Observations of convection using both qualitative and quantitative products from GOES-16

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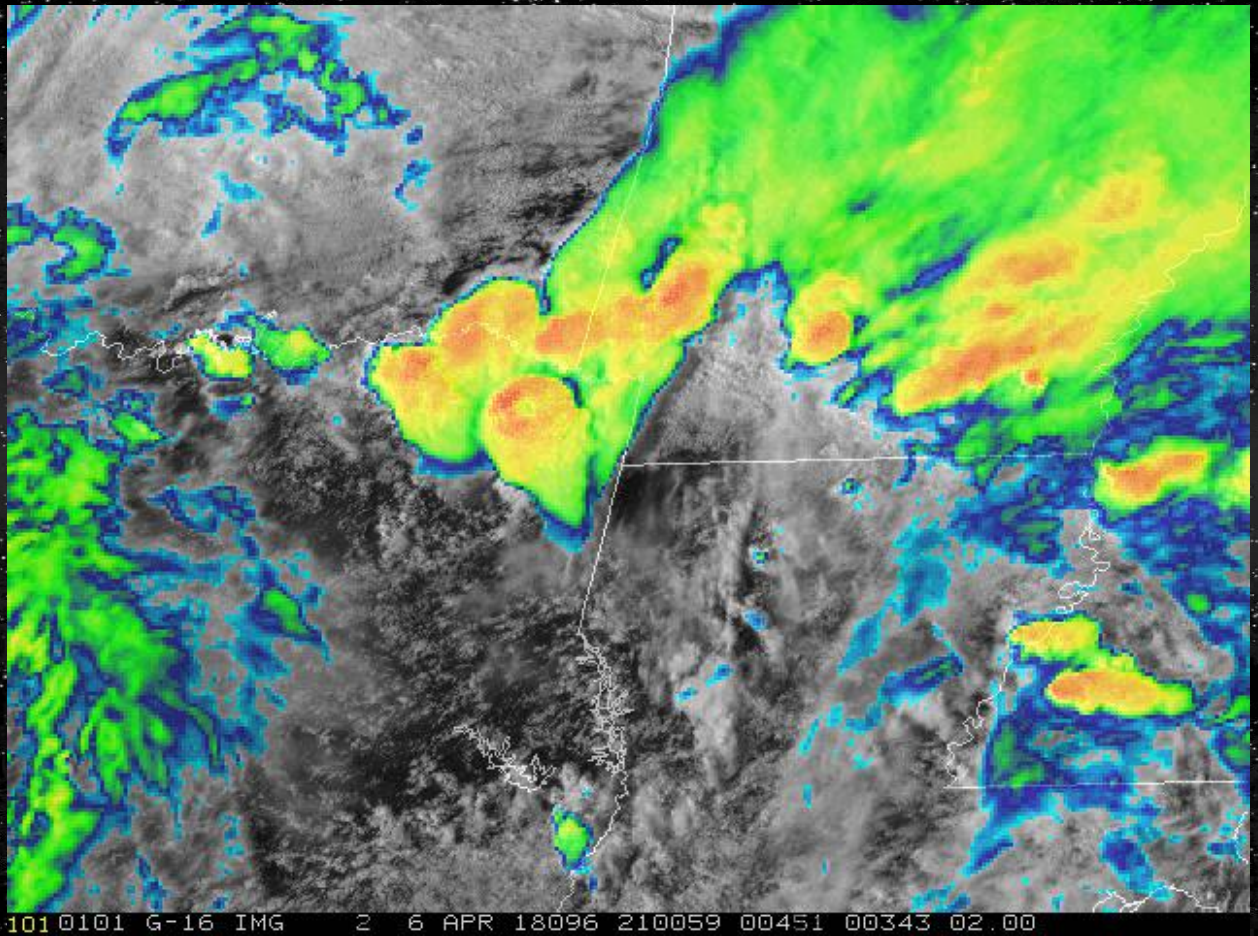
Convection Working Group Meeting

Ljubljana, Slovenia – 19 Apr. 2018

GOES-16 Update

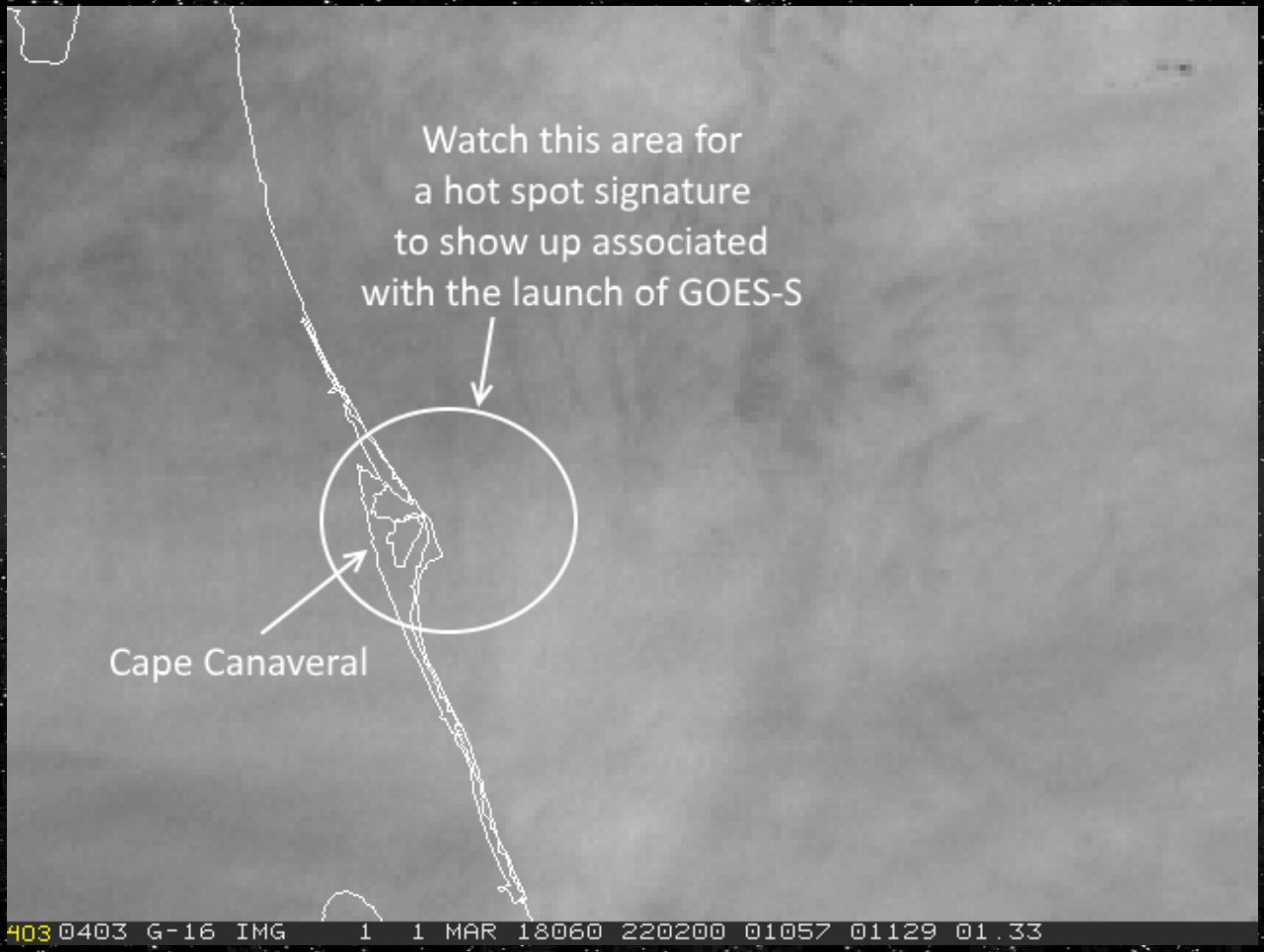
Friday, 6 April 2018



GOES-S Launch – March 1, 2018

- GOES-S was successfully launched on March 1, 2018, from Kennedy Space Center
- Reached geostationary orbit on March 12 and was renamed GOES-17
- Will undergo checkout from 89.5 W longitude for 6 months
- NWS will receive imagery and products after “Beta” is declared, probably in July
- Will be moved to 137 W in October, where it will become GOES-West
- Expect GOES-17 first image release the week of May 7 (!!!)

GOES-S Launch – March 1, 2018



1-minute
7.3 – 6.2 µm

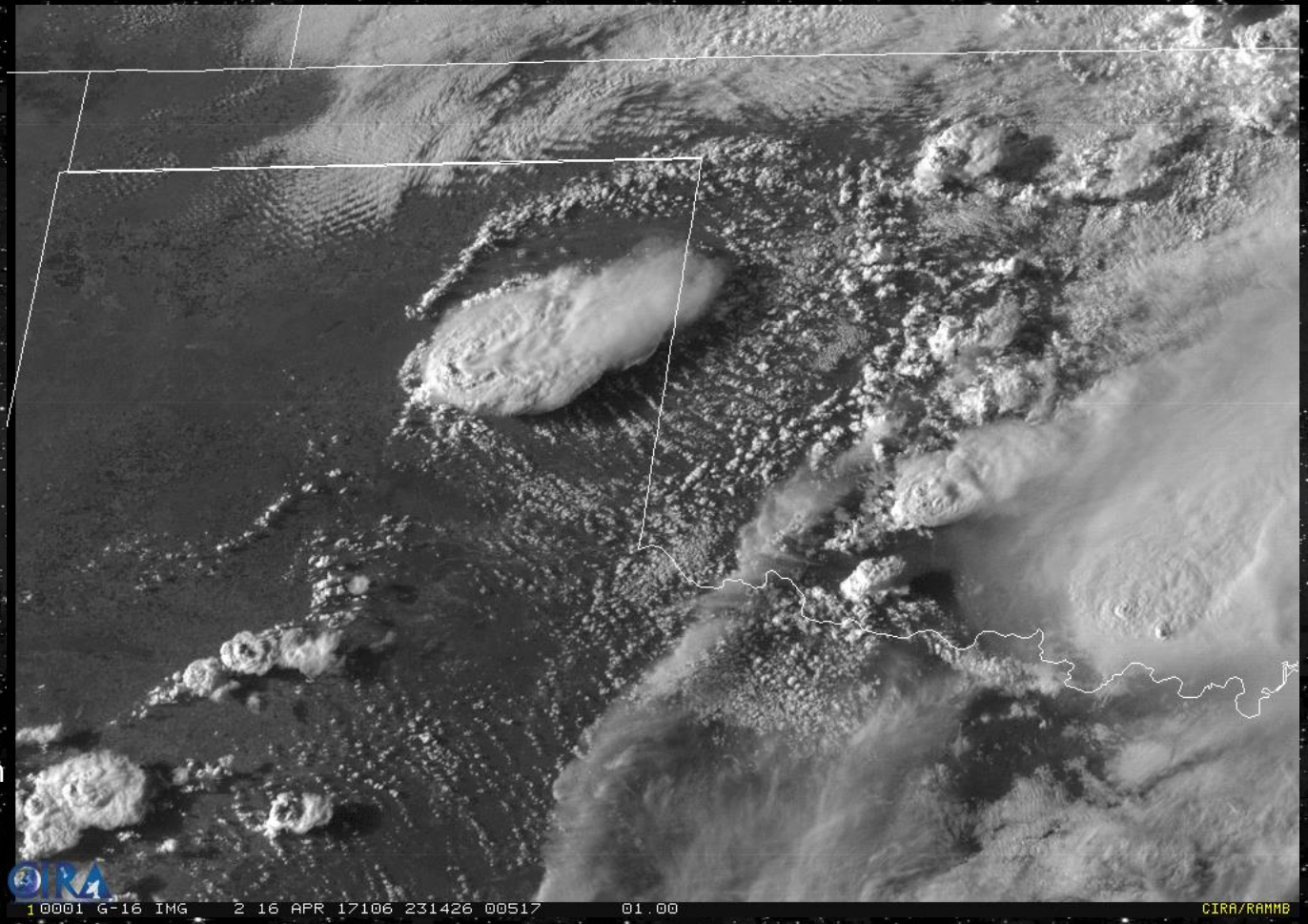
GOES-16 L2 Product Validation Status

ABI L2+ Products	Beta	Prov	Full
Cloud and Moisture Imagery (CMI) and Sectorized CMI (KPP)	2/28/17	6/1/17	6/1/18
Aerosol Detection (Smoke & Dust)	5/24/17	6/15/18	11/3/18
Aerosol Optical Depth (AOD)	5/24/17	6/15/18	11/3/18
Clear Sky Mask	4/19/17	2/16/18	11/3/18
Cloud Optical Depth	6/8/17	2/22/18	11/3/18
Cloud Particle Size Distribution	6/8/17	6/15/18	11/3/18
Cloud Top Height	5/16/17	2/16/18	11/3/18
Cloud Top Phase	5/16/17	2/22/18	11/3/18
Cloud Top Pressure	5/16/17	2/16/18	11/3/18
Cloud Top Temperature	5/16/17	2/16/18	11/3/18
Derived Motion Winds	6/8/17	2/9/18	11/3/18
Derived Stability Indices	5/16/17	2/22/18	11/3/18

ABI L2+ Products	Beta	Prov	Full
Downward S/W Radiation: Surface	6/23/17	6/15/18	11/3/18
Fire/Hot Spot Characterization	5/24/17	3/30/18	11/3/18
Hurricane Intensity Estimation	9/25/17	6/15/18	11/3/18
Land Surface Temperature	5/24/17	3/19/18	11/3/18
Legacy Vertical Moisture Profile	5/16/17	2/22/18	11/3/18
Legacy Vertical Temperature Profile	5/16/17	2/22/18	11/3/18
Rainfall Rate/QPE	9/13/17	3/30/18	11/3/18
Reflected S/W Radiation: TOA	6/23/17	6/15/18	11/3/18
Sea Surface Temperature	6/14/17	3/9/18	11/3/18
Snow Cover	TBD*	TBD*	TBD*
Total Precipitable Water	5/16/17	2/22/18	11/3/18
Volcanic Ash: Detection and Height	9/13/17	6/15/18	11/3/18

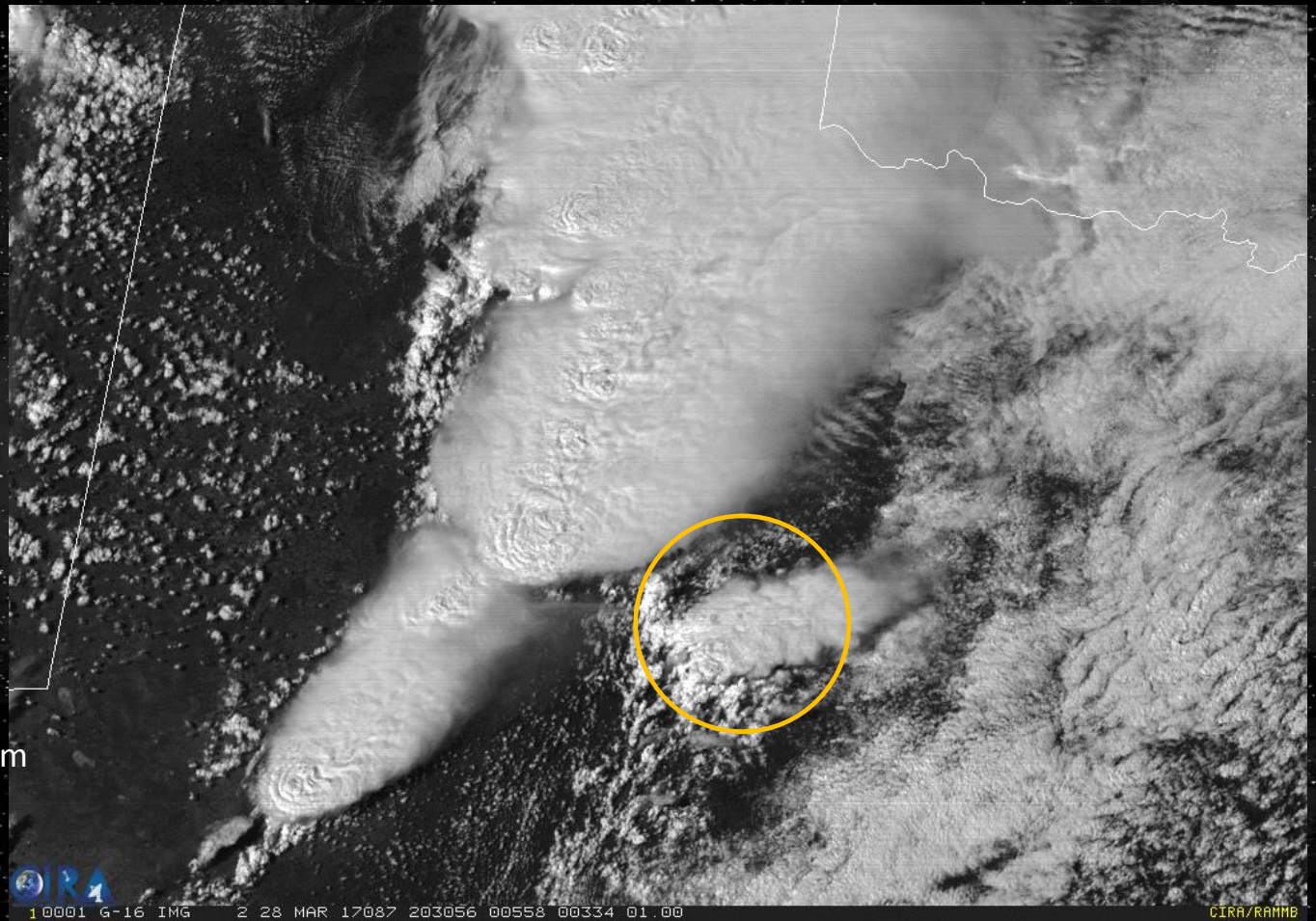
Not Validated | Beta Maturity | Provisional Maturity | Full Maturity

GOES-16 – Example convection observations



1-minute
Band 2 – 0.64 µm
Texas
16 Apr. 2017

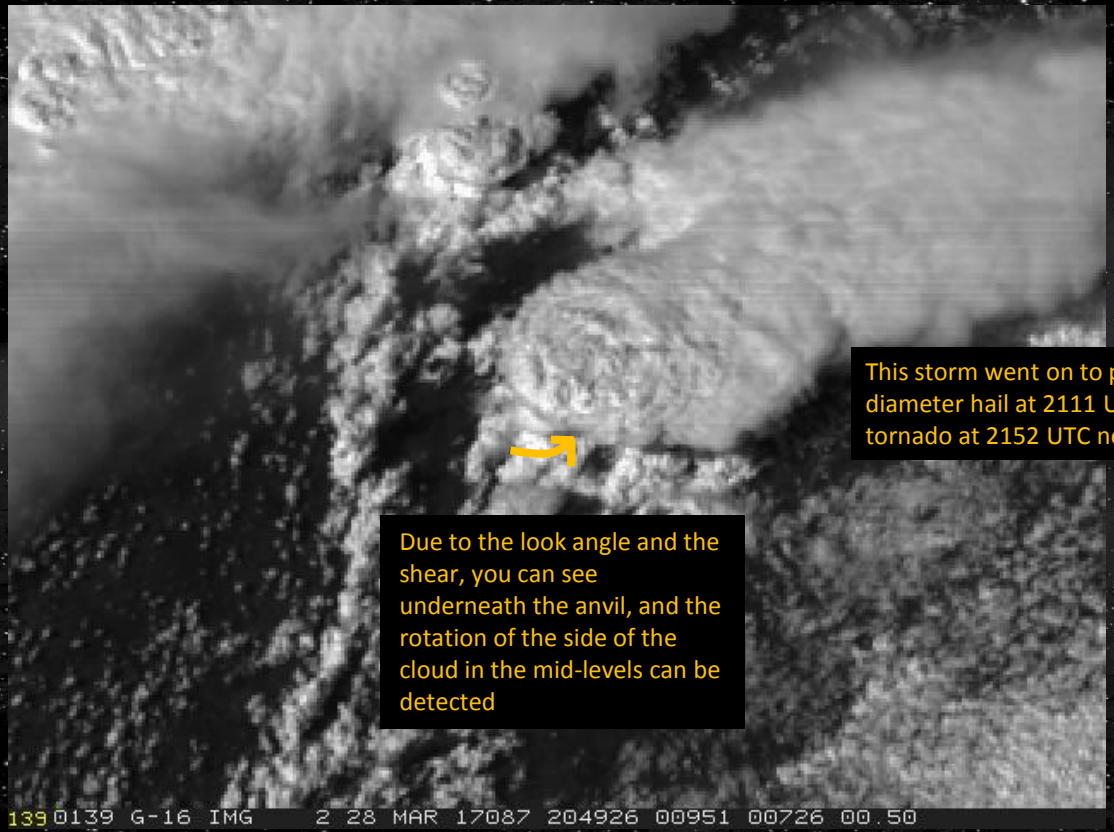
GOES-16 – Example convection observations



30-second
Band 2 – 0.64 µm
Texas
28 Mar. 2017

GOES-16 – Example convection observations

GOES-16 Loop - 2049 – 2104 UTC, 30 sec time steps

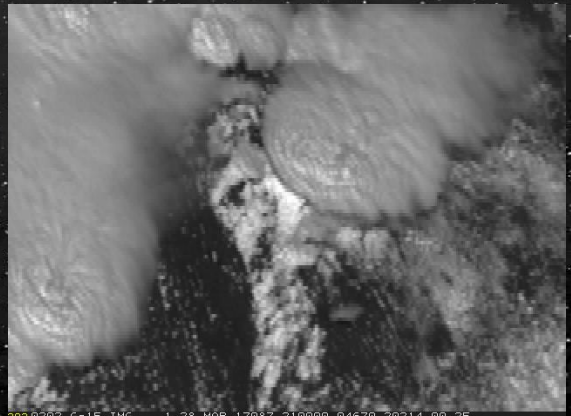


This storm went on to produce 1.75” diameter hail at 2111 UTC and a tornado at 2152 UTC near Tye, Texas

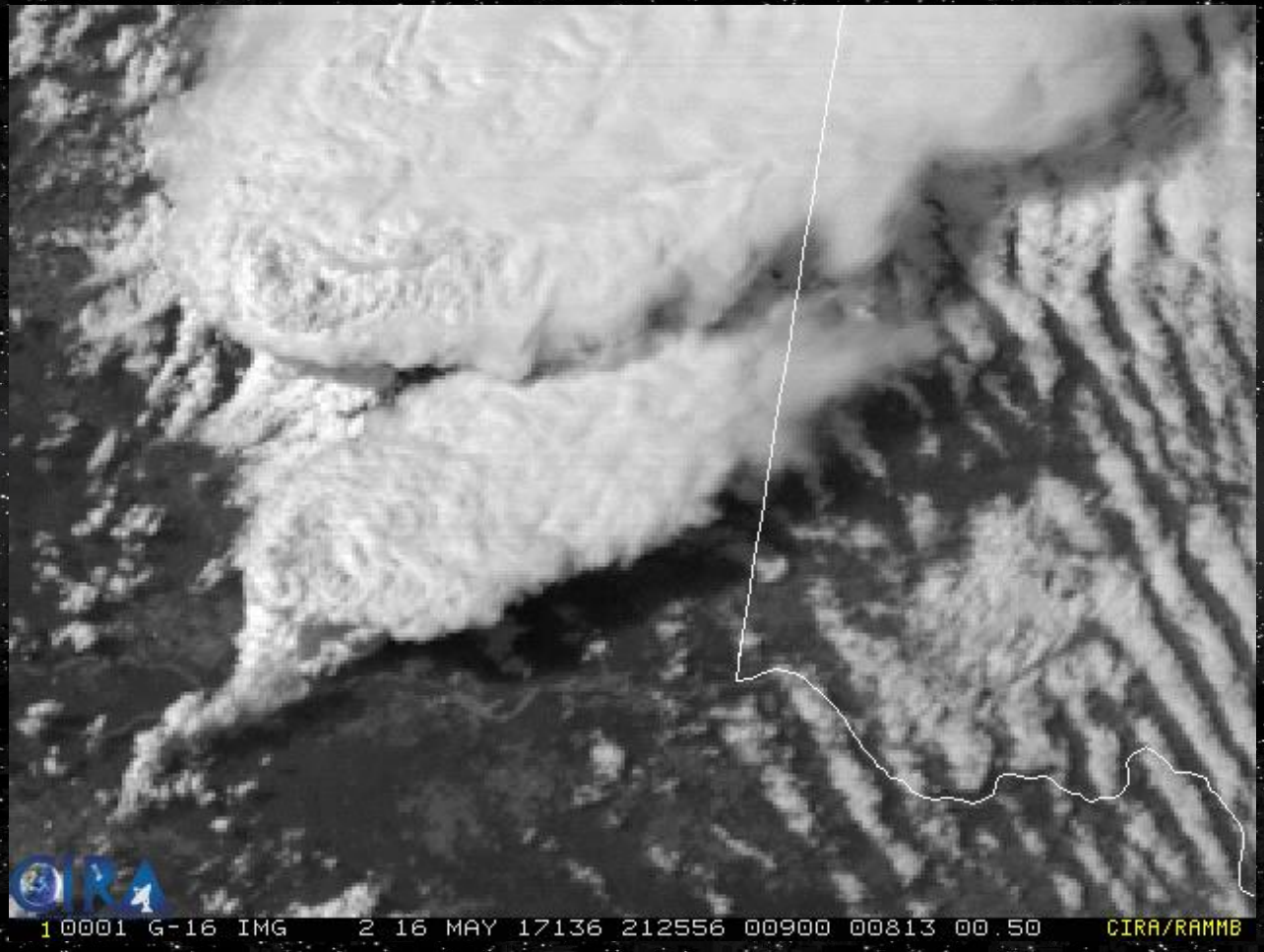
Due to the look angle and the shear, you can see underneath the anvil, and the rotation of the side of the cloud in the mid-levels can be detected

GOES-13 “Loop” - 2045 – 2045 UTC (full disk time)

GOES-15 “Loop” - 2100 – 2100 UTC (full disk time)

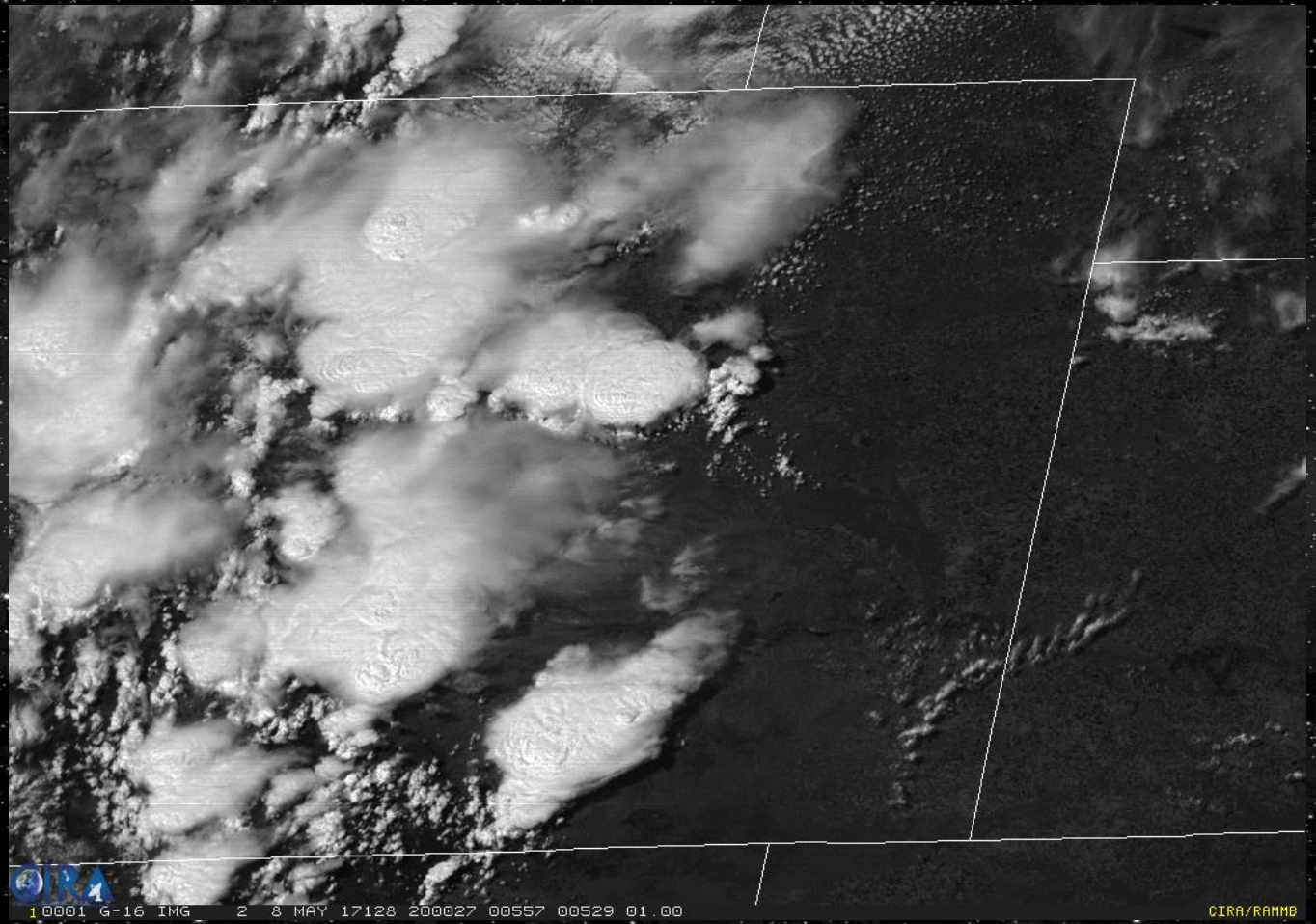


GOES-16 – Example convection observations

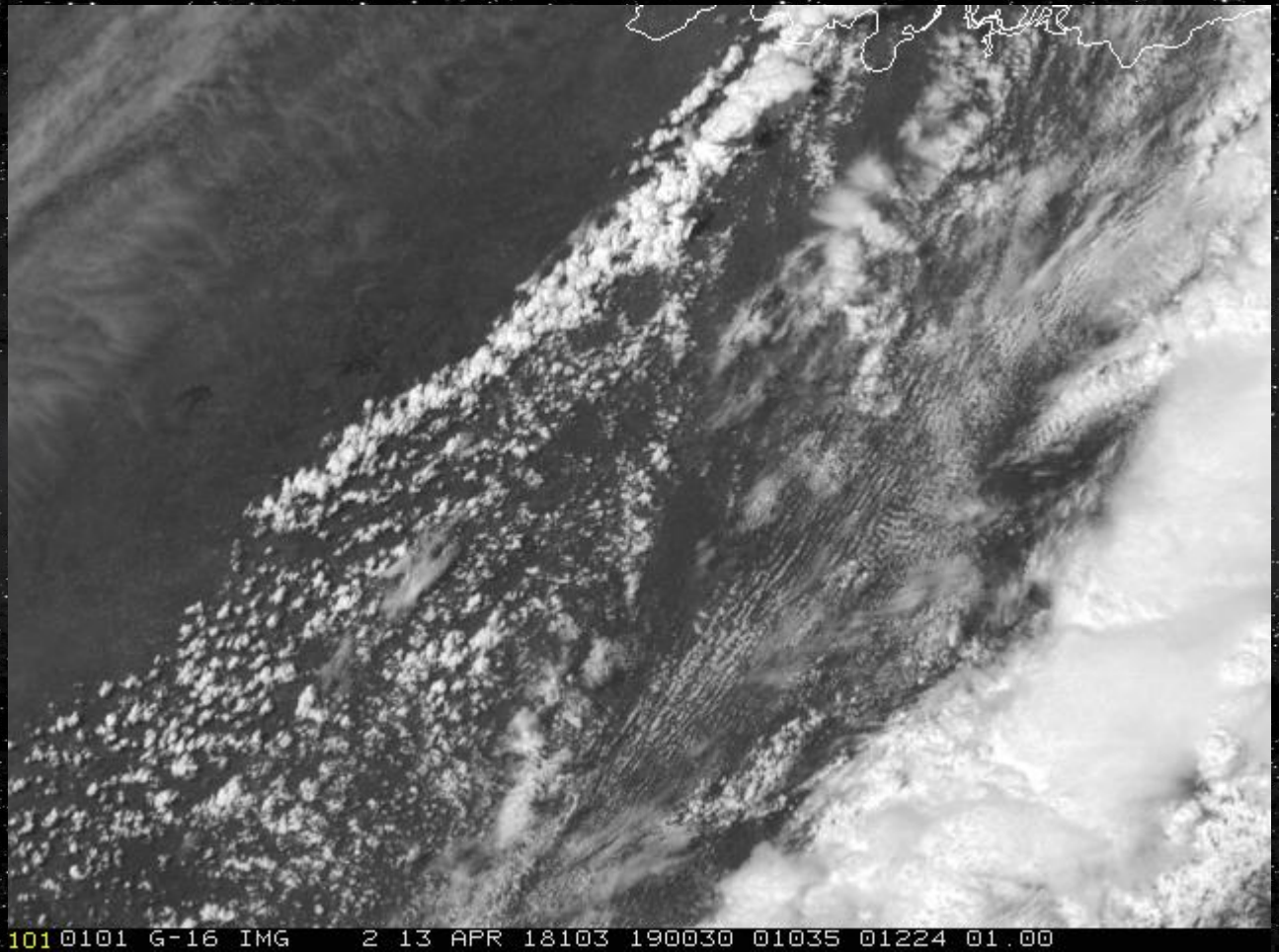


1-minute
Band 2 – 0.64 µm
Texas
16 May 2017

GOES-16 – Example convection observations



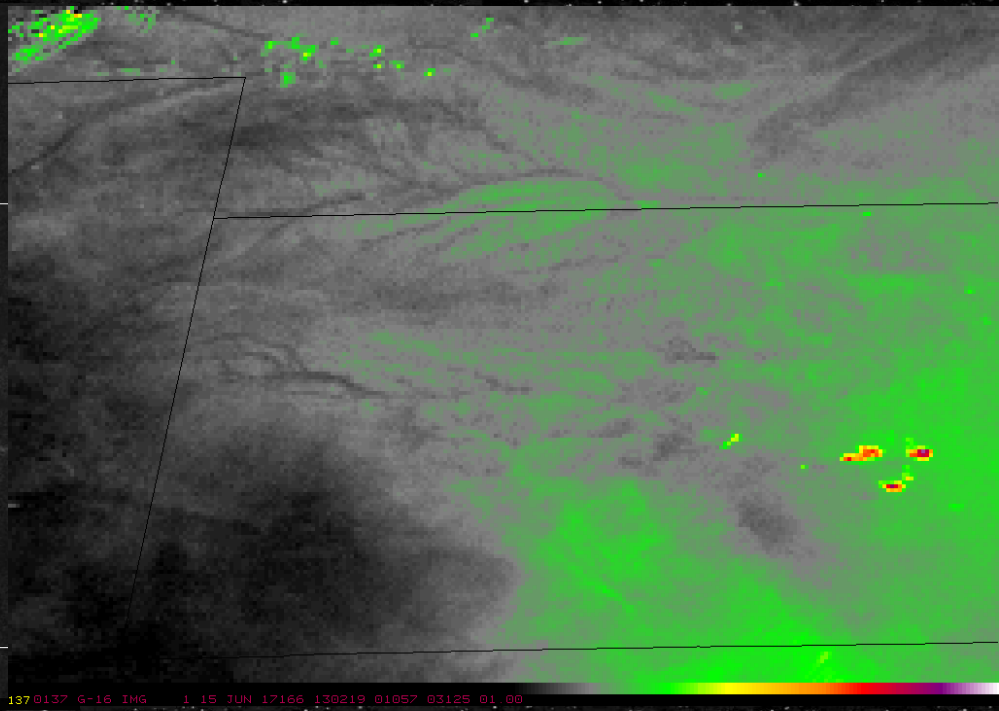
GOES-16 – Monitoring for convective initiation



1-minute
Band 2 – 0.64 µm
Texas
13 Apr. 2018

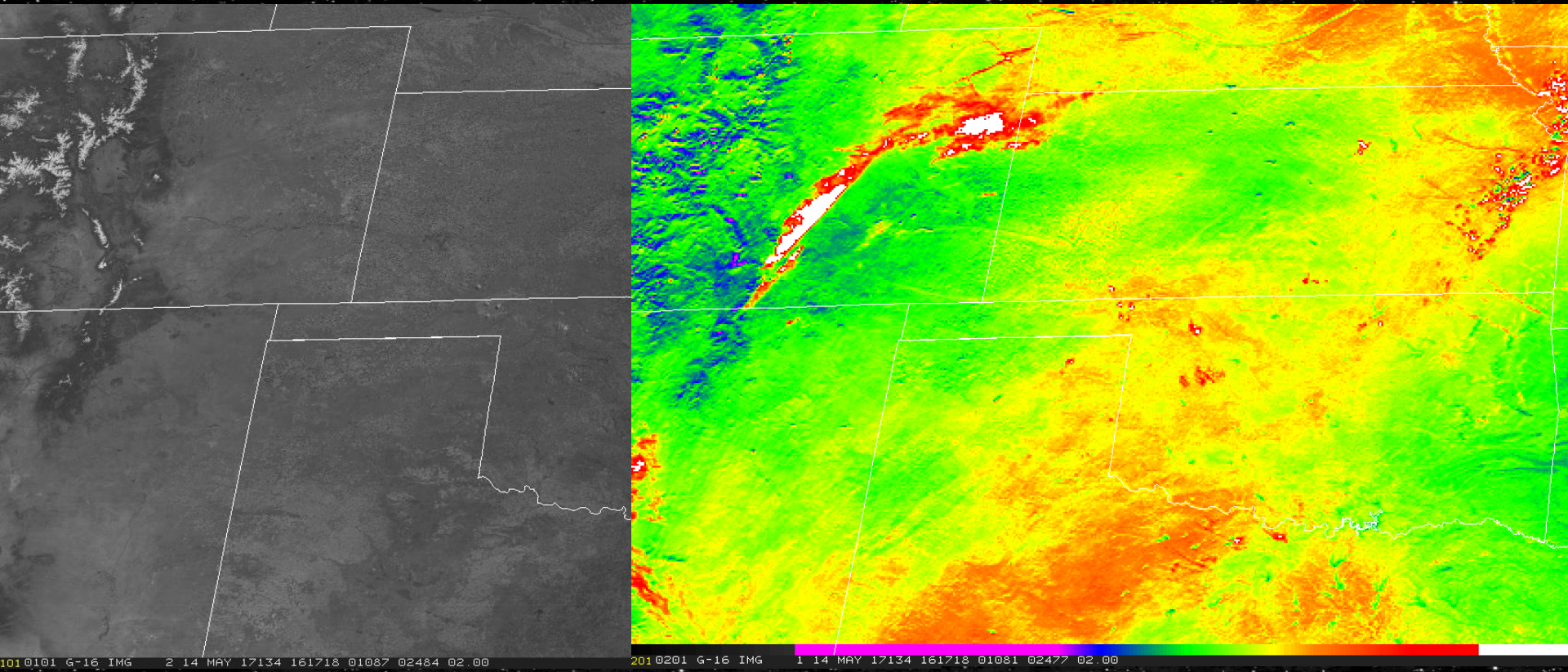
GOES-16 – Split Window Difference (10.3 – 12.3 micrometers)

Band 2 Visible



10.35 minus 12.3 µm

GOES-16 – Split Window Difference (10.3 – 12.3 micrometers)



Band 2 Visible

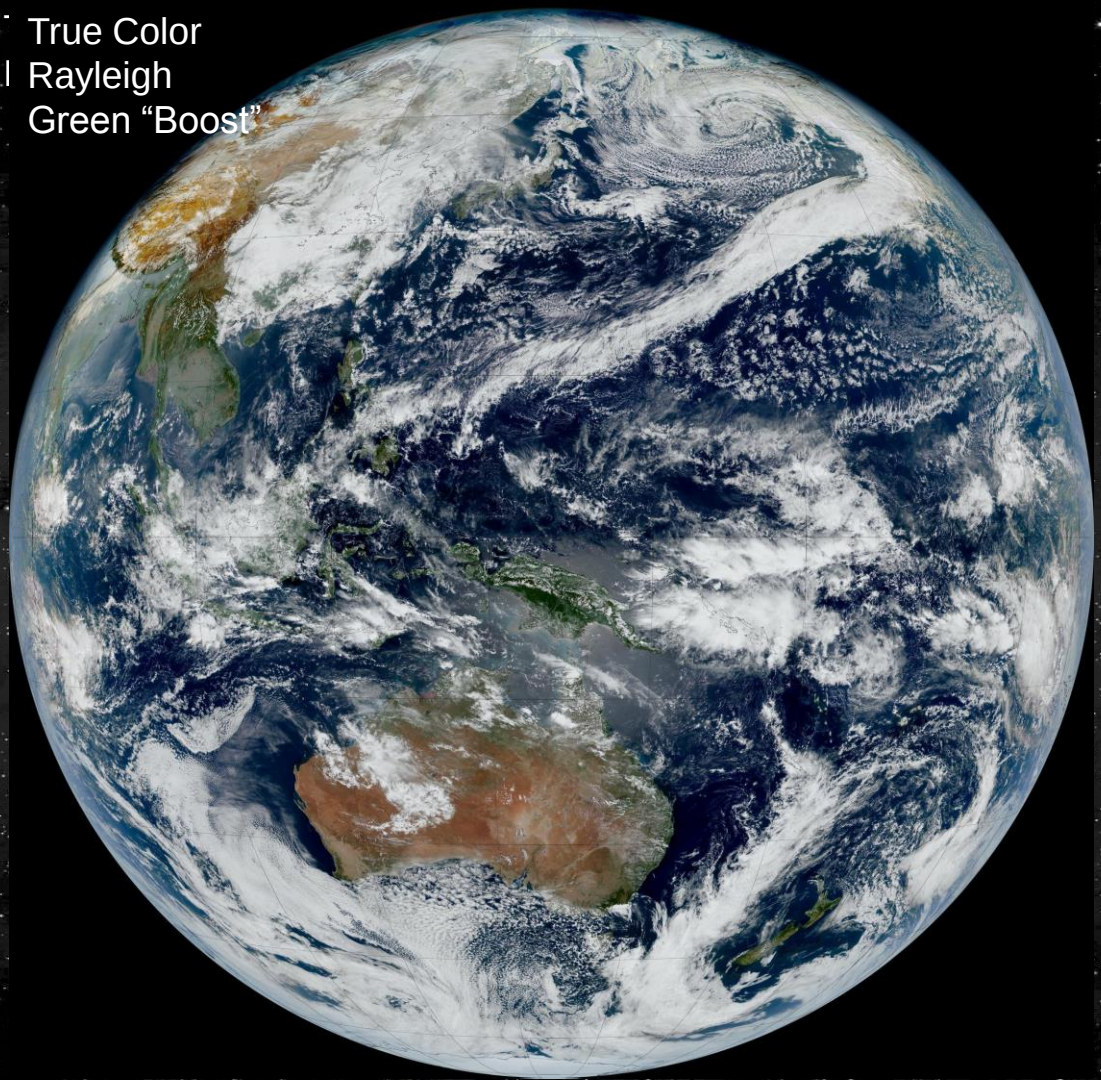
10.35 minus 12.3 µm

Channels on "Next Generation" Imagers

Approx. Central Wavelength (μm)	Band Explanation	GOES-R ABI	Himawari AHI	GK-2 AMI	MTG FCI	FY-4 AGRI
		Central Wavelength (μm) [Band Number]				
0.47	Visible/reflective	0.47 [1]	0.47 [1]	0.46 [1]	0.44 [1]	0.47 [1]
0.51		None	0.51 [2]	0.51 [2]	0.51 [2]	None
0.64		0.64 [2]	0.64 [3]	0.64 [3]	0.64 [3]	0.65 [2]
0.865	Reflective	0.865 [3]	0.86 [4]	0.86 [4]	0.865 [4]	0.825 [3]
0.91		None	None	None	0.914 [5]	None
1.378	Cirrus	1.378 [4]	None	1.38 [5]	1.38 [6]	1.375 [4]
1.61	Snow/Ice	1.61 [5]	1.61 [5]	1.61 [6]	1.61 [7]	1.61 [5]
2.25	Particle size	2.25 [6]	2.25 [6]	None	2.25 [8]	2.25 [6]
3.90	Shortwave IR	3.90 [7]	3.9 [7]	3.85 [7]	3.8 [9]	3.75[2] [7,8]
6.19	Water vapor	6.19 [8]	6.2 [8]	6.24 [8]	6.3 [10]	6.25 [9]
6.95		6.95 [9]	6.9 [9]	6.95 [9]	None	7.1 [10]
7.34		7.34 [10]	7.3 [10]	7.35 [10]	7.35 [11]	None
8.5	Water vapor, SO_2	8.5 [11]	8.6 [11]	8.6 [11]	8.7 [12]	8.5 [11]
9.61	Ozone	9.61 [12]	9.6 [12]	9.63 [12]	9.66 [13]	None
10.35	Longwave IR	10.4 [13]	10.4 [13]	10.43 [13]	10.5 [14]	10.7 [12]
11.2		11.2 [14]	11.2 [14]	11.2 [14]	None	None
12.3		12.3 [15]	12.3 [15]	12.3 [15]	12.3 [15]	12.0 [13]
13.3		13.3 [16]	13.3 [16]	13.3 [16]	13.3 [16]	13.5 [14]

True-color component bands are highlighted in red, green, and blue.

- True Color
- Rayleigh
- Green “Boost”



True Color with the ABI?

- Take advantage of the fact that Himawari has bands in the red, blue, nearIR, *and* green portions of the spectrum
- We build a 3-dimensional lookup table where the inputs are AHI 0.46 µm, 0.64 µm, and 0.86 µm reflectance, and the output is 0.51 µm (green)
- Example: this point

may have reflectance values of

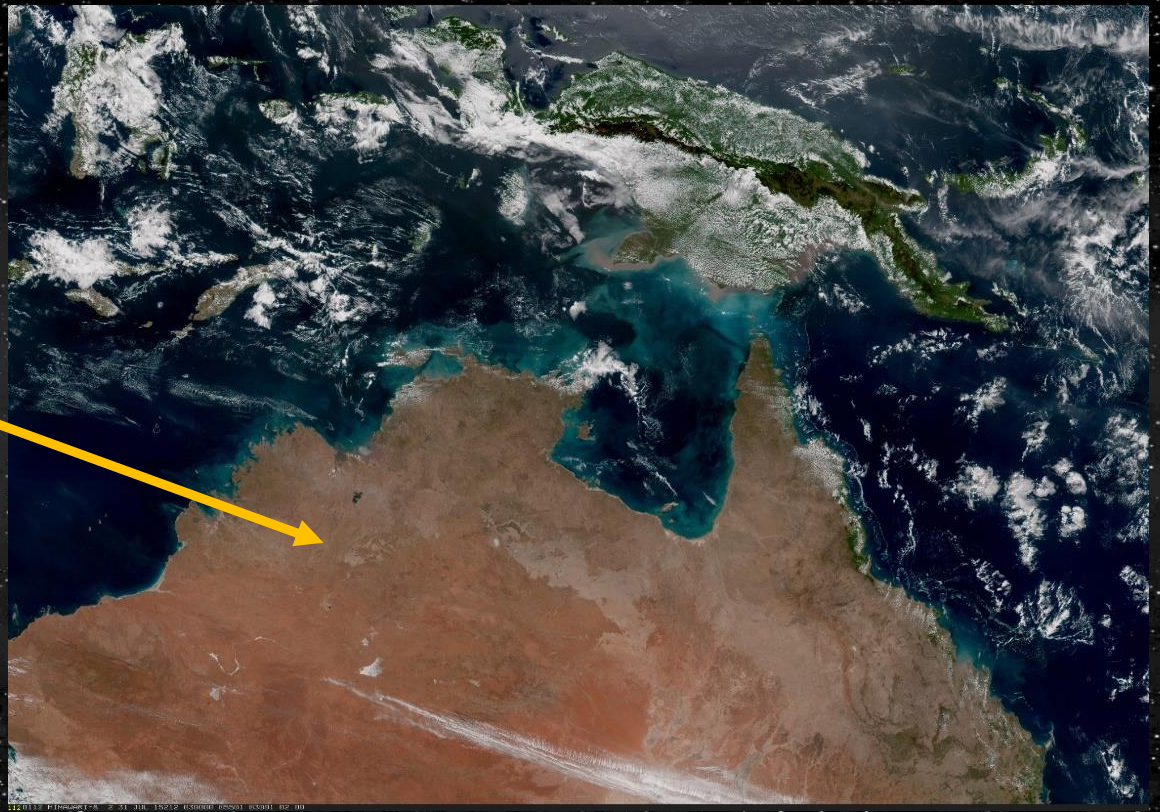
Blue: 0.17

Red: 0.64

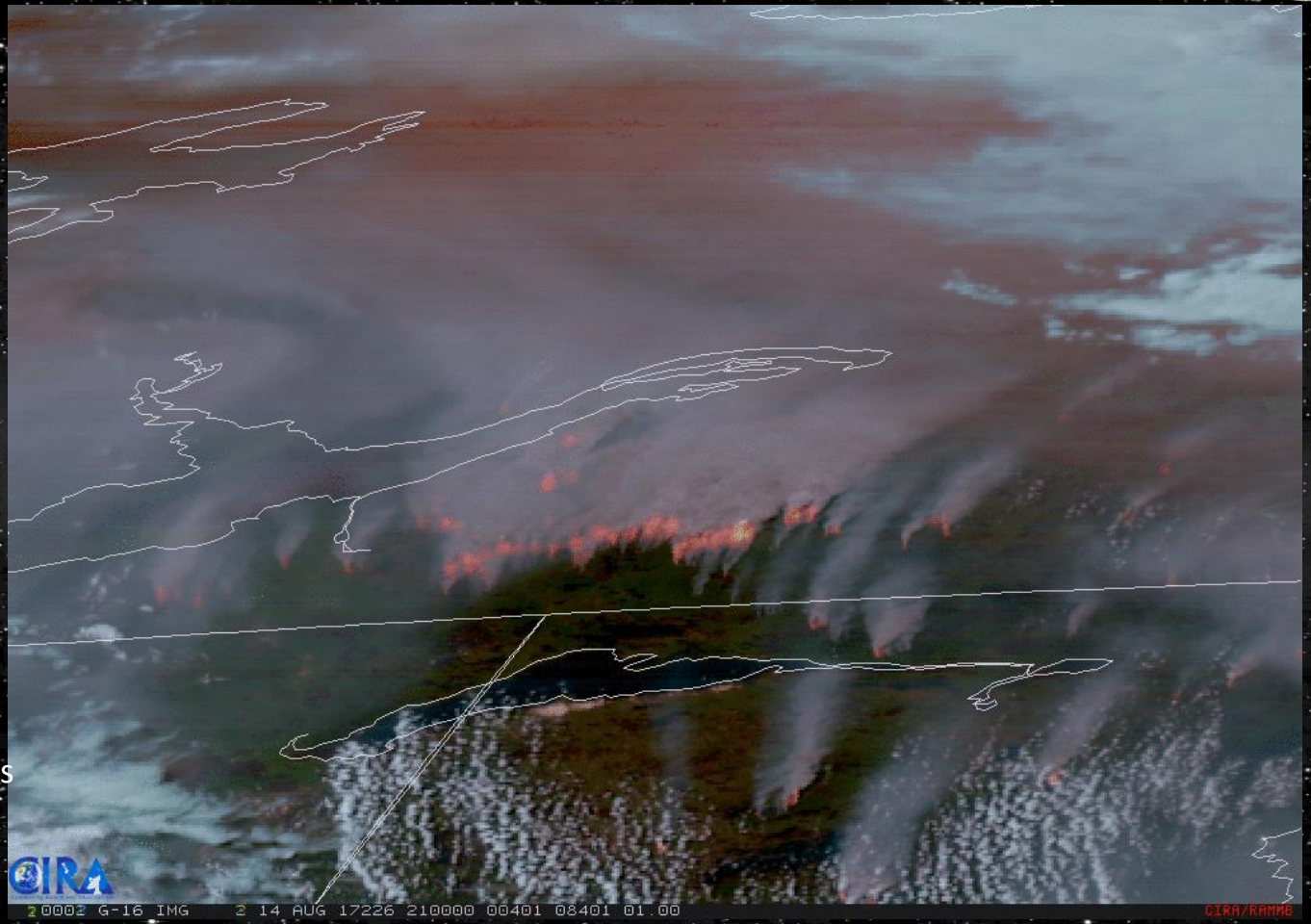
nearIR: 0.15

and its corresponding green 0.51 µm reflectance may be: 0.32.

- The table entry (0.17,0.64,0.15) gets populated as 0.32.
- Continue this process for a large number of observations at multiple times of day, times of year, and for multiple surface types.

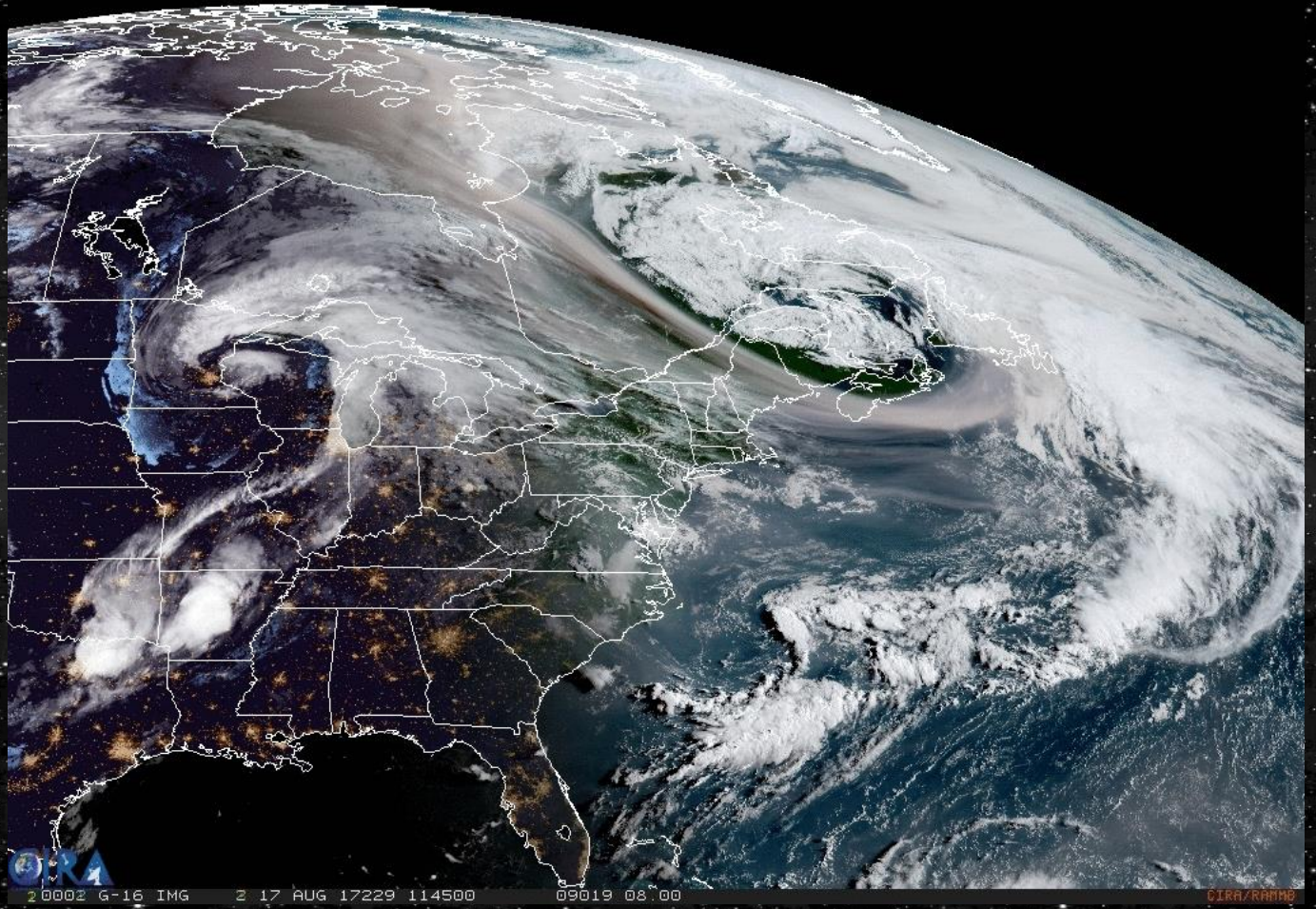


Fire Temperature RGB + Sim. True Color (“GeoColor”)



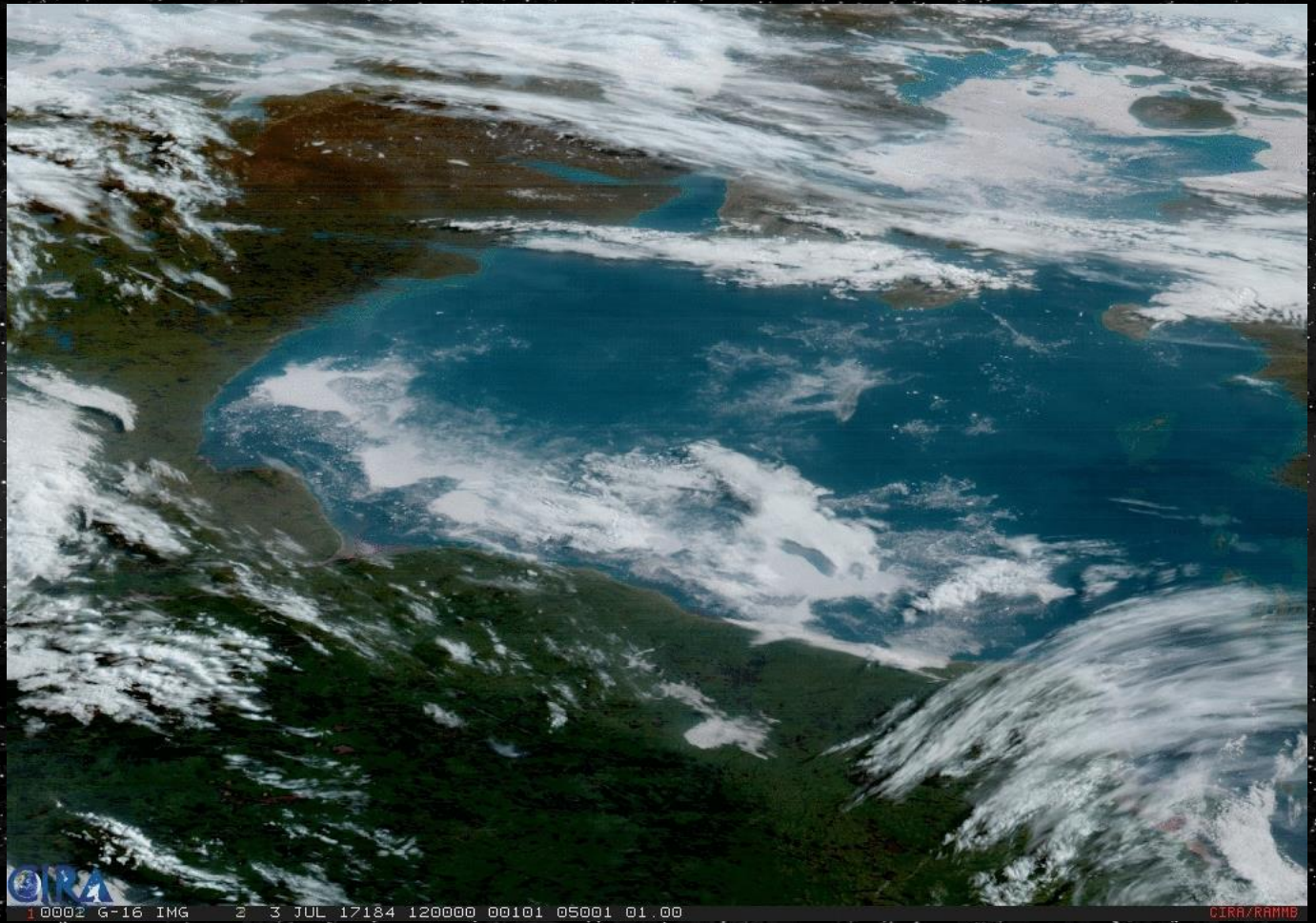
Canada
Northwest Territories
14 Aug. 2017

GeoColor



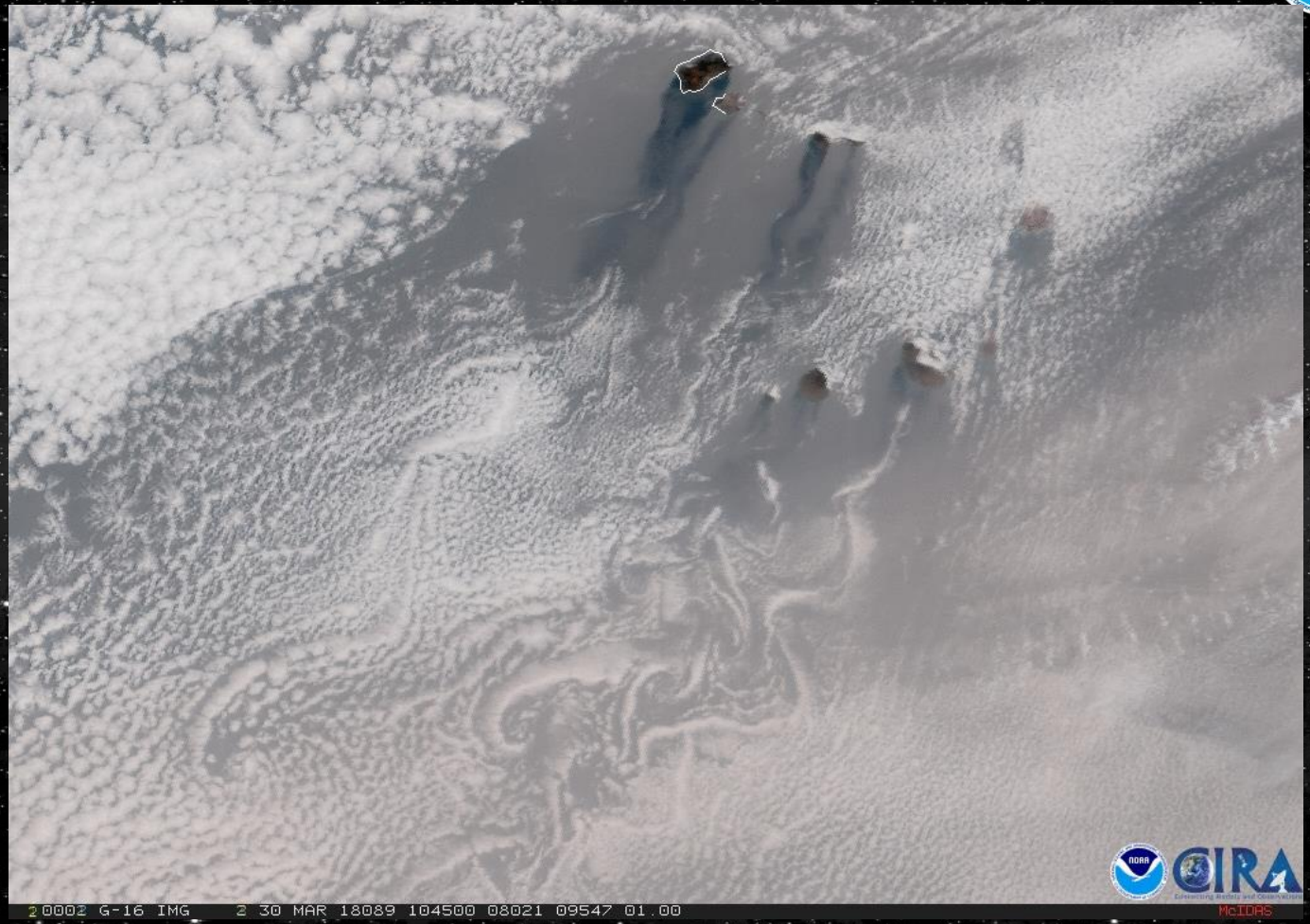
15-min data
17 Aug. 2017

GeoColor – Ice in Hudson Bay



15-min data
3 July 2017

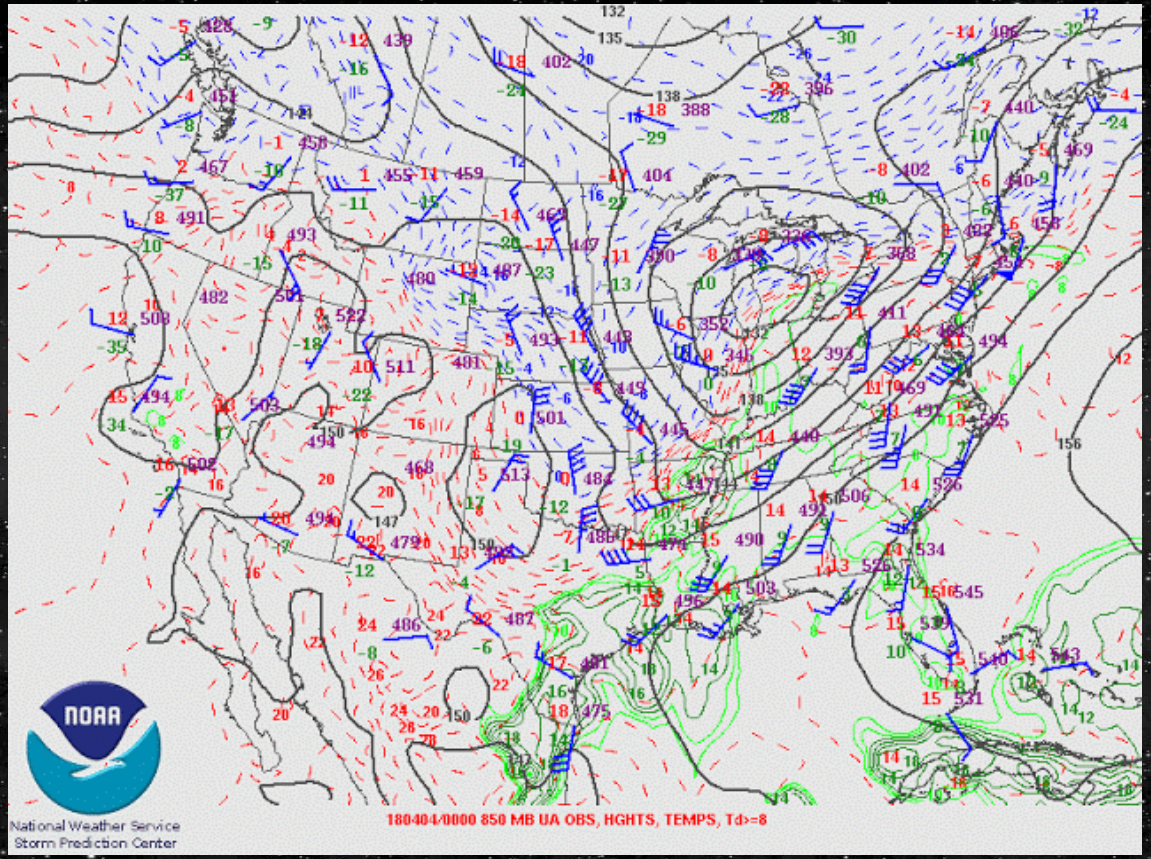
GeoColor – Saharan Dust – Cape Verde Islands



15-min data
30 Mar. 2018

ProbSevere (Experimental)

Mike Pavolonis (NOAA), John Cintineo and Justin Sieglaff (CIMSS)



Blog entry: https://goesrhwt.blogspot.si/2018/04/severe-storm-outbreak-in-mississippi.html

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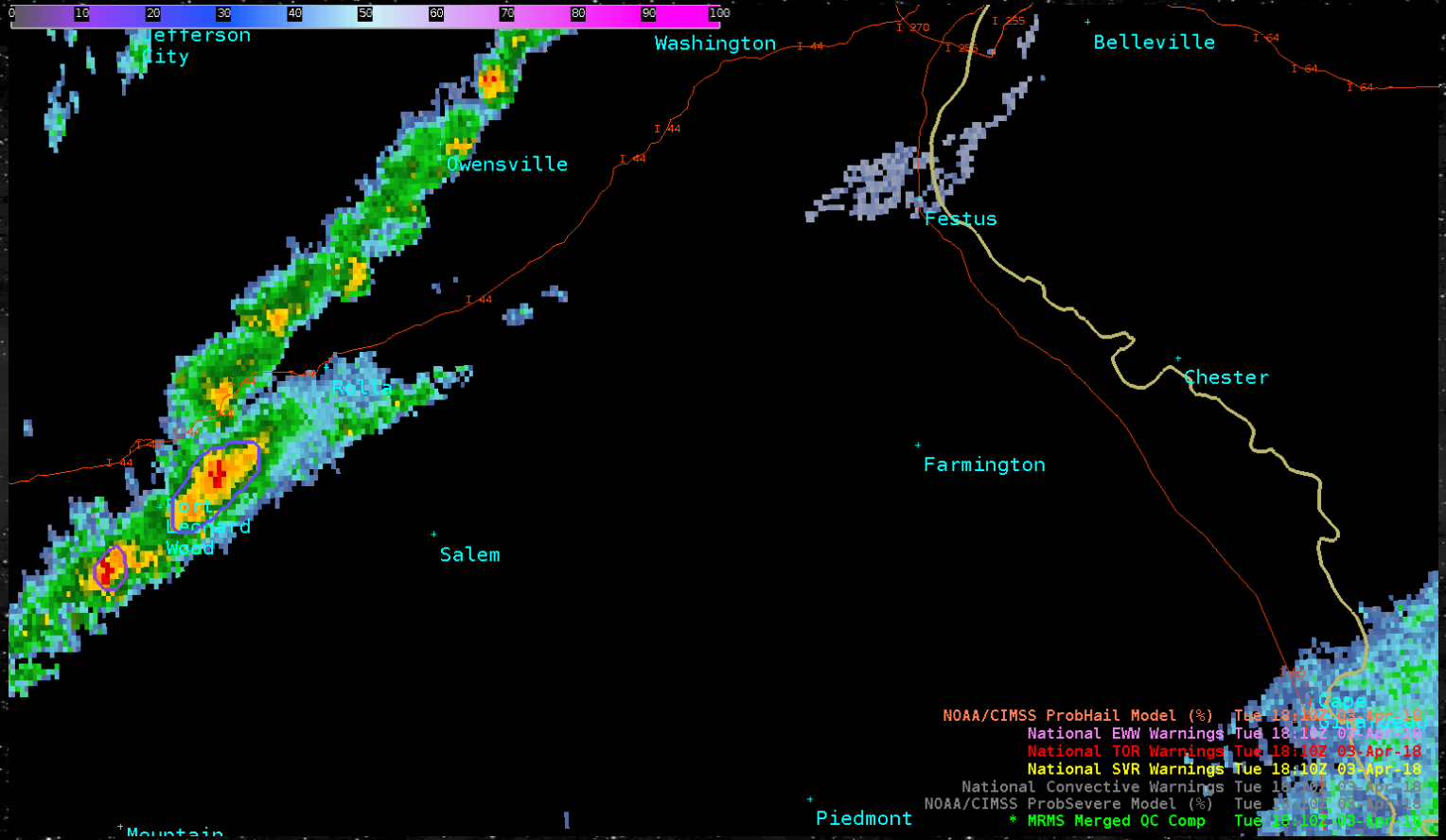

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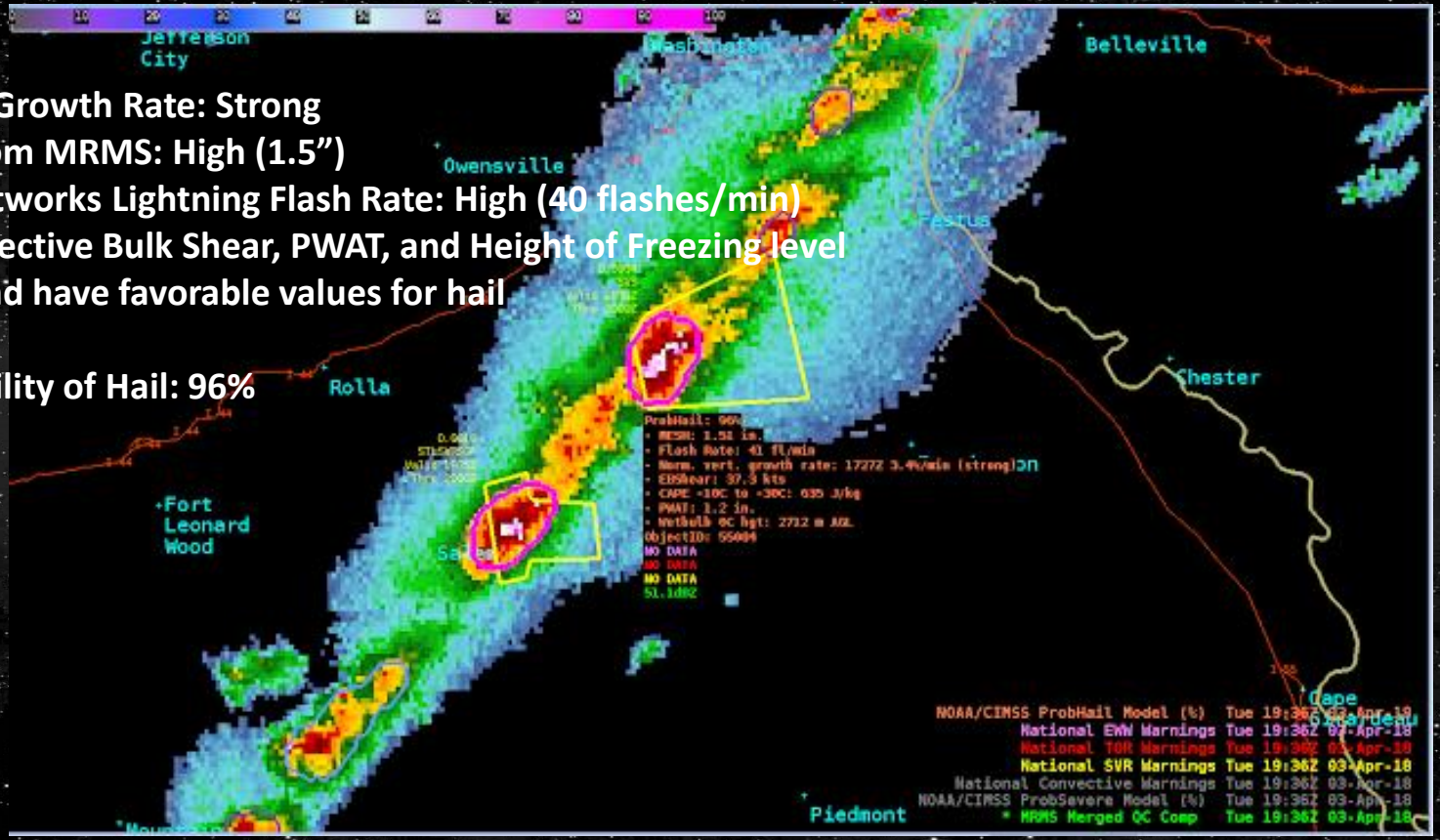
ProbSevere (Experimental)

Mike Pavolonis (NOAA), John Cintineo and Justin Sieglaff (CIMSS)

- Satellite Growth Rate: Strong
- MESH from MRMS: High (1.5”)
- Earth Networks Lightning Flash Rate: High (40 flashes/min)
- CAPE, Effective Bulk Shear, PWAT, and Height of Freezing level

all used and have favorable values for hail

→ Probability of Hail: 96%



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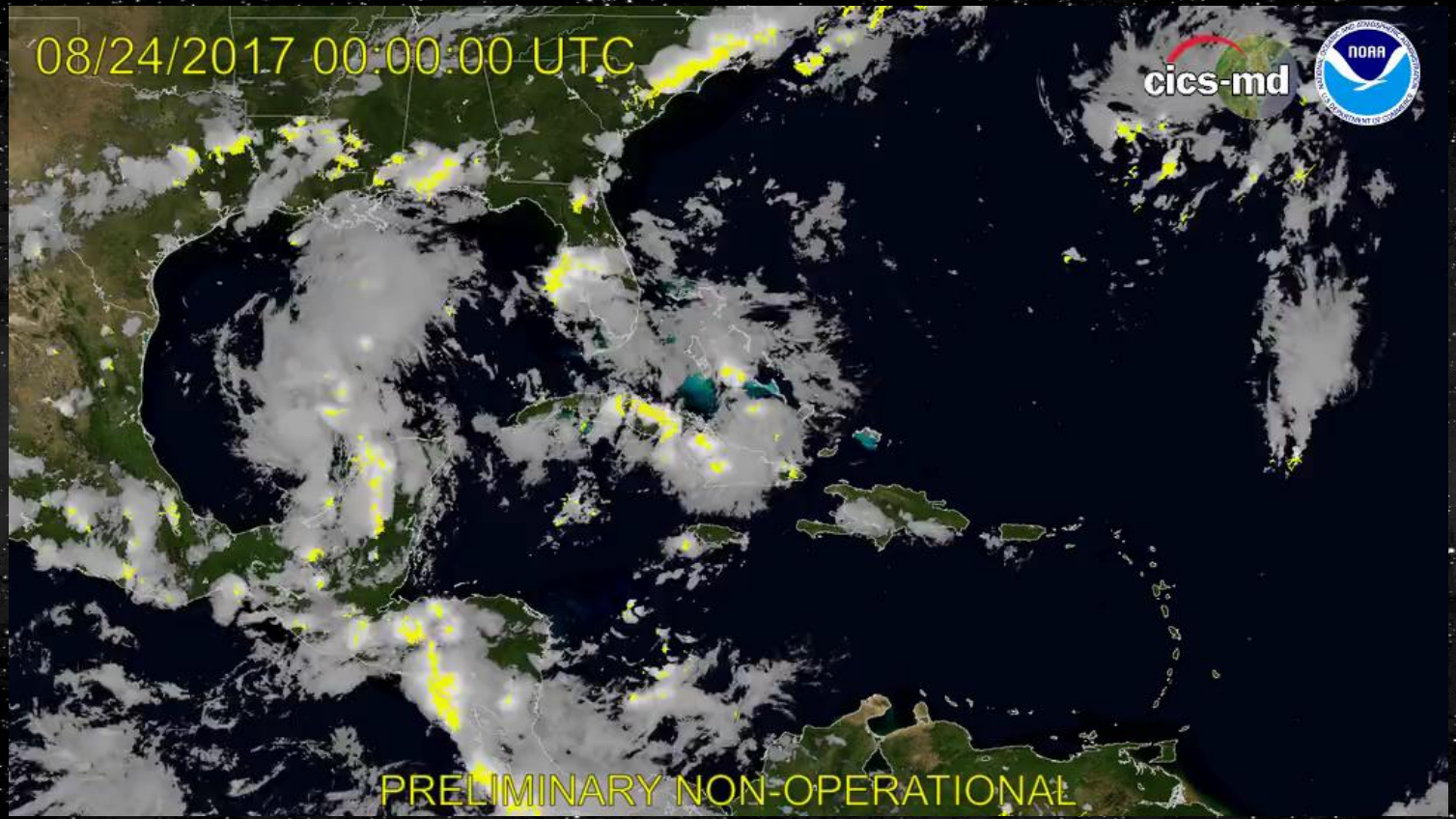
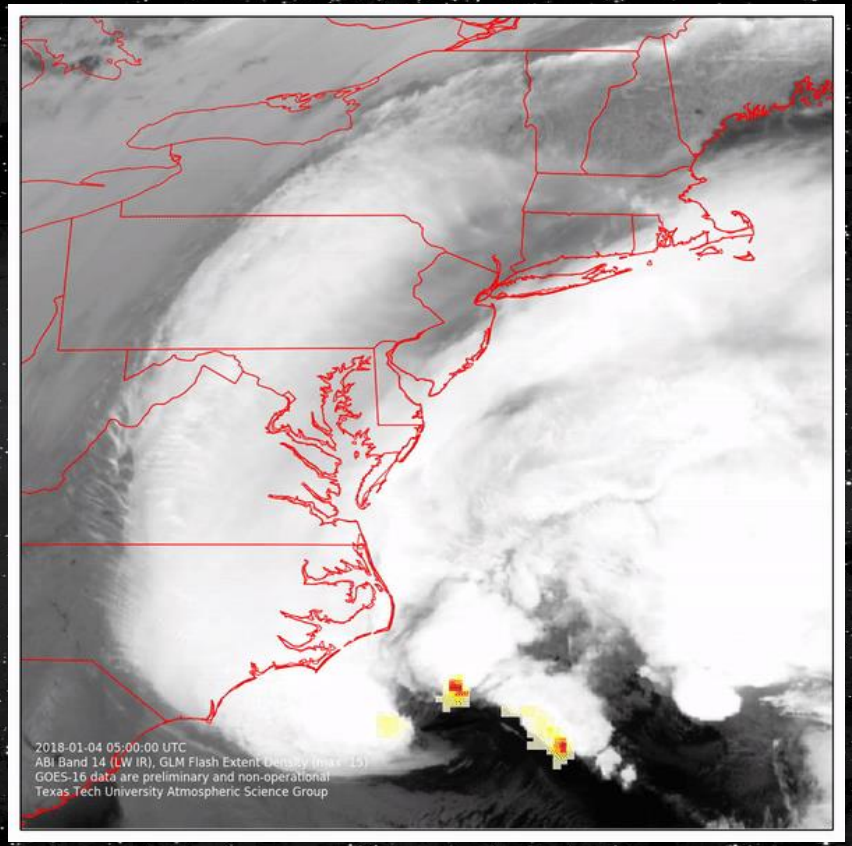
Geostationary Lightning Mapper (GLM)



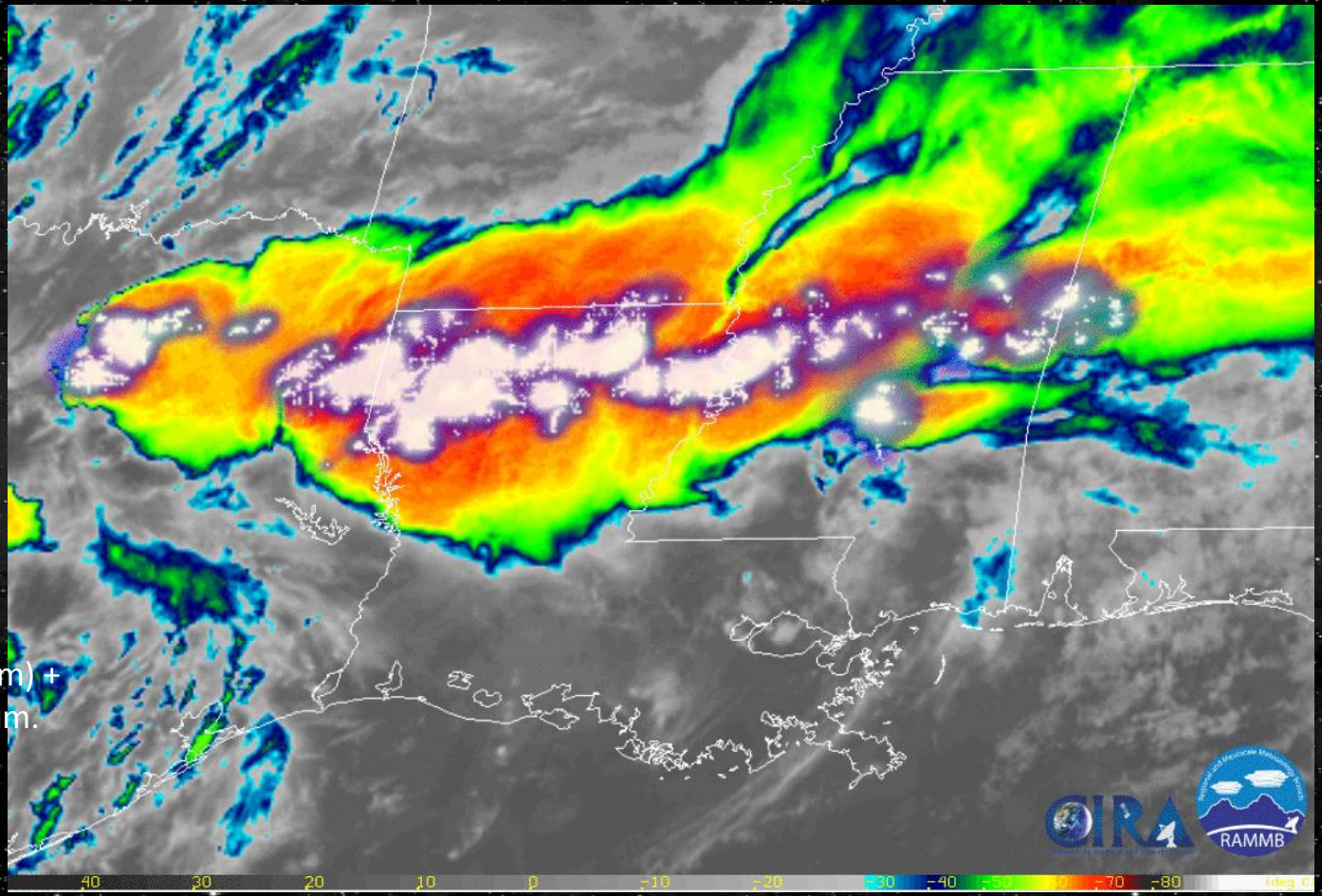
Geostationary Lightning Mapper (GLM)

- As of January 2018, updates to the ground processing algorithm have fixed the grand majority of original GLM issues
- Some false alarms still exist, particularly associated with sunglint
- Minor geo-location errors can occur, especially nearer the limb when the side of a convective cloud is being observed
- There are many possible ways to display the data, and the method used by the U.S. National Weather Service will be tested in summer 2018



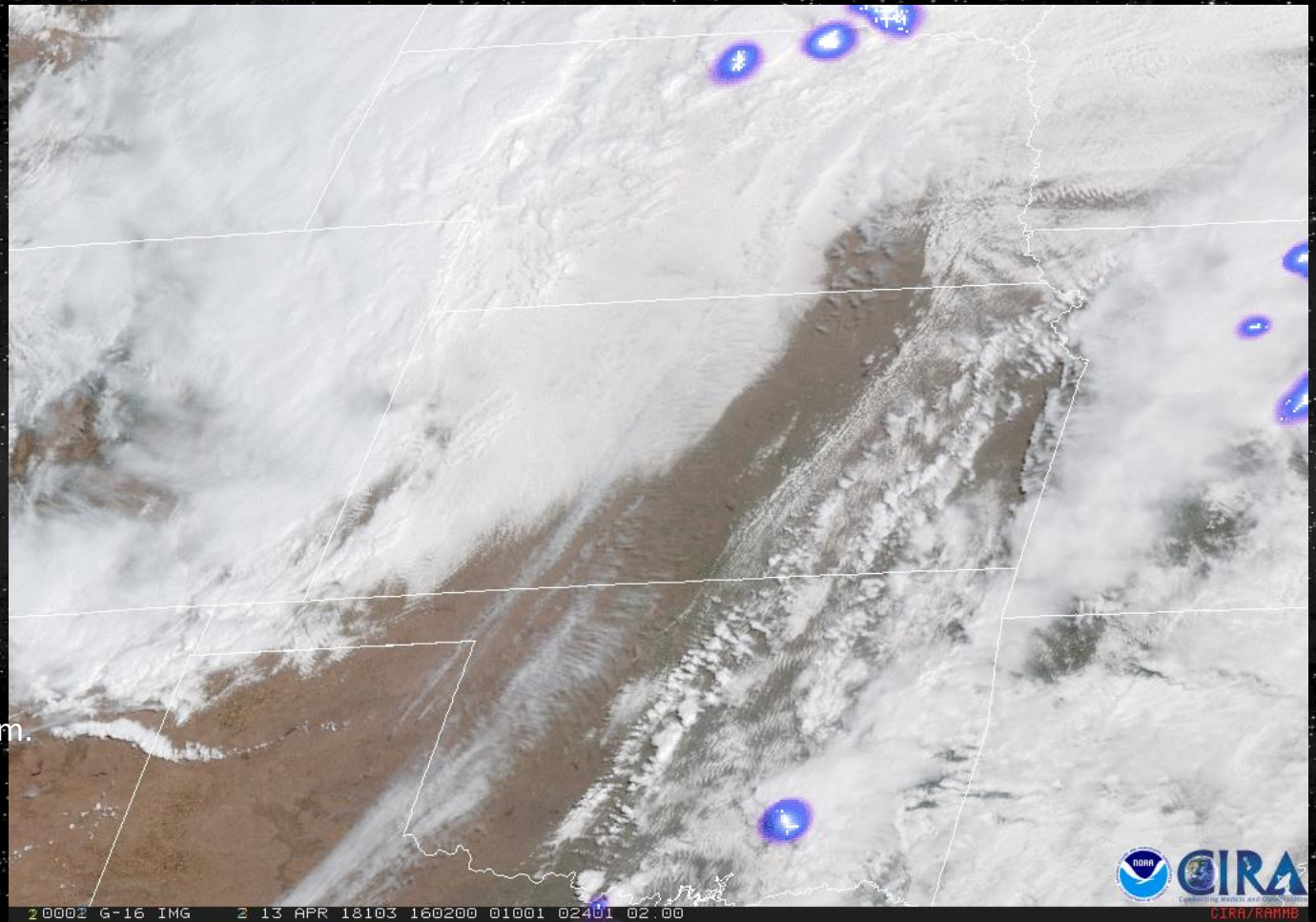
Courtesy of Scott Rudlosky and Geoffrey Stano

Geostationary Lightning Mapper (GLM)



Band 13 (10.3 µm) +
GLM 5-min accum.
group density
6 Apr. 2018

Geostationary Lightning Mapper (GLM)

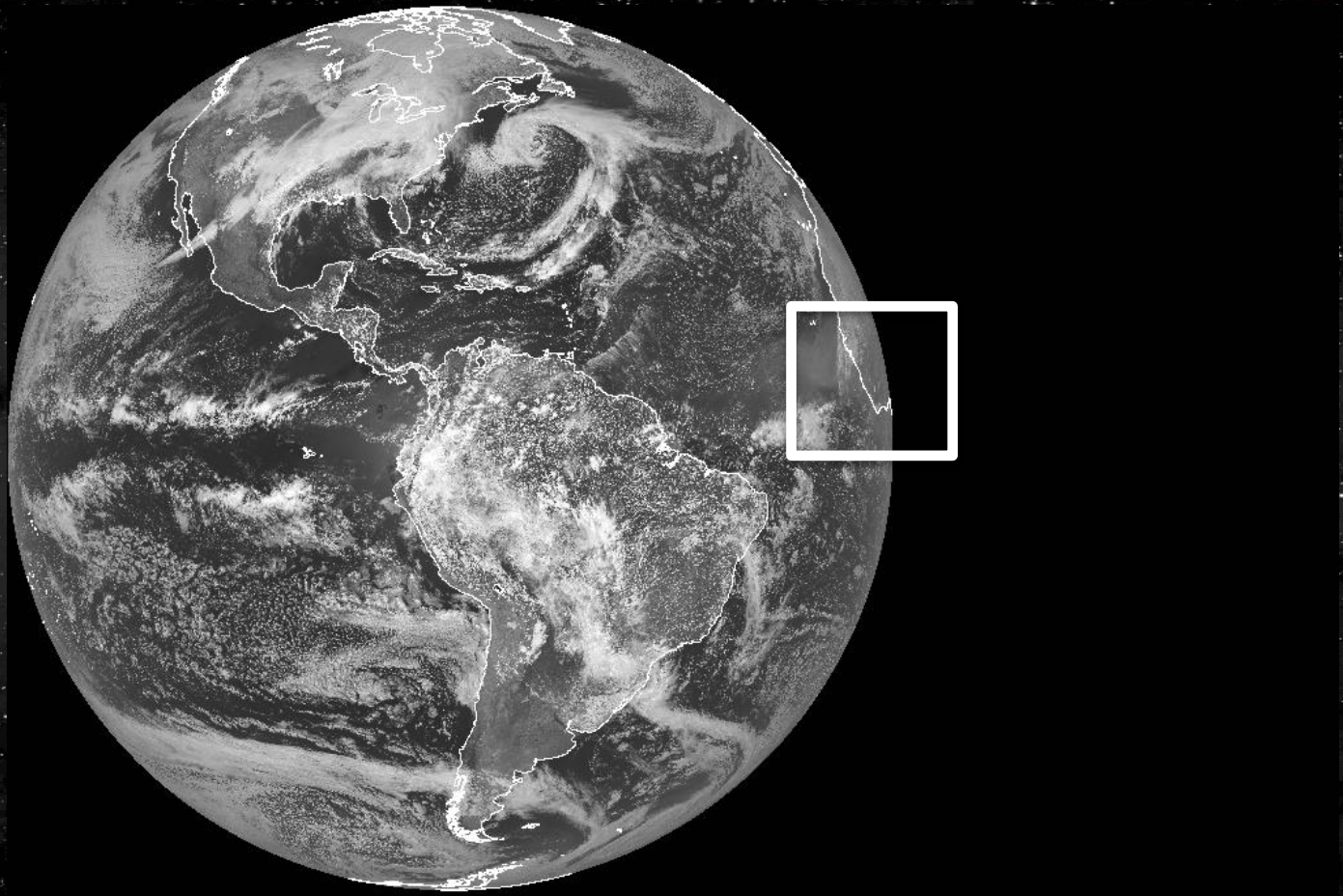


GeoColor +
GLM 5-min accum.
group density
13 Apr. 2018

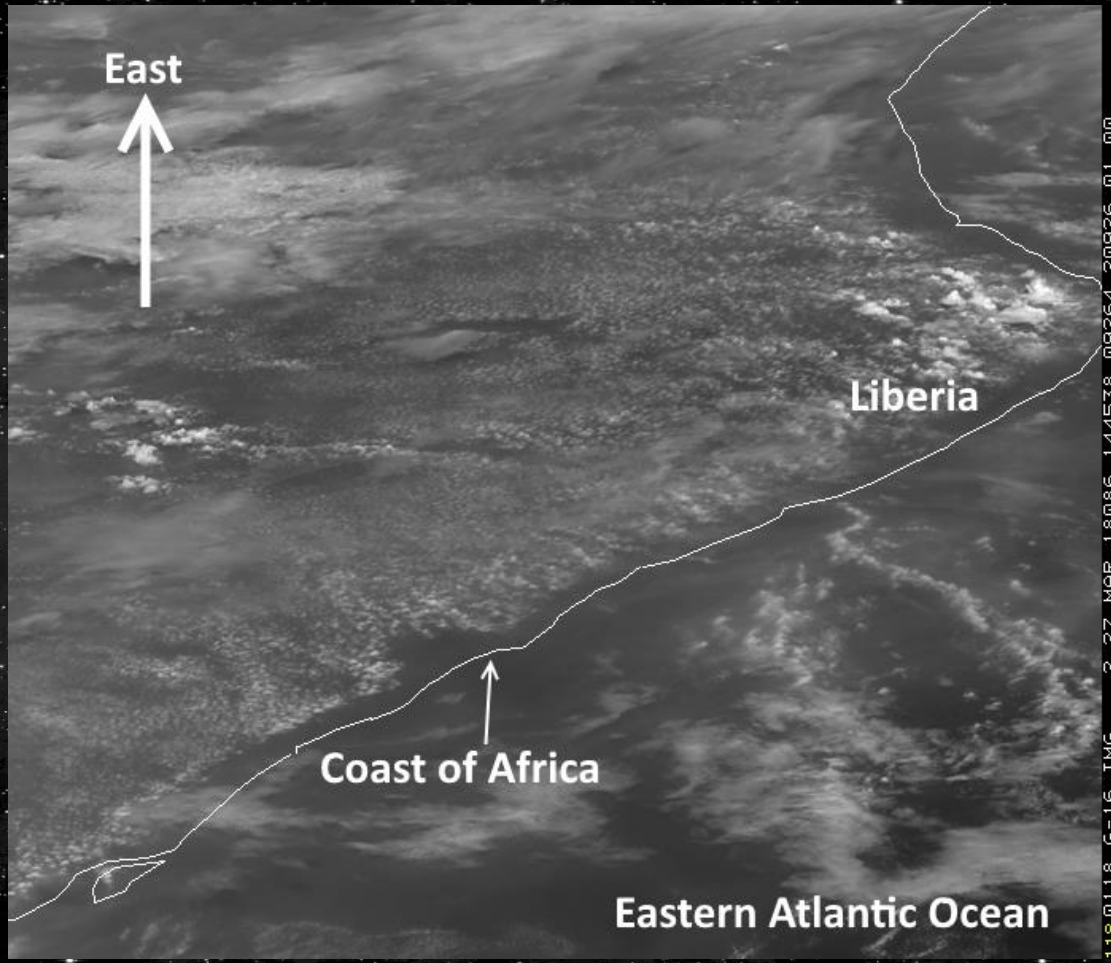
Recommendations for MTG/FCI based on 1+ years of GOES-16 ABI Observations by NOAA

1) Imagery is (and should be) used in both qualitative and quantitative ways by forecasters
2) The 500-m VIS band is excellent for monitoring clouds prior to convective initiation, and for assessing storm severity particularly in radar-free regions
3) Continue widespread use of RGBs
4) For the true color RGB, employ Rayleigh Correction and a hybrid green enhancement
5) Sometimes it's beneficial to display the components of RGBs in order to isolate a physical mechanism (e.g., 10.3 – 12.3 for low-level WV convergence)
6) For new lightning-detecting instruments, allow plenty of time post-launch to test and adopt ground processing algorithm
7) Rapid scanning (<= 2.5 min) provides excellent value for convective storm analysis (including the pre-storm time frame)
8) Limb observations are significantly improved with the ABI; expect similar with FCI

Limb View



Limb View


East
Liberia
Coast of Africa
Eastern Atlantic Ocean
118 01 18 G-16 IMG 2 27 MAR 18086 144538 09264 20926 01 00