Applied Meteorology Unit (AMU)

Quarterly Report

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ENSCO, Inc.
1980 N. Atlantic Ave., Suite 230
Cocoa Beach, FL 32931
(321) 853-8202 (AMU)
(321) 783-9735

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ENSCO Contracts/E. Lambert

Executive Summary

This report summarizes the Applied Meteorology Unit (AMU) activities for the fourth quarter of Fiscal Year 2001 (July – September 2001). A detailed project schedule is included in the Appendix.

Ms. Lambert began work on the Statistical Short-Range Forecast Tools task to develop short-range peak winds forecast equations for use in support of Expendable Launch Vehicle (ELV) and Space Shuttle launch and landing operations. The 45th Weather Squadron (45 WS) and the Spaceflight Meteorology Group (SMG) indicate that peak winds are difficult to forecast. Ms. Lambert will use historical 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 specific tower sites designated by the 45 WS and SMG. She began the task by meeting with the forecasters to determine the element to be predicted, the data types to use in the equation development, and statistical methods that could be successful in predicting peak winds. She also began examining possible quality control routines for the wind tower network data.

Dr. Short and Mr. Wheeler continued work on the Improved Anvil Forecasting Phase II task to develop an anvil-forecasting tool that will aid forecasters in predicting the triggered lightning Launch Commit Criteria (LCC) violation probability. Dr. Short added 74 anvil cases to the database increasing the total to 167 and recalculated the linear regression relationship between anvil length and the average wind speed in the anvil layer. He found similar relationships to those found with the previous smaller database, with over 70% of the variance explained. Dr. Short then continued to build a graphical display that depicts an anvil threat sector over a satellite image, the width and length of which is determined by the output of the linear regression equation. If a storm forms in the predicted anvil threat sector, forecasters will be alerted that an anvil from that storm is likely to affect space operations.

Mr. Case began work on the Land Breeze Forecasting task to improve the forecast of occurrence and timing of the land breeze over KSC/CCAFS. The occurrence and timing of the nocturnal land breeze affects low-temperature, fog, and toxic material dispersion forecasts. The 45 WS forecasters are currently able to predict the occurrence of a land breeze with good accuracy, but find it difficult to forecast the timing. As a result, the AMU was tasked 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. Mr. Case began the task by meeting with forecasters to determine the observational characteristics of land breezes, possible dates for land-breeze case studies, observational data sets that may be most important in determining a land-breeze signature, and strategies that may be used to develop a climatology and forecasting rules of thumb. He also began a literature search for relevant studies of land breezes, and acquired the Florida hourly surface observations.

Mr. Case continued work on Phase IV of the Local Data Integration System (LDIS) task. 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. Phase IV involves including additional real-time observational datasets, fine tuning the analysis configuration to improve continuity and blending of observations, and improving real-time graphics capabilities. Mr. Case developed programs at the National Weather Service in Melbourne, Florida (NWS MLB) to ingest three additional data sources into the LDIS in real time. They are the Florida Automated Weather Network surface observation towers, Aircraft Communication Addressing and Reporting System observations, and Automatic Position Reporting System surface observations.

Mr. Dianic continued work on the extension and enhancement of the Eastern Range Dispersion Assessment System (ERDAS) Regional Atmospheric Modeling System (RAMS) Evaluation task to improve the archived database and to perform sensitivity tests to identify the possible cause(s) of the model cold bias. He modified the Graphical User Interface (GUI) to include a display for monitoring the root mean square (RMS) error and bias of RAMS forecast temperatures and dew point temperatures at any of the KSC/CCAFS wind towers. These error statistics can provide a forecaster with important real-time information about the accuracies in the recent RAMS forecasts within the KSC/CCAFS wind-tower network.

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The AMU Quarterly Reports are also available in electronic format via email. If anyone on the current distribution would like to be added to the email list, please send your email address to Winifred Lambert (321-853-8130, lambert.winifred@ensco.com). If any of your mailing information changes or if you would like to be removed from the distribution list, please notify Frank Merceret (321-867-0818, francis.merceret-1@ksc.nasa.gov) or Winifred Lambert (321-853-8130, lambert.winifred@ensco.com).

1. 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 Section 2 with the primary AMU point of contact reflected on each task and/or subtask. A list of acronyms used in this report immediately follows Section 2.

2. AMU ACCOMPLISHMENTS DURING THE PAST QUARTER

2.1 TASK 003 SHORT-TERM FORECAST IMPROVEMENT

SUBTASK 3 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 is assigned 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 challenging to forecast. The goal of this task is to develop short-range peak-wind forecast tools to be used in support of ELV launches and Shuttle landings. Ms. Lambert will use historical 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 forecasts for peak winds will be made and the associated launch operation.

Launch Operation	***Tower(s)***	***Primary Height (ft)***	***Backup Height (ft)***
Shuttle	39A / 39B	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

The Range Technical Services Contractor, Computer Sciences Raytheon (CSR), provided the data from all towers in the network over the period 1995 – 2001 for the task. Ms. Lambert will not use data before 1995 because the wind tower network peak winds were unreliable prior to that time (Bill Roeder, 45 WS, personal communication). She collected buoy data and has access to the hourly surface observation data for the same period collected by Mr. Jon Case. Ms. Lambert began examining wind tower data quality control (QC) routines developed by Dr. Fred Riewe of ENSCO, Inc. to determine how the algorithms distinguish between good and erroneous data. She also began an examination of the data to determine if the parameters in the existing QC routines should be modified and if new routines should be developed.

Ms. Lambert also led meetings between the AMU and 45 WS Launch Weather Officers (LWOs) and SMG personnel. During these meetings, forecaster input was obtained concerning the variables to be predicted, the appropriate data types to use in the development of the equations, and statistical methods that could be successful in predicting peak winds.

SUBTASK 5 IMPROVED ANVIL FORECASTING PHASE II (DR. SHORT AND MR. WHEELER)

An objective technique for forecasting the horizontal extent of anvil clouds generated by thunderstorm activity is needed to assist forecasters in predicting the probability of violating the triggered lightning LCC. An anvil cloud can extend 100 miles or more from its parent thunderstorm complex depending on the winds aloft, and can serve as a long distance conduit for lightning discharges. Charging mechanisms in anvil clouds are complex; but, in general, the observed structure is a positively charged center surrounded by negatively charged exterior screening layers above and below. The screening layers can have an adverse effect on the ability of the Launch Pad Lightning Warning System (LPLWS) to detect electrification in an anvil above the network. Anvil clouds can become detached from their parent thunderstorm but still carry hazardous electrical charges (Garner et al. 1997).

The 45 WS LWOs have identified anvil forecasting as one of the most challenging tasks when attempting to predict the triggered lightning LCC violation probability. The 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 that will increase the sample size of anvil cases to improve the reliability of resulting statistics and 2) develop objective tools for forecasting the occurrence of anvil clouds over the KSC/CCAFS area with lead times of 36 hours or less.

Additional Anvil Cases

Dr. Short determined the life cycle of 74 anvil clouds in visible imagery from the Geostationary Operational Environmental Satellite - Number 8 (GOES-8) on 20 anvil case days during July 2001, raising the total number for May - July 2001 to 167 anvils and 50 case days. He computed daily averages of anvil distance, anvil orientation, wind speed and wind direction in the lower and upper troposphere, and dew point depression in the upper troposphere. The linear regression between layer averaged wind speed in the upper layer and anvil distance for the expanded data base, shown in Figure 1, indicates an intercept of about 21 n mi and a slope of 1.9 n mi/kt, consistent with the results for May and June anvils documented in the previous quarterly report. The regression relationship now explains 73% of the variance of anvil distance by the wind speed, compared to 76% variance explained for the May/June cases. The decrease in explained variance for the May to July dataset can be attributed to the lighter and more variable upper level winds observed as the warm season progresses. A stepwise regression procedure was used to determine that the dew point depression information in the upper troposphere does not explain additional variance for this database of warm season anvils.

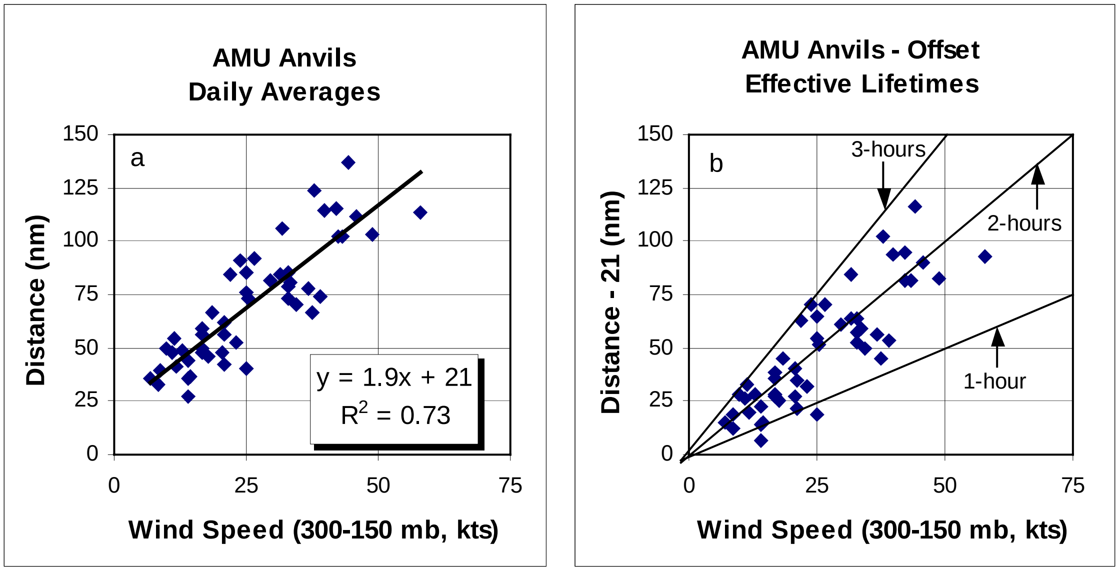

Figure 1. Daily averages of upper tropospheric wind speed versus anvil characteristics. a) Daily averages of wind speed and anvil distance; b) Daily averages of wind speed versus anvil distance - offset, where the offset, 21 n mi, was determined from the linear regression in a). The sloping lines denote effective transport lifetimes, calculated from the ratio of distance minus offset to wind speed.

Prototype Forecast Tool

The AMU conducted a teleconference with the 45 WS, SMG and National Weather Service Office at Melbourne, Florida (NWS MLB) personnel to discuss recent AMU progress on the task and to obtain customer guidance on near-term directions and goals. The result was a consensus for the AMU to proceed with a general formulation of a forecast tool for the Meteorological Interactive Data Display System (MIDDS), displaying an anvil threat corridor overlaid on a satellite image.

Dr. Short determined parameters for an anvil threat corridor from the statistical analyses shown in Figure 1. The intercept in Figure 1a indicates that an anvil with a diameter of 20 n mi can be generated when the upper level winds are near zero due to the inertia of convective updrafts and upper level divergence at the tropopause. This suggests a minimum standoff circle centered on the SLF with a 20 n mi radius. The data shown in Figure 1b indicate that the vast majority of anvil transport lifetimes are between 1- and 3- hours, with an average of about 2 hours. Therefore, the threat sector extends upwind of the standoff circle, and its length is the distance that the upper level winds could transport an anvil cloud in three hours or less. A first-guess for the width of the threat sector is 40°, which is based on Dr. Short's statistical analyses of anvil orientation and upper level wind direction. The upper level winds would be obtained from observations in the pre-convective environment, as much as 12 hours before the formation of thunderstorms and resultant anvil clouds.

Dr. Short developed a prototype program for drawing an anvil threat sector on a satellite image using MIDDS. The program computes and plots the threat sector using spherical trigonometry in combination with MIDDS commands, given an upper tropospheric wind speed and direction. Dr. Short designed the program to be executed from a MIDDS terminal using standard commands. Figure 2 shows a GOES-8 visible image from 2132 Universal Coordinated Time (UTC) on 13 May 2001 with an overlaid anvil threat corridor. It is a 40° sector extending upwind from the Shuttle Landing Facility (SLF) at a 257° orientation, determined by the upper tropospheric winds reported in the 1015 UTC XMR sounding (CCAFS 3-letter identifier) weather station. The threat corridor has a 20 n mi standoff circle centered on the SLF and three arcs representing the 1-, 2- and 3-hour transport distances from the outer edge of the standoff circle, based on an average wind speed of 49 kts in the layer from 300 to 150 mb.

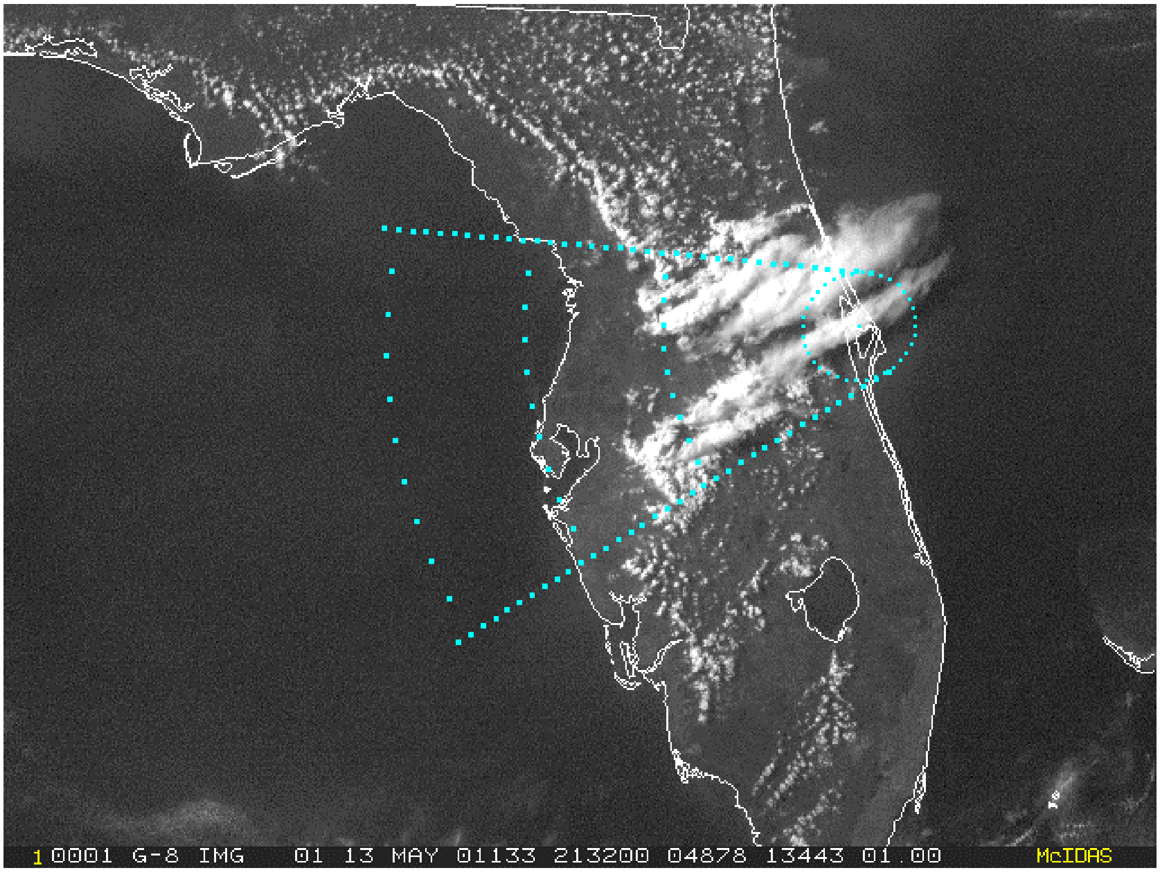

Figure 2. Prototype threat sector for 13 May 2001, overlaid on a GOES-8 visible image from 2132 UTC. The threat sector parameters were determined from upper level wind speed and direction reported in the 1015 UTC radiosonde from the XMR weather station. Thunderstorm activity that generated the long, narrow anvil clouds began to develop around 1830 UTC in west-central Florida.

Conference Paper

Dr. Short described the results of the analysis in a paper titled "Propagation and Lifetime Characteristics of Thunderstorm Anvil Clouds over Florida" for the 18th International Conference on Interactive Information and Processing Systems (IIPS) for Meteorology, Oceanography and Hydrology. The conference will be held in Orlando, Florida, 13-18 January 2002 in conjunction with the Annual Meeting of the American Meteorological Society (AMS). The paper (Short et al. 2002) was co-authored by Mr. Sardonia of the 45 WS and Ms. Lambert and Mr. Wheeler of the AMU.

References

Garner, T., R. Lafosse, D. G. Bellue, and E. Priselac, 1997: Problems associated with identifying, observing, and forecasting detached thunderstorm anvils for Space Shuttle operations. *7th Conference on Aviation, Range and Aerospace Meteorology,* Long Beach, CA, Amer. Meteor. Soc., 302 - 306.

Lambert, W. C., 2000: Improved anvil forecasting: Phase I Final Report. NASA Contractor Report CR-2000-208573, Kennedy Space Center, FL, 24 pp. [Available from ENSCO, Inc., 1980 N. Atlantic Ave., Suite 230, Cocoa Beach, FL, 32931].

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.

SUBTASK 7 LAND BREEZE FORECASTING (MR. CASE)

The onset of a nocturnal land breeze at CCAFS, KSC, 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.

Mr. Case led preliminary discussions between the AMU and the 45 WS LWOs, and SMG and NWS MLB forecasters. These discussions were designed to obtain forecaster input on the observational characteristics of land breezes, possible dates for land-breeze case studies, observational data sets that may be most important in determining a land-breeze signature, and strategies that may be used to develop a climatology and forecasting rules of thumb. Mr. Case also began a literature search for pertinent studies of land breezes. His literature search revealed two older, but useful studies of land breezes in India. In addition, the KSC Atmospheric Boundary Layer Experiment (KABLE) may provide some insight into land breezes at KSC/CCAFS. Finally, the AMU acquired data necessary for the task, including Florida surface METAR observations from the Air Force Combat Climatology Center and buoy observations from the National Data Buoy Center.

2.2 TASK 004 INSTRUMENTATION AND MEASUREMENT

SUBTASK 5 I&M AND RSA SUPPORT (DR. MANOBIANCO AND MR. WHEELER)

No work was done on this task during the quarter.

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)***
0	320.0

2.3 TASK 005 MESOSCALE MODELING

SUBTASK 8 MESO-MODEL EVALUATION (MR. CASE)

The Eastern Range Dispersion Assessment System (ERDAS) is designed to provide emergency response guidance to the 45th Space Wing/Range Safety (45 SW/SE) in support of operations at the Eastern Range in the event of an accidental hazardous material release or an aborted vehicle launch. ERDAS uses the Regional Atmospheric Modeling System (RAMS) numerical weather prediction (NWP) model to generate prognostic wind and temperature fields for input into ERDAS diffusion algorithms. The RAMS model is run twice per day and generates 24-hour forecasts initialized at 0000 and 1200 UTC. In addition to winds and temperatures, RAMS predicts a number of other meteorological quantities on four nested grids with horizontal grid spacing of 60, 15, 5, and 1.25 km, respectively. Since the 1.25-km grid is centered over KSC/CCAFS, real-time RAMS forecasts provide an opportunity for improved weather forecasting in support of space operations through high-resolution NWP over the complex land-water interfaces of KSC/CCAFS. The 45 SW/SE and the 45 WS have tasked the AMU to evaluate the accuracy of RAMS for all seasons and under various weather regimes during 1999 and 2000.

Efforts this past quarter have focused on the presentation and dissemination of the results from the ERDAS RAMS final report. Mr. Case presented two posters covering a portion of the objective and subjective evaluation of ERDAS RAMS at the AMS 18th Conference on Weather Analysis and Forecasting, 14th Conference on Numerical Weather Prediction, and 9th Conference on Mesoscale Processes. In addition, Mr. Case and Dr. Short prepared and submitted a paper that will be presented at the AMS 4th Conference on Coastal Atmospheric and Oceanic Prediction and Processes, to be held in St. Petersburg, Florida from 6-9 November 2001. This conference paper focuses on the subjective sea-breeze verification results that were published in the previous AMU quarterly report. Finally, Mr. Case formally presented the results of the ERDAS RAMS final report to AMU customers on 21 August at the Range Operations Control Center.

SUBTASK 10 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.

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.

During this past quarter, the AMU developed data ingest programs for additional real-time data sets at the NWS MLB. In addition, Mr. Case presented a 20-minute talk on the history and most recent developments of the real-time ADAS to NWS MLB forecasters at a station meeting that took place on 28 August. Finally, some configurable parameters in ADAS were modified in order to improve the cloud analysis products and ADAS run-time performance characteristics. Samples of real-time ADAS analyses generated every 15 minutes can be found at http://www.srh.noaa.gov/mlb/ldis/ldis_realtime_top.htm for the NWS MLB office, and for SMG the web address is: http://www.srh.noaa.gov/smg/adas_realtime.html.

Most AMU efforts this past quarter were spent developing data-ingest programs at the NWS MLB for new real-time data sets. Specifically, Mr. Case designed programs to ingest the following three additional data sources into ADAS in real time:

- The Florida Automated Weather Network (FAWN) surface observation towers,
- Aircraft Communication Addressing and Reporting System (ACARS) observations, and
- Automatic Position Reporting System (APRS) surface observations.

Additional details about each data source and the procedures used to ingest these data into ADAS are provided below.

Data Ingest of FAWN Surface Observations

The AMU and NWS MLB wrote and installed programs in July 2001 that obtain FAWN data from the NWS Southern Region web server and convert the data into a format used by ADAS in real time. The FAWN observations are distributed by the University of Florida Institute of Food and Agricultural Sciences and can be found at http://fawn.ifas.ufl.edu. FAWN data consist of temperatures at 2-ft, 6-ft, and 30-ft, dew point temperature measurements at 6-ft, and 30-ft wind measurements every 15 minutes at 21 locations across the central and southern Florida peninsula. Measurements of 10-cm soil temperature, accumulated precipitation, and total incoming radiation are also available. Plans are underway to add more stations to the network in remote locations where surface observations are currently not available in the Florida peninsula.

Data Ingest of ACARS Observations

The AMU and NWS MLB also implemented procedures to obtain ACARS data in real time from the Forecast System Laboratory (FSL) and convert the data into the ADAS format for ingest into the analyses. The data are obtained from FSL using Unidata's Local Data Manager, and then converted to the ADAS format using code developed by the AMU. ACARS data consist of temperature, wind, and occasionally dew point temperature data from commercial aircraft flights. Perhaps the most valuable data obtained from ACARS are the vertical profiles of temperatures and winds generated during aircraft ascents and descents near airports. It is important to note, however, that the amount of ACARS data available to the ADAS analysis can experience a large amount of fluctuations due to varying flight schedules as a function of hour of day and time of year.

Data Ingest of APRS Surface Observations

The AMU and NWS MLB developed a procedure to obtain APRS surface observations from FSL and convert the data into the ADAS format in real time. The APRS surface observations consist of temperature, dew point temperature, winds, and altimeter-setting measurements provided by the APRS Weather Network (APRSWXNET, refer to http://www.findu.com/aprswxnet.html). APRSWXNET is a group of amateur radio operators and private citizens around the United States who have volunteered the use of their weather data for the meteorological community and other interested parties. The APRS infrastructure collects the data transmitted from individual weather stations and communicates these data to a server. The server then organizes the incoming data stream and provides the weather data to FSL at 15-minute intervals. These data are subsequently obtained from FSL every 15 minutes for ingest into the ADAS analyses.

SUBTASK 11 EXTENSION / ENHANCEMENT OF THE ERDAS RAMS EVALUATION (MR. CASE AND MR. DIANIC)

The Extension / Enhancement of the ERDAS RAMS Evaluation is being funded by KSC under AMU option hours. During the course of the evaluation under Subtask 8 (Meso-Model Evaluation), the AMU discovered a systematic low-level cold bias in the RAMS forecasts. In addition, several RAMS forecasts were not successfully run in real time due to various technical issues. As a result, KSC tasked the AMU to re-run historical RAMS forecasts to improve the archived database, and to perform sensitivity tests to identify the possible cause(s) for the model cold bias. Also, depending on the remaining funds in the options hours task, the AMU will explore the possibility of transferring real-time RAMS forecasts to the NWS MLB and SMG offices, and to improve the ENSCO-generated graphical user interface that verifies RAMS forecasts in real time.

The work performed on this task involved continued improvements to the Graphical User Interface (GUI) used to verify RAMS forecasts in real time. The GUI was improved and modified to include an additional display for monitoring the root mean square (RMS) error and bias of RAMS forecast temperatures and dew point temperatures at any of the KSC/CCAFS wind towers. This GUI option can display both the RMS error and bias for the most recent RAMS forecasts, as well as the RMS error and bias for the previous 30 successful RAMS forecasts. These types of error statistics can provide a forecaster with important real-time information about the accuracies in the recent RAMS forecasts within the KSC/CCAFS wind-tower network. Forecasters could subsequently utilize this information about the accuracy of the RAMS model guidance when generating short-range forecast products. A sample display of these error statistics is shown in Figure 2.

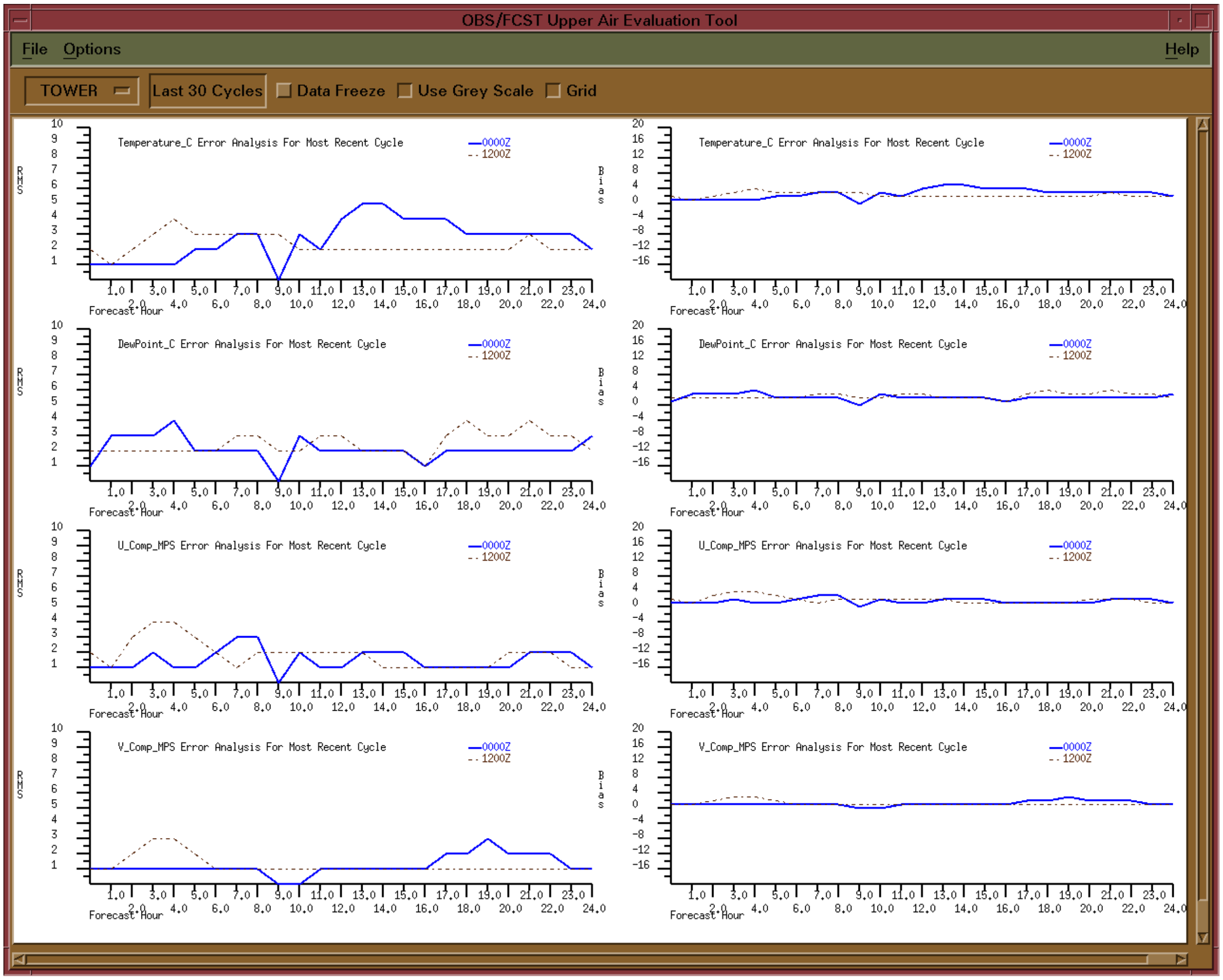

Figure 2. A sample display of the root mean square error and bias statistics for RAMS forecasts from the most recent 0000 and 1200 UTC forecast cycles. A similar display of error statistics is also available for the previous 30 RAMS 0000 and 1200 UTC forecasts.

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

Dr. Merceret began preliminary work on extending his research on wind characteristics from the mid-troposphere to the boundary layer with the development of software to analyze boundary-layer wind change characteristics measured by the 915-MHz profiler network. Dr. Merceret also worked on a HyperSODAR analysis for a journal manuscript that he is preparing along with co-authors, including Dr. Manobianco.

2.5 TASK 001 AMU OPERATIONS

Mr. Wheeler coordinated with NASA and ODIN on the inventory and return of some of the AMU's excess equipment. He worked with NASA procurement on the order and delivery of the AMU PC workstations. The original order that was placed in May 2001 was cancelled because of excessive delays. NASA placed a direct order with Dell Computer Corporation. Because of the delays and lower prices, the AMU's new PCs will be upgraded from the original order. He also continued configuring the LINUX cluster by adding user accounts, updating the software license manager information, and cross-mounting the cluster with external disks in the AMU network.

Mr. Case and Ms. Lambert traveled to Ft. Lauderdale, Florida at the end of July to attend the AMS 18th Conference on Weather Analysis and Forecasting, 14th Conference on Numerical Weather Prediction, and 9th Conference on Mesoscale Processes. Mr. Case presented two posters covering a portion of the objective and subjective evaluation of RAMS within ERDAS. Ms. Lambert presented a poster on the short-range statistical forecasting of cloud ceilings over the SLF. Mr. Case and Ms. Lambert also attended several talks in order to maintain the AMU's knowledge of the latest research and operational developments in the meteorological community.

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
ACARS	Aircraft Communication Addressing and Reporting System
ADAS	ARPS Data Analysis System
AFRL	Air Force Research Laboratory
AFSPC	Air Force Space Command
AFWA	Air Force Weather Agency
AMS	American Meteorological Society
AMU	Applied Meteorology Unit
APRS	Automatic Position Reporting System
APRSWXNET	APRS Weather Network
ARPS	Advanced Regional Prediction System
CCAFS	Cape Canaveral Air Force Station
CSR	Computer Sciences Raytheon
ELV	Expendable Launch Vehicle
ERDAS	Eastern Range Dispersion Assessment System
FAWN	Florida Automated Weather Network
FR	Flight Rules
FSL	Forecast Systems Laboratory
FSU	Florida State University
FY	Fiscal Year
GOES	Geostationary Operational Environmental Satellite
GUI	Graphical User Interface
JSC	Johnson Space Center
KSC	Kennedy Space Center
LCC	Launch Commit Criteria
LDIS	Local Data Integration System
LPLWS	Launch Pad Lightning Warning System
LWO	Launch Weather Officer
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
NWP	Numerical Weather Prediction

List of Acronyms

NWS MLB	National Weather Service in Melbourne, FL
QC	Quality Control
RAMS	Regional Atmospheric Modeling System
RMS	Root Mean Square
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 10 October 2001				
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	On Schedule
	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
Land Breeze Forecasting	Data collection, data reduction, and QC	Aug 01	Nov 01	On Schedule
	Identification and analysis of case studies	Sep 01	Nov 01	On Schedule
	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
Meso-Model Evaluation	Develop ERDAS/RAMS evaluation protocol	Feb 99	Mar 99	Completed
	Perform ERDAS/RAMS evaluation	Apr 99	Sep 99	Completed
	Extend ERDAS/RAMS evaluation	Oct 99	Nov 00	Completed
	Interim ERDAS/RAMS report	Dec 99	Aug 00	Completed
	Final ERDAS/RAMS report	Oct 00	Jun 01	Completed
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	On Schedule
	Memorandum summarizing modified ADAS configuration and task issues	Nov 01	Nov 01	On Schedule
ERDAS RAMS Extension Task	Memorandum summarizing data transfer feasibility to SMG & NWS MLB	Jul 00	May 01	Completed
	Develop data transfer	Sep 00	Mar 01	Completed
	Input of methodology and results into ERDAS RAMS final report	Nov 00	Mar 01	Completed

AMU Project Schedule 10 October 2001				
AMU Projects	Milestones	Scheduled Begin Date	Scheduled End Date	Notes/Status
ERDAS RAMS Extension Task (continued)	Enhancement of verification Graphical User Interface	Apr 00	Oct 01	Behind Schedule–Data recovery took longer than expected
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