



# First Images and Products from VIIRS on NPP

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<sup>2</sup>The Aerospace Corporation

# VIIRS EDR Imagery Team

- NESDIS/StAR (D. Hillger, D. Molenaar, D. Lindsey, T. Schmit – GOES liaison)
- CIRA/CSU (S. Miller, S. Kidder, S. Finley, H. Gosden, R. Brummer, C. Seaman)
- CIMSS/SSEC (T. Achtor, T. Jasmin, T. Rink)
- Aerospace (T. Kopp, J. Drake, J. Feeley)
- NOAA/NGDC (C. Elvidge)
- AFWA (J. Cetola)
- NIC (P. Clemente-Colon)
- Northrop Grumman (K. Hutchison, R. Mahoney)
- NASA (W. Thomas, P. Meade)
- NOAA/OSPO (A. Irving)
- NASA/SPoRT (G. Jedlovec, M. Smith)



# NPP



- **NPOESS Preparatory Project (NPP)** satellite
  - Formerly part of NPOESS program
  - Now the first JPSS satellite
- Joint **NASA/NOAA** mission, but NPP data will be used by many civilian and military customers
- **Visible Infrared Imager Radiometer Suite (VIIRS)**
  - just one of several instruments on NPP

# NPP Timeline

- **Launch: 2011-10-28**
- **VIIRS visible/reflective band doors open: 2011-11-21**
- **Day Night Band (DNB) started at the same time.**
- **VIIRS thermal/IR band doors open: 2012-01-18**

# VIIRS Imagery EDRs

VIIRS Band	Central Wavelength (μm)	Wavelength Range (μm)	Band Explanation	Spatial Resolution (m) @ nadir
<b>M1</b>	0.412	0.402 - 0.422	Visible	750 m
<b>M2</b>	0.445	0.436 - 0.454		
<b>M3 (blue)</b>	0.488	0.478 - 0.488		
<b>M4 (green)</b>	0.555	0.545 - 0.565		
<b>M5 (red)</b>	0.672	0.662 - 0.682		
<b>M6</b>	0.746	0.739 - 0.754	Near IR	
<b>M7</b>	0.865	0.846 - 0.885		
<b>M8</b>	1.240	1.23 - 1.25	Shortwave IR	
<b>M9</b>	1.378	1.371 - 1.386		
<b>M10</b>	1.61	1.58 - 1.64		
<b>M11</b>	2.25	2.23 - 2.28		
<b>M12</b>	3.7	3.61 - 3.79	Medium-wave IR	
<b>M13</b>	4.05	3.97 - 4.13		
<b>M14</b>	8.55	8.4 - 8.7	Longwave IR	
<b>M15</b>	10.763	10.26 - 11.26		
<b>M16</b>	12.013	11.54 - 12.49		
<b>DNB</b>	0.7	0.5 - 0.9	Visible	750 m across full scan
<b>I1 (red)</b>	0.64	0.6 - 0.68	Visible	375 m
<b>I2</b>	0.865	0.85 - 0.88	Near IR	
<b>I3</b>	1.61	1.58 - 1.64	Shortwave IR	
<b>I4</b>	3.74	3.55 - 3.93	Medium-wave IR	
<b>I5</b>	11.45	10.5 - 12.4	Longwave IR	

Only 6 EDRs for 16 bands  
(default bands are highlighted)

1 EDR

All 5 of 5

# VIIRS granules

- Granule duration [**~85.752 seconds**] fixed
- Granule dimensions:
  - **I (imagery-resolution) bands** [1541 x 8241] @ **375 m** resolution
  - **M (moderate-resolution) bands** [771 x 4121] @ **750 m** resolution
- Granule swath: **~3000 km @ 824 km** altitude
- Granules: **~70/ orbit** (~100 minutes), or **~1000/day**
- Equator crossing: **~1330 local time**, sun-synchronous
- **Reflectance and radiance** are stored as two-byte (12-bit) unsigned integers. Supplied, slopes and offsets transform the scaled integers to radiance/reflectance or radiance/brightness temperature.
- **Sources of VIIRS data:**
  - GRAVITE
  - CLASS
  - Star Central Data Repository (SCDR) soon

# NPP Imagery Team page

<http://rammb.cira.colostate.edu/projects/npp/>



## NPOESS Preparatory Project (NPP) VIIRS Imagery and Visualization Team

(Last updated: 2011-11-15)

The first of the **Joint Polar Satellite System (JPSS)** spacecraft, the **National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP)** satellite was successfully launched **at 0948 UTC on 28 October 2011**.

See NASA's [NPP launch video](#).

The **first visible/reflective images** are expected on **Launch+24 Days (~21 November 2011)**.  
The **first infrared/thermal images** are expected on **Launch+42 Days (~9 December 2011)**.

The NESDIS/STAR Imagery and Visualization and Visualization Team (co-led by Don Hillger @ NOAA and Tom Kopp @ Aerospace Inc.) will be responsible for the checkout of imagery (and data) from the **Visible/Infrared Imager Radiometer Suite (VIIRS)** instrument on NPP.

A RAMSDIS Online display of **simulated/proxy VIIRS data** is available at [http://rammb.cira.colostate.edu/ramsdis/online/npp\\_viirs.asp](http://rammb.cira.colostate.edu/ramsdis/online/npp_viirs.asp). The selected images may vary widely in location and size.



[NPP Orbital Passes](#)

[Reverse Chronology of NPP VIIRS Significant Events](#)

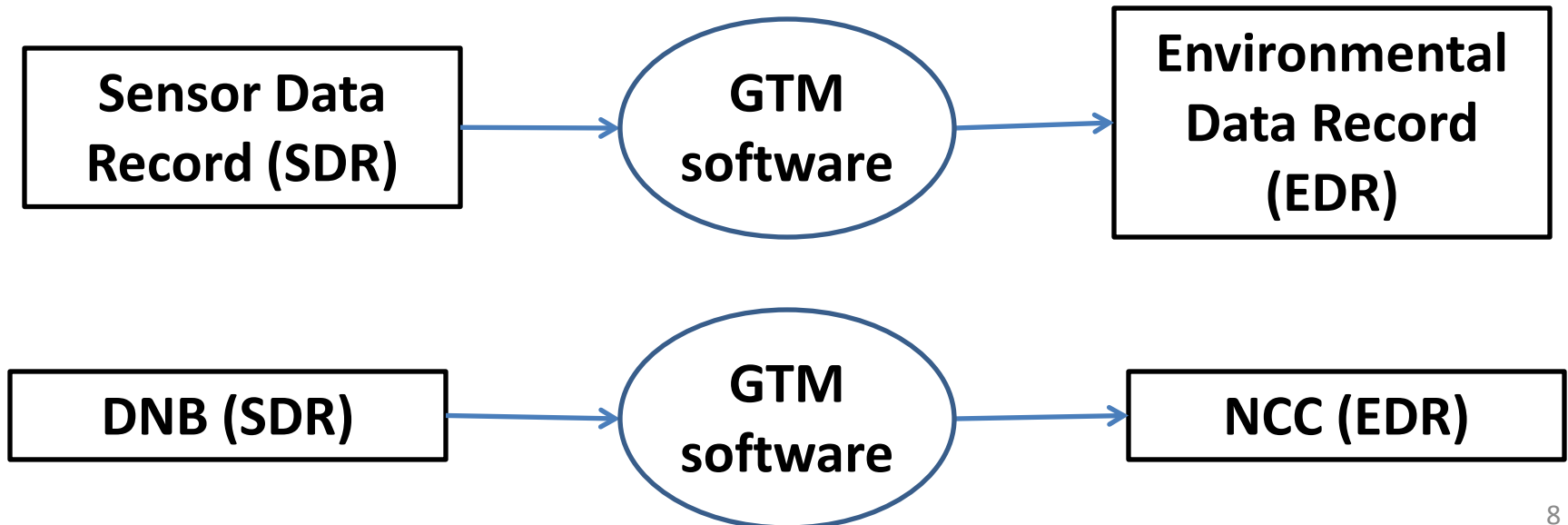
[NPP Reference Information/Websites](#)

### NPP Orbital Passes

The NPP predicted track is plotted on GOES-13 full-disk 10.7  $\mu\text{m}$  imagery to assist with matching NPP data with meteorological features of interest. Since the full disk scans occur every 3 hours, only the track within +/- 90 minutes of each scan is plotted.

# SDR to EDR

- **Ground Track Mercator (GTM)** remapping software.
- GTM is a **remapping** of the data, but the same radiances/reflectances





# SDR Examples

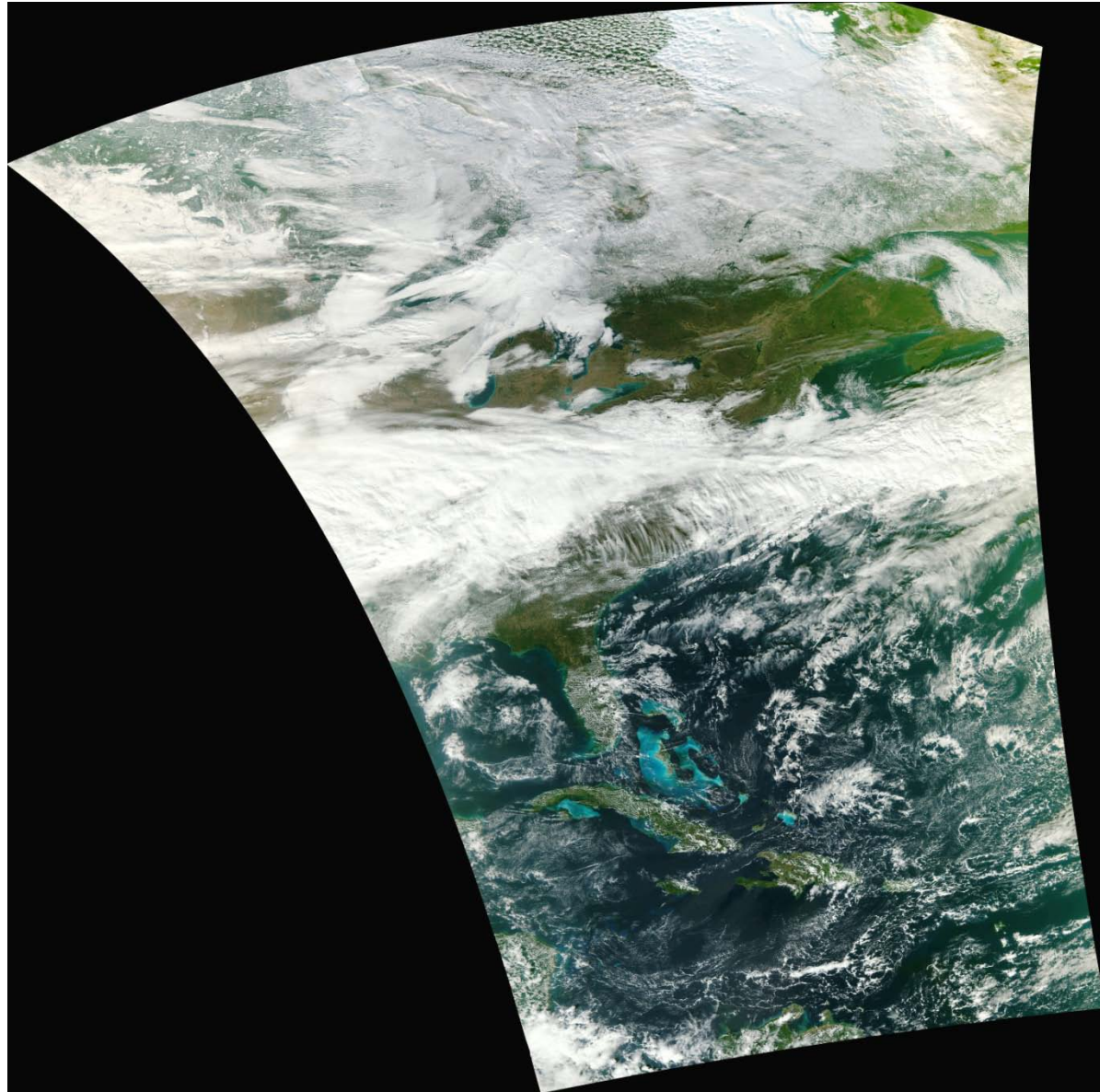
- The following images are **examples** built from VIIRS SDRs by members of the Imagery Cal/Val team
- In particular, Imagery **EDRs** are not produced from all of the VIIRS bands (in particular, the three bands needed for true-color imagery)
- Some of the examples show the **advantages of VIIRS** over MODIS (and over operational NOAA/AVHRR in particular)

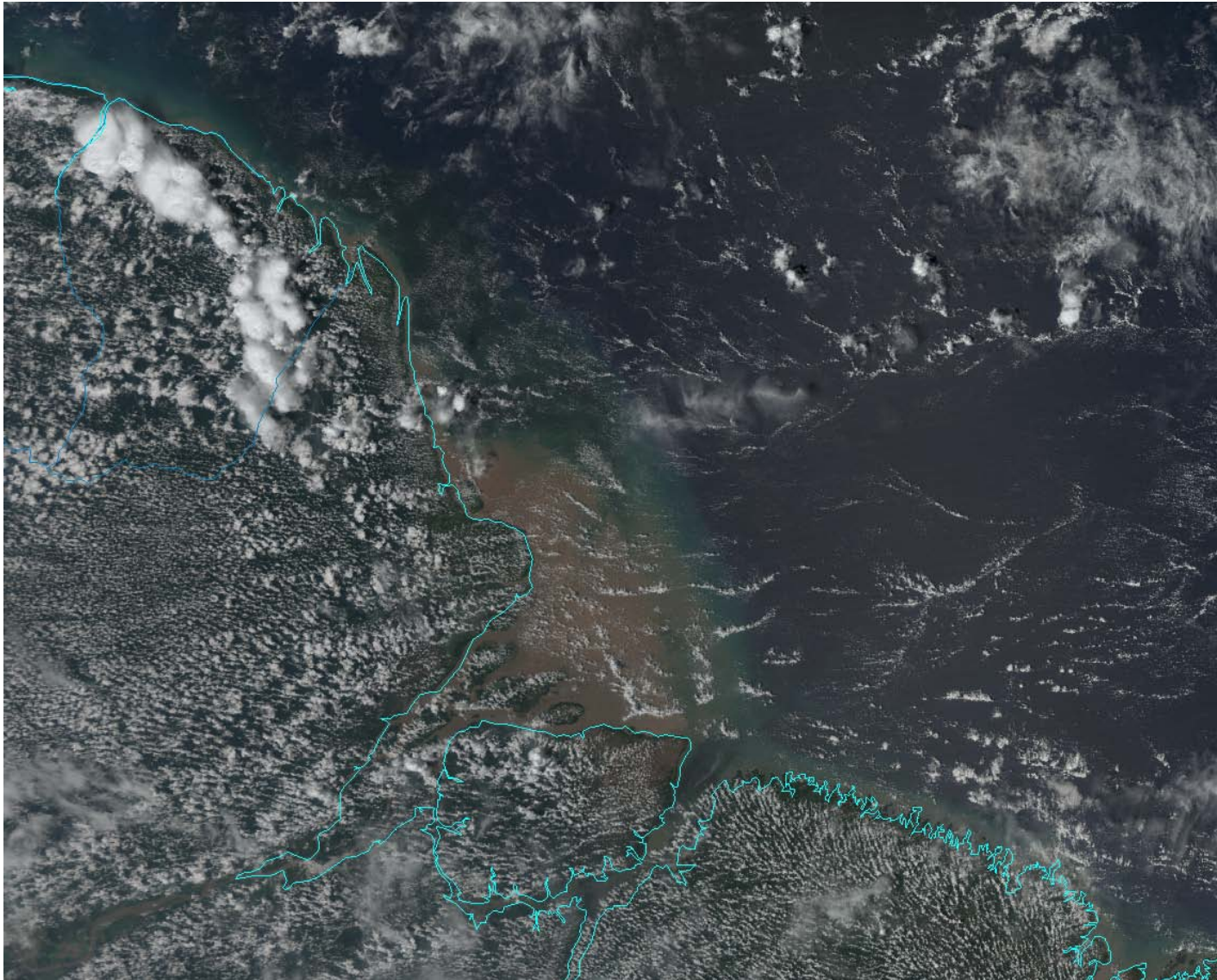
# VIIRS display tools

- **McIDAS-V** (VIIRS ready) –  
SSEC/CIMSS/Wisconsin
- **McIDAS-X** (VIIRS capabilities under  
development) –  
SSEC/CIMSS/Wisconsin
- **TeraScan / NexSat** (web display) –  
NRL
- Other

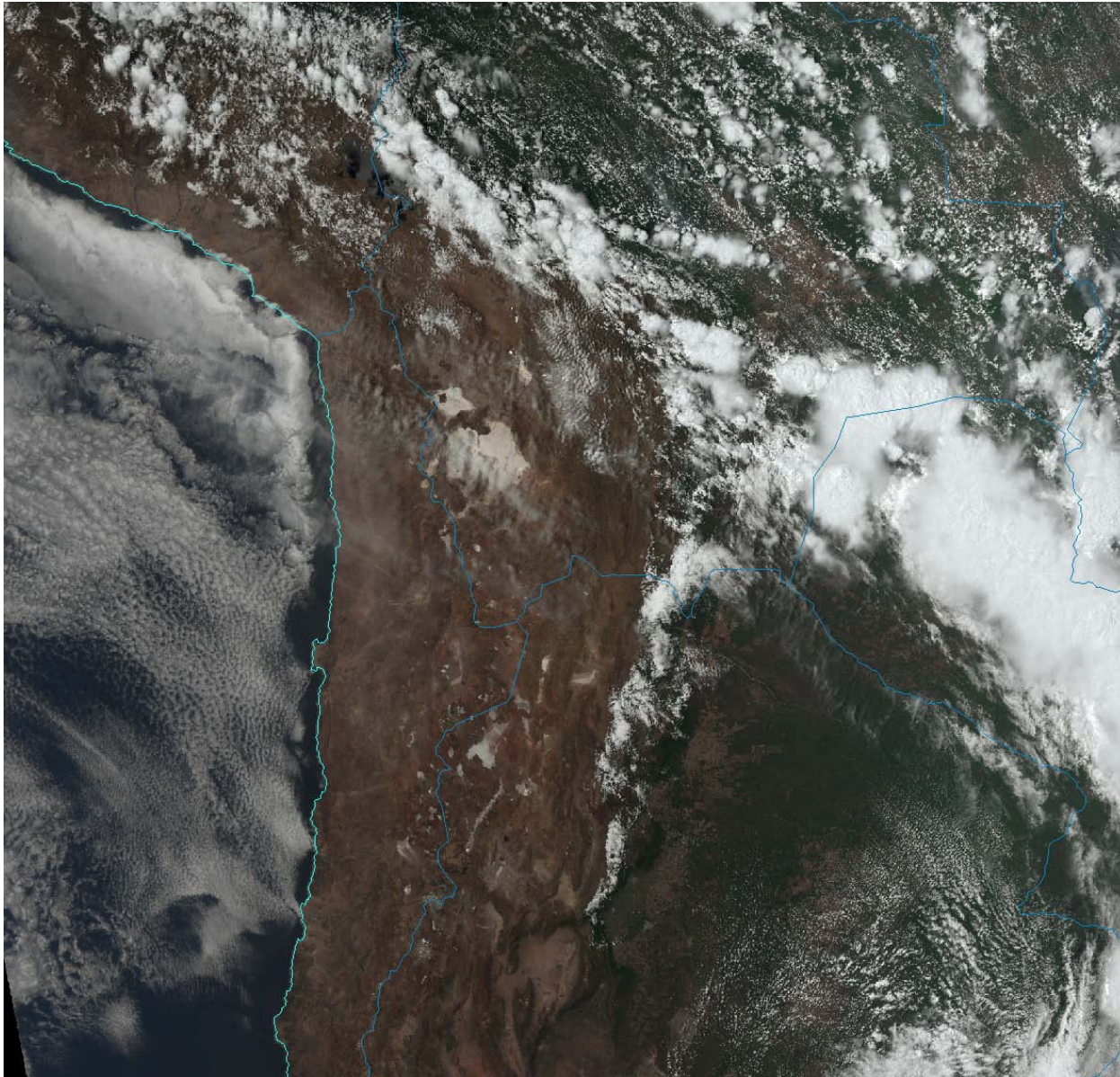


# First VIIRS swath – 2011-11-21 (Courtesy of Atmos PEATE)

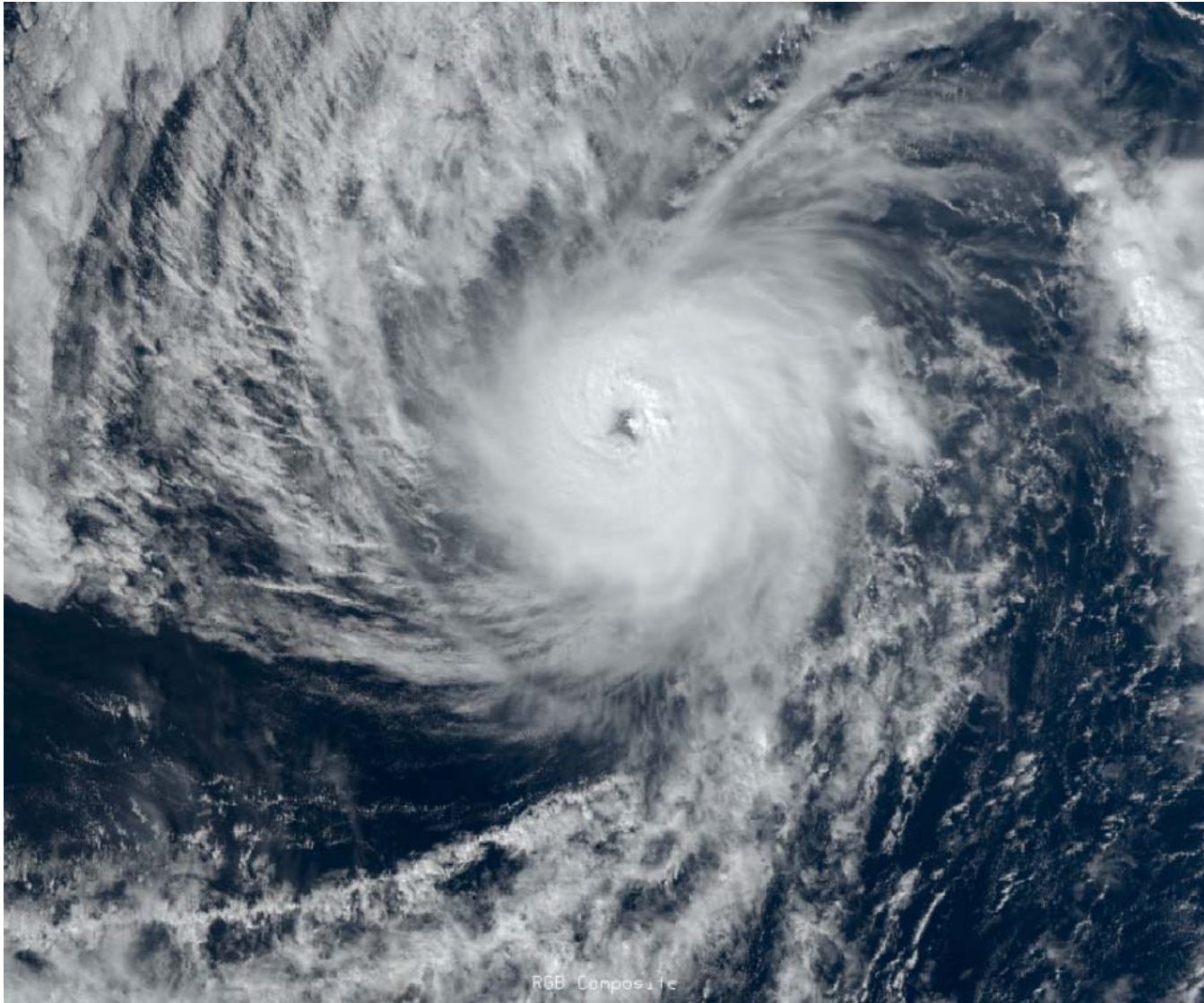




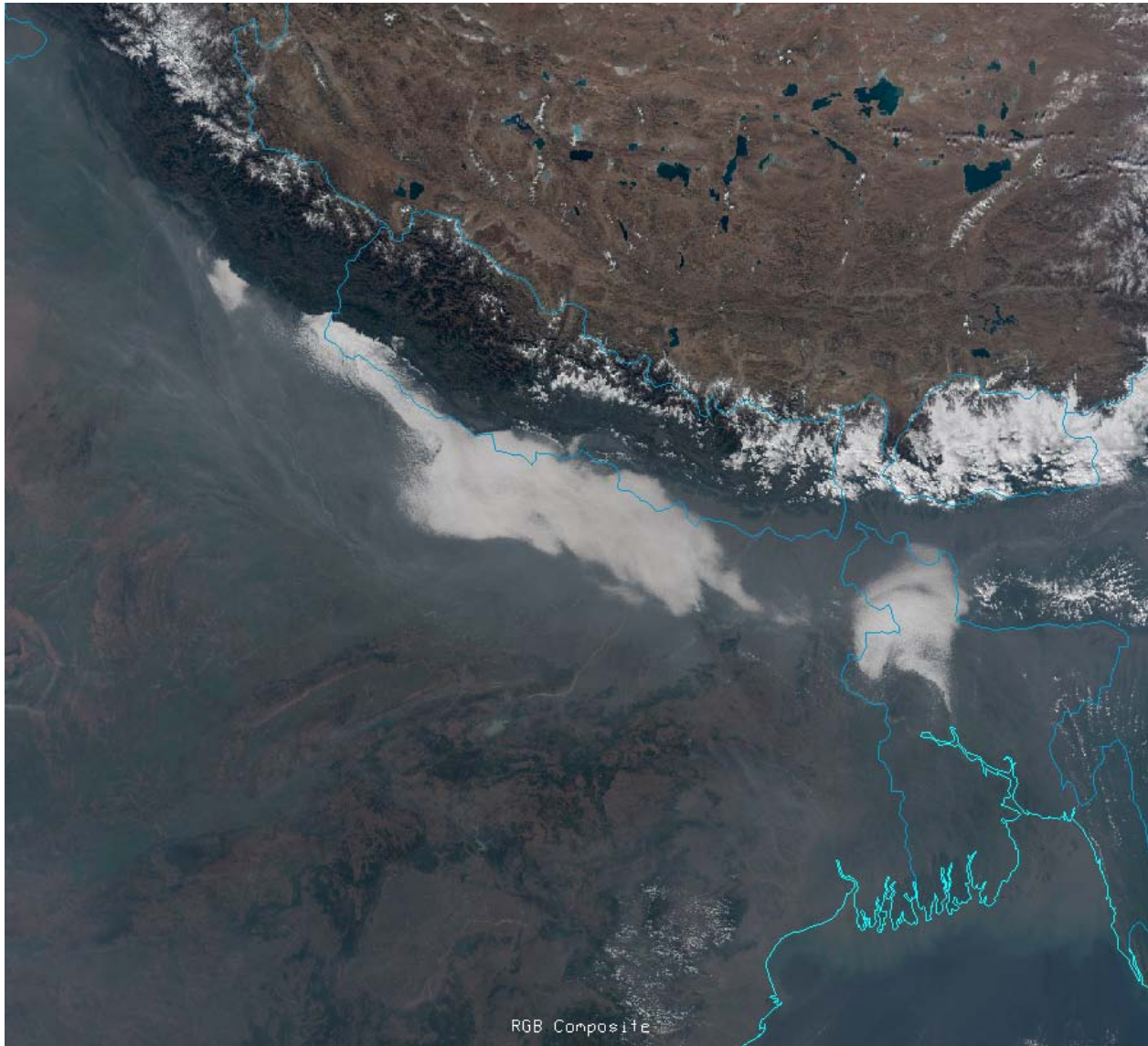
**VIIRS M-band (750 m) true-color/RGB images created from the first data from VIIRS is the following image of the Brazilian coast created using McIDAS-V. [Image courtesy of Tom Rink, CIMSS]**



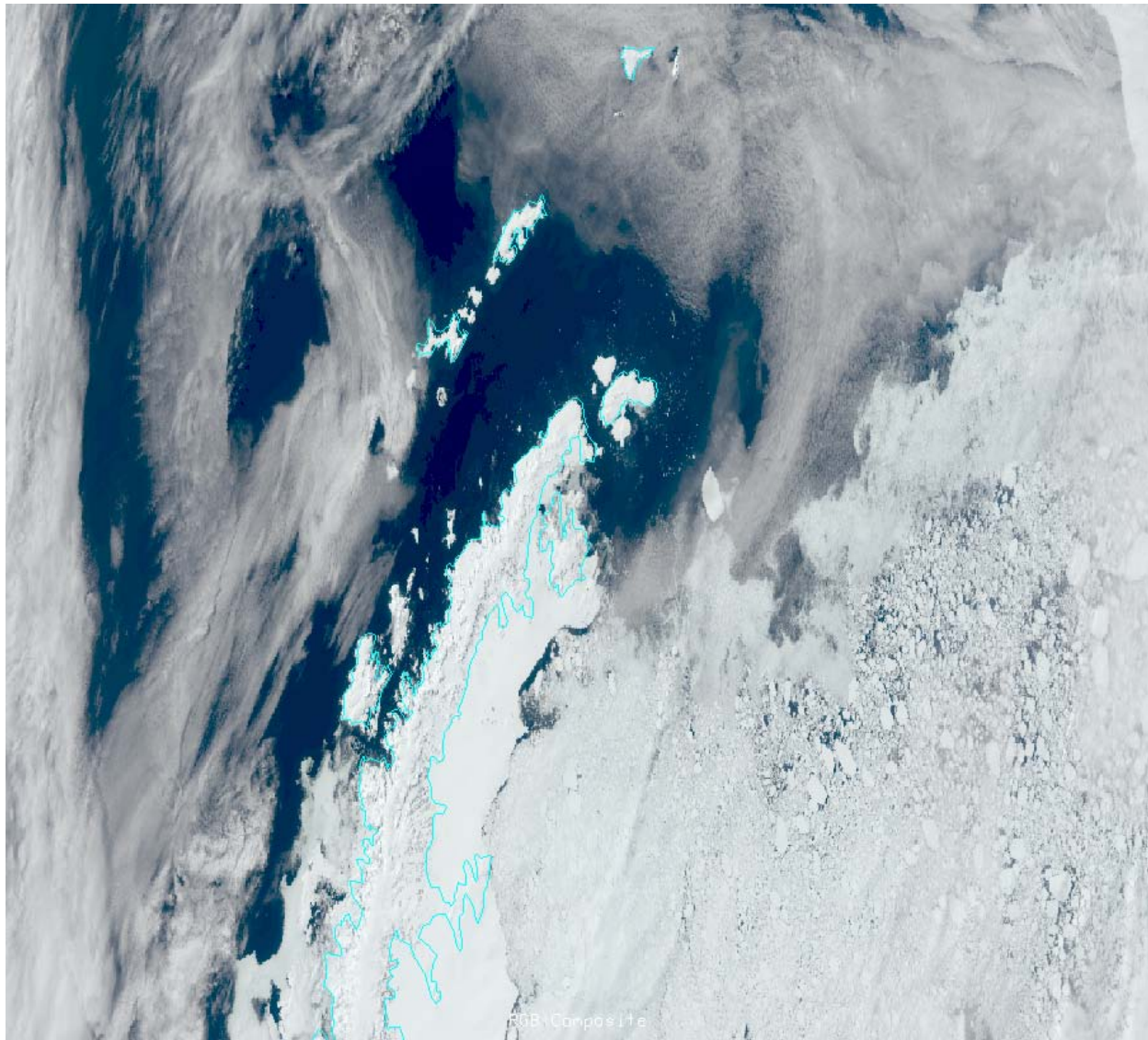
**VIIRS M-band (750 m) true-color/RGB image of the western coast of South America. [Image courtesy of Tom Rink, CIMSS]**



**VIIRS M-band (750 m) true-color/RGB image (for 22 November 2011) over Hurricane Kenneth in the east Pacific. [Image courtesy of Dan Lindsey, NOAA/StAR]**

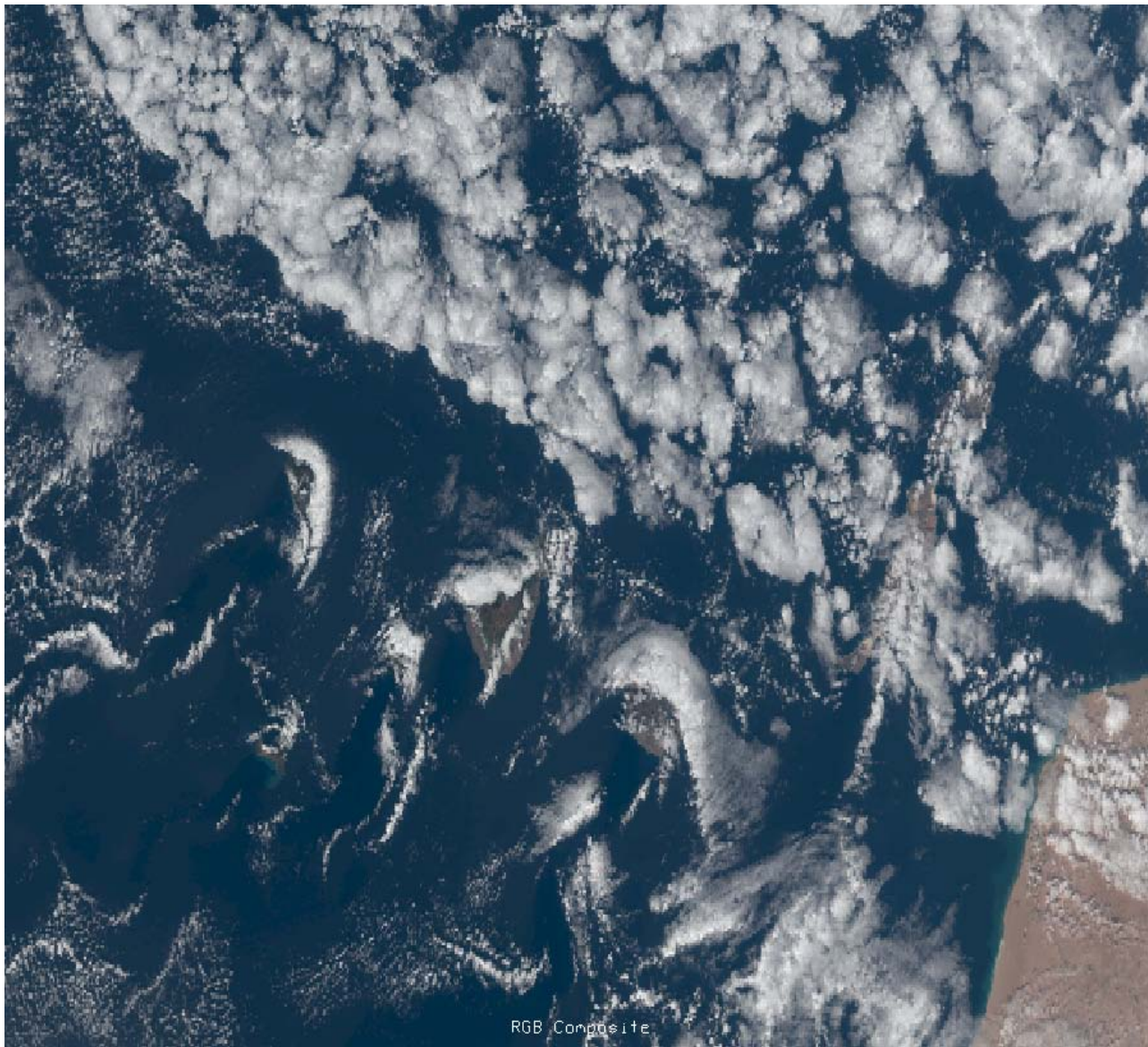


**VIIRS M-band (750 m) true-color/RGB image (for 14 December 2011) over northeastern India and Nepal. Note the large amount of pollution over India relative to Tibet, and how the mountains keep it all to the south. [Image courtesy of Dan Lindsey, NOAA/StAR] <sup>15</sup>**

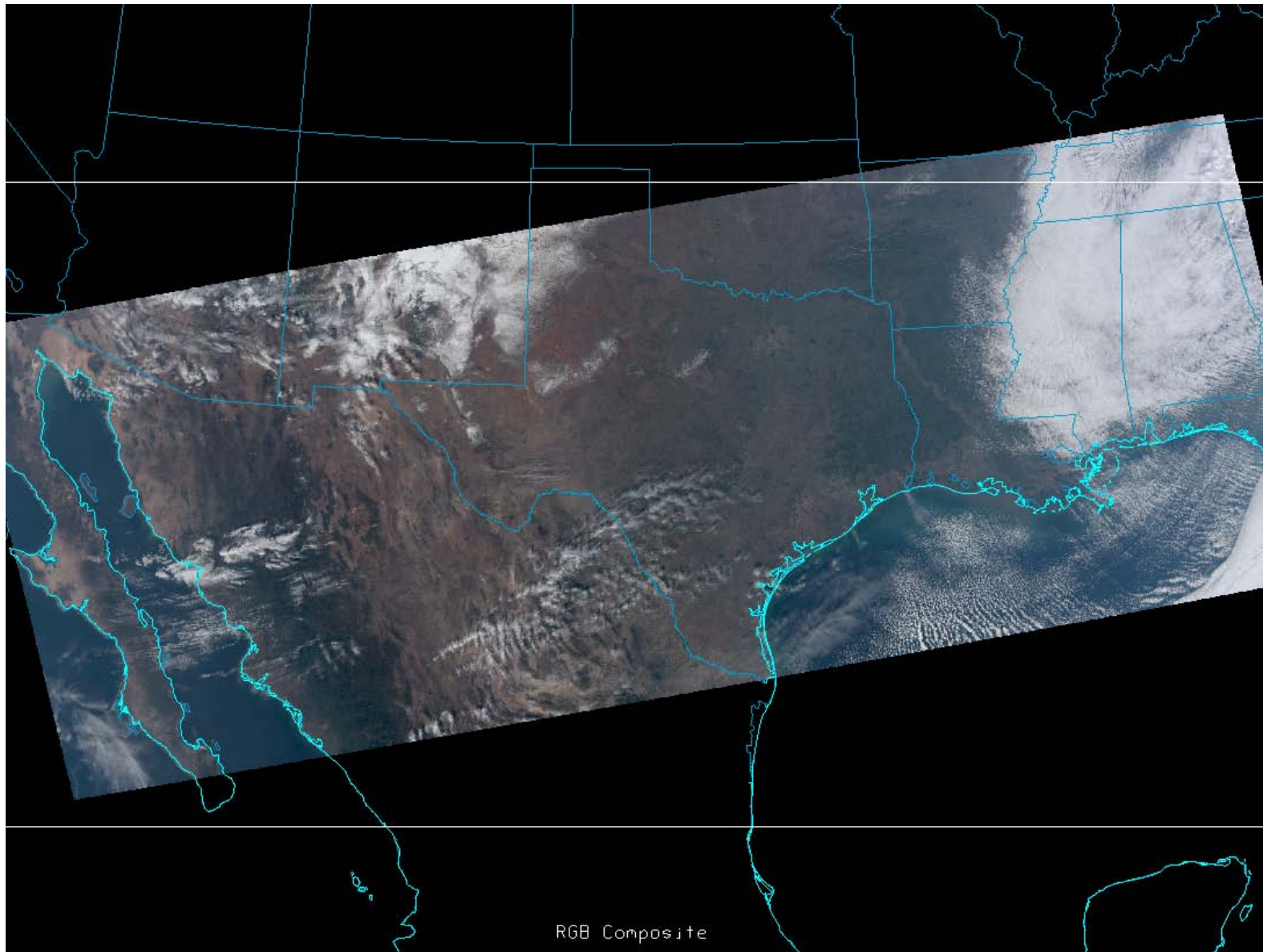


**VIIRS M-band (750 m) true-color/RGB image (for 25 November 2011) with a nice contrast of the open ocean vs. ice. The map is the Antarctic Peninsula which extends toward the tip of S. America, and the Weddell Sea on the right in the image. [Image courtesy of Dan Lindsey, NOAA/StAR]**

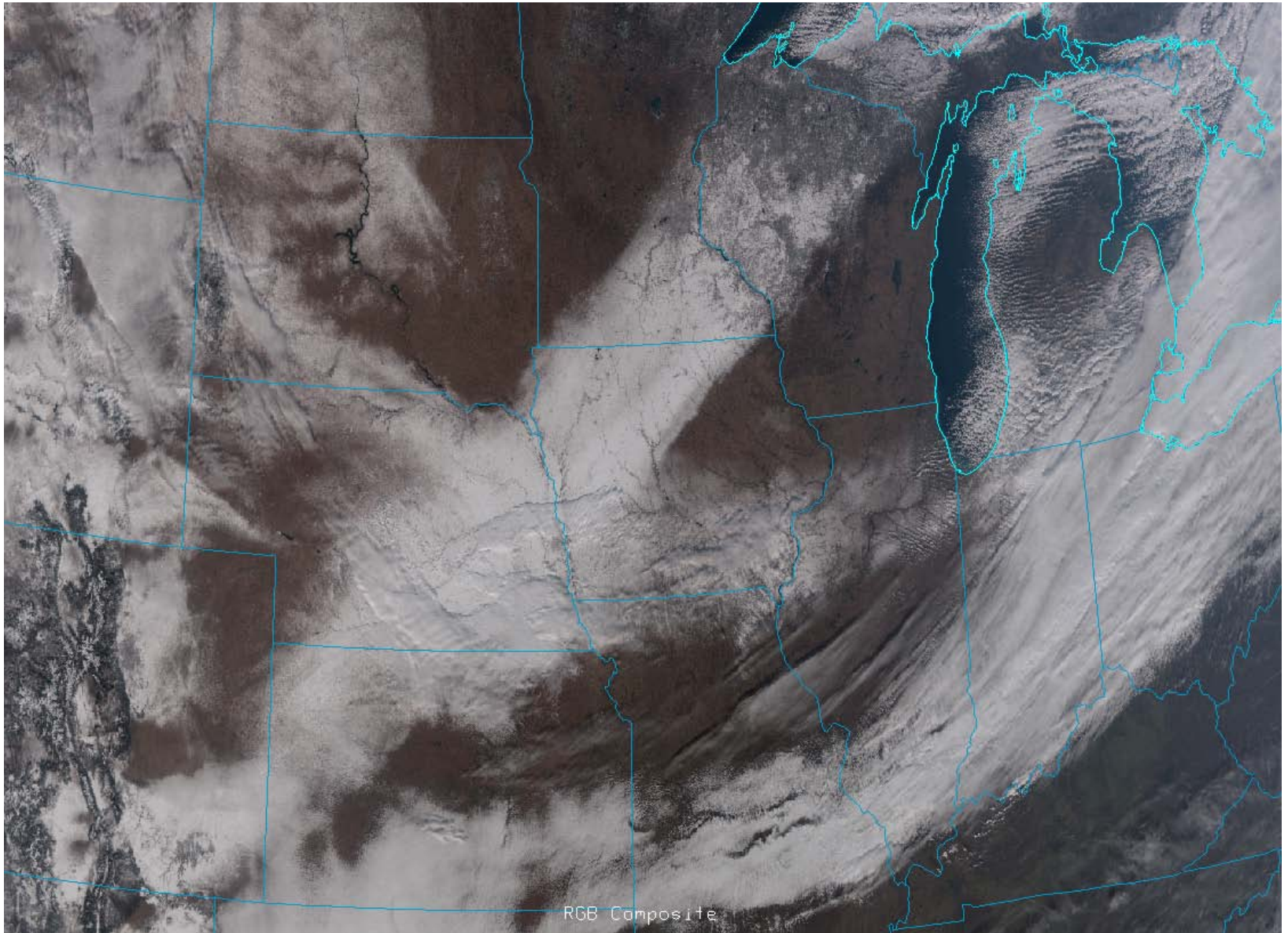




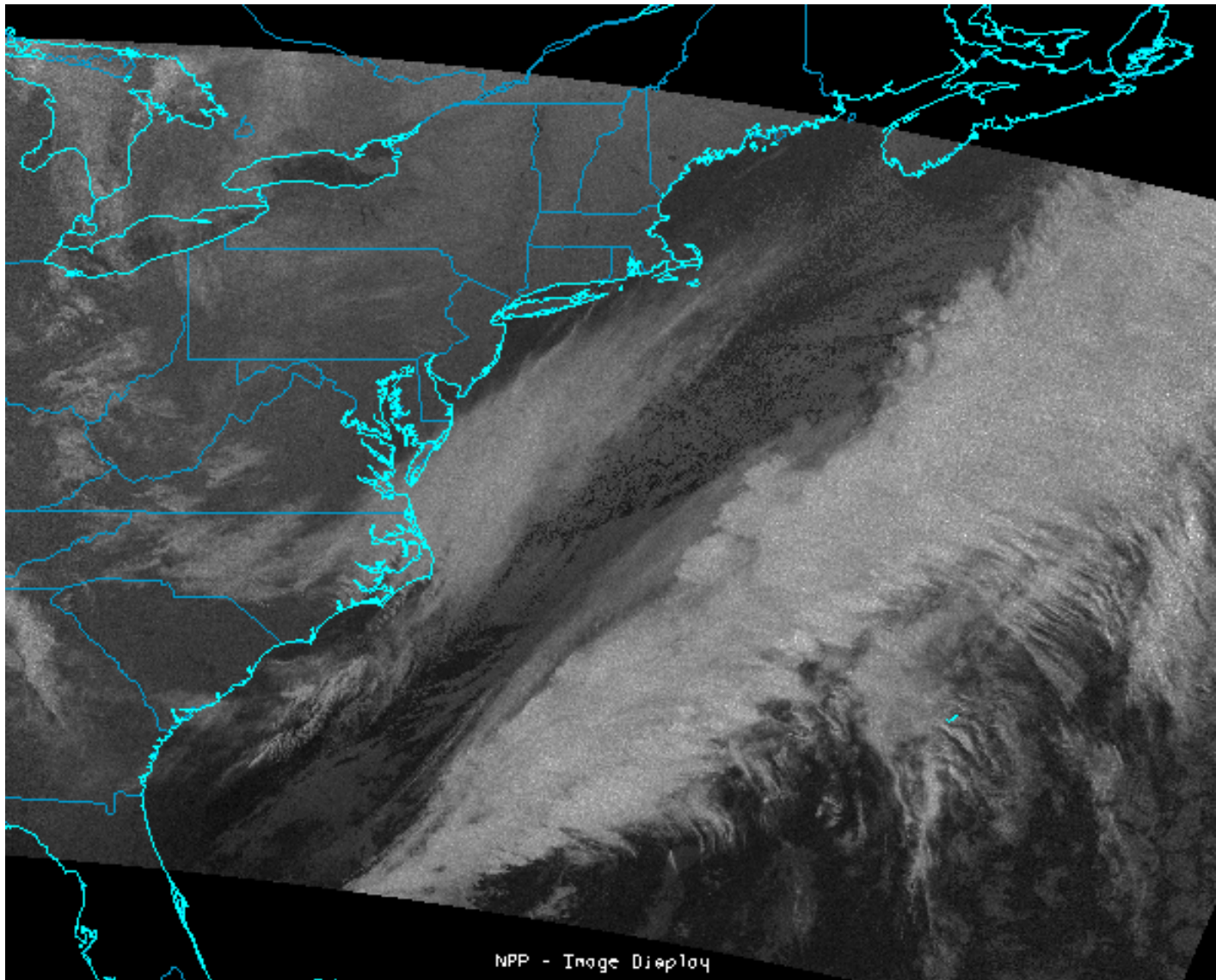
**VIIRS M-band (750 m) true-color/RGB image (for 3 December 2011) with cloud vortices over the Canary Islands, just off of NW Africa. [Image courtesy of Dan Lindsey, NOAA/StAR]**



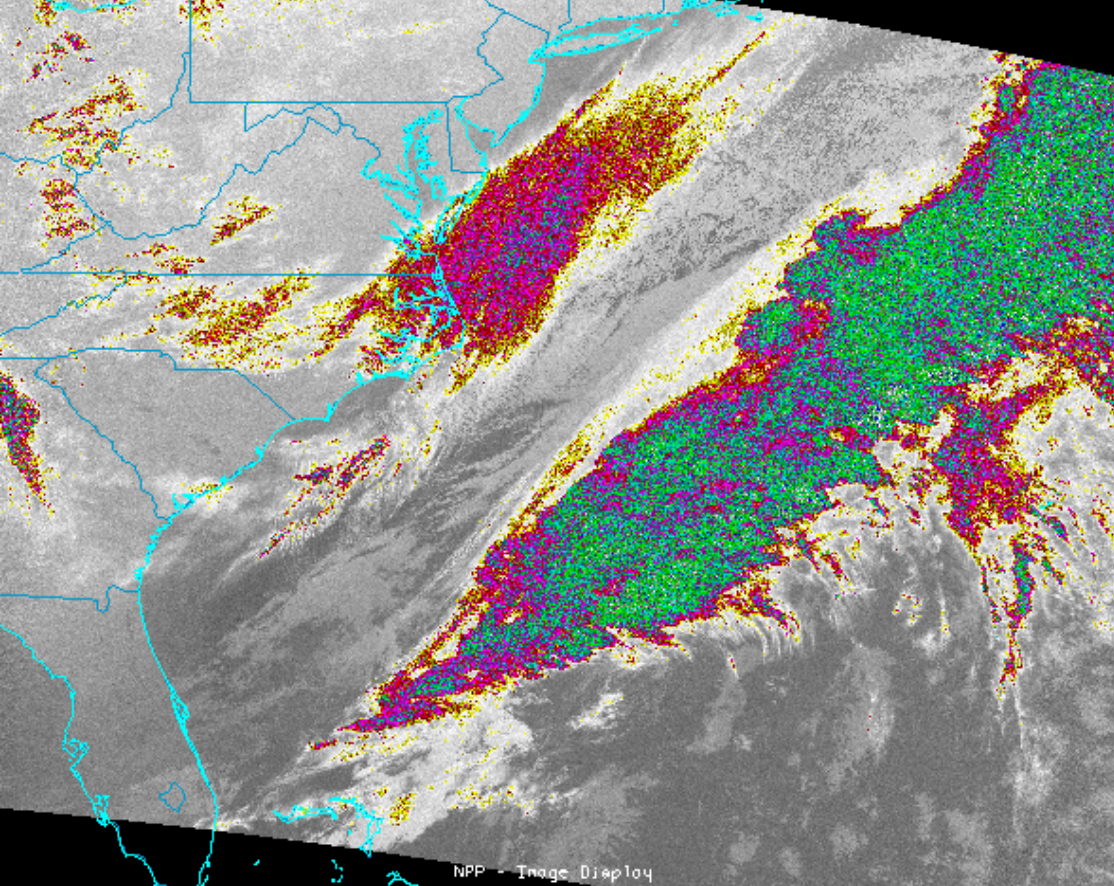
**VIIRS M-band (750 m) true-color/RGB image (for 7 December 2011) over the southern U.S. [Image courtesy of Dan Lindsey, NOAA/StAR]**



**VIIRS M-band (750 m) true-color/RGB image (for 9 December 2011) over the U.S. Upper Midwest. [Image courtesy of Dan Lindsey, NOAA/StAR]**



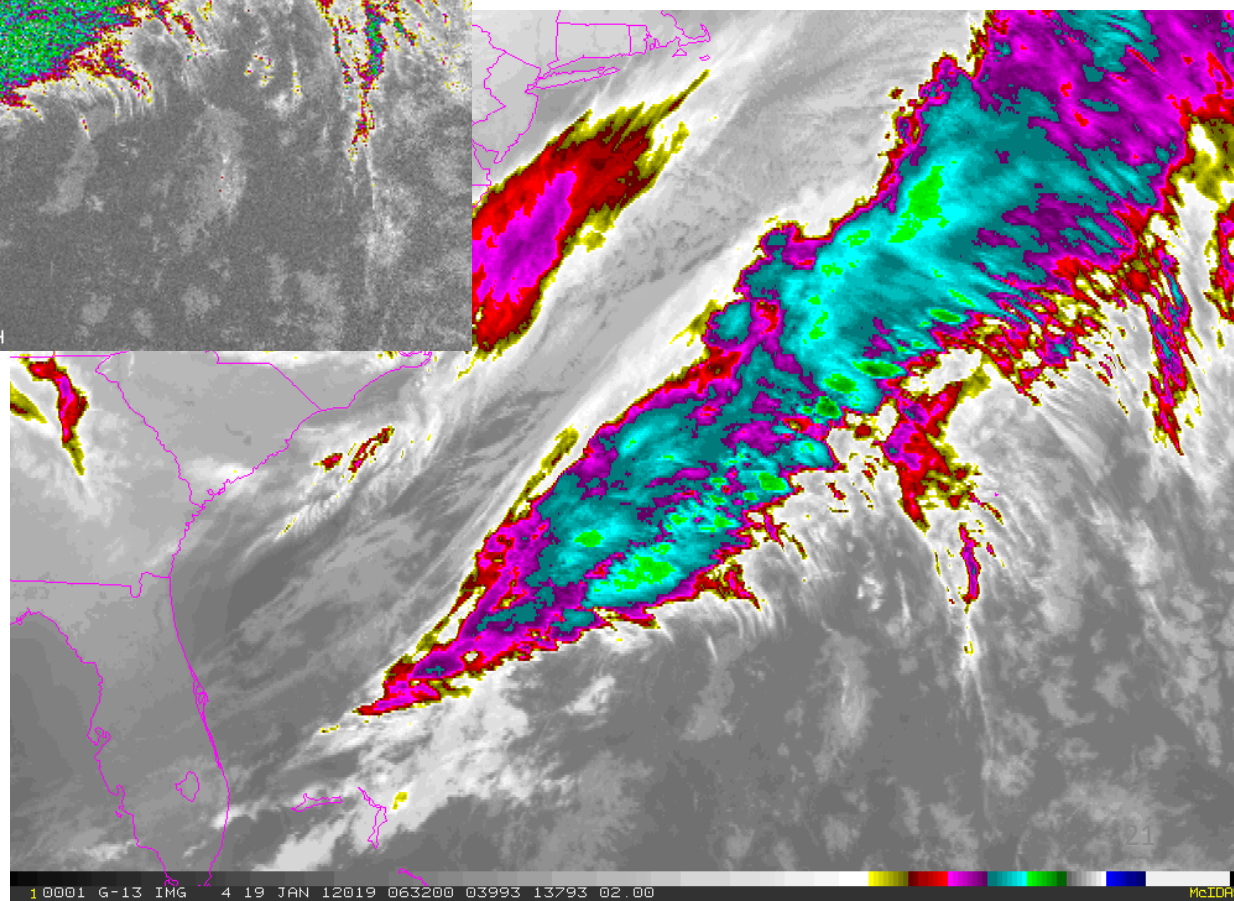
**VIIRS I-band-5 (375 m) IR image (consisting of more than one granule for 19 January 2012 @ ~0620 UTC) over the U.S. Note that this IR image is noisy, due to the still-cooling IR detectors at this time. [Image courtesy of Dan Lindsey, NOAA/StAR]**

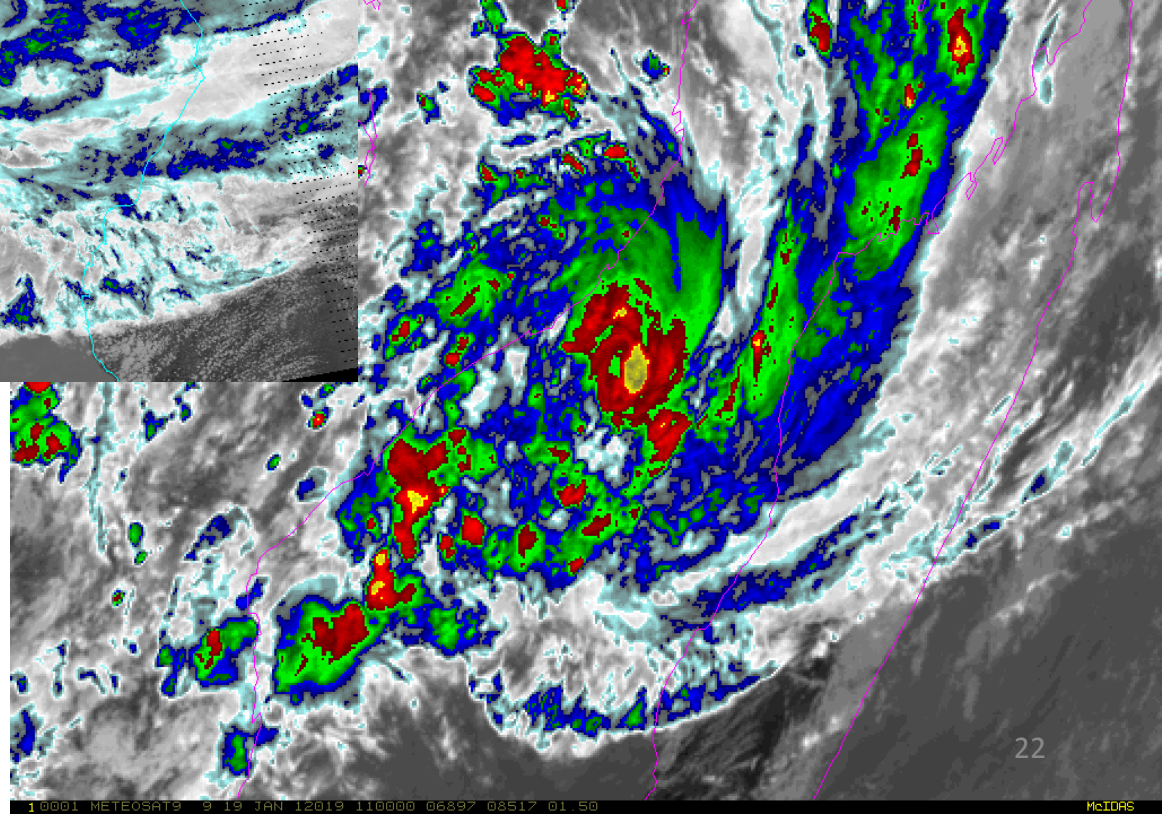
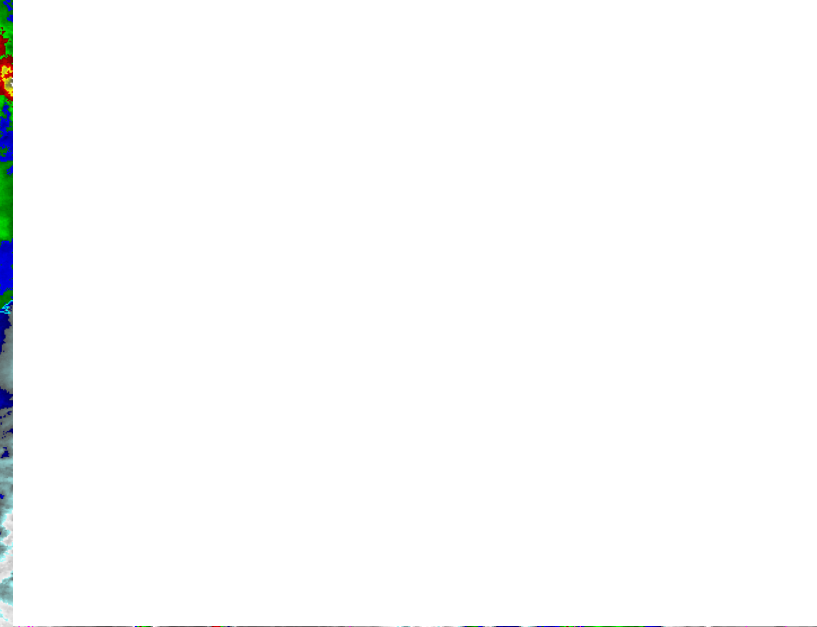
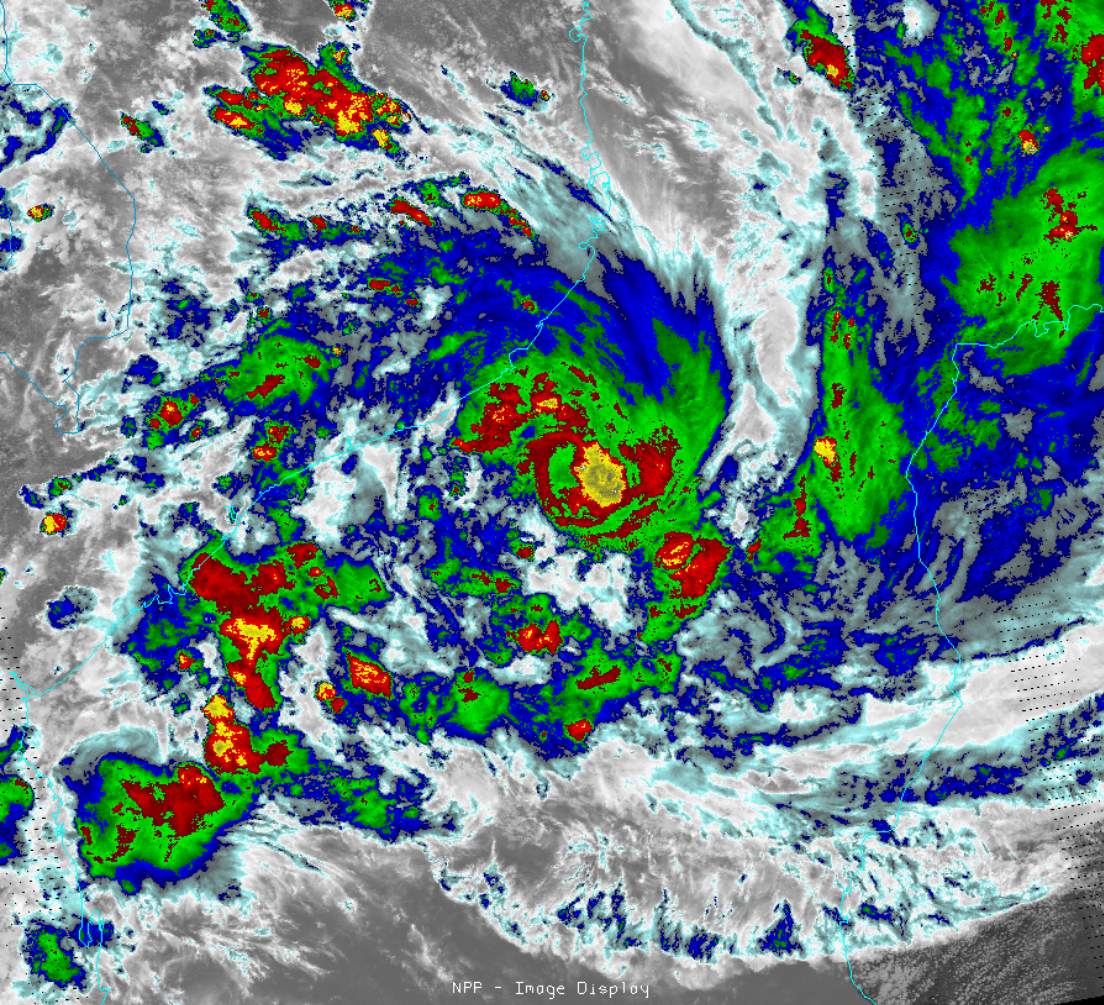


Early NPP VIIRS IR image

**19 January 2012  
0620 UTC  
Eastern U.S.**

Equivalent GOES-13 image

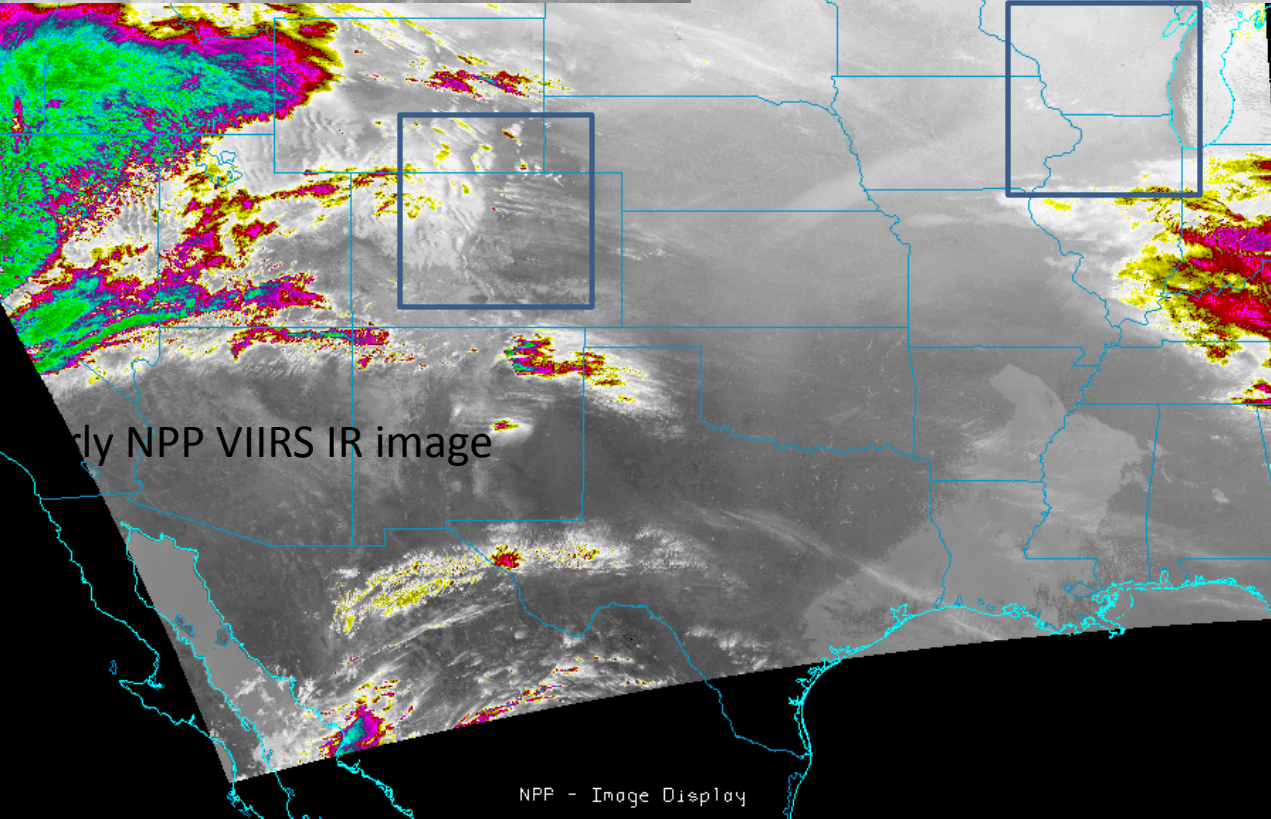
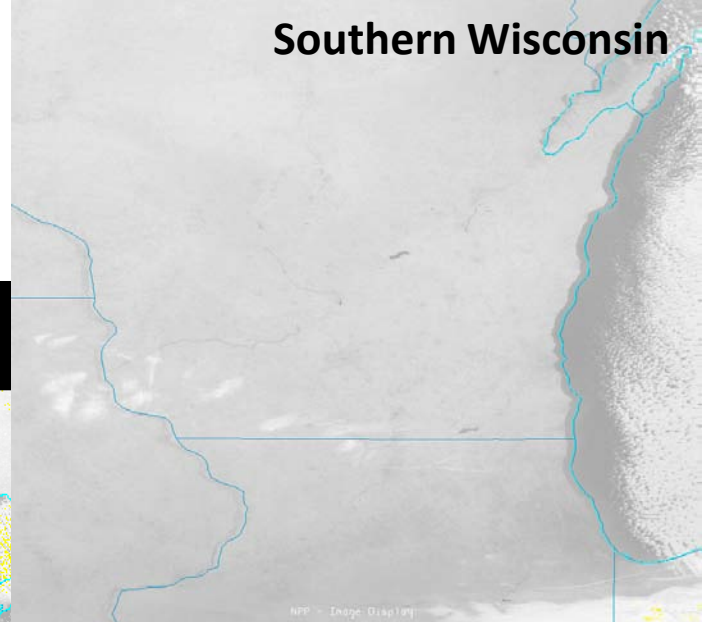
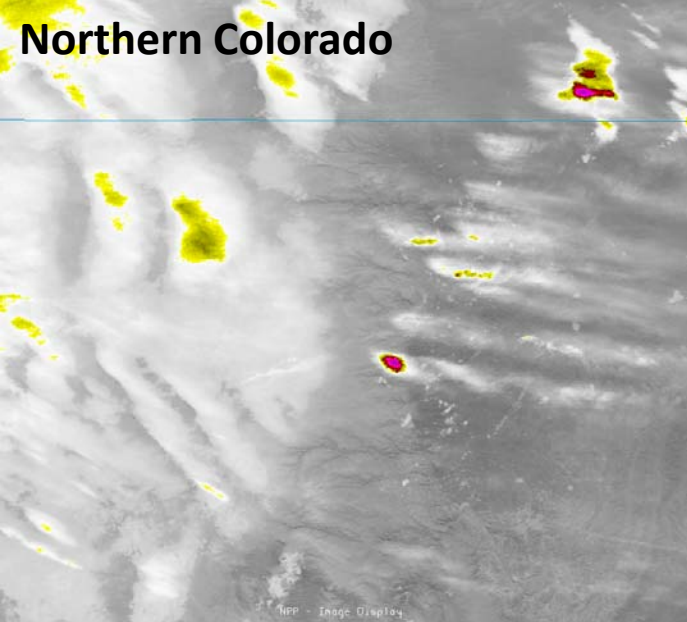




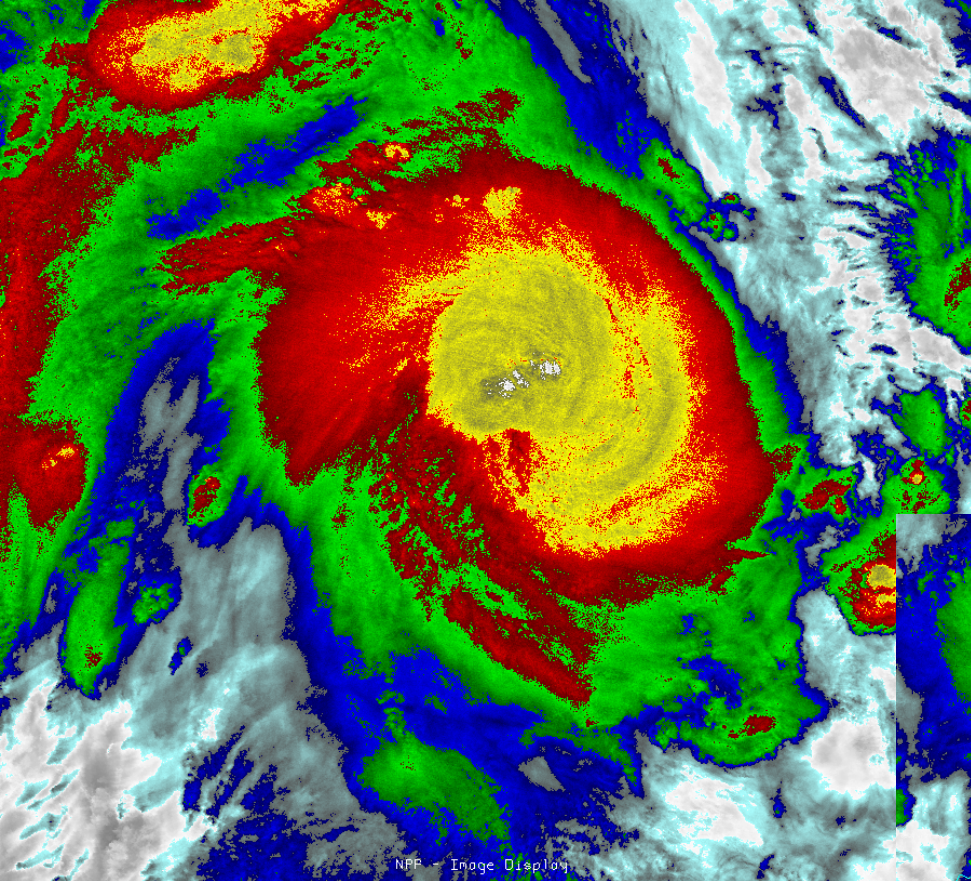
Early NPP VIIRS IR image

**19 January 2012**  
**1059 UTC**  
**TC Funso**

Equivalent MSG image

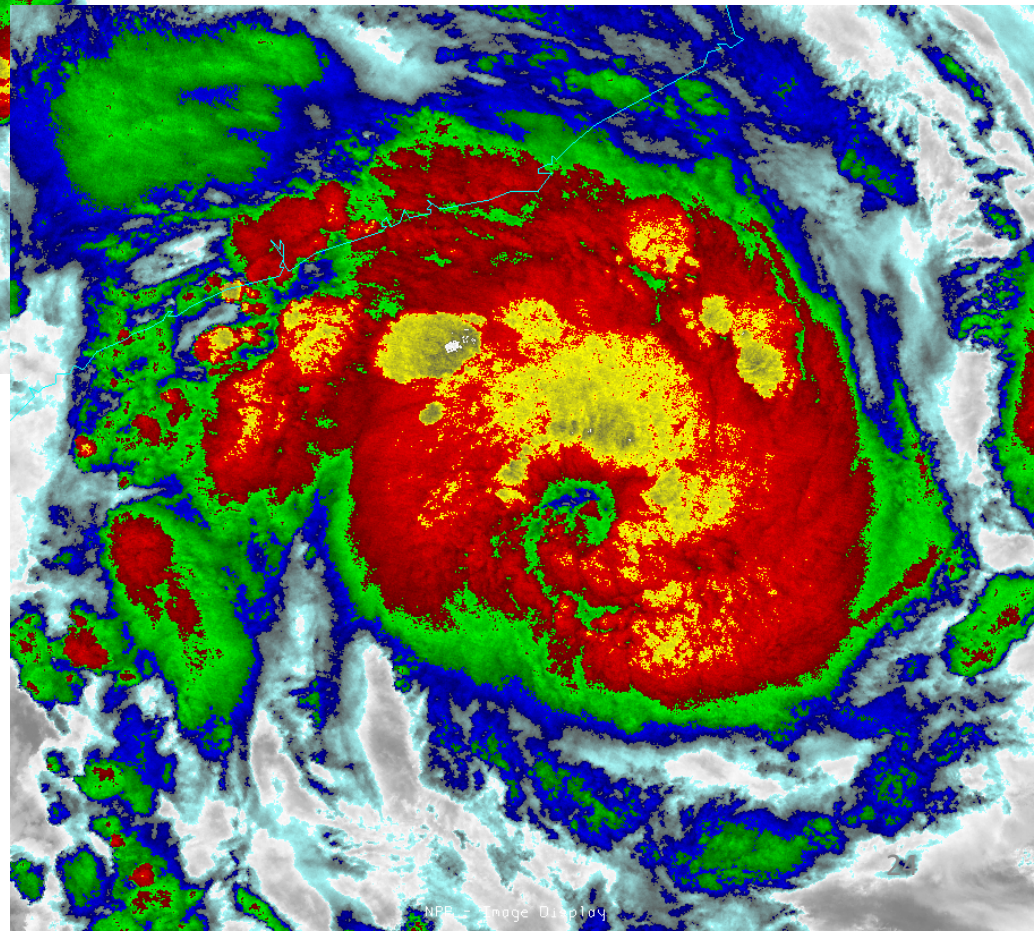


**19 January 2012  
1940 UTC  
Western U.S.  
and detail images**



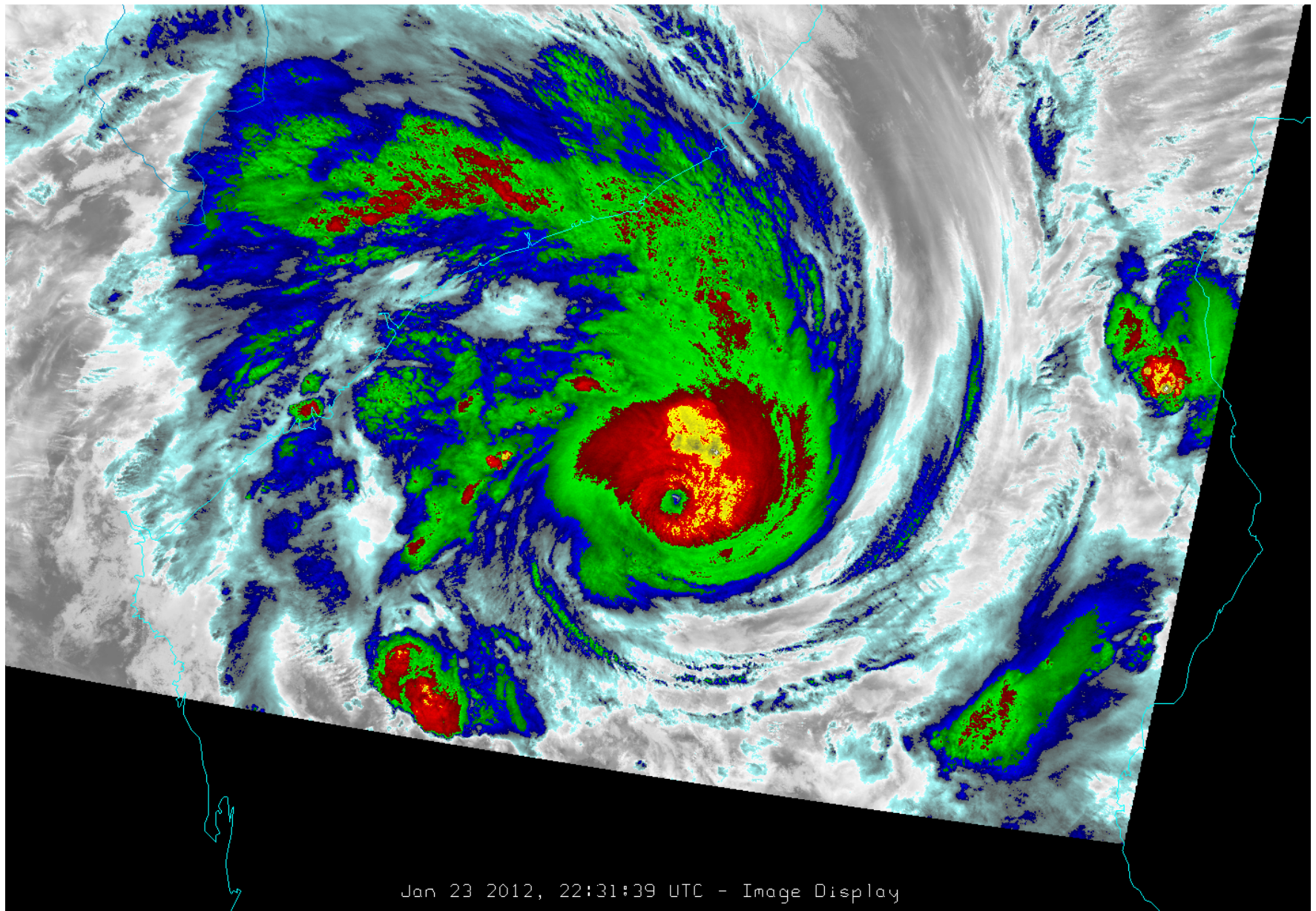
**19 January 2012  
2206 UTC  
TC Funso**

**19 January 2012  
2026 UTC  
TC Ethel**



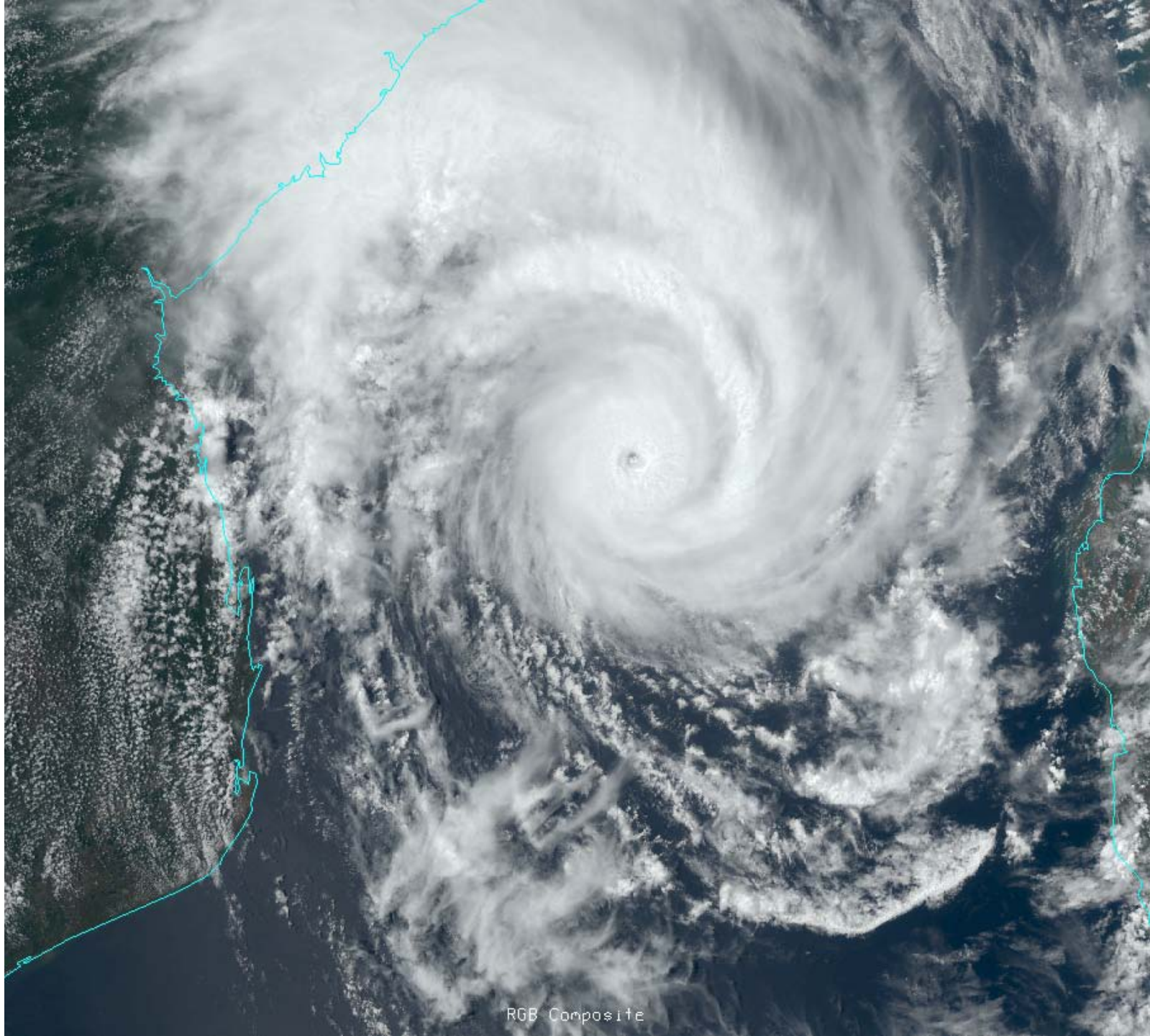
NPP - Image Display



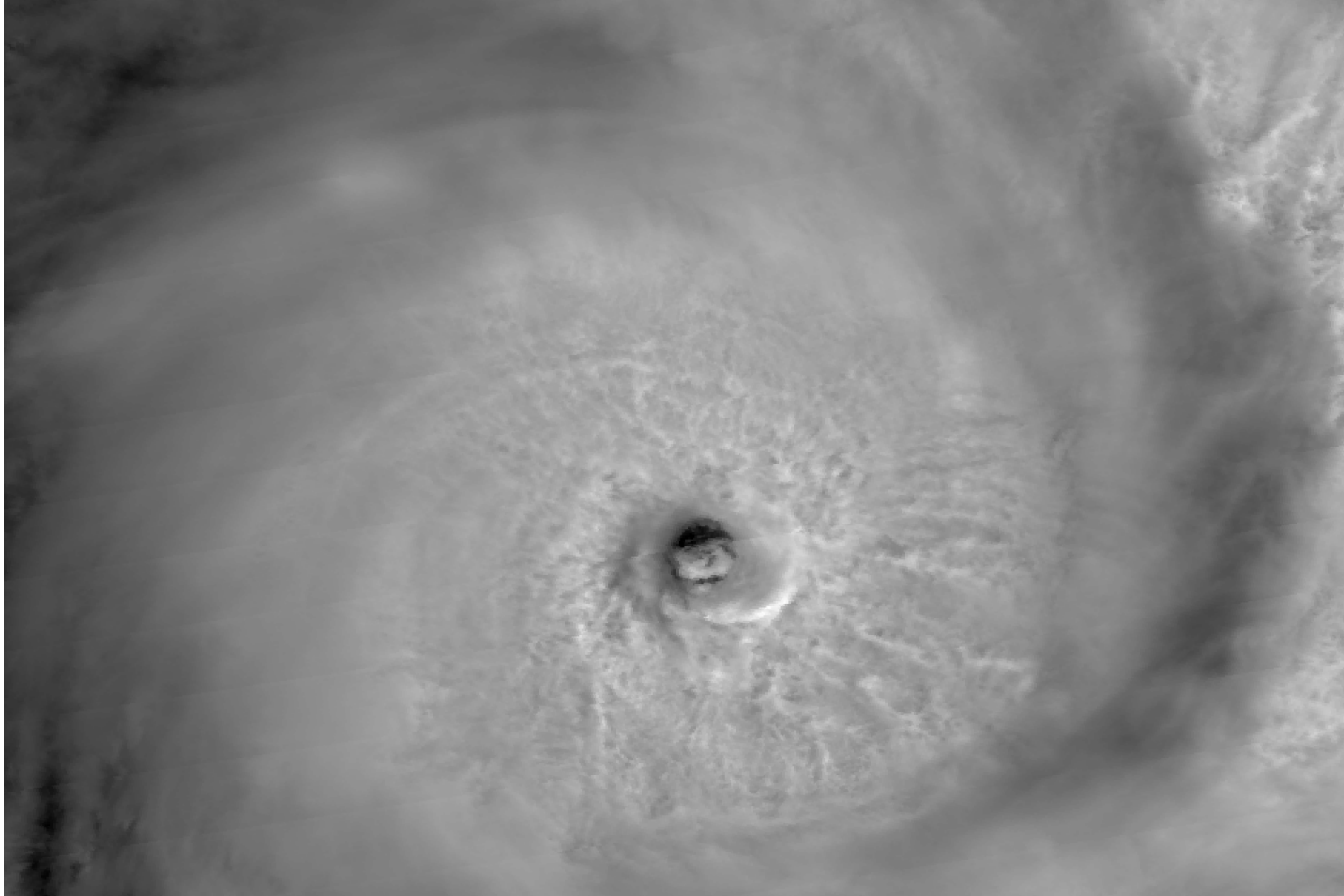


**VIIRS I-band-5 (375 m) IR image for 23 January 2012 @ ~2231 UTC over TC Funso. Note that the improved signal-to-noise. [Image courtesy of Curtis Seaman, CIRA]**

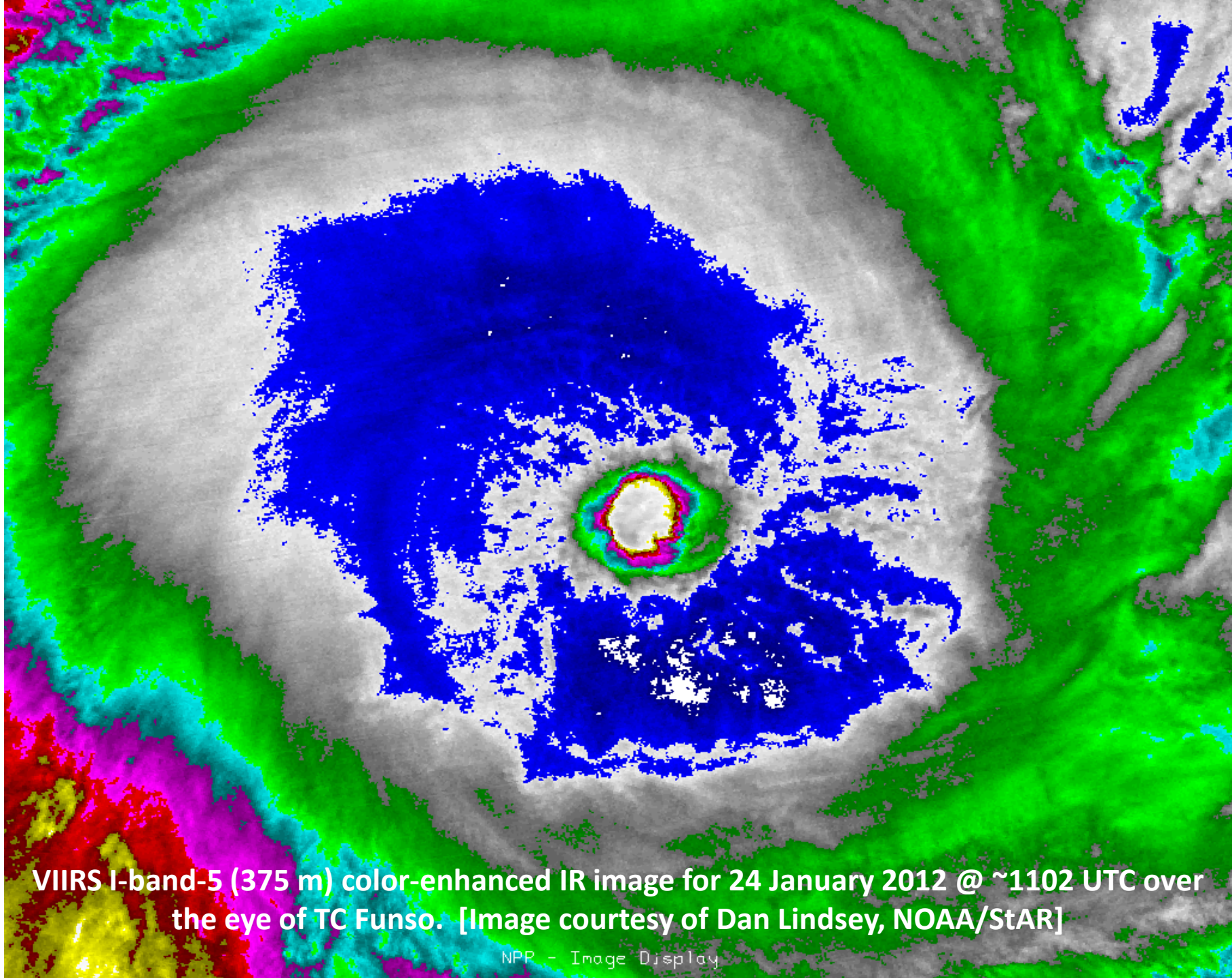
**VIIRS M-  
band (750 m)  
true-color  
image for 24  
January 2012  
@ ~1102  
UTC over TC  
Funso.  
[Image  
courtesy of  
Dan Lindsey,  
NOAA/StAR]**



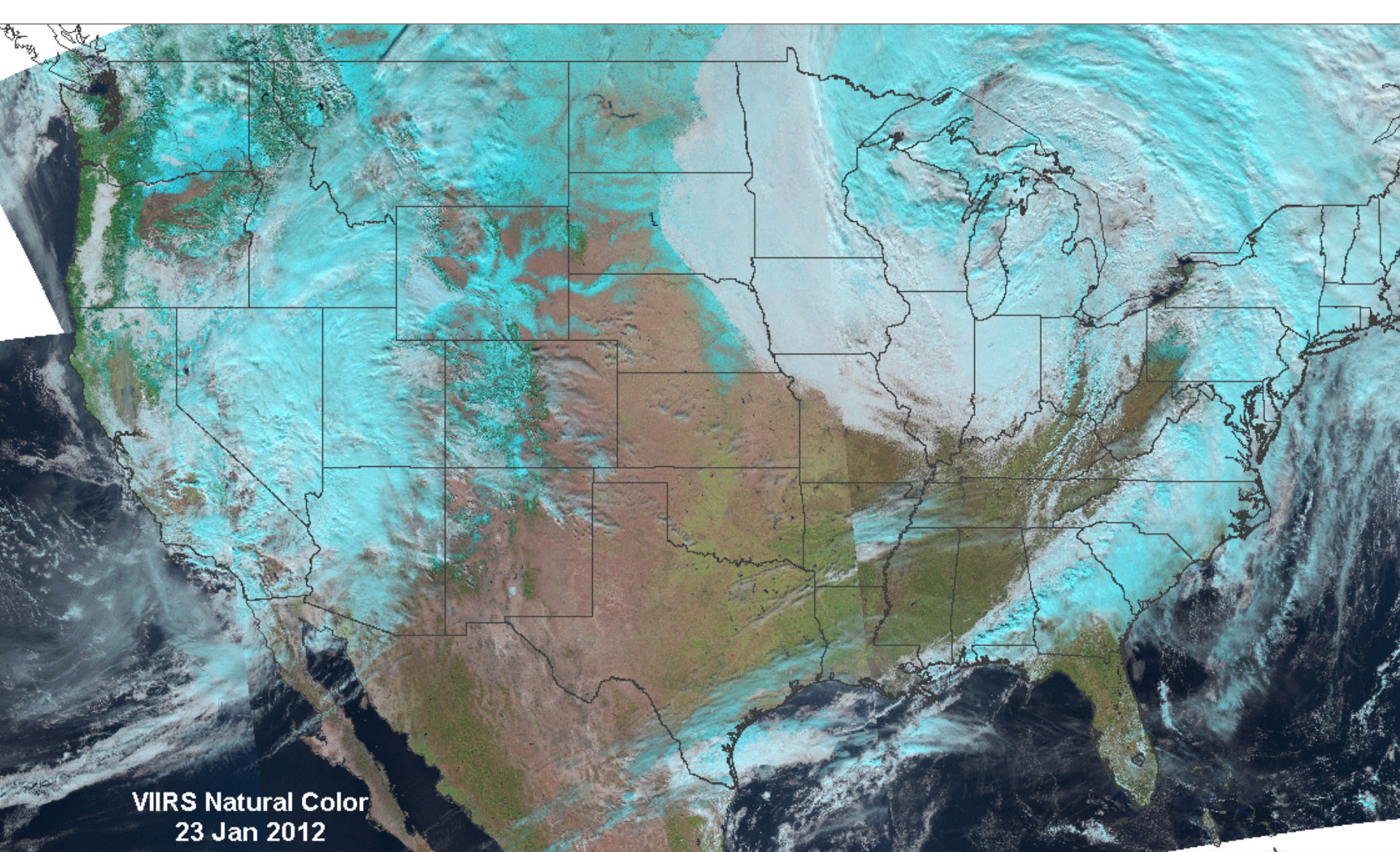
RGB Composite



**VIIRS I-band-1 (375 m) IR image for 24 January 2012 @ ~1102 UTC over the eye of TC Funso. Note the sloping eyewall at this resolution. [Image courtesy of Dan Lindsey, NOAA/StAR]**



VIIRS I-band-5 (375 m) color-enhanced IR image for 24 January 2012 @ ~1102 UTC over the eye of TC Funso. [Image courtesy of Dan Lindsey, NOAA/STAR]



VIIRS Natural Color  
23 Jan 2012

**1.6/0.8/0.6  $\mu\text{m}$  (R/G/B) “natural color” image for 23 January 2012. Advantages over true color: (a) less Rayleigh scattering, (b) vegetation shows up as unmistakable green, (c) cloud phase is indicated (cyan clouds are ice, white are liquid), and (d) snow on the ground is easy to distinguish from low clouds (but not from high clouds). [Image courtesy of Stan Kidder, <sup>29</sup>CIRA]**

# The VIIRS Imagery Team work continues

- **Quantitative** analyses:
  - Noise levels
  - Detector-to-detector striping
  - Inter-satellite comparisons
- **Overall imagery assessment**, for use as image products
- **Multi-spectral products**, as a means of assessing image quality, where signal-to-noise ratio is reduced.



# VIIRS Imagery Examples



**Steven Miller**

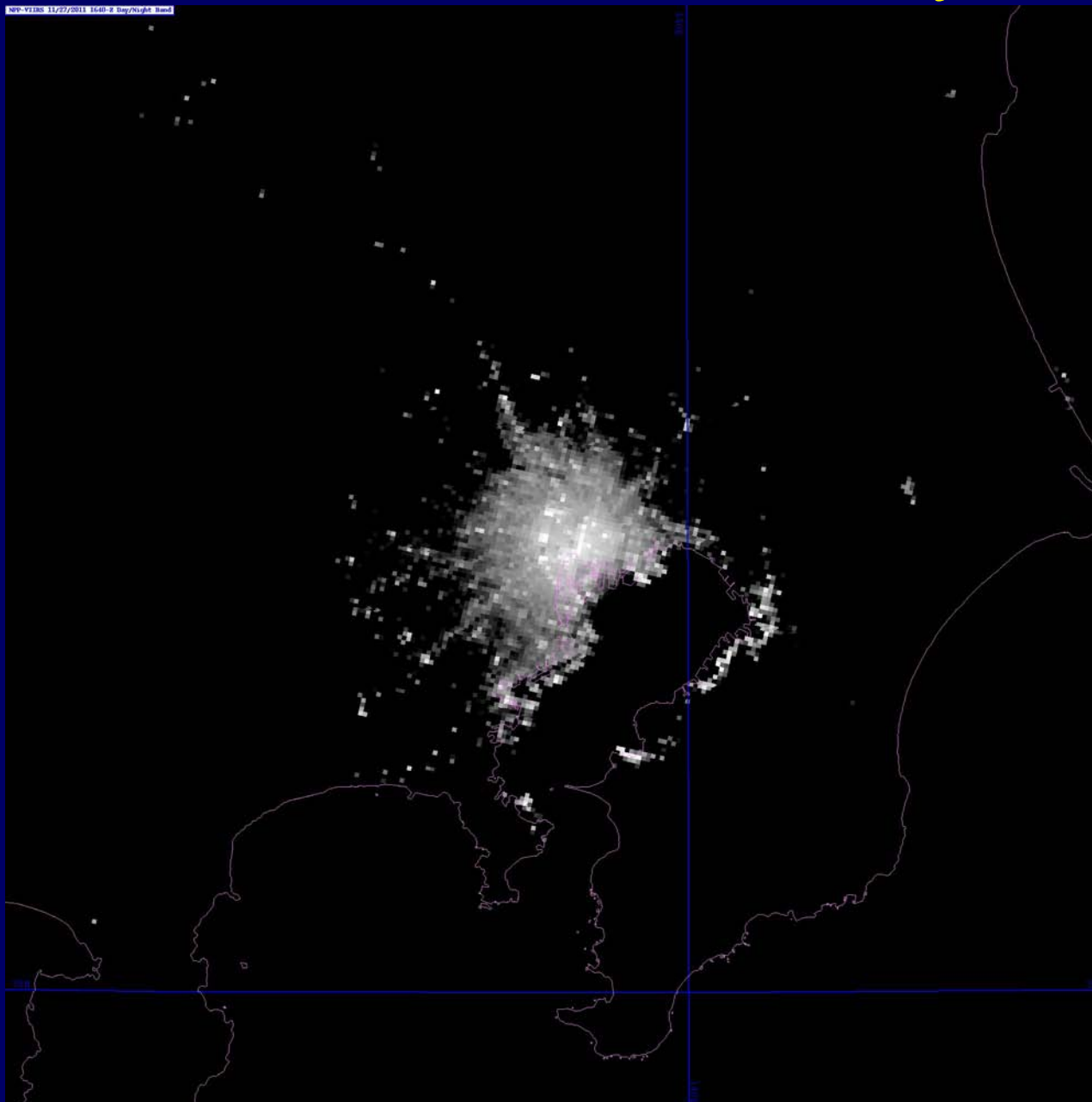
*Cooperative Institute for Research in the Atmosphere (CIRA),  
Colorado State University, Ft. Collins, CO*

**Jeremy Solbrig, Mindy Surratt, Kim Richardson, Arunas  
Kuciauskas, Jeff Hawkins, Tom Lee and Richard Bankert**

*Naval Research Laboratory, Monterey, CA*



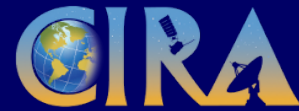
# VIIRS: Zoom-In On Tokyo



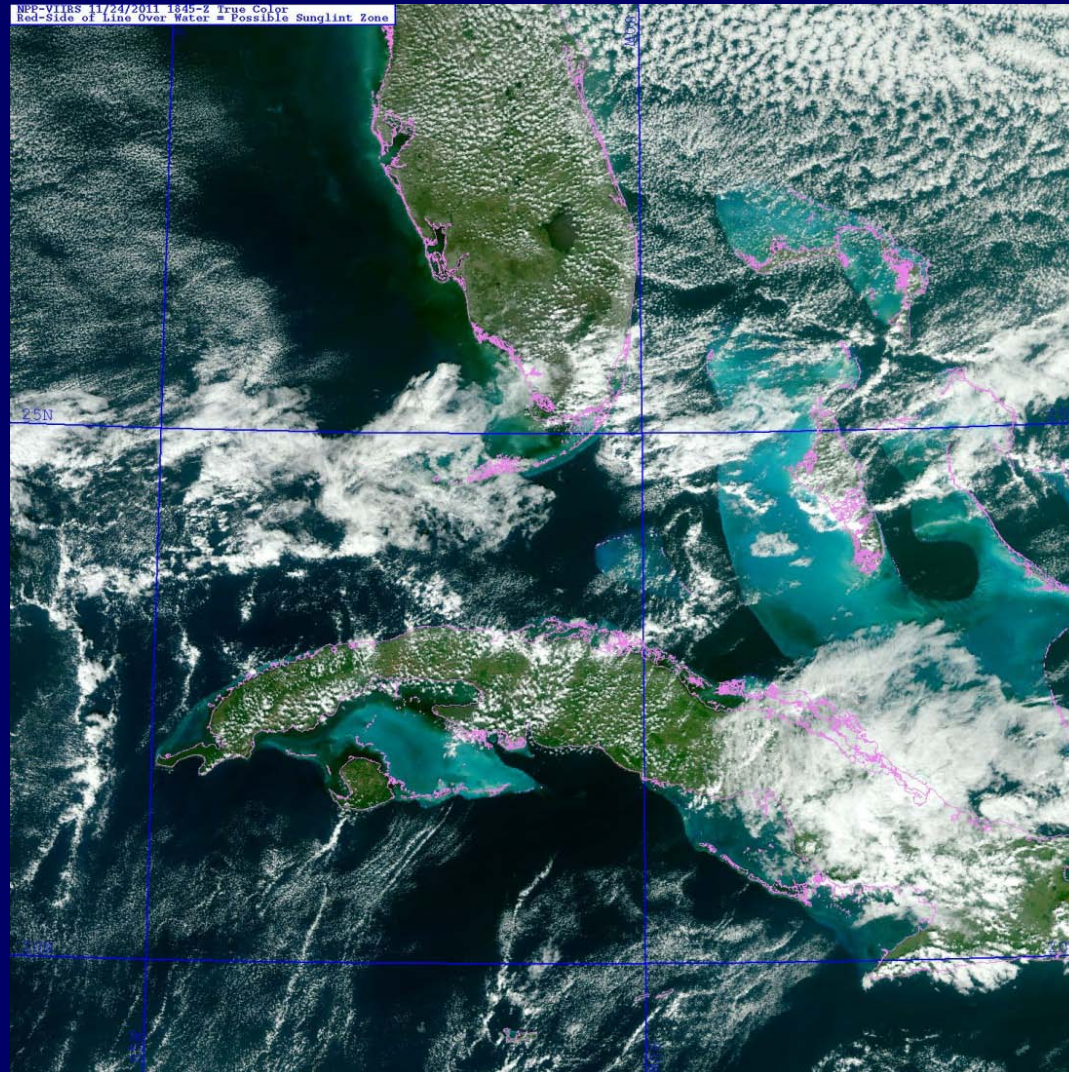




# NPP VIIRS True Color Examples

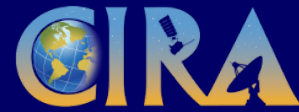


## South Florida, Bahamas and Cuba

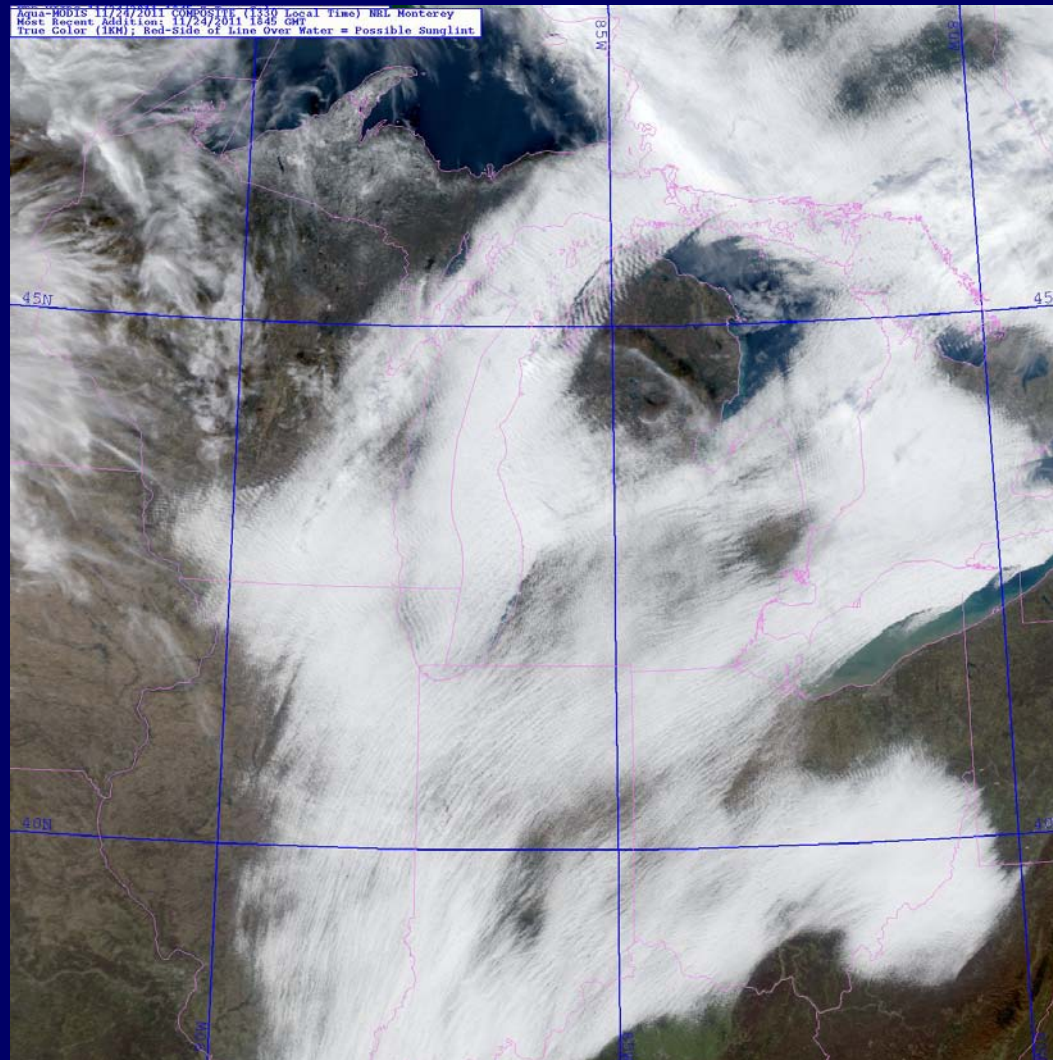




# NPP VIIRS True Color Examples

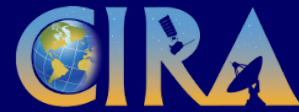


## Great Lakes Region

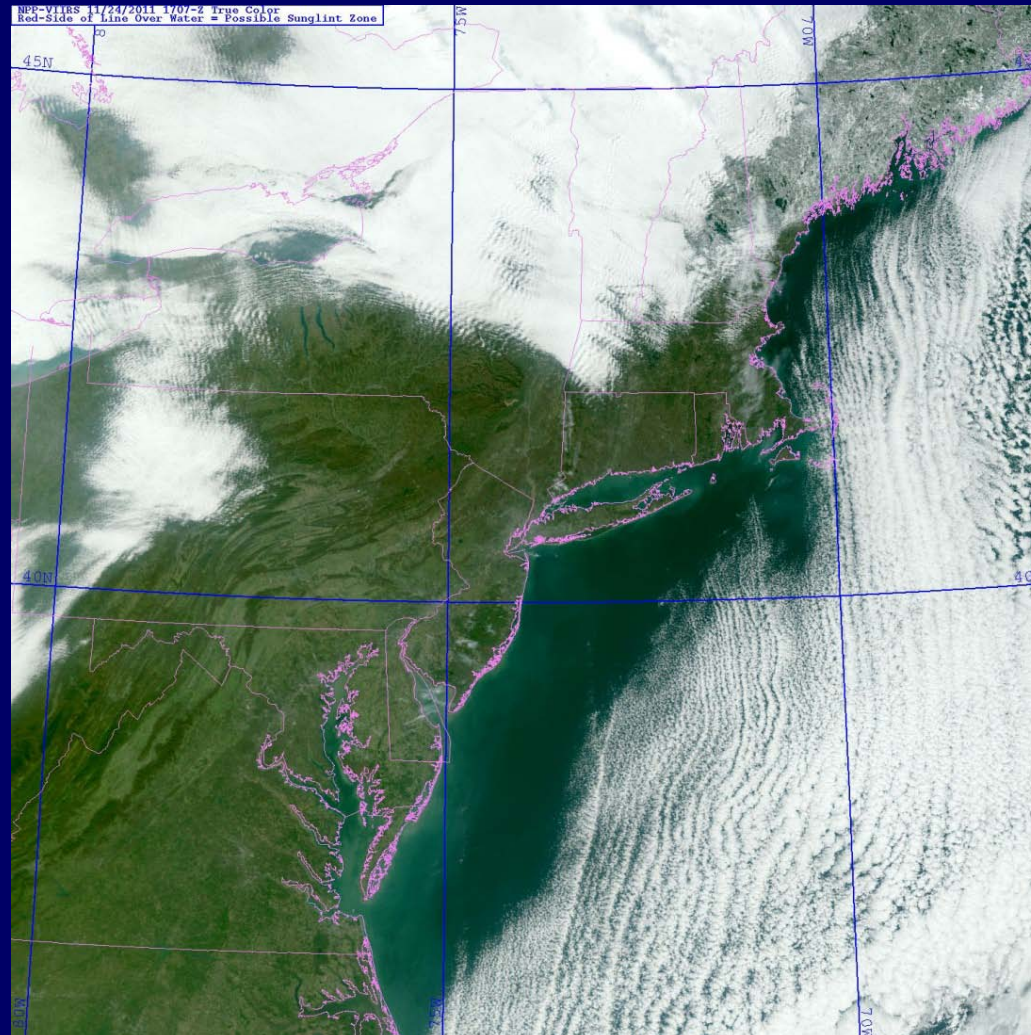




# NPP VIIRS True Color Examples

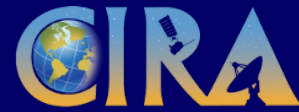


## Northeastern USA

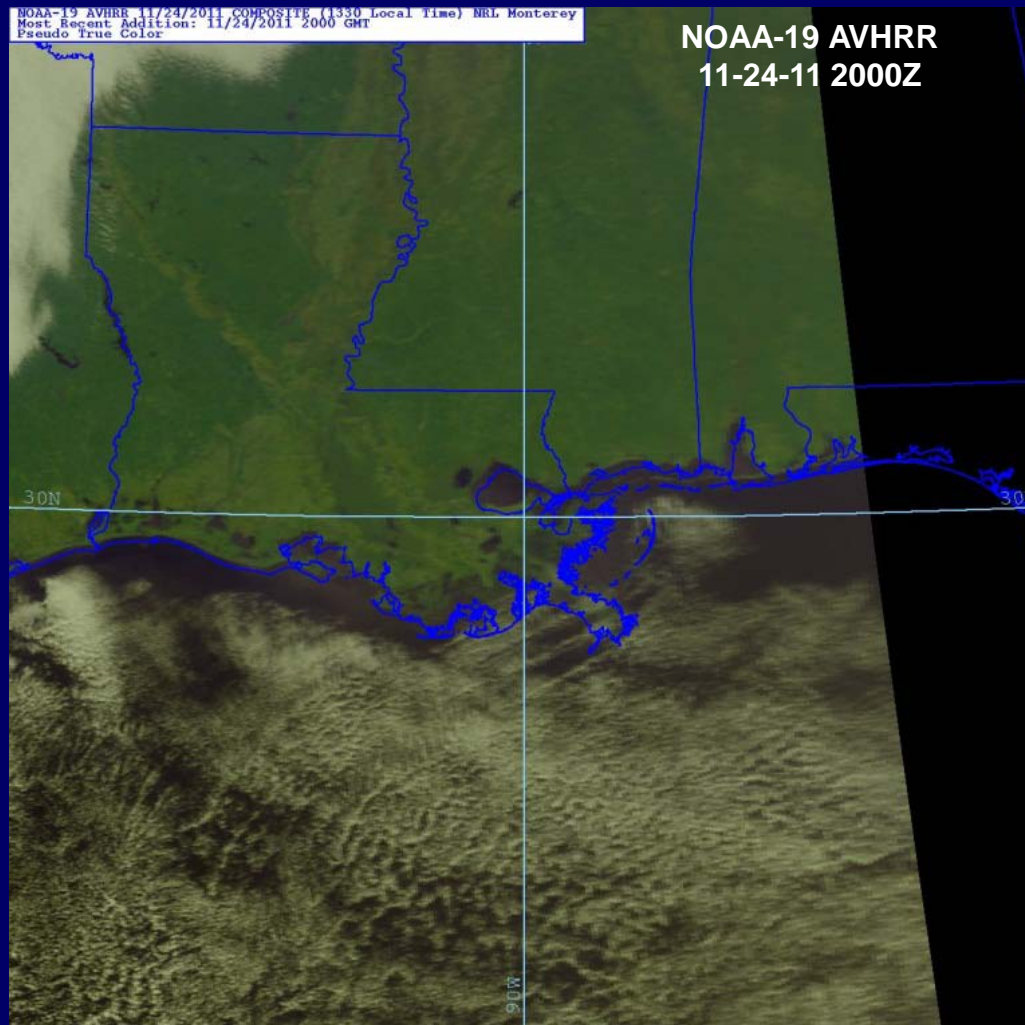




# NPP VIIRS True Color Examples



## New Orleans and Gulf of Mexico

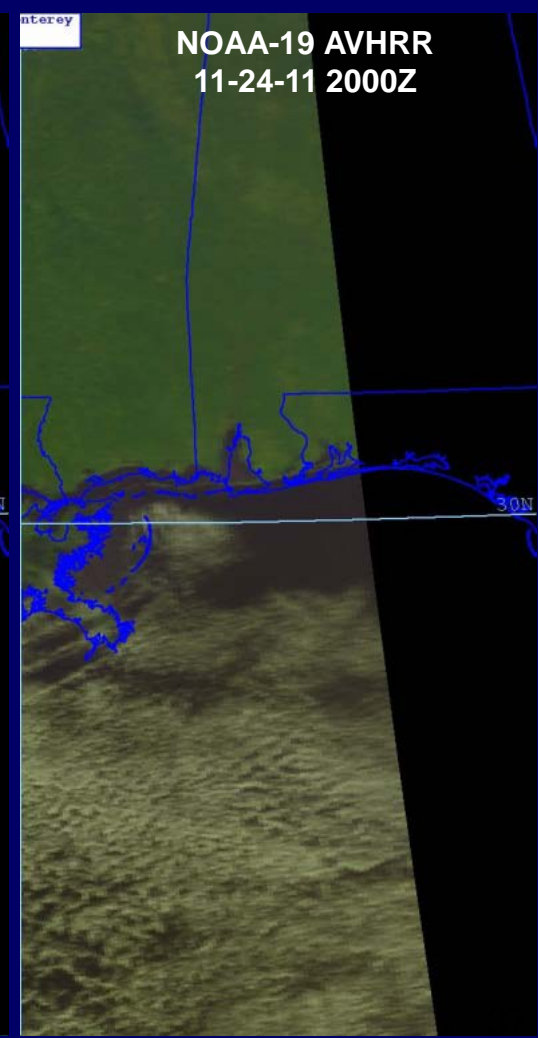
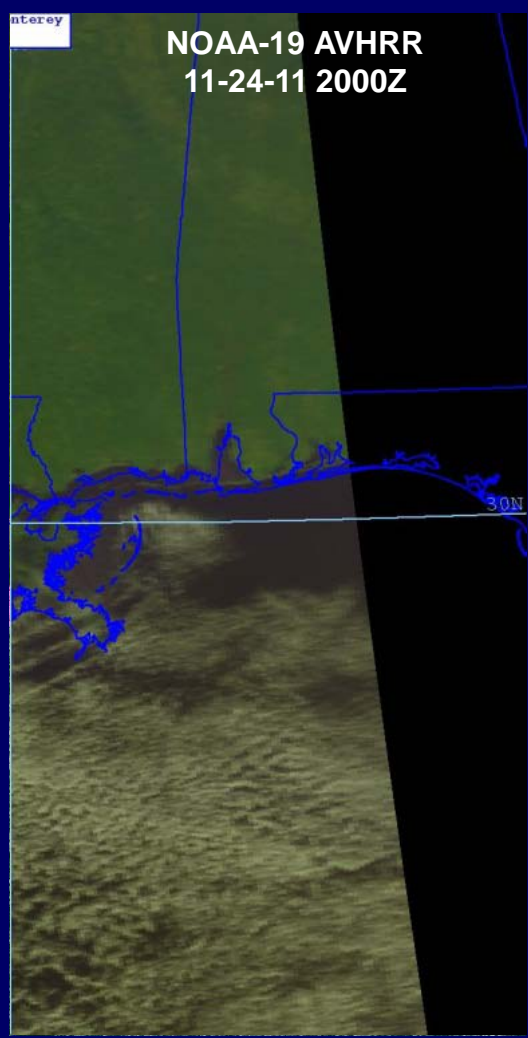




# NPP VIIRS True Color Examples



## Edge of Scan Intercomparisons

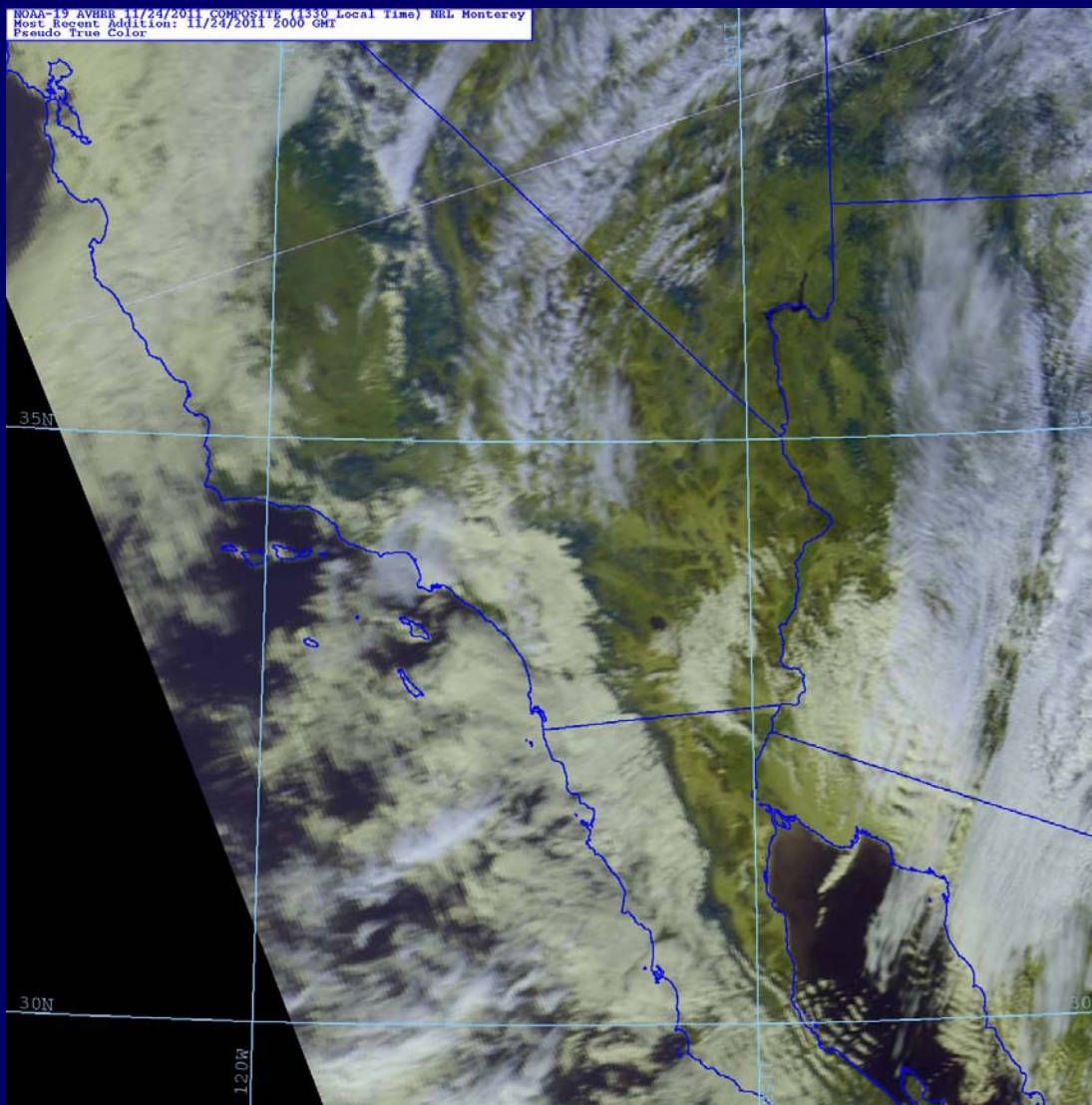




# NPP VIIRS True Color Examples



## Southwest US and Baja California



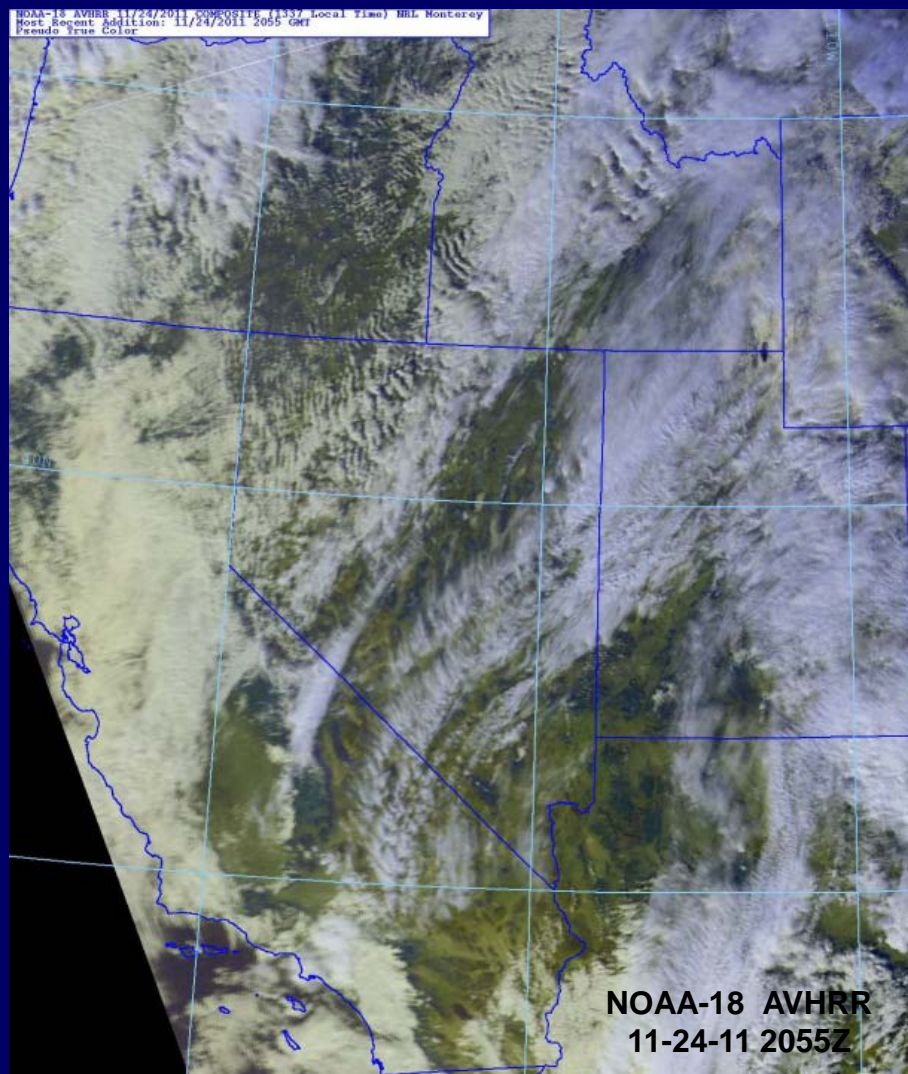
Note edge of scan  
resolution  
degradation with  
MODIS imagery



# NPP VIIRS True Color Examples



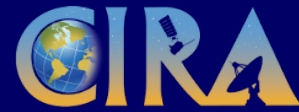
## Southwest US and Baja California



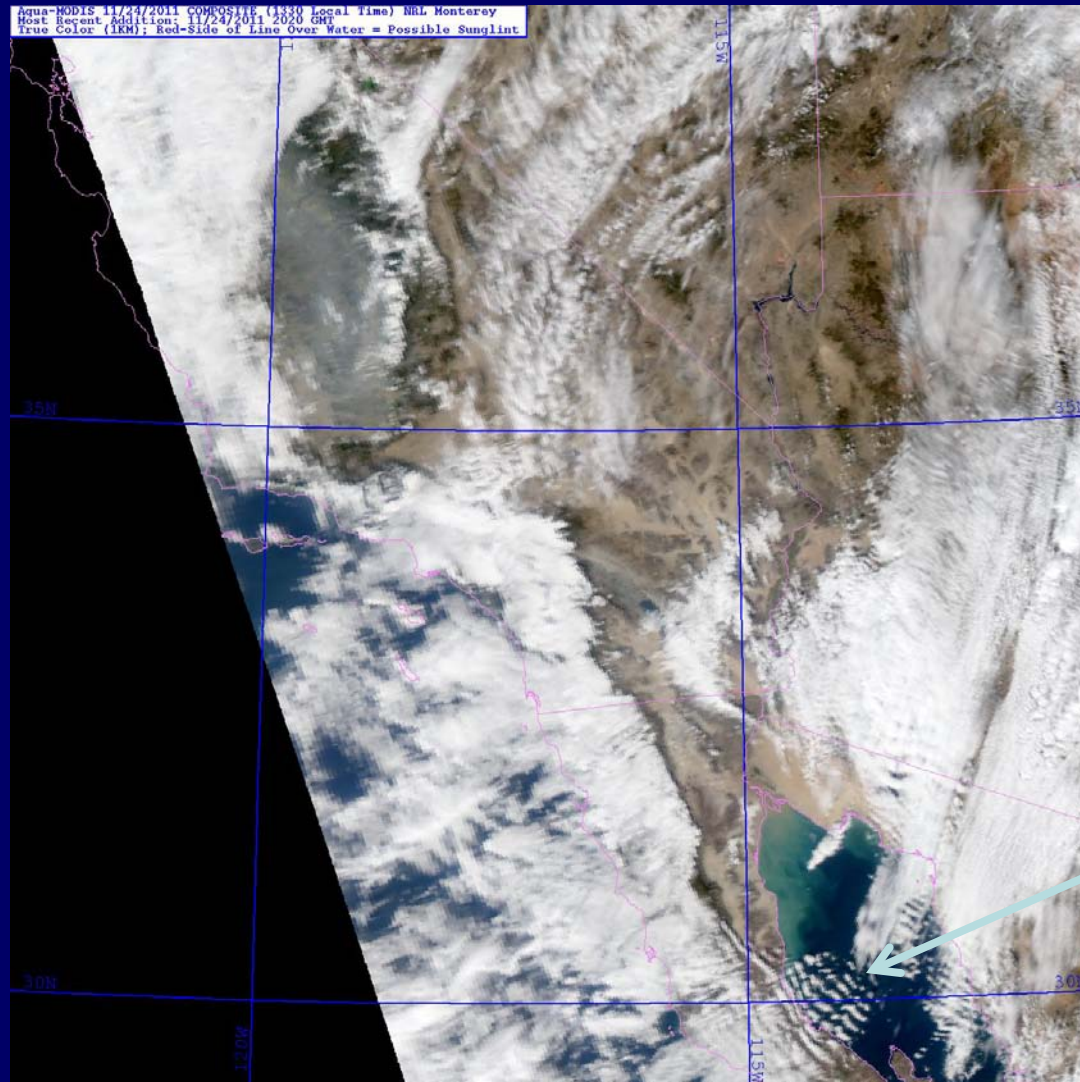
Note edge of scan  
resolution  
degradation with  
MODIS imagery



# NPP VIIRS True Color Examples



## Southwest US and Baja California Zoom-In

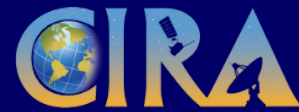


Orographic  
Wave Clouds





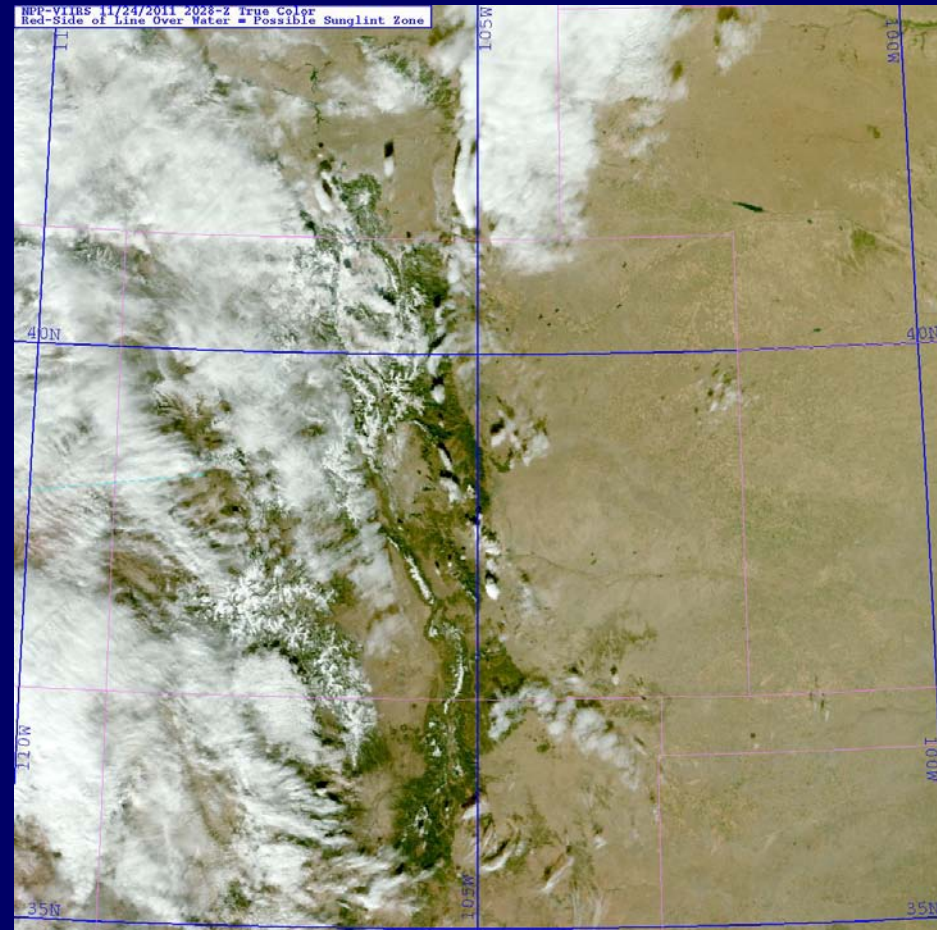
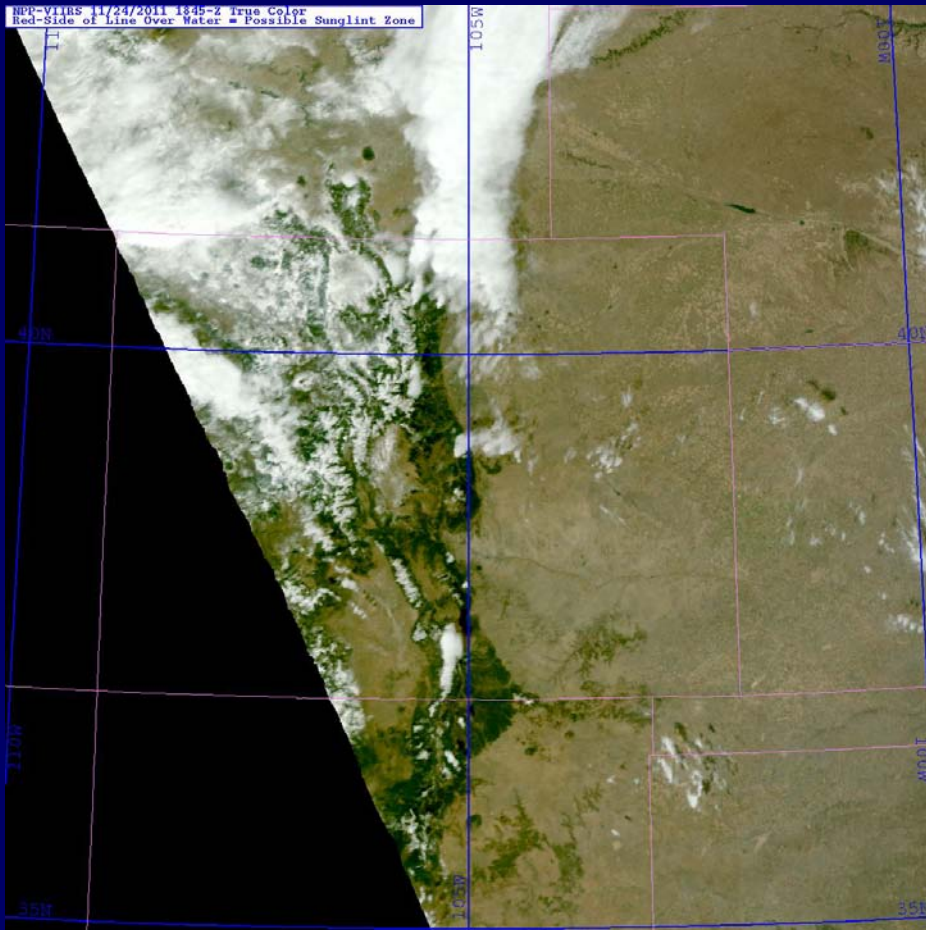
# NPP VIIRS True Color Examples



## Colorado

11.24.2011 1845 Z, Near Edge of Scan

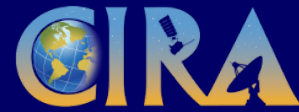
11.24.2011 2028 UTC, Near Nadir



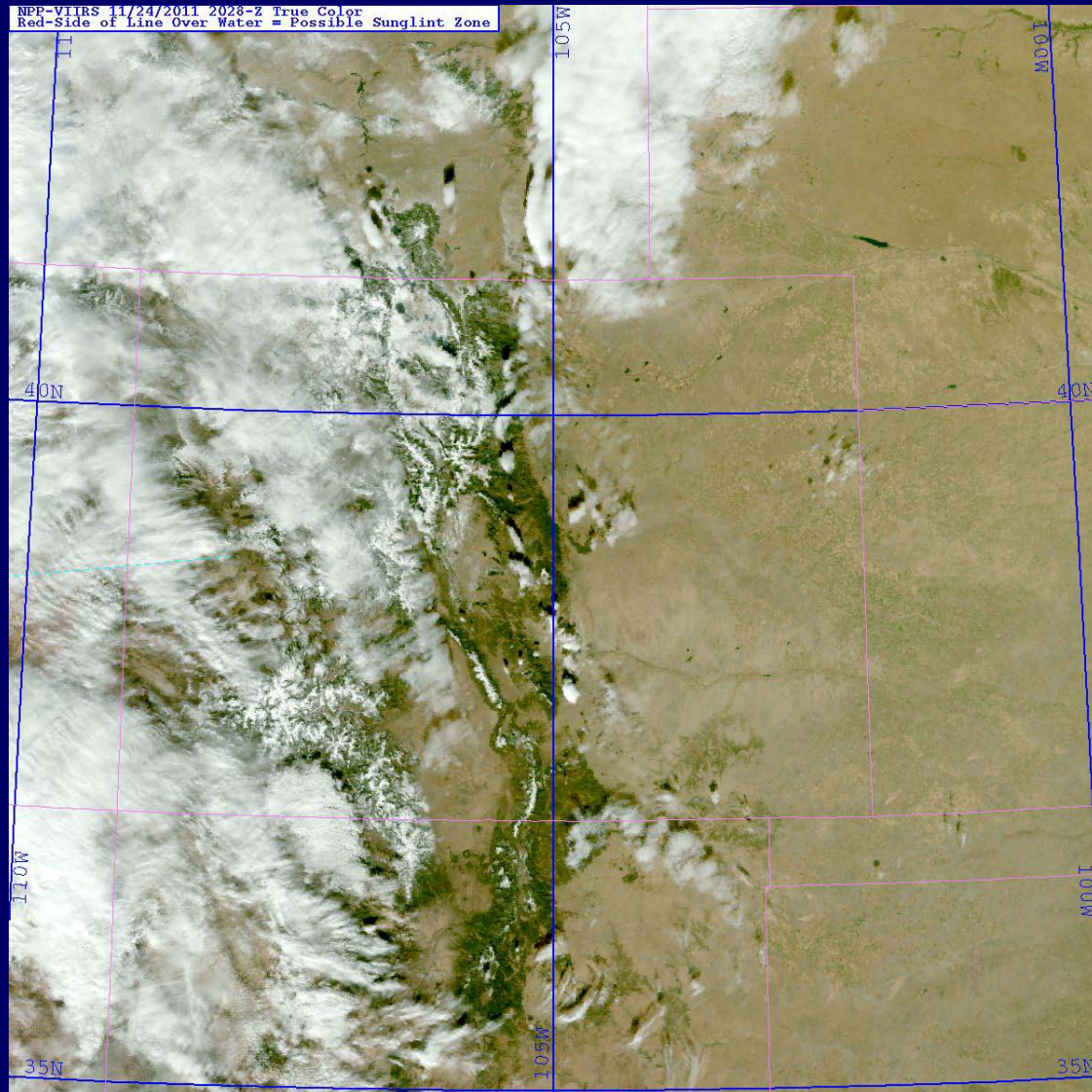
→ VIIRS maintains similar spatial resolution quality at edge of 3000 km swath



# NPP VIIRS True Color Examples



## Colorado





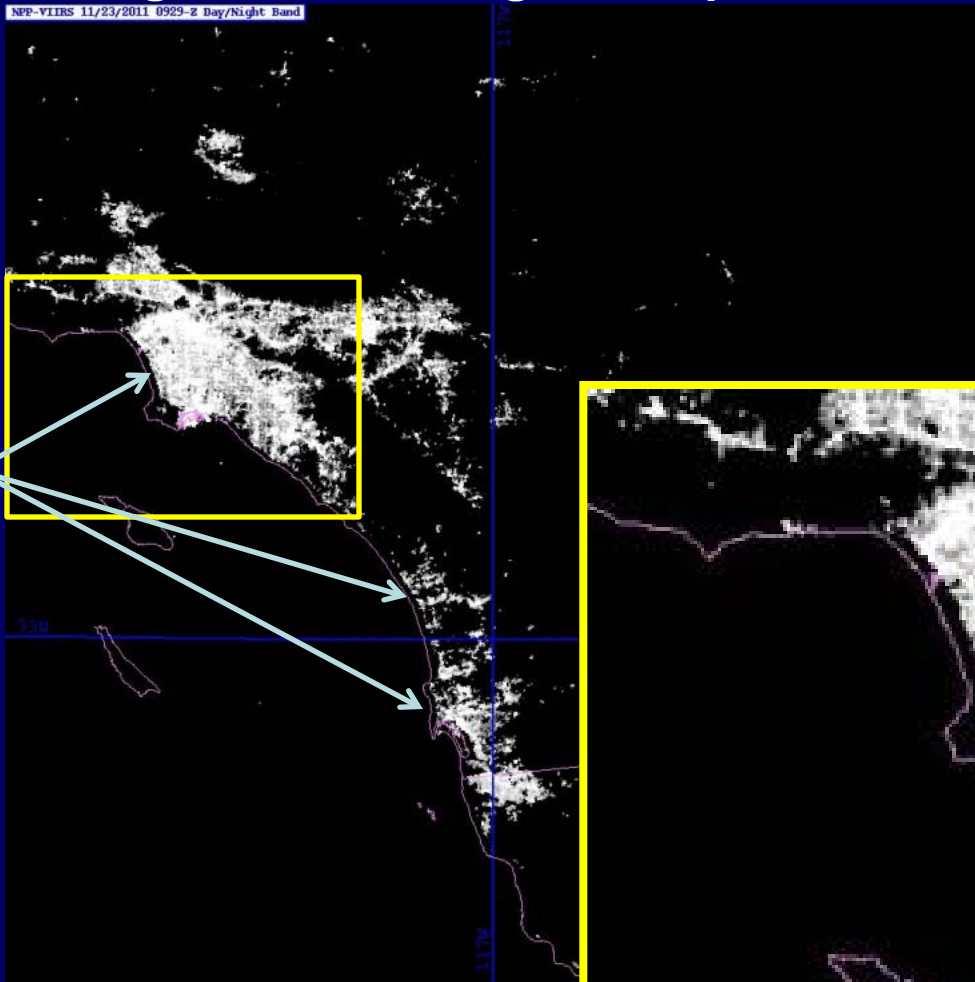
# NPP VIIRS DNB Examples



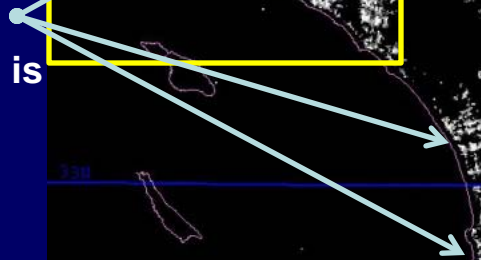
## City Lights

### Los Angeles & San Diego Metropolitan Areas

NPP-VIIRS 11/23/2011 0929-z Day/Night Band



Slight geolocation bias evident in coastal city light imagery. Correction is pending analysis



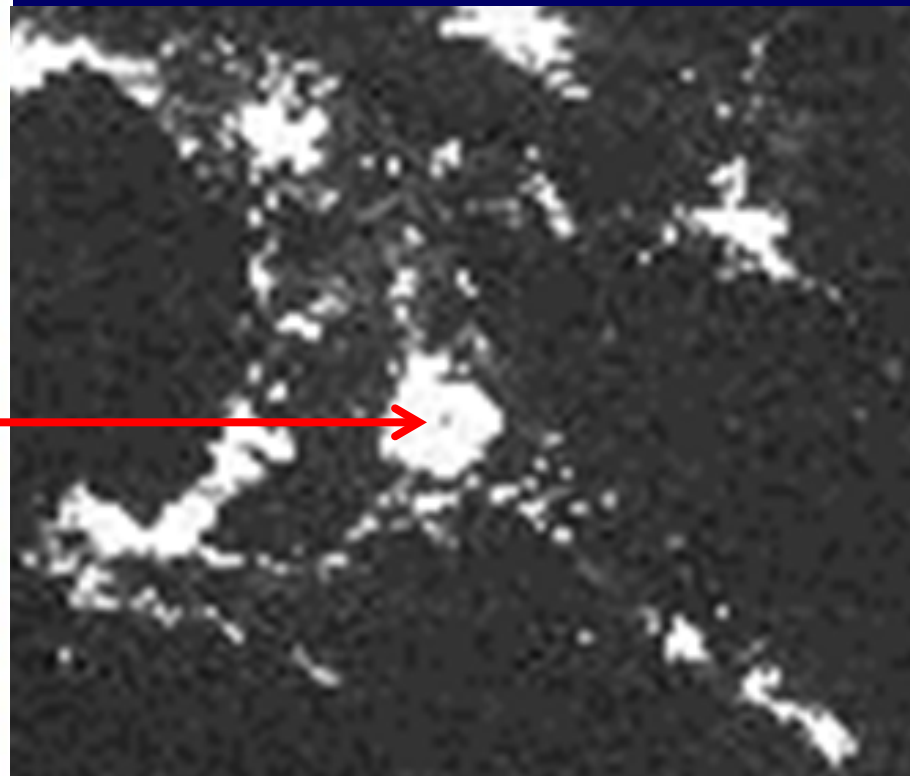
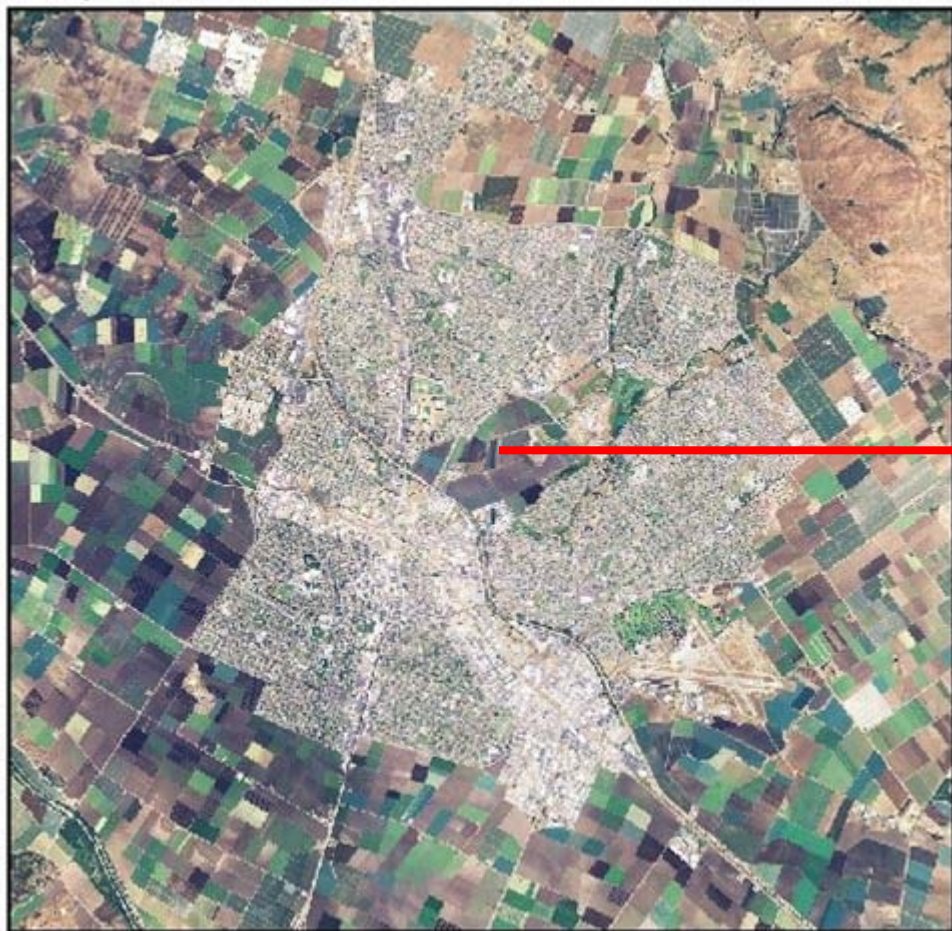


# NPP VIIRS DNB Examples



Agriculture “hole” in Salinas (dark spot in right image)

☀ Your town & state name here



# VIIRS imagery issues/problems so far:

- **Missing geo-location** values in granules
- **Missing data** in granules
- Other **server (GRAVITE) issues**
  - Missing (or delayed) granules
  - Duplicate granules
- Lack of DNB EDR (NCC) imagery at night under conditions other than a full moon
- Padding stripes (fill values) from the use of GTM and a constant array size in the Imagery EDR

These issues are being confirmed at multiple sites, and addressed as **Discrepancy Reports**, and sent up the chain of command for resolution.

- Coordination with **VIIRS SDR Team**.
- Input for many other **EDR Teams**.
- **Future: JPSS-1 (2016) and JPSS-2 (2022)**