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Applied Meteorology Unit (AMU)

Quarterly Report

First Quarter FY-02

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EXECUTIVE SUMMARY

This report summarizes the Applied Meteorology Unit (AMU) activities for the first quarter of Fiscal Year 2002 (October – December 2001). A detailed project schedule is included in the Appendix. Significant progress was made on the three main AMU tasks this quarter.

Task	Improved Anvil Forecasting Phase II
Goal	Develop an anvil-forecasting tool to aid forecasters in predicting the probability of violating the triggered lightning Launch Commit Criteria and Space Shuttle Flight Rules.
Milestones	Conducted a teleconference to solicit feedback from the forecasters in the 45th Weather Squadron and the Spaceflight Meteorology Group to ensure customer satisfaction with the end product. Completed preliminary development of forecast tool that graphically displays an anvil threat corridor on a satellite image.
Discussion	Customers are so satisfied with the tool that they requested immediate implementation for testing and familiarization on operational system by February 2002.
Task	Statistical Short-Range Forecast Tools
Goal	Develop short-range peak winds forecast equations for use in support of launch and landing operations.
Milestones	Completed quality control of all observational data. Created wind climatologies from a 7-year set of 5-minute wind speed and direction data from the Kennedy Space Center/Cape Canaveral Air Force Station wind tower network.
Discussion	Climatologies reveal interesting relationships including diurnal changes in wind speed and direction, strong correlations between the peak and mean wind speeds, and seasonal changes in predominant wind direction. These relationships will be used to determine how the forecast tool should be developed, as well as provide information to the forecasters on the behavior of the winds at the towers.
Task	Land Breeze Forecasting
Goal	Develop rules of thumb that will improve the reliability of the land-breeze occurrence forecasts and help determine land-breeze timing.
Milestones	Analyzed wind-tower data from October 1999 to April 2000 and identified 43 land breeze cases with a wide variety of onset times, propagation speeds, and spatial characteristics.
Discussion	Some land-breeze passages resulted in temperature changes as large as 10°F in only 15 minutes. Depending on the prevailing wind flow and location relative to the coast, near-surface temperatures may increase or decrease following the passage of a land-breeze front. All information obtained from the land-breeze climatology will be used to develop rules of thumb.

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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.merceret-1@ksc.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

STATISTICAL SHORT-RANGE FORECAST TOOLS (MS. LAMBERT)

The peak winds are an important forecast element for both the Space Shuttle and Expendable Launch Vehicle (ELV) programs. As defined in the Shuttle Flight Rules (FR) and the Launch Commit Criteria (LCC), each vehicle has certain peak wind thresholds that cannot be exceeded in order to ensure the safety of that vehicle during launch and landing operations. The 45th Weather Squadron (45 WS) and the Spaceflight Meteorology Group (SMG) indicate that peak winds are a challenging parameter to forecast. The goal of this task is to develop short-range peak-wind forecast tools to be used in support of ELV/Shuttle launches and Shuttle landings. Ms. Lambert will use seven years (January 1995 – December 2001) of 5-minute data from the Kennedy Space Center/Cape Canaveral Air Force Station (KSC/CCAFS) wind tower network and any other appropriate data sets to develop a statistical short-term forecast method for peak winds at the specific tower sites shown in Table 1.

Table 1. The towers and heights at which peak winds forecasts will be made, and their associated launch or landing operation.

Launch Operation	*Tower(s)*	*Primary Height (ft)*	*Backup Height (ft)*
Shuttle	0393/94, 0397/98	60	N/A
Shuttle (*landing*)	511 / 512 / 513 313	30 492	N/A N/A
Atlas	36	90	N/A
Delta	20 / 21	90	54
Titan	1101 / 1102	162	54

Data Quality Control

In order for meaningful conclusions to be drawn from analyses of the data, erroneous observations were first removed from the data set. Ms. Lambert used quality control (QC) software specific to the local wind tower network to accomplish this step. In all, five routines were used to QC the data:

- An impossible value check (e.g. wind speed < 0),
- A standard deviation (σ) check (e.g. temperature not within 10 σ of mean),
- A peak-to-average wind speed ratio check in which the peak wind must be within a specified factor of the average wind speed (factor value dependent on average speed),
- A vertical consistency check between sensor levels at each individual tower, and
- A temporal consistency check for each individual sensor.

Only a small percentage of the data were flagged as erroneous by the QC routines, with values ranging from 0.56 to 2.1% per tower and month. This left a large set of good quality data for analysis and forecast tool development, thereby increasing confidence in the future results of the task.

Climatologies

The 45 WS and SMG requested forecasts of the mean hourly peak wind speeds and directions. Before beginning development of the forecast equations, Ms. Lambert determined the hourly and directional climatology of the wind speeds for each month. These values could help determine the optimal forecast model and be used for input to that model. She calculated wind speed means and σ's for the towers and heights in Table 1 using a commercial-off-the-shelf statistical software package called S-PLUS® (Insightful Corporation 2000). The data, 5-minute average and 5-minute peak winds, were stratified three ways:

- By month and hour,
- By month and direction in 10° bins, and
- By month, direction in 45° bins, and hour.

The first stratification reflects the customer request for forecasts of mean hourly winds for each month. The second stratification showed the high-resolution direction climatologies by month. Several direction-bin increments were tested in combination with the 24 hour-bins for the third stratification. The direction increments had to be small enough to derive meaningful hourly wind direction climatologies, yet large enough such that a sufficient number of observations were available to calculate dependable values. Ms. Lambert found that eight 45°-direction bins provided the best balance. In addition to calculating the mean and standard deviations of the wind speeds, Ms. Lambert computed the number of observations used to calculate these variables. After calculating all the values in S-PLUS, Ms. Lambert displayed the results in Microsoft® Excel pivot charts. These charts allow flexibility in displaying the wind speed data by hour, direction, month, and variable (mean, standard deviation, number of observations). Relationships such as diurnal, monthly, and yearly trends can be seen easily and quickly with pivot charts. While there are several possible ways of viewing the data, only three charts are shown here for brevity.

Figure 1 shows mean hourly wind speed parameters for March at Tower 0393, just north of the Shuttle launch pad 39A. The hourly values were calculated by using the 12 5-minute values in each hour for each day of the month from every year in the data set. The total number of possible observations in March is 62 496 (*12 obs/hr x 24 hrs/day x 31 days/March x 7 Marches)*; and the total number of possible observations per hour is 2604 (*62 496 obs / 24 hrs*). The actual number of observations used to calculate the values was lower due to missing data and the QC routines. In Figure 1 the numbers ranged from 2300 – 2400, which is a sufficiently large sample from which to calculate reliable climatologies.

The main phenomenon to note is the diurnal trend in both the mean peak and average wind speeds. The local sunrise in March is between 1100 - 1200 UTC (0600 - 0700 EST), and sunset is between 2300 - 2400 UTC (1800 – 1900 EST). An increase in mean speed is apparent after sunrise, as is the decrease in the late afternoon to evening hours. The increase at sunrise is likely due to the mixing down of higher momentum winds aloft by the convective updrafts and downdrafts created by daytime heating. Also note the close correlation between the mean peak and average wind speeds, which is an expected result. This suggests that the gust factor forecast method used at SMG (McVehil and Camnitz 1969) should be used as a benchmark to test the added value of a new technique. The σ's indicate a large variability in the winds of ~6 knots for the peak speeds and ~4 knots for the average speeds. This large variability may make forecast tool development more difficult.

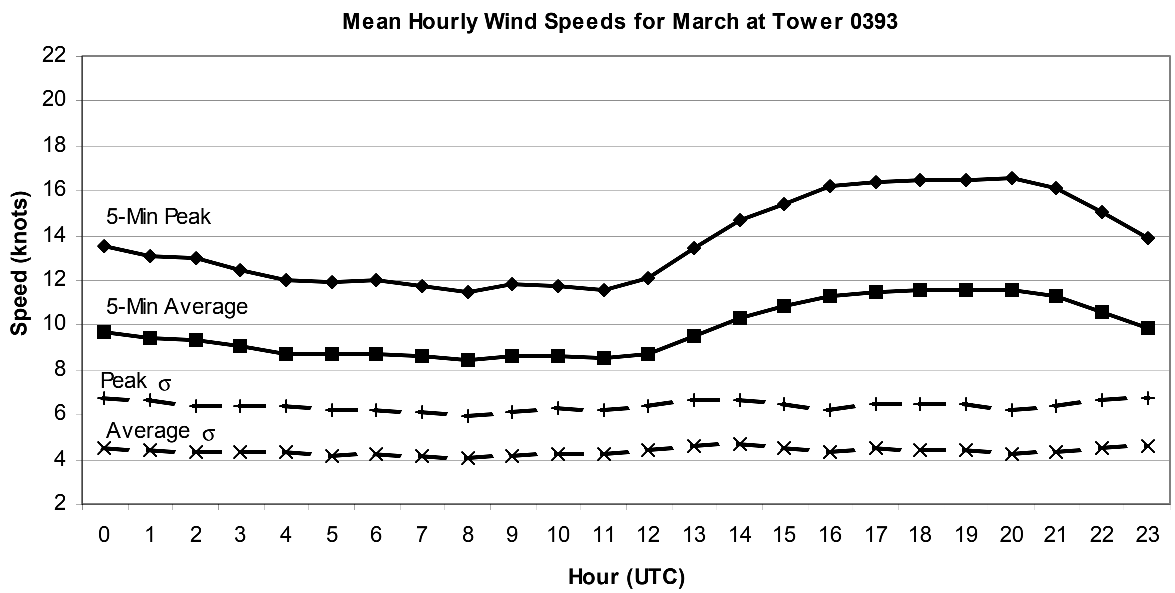

Figure 1. Mean hourly wind speed (knots) for March at Tower 0393. The first (top) solid line is the hourly mean of the 5-minute peak wind speed, the second solid line is the mean of the 5-minute average wind speed, the first dashed line is the standard deviation (σ) of the peak speed, and the second dashed line is the σ of the average speed.

Figure 2 shows mean wind speed parameters for March at Tower 0393 stratified by direction in 10° bins. It is not possible to predetermine how many of the 62 496 possible observations in March are available to each bin. The actual number is dependent on the predominant wind direction(s) for the month. The number of observations used to calculate the values in Figure 2 ranged from 900 – 3000. The lowest number was from the ENE (50°), and the largest numbers were from the SSE (160°) and N (360°). It is also difficult to note any kind of trend in wind speed with direction, but it is apparent in Figure 2 that the strongest mean speeds are from the NNW (340 - 360°). The close correlation between the mean peak and average wind speeds found in Figure 1 is present in Figure 2, as are the large σ values. There is a close correlation between mean peak and average wind speeds as well as large standard deviation regardless of whether they are stratified by direction or time of day.

Figure 3 shows mean hourly wind speed parameters from the NNW (315 - 360°) for March at Tower 0393 to illustrate what time of day the maximum mean winds are most likely to occur. The number of observations used to calculate the mean hourly NNW wind speeds ranged from 200 – 600. The lowest numbers were in the nighttime and early morning hours, and the largest numbers were around local mid-morning at 1500 UTC. Consistent with the previous stratifications in Figures 1 and 2, there is a diurnal trend, large σ values, and the close correlation between the mean peak and average wind speeds. The mean winds as a function of wind direction and time of day (Figures 2 and 3) suggests that the strongest winds in March are ~20 knots from the NNW from 1800 to 0100 UTC (1300 – 2000 EST).

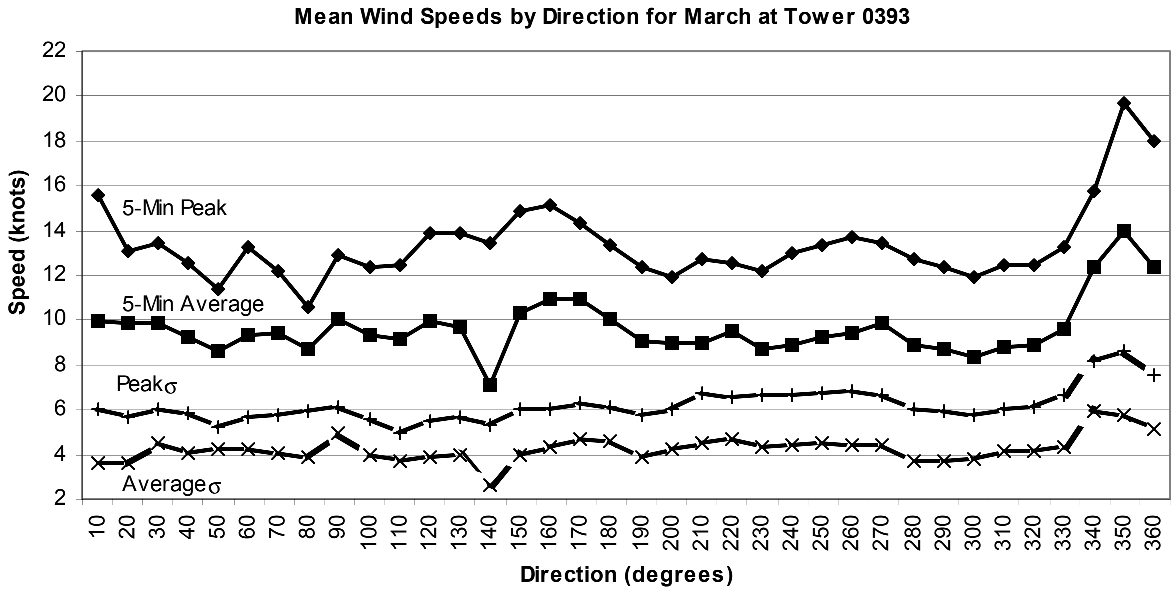

Figure 2. Mean winds speeds (knots) as a function of wind direction for March at Tower 0393. The values on the x-axis represent the upper range of the direction-bins. The first (top) solid line is the hourly mean of the 5-minute peak wind speed, the second solid line is the mean of the 5-minute average wind speed, the first dashed line is the standard deviation (σ) of the peak speed, and the second dashed line is the σ of the average speed.

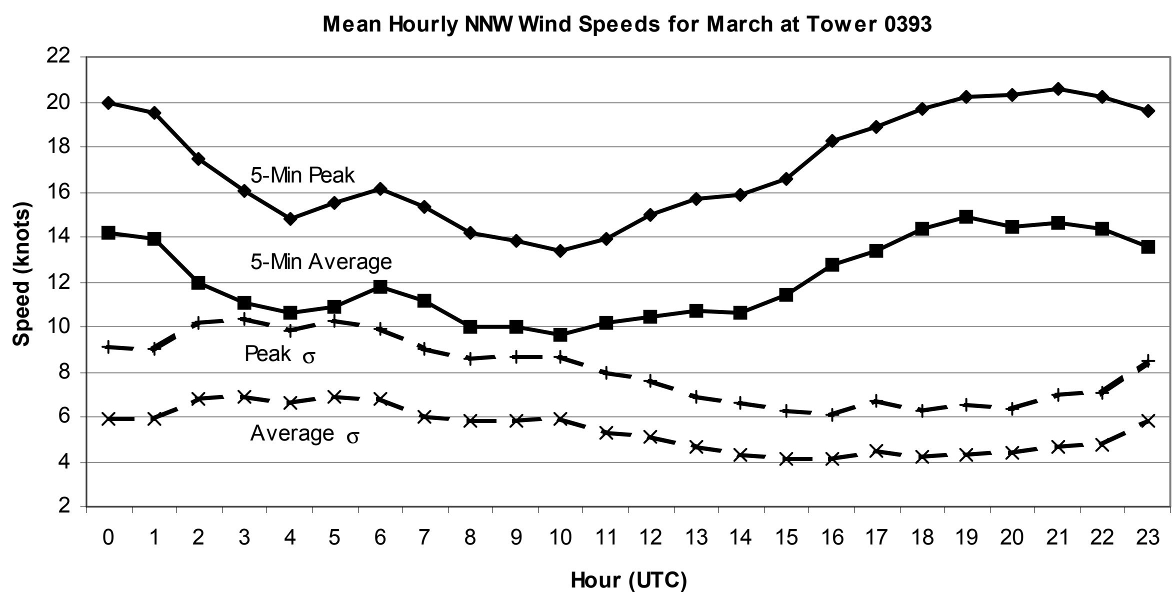

Figure 3. Mean hourly wind speed (knots) for a NNW wind (315 - 360°) in March at Tower 0393. The first (top) solid line is the hourly mean of the 5-minute peak wind speed, the second solid line is the mean of the 5-minute average wind speed, the first dashed line is the standard deviation (σ) of the peak speed, and the second dashed line is the σ of the average speed.

These simple statistics will likely reveal similar information about the average behavior of the wind speeds and directions at each of the other towers of interest as well. Charts of the peak and average wind speed means and σ's show diurnal trends and relationships between the peak and average wind speeds as well as preferred directions for the maximum and minimum speeds at specific times of day during specific months. Charts of the number of observations used to calculate the mean and σ reveal wind direction preferences per month or month and hour. Ms. Lambert will continue to analyze the data for relationships that will help in the development of a peak-wind forecasting tool.

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

IMPROVED ANVIL FORECASTING PHASE II (DR. SHORT AND MR. WHEELER)

The 45 WS Launch Weather Officers (LWOs) have identified anvil forecasting as one of their most challenging tasks when attempting to predict the probability of an LCC violation due to a threat of natural and triggered lightning. SMG forecasters have reiterated this difficulty when evaluating Space Shuttle FR. Phase I of this task (Lambert 2000) established the technical feasibility of developing an observations-based forecasting technique, given the promising relationships found by the 45 WS between anvil length and lifetime and the average wind speed/direction and moisture content in the anvil layer. The goals of Phase II are to 1) build upon the results of Phase I with data collection and analysis to increase the sample size of anvil cases and improve the reliability of resulting statistics, and 2) develop objective graphical tools for forecasting the occurrence of anvil clouds over the KSC/CCAFS area with lead times of 36 hours or less.

Customer Input

Dr. Short and Mr. Wheeler participated in a telephone conference (telcon) to obtain customer input on the task. Representatives from the 45 WS, SMG, and the National Weather Service in Melbourne, Florida (NWS MLB) participated in the telcon, providing feedback and guidance on recent accomplishments and future directions of the task. The customer consensus was to implement the anvil threat corridor graphic tools on the operational system by February 2002 and to halt the analysis of model data.

Prototype Forecast Tool

In response to the customer input, Dr. Short and Mr. Wheeler accelerated development of a graphical forecast tool, designed to depict an anvil threat corridor based on upper tropospheric wind information. The tool executes Man-Computer Interactive Data Analysis System (McIDAS) commands in a script based on the McIDAS basic (McBASI) language, computing average wind speed and direction from the latest sounding at a station prescribed by the user. The display is implemented by a single command line on the Meteorological Information Data Display System (MIDDS), overlaying an anvil threat corridor on a satellite image.

The tool has three optional modes of execution, plotting a threat corridor for the following kinds of locations:

- KSC/CCAFS area locations such as the Shuttle Landing Facility (SLF) and various launch pads using the XMR (CCAFS 3-letter identifier) sounding,
- Standard worldwide radiosonde stations, and
- User prescribed latitude/longitude coordinates, wind speed/direction.

The display includes a text line giving the date/time of the sounding data, the computed wind speed and direction, and the station identifier.

Upper Troposphere and Tropopause Statistics

Empirical evidence presented in earlier documentation of this task (e.g. Lambert 2000; Short et al. 2002) has shown that the propagation characteristics of anvil clouds are highly correlated with the wind speed and wind direction in the layer between 300 and 150 mb. However, the majority of cases studied thus far have been from the warm season (May, June, July, August, and September). Dr. Short examined climatological statistics of the heights and thicknesses associated with that layer to determine their seasonal variability.

The data were obtained from XMR soundings taken two or more times per day. A climatology of the monthly and annually averaged profiles and their variability were created by the Range Commanders' Council Meteorology Group and are available from the Edwards Air Force Base website (http://www.edwards.af.mil/weather/). Pressure and height statistics are available for each month. The period of record for the observations is January 1973 to December 1992. Figure 4 shows that the heights of the 300 mb and 150 mb surfaces are narrowly confined to layers near 31 000 ft and 46 000 ft, respectively, with an average thickness between the surfaces of 14 730 ft.

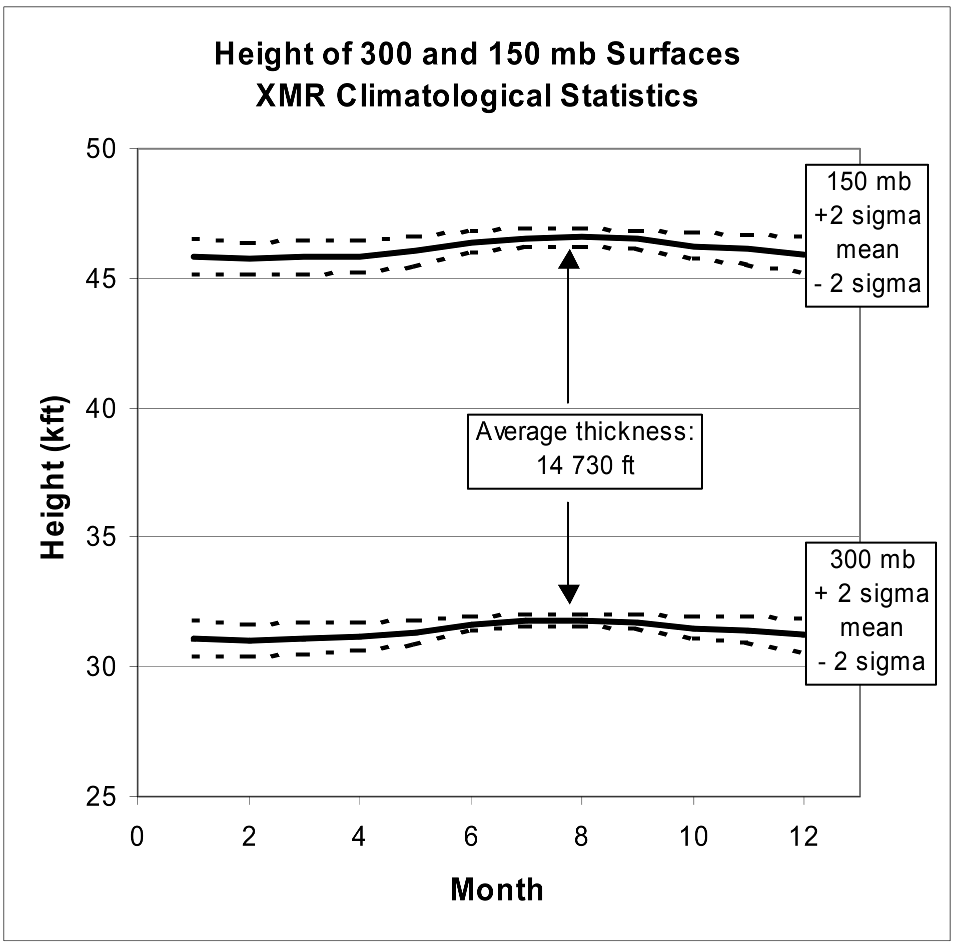

Figure 4. Annual cycle of the heights of the 300 and 150 mb surfaces. The average heights of the 300 mb and 150 mb surfaces are 31 420 ft and 46 150 ft, respectively. The solid lines are the mean values and the dashed lines above and below the means are + and – 2 σ, respectively.

Dr. Short also examined statistics of the tropopause, the stable layer marking the upper boundary of the troposphere. The top of the anvil cloud layer is almost always found at or below the tropopause. This stable region separates the troposphere from the stratosphere and is responsible for the smooth appearance of anvil clouds in satellite imagery. The tropopause statistics were also obtained from the Range Commanders' Council Meteorology Group database. Figure 5 shows monthly statistics on the pressure at the tropopause. The average pressure is 142 mb with higher variability during the cool season (November, December, January, February, March, April) associated with cold frontal activity. The analysis of tropopause heights suggests that the top of the anvil layer is more variable during the cool season than during the warm season. A future refinement of the forecast tool may include input of the tropopause height and a corresponding adjustment of the layer over which average wind speed and direction are computed.

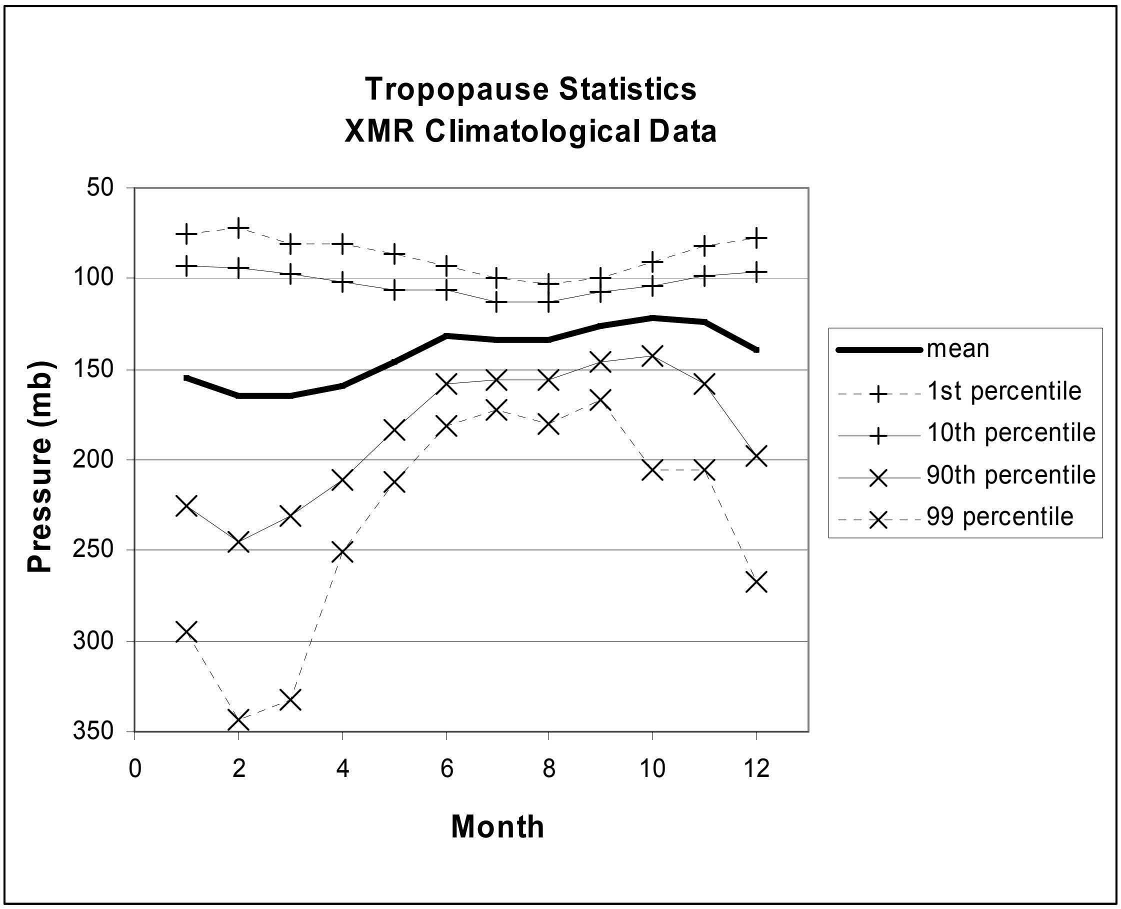

Figure 5. Annual cycle of the pressure at the tropopause. The dashed lines at the top and bottom depict the 1st and 99th percentiles, the thin solid lines show the 10th and 90th percentiles, and the solid line depicts the mean pressure.

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.

Land Breeze Forecasting (Mr. Case)

The onset of a nocturnal land breeze at KSC, CCAFS, and Patrick Air Force Base is operationally significant, yet challenging to forecast. The occurrence and timing of the land breeze at night affects low-temperature and fog forecasts, and is especially critical for toxic material dispersion forecasts during hazardous operations. With current tools, 45 WS forecasters are able to predict the occurrence of a land breeze for a particular evening reasonably well, but find it challenging to forecast the timing. As a result, the 45 WS has tasked the AMU to develop rules of thumb that will improve the reliability of the occurrence forecasts, and help determine the timing of land-breeze occurrences. These rules of thumb will include guidance on the duration, speed, and approximate direction of the winds associated with the land breeze.

Land Breeze Climatology Development Effort

To determine the typical behavior of the land breeze at KSC/CCAFS, Mr. Case will develop a climatology of the land-breeze occurrence, timing, and movement within the wind-tower network. To understand the characteristics of land breezes for constructing this climatology, he first identified all land breeze events during the 1999 – 2000 dry season (October to April). He searched for land-breeze occurrences on nights when the mean wind speed was less than 5 m s^{-1}, skies were mostly clear, and no frontal passages were observed. Mr. Case identified 43 events based on plots and time-series data of 5-minute KSC/CCAFS tower winds, temperatures, and dew point temperatures each night between 0000 and 1200 UTC. Nearly half of these events (21) occurred during March and April when the diurnal range between high and low temperatures was typically largest. He recorded various characteristics of each land breeze event such as the prevailing synoptic flow, the direction from which the land breeze originated, the onset time, and the length of time the land breeze was located within the KSC/CCAFS wind-tower network.

The characteristics of land breezes during the 1999 – 2000 dry season varied significantly between events. The mean and median onset times were 0437 and 0430 UTC, respectively, with a standard deviation of 2.6 hours. The length of time spent within the wind-tower network also exhibited a large amount of variability, having a mean, median, and standard deviation of 3.2, 2.5, and 2.2 hours, respectively. Fourteen of the 43 events occurred only across a portion of the wind-tower network. These partial land-breeze events can be grouped into three categories:

- Land breezes that reached only the westernmost wind towers due to relatively strong synoptic easterly flow or weak land breezes,
- Land-breeze passages the occurred only at coastal locations under prevailing northwesterly flow, and
- Land breezes that remained quasi-stationary, offset by the strength of synoptic easterly flow.

6 March 2000 Case Study

A few land breezes were quite dramatic, consisting of sharp wind-shift lines that propagated west-to-east across the tower network in two hours or less. Such a sharp land breeze occurred on 6 March 2000, as illustrated in Figures 6 and 7. The prevailing surface wind flow was light northeasterly with mostly clear skies and only patchy high clouds. The land breeze reached the westernmost KSC/CCAFS towers just before 0500 UTC and moved east of the wind towers by 0515 UTC (Figure 6a). The land-breeze front quickly progressed eastward during the next 45 minutes, reaching western Merritt Island by 0530 UTC (Figure 6b), eastern Merritt Island by 0545 UTC (Figure 6c), and the tip of Cape Canaveral by 0600 UTC (Figure 6d). In this case, the land breeze moved across the entire KSC/CCAFS tower network in 1.4 hours. The time series plots of wind direction at Towers 1, 3, 506, and 1204 all exhibit a distinct wind shift from onshore to offshore between 0500 and 0600 UTC (Figure 7a). The post land-breeze wind direction was initially from the west (~270 deg), but gradually veered to northwesterly during the remainder of the night.

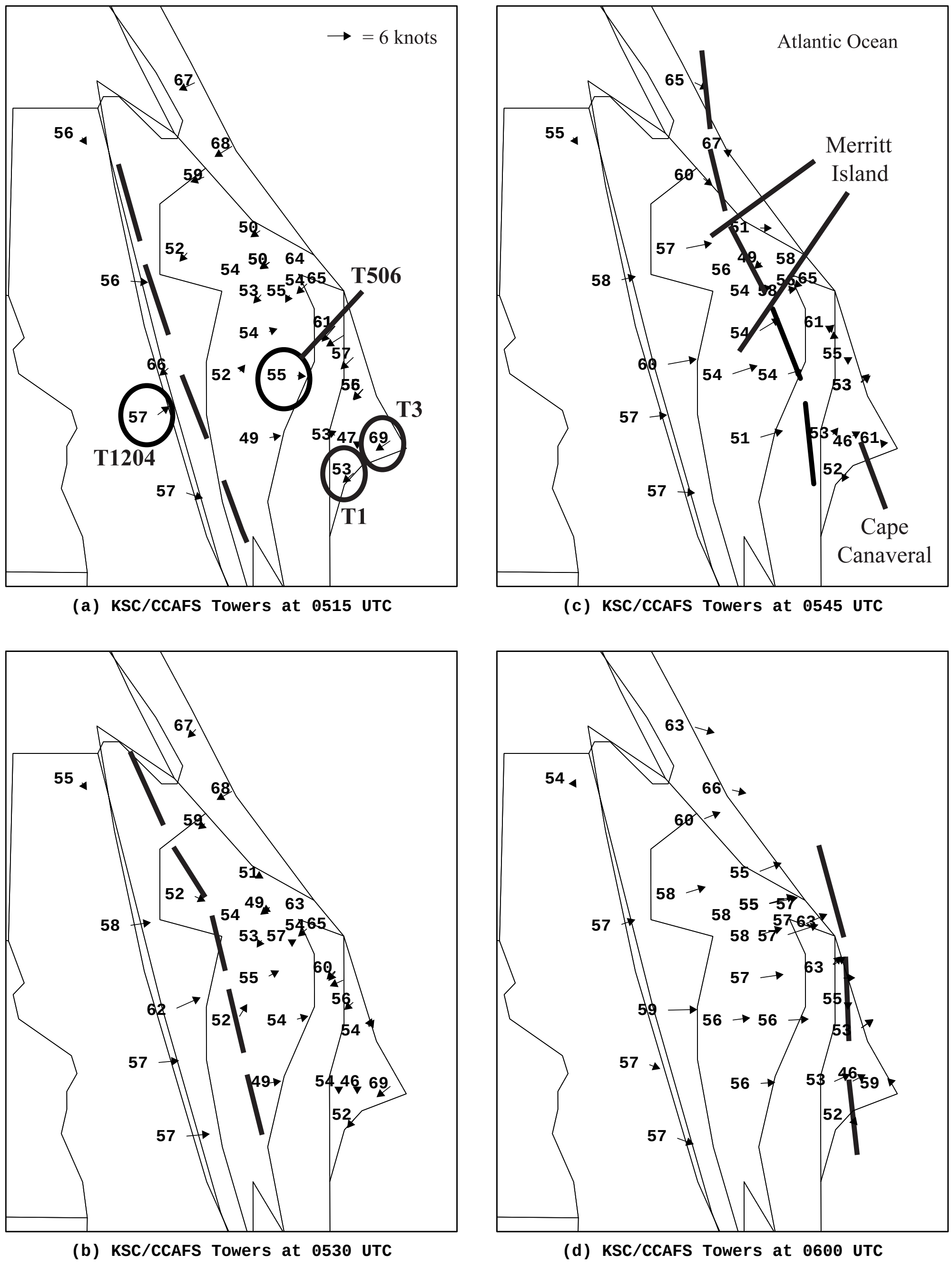

Figure 6. KSC/CCAFS tower observations of winds and 6-ft temperatures for 6 March 2000, valid at (a) 0515 UTC, (b) 0530 UTC, (c) 0545 UTC, and (d) 0600 UTC. The winds are given by arrows, with the tail centered on each station [speed scale provided in panel (a)], and 6-ft temperatures are plotted to the left of the wind arrow. The locations of wind Towers 1, 3, 506, and 1204 for Figure 7 are circled in (a) and major geographical features are given in (c). Thick dashed lines denote the location of the land-breeze front.

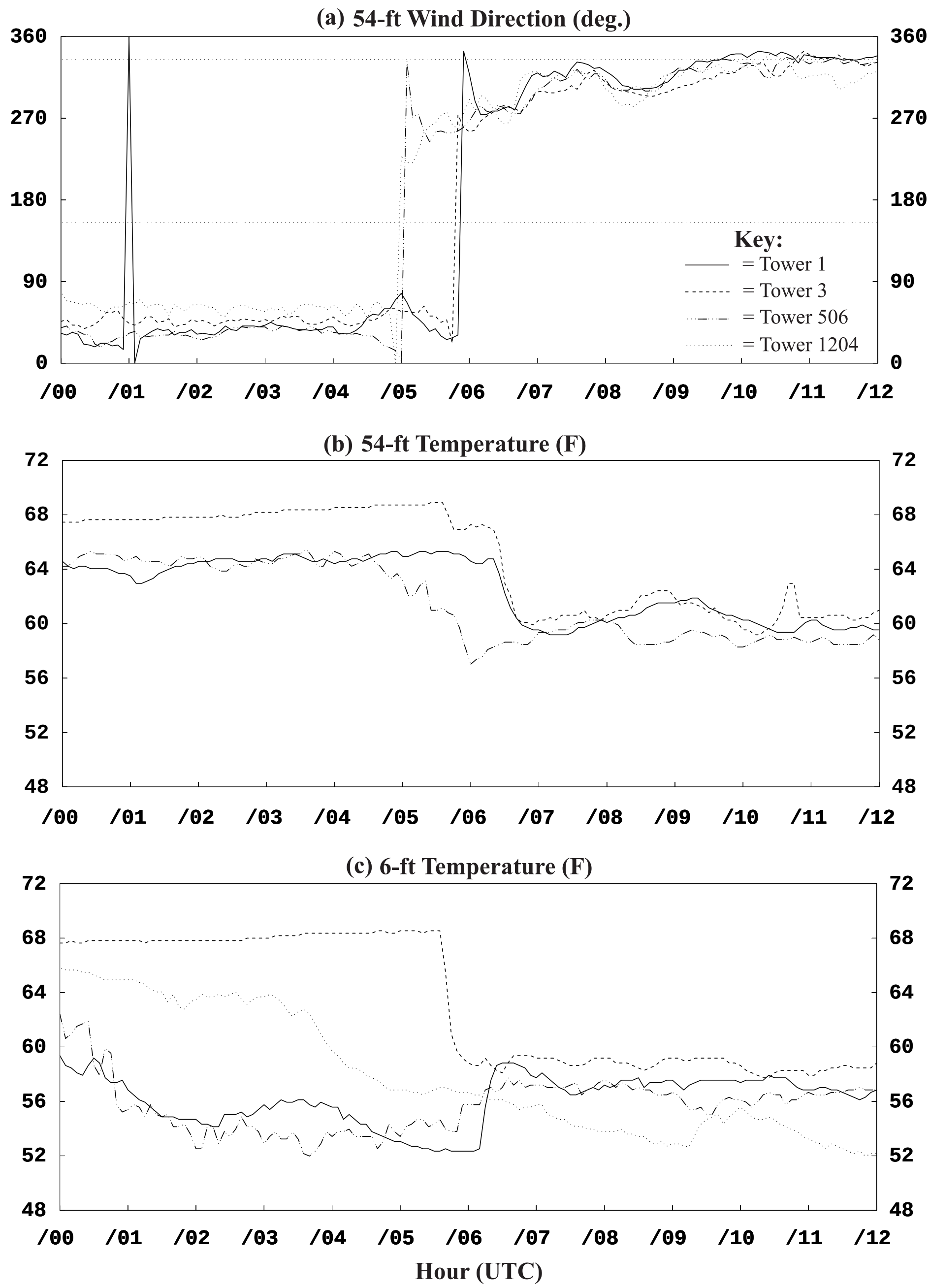

Figure 7. Time series plots for KSC/CCAFS wind Towers 1, 3, 506, and 1204 (key provided in panel (a), tower locations shown in Figure 6a), from 0000–1200 UTC 6 March 2000. Variables plotted are (a) 54-ft wind direction, (b) 54-ft temperature, and (c) 6-ft temperature. Note that 54-ft temperatures are not available for wind Tower 1204. The horizontal dotted lines in panel (a) differentiate between onshore and offshore wind direction.

Similar to the sea breeze, the land-breeze circulation is driven by the temperature (density) contrast between the ocean and the land. The cooler, denser air over the land advances seaward, as a result of the land-breeze circulation. Lagging the wind shift by up to one hour, all three time series indicate a decrease in 54-ft temperatures associated with the land-breeze passage (Figure 7b). However, the 6-ft temperature changes are not as straightforward. In fact, many of the 6-ft temperatures over Merritt Island increased by several degrees following the passage of the land breeze, especially by 0600 UTC (see Figure 6). In addition, the time series plots in Figure 7c show 6-ft temperature increases at Towers 1 and 506 at about 0600 UTC.

It is interesting to note that although Towers 1 and 3 are very close to each other, they exhibited completely different 6-ft temperature changes following the passage of the land breeze. The light northeasterly wind flow maintained warm temperatures along the immediate coast at Tower 3 prior to the land breeze. Once the land-breeze front passed Tower 3, the 6-ft temperature dropped rapidly by about 10°F in 15 minutes. Conversely at Tower 1, there is enough land upstream under light northeast flow to allow for strong radiational cooling and the development of a temperature inversion prior to the land breeze. This resulted in a temperature increase once the stronger winds of the land breeze eroded the shallow temperature inversion. The complexity of the wind and temperature distributions over KSC/CCAFS clearly illustrates the need to develop a climatology and forecasting rules of thumb to better predict the onset and movement of the nocturnal land breeze.

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

INSTRUMENTATION AND MEASUREMENT

I&M and RSA Support (Dr. Manobianco and Mr. Wheeler)

Dr. Manobianco and Mr. Wheeler attended a meeting with representatives from NASA KSC, 45 WS, 45th Logistics Group (45 LG), USAF Space Command, and Lockheed Martin to discuss further modifications and issues with the proposed RSA AMU hardware configuration and connectivity.

Table 2. AMU hours used in support of the I&M and RSA task in the fourth quarter of FY 2001 and total hours since July 1996.

Quarterly Task Support (hours)	***Total Task Support (hours)***
8	328.0

MESOSCALE MODELING

LOCAL DATA INTEGRATION SYSTEM PHASE IV (MR. CASE)

The Local Data Integration System (LDIS) task emerged out of the need to simplify short-term weather forecasting in support of launch, landing, and ground operations. The complexity of creating short-term forecasts has increased due to the variety and disparate characteristics of available weather observations. Therefore, the goal of the LDIS task is to generate high-resolution weather analysis products that may enhance the operational forecasters' understanding of the current state of the atmosphere, resulting in improved short-term forecasts.

Three phases of this task have been completed by the AMU. In Phase I, the AMU configured a prototype LDIS using the Advanced Regional Prediction System (ARPS) Data Analysis System (ADAS). In Phase II, the AMU simulated a real-time LDIS configuration using two weeks of archived data. In Phase III, the AMU provided assistance to SMG and NWS MLB to install a working real-time LDIS that routinely generates high-resolution products for operational guidance. Based on the examination of real-time analysis output, both SMG and the NWS MLB forecasters have identified several issues that limit the utility of the analyses for evaluating Space Shuttle FR and forecasting problems of east-central Florida. As a result, the LDIS Phase IV task involves modifying the ADAS ingest to include additional real-time observational data sets, fine-tuning the analysis configuration to improve continuity and the blending of observations, and improving real-time graphics capabilities. Mr. Case completed the data ingest modifications for NWS MLB and SMG and distributed a memorandum that summarizes the LDIS Phase IV task efforts.

AMU CHIEF'S TECHNICAL ACTIVITIES (DR. MERCERET)

Dr. Merceret continued developing software to analyze boundary-layer wind change characteristics measured by the 915-MHz profiler network.

AMU OPERATIONS

Mr. Wheeler worked with the NASA procurement office on the order of 5 new AMU PCs. There were several problems in receiving these PCs that were initially ordered in March 2001, but they were finally delivered and configured. He also developed the AMU Information Technology (IT) 2002 Purchase Plan that identifies the planned IT procurements for the current fiscal year. He developed the equipment and software requirements, researched possible solutions to those requirements, and received quotes on several of the proposed hardware purchases. Mr. Wheeler helped change the AMU's single dial-out Internet connection to a 6-modem router that allows for a faster transfer of data and more timely e-mail.

All members of the AMU attended the 6th Annual Local Weather Technical Interchange Meeting at the Florida Institute of Technology in Melbourne, FL in November, and three members gave presentations. Dr. Short gave a presentation on the current status of the Anvil Forecasting task. Mr. Case gave two presentations: one described the real-time ADAS as run at SMG and NWS MLB and the other discussed characteristics of the ARPS numerical weather prediction model and provided information on the upcoming AMU ARPS modeling task. Dr. Manobianco presented an overview and status of the Weather Research and Forecasting System that will eventually replace current generation operational and research mesoscale modeling systems.

AMU members attended other conferences as well. Mr. Case attended the National Weather Association Annual Meeting in Spokane, WA, where he presented the configuration of the ADAS as run at SMG and NWS MLB. Dr. Short attended the AMS 4th Conference on Coastal Atmospheric and Oceanic Prediction and Processes in St. Petersburg, FL, where he presented results of the Regional Atmospheric Modeling System (RAMS) sea-breeze verification study conducted by Mr. Case. Mr. Wheeler attended the 11th Conference on Satellite Meteorology and Oceanography and the McIDAS Users' Group Meeting in Madison, WI.

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Short, D. A., J. E. Sardonia, W. C. Lambert, and Mark M. Wheeler, 2002: Propagation and lifetime characteristics of thunderstorm anvil clouds over Florida. To appear as paper 2.8 in the proceedings of the *18th International Conference on Interactive Information and Processing Systems (IIPS) for Meteorology, Oceanography and Hydrology*, 13-18 January 2002, Orlando, FL, Amer. Meteor. Soc.

NOTICE

List of Acronyms

30 SW	30th Space Wing
30 WS	30th Weather Squadron
45 LG	45th Logistics Group
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
AMS	American Meteorological Society
AMU	Applied Meteorology Unit
ARPS	Advanced Regional Prediction System
CCAFS	Cape Canaveral Air Force Station
CSR	Computer Sciences Raytheon
ELV	Expendable Launch Vehicle
FR	Flight Rules
FSL	Forecast Systems Laboratory
FSU	Florida State University
FY	Fiscal Year
JSC	Johnson Space Center
KSC	Kennedy Space Center
LCC	Launch Commit Criteria
LDIS	Local Data Integration System
LWO	Launch Weather Officer
McBASI	McIDAS Basic Language
McIDAS	Man-Computer Interactive Data Analysis System
MIDDS	Meteorological Interactive Data Display System
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NOAA	National Oceanic and Atmospheric Administration
NSSL	National Severe Storms Laboratory
NWS MLB	National Weather Service in Melbourne, FL
QC	Quality Control
RAMS	Regional Atmospheric Modeling System
RSA	Range Standardization and Automation
SLF	Shuttle Landing Facility
SMC	Space and Missile Center
SMG	Spaceflight Meteorology Group
SRH	NWS Southern Region Headquarters
USAF	United States Air Force
UTC	Universal Coordinated Time
WWW	World Wide Web
XMR	CCAFS 3-letter identifier

Appendix A

AMU Project Schedule 31 January 2002				
AMU Projects	Milestones	Scheduled Begin Date	Scheduled End Date	Notes/Status
Statistical Forecast Guidance (Peak Winds)	Determine predictand(s)	Aug 01	Aug 01	Completed
	Data reduction, formulation and method selection	Sep 01	Dec 01	Delay 1 Month due to Customer Request for Further Analysis
	Equation development, tests with independent data and individual cases	Dec 01	Mar 02	On Schedule
	Prepare products, final report for distribution	Apr 02	Jun 02	On Schedule
Improved Anvil Forecasting Phase II	Collection and processing of data	May 01	Aug 02	On Schedule
	Algorithm formulation and testing	Aug 01	May 02	On Schedule
	Final report	May 02	Aug 02	On Schedule
Land Breeze Forecasting	Data collection, data reduction, and QC	Aug 01	Nov 01	Completed
	Identification and analysis of case studies	Sep 01	Nov 01	Completed
	Development of land-breeze climatology	Dec 01	Apr 02	On Schedule
	Development of forecast rules of thumb / automated tool	Apr 02	Jul 02	On Schedule
	Final report with forecasting rules of thumb	Jul 02	Sep 02	On Schedule
LDIS Extension: Phase IV	Modify ADAS ingest to include additional data sets	May 01	Oct 01	Completed
	Fine-tune ADAS configuration	May 01	Oct 01	Completed
	Improve visualization tools	May 01	Oct 01	Completed
	Memorandum summarizing modified ADAS configuration and task issues	Nov 01	Nov 01	Completed