GOES-16

ATM 480 – Forecasting & NWS Operations Course

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General Forecaster - WFO Albany, NY
April 22nd, 2019

Outline

Intro – Benefits of new technologies

GOES-16 ABI Bands

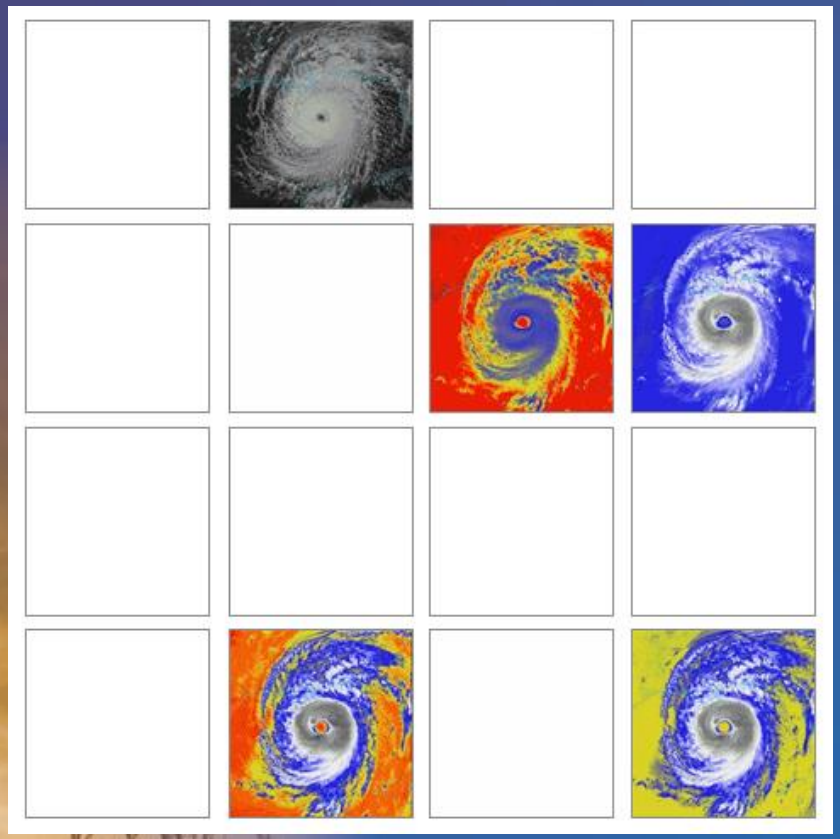
- ✓ Examples
- ✓ Strengths of each

Applications

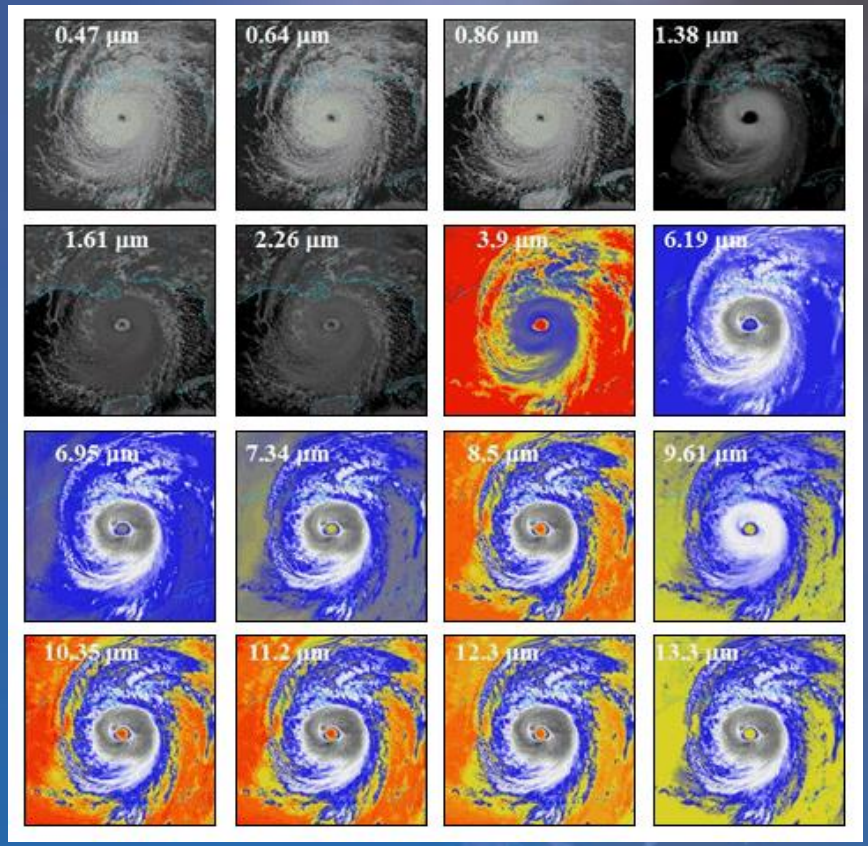
Real-time Examples

Three Times More Spectral Information

GOES-13/14/15 Spectral Bands

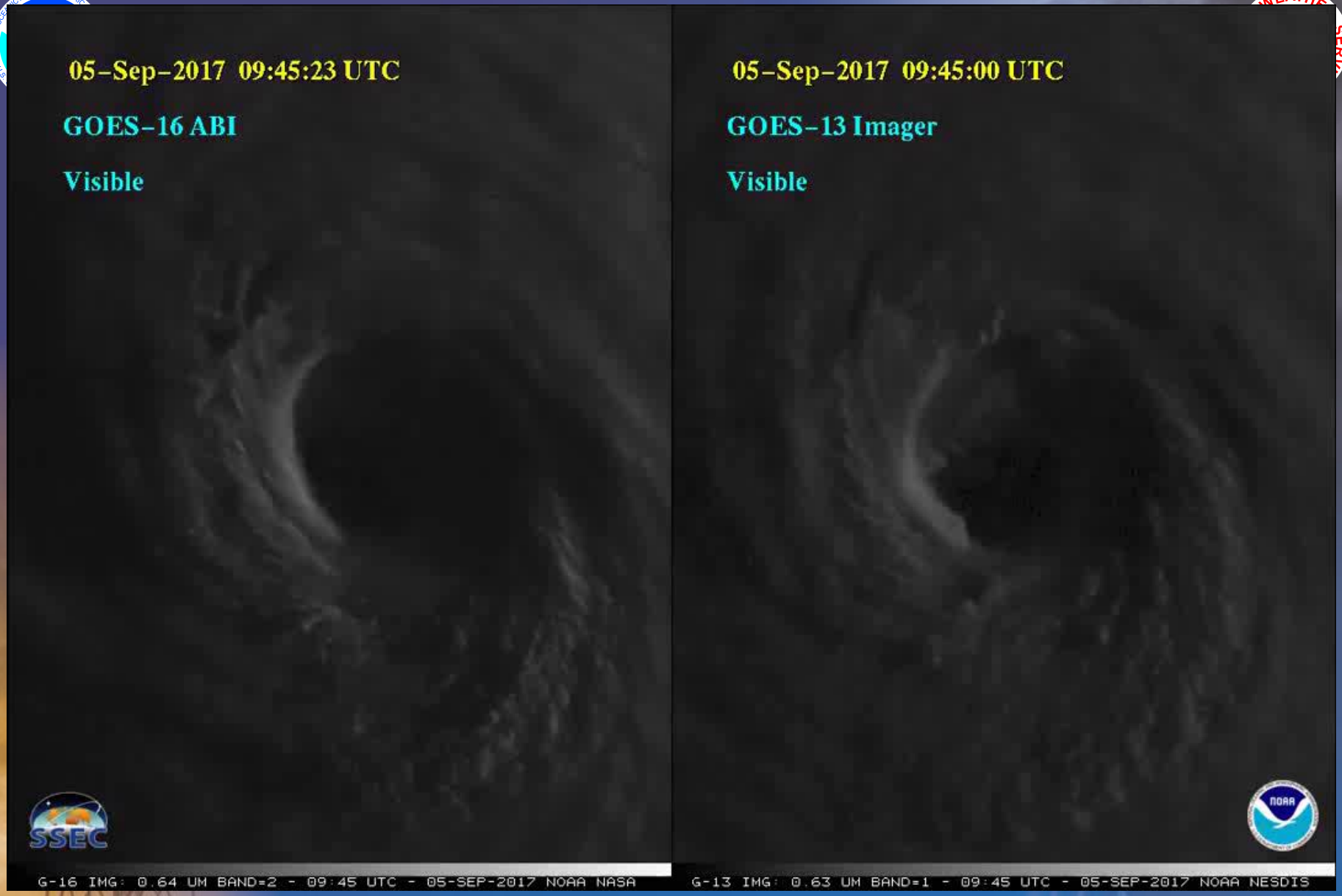


GOES-16 & 17 Spectral Bands

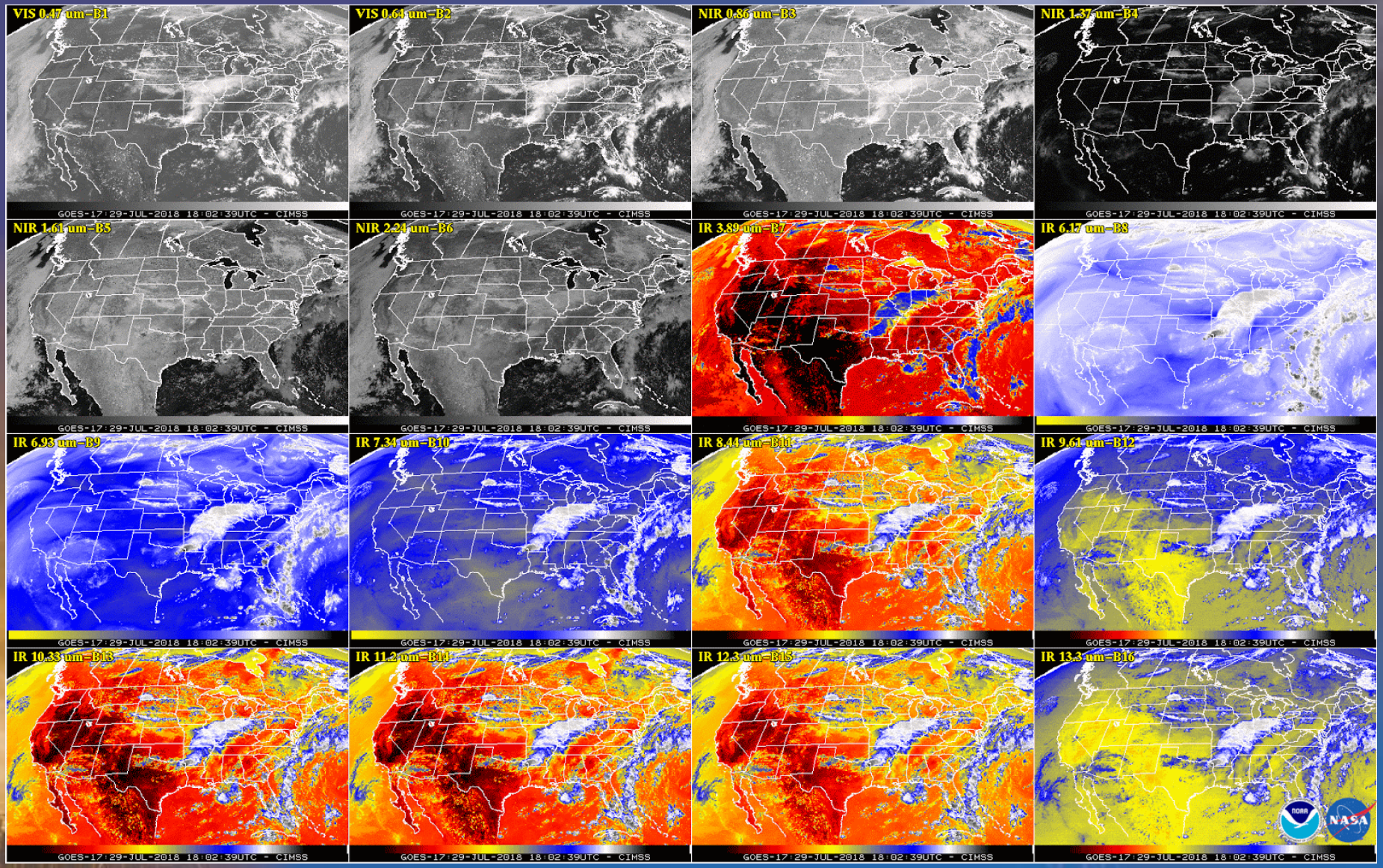


GOES-16 Improvements

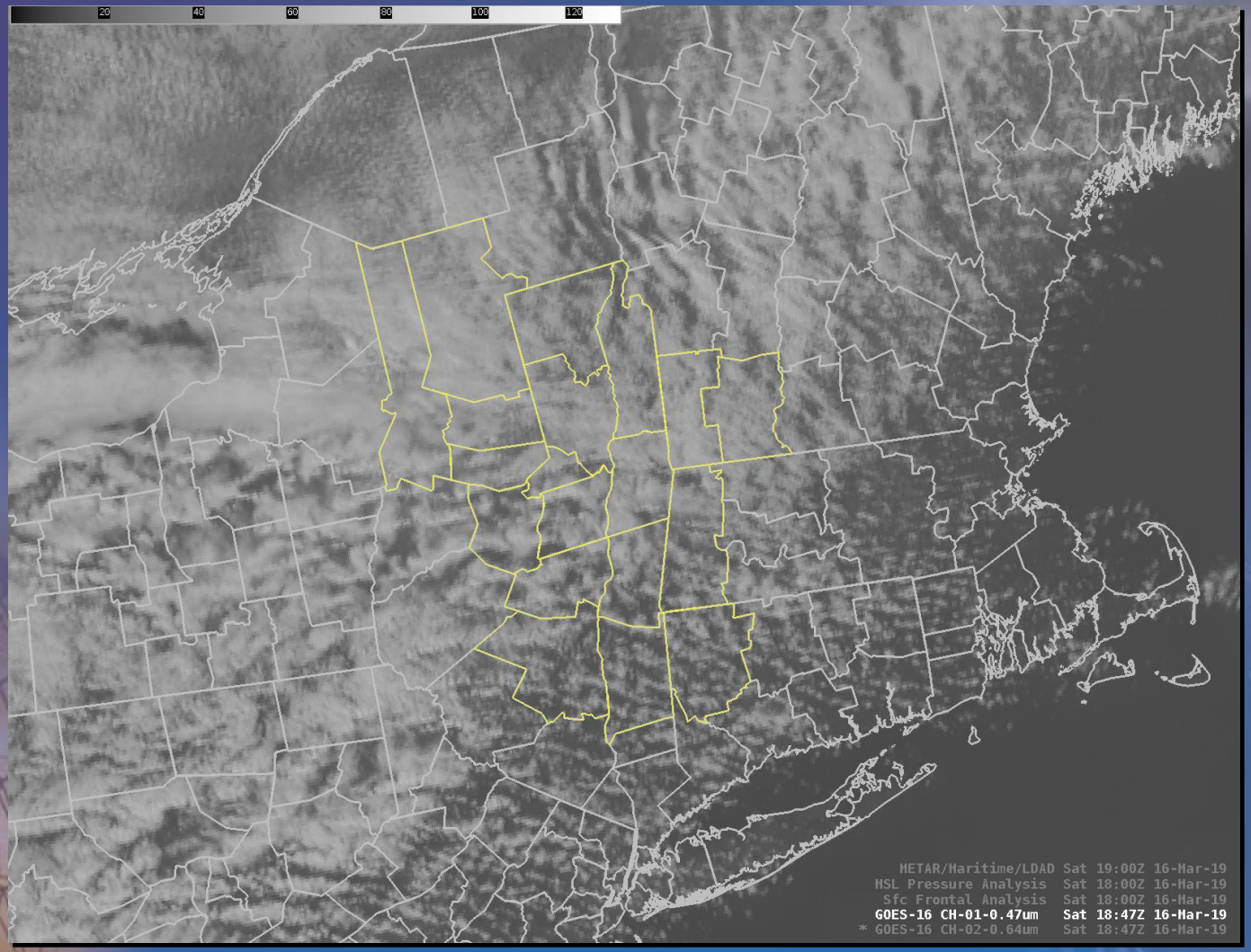
	GOES-16	GOES-13
Spectral Coverage:	16 bands	5 bands
Spatial Resolution:		
0.64µm Visible	0.5 km	~ 1.0 km
Other Vis/nearIR	1.0 km	N/A
Bands (> 2µm)	2.0 km	~ 4.0 km
Spatial Coverage:		
Full Disk	4/hour	Every 3 hours
CONUS	12/hour	~4/hour
Visible		
On-orbit calibration	YES	NO
Meso/Rapid Scan	1 min	5 min


05-Sep-2017 09:45:23 UTC
GOES-16 ABI
Visible
SSEC
G-16 IMG: 0.64 UM BAND=2 - 09:45 UTC - 05-SEP-2017 NOAA NASA
05-Sep-2017 09:45:00 UTC
GOES-13 Imager
Visible
NOAA
G-13 IMG: 0.63 UM BAND=1 - 09:45 UTC - 05-SEP-2017 NOAA NESDIS

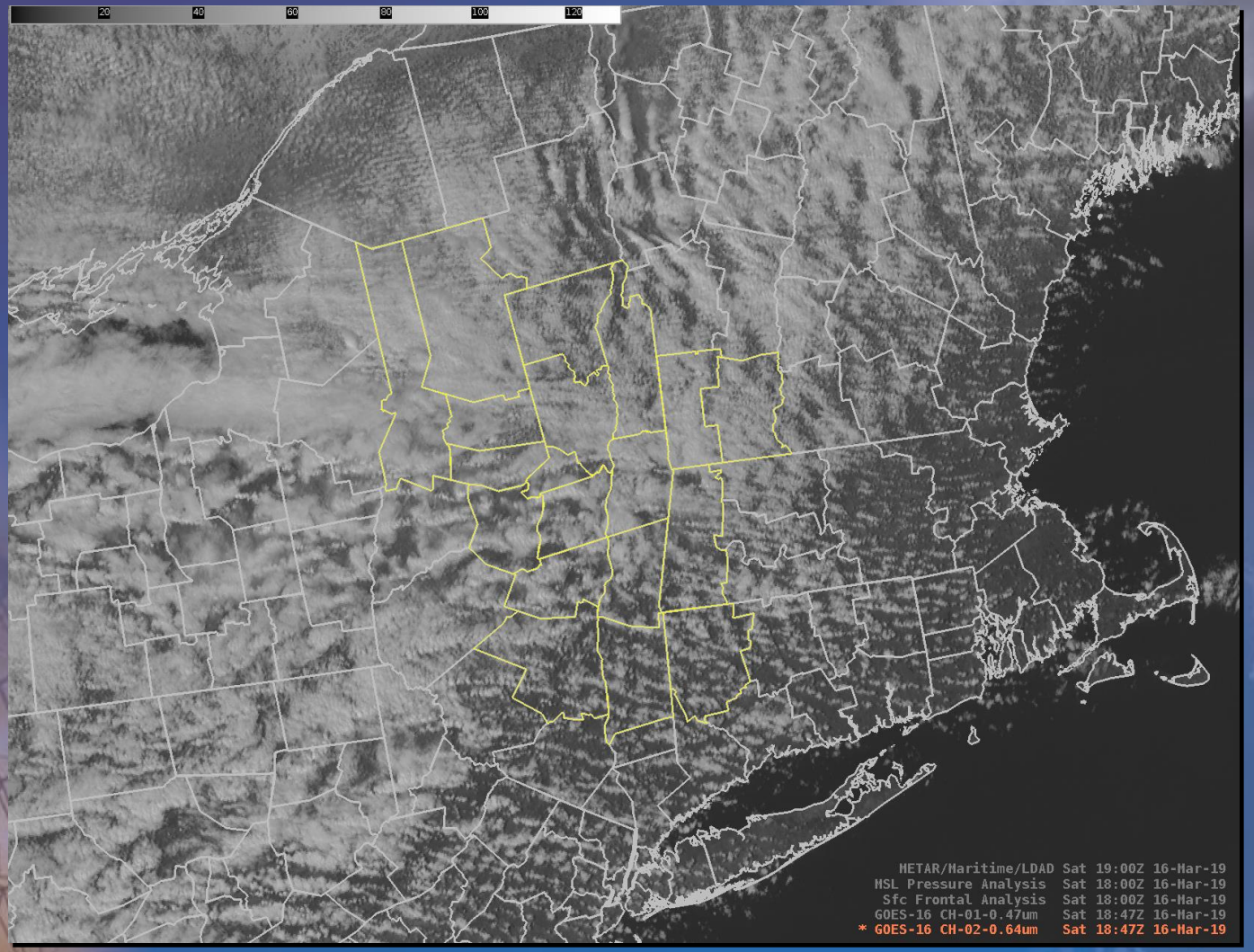
16 ABI Bands


VIS 0.47 um-B1
VIS 0.64 um-B2
NIR 0.86 um-B3
NIR 1.37 um-B4
NIR 1.61 um-B5
NIR 2.24 um-B6
IR 3.89 um-B7
IR 6.17 um-B8
IR 6.93 um-B9
IR 7.34 um-B10
IR 8.44 um-B11
IR 9.61 um-B12
IR 10.33 um-B13
IR 11.2 um-B14
IR 12.3 um-B15
IR 13.3 um-B16
GOES-17:29-JUL-2018 18:02:39UTC - CIMSS
NOAA
NASA

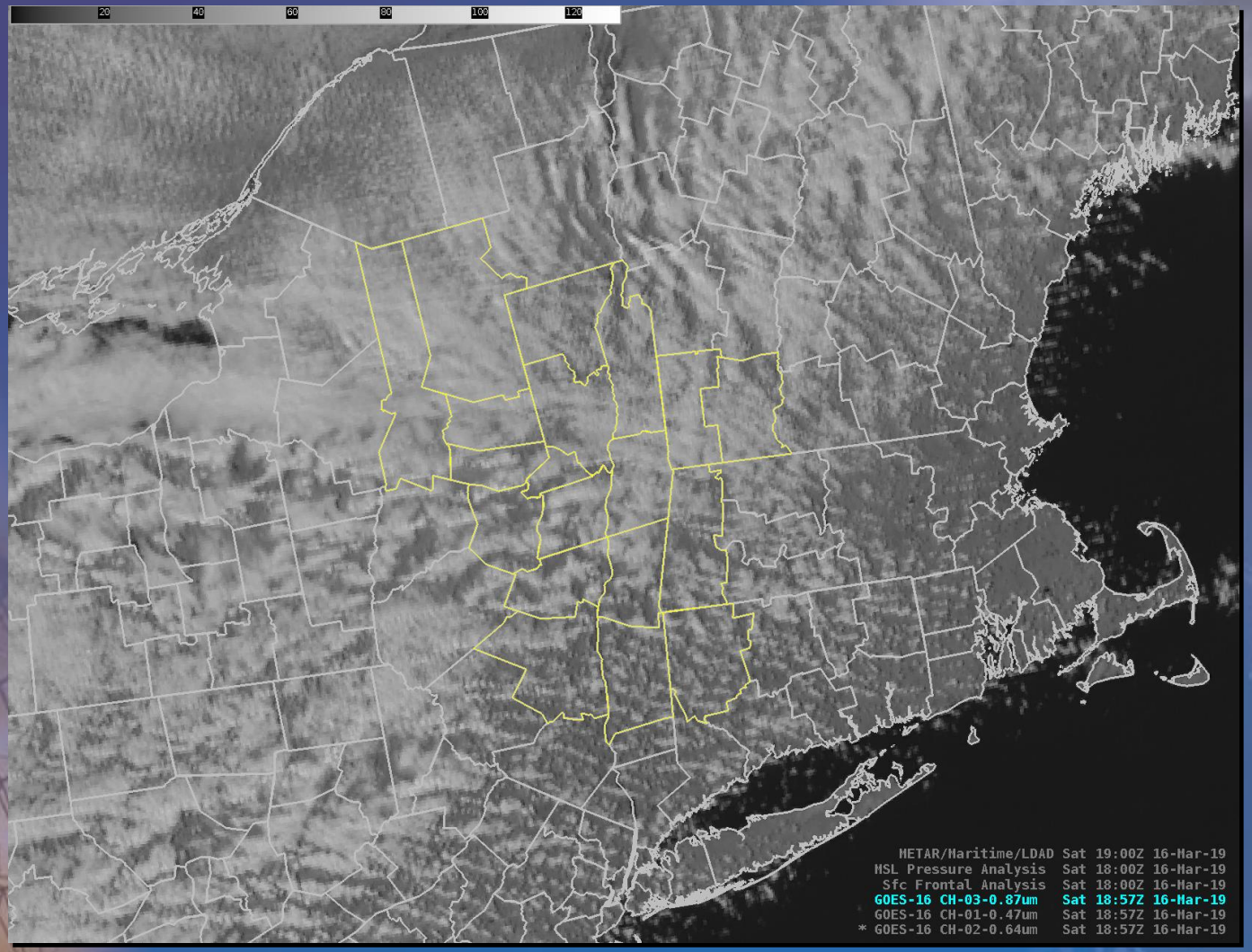
ABI Band 1 (0.47 µm)
Visible "Blue" Band



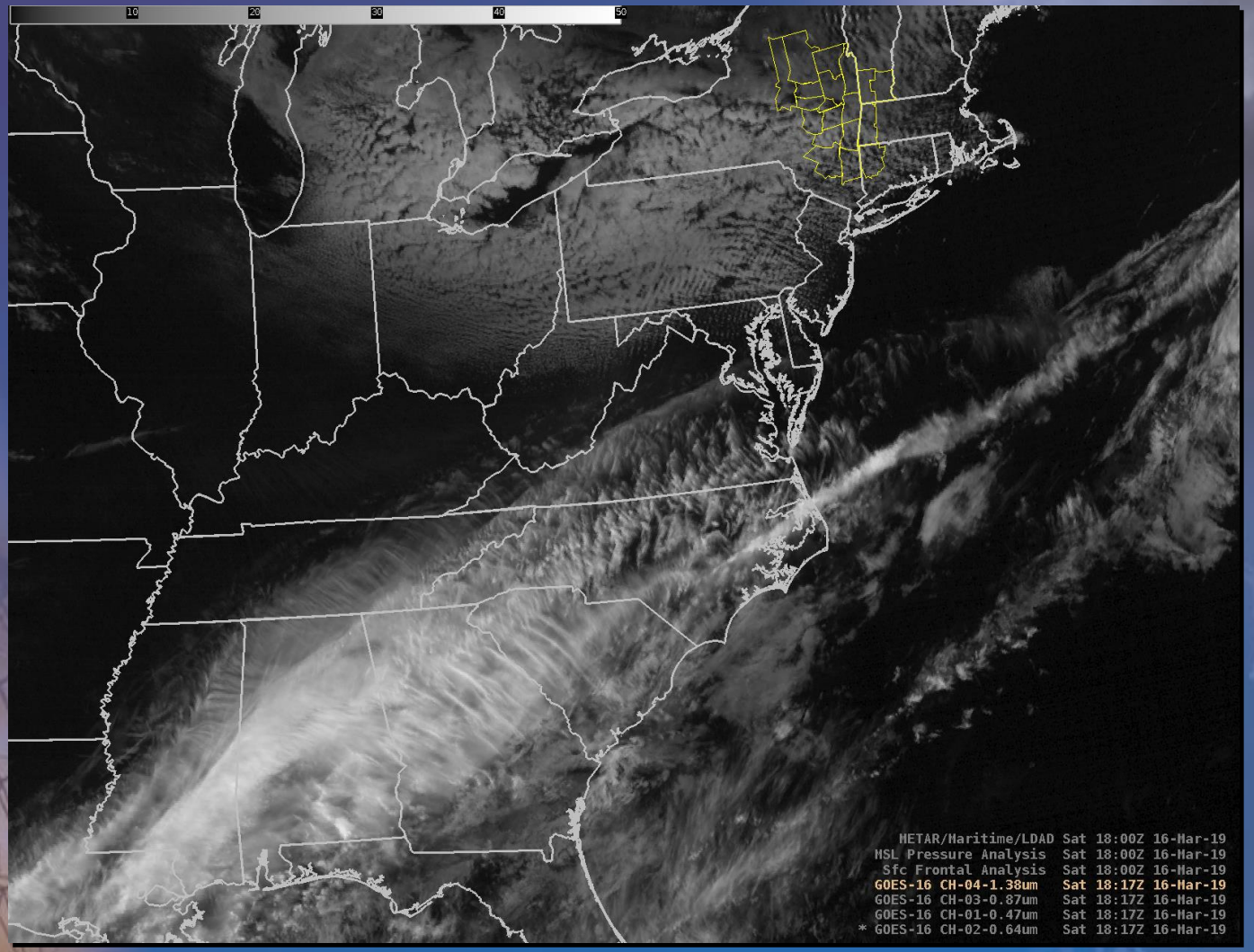
ABI Band 2 (0.64 µm)
Visible "Red" Band



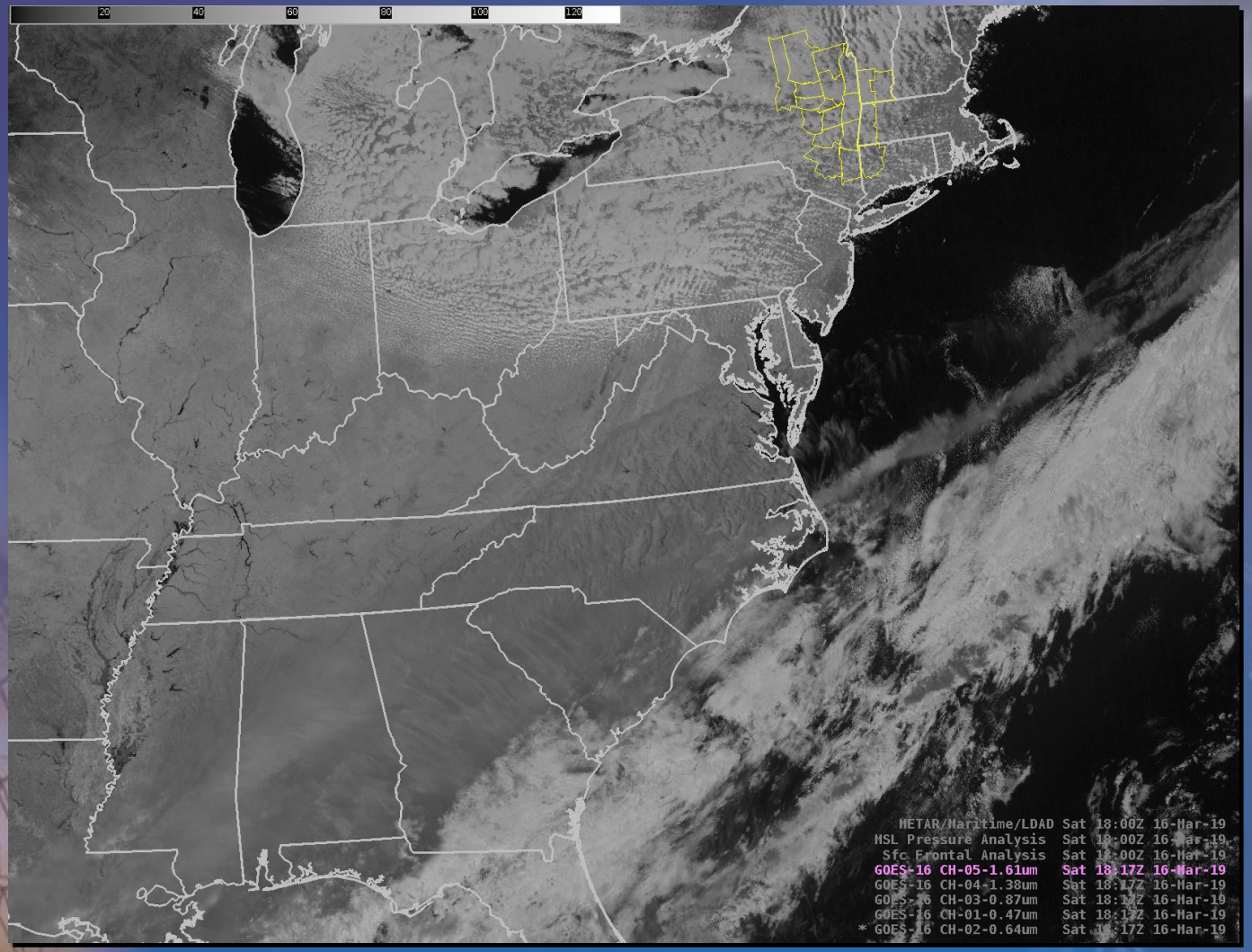
ABI Band 3 (0.86 µm) Near-IR "Veggie" Band



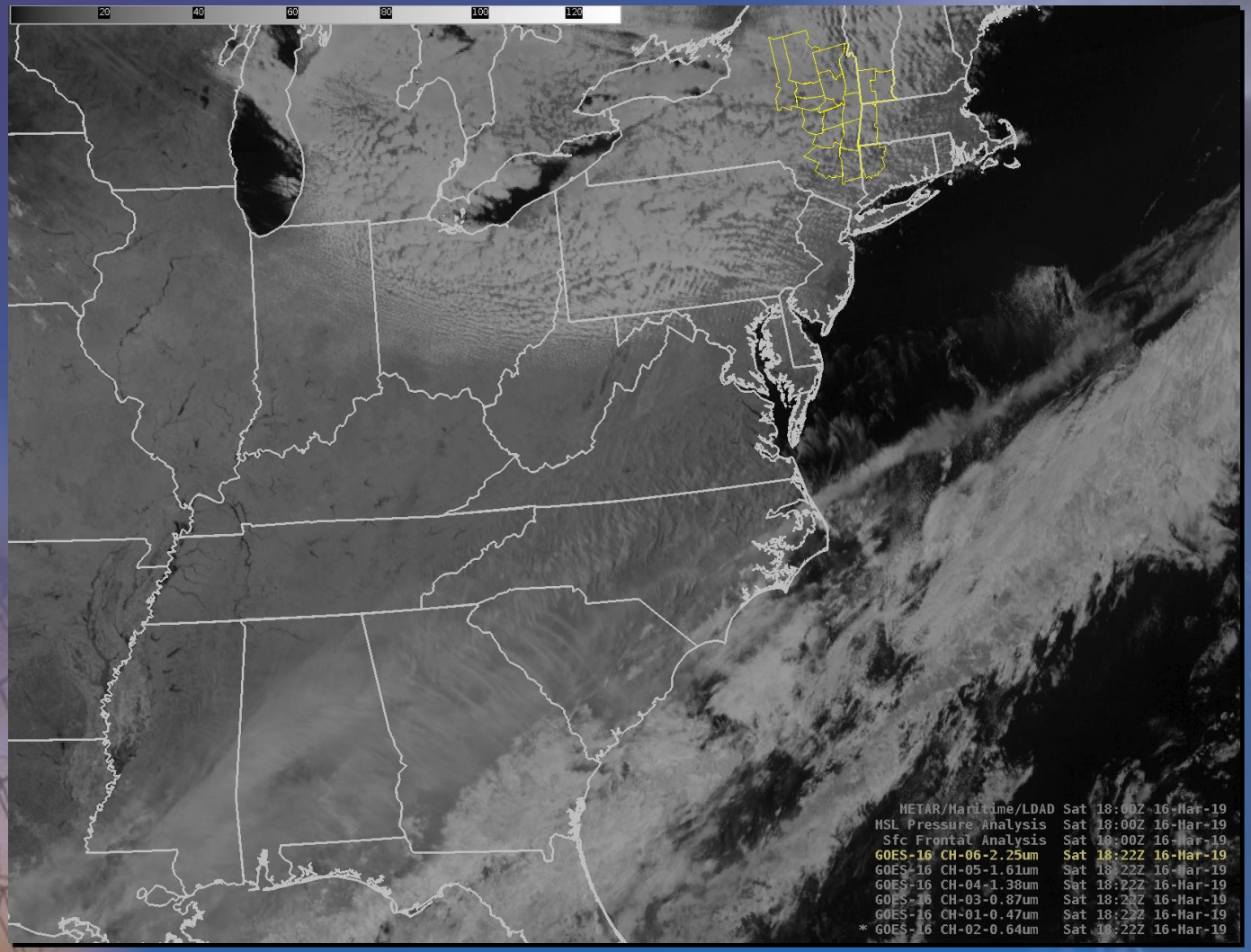
ABI Band 4 (1.37 μm) Near-IR "Cirrus" Band



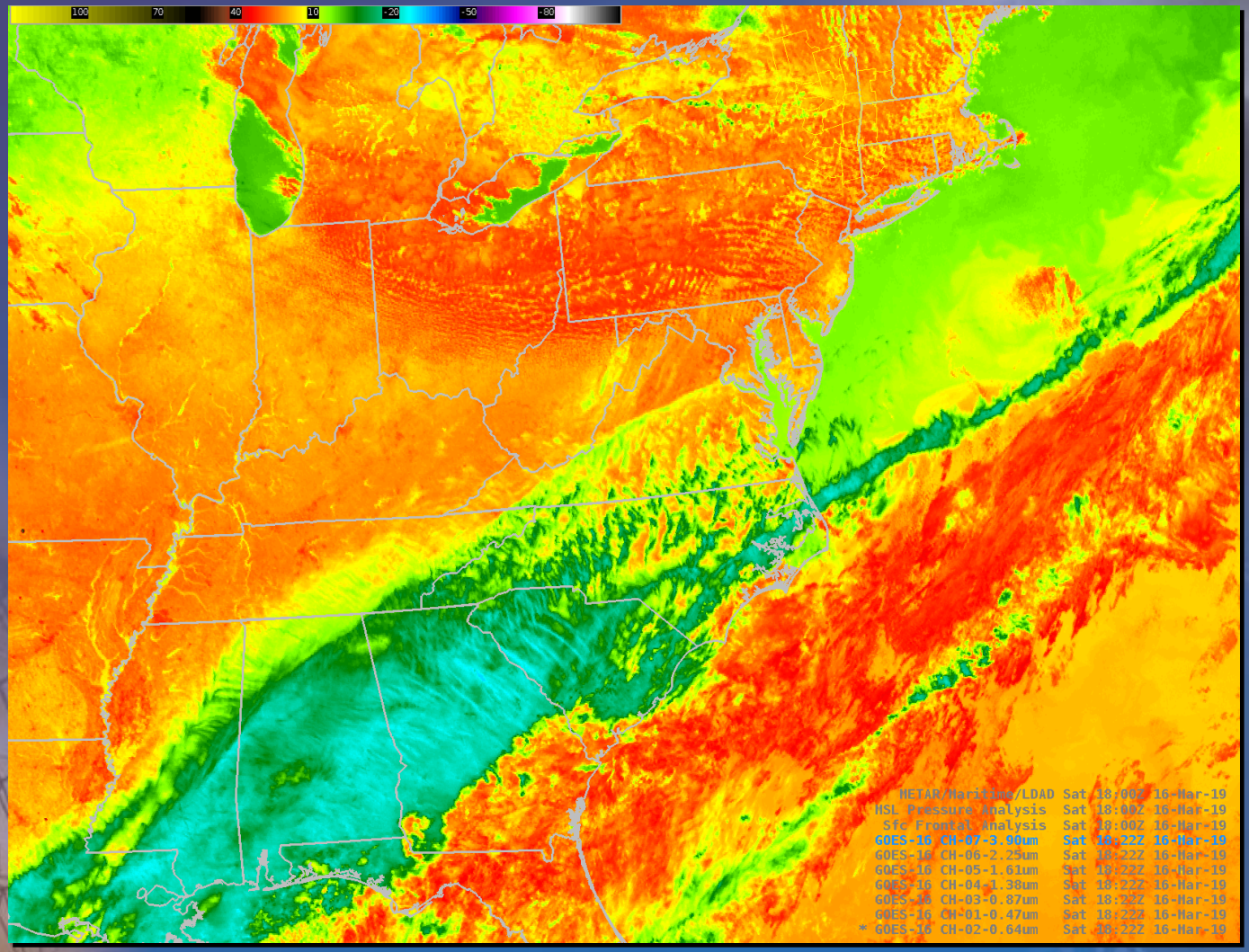
ABI Band 5 (1.6 µm) Near-IR "Snow/Ice" Band



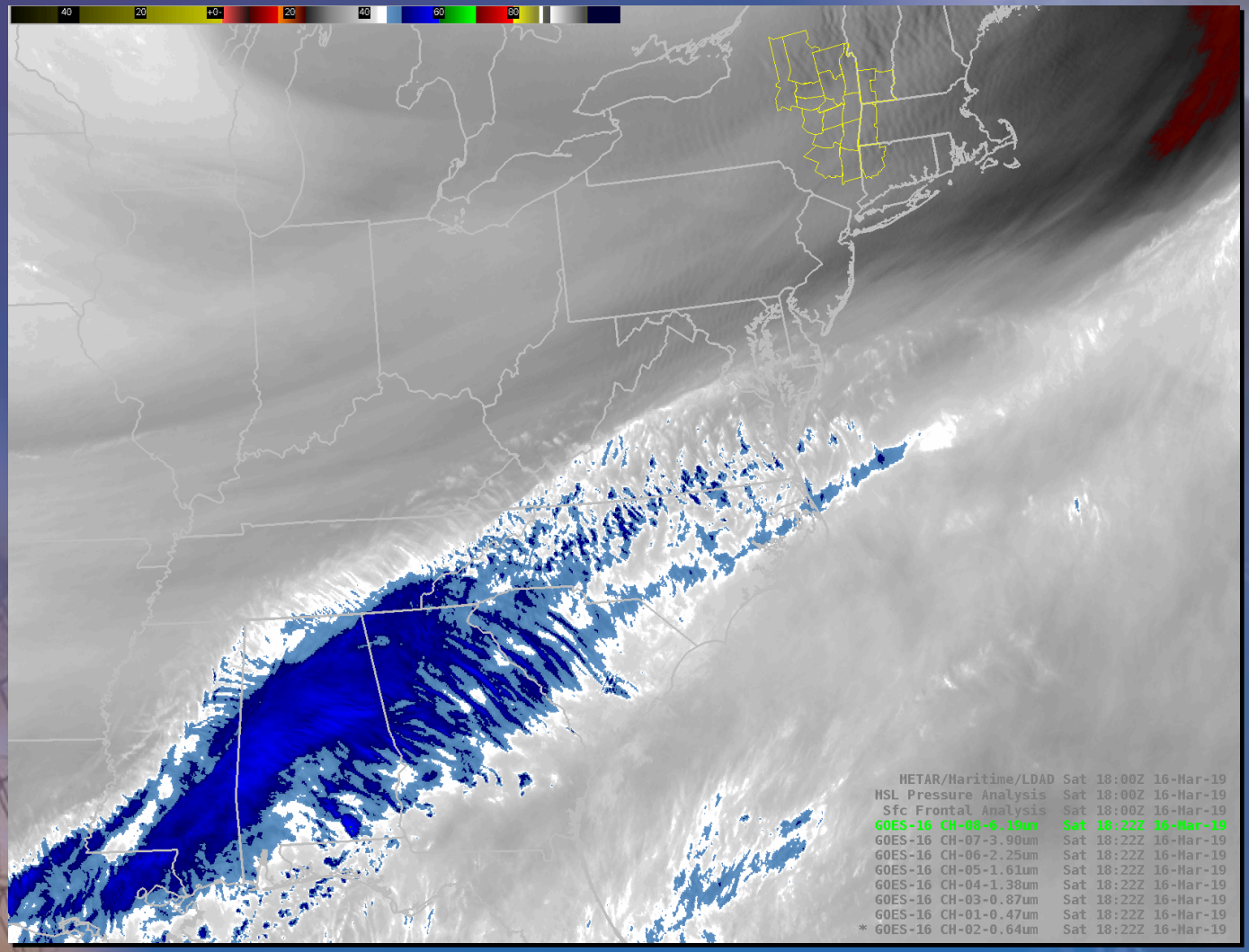
ABI Band 6 (2.24 µm)
Near-IR “Cloud Particle Size” Band



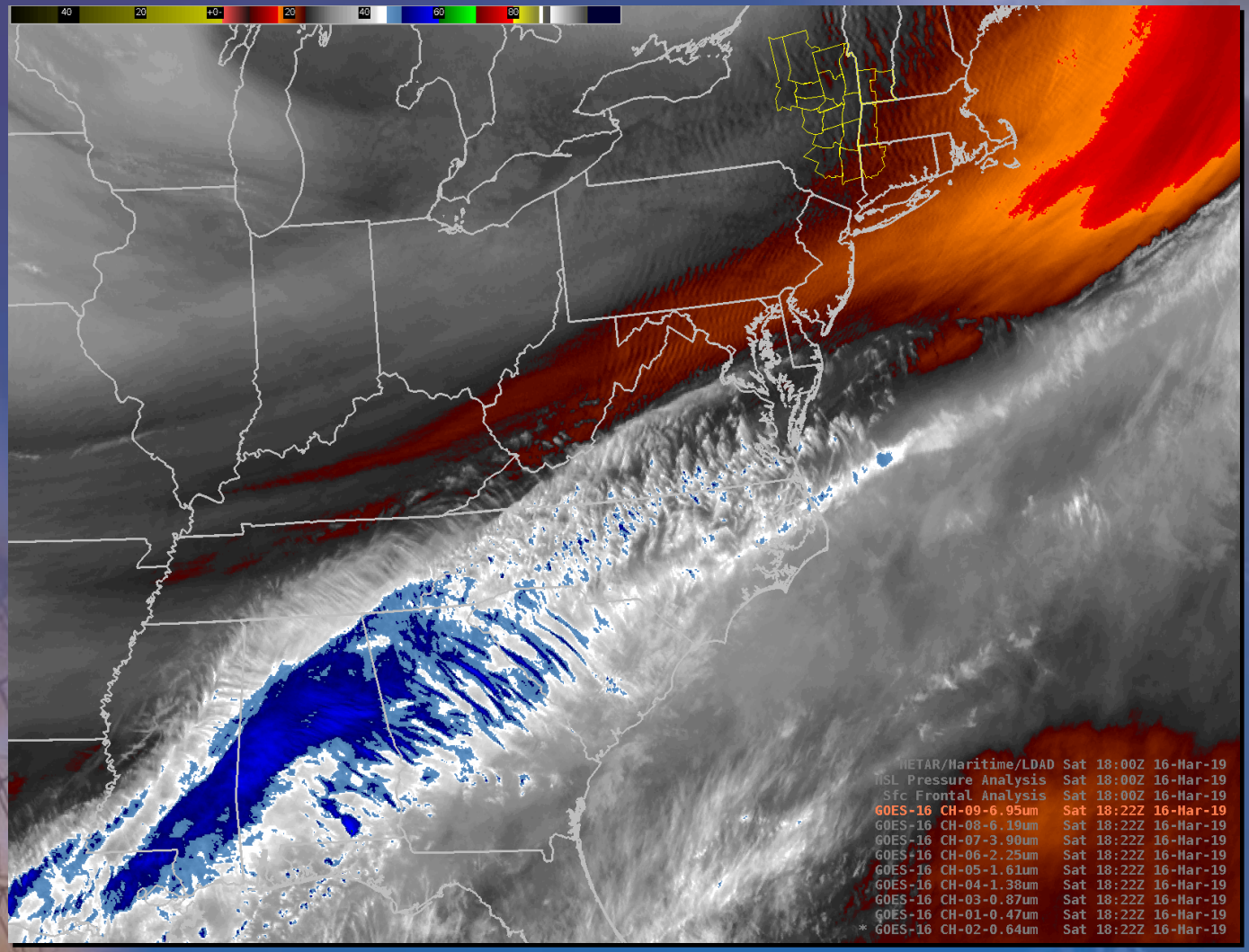
ABI Band 7 (3.9 µm)
IR "Shortwave Window" Band



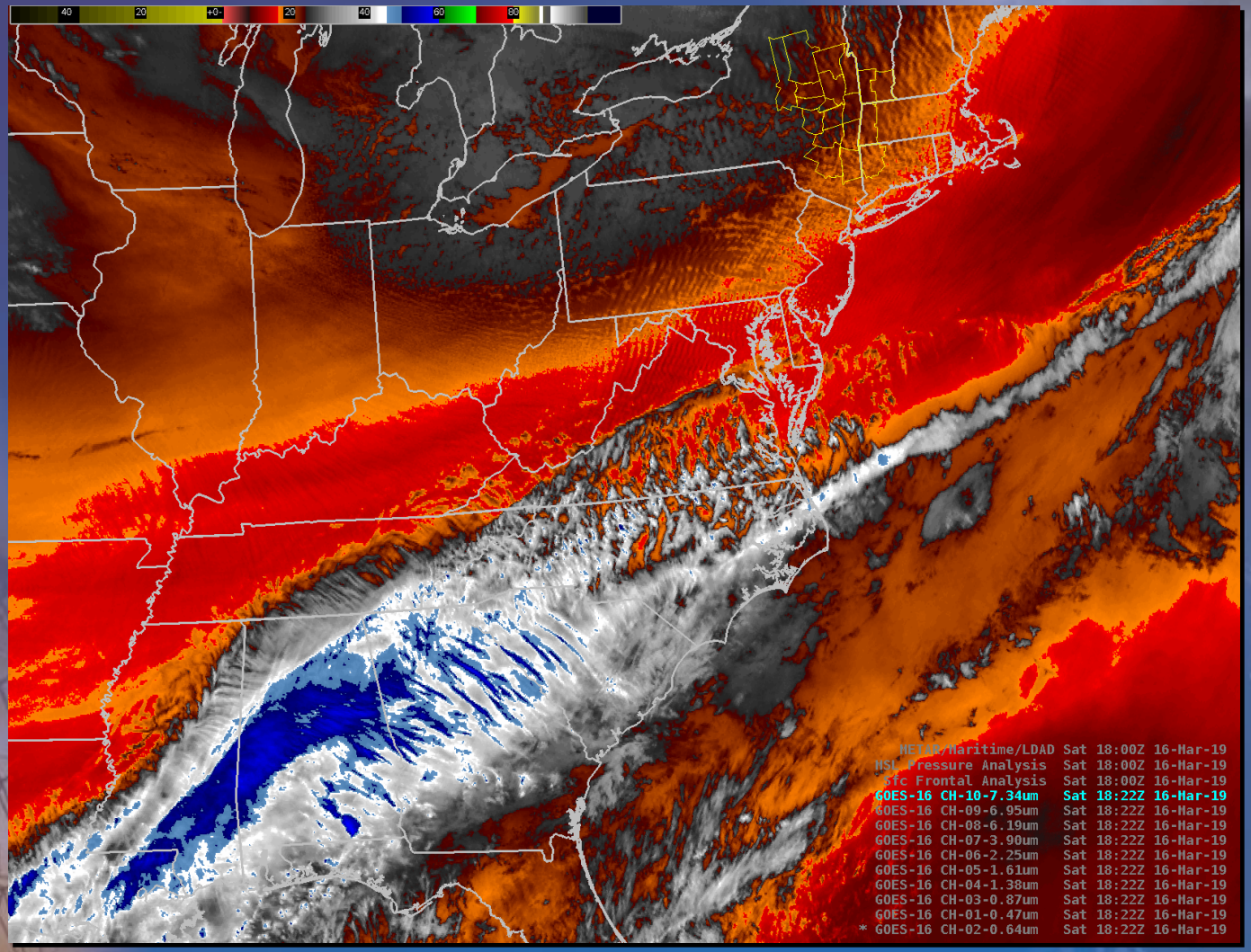
ABI Band 8 (6.2 µm) Upper Level WV



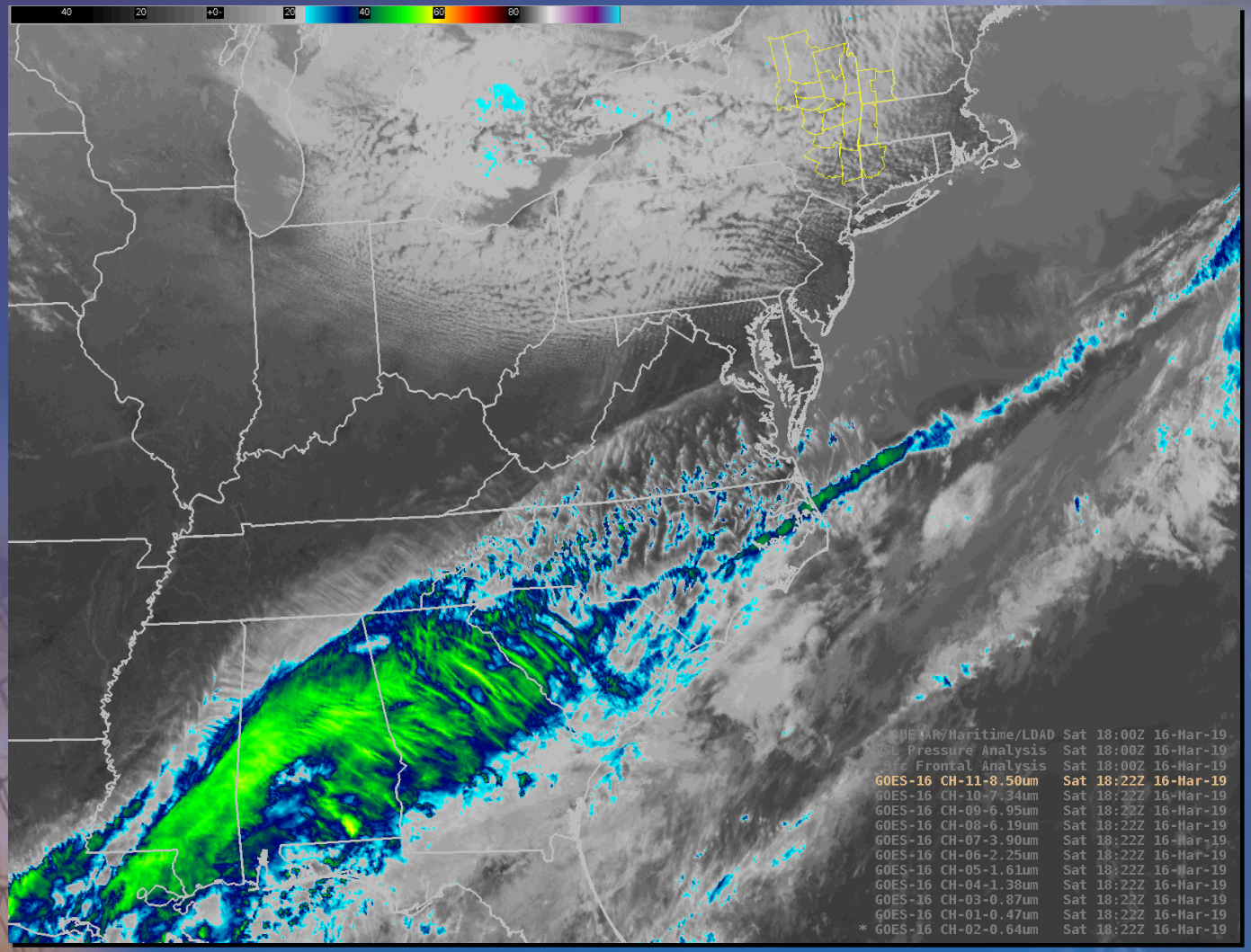
ABI Band 9 (6.9 µm) Mid-Level WV



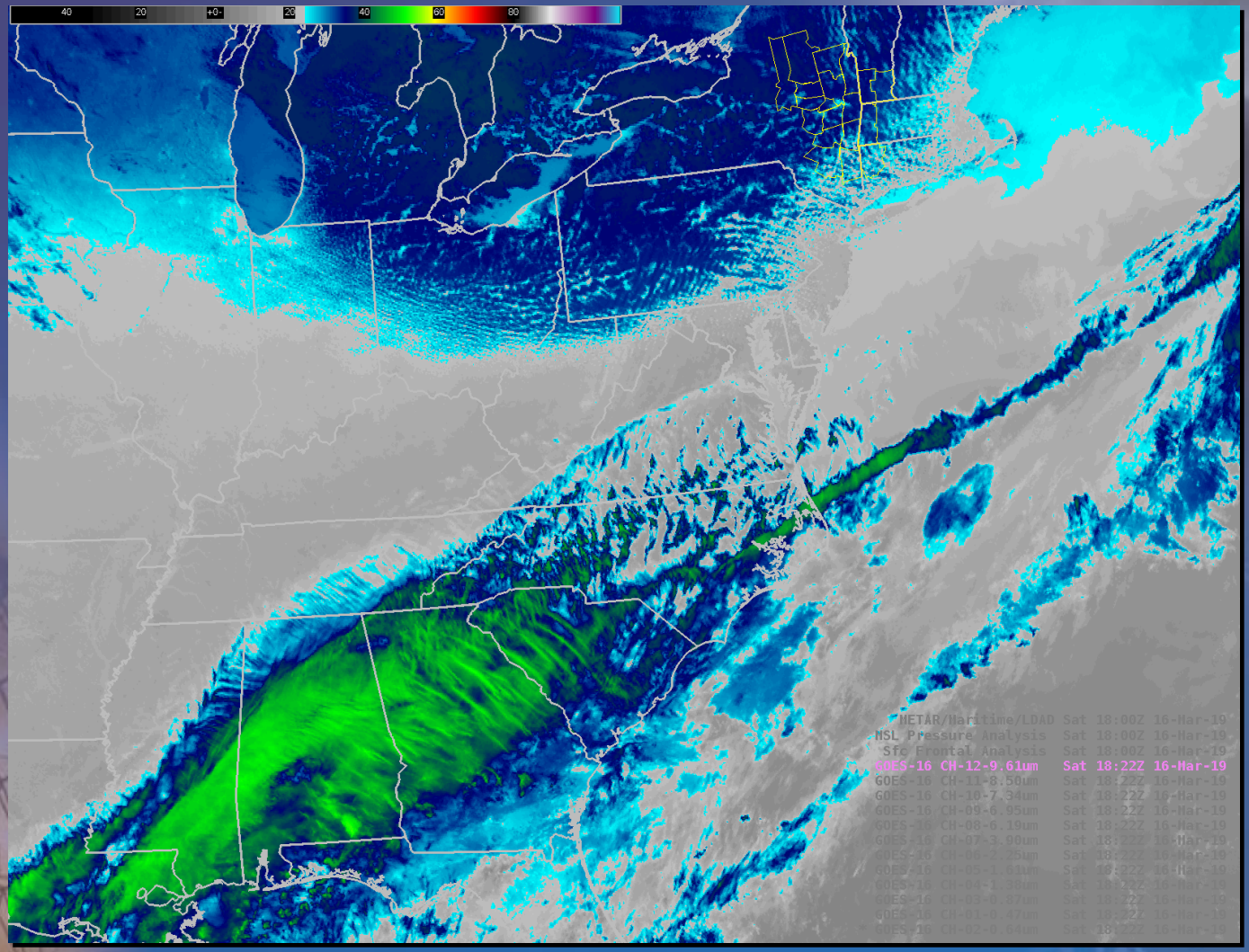
ABI Band 10 (7.3 µm) Low-Level WV



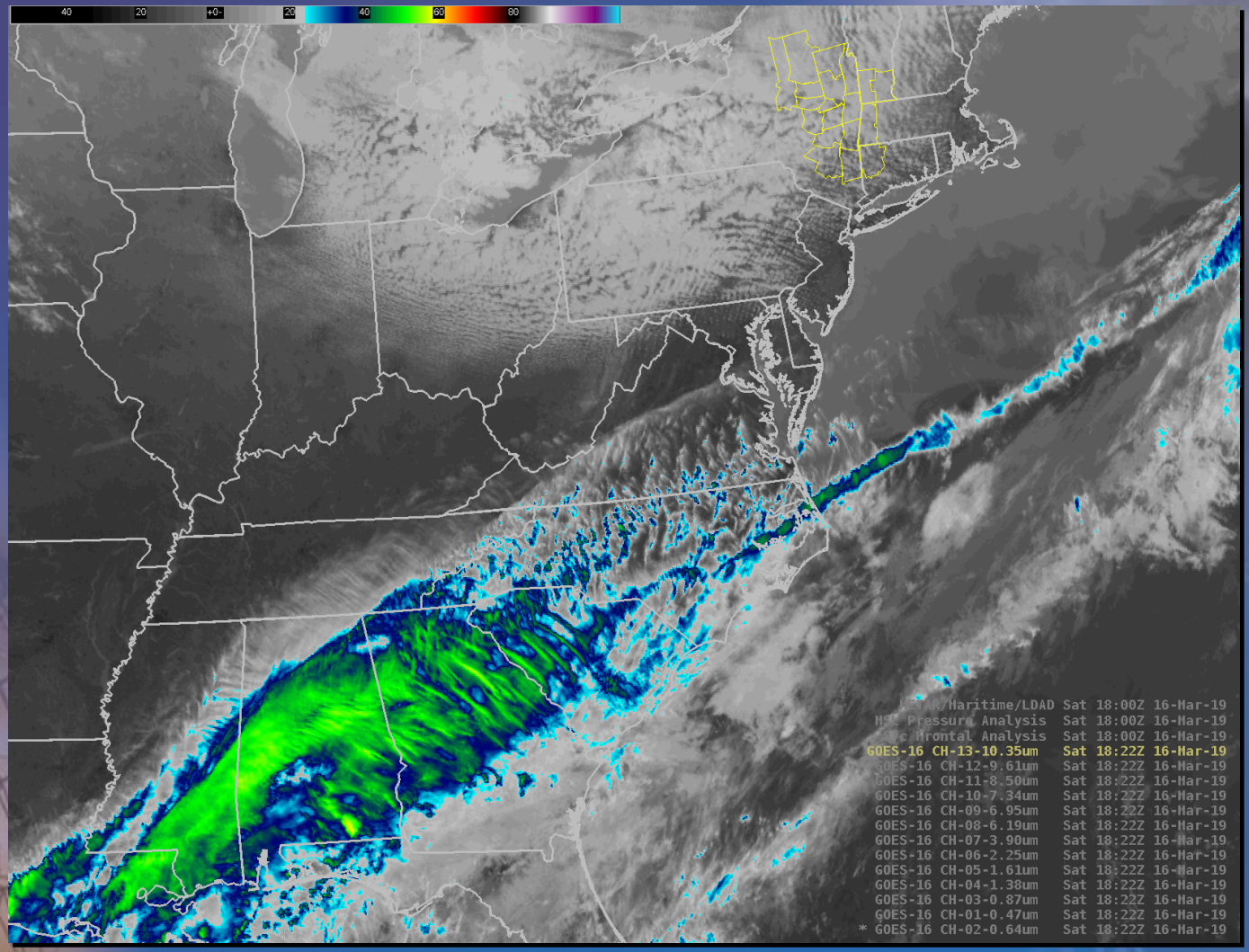
ABI Band 11 (8.4 µm)
IR “Cloud Top Phase” Band



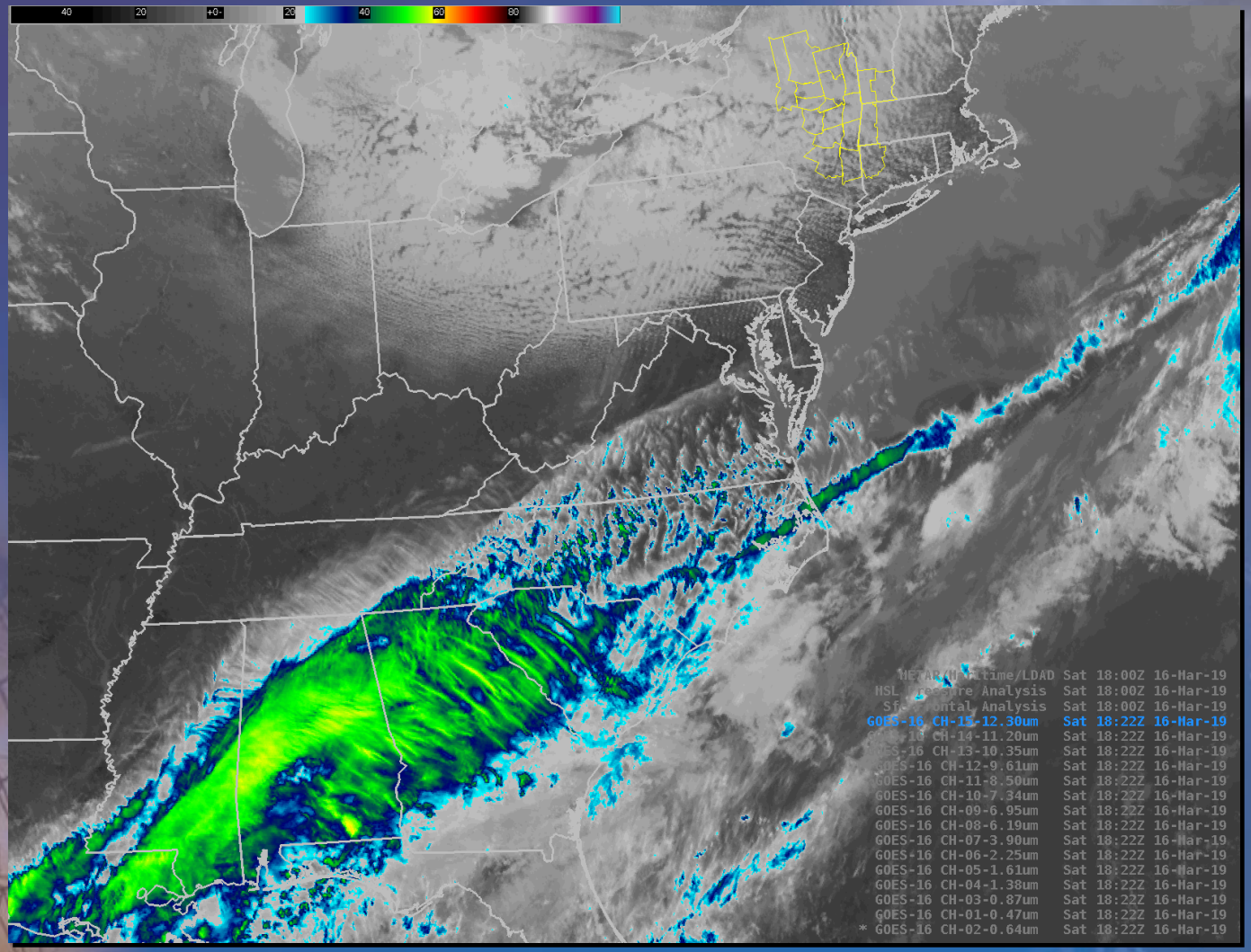
ABI Band 12 (9.6 µm)
IR "Ozone" Band



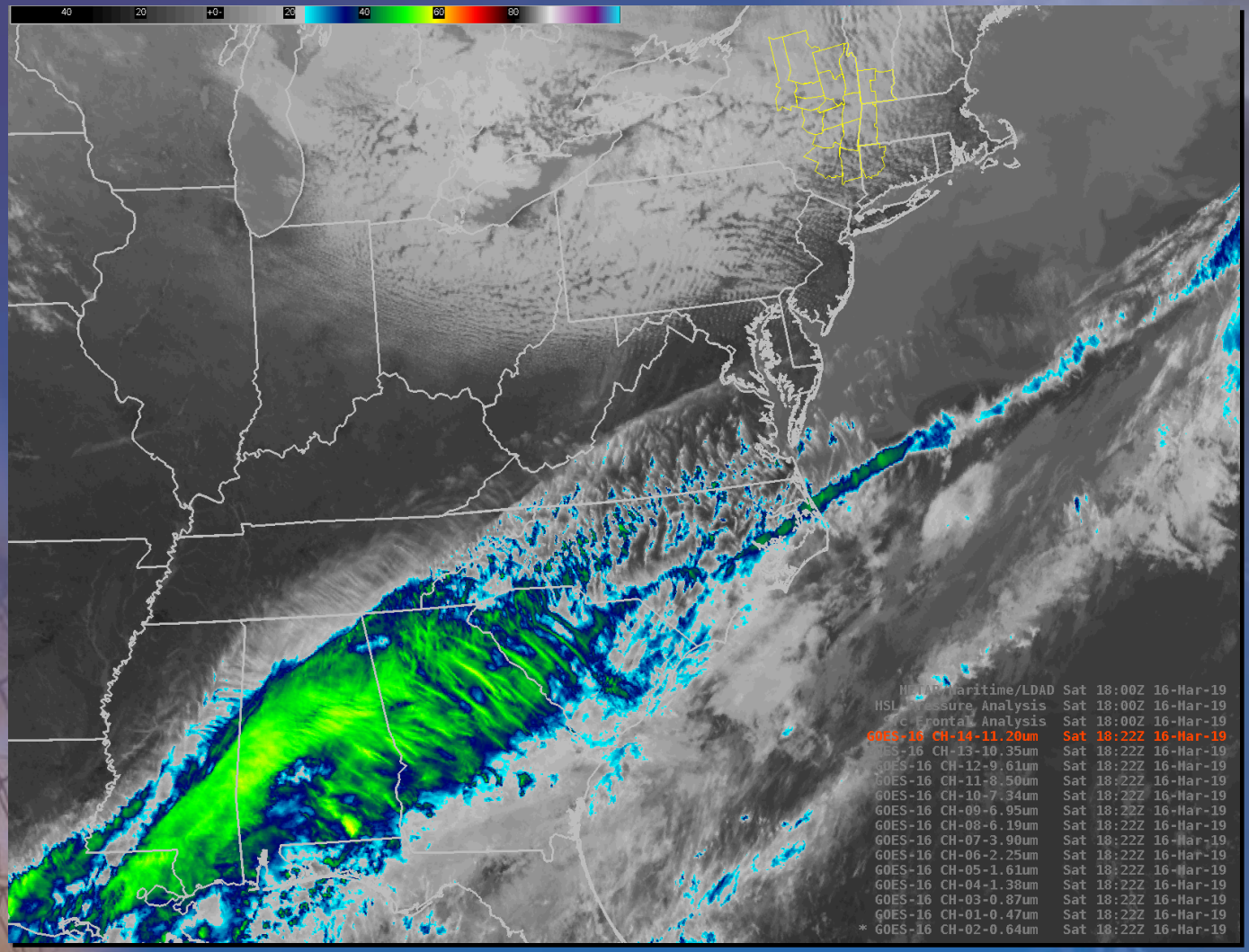
ABI Band 13 (10.3 µm)
IR "Clean IR Longwave" Band



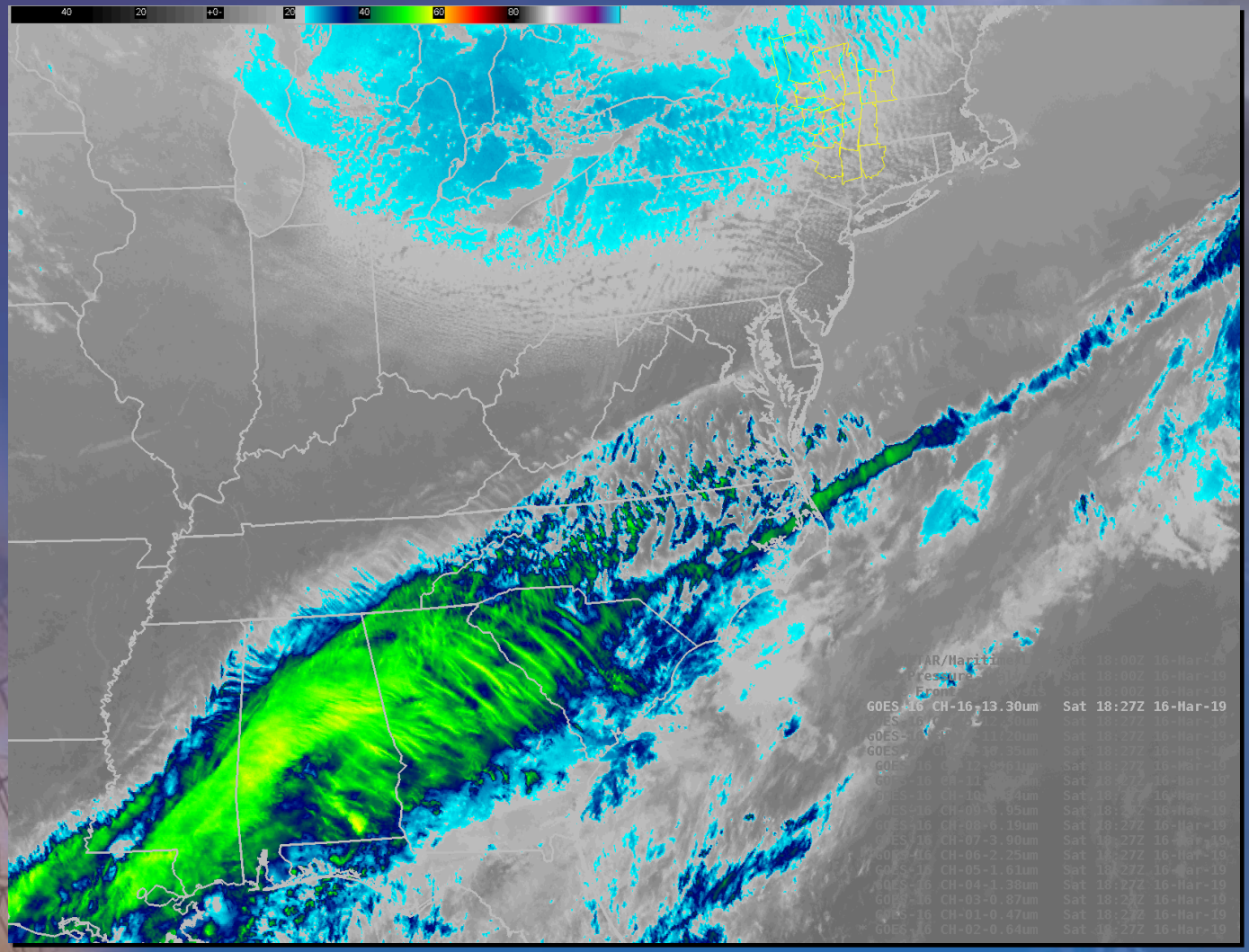
ABI Band 14 (11.2 µm)
IR "Longwave IR" Band



ABI Band 15 (12.3 μm)
IR “Dirty IR Longwave” Band



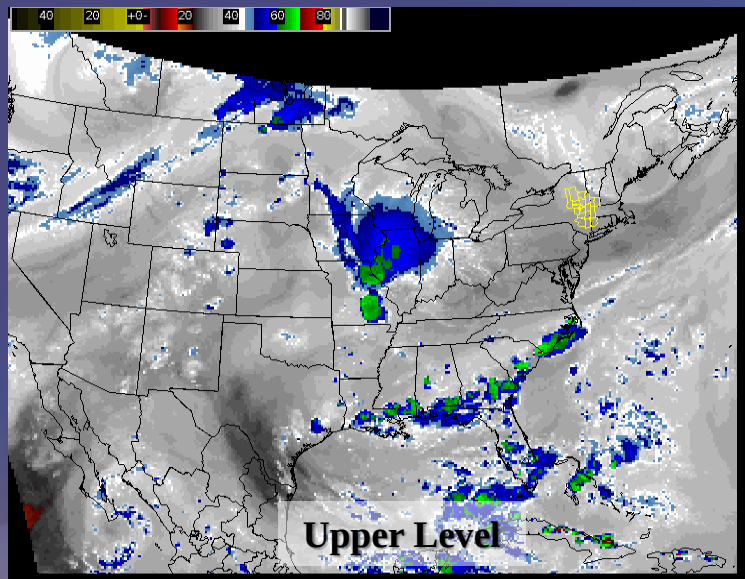
ABI Band 16 (13.3 µm)
IR "CO2 Longwave" Band

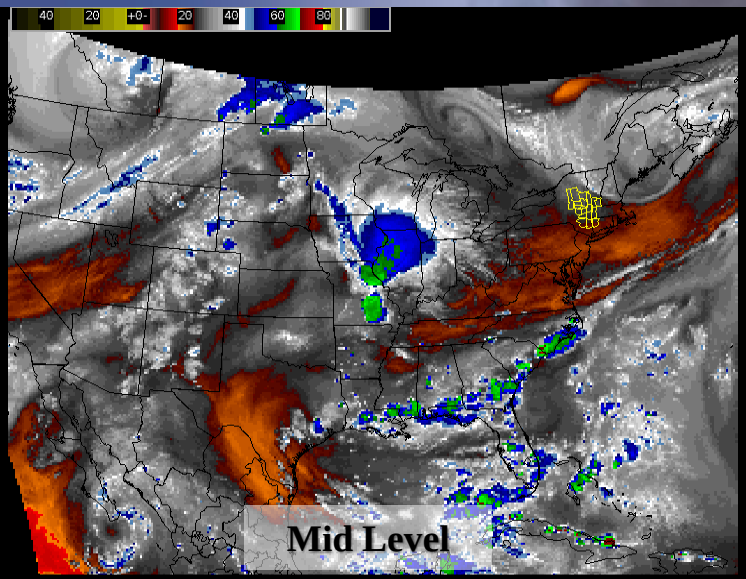


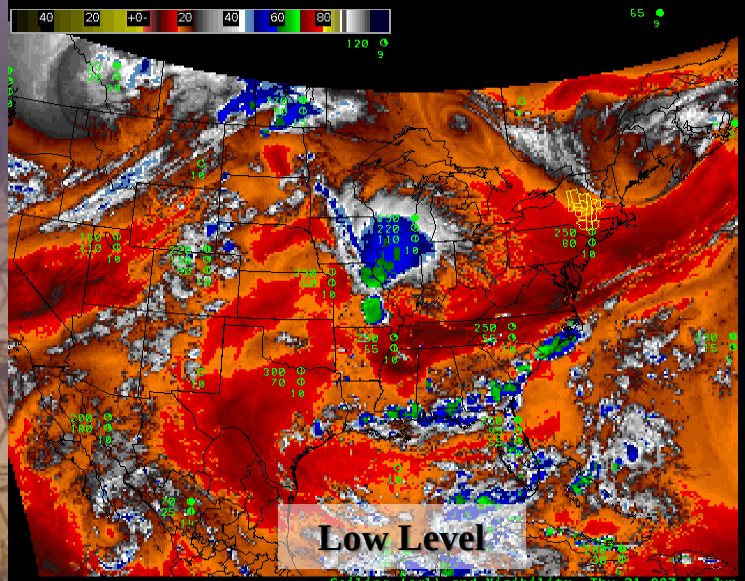
ABI Table and Applications

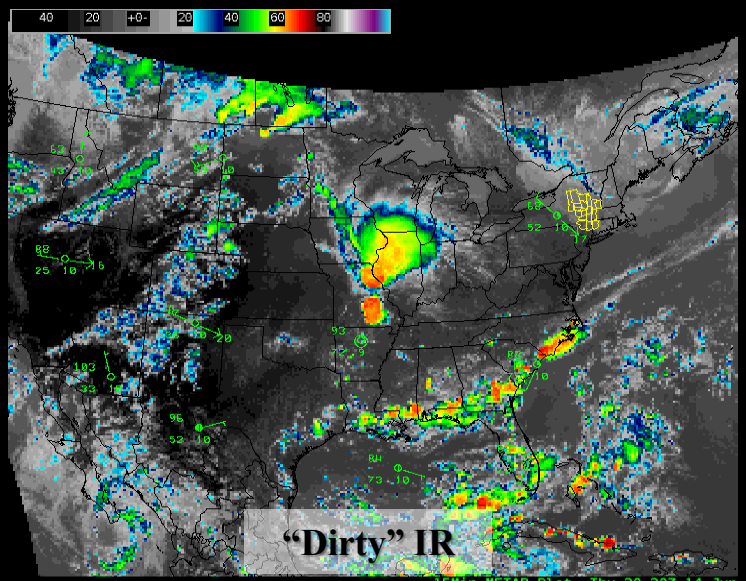
ABI Band	Approximate Central Wavelength	Type	Resolution (km)	Nickname	Short Description of Applications
1	0.47 µm	Visible	1	Blue	Daytime aerosol over land, coastal water mapping
2	0.64 µm	Visible	0.5	Red	Daytime clouds fog, insolation, winds
3	0.86 µm	Near-Infrared	1	Veggie	Daytime vegetation/burn scar and aerosol over water, winds
4	1.37 µm	Near-Infrared	2	Cirrus	Daytime cirrus cloud Not on Himawari
5	1.61 µm	Near-Infrared	1	Snow/Ice	Daytime cloud-top phase and particle size, snow
6	2.24 µm	Near-Infrared	2	Cloud Particle Size	Daytime land/cloud properties, particle size, vegetation, snow
7	3.9 µm	Infrared	2	Shortwave Window	Surface and cloud, fog at night, fire, winds
8	6.2 µm	Infrared	2	Upper-level Water Vapor	High-level atmospheric water vapor, winds, rainfall
9	6.9 µm	Infrared	2	Mid-level Water Vapor	Midlevel atmospheric water vapor, winds, rainfall
10	7.3 µm	Infrared	2	Lower-level Water Vapor	Lower-level water vapor, winds, and SO2
11	8.4 µm	Infrared	2	Cloud-Top Phase	Total water for stability, cloud phase, dust, SO2 rainfall
12	9.6 µm	Infrared	2	Ozone	Total ozone, turbulence, and winds
13	10.3 µm	Infrared	2	"Clean" Longwave Window	Surface and cloud
14	11.2 µm	Infrared	2	Longwave Window	Imagery, SST, clouds, rainfall
15	12.3 µm	Infrared	2	"Dirty" Longwave Window	Total water, ash, and SST
16	13.3 µm	Infrared	2	CO_2 Longwave	Air temperature, cloud heights and amounts

Layered WV & IR



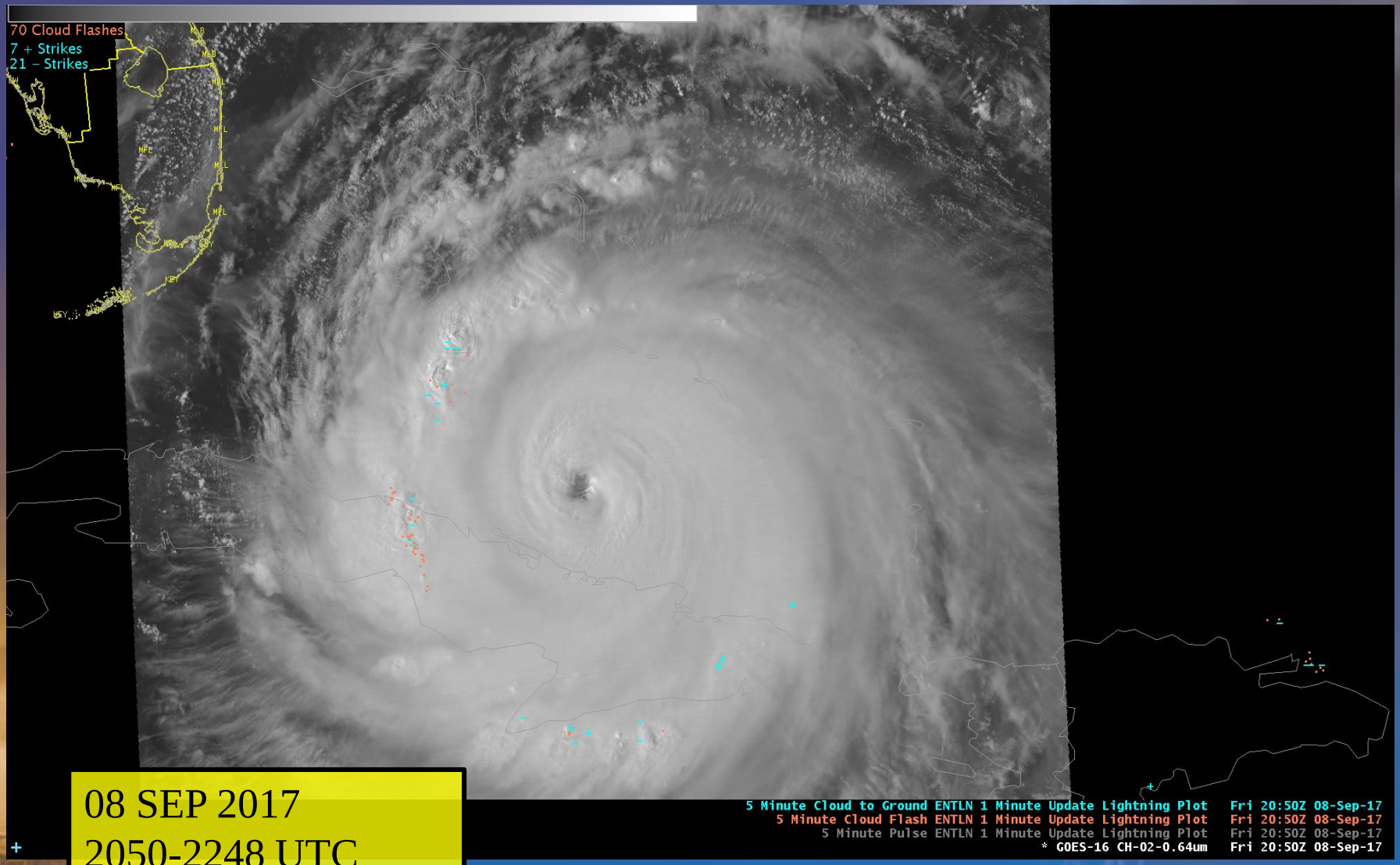






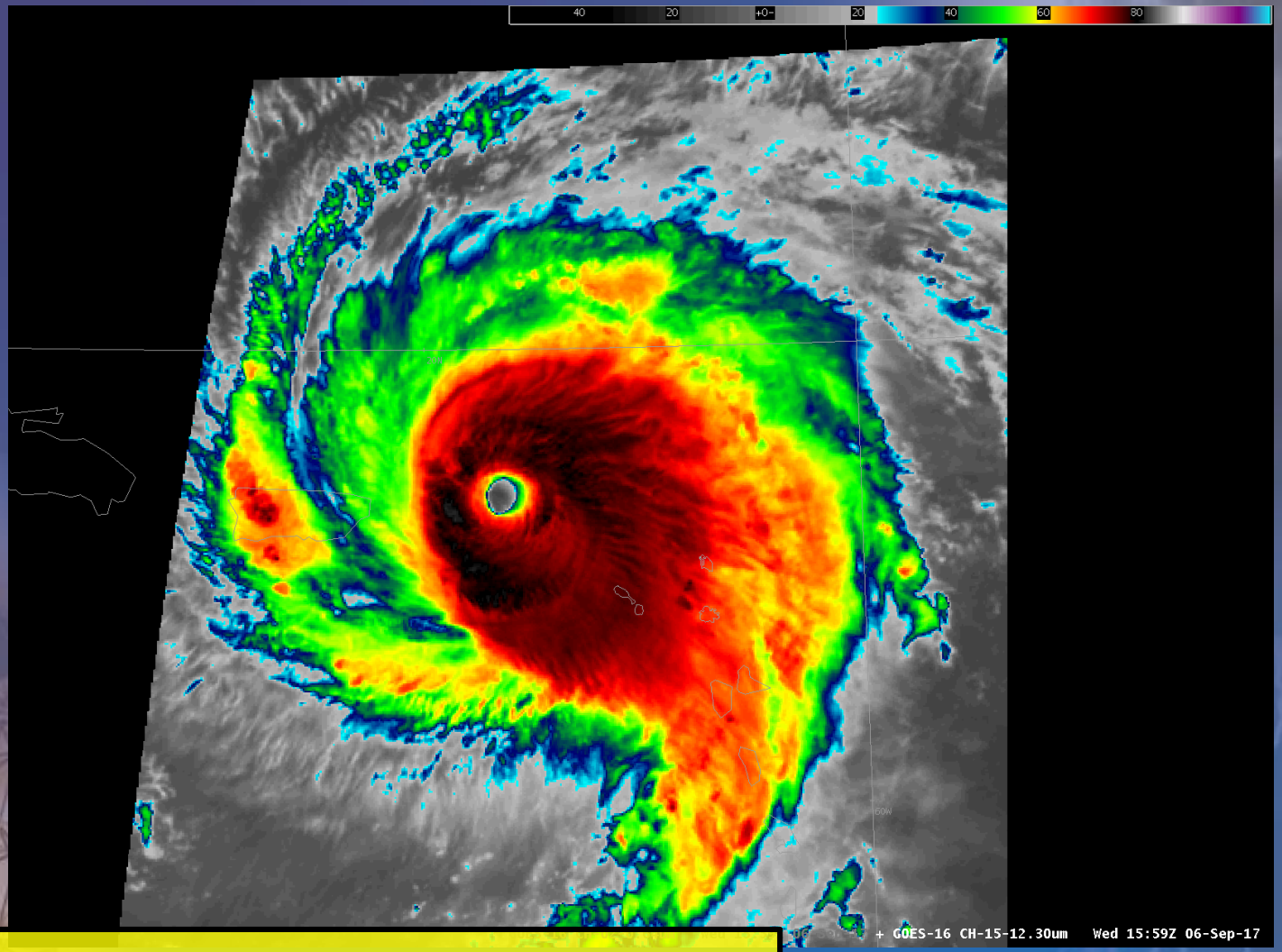
And now for some awesome examples…

1-minute Visible Imagery
Hurricane Irma with ENTLN Lightning

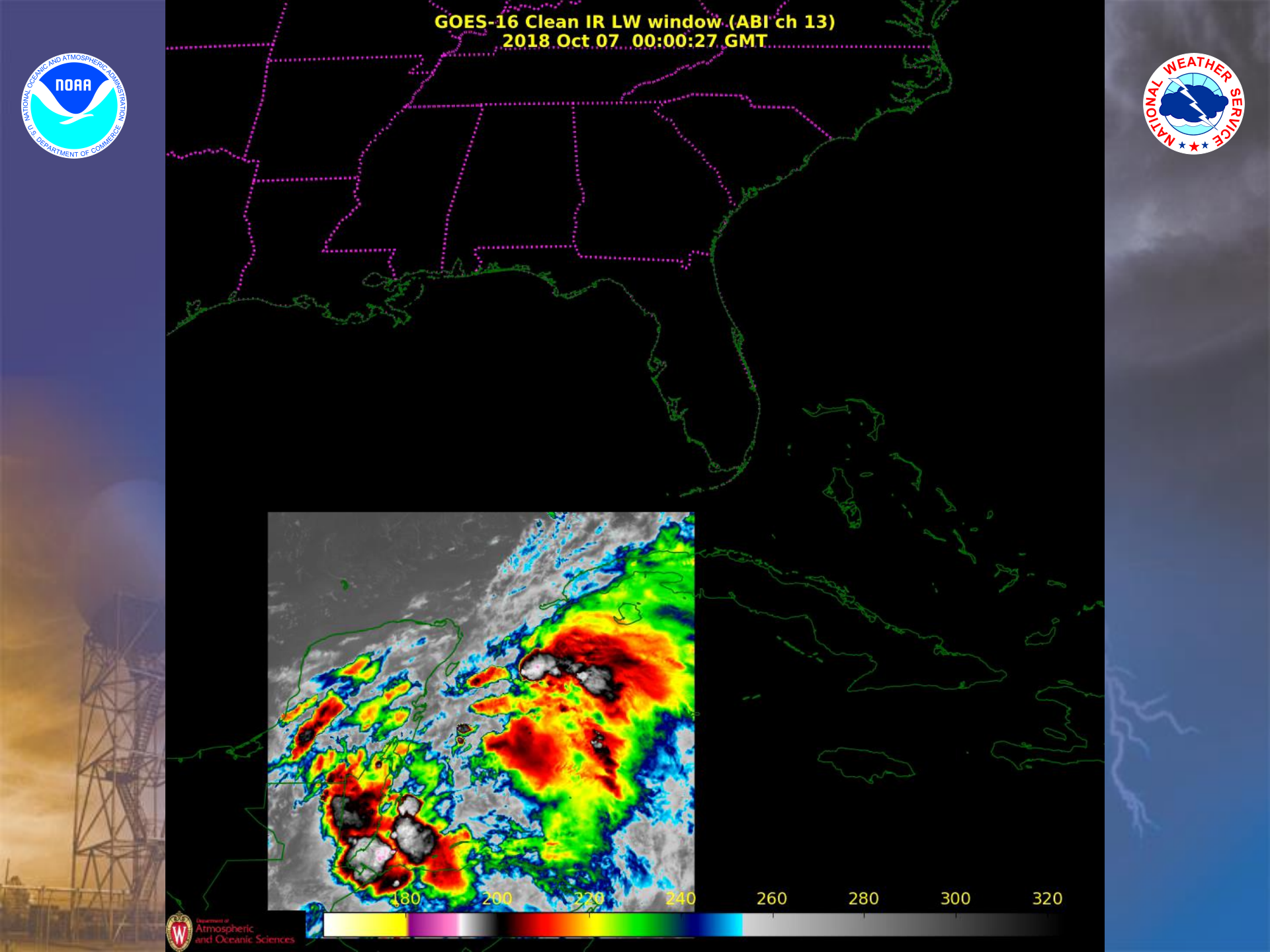


08 SEP 2017
2050-2248 UTC

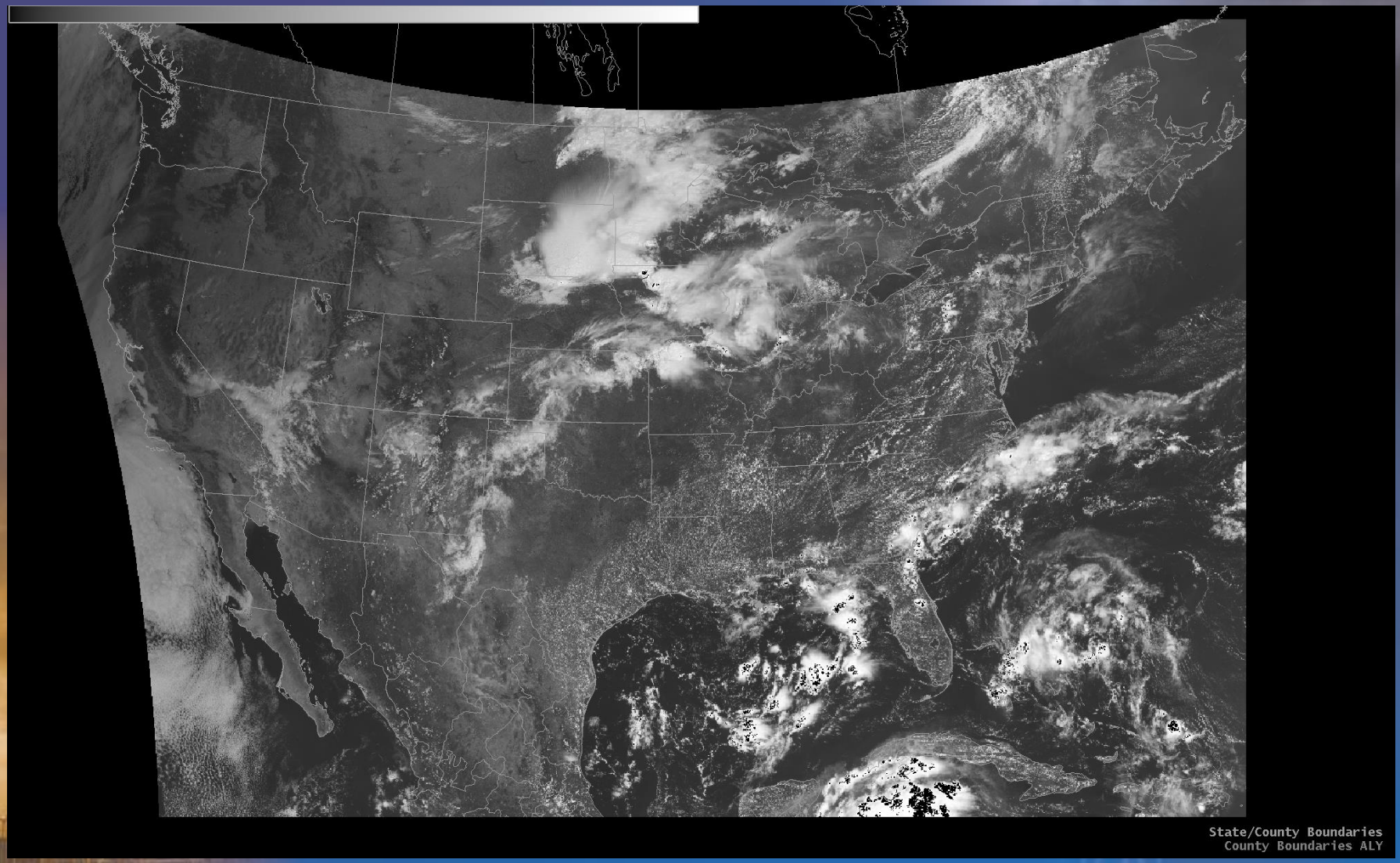
“Dirty” Longwave IR (Band 15, 12.3 μm)



1559-1739 UTC 6 SEP 2017 Hurricane Irma

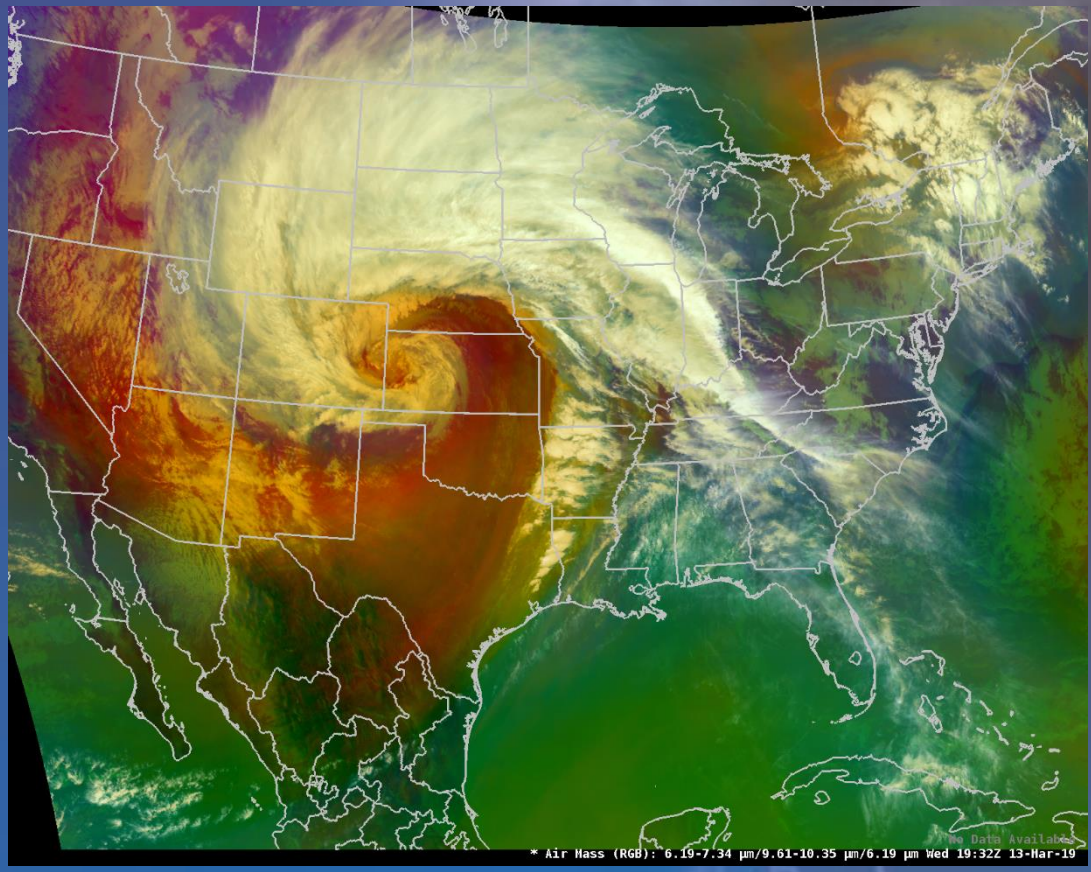

GOES-16 Clean IR LW window (ABI ch 13)
2018 Oct 07 00:00:27 GMT
180
200
220
240
260
280
300
320
Department of Atmospheric and Oceanic Sciences

21 August 2017 Solar Eclipse

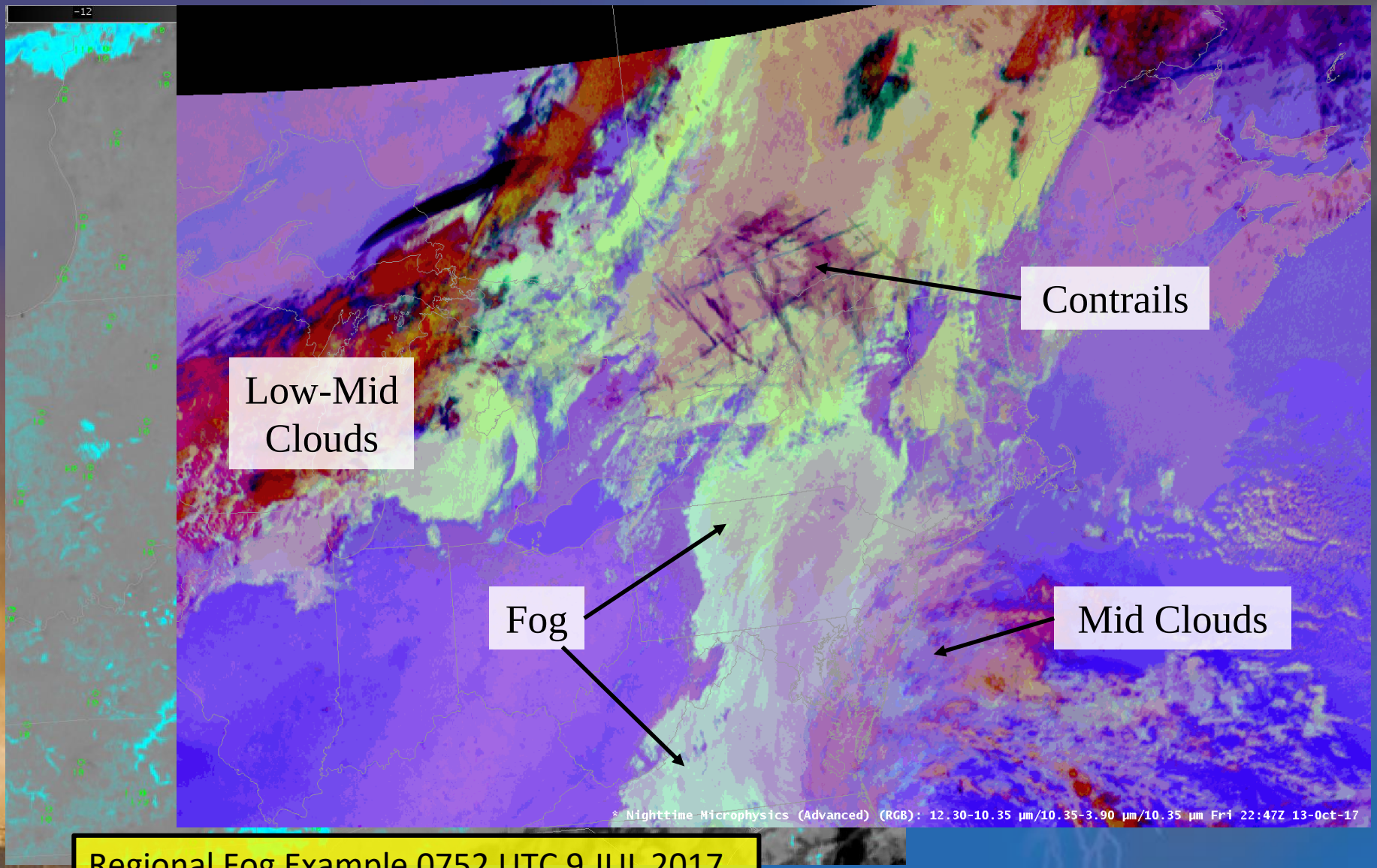


Applications

- ✓ Fog Detection
- ✓ Fire Detection
- ✓ Differentiate Between Cloud Types and Snow/Ice on Ground
- ✓ Stability
- ✓ Rapid Cyclogenesis

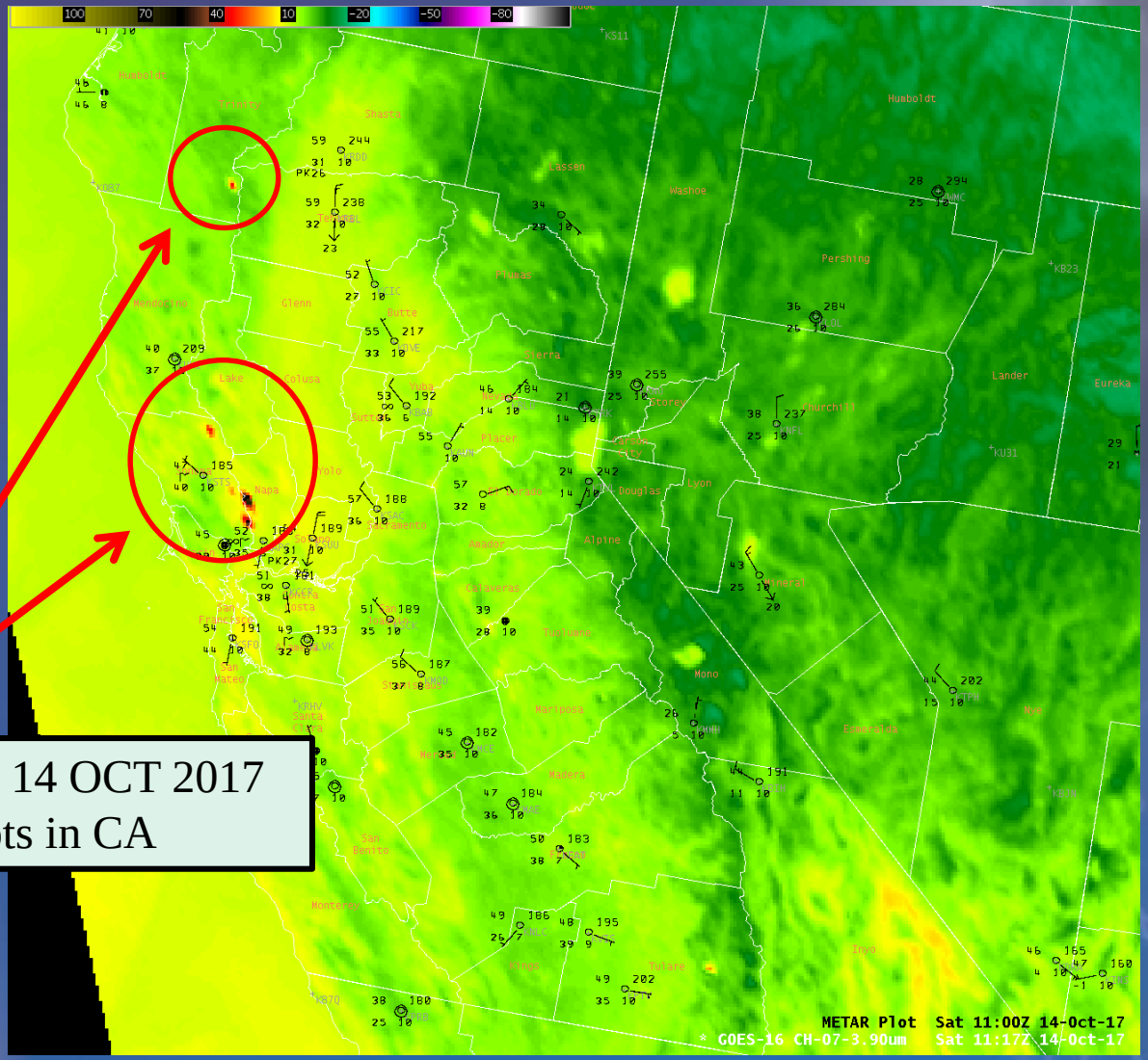


Fog Detection



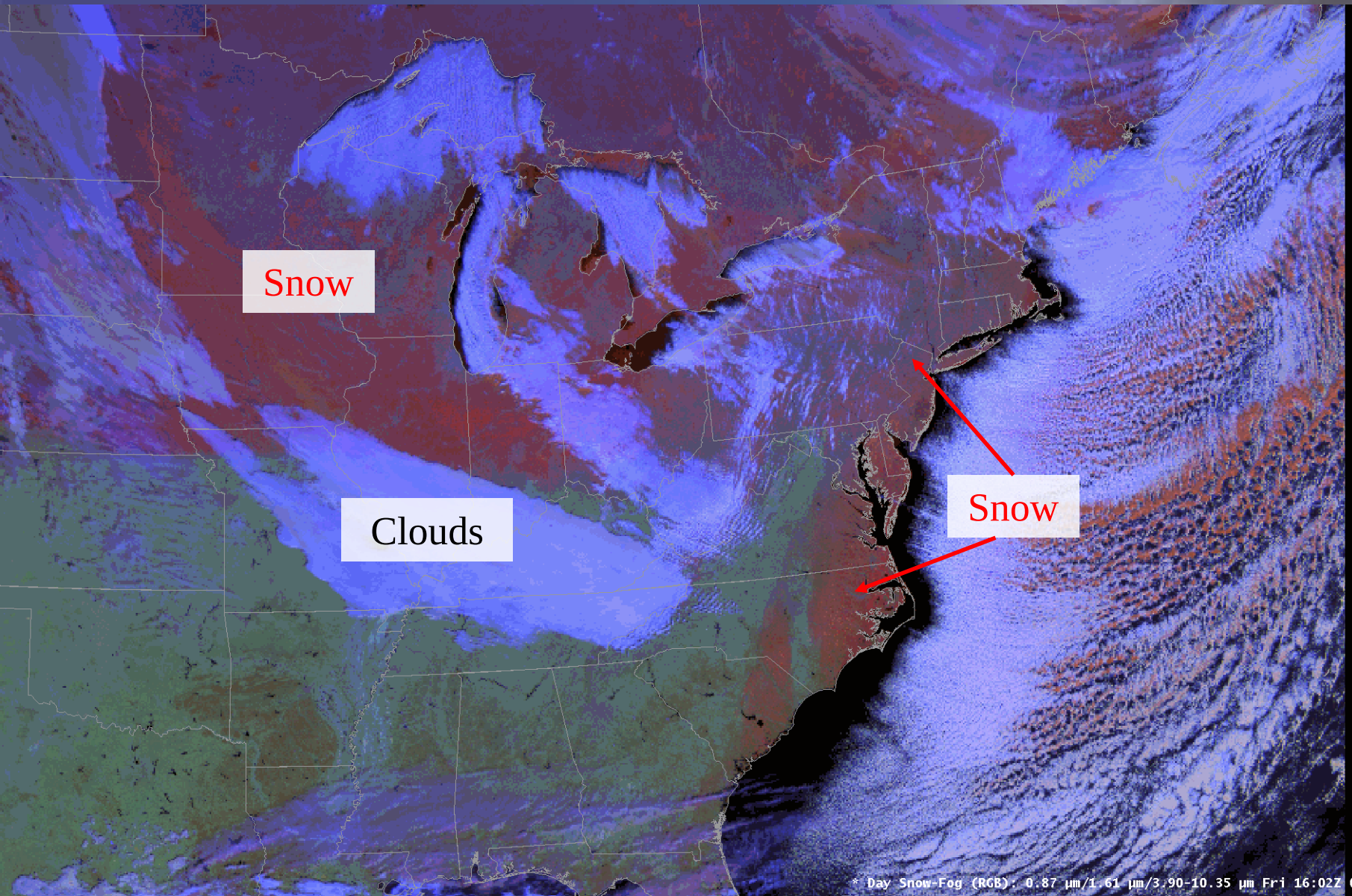
Regional Fog Example 0752 UTC 9 JUL 2017

Fire Detection (SW IR, Band 7)



1117-1217 UTC 14 OCT 2017
with fire hot spots in CA

Differentiate Between Clouds and Snow



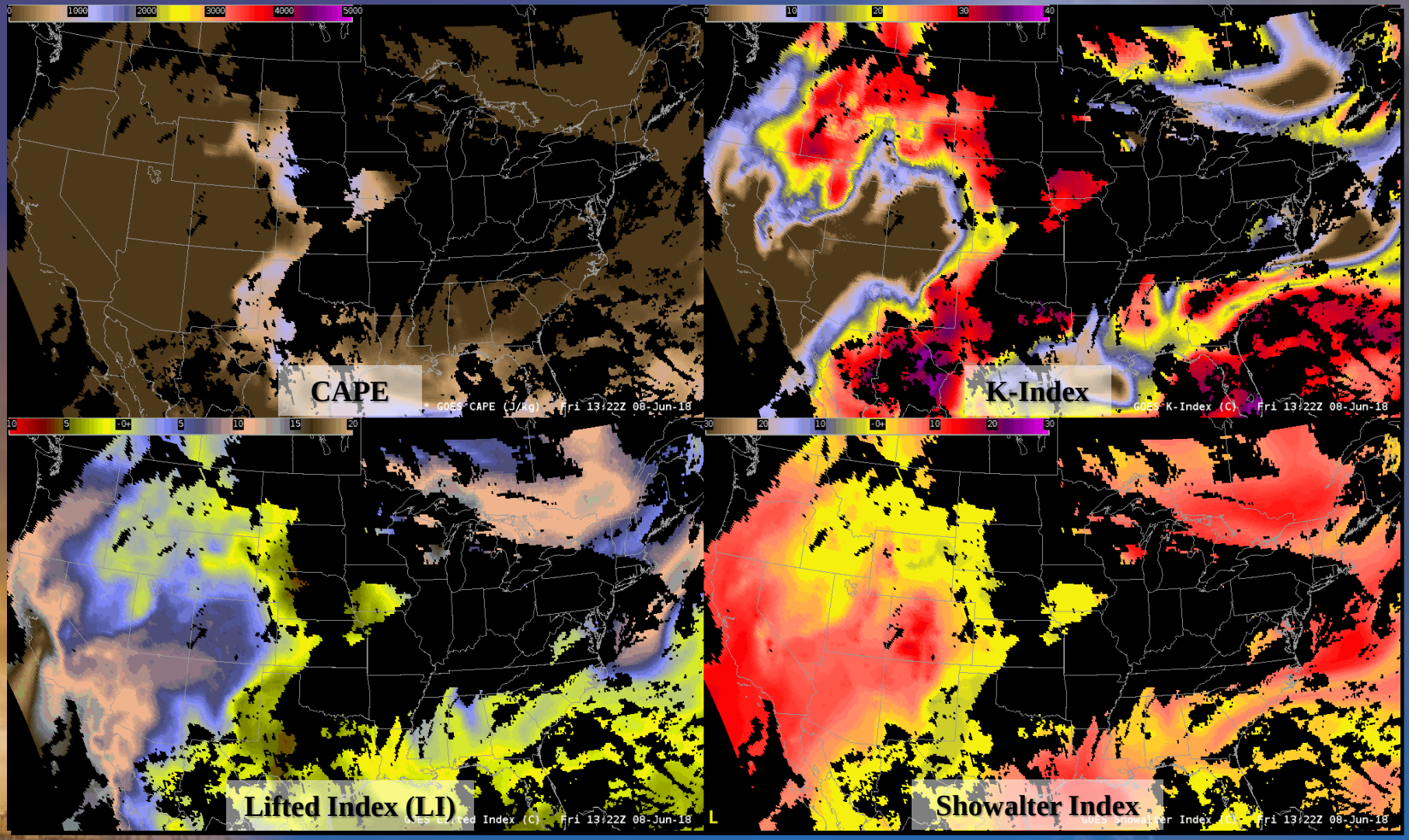
RGB Quick Guides

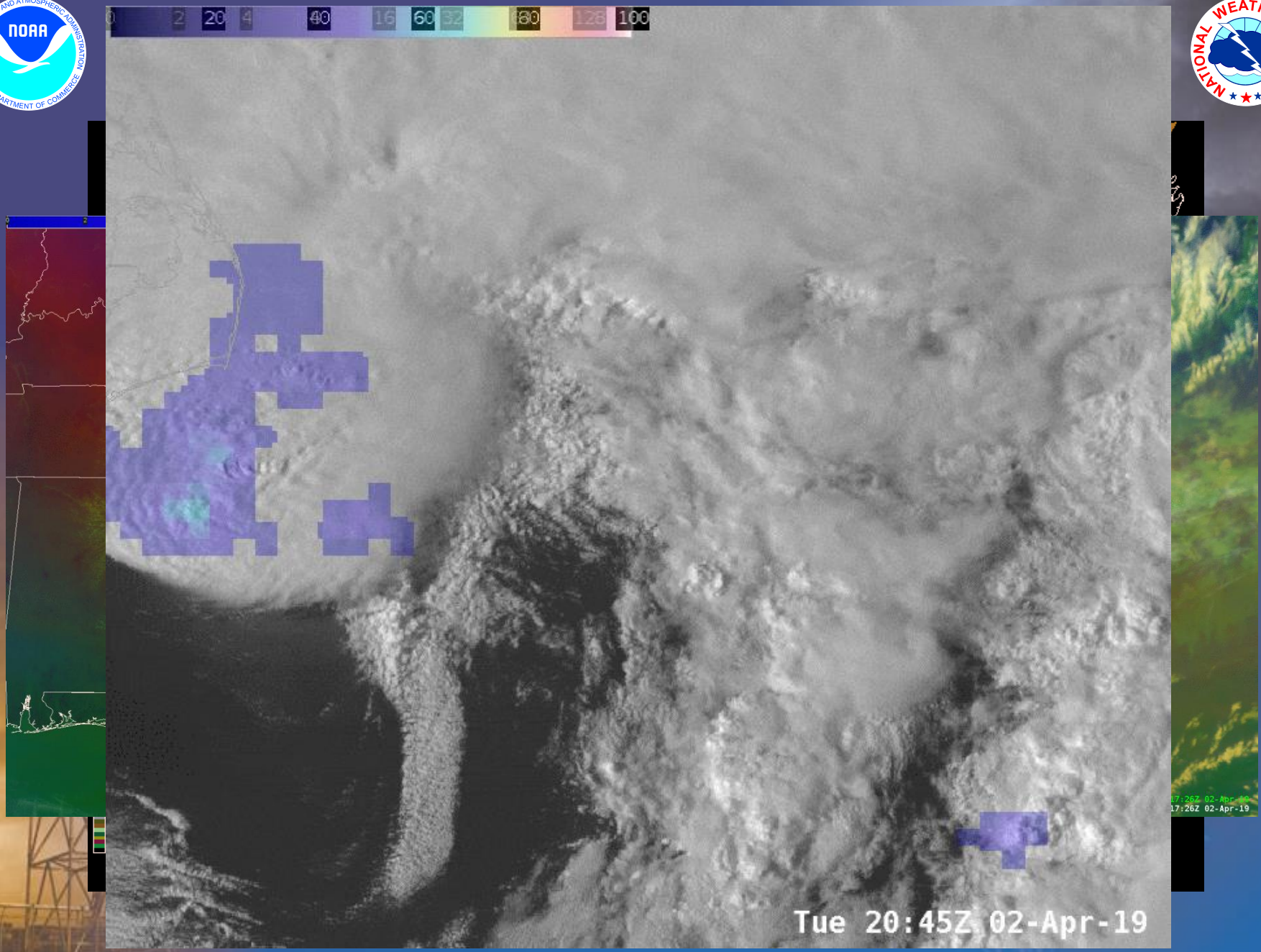
Name	Red	Green	Blue	Common Uses
Air Mass	6.2 - 7.3 µm	9.6 - 10.3 µm	6.2 µm (inverted)	Identifying air masses, inferring cyclogenesis
Day Snow Fog	0.86 µm	1.6 µm	3.9-10.3 µm	The channels which bring out the distinguishing differences are combined in the Day Snow-Fog RGB to show greater contrast between snow and cloud.
Day Convection	6.2 - 7.3 µm	3.9 - 10.3 µm	1.6 - 0.64 µm	Identify intense vs. weak/mature updrafts
Day Land Cloud	1.6 µm	0.86 µm	0.64 µm	Identify surface features (inc. fire hotspots), high vs. low clouds, snow
Day Land Cloud Fire	2.2 µm	0.86 µm	0.64 µm	Identify surface features, high vs. low clouds, snow
Differential Water Vapor	7.3 - 6.2 µm (inverted)	7.3 µm (inverted)	6.2 µm (inverted)	Analyze water vapor distribution, depth of moisture, trough/ridge patterns
Dust	12.3 - 10.3 µm	11.2 - 8.4 µm	10.3 µm	Identifying dust
Fire Temperature	3.9 µm	2.2 µm	1.6 µm	Assess more intense vs. less intense fires
Nighttime Microphysics	12.4 - 10.4 µm	10.3 - 3.9 µm	10.3 µm	Identify high clouds vs. low clouds vs. fog at night
Simple Water Vapor	10.35 µm (inverted)	6.19 µm (inverted)	7.34 µm (inverted)	Assess distribution of moisture
CIMSS Natural True Color	0.64 µm	0.45* (0.64 µm) 0.1* (0.86 µm)	0.47 µm	True color gives an image the approximate look as one would see from space.
Day Cloud Convection	0.64 µm	0.64 µm	10.3 µm	Helps to distinguish between high and low clouds and can help reveal wind shear when animated.
Day Cloud Phase Distinction	10.3 µm	0.64 µm	1.6 µm	This RGB is used to evaluate the phase of cooling cloud tops to monitor convective initiation, storm growth, and decay.
Ash RGB	12.3 - 10.3 µm	11.2 - 8.4 µm	10.3 µm	The Ash RGB can be used both day and night for the detection of and monitoring of volcanic ash as well as sulfur dioxide gas.
SO2 RGB	6.95 - 7.34 µm	10.35-8.5 µm	10.3 µm	The SO2 RGB product can be used to detect and monitor large sulfur dioxide emissions from volcanoes, as well as industrial facilities such as power plants.

Channel Difference Quick Guides

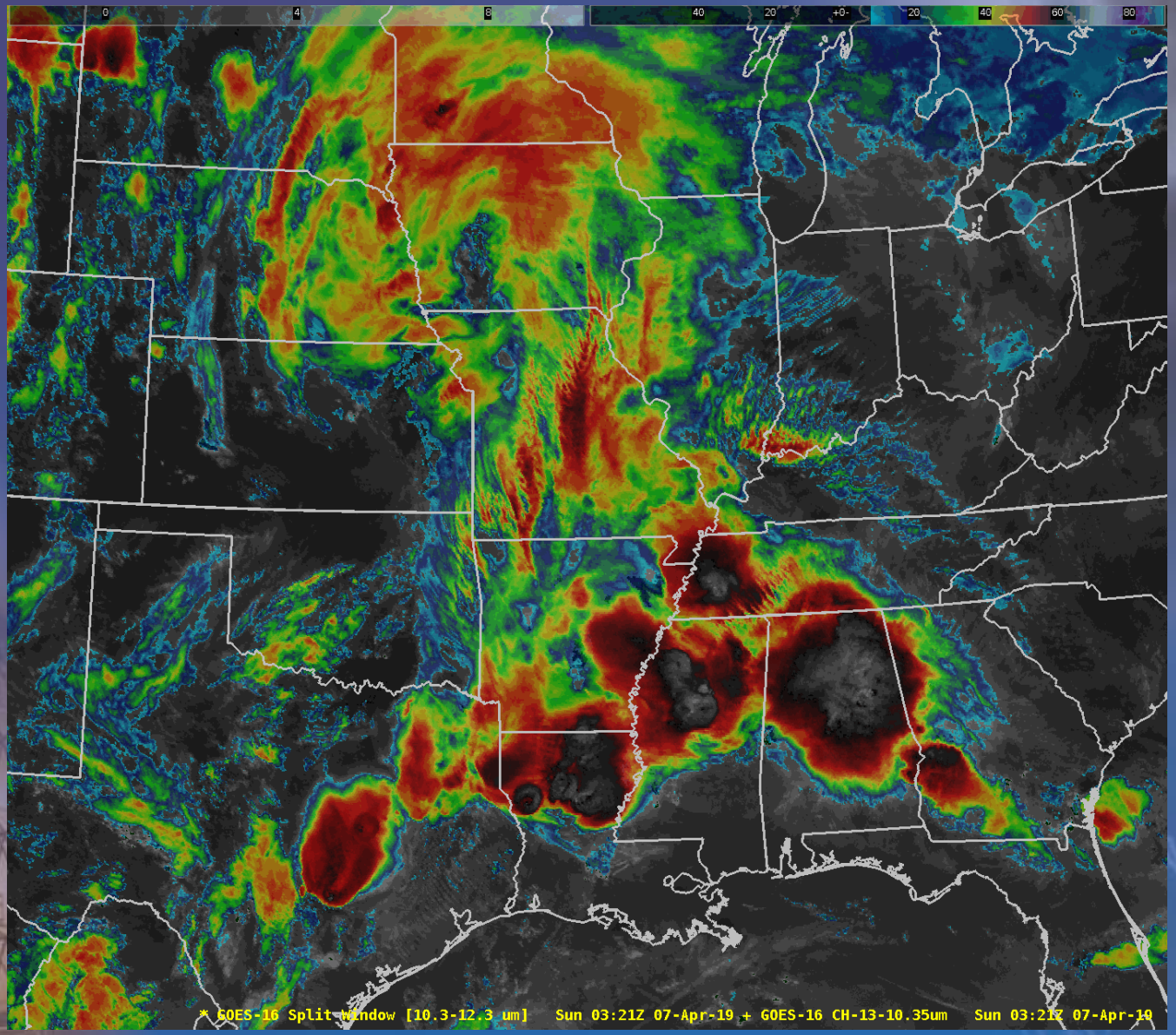
Name	Channel Difference	Common Uses
Night Fog	10.3 - 3.9 µm	Identify clouds made up of small water droplets (e.g., fog/stratus)
Split Window Difference	10.3 - 12.3 µm	Identify gradients in moisture, regions of low-level dust
Split Cloud Phase	8.5-11.2 µm	Differentiate cloud size particles
Split Water Vapor Difference	6.2-7.3 µm	The band difference give an approximation of the concentration and distribution of Water Vapor
Split Snow	1.6-0.64 µm	Highlights regions where ice is present
Split Ozone	9.6-10.3 µm	Reveals the influence of ozone absorption

GOES-16 Stability Indices




0 2 20 4 40 16 60 32 80 128 100
Tue 20:45Z 02-Apr-19
17:26Z 02-Apr-19

Split-Window + IR



Now for some real-time examples…

- Geostationary Lightning Mapper (GLM)
- **GOES Image Viewer**
- GOES-16 Loop of the Day
- Slider (this has many RGB composites, overlays, satellites) You can also annotate the graphics and save them.
- NASA Sport (has derived products including nighttime microphysics, RGB Airmass, Day snow-fog, etc)

Thank you!

Any Questions?

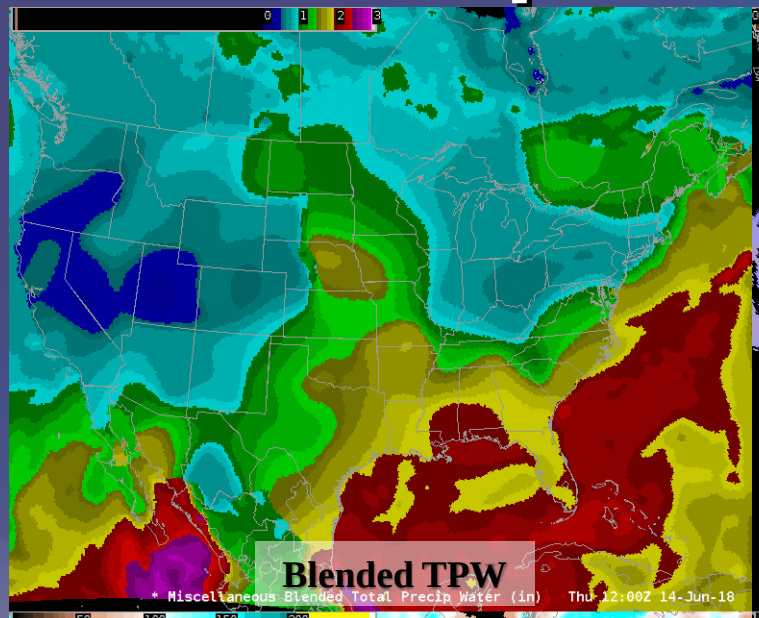
Amazing detail with 1-min imagery from GOES-16 Legacy IR (Ch. 14)

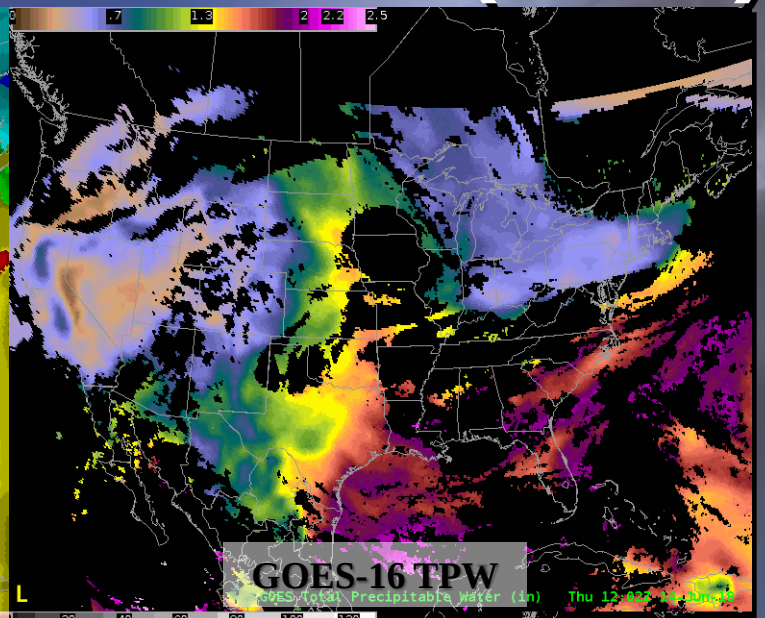
2018-06-07 - Severe storms over Iowa and Nebraska - 1-min. Band 14 (11.2 µm) - HTML5 Loop

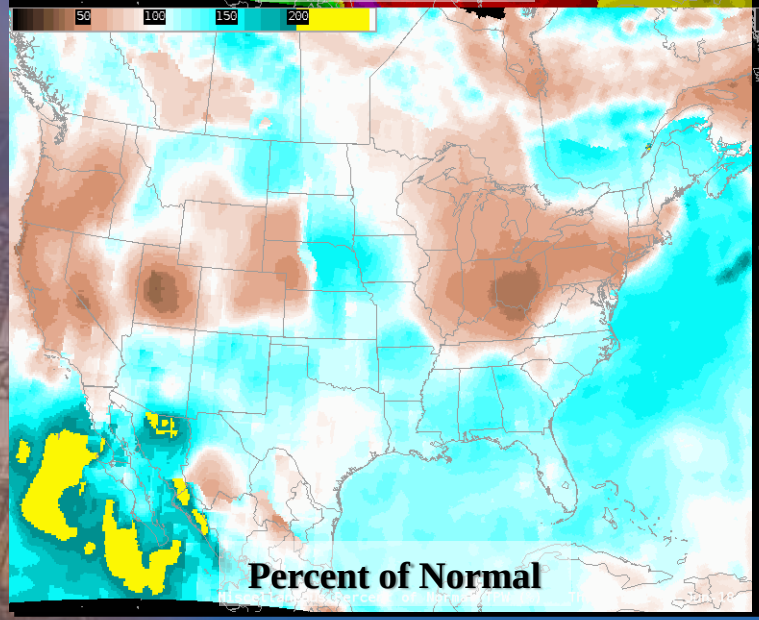
Most Frequently Used Products

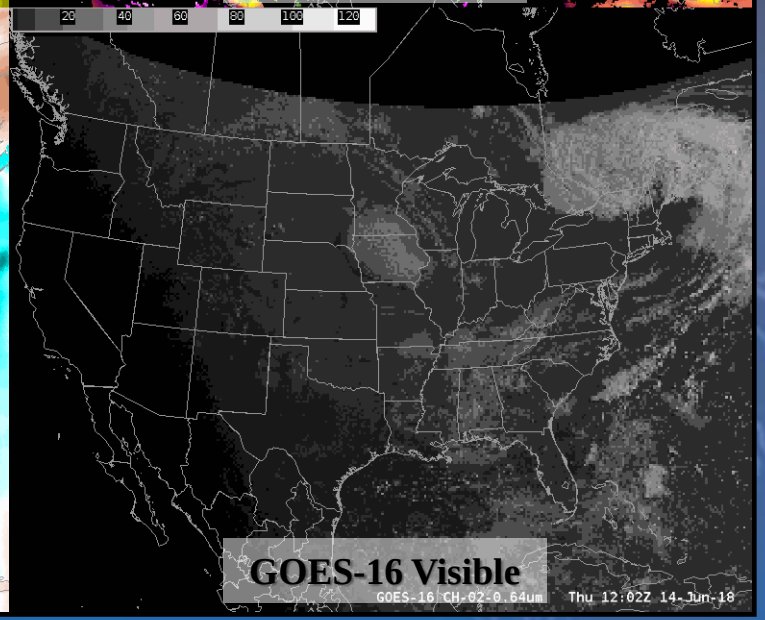
- Layered WV
- IR (Clean, Dirty, Legacy)
- Visible
- RGB Airmass
- Advanced Microphysics (fog/nighttime convection)
- Lightning Data (ENI Total Lightning)
- CIMMS ProbSevere

Total Precipitable Water (TPW)

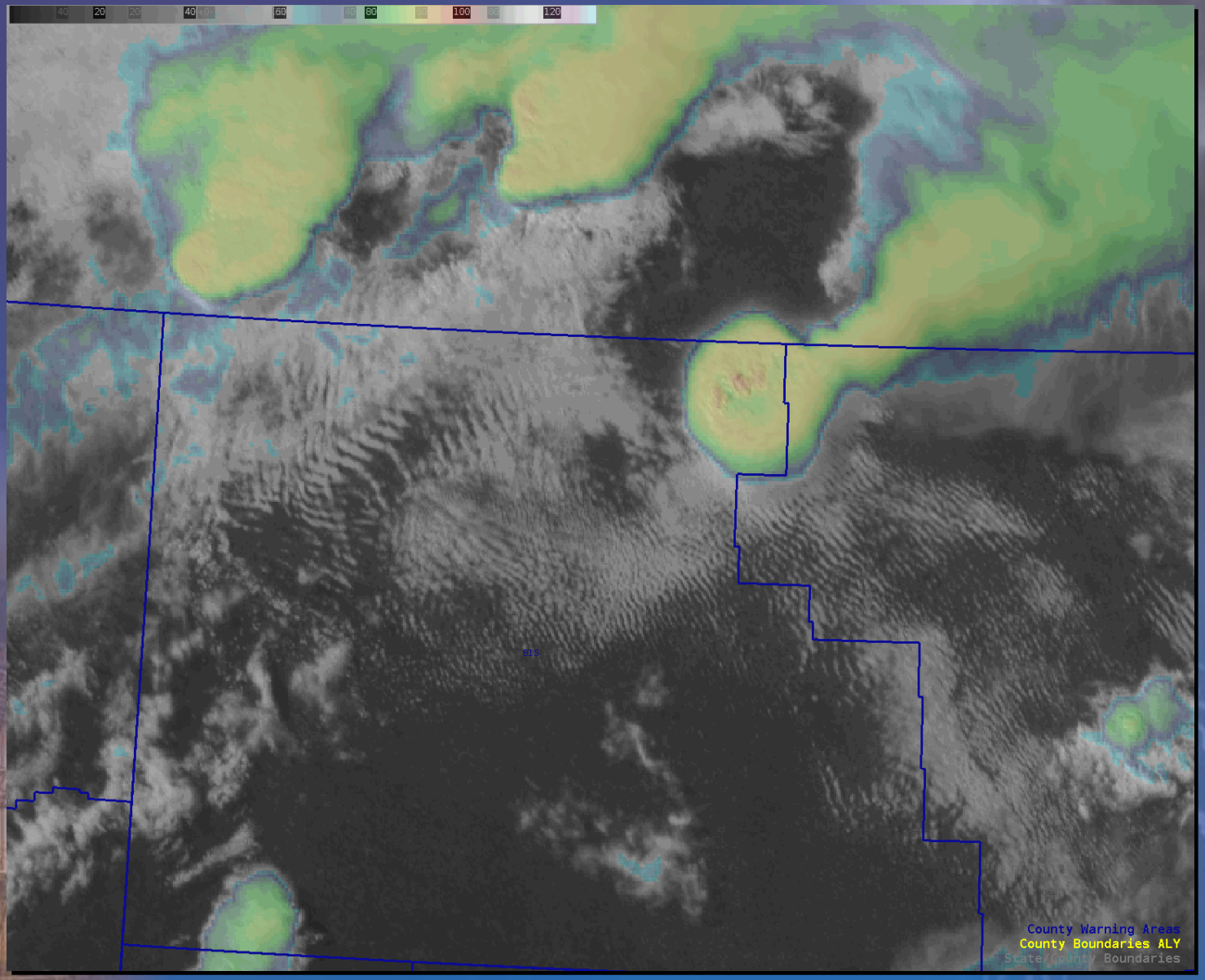








VIS + IR Sandwich



Split Window Difference Quick Guide
GOES_16 Band Reference Guide
GOES-16 Loop of the Day
NOAA/CIMMS ProbTor Model
SSEC Satellite Viewer (Real-time data)
SSEC Data
Real Earth Viewer
Satellite Parallax

Satellite – Intranet Page: https://sites.google.com/a/noaa.gov/nws-er-aly/home/satellite

June 14th Storm Reports (SPC):
http://www.spc.noaa.gov/climo/gmf.php?rpt=180614_rpts_filtered