



Data User Guide

GPM Ground Validation Advanced Microwave Precipitation Radiometer (AMPR) MC3E

Introduction

The GPM Ground Validation Advanced Microwave Precipitation Radiometer (AMPR) MC3E dataset used the Advanced Microwave Precipitation Radiometer (AMPR) instrument, which played a key role in the Midlatitude Continental Convective Clouds Experiment (MC3E). The AMPR remotely senses passive microwave signatures of geophysical parameters from an airborne platform. The instrument is a low-noise system, which can provide multi-frequency microwave imagery with high spatial and temporal resolution. AMPR data are collected at a combination of four microwave frequencies (10.7, 19.35, 37.1, and 85.5 GHz) with two orientations each (Vpol-to-Hpol and Hpol-and-Vpol), which are complementary to current aircraft and satellite instrumentation. These frequencies are best suited to the study of rain systems, but are also useful to studies of other atmospheric, oceanic, and land surface processes.

Citation

Roberts, Brent. 2012. GPM Ground Validation Advanced Microwave Precipitation Radiometer (AMPR) MC3E [indicate subset used]. Dataset available online from the NASA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center, Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/GPMGV/MC3E/AMPR/DATA101>

Keywords:

NASA, GHRC, GPM GV, MC3E, Oklahoma, AMPR, Microwave

Campaign

The Global Precipitation Measurement (GPM) mission Ground Validation (GV) campaign used a variety of methods for validation of GPM satellite constellation measurements prior

to and after launch of the GPM Core Satellite, which launched on February 27, 2014. The instrument validation effort included numerous GPM-specific and joint-agency/ international external field campaigns, using state of the art cloud and precipitation observational infrastructure (polarimetric radars, profilers, rain gauges, and disdrometers). Surface rainfall was measured by very dense rain gauge and disdrometer networks at various field campaign sites. These field campaigns accounted for the majority of the effort and resources expended by GPM GV. More information about the GPM mission is available at <http://pmm.nasa.gov/GPM>.

The Midlatitude Continental Convective Clouds Experiment (MC3E) was a GPM GV field campaign which took place in central Oklahoma during April-June 2011. MC3E used a multi-scale observing strategy with the participation of a network of distributed sensors (both passive and active). The objective was to document and monitor in 3D not only precipitation, but also clouds, winds, and moisture in an attempt to provide a holistic view of convective clouds, their environment, and any associated feedbacks. The experiment was a collaborative effort between the U.S. Department of Energy (DOE), Atmospheric Radiation Measurement (ARM), Climate Research Facility, and the National Aeronautics and Space Administration's (NASA) GPM GV program and consisted of measurements from the observing infrastructure currently available in the central United States, an extensive set of sounding array, remote sensing, and in situ aircraft observations, data from the NASA GPM GV remote sensors, and a new ARM instrumentation purchased with American Recovery and Reinvestment Act funding. The measurements have provided newly available constraints for model cumulus parameterizations and space-based rainfall retrieval algorithms over land. Table 1 shows AMPR MC3E flight times. Further details on GPM MC3E are available at <https://ghrc.nsstc.nasa.gov/home/field-campaigns/mc3e> and <http://www.nasa.gov/topics/earth/features/rain-campaign.html>.

Table 1: MC3E AMPR flight times

| Flight Date | Start-Stop Time (UTC) |
|--------------------|------------------------------|
| April 19, 2011 | 1540 - 1726 |
| April 20, 2011 | 1658 - 1924 |
| April 22, 2011 | 1921 - 0057 |
| April 25, 2011 | 0714 - 1234 |
| April 27, 2011 | 0500 - 1151 |
| May 7, 2011 | 1808 - 2251 |
| May 8, 2011 | 1800 - 2054 |
| May 11, 2011 | 1507 - 1907 |
| May 18, 2011 | 0514 - 0940 |
| May 20, 2011 | 1315 - 1834 |
| May 24, 2011 | 1857 - 2311 |
| May 29, 2011 | 1754 - 2340 |
| May 31, 2011 | 1604 - 2333 |
| June 2, 2011 | 1153 - 1444 |

Instrument Description

The Advanced Microwave Precipitation Radiometer (AMPR) remotely senses passive microwave signatures of geophysical parameters from an airborne platform. The instrument is a low-noise system, which can provide multi-frequency microwave imagery with high spatial and temporal resolution. The AMPR is a cross-track scanning total power microwave radiometer with four channels centered at 10.7, 19.35, 37.1, and 85.5 GHz. It has a dual-lens antenna to accommodate two separate feed horns. The horn that feeds the three higher frequency channels is a copy of the Special Sensor Microwave/Imager (SSM/I) space borne multi-frequency feed horn currently flying onboard the Defense Meteorological Satellite Program (DMSP) satellites. A separate AMPR feed horn, which was built by the Georgia Technology Research Institute (GTRI), accommodates the 10.7 frequency. Table 2 lists several of the AMPR performance characteristics.

Table 2: AMPR performance characteristics

| Characteristic | 85.5 GHz | 37.1 GHz | 19.35 GHz | 10.7 GHz |
|---|----------|----------|-----------|----------|
| Bandwidth (MHz) | 1400 | 900 | 240 | 100 |
| Integration time (ms) | 50 | 50 | 50 | 50 |
| Horn Type | SSM/I | SSM/I | SSM/I | GTRI |
| Lens Diameter (inches) | 5.3 | 5.3 | 5.3 | 9.7 |
| Beam width (degrees) | 1.8 | 4.2 | 8.0 | 8.0 |
| Footprint (km) at 20 km ER-2 alt. 500 knots | 0.64 | 1.48 | 2.78 | 2.78 |
| Beam Efficiency (%) | N/A | 98.8 | 98.7 | 97.8 |
| Cross Polarization (%) | N/A | 0.4 | 1.6 | 0.2 |

The AMPR radiometer has flown on the NASA ER-2 and DC-8 aircraft. The instrument has a 90 degree total scan centered at nadir. The data footprints are designed to be contiguous (for altitude of 20 km and aircraft speed of 200 m/s) at 85.5 GHz and coincident at all four channels leading to over-sampling at the lower frequencies. The polarization varies from vertical/horizontal at 45 degrees to the left of nadir, an equal mixture of vertical and horizontal polarization at nadir, and horizontal/vertical at 45 degrees to the right of nadir.

Investigators

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Data Characteristics

The GPM Ground Validation Advanced Microwave Precipitation Radiometer (AMPR) MC3E dataset is available in ASCII files, with the browse imagery available in GIF format. These data are also in a Level 1B processing level.

Table 3: Data Characteristics

| Characteristic | Description |
|---------------------|--|
| Platform | NASA ER-2 |
| Instrument | Advanced Microwave Precipitation Radiometer (AMPR) |
| Projection | n/a |
| Spatial Coverage | N: 43.0 , S: 28.0, E: -91.0, W: -121.0 (Oklahoma) |
| Spatial Resolution | n/a |
| Temporal Coverage | Start date: April 19, 2011 Stop date: June 3, 2011 |
| Temporal Resolution | File per flight |
| Sampling Frequency | n/a |
| Parameter | microwave |
| Version | 1 |
| Processing Level | 1B |

File Naming Convention

The GPM Ground Validation Advanced Microwave Precipitation Radiometer (AMPR) MC3E dataset are in the following naming convention.

Tarred Data files: exp_ampr_YYYYMMDD_ghrc_ver1.txt.gz

Browse files: exp_ampt_YYYYMMDD_<start time>-<stop time>.gif

Table 4: File naming convention variables

| Variable | Description |
|--------------|--|
| exp | Experiment name (full name or abbreviation) |
| YYYY | Four-digit year |
| MM | Two-digit month |
| DD | Two-digit day |
| <start time> | Flight start time in hhmmss Where, hh: two-digit hour in UTC mm: two-digit minute in UTC ss: two-digit second in UTC |
| <stop time> | Flight stop time in hhmmss Where, hh: two-digit hour in UTC mm: two-digit minute in UTC ss: two-digit second in UTC |
| .txt.gz | Zipped ASCII text files |

| | |
|------|--|
| .gif | Graphics Interchange Format (GIF) format |
|------|--|

Data Format and Parameters

The GPM Ground Validation Advanced Microwave Precipitation Radiometer (AMPR) MC3E data record structure is shown in Table 5. The aircraft's latitude, longitude, and altitude are GPS when available.

Table 5: Data Fields

| Sequence | Format | Size | Data type | Units |
|-----------|---------|------|-----------------------------------|---------|
| 1 | integer | 1 | Scan number | - |
| 2 | integer | 1 | Day of year | UTC |
| 3 | integer | 1 | Hour | UTC |
| 4 | integer | 1 | Minute | UTC |
| 5 | integer | 1 | second | UTC |
| 6 | integer | 1 | QC Code (not used) | - |
| 7 | real | 1 | GPS latitude | degrees |
| 8 | real | 1 | GPS longitude | degrees |
| 9 | real | 1 | GPS altitude | meters |
| 10 | real | 1 | Pitch (+ is nose up) | degrees |
| 11 | real | 1 | Roll (+ is right wing down) | degrees |
| 12 | real | 1 | Yaw (0-360, 0 is N, 90 is E) | degrees |
| 13 | real | 1 | Heading (true) | degrees |
| 14 | real | 1 | Ground speed | m/s |
| 15 | real | 1 | Air speed | m/s |
| 16 - 19 | real | 4 | RMS Noise (10, 19, 37, 85 GHz) | tbd |
| 20 - 69 | real | 50 | Pixel TB's at 10.7 GHz | Kelvin |
| 70 - 119 | real | 50 | Pixel TB's at 19.35 GHz | Kelvin |
| 120 - 169 | real | 50 | Pixel TB's at 37.1 GHz | Kelvin |
| 170 - 219 | real | 50 | Pixel TB's at 85.5 GHz | Kelvin |
| 220 - 269 | real | 50 | Pixel latitude | degrees |
| 270 - 319 | real | 50 | Pixel longitude | degrees |
| 320 - 369 | integer | 50 | Mean sea-level elevation | meters |
| 370 - 419 | real | 50 | Fraction land at | - |

| | | | | |
|--|--|--|------------------------|--|
| | | | 10.7 GHz resolution | |
|--|--|--|------------------------|--|

Software

The GPM Ground Validation Advanced Microwave Precipitation Radiometer (AMPR) MC3E data are in ASCII format, so not software is required to read the data; however, a [Fortran read program](#) given can be used.

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Related Data

All other data collected during the MC3E field campaign is considered related data. MC3E data can be located using the HyDRO 2.0 search tool. In addition, the AMPR was used in other GPM Ground Validation field campaigns. These other datasets are listed below and may be of interest:

GPM Ground Validation Advanced Microwave Precipitation Radiometer (AMPR) **IPHEX** (<http://dx.doi.org/10.5067/GPMGV/IPHEX/AMPR/DATA202>)

Contact Information

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

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