



Underflights of STP-H8 with airborne microwave sensors during the ALOFT field campaign in July 2023

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The ALOFT Field Campaign



ALOFT means Airborne Lightning Observatory for FEGS [Fly's Eye GLM (Geostationary Lightning Mapper) Simulator] and TGFs [Terrestrial Gamma-ray Flashes]

ALOFT was a collaborative field campaign (NASA + University of Bergen) in July 2023 that used the NASA ER-2 to hunt for gamma-rays and lightning in tropical thunderstorms

GOALS

1. Observe TGFs in one of the most TGF-intense regions on the planet.
2. Observe gamma-ray glows in thunderstorms and their relation to TGFs.
3. **Perform International Space Station Lightning Imaging Sensor (ISS LIS) and GLM validation using improved suborbital instrumentation (including upgraded FEGS).**
4. Evaluate new design concepts for next-generation spaceborne lightning mappers.
5. **Make measurements of tropical convection from a suborbital platform.**



AMPR and CoSSIR Instruments



AMPR: Advanced Microwave Precipitation Radiometer

- Cross-Track Scanning
- Scene Polarization Basis Varies as a Function of Scan Angle
- Two orthogonal mixed-pol channels per frequency

Characteristic	85.5GHz	37.1GHz	19.35GHz	10.7GHz
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) [<small>@20 km ER-2 alt. 500kts</small>]	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

AMPR specs

CoSSIR: Conical Scanning Submillimeter-wave Imaging Radiometer

- Conical and Along-Track Scanning
- Scene Polarization Basis Constant

Channel	Center Frequency (GHz)	Bandwidth (GHz)	Spectral Band (GHz)	NEDT (K)
170v/h	170.5	1.0	170.0-171.0	0.2/0.3
177v/h	177.3	1.0	176.8-177.8	0.4/0.5
180v/h	180.3	1.0	179.8-180.8	0.4/0.4
182v/h	182.3	1.0	181.8-182.8	0.4/0.5
325±11v/h	325.0±11.3	3.6 (x2)	311.9-315.5 and 334.5-338.1	0.5/0.7
325±3v/h	325.0±3.55	2.85 (x2)	320.0-322.85 and 327.15-330	0.5/0.5
325±1v/h	325.0±0.9	0.9 (x2)	323.6-324.5 and 325.9-326.4	1.5/1.5
684v/h	684±4.0	6.0 (x2)	677.0-683.0 and 685.0-691.0	0.9/0.6

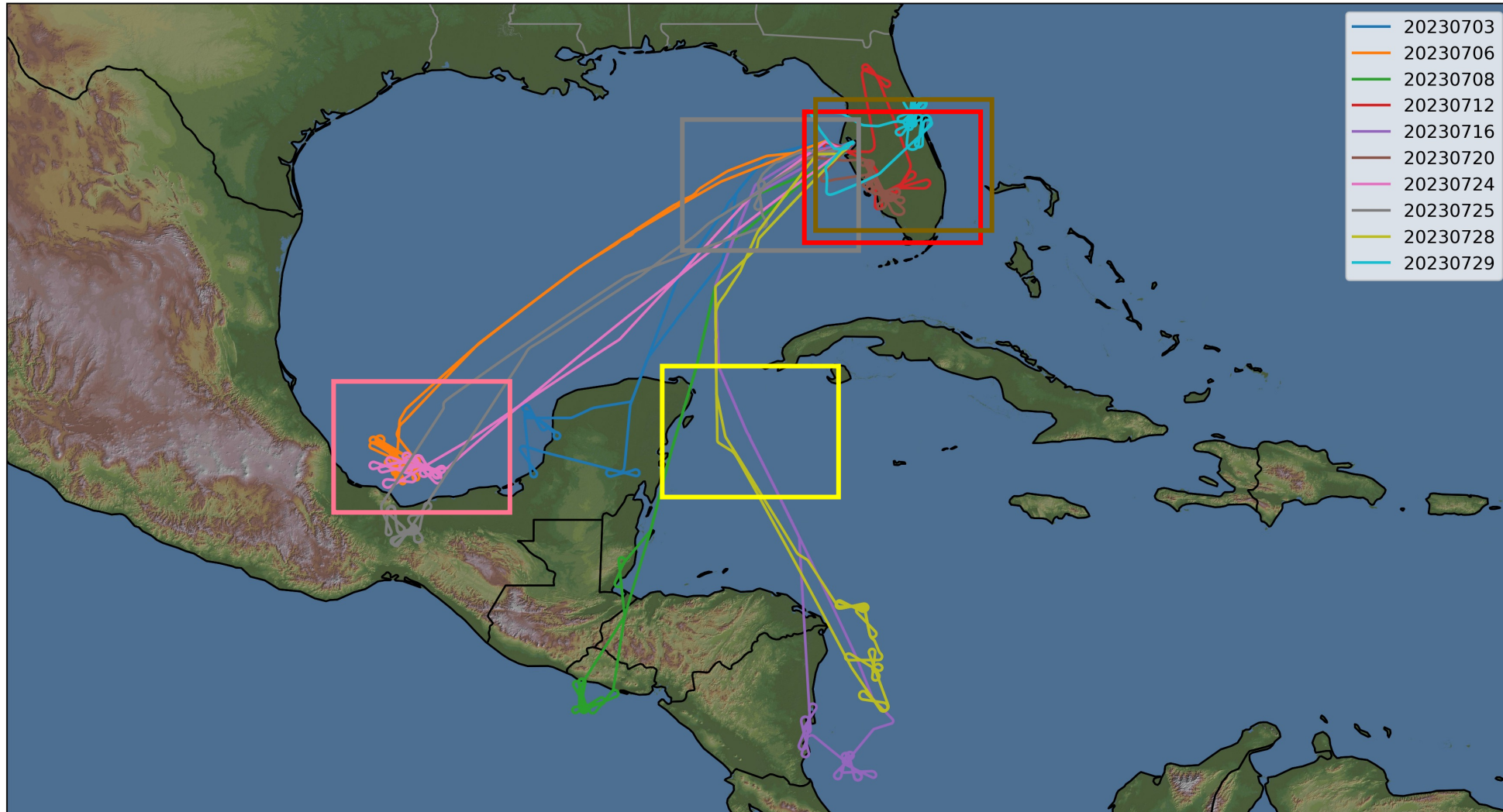
CoSSIR specs



ALOFT Flight Summary



ALOFT Domain - ER-2 Science Flights



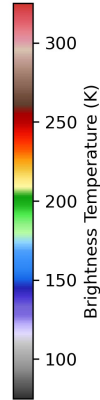
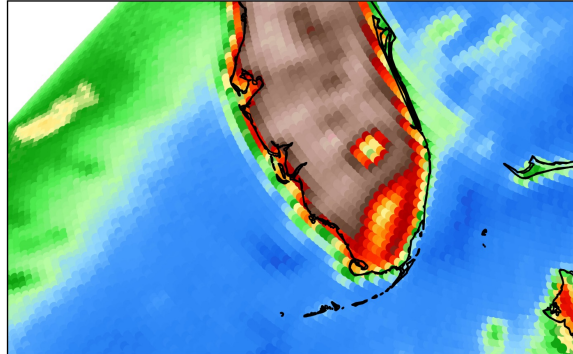
Coordinated flights with ISS overpasses on 7/12-13, 7/20, 7/24, 7/25-26, and 7/28



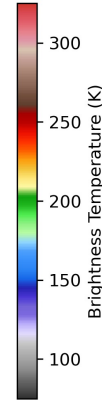
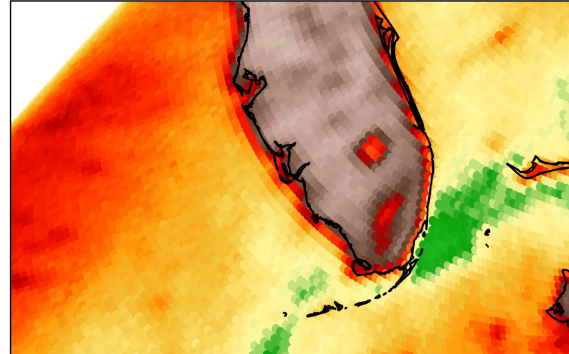
20 July Overpass, ~2145 UTC



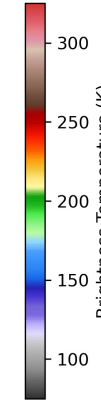
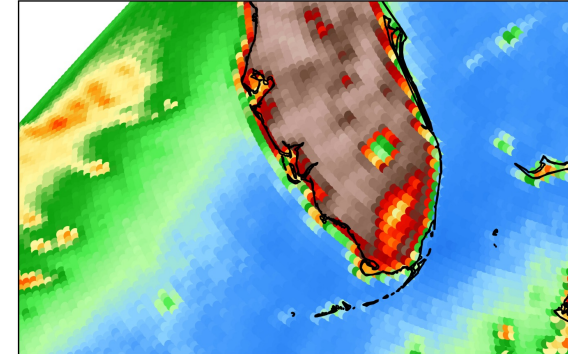
(a) COWVR 18V GHz



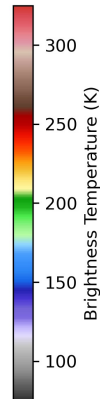
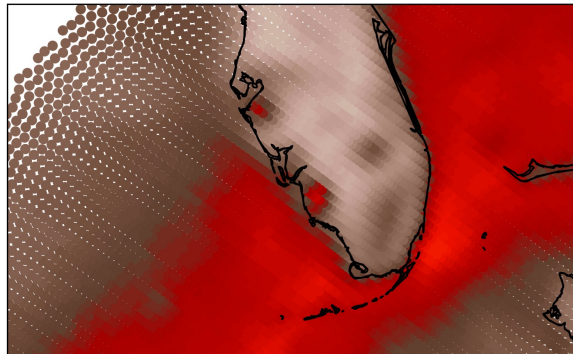
(b) COWVR 23V GHz



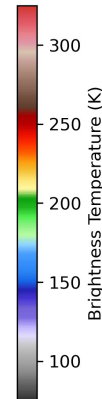
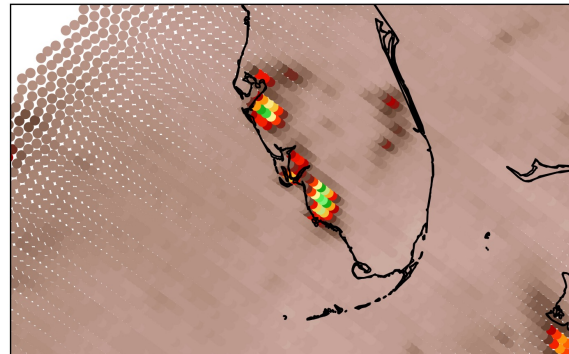
(c) COWVR 34V GHz



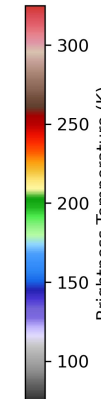
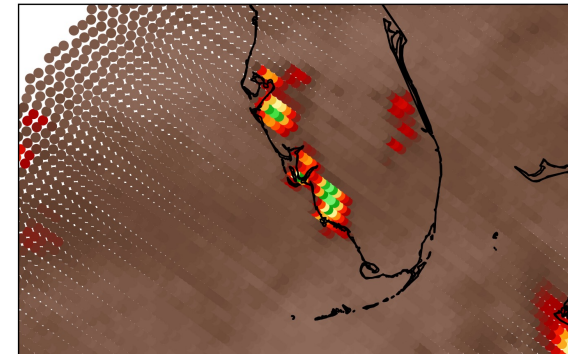
(d) TEMPEST 89 GHz



(e) TEMPEST 165 GHz



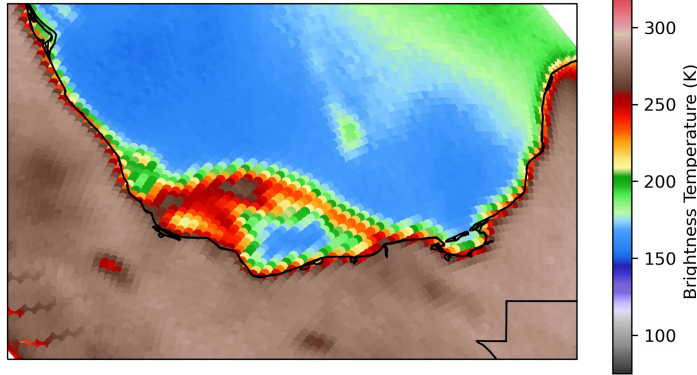
(f) TEMPEST 180 GHz



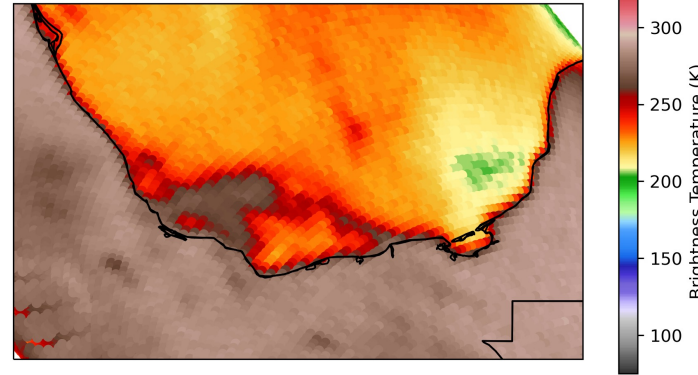
24 July Overpass, ~0645 UTC



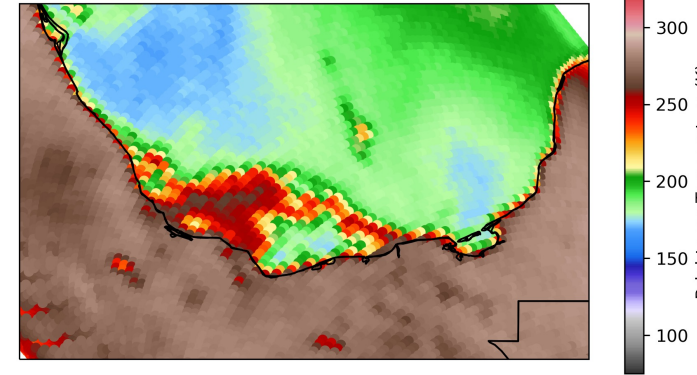
(a) COWVR 18V GHz



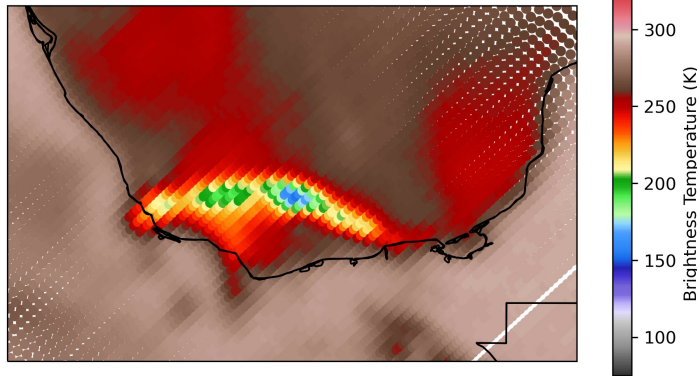
(b) COWVR 23V GHz



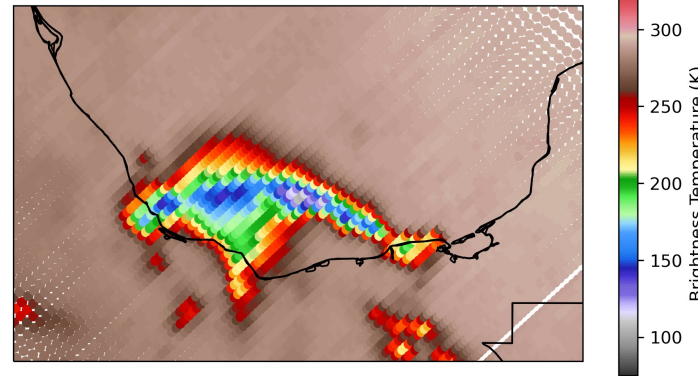
(c) COWVR 34V GHz



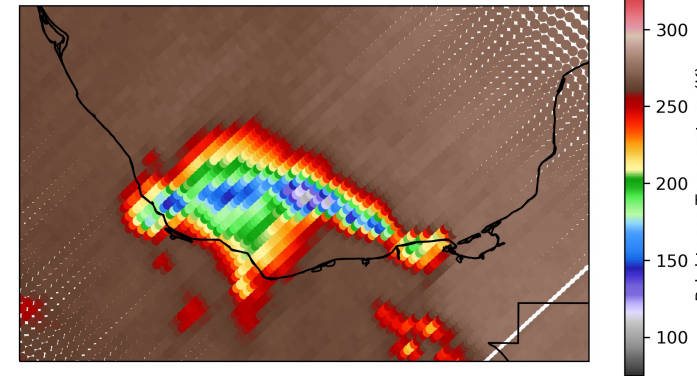
(d) TEMPEST 89 GHz



(e) TEMPEST 165 GHz



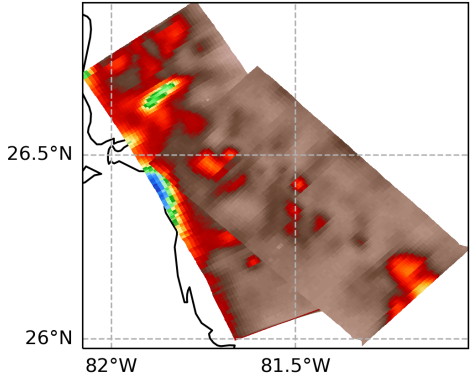
(f) TEMPEST 180 GHz



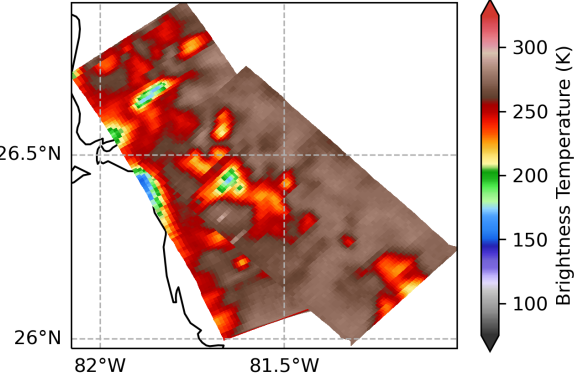
AMPR Observations during 7/20 & 7/24 Underflights



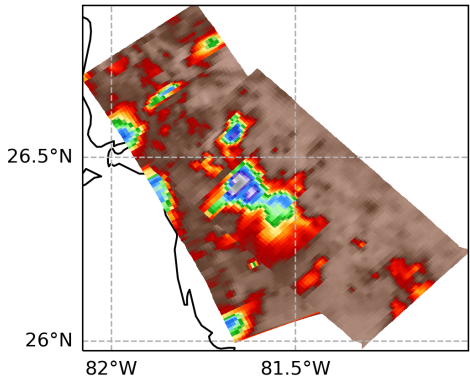
(a) AMPR 10 GHz (A)
7/20/2023, 21:35:02-21:54:55 UTC



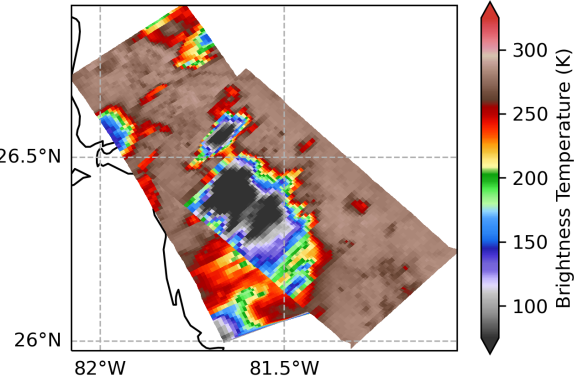
(b) AMPR 19 GHz (A)
7/20/2023, 21:35:02-21:54:55 UTC



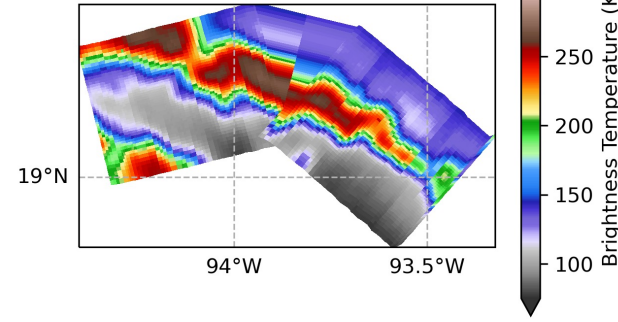
(c) AMPR 37 GHz (A)
7/20/2023, 21:35:02-21:54:55 UTC



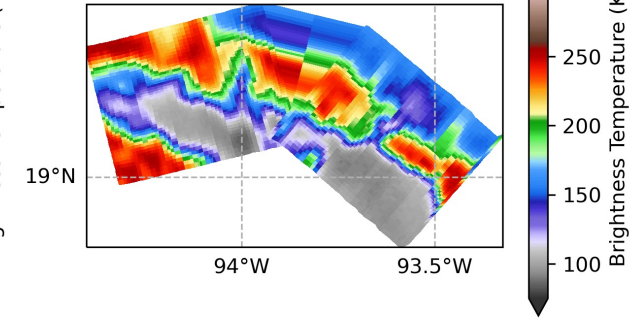
(d) AMPR 85 GHz (A)
7/20/2023, 21:35:02-21:54:55 UTC



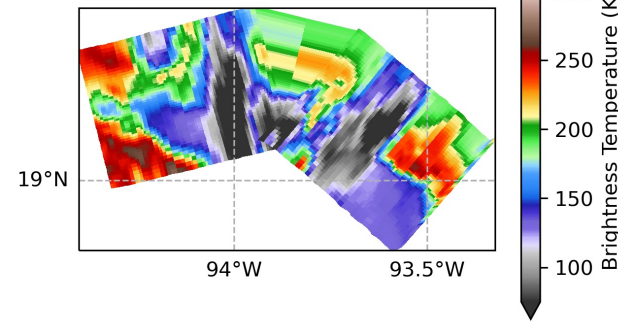
(a) AMPR 10 GHz (A)
7/24/2023, 06:38:06-06:47:55 UTC



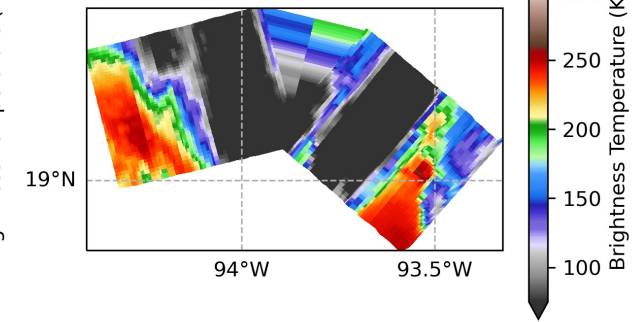
(b) AMPR 19 GHz (A)
7/24/2023, 06:38:06-06:47:55 UTC



(c) AMPR 37 GHz (A)
7/24/2023, 06:38:06-06:47:55 UTC



(d) AMPR 85 GHz (A)
7/24/2023, 06:38:06-06:47:55 UTC



CoSSIR Observations during ALOFT Underflights



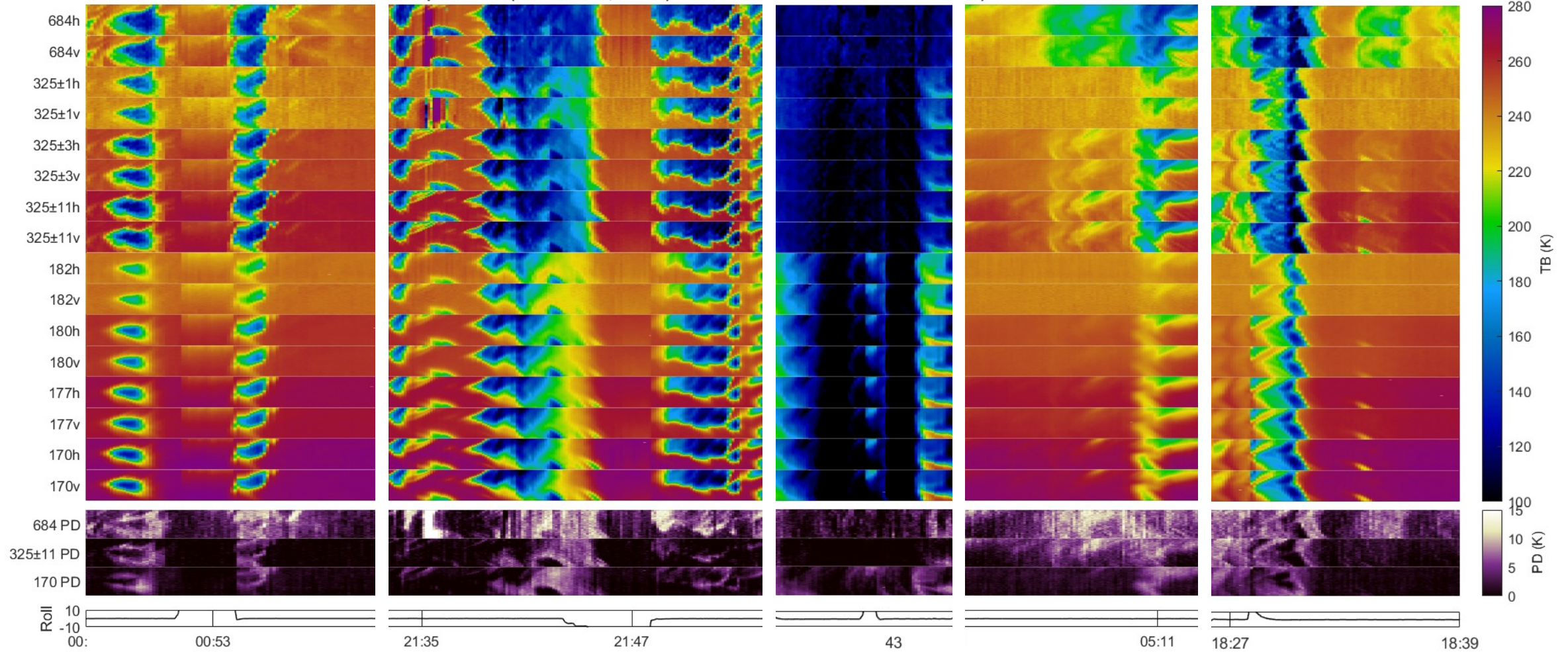
7/13

7/20

7/24

7/26

7/28



Forward Conical Scans





ER-2 carried two airborne microwave radiometers during ALOFT

- **AMPR**
 - 10.7, 19.35, 37.1, 85.5 GHz
 - Cross-Track – mixed-pol but can deconvolve to component V & H
- **CoSSIR**
 - 170, 177, 180, 182; 325 +/- 1, 3, 11; 684 GHz
 - Conical & Along-Track – Both H & V

Five Underflights of ISS & STP-H8/COWVR/TEMPEST

- 7/13, ~0058 UTC – Small, single-cell thunderstorm over land
- 7/20, ~2147 UTC – Multicell thunderstorm over land, aircraft in turn during overpass
- 7/24, ~0645 UTC – Mesoscale convective system over water
- 7/26, ~0508 UTC – Decaying convection over water
- 7/28, ~1830 UTC – Decaying convection over water

Data publicly available within 6-9 months of campaign, but can coordinate earlier access if needed



