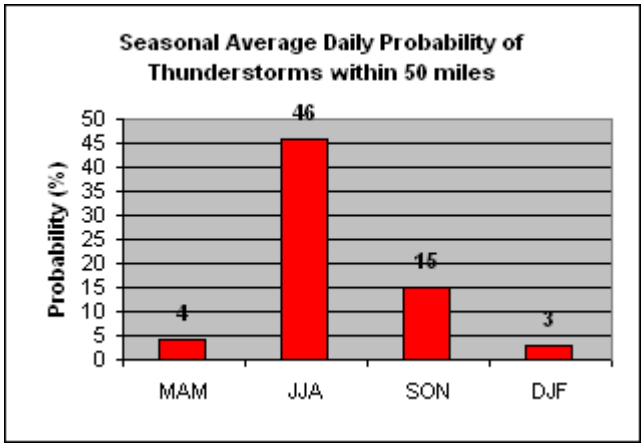
St. Louis – STL



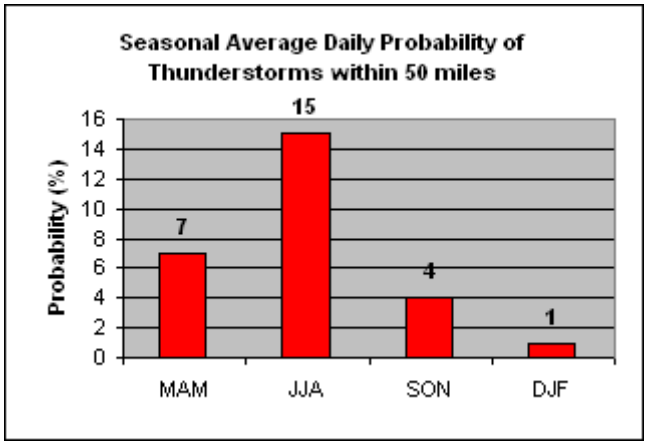
Tampa – TPA



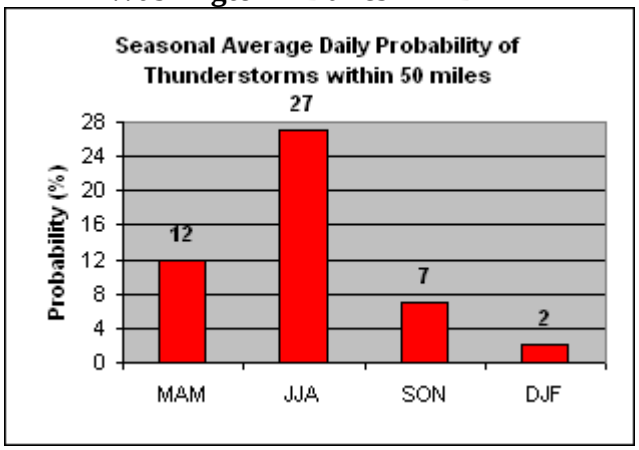
Tucson – TUS



Warwick – PVD



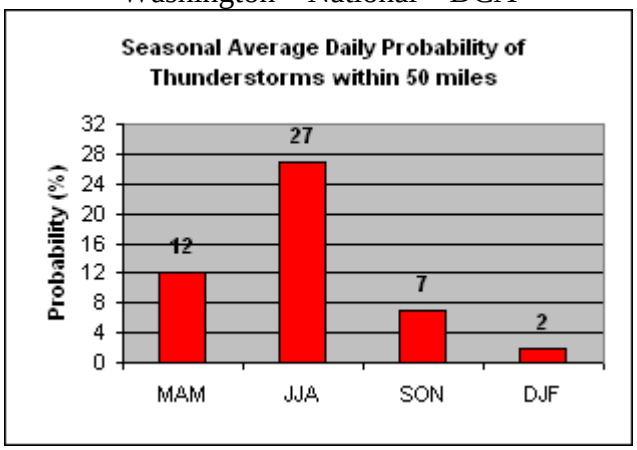
Washington – Dulles – IAD



Thunderstorm Daily Probabilities by Season

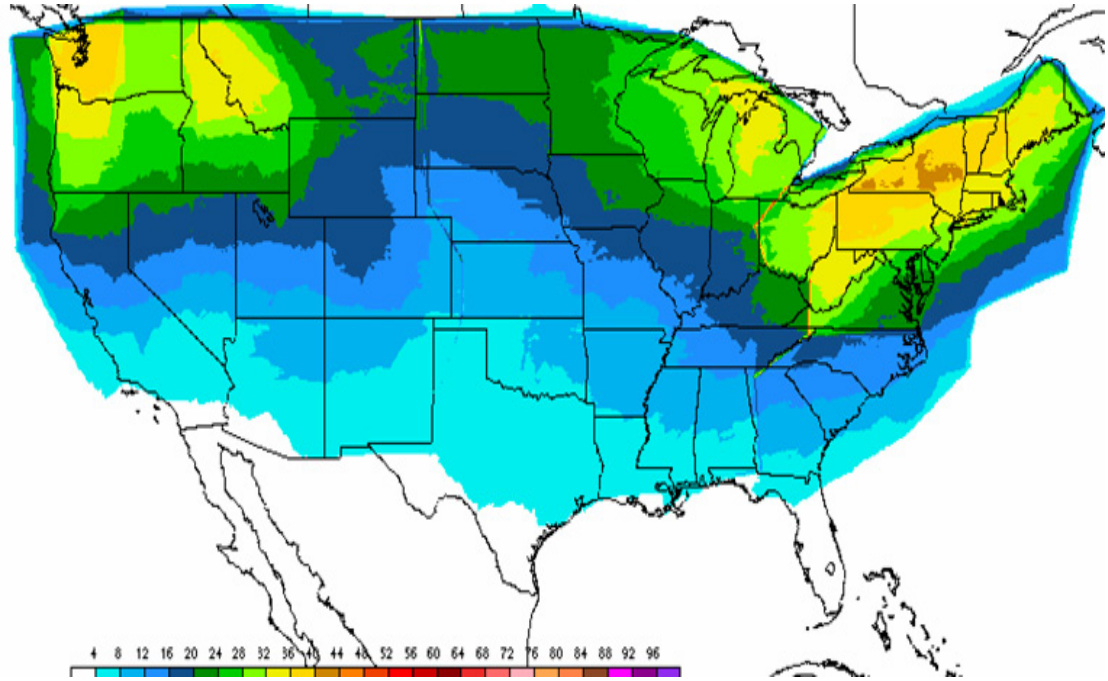
(Probability of having at least one thunderstorm within a 50-mile radius of the airport)

Washington – National – DCA



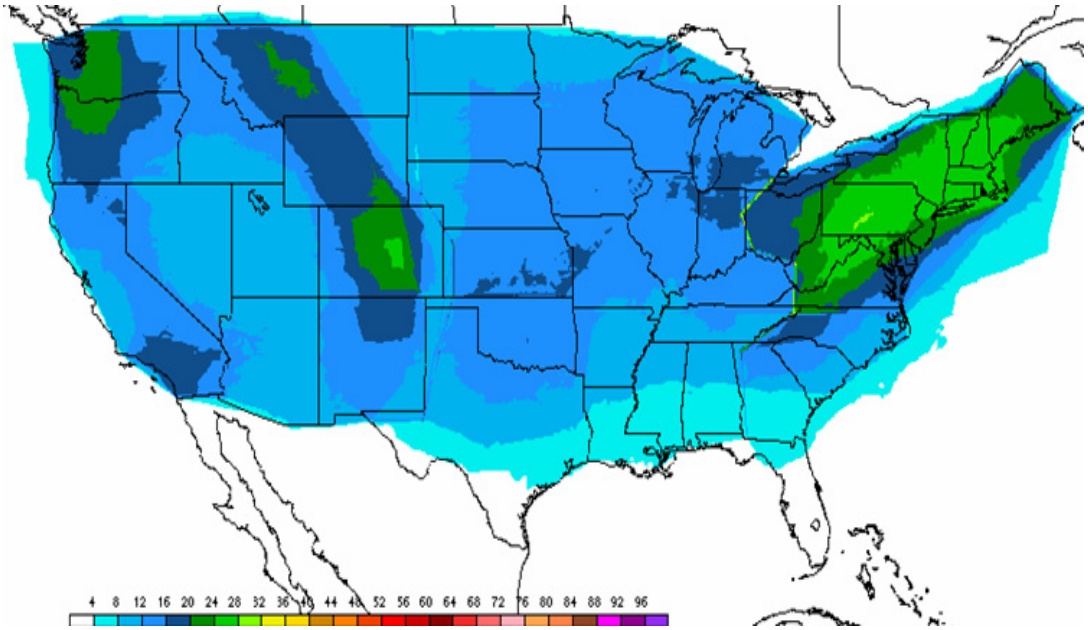
Icing Airmet Composite

Icing Airmet Composite at 1200Z for a 3-year Period (AWC)

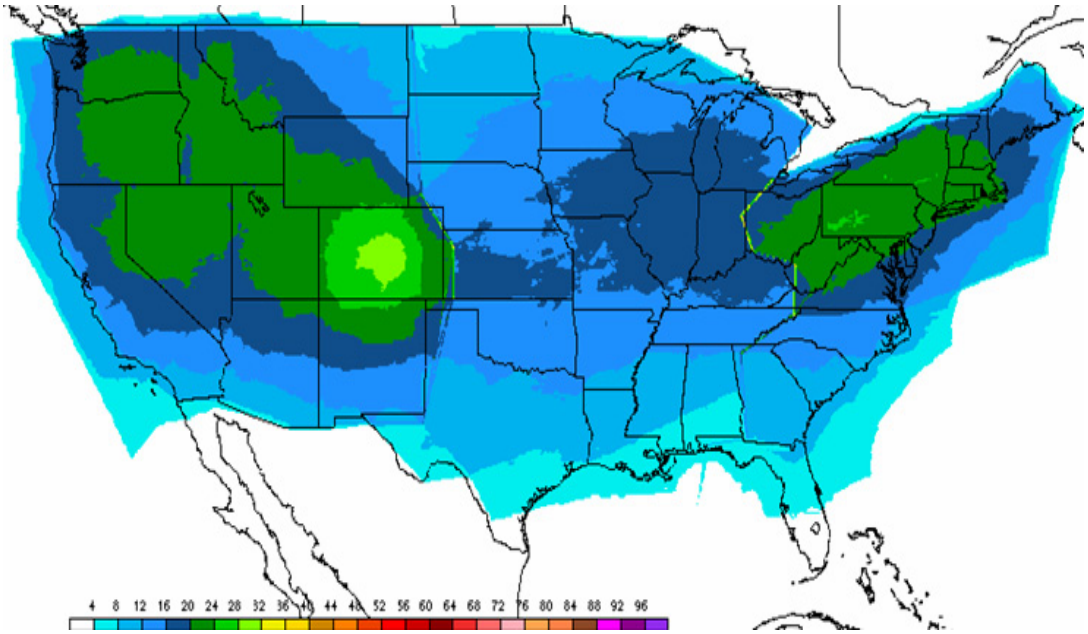


Turbulence Graphics

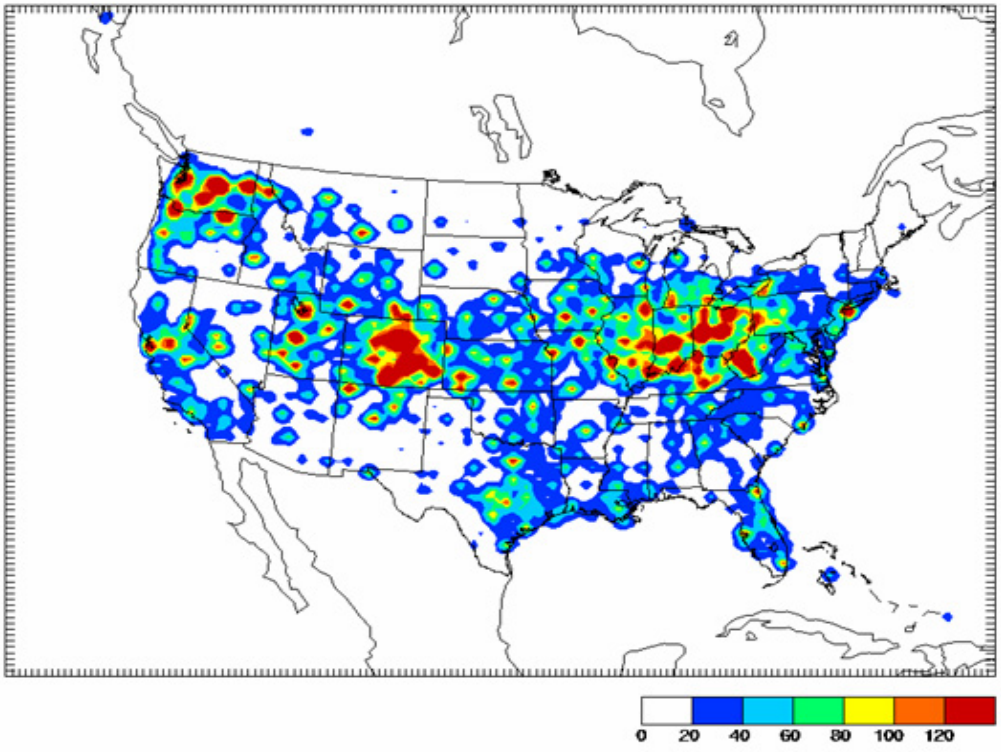
Airmet Turbulence Composite for Low-level Turbulence for a 3-year Period (AWC)



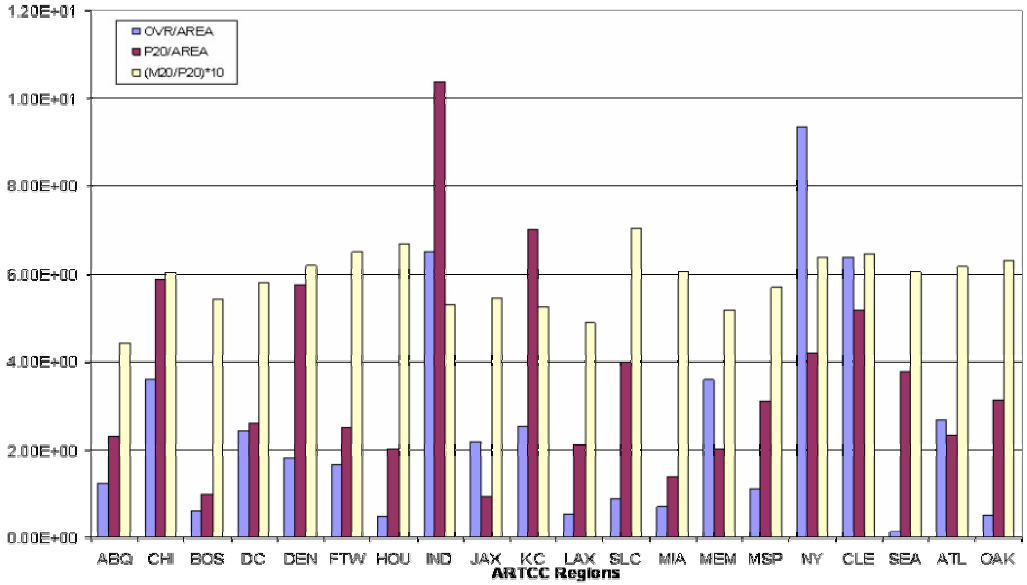
Airmet Turbulence Composite for High-level Turbulence for a 3-year Period (AWC)



Ratios of Moderate or Greater (MOG) Turbulence to all Pireps
(Sharman et al 2002)



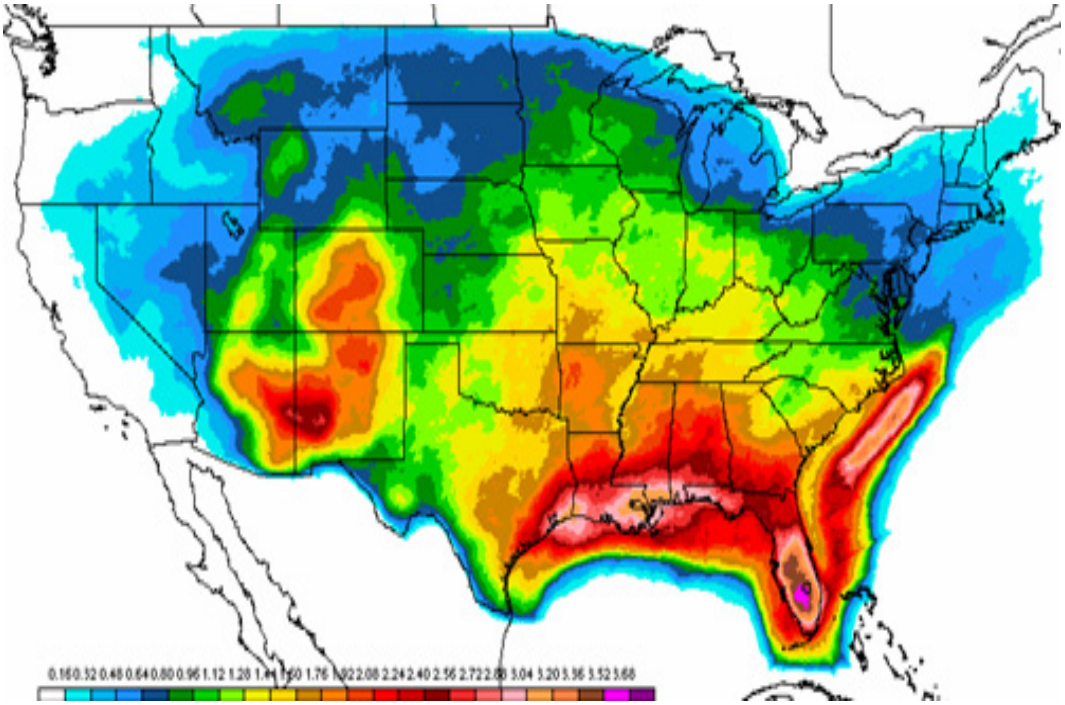
MOG/Total Pirep Ratios, Flight Density, and Pirep Density
(Sharman et al 2002)



Commercial air traffic overflight density (blue), pirep density (red), and mog/total pirep ratio for each ARTCC region.

Convective Sigment

Convective Sigmet Composite for a 3-year Period (AWC)



Bibliography

Bernstein, B.C., and F. McDonough, 2002: An Inferred Icing Climatology- Part II: Applying a Version of IIDA to 14-years of Coincident Soundings and Surface Observations. *Preprints: 10th Conference on Aviation, Range and Aerospace Meteorology*, 12-15 May, Portland.

Bieringer, P., D.M. Miller, and D. Meyer: A Refinement of Thunderstorm Climatology for the Terminal Radar Control Airspace. Retrieved 20 May 2004 from Lincoln Laboratory, Massachusetts Institute of Technology Web Site: http://www.ll.mit.edu/AviationWeather/Av8.pdf

Cortinas, J.V. Jr., C.C. Robbins, B.C. Bernstein, and J.W. Strapp, 2000: A Climatology of Freezing Rain, Freezing Drizzle, and Ice Pellets Across North America. *Preprints: 9th Conference on Aviation, Range, and Aerospace Meteorology*, 11-15 Sep Orlando.

Ellrod, G.P., 2000: Global Climatology of Clear Air Turbulence Activity Deduced from a Numerical Model Index. *Preprints: 9th Conference on Aviation, Range, and Aerospace Meteorology*, 10-14 Sep Orlando.

Fowler, T.L., M. Crandell, and B.G. Brown, 2002: An Inferred Icing Climatology. Part III: Icing Airmets and IIDA. *Preprints: 10th Conference on Aviation, Range and Aerospace Meteorology*, 12-15 May, Portland.

Research Applications Program, 2001: In-Flight Icing. RAP 2002 Annual Scientific Report. Retrieved 10 May 2004 from Research Applications Program Web Site: http://www.rap.ucar.edu/asr2002/a-icing/a-inflight_icing.htm

Research Applications Program, 2001: Atmospheric Turbulence. RAP 2002 Annual Scientific Report. Retrieved 17 May 2004 from Research Applications Program Web Site: http://www.rap.ucar.edu/asr2001/d-turblence2.html

Sharman, R., J. Wolff, T.L. Fowler, and B.G. Brown, 2002: Climatologies of Upper-Level Turbulence over the Continental U.S. and Oceans. *Preprints: 10th Conference on Aviation, Range and Aerospace Meteorology*, 12-15 May, Portland.

Slemmer, J., 2004: Airmet Climatology (slides). Kansas City, MO. Aviation Weather Center.

Slemmer, J., 2004: Convective Sigmet Climatology (slides). Kansas City, MO. Aviation Weather Center.

Young, G.S., B.G. Brown, and F. McDonough, 2002: An Inferred Icing Climatology – Part I: Estimation from Pilot Reports and Surface Conditions. *Preprints: 10th Conference on Aviation, Range and Aerospace Meteorology*, 12-15 May, Portland