



**Don Hillger¹ and Tom Kopp², Steven Miller³, Daniel Lindsey¹,
and Curtis Seaman³**

9th Annual Symposium on Future Operational Satellite Systems
AMS, Austin TX

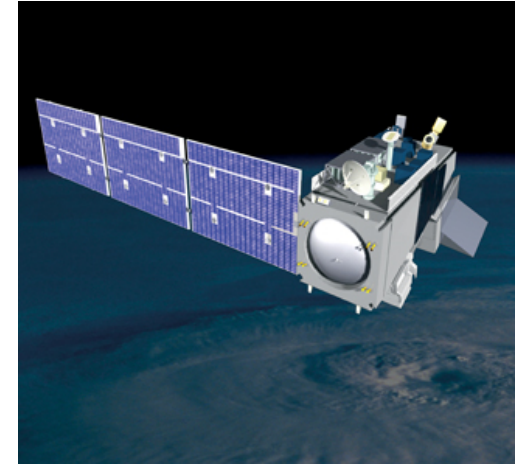
³CIRA, Colorado State University

VIIRS EDR Imagery (and Visualization) Team

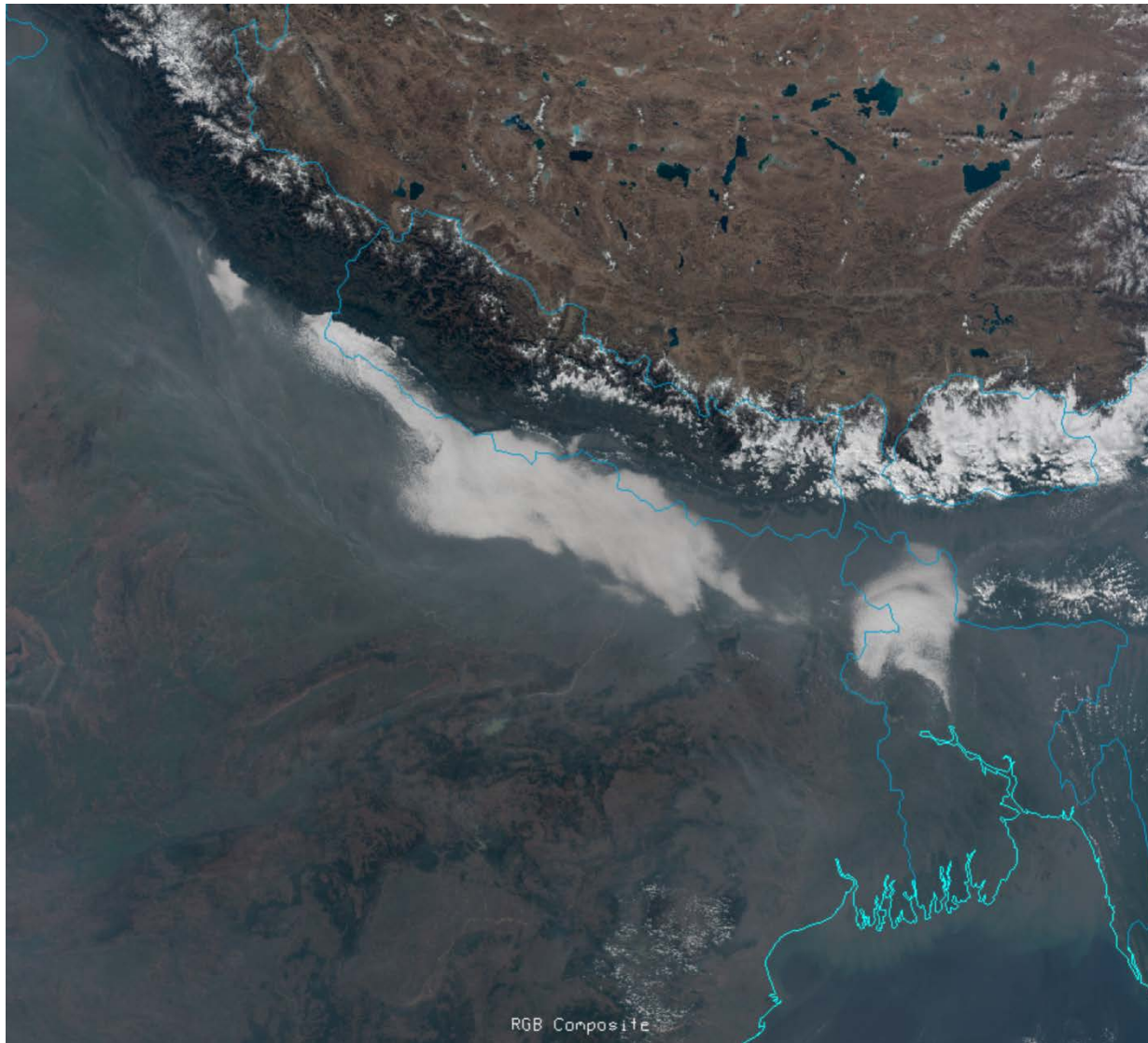
- NESDIS/StAR (D. Hillger, D. Molenaar, D. Lindsey, T. Schmit – GOES liaison)
- CIRA/CSU (S. Miller, S. Kidder, S. Finley, H. Gosden, R. Brummer, C. Seaman)
- CIMSS/SSEC (T. Jasmin, T. Rink)
- Aerospace (T. Kopp, J. Drake, J. Feeley)
- NOAA/NGDC (C. Elvidge)
- NRL (J. Hawkins, K. Richardson, J. Solbrig,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



Suomi NPP



- **Suomi NPP**
 - Started under NPOESS program (**NPOESS Preparatory Project (**NPP**)** satellite)
 - Renamed **Suomi NPP (National Polar-orbiting Partnership)**
 - The first operational **JPSS (Joint Polar Satellite System)** satellite
- **Joint NASA/NOAA mission**
 - data will be used by many **civilian and military** customers
- **Visible Infrared Imager Radiometer Suite (VIIRS)**
 - one of several instruments on NPP



VIIRS true-color image from bands M3 (0.488 μm), M4 (0.555 μm), and M5 (0.672 μm) over northern India and Tibet on 14 December 2011 at 0725 UTC. Note the large contrast in aerosol scattering between the cooler and drier and shallower air mass to the north of the Himalayan chain and the warm and humid and deeper air mass to the south.

VIIRS Environmental Data Record (EDR)s

VIIRS Band	Central Wavelength (μm)	Bandwidth (μm)	Wavelength Range (μm)	Band Explanation	Spatial Resolution (m) @ nadir
M1	0.412	0.02	0.402 - 0.422	Visible	750 m
M2	0.445	0.018	0.436 - 0.454		
M3	0.488	0.02	0.478 - 0.488		
M4	0.555	0.02	0.545 - 0.565		
M5 (B)	0.672	0.02	0.662 - 0.682		
M6	0.746	0.015	0.739 - 0.754	Near IR	
M7 (G)	0.865	0.039	0.846 - 0.885		
M8	1.240	0.020	1.23 - 1.25	Shortwave IR	
M9	1.378	0.015	1.371 - 1.386		
M10 (R)	1.61	0.06	1.58 - 1.64		
M11	2.25	0.05	2.23 - 2.28	Medium-wave IR	
M12	3.7	0.18	3.61 - 3.79		
M13	4.05	0.155	3.97 - 4.13		
M14	8.55	0.3	8.4 - 8.7	Longwave IR	
M15	10.763	1.0	10.26 - 11.26		
M16	12.013	0.95	11.54 - 12.49		
DNB	0.7	0.4	0.5 - 0.9	Visible	750 m across full scan
I1 (B)	0.64	0.08	0.6 - 0.68	Visible	375 m
I2 (G)	0.865	0.039	0.85 - 0.88	Near IR	
I3 (R)	1.61	0.06	1.58 - 1.64	Shortwave IR	
I4	3.74	0.38	3.55 - 3.93	Medium-wave IR	
I5	11.45	1.9	10.5 - 12.4	Longwave IR	

Notes:

M-bands highlighted in pale yellow are available as EDRs, in addition to SDRs.

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

Natural-color component bands are noted with R, G, and B.

M6 on Suomi NPP has a high radiance fold-over issue with many saturated pixels.

NPP/JPSS data sources

- **GRAVITE*** (Suitland, 7-hour delay)
- **NOAA CLASS**** (Asheville, 7-hour delay) – not actively used
- **Atmosphere PEATE***** (Wisconsin, 7-hour delay)
 - ADDE server for McIDAS-X
 - FTP
- **Direct Readout** (Wisconsin, minimal delay, but provides data only over North America, when the satellite is with sight of Madison)

*Government Resource for Algorithm Verification, Integration, Test and Evaluation

**Comprehensive Large Array-data Stewardship System

***Product. Evaluation and Algorithm Test Elements

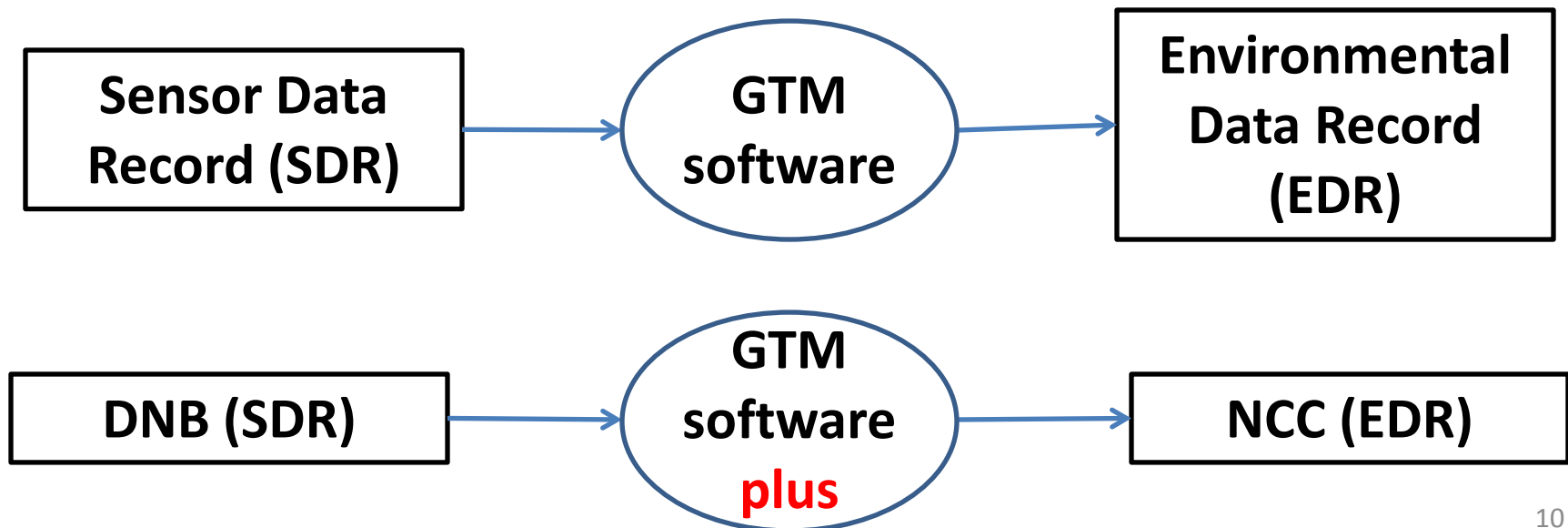
VIIRS display tools

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



Sensor Data Record (SDR) to Environmental Data Record (EDR)

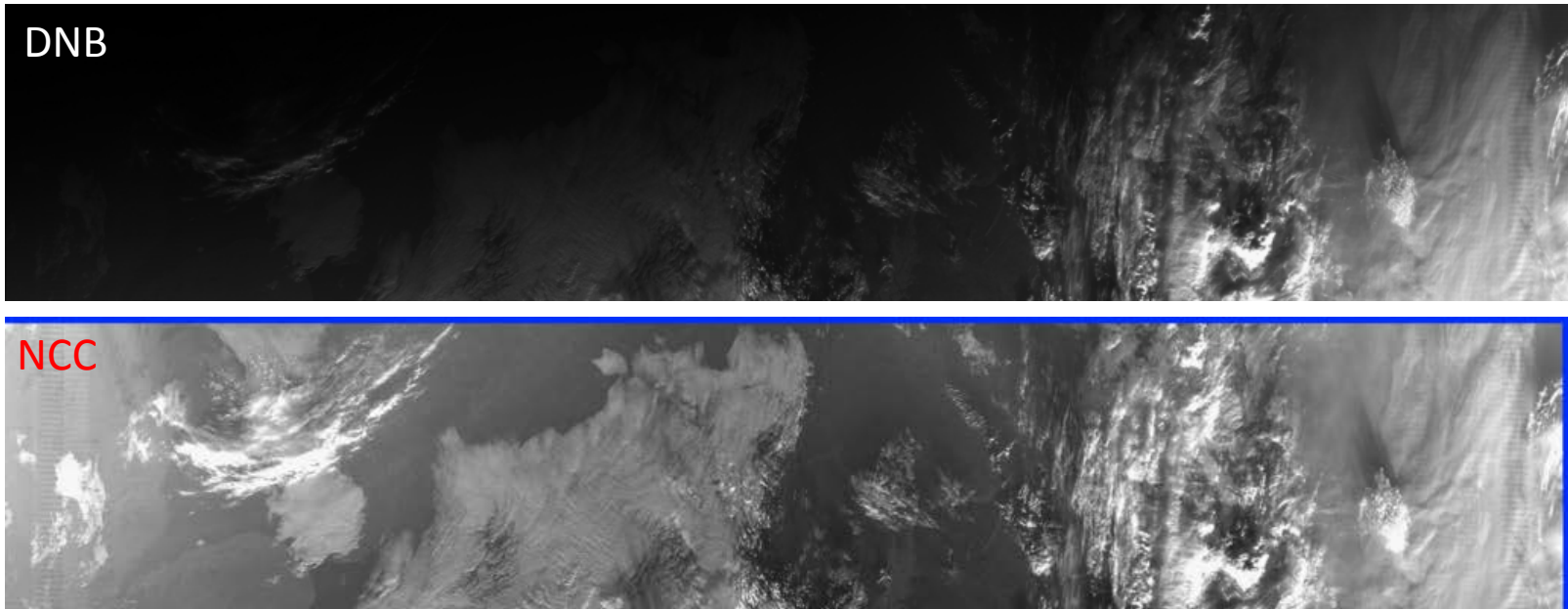
- **Ground Track Mercator (GTM)** remapping software.
 - GTM is a **remapping** of the data, but the **same radiances/reflectances** for Non-NCC bands only.
- For NCC imagery there is **additional radiance processing**



Near Constant Contrast (NCC) Product

Example of NCC performance for a day/night terminator (non-lunar) case.

NCC extends constant contrast into the twilight portion of the granule swath.



Curtis Seaman, CIRA

For **nighttime** scenes, the NCC product **initially worked only around the time of Full Moon**. **This bug is being fixed.**

Suomi NPP Imagery and Visualization Team web page

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

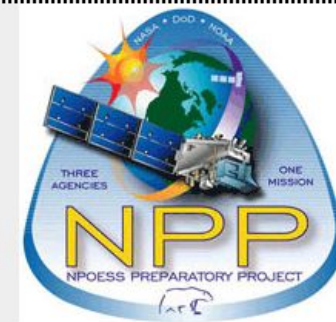


Suomi NPP (National Polar-orbiting Partnership) VIIRS Imagery and Visualization Team

(Last updated: 2012-12-18)

The NESDIS/StAR Imagery and Visualization and Visualization Team is responsible for the checkout of EDR imagery (and data) from the NASA/NOAA **Joint Polar Satellite System (JPSS)** spacecraft, the **Suomi NPP (National Polar-orbiting Partnership)**.

Date	Event
28 October 2011 @ 0948 UTC	NPP launch
21 November 2011 @ 1604 UTC	First visible/reflective images
19 January 2012 @ 0620 UTC	First infrared/thermal images
25 January 2012	NPP renamed Suomi NPP



For a roster of VIIRS EDR Imagery Team members see [JPSS Imagery and Visualization Team.docx](#).

For a list of VIIRS bands and band information see [VIIRS bands and bandwidths.pdf](#).

Website	URL
CIRA's Suomi NPP Blog	http://rammb.cira.colostate.edu/projects/npp/blog/
CIRA's VIIRS granules	http://rammb.cira.colostate.edu/ramsd/online/npp_viirs.asp
NRL's VIIRS imagery	http://www.nrlmry.navy.mil/VIIRS.html
CIMSS' Satellite Blog for VIIRS	http://cimss.ssec.wisc.edu/goes/blog/archives/category/viirs
StAR-JPSS ADP (Algorithm and Data Products)	http://www.star.nesdis.noaa.gov/jpss/index.php
NOAA CLASS	http://www.class.ncdc.noaa.gov/

Suomi NPP VIIRS Online

http://rammb.cira.colostate.edu/ramsdisk/online/npp_viirs.asp

RAMMB: RAMSDIS Online - Suomi NPP VIIRS Online - Windows Internet Explorer

http://rammb.cira.colostate.edu/ramsdisk/online/npp_viirs.asp

File Edit View Favorites Tools Help

★ Favorites RAMMB: RAMSDIS Online - Suomi NPP VIIRS Online

RAMMB
Regional and Mesoscale
Meteorology Branch

NOAA Satellites and Information
National Environmental Satellite, Data, and Information Service

CIRA
Cooperative Institute for Research in the Atmosphere

[Cooperative Research Program](#) | [Office of Research and Applications/Center for Satellite Applications and Research](#)

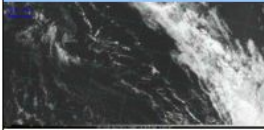
Suomi NPP VIIRS Online

Please see the [NPP VIIRS Imagery and Visualization Team page](#) for more information about the following products.

RAMSDIS Online Home
Tropical
GOES-West / GOES-East
GOES-R Proving Ground
RMTC
GOES Sounder
Suomi NPP VIIRS

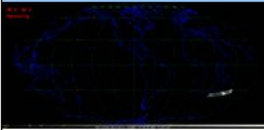
View several hi-res products in [Google Earth](#)

VIIRS Visible Granule (Center Half)
(band M5, 0.67 μm)



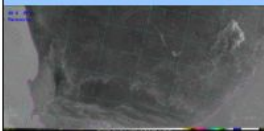
[Flash Loop](#)
[Latest Image](#)
[4 Wk Archive](#)
[Product Info](#)

VIIRS Visible Remapped (Mollweide Projection)
(band M5, 0.67 μm)



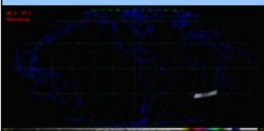
[Flash Loop](#)
[Latest Image](#)
[4 Wk Archive](#)
[Product Info](#)

VIIRS Infrared Granule (Center Half)
(band M15, 10.7 μm)



[Flash Loop](#)
[Latest Image](#)
[4 Wk Archive](#)
[Product Info](#)

VIIRS Infrared Remapped (Mollweide Projection)
(band M15, 10.7 μm)



[Flash Loop](#)
[Latest Image](#)
[4 Wk Archive](#)
[Product Info](#)

[Site Map](#)
[US Dept of Commerce](#) - [NOAA](#) - [NESDIS](#) - [ORA/STAR](#) - [CoRP](#)
This page verifies as: [XHTML](#), [CSS](#), [Section 508](#)

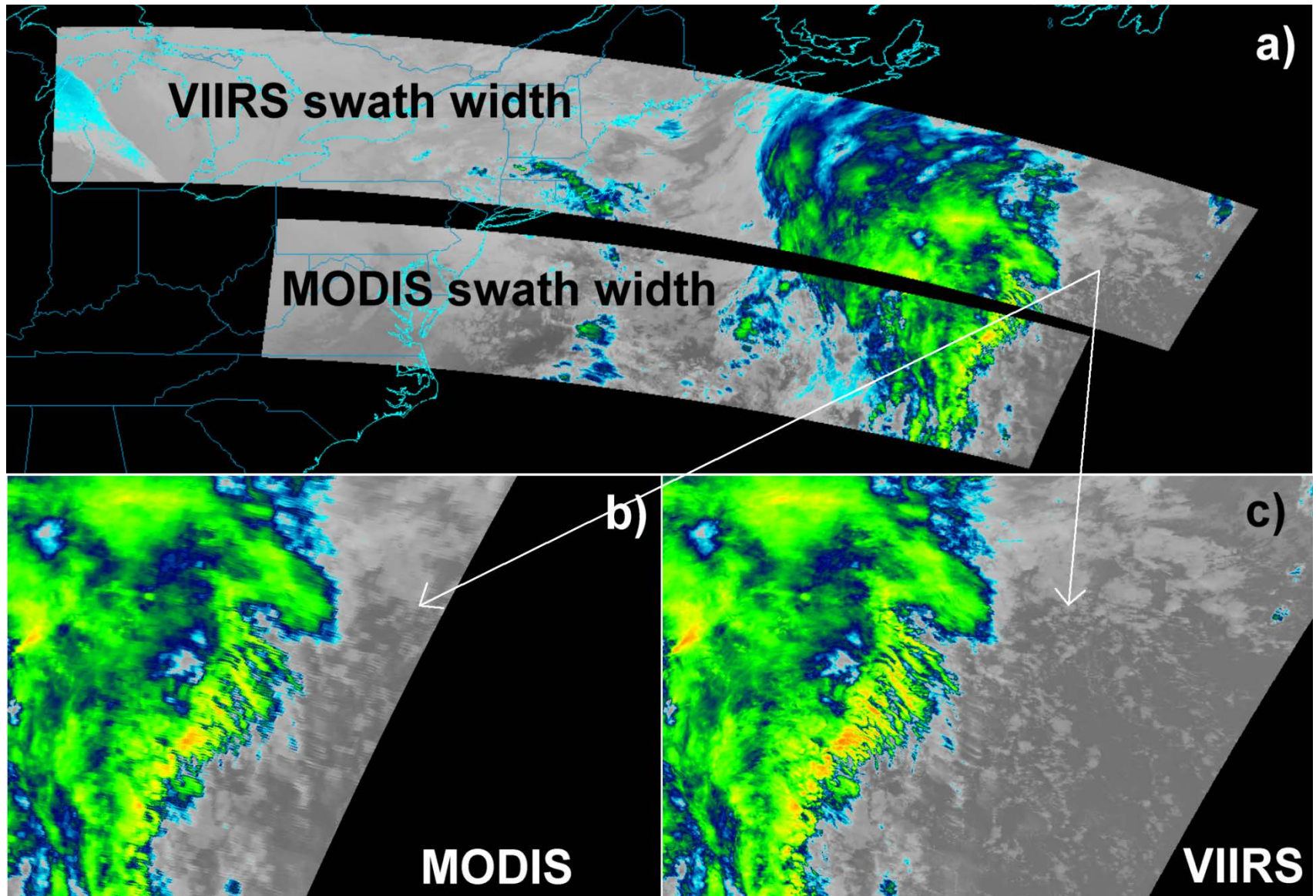
[Privacy Policy](#) | [Disclaimer](#) | [Information Quality](#)
Problems or questions? [Contact the webmaster](#).
[RAMMB Home](#) - <http://rammb.cira.colostate.edu/>

Internet 100%

Unique features of VIIRS, as compared with its predecessors

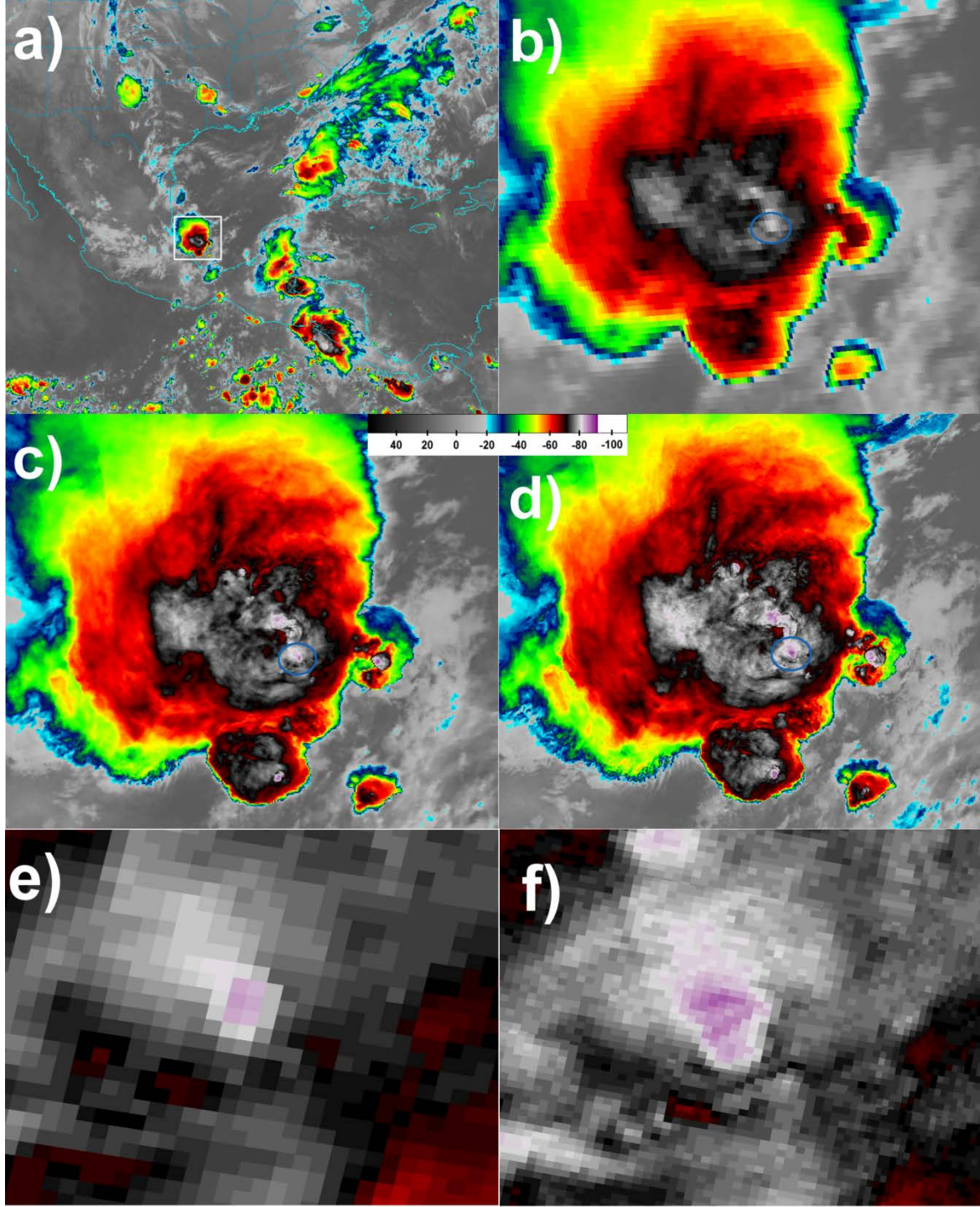
- **Finer spatial resolution** for all bands (down to 375 m)
- **Finer spatial resolution at swath edge in particular**
- **Wider (3000 km) swath**, leaving no gaps between adjacent orbits
- **DNB / NCC enables visible light imagery under all natural and artificial illumination conditions**

Better spatial resolution at swath edge



***BAMS* article to appear in 2013**

- **Hillger, D.,** T. Kopp, T. Lee, D. Lindsey, C. Seaman, S. Miller, J. Solbrig, S. Kidder, S. Bachmeier, T. Jasmin, and T. Rink, 2013: **First-Light Imagery from Suomi NPP VIIRS.** Manuscript accepted by *BAMS*.
- Examples that follow are from that manuscript.



a) GOES-13 10.7 μm image from 0815 UTC on 6 June 2012

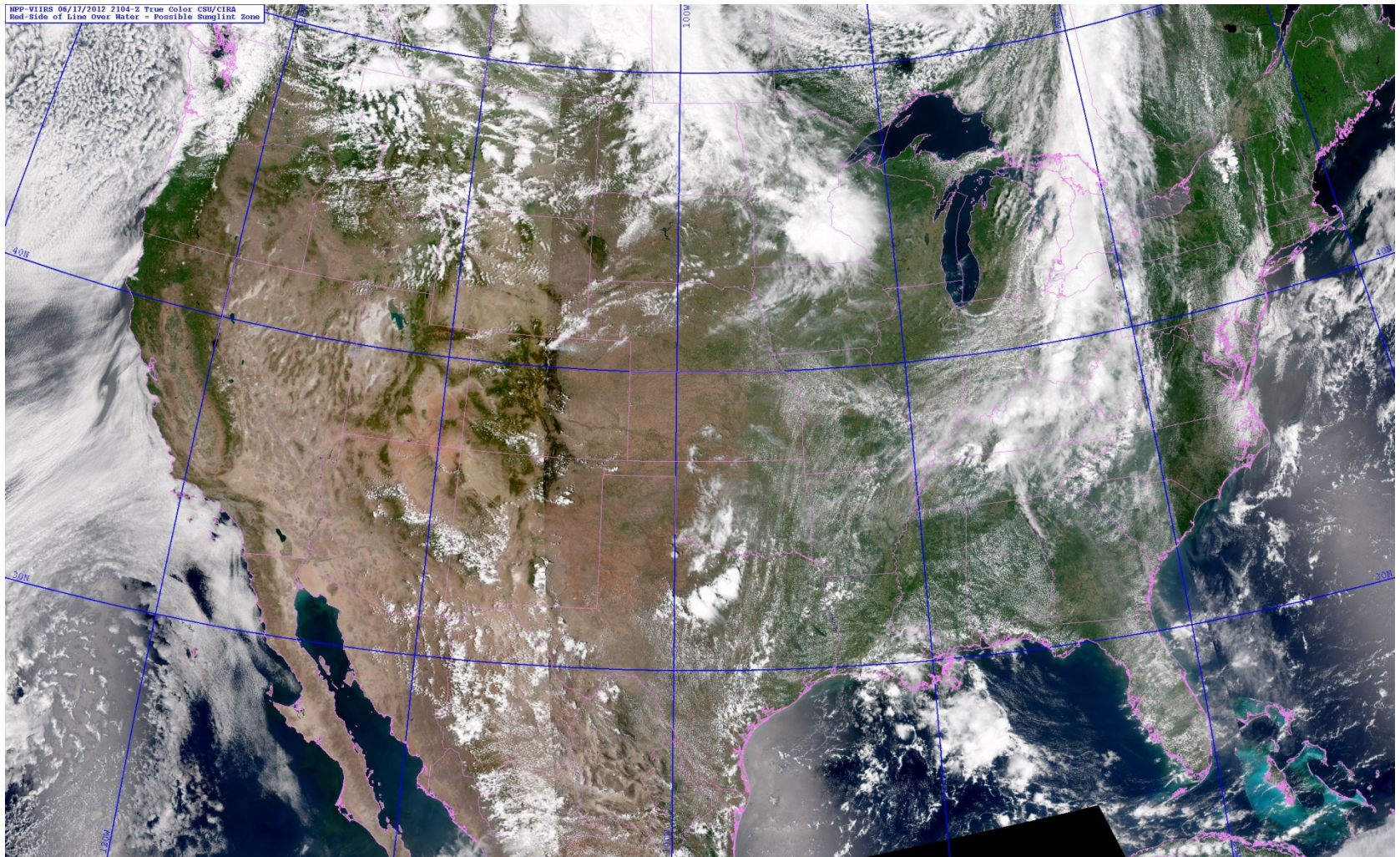
b) Zoomed-in **GOES** over the highlighted thunderstorm complex in the southwestern Gulf of Mexico,

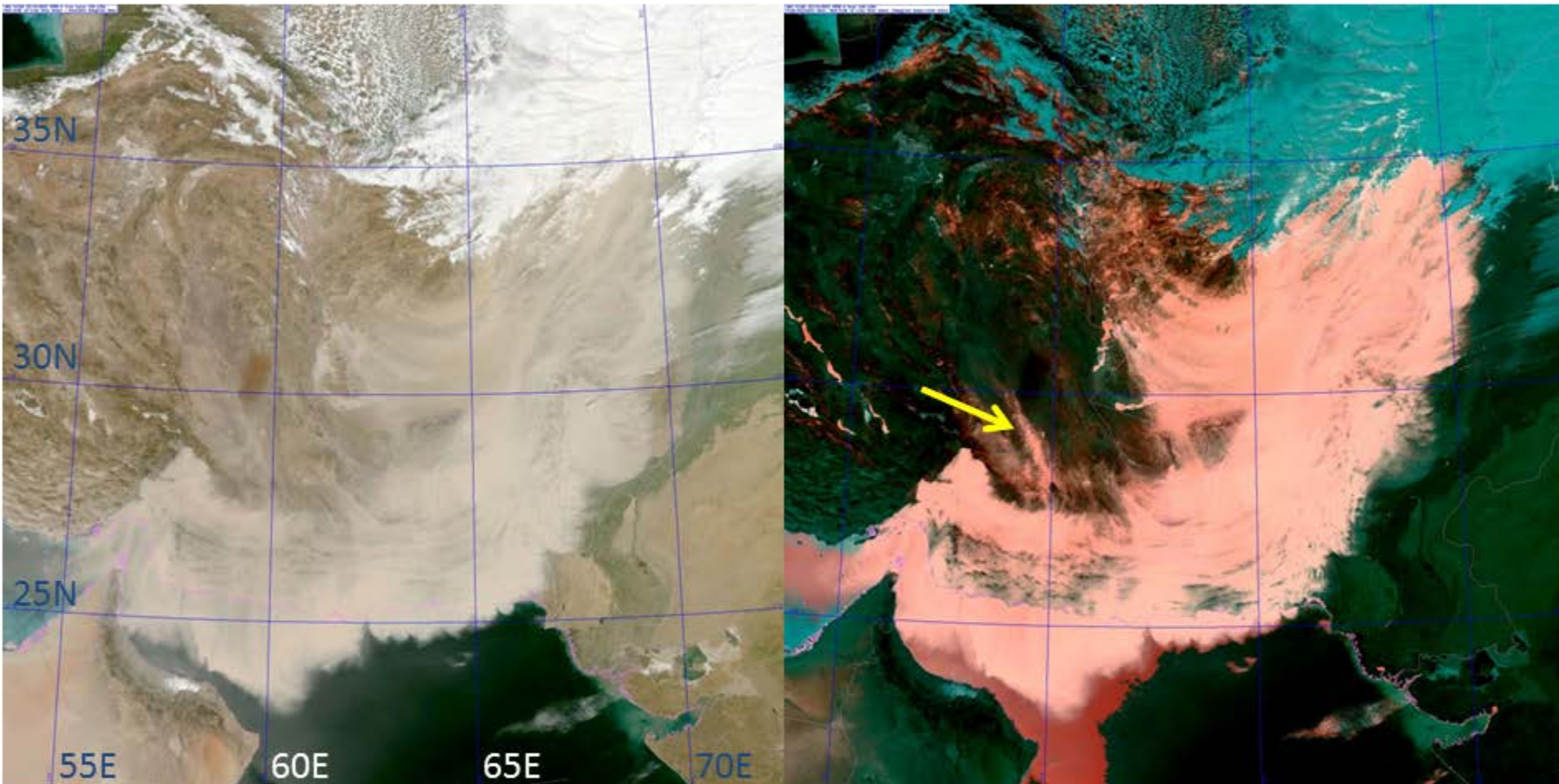
c) Aqua **MODIS** band 31 (11.0 μm) view of the same thunderstorm complex at 0816 UTC

d) NPP **VIIRS** band I5 (11.45 μm) view at 0817 UTC.

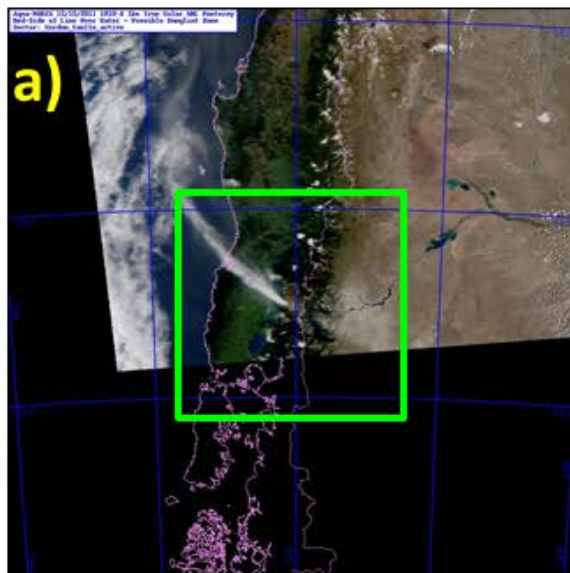
e and f) **Extreme close-ups** approximately covering the circled region from the MODIS and VIIRS images.

NRL VIIRS true-color composite (NRL's NexSat website)

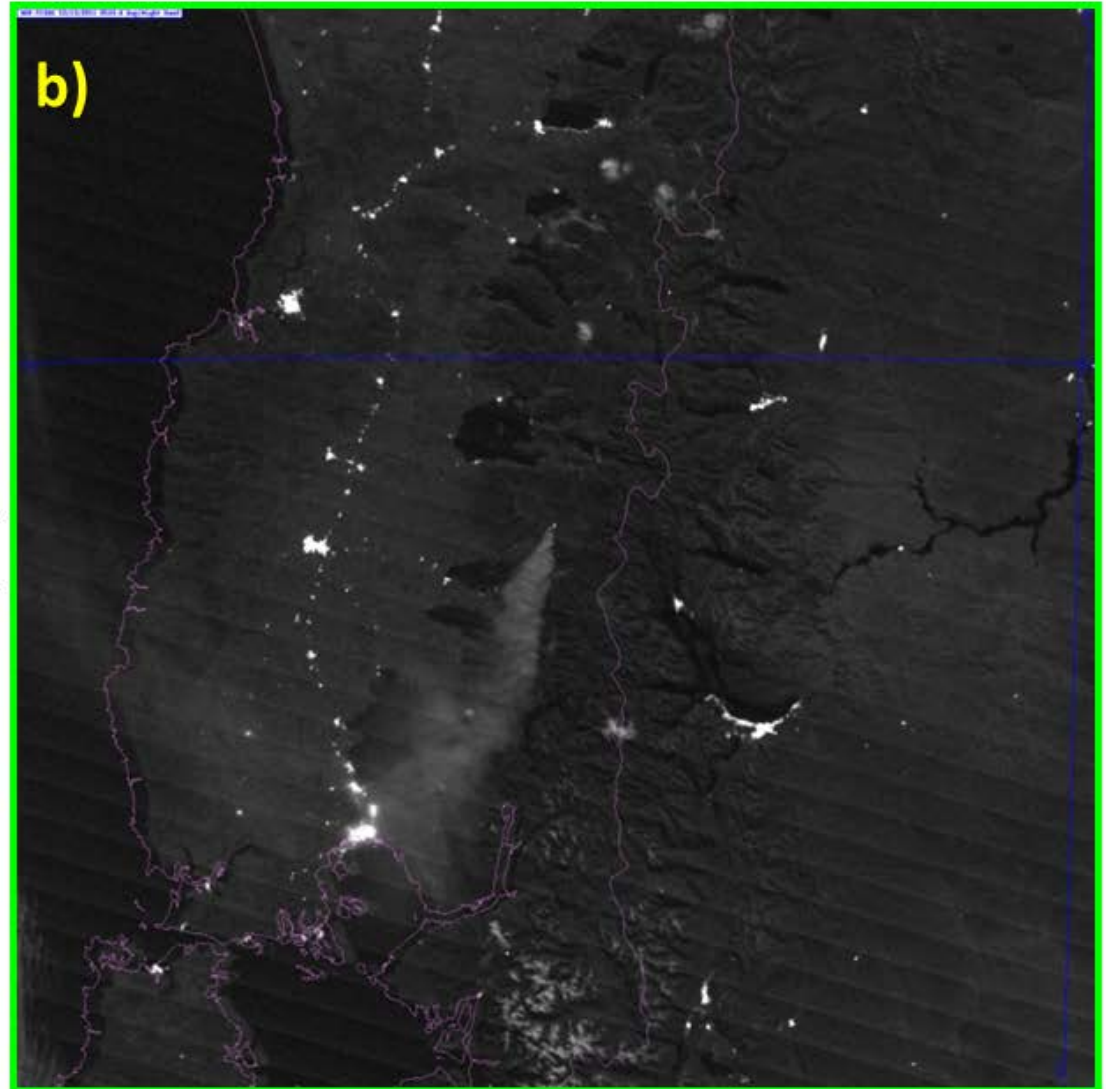
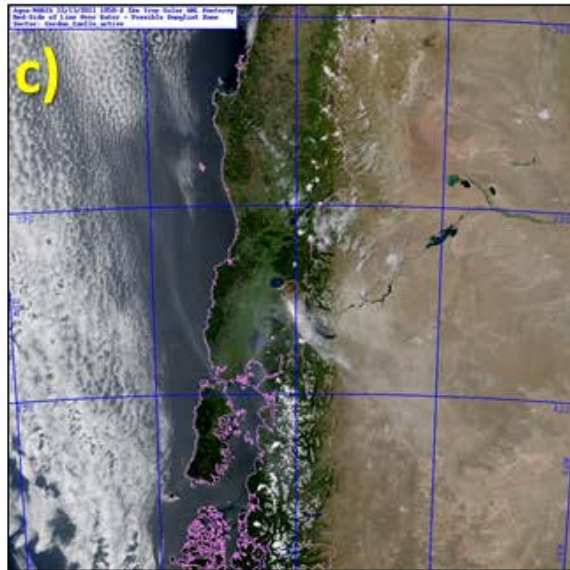




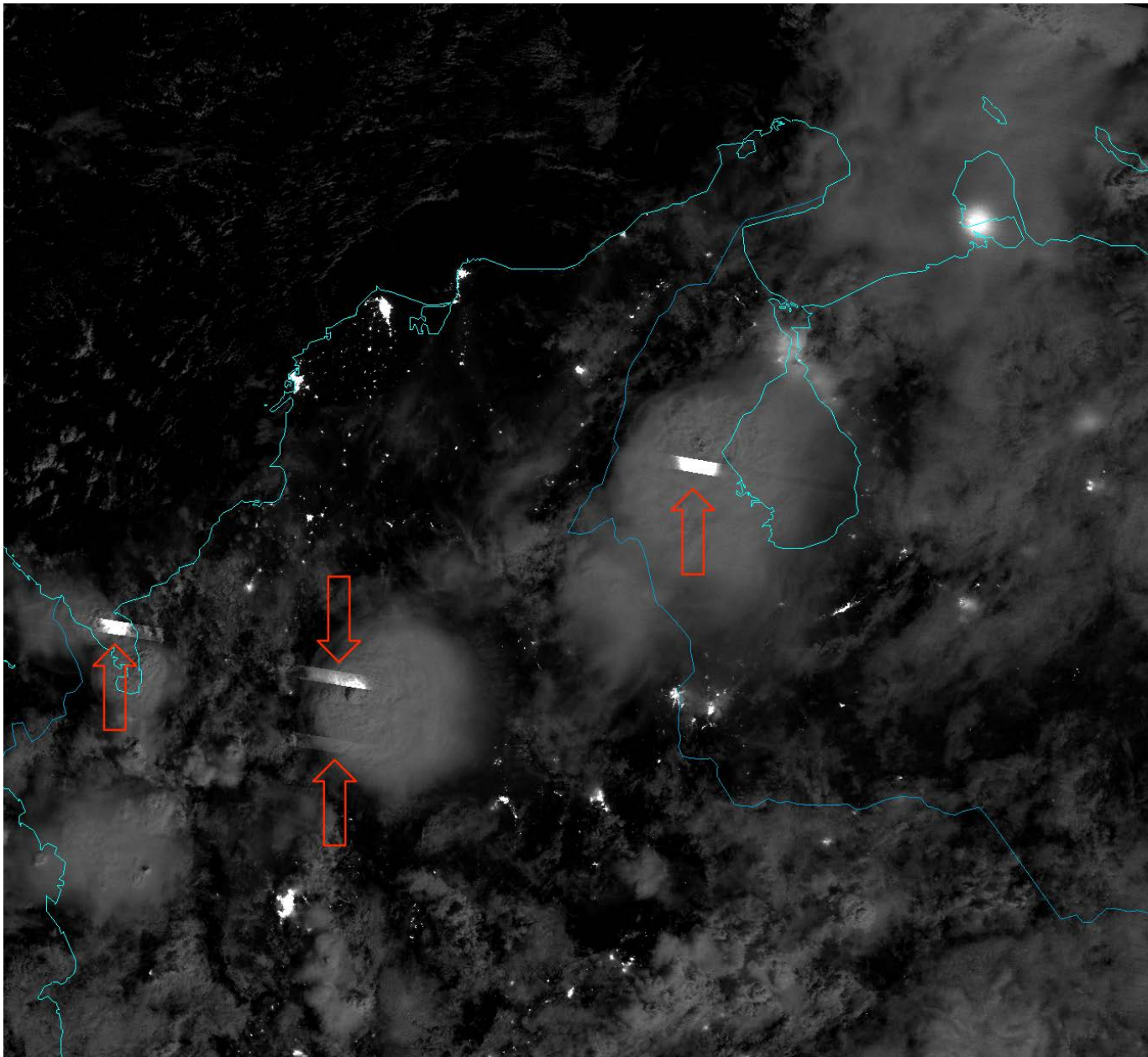
Suomi NPP VIIRS true color (left) and enhanced dust (right) imagery over Middle East. Dust appears as pink, clouds in cyan, and land in shades of green. Images are from 19 March 2012 at 0905 UTC. The enhanced imagery is particularly useful for identifying dust over bright land surface backgrounds, such as the narrow plume indicated in the enhancement by the yellow arrow.



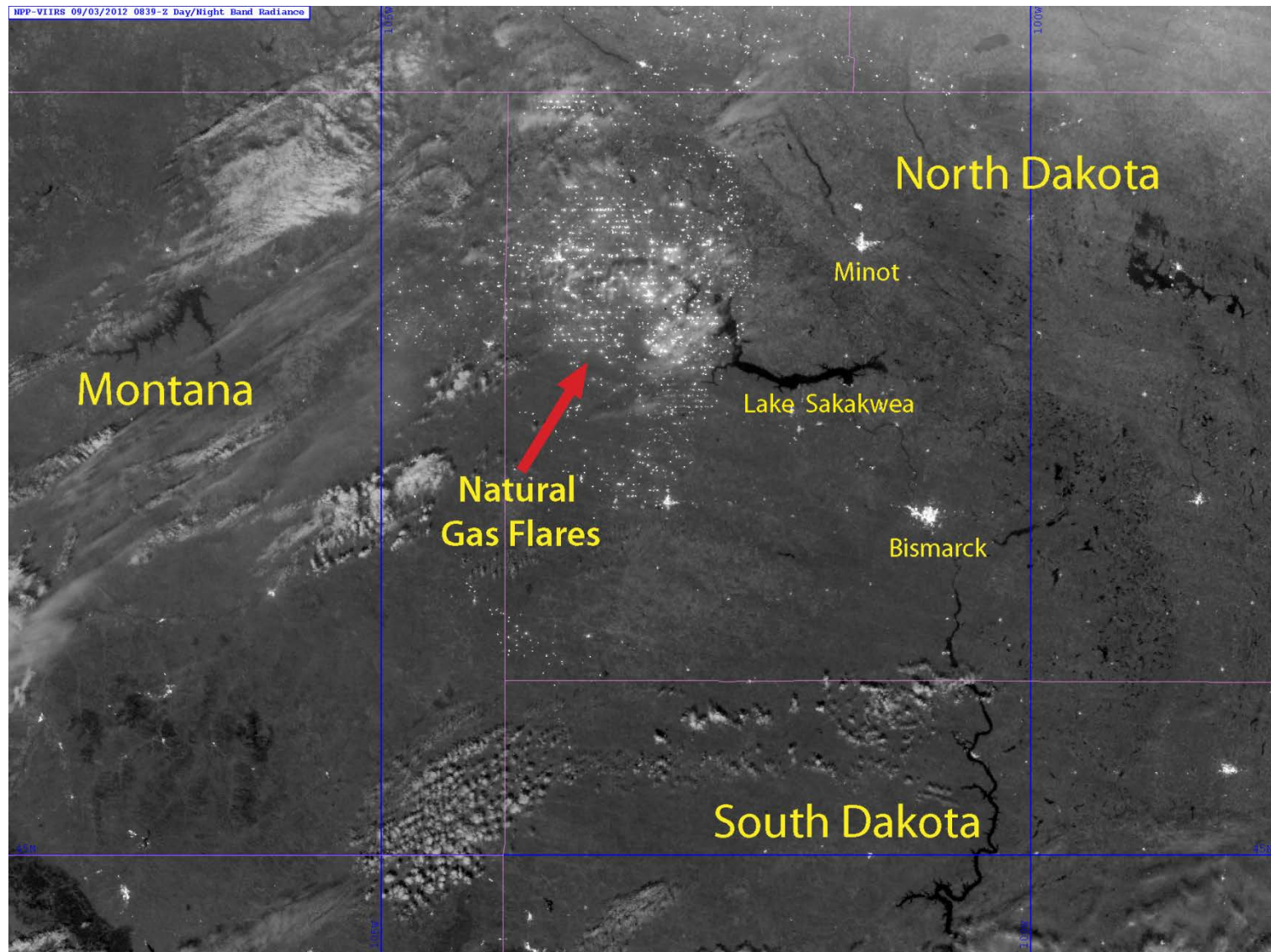
NIGHT



Multi-sensor imagery sequence over the **Puyehue-Cordón Caulle volcanic chain in Chile during an ongoing eruption**, showing a) Aqua MODIS on 12 December 2011 at 1810 UTC, b) VIIRS DNB on 13 December at 0510 UTC for the inset box region of (a) , and c) Aqua MODIS on 13 December at 1850 UTC.



VIIRS DNB image of **lightning from thunderstorms over Colombia and Venezuela** taken 0644 UTC on 10 May 2012. Lightning strikes are identified by the red arrows. At the time this image was taken, the moon was approximately 80% full.

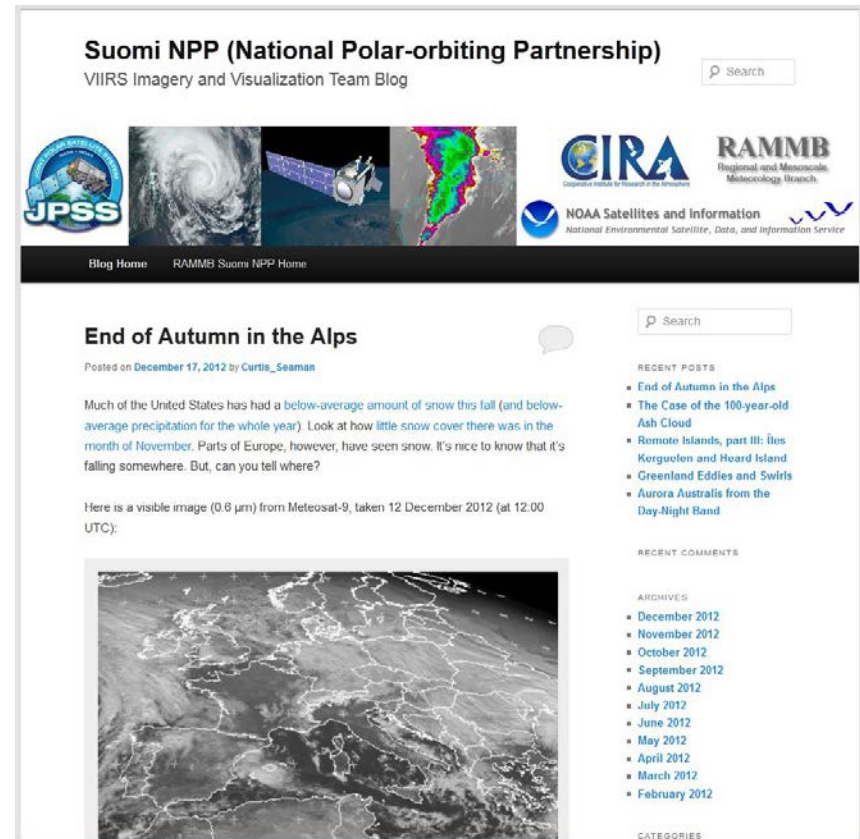


Mostly cloud-free DNB image over the U.S. Upper Midwest on 3 September 2012 at 0839 UTC. Note the lights from major cities, as well as a large cluster of oil flare signatures in northwestern North Dakota from the recently-developed Bakken formation.

JPSS/Suomi NPP VIIRS Imagery Blog

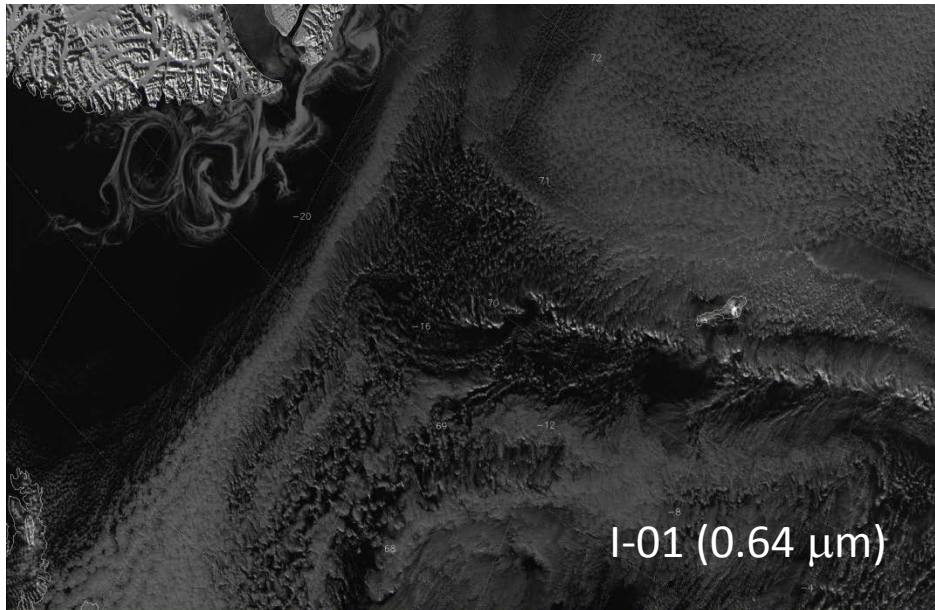
<http://rammb.cira.colostate.edu/projects/npp/blog/>

- Blog maintained at CIRA to **highlight capabilities of VIIRS** instrument.
- Designed to provide **education/outreach** of VIIRS imagery applications.
- Blog covers **wide range of topics**: tropical cyclones, severe weather, fire detection, auroras, volcanic eruptions, flooding, snow and ice detection, DNB applications, RGB composites and other interesting high-resolution imagery from VIIRS

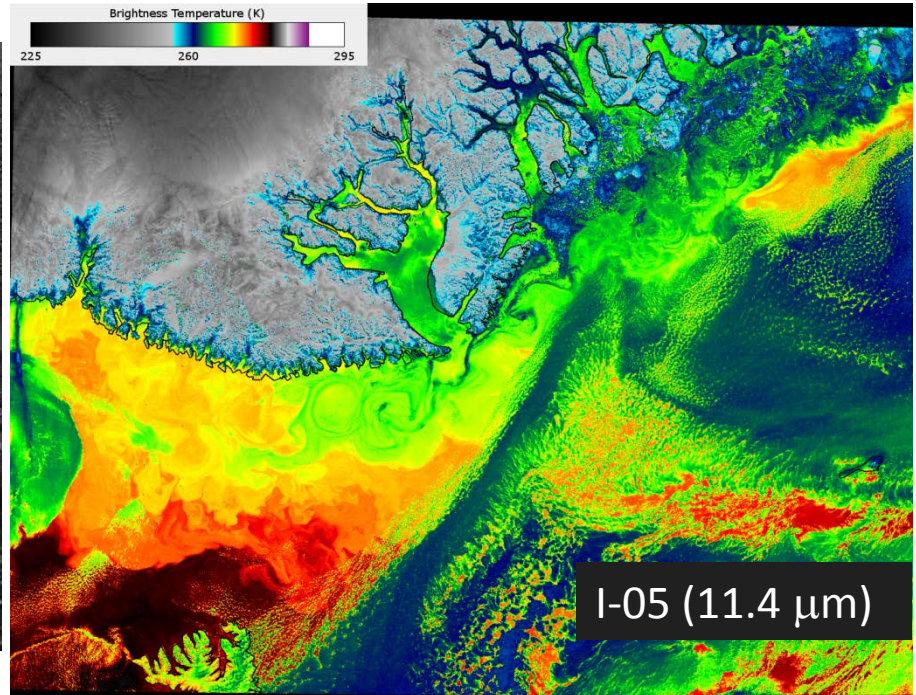


Greenland Swirls

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



Visible and IR images from 12:43 UTC 18 October 2012 (C. Seaman)



- Interaction of East Greenland Current and North Atlantic Drift represented by swirling ribbons of ice (left) caught in eddies as a result of the SST contrast (right)
- Many details visible at ~ 375 m resolution

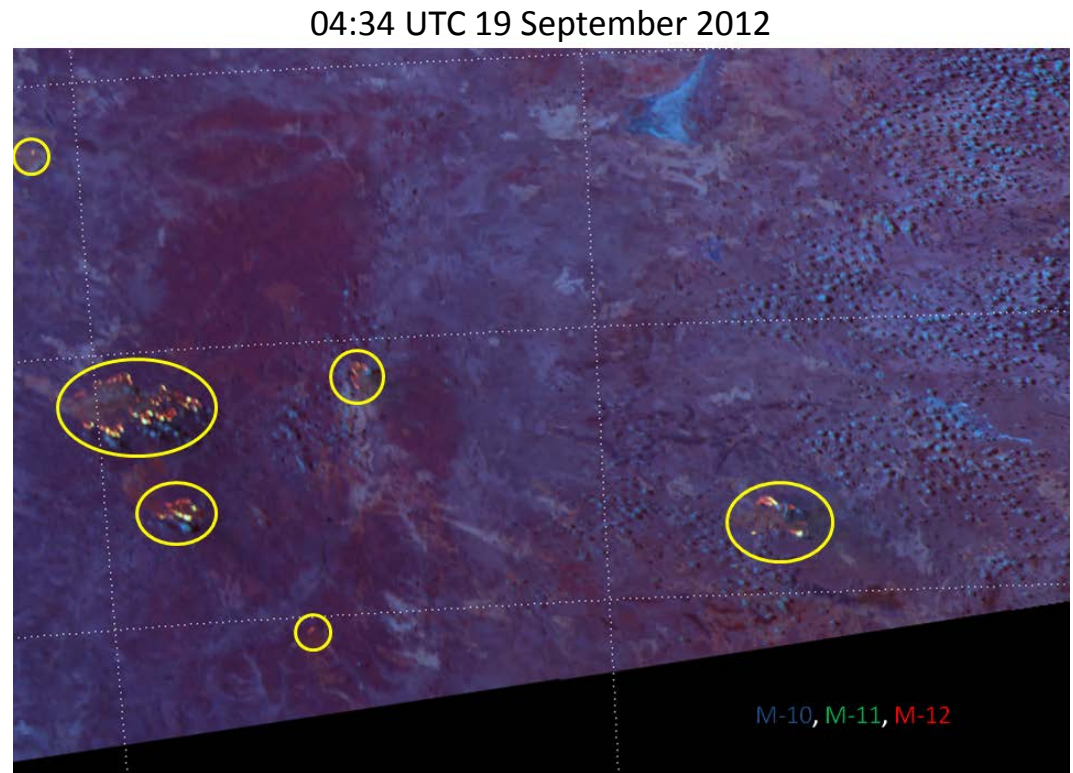
Fires in Australia

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

➤ Numerous fires visible in 3.9 μm image (M-13) of the Australian Outback

➤ “Natural Fire Color RGB” composite of 0.67 μm (M-5), 0.87 μm (M-7) and 2.25 μm (M-11)

➤ “Fire Power RGB” composite of 1.61 μm (M-10), 2.25 μm (M-11) and 3.7 μm (M-12)



(C. Seaman)

➤ Exploring new RGB composites to aid in fire detection

➤ VIIRS has detected fires at wavelengths as short as 1.61 μm

Flooding from Hurricane Isaac

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

- “Natural Color” RGB composite (0.64 μm [I-01], 0.87 μm [I-02], 1.61 μm [I-03]) shows the extent of the flooding caused by Hurricane Isaac
- The isthmus between Lake Pontchartrain and Lake Maurepas disappears under water
- Flooding also visible along the Mississippi River below New Orleans, and along the Gulf Coast

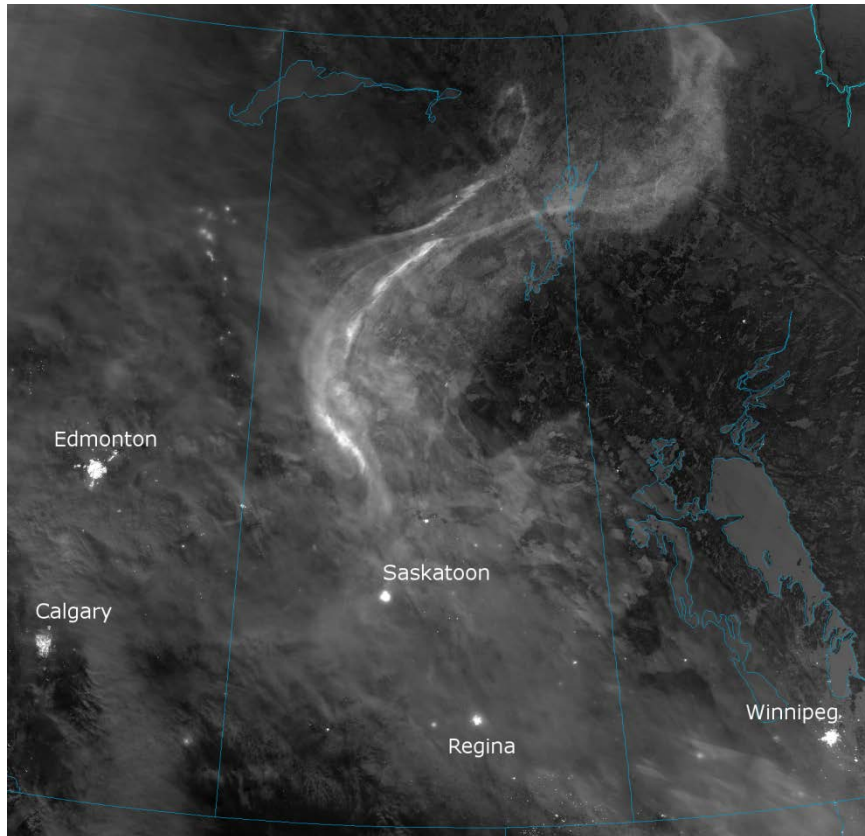


1 September 2012

(C. Seaman)

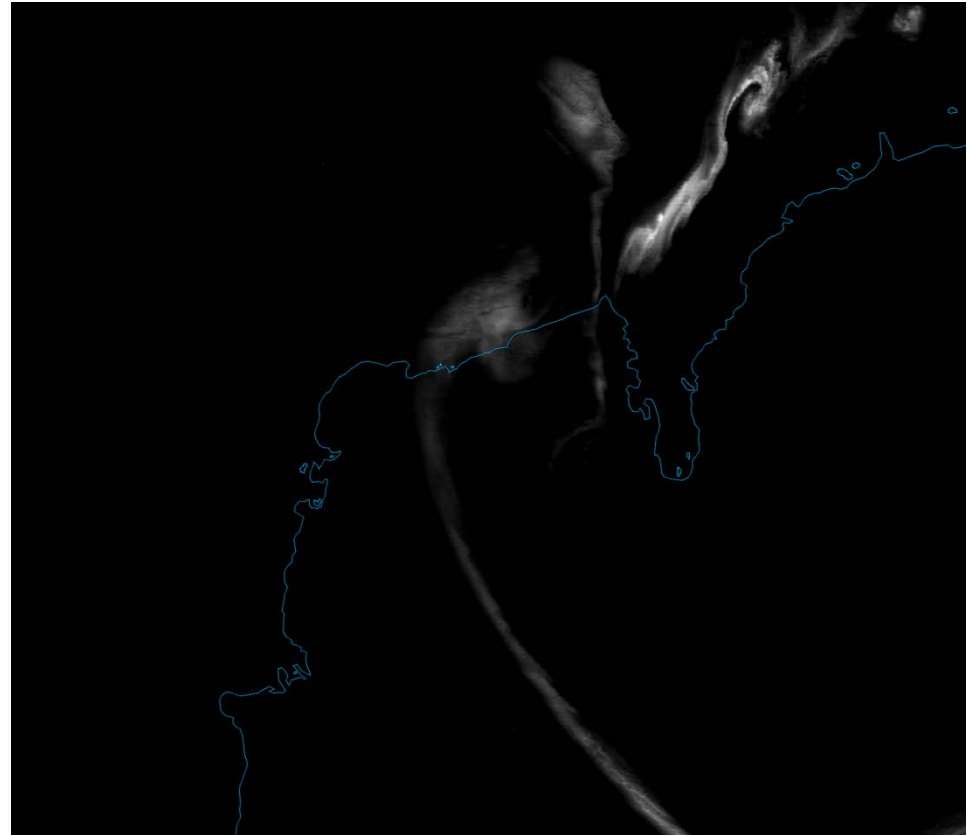
Auroras in the DNB

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



(C. Seaman)

➤ Aurora Borealis over Saskatchewan, Canada on 9 March 2012, visible during a full moon!

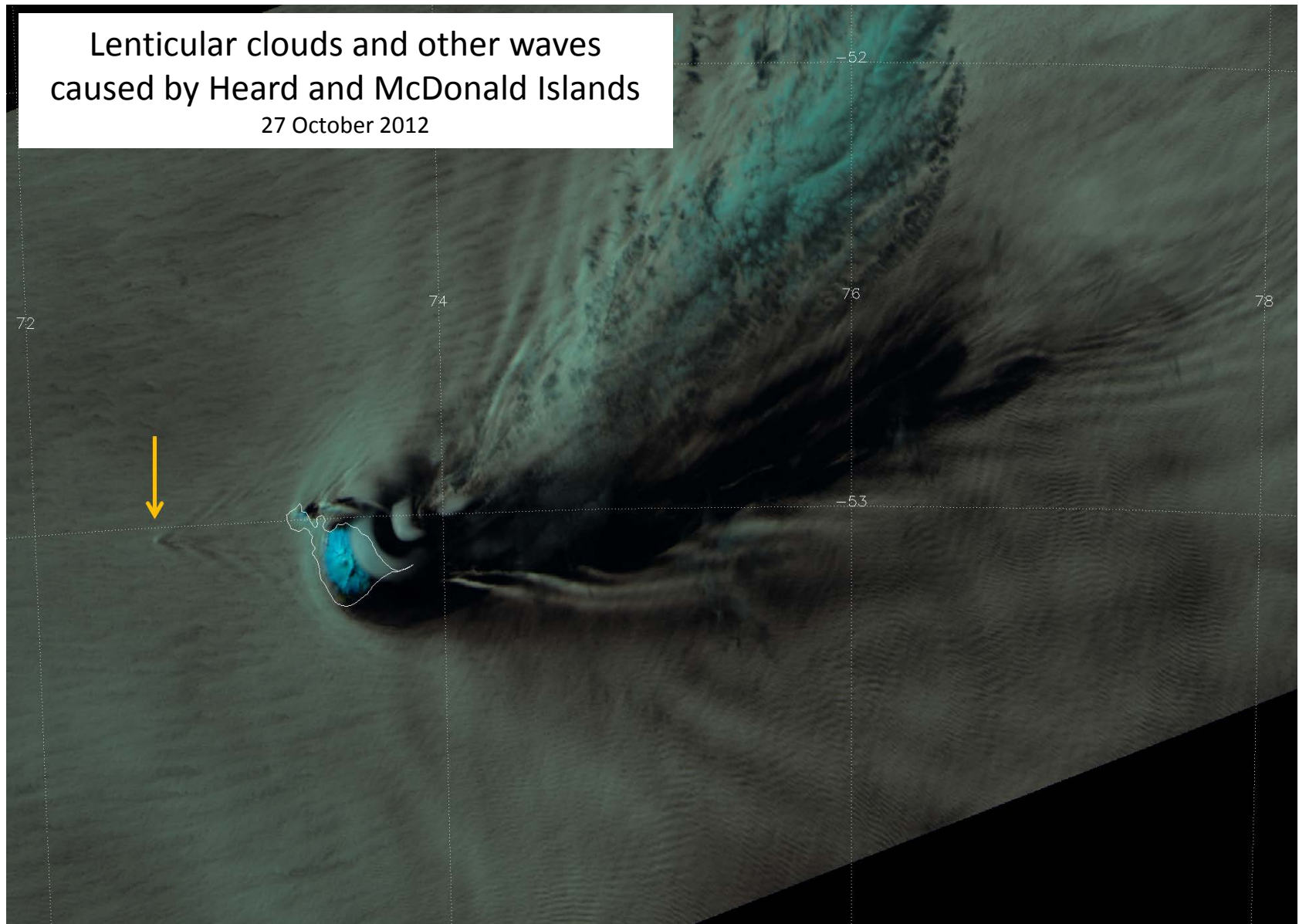


(C. Seaman)

➤ Aurora Australis over Antarctica on 15 September 2012, during a new moon.

High-resolution Images of Remote Islands

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



(C. Seaman)

VIIRS imagery issues/problems so far:

- **Server (GRAVITE) issues**
 - Missing (or delayed) granules
 - Duplicate granules
- **Missing geo-location** values in granules
- **Missing data “triangles”** in granules
- **Padding stripes (fill values)** from the use of GTM and a constant array size
- **Lack of DNB EDR (NCC) imagery** at night under low-illumination conditions
- **Stray light** hardware issue, to be remedied by software eventually.

These issues were (and are being) addressed as **Discrepancy Reports**, and sent up the chain of command.

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

Questions?

- **We've made excellent progress with VIIRS Imagery after 1 year!**
- Don't forget to see other Suomi NPP presentations and posters here at AMS 2013 by:
 - NRL/Monterrey
 - CIMSS/Wisconsin
 - Others
- Town Hall Meeting: Early Success from the Suomi NPP Mission – Tuesday 12:15 – Ballroom G

Don.Hillger@NOAA.gov