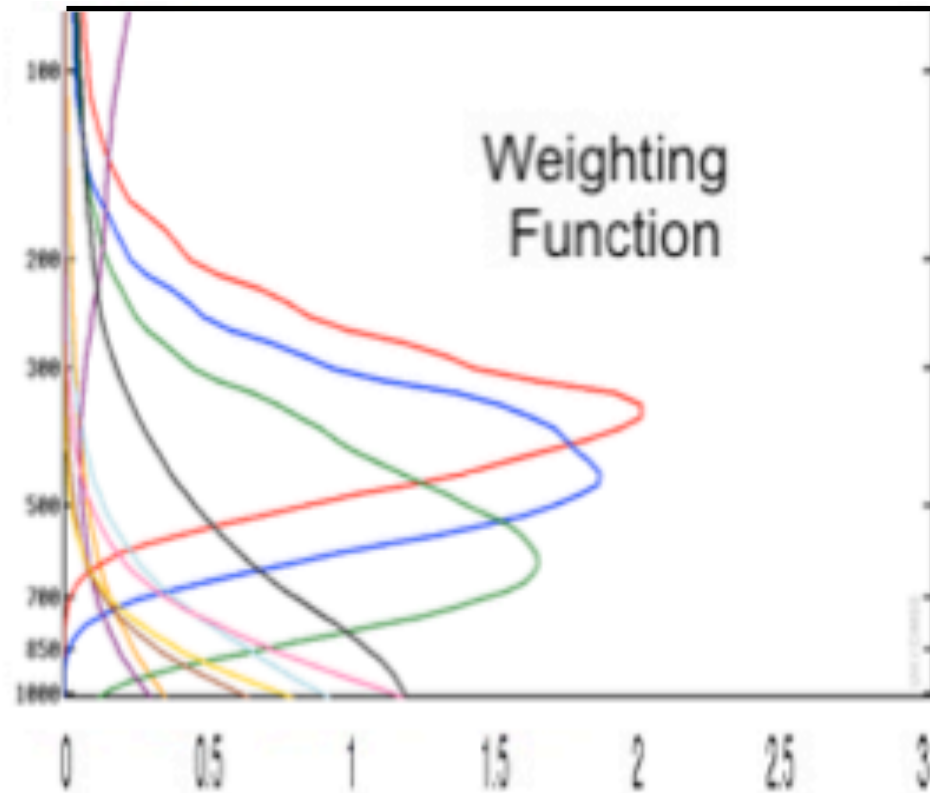


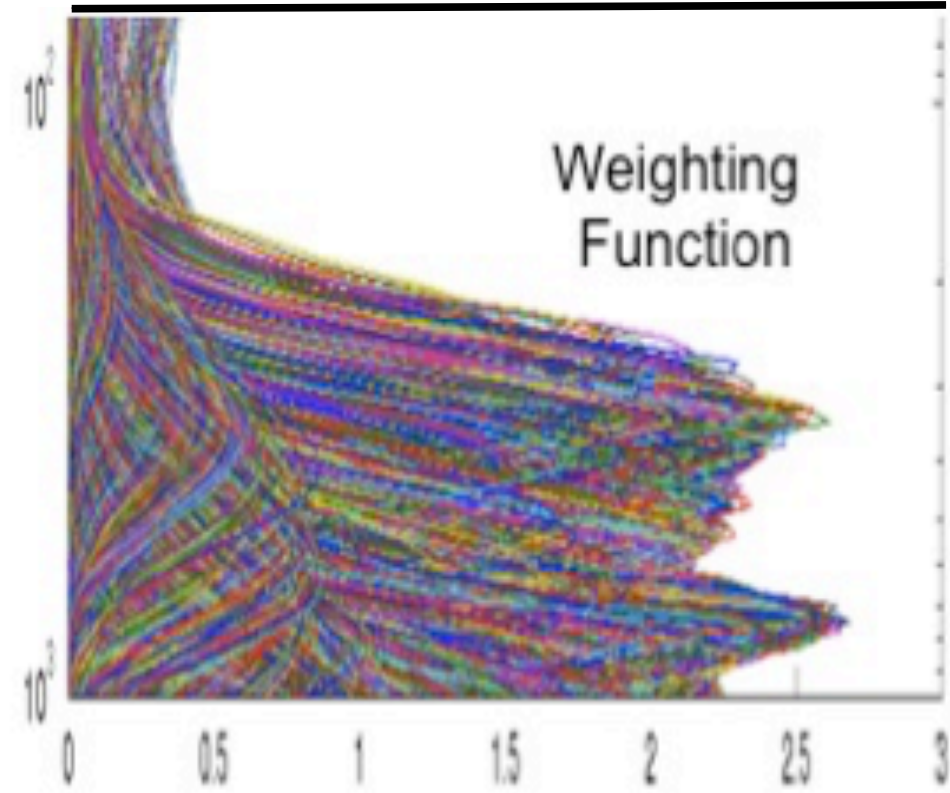
Combining Polar Hyper-spectral and Geostationary Multi-spectral Sounding Data – A Method to Optimize Sounding Spatial and Temporal Resolution

W. L. Smith^{1,2}, E. Weisz¹, and J. McNabb²

¹University of Wisconsin, Madison WI, USA ; ²Hampton University, Hampton VA, USA

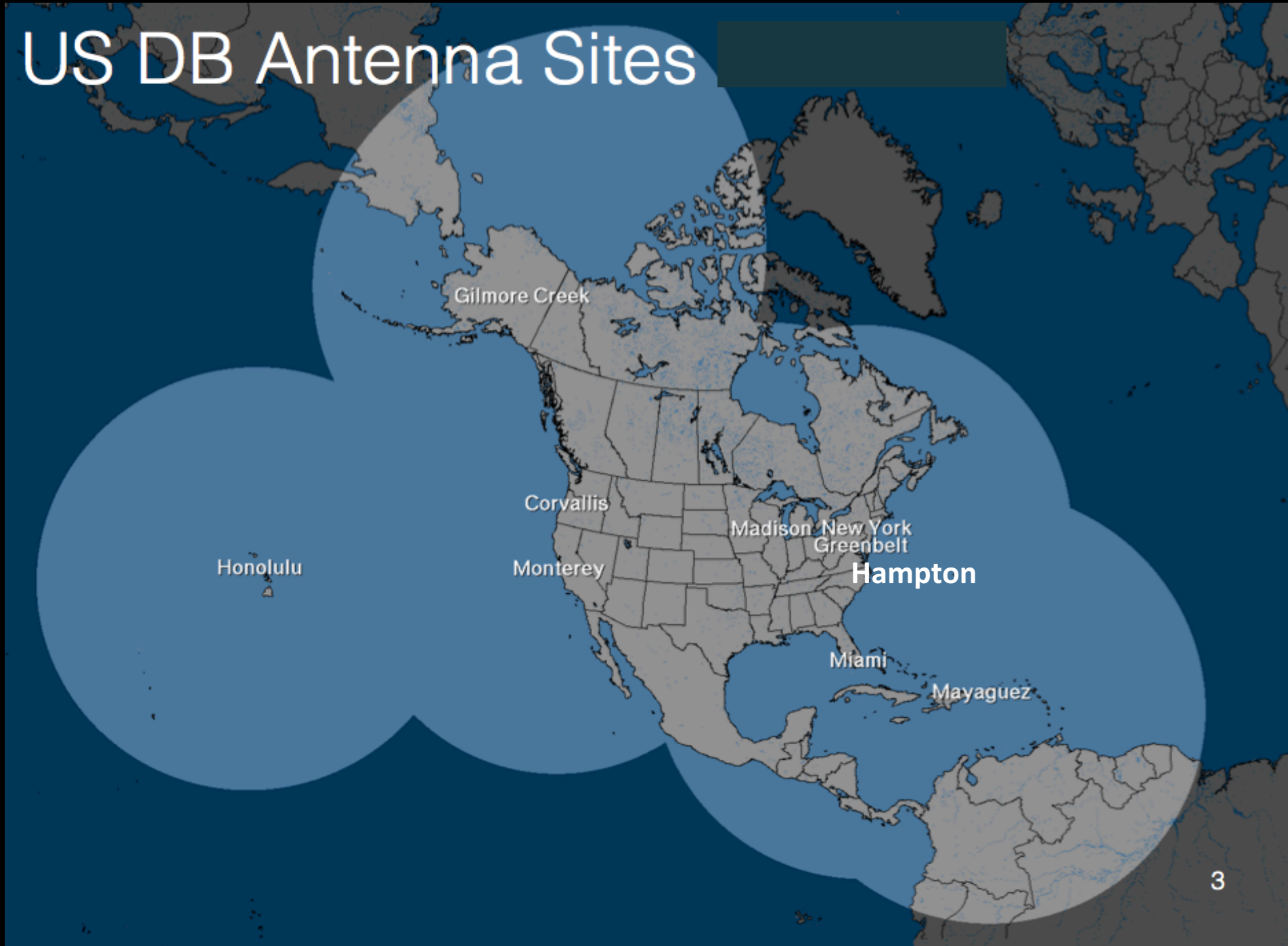


**ABI: Vertical Res. 5-10 km
Horizontal Res. 2-km
Time Res. 5-15 min.**



**AIRS, IASI, CrIS: Vertical Res. 1-4 km
Horizontal Res. 14-km
Time Res. 1-7 hr.**

US DB Antenna Sites



http://cas.hamptonu.edu/dbps_cron/plots/

Hampton University

Center for Atmospheric Research and Education

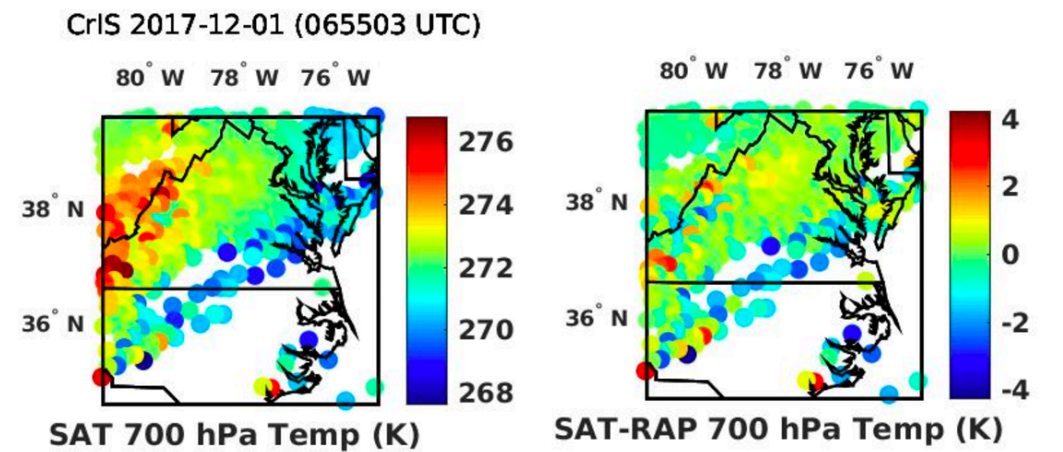
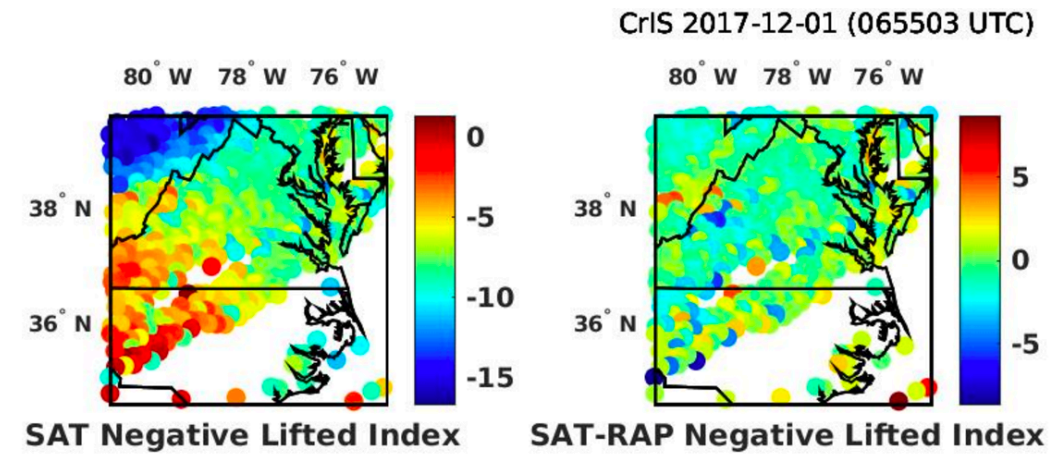
Direct Broadcast Processing Server Quicklook

[Archive of Previous Images](#)

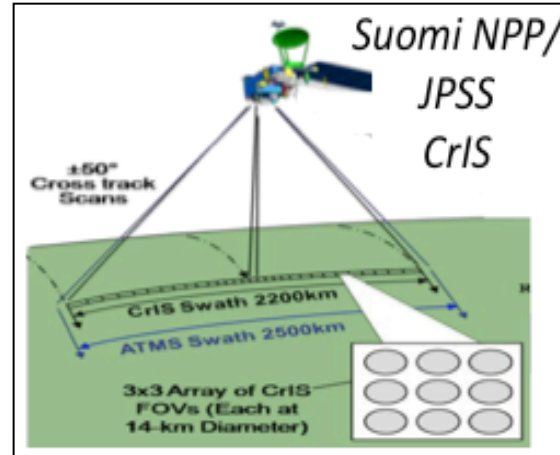
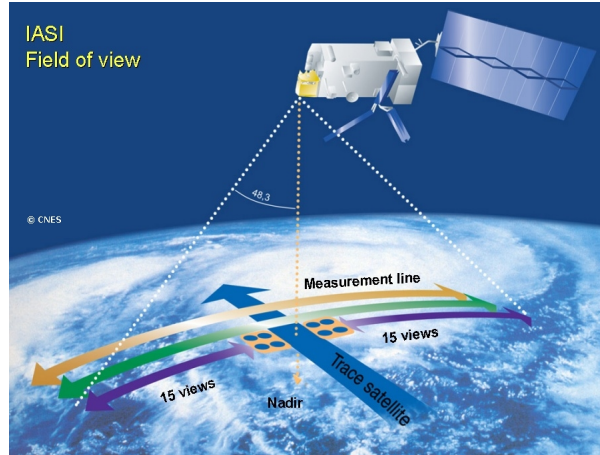
Choose a Filter to display images		
Satellite Directory	File Type	Generation Date (UTC)
All Directories <input type="button" value="v"/>	All File Types <input type="button" value="v"/>	All Dates <input type="button" value="v"/>

20 files match of 20 images

File	Generation Time (UTC)	Image
current CRIS f3.jpg	2017-12-01 07:37:33	
current CRIS f2.jpg	2017-12-01 07:37:22	
current CRIS f1.jpg	2017-12-01 07:37:10	



Polar-Orbiting Ultra-Spectral & Geostationary Sounders



Instrument	IASI	CrIS	ABI
Satellite	Metop-A, Metop-B	Suomi-NPP	GOES-16
Type	Michelson Interferometer	Michelson Interferometer	Radiometer
Spectral resolution	0.25 cm ⁻¹	0.625 (LW), 1.25 (MW), 2.5 cm ⁻¹ (SW)	GOES-16
Spectral range	645 – 2760 cm ⁻¹ (15.5 – 3.62 μm)	650 – 2550 cm ⁻¹ (15.4 – 3.9 μm)	751.9 - 21276 cm ⁻¹ 0.47 – 13.3 μm
Number of Detectors/ Channels	12 / 8461	27 / 1305	16 / 16
NEDT range	0.1 – 0.75 K	0.05 – 0.5 K	0.01 / 0.07
Spatial Resolution (at nadir)	12 km	14 km	2 km
Launched	2006, 2012	2011	2016

PHS (CrIS/IASI) + ABI Sounding

$$\text{ABI/PHS} = \text{ABI}(x, y, t) + [\text{PHS}(x_0, y_0, t_0) - \text{ABI}(x_0, y_0, t_0)]$$

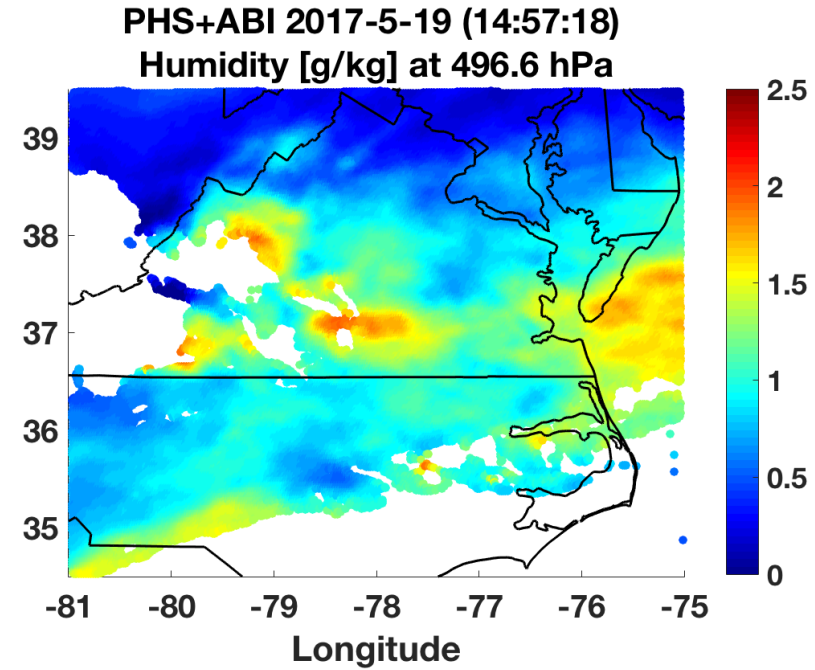
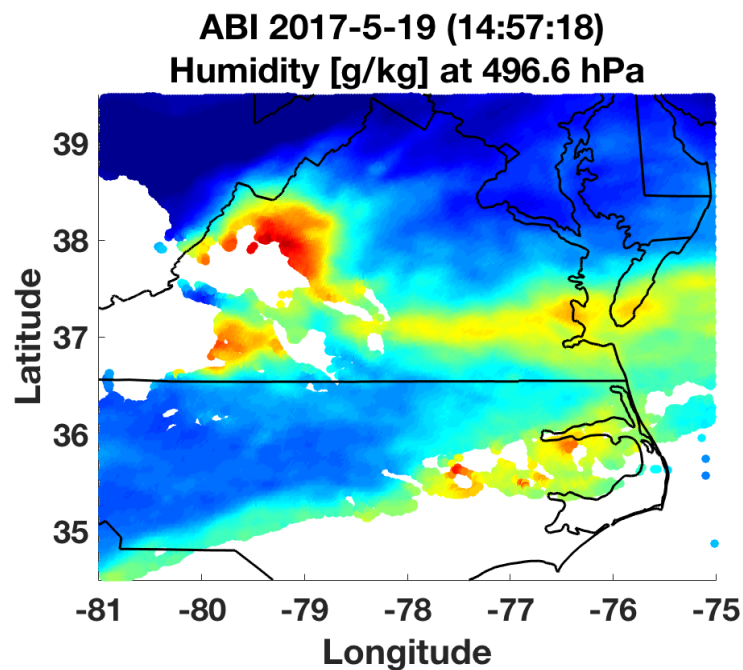
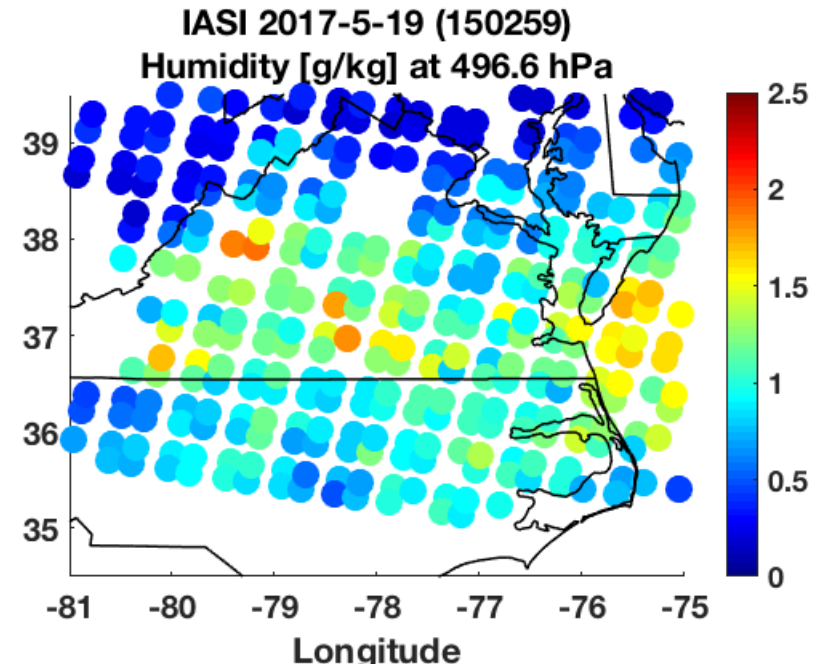
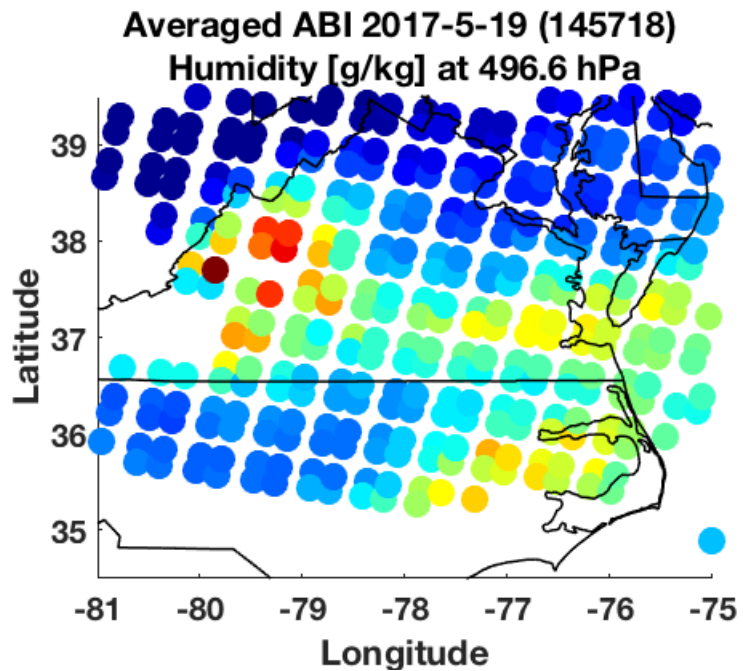
ABI(x, y, t): ABI retrieval value at location and time (x, y, t)

PHS(x₀, y₀, t₀): Mean of 5 reference PHS values closest to ABI location and time (x, y, t)

ABI(x₀, y₀, t₀): Mean of 5 reference PHS Field-of-View average ABI retrieval values closest to the ABI location and time (x, y, t)

Implicit Assumption: *The vertical resolution induced error of multi-spectral ABI retrievals is persistent over the time interval between the acquisition times of the high vertical resolution polar hyperspectral soundings and over the spatial scale (i.e., 14-km) of the hyperspectral sounding data.*

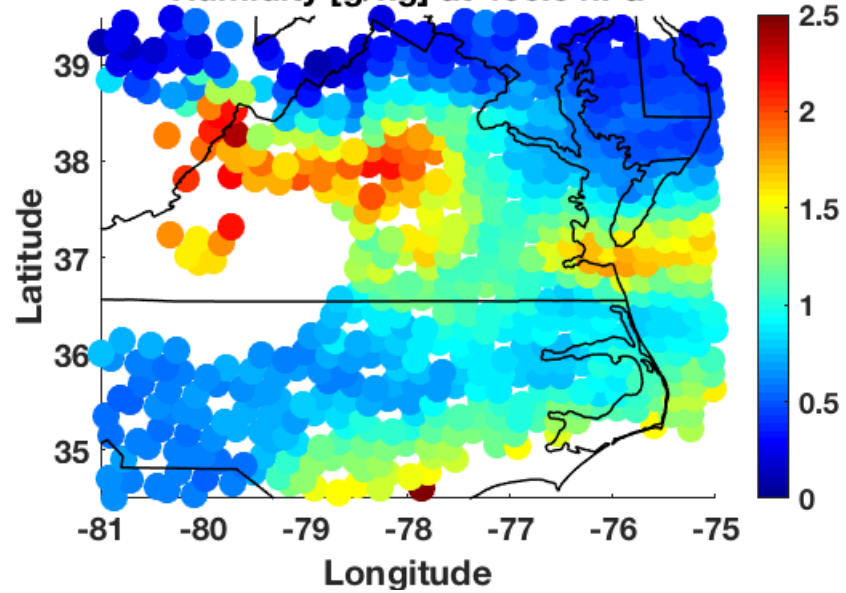
Combining 500 hPa ABI with PHS (IASI) @ 15:00 UTC



Combining ABI with PHS (CrIS) @ 17:55 UTC

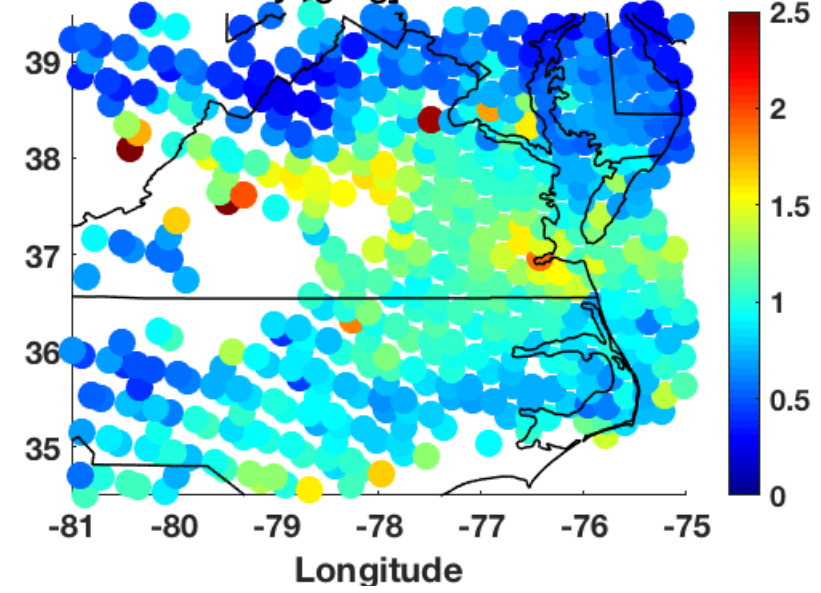
Averaged ABI 2017-5-19 (17:57:18)

Humidity [g/kg] at 496.6 hPa



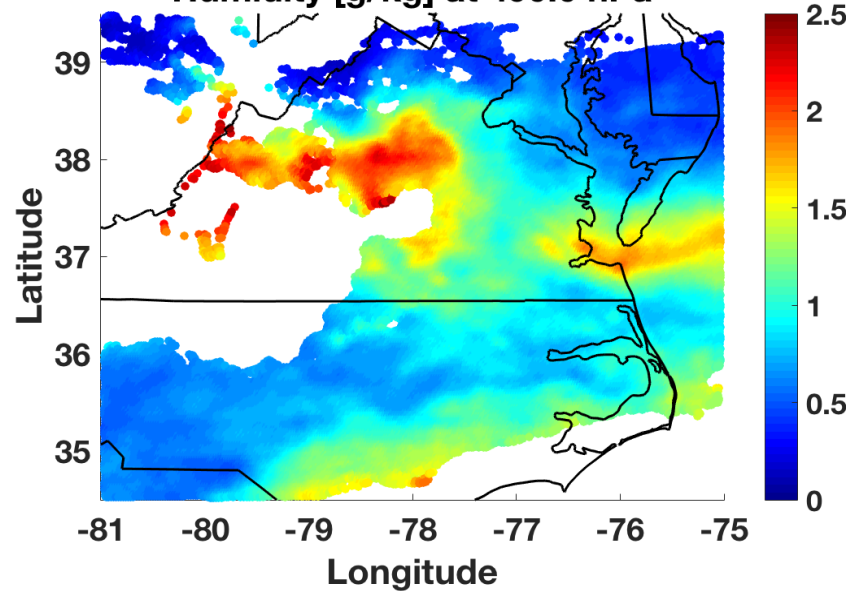
CrIS 2017-05-19 (175119)

Humidity [g/kg] at 496.6 hPa



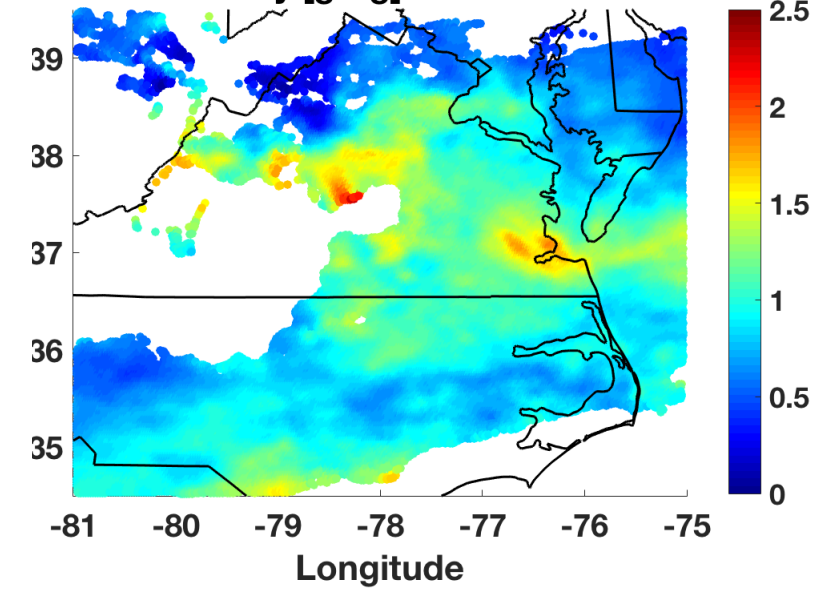
ABI 2017-5-19 (17:57:18)

Humidity [g/kg] at 496.6 hPa

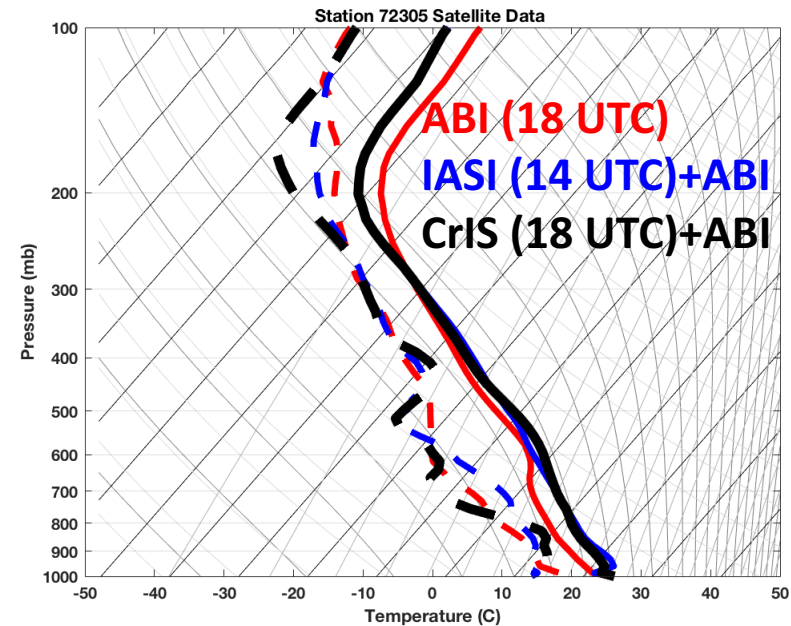
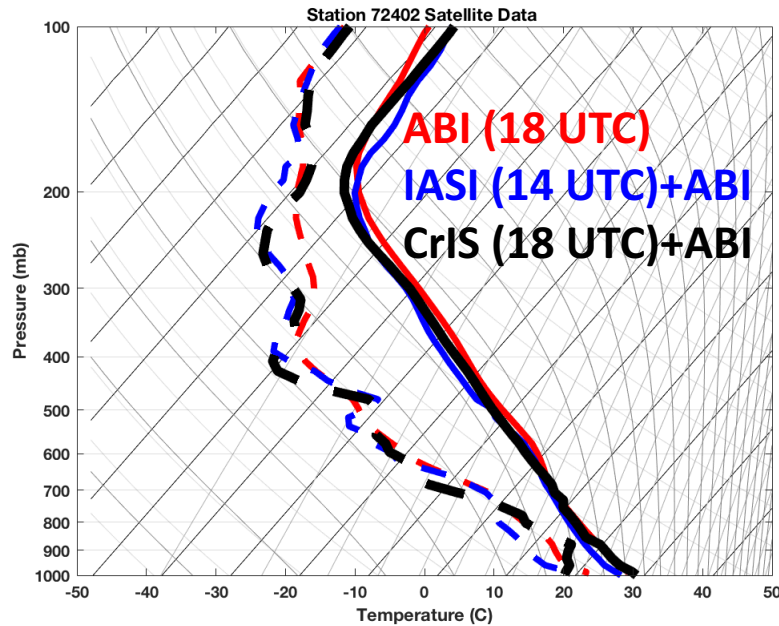
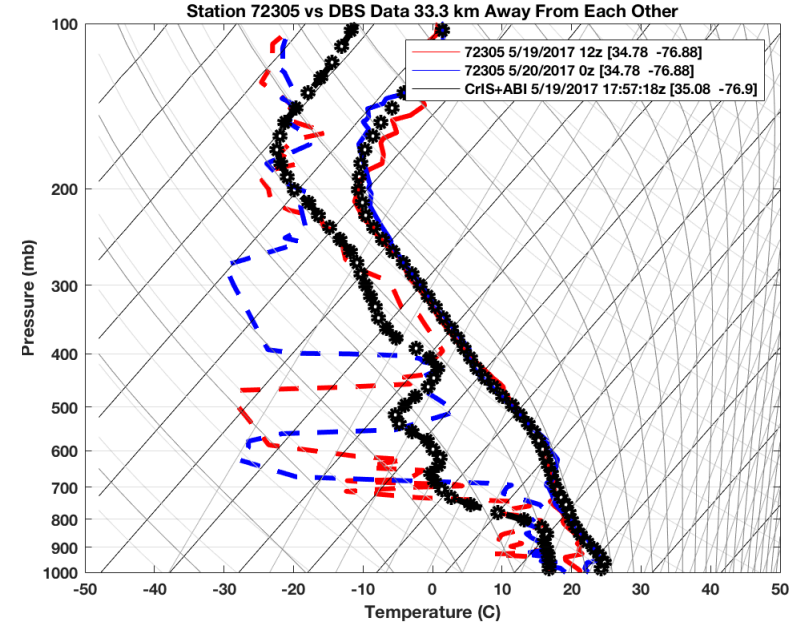
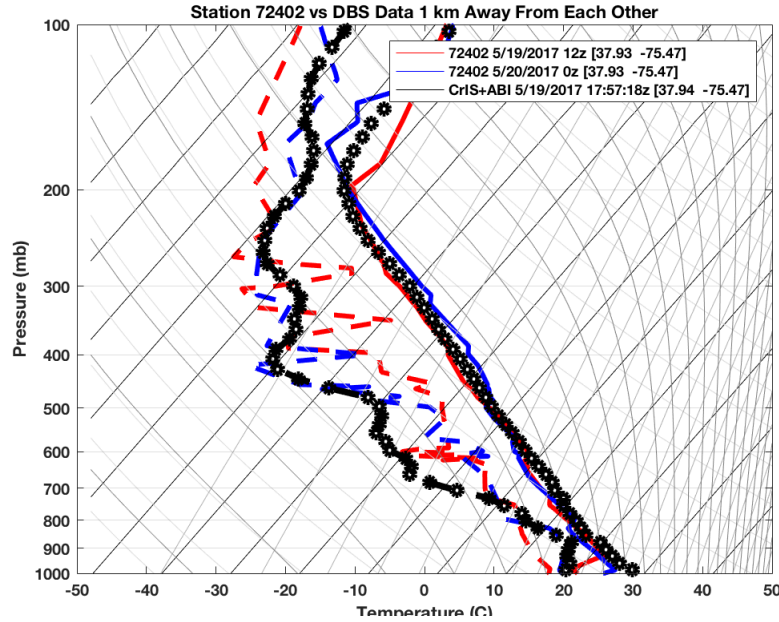


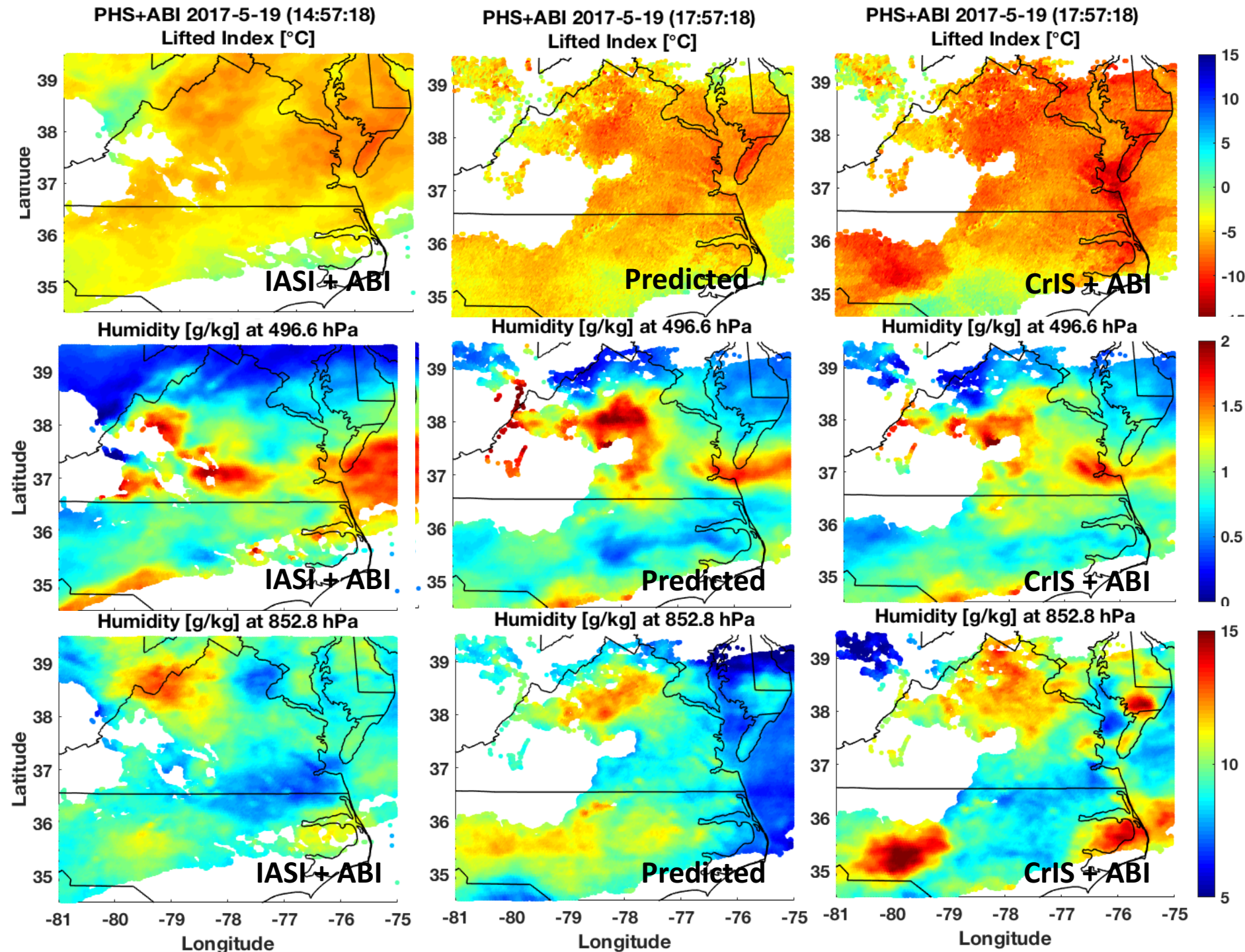
PHS+ABI 2017-5-19 (17:57:18)

Humidity [g/kg] at 496.6 hPa



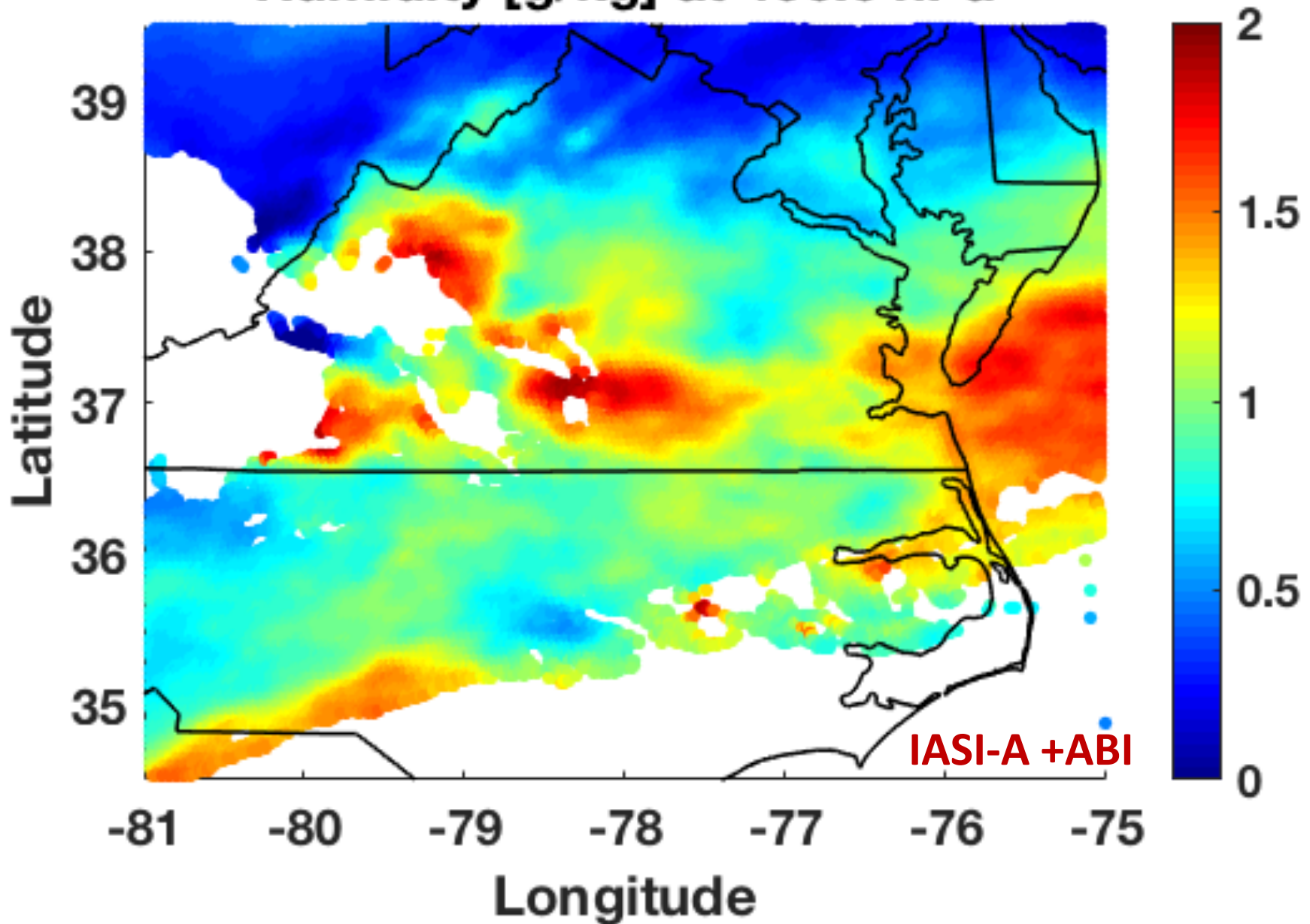
CrIS + ABI Vs Radiosondes (May 19, 2017)



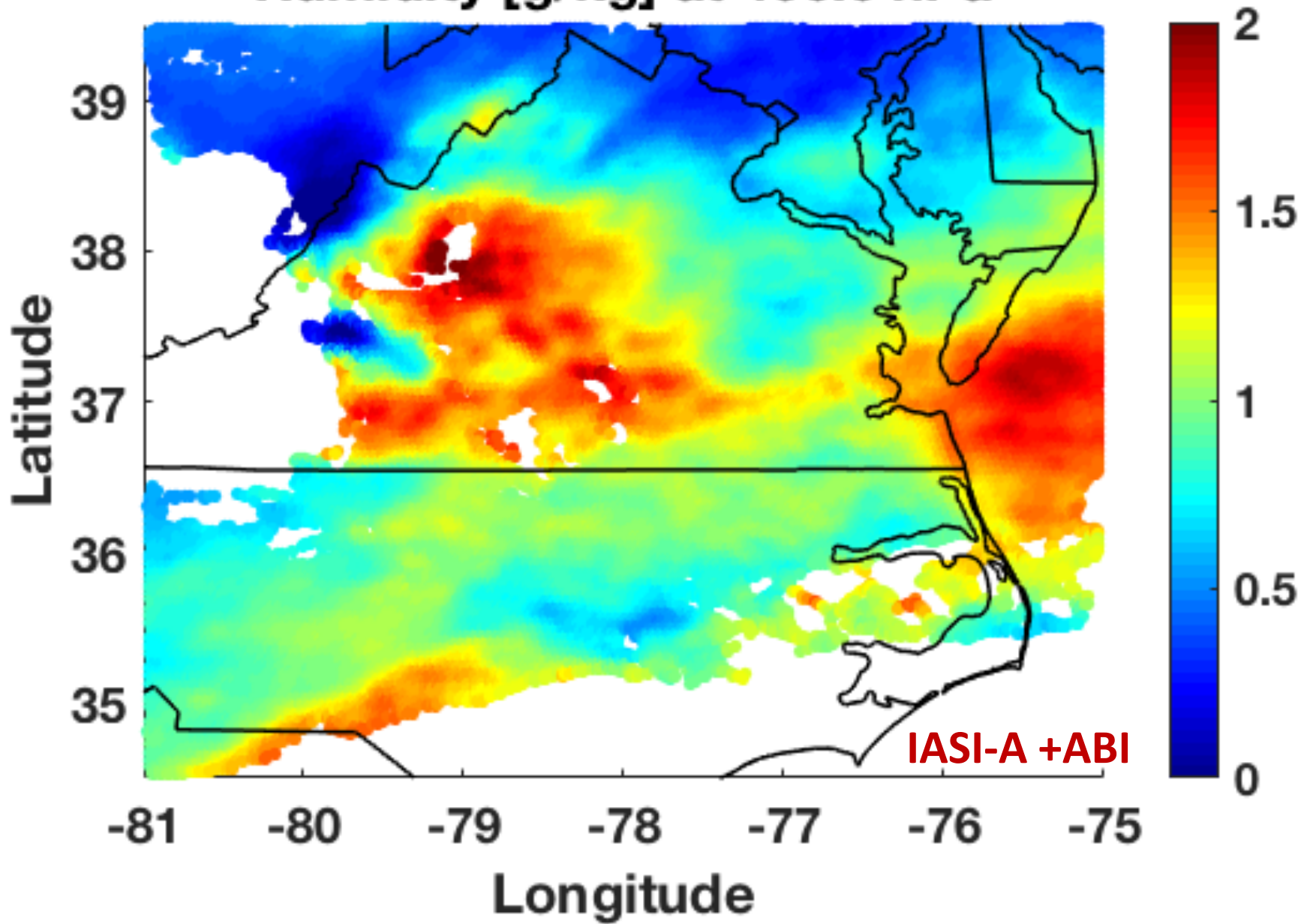


PHS+ABI Time Series (MOVIE)

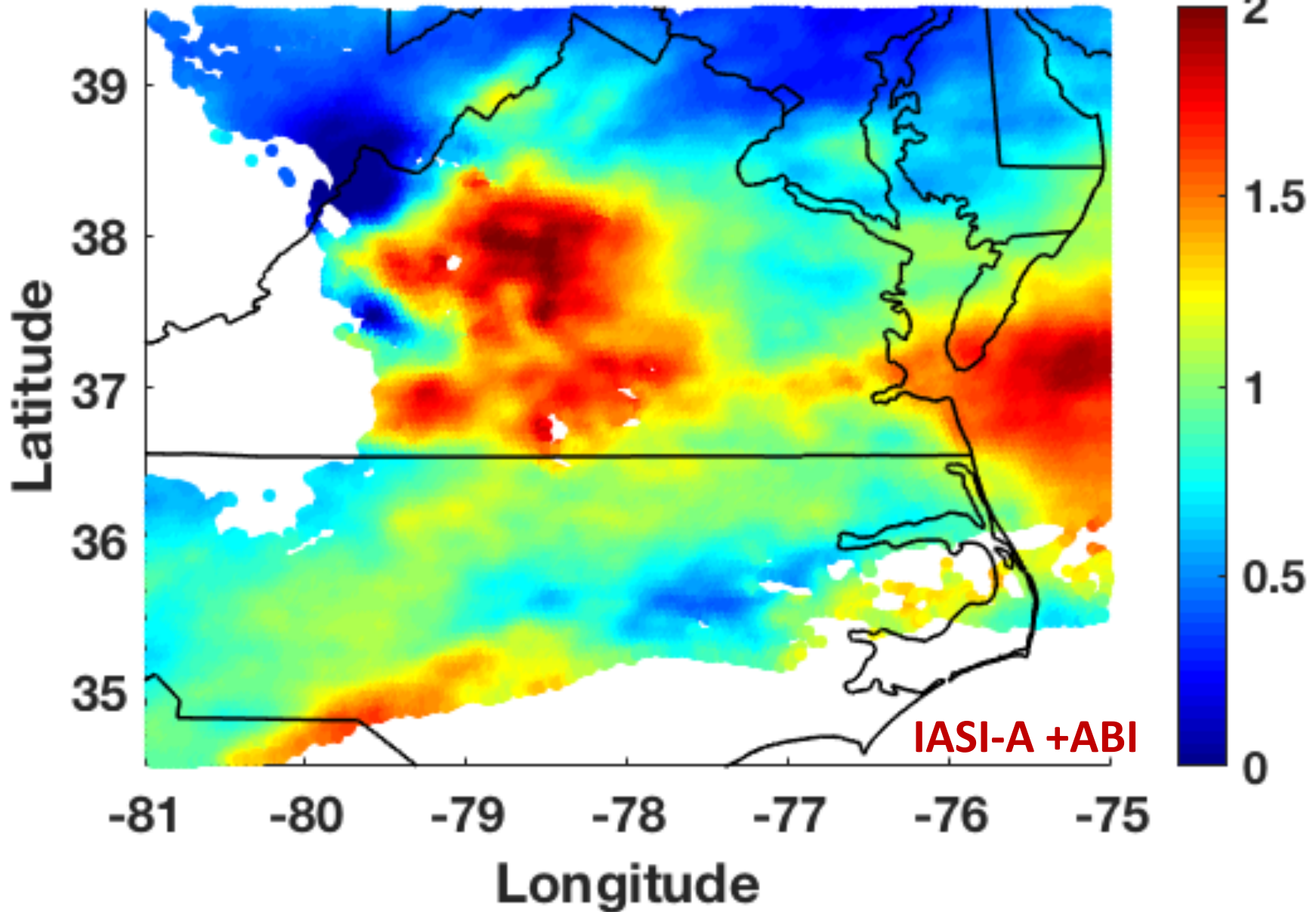
PHS+ABI 2017-5-19 (14:57:18)
Humidity [g/kg] at 496.6 hPa



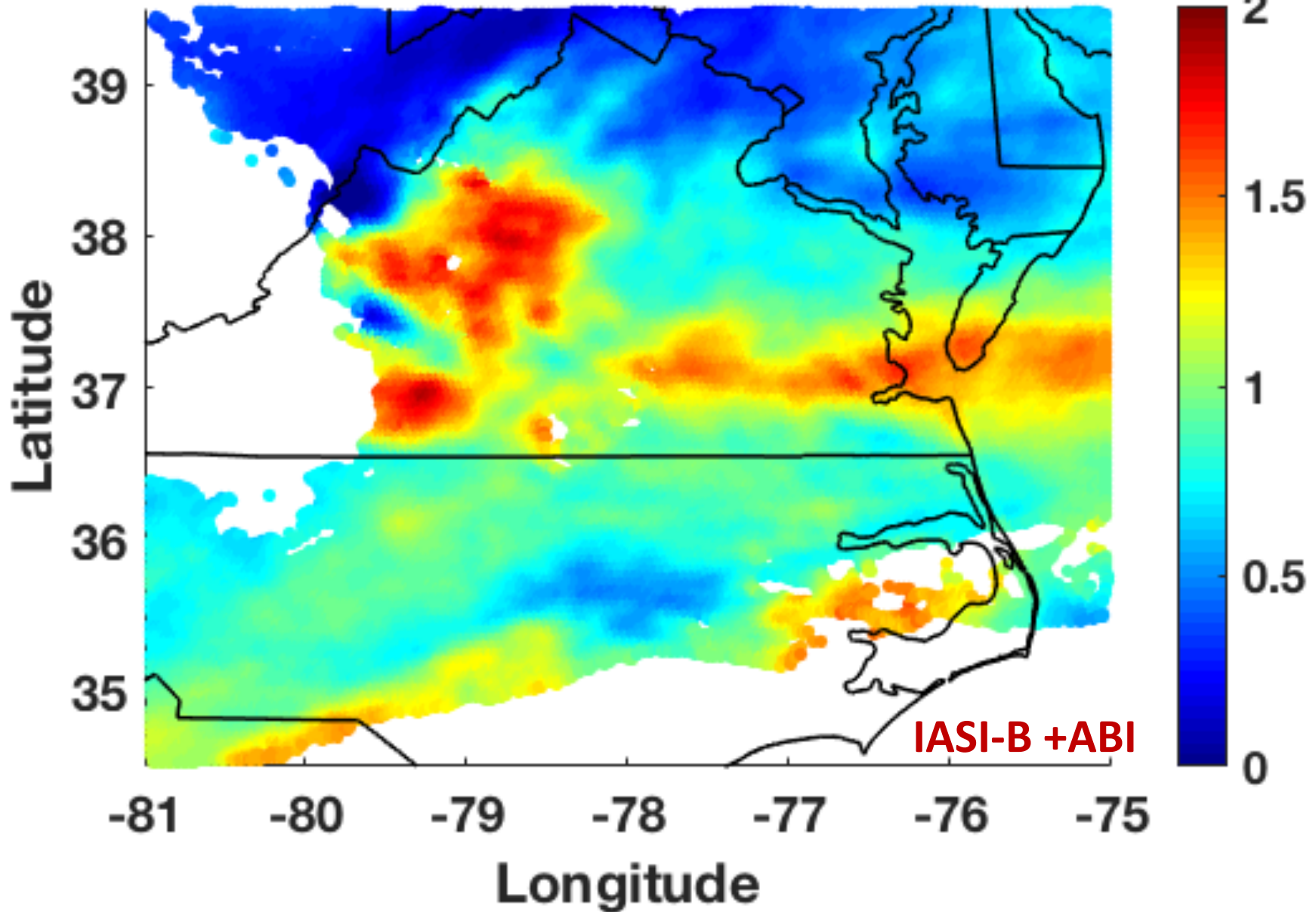
PHS+ABI 2017-5-19 (15:32:18)
Humidity [g/kg] at 496.6 hPa



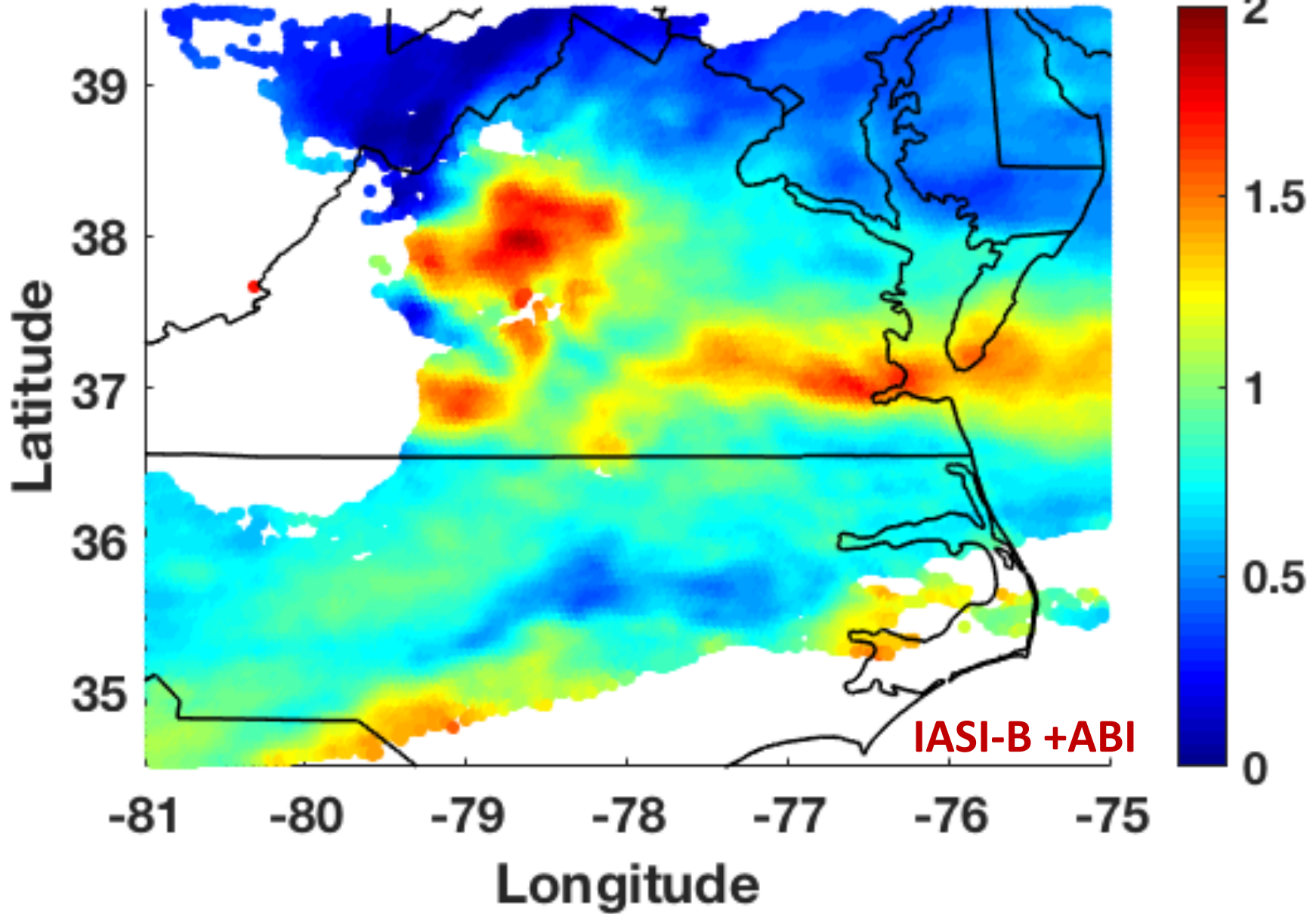
PHS+ABI 2017-5-19 (15:57:18)
Humidity [g/kg] at 496.6 hPa



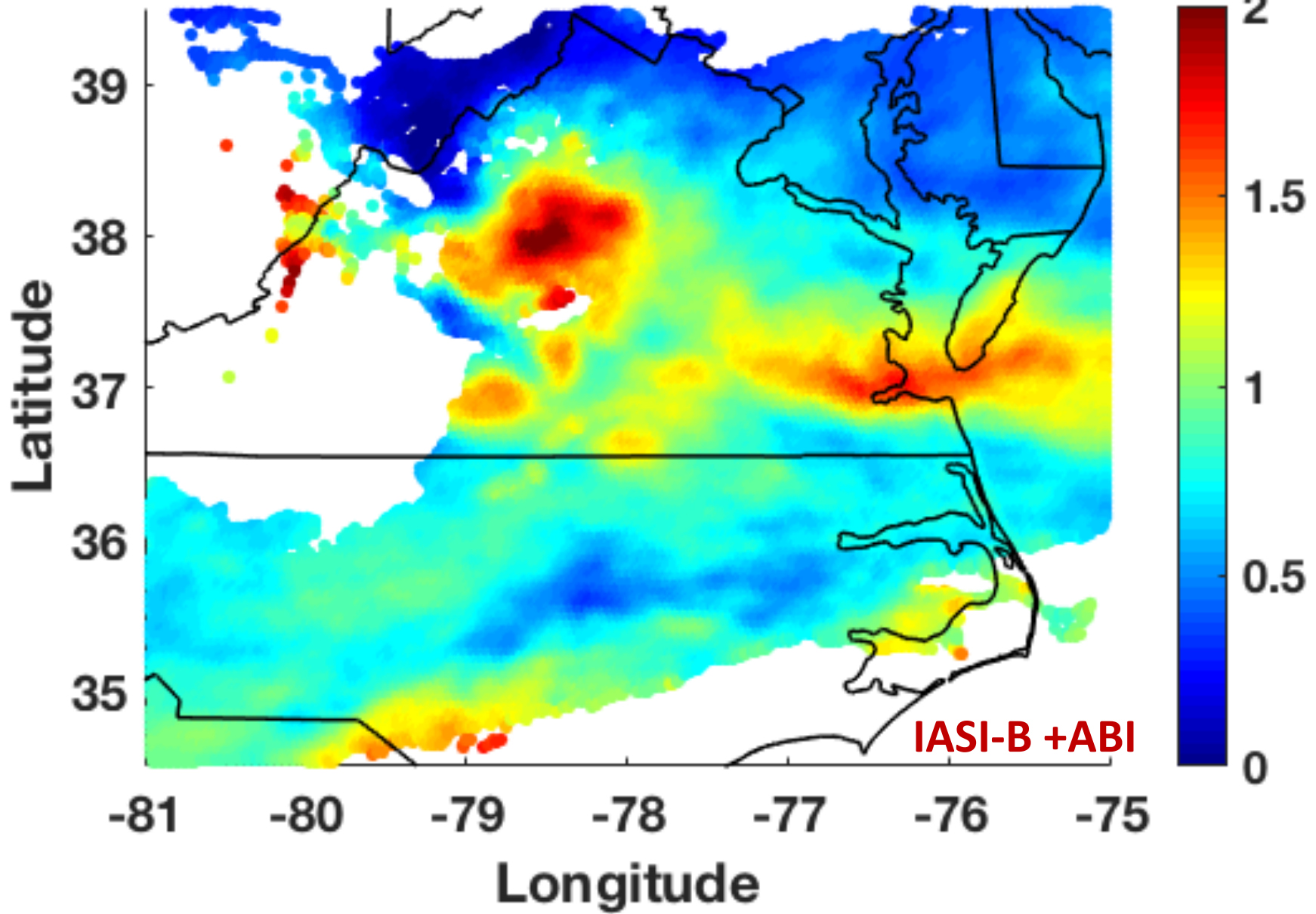
PHS+ABI 2017-5-19 (15:57:18)
Humidity [g/kg] at 496.6 hPa



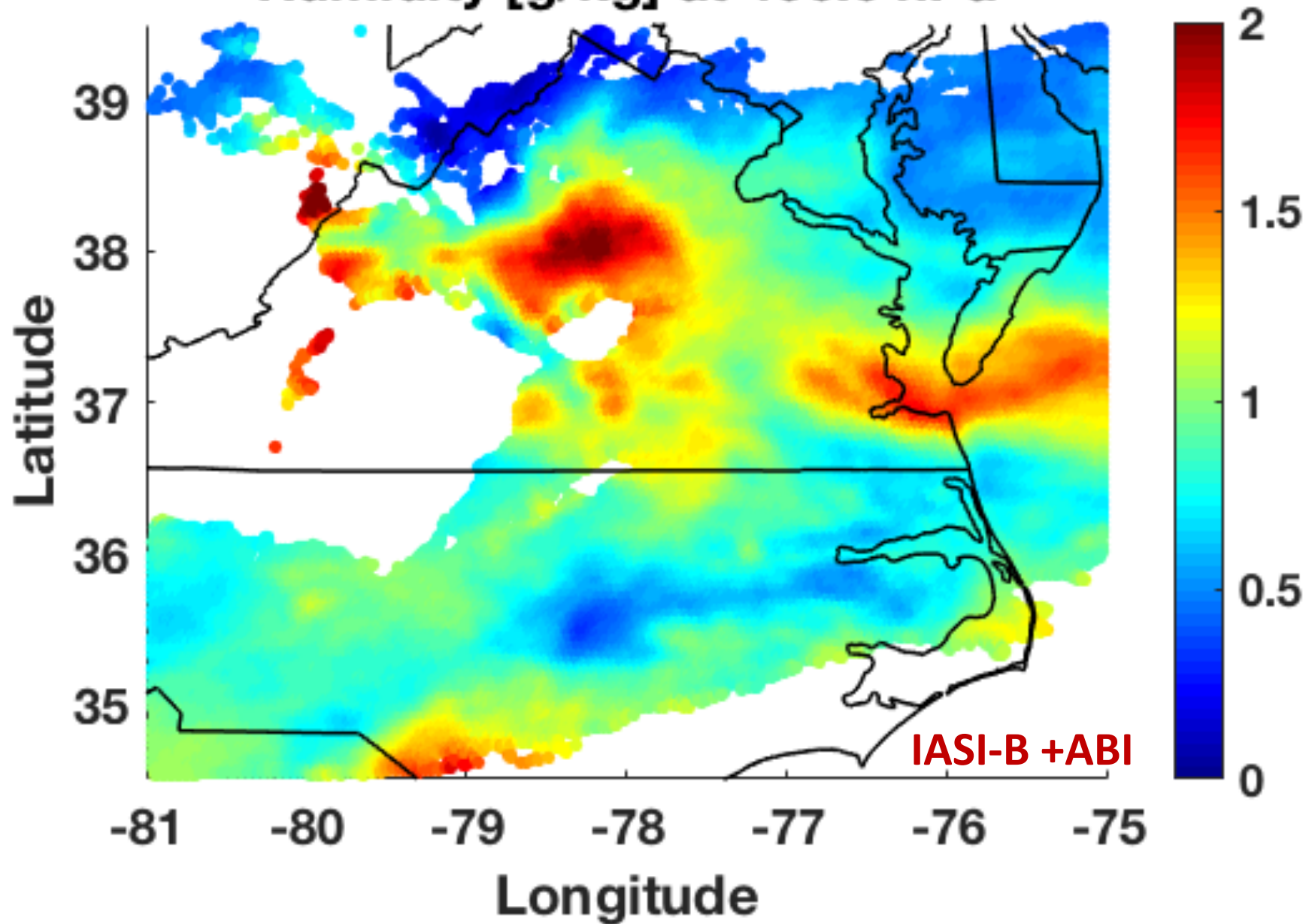
PHS+ABI 2017-5-19 (16:32:18)
Humidity [g/kg] at 496.6 hPa



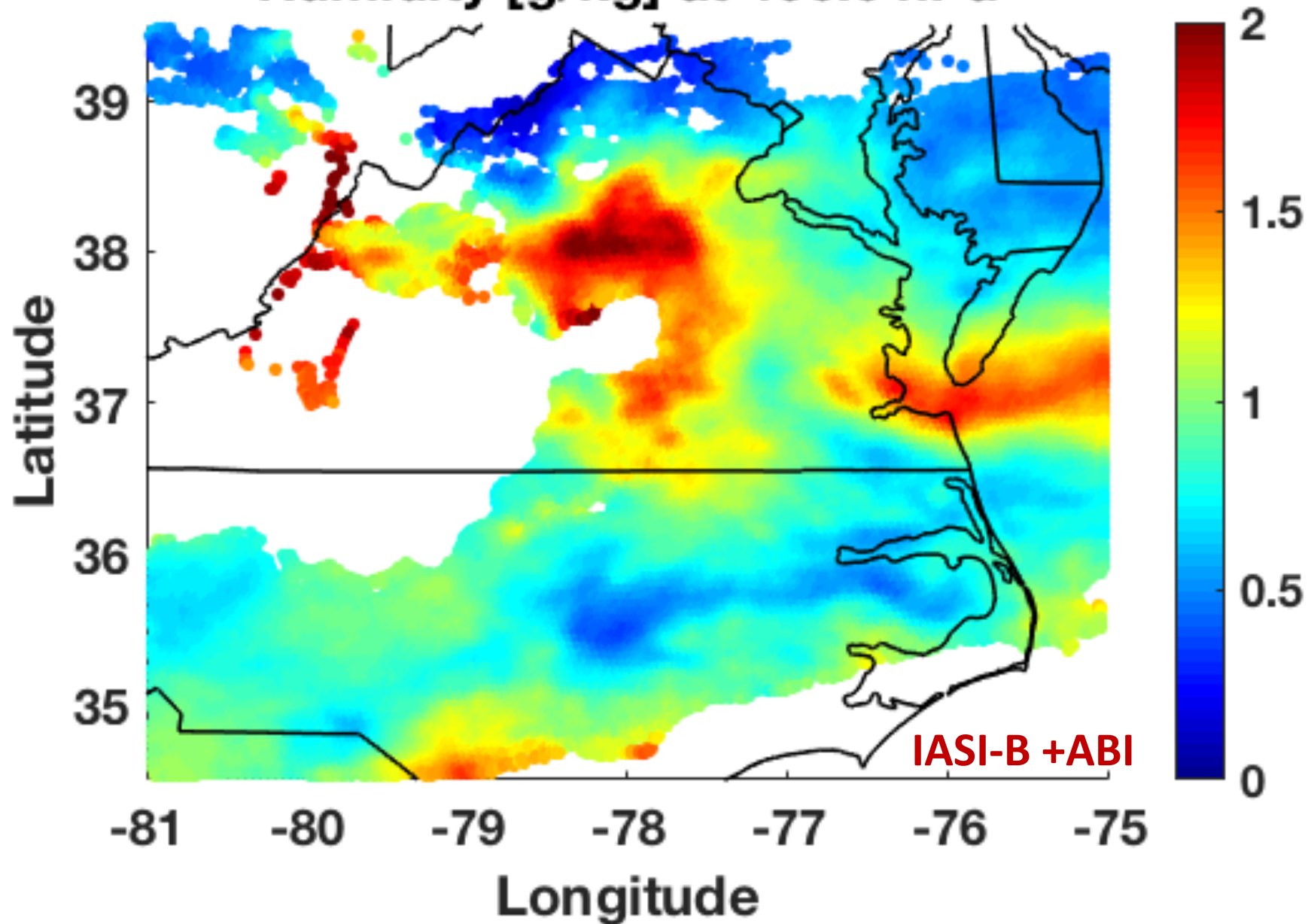
PHS+ABI 2017-5-19 (16:57:18)
Humidity [g/kg] at 496.6 hPa



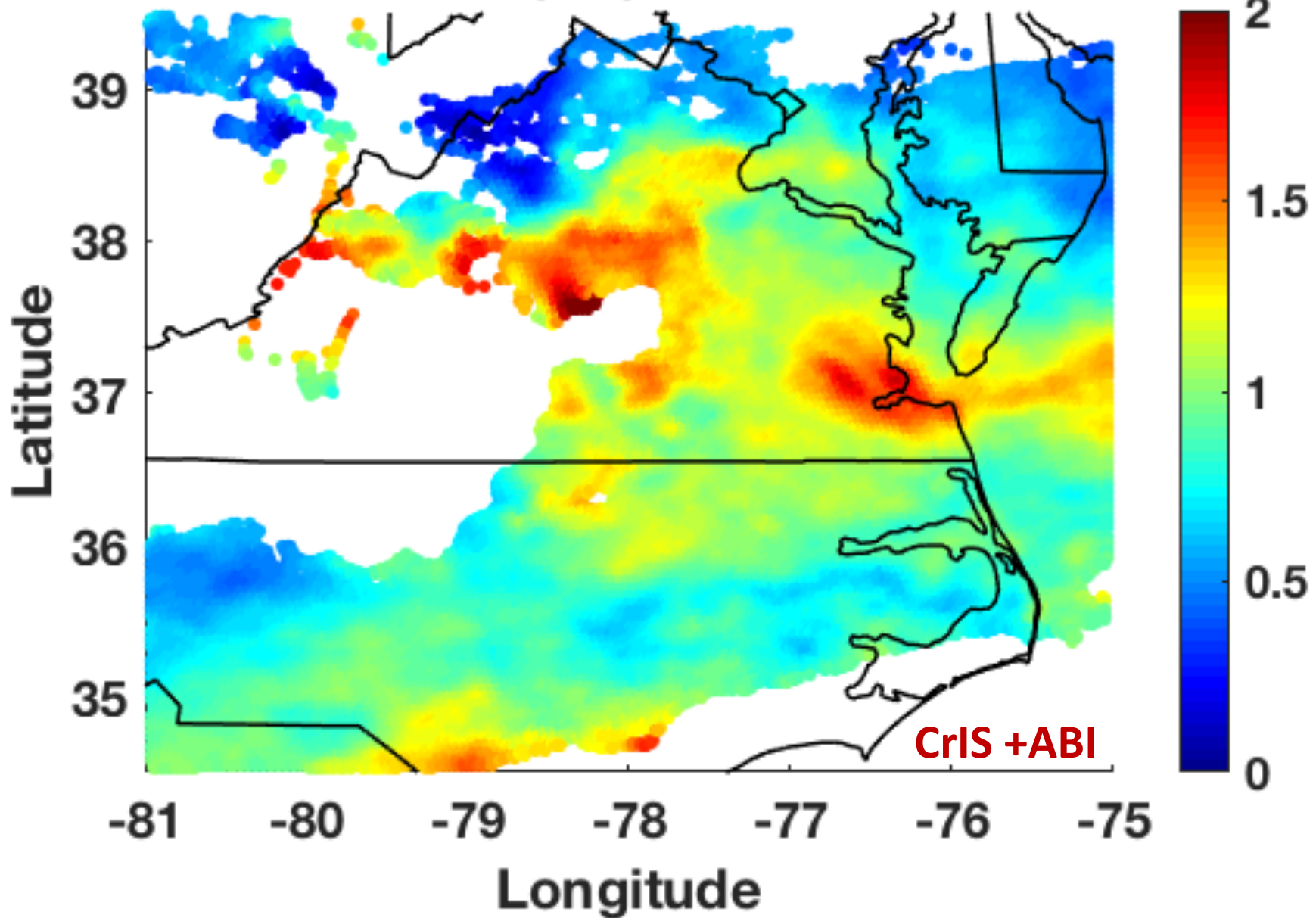
PHS+ABI 2017-5-19 (17:32:18)
Humidity [g/kg] at 496.6 hPa



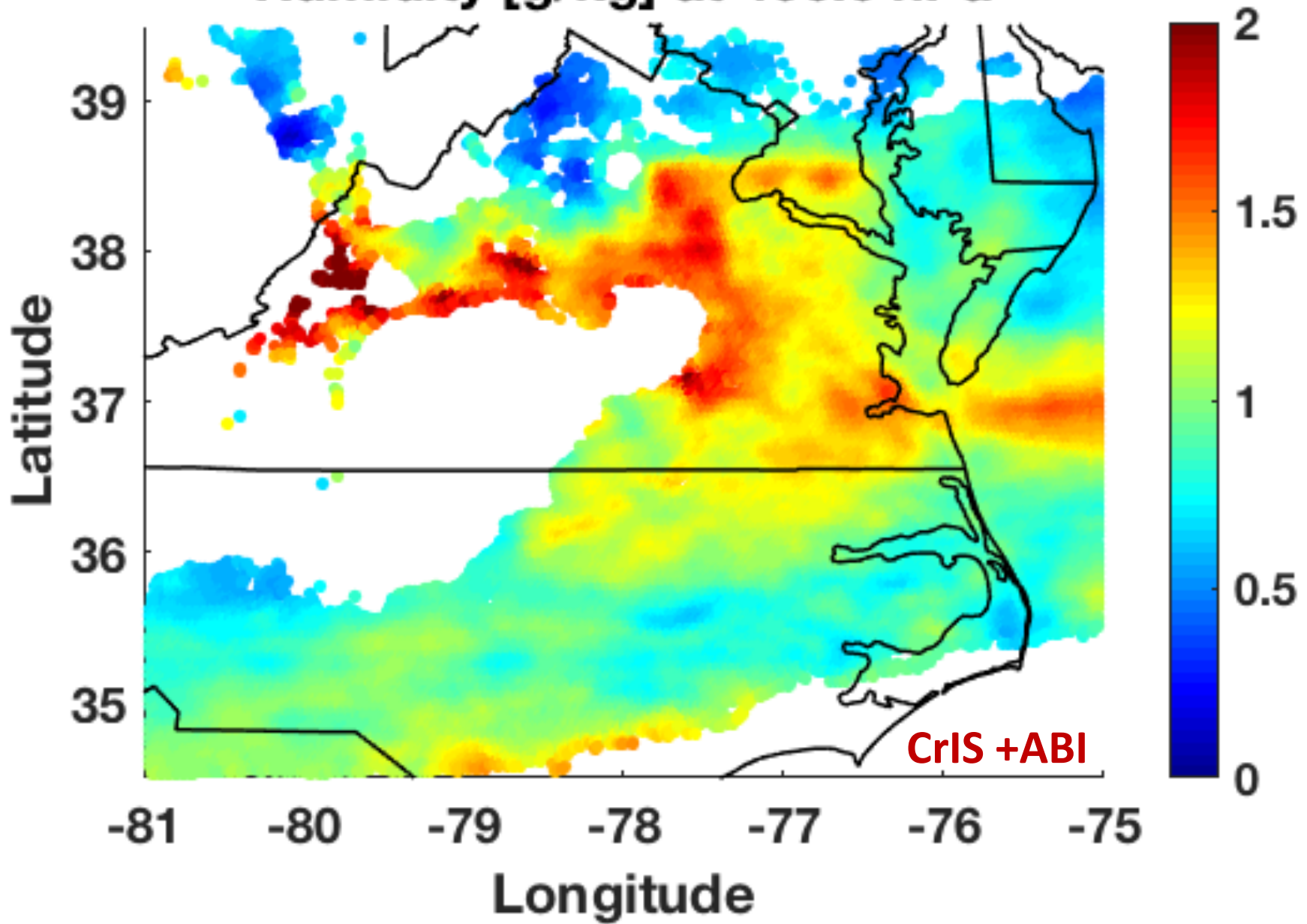
PHS+ABI 2017-5-19 (17:57:18)
Humidity [g/kg] at 496.6 hPa



PHS+ABI 2017-5-19 (17:57:18)
Humidity [g/kg] at 496.6 hPa

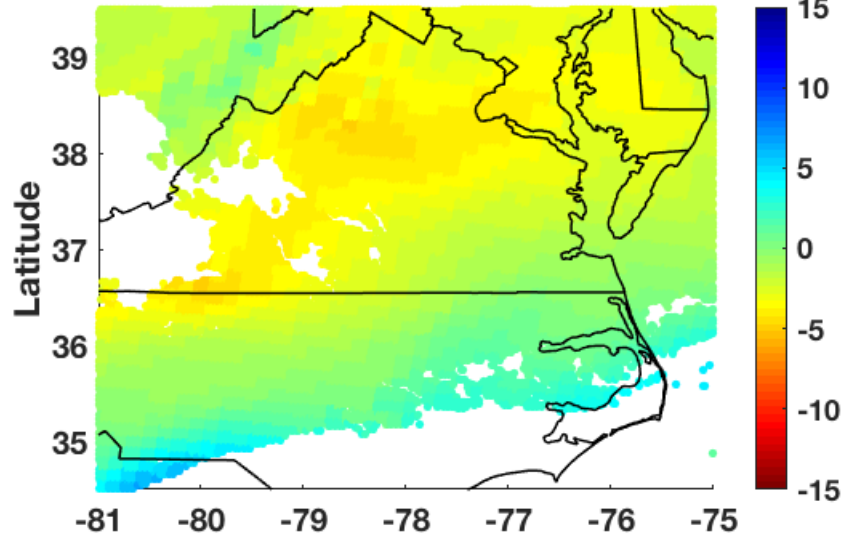


PHS+ABI 2017-5-19 (18:32:18)
Humidity [g/kg] at 496.6 hPa

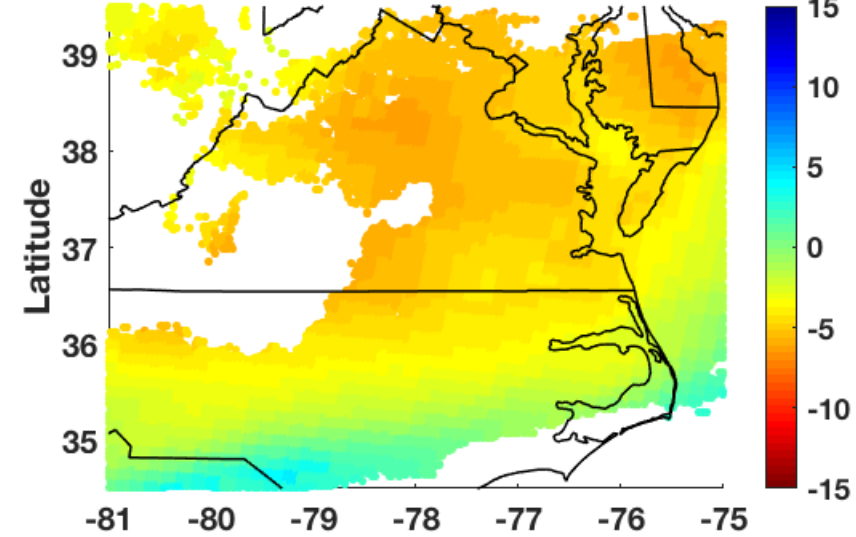


Atmospheric Stability Change

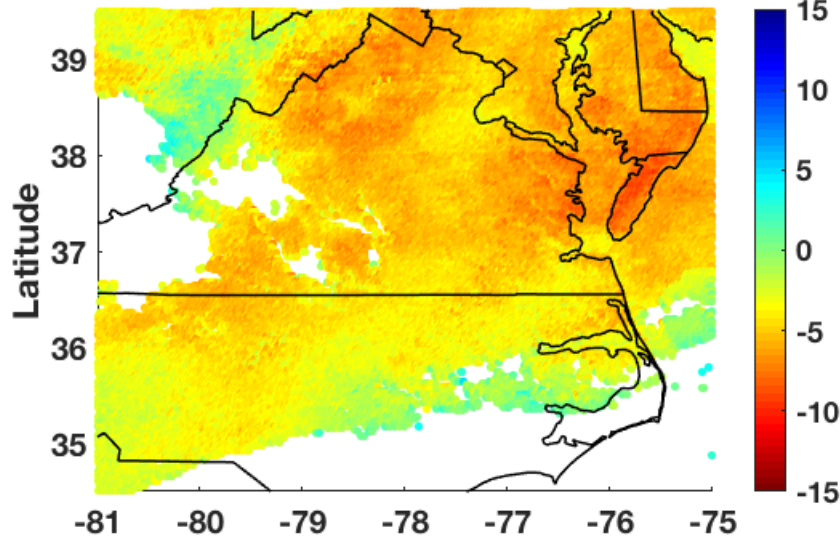
RAP 2017-05-19 (145718)
Lifted Index [°C]



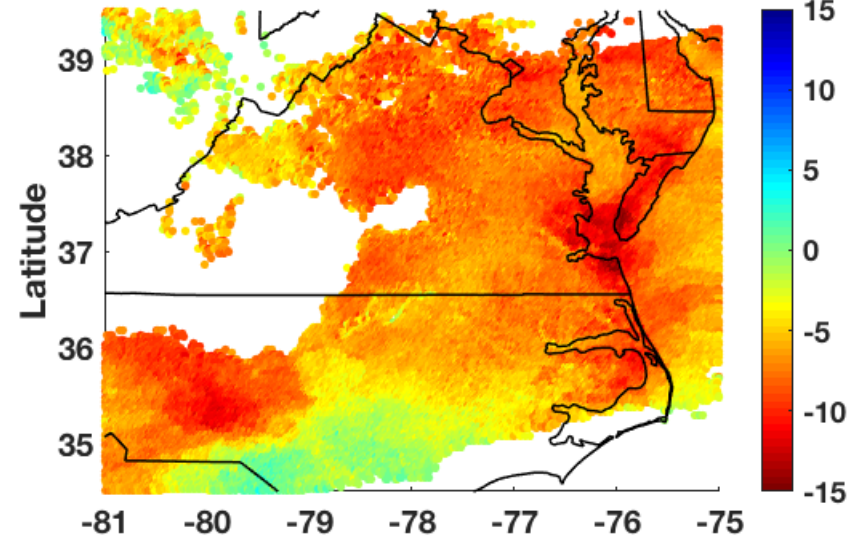
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Lifted Index [°C]



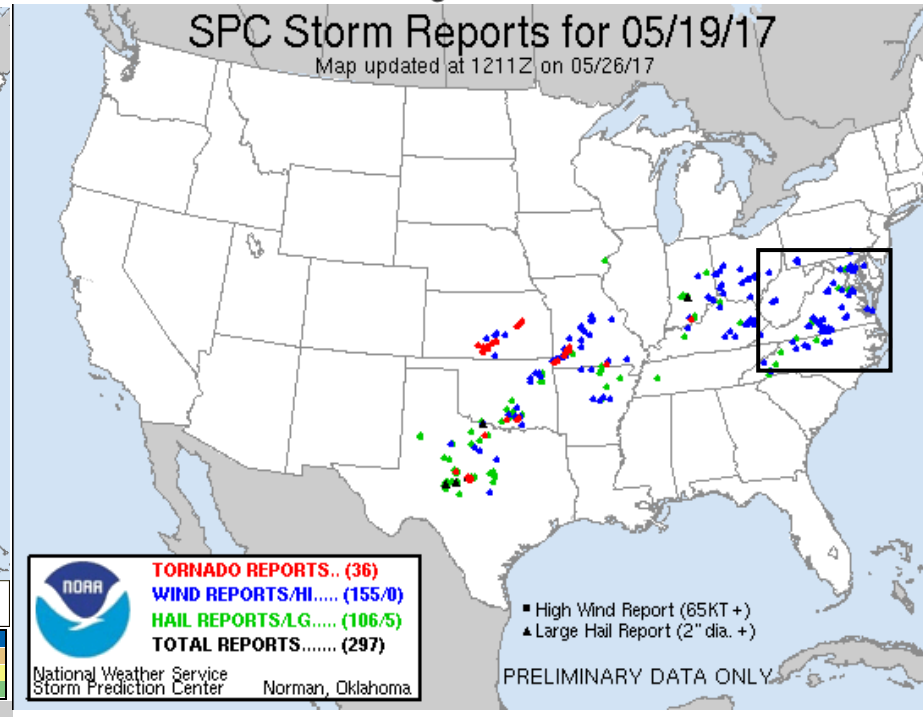
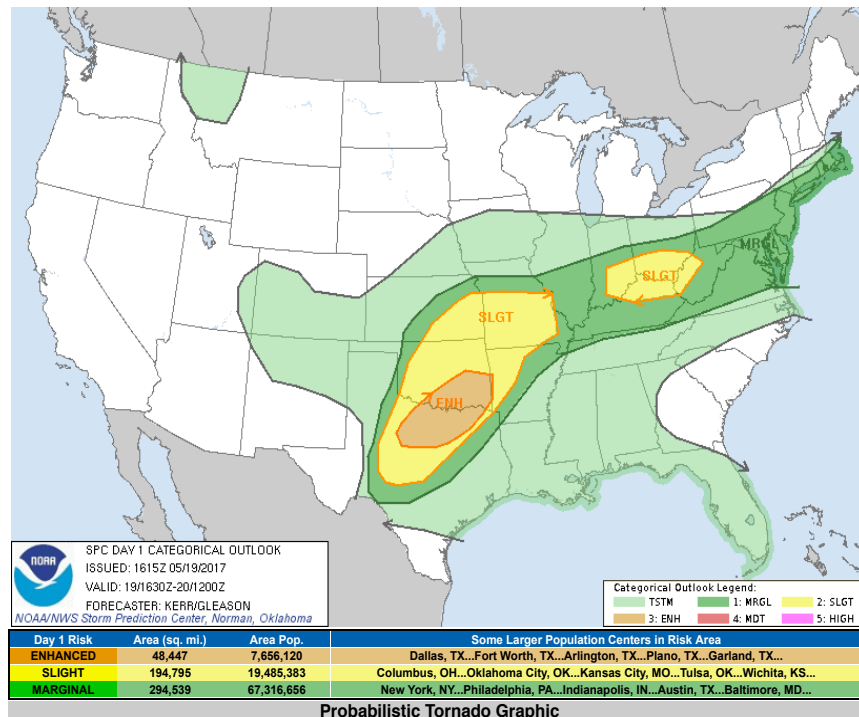
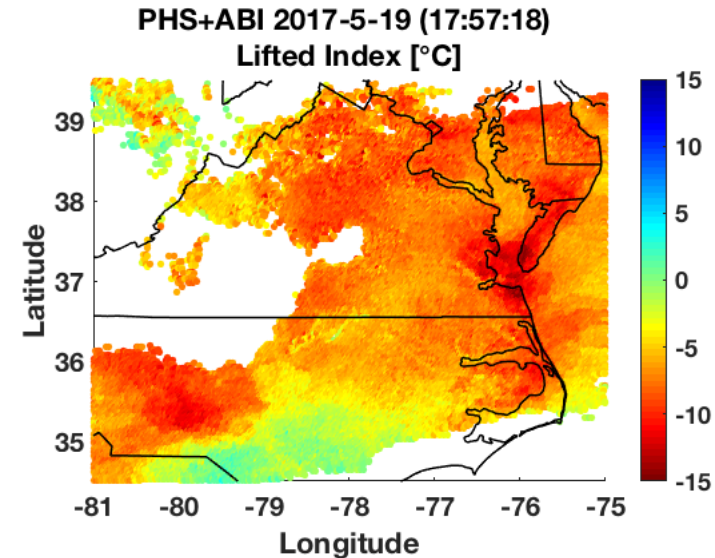
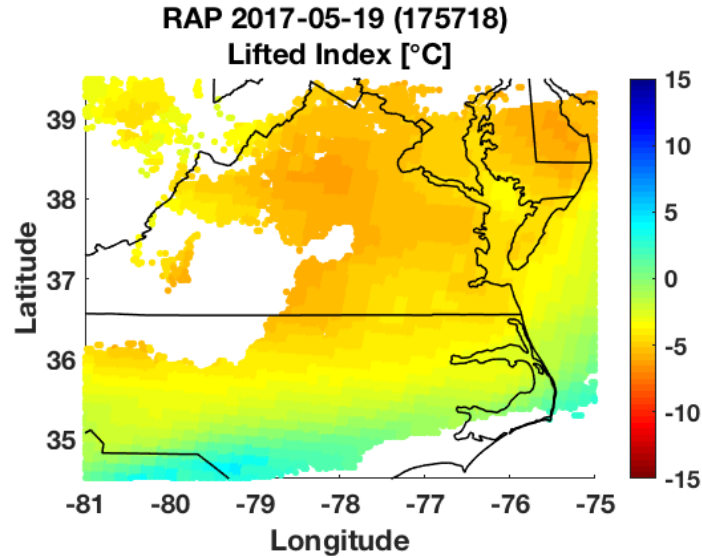
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Lifted Index [°C]



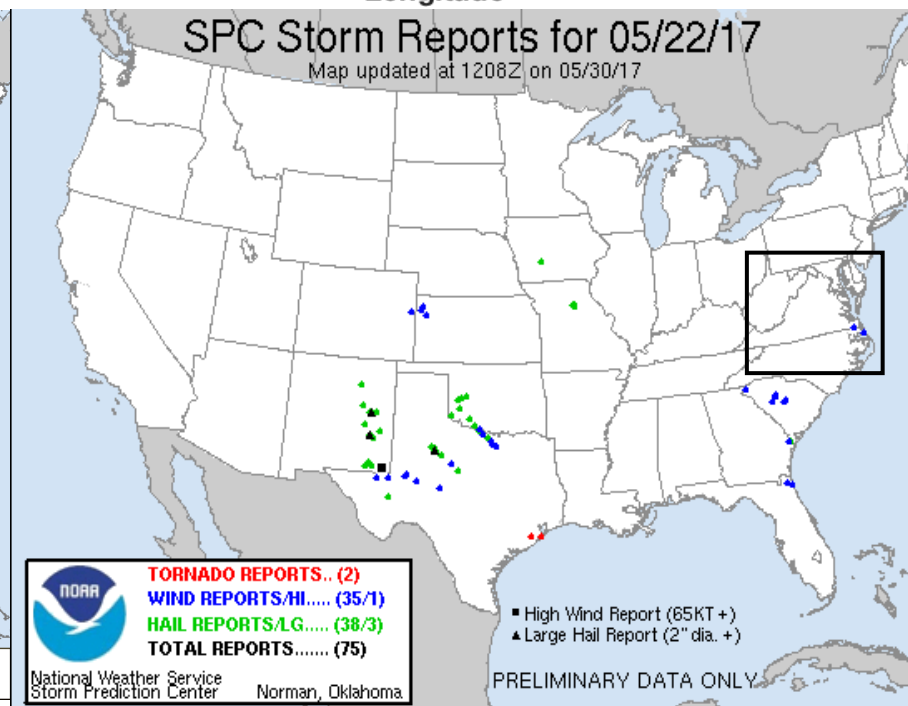
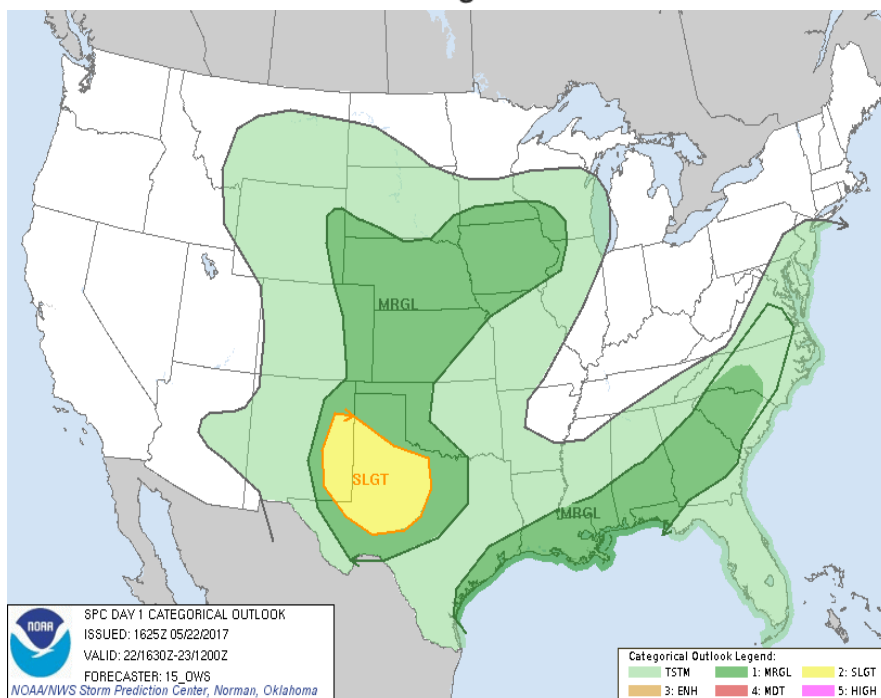
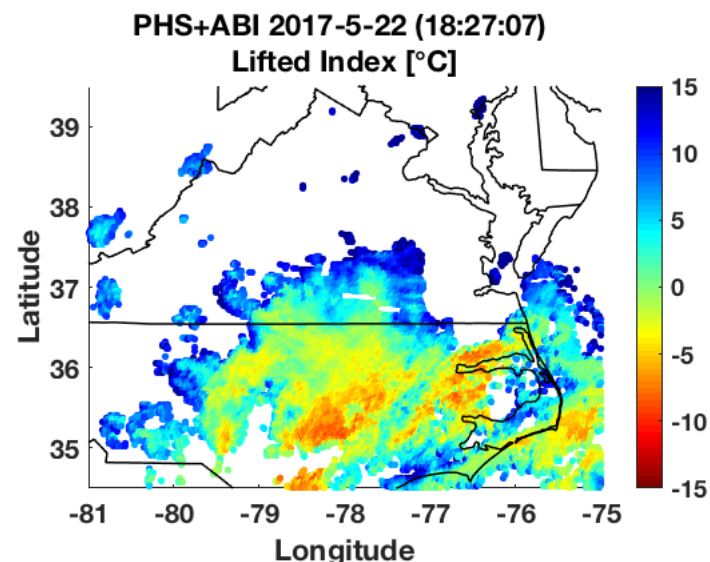
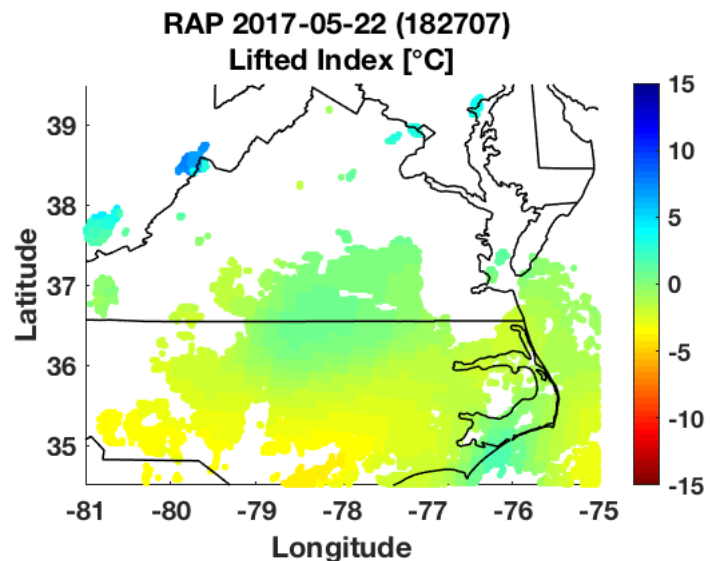
PHS+ABI 2017-5-19 (17:57:18)
Lifted Index [°C]



HR Severe Weather Not Predicted by NWS (May 19, 2017)



HR Severe Weather Predicted by NWS (May 22, 2017)



Summary and Conclusions

- **Profile Retrievals from Polar Hyperspectral Sounders and Geostationary Multi-spectral Instruments to Optimize the Vertical, Horizontal, and Temporal resolution of the Satellite Sounding Product**
 - Improving low altitude sounding coverage in partly cloudy areas
 - Observe spatial mesoscale details important for intense weather prediction
 - Provide high temporal resolution for predicting the onset of severe convection
 - Provide altitude-resolved water vapor imagery time sequences potentially useful for estimating 4-d wind profiles for NWP applications
- **Technique Can Provide Near-Global Coverage Using be Polar Satellite Hyperspectral Sounders (e.g., IASI, CrIS, HIRAS) Data Obtained Using the International Network of Direct Broadcast Systems (e.g., DBnet) and Geostationary Satellite Multi-spectral Instruments (e.g., ABI, AHI, AMI, and SEVIRI)**
- **PHS + ABI is **NOT** a replacement for the Geo-Hyperspectral Sounder**