AMPR IMPACTS 2022
Science Dataset
Level 2B, Version 2

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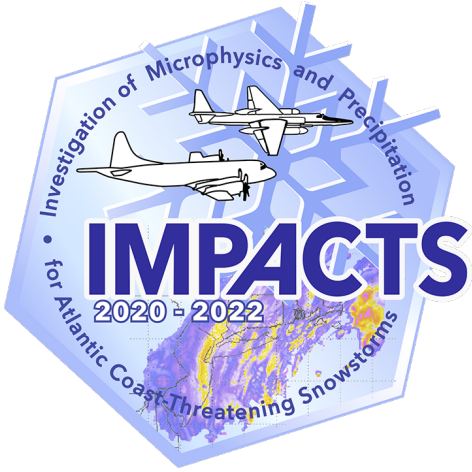
3 November 2022



1. Introduction

Data were acquired by the Advanced Microwave Precipitation Radiometer (AMPR) during the Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) field campaign during December 2021 - February 2022.

These files include the Level 2B geo-referenced brightness temperatures for the four AMPR-observed frequencies (10, 19, 37, 85 GHz). These data are archived in a self-describing, Climate and Forecasting (CF) 1.6-compliant Version 4 Network Common Data Format (netCDF4) format.

Python software has been developed for reading, plotting, and providing some additional analysis capabilities. This software is available from: https://github.com/nasa/pyampr. The AMPR instrument is explained in more detail here: https://weather.msfc.nasa.gov/ampr/.

These data have been determined to be viable for publishable scientific research, and also should be useful for generating quicklooks or understanding what happened during a flight. Note: AMPR is not expected to provide useful data during significant aircraft maneuvers.

AMPR is a significant project at MSFC. If you plan to use the final version of these data in a publication, please contact the principal investigator (PI), Timothy Lang (timothy.j.lang@nasa.gov), to discuss potential co-authorship.

2. Data Description

The primary data in these files are brightness temperatures at all AMPR frequencies and polarization channels (i.e., 10.7, 19.35, 37.1, and 85.5 GHz mixed-pol A/B channels).

In addition to the brightness temperatures, an objectively determined quality control (QC) metric is provided. The quality control metric is estimated based on the brightness temperature difference of a pixel within a 9x9 kernel of neighboring brightness temperatures. The QC metric is a discretized indicator of the difference within 5-Kelvin increments. Typical scene values fall in the QC 1 & 2 bins. However, very noisy scenes - generally indicative of instrument issues or potential scene contamination or excessive instrument noise - are isolated to values >= 4. As with any objective measure based on thresholding, however, there is a gray area in the higher bins where some of the data is of high quality but physical phenomena are generating sharp, local features that are flagged as suspect. This, in and of itself, could be useful for those wanting to isolate features (e.g., the edges of a strong convective cell).

An incidence angle flag has also been included for quickly identifying pixels associated with large incidence angles typically encountered during aircraft roll maneuvers. During a roll, often the edge pixels began to see very large incidence angles or may even contain off-Earth sidelobe contamination. But, non-edge pixels may still be receiving observations from a typical/moderate (say -45° to 45°) incidence angle. Thus, we have opted for use of incidence

angle flagging directly versus simply eliminating entire scans when the |roll angle| is greater than a threshold.

Pixel field of view (FOV) water fractions are included for all flights. A 1-km gridded land/water fraction dataset - constructed from 250-m Moderate Resolution Imaging Spectroradiometer (MODIS) land/water mask (https://lpdaac.usgs.gov/products/mod44wv006/) - has been used, together with the instrument FOV beamwidths to estimate the percent FOV that contains surface-water features. These data can be used to quickly identify (and eliminate if desired) those pixels originating from a mixed-surface (land and water) scene. The 250-m MODIS land/water mask includes water flagging for inland water bodies. However, no land-water mask is perfect, and it is possible that some smaller inland water bodies are missed. If so, then our FOV estimates will also be missing the water fraction contributions in such cases.

Notes:

- The 37 GHz (B) and 85 GHz (B) channels experienced significant noise during several IMPACTS 2022 flights. These flights were: 1/19, 1/29, 2/4, 2/13, 2/17, and 2/19. This noise was intermittent and did not occur for the full duration of these flights. Other flights may have been affected by minor noise on one or both of these channels.
- The 37 GHz (A) channel was affected by occasional noise spikes on most flights. This channel was completely unavailable during 2/17 and 2/19. QC flags have been set to 8 for the entire channel during these flights.
- The 10 GHz (A) channel was not available during the 2/17, 2/19, and 2/22 flights. QC flags have been set to 8 for the entire channel during these flights.
- All AMPR brightness temperatures during all flights between 12/6/2021 and 2/19/2022 have been corrected for a calibration error in the cold load thermistor recording. This is the most significant change between the v1 and v2 AMPR IMPACTS 2022 dataset versions.

3. Identifying Likely Good Data

As an example to quickly identify typical good data, a series of flagging based on the following conditions may be used:

QC incidence angle = 1
Pixel FOV < 0.1 or pixel FOV > 0.9 (i.e., mostly land or mostly water)
QC flag value <= 4

It is possible that sharp but valid contrasts near precipitation/clouds edges will be flagged by this. Thus, recommended usage of these criteria is only as a guide and not an objective mask.

Appendix A. AMPR File Structure

Notable variables in AMPR data files are listed below.
(Note: Order in documentation does not necessarily match order in data files)

Dimensions

- AlongTrackDim = Variable, depends on flight length
- CrossTrackDim = 50
- BandDim = 4
- ChannelDim = 2

AMPR-specific variables in all files

- float Frequency(BandDim)
- char Channel(ChannelDim) - A = Mixed-pol, left scan edge pure vertical, right scan edge pure horizontal; B = Opposite polarizations from A
- double Time(AlongTrackDim)
- double TB(ChannelDim, BandDim, AlongTrackDim, CrossTrackDim) - Brightness temperatures for all channels/bands.
- double ScanAngle(CrossTrackDim)
- double Lat(AlongTrackDim, CrossTrackDim)
- double Lon(AlongTrackDim, CrossTrackDim)
- double IncidenceAngle(AlongTrackDim, CrossTrackDim)
- double RelativeAzimuth(AlongTrackDim, CrossTrackDim)
- double LandFraction(BandDim, AlongTrackDim, CrossTrackDim)
- short QC(ChannelDim, BandDim, AlongTrackDim, CrossTrackDim)
- short IncidenceAngleQC(AlongTrackDim, CrossTrackDim)

Aircraft-related data derived from the ER-2 IWG1 feed

- double GPSAltitude(AlongTrackDim)
- double GPSLatitude(AlongTrackDim)
- double GPSLongitude(AlongTrackDim)
- double Pitch(AlongTrackDim)
- double Roll(AlongTrackDim)
- double Yaw(AlongTrackDim)
- double Head(AlongTrackDim)
- double WindDirection(AlongTrackDim) - This refers to wind direction at the aircraft's position
- double WindSpeed(AlongTrackDim) - This refers to wind speed at the aircraft's position
- double AirSpeed(AlongTrackDim)
- double GroundSpeed(AlongTrackDim)
- double Pressure(AlongTrackDim)
- double Temperature(AlongTrackDim)