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**ATMOSPHERIC NUMERICAL MODELING RESOURCE
ENHANCEMENT AND MODEL CONVECTIVE PARAMETERIZATION/
SCALE INTERACTION STUDIES**

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Program Director:

Donald J. Perkey, Ph.D.

Submitted to:

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FINAL PROGRESS REPORT

ATMOSPHERIC NUMERICAL MODELING RESOURCE ENHANCEMENT AND MODEL CONVECTIVE PARAMETERIZATION/ SCALE INTERACTION STUDIES

NAS8-37141

October 28, 1987 - December 31, 1993

Visiting Scientists and Research Associates

Ms. Jayanthi Srikishen and Ms. Vada LaFontaine completed their appointments as Research Associate II's on this contract.

Mr. Mathew Smith served as a Visiting Scientist to work as the Applications Consultation focal person with the Earth Science and Application Divisions Data Systems group. He assisted in solving local and remote user problems for USRA and MSFC scientists. Mr. Smith was responsible for running the McIDAS Users' Group Meetings at MSFC.

Dr. Jeh Won Lee served as a Visiting Scientist to investigate the Hubble Space Telescope problem, May 1, 1990. He downlinked the flight data to the VAX and its frequency characteristic was analyzed using a power spectrum density plot. The effect of a solar array dynamics on the main body dynamics was studied using TREETOPS model and the point controller was redesigned. His work focused mainly on the verification and application of the TREETOPS model which was a time history simulation program for a flexible multi-body dynamics.

Dr. Young Kim was appointed as a Visiting Scientist through July 1993, to develop a Multi-body Modeling Verification and Control (MMVC) System. The dynamics simulation and control system design of multi-body structures was performed using the NASTRAN, MATLAB and TREETOPS, which is a multi-body dynamics control simulation. He performed a structural dynamic analysis of the flexible dipole antenna. He developed a solar x-ray imager (SXI) telescope design; a dynamics simulation and control model of the SXI with interaction of the Geostationary Operational Environmental Satellite (GOES) spacecraft, and a preliminary pointing control analysis of the SXI by using NASTRAN and TREETOPS. He participated in the Error Budget Team of the SXI telescope design, and studied the X-ray Positioner (XRP) and Solar Array Stability.

1. Activities Performed

Ms. Jayanthi Srikishen assisted scientists in developing numerical models. During this project, Ms. Srikishen generated read tapes on many machines, such as the IBM and the VAX. She compiled file transfers between the VAX & the IBM and the VAX & the PC. She has designed and maintained databases consisting of users on the EADS system and made them readily available for all users. She has demonstrated programs for the CRAY on the EADS for the user community and helped users with problems.

She worked on the GENESIS and GCM Models on the CRAY. She conducted modifications to the RAMS Model and implemented the LAMPS90 on the CRAY X-MP.

Ms. Srikishen utilized the graphics package "GRADS" for visualizing the model output on the LAMPS Model. She also consistently trained scientists and others to use the updates and all new computing packages and the data storage facility under EADS II. She installed the NCAR Community Climate Model to the CRAY Disk at MSFC. She served as troubleshooter and assisted users in debugging and solving problems.

Ms. C. Vada LaFontaine focused her participation on assisting scientists in the WetNet development and supporting hardware setup, its policies and promoting data availability. She continued to support WetNet scientists on hardware and software problems and McIDAS command questions. She completed the WetNet manual tutorial and participated in several WetNet training sessions throughout the United States. The WetNet group produced a series of datasets and Ms. LaFontaine supervised the reproduction and distribution of these datasets to all WetNet System Scientists.

2. Workshops and Consulting

The following consultants were retained by USRA to provide services. The consultants and their activities are listed below in alphabetical order.

Dr. William Boeck from Niagara University was appointed to attend the Hydrologic Data Access and Archive Working Group (HDAAWG) meeting at NASA/MSFC, June 29-30, 1989. He attended the HDAAWG October 22-24, 1991, and again in June 29-30, 1993.

Dr. V. Chandrasekar from the University of Alabama in Huntsville was appointed to serve as a 1989 Summer Visitor to conduct research on Dual-Polarized/Doppler Radar, May 2-June 2, 1989.

Dr. Charles Cohen presented a seminar in MSFC's Earth Sciences and Applications Division regarding his research at The Pennsylvania State University, November 8-9, 1988.

Mr. Dave Dooling from Huntsville, Alabama, was appointed to attend the 1993 Hydrologic Distributed Active Archive Center Working Group (HDAACWG) meeting, June 29-30, 1993, to take detailed notes and audio taping for preparation of a report that focused on major points discussed and to provide a reference for follow-up on action items. He also attended the WETNET meeting in Salt Lake City, Utah, September 20-22, 1993, for the same purpose.

Dr. Robert Eli from West Virginia University was authorized to travel to Logan, Utah, September 19-23, 1993, to participate in the WETNET meeting.

Dr. G. David Emmitt from Simpson Weather Associates, Inc., was authorized to travel to NASA/MSFC to attend the HDAAWG meeting, June 29-30, 1993. The scope of effort was to review accomplishments to date and make recommendations for the EOSDIS DAAC FY '93 proposal.

Mr. James Ferriday from the University of Colorado, attended the WETNET Meeting September 18-23, 1993, in Salt Lake City, Utah.

Mr. David Hiatt from Software Technologies, Inc., traveled to MSFC to present a seminar entitled, "Current and Future Optical Storage Technology," in the Earth Science and Applications Division and to consult with members of the WETNET project on an optical disk device driver, May 19-21, 1993.

Mr. Ron Koczor from Fort Wayne, Indiana, visited NASA/MSFC to hold discussions with the Earth Science and Applications Division personnel regarding hardware development for future planned visible/IR satellite sensor systems, December 18, 1988. He later returned March 1-4, 1989, to hold discussions on hardware development plans for the Earth Observing System and Geoplatform.

Dr. John Latham from Manchester, England, was appointed to work with Dr. Hugh Christian on research directed toward assessing the value of the lightning mapper sensor. The date of his appointment were June 5-12, 1989, and his effort included:

- a) performance of laboratory experiments designed to establish the importance of the non-inductive ice-ice mechanism of charge transfer in thunderstorm electrification/lightning production;
- b) examination of field data from airborne studies of lightning producing clouds;
- c) theoretical/modeling studies of thunderstorm electrification; and
- d) application of model, when developed, to lightning occurrence over a wide range of climatological conditions.

Mr. Jeh Won Lee from Atlanta, Georgia, visited NASA/MSFC to give a seminar on his thesis research to the Control Systems Division, July 19, 1993.

Dr. Hwei-Iin Lu from Tallahassee, Florida, traveled to NASA/MSFC to give a presentation, November 7-8, 1988.

Ms. Gueta Mezzetti from Washington, D.C., was appointed to hold discussions with various nationally based environmental groups, agricultural organizations and university research groups in order increase their awareness of the nature and potential applications of data which may be available via NASA's Mission to Planet Earth Program and EOSDIS. Additionally, the purpose was to have discussions to generate interest among the groups in the objectives of Mission to Planet Earth, and to identify viable mechanisms for disseminating data from EOS and proposed Mission to Planet Earth to those interested communities. The period of appointment was September 1, through December 30, 1989.

Dr. Terry Nathan from Iowa State University, was a Summer Visitor in the 1989 program for a period of 2 weeks starting June 19, 1989.

Dr. Donald J. Perkey from Drexel University was appointed to hold scientific discussions with Drs. Robertson, Kalb, Jedlovec and Chang, regarding studies with the LAMPS model, July 26 through August 1, 1988. He returned from September 7, through September 9, 1988, and April 25-27, 1989, for the same reason.

Dr. Murry Salby from the University of Colorado, was authorized to travel to NASA/MSFC to present a seminar to the Earth Sciences and Applications Division and to hold research discussions with USRA and NASA personnel on his research, June 5-7, 1989.

Dr. Eric Smith from Florida State University and Dr. Jeffrey Star from the University of California-Santa Barbara, were authorized to travel to NASA/MSFC several times to attend the HDAAWG meetings to review accomplishments and make recommendations for the EOSDIS DAAC FY '93 proposal, October, 22-24, 1991, December 16-18, 1992, and June 29-30, 1993.

Dr. Frank Wentz from Santa Rosa, California, was authorized to travel to travel to NASA/MSFC to attend the HDAAWG meeting to review accomplishments and make recommendations for the EOSDIS DAAC FY '93 proposal, December 16-18, 1992.

Dr. Frank B. Vaughn from Huntsville, Alabama, was appointed September 7 through December 7, 1989, to perform the activities described in Appendix I.

3. Subcontracts

USRA entered into a subcontracting relationship with Mesoscale Environmental Simulations and Operations, Inc., from February 9, 1987, through July 22 1991. Key personnel were Kenneth T. Waight III, J. Aaron Song, John W. Zack, and Pamela E. Price. This subcontract entitled, "Model Studies on the Role of Moist Convection as a Mechanism for Interaction Between the Mesoscales," was a three year research effort to develop techniques to improve the numerical prediction of cumulus convection on the meso- β and meso- γ scales. Two MESO models were used, the MASS (mesoscale) and the TASS (cloud scale) models. The primary meteorological situation studied was the June 28-29, 1986 COHMEX case study, in which significant mesoscale precipitation occurred over the COHMEX study area on a day with relatively weak large scale forcing.

Five conference preprints were produced as a result of this effort:

Song, J. A., "A Divided Meso-beta Scale Convectively Explicit Simulation," *Weather Analysis and Forecasting*, Monterey, American Meteor. Soc., 569-574, 1989.

Waight, K. T., J. W. Zack, and V. M. Karyampudi, "The Need for Enhanced Initial Moisture Information in Simulations of a Complex Summertime Precipitation Event," *The 12th Conference on Weather Analysis and Forecasting*, Monterey, American Meteor. Soc., 121-124, 1989.

Song, J. A., "A Numerical Investigation of an Enhanced Rainfall Due to Multi-Scale Processes Observed on June 28 of COHMEX," *The Conference on Operational Precipitation Estimation and Prediction*, Anaheim, American Meteor. Soc., 1990.

Song, J. A., and M. Kaplan, "Thunderstorm Initiation as a Result of Scale-Interactions," *The Fourth Conference on Mesoscale Processes*, Boulder, American Meteor. Soc., 102-103, 1990.

Waight, K. T., and J. W. Zack, "An Analysis of a Small Mesoscale Convective System During COHMEX," *The Fourth Conference on Mesoscale Processes*, Boulder, American Meteor. Soc., 100-101, 1990.

Song, J. A. and M. L. Kaplan, "Observation and Numerical Simulation of a Convective Initiation During COHMEX," NASA Technical Memorandum, 1990.

Also produced as a result of this subcontract:

1. A MASS Preprocessor User's Guide and the MASS Model User's Guide, documentation for MASS.
2. The TASS User's Guide, documentation for the TASS Model.

A Final Report which describes MESO's accomplishments remains on file at the USRA Corporate Drive Office in Huntsville, Alabama.

USRA entered into a subcontracting relationship with Utah State University, September 1993, to provide logistic support for the NASA WETNET Meeting which was held at Utah State University Conference and Institute Division.

4. Financial

Total Contract Value:	\$1,812,469
Total Cumulative Costs and Fee:	\$1,667,439
Estimated Residual:	\$ 348

The cumulative costs incurred are representative of the estimated percentage of physical completion of the contract based on incremental funding of \$1,667,787.

APPENDIX 1

USRA NAS8-37141 Task
Activity Report

During this period efforts were mainly devoted to the following activities:

(1) Reviewing and incorporating the atmosphere models developed within or under sponsorship of the MSFC Earth Science and Atmospheric Division into the AIAA Atmosphere Model Guideline Document. The task has enabled support for retyping and editing of various parts of the document. It has now been finalized and provided to AIAA for final approval and publication.

(2) Dr. Jeff Anderson and I have collaborated on the preparation of a paper for presentation at the International Conference on Environmental Risk Analysis. It is entitled "Management of Environmental Risk".

(3) Some time has been devoted to the preliminary review of a couple of chapters for the Terrestrial Environment Criteria Guidelines Document. Plans and preparation have been made to review the complete document when in draft form. Some discussions have been held with Mr. Dale Johnson and Mr. Kelly Hill in this regard.

(4) Various items the literature have been reviewed and selected topics and materials brought to the attention of various members of the Earth Science and Applications Division.

(5) Communications have been maintained with various Scientific and Engineering groups/individuals within NASA, or other government agencies, industries and professional scientists and where appropriate, activities of the Division have been brought to the attention of interested parties. Discussions have also been held with various division members on work.

William Vaughan



Report Documentation Page

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15. Supplementary Notes					
16. Abstract Research will be undertaken in this contract in the area of Modeling Resource and Facilities Enhancement to include computer, technical and educational support to NASA investigators to facilitate model implementation, execution and analysis of output; to provide facilities linking USRA and the NASA/EADS Computer System as well as resident work stations in ESAD; and to provide a centralized location for documentation, archival and dissemination of modeling information pertaining to NASA's program. Additional research will be undertaken in the area of Numerical Model Scale Interaction/Convective Parameterization Studies to include implementation of the comparison of cloud and rain systems and convective-scale processes between the model simulations and what was observed; and to incorporate the findings of these and related research findings in at least two refereed journal articles.					
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