The Challenge of VIIRS Imagery in McIDAS-X: How McIDAS Experience Helps

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VIIRS Bands and Bandwidths

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 / Reflective	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		
M12	3.7	0.18	3.61 - 3.79	Medium-wave IR	
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	0.4	0.5 - 0.9	Visible	Visible / Reflective	750 m across full scan
I1 (B)	0.64	0.08	0.6 - 0.68	Visible / Reflective	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**.

NPP/JPSS data sources

- **GRAVITE**[1] (Suitland, 7-hour delay)
- **NOAA CLASS**[2] (Asheville, 7-hour delay) – not actively used
- **Atmosphere PEATE**[3] (Wisconsin, 7-hour delay)
  - **ADDE server for McIDAS-X**
  - FTP and HTML
- **Direct Readout** (Wisconsin, minimal delay, but provides data only over North America, when the satellite is with sight of Madison)
- **AFWA IDPS**[4] (Omaha, near real-time)

[1]Government Resource for Algorithm Verification, Independent Test, and Evaluation
[2]Comprehensive Large Array-data Stewardship System
[3]Product Evaluation and Algorithm Test Elements
[4]*Air Force Weather Agency* Interface Data Processing Segment

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: 2013-08-13)

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.

For a spreadsheet of VIIRS EDR maturity levels, see EDR_Imagery_maturity_levels.xlsx.

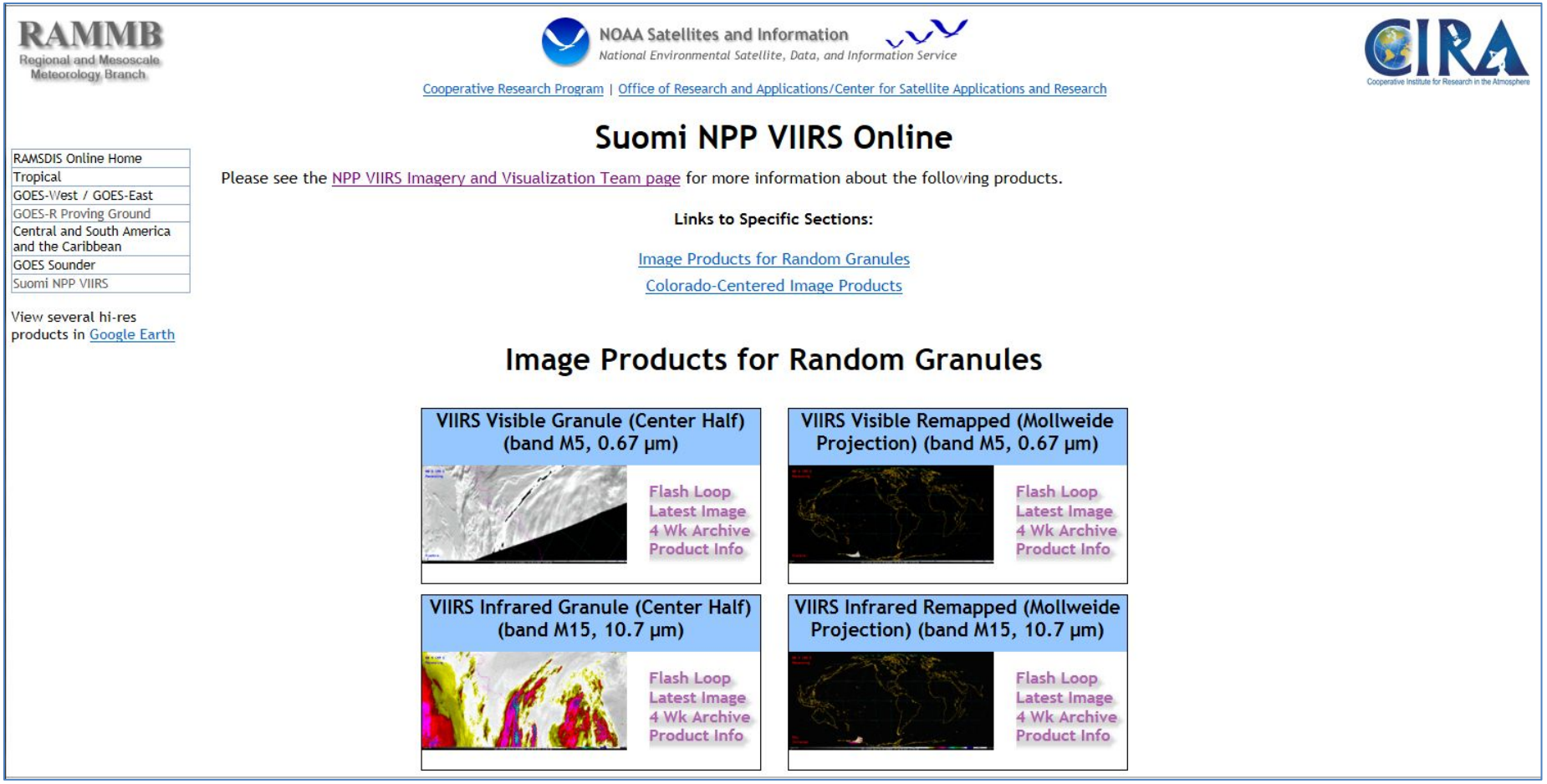
For a beginners guide to VIIRS imagery data, see Beginner_Guide_to_VIIRS_Imagery_Data.pdf. (~1 MB) (Presentation courtesy of C. Seaman, CIRA]

Website	URL
CIRA's **Suomi NPP Blog**	http://rammb.cira.colostate.edu/projects/npp/blog/
CIRA's **Suomi NPP Cal/Val**	http://rammb.cira.colostate.edu/projects/npp/calval/
CIRA's **VIIRS granules online**	http://rammb.cira.colostate.edu/ramsdis/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/

NPP Orbital Passes	Reverse Chronology of NPP VIIRS Imagery Significant Events (Newest information at the top)	NPP Reference Information/Websites and VIIRS Imagery Documents

Suomi NPP VIIRS Online

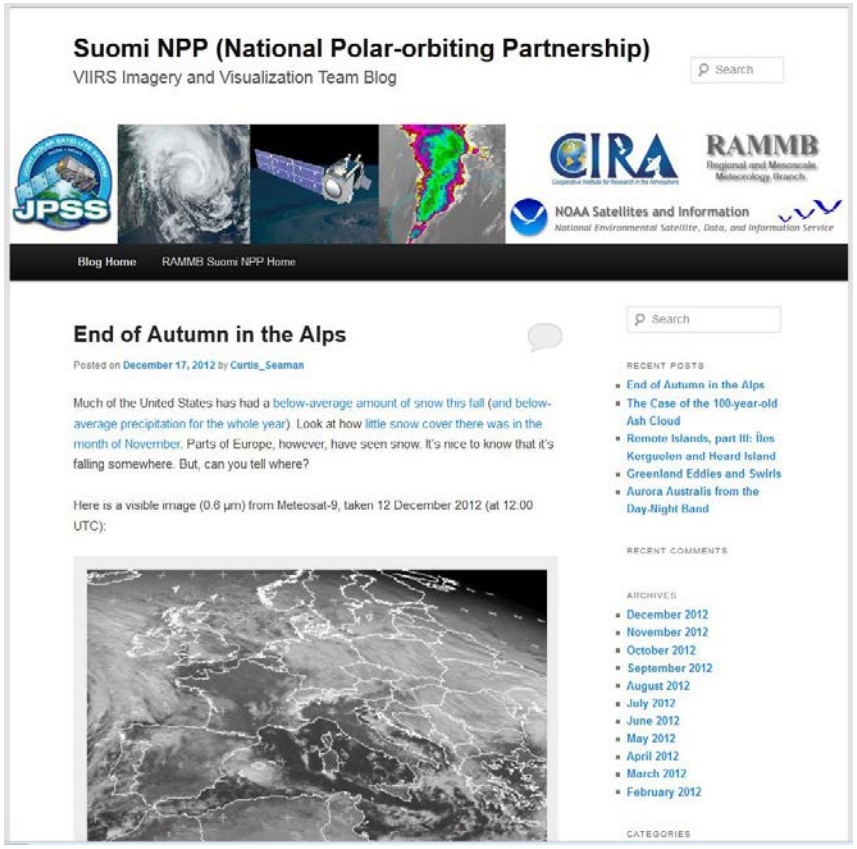
http://rammb.cira.colostate.edu/ramsdis/online/npp_viirs.asp



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



Beginner's Guide to VIIRS Imagery Data

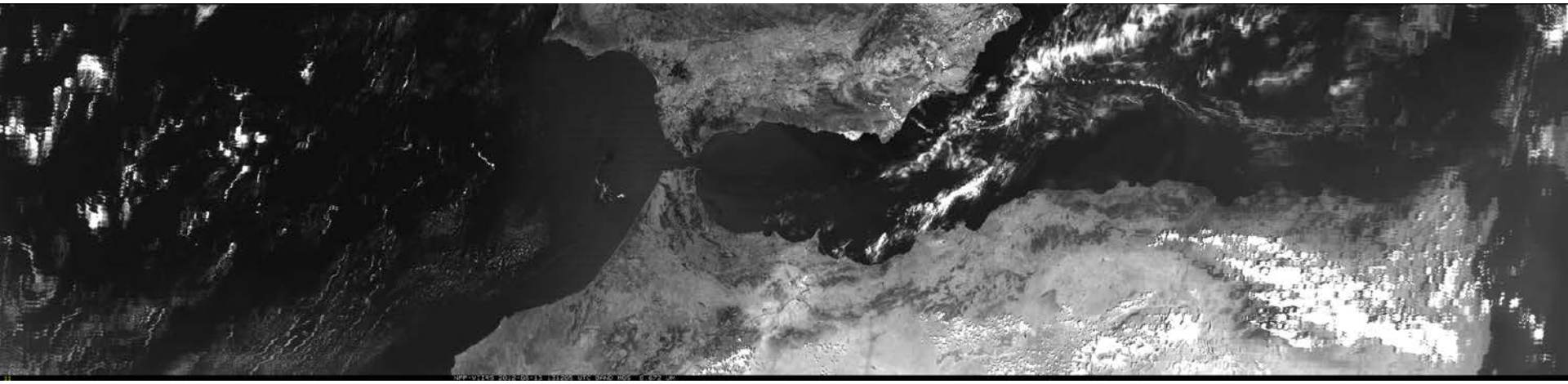
Curtis Seaman
CIRA/Colorado State University
http://rammb.cira.colostate.edu/projects/npp/Beginner_Guide_to_VIIRS_Imagery_Data.pdf

VIIRS single granule information

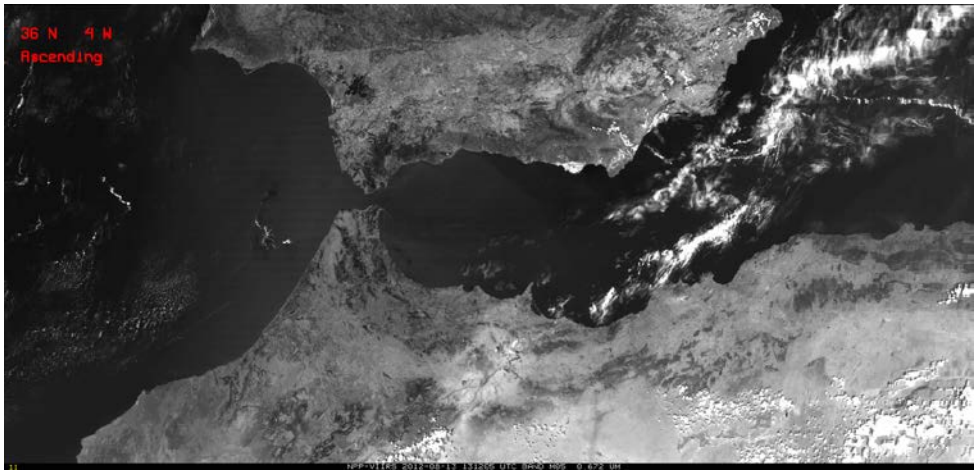
VIIRS	Lines x Elements	Suggested McIDAS-X magnification
Size (km)	~550 km x ~3000 km (~5° x ~27°)	
I-bands (full size)	**1536 x 6400**	-2 x -4
M-bands (full size)	**768 x 3200****	1 x -2
Suggested McIDAS-X window	**768 x 1600***** or 768 x 1920	**1 x 1 (with LINE=X 800)** **to get center half of granule** 1 x 1 (with LINE=X 640) to get center of granule between outermost bowtie deletions
DNB (full size)	**768 x 4064**	
Suggested McIDAS-X window	768 x 2032 or 786 x 1600 (same size as other bands)	1 x 1 (with LINE=X 1016) to get center half of granule 1 x 1 (with LINE=X 1232) to get center portion of granule same size as other bands
NCC (from DNB)	**768 x 3200****	[Same treatment as M-bands]

Each granule, ~86 seconds long, or ~556 km along track
*Based on an altitude of 833 km
**48 scans x 16 detectors/scan = 768 lines
***Based on a McIDAS window as large as most single monitors will display

VIIRS granule display in McIDAS-X (band M5 example)

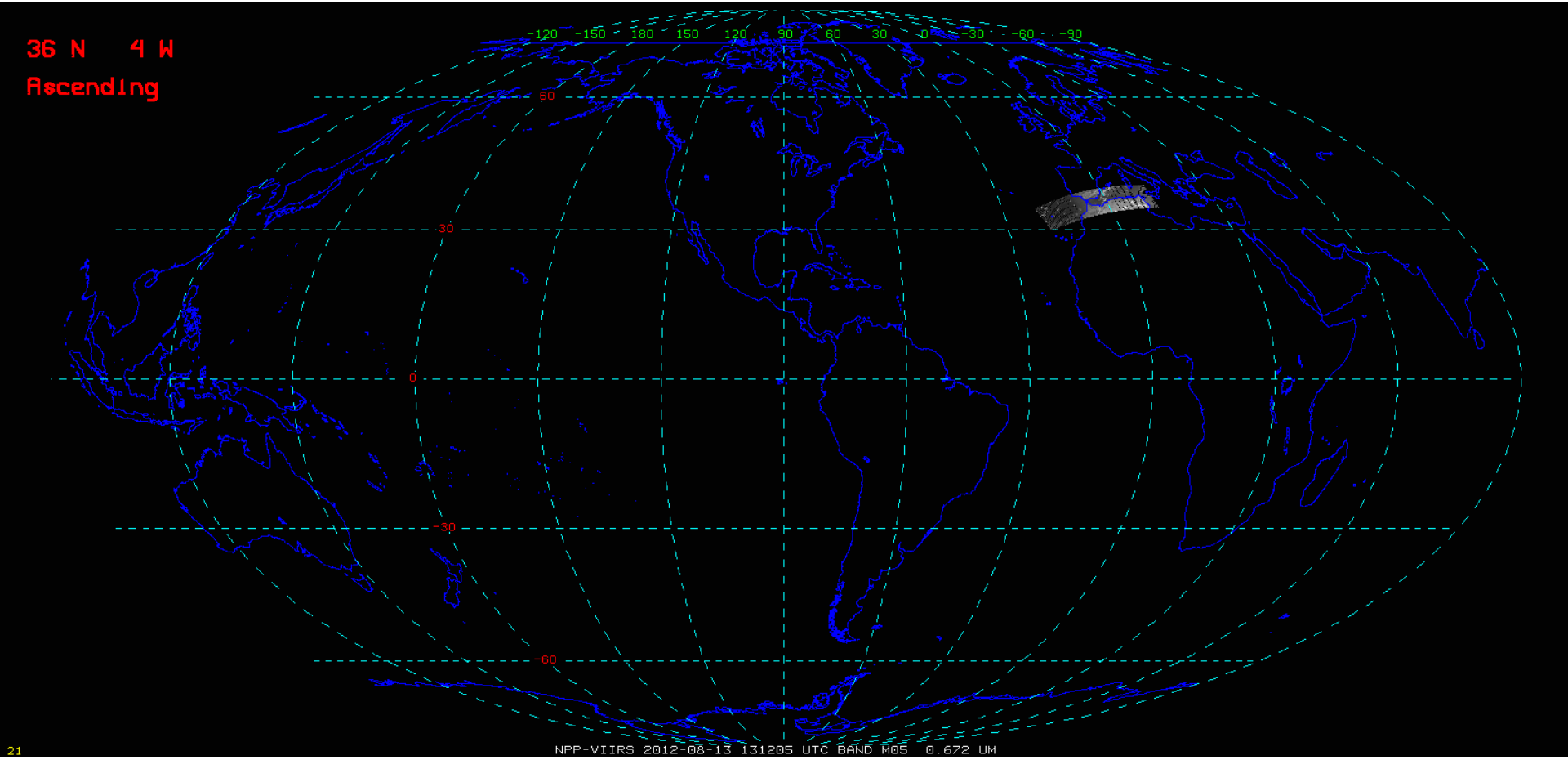


Full 90-second granule (768 x 3200)
(Bow-tie deletions at each end of SDR granule are filled)



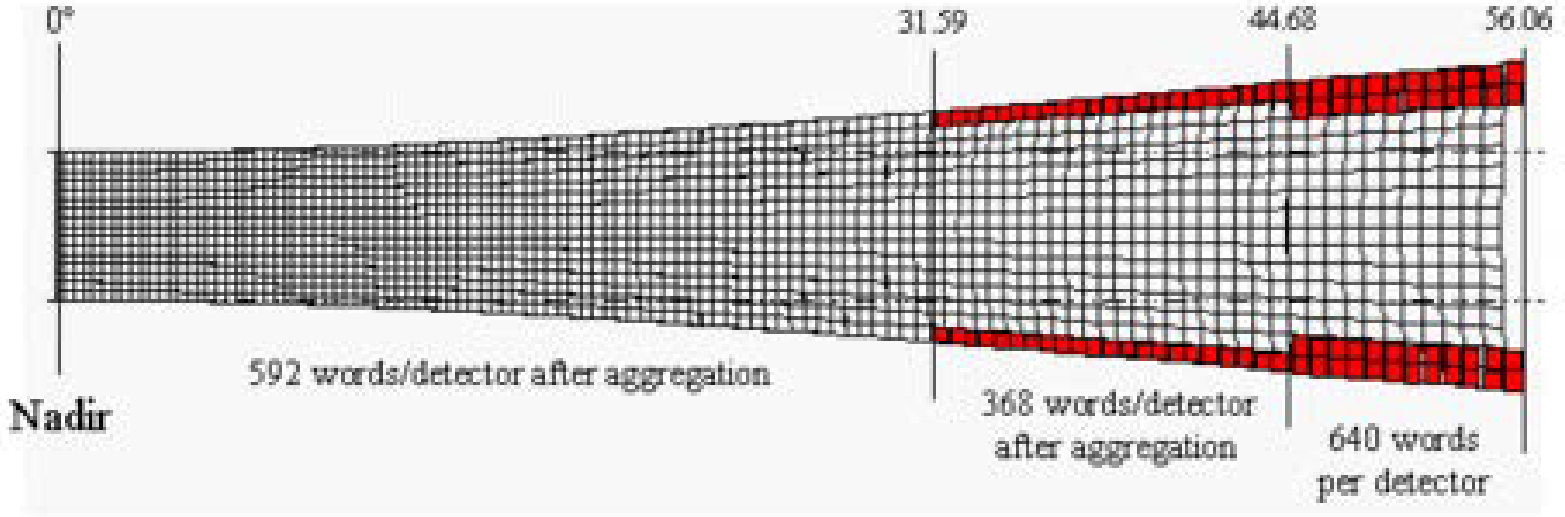
Center half of granule (768 x 1600)
(Avoids filled-in bow-tie deletion areas at each end of SDR granule)

Full 90-second granule remapped to Mollweide projection (in McIDAS-X)

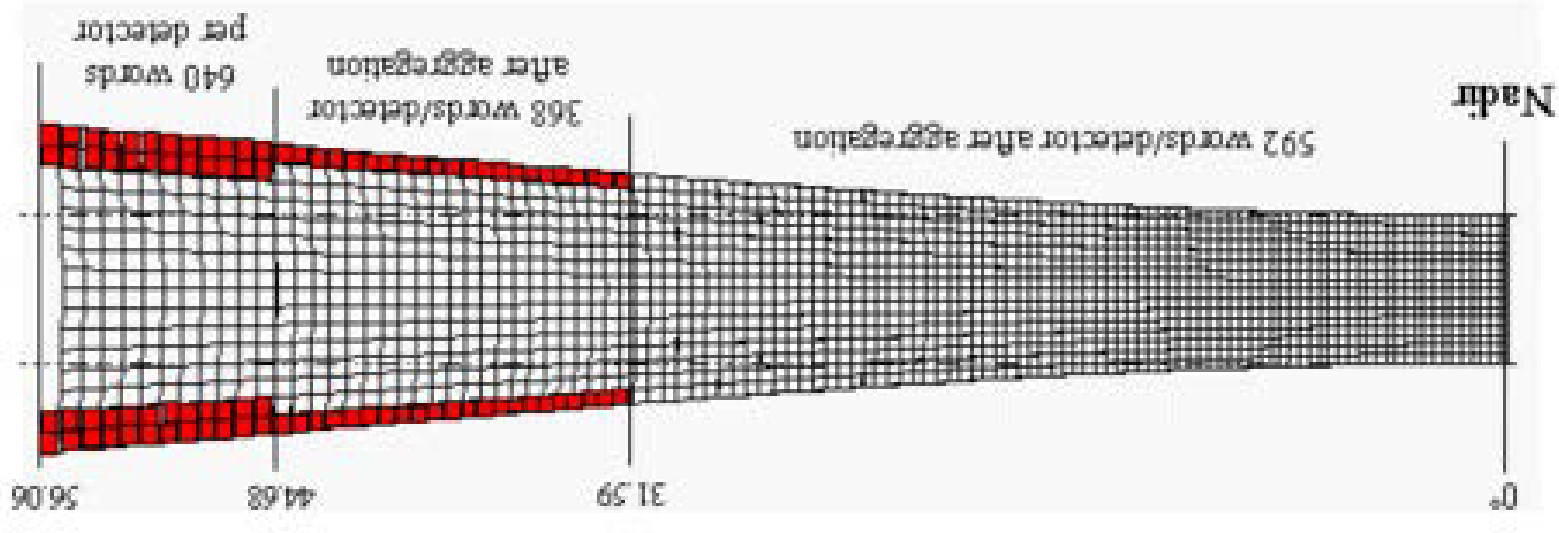


16 M-band detectors per scan
(red pixels are bowtie deletion pixels, first one then two lines.)
Should be a repeating pattern every 16 lines.

Right half



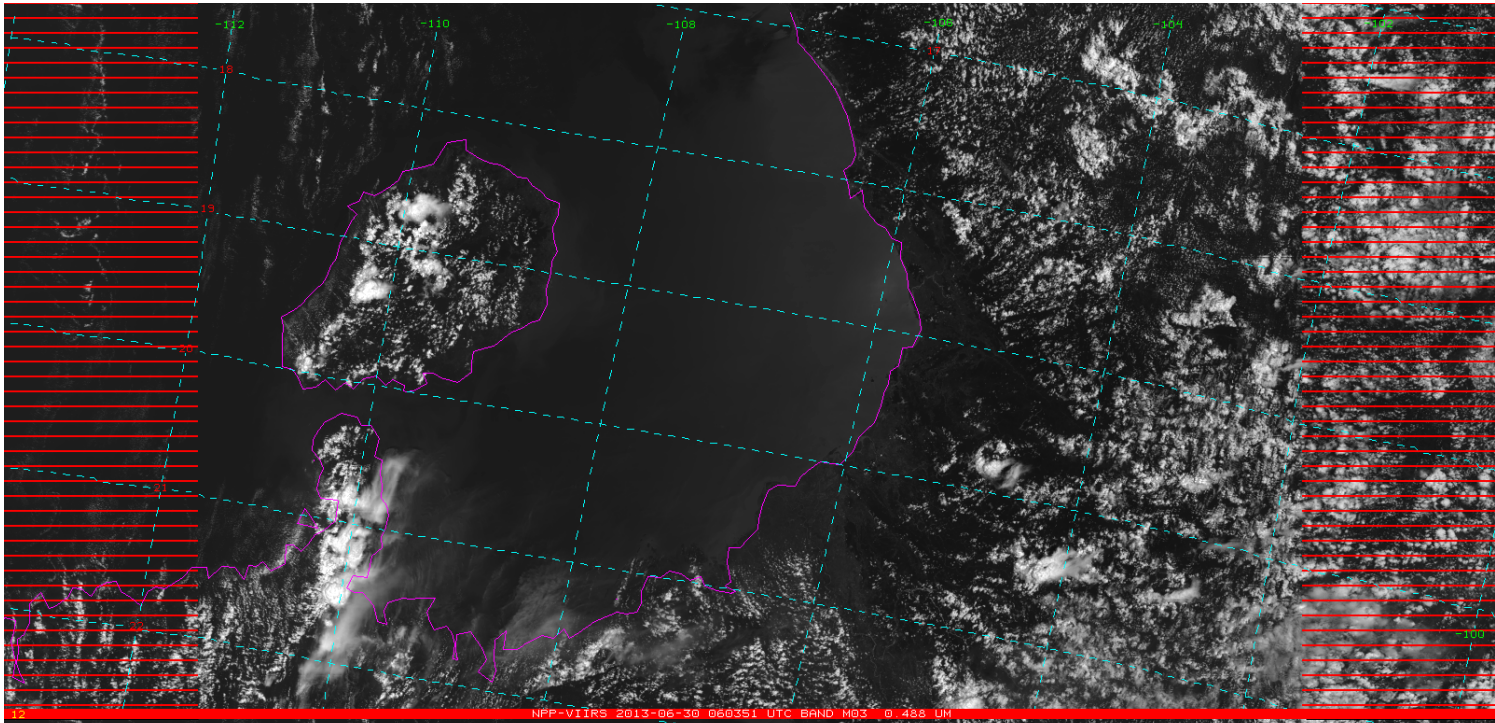
Left half



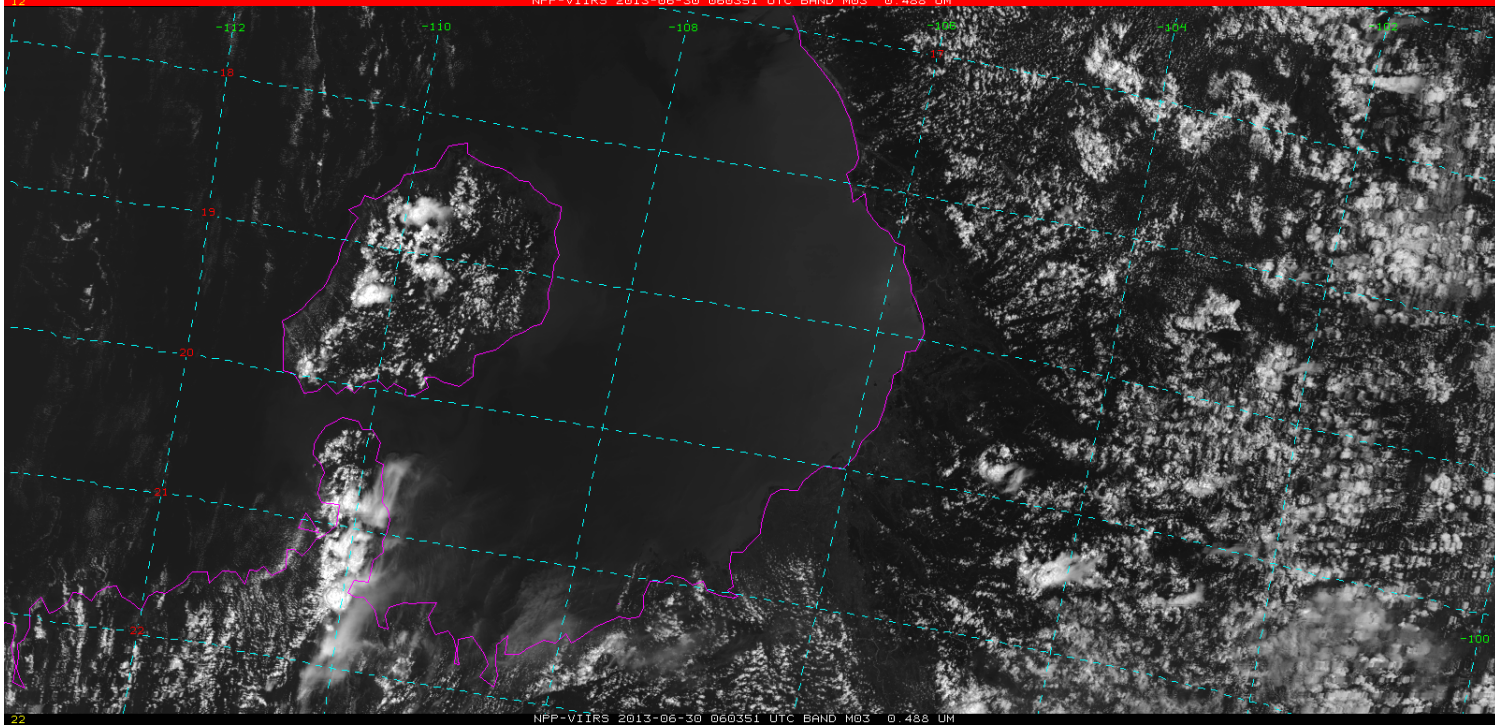
Bow Tie Line Deletions

Sequential lines missing (M-bands)	2	1	0	1	2
Lines missing out of 16 lines/scan (M-bands)	4	2	0	2	4
Elements (M-bands)	1-640	641-1008	1009-2192	2193-2560	2561-3200
Number of elements (M-bands)	640	368	1184 (2x592)	368	640
Scan angle	56°-44.7°	44.7°-32°	32°-0°-32°	32°-44.7°	44.7°-56°
Zenith angle	69.4°-52.6°	52.6°-36.7°	36.7°-0°-36.7°	36.7°-52.6°	52.6°-69.4°

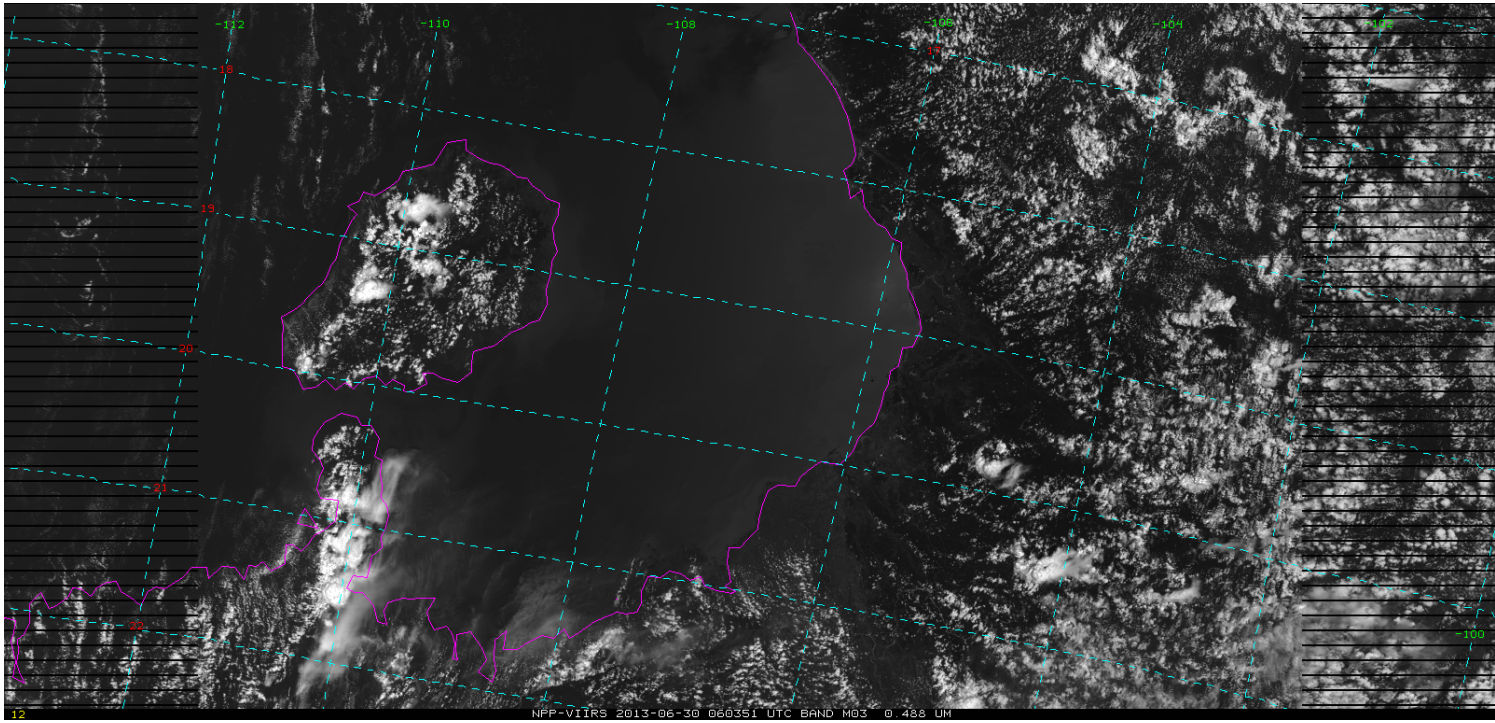
VIIRS M3 band 2013-06-30 06:03:51 UTC



VIIRS M3 band 2013-06-30 06:03:51 UTC with bowtie deletions filled-in

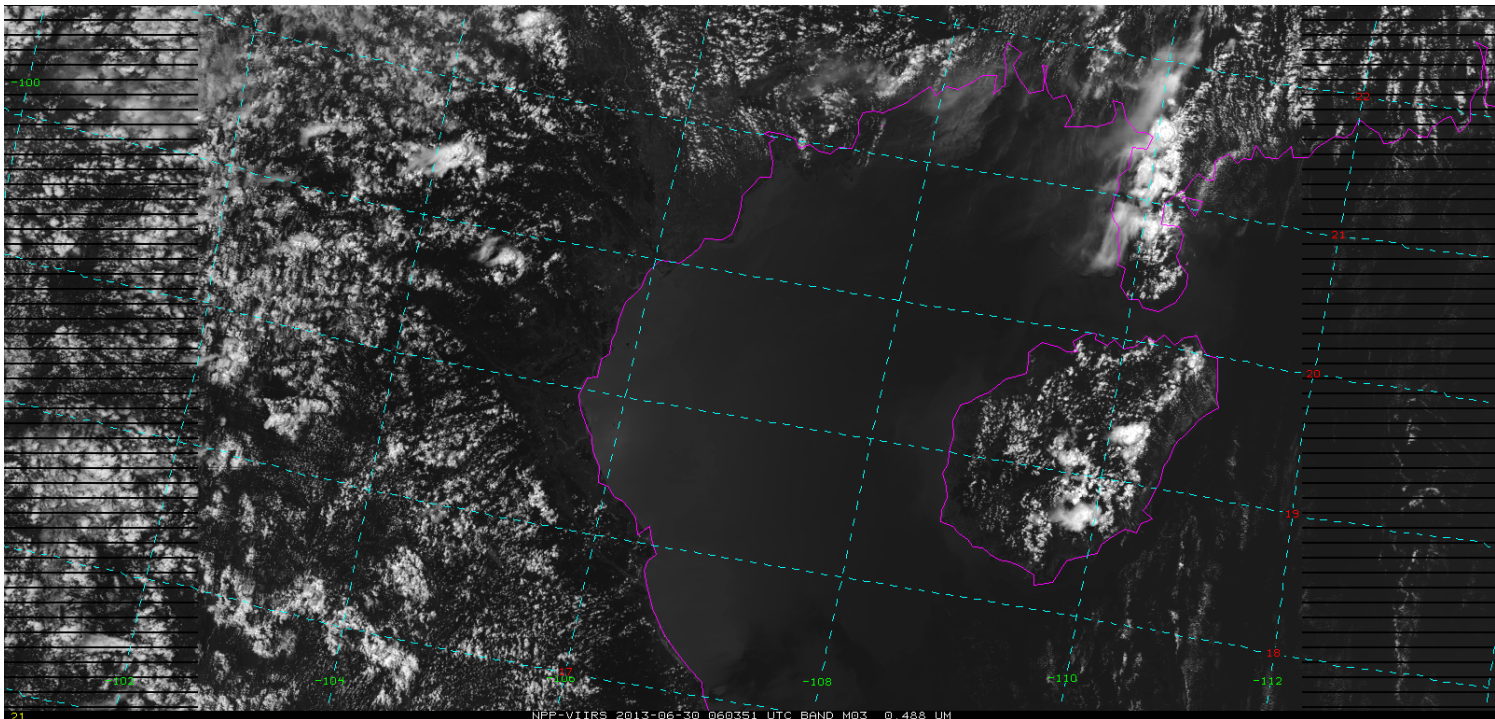


VIIRS M3 band 2013-06-30 06:03:51 UTC



VIIRS M3 band 2013-06-30 06:03:51 UTC

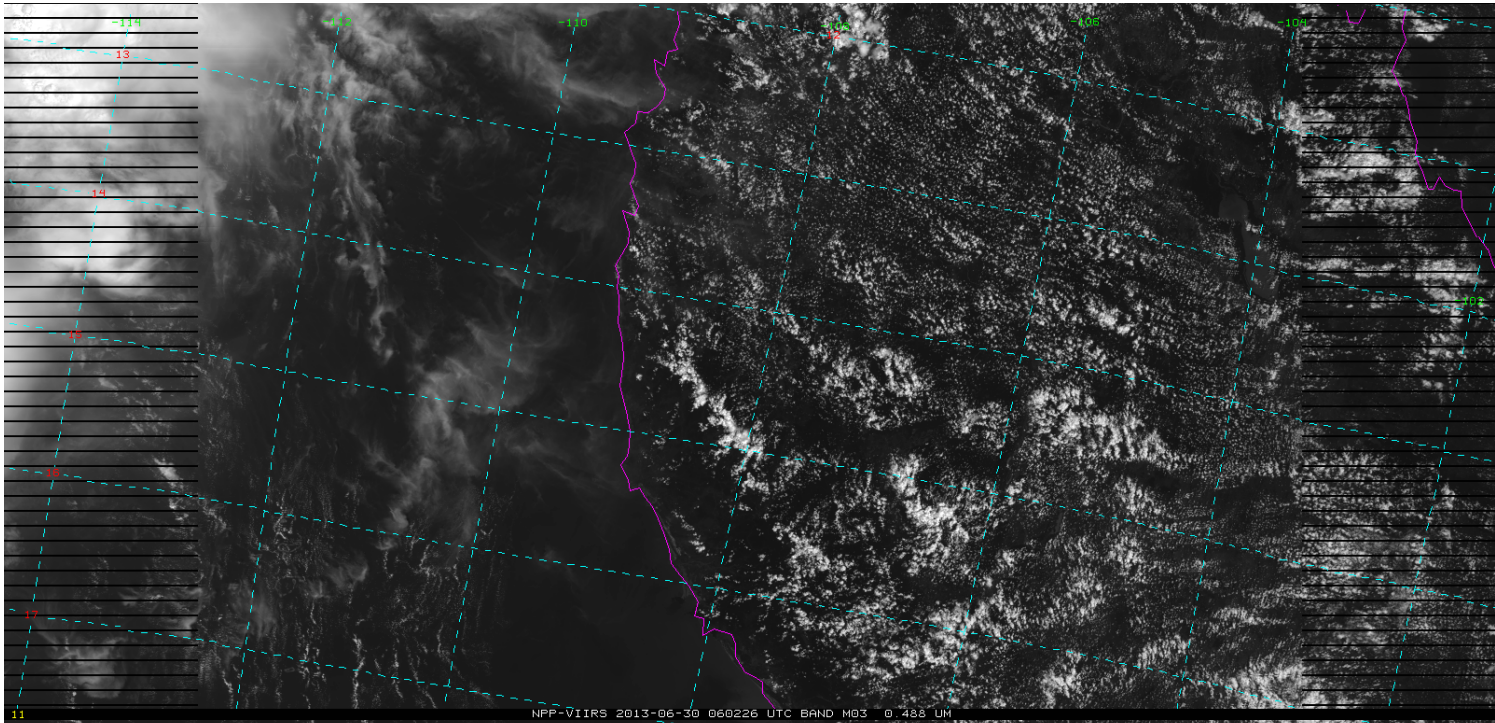
<u>rotated</u> so that north is to the top

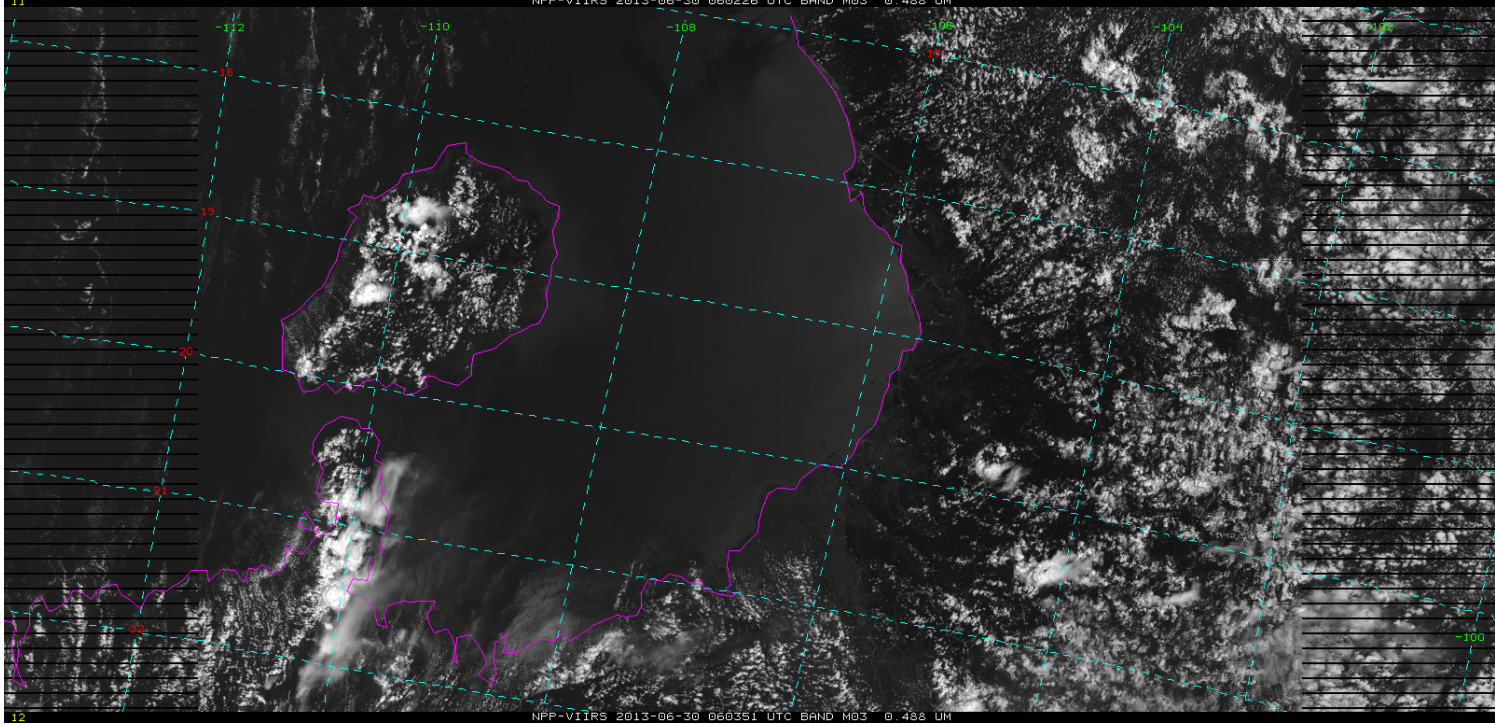


VIIRS M3 band 2013-06-30 06:02:26 UTC

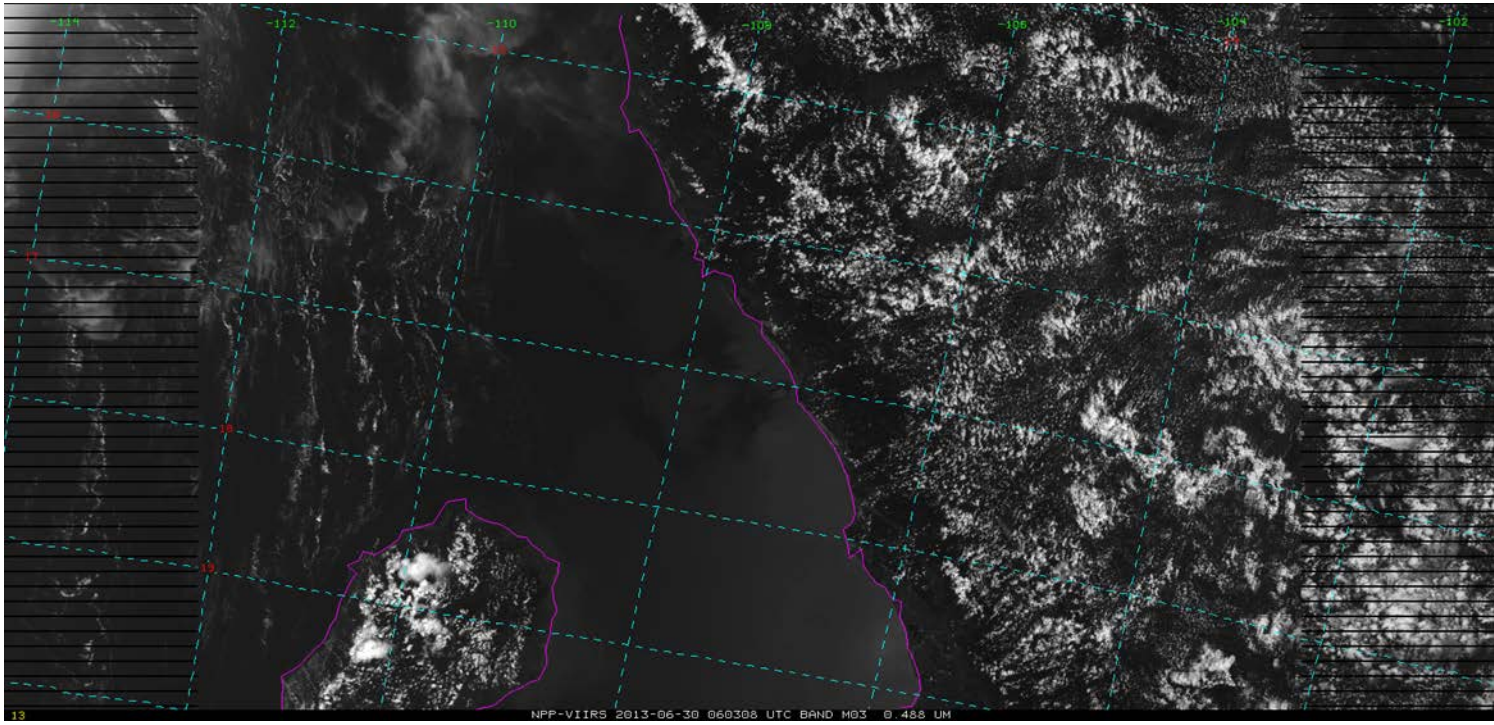
Images of two adjacent granules

VIIRS M3 band 2013-06-30 06:03:51 UTC





VIIRS M3 band 2013-06-30 06:03:08 UTC



VIIRS scientific units

(unlike GOES radiances in RAW counts)

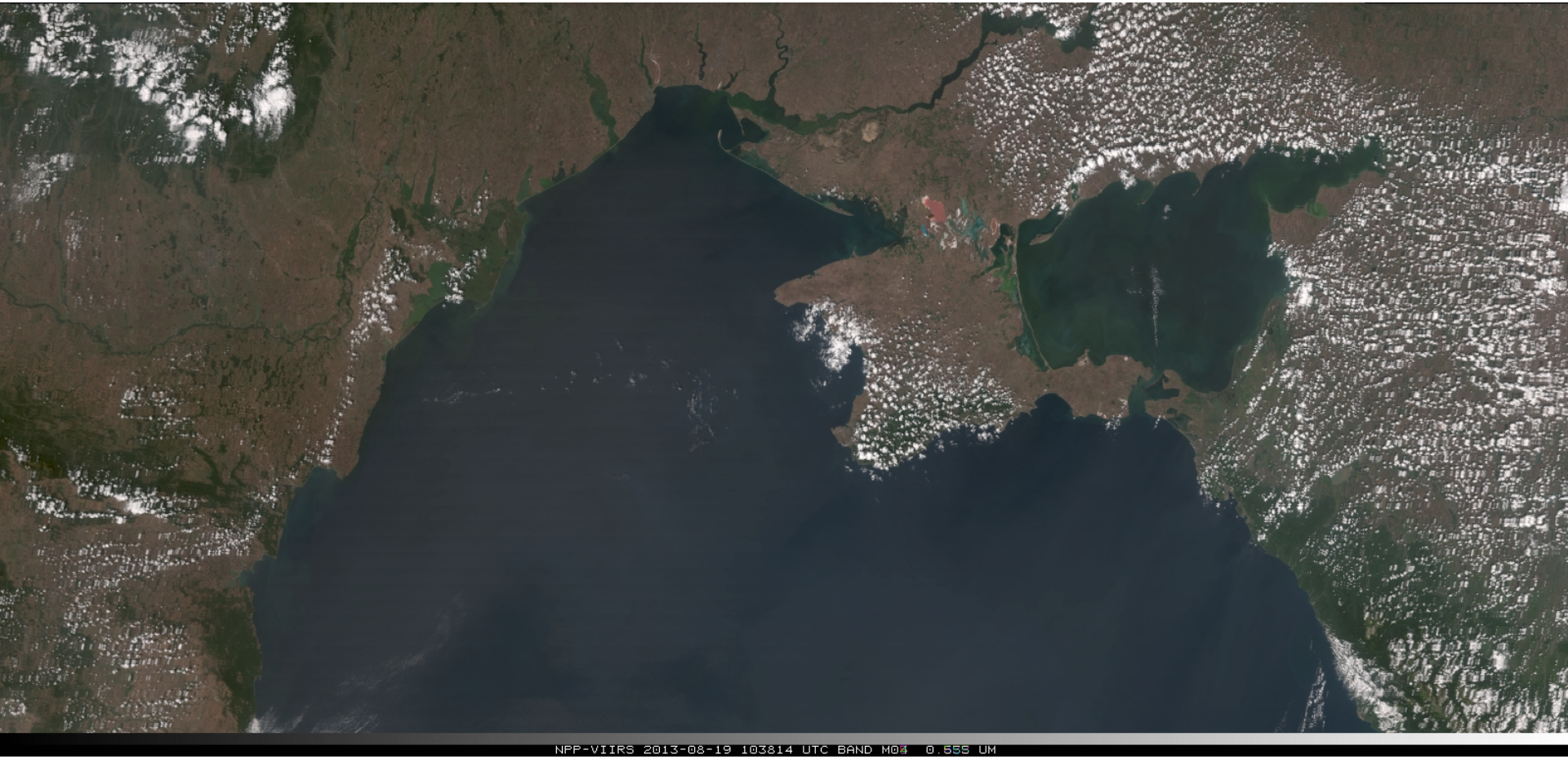
VIIRS bands	Units available from HDF5 via ADDE server (only)		Other units in McIDAS
Visible / Reflective	Radiances	Reflectances	Brightness counts
Thermal / Emissive	Radiances	Brightness Temperatures	Brightness counts
Day/Night Band	Radiances	Reflectances	Brightness counts

Best to copy the VIIRS images from the server in the units needed, since once separated from the server, other unit scalings are not automatic, but need to be done manually.

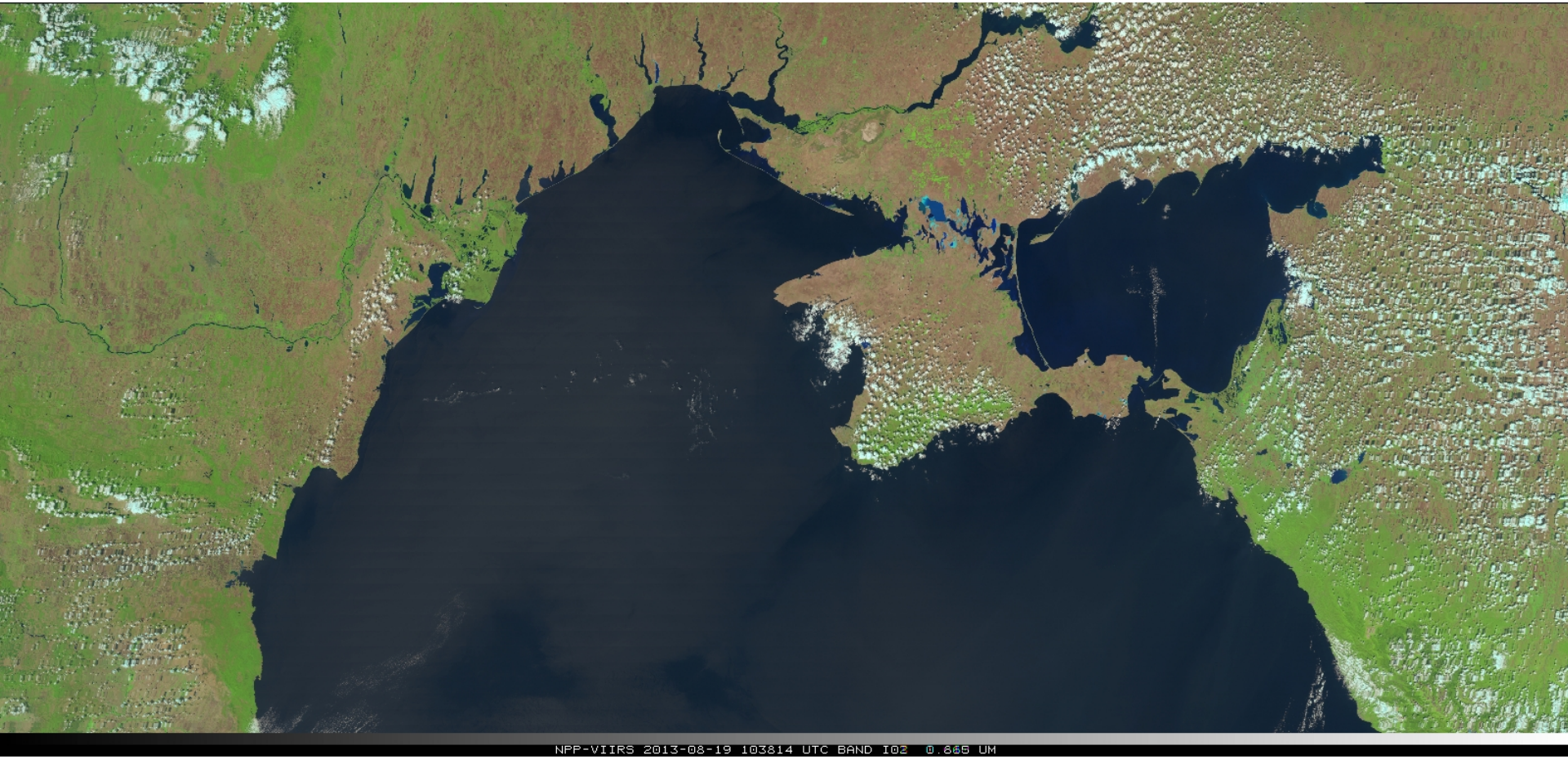
Commonly used three-color (RGB) combinations of VIIRS bands.

Three-color (RGB) Product	Red	Green	Blue
True color	M5 (0.672 µm)	M4 (0.555 µm)	M3 (0.488 µm)
Natural color	M10 (1.61 µm)	M7 (0.865 µm)	M5 (0.672 µm)
	I3 (1.61 µm)	I2 (0.865 µm)	I1 (0.64 µm)

VIIRS true-color RGB combination

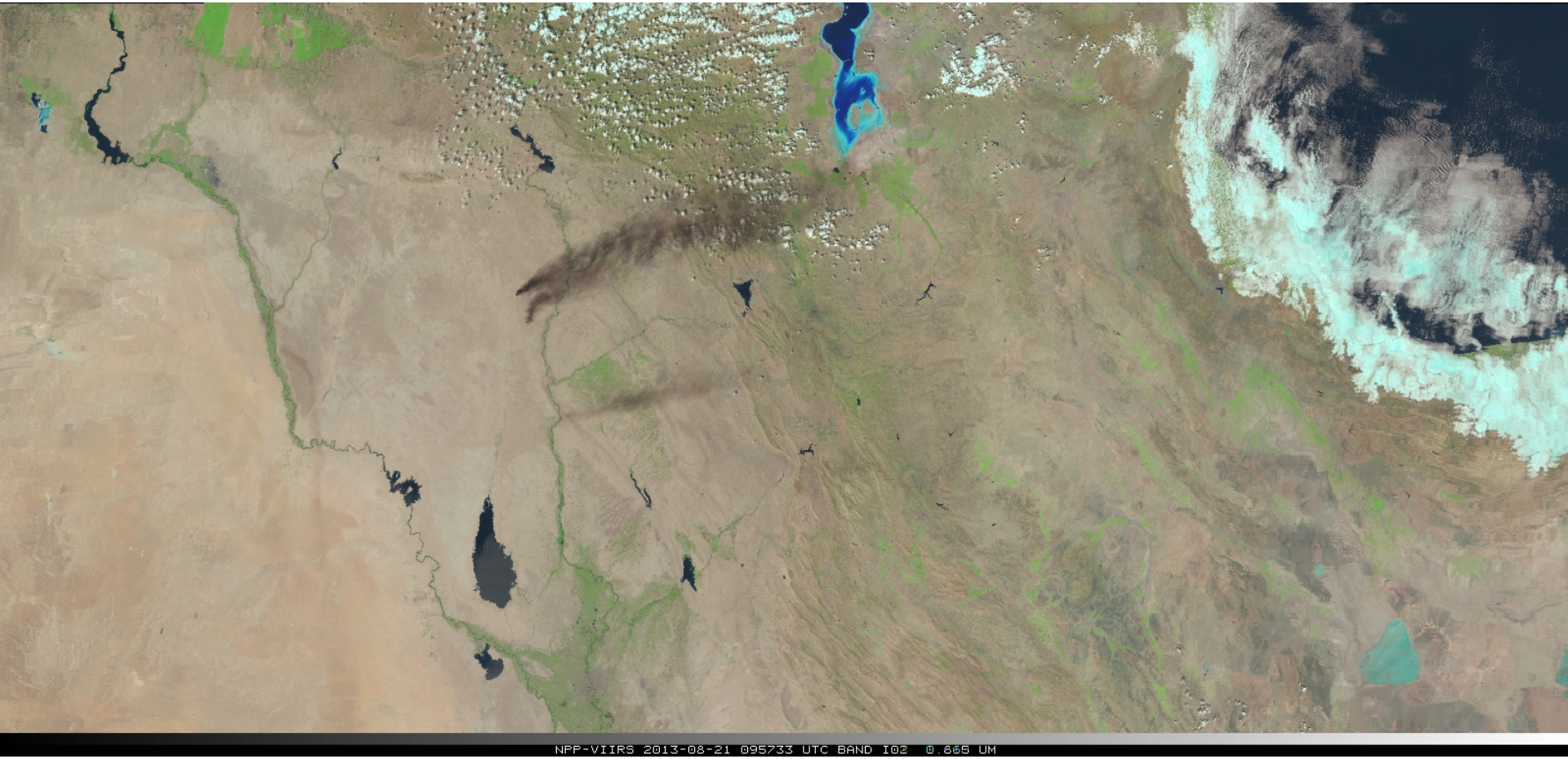


VIIRS natural-color RGB combination

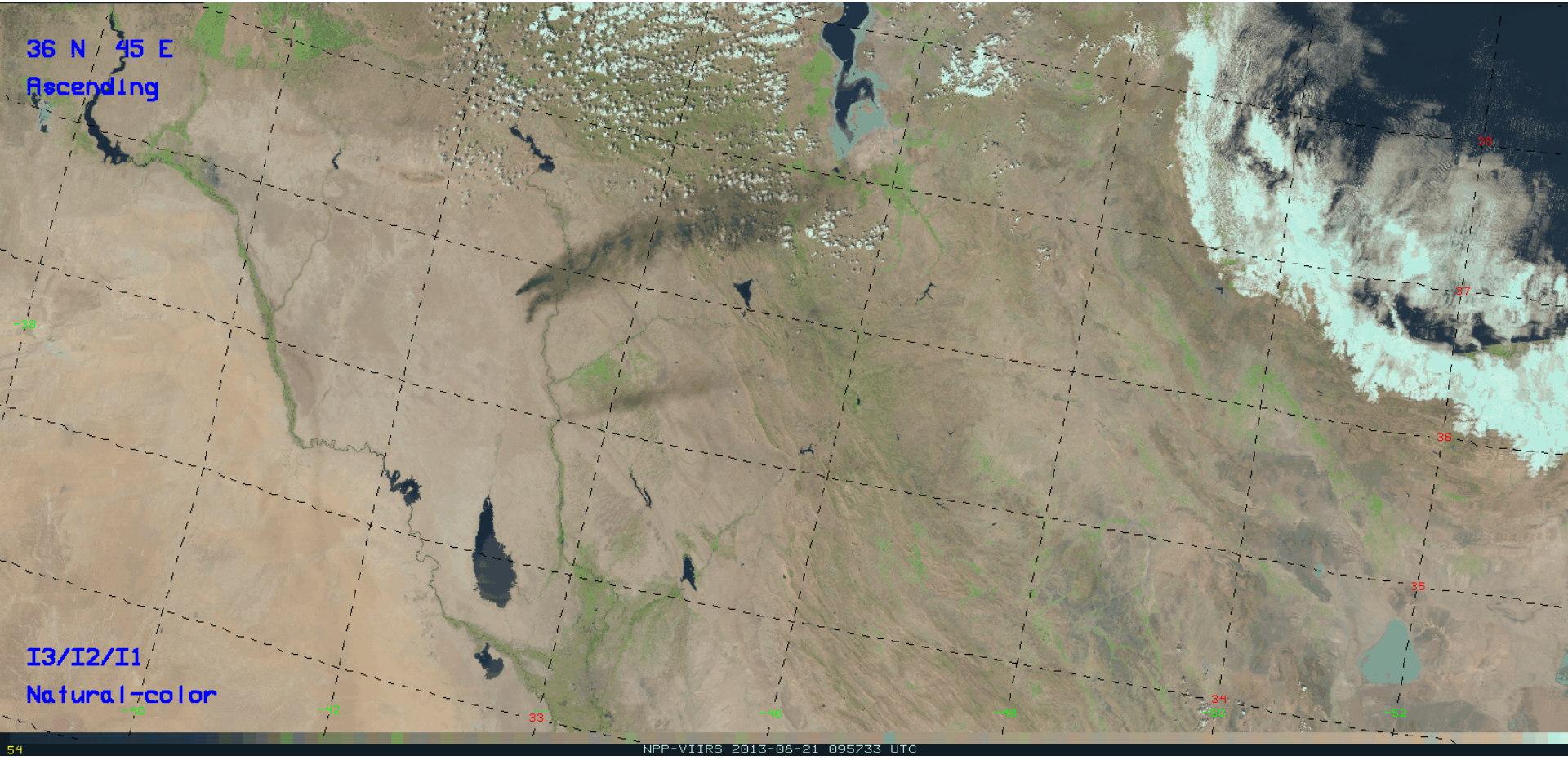


North shore of Black Sea (Odessa)

VIIRS natural-color image from 24-bit RGB combination (JPG) using COMBINE command



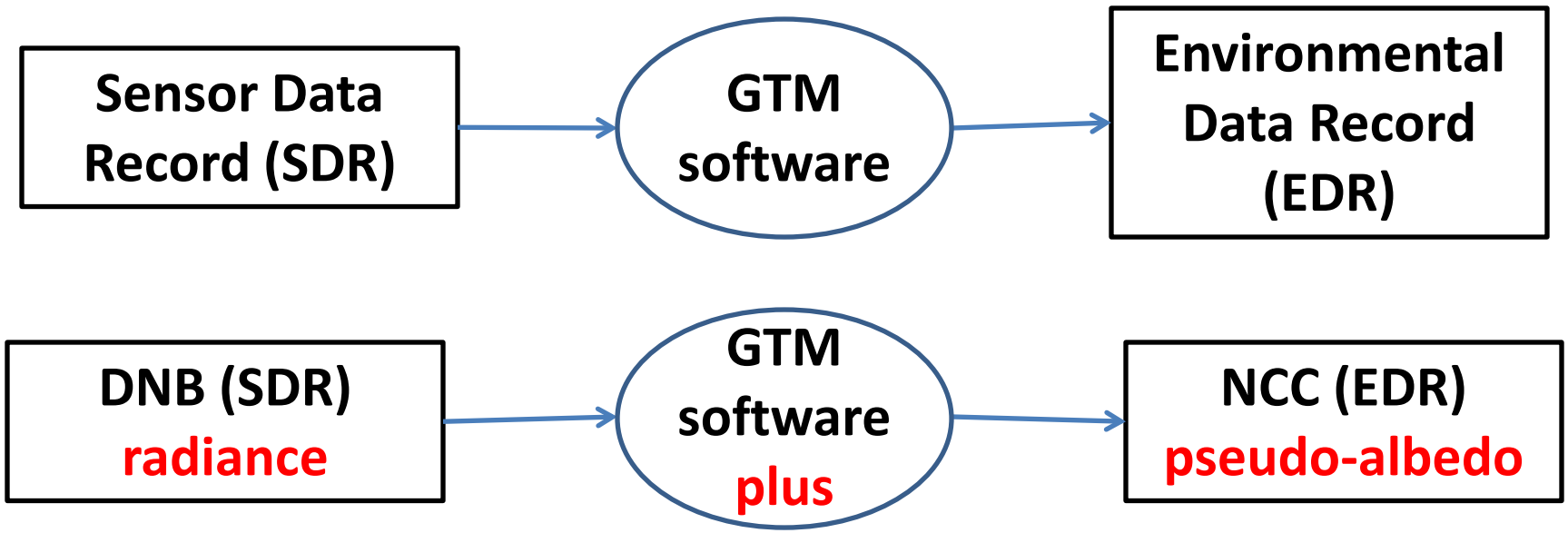
VIIRS natural-color image from 8-bit RGB combination (GIF) using AREACOLOR program



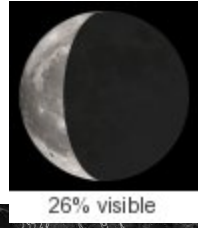
Northeastern Iraq fires

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/temperatures** for Non-NCC bands only.
- For NCC imagery, which is derived from the Day Night Band (DNB), there is **additional radiance (reflectance) processing**



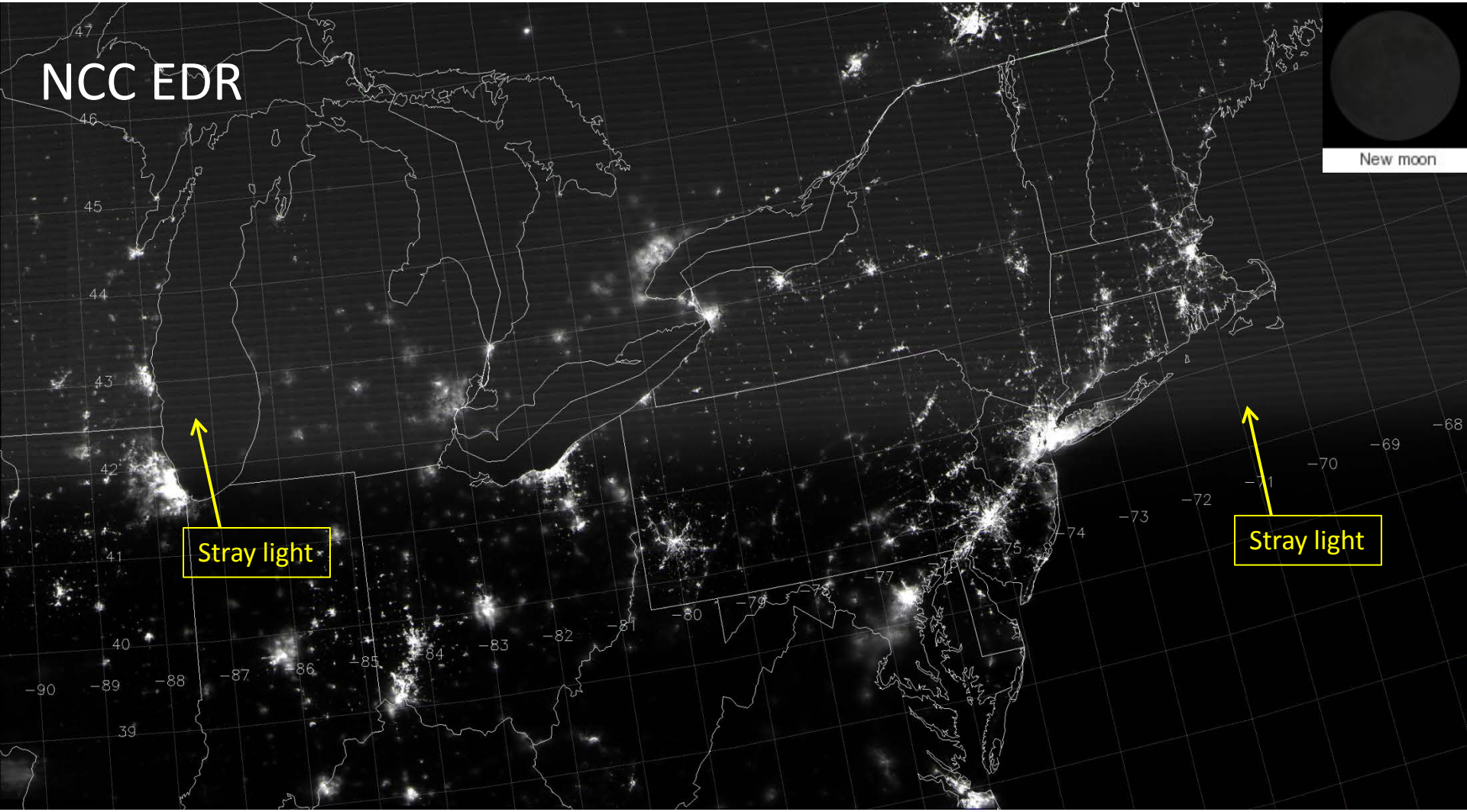
At the Day/Night Terminator



NCC EDR

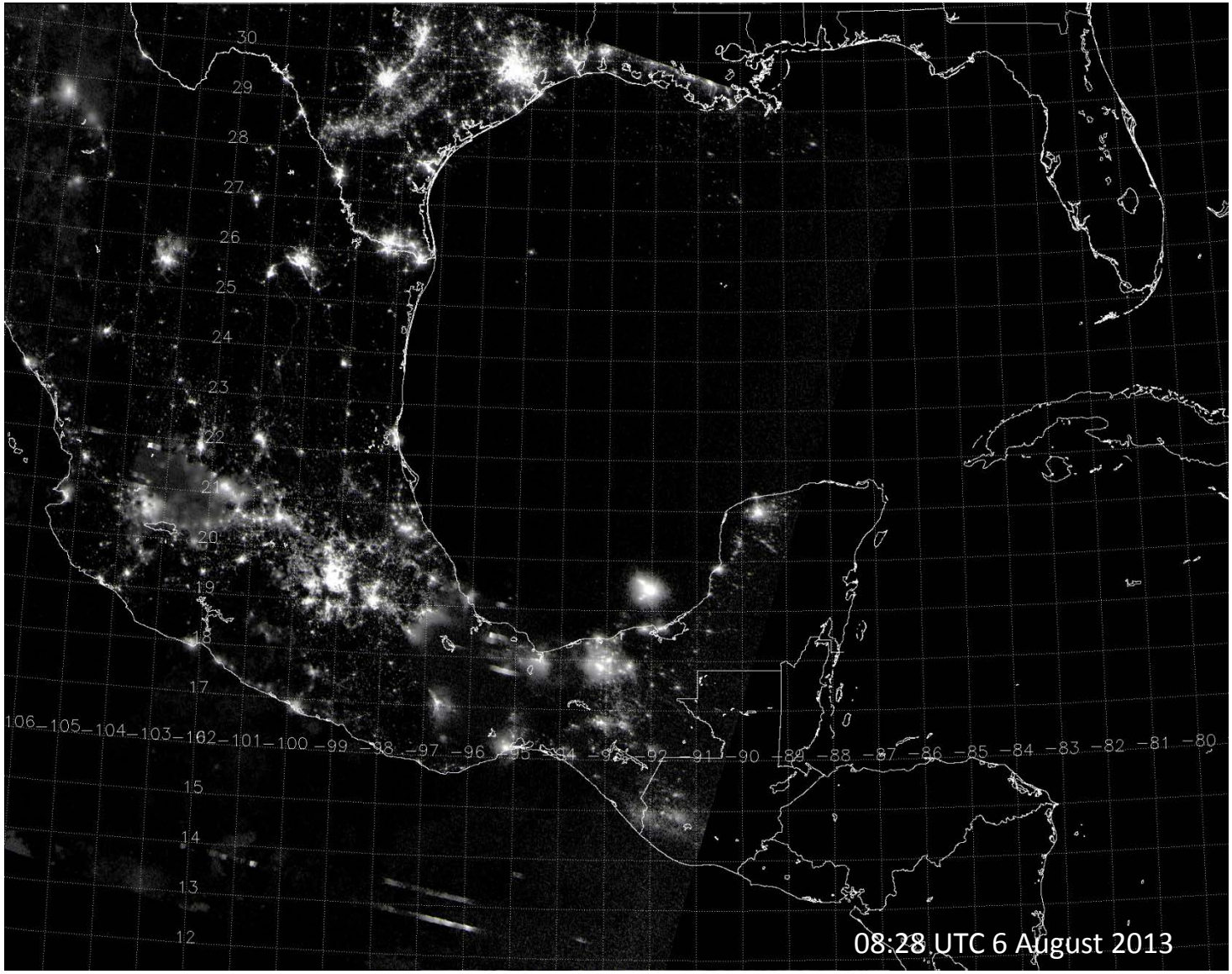
11:53 UTC 31 July 2013

During a New Moon



06:43 UTC 6 August 2013

NCC Over a Full Lunar Cycle



New moon

Summary

- **We've made excellent progress with VIIRS Imagery after 18 months!**
  - Various RGB imager products are impressive.
  - DNB/NCC Imagery is a great addition to heritage MODIS-type imagery.
- McIDAS-X is VIIRS-capable from the server only.
  - Offline, VIIRS needs special handling.
  - VIIRS geo-locations are inexact for large granule-size images. (not explained here)
- McIDAS-V for VIIRS will be addressed by the Mc-V Team.

BAMS article from the Imagery Team

- 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.** *Bull. Amer. Meteor. Soc.*, 94(7), 1019-1029, plus cover images. doi:10.1175/BAMS-D-12-00097.1