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CLOUDS AND THE EARTH'S RADIANT ENERGY SYSTEM (CERES) DATA SETS AND TOOLS

Linda A. Hunt*, R. K. Seals, S. E. Sorlie
Science Applications International Corporation,
NASA Langley Atmospheric Sciences Data Center, Hampton, VA

1. INTRODUCTION

The Clouds and the Earth's Radiant Energy System (CERES) experiment is a cornerstone of NASA's Earth Science Enterprise (ESE). The CERES instruments are designed to measure broadband radiative fluxes at the top of the atmosphere (TOA), including reflected solar radiation and longwave emission from the Earth's surface and atmosphere, as well as several cloud property variables. These observations will help provide a scientific understanding of Earth's radiation budget and global climate change.

The NASA Langley Atmospheric Sciences Data Center (ASDC) processes, archives and distributes the CERES data products. Software tools have been developed to work with the CERES data files. The data and tools are available free of charge from the ASDC at

http://eosweb.larc.nasa.gov

2. CERES INSTRUMENT

The first CERES instrument was launched in November 1997 on the Tropical Rainfall Measuring Mission Satellite (TRMM). CERES instruments are also included on the Earth Observing System (EOS) Terra and Aqua satellites, launched in December 1999 and May 2002, respectively. Follow-on missions are planned that will provide a 15-year history of continuous measurements.

The CERES instrument is a scanning radiometer with three channels: a shortwave channel (0.3-5.0 μm) to measure reflected sunlight, a longwave channel to measure Earth-emitted radiation in the 8-12 μm window region, and a total channel to measure all wavelengths (0.3 to > 100 μm). The spatial resolution at nadir is 10 km from the TRMM platform, which orbits at an altitude of 350 km, and 20 km from the EOS Terra and Aqua platforms due to their higher orbit altitude of 705 km.

Two scan modes are used in CERES operations. A cross-track scan mode takes measurements similar to those made by the Earth Radiation Budget Experiment (ERBE) instruments for long term continuity. A rotating biaxial scan mode provides new angular flux information. The CERES instrument on the TRMM satellite switches between these two modes, while the EOS satellites each have two CERES instruments, one operating in each mode.

3. CERES DATA SETS

There are three main categories of CERES archival data products. The first category includes the "ERBE-like" products, which are processed to produce data similar to measurements made by the ERBE instruments beginning in 1984 and continuing to the present. The ERBE and CERES experiments together provide a continuous long term series of data that can be used for climate monitoring and climate change studies. There are three CERES ERBE-like data sets: 24 hour instantaneous data (ES-8), monthly geographically averaged data (ES-4) and monthly regionally averaged data (ES-9). Parameters in these products include broadband shortwave, longwave and net radiative fluxes for clear sky and cloudy sky conditions.

The second category includes surface and TOA products. New CERES algorithms calculate TOA fluxes that can be used with surface fluxes to estimate the surface radiation budget. These products can be used for land and ocean surface budget research and climate studies.

Third are the atmosphere products, which calculate shortwave and longwave fluxes at the surface,

* Correspondence address: Science, User and Data Services; Atmospheric Sciences Data Center; NASA Langley Research Center; MS 157D, 2 S. Wright St.; Hampton, VA 23681-2199; e-mail: larc@eos.nasa.gov

TOA, and at levels in between using cloud properties, aerosol and ozone data, and other atmospheric parameters.

4. CERES TOOLS AND INFORMATION

The **view_hdf** tool was developed by the CERES Data Management Team for visualization and analysis of CERES data files. It can also be used with other data files written in the National Center for Supercomputing Applications' Hierarchical Data Format (HDF) and HDF-EOS format (developed to provided additional geolocated HDF data structures).

The view_hdf tool is written in Research Systems, Inc. Interactive Data Language (IDL) and uses a graphical user interface to manipulate the data. The view_hdf tool can select and subset variables from HDF Science Data Sets (SDS) or tabular vdata structures in an HDF file, render both two- and three-dimensional graphics, and plot geo-located data onto various world map projections. Other features include multiple variable plots, difference plots, and simple statistics. Plots can be saved in PostScript, encapsulated PostScript, MPEG or PNG format, or sent directly to a printer. Filtered subsets and statistical results can be written to a file in ASCII format for use in other analysis programs.

Read software programs are provided for each of the CERES products as examples for accessing the various parameter data structures. Additional tools are available to work with HDF and HDF-EOS files, including tools to convert the data to other formats such as binary.

Links from the ASDC web pages provide access to CERES documentation, browse images, and related information. Assistance is provided by User Services representatives who may be contacted by e-mail (larc@eos.nasa.gov), phone (757-864-8656) or fax (757-864-8807).