



AMPR/LIP observations during IMPACTS 2023

Timothy Lang, Christopher Schultz, Corey Amiot,
Douglas Mach, Rachael Kroodsma, Ian Adams, Gerry
Heymsfield, Amanda Richter, and Sebastian Harkema

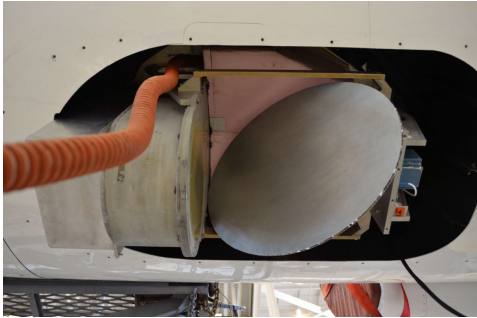


AMPR Instrument Data Update

Timothy Lang, Christopher Schultz,
Corey Amiot, and Doug Mach



IMPACTS ER-2 Payload



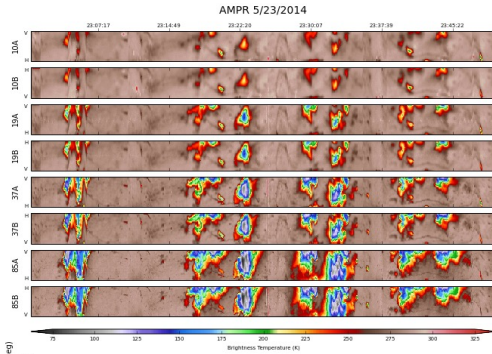
Instrument name/team:

AMPR (Advanced Microwave Precipitation Radiometer)

Team involved in IMPACTS 2023: Timothy Lang (PI), Paul Meyer (PM), Doug Huie, Julia Burton, Jonathan Hicks, Corey Amiot, Amanda Richter, Eric Cantrell

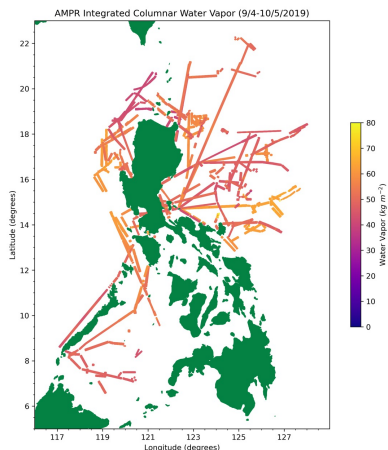
1) What does AMPR measure?

- Passive microwave radiometer – Retrieve precipitation, surface emission, cloud liquid water, ice water path, water vapor, etc.
- Four frequencies - 10.7, 19.35, 37.1, 85.5 GHz, with 2 variable polarization channels apiece (Channel A: V -> H and Channel B: H -> V)
- Cross-track scanning



2) What science role is AMPR playing in IMPACTS?

- Objective 1: Characterize the spatial/temporal scales/structures of snowbands - Precipitation horizontal structure
- With CoSMIR, provide coverage of 10-183 GHz microwave range
- With CoSSIR, provide coverage of 10-684 GHz range!
- Low frequencies provided by AMPR especially valuable over water





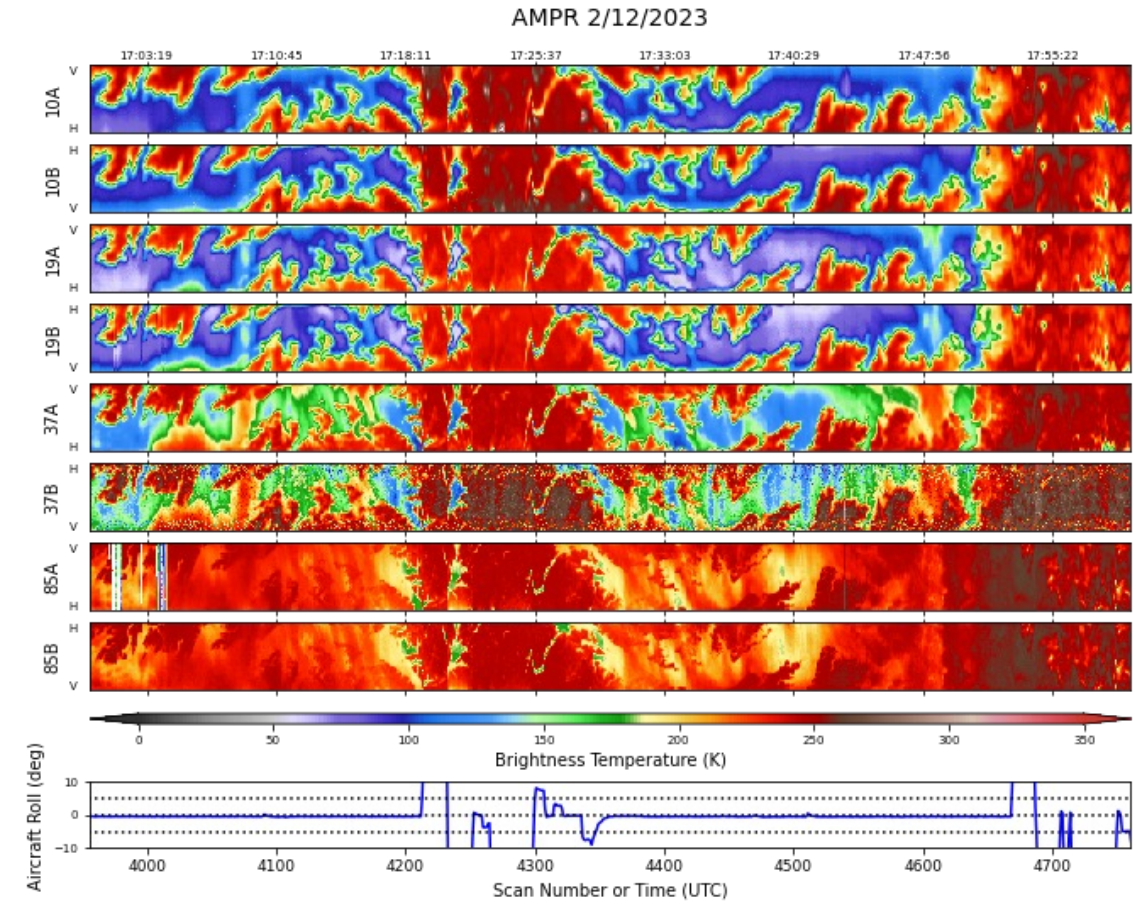
Data Status



- AMPR IMPACTS 2023 data have been uploaded to the GHRC DAAC's FTP site
- AMPR had no significant outages during IMPACTS 2023
- Data consist of geolocated mixed-polarization brightness temperatures in CF-compliant netCDF files, along with quality-control flagging
- Readme document provided
- AMPR software: <https://github.com/nasa/PyAMPR/>
- PI contact: timothy.j.lang@nasa.gov

Notes

- Chronic noise on 37 GHz (B) channels
- Occasional noise spikes/episodes on other channels, especially during ascent/descent

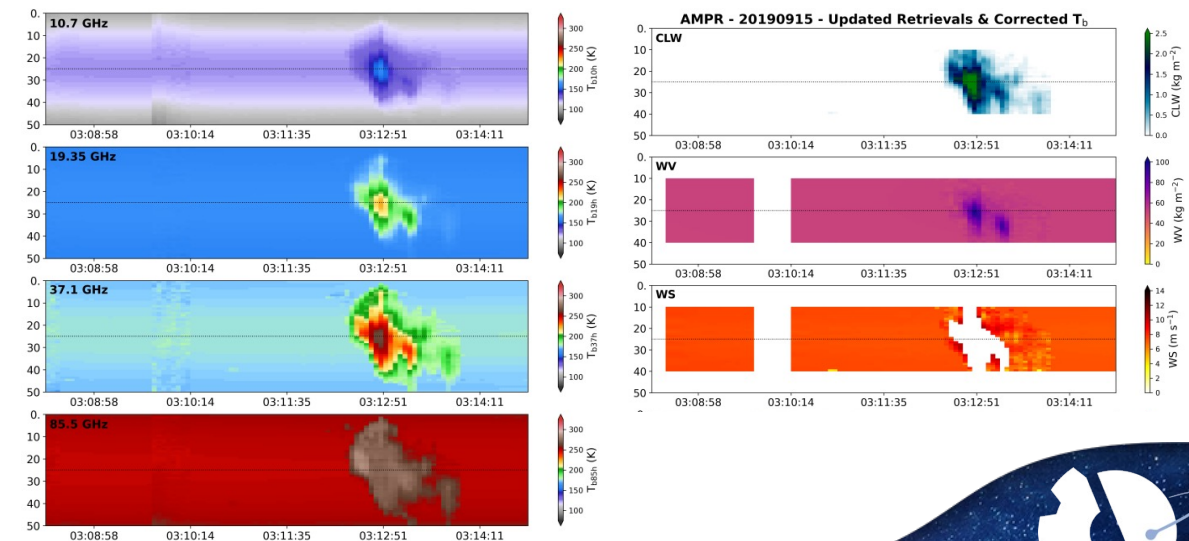
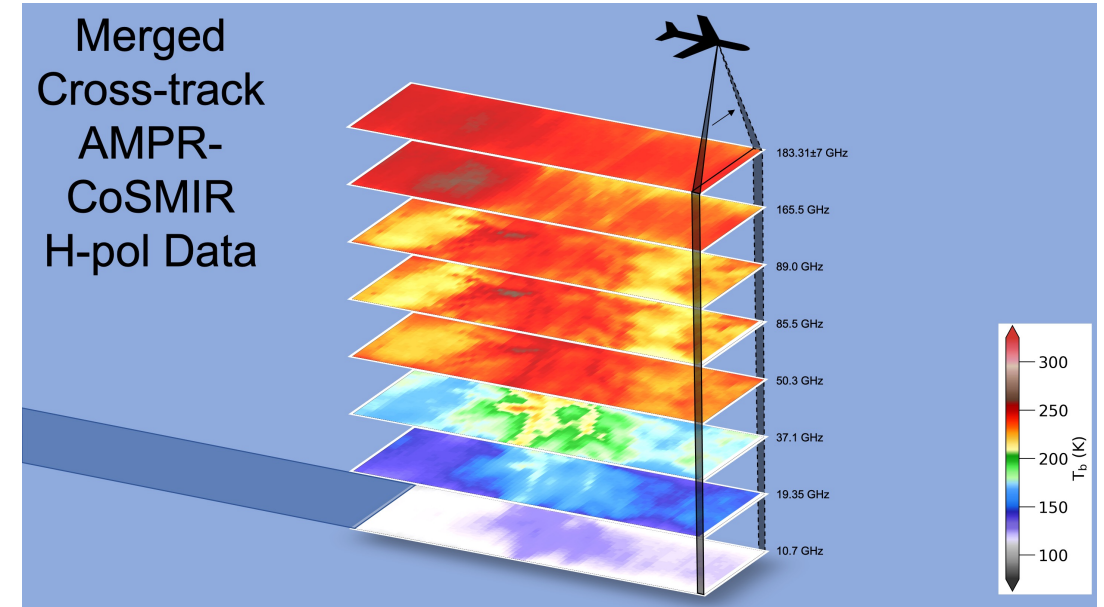




Expected Updates



- Combined matched-swath datasets with CoSMIR/CoSSIR radiometers for IMPACTS 2020-2023
 - Deconvolved AMPR TBs – pure H & V
 - Noise filtering
 - Empirically based and validated geophysical retrievals, including cloud liquid water, atmospheric water vapor, and near-surface wind speed over water
 - ETA second half of FY24
- (Combined retrievals with CoSMIR/CoSSIR later)





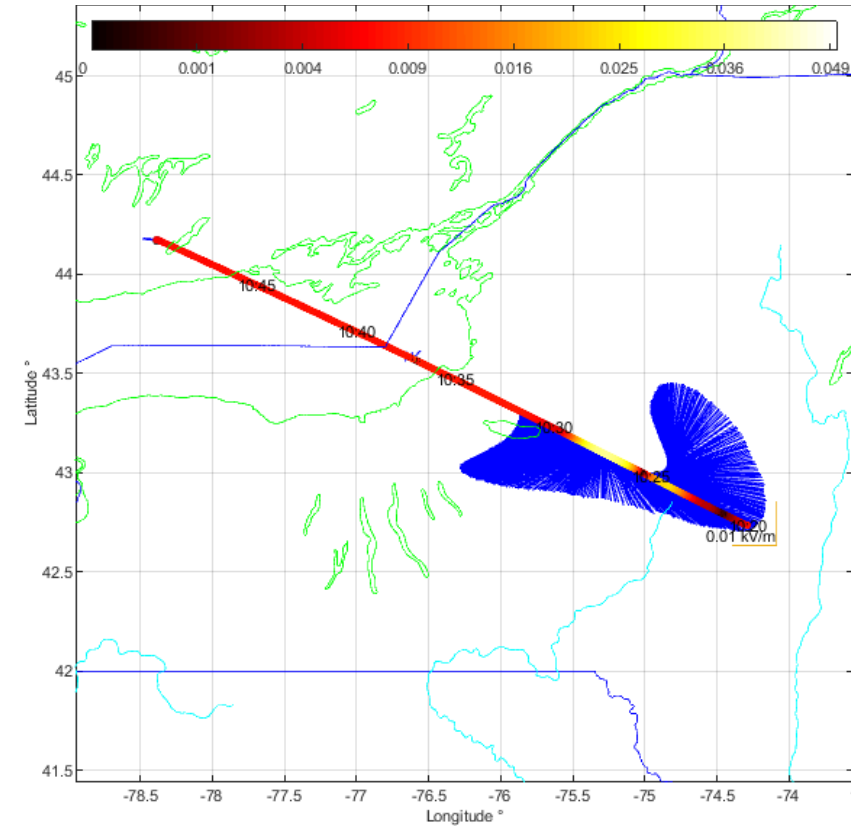
LIP Instrument Data Update

Timothy Lang, Christopher Schultz,
and Douglas Mach

Lightning Instrument Package (LIP)



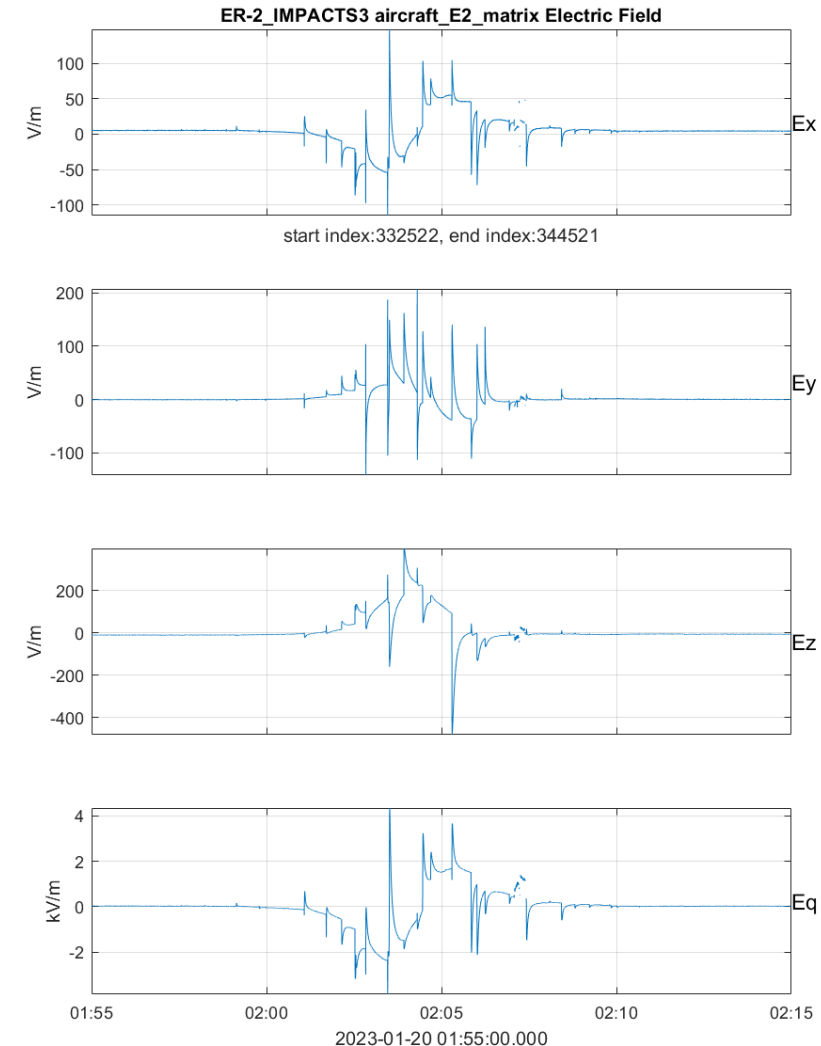
- Instrumentation
 - Electric Field Mills (7)
- Measurements
 - Vector components of the electric field (E_x , E_y , E_z)
 - Aircraft Charge
 - Lightning statistics (identified from electric field changes)
 - Storm electric currents (derived result)
 - Storm charge structure (derived result)
- Measurement Range / Accuracy
 - Electric Field : few V/m to tens of kV/m ~10%



Lightning Instrument Package (LIP)

- LIP IMPACTS 2023 will be uploaded to the GHRC DAAC's FTP site within a month
- LIP had no significant outages during IMPACTS 2023
- Occasional noise observed on some mills
- Data consist of ASCII text files with "4-D" (Ex, Ey, Ez, Eq) time series
- PI contact:
christopher.j.schultz@nasa.gov

Data Status



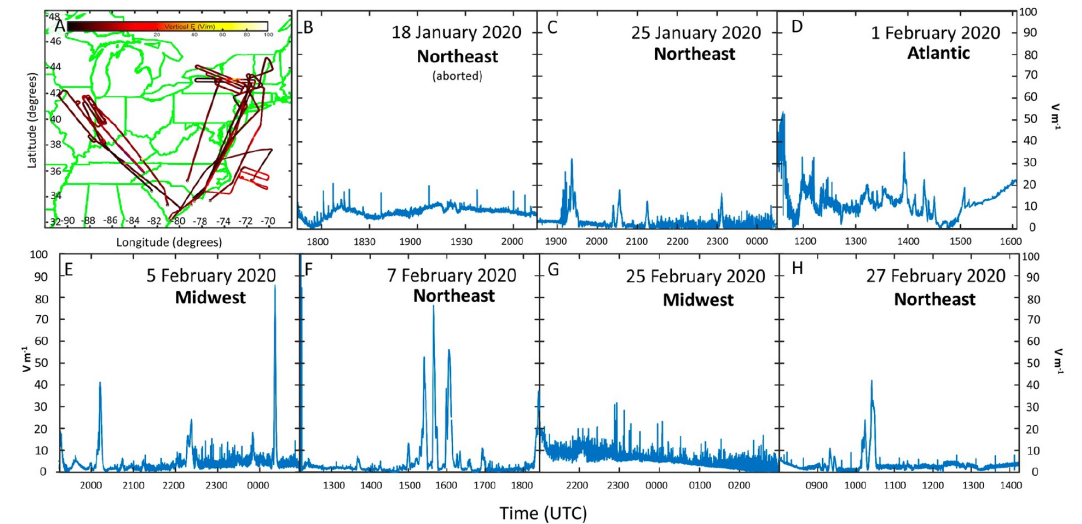
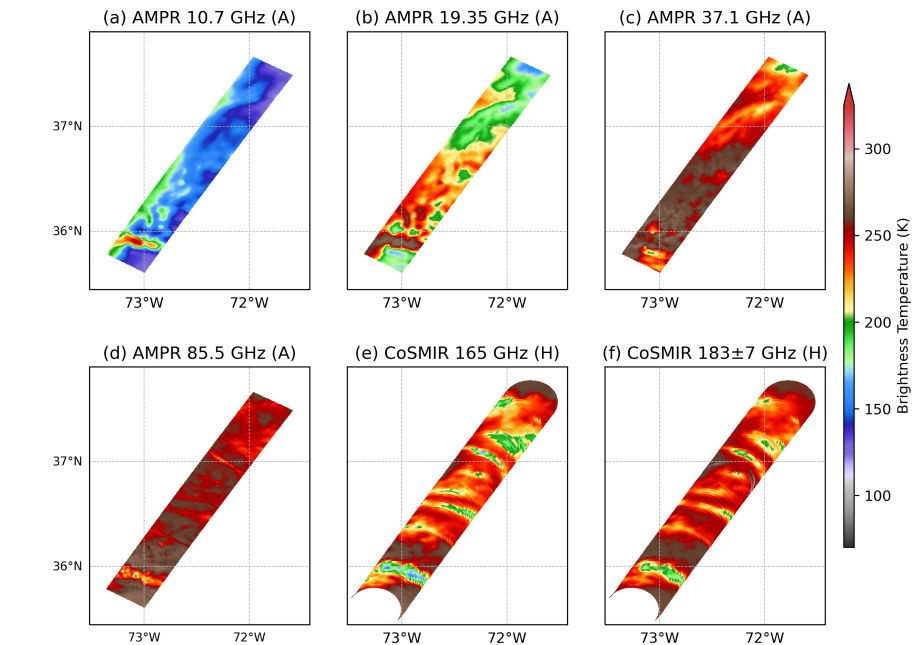


AMPR/LIP observations during IMPACTS 2023

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Background

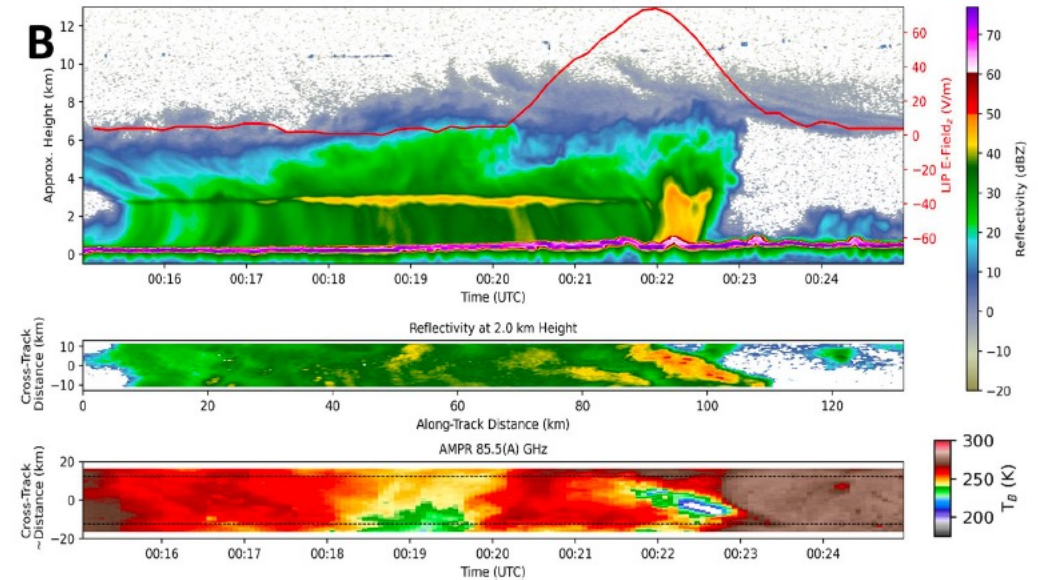
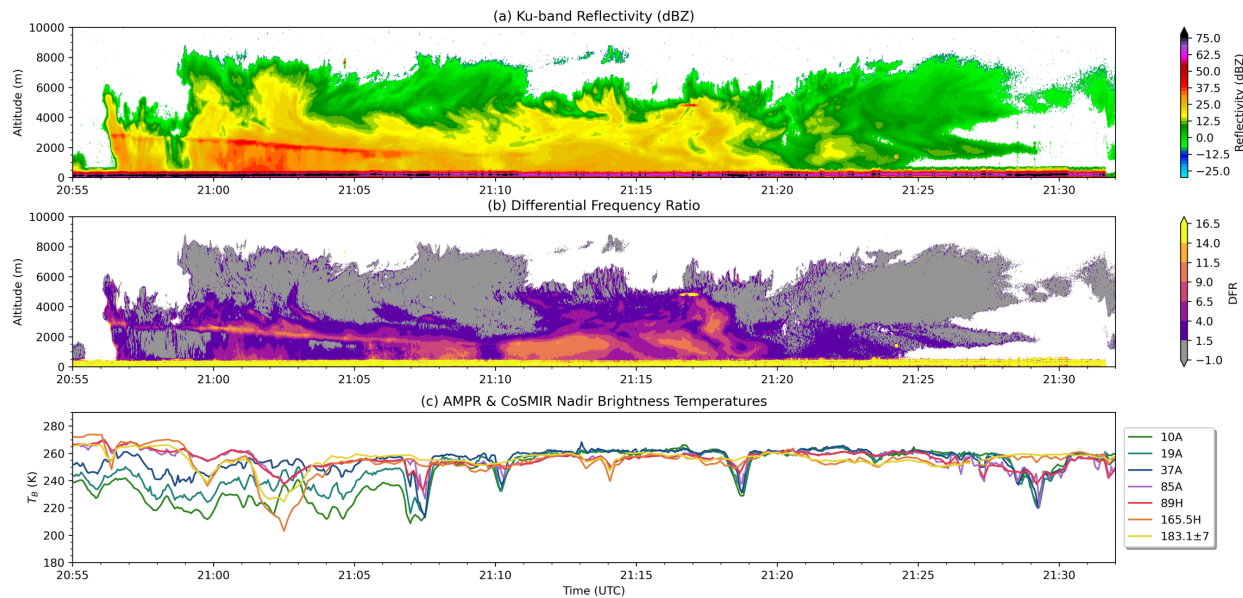
- AMPR and CoSMIR/CoSSIR provided passive microwave observations of clouds and precipitation from 10 GHz up to 183/684 GHz
- Radiometers important for characterizing 2D structure of winter storms, complementing the high-resolution nadir-focused radar observations (tho EXRAD also had a horizontal swath)
- LIP was an add-on instrument to IMPACTS 2020-2023 which remotely sensed electric fields
- LIP able to infer active electrification processes, indicating important microphysical structures



Previous Results

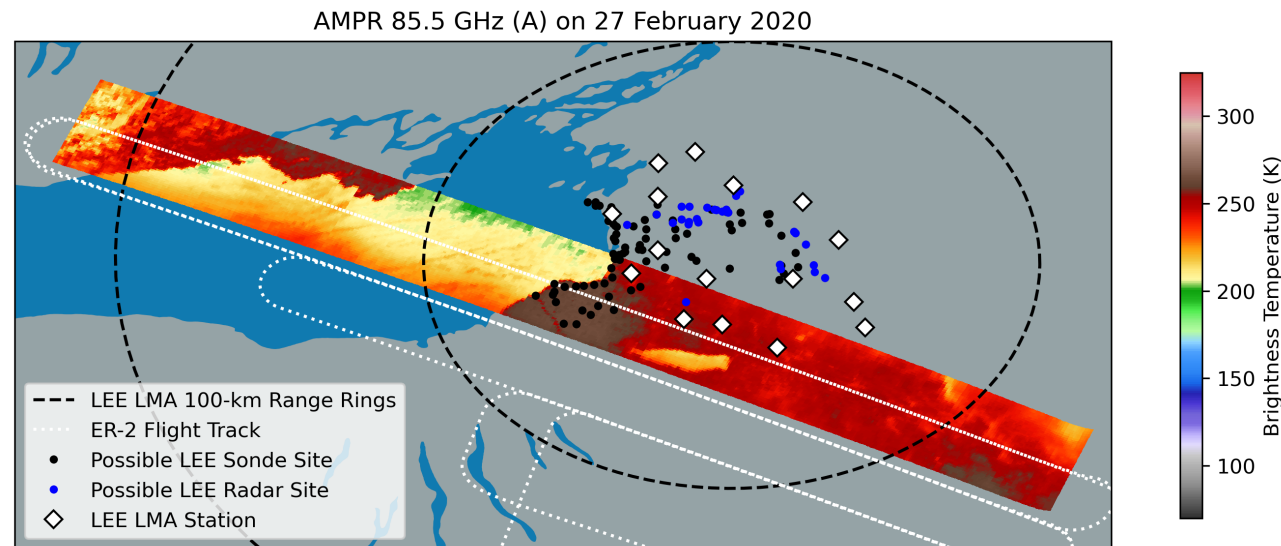
- Richter et al. (2023) examined AMPR, CoSMIR, and HIWRAP observations of 1 and 5 February 2020 winter storms. Results showed value of combined multi-frequency observations and noted radiometers were sensitive to presence of convective turrets, bright-band slopes, and phase changes, but inferring snowfall over dry terrain was challenging without radar
- Schultz et al. (2021) compared AMPR, LIP, and EXRAD data for multiple 2020 cases. Results demonstrated LIP's value for inferring microphysics and electrification, even if no lightning occurred.

Ku Reflectivity, DFR, AMPR & CoSMIR Nadir Brightness Temperature
2020/02/05 20:55-21:32



Project LEE Coordination

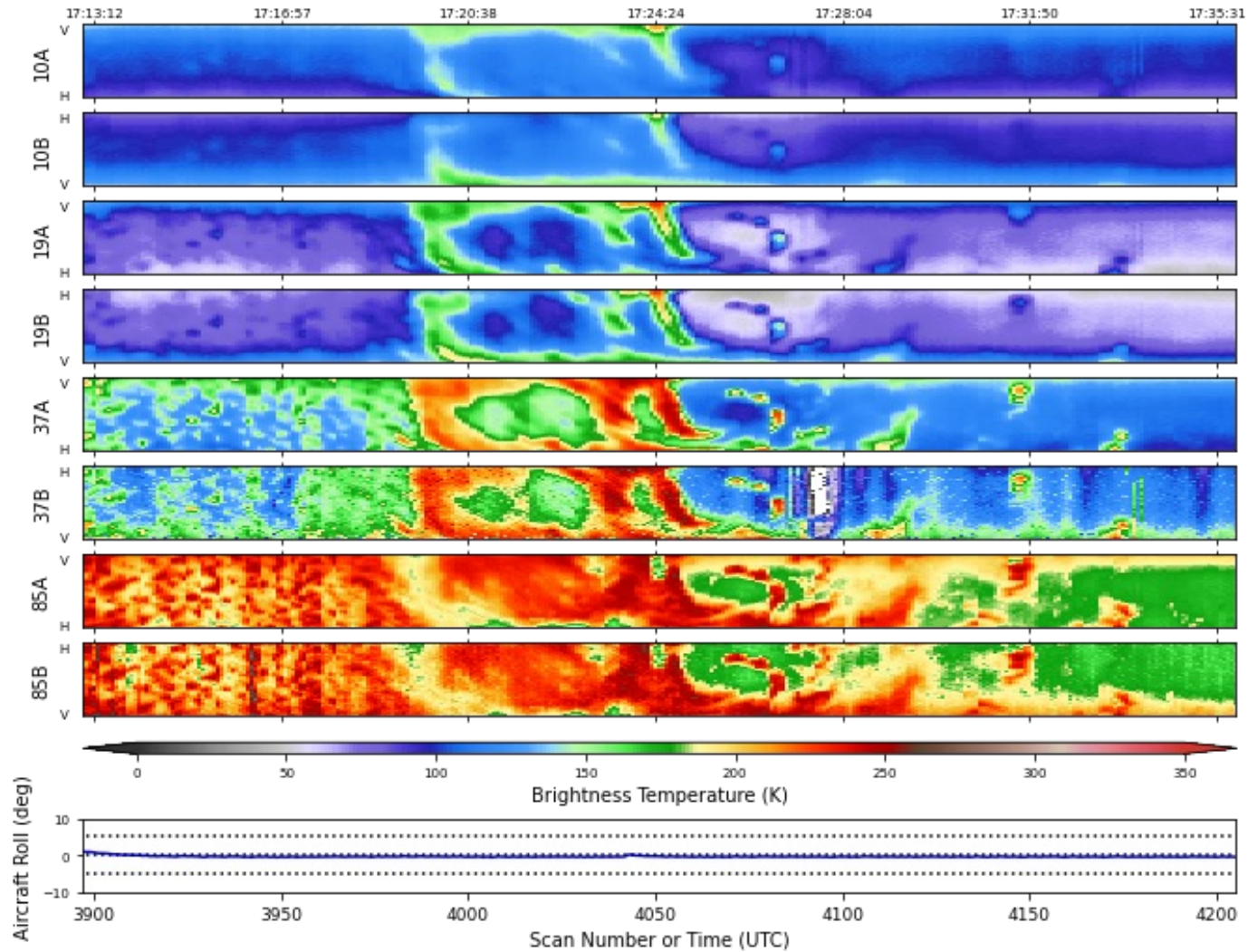
- NSF Project LEE focused on lake effect snowband electrification, and deployed a Lightning Mapping Array (LMA) near the eastern shore of Lake Ontario, as well as mobile soundings and a mobile radar
- IMPACTS coordinated with LEE on 4 flights – 13, 19, 25, and 29 January 2023
- This coordination mainly consisted of a single radiosonde per flight, complementing the rest of IMPACTS ground assets
- Missed opportunity to support lake effect lightning observations during polar front passage on 3 February



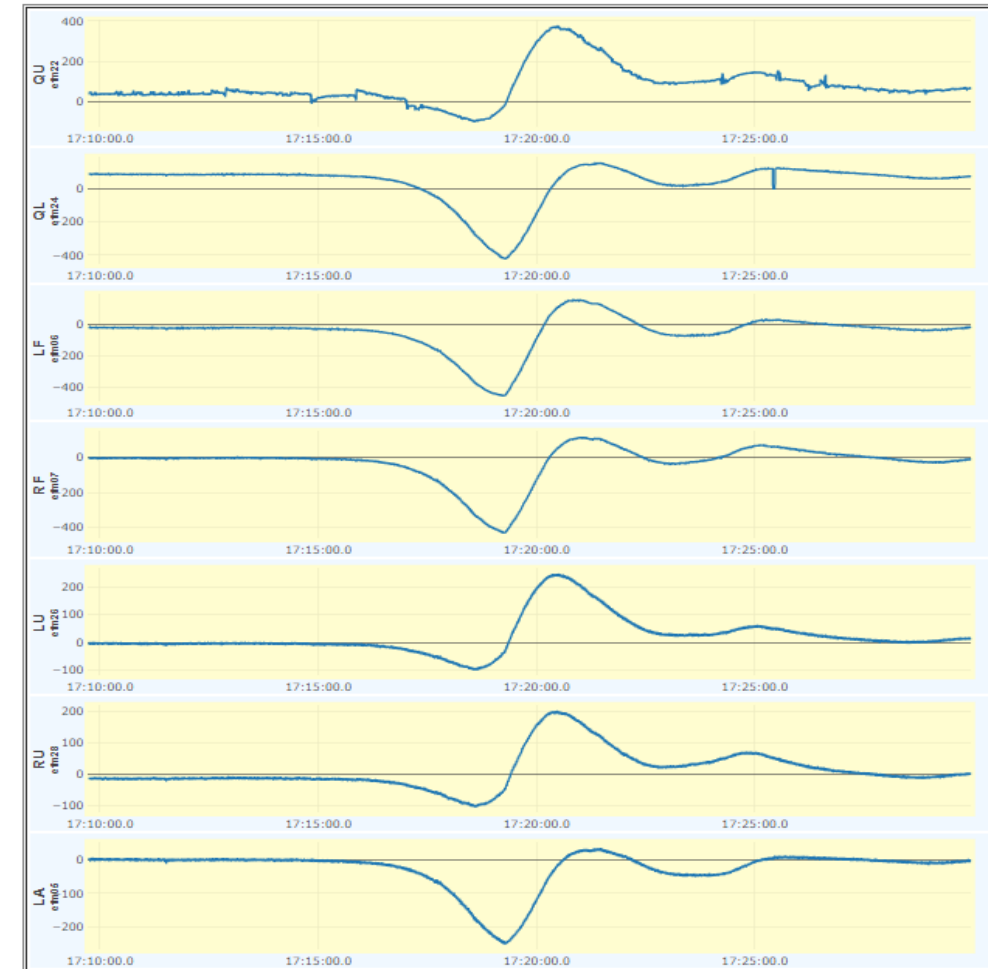
1710 UTC Northeastward Leg



AMPR 1/15/2023



LIP Real-Time Display (v 0.1)



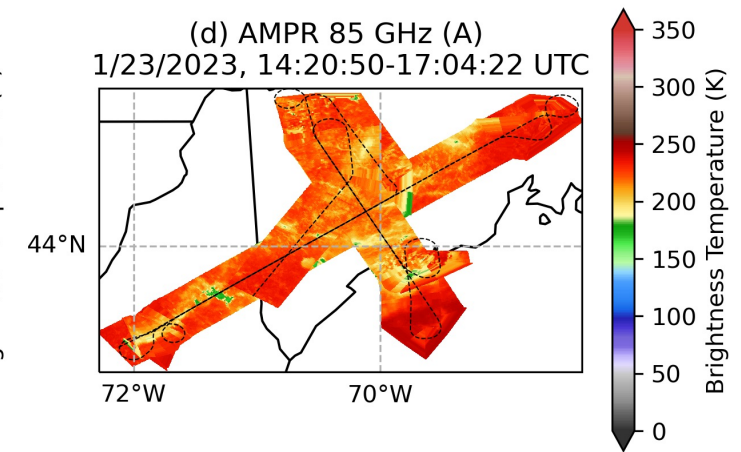
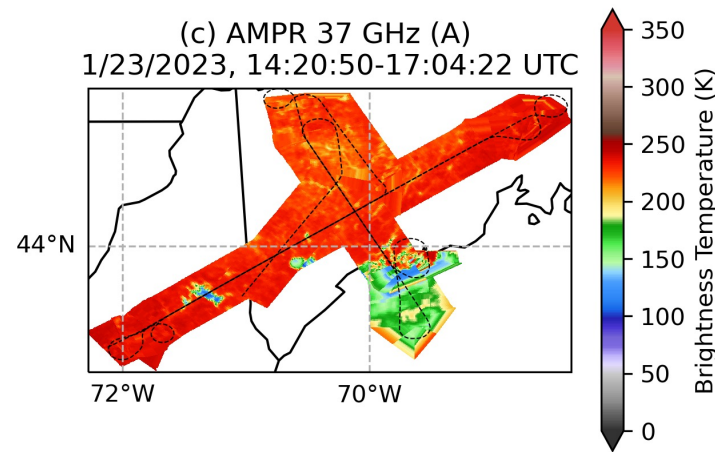
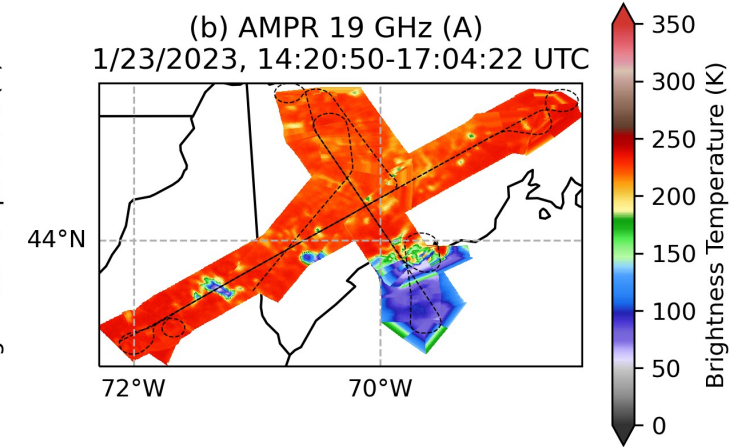
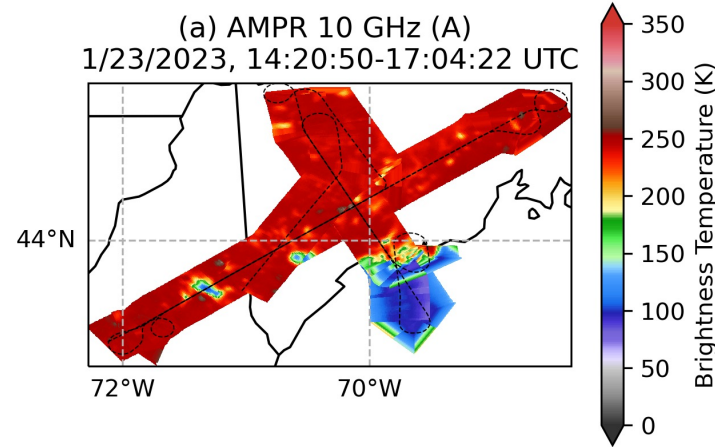
23 January 2023

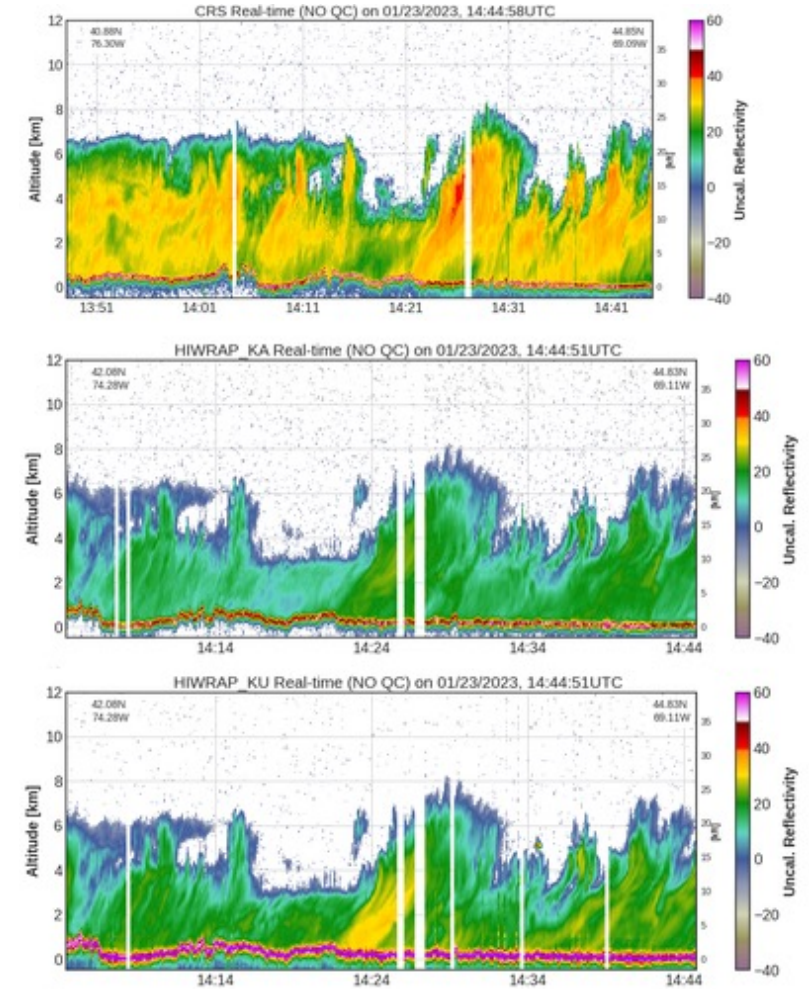
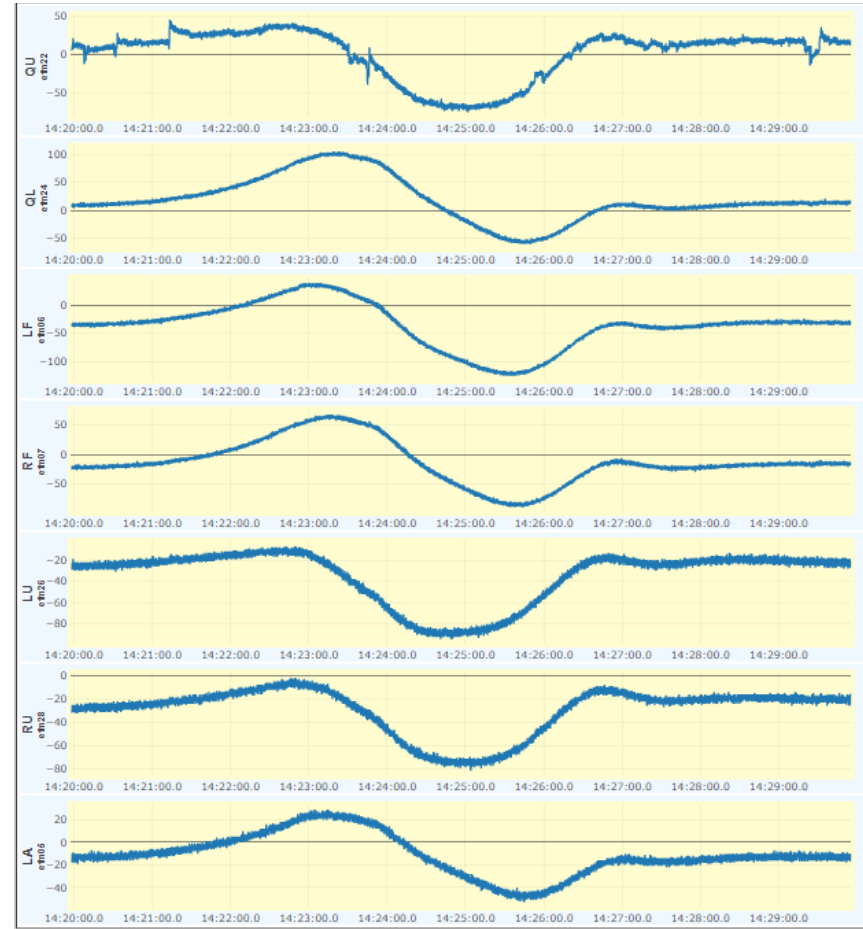
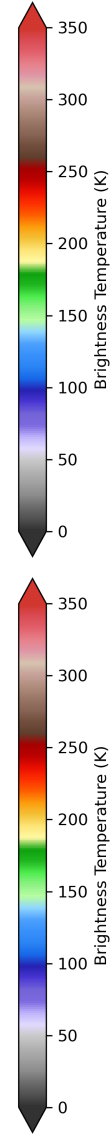
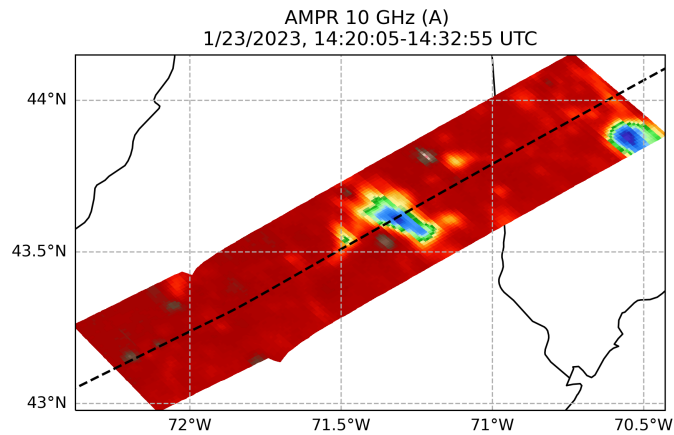
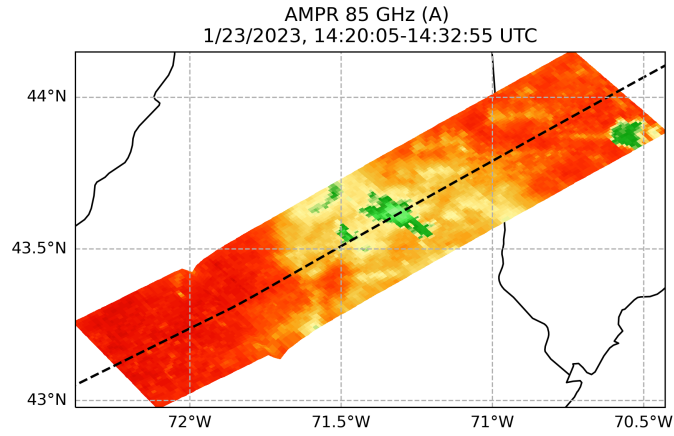
Winter storm in Maine, with offshore low pressure.

Aircraft sampled along the main precipitation band as well as across it.

85 GHz most sensitive AMPR channel to precip over land

Offshore there are precipitation signatures down to at least 19 GHz





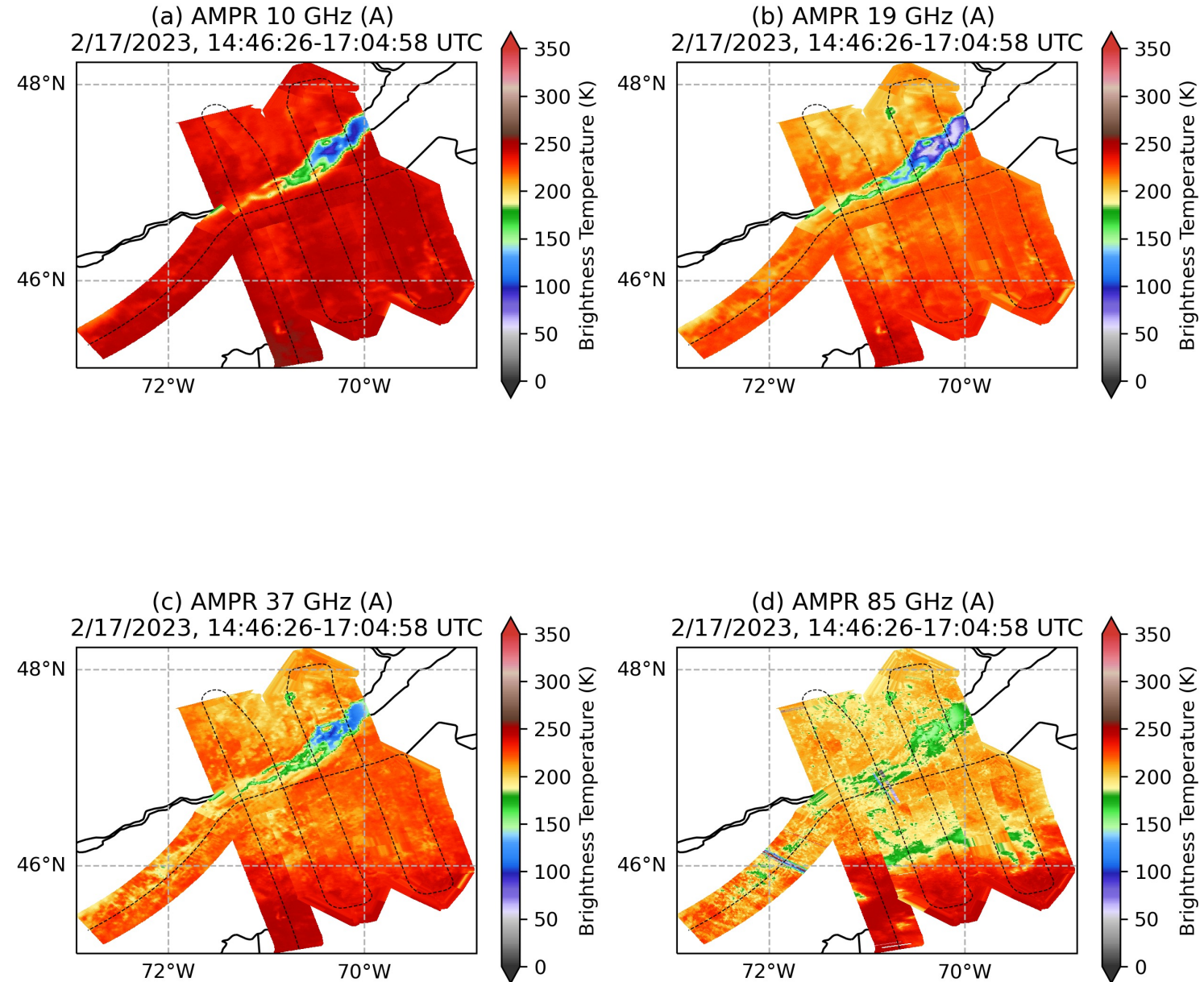
17 February 2023

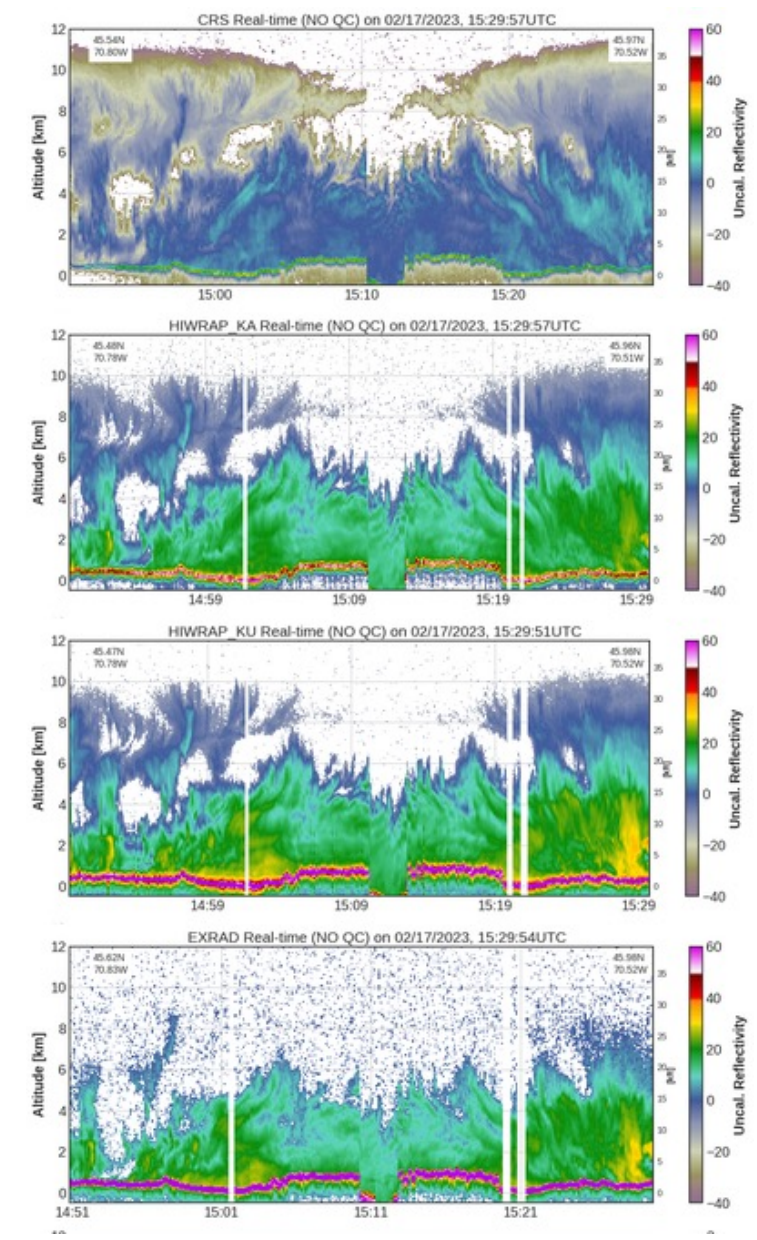
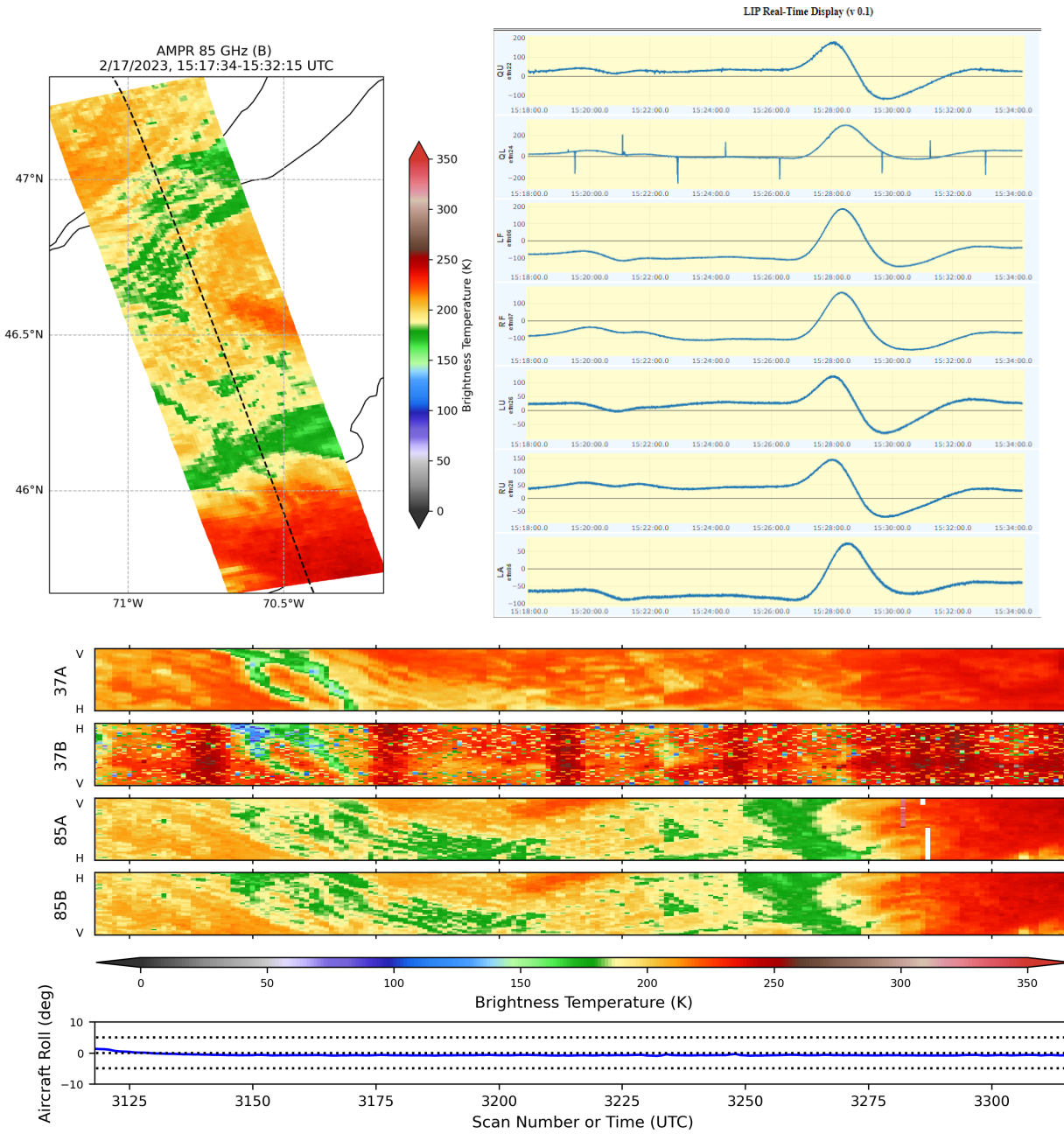
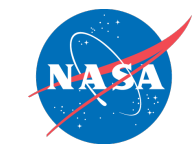
Winter storm near St. Lawrence River in Canada.

Goal was to “map out potential banded snow/mixed/rain structures ... with a near seamless swath for the radiometers and radars”

Possible precipitation signal down to 37 GHz

Evidence of electrification in ground-based polarimetric radar





Summary

- AMPR and LIP performed well in IMPACTS 2023 and observed multiple instances of significant precipitation and electrification
- 15 January – AMPR resolved spiral rain bands near low center, and LIP captured electrification on SW half of storm
- 23 January – Strong 85 GHz signal in electrified snowfall region, but still need to consider surface emission when interpreting AMPR
- 17 February – Electrification and strongest ice scattering signatures seen in warm sector

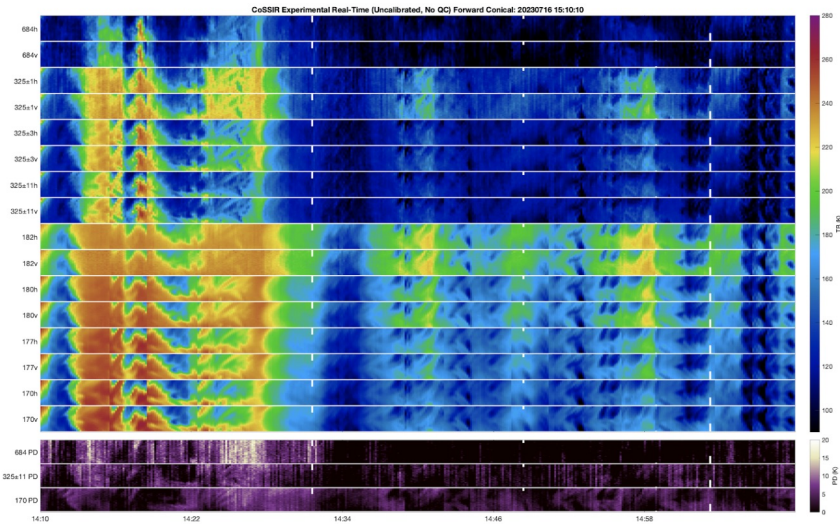


If you liked the 15 January 2023 case ...

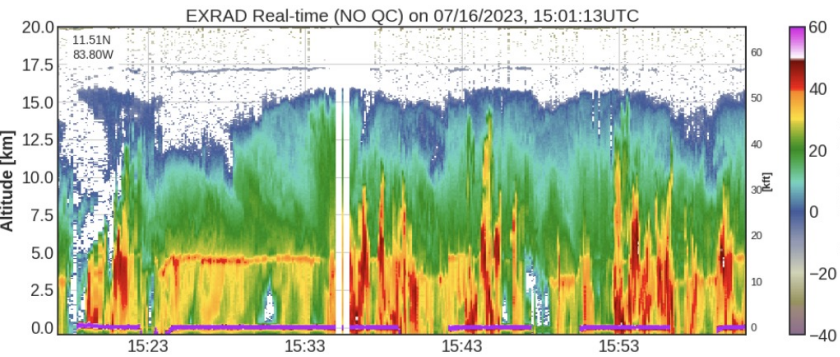


CoSSIR

Last checked about 24 sec

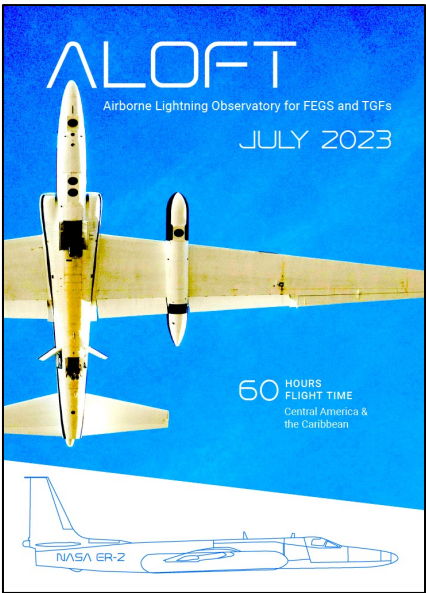
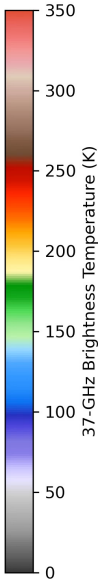
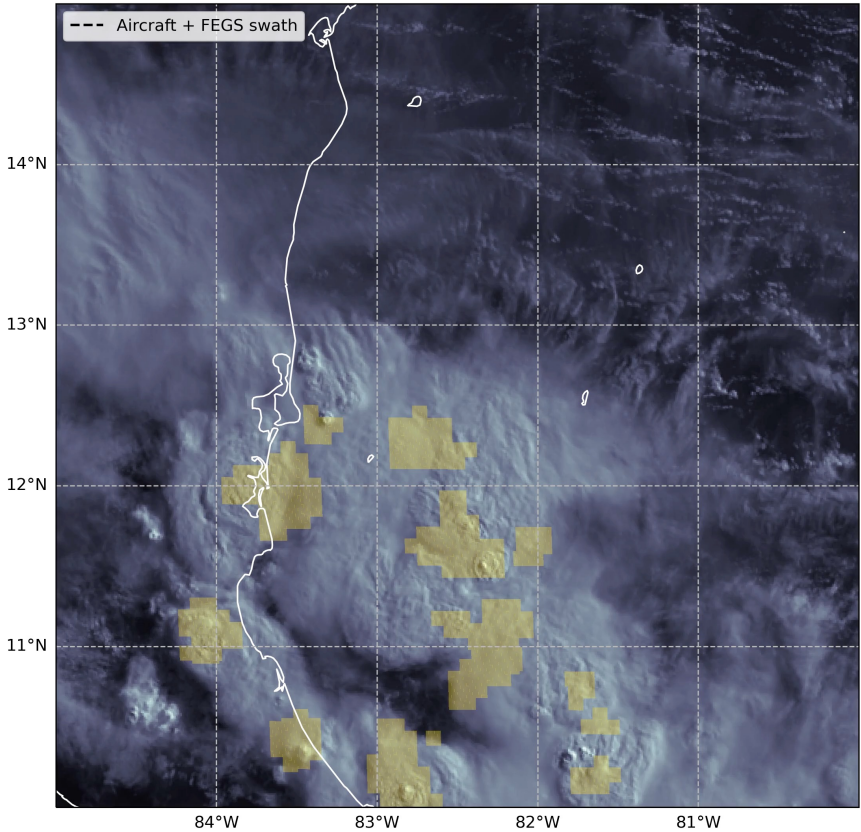


EXRAD



AMPR, etc.

GOES-16 Visible/GLM + FEGS & AMPR Swaths + TGFs 16 Jul 2023, 1256-1304 UTC



Also CRS!

