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Applied Meteorology Unit (AMU)

Quarterly Report

First Quarter FY-04

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NWS/"W/OSD5"/B. Saffle
NSSL/D. Forsyth
NSSL/C. Crisp
30 WS/SY/S. Emert
30 WS/CC/C. Keith
30 WS/DO/S. Saul
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EXECUTIVE SUMMARY

This report summarizes the Applied Meteorology Unit (AMU) activities for the First Quarter of Fiscal Year 2004 (October – December 2003). A detailed project schedule is included in the Appendix.

Task Objective Lightning Probability Forecast: Phase I

Goal Develop a set of statistical equations to forecast the probability of lightning occurrence for the day. This will aid forecasters in evaluating flight rules and determining the probability of launch commit criteria violations, as well as preparing forecasts for ground operations.

Milestones The Man-computer Interactive Data Access System (McIDAS) sounding analysis algorithms were used to calculate stability parameters from the Cape Canaveral Air Force Station (CCAFS) 1000 UTC warm season sounding data in the years 1989 – 2003.

Discussion These stability parameters are possible predictors of lightning occurrence over the Kennedy Space Center (KSC)/CCAFS area. They are also being used in the AMU's Severe Weather Forecast Decision Aid task.

Task Mesonet Temperature and Wind Climatology

Goal Identify biases in the wind and temperature observations at individual or groups of sensors based on location, weather conditions, and sensor exposure. Any deviations in the data field could adversely affect forecasts and analyses for ground, launch, and landing operations.

Milestones The quality control of the 6- and 54-ft temperatures for February – December 1995 – 2003 was completed. The resulting dataset was used to compute hourly mean temperatures and standard deviations at all towers by month.

Discussion The hourly means and standard deviations are displayed in Microsoft® Excel© pivot charts. The pivot chart allows a user to summarize information from a large database quickly. The plots shown in this report illustrate the types of comparisons that will be available to our customers.

Task Severe Weather Forecast Decision Aid

Goal Create a new severe weather forecast decision aid to improve the severe weather watches and warnings meant for the protection of KSC/CCAFS personnel and property.

Milestones The severe weather event database for east-central Florida was combined with stability indices calculated from the morning sounding at CCAFS. Other meteorological conditions such as the surface ridge position and jet stream locations are being added to the database.

Discussion The historical and climatological patterns of severe weather events and associated meteorological settings will be incorporated into the severe weather forecasting decision aid.

Task Anvil Transparency Relationship to Radar Reflectivity

Goal Determine if products from the WSR-88D radar at the Melbourne National Weather Service office can be used to determine thunderstorm anvil cloud transparency, and important element in forecasting launch commit criteria. Opaque anvils can carry a substantial electrical charge. If a vehicle flies through such an environment, it could trigger lightning and be destroyed.

Milestones Observations of high cloud transparency were recorded during the summer of 2003 by Computer Science Raytheon weather observers at Weather Station B (KTTS). Mr. Wheeler transposed the observations to a database for further analysis with radar and satellite data.

Discussion The satellite data will be used to determine if the high clouds observed over KTTS had originated from thunderstorms and the radar data for those cases will be analyzed in detail.

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Applied Meteorology Unit (AMU) Quarterly Reports are now available on the Wide World Web (WWW) at http://science.ksc.nasa.gov/amu/home.html.

The AMU Quarterly Reports are also available in electronic format via email. If you would like to be added to the email distribution list, please contact Ms. Winifred Lambert (321-853-8130, lambert.winifred@ensco.com). If your mailing information changes or if you would like to be removed from the distribution list, please notify Ms. Lambert or Dr. Francis Merceret (321-867-0818, Francis.J.Merceret@nasa.gov).

BACKGROUND

The AMU has been in operation since September 1991. Tasking is determined annually with reviews at least semi-annually. The progress being made in each task is discussed in this report with the primary AMU point of contact reflected on each task and/or subtask.

AMU ACCOMPLISHMENTS DURING THE PAST QUARTER

SHORT-TERM FORECAST IMPROVEMENT

OBJECTIVE LIGHTNING PROBABILITY: PHASE I (MS. LAMBERT AND MR. WHEELER)

The 45th Weather Squadron (45 WS) forecasters include a probability of thunderstorm occurrence in their daily morning briefings. This information is used by personnel involved in determining the possibility of violating Launch Commit Criteria (LCC), evaluating Flight Rules (FR), and daily planning for ground operation activities on Kennedy Space Center/Cape Canaveral Air Force Station (KSC/CCAFS). Much of the current lightning probability forecast is based on a subjective analysis of model and observational data. The forecasters requested that a lightning probability forecast tool based on statistical analysis of historical warm-season data be developed. Such a tool would increase the objectivity of the daily thunderstorm probability forecast. The AMU is developing statistical lightning forecast equations that will provide a lightning occurrence probability for the day by 1100 UTC (0700L) during the months May – September (warm season). The tool will be based on the results from several research projects. If tests of the equations show that they improve the daily lightning forecast, the AMU will develop a PC-based tool from which the daily probabilities can be displayed by the forecasters.

The three data types to be used in this task were described in the previous AMU Quarterly Report (Q4 FY03):

- Cloud-to-Ground Lightning Surveillance System (CGLSS) data,
- 1200 UTC sounding data from synoptic sites in Florida, and
- 1000 UTC CCAFS sounding (XMR) data.

A description of the use and analysis of the CGLSS and 1200 UTC sounding data was also provided in that report. All the warm season data were collected for the period of record (POR) 1989 – 2003. In October, Ms. Lambert began pre-processing and analysis of the 1000 UTC XMR data using the S-PLUS® software package (Insightful Corporation 2000).

XMR Data Pre-Processing

The XMR sounding data will be used to calculate the stability parameters normally available to the forecasters through the Meteorological Interactive Data Display System (MIDDS). MIDDS uses the Man-computer Interactive Data Access System (McIDAS) software (Lazzara et al. 1999) for processing and displaying the sounding data. The McIDAS algorithms that process the sounding data will be used in this task to ensure that the calculated stability parameter values will be consistent with those available to the forecasters. The archived XMR data consist of individual daily files containing all soundings taken on a particular day. Each individual sounding is separated into three groups: thousand-foot, mandatory-level, and significant-level data. The McIDAS software uses the combined mandatory- and significant-level data. Therefore, Ms. Lambert first filtered the files to exclude the thousand-foot data, then combined the mandatory- and significant-level data and sorted them by height to create complete individual daily soundings beginning at the surface and extending to the highest observed level.

Ms. Lambert then filtered the data to include only 1000 UTC soundings. After noticing many days with missing data, she included soundings that were taken anytime between 1000 – 1030 UTC, inclusive. This was done because not all of the 1000 UTC soundings were launched at that exact time. Many of the soundings were launched at 1015 and 1020 UTC, and a few between 1020 and 1030 UTC. The end time of 1030 UTC was chosen because there were very few soundings launched after that time. Another reason was to simulate a real-time situation in which the sounding data and calculated parameters must be available to the 45 WS forecasters for the 1100 UTC weather briefing to the KSC/CCAFS community. A sounding launched after 1030 UTC may not provide the data in time for the briefing. Ms. Lambert also developed an automated check to ensure that only 1 sounding occurred during the 30-minute period on each day. On the few days where two soundings were found within the period, she noticed that they were 1-2 minutes apart. Mr. John Weems of the 45 WS said that these were most likely re-transmissions of the sounding due to a possible error in the first transmission, and that the later of the 2 soundings should be used in the analysis.

XMR Data Analysis

As stated in the previous section, the McIDAS sounding analysis algorithms currently used in operations will be used to calculate the sounding parameters of the archived XMR data. The parameters calculated by these algorithms are

- Boundary layer parcel values of temperature, dewpoint temperature, potential temperature (θ), equivalent potential temperature (θ_e), and mixing ratio,
- Forecast maximum temperature,
- Convective temperature,
- Temperature and pressure at the Lifted Condensation Level (LCL),
- 0 – 4 km helicity,
- Precipitable water up to 500 mb,
- Pressures at the Level of Free Convection (LFC) and Equilibrium Level (EL),
- Convective Available Potential Energy (CAPE) and Convective Inhibition (CIN),
- CAPE based on the forecast maximum temperature,
- CAPE based on the maximum θ_e below 300 mb,
- Lifted Index, Total Totals Index, K-Index, Severe WEAther Threat (SWEAT) Index, and Showalter Index.

All parameters in the above list except the LFC, EL, CIN, and the three CAPE values are calculated for all soundings in the POR. After all the parameters are calculated, they will be used as possible predictors for lightning occurrence over the KSC/CCAFS complex. These values will also be used by Dr. Short and Mr. Wheeler in the AMU's Severe Weather Forecast Decision Aid task.

For more information on this work, contact Ms. Lambert at 321-853-8130 or lambert.winifred@ensco.com.

MESONET TEMPERATURE AND WIND CLIMATOLOGY (MR. CASE)

Forecasters at the 45 WS use the wind and temperature data from the KSC/CCAFS tower network to evaluate LCC and to issue and verify temperature and wind advisories, watches, and warnings for ground operations. The Spaceflight Meteorology Group (SMG) also uses these data when evaluating FR for Shuttle landings at the KSC Shuttle Landing Facility (SLF). Unidentified sensor and/or exposure biases in these measurements at any of the towers could adversely affect an analysis, forecast, or verification for all of these operations. In addition, substantial variations in temperature and wind speed can occur due to geographic location or prevailing wind direction. Forecasters need to know if any towers exhibit a consistent bias in temperature and/or wind speed, and the typical geographical and diurnal variations of temperature and wind speed throughout the tower network. The AMU was tasked to identify any systematic biases, geographical variability, or meteorological discrepancies that occur within the tower network by analyzing archived 5-minute tower observations over the past nine years. The task will also result in a tool that forecasters can use to view the results.

Status of Quality Control and Tower Climatology Database

Mr. Case and Ms. Lambert continued the quality control (QC) of 6-ft and 54-ft temperature and wind data for the POR 1995 – 2003. Ms. Lambert ran an automated QC algorithm (Lambert 2002) on the 9-year database of tower data for the months of July to December, while Mr. Case conducted additional manual QC on the 6-ft and 54-ft temperature data as described in the previous AMU Quarterly Report (Q4 FY03). Because very little data were collected in January 1995, the POR was extended into January 2004 in order to have nine full years of data for each month. Subsequently, the dataset for this task will be finalized after January 2004 data are delivered from Mr. Wahner of Computer Sciences Raytheon (CSR).

There are a total of 45 possible tower sites that could be used in the mesonet climatology, considering inland and coastal sites, launch complexes, and the Shuttle landing facility towers. Several towers, however, were eliminated from consideration for the climatology due to insufficient data availability (7 towers on mainland Florida), relocation during the period of record (1 tower), and lack of 6-ft temperatures and/or 54-ft wind measurements (6 towers). The resulting 32 towers that will be used for this climatology are shown in Figure 1.

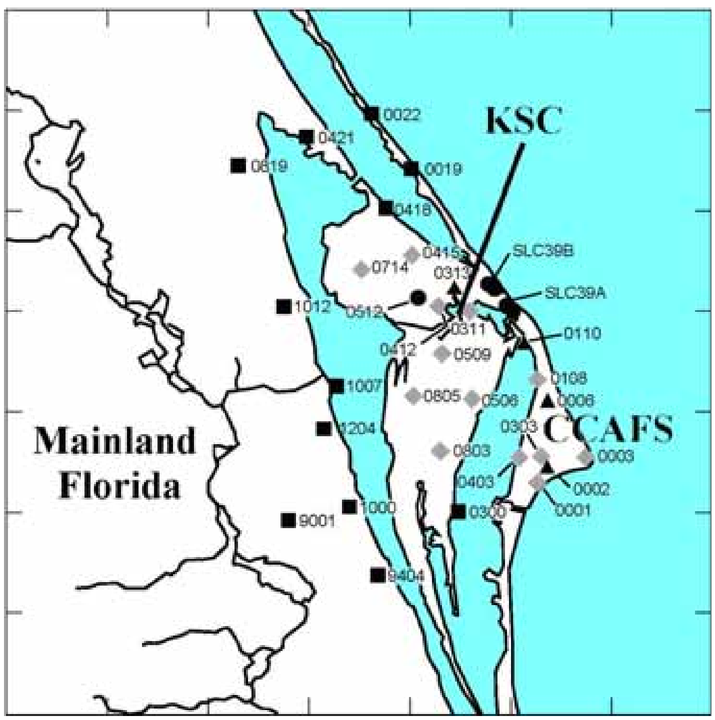

Figure 1. Map of the 32 tower locations and their station numbers used in the 9-year climatology with a POR of 1995–2003. Black squares are the forecast critical towers, gray diamonds are the safety critical towers, black circles are the launch critical towers, and black triangles are the launch and safety critical towers.

Development of Tower Climatology

Mr. Case developed algorithms using the S-PLUS software to calculate simple statistics based on the task requirements for the conditional climatology. The algorithms compute the hourly mean and standard deviation of 6-ft and 54-ft (if available) temperatures at each individual tower, as well as the hourly means for all towers combined, and groups of towers with similar sensor characteristics. The quality-controlled 5-minute observations for each UTC hour were grouped together to compute means and standard deviations so that users can get an understanding of the typical diurnal variations across the tower network on a month-by-month basis. For example, all available 5-minute observations between 0600 − 0655 UTC from each December during the period of record (1995 – 2003) at tower 0300 were used to compute a 0600 UTC mean and standard deviation at tower 0300 for December. These statistics were generated for all hours, months, and towers at both 6 ft and 54 ft. In addition, mean temperatures were computed for specific wind direction and wind speed bins to determine how observations typically varied under different wind regimes throughout the year.

Sample Climatological Output using Microsoft® Excel© Pivot Charts

Figures 2 – 4 are samples of the output that will be available to AMU customers using the pivot-chart capability of Microsoft® Excel©. Pivot charts and tables are exclusive to Excel, and are a means to summarize information in a large database quickly and in a way that is understandable to the user. These charts and tables are very flexible, allowing the user to make changes with point-click-drag-drop techniques. Axes can be switched, multiple variables can be represented on one axis, and specific curves can be temporarily removed from the display to facilitate closer examination of other curves. Since the conditional climatology contains statistics categorized by many different parameters (i.e. by hour, tower location and height, month, etc.), the Excel pivot charts provide the means for visualizing these data succinctly.

Some interesting examples of combination plots that can be viewed using pivot charts are given in Figures 2 – 4. The first example in Figure 2 shows the diurnal range of the mean 6-ft temperatures at Towers 0003 and 1204 (see Figure 1 for locations), and for all towers averaged together during July. Based on these results, Tower 1204 located on mainland Florida has considerably higher mean temperatures during the daytime hours compared to the overall tower network (ALL). Between 1400−1800 UTC, the mean temperature at tower 1204 is between 3−5°F higher than the overall network, and 5−7°F higher than the coastal Tower 0003. During the nighttime, however, the mean temperatures at Tower 1204 fall below the network means and Tower 0003 by about 1−3°F after 0300 UTC. Figure 2 helps to illustrate the differences between a coastal site and a mainland site during the summer.

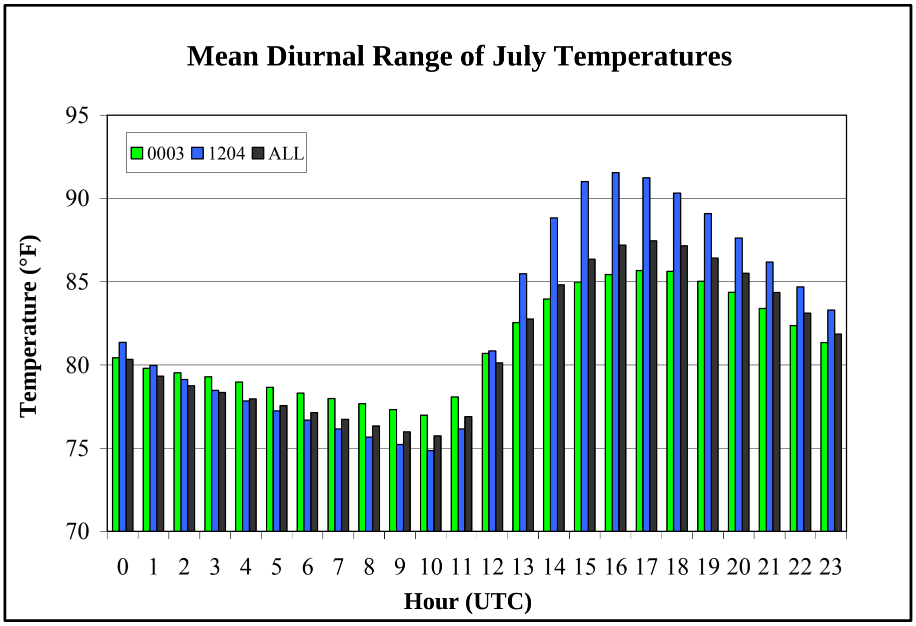

Figure 2. The diurnal range of hourly mean 6-ft temperatures at towers 0003, 1204, and for all towers combined during the month of July, 1995–2003.

The example in Figure 3 shows the diurnal range of mean temperatures during July at three towers for west-southwest winds (Figure 3a) versus east-northeast winds (Figure 3b). The three Towers 0003, 0403, and 0803 are aligned east-west from the tip of Cape Canaveral to central Merritt Island (see Figure 1). Tower 403 is on the east bank of the Banana River, Tower 0003 is surrounded by the Atlantic Ocean on its east, south, and north sides, and Tower 0803 is somewhat land-locked on Merritt Island. The geographical variations among these towers have a significant impact on the hourly mean temperatures, particularly during the nighttime hours. Under west-southwest flow, Tower 0403 experienced winds off the Banana River and had mean temperatures several degrees warmer than both Towers 0003 and 0803 between 0000–1100 UTC (Figure 3a). During the daytime, Tower 0003 was initially the warmest of these towers up to 1500 UTC; thereafter, Tower 0803 was the warmest through 2200 UTC under west-southwest wind flow. Conversely, under east-northeast flow, Tower 0403 experienced winds with the largest fetch over land and Tower 0003 experienced winds with a large fetch over the ocean. Subsequently, Tower 0003 had the warmest mean temperatures during the nighttime hours by 3–5°F over Towers 0403 and 0803. Between 1500–2200 UTC, Towers 0403 and 0803 tended to be warmer by about 1–2°F under east-northeast flow.

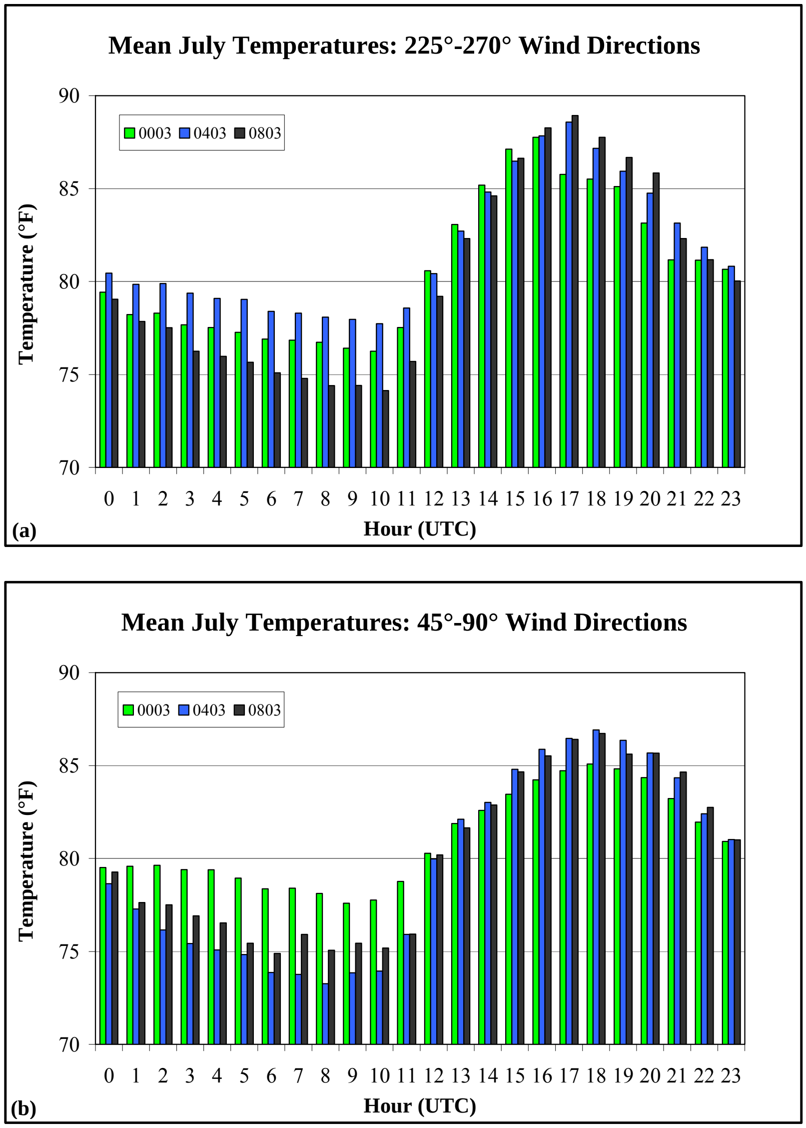

Figure 3. The hourly mean 6-ft temperatures at Towers 0003, 0403, and 0803 for (a) prevailing wind directions between 225–270°, and (b) prevailing wind directions between 45–90°.

The example in Figure 4 depicts the number of occurrences of categorical wind directions versus time of day during July for all 32 towers in the climatology. In this plot, each category represents a 45° range of wind directions. For example, the 135° bin represents wind directions > 90° and ≤ 135° (east-southeast winds). Figure 4 illustrates the most common diurnal variation of wind directions throughout the tower network during July. From 0000 – 1300 UTC, the mode of the wind direction veers from 135° – 180° to 225° – 270°. Between 1400 – 1700 UTC, the mode of the wind direction becomes less distinct. The direction-bin frequency distribution is more spread out due to the typical sea-breeze transition during these hours. However, after 1700 UTC in the post-sea breeze regime, the wind directions strongly favor 90° – 135° (east-southeast) and gradually veer to 135° – 180° by 2300 UTC. With pivot charts, similar diagrams can be examined for all months of the year, for each individual tower, as well as various combinations of months, towers, and wind direction bins.

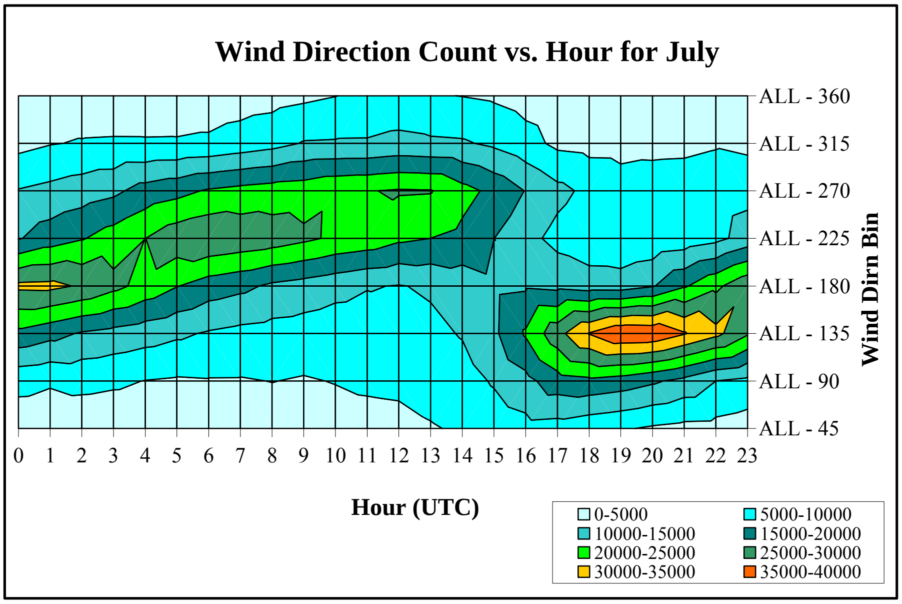

Figure 4. The number of occurrences of wind directions in 45° bins during July 1995–2003 for all towers combined. The bins are labeled by the maximum value in the wind direction range (i.e. 45° bin: 0° < wind direction ≤ 45°; 90° bin: 45° < wind direction ≤ 90°; etc.).

For more information on this work, contact Mr. Case at 321-853-8264 or case.jonathan@ensco.com.

SEVERE WEATHER FORECAST DECISION AID (MR. WHEELER AND DR. SHORT)

The 45 WS Commander's morning weather briefing includes an assessment of the likelihood of local convective severe weather for the day in order to enhance protection of personnel and material assets of the 45th Space Wing, CCAFS, and KSC. The severe weather elements produced by thunderstorms include tornadoes, wind gusts ≥ 50 kts, and/or hail with a diameter ≥ 0.75 in. Forecasting the occurrence and timing of these phenomena is challenging for 45 WS operational personnel. The AMU has been tasked with the creation of a new severe weather forecast decision aid, such as a flow chart or nomogram, to improve the various 45 WS severe weather watches and warnings. The tool will provide severe weather guidance for the day by 1100 UTC (0700 EDT).

In a continuing effort to identify historical and climatological patterns of severe weather events, Mr. Wheeler began documenting the meteorological conditions for all severe storm events reported in east-central Florida from January 1989 – May 2003. The storm event database for Brevard, Volusia, Indian River, St. Lucie, Seminole and Orange counties was obtained by Dr. Short from the National Climatic Data Center. Mr. Wheeler added the atmospheric stability indices computed by Ms. Lambert from the 1000 UTC sounding at XMR, the surface high pressure ridge location, jet stream location and other upper air features for the severe weather events and non-event days. Figure 5 highlights the east-central Florida counties of interest in yellow and the locations of all radiosonde stations on the Florida peninsula.

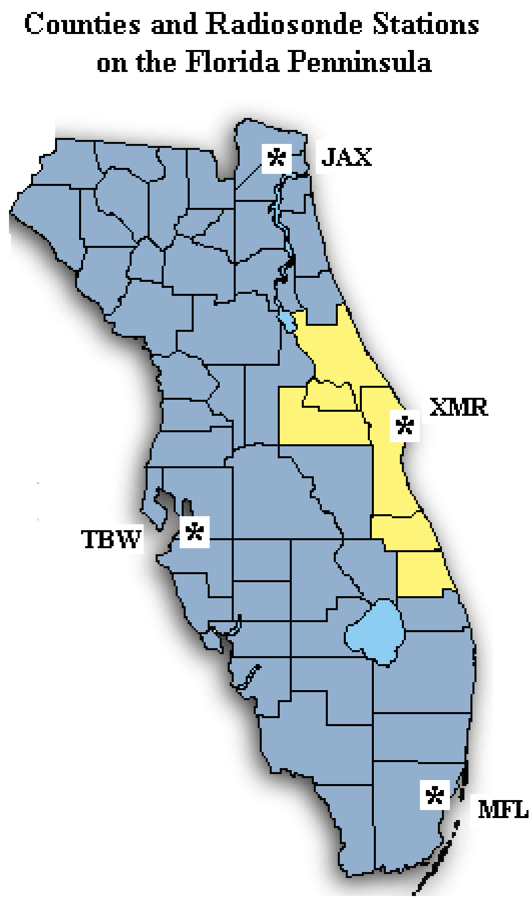

Figure 5. Locations of the six counties in east-central Florida whose severe weather events are used in the task and the locations of all radiosonde stations on the Florida peninsula.

Figure 6 shows cumulative distributions of the Total Totals (TT) stability index from the 1000 UTC sounding at XMR for severe event days and all days in east-central Florida during the warm season 1989 – 2003. The TT index is based on temperature and humidity differences between the lower and middle troposphere and is used to identify potential areas of thunderstorm development, a prerequisite for severe weather events as defined above. Heavy lines are drawn in Figure 6 for TT values of 46 and 48, which are the current thresholds used to indicate a medium threat of severe weather on 45 WS Form 5 (Patrick AFB/SLF Summer TAF Worksheet). Figure 6 indicates that 30% of east-central Florida severe weather events occurred with TT values less than 46, yet 47% of all days had TT values less than 46. On the other hand, about 44% of severe weather events occurred with TT values greater than 48, yet only about 28% of all days had TT values greater than 48. This suggests that when the TT index is greater than 48, the threat of severe weather is about 2.5 times greater than when the TT index is below 46. The factor of 2.5 was obtained by comparing the ratio 30/47 to 44/28.

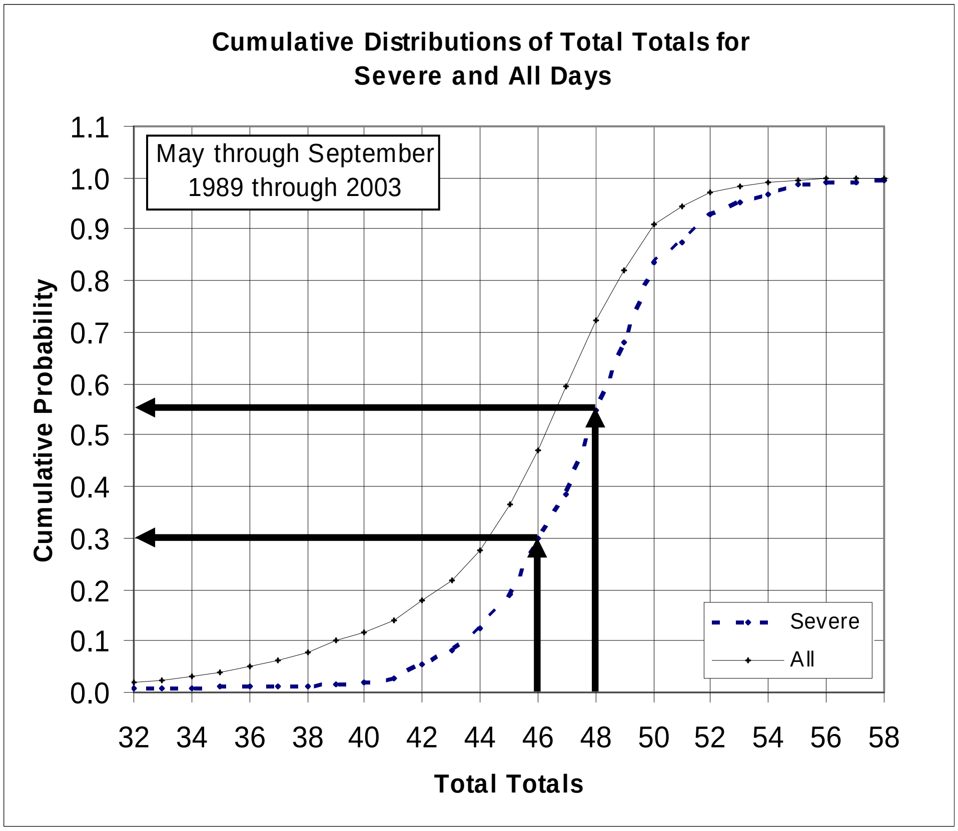

Figure 6. Cumulative distributions of the Total Totals index for May – September 1989 – 2003. The solid line represents all days, and the dashed line represents days with severe weather.

Figure 7 shows cumulative distributions of the K Index (KI) from the 1000 UTC sounding at XMR from the same database as Figure 6. The KI is a measure of thunderstorm potential, based on the vertical temperature lapse-rate, moisture content of the lower atmosphere and the vertical extent of the moist layer. Heavy lines are drawn in Figure 7 for KI values of 26 and 28, which are the current thresholds used to indicate a medium threat of severe weather on 45 WS Form 5. Figure 7 indicates that 16% of east-central Florida severe weather events occurred with KI values less than 26, yet 33% of all days had KI values less than 26. On the other hand, about 77% of severe weather events occurred with KI values greater than 28, while about 62% of all days had KI values greater than 28. This suggests that when the KI is greater than 28, the threat of severe weather is about 2.6 times greater than when the KI index is below 26. The factor of 2.6 was obtained by comparing the ratio 16/33 to 77/62.

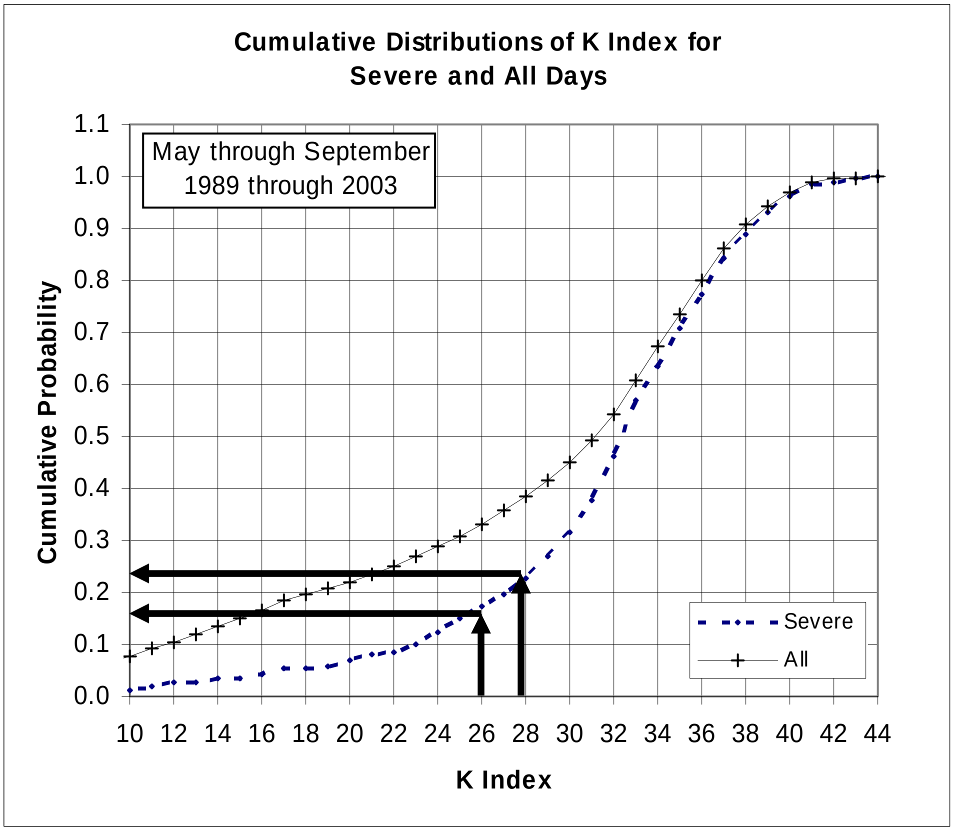

Figure 7. Cumulative distributions of the K Index for May – September 1989 – 2003. The solid line represents all days, and the dashed line represents days with severe weather.

For more information on this work, contact Mr. Wheeler at 321-853-8205 or wheeler.mark@ensco.com, or Dr. Short at 321-853-8105 or short.david@ensco.com.

INSTRUMENTATION AND MEASUREMENT

I&M AND RSA SUPPORT (DR. BAUMAN AND MR. WHEELER)

Mr. Wheeler began testing the AMU RSA Advanced Weather Interactive Processing System (AWIPS) hardware and display options. He also developed procedures for analysis and display of model and synoptic data and continued his support of the AMU and Range Weather Operations (RWO) display systems.

Table 1. AMU hours used in support of the I&M and RSA task in the First Quarter of FY 2004 and total hours since July 1996.

Quarterly Task Support (hours)	***Total Task Support (hours)***
33.5	616.5

ANVIL TRANSPARENCY RELATIONSHIP TO RADAR REFLECTIVITY (DR. SHORT AND MR. WHEELER)

Determining the transparency of anvil clouds is critical for the operational evaluation of FR and LCC that are designed to protect launch and landing vehicles from natural and/or triggered lightning. Forecasters currently rely on satellite observations, pilot reports and surface based observations to determine if anvil clouds are non-transparent, representing a violation of LCC and/or FR if the flight path of a vehicle would pass through such clouds (Figure 8). However, these types of cloud observations are not always available, depending on the location of the anvil clouds, the presence of other cloud layers and the time of day. The Weather Surveillance Radar 88 Doppler (WSR-88D) at the National Weather Service (NWS) office in Melbourne (MLB), Florida provides high-resolution cloud reflectivity information over the KSC and CCAFS area on a continuous basis. WSR-88D data products could be useful for determining anvil transparency and are available in real-time at SMG and in the RWO. The AMU was tasked to determine if data from the WSR-88D Layered Reflectivity Max (LRM) High product could be used in evaluating anvil transparency.

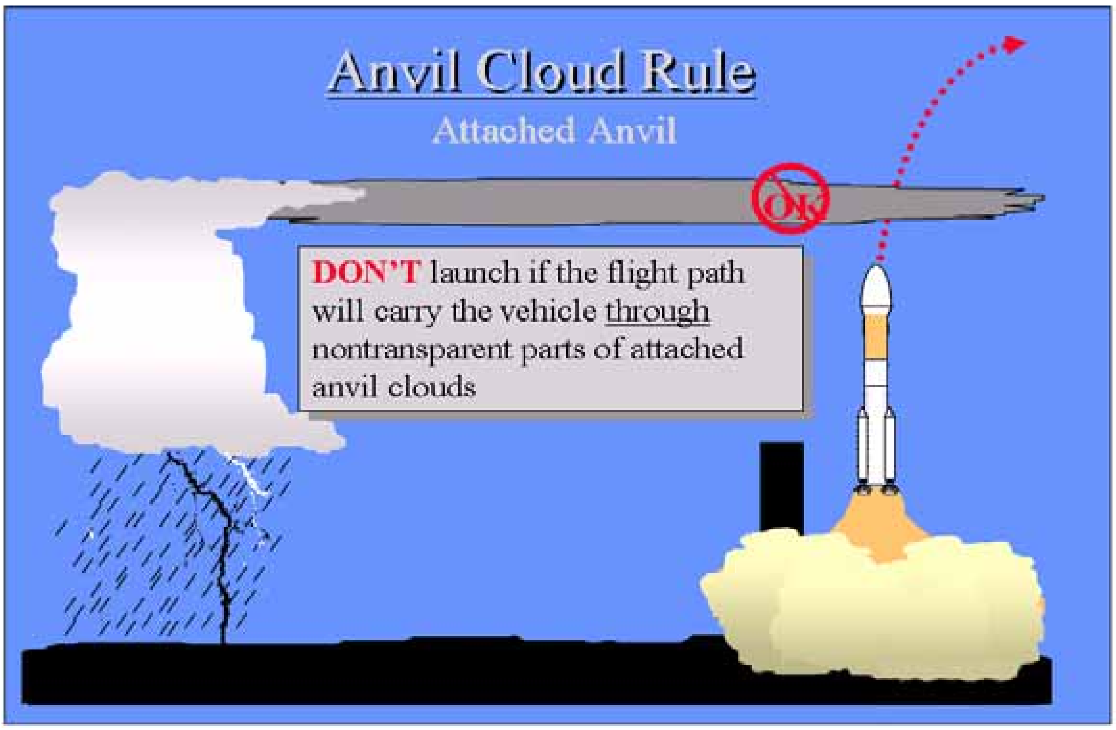

Figure 8. Schematic representation of the Anvil Cloud Rule for attached anvils.

Preparations for this task began in May of 2003 when CSR weather observers began recording visual observations of high cloud transparency at Weather Station B (KTTS) near the SLF. The observations were made hourly, with the remark THN CI OVHD recorded to indicate transparent high clouds overhead and CS OVHD to indicate opaque cirrus conditions. 'Overhead' was defined as a circle centered over the observer, 60° above the horizon. Clouds were considered transparent when higher clouds, blue sky, stars, the sun's disk, etc. could be distinctly seen from below or if the sun cast distinct shadows of objects on the ground. Figure 9 shows the locations of Weather Station B and the WSR-88D. The circle over the weather station is approximately 5.7 n mi in diameter (25.5 sq. n mi), indicating the size of the domain that is 60° above the horizon at an altitude of 30 000 ft, a typical altitude for high clouds. The distance from the WSR-88D to the weather station is 30.7 n mi and the circle subtends an angle of about 10°. With a beam width of 1° and gate spacing of 0.54 n mi (1 km) the WSR-88D LRM High product is well suited for a comparative analysis with ground-based observations of high clouds.

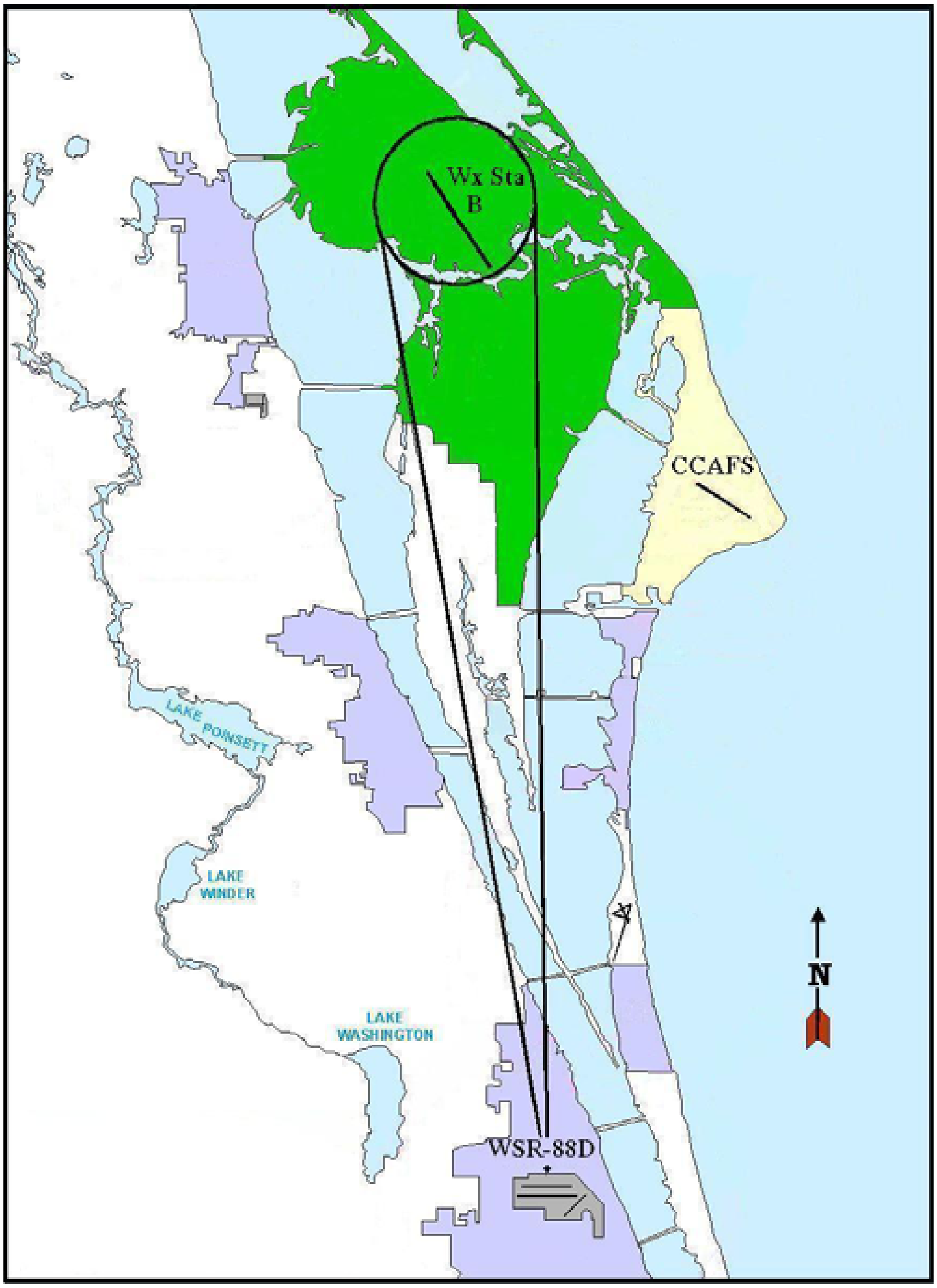

Figure 9. Map of the observing geometry of the WSR-88D at NWS MLB over Weather Station B on KSC. The range from the radar to the weather station is 30.7 n mi. The circle over the weather station is approximately 5.7 n mi in diameter, representing the domain that is 60° above the horizon at an altitude of 30 000 ft.

Mr. Wheeler transposed the cirrus transparency remarks from the official KTTS observation forms to a database worksheet. He also collected and archived satellite images from May – September 2003 to provide a large-scale meteorological context for the interpretation of ground-based observations of high clouds over KTTS. For those observations where the satellite and ground-based observations indicated that the high clouds were associated with thunderstorm activity, the WSR-88D data from NWS MLB will be acquired for further analysis. Dr. Short conducted a literature search and found results from previous empirical and theoretical studies that could be applicable in estimating anvil cloud transparency from radar reflectivity observations.

For more information on this work, contact Dr. Short at 321-853-8105 or short.david@ensco.com, or Mr. Wheeler at 321-853-8205 or wheeler.mark@ensco.com.

MESOSCALE MODELING

ARPS OPTIMIZATION AND TRAINING (MR. CASE)

Accurate guidance from the Advanced Regional Prediction System (ARPS) numerical weather prediction model is necessary to continue improvements to operational short-range forecasts (< 12 hours) of local atmospheric fields across east-central Florida. Realistic depictions of the short-range prognostic state of meteorological phenomena such as sea breezes and convection will assist forecasters with critical short-term forecasts and severe weather outlooks/warnings at NWS MLB. In addition to these types of forecasts, SMG will also use the ARPS in FR evaluation. Recommendations for future improvements, along with documentation of local configurations, will facilitate the transfer of routine ARPS maintenance responsibilities to NWS MLB and SMG personnel. The AMU was tasked to assist with testing, optimizing, and adjusting as necessary the ARPS forecast cycle configuration at NWS MLB, and provide documentation and training for the transfer of ARPS maintenance to NWS MLB and SMG.

Mr. Case completed a draft of the final task memorandum, which is currently under review by AMU customers. The task officially concludes with the release of this memorandum, once customer revisions are incorporated.

For more information on this work, contact Mr. Case at 321-853-8264 or case.jonathan@ensco.com.

AMU CHIEF'S TECHNICAL ACTIVITIES (DR. MERCERET)

Dr. Merceret presented a paper co-authored with Dr. Manobianco describing the AMU at the National Weather Association (NWA) 28th Annual Meeting in Jacksonville, FL. He also presented a briefing on the persistence of wind features as a function of vertical scale during the Space Shuttle Natural Environments Panel Meeting. Along with Ms. Ward, he revised the cloud-edge detection algorithm manuscript submitted to the American Meteorological Society Journal of Atmospheric and Oceanic Technology in accordance with the reviewers' comments. The revised manuscript was accepted for publication.

AMU OPERATIONS

Mr. Wheeler completed the memorandum describing the 45 WS Option Hours task to analyze wind tower and other data from a severe weather event that occurred near the SLF on 4 March 2003 and distributed it to the customers. He continued working with the NASA Procurement Office on the AMU IT hardware and software requirements for FY 2004 and conducted research for equipment and software needed to support AMU tasks.

Dr. Short and Mr. Case attended the NWA 28th Annual Meeting in Jacksonville, FL. Dr. Short presented a paper co-authored with Mr. Wheeler on forecasting the propagation of anvil clouds using model output. Mr. Case presented a talk that illustrated the importance of incorporating high-resolution local observational data sets into the ARPS model initial condition using forecasts of the tornadic event associated with Tropical Storm Gabrielle in September 2001.

Dr. Bauman completed the KSC Weather Office Option Hours task to identify and evaluate methods for determining whether a sufficient number of imaging cameras will have a field of view unobstructed by weather during a Shuttle launch. Dr. Merceret, Dr. Bauman and Ms. Lambert attended the Space Shuttle Natural Environments Panel Meeting at KSC 4 – 7 November. Topics included the thermodynamic and height analysis of the Sippican W-9000 upper air sounding system, Range Standardization and Automation issues and schedules, and winds and loads methodologies for Space Shuttle, Titan, Atlas, and Delta launch vehicles.

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List of Acronyms

30 SW	30th Space Wing
30 WS	30th Weather Squadron
45 RMS	45th Range Management Squadron
45 OG	45th Operations Group
45 SW	45th Space Wing
45 SW/SE	45th Space Wing/Range Safety
45 WS	45th Weather Squadron
ADAS	ARPS Data Analysis System
AFSPC	Air Force Space Command
AFWA	Air Force Weather Agency
AMU	Applied Meteorology Unit
ARPS	Advanced Regional Prediction System
AWIPS	Advanced Weather Interactive Processing System
CAPE	Convective Available Potential Energy
CCAFS	Cape Canaveral Air Force Station
CIN	Convective INhibition
CGLSS	Cloud-to-Ground Lightning Surveillance System
CSR	Computer Sciences Raytheon
EDT	Eastern Daylight Time
EL	Equilibrium Level
FR	Flight Rules
FSL	Forecast Systems Laboratory
FSU	Florida State University
FY	Fiscal Year
JSC	Johnson Space Center
KI	K Index
KSC	Kennedy Space Center
KTTS	Weather Station B Identifier
LCC	Launch Commit Criteria
LCL	Lifted Condensation Level
LFC	Level of Free Convection
LRM	Layered Reflectivity Max
McIDAS	Man-computer Interactive Data Access System
MIDDS	Meteorological Interactive Data Display System
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
NOAA	National Oceanic and Atmospheric Administration
NSSL	National Severe Storms Laboratory
NWA	National Weather Association
NWS MLB	National Weather Service in Melbourne, FL
PC	Personal Computer
POR	Period of Record
QC	Quality Control
RSA	Range Standardization and Automation
RWO	Range Weather Operations
SLF	Shuttle Landing Facility

SMC	Space and Missile Center
SMG	Spaceflight Meteorology Group
SRH	NWS Southern Region Headquarters
SWEAT	Severe WEAther Threat
TT	Total Totals
USAF	United States Air Force
WSR-88D	Weather Surveillance Radar 88 Doppler
UTC	Universal Coordinated Time
WWW	World Wide Web
XMR	CCAFS Sounding Identifier

Appendix A

AMU Project Schedule 31 January 2004				
AMU Projects	Milestones	Scheduled Begin Date	Scheduled End Date	Notes/Status
Objective Lightning Probability Phase I	Literature review and data collection/QC	Feb 03	Jun 03	Completed
	Statistical formulation and method selection	Jun 03	Oct 03	Delayed Due to Data Collection and McIDAS Code Interpretation
	Equation development, tests with verification data and other forecast methods	Aug 03	Nov 03	Delayed as above (Mar 04)
	Develop operational products	Nov 03	Jan 04	Delayed as above (Apr 04)
	Prepare products, final report for distribution	Jan 04	Mar 04	Delayed as above (May 04)
Mesonet Temperature and Wind Climatology	Process data and calculate climatology of biases/deviations	Jul 03	Jan 04	On Schedule
	Develop tabular and geographical displays	Feb 04	Apr 04	On Schedule
	Final Report	Apr 04	Jun 04	On Schedule
	Assistance in transitioning product into operations	Jul 04	Jul 04	On Schedule
Severe Weather Forecast Tool	Local and national NWS research, discussions with local weather offices on forecasting techniques	Apr 03	Sep 03	Completed
	Develop database, develop decision aid, fine tune	Oct 03	Feb 04	On Schedule
	Final report	Feb 04	Mar 04	On Schedule
Anvil Transparency Relationship to Radar Reflectivty	Literature search and identification of days with anvil cloud over weather station B near the SLF	Nov 03	Dec 03	Completed
	Analysis of WSR-88D and satellite data for anvil days	Jan 04	May 04	On Schedule
	Memorandum	Jun 04	Jul 04	On Schedule
ARPS Optimization and Training	Assistance for testing and optimizing the real-time ARPS configuration	Jul 03	Dec 03	Completed
	Final task memorandum and training/maintenance manual	Dec 03	Dec 03	Completed

NOTICE