The Advanced Microwave Precipitation Radiometer (AMPR) – Initial Results from the Integrated Precipitation Hydrology Experiment (IPHEx)

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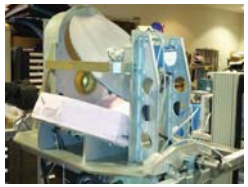
1. Background and Recent Updates

- AMPR is a cross-track scanning, airborne passive microwave radiometer maintained by NASA Marshall Space Flight Center. It has served in more than 15 airborne science missions since 1990.
- Four microwave frequencies (10.7, 19.35, 37.1 and 85.5 GHz) with spatial resolutions at typical ER-2 altitudes of 2.8, 2.8, 1.5, and 0.6 km, respectively
- Cross-track scanning -45° to +45° results in a rotating polarization basis as function of scan angle
  - **Channel A:** Left edge full V, right edge full H
  - **Channel B:** Left edge full H, right edge full V
  - *Channel B added as dual-pol upgrade in 2010*
- Flown on the ER-2 during IPHEx, which focused on the mountains and offshore waters of North and South Carolina during May-June 2014



AMPR setup for benchtop testing at MSFC

AMPR installation on the ER-2

Key IPHEx goal: The calibration and validation of GPM precipitation measurements

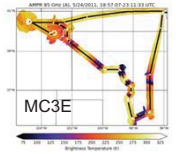
2. The Python AMPR Data Toolkit (PyAMPR)

To lay the foundation for real-time data availability during IPHEx, and to facitilate future scientific efforts with AMPR data, the PyAMPR software package was developed at MSFC.

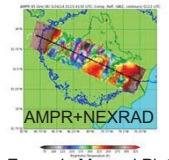
Key Features of PyAMPR

- Uses open-source, objected-oriented, modern scientific programming language (Python 2.7)
- Easily installed Python module
- Can read AMPR data from all past field campaigns into a common data model
- Support for single- and dual-pol AMPR data, including polarization deconvolution
- Rapid, simplified production of standard and customized plots (e.g., strip charts, track plots, Google Earth overlays, mergers with other datasets)
- Scalable for future applications and needs

PyAMPR will be openly distributed to the community once the quality-controlled AMPR data from IPHEx are available.

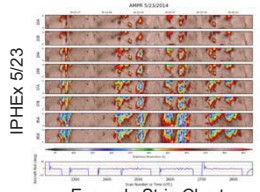


Example Track Plot



Example Merged Plot

Example Google Earth Overlay



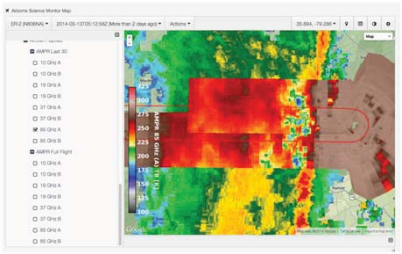
Example Strip Chart

3. Real-Time Data During IPHEx

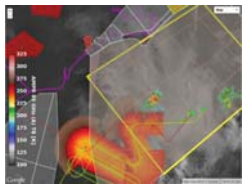
AMPR was the only airborne imaging instrument on the ER-2 during IPHEx to provide real-time imagery on the NASA Mission Tools Suite (MTS). This provided valuable guidance to Mission Scientists as they made decisions on storm sampling and aircraft waypoints, and also allowed AMPR instrument scientists and engineers to assess data quality in real-time.

How It Was Done

- Low-bandwidth needs allowed transmission of real-time raw data via the ER-2 Inmarsat connection.
- ER-2 navigation and AMPR packets decoded and merged at MSFC, then converted into real-time brightness temperature estimates and stored as ASCII data files.
- PyAMPR read those data files and produced for every channel Google Earth KMZs that were ingested into the MTS, as well as strip charts.



MTS view of AMPR 85 GHz (A) brightness temperatures overlaid with NEXRAD reflectivity and the ER-2 track on 5/15. Note the ice scattering occurring in the squall line convection.



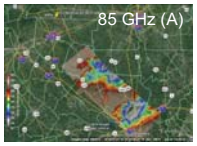
AMPR was particularly helpful for guiding oceanic missions, such as the 5/28 ACE congestus hunt

Real-time AMPR KMZs were viewable using the Google Earth app on a smartphone! Example from 6/8 mission flight.

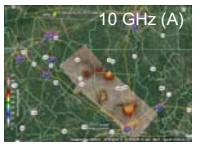
4. Future Plans

- Quality control of IPHEx AMPR data is underway. Look for them to be publicly posted at the NASA Global Hydrology Resource Center (GHRC) DAAC.
- Polarization deconvolution is available as an experimental PyAMPR feature, and is undergoing testing and refinement at MSFC. Deconvolution requires very precise calibration between channels and uses a constrained linear inversion technique.
- The AMPR brightness temperatures will be collated with other ER-2 airborne and ground instruments, including CoSMIR and HIWRAP.
- Seeking funding for data system upgrade to lighten payload and modernize onboard processing.
- Available for OLYMPEX!

AMPR During GPM Overpass – Scattering apparent at 10 GHz!

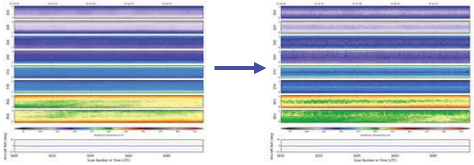


5/23/14
23:16 to
23:24 UTC

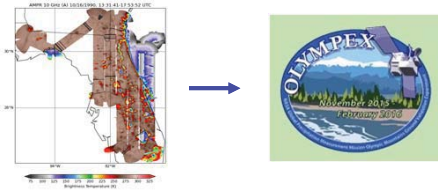


Mixed H & V polarizations

Deconvolved H & V



25-year scientific legacy!



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