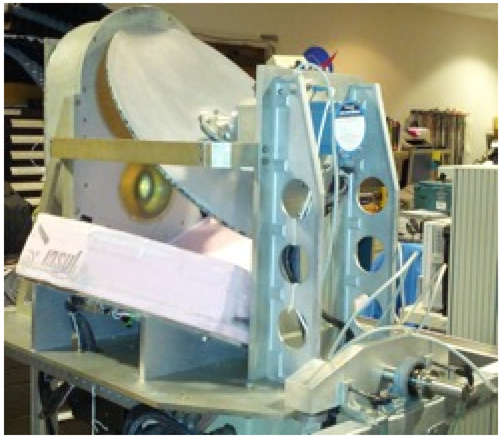
AMPR (Advanced Microwave Precipitation Radiometer): Overview and Relevance to IMPACTS

Timothy Lang / NASA MSFC
AMPR Principal Investigator

IMPACTS ER-2 Payload



Instrument name / PI:

AMPR (Advanced Microwave Precipitation Radiometer)

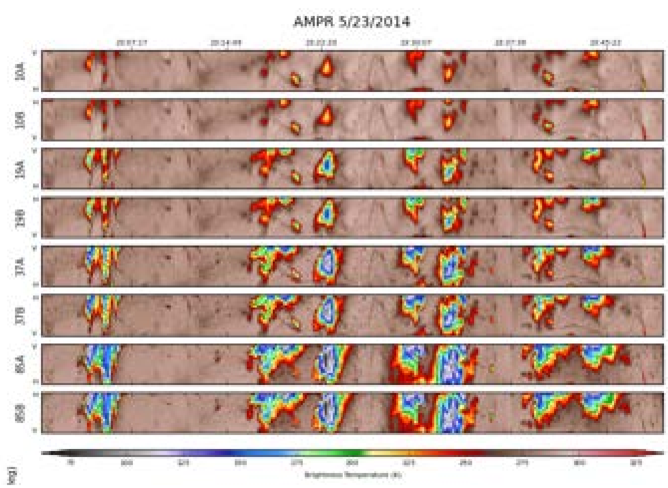
Timothy Lang, NASA MSFC

1) What does AMPR measure?

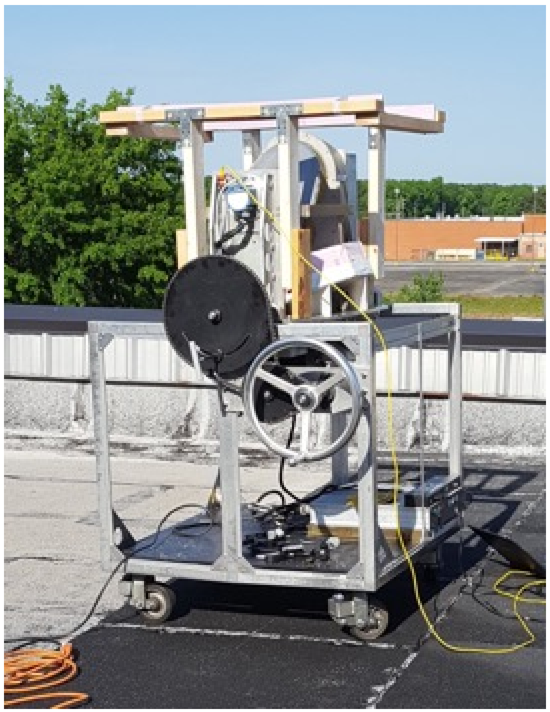
- Passive microwave radiometer – Retrieve surface emission, cloud liquid water, ice water path, water vapor, etc.
- Four frequencies - 10.7, 19.35, 37.1, 85.5 GHz, with 2 variable polarization channels apiece (Channel A: V -> H and Channel B: H -> V)
- Cross-track scanning or nadir staring

Left: Strip chart time series of T_B from 5/23/14 IPHEx flight.

Right: 10 GHz (A) T_B for every TCSP (2005) flight.



IMPACTS ER-2 Payload



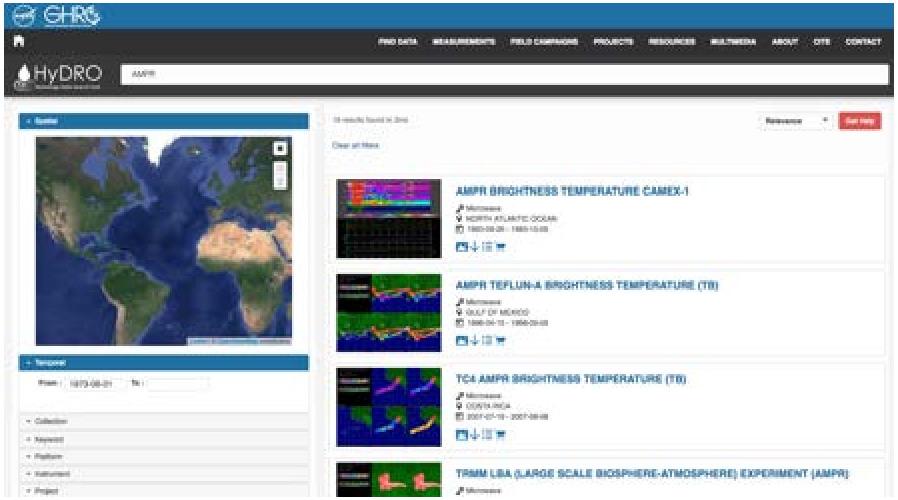
<u>2) What science role is AMPR playing in IMPACTS?</u>

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

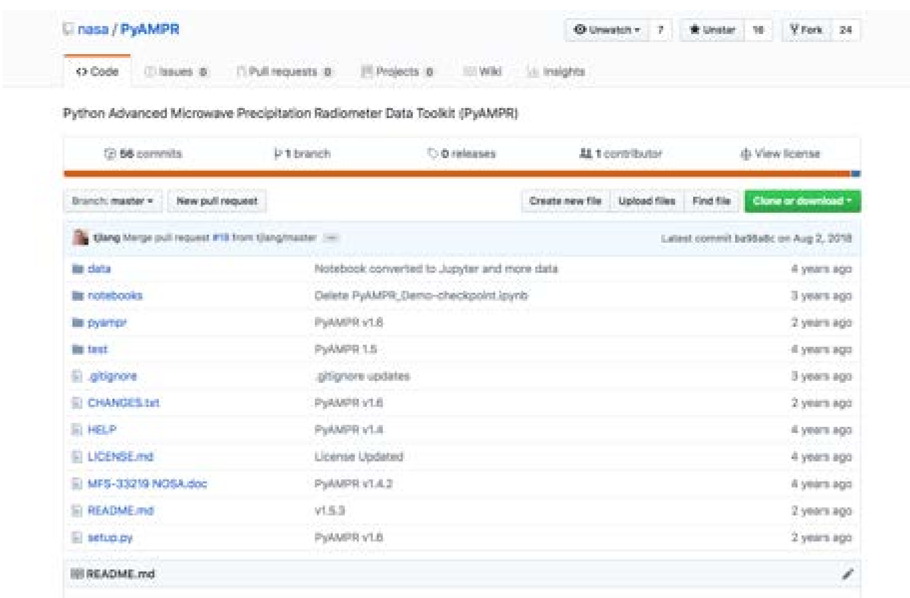
<u>3) What do flight planners and the science team need to know about AMPR?</u>

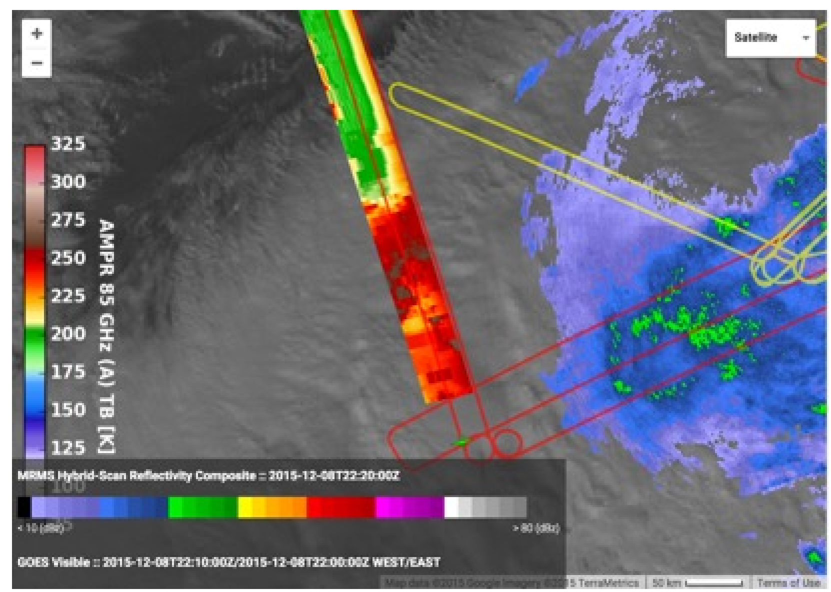
- AMPR can provide real-time imagery on MTS
- AMPR is involved in CAMP^{2}Ex (June-Oct) - P-3
- AMPR may be able to provide one student for IMPACTS forecasting help

AMPR is open!



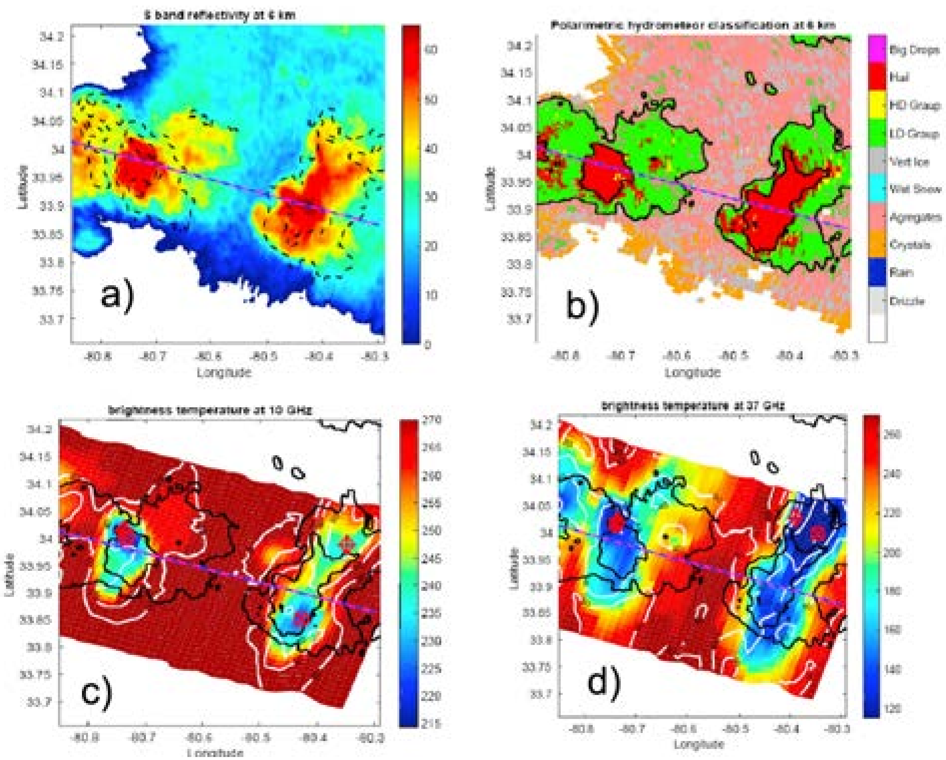
- Open Data
- Open Source Software
- Near real-time imagery on NASA MTS during campaigns
- Working toward Climate & Forecast (CF) compliant datasets

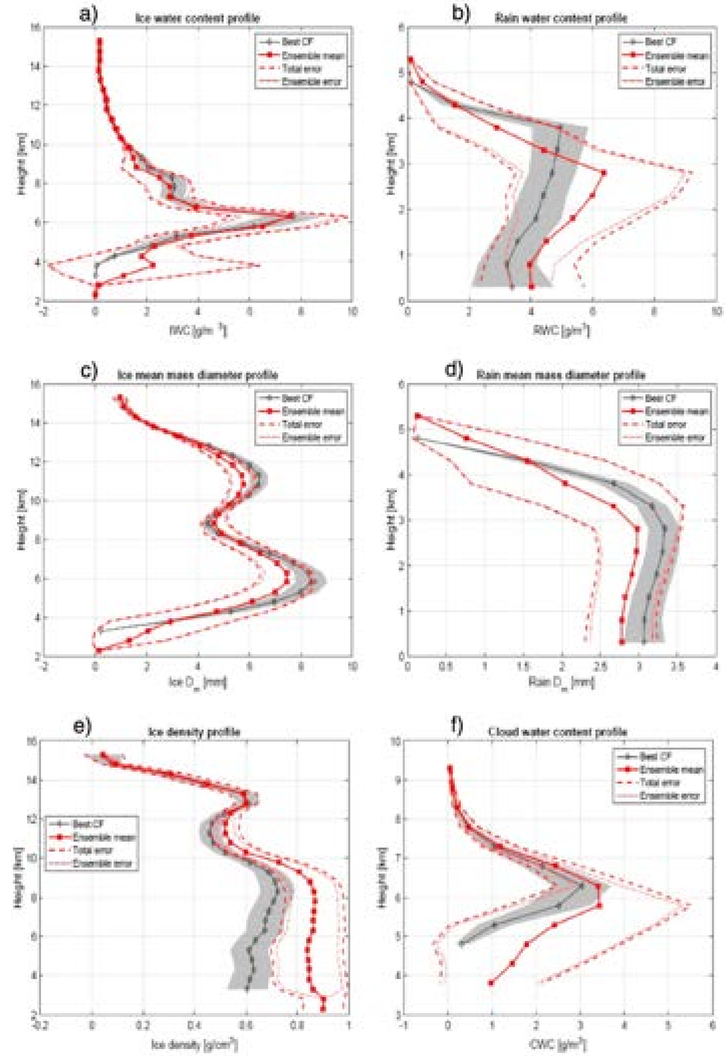




Coupled active-passive microwave retrievals of hydrometeors

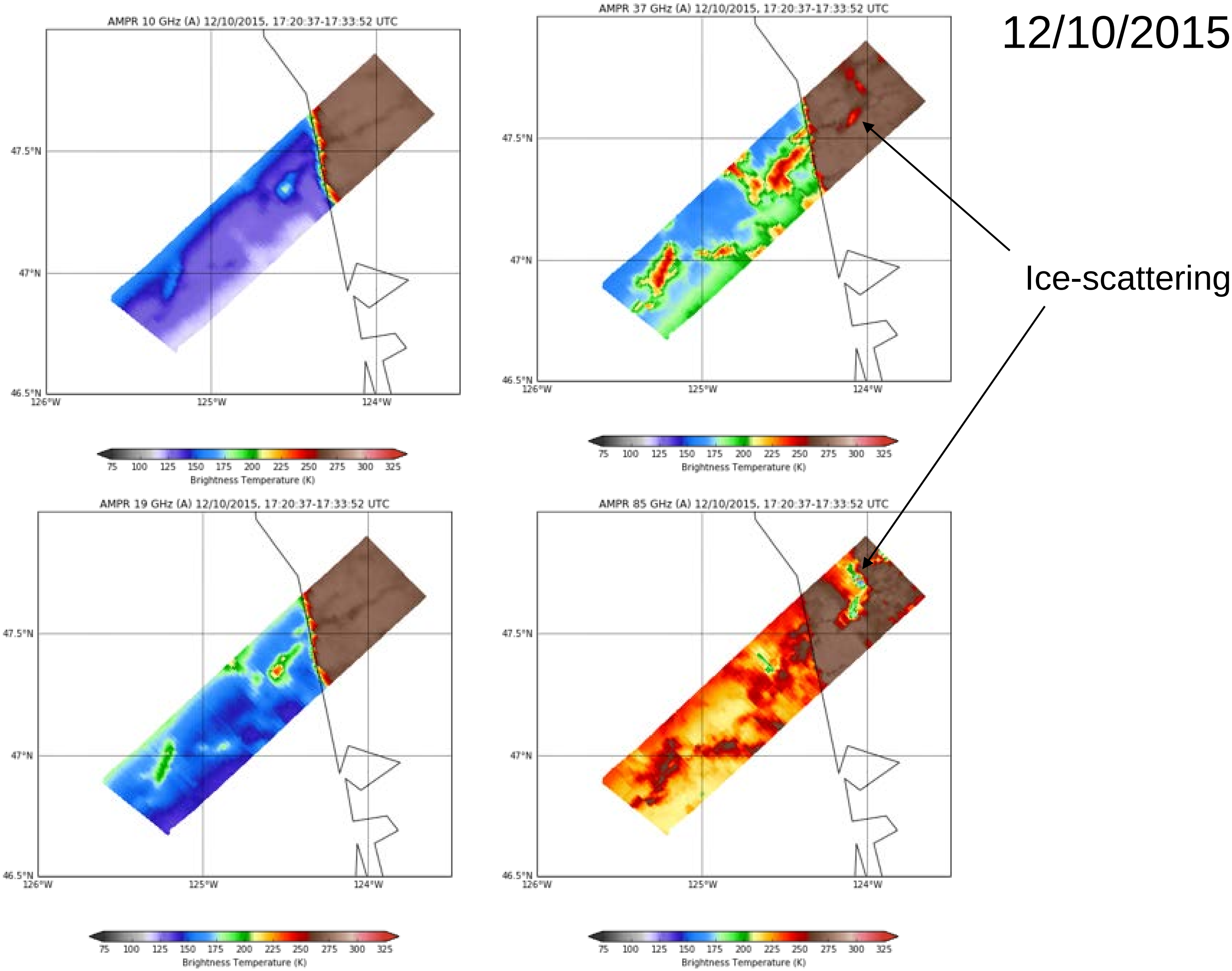
- IPHEx severe hailstorm (5/23/2014)
- AMPR + CoSMIR + 4-freq radars
- Optimal estimation technique





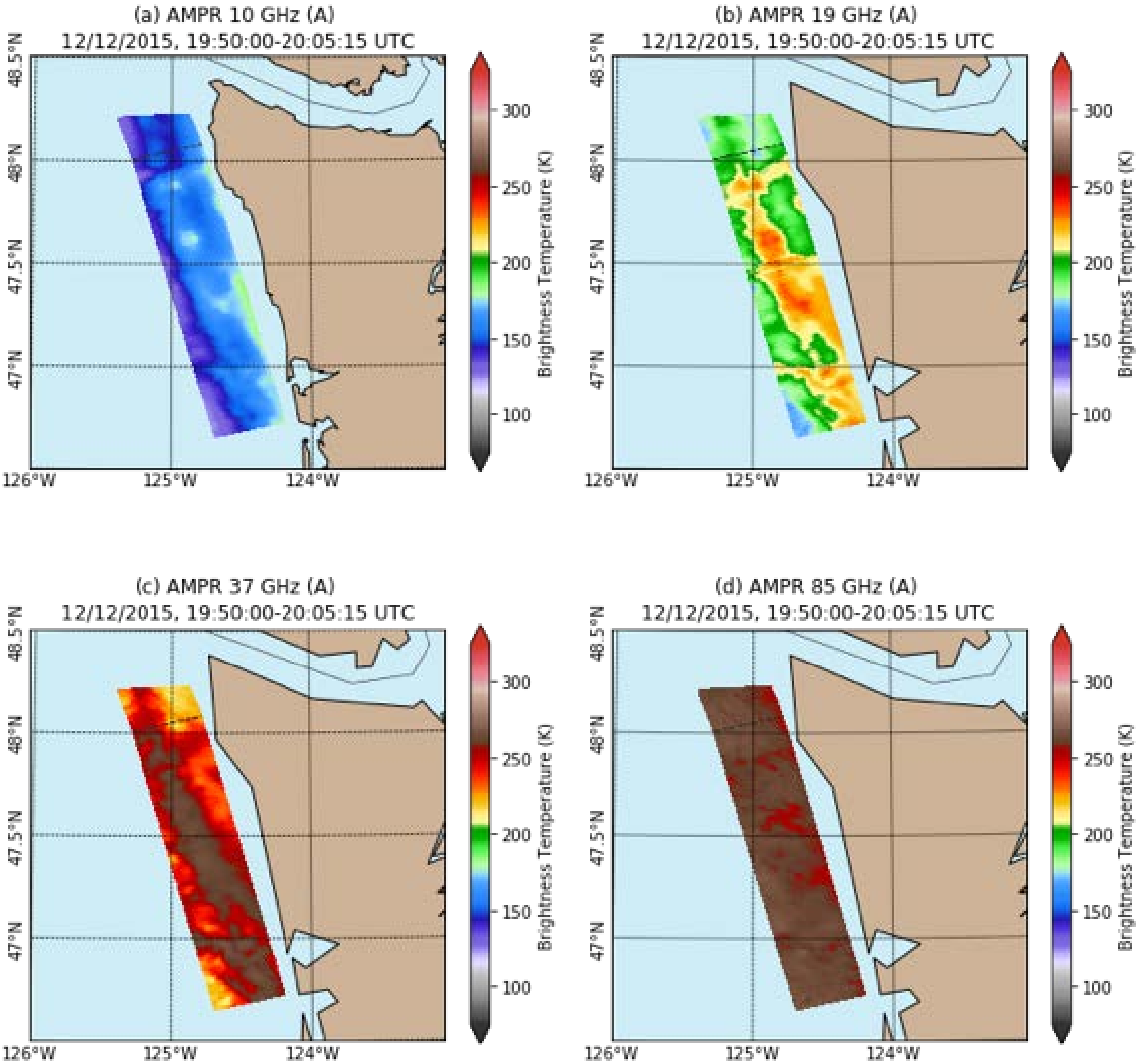
Battaglia et al. (2016)

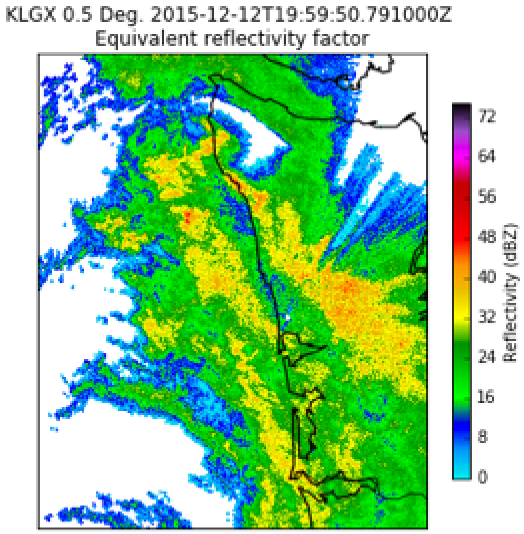
12/10/2015



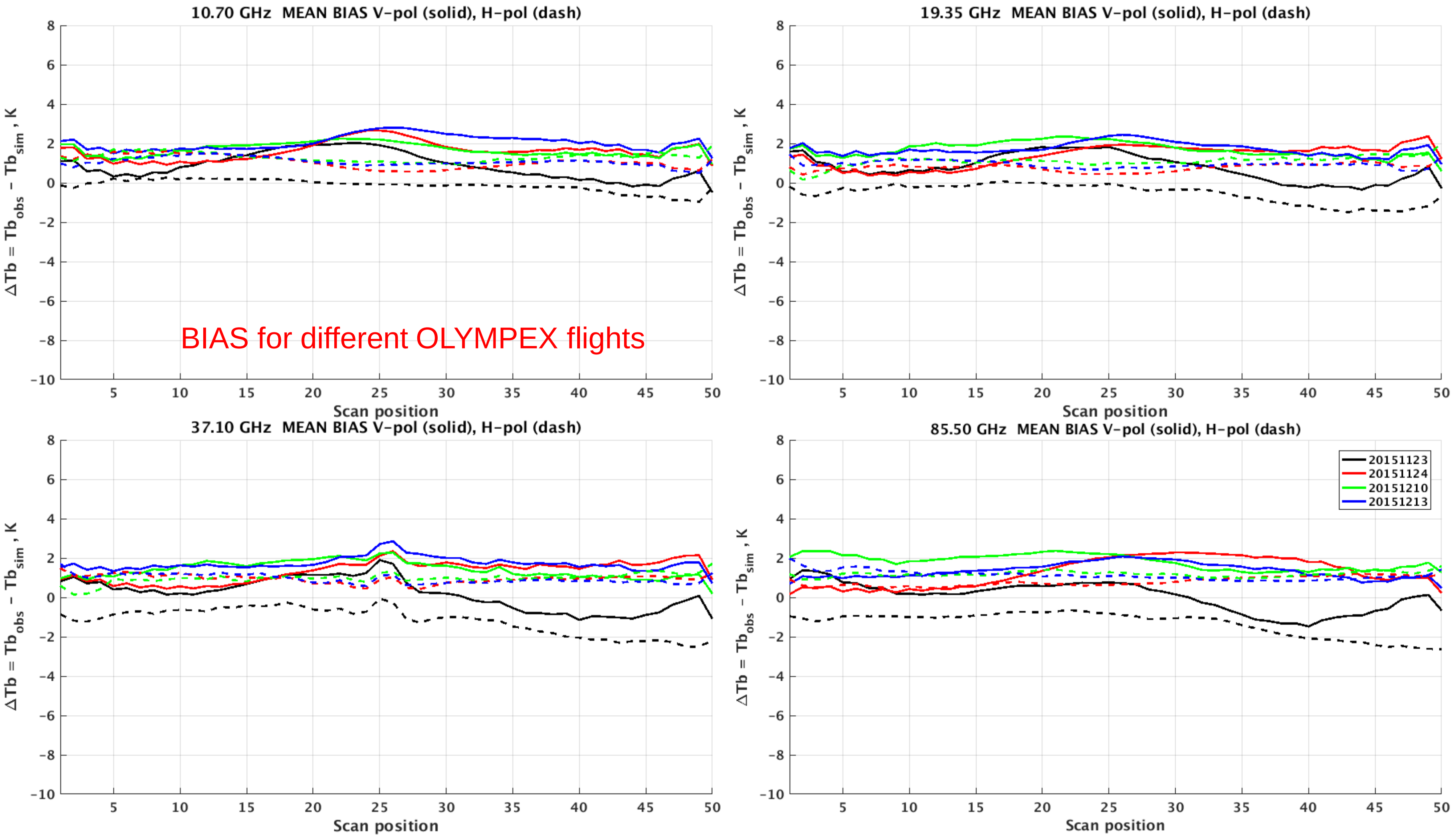
AMPR 10 GHz (A) 12/10/2015, 17:20:37-17:33:52 UTC
AMPR 37 GHz (A) 12/10/2015, 17:20:37-17:33:52 UTC
AMPR 19 GHz (A) 12/10/2015, 17:20:37-17:33:52 UTC
AMPR 85 GHz (A) 12/10/2015, 17:20:37-17:33:52 UTC
47.5°N
47°N
46.5°N
126°W
125°W
124°W
75 100 125 150 175 200 225 250 275 300 325
Brightness Temperature (K)
Ice-scattering

12/12/2015


(a) AMPR 10 GHz (A)
12/12/2015, 19:50:00-20:05:15 UTC
(b) AMPR 19 GHz (A)
12/12/2015, 19:50:00-20:05:15 UTC
(c) AMPR 37 GHz (A)
12/12/2015, 19:50:00-20:05:15 UTC
(d) AMPR 85 GHz (A)
12/12/2015, 19:50:00-20:05:15 UTC
48.5°N
48°N
47.5°N
47°N
126°W
125°W
124°W
Brightness Temperature (K)
300
250
200
150
100


KLGX 0.5 Deg. 2015-12-12T19:59:50.791000Z
Equivalent reflectivity factor
Reflectivity (dBZ)
72
64
56
48
40
32
24
16
8
0

V- & H-pol T_b Bias – AFTER CORRECTION



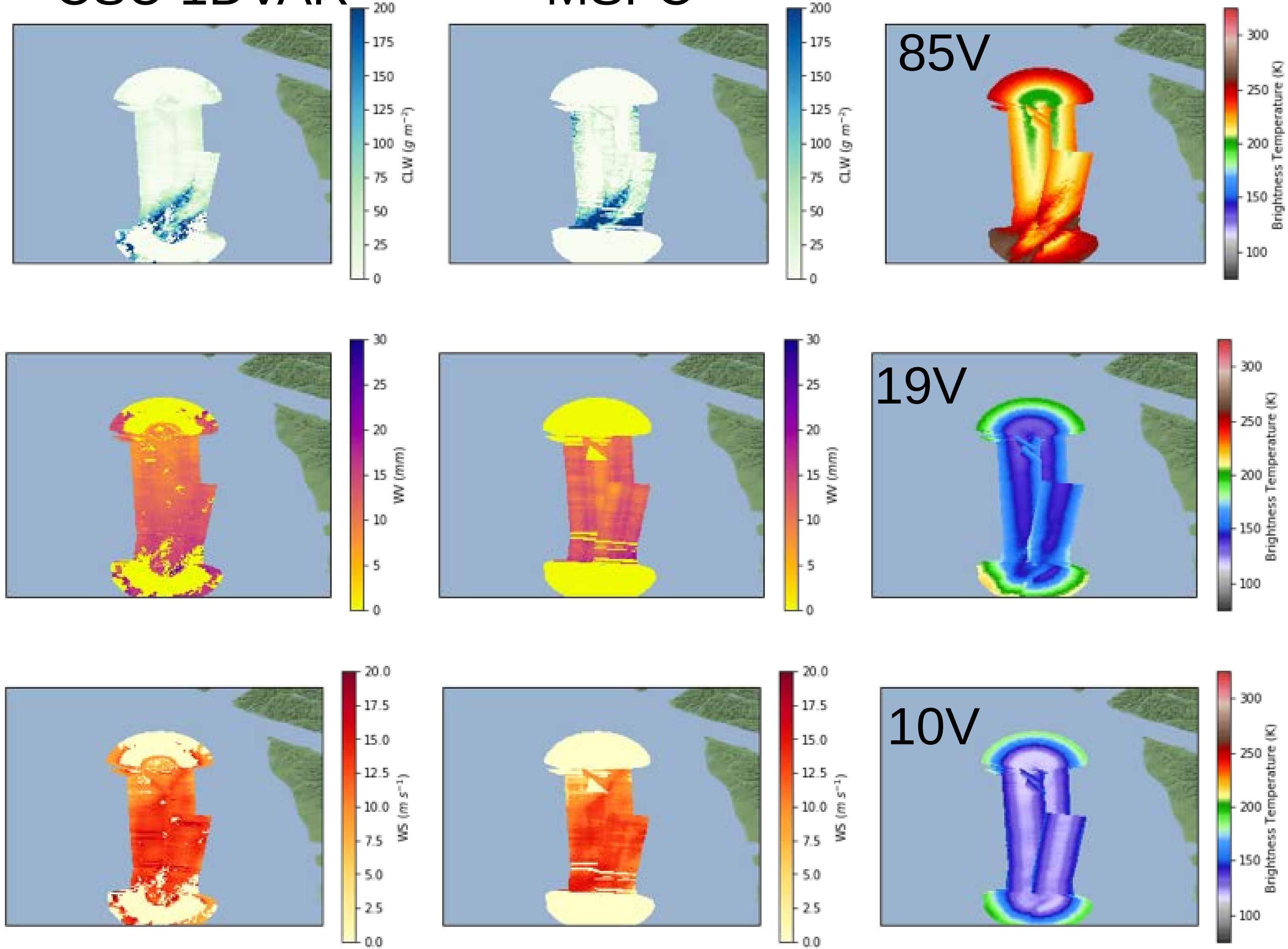
11/24/15 2000-2038 UTC

CSU 1DVAR | MSFC

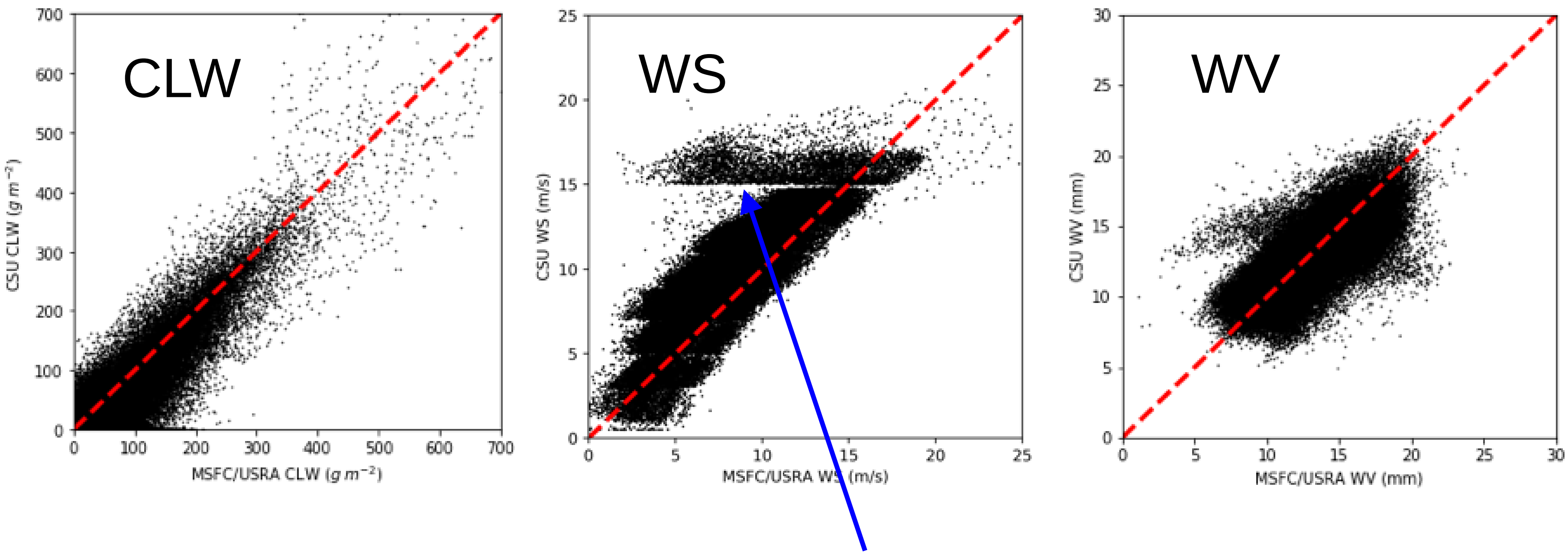
Cloud Liquid Water

Water Vapor

Near-Surface Wind Speed



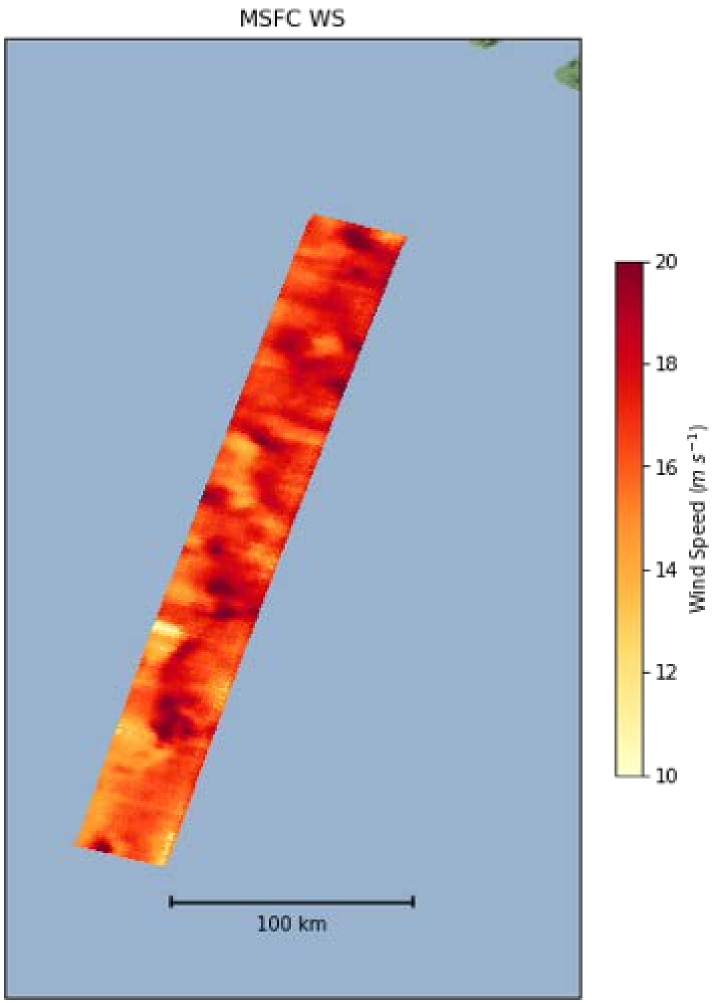
Comparison between AMPR Empirical Retrievals and CSU 1DVAR algorithm



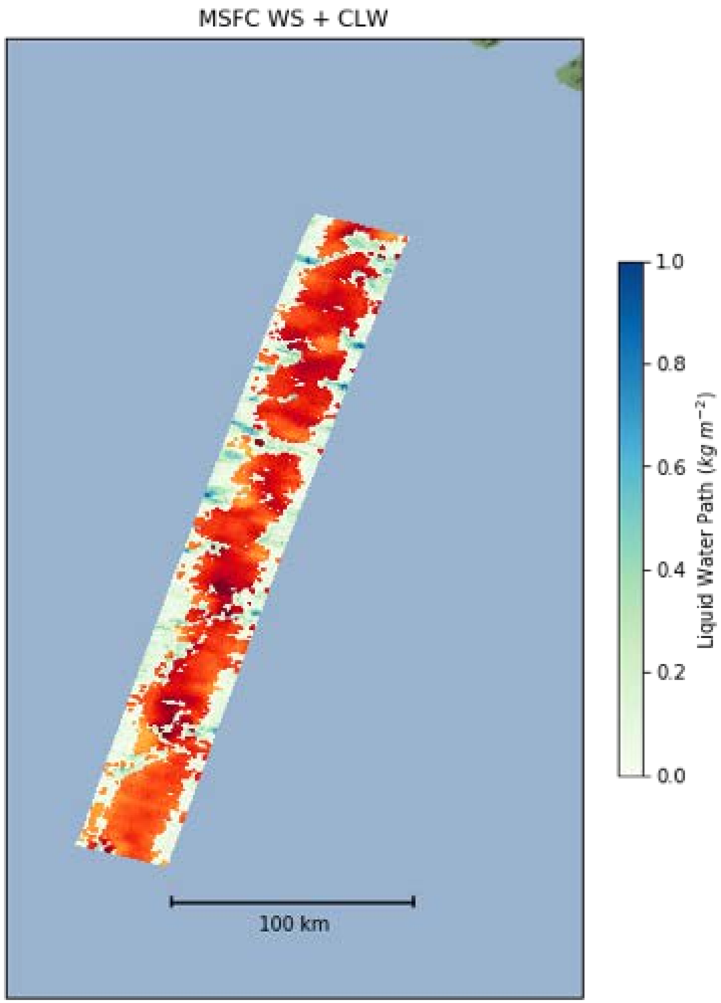
1DVAR relying more on a priori info from model

12/13, 1916-1947 UTC

Small-scale variability in WS suggests post-frontal convection influencing surface winds

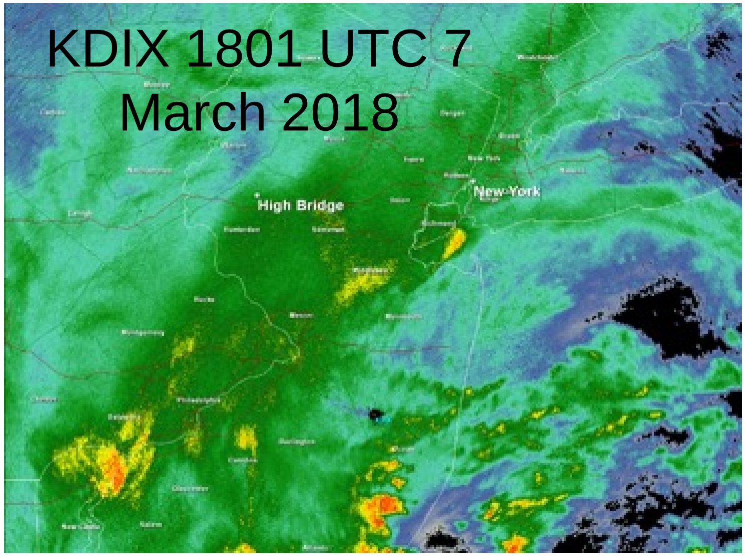


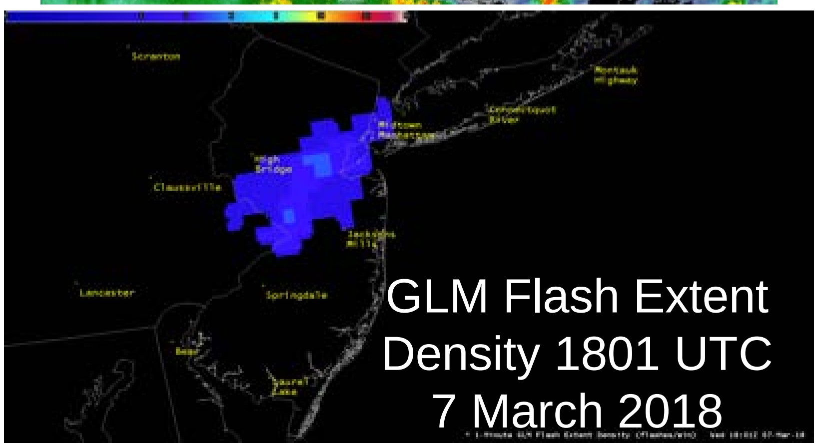
Lumpiness

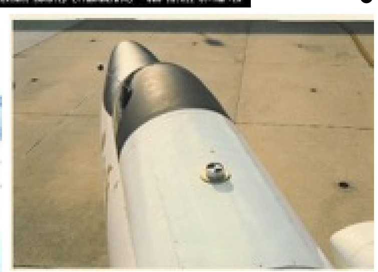


Wind speed masked for CLW > 0.01 kg m^{-2}

Utility of the Lightning Instrument Package for IMPACTS







- Lightning flashes observed in heavy snowfall events are in the top 90th percentile of flash size, total flash energy, and flash duration
- The flash properties are dependent upon the mixed phase microphysical structure within snowbands that will be studied by IMPACTS
- Electric field measurements in these types of systems are rare and the LIP package would help provide insight into how the microphysical structure may or may not generate lightning
- LIP information can be disseminated in real-time, so the electric field observations can help the P-3 aircraft avoid areas of potential lightning and severe icing