

Colorado State University
Center for Geosciences/Atmospheric Research (CG/AR)
Quarterly Report No. 3
by T.H. Vonder Haar and Collaborators

Reporting period: October 1 to December 31, 2002

Cooperative Agreement #DAAD19-02-2-0005

Overview

[Note: For this reporting period, the same technical contents will be submitted under Cooperative Agreements #DAAD19-01-2-0018 and DAAD19-02-2-0005. At the request of the Army Research Laboratory Contracts Office, the new CA began May 8, 2002, overlapping the previous CA by 5 months. By design, the Center for Geosciences/Atmospheric Research activities are phasing into the new CA as they phase out of the previous CA (now to end September 30, 2003).

Numerous research activities occurred during this reporting period. Some of the most significant are listed here.

- Drs. Vukicevic and Jones have made significant progress on the cloudy data assimilation problem and are vigorously pursuing first efforts to include observational GOES IR/VIS data sets within the RAMDAS 4DDA system that employs explicit cloud microphysics and sophisticated remote sensing observational operators developed previously with CGAR support. First tests using simulated GOES IR data sets were successful and are very encouraging. Those results will be briefed at the upcoming CG/AR Annual Review at ARL at Adelphi, MD in January 2003.
- CASC2D-SED continues to undergo upgrades to its capabilities in preparation for an exciting new case study at the EPA California Gluch Super Fund site in Colorado. This will allow for excellent testing of the system capabilities in challenging conditions with excellent verification data sets.
- Dr. Jones and Mr. Forsythe are continuing the validation work of the realtime AMSU 1DVAR water vapor retrieval system. Efforts are underway to convert the system for use over land surfaces to enhance the ongoing microwave emissivity research of Mr. Ben Ruston.
- Several intercomparisons with the CHANCES regional products are making significant progress. This includes use of the AFWA CDFSII cloud products at CIRA, intercomparisons with NASA MODIS information, and additional application and collaboration planning with AFWA.
- CLEX is maturing with several ongoing research activities surrounding the CLEX-9 Nov. 2, 2001 case producing excellent new results (please see the full report for the many

details). Dr. Larry Carey is coordinating a paper that will be submitted for publication within BAMS summarizing the field program. CLEX-9 will be a highlight of that work.

- Aerosol activities are focusing on the effect of thin cirrus on the aerosol retrieval capabilities. Current work includes examining advanced enhancements (such as using Oxygen A-band data) to overcome traditional limitations surrounding the thin cirrus effects.
- Several manuscripts were prepared and submitted this period with regards to the stable boundary layer research from the CASES-99 data set.
- Dr. Campbell continues to collaborate closely with ARL to compare satellite cloud motion and Lidar winds. A special visit was made in November to coordinate these activities.
- The boundary layer research into surface inhomogeneities continues to focus activities on the URBAN 2000 study over the Salt Lake City, Utah area. These new results will be briefed more completely at the CG/AR Annual Review in January 2003.

Many additional research activities also occurred. Please see the following report details for specific research that is ongoing.

Dr. Andrew S. Jones

For more information on the DoD Center for Geosciences/Atmospheric Research at Colorado State University, please access our web page at <http://www.cira.colostate.edu>

**Colorado State University
Center for Geosciences/Atmospheric Research
Scientific Interactions December 2001 to Present**

- Tom Vonder Haar, Ken Eis, et al. with BGen. Johnson, USAF/XOW
- Ken Eis attended NRL Annual Program Review
- Ken Eis briefed AFMC Wright-Patterson AFB Sensor Directorate
- Ken Eis participated in the ARL/CISD Technical Assessment Board (TAB) Review – Dennis Thompson, Bruce Hicks, Eugenia Kalnay, Jon Mercurio, Jim Gantt, N. Radhakrishnan, Dan McMorrow, Bob Dumais, Dennis Garvey, Don Hooch, and Doug Brown
- Ken Eis, Tom Vonder Haar, Stan Kidder, Don Reinke, John Forsythe and Cindy Combs with Drs. John Zapotocny, AFWA and Ed Hume, UPOS/JHU

Research Theme: Hydrometeorology

Administrative

No actions during this period.

Research activity and/or results

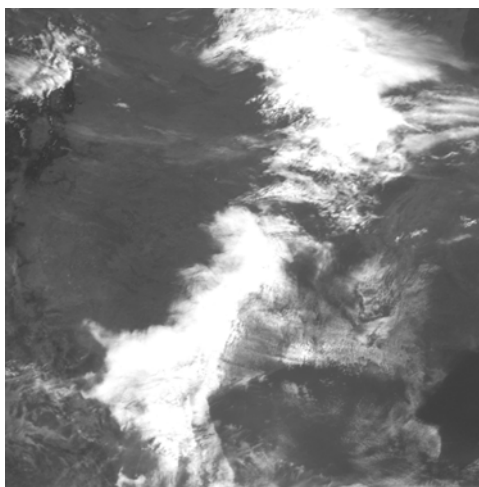
Dr. Andrew Jones

A manuscript draft of the Microwave Land Surface Model (MWLSM) observational operator work is still in progress for submission to the *J. Hydrometeorology*.

Began initial processing of the May 2, 1996 GOES 4DVAR case study. Preliminary results of the merged GOES/RAMDAS projection are now available and will be shown at the CGAR Annual Review in early January. There are still some projection definition inconsistencies and the RAMDAS/DPEAS interface has not yet been defined. I will be working with Tomi Vukicevic to complete this phase of the work.

4DDA case study (May 2, 1996)

GOES-9
Visible
RAMDAS
Projection
(via DPEAS)



DoD Center for Geosciences/Atmospheric Research at Colorado State University Annual Review Jan 7-9, 2003

Phil Stephens has completed the second phase of his work with the discrete BG code. This work is fundamental to the AMSR and AMSU work. Phil is now extending that work to 2D fields. Up to this point, we've used only theoretical antenna patterns and scenes. The likely first application of this method would be for the AMSU WV/emissivity retrieval work.

Prof. Pierre Julien

The CASC2D-SED channel routing has been modified to allow for channel cells connected in 8 possible directions. A new module on metals transport is going to be added to the CASC2D-SED hydrological and erosion model. The EPA California Gulch Superfund site in Colorado has

been selected to apply this new module. GIS raster and vector data, remote sensing and orthodigital photos data of the site have been collected. Two field trips provided us with site pictures and soil samples.

Rosalia Rojas attended two meetings at the USGS Denver Federal Center in preparation for a workshop to be given at the Meeting of the American Society of Mining Reclamation and the Billings Land Reclamation Symposium, to be held in Montana in June 2003.

Dr. Jorge Ramirez

We have continued the development of a physical, mechanistic hillslope hydrology model. A previously developed overland flow model that implements the full hydrodynamic flow equations has been improved to include a one-dimensional implementation of Richard's equation for infiltration, and a two-dimensional erosion and sedimentation algorithm. The new model allows, previously impossible, investigations into the impact of fine-, small-, and meso-scale variability of many physical characteristics of the hillslope (e.g., soil moisture, erosivity, etc.) on distributed hillslope rainfall-runoff characteristics and landscape morphology. We use the new model to examine how plot size and rainfall event length affect the influence of hillslope discretization on rainfall/runoff response.

David Raff, Department of Civil Engineering, successfully defended his PhD research and graduated. His dissertation entitled "Evolution of Drainage Networks and Hillslopes" was submitted to the Graduate School.

Travel

None during this period.

Technology transfer

The Discrete Backus-Gilbert (DBG) paper is now published in *IEEE Trans. Geosci. Remote Sensing* (see the attached publication list for the full reference). Copies of the journal and conference papers are available online at:
<http://lamar.colostate.edu/~asjones/Jones/Publications.htm>

Equipment/systems status

None during this period.

Research Theme: Cloud Structure, Dynamics and Climatology

Administrative

No actions during this period.

Research activity and/or results

John Forsythe

Coordinated with Dr. Darren McKague (who left CIRA employment at the end of November) and took over control of his realtime AMSU systems, in cooperation with Dr. Andy Jones. Took extensive notes on existing code on Dr. McKague's system so we could take custody of it.

Continued software development and science analysis for comparison of MODIS cloud mask with CHANCES regional products. First results look promising. Continued writing sections of the paper "Development of Regional Cloud Statistics from the CHANCES Satellite Database and Comparison with MODIS Cloud Mask" with Reinke et al.

Collaborated with Darren McKague on examining performance of AMSU global water vapor retrieval as compared to independent SSM/I and ATOVS measurements. The prototype real-time retrieval system is running. Several experiments and adjustments performed relating to covariance matrices and first guesses.

Continued maintenance of CIRA's Radiative Transfer Toolbox website, fixed several links.

Realtime CHANCES "Reconnaissance Denial Time" website implemented late November. Product was shown to Eis and Vonder Haar.

Submitted or assisted on several CGAR-related papers for the 12th AMS Satellite Meteorology and Oceanography Conference to be presented in February, 2003.

J. Adam Kankiewicz

The archiving of Cloud Depiction and Forecast System (CDFS II) data has begun at CIRA. We have been receiving and archiving these data via ftp push from AFWA since 12 Dec 2002. I have written IDL code that can access and plot CDFS II data and am currently working on IDL code that will regrid the CDFS II data onto the CHANCES map projection. The native CDFS II data format is GRid in Binary (GRIB) and is currently read and write-accessible here at CIRA.

Larry Carey and Larry Belcher have been obliged with further CLEX-9 data and support with both data processing and quality control issues. I have also given input into the CLEX overview journal article that Larry Carey is currently coordinating for publication. John Forsythe has been provided with continued programming help with the MODIS cloud mask data being used for the cloud climatology paper that John is working on.

I have continued to work with Jim Jones and have provided him with GOES data collected during the CLEX-9 field campaign. Work has been finished on the CLEX-MODIS cloud phase

comparisons from the 13 June and 14 Oct 2001 CLEX field campaign days. Our in-situ observations compare favorably with the regions identified as mixed phase and liquid water by the MODIS cloud phase algorithms. We are planning on incorporating these results into the CLEX-overview journal article currently being scripted.

I have continued to work with Curtis Seaman by identifying data quality control issues with in-situ data from the CLEX-9 field campaign.

N-Dimensional Data Assimilation and Fusion work:

Work has continued on the 2 Nov 2001 CLEX-9 4DVAR study. The ETA model initialization data has been compiled into the 4DVAR system and initial forward modeling studies are continuing. Various sensitivity studies have been run on the 2 Nov 2001 CLEX-9 day including variation of the model's vertical resolution. Preliminary results indicate that RAMS 4.29 is capable of forming an all ice cloud when the vertical resolution is smaller than a critical level. What exactly influences this critical level is not known at this time and is being studied further. Simulations are also being run to determine if RAMS 4.29 is capable of generating a mixed phase cloud similar to that observed on 2 Nov 2001 during CLEX-9.

Dr. John M. Davis, CLEX Leader

Work continued on inferring cloud microphysical properties from the surface data collected during CLEX-9, particularly for the Nov. 02, 2001 case. A bi-product of this work is the result indicating that bi-spectral or tri-spectral methods have the potential for diagnosing mixed phase microphysics when passive infrared radiance measurements made at the surface are combined with corresponding measurements made near cloud base.

Prof. Larry Carey continued the analysis of the Airborne Cloud Radar data collected during CLEX-9. He and his graduate student, Mr. Larry Belcher, are assessing the effects of attenuation by water vapor, liquid water and ice on the radar signals. They are also performing careful geographical registration of the radar data with observed cloud properties in order to avoid misinterpretation of the data. These efforts will result in a "Beta" version of the radar data permitting realistic cloud property retrievals.

In addition Prof. Carey has obtained preliminary acceptance for publication of an article in the Bulletin of the American Meteorological Society summarizing the CLEX-9 experiment and initial findings.

Prof. Vince Larson is continuing his simulations of mid level clouds. A primary question at present is: How is the evolution of altocumulus clouds influenced by entrainment through cloud base? This is a different question than normally asked of stratocumulus, where it is more important to know entrainment through cloud top. In addition, he has submitted a paper to Journal of the Atmospheric Sciences entitled "Prognostic Equations for Cloud Fraction and Liquid Water, and their Relation to Probability Density Functions." Such equations, if properly formulated and modeled, could help in the parameterization of mid level clouds.

Mr. Adam Kankiewicz began a new effort in collaboration with the N-DDA group in CG/AR to use data assimilation and adjoint modeling techniques as a tool in diagnosing deficiencies in

mesoscale model forecasts of mid-level, mixed-phase clouds. His initial results focused on increasing the model's vertical resolution, which resulted in an improvement in the original forecast of the Nov. 2, 2001 CLEX-9 cloud case.

Capt. James Jones, USAF, is finalizing his research efforts for comparing various methods of remotely sensing cloud top height from GOES measurements. This research will fulfill part of his requirements for a Masters of Science Degree at the Dept. of Atmospheric Science at Colorado State University. His latest results include application of data assimilation techniques quantify the errors in the methods of cloud top height determinations.

Don Reinke

CHANCES Regional Products

The process of sectorizing the Middle East sector is now complete through, and including, December 2002. The sector, taken from the Meteosat-5 data set that has been archived by CIRA, includes data from March 1999 – present. These data are all on-line on the CHANCES terabyte server, and have also been archived to DVD (uncompressed) and CD (compressed) media. Jpeg files of both visible and infrared images have also been generated for all months. These image files can be easily converted to mpeg movie loops (as demonstrated at the last review – these loops can be used as training aids for forecasters and operations personnel).

R&D on the regional products application has focused on the refinement of the infrared background product and the application of improved cloud/no cloud analysis.

I modified the Temporal Differencing test to include the use of both the Land Use and Digital Elevation data. These data are both available at 1 km resolution and are remapped into the CHANCES RP 5-km grid. Initial work has produced diurnal IR background temperature curves that are stratified by both land type and elevation. These curves will be used as the basis for applying the improved Temporal Differencing test. Initial results are quite promising.

I have also prepared a detailed presentation for a planned trip to the Air Force Weather Agency Headquarters in Omaha. The focus will be on the application of RP products to training, simulations, and operational forecasting. The examples to be presented are all from the middle east sector.

Contacts at AFWA have been established to receive CDFS II output data. These data will be compared with our CHANCES RP data for the same period to identify biases that may exist in either data set, and to explore the possibility of using the higher spatial resolution of the RP data to enhance the CDFS II output. CDFS II data are sent regularly to our ftp server and have been stored from December 12 to present.

I have completed about 80% of a draft journal paper describing the CHANCES RP products and applications.

Cynthia Combs

CHANCES Regional Products

Obtained NCEP Reanalysis data and processed wind information from grib files for January 2001. Wrote up procedure for processing future months.

Using wind information from NCEP Reanalysis data, have developed and tested code for dividing CHANCES cloud frequency data into wind regimes and produced products for January 2001 over the Afghanistan sector.

Presented previous wind regime climatology work to Dr. Zapotocny from Air Force Weather Agency (AFWA) and Ed Hume from University Partnering for Operational Support (UPOS) on November 7, 2002. Also included ideas of how to make similar products using CHANCES and NCEP Reanalysis data.

Matt Rogers

After completing and passing the Ph.D. qualifying exams in October, began 'spin-up' activities with regard to researching the detection and quantification of supercooled water in mixed-phase, mid-level clouds. I plan to use CLEX data (working with Dr. John Davis) to address this problem.

Dr. Vincent Larson - University of Wisconsin-Milwaukee

There are two undergraduate students who are assisting on this project, Cory Behnke and Brian Griffin. We have been modifying the new Weather and Research Forecast (WRF) model to do high-resolution simulations of altocumulus clouds. We have experimented with the subgrid eddy diffusivity scheme in WRF and are performing test simulations of well-studied boundary layer cases, which required adding code to impose surface heat and moisture fluxes. Preliminary simulations of an altocumulus cloud measured during CLEX-5 have been run. We have begun to write software to analyze the results of our simulations and have also set up software to back up our computer's hard drive onto DVDs. Graduate student Chris Sears maintains the computer cluster built previously.

Dr. Lawrence Carey and Larry Belcher - North Carolina State University

Developed software to peruse, display, and analyze the University of Wyoming King Air (UWKA) microphysical (in-situ) probe data and Wyoming Cloud Radar (WCR) data. This software has made possible the visualization of time-series microphysical data along side radar data, aiding in the selection of case studies and the formulation of statistical algorithms.

Posted "quick-look" images of WCR data on the World Wide Web (<http://www4.ncsu.edu/~ldcarey/radarlab/sample.html>) and delivered CD-ROM version of images to CG/AR.

Manual classification of flight lines based on UWKA flight level data and WCR data. Each flight line of the entire CLEX-9 data set has been documented and classified. An MSExcel spreadsheet with details was delivered to CG/AR.

Preliminary case study analysis and quality control of UWKA and WCR data from CLEX-9 suggests a consistent picture of mid-level clouds with supercooled liquid water peak typically near cloud top and ice maximum beneath. Furthermore, early evidence indicates that some enhanced cells have mixed phase characteristics through a deep layer pointing to importance of horizontal variability.

Study of radar attenuation at 95 GHz (3 mm) for typical mid-level, mixed-phase (i.e., CLEX) cloud conditions to assess need for attenuation corrections. Attenuation from water vapor in typical conditions is significant (> 1 dB) only for over very large paths (5-10 km) and is relatively easy to correct using aircraft and/or radiosonde thermodynamic data. However, attenuation due to cloud water droplets can be significant (several dB per g m^{-3}) and may require corrections. The contribution to attenuation from cloud ice is insignificant for most CLEX cloud conditions (i.e., typical ice water contents and path lengths).

Wrote a 3-abstract proposal to the Editor of the Bulletin of the American Meteorological Society (BAMS) for an overview article on CLEX and CLEX-9. The BAMS Editor accepted the proposal and the article is now in preparation.

Travel

None during this period.

Technology transfer

None during this period.

Equipment/systems status

John Forsythe

Other than routine backups, system performing normally. Spent two days with a network failure, but it was repaired by Karl Renken.

Research Theme: N-Dimensional Data Assimilation and Fusion

Administrative

No actions during this period.

Research activity and/or results

Drs. Vukicevic and Jones have made significant progress on the cloudy data assimilation problem and are vigorously pursuing first efforts to include observational GOES IR/VIS data sets within the RAMDAS 4DDA system that employs explicit cloud microphysics and sophisticated remote sensing observational operators developed previously with CGAR support. First tests using simulated GOES IR data sets were successful and are very encouraging. Those results will be briefed at the upcoming CG/AR Annual Review at ARL at Adelphi, MD in January 2003.

Dr. Milija Zupanski

RAMDAS system has been tested in more detail. Some issues regarding the Hessian preconditioning were examined and partially corrected. Results with the basic version of RAMDAS are being prepared for publication, focusing on the system algorithm presentation and optimization performance.

Travel

None during this period.

Technology transfer

None during this period.

Research Theme: Chemistry, Aerosols and Visibility

Administrative

Prof. Sonia M. Kreidenweis and Dr. Laurent Labonnote

Accepted Ph.D. student Ping Du was unable to get a visa from China to study in the U.S., therefore her acceptance to CSU was therefore rescinded. Applications for a Fall 03 graduate student will be looked at in early 2003.

Research activity and/or results

Prof. Sonia M. Kreidenweis and Dr. Laurent Labonnote

Dr. Laurent Labonnote worked on the quantification of the effect of the presence of sub-visible cirrus cloud on aerosol retrieval from satellite data. In order to answer the question, "How thin must a cirrus cloud be, so as not to interfere with the aerosol optical parameters retrieval?", he simulated the light reflected at the top of the atmosphere by the ocean-atmosphere system, taking into account a very thin cirrus layer above an aerosol layer. The goal was then to quantify the error introduced by the presence of such a sub-visible cirrus cloud on the retrieved aerosol parameters as a function of the cirrus optical depth. Results show that even cirrus as thin as $\tau=0.02$ can introduce a significant error of 20% on the retrieved optical parameters, pointing out the essential problem of the cloud mask detection. For example, the MODIS water vapor band at $\lambda=1.37$ microns, currently used to detect sub-visible cirrus, cannot identify cirrus below $\tau=0.05$. This optical depth is much larger than the minimum that we found to have a significant effect on the aerosol retrieval. Our findings point out the necessity of improving instrument characteristics, and / or the need to develop new method for detection. One possibility that we propose is to use high resolution O_2 A-band measurements in order to detect very thin cirrus, with optical depths as low as $\tau=0.01$. These possibilities will be considered further in upcoming work.

Dr. Rob Newsom and Dr. Yelena Pichugina

Continued research on stable boundary layers from the CASES-99 data set. During this period, continued to examine the influence of the convective boundary layer during the preceding afternoon, surface cooling rates near sunset, geostrophic winds, and baroclinicity on low-level jet structure. We have also collaborated with other investigators to examine low-speed streaks, gully surges and gravity waves observed during CASES-99. Several manuscripts were prepared and submitted, as follows:

- Chai, T., C. L. Lin, R. K. Newsom 2003: Retrieval of Microscale Flow Structures from High Resolution Doppler Lidar using an Adjoint Model. *J. Atmos. Sci.*, submitted.
- Drobinski, P., P. Carlotti, R. Newsom, R. Foster, R. Banta, J. Redelsperger, 2003: Review of near-surface flow dynamics in the neutral planetary boundary-layer from a CASES'99 case study. *J. Atmos. Sci.*, submitted.
- Fritts, D. C., C. Nappo, D. M. Riggins, B. B. Balsley, W. E. Eichenger, R. K. Newsom, 2003: Analysis of Ducted Motion in the Stable Nocturnal Boundary Layer during CASES-99." *J. Atmos. Sci.*, submitted.

Travel

Dr. Rob Newsom

Invited to Arizona State University in Tempe, Arizona, November 19-21 (travel funded by another source).

Technology transfer

Dr. Rob Newsom

Presented informal seminar on initializing LES with lidar data, 4DVAR at Arizona State University, Environmental Fluid Dynamics.

Two papers were published during this period in Boundary Layer Meteorology entitled “Nocturnal low-level jet characteristics over Kansas during CASES-99” and “Intermittent turbulence in stable boundary layers and its relationship with density “currents.” (See full references in the attached publication list.)

Equipment/systems status

None during this period.

Research Theme: Remote Sensing of Battlespace Parameters

Administrative

Prof. Mahmood R. Azimi-Sadjadi

An offer was made to a masters applicant; Ms. Amanda Falcone will start in Fall 2003. I am also looking for a Ph.D. student to work on the project.

Research activity and/or results

Dr. Stanley Kidder

I submitted an extended abstract for the 12th AMS Conference on Satellite Meteorology and Oceanography which will be presented as a poster at the conference in February.

On November 4th, I met with Major Pete Roohr (Director of Operations, 88 WS, Wright-Patterson AFB) and Dr. Frank Eaton (AFRL) about the possible use of AMSU data to detect stratospheric turbulence

I also met with Dr. John Zapotocny (AFWA Chief Scientist) during his November 7th visit to Colorado State University about the possibility of transferring some of our GOES products to AFWA.

Benjamin Ruston

Have developed and implemented an observational approach to retrieve the land emissivity at microwave frequencies. The analysis includes the land surface temperature, and temperature and moisture profiles from Numerical Weather Prediction (NWP) models along with passive microwave observations from a network of four satellites. The satellites used are the DoD-Defense Meteorological Satellite Program (DMSP) satellites F-13, F-14, and F-15 along with the NASA-Tropical Rainfall Measurement Mission (TRMM) which all harbor conically scanning passive microwave imagers. The data used span the summer months June, July, and August of 1999-2002.

I have been successful in producing monthly emissivity results using both the DoD-Navy Operational Global Atmospheric Prediction System (NOGAPS) and NCEP-Rapid Update Cycle (RUC) models along with the satellite brightness temperatures. Diagnostics of the retrieval technique are now being performed. Evaluations of the sensitivity to different models, and to the individual satellites have been completed. The mean and variance of the land emissivity has been categorized by vegetation type, and a greater sensitivity to vegetation at the lower frequencies has been reported. The examination of screening methodology is underway which compares a microwave alone screening method against IR cloud screens. Also underway is correlation of land emissivity to rain events.

The goal of this research is to improve the statistics on ground emissivity in the microwave spectrum. This will lead to better NWP model parameterization of the surface and the atmosphere, more specifically the soil moisture, and low-level water vapor fields. Future goals

are to extend the method all months and produce results at additional frequencies using cross-track scanners such as the NOAA-Advanced Microwave Sounding Unit (AMSU).

Dr. G. Garrett Campbell

Planned a small cooperative experiment with Young Yee, ARL, to compare satellite cloud motion and winds with Lidar and other ground observations. The experiment will involve several days in January and February 2003 with detailed observations at Blossom Point, Maryland. The comparison experiment should allow a two way transfer of technology between ARL and CIRA. We will gain a better understanding of surface based measurements in the context of satellite observations. ARL will gain experience in the use of satellite observations and be trained to run the automatic stereo analysis system.

Improvements were made to the stereo analysis software for delivery to ARL, which will be tested in the experiment.

Prof. Roger Pielke, Sr., Dr. Adrian Marroquin, Maj. Tim Nobis and Giovanni Leoncini

In order to continue research on the influence of surface inhomogeneities on the planetary boundary layer (PBL) circulations, we have chosen to investigate the urban influences on the PBL development. For this purpose, we will use data from the U.S. Department of Energy's Chemical and Biological National Security Program (CBNP) URBAN 2000 tracer and meteorological study and from the Vertical Transport and Mixing (VTMX) campaign that took place in October 2000 over the Salt Lake City, Utah, area. A preliminary test of RAMS initialized with output from the operational Rapid Update Cycle (RUC 20 km) model was performed with a three-nested grid configuration with initial conditions at 2200 MST 14 October 2000. The grid spacing of the innermost grid (centered on Salt Lake City) is 50 m and its domain covers 15 km x 15 km. This test was conducted to investigate the appropriate numerical model background that will be used with other VTMX data for ingest into the Local Analysis and Prediction System (LAPS) developed at FSL. We chose the 14 October 2000 case that, during the night, was characterized by a stable environment, clear skies and very well developed drainage flow. The RAMS model begins to generate the drainage flow early into the simulation (after 30 minutes) which indicates that given an appropriate numerical model, the spin up problem can be reduced considerably. Other tests will be conducted with output from the operational Eta model from NCEP. Since the data ingest into LAPS requires specific formats, an effort is now under way to preformat the VTMX data.

Maj. Tim Nobis

Solidified research direction and prepared a presentation for the CG/AR Annual Review to be held early in January in Adelphi, Maryland. I plan to run a high resolution mesoscale model over an urban area (Oklahoma City) and test the model's sensitivity to initialization and urban parameterization. I also intend to explore the use of ensemble (multiple model runs) to try and frame forecast uncertainty. Efforts during this report period consisted largely of background readings to familiarize myself with the various techniques available.

Giovanni Leoncini

In order to evaluate the Laplacian of the Exner function for the RAMS equations and compare the result with Dalu et al. (2000), most of the effort during this period was devoted to

understanding how to compute derivatives taking into account map and terrain factors. Once this was done, a hydrostatic option was developed and is currently under testing. The capability of taking derivatives has also allowed the possibility of customizing 3D sensible heat.

Prof. William Cotton, Russell Chibe and Gustavo Carrio

Russell Chibe has continued to make progress on his research. The goal of this research is to determine if fog can be accurately forecast in the 12- to 24-hour range at local scales using the RAMS 4.3.0 realtime model. Russell modeled five different fog events using Eta 80-km data. The results were somewhat disappointing, with only one case yielding results which closely matched observations. Analysis suggests that the poor results are related to poor initialization, and as such Russell will repeat the model runs with Eta 40-km data. This past semester, Russell completed two required classes and audited Dr. Cotton's cloud dynamics course. At this point, Russell has completed all required classes, and as such is carrying no course load for the spring. Russell hopes to complete his research this semester and defend his thesis in July or August.

Travel

Dr. G. Garrett Campbell

A short visit was made to ARL in Adelphi, November 11-14, to meet with Young Yee and Dennis Garvey. Details of the comparison experiment were discussed (travel funded by another source).

Technology transfer

None during this period.

Equipment/systems status

Prof. William Cotton, Russell Chibe and Gustavo Carrio

Throughout the last quarter, Todd Gamber has completely upgraded our clustering capabilities under support of the CG/AR. We are now running 14 dual-processor "AMD AthlonMP 1600+" systems, including the master node. This upgrade involved completely overhauling, reorganizing, and rebuilding the environment in which our cluster operates. Among hardware improvements is a theft-deterrent cable locking system to secure our machines. In addition to the changes/upgrades in hardware, we have upgraded the software which helps to administrate each node in the cluster. The major components are: a DHCP server to dynamically name the machines, a DNS server to provide name queries, NFS file serving for centralized file storage, and NIS information serving for synchronization of user and system status. Each system is running RedHat Linux 8.0.

Todd Gamber reports that with help of the new hardware, we now have a very robust system, with longer "uptimes," easier administration procedures, and more scalability.

Research Theme: Technology Transition and Interactions

Administrative

No actions during this period.

Research activity and/or results

Ken Eis

Completed the following three white papers for potential supplemental funding:

“Homeland Defense Experiments in Toxic Material Dispersion” with Roger A. Pielke;

“High Resolution Conditional Satellite Climatology Training Tools (HRCST)” with Bernadette Connell and Cynthia Combs; and

“Improved Weather Simulation System” with Donald L. Reinke and Tomislava Vukicevic.

Nearing completion is another white paper with Milija Zupanski entitled “Assessing the Impact of Observation and Model Resolution in Advanced Satellite Data Assimilation.”

Travel

None during this period.

Technology transfer

(See appropriate sections under the other research theme headings.)

Equipment/systems status

No report this period.