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Applied Meteorology Unit (AMU)

Quarterly Report

Third Quarter FY-03

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NOAA/OAR/SSMC-I/J. Golden
NOAA/NWS/OST12/SSMC2/J. McQueen
NOAA Office of Military Affairs/M. Weadon
NWS Melbourne/B. Hagemeyer
NWS Southern Region HQ/"W/SRH"/X. W. Proenza
NWS Southern Region HQ/"W/SR3"/D. Smith
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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ENSCO, Inc./E. Lambert

EXECUTIVE SUMMARY

This report summarizes the Applied Meteorology Unit (AMU) activities for the Third Quarter of Fiscal Year 2003 (April – June 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 (FR) and determining the probability of launch commit criteria (LCC) violations, as well as preparing forecasts for ground operations.

Milestones The relevant literature and needed rawinsonde and lightning observations were collected.

Discussion This forecast tool will be based of the results of recent studies of lightning occurrence in the Cape Canaveral area. Synoptic-scale flow regimes and stability parameters gleaned from local observations will be combined in a system of statistical relationships to provide forecasters with an objective probability of lightning occurrence for the day.

Task Severe Weather Forecast Decision Aid

Goal Create 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.

Milestones A search is underway to collect literature and gather information from National Weather Service (NWS) offices pertaining to severe weather forecasting procedures in the southeast United States (U.S.).

Discussion Recent literature describing advances in severe weather forecasting and information gleaned from discussions with operational forecasters in the southeast U.S. will likely lead to an improved severe weather forecasting aid for the personnel producing severe weather forecasts for the Cape Canaveral Air Force Station/Kennedy Space Center area.

Task Doppler miniSODAR™ System (DmSS) Evaluation

Goal Compare data from the DmSS near SLC-37 to data from nearby towers to determine the quality of the DmSS data. Boeing is evaluating these data for their utility in analyzing and forecasting winds for the new Evolved Expendable Launch Vehicle during ground and launch operations.

Milestones Continued acquisition and analysis of data from the DmSS and Towers 0006 and 0108.

Discussion DmSS performance during the May 24-hour diurnal cycle confirms discrepancies seen in earlier comparisons between the sodar and nearby wind towers. During the nighttime hours the DmSS average wind speed was lower than observed on the towers, but the two values were consistent during daylight hours. DmSS peak winds were higher than tower peak winds by 10-30% during all hours.

Task Advanced Regional Prediction System (ARPS) Phase I: Configuration of Prototype

Goal Implement a high-resolution operational configuration of the ARPS Numerical Weather Prediction (NWP) model at the Spaceflight Meteorology Group (SMG) and NWS office at Melbourne, FL (MLB).

Milestones Configured and implemented an operational version of ARPS at NWS MLB.

Discussion The AMU configured the ARPS to run operationally with 4-km horizontal grid spacing over the entire Florida peninsula and adjacent coastal waters. SMG plans to implement a similar configuration of the ARPS in the near future.

Table of Contents

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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 and possibly improve the daily thunderstorm probability forecast. The AMU will develop statistical lightning forecast equations that will provide a lightning occurrence probability for the day by 1100 UTC (0700L) during the months May – September. 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.

Mr. Wheeler collected Cloud to Ground Lightning Surveillance System (CGLSS) data for the period 1986 – 2001 and the sounding data from CCAFS (XMR) for the period 1989 – 2002. Ms. Lambert began work to import the two data types into the S-PLUS® software package for analysis (Insightful Corporation 2000). The period of record, all data types, and procedures needed to develop an objective lightning probability-forecasting tool will all be determined next quarter in meetings with operational personnel.

For more information on this work, contact Ms. Lambert at 321-853-8130 or lambert.winifred@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 45 Space Wing, CCAFS, and KSC. The severe weather elements produced by thunderstorms are tornadoes, wind gusts ≥ 50 kts, and/or hail that is ≥ ¾" in diameter. Forecasting the occurrence and timing of these phenomena is a challenging task 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).

Mr. Wheeler initiated a search to collect journal articles, research papers and operational worksheets that address severe thunderstorm and severe weather forecasting. An emphasis was placed on studies pertaining to the southeast United States and/or Florida that discussed rules of thumb or thresholds in RAOB stability parameters. These articles are being reviewed and applicable portions will be extracted for use in tool development. Mr. Wheeler started a worksheet that will identify potential severe weather environmental conditions along with their thresholds. He also held discussions with several 45 WS forecasters to understand the procedures each individual uses to determine the severe weather potential, and found that they each utilize a severe weather worksheet to assess atmospheric stability and other environmental conditions. Mr. Wheeler noted that this worksheet was developed over many years with no verification and no recent updates. In order to find out what other groups are doing, Mr. Wheeler requested a meeting with the forecasters at the National Weather Service in Melbourne, FL (NWS MLB) and plans to meet with the forecasters at the NWS offices in Tampa and Jacksonville, FL.

For more information on this work, 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. MANOBIANCO AND MR. WHEELER)

The AMU weather display equipment console was removed and replaced by a new RSA 3-bay console. All government equipment along with the new AWIPS hardware was installed into the new console. Lockheed Martin personnel performed the installation of the AWIPS hardware and software. The equipment should be signed over to the AMU by the end of July. Familiarization training continued through the period.

Table 1. AMU hours used in support of the I&M and RSA task in the Third Quarter of FY 2003 and total hours since July 1996.

Quarterly Task Support (hours)	*Total Task Support (hours)*
86.5	513

MINISODAR EVALUATION (DR. SHORT AND MR. WHEELER)

The Doppler miniSODAR™ System (DmSS) is an acoustic wind profiler from AeroVironment, Inc., that provides vertical profiles of wind speed and direction with high temporal and spatial resolution. The DmSS in this evaluation is a model 4000 system configured to provide 30-second wind estimates at 23 vertical levels from 49.2 to 410.1 ft (15 to 125 m) every 16.4 ft (5 m). It is a phased array system with 32 speakers that are used to form 3 beams for measuring orthogonal components of the wind field, 2 horizontal and 1 vertical. The Boeing Company installed a DmSS near Space Launch Complex 37 (SLC-37) as a substitute for a tall wind tower. It will be used to evaluate the launch pad winds for the new Evolved Expendable Launch Vehicle during ground operations and to evaluate launch commit criteria (LCC) during launch operations. In order to make critical Go/No Go launch decisions the 45 WS Launch Weather Officers (LWOs) and forecasters need to know the quality and reliability of DmSS data.

The AMU was tasked to perform an objective comparison between the DmSS wind observations near SLC-37 and those from the nearest tall (≥ 204 ft) wind tower. The tall wind tower nearest to SLC-37 is Tower 0006, at a distance of 0.95 n mi to the south-southeast. Tower 0006 has wind speed and direction instruments at 4 levels: 12, 54, 162, and 204 ft. Tower 0108 is closer, a distance of 0.6 n mi to the NW, but its wind sensors are only at 12 and 54 ft, the latter being close to the lowest level from the DmSS at 49.2 ft. In addition to these nearby wind towers there is a sonic anemometer at the DmSS site mounted on a 33 ft (10 m) pole, about 100 ft SW of the DmSS. Wind data from the sonic anemometer is integrated into the DmSS data stream and reported at the 33-ft level.

Diurnal Cycle of Average and Peak Wind Speeds

The DmSS uses the principal of acoustic backscattering, with a small fraction of the transmitted acoustic energy scattered back to the receiver by small-scale atmospheric temperature inhomogeneities (Crescenti 1998). Because one important source of these temperature inhomogeneities is thermal plumes which are produced by surface heating, characteristics of DmSS performance throughout the diurnal cycle are of interest.

In May 2003, 24 complete days of DmSS data were available for comparison with wind tower data. Dr. Short developed software to compute 5-minute block-average DmSS wind data in order to allow direct comparisons with the wind tower data. For each 5-minute interval, the DmSS supplies 5 values of 1-minute average wind speed/direction and peak wind speed/direction. Vector averaging was applied to calculate the average wind speed and direction data, and the maximum peak speed of the 5 values and its associated direction was used for each 5-minute interval.

A joint analysis of the DmSS and wind tower data was performed in which temporally-matched pairs of valid 5-minute wind data from the DmSS and Tower 0006 were averaged separately for each hour of the diurnal cycle. The DmSS data were considered valid only if the standard deviation of both the u- and v-components were less than 2 kts. This threshold was recommended by the vendor for screening out high-speed outliers from the DmSS data.

Figure 1a shows the diurnal cycles of average and peak wind speeds for the month of May 2003 from the 54 ft level on Tower 0006 and the 49 ft level of the DmSS, the level closest level to 54 ft. The Tower 0006 highest average wind speed of 13 kts was observed at 2100 UTC (1700 EDT). The average DmSS wind speeds were lower than the tower wind speeds during the entire day. This low bias is consistent with the effects of contamination by a stationary target near the DmSS as it is within less than 50 ft of a building. In addition, DmSS performance may have been affected by the failure of isolated speaker/receiver components that were replaced in mid-June. The peak DmSS wind speed exceeds the peak tower speed for several hours in the mid-afternoon (1400-1900 UTC) but is otherwise lower. The diurnal cycle of average and peak wind speeds from Tower 108 (not shown) are very close to those seen from Tower 0006, suggesting that the discrepancies between the DmSS and Tower 0006 are attributable to deficiencies in DmSS performance at its lowest gate.

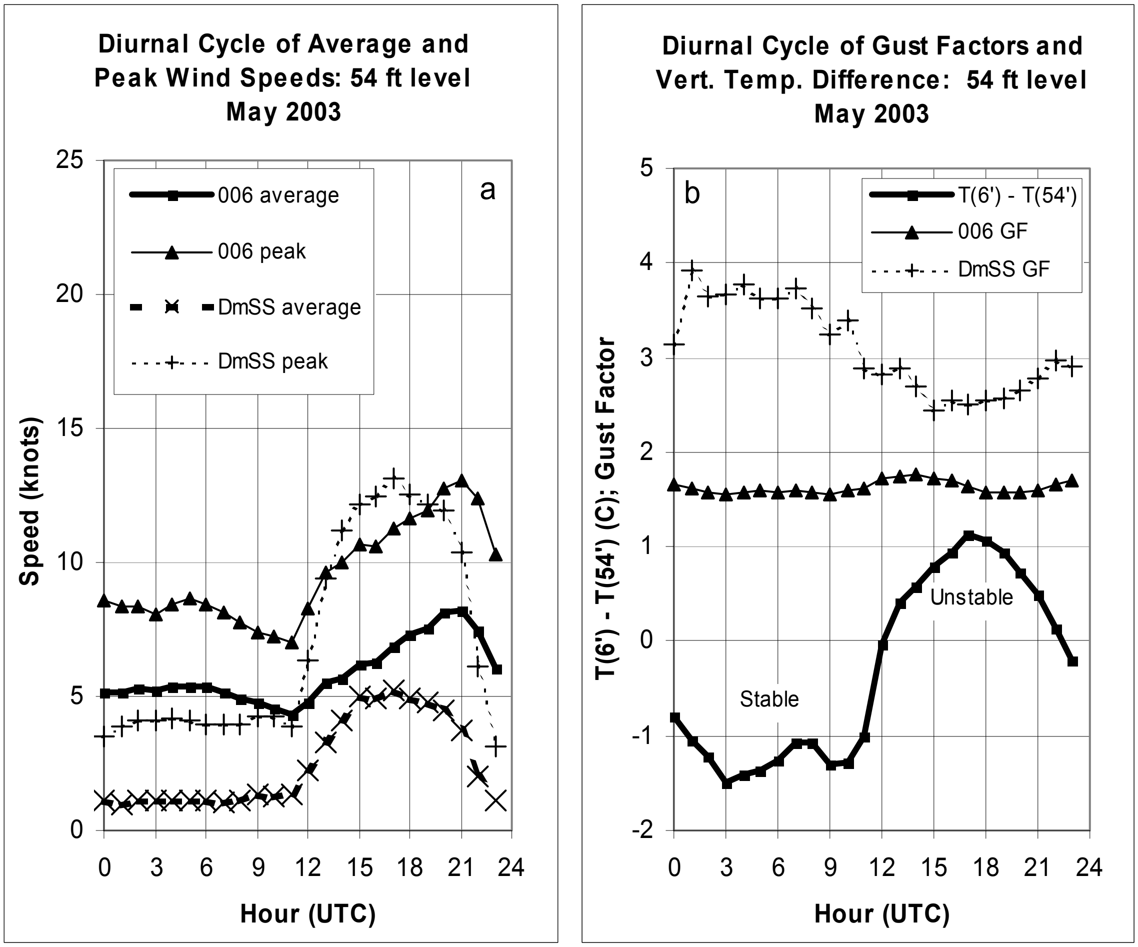

Figure 1. a) Diurnal cycle of average and peak wind speed from Tower 0006 at the 54 ft level and from the DmSS at the closest corresponding level, 49 ft. b) Diurnal cycle of gust factors from 1a and the vertical temperature difference between the 6 ft and 54 ft on Tower 0006.

Figure 1b shows the diurnal cycles of gust factors from Figure 1a, gust factor being the ratio of the peak speed to the average speed, and the vertical temperature difference between the 6 ft and 54 ft levels on Tower 0006. DmSS gust factors are systematically higher than those from Tower 0006. A gust factor of about 1.4 is consistent with previous studies (Lambert 2002). The diurnal cycle in temperature differences indicates atmospheric stability and the presence of a temperature inversion during the nighttime hours (2300-1100 UTC or 1900-0700 EDT). A temperature inversion can cause contamination in the DmSS signal as the transmitted acoustic signal can be refracted downward toward stationary ground targets. The zero-Doppler shift from stationary targets produces a negative bias in wind speed. The transition from stable to unstable conditions at 1100 UTC is marked by a more rapid increase of the DmSS wind speeds than what is observed in the Tower wind speeds (see Fig. 1a).

Figure 2a shows the diurnal cycles of average and peak wind speeds for May 2003 from the 162 ft level on Tower 0006 and the 164 ft level of the DmSS, the level closest level to 162 ft. The Tower 0006 highest average wind speed of 14.3 kts was observed during 2100 UTC, as in Figure 1a. The average DmSS wind speeds during the nighttime hours were about 10% lower than the tower wind speeds, but they agreed well during the daytime hours. The nighttime low bias may have been due to contamination by stationary ground targets, however a more complete study of the DmSS data would be required to account for this difference. The peak DmSS wind speed exceeded the peak tower speed throughout the entire diurnal cycle. Figure 2a also shows a rapid rise in DmSS peak wind speeds, similar to that seen in Figure 1a.

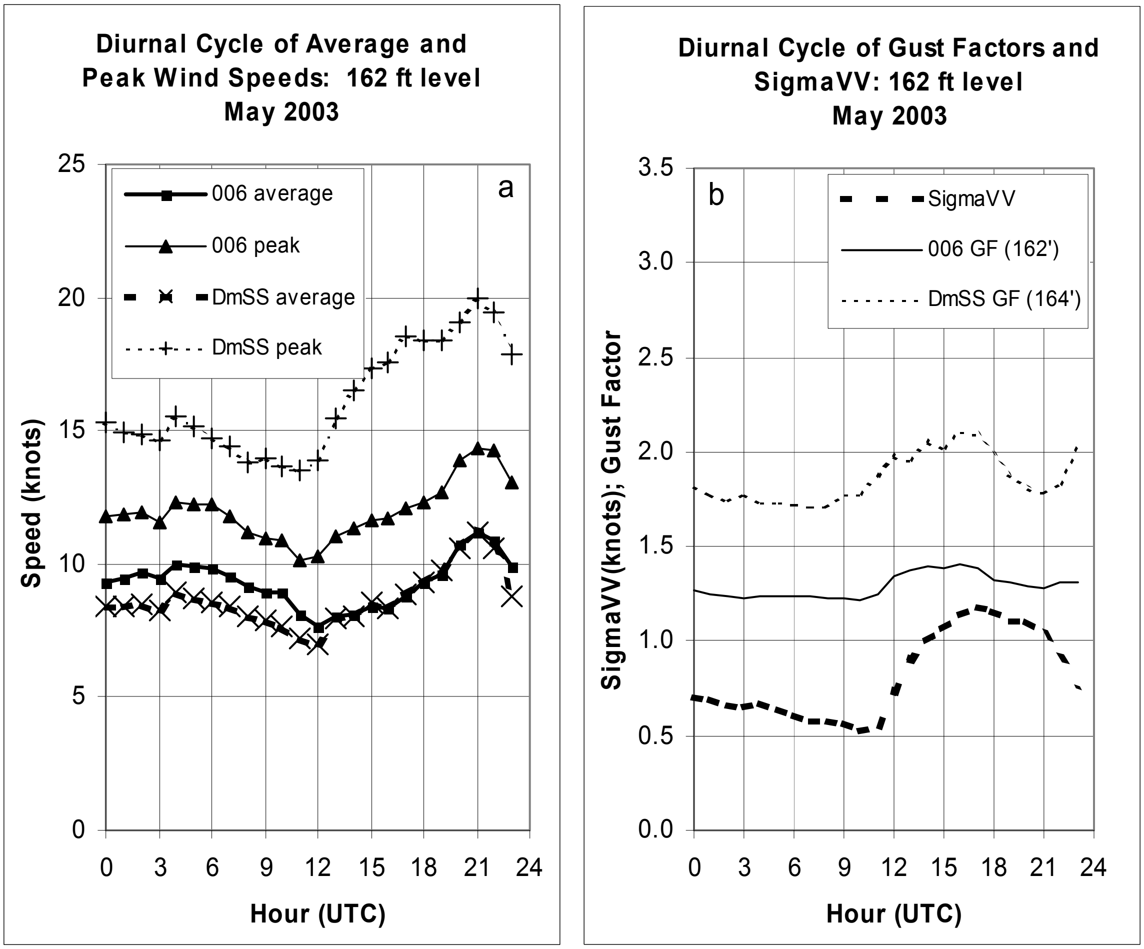

Figure 2. a) Diurnal cycle of average and peak wind speed from Tower 0006 at the 162 ft level and from the DmSS at the closest corresponding level, 164 ft. b) Diurnal cycle of gust factors from Fig 2a and the standard deviation of vertical velocity from the DmSS at the 164 ft level.

Figure 2b shows the diurnal cycles of gust factors from Figure 2a and the standard deviation of vertical velocities (σ_w) from the DmSS at the 164 ft level. DmSS gust factors were systematically higher than those observed at Tower 0006, as in Figure 1b. The diurnal cycle in vertical velocity characteristics was consistent with a more turbulent atmosphere during the daytime hours due to effects of surface heating. The rapid rise of σ_w after 1100 UTC and its shape were similar to peak wind characteristics from the DmSS suggesting a linkage between the two.

Dr. Short developed a mathematical Doppler profiler model that presents plausible physical and statistical arguments for explaining why the average wind speed from the profiler would be unbiased, but the peak wind speed would have a positive bias whose magnitude is linked to σ_w. The model results suggest that rapid spatial and temporal variations in vertical velocity can cause the instantaneous retrieved wind speeds to be more variable than the true wind speeds, resulting in retrieved peak winds speeds that are higher than the true peak wind speeds. Details of the model and model results will be presented in the final report.

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 Phase I: Configuration of Prototype (Mr. Case)

The Spaceflight Meteorology Group (SMG) and NWS MLB are currently running a local configuration of the Advanced Regional Prediction System (ARPS) Data Analysis System (ADAS) to integrate a wide variety of national and local-scale observational data. Both SMG and NWS MLB also plan to run the ARPS numerical weather prediction (NWP) model in real time on PC / Linux clusters, which have been procured by each forecast office. Under this task, the AMU is providing support to configure, install, and test the ARPS NWP model at SMG and NWS MLB. This support includes configuring files, running test simulations over east-central Florida, and assisting SMG and NWS MLB with the installation of a real-time, operational ARPS.

Mr. Case and NWS MLB personnel configured and implemented an operational version of the ARPS NWP model. The NWS MLB procured a 10-node / 20-processor PC-Linux cluster with 2.2-GHz and 2.4GHz Xeon chips for their forecast office. Similarly, SMG has acquired a 17-node / 34-processor PC-Linux cluster with 1.26-GHz Pentium-III chips for running the ARPS model in real time. For the NWS MLB, the AMU configured ARPS to run on a single grid with 4-km horizontal grid spacing, 400-m average vertical grid spacing, and 177 x 177 x 45 points in the west-east, north-south, and vertical dimensions, respectively. The resulting grid domain covers all of the Florida peninsula and adjacent coastal waters (Fig. 3).

The ARPS is currently initialized four times daily at 0200 UTC, 0800 UTC, 1400 UTC, and 2000 UTC using first-guess fields from the Rapid Update Cycle (RUC) 2-hour forecasts of winds, temperature, moisture, soil temperature, soil moisture, and sea-surface temperature. An intermittent data assimilation cycle was developed to analyze operationally available observational data onto the forecast grid. This intermittent data assimilation cycle involves running ADAS every 15 minutes for one hour to incorporate observations onto the grid, and running the ARPS NWP model in between the ADAS analyses in order to preserve mesoscale structure and detail. Surface and buoy observations, KSC/CCAFS towers and profilers, satellite infrared and visible brightness temperatures, and Weather Surveillance Radar-1988 Doppler data are analyzed onto the model grid using ADAS. At each interval, the 15-minute ARPS forecast is used as the first-guess field for the subsequent ADAS analysis, which incorporates additional real-time data. After one hour of intermittent data assimilation, the ARPS is run for nine hours, with model output available to forecasters at half-hour intervals. The entire 10-hour data assimilation and forecast cycle takes less than four hours to complete on the NWS MLB cluster.

The ARPS provides NWS MLB meteorologists with high-resolution forecast products not currently available from national-scale operational NWP models. These high-resolution forecasts can resolve meso- and convective-scale phenomena such as sea breezes, thunderstorms, and outflow boundaries. Improvements and enhancements to the real-time ARPS, as well as forecaster training will occur under the current ARPS Optimization and Training task.

Figure 3. The NWS MLB 4-km ADAS domain with each grid point denoted by a small dot.

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

UPDATING ARPS/ADAS SOFTWARE (MR. CASE)

SMG and NWS MLB are currently running a local configuration of the ADAS to integrate a wide variety of national and local-scale observational data. SMG will also run the ARPS NWP model in real time in the near future, and the NWS MLB is currently running an operational configuration ARPS (version 4.5.2). The latest release of ARPS (version 5.0) has a new source-code structure that makes it easier to maintain than previous versions, and contains many corrections and enhancements to the model and system. The upgrade of the ARPS/ADAS software to version 5.0 will allow SMG to take advantage of the latest advances in ARPS/ADAS by the developers at the Center for Analysis and Prediction of Storms at the University of Oklahoma. The NWS MLB will be able to switch to version 5.0 at a later date if desired. The goal of this task is for the AMU to provide SMG with a summary of all the local modifications made to ARPS/ADAS version 4.5.2, specifically identifying code that is separate from the CAPS baseline software, as well as verbal assistance in incorporating the necessary modifications to the version 5.0 baseline software.

Mr. Case documented all source-code modifications made to the ARPS version 4.5.2 baseline software. He prepared a detailed document that was delivered to SMG to assist in their upgrade and transition to the ARPS version 5.0. Many of the modifications to the software have been made to the ADAS program in order to integrate the unique observational data sets from KSC/CCAFS (i.e. towers, profilers), as well as surface mesonet observations across Florida (e.g. the Florida Automated Weather Network and Automatic Position Reporting System observations). In addition, Mr. Case made substantial modifications to the pre- and post-processing programs used to interpolate external NWP model forecasts for first-guess fields, and developed unique graphical products for SMG and NWS MLB forecasters. SMG will incorporate these changes into the baseline version 5.0 software so that it can ingest all local KSC/CCAFS observational data and have all the capabilities of the current operational ARPS/ADAS at NWS MLB.

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 and Ms. Ward developed and tested an automated algorithm to detect cloud boundaries using airborne cloud physics data and simultaneous ground-based radar measurements. Dr. Merceret continued analysis of radar volume averaging options for the Lightning Launch Commit Criteria (LLCC) project.

Dr. Merceret wrote and tested software to perform spectral and statistical analysis on selected LLCC flight data. He and Ms. Ward then conducted and completed initial spectral and correlation analyses of the full ABFM data set. The spectral and correlation analyses have been circulated for external review. A preliminary statistical analysis was done, but the results are proving difficult to interpret. Additional work will be done to understand the results.

AMU OPERATIONS

Mr. Wheeler continued work on a 45 WS Option Hours task to analyze wind tower and other data from a severe weather event that occurred near the Shuttle Landing Facility (SLF) on 4 March 2003. His report should be completed in the next quarter. All Fiscal Year 2003 AMU equipment and software purchase request have been submitted and ordered through KSC Procurement.

Ms. Lambert attended the American Meteorological Society's 10th Conference on Mesoscale Processes in Portland OR, 23-27 June. She presented a poster titled "Using a Suite of Observational and Forecasting Tools to Study a Sea/Land Breeze Event", co-authored by Mr. Case, Ms. Lambert, Dr. Merceret, Ms. Ward, and Drs. Lane and Immer of ASRC Aerospace.

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Lambert, W. C., 2002: Statistical short-range guidance for peak wind speed forecasts on Kennedy Space Center/Cape Canaveral Air Force Station: Phase I Results. NASA Contractor Report CR-2002-211180, Kennedy Space Center, FL, 39 pp. [Available from ENSCO, Inc., 1980 N. Atlantic Ave., Suite 230, Cocoa Beach, FL, 32931.]

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
ASRC	Arctic Slope Regional Corporation
CCAFS	Cape Canaveral Air Force Station
CSR	Computer Sciences Raytheon
DmSS	Doppler miniSODAR System
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
LLCC	Lightning LCC
LWO	Launch Weather Officer
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
NWP	Numerical Weather Prediction
NWS MLB	National Weather Service in Melbourne, FL
PC	Personal Computer
RAOB	Rawinsonde Observation
RSA	Range Standardization and Automation
SLC-37	Space Launch Complex 37
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 July 2003				
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	Data Still Being Collected
	Statistical formulation and method selection	Jun 03	Jul 03	Data Still Being Collected
	Equation development, tests with verification data and other forecast methods	Jul 03	Nov 03	On Schedule
	Develop operational products	Nov 03	Jan 04	On Schedule
	Prepare products, final report for distribution	Jan 04	Mar 04	On Schedule
Extend Statistical Forecast Guidance to the SLF Towers	Create climatologies / determine theoretical distribution for 10-min peaks	Sep 02	Oct 02	Completed
	Develop PC-based tool to display climatologies and probabilities	Oct 02	Mar 03	Completed
	Prepare products, final report for distribution	Mar 03	May 03	Completed
Severe Weather Forecast Tool	Local and national NWS research, discussions with local weather offices on forecasting techniques	Apr 03	Sep 03	On Schedule
	Develop database, develop decision aid, fine tune	Oct 03	Feb 04	On Schedule
	Final report	Feb 04	Mar 04	On Schedule
MiniSODAR Evaluation	Data collection, data reduction, and QC	Aug 02	Jul 03	On Schedule
	Comparative analysis of miniSODAR and nearby wind tower observations	Sep 02	Jul 03	On Schedule
	Final Report	Jul 03	Sep 03	On Schedule
ARPS Phase I Configuration of Prototype	Configure source code and scripts to prepare for real-time installation	Jan 03	Mar 03	Completed
	Formal assistance in configuring and installing ARPS at NWS MLB	Apr 03	Jun 03	Completed

AMU Project Schedule 31 July 2003				
AMU Projects	Milestones	Scheduled Begin Date	Scheduled End Date	Notes/Status
Updating ADAS/ARPS Software	Document detailing the AMU changes made to ARPS version 4.5.2	Apr 03	Jul 03	Completed
	Remote / verbal assistance for incorporating AMU code modifications	Jun 03	Jul 03	On Schedule
	Final memorandum	Jul 03	Jul 03	On Schedule

NOTICE

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