Applied Meteorology Unit (AMU)
Quarterly Report
Third Quarter FY-96

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The AMU Home Page can also be accessed via links from the NASA KSC Home Page. The AMU link is under the KSC servers section.

If anyone on the current distribution would like to be removed and instead rely on the WWW for information regarding the AMU's progress and accomplishments, please respond to Frank Merceret (407-853-8200, francis.merceret-1@kmail.ksc.nasa.gov) or Ann Yersavich (407-853-8217, anny@fl.ensco.com).

1. BACKGROUND

The AMU has been in operation since September 1991. Brief descriptions of the current tasks are contained within Attachment 1 to this report. The progress being made in each task is discussed in Section 2.

2. AMU ACCOMPLISHMENTS DURING THE PAST QUARTER

The primary AMU point of contact is reflected on each task and/or subtask.

2.1 TASK 001 AMU OPERATIONS

During May, Ms. Yersavich performed the annual review of the AMU's hurricane preparedness plan. The plan was revised and then distributed to all AMU personnel.

HARDWARE/ SOFTWARE INSTALLATION AND MAINTENANCE (MS. YERSAVICH)

During June, the AMU received 3 Power Macintoshes to replace 3 Macintoshes which were 7 years old or greater. Prior to the installation of these Power Macintoshes, all non-commercial software and working files on the old Macintoshes were backed up. Once the back ups were complete, the new systems were installed and all previous software packages and working files were restored. Two external Apple CD-ROMs were also received and installed on existing Power Macintoshes which did not have a CD-ROM.

PROCUREMENT (MS. YERSAVICH)

In April, the AMU submitted a purchase request for a Hewlett Packard (HP) 9000 J210 workstation. The workstation is being configured with two processors, 256 MB RAM, 4 GB hard drive, CD-ROM, DAT tape drive, 20″ monitor, and Visualize-24 graphics accelerator. The workstation is being configured with dual processors and maximum RAM so it can support a variety of AMU initiatives and yet save cost and laboratory space (i.e., one workstation instead of two or three workstations). This workstation will be used to run the Advanced Meteorological Interactive Data Display System (MIDDS) (the Eastern and Western Range MIDDS upgrade) and two WSR-88D data processing and visualization systems - the WSR-88D Algorithm Testing And Display System (WATADS) and the Warning Decision Support System (WDSS).

MISSION IMMEDIATE TASKS (MR. WHEELER)

Mr. Wheeler assisted in solving several MIDDS workstation problems during this period. The Launch Weather Officers (LWOs) for Atlas and Shuttle operations requested minor fixes be made to their workstations. These fixes ranged from a graphical display not being updated correctly to not being able to save the changes that they had made in their operational support forecast. All fixes were done with no impact to the LWOs' work schedule in support of the operation.

2.2 TASK 003 SHORT TERM FORECAST IMPROVEMENT (MR. WHEELER)

SUBTASK 6 MIDDS F-KEY MENU SYSTEM

During this quarter, the Range Weather Operations (RWO) requested the addition of a hurricane support submenu to the forecaster's F-key menu system. This new submenu gives the duty forecaster quick access to satellite images focused on selected storms, graphical products for briefings on storm strength, movement and intensification, and selected storm-related bulletins. The Pentium PC McIDAS OS/2 workstation was upgraded from version 6.1 to 7.0.

SUBTASK 7 WINDEX AND MICROBURST DAILY POTENTIAL INDEX (MDPI)

The *Verification and Implementation of Microburst Day Potential Index (MDPI) and Wind INDEX (WINDEX) Forecasting Tools at Cape Canaveral Air Station* report was distributed in June. Anyone else interested in obtaining a copy of the final report should contact Mr. Wheeler.

2.3 TASK 004 INSTRUMENTATION AND MEASUREMENT

SUBTASK 3 50 MHZ DOPPLER RADAR WIND PROFILER (DRWP)

In April, Ms. Yersavich produced ASCII profiler data sets for each day in the January - March 1996 profiler McIDAS MD file archive. These data sets were transferred to Dr. Merceret for use in his climatological analysis of profiler data.

SOFTWARE MODIFICATIONS TO THE 50 MHZ DRWP DISPLAYS (MS. LAMBERT)

Capt. Heckman of the 45th Weather Squadron (45 WS) requested changes be made to the 50 MHz DRWP displays on the Digital VT340 terminal to improve the quality control (QC) of the profiler's data. This task was performed under option hours using KSC funds. QC of the data had been difficult due to both the size of the display and the resolution of the height scale. The requested modifications were made to the profile display of wind speed and direction, and to the spectral data display of the east, north, and vertical beams. The changes to the profile display were necessary to make the units of the plots consistent with the jimsphere plots, and the changes to the spectral data display were necessary to increase the resolution and size of the plots as well as making them consistent with the jimsphere plots.

The modifications to the profile display were completed in the previous quarter. The requested changes to the spectral data display were completed by Ms. Lambert in April. The vertical extent of all the plots was increased by reducing the number of cycles displayed from three to two. Then the horizontal width of the east and north beam plots was increased and, to accommodate this, the width of the vertical beam and signal-to-noise ratio (SNR) plots was decreased. The displayed data ranges of all the horizontal axes (m/s for the velocity plots and dB for the SNR plot) were decreased for a further increase in their horizontal resolution. The range decrease for the vertical velocity plot was much greater than that of the horizontal beam plots due to its decrease in width. This did not create an information loss as the vertical velocity rarely varies far from 0 m/s, and when it does the horizontal velocities are rendered inaccurate. The vertical axis unit of measure was changed from kilometers to thousands of feet and extra tick marks were added to the horizontal and vertical axes.

Upon completion of all requested modifications to the displays, Ms. Lambert made revisions to the figures and text describing the profile and spectral data displays in the appropriate manuals in May. The first formal test of the software was held in late May, but failed due to obsolete procedures and inaccurate figures in the software test manual. Corrections were made to the manual and a successful re-test was held in June. The final test report and revised manuals were completed in June and will be distributed in mid-July.

ADVANCED MIDDS WEATHER SYSTEM UPGRADE (MR. WHEELER)

Mr. Wheeler attended the Eastern Range Advanced MIDDS workgroup meeting (PRC, SMC, CSR, 45 WS, and AMU) dealing with the Status Report and System Acceptance Test Plan. Due to problems getting the equipment request through contracts, the delivery and set up of the prototype model will be delayed until the end of July 1996. However, a demonstration of the graphical user interface was given to the Eastern Range Advanced MIDDS workgroup on a HP workstation provided by PRC, Inc.

Mr. Wheeler also attended several workgroup meetings (RWO, CSR, and AMU) dealing with the launch operations configuration setup for the graphical user interface on the Advanced MIDDS weather system. In June, Mr. Wheeler reviewed the newly developed graphical user interface designed for the LWO Advanced MIDDS setup and provided suggestions and comments to the PRC representative. PRC requested assistance in understanding the different satellite loop configurations that the RWO uses. Standard satellite display configurations (i.e., latitude/longitude center points, intervals and resolutions) for the different RWO satellite loop configurations were supplied to PRC.

SUBTASK 4 LIGHTNING DETECTION AND RANGING SYSTEM (MR. DRAPE)

The Lightning Detection And Ranging (LDAR) computer-based training (CBT) course was designed to familiarize new users with the operation of the LDAR system and provide a quick refresher course for users having limited experience with LDAR. The contents of the course are contained in four modules or lessons, each of which are comprised of individual topics. A course map showing the organization and flow of the information is contained in the figure below.

The CBT prototype was distributed to RWO, NWS MLB, NASA/PZ-B2-A, and SMG for evaluation on 2 April 1996. Evaluation forms were enclosed with the CBT software to facilitate the review. The reaction of the reviewers was overwhelmingly positive, with many insightful comments and recommendations for improvement. In mid-May, ENSCO categorized all of the suggestions by type and prioritized in terms of the cost versus benefit of implementing each item. Based on the pilot evaluation, modifications were made to the CBT course during May and June which represented the greatest value to the user and could be accomplished within time and resource constraints. Those change items that were implemented in the first version of the course are summarized as follows:

- Enhancement of the presentation of the examples in the Data Interpretation lesson to explain the signature features in greater detail as they appear on the display,

- Addition of a page in the Display Operation lesson which permits the user to run the emulation program to practice the LDAR menu functions (zoom, pan, etc.) on a sample data set,

- Improvement of the installation procedure to more effectively handle the required library files and to prompt the user for the proper Windows settings, and

- Minor modifications to clarify text and graphics throughout the course (e.g. improve the explanation of how LDAR detects lightning), totaling approximately 25 items.

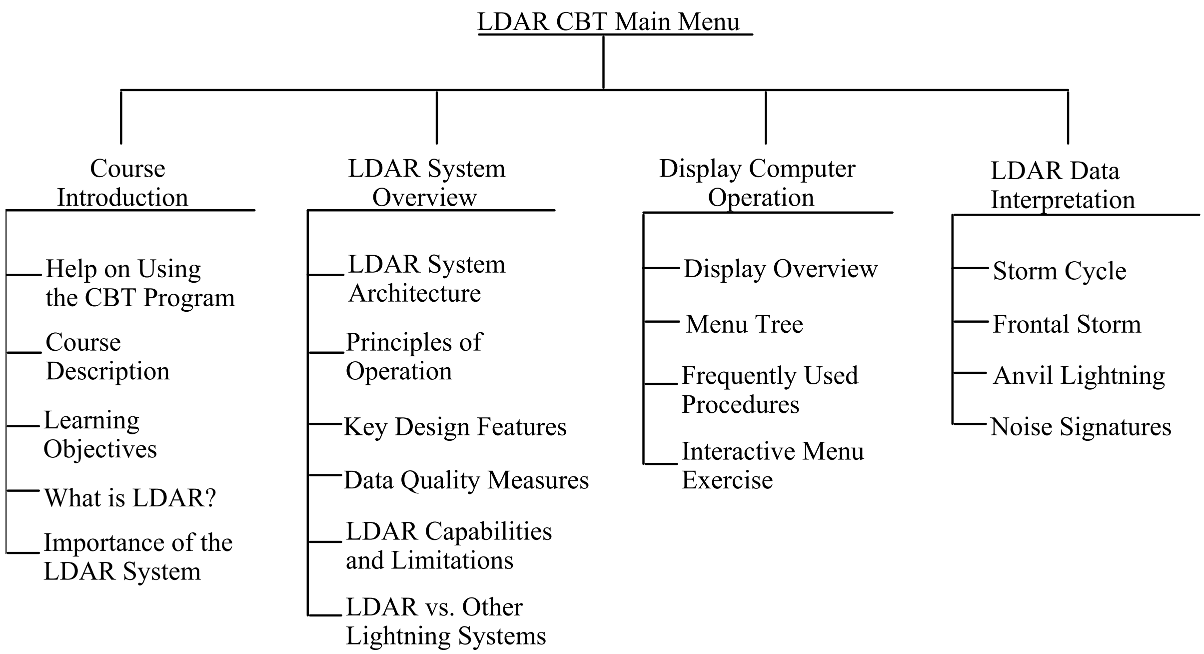

Figure 1. Course Map of LDAR Computer Based Training Program

By the end of June, all planned changes were implemented and verified. In July, copies of the updated version of the course will be created on floppy disk for distribution to LDAR users and other interested organizations. Although not all of the evaluators' recommendations were incorporated in this version of the course, several good ideas were recorded for future enhancements, which included the following:

- Inclusion of additional LDAR data examples, including a "pre-frontal squall line", or an event isolating a single lightning flash,

- Addition of a logon page and the capability to record student performance by identification number,

- Addition of quizzes or test questions following the lessons,

- Inclusion of information from other systems (e.g. radar) to accompany LDAR examples,

- Incorporation of a tutorial method of presentation for the examples, narrated via audio,

- Developing the capability to operate the CBT over the LAN from a central server (i.e. a shared disk drive),
- Inclusion of menu functions available in the latest release of LDAR in the CBT's emulation program, and
- Development of an on-line linkage to LDAR reference documents and an input form to log questions and comments from users.

When implemented, the LDAR CBT course will provide personnel with a convenient, easy-to-use training aid that will save time and improve users' familiarity and operational proficiency with the LDAR system. Feedback provided by course evaluators was essential in making the product more useful and effective, and indicates the CBT method is probably applicable to other similar systems.

SUBTASK 5 WSR-88D EVALUATION

Mr. Wheeler and Ms. Lambert continued their review and analysis of the 16 cases studies for convection initiation and severe/non-severe storm determination. The AMU also started analyzing the WSR-88D data through the WATADS and Motif-IRAS display software programs for storm identification and analysis. The final report will be completed by mid-August 1996.

SUBTASK 9 915 MHZ BOUNDARY LAYER PROFILERS (DR. TAYLOR)

During April, an analysis was completed for the March 15 and 19 False Cape radar data which were collected using Radian's Profiler On-line Program (POP) 4.0. Version 4.0 of POP contains the new Intermittent Clutter Reduction Algorithm (ICRA) developed by NOAA/ERL. The data collected for the March cases were reprocessed at NYMA, Inc.'s facility to generate mean consensus and graphical spectra data plots. The ICRA consensus data for these days had already been generated in real-time at the profiler site. Three hours of data were chosen from 15 March and 13 hours of data were chosen from 19 March to compare the u-components and v-components of the mean consensus versus ICRA consensus for 4 different layers. In addition, graphs of the spectra from both ICRA and mean processing routines were examined to gain additional insight into the advantages and disadvantages of the ICRA. On 8 May, Dr. Taylor presented a briefing on these results at a WINDS Technical Interchange Meeting.

In May, Dr. Taylor reviewed software code written by NYMA, Inc. that will be used in the WINDS system for divergence calculations and assisted NYMA personnel in understanding and developing a top-level design for software to implement a Barnes objective analysis scheme in WINDS.

KTAADN, INC.'S LIGHTNING PREDICTOR

KTAADN's work has been supported by the Air Force and by NASA under Phase I and II SBIR contracts. A major technical achievement of the Phase II research is a live test in the AMU. KTAADN seeks to improve the forecasting of lightning by applying artificial neural network (ANN) technology. The goal of this work is to improve the precision and accuracy of lightning prediction so that ground processing costs may be reduced.

During the week of 10 June 1996, Ms. Yersavich and Mr. Wheeler assisted KTAADN with the installation of their lightning predictor in the AMU. Ms. Yersavich and Mr. Wheeler helped connect KTAADN's Sun workstation into the AMU LAN, mount the AMU MIDDS PC on their workstation so that local data sets (LLP, wind tower, and rawinsonde) could be ingested, and set up entries in the AMU MIDDS scheduler to process the necessary data sets. The MLB NEXRAD echo top product data that is used in the ANN will be obtained from the NEXRAD Information Dissemination System (NIDS) via modem using Unisys Skyvision software.

Currently, the lightning predictor is not functioning properly due to problems interfacing with the Unisys data server and processing MIDDS data. Late in June, Ms. Yersavich installed a new modem from Unisys in attempt to solve the NEXRAD data ingestion problem. However, this effort failed to resolve the problem. KTAADN hopes to achieve successful predictions by August 1996.

2.4 TASK 005 MESOSCALE MODELING

SUBTASK 2 INSTALL & EVALUATE MESO, INC.'S MASS MODEL (DR. MANOBIANCO)

The real-time MASS runs were restarted at the end of April 1996. As directed by Dr. Merceret, the MASS runs are performed on a non-interference, no additional labor cost basis so there is no guarantee that daily MASS forecasts will be available. Furthermore, the AMU is not archiving MASS runs nor doing any further statistical verification of MASS forecasts. Nevertheless, the real-time run statistics from 1995 suggest that MASS is reliable enough so that it should not require much effort to keep it running during the 1996 warm season. In fact, the real-time runs executed with no manual intervention during the months of May and June 1996.

The *Report on the Installation and Evaluation of the Mesoscale Atmospheric Simulation System (MASS)* was published as a NASA contractor report and distributed in May 1996. Anyone else interested in obtaining a copy of the final report should contact Ms. Yersavich.

At the end of the MASS final report, the AMU made several recommendations for improving local mesoscale modeling systems such as MASS. The current MASS runs incorporate these recommendations that include changes to the run-time configuration and initialization data. The model configuration was modified to discontinue the 24-h 45 km forecasts and to run one 24-h 11 km forecast. In addition, the 11 km domain was expanded from 45x50 to 75x70 grid points and the vertical resolution was increased from 20 to 30 layers. MASS is now initialized using weekly-composite sea surface temperatures (SST) rather than monthly climatological analyses and 48 km eta rather than 80 km NGM gridded fields. The SST data are retrieved from the Space Sciences and Engineering Center at the University of Wisconsin while the 48 km eta data are available from the ROCC MIDDS. Finally, MASS is run on the AMU's IBM RS/6000 Model 390 rather than the four-processor Stardent since the Model 390 executes MASS about three times faster than the Stardent.

In June 1996, existing software and UNIX scripts were reactivated to transfer gridded model output from the AMU IBM RS/6000 Model 390 to the Pentium PC and then to the MIDDS test machine. In addition, hourly surface and upper air forecasts at selected stations are being transferred to the Pentium PC. These point forecasts are converted to McIDAS MD files using a McIDAS utility that writes ASCII text into the MD file format. After the transfer to the MIDDS test machine, RWO, SMG, and NWS MLB can access MASS' gridded and point forecasts to conduct informal evaluations over a larger number of cases than was possible during 1995.

SUBTASK 4 INSTALL AND EVALUATE ERDAS (MR. EVANS)

During the past quarter, Mr. Evans completed *The Final Report on the Evaluation of the Emergency Response Dose Assessment System (ERDAS).* The report will be distributed in July.

The AMU has been evaluating the Emergency Response Dose Assessment System (ERDAS) located in the Range Operations Control Center (ROCC) at CCAS/KSC since its installation in March 1994. Before the Air Force's 45th Space Wing (45 SW) including Range Safety, the 45 WS, and the Eastern Range Program Office (SMC/CW-OLAK) accepts ERDAS as an operational emergency response system, they must determine its value, accuracy, and reliability. In support of this requirement, the AMU has evaluated ERDAS in a near-operational environment. Following the evaluation, the AMU has been tasked to assist in the transition of ERDAS to the 45 SW as an operational system. The following is a discussion of the tasks the AMU will perform to assist in this transition.

Develop Training Materials and Provide Training

The AMU will develop a training briefing that will consist of two parts. The first part will be directed at the personnel who will be performing high level maintenance on ERDAS. The second part will be directed at personnel who want to run and display model output from ERDAS. Each briefing will consist of an overview presentation with slides and handouts and then a hands-on demonstration of operating ERDAS and its various functions. Work on this task began in June and will be completed in early July.

Assist in ERDAS Transition from AMU LAN to McIDAS LAN

The AMU will work with CSR to be sure that the switch from the AMU LAN to the McIDAS LAN is smooth and minimizes the interruption of input and output of data to and from ERDAS. The items which will be addressed include the following:

- All the McBASI commands now running on the AMU's Pentium PC must be transferred to the McIDAS workstation and tested,
- The AMU will modify and test the ingest routines on ERDAS, and
- Printing and other data transfer methods will need to be tested with the McIDAS LAN.

Develop Operational Acceptance Test Procedure (OATP)

The OATP will cover:

- Power-on and expected response
- Normal activation process, expected results
- Application Operation (abridged if lengthy)
    - Standard operator interaction
    - Expected results (test case)
    - Screen hardcopy (AMU printer)
- Other Pertinent Operations
    - Save MIDDS data
    - Operation of peripherals
- Power-off procedure

The AMU will cooperate with CSR to produce an OATP for testing ERDAS. The AMU will modify the draft OATP used for testing the initial (Phase 1) move of ERDAS from the AMU to the Range Safety room. This new draft will include the procedures mentioned above. This OATP will be presented to CSR to modify, review and/or edit as necessary so that the final OATP can be prepared and submitted for approval and a testing schedule. The AMU's work on this task will begin in July and should be completed in September.

Develop Operations Procedures

CSR will provide the AMU with an example Operations Procedures document along with any other documents describing the requirements for an Operations Procedures by 15 July 1996. The AMU will use this document as a model to follow in developing the draft Operations Procedures document for ERDAS. This Operations Procedures will be presented to CSR to modify, review and/or edit as necessary so that the final Operations Procedures can be prepared and submitted through the proper channels for approval.

Develop Maintenance Procedures

CSR will provide the AMU with an example Maintenance Procedures document along with any other documents describing the requirements for a Maintenance Procedures by 5 August 1996. The AMU will use this document as a model to follow in developing the draft Maintenance Procedures document for ERDAS. This Maintenance Procedures will be presented to CSR to modify, review and/or edit as necessary so that the final Maintenance Procedures can be prepared and submitted through the proper channels for approval.

Provide Pertinent ERDAS Documentation and Changes

The AMU will provide the following existing documentation:

- ERDAS SBIR Final Report by MRC/ASTER,
- User's Manual for RAMS, HYPACT, and ERDAS by MRC/ASTER,
- *The Final Report on the Evaluation of the Emergency Response Dose Assessment System (ERDAS)* by the AMU, and a
- List and copy of application software documentation.

Provide Deficiency List to Help in Phase 3 Study

The AMU will provide a list of current ERDAS deficiencies and recommended enhancements. The deficiency list will include minor problems such as bugs in the user interface and more significant problems such as the slow run time due to computer hardware limitations. The recommended enhancements will include short, medium, and long term items which will enable the system to be certified for operational use.

In addition to supplying the lists, the AMU will participate in meetings with SMC/CWP, CSR, 45 SE, and/or 45 WS to discuss and determine the direction and action required to certify ERDAS for operational use.

Assist in Development of System Segment Specification

The AMU will assist in the preparation of a System Segment Specification for a replacement of ERDAS. The AMU will participate in meetings to determine the details of this document as well as the parties responsible for the different sections of the document.

MODEL VALIDATION PROGRAM (MVP)

Mr. Evans supported the MVP Tracer Session III which was conducted from 26 April to 9 May 1996. The support included displaying and collecting model data from ERDAS and PROWESS and providing the MVP team with data from the 915 MHz profiler. Mr. Evans ran both PROWESS and ERDAS during the MVP and archived the data for later analysis.

SUBTASK 7 29 KM ETA MODEL EVALUATION (DR. MANOBIANCO)

As part of the "mid-course correction" to the mesoscale modeling effort in February 1996, the AMU was tasked to begin evaluating the National Centers for Environmental Prediction's (NCEP) 29 km eta (meso-eta) model. The evaluation criteria were determined by a technical group chaired by Dr. Manobianco and consisting of several meteorologists and forecasters from RWO, SMG, and NWS MLB. The technical working group held three teleconferences that resulted in an evaluation strategy consisting of both objective and subjective components. The objective verification of the 29 km eta model focuses on the occurrence of convective activity, and wind and temperature forecasts that define weather-related launch commit criteria (LCC) for manned and unmanned vehicles and flight rules (FR) for Shuttle landings. The subjective or phenomenological verification assesses the 29 km eta model skill in forecasting events such as the location and movement of fronts and the onset, depth, and propagation of sea-breezes. The following sections summarize how the AMU is currently accessing the 29 km eta model forecasts and provide specifics of the objective and subjective evaluation criteria.

Data Acquisition

The 29 km eta model data are obtained via the Internet from NOAA's Information Center (NIC) FTP server. The gridded data from the 0300 UTC cycle of the meso-eta are downloaded at approximately 0900 UTC. (Note the gridded data from the 1500 UTC cycle of the 29 km eta model are not being used for the evaluation discussed here.) NCEP interpolates the meso-eta model output to the Advanced Weather Interactive Processing System (AWIPS) 40 km grid at 3-h intervals for the entire meso-eta 33-h forecast period. After the meso-eta data on the AWIPS grid are retrieved from the NIC, they are decoded from GRIdded Binary (GRIB) format using software contained in the GEneral Meteorological PAcKage (GEMPAK). In addition to gridded data, the point forecasts at selected stations are downloaded from both the 0300 UTC and 1500 UTC cycles of the meso-eta model. These files contain surface and upper air parameters at 1-h intervals and are decoded from Binary Universal Form for the Representation of meteorological data (BUFR) using GEMPAK software.

Objective Evaluation Criteria

The objective verification of the 29 km eta model examines forecast errors for the parameters shown in Table 1 at the Shuttle Landing Facility, FL (TTS), Edwards Air Force Base, CA (EDW), and Tampa Bay, FL (TPA). The TTS and EDW stations are selected because they are the primary and secondary landing sites for the Shuttle. In addition, TPA is chosen to compare model errors under different flow regimes at two coastal stations on the eastern (TTS) and western (TPA) edge of the Florida peninsula. The station or point forecasts from the 0300 UTC and 1500 UTC meso-eta model cycles are verified against standard surface and rawinsonde observations at TTS, EDW, and TPA. The bias and root mean square error (RMSE) are computed for the parameters in Table 1 at 1-h (12-h) intervals for surface (rawinsonde) observations. The surface bias and RMSE are derived for 10 m winds and 2 m temperatures and dew point temperatures. The upper air bias and RMSE for wind (u, v), temperature (T), moisture (q), and height (z) are derived at 25 mb intervals from 1000 to 50 mb and at selected height levels from 1000 to 70000 ft. In addition, a parameter known as consistency is computed to measure the difference between subsequent forecasts of the parameters in Table 1 verifying at the same time but initialized at different times.

The parameters such as precipitable water, mean layer wind and relative humidity, and stability indices are included because they can be used to assess the potential for convective activity. However, the 29 km eta model forecasts of these parameters are not verified at EDW since convection is rarely a concern at that location. Except for the 10 m winds at TTS, EDW, and TPA, the meso-eta model forecasts are not benchmarked against other models, climatology, or persistence. For 10 m winds, model forecasts are compared with persistence for a period of 1 to 6 h.

The objective verification considers 29 km eta model forecasts errors during a warm season covering the months of May through August 1996 and a cool season covering the months of October 1996 through January 1997. Except for the 1000-850 mb thickness listed in Table 1, the bias, RMSE, and consistency are computed for all other parameters for both four month periods of the warm and cool season. In addition, the warm and cool season verification statistics are stratified according to the average wind direction in the layer from 950 to 600 mb. The stratification is designed to determine if the model forecast errors are sensitive to specific flow regimes which are defined by layer-averaged wind directions. It is anticipated that error statistics grouped by flow regime will provide more useful information to model users than those computed from all meso-eta forecasts over the four month periods of the warm and cool seasons.

Table 1. 29 km Eta Model Objective Verification

Parameter(s)	**Levels**
Mean sea-level pressure	--
u, v	10 m
T, T_d	2 m
u, v, T, q, z	selected*
Convective available potential energy	--
Convective inhibition	--
Lifted index	--
K index	--
Precipitable water	--
Thickness	1000-850 mb
Mean layer wind	850-500 mb
Mean layer relative humidity	850-500 mb

*refer to text for description

Subjective Evaluation Criteria

The subjective component of the 29 km eta model evaluation consists of daily, real-time forecasting by AMU personnel and very limited analyses of selected case studies from the warm and cool season. The specific goal of the real-time, warm season forecasting exercise is to determine if the 29 km eta model predicts the onset, depth, and motion of the east and/or west coast sea breeze, the occurrence and severity of convection within 25 miles of TTS, and the occurrence of steady state winds in excess of 18 kt at TTS. These phenomenon are being evaluated due to their primary importance for evaluation of LCC, Shuttle FR, and because severe weather associated with thunderstorms can be hazardous to equipment and personnel performing ground operations at KSC/CCAS. As an added benefit, the daily forecasting exercise provides an opportunity to determine the most effective ways to visualize, interpret, and use the 29 km eta model for short range (< 24 h) forecasting.

The AMU is currently using GEMPAK/ntrans software to generate and view metafiles containing graphics of 29 km eta model output. The forecast variables such as wind, moisture, stability indices, convergence, helicity, etc. are displayed using time series plots, vertical cross sections, horizontal sections, and time-height sections. The vertical and horizontal sections of wind, moisture, temperature, height, and other parameters produced from 3-h meso-eta model output are animated in time using the ntrans software.

The AMU daily weather forecast discussion is held Monday through Friday at approximately 1330 UTC. In part, this component of the subjective evaluation is designed to simulate how operational forecasters may use the 0300 UTC cycle of meso-eta model to assist in forecasting sea breezes, winds, and thunderstorm occurrence over the subsequent 12 to 24 h. One member of the AMU staff leads the weather briefing and fills out a daily evaluation worksheet. The worksheet is used to record the availability of meso-eta data, note the occurrence and movement of east and/or west coast sea breezes and thunderstorms, log periods when winds exceed 18 kt, and identify days suitable for case studies. The data from the Melbourne WSR-88D radar, geostationary satellites (GOES-8), 50 MHz and 915 MHz profilers, and KSC/CCAS mesonet towers are available to verify the specific phenomenon of interest.

The case studies focus on propagation and intensity of easterly waves, cloud ceilings and thickness, propagation of cold fronts, and mesoscale wind features identified from time-height sections of 50 MHz or 915 MHz profiler data that are not resolved by 12-h rawinsonde observations. Accurate forecasts of easterly waves, clouds, cold fronts, and winds are important for weather support to manned (Shuttle) and unmanned missions and ground support operations at KSC/CCAS. In order to perform the case study analyses, the AMU is archiving gridded forecasts of wind, temperature, relative humidity, cloud water, and geopotential height and point forecasts at TTS and TPA from all available 0300 UTC runs of the meso-eta model during the warm and cool season. In addition, the surface, rawinsonde, 50 MHz and 915 MHz profiler, and GOES-8 data as well as cloud observations from launch reconnaissance aircraft are available to verify these phenomenon.

The analyses of mesoscale wind features include cases from the warm and cool season while the analyses of clouds and cold fronts (easterly waves) are limited to cases from the cool (warm) season. The cases are selected based on the occurrence or existence of easterly waves and cold fronts that are within 500-1000 km of KSC/CCAS or for challenging forecasts such as the development of stratocumulus clouds that occurs frequently in the cool season following the passage of a cold front. The analyses for each case study are limited so that a number of cases can potentially be examined to determine what (if any) guidance the meso-eta model provides in forecasting the aforementioned aspects of easterly waves, clouds, cold fronts, and winds.

Summary

The previous two sections highlight the AMU's objective and subjective verification of the 29 km eta model. The AMU's evaluation of the meso-eta model is designed to determine how well the model can forecast specific parameters and phenomenon that affect real-time weather support to operations at KSC/CCAS. The collection of meso-eta forecast data and observations and real-time daily forecasting by AMU personnel began in May 1996. The preliminary results from the first half of the warm season objective and subjective evaluation will be presented by Dr. Manobianco at the 11th Conference on Numerical Weather Prediction in Norfolk, VA (August 1996). These results will be somewhat preliminary since the warm season evaluation period extends for four months and includes August 1996. Nevertheless, the initial evaluation should reveal how well the mesoscale version of the eta model with a horizontal resolution of 29 km and 50 vertical layers can forecast the weather in east central Florida where there is an absence of large-scale dynamical forcing during much of the year.

2.5 AMU CHIEF'S TECHNICAL ACTIVITIES (DR. MERCERET)

MID-TROPOSHERIC WIND CHANGE CLIMATOLOGY

Dr. Merceret completed the wind change climatology and generated probability of exceedance curves for 0.25, 1, and 4 hour wind changes. These data were provided to both the Shuttle and Titan communities for use in their risk analysis. The results were also presented to NASA, USAF, and NWS personnel at a technical interchange meeting at the NWS MLB. A general article will be prepared next quarter.

Attachment 1: AMU FY-96 Tasks

TASK 001 AMU OPERATIONS

• Operate the AMU. Coordinate operations with NASA/KSC and its other contractors, 45th Space Wing and their support contractors, the NWS and their support contractors, other NASA centers, and visiting scientists.

• Establish and maintain a resource and financial reporting system for total contract work activity. The system shall have the capability to identify near-term and long-term requirements including manpower, material, and equipment, as well as cost projections necessary to prioritize work assignments and provide support requested by the government.

• Monitor all Government furnished AMU equipment, facilities, and vehicles regarding proper care and maintenance by the appropriate Government entity or contractor. Ensure proper care and operation by AMU personnel.

• Identify and recommend hardware and software additions, upgrades, or replacements for the AMU beyond those identified by NASA.

• Prepare and submit in timely fashion all plans and reports required by the Data Requirements List/Data Requirements Description.

• Prepare or support preparation of analysis reports, operations plans, presentations and other related activities as defined by the COTR.

• Participate in technical meetings at various Government and contractor locations, and provide or support presentations and related graphics as required by the COTR.

TASK 002 TRAINING

• Provide initial 40 hours of AMU familiarization training to Senior Scientist, Scientist, Senior Meteorologist, Meteorologist, and Technical Support Specialist in accordance with the AMU Training Plan. Additional familiarization as required.

• Provide KSC/CCAS access/facilities training to contractor personnel as required.

• Provide NEXRAD training for contractor personnel.

• Provide additional training as required. Such training may be related to the acquisition of new or upgraded equipment, software, or analytical techniques, or new or modified facilities or mission requirements.

TASK 003 SHORT TERM FORECAST IMPROVEMENT

• Develop databases, analyses, and techniques leading to improvement of the 90 minute forecasts for STS landing facilities in the continental United States and elsewhere as directed by the COTR.

• Design McBASI routines to enhance the usability of the MIDDS for forecaster applications at the RWO and SMG. Consult frequently with the forecasters at both installations to determine specific requirements. Upon completion of testing and installation of each routine, obtain feedback from the forecasters and incorporate appropriate changes.

• Subtask 2 - Fog and Stratus At KSC

•• Develop a database for study of weather situations relating to marginal violations of this landing constraint. Develop forecast techniques or rules of thumb to determine when the situation is or is not likely to result in unacceptable conditions at verification time. Validate the techniques and transition to operations.

Subtask 6 - MIDDS F-key Menu Systems

•• Document the MIDDS F-key menu systems developed by the AMU.

Subtask 7 - WINDEX and Microburst Daily Potential Index (MDPI)

•• Evaluate the WINDEX and MDPI.

TASK 004 INSTRUMENTATION AND MEASUREMENT SYSTEMS

• Evaluate instrumentation and measurement systems to determine their utility for operational weather support to space flight operations. Recommend or develop modifications if required, and transition suitable systems to operational use.

• Subtask 3 - Doppler Radar Wind Profiler (DRWP)

•• Evaluate the current status of the DRWP and implement the new wind algorithm developed by MSFC. Operationally test the new algorithm and software. If appropriate, make recommendations for transition to operational use. Provide training to both operations and maintenance personnel. Prepare a final meteorological validation report quantitatively describing overall system meteorological performance.

• Subtask 4 - Lightning Detection And Ranging (LDAR) System

•• Develop training material for the NASA/KSC Lightning Detection And Ranging (LDAR) system which will include a computer based training (CBT) course, video, and user's manual.

• Subtask 5 - Melbourne NEXRAD

•• Evaluate the effectiveness and utility of the Melbourne NEXRAD (WSR-88D) operational products in support of spaceflight operations. This work will be coordinated with appropriate NWS/FAA/USAF personnel.

• Subtask 9 - Boundary Layer Profilers

•• Evaluate the meteorological validity of current site selection for initial 5 DRWPs and recommend sites for any additional DRWPs (up to 10 more sites). Determine, in a quantitative sense, advantages of additional DRWPs. The analysis should determine improvements to boundary layer resolution and any impacts to mesoscale modeling efforts given additional DRWPs. Develop and/or recommend DRWP displays for operational use.

TASK 005 MESOSCALE MODELING EVALUATION

• Evaluate Numerical Mesoscale Modeling systems to determine their utility for operational weather support to space flight operations. Recommend or develop modifications if required, and transition suitable systems to operational use.

- Subtask 1 - Evaluate the NOAA/ERL Local Analysis and Prediction System (LAPS)

•• Evaluate LAPS for use in the KSC/CCAS area. If the evaluation indicates LAPS can be useful for weather support to space flight operations, then transition it to operational use.

- Subtask 2 - Install and Evaluate the MESO, Inc. Mesoscale Forecast Model

•• Install and evaluate the MESO, Inc. mesoscale forecast model for KSC being delivered pursuant to a NASA Phase II SBIR. If appropriate, transition to operations.

- Subtask 3 - Acquire the Colorado State University RAMS Model

•• Acquire the Colorado State University RAMS model or its equivalent tailored to the KSC environment. Develop and test the following model capabilities listed in priority order:

1) Provide a real-time functional forecasting product relevant to Space shuttle weather support operations with grid spacing of 3 km or smaller within the KSC/CCAS environment.
2) Incorporate three dimensional explicit cloud physics to handle local convective events.
3) Provide improved treatment of radiation processes.
4) Provide improved treatment of soil property effects.
5) Demonstrate the ability to use networked multiple processors.

Evaluate the resulting model in terms of a pre-agreed standard statistical measure of success. Present results to the user forecaster community, obtain feedback, and incorporate into the model as appropriate. Prepare implementation plans for proposed transition to operational use if appropriate.

- Subtask 4 - Evaluate the Emergency Response Dose Assessment System (ERDAS)

•• Perform a meteorological and performance evaluation of the ERDAS. Meteorological factors which will be included are wind speed, wind direction, wind turbulence, and the movement of sea-breeze fronts. The performance evaluation will include:

1) Evaluation of ERDAS graphics in terms of how well they facilitate user input and user understanding of the output.
2) Determination of the requirements that operation of ERDAS places upon the user.
3) Documentation of system response times based on actual system operation.
4) Evaluation (in conjunction with range safety personnel) of the ability of ERDAS to meet range requirements for the display of toxic hazard corridor information.
5) Evaluation of how successfully ERDAS can be integrated in an operational environment at CCAS.
6) Evaluate the ability of ERDAS to predict cloud and plume dispersion. Factors to consider include cloud rise, bifurcation, trajectory, and horizontal/vertical dispersion.

• Subtask 7 - 29 km Eta Model Evaluation

•• Evaluate the most effective ways to use the NCEP 29 km eta model to meet 45 WS, SMG, and NWS MLB requirements. The AMU shall determine the data acquisition requirements, and design and implement the evaluation protocol. The evaluation protocol includes:

1) Finalize the data acquisition requirements for the 29 km eta model evaluation based on recommendations from the technical working group (45 WS, SMG and NWS MLB).

2) Design the evaluation protocol for the 29 km eta model. The evaluation strategy will consist of two main components. The first component will use an objective and subjective evaluation strategy to assess model forecast skill. The second component will involve daily, real-time forecasting by AMU personnel using 29 km eta model output to determine the most effective ways to visualize, interpret and use a mesoscale model for short-range forecasting in east central Florida (KSC/CCAS and surrounding areas).

3) Collect data and perform real-time forecasting from 1 May through 31 August 1996 and 1 October 1996 through 31 January 1997 then analyze the results from the warm and cool season, respectively.

4) Prepare and deliver the first draft of the 29 km Eta model evaluation final report by 28 March 1997.