ARM (Atmospheric Radiation Measurement Enhanced Shortwave Experiment (ARESE) NASA ER-2 MODIS Airborne Simulator (MAS) Langley DAAC Data Set Document

Summary:

The ARM Enhanced Shortwave Experiment (ARESE) was conducted at the Department of Energy's ARM Southern Great Plains (SGP) Central Facility between September 22, 1995 and November 1, 1995. The principal objectives of ARESE were (1) to directly measure the absorption of solar radiation by the clear and cloudy atmosphere and to place uncertainty bounds on these measurements; and (2) to investigate the possible causes of absorption in excess of model predictions.

This document provides information for the ARESE_ER2_MAS data set archived at the Langley DAAC. For further information, visit the ARESE Home Page.

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1. Data Set Overview:

Data Set Identification:

ARESE_ER2_MAS	ARM (Atmospheric Radiation Measurement Enhanced Shortwave Experiment (ARESE) NASA ER-2 MODIS Airborne Simulator (MAS)

Data Set Introduction:

Recent field measurements have brought into question the present understanding of shortwave absorption by clouds and suggested that clouds absorb shortwave radiation in amounts which would be of great significance in atmospheric models and which are not now represented in these models. These studies indicate the need for further examination of the absorption of solar radiation by the atmosphere both theoretically and experimentally, because of the major potential consequences associated with the uncertainties in present day understanding of atmosphere-clouds-radiation interactions.

ARESE, the ARM Enhanced Shortwave Experiment, concluded a very successful deployment to Oklahoma on November 1, 1995. The purpose of this five week long campaign was to conduct a series of instrumented flights to measure the interaction of solar energy with clear and cloudy skies to provide additional insight into recent observations of enhanced absorption in cloudy atmospheres. As such, ARESE focused on two scientific objectives:

- the direct measurement of the absorption of solar radiation by clear and cloudy atmospheres and the placement of bounds on these measurements; and
- the investigation of the possible causes of absorption in excess of the model predictions.

To accomplish these objectives, ARESE used a combination of satellite, aircraft, and ground observations to make highly accurate solar flux measurements at different altitudes throughout the atmospheric column. At the heart of this was a carefully "stacked" Twin Otter and Egrett "cloud sandwich" with the Otter at 1500 - 5000 ft and the Egrett at 43,000 ft. This was overflown by an ER-2 flying at 65,000 ft, which because of its much higher speed did not stay in constant alignment with the Twin Otter/Egrett stack but did provide periodic coincidences with these other aircraft. All three aircraft carried identical up- and down-looking "Valero" radiometers and flew over identical up-looking radiometers at the CART central and extended facilities. Radiance measurements from the GOES satellites were used to retrieve top-of-the atmosphere fluxes. These flux measurements were supplemented by a variety of cloud property measurements from the ground, the Egrett and the ER-2, including radar, lidar and multispectral measurements.

Spectral broadband, partial bandpass, and narrow bandpass (10 nm) solar radiative fluxes were measured at different altitudes and at the surface with the objective of directly determining the magnitude and spectral characteristics of the absorption of shortwave radiation by the atmosphere (clear and cloudy). Narrow spectral channels selected to coincide with absorption by liquid water and ice will help in identifying the process of absorption of radiation. Additionally, information such as water vapor profiles, aerosol optical depths, cloud structure and ozone profiles, needed to use as input in radiative transfer calculations, will be acquired using the aircraft and surface facilities available to ARESE.

These baseline ARESE flights were conducted at the CART site from September 25 through November 1. During that time twelve scientific data flights were made and accumulated approximately 60 hours of in-flight data under a variety of atmospheric conditions ranging from clear to solid overcast. These flights include: cloud forcing experiments under scattered, broken, and solid overcast conditions including low, mid-, and high-level cloud decks; clear sky column absorption and surface albedo measurements; clear sky flux profiling measurements; and in-flight, co- altitude intercomparisons of flux measurements made from the two aircraft. The data appear to be of excellent quality and comprise a unique data set for testing our understanding of the absorption of solar radiation in both clear and cloudy atmospheres.

In addition to these baseline solar absorption experiments, the ER-2 also performed some key calibration experiments. These used highly accurate spectral radiance measurements from the MODIS Airborne Simulator (MAS) to calibrate radiance measurements from the GOES satellite and to improve retrieval algorithms for converting spectral radiances to spectral fluxes.

The success of this deployment was the result of the tremendous efforts of a multi-laboratory multiagency team comprised of five DOE Laboratories, three NASA Centers, about a dozen universities and three aircraft companies. The ARM Program sponsored the ground-based measurements, ARM-UAV (Unmanned Aerospace Vehicle) the coordinated Egrett and Otter measurements, and ARM and NASA the ER-2 flights. Funding was provided through the DOE's ARM Program and through DoD's Strategic Environmental Research and Development Program (SERDP).

Objective/Purpose:

ARESE focused on two scientific objectives: (1)the direct measurement of the absorption of solar radiation by clear and cloudy atmospheres and the placement of bounds on these measurements; and (2) the investigation of the possible causes of absorption in excess of the model predictions.

Summary of Parameters:

RADIANCE

Discussion:

See Data Set Introduction section.

Related Data Sets:

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2. Investigator(s):

Investigator(s) Name and Title:

Project Principal Investigator: Dr. Francisco Valero
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Title of Investigation:

ARM (Atmospheric Radiation Measurement) Enhanced Shortwave Experiment (ARESE)

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3. Theory of Measurements:

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4. Equipment:

Sensor/Instrument Description:

MODIS Airborne Simulator (MAS)

Collection Environment:

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Source/Platform:

NASA ER2

Source/Platform Mission Objectives:

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Key Variables:

RADIANCE

Principles of Operation:

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Sensor/Instrument Measurement Geometry:

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Manufacturer of Sensor/Instrument:

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Calibration:

Specifications:

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Tolerance:

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Frequency of Calibration:

...

Other Calibration Information:

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5. Data Acquisition Methods:

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6. Observations:

Data Notes:

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Field Notes:

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7. Data Description:

Spatial Characteristics:

Spatial Coverage:

Data Set Name	Min Lat	Max Lat	Min Lon	Max Lon
ARESE_ER2_MAS	20.25	38.55	-85.44	-117.74

Spatial Coverage Map:

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Spatial Resolution:

Variable

Projection:

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Grid Description:

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Temporal Characteristics:

Temporal Coverage:

September 25, 1995 to October 23, 1995

Temporal Coverage Map:

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Temporal Resolution:

Daily

Data Characteristics:

Parameter/Variable:

Radiance

Variable Description/Definition:

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Unit of Measurement:

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Data Source:

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Data Range:

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Sample Data Record:

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8. Data Organization:

Data Granularity:

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary.

Data Format:

The data are in HDF (Hierarchical Data Format).

9. Data Manipulations:

Formulae:

Derivation Techniques and Algorithms:

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Data Processing Sequence:

Processing Steps:

...

Processing Changes:

There are no plans for reprocessing.

Calculations:

Special Corrections/Adjustments:

...

Calculated Variables:

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Graphs and Plots:

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10. Errors:

Sources of Error:

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Quality Assessment:

Data Validation by Source:

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Confidence Level/Accuracy Judgement:

...

Measurement Error for Parameters:

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Additional Quality Assessments:

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Data Verification by Data Center:

The Langley DAAC performs an inspection process on this data received by the data producer via ftp. The DAAC checks to see if the transfer of the data completed and were delivered in their entirety. An inspection software was developed by the DAAC to see if the code was able to read every granule. The code also checks to see if every parameter of data falls within the ranges which are included in the granule. This same code extracts the metadata required for ingesting the data into the IMS. If any discrepancies are found, the data producer is contacted. The discrepancies are corrected before the data are archived at the DAAC.

11. Notes:

Limitations of the Data:

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Known Problems with the Data:

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Usage Guidance:

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Any Other Relevant Information about the Study:

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12. Application of the Data Set:

To investigate the absorption of solar radiation by clouds, aerosols, and atmospheric gases.

13. Future Modifications and Plans:

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14. Software:

Software Description:

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Software Access:

The software can be obtained through the Langley DAAC. Please refer to the contact information below. The software can also be obtained at the same time the user is ordering this data set.

15. Data Access:

Contact Information:

Langley DAAC User and Data Services Office
NASA Langley Research Center
Mail Stop 157D
Hampton, Virginia 23681-2199
USA
Telephone: (757) 864-8656
FAX: (757) 864-8807
E-mail: support-asdc@earthdata.nasa.gov

Data Center Identification:

Langley DAAC User and Data Services Office
NASA Langley Research Center
Mail Stop 157D
Hampton, Virginia 23681-2199
USA
Telephone: (757) 864-8656
FAX: (757) 864-8807
E-mail: support-asdc@earthdata.nasa.gov

Procedures for Obtaining Data:

The Langley DAAC provides multiple interfaces to access its data holdings. The graphical and character user interfaces allow users to search and order data; and web interfaces allow direct access to some data holdings for immediate downloading or placing media orders, for searching the data holdings, and downloading electronically available holdings, and for ordering prepackaged CD-ROMs and videocassettes. All of these methods are easily obtained from the Langley DAAC web site.

Data Center Status/Plans:

The Langley DAAC will continue to archive this data.

16. Output Products and Availability:

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17. References:

Ayers, J.K, Minnis, P., et al: "Calibration of GOES Using Satellite and ARESE Aircraft Data". 6th ARM Science Team Meeting (San Antonio, TX, March 4-7, 1996)

Minnis, P., et al: "Cloud Shortwave Radiative Forcing from Satellite and Surface Data During ARESE". 6th ARM Science Team Meeting (San Antonio, TX, March 4-7, 1996)

18. Glossary of Terms:

EOSDIS Glossary.

19. List of Acronyms:

EOSDIS Acronyms.

20. Document Information:

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