Global Hydrology Resource Center

Data User Guide

AMPR FIRE III ACE

Introduction

The AMPR FIRE III ACE dataset was collected during the First International Satellite Cloud Climatology Project (ISCCP) Regional Experiment, or FIRE, which studied a variety of Arctic cloud systems during the spring and summer. A team of national and international scientists conducted the FIRE Arctic Cloud Experiment (ACE) in a two-phase field campaign. The scientific objectives of FIRE ACE were to study the impact of Arctic clouds on radiation exchange between the surface, atmosphere, and space, and the influence of surface characteristics of sea ice, leads, and ice melt ponds. These data are available in ASCII and netCDF-4/CF formats for May 18, 1998 through June 6, 1998.

Citation

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GHRC, AMPR, Alaskan North Slope, Microwave, FIRE III, ACE, arctic, clouds, surface characteristics, brightness temperature

Campaign/Instrument Description

The Advanced Microwave Precipitation Radiometer (AMPR) has participated in more than 14 major research programs and numerous instrument integrations beginning in October 1990. A summary of AMPR research missions is given in Table 1.

Table 1: AMPR Research Mission Summary

Time Period	Campaign Name	Acronym	Region of Interest
October 1990	Validation flights from Jacksonville, Florida	JAX90	Gulf of Mexico
July 1991	Convection and	CaPE	Melbourne, Florida

	Precipitation/Electrification Experiment		
February-March 1992	STormscale Operational and Research Meteorology Fronts Experiment Systems Test	STORMFEST	Central United States
January-February 1993	Tropical Ocean Global Atmosphere Coupled Ocean-Atmosphere Response Experiment	TOGA COARE	Southwest Pacific Ocean
September 1993	First Convection and Moisture Experiment	CAMEX-1	United States Atlantic
August 1995	Second Convection and Moisture Experiment	CAMEX-2	United States Atlantic
June-July 1996	Huntsville Soil Moisture Experiment	HSME-96	Huntsville, Alabama
March-April 1998	Texas-Florida Underflight Experiment-A	TEFLUN-A	Gulf Coast
July 1998	First International Satellite Cloud Climatology Project (ISCCP) Regional Experiment III (FIRE-III) Arctic Cloud Experiment (ACE)	FIRE-III/ACE	Arctic Ocean
August-September 1998	Third Convection and Moisture Experiment/Texas-Florida Underflight Experiment-B	CAMEX-3/ TEFLUN-B	Southeast United States/Atlantic/Gulf of Mexico
January-February 1999	Tropical Rainfall Mission - Large-scale Biosphere-Atmosphere (LBA) experiment	TRMM-LBA	Amazon Basin
July-September 1999	Kwajalein Experiment	KWAJEX	Central Pacific
August-September 2001	Fourth Convection and Moisture Experiment/Keys Area Microphysics Project	CAMEX-4	Atlantic Ocean, Florida Keys
July 2005	Tropical Cloud Systems Processes Experiment	TCSP	Eastern Pacific Ocean, Caribbean Sea
July-August 2007	Tropical Composition, Cloud and Climate Coupling	TC4	Tropical Eastern Pacific/San Jose, Costa Rica

The First International Satellite Cloud Climatology Project (ISCCP) Regional Experiment (FIRE) studied a variety of Arctic cloud systems under spring and summer conditions. A team of national and international scientists conducted the FIRE Arctic Cloud Experiment (ACE) in a two-phase field campaign. The science objectives of FIRE ACE were to study the impact of Arctic clouds on radiation exchange between the surface, atmosphere, and space, and the influence of surface characteristics of sea ice, leads, and ice melt ponds on these clouds. FIRE ACE attempted to document, understand, and predict the Arctic cloud-radiation feedbacks, including changes in cloud fraction and vertical distribution, water vapor cloud content, cloud particle concentration and size, and cloud phase as atmospheric temperature and chemical composition change. FIRE ACE data is used to focus on improving current climate model simulations of the Arctic climate, especially with respect to clouds and their effects on the surface energy budget. In addition, FIRE ACE investigated a number of scientific questions dealing with radiation, cloud microphysics, and atmospheric chemistry. Table 2 shows the flight date and times of AMPR during the FIRE ACE campaign.

Table 2: FIRE ACE AMPR Flight Date and Times

Flight Date	Start-Stop Time (UTC)
May 18, 1998	2000 - 0100
May 20, 1998	1915 - 0100
May 22, 1998	2030 - 0030
May 24, 1998	2015 - 0030
May 26, 1998	1930 - 0045
May 27, 1998	2030 - 0100
May 29, 1998	1945 - 0100
June 2, 1998	2000 - 0200
June 3, 1998	1915 - 0030
June 4, 1998	1915 - 0000
June 6, 1998	1915 - 2230

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 resolutions. AMPR data are collected at a combination of four microwave frequencies (10.7, 19.35, 37.1, and 85.5 GHz), 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.

The AMPR is a cross-track scanning total power microwave radiometer. 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) spaceborne multi-frequency feed horn on 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 GHz frequency. Table 3 lists several of the AMPR performance characteristics.

Table 3: AMPR Performance Characteristics

Characteristic	85.5 GHz	37.1 GHz	19.35 GHz	10.7 GHz
Bandwidth (MHz)	1,400	900	240	100
Integration Time (ms)	50	50	50	50

Horn Type	SSM/I	SSM/I	SSM/I	GTRI
Lens Diameter (in)	5.3	5.3	5.3	9.7
Beamwidth (degrees)	1.8	4.2	8.0	8.0
Footprint (km) At 20 km ER-2 altitude 500 kts	0.64	1.48	2.78	2.78
Beam Efficiency (%)	-	98.8	98.7	97.8
Cross Polarization (%)	-	0.4	1.6	0.2

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

Investigators

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Data Characteristics

The AMPR FIRE III ACE data are available in both ASCII and netCDF-4/CF formats for the processing level 1B data. The browse images are available in GIF format and contain AMPR brightness temperature plots over a specific flight time.

Table 4: Data Characteristics

Characteristic	Description
Platform	NASA ER-2
Instrument	Advanced Microwave Precipitation Radiometer (AMPR)
Spatial Coverage	N: 78.19 , S: 64.79, E: -147.23, W: -174.29 (Alaskan North Slope)
Spatial Resolution	85.5 GHz channel: 0.6 km 37.1 GHz channel: 1.5 km 19.35 GHz channel: 2.8 km 10.7 GHz channel: 2.8 km
Temporal Coverage	May 18, 1998 - June 6, 1998
Temporal Resolution	File per flight
Sampling Frequency	1.8 seconds

Parameter	Brightness temperature
Version	1
Processing Level	1B

File Naming Convention

The AMPR FIRE III ACE dataset has the following naming conventions shown below. The data files are available in both ASCII and netCDF-4/CF format, and the browse images are available in GIF format.

Data files: fire_ampr_YYYYMMDD_ghrc_ver2.[txt.gz|nc]
Browse files: fire_ampr_YYYYMMDD_<start time>-<stop time>.gif

Table 5: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
[txt.gz|nc]	txt.gz: zipped ASCII file nc: netCDF-4/CF file
<start time>	Start time of flight in hhmmss format hh: Two-digit hour in UTC mm: Two-digit minute in UTC ss: Two-digit second in UTC
<stop time>	Stop time of flight in hhmmss format hh: Two-digit hour in UTC mm: Two-digit minute in UTC ss: Two-digit second in UTC
.gif	Graphics Interchange Format

Data Format and Parameters

The AMPR FIRE III ACE data consists of brightness temperature measurements, as well as other flight characteristics, in ASCII and netCDF-4/CF formats. There are also browse images available in GIF format. The variables in the AMPR FIRE III ACE netCDF-4/CF files are shown in Table 6, while variables within the ASCII files are shown in Table 7.

Table 6: Data Fields within netCDF-4/CF data file

Field Name	Description	Data Type	Unit
AirSpeed	Derived air speed	double	m/s
Channel	Polarization channel A: left scan edge pure vertical polarization, right edge pure horizontal	char	-

	B: right scan edge pure vertical polarization, left edge pure horizontal H: deconvolved horizontal polarization. V is deconvolved vertical polarization		
DayofYear	Day of the year	short	day
Frequency	Central frequency of AMPR sensor channel. AMPR operates at 10.7, 19.35, 37.1, and 85.5 GHz	float	GHz
GPSAltitude	GPS estimated aircraft altitude above mean sea level	double	m
GPSLatitude	GPS estimated aircraft latitude	double	Degrees North
GPSLongitude	GPS estimated aircraft longitude	double	Degrees East
GroundSpeed	INS estimated ground speed	double	m/s
Head	Aircraft true heading, clockwise from North	double	degrees
Hour	Hour in UTC	short	hour
LandFraction	The IFOV is estimated based on oversampling rate, and inverse-distance weighting is used to estimate the approximate contribution of land-containing scenes within the IFOV. Fraction of land in 2.5 km radius (approximate) at 10.7 GHz resolution	double	-
Lat	Latitude of georeferenced pixel	double	Degrees North
Lon	Longitude of georeferenced pixel	double	Degrees East
Minute	Minute in UTC	short	minute
MSL_Elevation	Mean Sea Level elevation. Value of -9999.0 indicates over water	short	m
Noise	RMS noise in four channels (10, 19, 37 and 85). Negative values indicate missing or bad data	double	K
Pitch	aircraft pitch (+ up)	double	degrees
QC	Quality Control field	double	-
Roll	aircraft roll (+ right)	double	degrees
Second	Second in UTC	short	seconds
TB	Brightness Temperature in four frequencies (10, 19, 37 and 85) and up to four channels (A, B, H, and V). Negative values indicate missing or bad data.	double	K

Time	Time of scene scan	double	Seconds since 1970-01-01 00:00:00.000
Yaw	INS estimated true track angle, clockwise from north	double	degrees

Table 7: Data Fields within ASCII data file

Column	Description	Unit
1	First row shows year of data collection, with the following rows showing the row number	Year
2	Julian Date of data collection	Date
3	Hour in UTC	Hour
4	Minute in UTC	Minute
5	Second in UTC	Second
6	Quality Control field	-
7	GPS estimated Latitude	Degrees North
8	GPS estimated Longitude	Degrees East
9	GPS estimated aircraft altitude above mean sea level	m
10	aircraft pitch (+ up)	degrees
11	aircraft roll (+ right)	degrees
12	INS estimated true track angle, clockwise from north	degrees
13	Aircraft true heading, clockwise from North	degrees
14	Derived air speed	m/s
15	INS estimated ground speed	m/s
16	RMS noise in channel 10. Negative values indicate missing or bad data	K
17	RMS noise in four channel 19. Negative values indicate missing or bad data	K
18	RMS noise in four channel 37. Negative values indicate missing or bad data	K
19	RMS noise in four channel 85. Negative values indicate missing or bad data	K
20-70	Brightness Temperature at frequency 10 GHz with 50 cross-track scanning measurements. Negative values indicate missing or bad data.	K
71-121	Brightness Temperature at frequency 19 GHz with 50 cross-track scanning	K

	measurements. Negative values indicate missing or bad data.	
122 - 172	Brightness Temperature at frequency 37 GHz with 50 cross-track scanning measurements. Negative values indicate missing or bad data.	K
173 - 223	Brightness Temperature at frequency 85 GHz with 50 cross-track scanning measurements. Negative values indicate missing or bad data.	K
224-274	Latitude of georeferenced pixel at each 50 cross-track scan.	Degrees North
275-325	Longitude of georeferenced pixel at each 50 cross-track scan.	Degrees East
326-376	Mean Sea Level elevation at each 50 cross-track scan. Value of -9999.0 indicates over water	m
377-427	The IFOV at each 50 cross-track scan is estimated based on oversampling rate, and inverse-distance weighting is used to estimate the approximate contribution of land-containing scenes within the IFOV. Fraction of land in 2.5 km radius (approximate) at 10.7 GHz resolution	-

Quality Assessment

Each data file has a quality control field variable. Also, the efficiency of the main beam on AMPR is 93.2% oversampling 1.0x for 85.5 GHz, 98.8% oversampling 2.3x for 37.1 GHz, 98.7% oversampling 4.4x for 19.35 GHz, and 97.8% oversampling 4.4x for 10.7 GHz. More information about the instrument characteristics are shown in Table 1 above, as well as in Hood et al., 1994.

Software

No software is required to view the ASCII data; however, Panoply can be used to view the netCDF-4/CF data files.

Known Issues or Missing Data

Within the 'MSL_Elevation', or the Mean Sea Level elevation, variable, values of -9999.0 indicates areas over water. Also, negative values indicate missing or bad data within the 'Noise' and the 'TB' variables.

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Related Data

All data collected during the AMPR field campaign should be considered related datasets. Other AMPR campaign and instrument data can be located using the GHRC HyDRO 2.0 search tool.

Contact Information

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

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