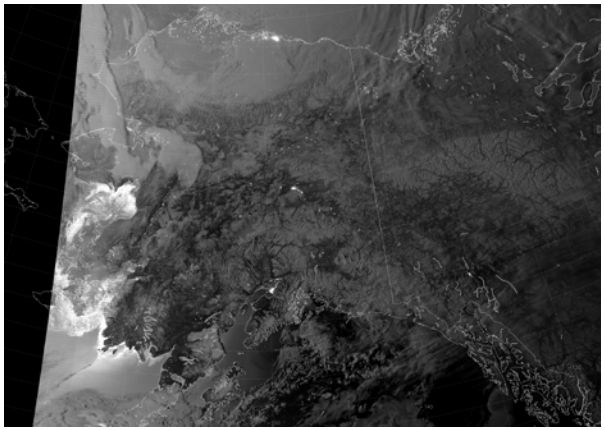
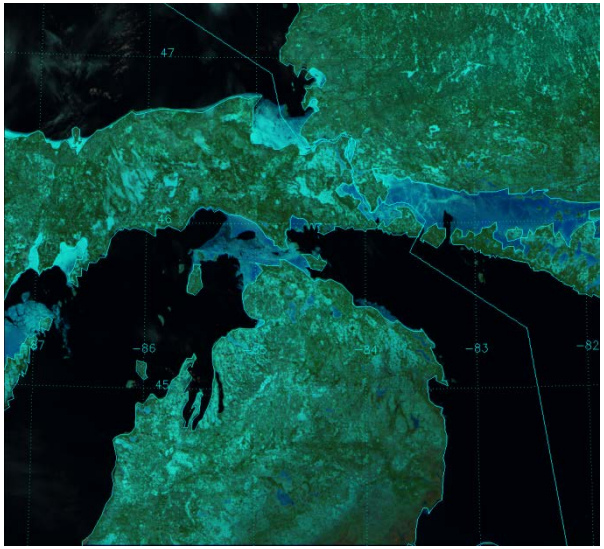
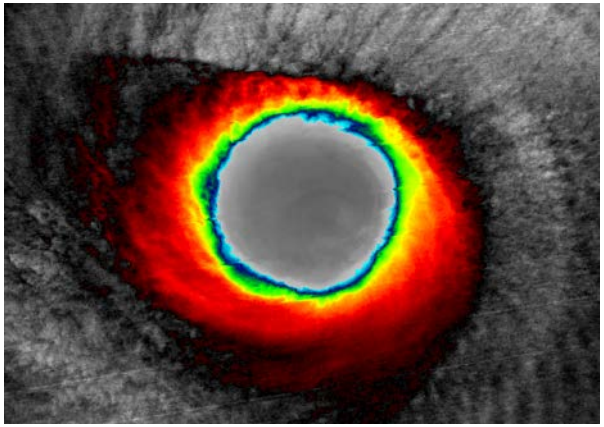
Evaluation of Suomi NPP VIIRS Imagery







Curtis J. Seaman, Steven D. Miller

Colorado State University/CIRA

Donald W. Hillger, Daniel T. Lindsey

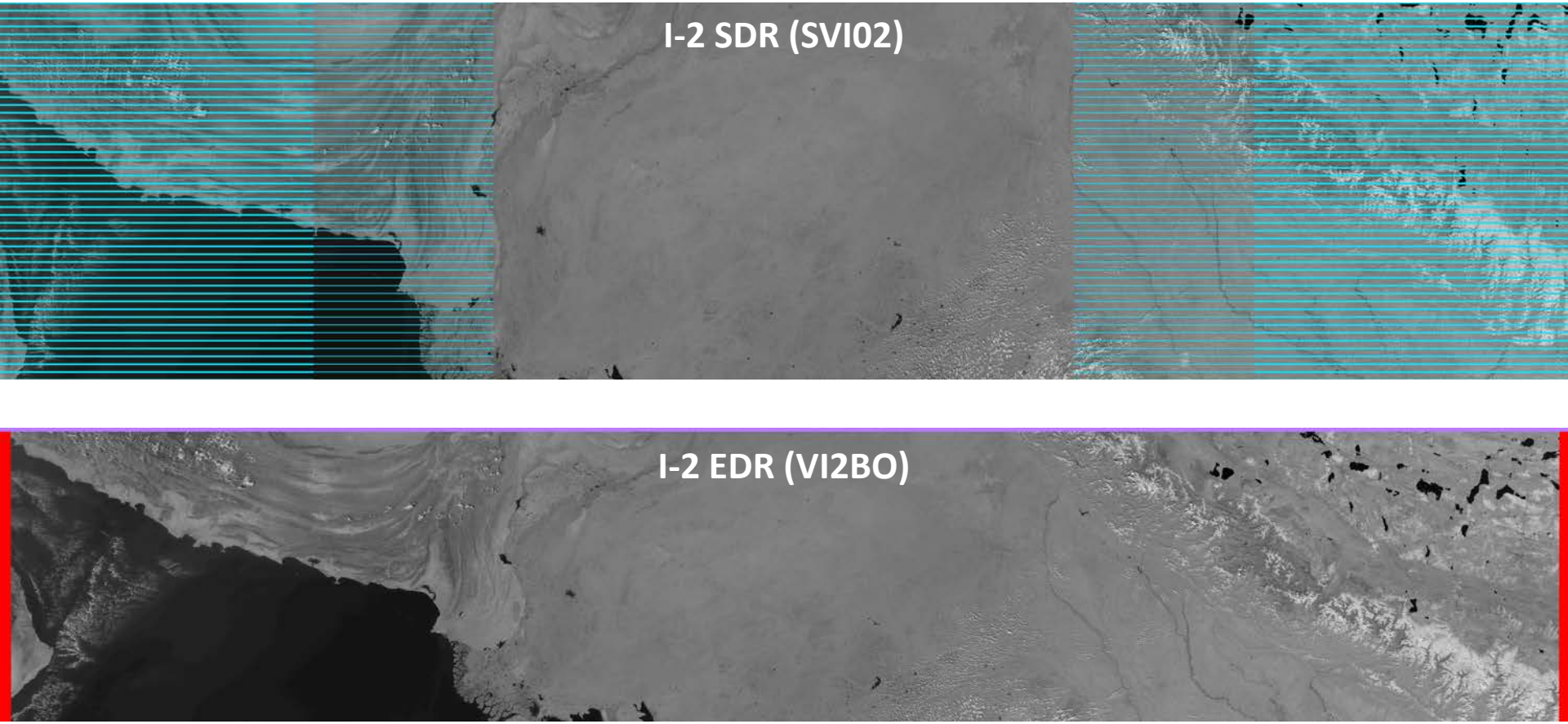
NOAA/NESDIS/Satellite Applications and Research

VIIRS Imagery: SDRs and EDRs

- VIIRS: Visible Infrared Imaging Radiometer Suite
- All 22 bands are available as Sensor Data Records (SDRs)
- Bands highlighted in red are available as Environmental Data Records (EDRs)
- Day/Night Band (DNB) SDRs are converted to Near Constant Contrast (NCC) EDRs

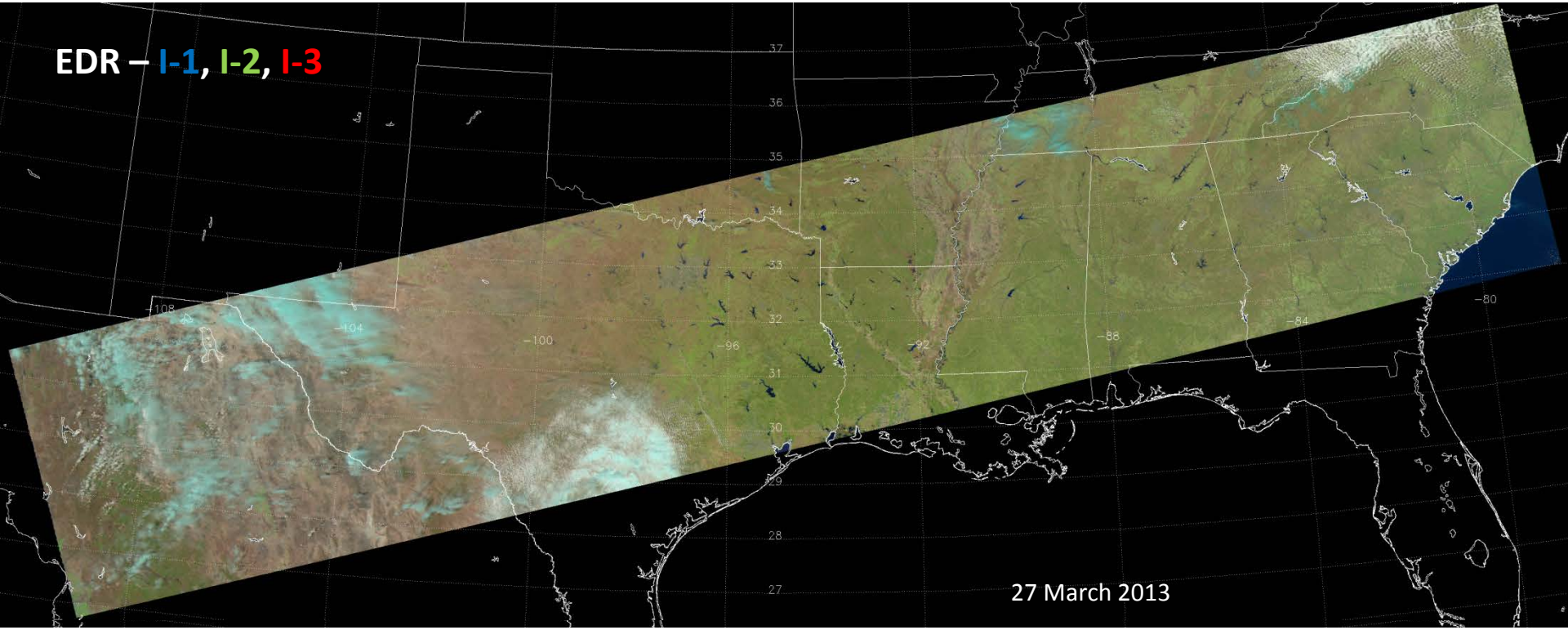
VIIRS Band	Central Wavelength (µm)	Band Explanation	Spatial Resolution (m) @ nadir
M1	0.412	Visible/ Reflective	750 m
M2	0.445		
M3	0.488		
M4	0.555		
M5	0.672		
M6	0.746	Near IR	
M7	0.865		
M8	1.240	Shortwave IR	
M9	1.378		
M10	1.61		
M11	2.25		
M12	3.7	Medium-wave IR	
M13	4.05		
M14	8.55	Longwave IR	
M15	10.76		
M16	12.01		
DNB (NCC)	0.7	Visible / Reflective	750 m across full scan
I1	0.64	Visible / Reflective	375 m
I2	0.87	Near IR	
I3	1.61	Shortwave IR	
I4	3.74	Medium-wave IR	
I5	11.45	Longwave IR	

SDRs and EDRs: What's the difference?

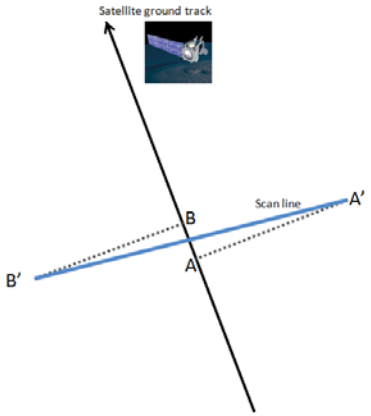


Unmapped SDR and EDR granules from 08:14 UTC 24 October 2013

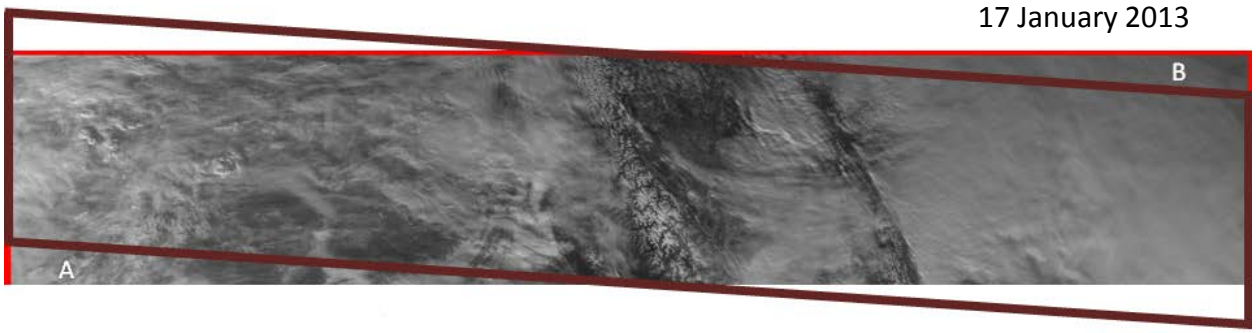
SDRs and EDRs: Apparent Rotation



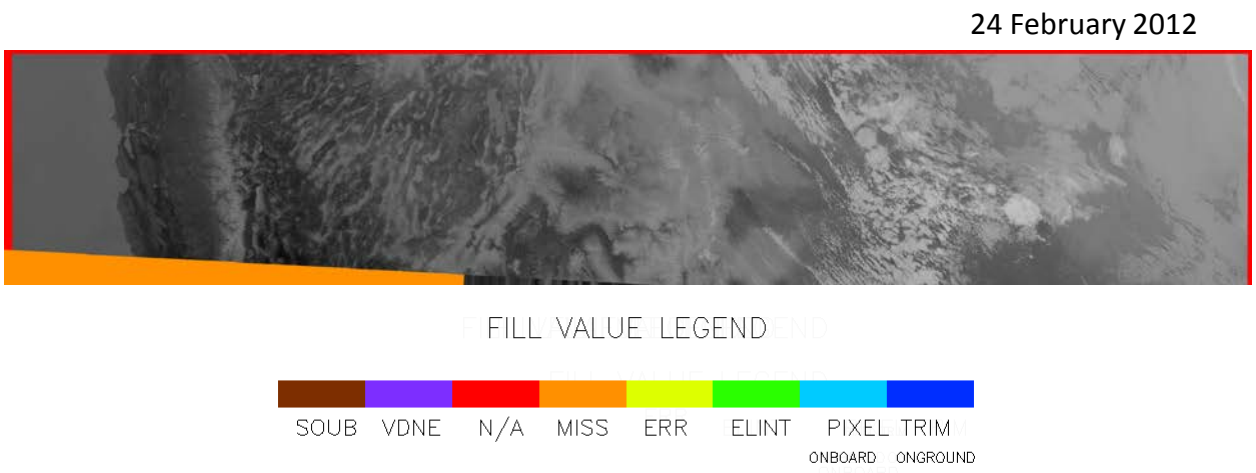
Scan lines in SDR data are not orthogonal to the satellite ground track, due to the constant motion of the satellite. Mapping the data to the Ground Track Mercator (GTM) grid restores orthogonality. This is the cause of the apparent rotation between SDRs and EDRs.



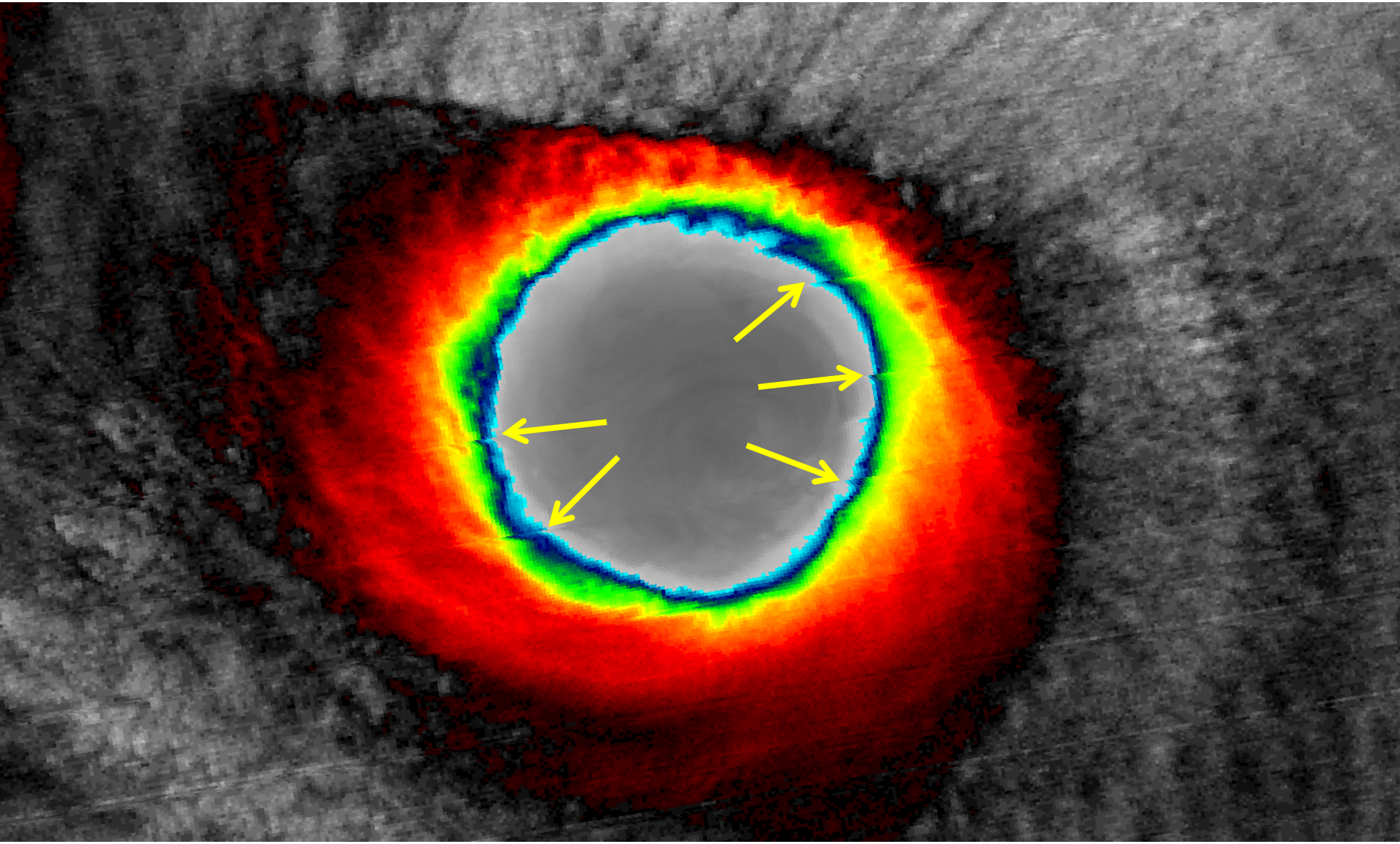
The Case of the Missing Triangles



The brown outline shows where a SDR granule matches up with a given EDR granule. It takes three SDR granules to produce one EDR granule. If an SDR granule is missing when the EDR is created, you get a “missing triangle”…

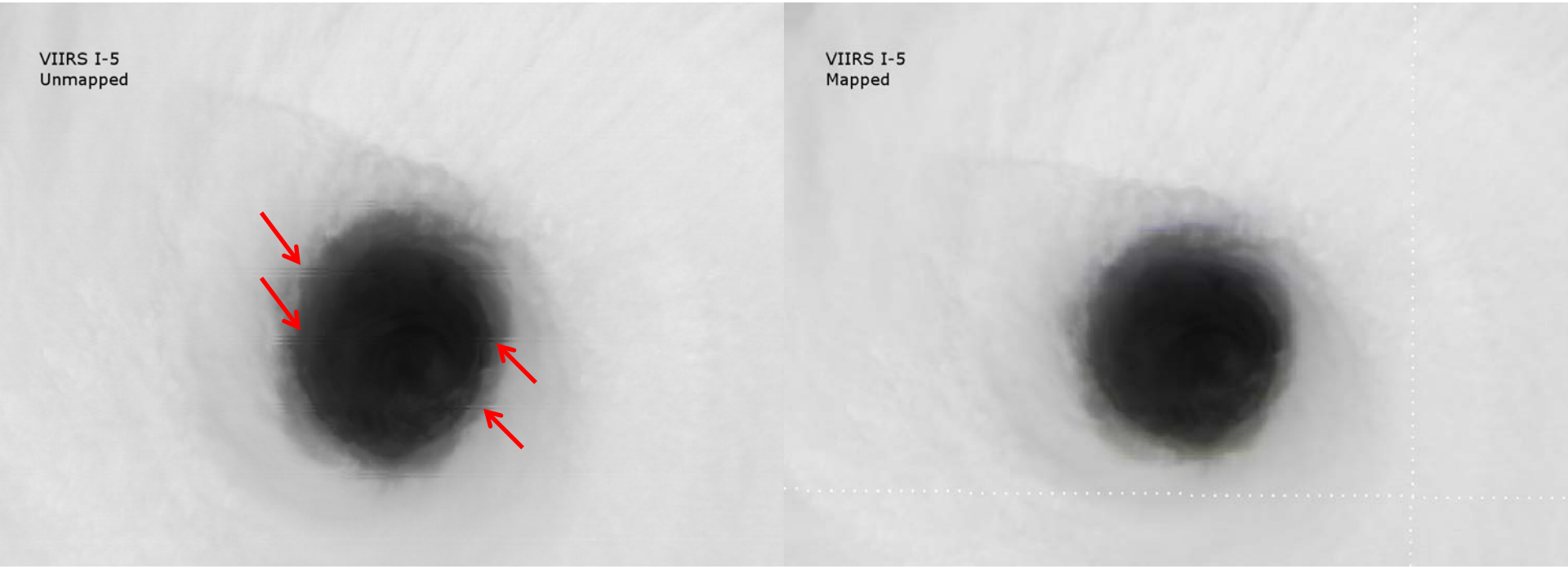


The Case of the Sawtoothed Eye



I-5 SDR image of the eye of Typhoon Jelawat (25 September 2012) produced using McIDAS-v

The Case of the Sawtoothed Eye

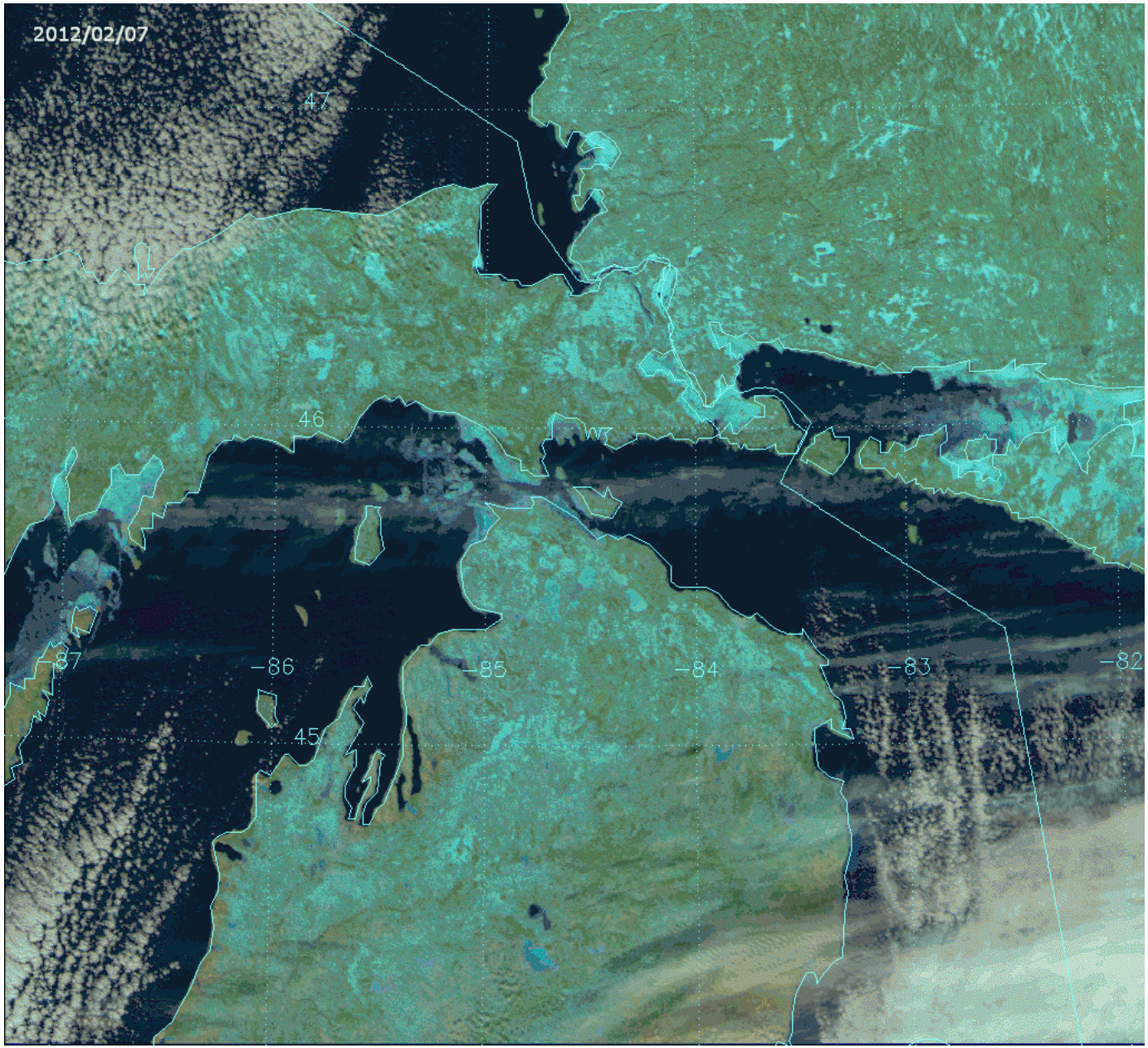


The unmapped image of the typhoon eye (left) shows artifacts caused by the bowtie effect. These artifacts disappear when the same data was correctly mapped to the Earth's surface using IDL.

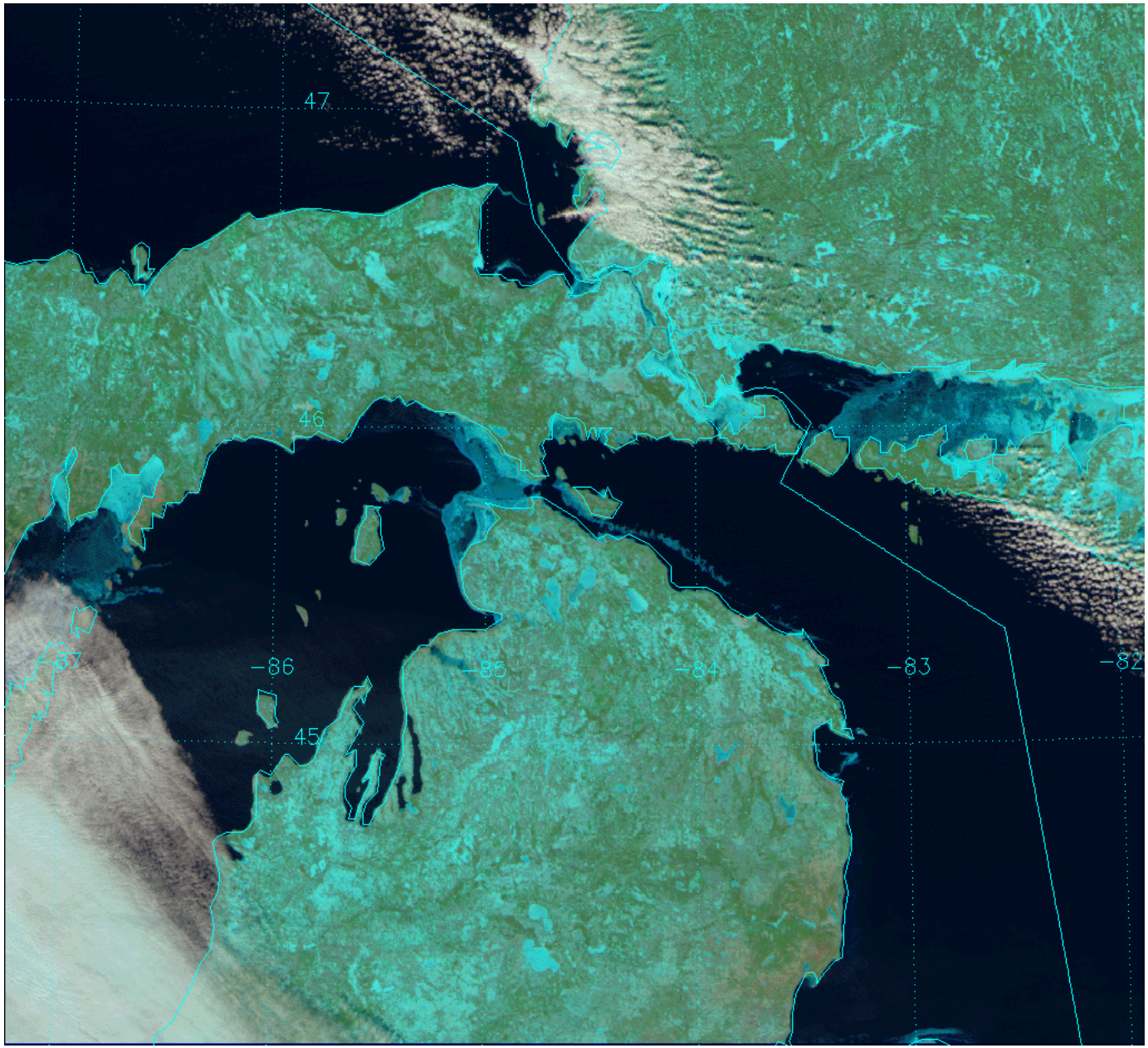
The "sawtooth pattern" was caused by improper mapping. It is a display issue, not a problem with the data!

NOTE: McIDAS-v does have the ability to properly map VIIRS data to avoid this issue.

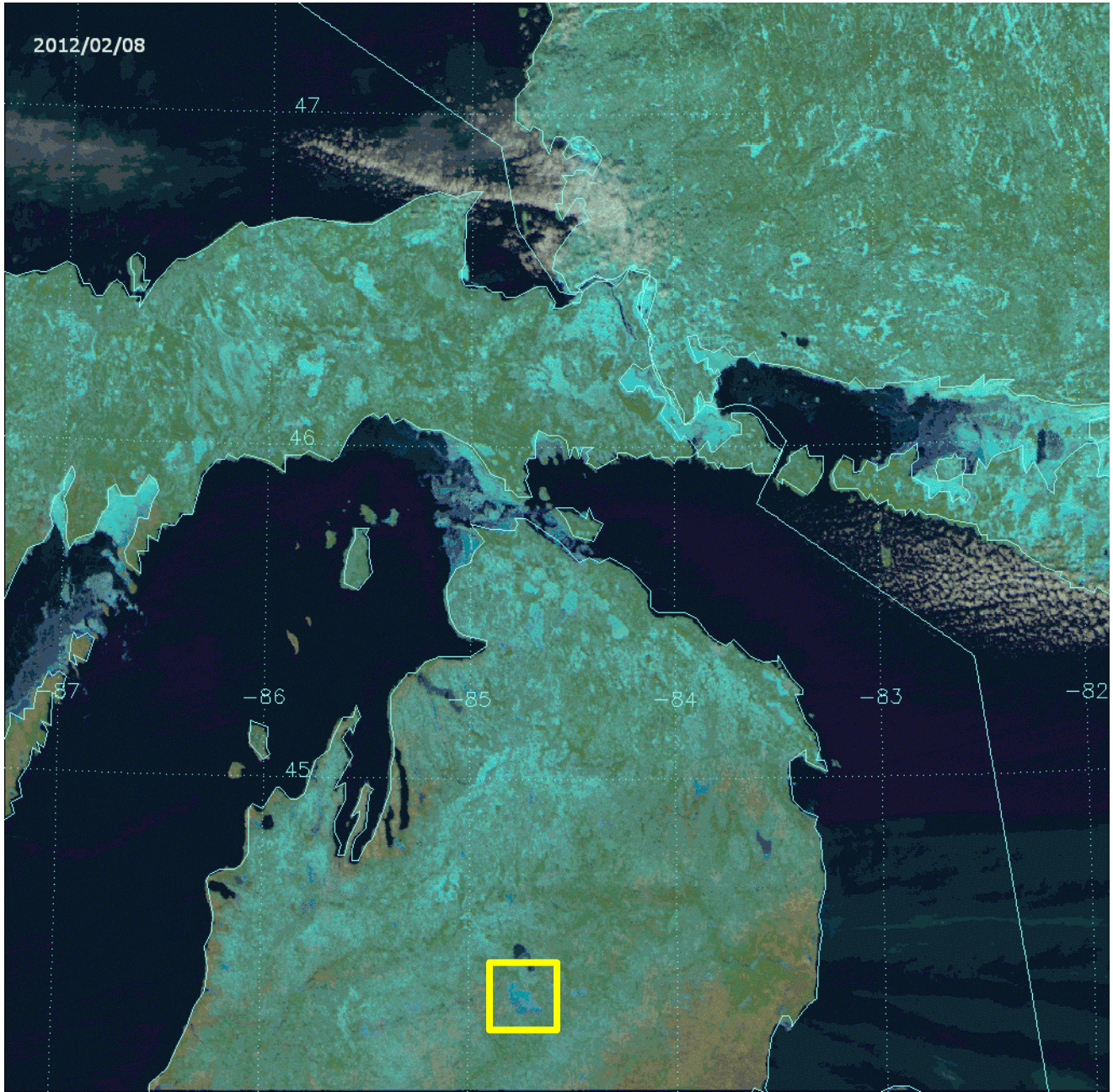
Geolocation Evaluation: I-band SDR



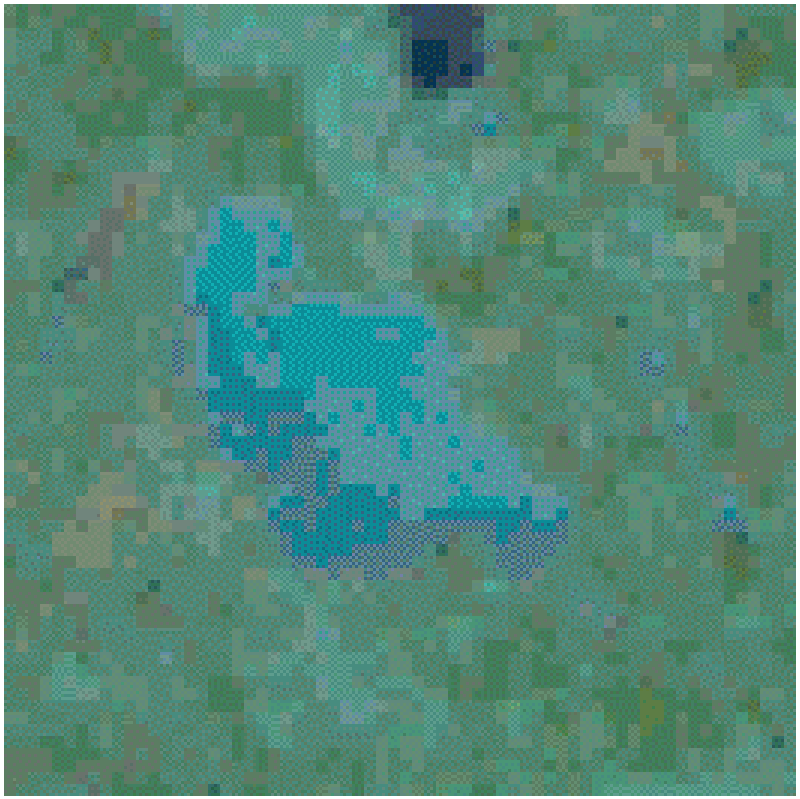
Geolocation Evaluation: I-band SDR



Geolocation Evaluation: I-band EDR

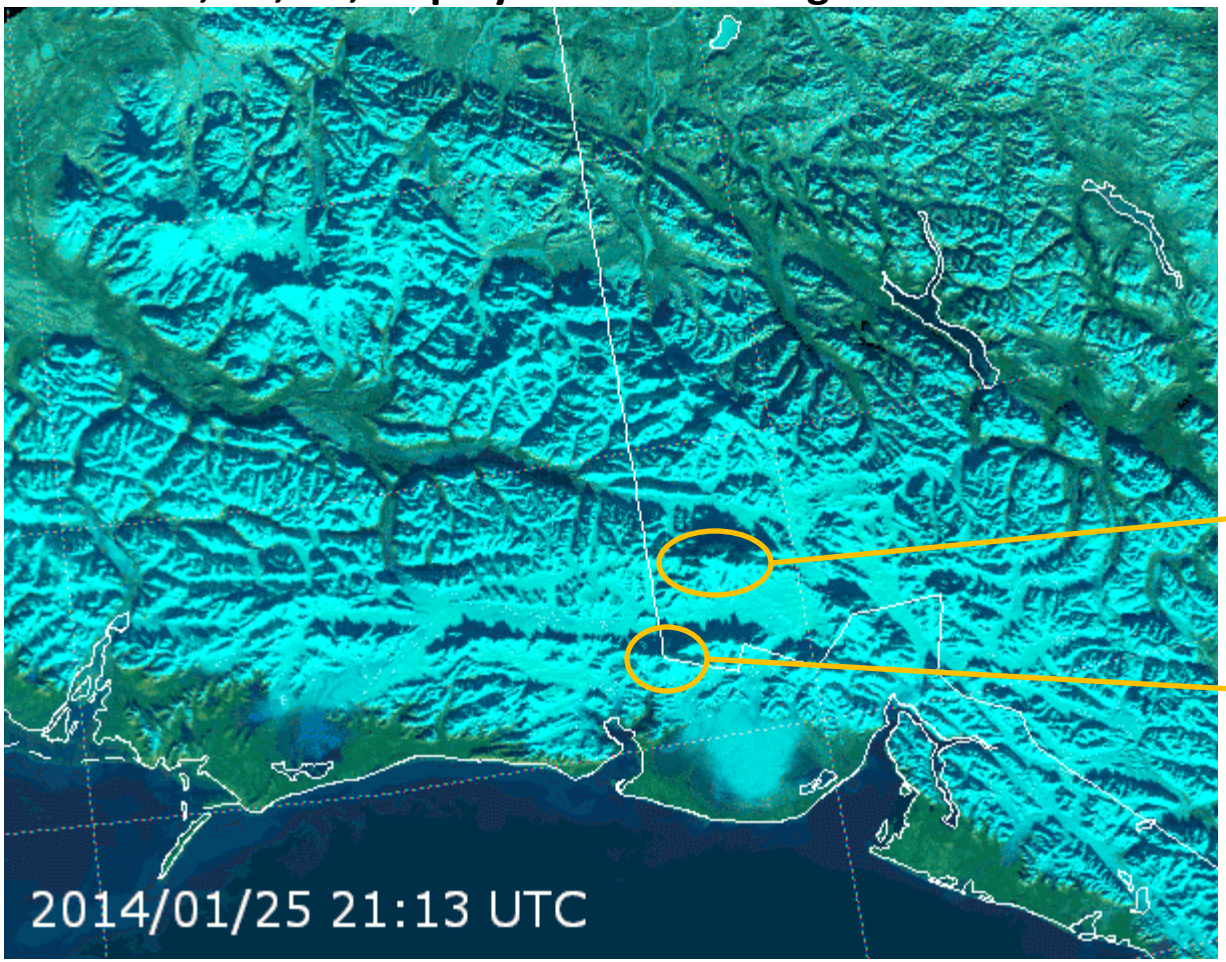


Geolocation Evaluation: I-band EDR



Terrain Correction Evaluation: SDR

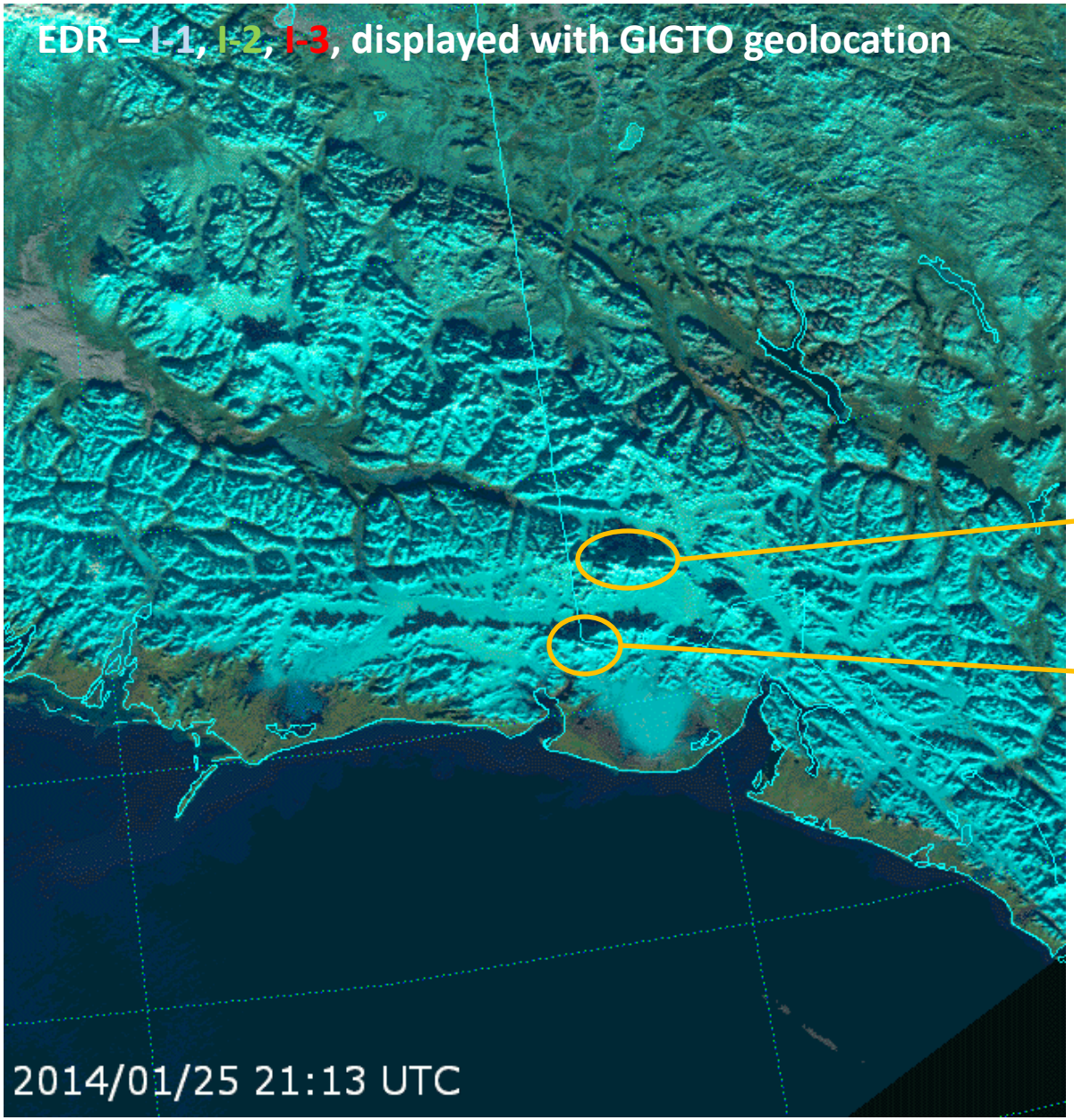
SDR – I-1, I-2, I-3, displayed with GITCO geolocation



Mt. Logan
(6050 m MSL)

Mt. St. Elias
(5489 m MSL)

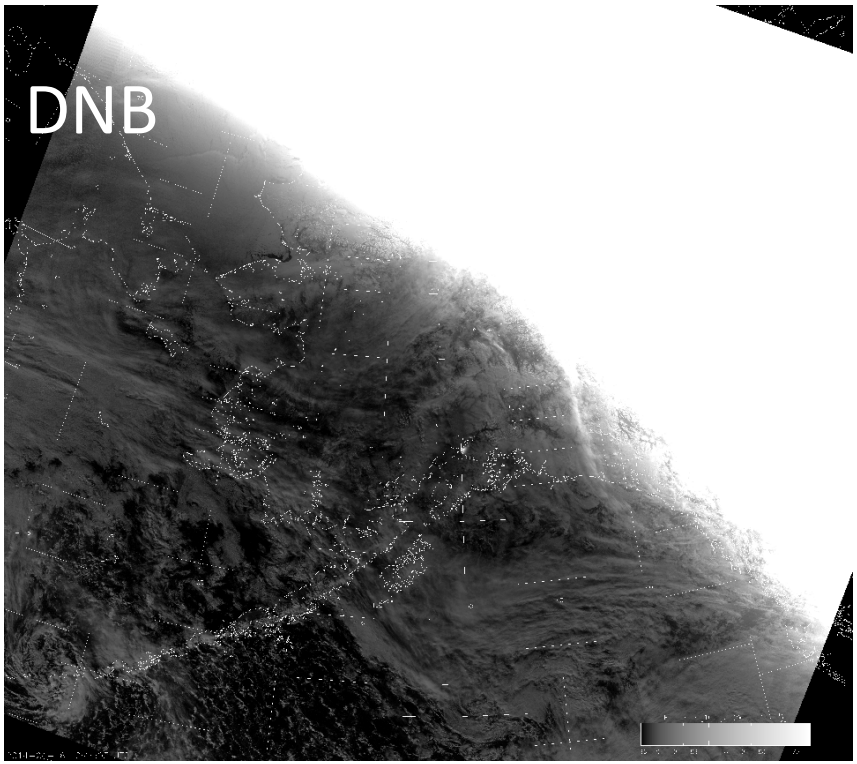
EDRs are not Terrain Corrected!

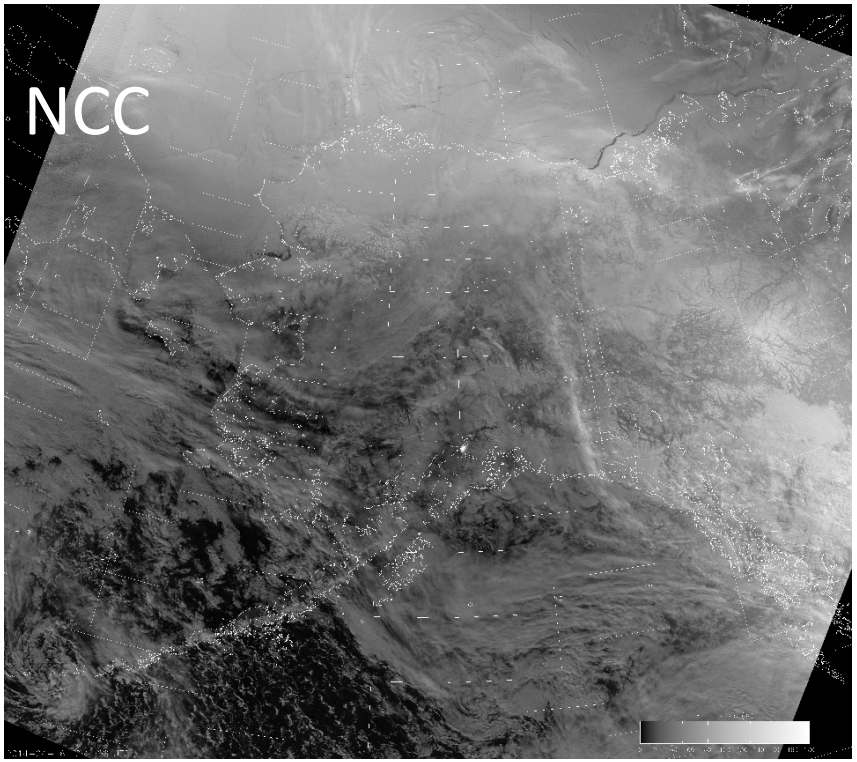


Mt. Logan
(6050 m MSL)

Mt. St. Elias
(5489 m MSL)

DNB (SDR) vs. NCC (EDR)

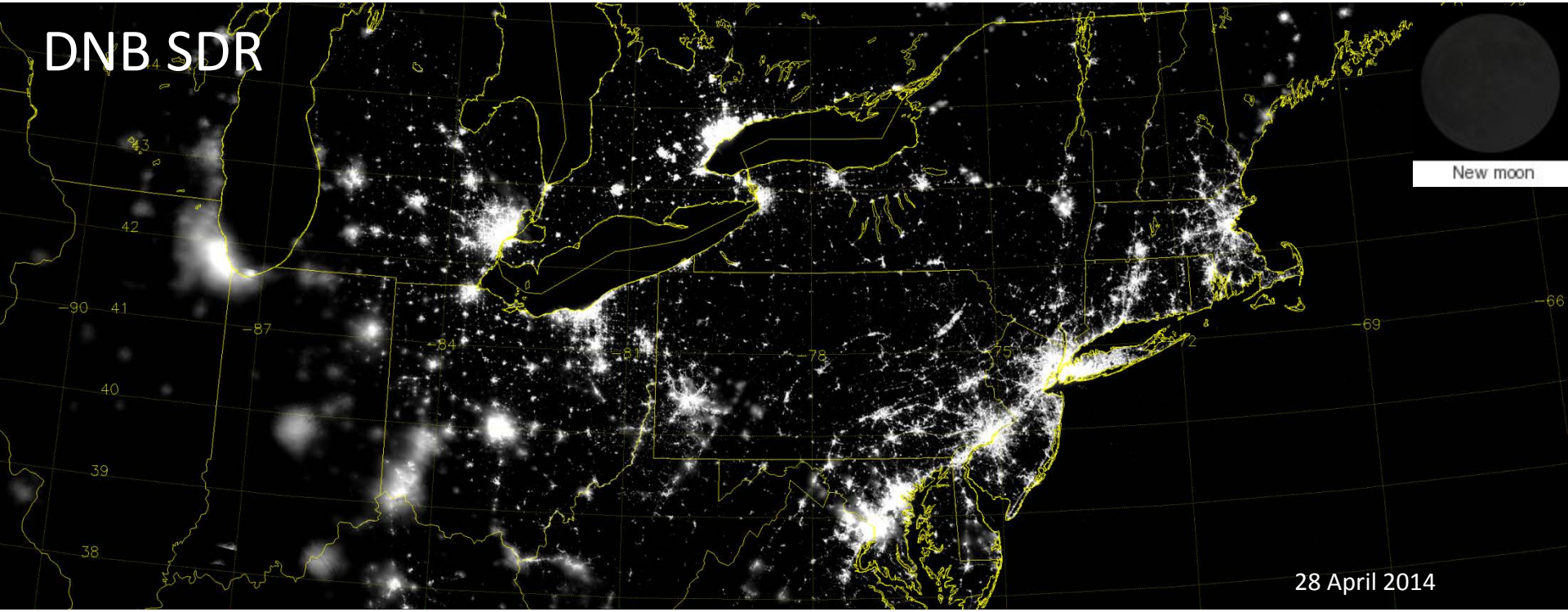




It is difficult to display DNB images near the day/night terminator, as radiance values vary by 7-8 orders of magnitude from day to night, and many displays only have 256 colors.

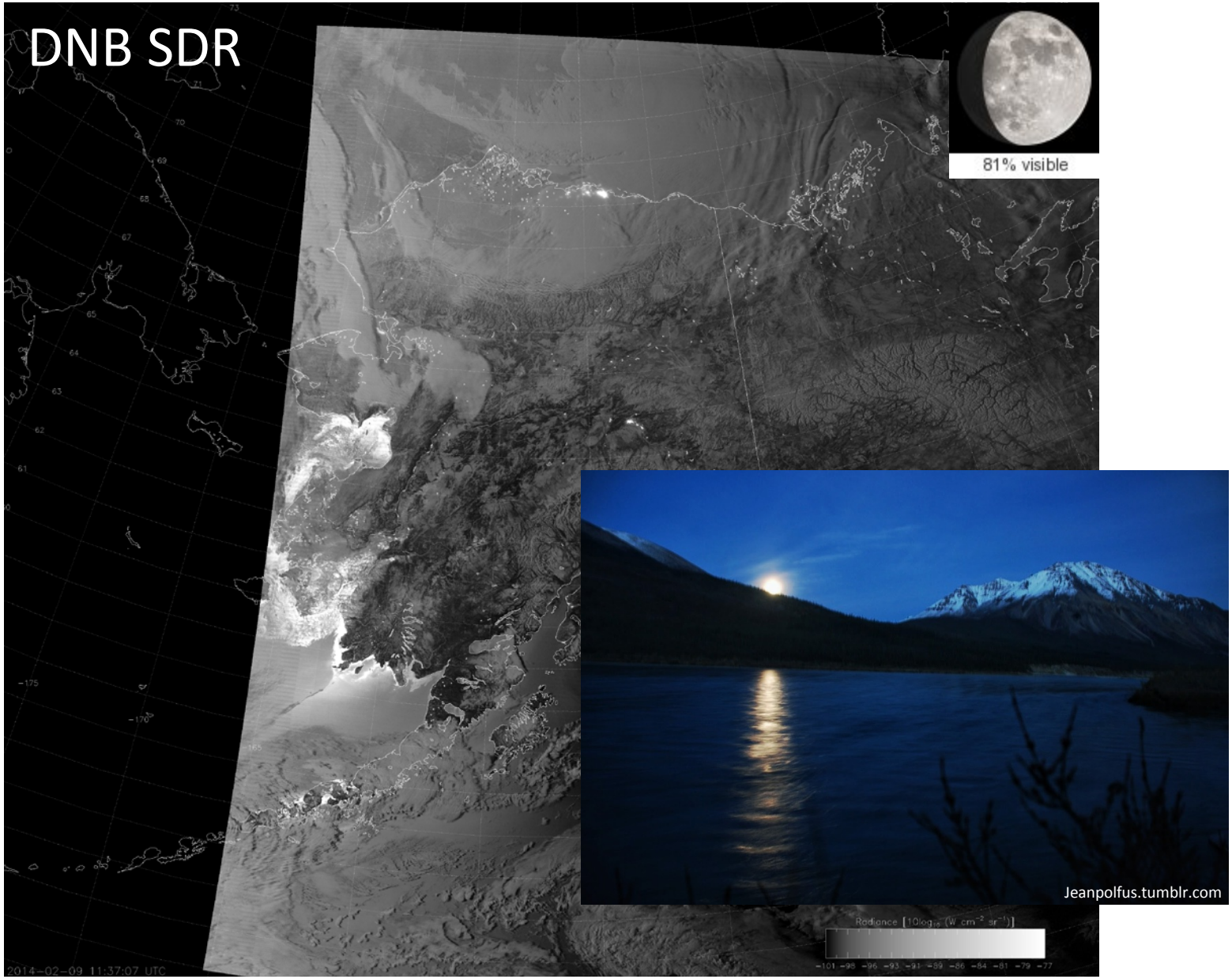
The NCC EDR converts DNB radiance to a “reflectance” to reduce the dynamic range of the data, improving the display across the terminator.

Stray Light and Striping



Stray light and striping were an issue with DNB and NCC imagery until 20 August 2013, when a correction was applied. Problem solved!

~~Bug~~? Or Feature?



Nighttime DNB image of Alaska, 11:37 UTC 9 February 2014

~~Bug~~? Or Feature? Part 2

BAMS Nowcast, October 2013

NOWCAST

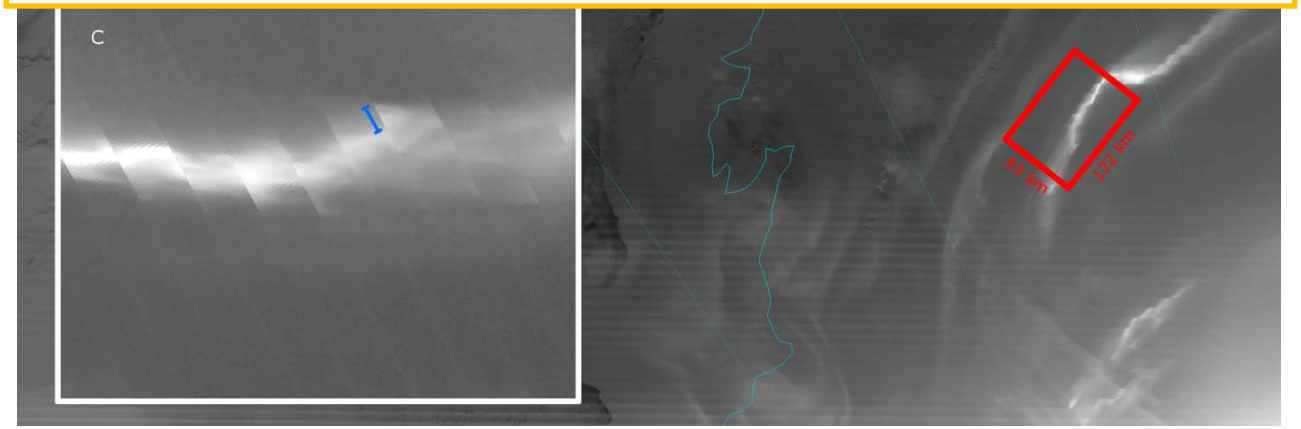
OBSERVATIONS

VIIRS CAPTURES AURORA MOTIONS

BY CURTIS J. SEAMAN AND STEVEN D. MILLER

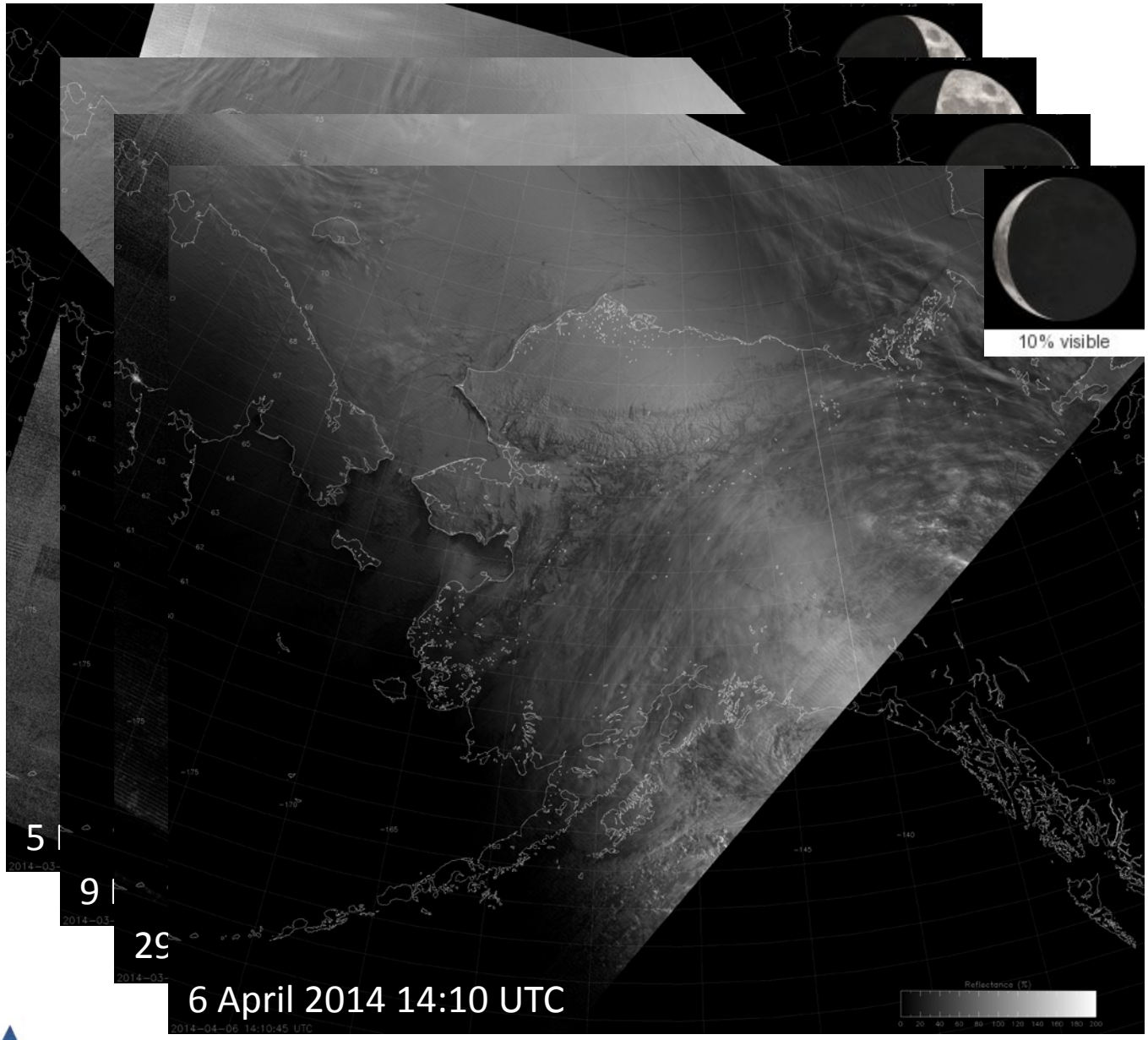
Auroras are the visible manifestation of interactions between the atmospheres of the Sun and the Earth. Massive amounts of high-energy hydrogen and helium atoms, spewed from the so-

The day/night band has captured images of auroras during a new moon (Fig. 1) and near-full moon (Fig. 2). Both of these auroras occurred near the coast of Antarctica, as shown in Figs. 1a and 2a.



Nighttime DNB images of Antarctica with aurora, 00:22 UTC 1 October 2012

Bug? Or ~~Feature~~? Part 3



Nighttime NCC images of Alaska, Spring 2014

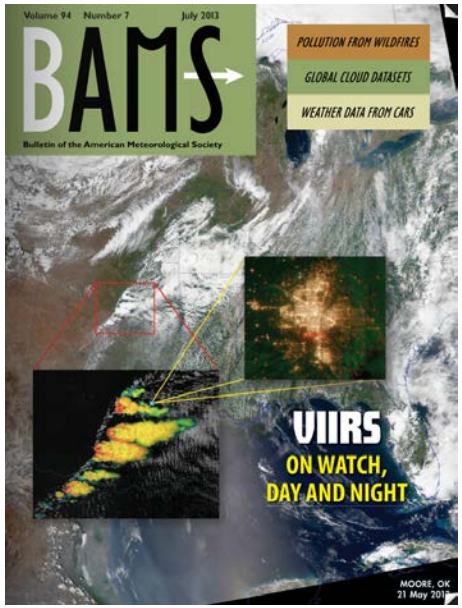
Summary

- VIIRS Imagery is alive and well!
  - Geolocation has been accurate and stable since mid-2012
  - "Missing Triangle" problem eliminated (mid-2012)
  - Striping reduced or eliminated (August 2013 for DNB and NCC imagery)
  - Stray Light in DNB reduced or eliminated (August 2013)
  - NCC imagery available at night throughout the lunar cycle
  - All Imagery EDR products have achieved Validation Stage 3 (April 2014)

- Many "bugs" are actually features of the data
  - Moon glint
  - Aurora motions

- Others are attributed to "user error"
  - Incorrect mapping of SDR data by users, e.g.

- For the future:
  - Anomalously dark/light areas in NCC near terminator
  - Terrain correction for the EDR geolocation
  - Make EDRs from all 16 M-bands
  - Make M-band EDRs more readily available

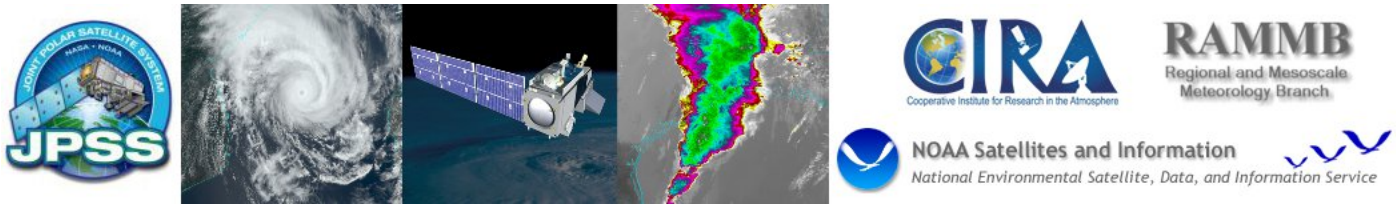


Resources

Geolocation evaluation tests:

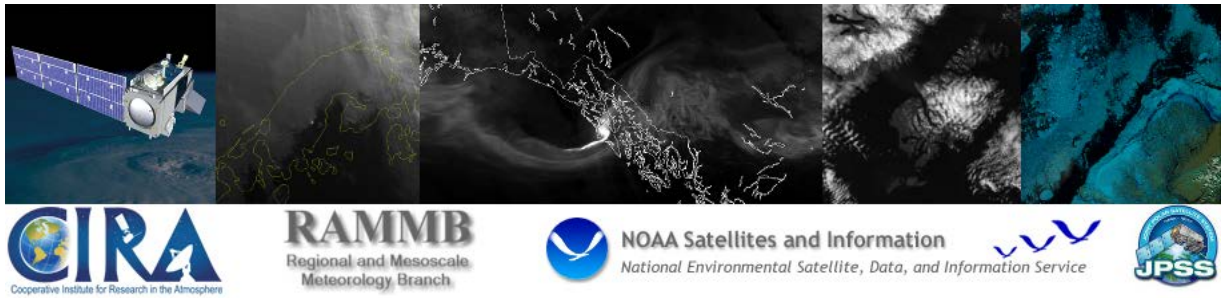
http://rammb.cira.colostate.edu/projects/npp/calval/

JPSS Imagery and Visualization Team blog:



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

High-latitude applications of VIIRS Imagery:



http://rammb.cira.colostate.edu/projects/alaska/blog/