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2 November 2001

Ms. Carol Reddic
Grant Negotiator
NASA, Langley Research Center
Mail Stop 126.
9A Langley Boulevard
Hampton, VA 23681-2199

THE SCHWERTFEGER LIBRARY
1225 W. Dayton Street
Madison, WI 53706

RE: Progress report for NAG1-2322

Dear Ms. Reddic:

Please find enclosed one copy of the progress report for the referenced grant. The grant is entitled "Overlapping Cloud Investigations using MODIS, CERES and ARM Cart Site Data" with Professor Steven A. Ackerman.

If you have any questions or need further information, please contact me at (608) 262-0985 or Polly Ruff at (608) 263-3037.

Sincerely,

John P. Roberts
Executive Director-Administration
SSEC

cc: John A. Greco, TO
1240
S. Ackerman
144-JS43

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Progress report for Program 1240

Our work addresses an outstanding problem of the cloud modeling and remote sensing community as related to ARM: the improvement of satellite- and ARM-derived multilayered cloud microphysical and macrophysical properties. While overlapping cloud layers occur quite frequently, ARM CART site analyses currently do not support operational retrieval of cloud macrophysical or microphysical properties under these conditions. We are developing and testing methodology to determine whether satellite imager pixels contain single-layer clouds or whether the pixels may contain potential cloud overlap in MODIS imagery. The techniques have been through extensive modification through the process of their application to MODIS data and subsequent systematic comparison to the cloud properties inferred from active lidar/radar measurements at the ARM CART sites.

Specific goals for which we have made progress on this year include the:

- a. development of methods to compare instantaneous MODIS data (high spatial resolution) analyses with ground-based measurements (high temporal resolution).
- b. evaluation of the ARM ground-based cloud profile products in conjunction with the MODIS-derived cloud products for scenes involving multilayered clouds.

Accomplishments

Software has been written and applied to *daytime* MODIS data for the purpose of classifying those imager pixels that potentially contain overlapping clouds. The MODIS/ARM data sets that we have analyzed in detail so far demonstrate that a fair amount of familiarity with the products, especially phase, is essential to making further progress. We have developed an approach for comparison of the retrieved MODIS cloud parameters to surface lidar/radar ARM products. Part of the problem is that cloud phase of each layer is critical for proper interpretation of the MODIS data, and cloud phase is often indeterminate in the ARM multilayered cloud product analyses.

A graduate student (Monica Harkey) has developed and applied a new infrared band technique to *nighttime* MODIS data to classify pixels that potentially contain overlapping cloud layers. We analyzed a few cases in the ARM SGP CART site in Oklahoma, which has a combined lidar/radar cloud boundary product. We are currently developing a research article based on her thesis work entitled "Nighttime cloud overlap discrimination using MODIS and ARM data."

Work with graduate students

Funds from this grant were also used to support two graduate students in the Atmospheric and Oceanic Science department at the University of Wisconsin-Madison during the spring semester of 2001. We are pleased to report on progress by these two graduate students, Monica Harkey and Sarah Thomas. Over the course of the spring semester, these two students took graduate classes and performed research on MODIS data. Monica Harkey completed her required coursework towards a Masters degree, which she anticipates completing by the end of calendar year 2001. Her research project involves the detection and analysis of overlapped cloud pixels in nighttime MODIS data. Most satellite cloud retrieval research is performed with daytime data as the visible and near-infrared bands provide much additional information independently of the infrared bands. At night, however, very little attention has been given towards the complex problem of how to perform these retrievals when multilayered clouds are present. Sarah Thomas began her studies at UW in the fall of 2000. The funding provided primarily covered the spring and summer period of 2001. The second year is typically when the majority of the research is performed, so as a result the majority of her research work has yet to be performed.

Presentation of Research

Research articles on the work are in progress; in the meantime, several posters have been prepared and presented at the American Meteorological Society's 11th Conference on Satellite Meteorology and Oceanography.

Nasiri, S. L., and B. A. Baum: Daytime Cloud Overlap using MODIS Data. Submitted to the 11th Conference on Satellite Meteorology and Oceanography, Madison, Wisconsin. 15-18 October, 2001.

Harkey, M., and B. A. Baum: Nighttime Cloud Overlap using MODIS Data. Submitted to the 11th Conference on Satellite Meteorology and Oceanography, Madison, Wisconsin. 15-18 October, 2001.

Thomas, S., B. A. Baum, S. L. Nasiri, A. J. Heymsfield, P. Yang, E. Clothiaux, R. Marchand, and J. Comstock: Development of Cirrus Models for MODIS and MISR. Submitted to the 11th Conference on Satellite Meteorology and Oceanography, Madison, Wisconsin. 15-18 October, 2001.