Data User Guide

CAMEX-3 ER-2 Millimeter-wave Imaging Radiometer (MIR)

Introduction

The CAMEX-3 ER-2 Millimeter-wave Imaging Radiometer (MIR) dataset is a browse-only dataset containing plots of brightness temperature measurements collected by the Millimeter-wave Imaging Radiometer (MIR) in support of the third field campaign in the Convection And Moisture EXperiment (CAMEX) series, CAMEX-3. This field campaign took place from August to September 1998 based out of Patrick Air Force Base in Florida, with the purpose of studying various aspects of tropical cyclones in the region. During CAMEX-3, MIR operated onboard the NASA ER-2 high-altitude research aircraft, collecting brightness temperature measurements of water vapor, clouds, precipitation, and other atmospheric features. The MIR browse image files are available from August 8 through September 8, 1998 in GIF format.

Notice:
These data are airborne and flights did not occur each day of the campaign, therefore, data is only available on flight days.

Citation

Wang, James R. 2020. CAMEX-3 ER-2 Millimeter-wave Imaging Radiometer (MIR) [indicate subset used]. Dataset available online from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi:
http://dx.doi.org/10.5067/CAMEX-3/MIR/DATA101

Keywords:

NASA, GHRC, CAMEX, CAMEX-3, ER-2, MIR, radiometer, electromagnetic spectrum, brightness temperature, Florida, tropical cyclones

Campaign

The Convection And Moisture EXperiment (CAMEX) is a series of field research investigations sponsored by the Earth Science Enterprise of NASA. The third field campaign in the CAMEX series, CAMEX-3, ran from August to September 1998, and was based out of Patrick Air Force Base, Florida. CAMEX-3 focused on the study of tropical cyclone development, tracking, and intensification impacts using NASA-funded aircraft and surface remote sensing instrumentation. The ultimate goal of the campaign was to improve the efficiency of hurricane evacuations and warnings. The campaign successfully studied hurricanes Bonnie, Danielle, Earl, and Georges (Figure 1). CAMEX-3 yielded high-resolution spatial and temporal data on hurricane structure, dynamics, and motion. These data, when analyzed within the context of more traditional aircraft, satellite, and ground-based radar observations, provided additional insight to hurricane modelers and forecasters who continually strive to improve hurricane predictions. More information about CAMEX-3 can be found on the CAMEX-3 Field Campaign webpage and in Kakar, Goodman, Hood, and Guillory (2006).

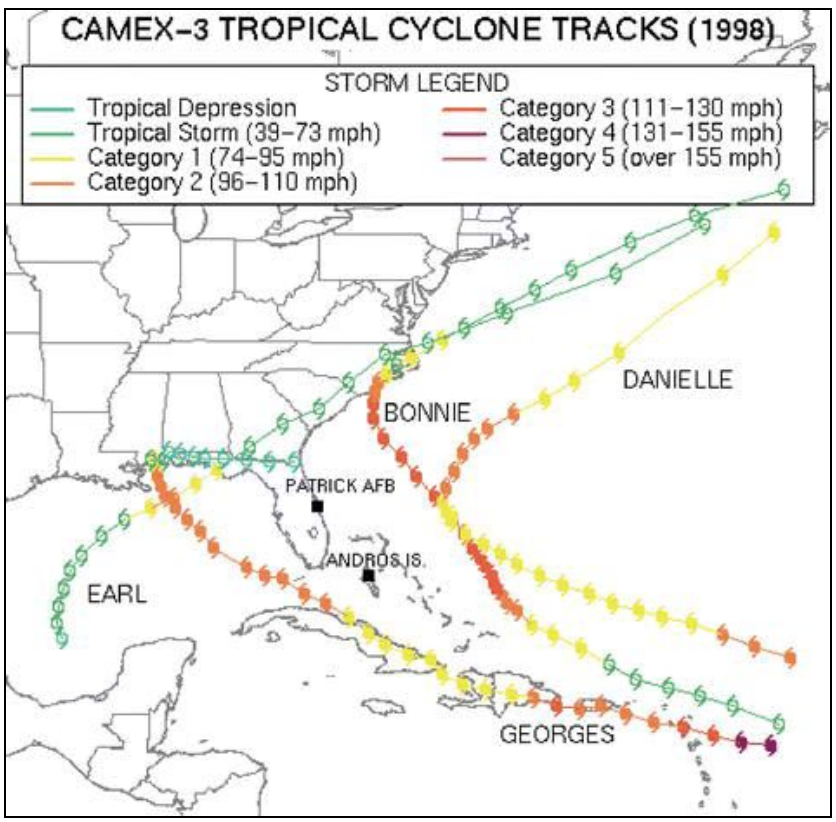

Figure 1: Tropical cyclone tracks during CAMEX-3
(Image source: Kakar et al. 2006)

Instrument Description

The Millimeter-wave Imaging Radiometer (MIR) is a scanning radiometer that collects brightness temperature measurements primarily within the atmosphere (Figure 2). During CAMEX-3, MIR operated onboard the NASA ER-2 high-altitude research aircraft. MIR is a passive remote sensor that measures the intensity of radiation emitted by atmospheric targets at 89, 150, 183±1, 183±3, 183±7, 220, and 325±3 GHz using five lens-feed horn antennas for each fundamental frequency (89, 150, 183, 220, and 325 GHz). These frequencies lie in the microwave/infrared portion of the electromagnetic spectrum and reveal certain characteristics about the observed targets. MIR uses a mirror attached to a motor to scan across (perpendicular to) the aircraft flight direction; with the full scan cycle taking just under 3 seconds to complete. As the scan mirror sweeps, it directs the observed radiation into the receiver antennas. The system then uses these radiation intensity observations to determine the brightness temperatures; whose measurements are used to analyze water vapor, clouds, precipitation, and other features in the atmosphere. More information about MIR is available in Racette et al. (1996). More information about remote sensing instruments and how they work can be found on the EOSDIS Remote Sensors webpage.

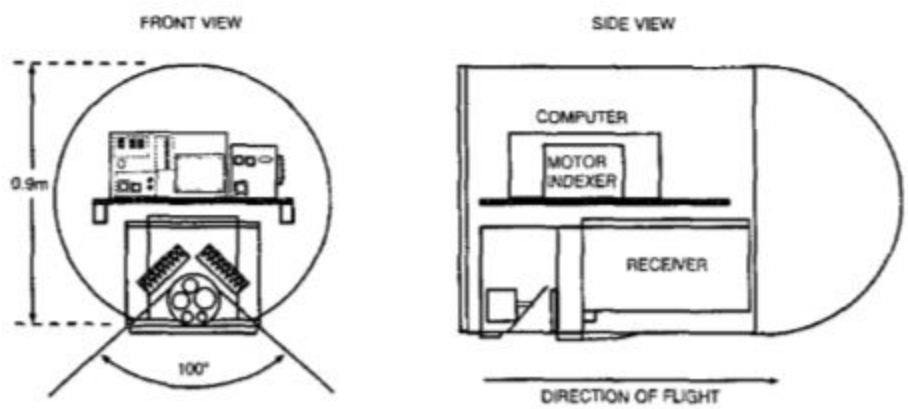

Figure 2: MIR configuration in the ER-2 wing pod
(Image source: Racette et al. 1996)

Investigators

James R. Wang
NASA GSFC
Greenbelt, MD

Data Characteristics

The CAMEX-3 ER-2 Millimeter-wave Imaging Radiometer (MIR) dataset is a browse-only dataset, containing daily plots of atmospheric brightness temperatures measured by MIR.

The browse imagery is available at a Level 1B processing level. More information about the NASA data processing levels is available on the EOSDIS Data Processing Levels webpage. Table 1 lists the characteristics of this dataset.

Table 1: Data Characteristics

Characteristic	Description
Platform	NASA Earth Resources 2 (ER-2) aircraft
Instrument	Millimeter-wave Imaging Radiometer (MIR)
Spatial Coverage	N: 33.937, S: 23.12, E: -70.053 , W: -85.5 (Florida)
Spatial Resolution	100° angular swath
Temporal Coverage	August 8, 1998 - September 8, 1998
Temporal Resolution	Daily
Sampling Frequency	~3 second scan cycle
Parameter	Brightness temperatures
Version	1
Processing Level	1B

File Naming Convention

The CAMEX-3 ER-2 Millimeter-wave Imaging Radiometer (MIR) dataset browse files are available in GIF format and named using the following convention:

Browse files: er2mir_YYYY_DDD.gif

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
DDD	Three-digit Julian day
.gif	Graphics Interchange Format (GIF)

Data Format and Parameters

The CAMEX-3 ER-2 Millimeter-wave Imaging Radiometer (MIR) dataset files are stored in GIF format. Each daily browse image displays MIR brightness temperature measurements collected during a CAMEX-3 ER-2 flight. Each plot contains the brightness temperatures measured at each of the seven MIR frequencies: 89, 150, 183±1, 183±3, 183±7, 220, and 325±3 GHz. Brightness temperatures observed during the flight are plotted in separate panels for each frequency. Each panel represents the view below the aircraft. The width of each frequency panel on the x-axis corresponds to the MIR scan swath diameter and the timescale on the y-axis corresponds to the distance along the flight path. Features with higher brightness temperatures are displayed in warm colors while features with lower brightness temperatures are displayed in cool colors. An example browse image is displayed in Figure 3 below.

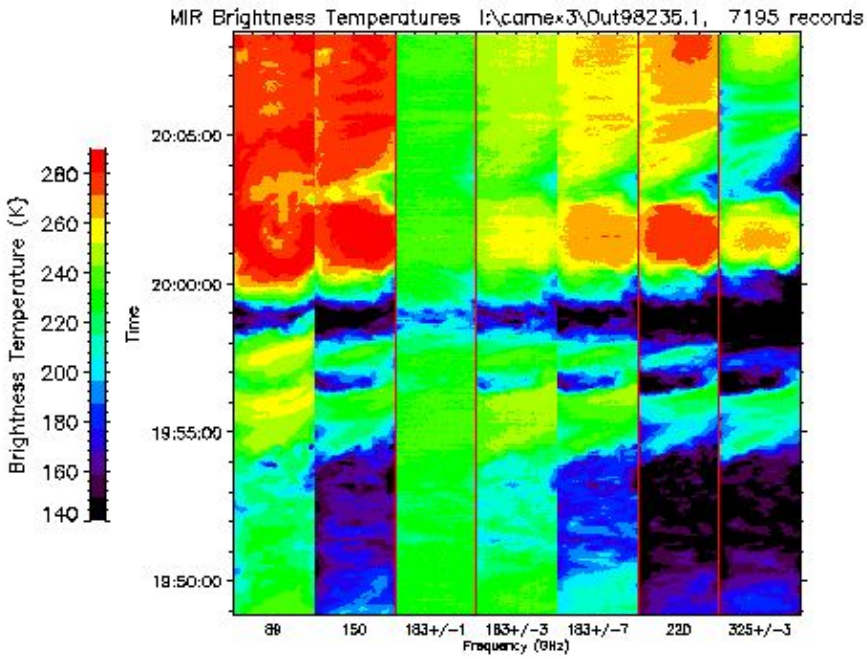

Figure 3: MIR brightness temperature plot for August 23, 1998
(Image source: NASA GHRC)

Algorithm

MIR operates by measuring the intensity of the radiation emitted by target. This intensity is called the "brightness temperature" because the intensity of the radiation emitted by an object is a function of the object's temperature. Brightness temperatures can be used to derive water vapor, clouds, precipitation, and other features. More information about brightness temperatures and radiometer measurements is available on the RSS Brightness Temperature webpage.

Quality Assessment

MIR undergoes an absolute calibration each scan cycle. There are two external calibration targets, one hot and one cold, mounted at 45 degrees within the MIR ER-2 wing pod. Each target is an array of aluminum pyramids coated with a microwave absorbing material. The hot target is heated to 330 K while the cold target is cooled to about 250 K by the air around the ER-2 at 20 km altitude. During each scan, the scan mirror rotates past the hot and cold calibration targets of known temperature to ensure the accuracy of MIR's brightness temperature measurements. More information about the MIR calibration process is available in Racette et al. 1996.

Software

No special software is needed to view the GIF image files. The files can be viewed in most image software.

Known Issues or Missing Data

These data are airborne and flights did not occur each day of the campaign, therefore, data is only available on flight days.

References

Kakar, R., Goodman, M., Hood, R., & Guillory, A. (2006). Overview of the Convection and Moisture Experiment (CAMEX). Journal of the Atmospheric Sciences, 63, 5–18. https://doi.org/10.1175/JAS3607.1

NASA. (2015). Millimeter Imaging Radiometer (MIR). https://airbornescience.nasa.gov/instrument/MIR

Racette, P., Adler, R. F., Wang, J. R., Gasiewski, A. J., Jakson, D. M., & Zacharias, D. S. (1996). An Airborne Millimeter-Wave Imaging Radiometer for Cloud, Precipitation, and Atmospheric Water Vapor Studies. *Journal of Atmospheric and Oceanic Technology*, *13*, 610–619. https://doi.org/10.1175/1520-0426(1996)013%3C0610:AAMWIR%3E2.0.CO;2

Related Data

All datasets collected during the CAMEX-3 field campaign are considered related. Other CAMEX-3 datasets can be located using the GHRC HyDRO2.0 search tool and entering the term 'CAMEX-3' in the search box.

Contact Information

To order these data or for further information, please contact:

NASA Global Hydrology Resource Center DAAC
User Services
320 Sparkman Drive
Huntsville, AL 35805
Phone: 256-961-7932
E-mail: support-ghrc@earthdata.nasa.gov
Web: https://ghrc.nsstc.nasa.gov/

Created: 02/27/20