Continuation of Data Analysis Software Development for the Atmospheric Emitted Radiance Interferometer (AERI) Progress Report 2001

DOE Award DE-FG-02-98ER61365

R. O. Knuteson, W. F. Feltz, D. H. DeSlover, and D. Tobin
University of Wisconsin, Cooperative Institute for Meteorological Satellite Studies (CIMSS),
Madison -- Wisconsin (608) 265-6283

P.D. Brown, S.A. Clough, E.J. Mlawer Atmospheric & Environmental Research, Inc.
Cambridge, MA

October 2001

Progress has been made in improving the AERI physical retrieval algorithm for all three permanent ARM sites and toward the proposed initiatives outlined in DOE Award DE-FG-02-98ER-61365.

At the Southern Great Plains site, RUC-2 numerical weather prediction model temperature and moisture profiles above the boundary layer have improved the number of successful AERI physical retrievals and provided a better hourly mid/upper tropospheric atmospheric state. A new 50 level fast model based on LBLRTM has been implemented within the AERI retrieval algorithm. AERI retrieved temperature and moisture fields in the lowest 2-km of the boundary layer can be used to validate how representative the thermodynamic state is within NWP models. AERIplus/wind profiler moisture flux convergence and advection has been evaluated during the 3 May 1999 Oklahoma/Kansas tornado outbreak, indicating that observing high resolution moisture gradients is critical to understanding the convective initiation problem. Area averaged moisture advection and convergence between SGP CART site locations would provide another validation product for comparison to CRM model output.

During the Tropical Western Pacific (TWP) Nauru 1999 deployment a Marine-AERI system was operating aboard the Japanese ship Mirai. The University of Miami M-AERI system provided ocean skin SST, ocean emissivity, and downwelling atmospheric radiances every 20 minutes. Temperature and moisture retrievals were calculated from the downwelling radiances and compared to retrievals derived from the Nauru Island AERI system. During the three IOP days of July 1-3, 1999, a heat island effect of about 1.5 degrees Celsius is observed during each day from the near surface with influence to 500 meters. The Mirai was located approximately 45 km southwest of Nauru island and therefore was unaffected by any island influence. There was also In addition, the water vapor mixing ratio increased during the day on Nauru Island. Validation using the two microwave radiometers and surface measurements is ongoing.

North Slope of Alaska AERI retrievals have been automated so that near real time retrievals are produced. AERI retrievals from the IPARSC-II IOP, performed at the NSA site from March 5-16, 2001, are being analyzed. AERI water vapor and temperature profiles from the Barrow site will be used as input to drive Large Eddy Simulation (LES) models. AERI data from the Surface Heat Energy Budget of the Arctic (SHEBA) have been used to produce several days of retrieved temperature and moisture. The data are currently being used by Dr. James Pinto and Dr. Judy Curry for LES simulations. A higher resolution fast model within the first one kilometer of atmosphere is being developed to optimize any vertical resolution within the AERI radiances.

Research objectives for the future:

- A 60 level fast model based upon LBLRTM is being implemented within the retrieval algorithm which should improve the vertical resolution within the first kilometer of the atmosphere. A new 50 level fast model (using the same levels as the FASCODE model) based upon LBLRTM has been implemented into the algorithm recently.
- The retrieval algorithm will be employed operationally for the North Slope of Alaska and Tropical Western Pacific AERI systems.
- Routine moisture flux divergence and advection products will be produced between the AERI/wind profiler locations in the Southern Great Plains for CRM/SCM input.

Papers:

Feltz, W. F. and J. R. Mecikalski, 2001: Monitoring High Temporal Resolution Convective Stability Indices Using the Ground-based Atmospheric Emitted Radiance Interferometer (AERI) During the 3 May 1999 Oklahoma/Kansas Tornado Outbreak. Wea. Forecasting, Accepted for publication.

Feltz, W. F., H. B. Howell, R. O. Knuteson, H. M. Woolf, and H E. Revercomb, 2001: Near Continuous Profiling of Temperature, Moisture, and Atmospheric Stability using the

Atmospheric Emitted Radiance Interferometer (AERI). . J. Atmos. Oceanic Technol., Submitted for Review.

Feltz, W. F., R. O. Knuteson, H. B. Howell, and D. D. Turner, 2000: Near Continuous Profiling of Temperature, Moisture, and Atmospheric Stability Using the Atmospheric Emitted Radiance Interferometer (AERI). Fifth International Symposium on Tropospheric Profiling, Adelaide, Australia, 4-8 December 2000 (preprints). Extended Abstracts, pp7-9.

Feltz, W. F., R. O. Knuteson, H. B. Howell, R. Petersen, 2001: AERIplus Retrieval Developments at the DOE ARM Sites. Eleventh ARM Science Team Meeting Proceedings, 19-23 March 2001 (preprints). http://www.arm.gov/docs/documents/technical/conf_0103/feltz-wf.pdf.

Feltz, W. F., T. J. Schmit, J. Hawkinson, D. Tobin, and S. Wetzel-Seeman, 2001: Validation of GOES and MODIS atmospheric products and radiances using DOE ARM data. Preprints, Eleventh Conference on Satellite Meteor. And Oceanography, 15-18 October, 2001, Madison, WI.

Revercomb, H. E., D. C. Turner, D. D. Tobin, R. O. Knuteson, W. F. Feltz, J. Barnard, J. Bösenburg D. Cook, R. Ferrare, J. Goldsmith, S. Gutman, R. Halthore, B. Lesht, J. Liljegren, H. Linné, S. Melfi, J. Michalsky, V. Morris, W. Porch, S. Richardson, B. Schmid, M. Splitt, T. Van Hove, E. Westwater, and D. Whiteman, 2001: The Atmospheric Radiation Measurement (ARM) Program's Water Vapor Intensive Operational Periods: Overview, Accomplishments, and Future Challenges. Bull. Amer. Meteor. Soc., Submitted for Review.

Turner, D.D., R. A. Ferrare, L. A. Heilman, W. F. Feltz, and T. P. Tooman, 2001: Automated Retrievals of Water Vapor and Aerosol Profiles Over Oklahoma from an Operational Raman Lidar. J. Tech. In review.