P5.26 SIMULTANEOUS EARTH VIEWS FROM CERES AND MISR: DATA FOR STUDYING THE ATMOSPHERE-LAND-OCEAN SYSTEM

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1. INTRODUCTION

The ultimate goal of NASA's Terra mission is to unravel the mysteries of climate and environmental change. The instruments on board the Terra spacecraft are collecting global data sets needed to study the inter-relationships inherent in the Earth's coupled atmosphere-land-ocean system. Issues such as the Earth's energy balance, global cloudiness, the effects of atmospheric aerosols, changes in the land surface and the hydrological impact of these can be addressed with simultaneous data from instruments such as the Clouds and the Earth's Radiant Energy System (CERES) and the Multi-angle Imaging SpectroRadiometer (MISR).

An important feature of the experiments onboard Terra is the ability to obtain data from multiple experiments viewing the same phenomena. CERES and MISR data are used to demonstrate complementary views of the Earth system. Phenomena of interest could include large-scale weather systems, aerosol concentrations from dust or fires and variations in surface features in regions of hydrological interest. An example of spatially and temporally coincident data during Typhoon Pabuk is shown. The CERES and MISR data are processed, archived and distributed by the Atmospheric Sciences Data Center (ASDC) at NASA's Langley Research Center. Data, information and tools are available at the ASDC web site,

http://eosweb.larc.nasa.gov.

2. CERES DATA

The CERES instrument is a scanning radiometer that measures broadband radiation in three channels to provide solar-reflected (0.3-5.0 μm), Earth-emitted (8-12μm) and total radiation (0.3 to > 100μm) throughout the atmosphere. In combination with simultaneous measurements from instruments such as the Moderate Resolution Imaging Spectrometer, CERES provides new information on cloud properties. The CERES instrument is also onboard the Tropical Rainfall Measuring Mission Satellite (launched November 1997) and Aqua satellites (launched May 2002).

There are many CERES data products that can be broadly categorized into three types: “ERBE-like”, surface and TOA, and atmospheric products. The “ERBE-like” products are processed similarly to measurements from the Earth Radiation Budget Experiment (ERBE) instrument (1984 – present). The CERES experiment expands the long-time series of Top of Atmosphere (TOA) measurements begun with ERBE and expands the science of Earth’s energy balance. The ERBE-like CERES products include 24-hour instantaneous data (ES-8), monthly geographically averaged data (ES-4) and monthly regionally averaged data (ES-9). Parameters contained in these products are broadband shortwave, longwave and net radiative fluxes for clear and cloudy conditions.

CERES also has surface and TOA data products which incorporate new algorithms that estimate the surface radiation budget from broadband TOA measurements. These products can be used for studying land and ocean surfaces, climate change and global warming.

The CERES atmospheric products are produced from highly developed algorithms that compute shortwave and longwave radiative fluxes at the surface, TOA and throughout the atmosphere using ancillary data that include cloud properties, aerosols and ozone.

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3. MISR DATA

The Multi-angle Imaging SpectroRadiometer (MISR) instrument provides a unique view of Earth, obtaining radiance, aerosol, cloud and land surface data from nine cameras at different angles and four wavelengths. MISR's nine cameras are pointed at fixed angles, one viewing the nadir and four each viewing the forward and aftward directions along the spacecraft ground track at 26.1, 45.6, 60.0, and 70.5 degrees. Each of the nine MISR cameras obtains images in four spectral bands: blue, green, red and near-infrared. The center wavelengths of these bands are 446, 558, 672, and 886 nm, respectively.

The nadir camera radiances and the red band of the angled cameras have a 275m pixel resolution. The remaining bands of the off-nadir cameras have a resolution of 1.1km. MISR's swath width is 360km allowing global coverage in 9 days and repeat coverage every 16 days. The total number of distinct orbit paths is 233. Each orbit is divided into 180 blocks.

MISR data products can be categorized by processing level. Level 1 data products provide calibrated instrument data. Level 2 products provide derived quantities such as aerosol, cloud heights, and surface reflectance. Level 3 products are globally gridded statistical summaries of selected Level 1 and Level 2 parameters aggregated over various time periods (monthly, seasonal, annual).

The Level 1B2 Georectified Radiance product contains imagery from the nine cameras, calibrated and registered to one another and to the ground and then mapped into a Space Oblique Mercator projection.

The Level 2 data products include many parameters that are suited for local and global scale research. Some specific parameters contained in these data products are aerosol optical depth, bidirectional reflectance factor, leaf-area index (LAI), fractional photosynthetically active radiation (FPAR) and normalized difference vegetation index (NDVI).

4. TOOLS

The ASDC provides access to tools that will aid in the visualization and analysis of CERES and MISR data products. Brief descriptions of the tools used for this paper follow. A comprehensive list of tools is available from the ASDC web site.

The MISR Browse Tool allows users to specify the orbit, area, and camera angle of interest and then view browse images matching those criteria. Browse images are lower resolution (2.2 km) renderings of MISR Level 1B2 georectified radiance data that are used to create a true color image.

The misr_view tool was developed by the MISR Team and it is written in Research Systems Inc. Interactive Data Language (IDL). This tool provides an interface for creating and manipulating images from the MISR data products.

The view_hdf tool was developed for the CERES Team and it is also written in IDL. The view_hdf tool provides an interface for visualizing the CERES data products. The tool will allow selection and subsetting of variables, creation of two- and three-dimensional graphics and multiple variable plots.

5. SIMULTANEOUS EARTH VIEWS

The following figures illustrate the use of MISR and CERES data in examining a large-scale weather system as it approached Japan in August 2001. Typhoon Pabuk had sustained winds of 67 mph with gusts up to 113 mph. The true-color image was created from the MISR Level 1B2 radiance product. Also shown are the MISR Level 2 cloud height and the CERES ES-8 (ERBE-like) longwave flux.

6. ACKNOWLEDGEMENTS

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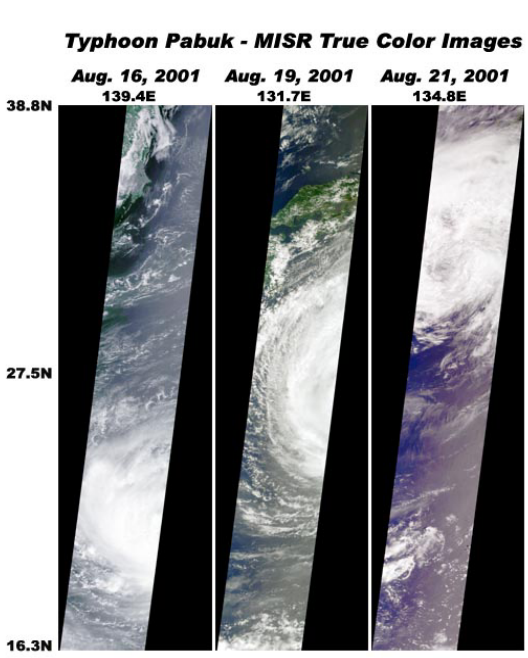
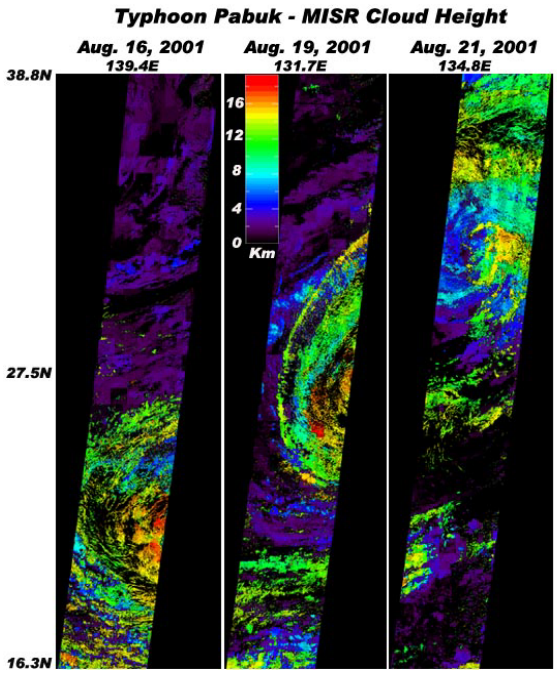
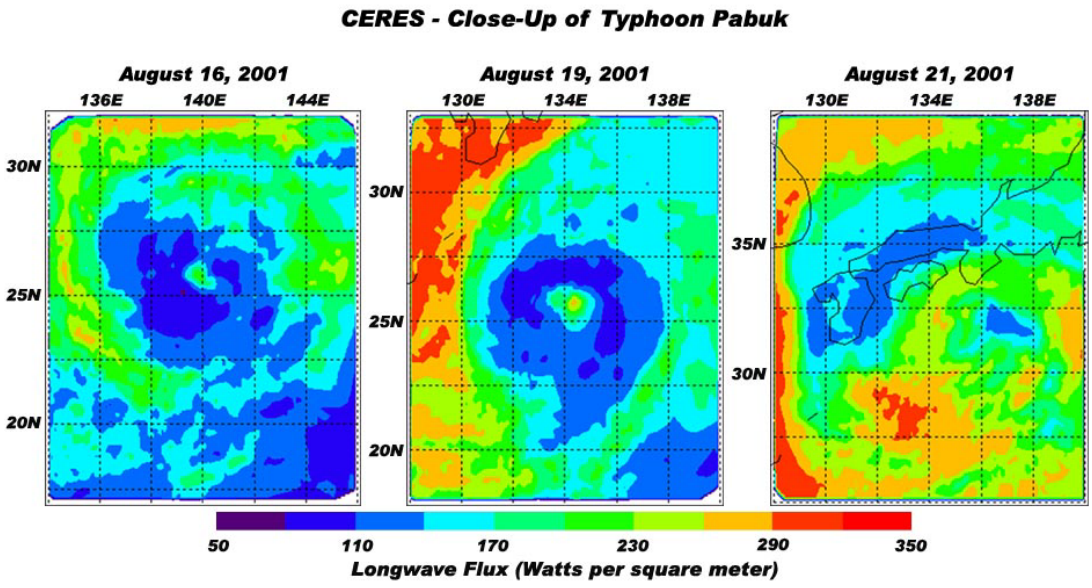

Typhoon Pabuk - MISR True Color Images
Aug. 16, 2001
139.4E
Aug. 19, 2001
131.7E
Aug. 21, 2001
134.8E
38.8N
27.5N
16.3N


Typhoon Pabuk - MISR Cloud Height
Aug. 16, 2001
139.4E
Aug. 19, 2001
131.7E
Aug. 21, 2001
134.8E
38.8N
27.5N
16.3N
16
12
8
4
0
Km


CERES - Close-Up of Typhoon Pabuk
August 16, 2001
136E
140E
144E
30N
25N
20N
August 19, 2001
130E
134E
138E
30N
25N
20N
August 21, 2001
130E
134E
138E
35N
30N
50
110
170
230
290
350
Longwave Flux (Watts per square meter)