Provisional Maturity Science Review For NOAA-20 (EDR) Imagery

Presented by **Don Hillger**

STAR Lead: VIIRS Imagery

Date: 2018-02-20

Outline

- Imagery Cal/Val Team Members
- Product Requirements
- Findings/Issues for **Provisional** Imagery
- Documentations (Science Maturity Check List)
- Conclusions
- Path Forward

Imagery Cal/Val Team

Imagery Cal/Val Team Members/Contributors

Name	Organization	Major Task
Don Hillger	NESDIS/StAR	Imagery Product Lead
Tom Kopp	Aerospace	Imagery Cal/Val Lead
Curtis Seaman	CIRA	Imagery/DNB expert
Steven Miller	CIRA	DNB/Imagery expert
Jorel Torres	CIRA	JPSS Liaison / trainer
William Straka III	CIMSS/SSEC	Imagery/DNB expert
Steve Finley	CIRA	IT/data expert
Rosalie Marley	GST	Imagery JAM

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	0.672	0.02	0.662 - 0.682		
M6	0.746	0.015	0.739 - 0.754	Near IR	
M7	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	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 / NCC	0.7	0.4	0.5 - 0.9	Visible	750 m across full scan
I1	0.64	0.08	0.6 - 0.68	Visible	375 m
I2	0.865	0.039	0.85 - 0.88	Near IR	
I3	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	

M-bands EDRs are highlighted in pale yellow, in addition to I-band EDRs.
True-color component bands are highlighted in red, green, and blue.

Requirements (1 of 2)

Product Requirements from JPSS L1RD

Attribute	Threshold	Objective
1. The Imagery EDR shall be delivered under all weather conditions, including any rain rate		
a. Horizontal Spatial Resolution for visible and IR Imagery bands		
1. Nadir	0.4 km	0.1 km
2. Edge of Swath	0.8 km	0.1 km
3. Night-time visual, Nadir	2.6 km	0.65 km
b. Horizontal Spatial Resolution for moderate resolution bands		
1. Nadir	0.8 km	NS
2. Edge of Swath	1.6 km	NS
c. Mapping Uncertainty		
1. Nadir	1 km	NS
2. Edge of Swath	3 km	0.5 km
3. Night-time visual, Nadir	TBS	1 km
d. Refresh for Visible and IR bands	At least 90% coverage of the globe every 12 hours	NS

Requirements (2 of 2)

The **Imagery** product consists of:

- **Visible/IR radiances/reflectances** remapped to the **Ground Track Mercator (GTM**) grid, eliminating overlapping pixels and bowtie deletions.
  - I-band and M-band Imagery
- **NCC Imagery** that is a **pseudo-albedo** derived from the DNB, creating an image product that removes large contrasts in DNB from day to night across the terminator.
- VIIRS Imagery products as a **Key Performance Parameter (KPP)** reads as follows:

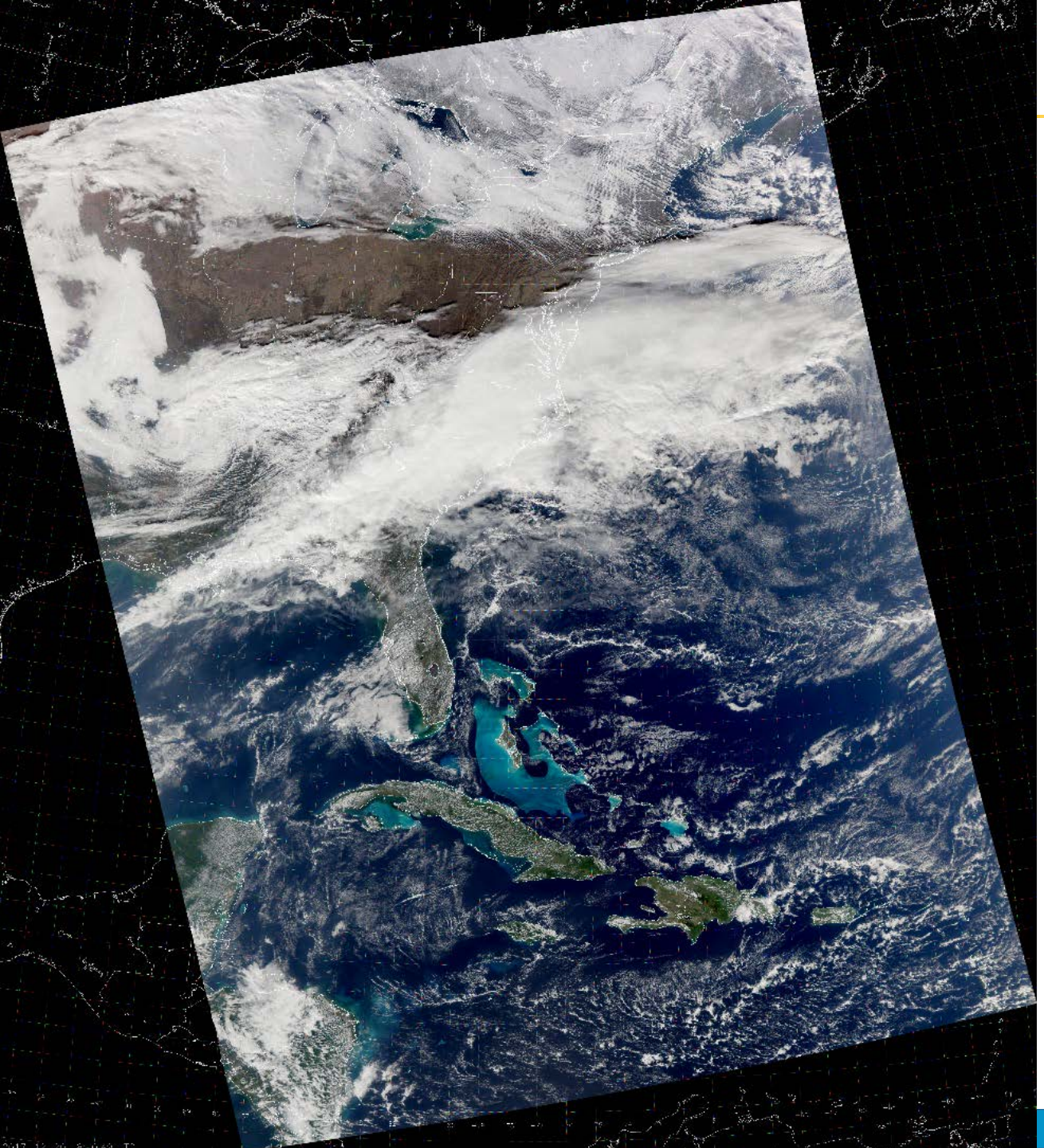
VIIRS Imagery EDR for (8) bands I1, I3, I4, I5, M14, M15, M16, and DNB for latitudes greater than 60°N in the Alaskan region (I3 and DNB bands added post SNPP launch)

- There are **no (quantitative) requirements** that address the quality of the Imagery products.
- The **user** decides if the quality of the Imagery is acceptable, therefore **including the users is a key consideration** (although end users just started to become involved at the Beta level when data became available)

Findings/Issues fixed at Provisional Review

- VIIRS **M-bands** (all good) – vis/IR bands
- VIIRS **I-bands i**ssues at **Beta** that were fixed,
  - **I3 bad detector**
    - Causing striping in the I3 SDR (CCR3742/ADR8560)
    - Imagery algorithm successfully removes striping from the I3 Imagery EDR
  - **I4 and I5 fill values**
    - I4/I5 blank images (CCR3742/ADR8559) - 80% of all granules were not usable
    - The former I4 and I5 issue of missing Imagery EDRs at beta no longer exists
- VIIRS **DNB/NCC** issues:
  - **Extended DNB granule processing** by NCC is working
  - **Geolocation issues** (fixed with LUT updates)
  - **Stray light (VIIRS SDR Team)**
    - Not unlike striping on SNPP DNB
    - Expected to be addressed with DNB calibration in Feb 2018
- **Better together: NOAA-20 and SNPP** (50 min half-orbit separation examples)

NOAA-20 M-bands visible/IR bands



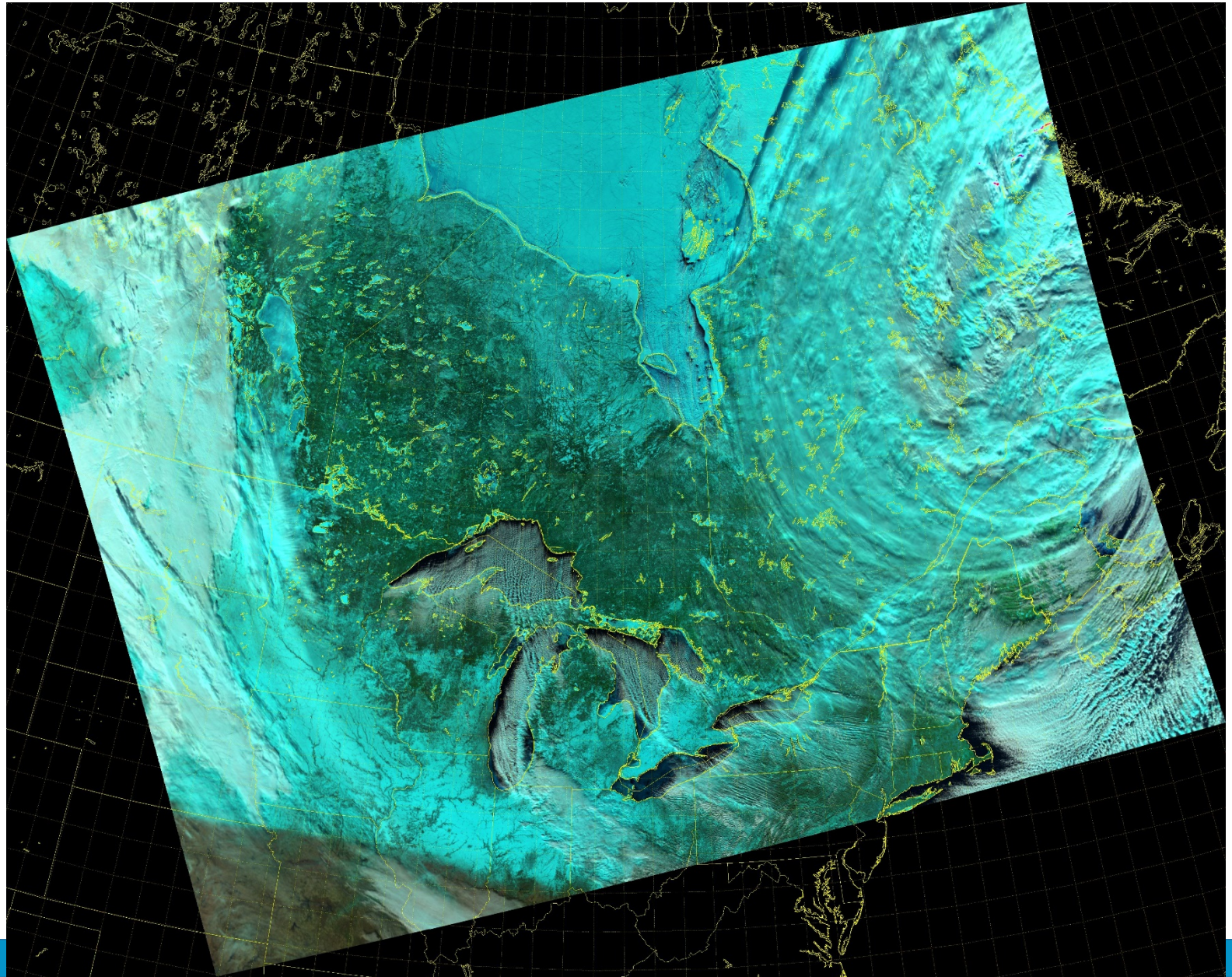
VIIRS True Color

Eastern US (2017-12-20)

(C. Seaman, CIRA)

Natural-color RGB – Frozen North (2018-01-05)

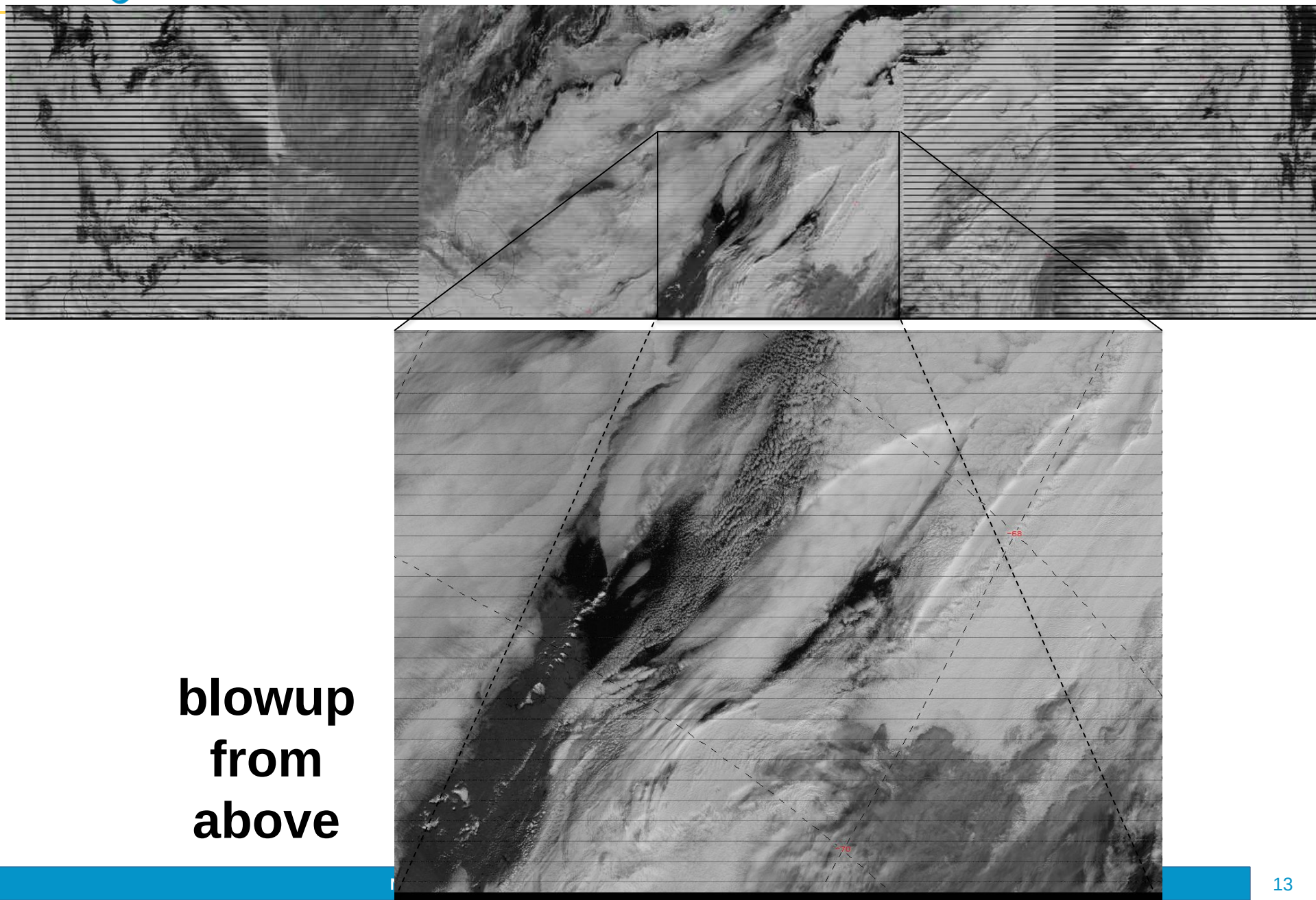
(C. Seaman, CIRA)



Day-Night-Band First Light CONUS (2017-12-14)
(S. Miller, CIRA; NOAA Facebook)

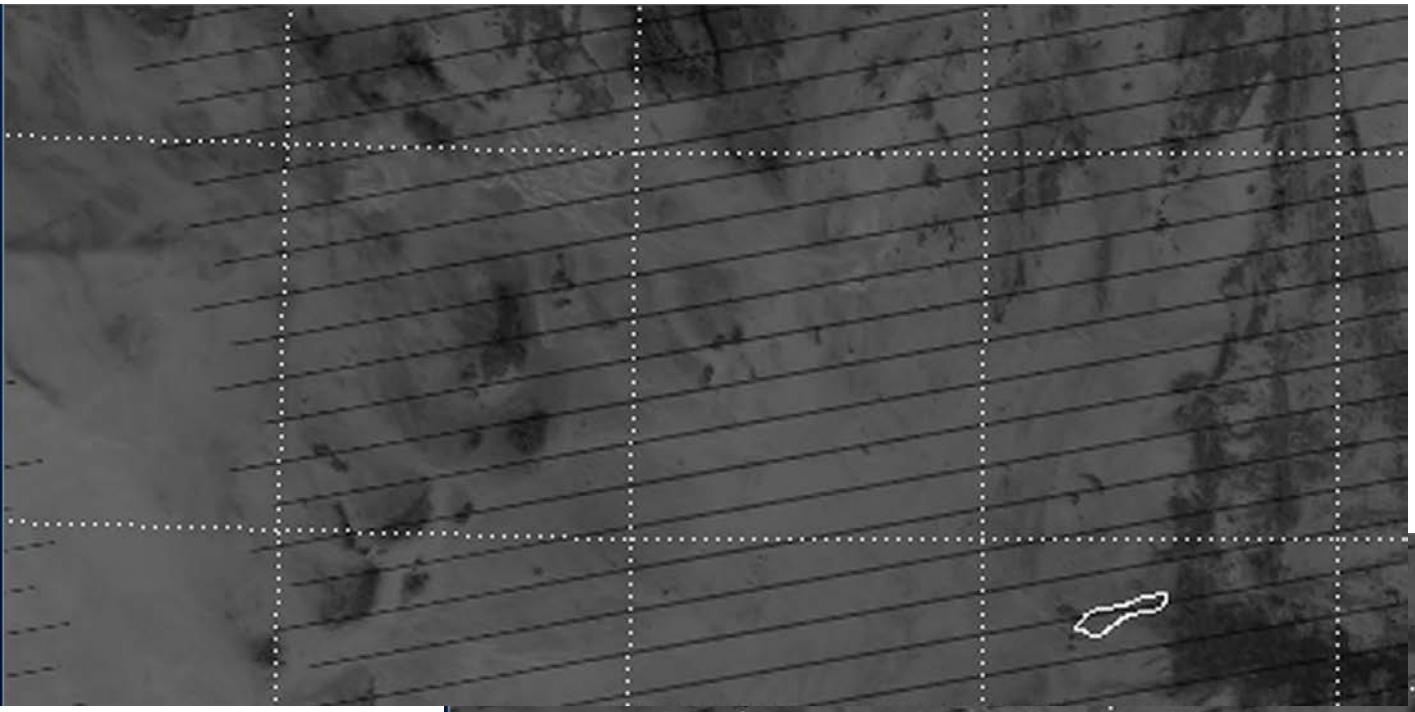
NOAA-20 I3 bad detector (Now fixed!)

I3 bad detector/striping (now fixed!) (granule view)

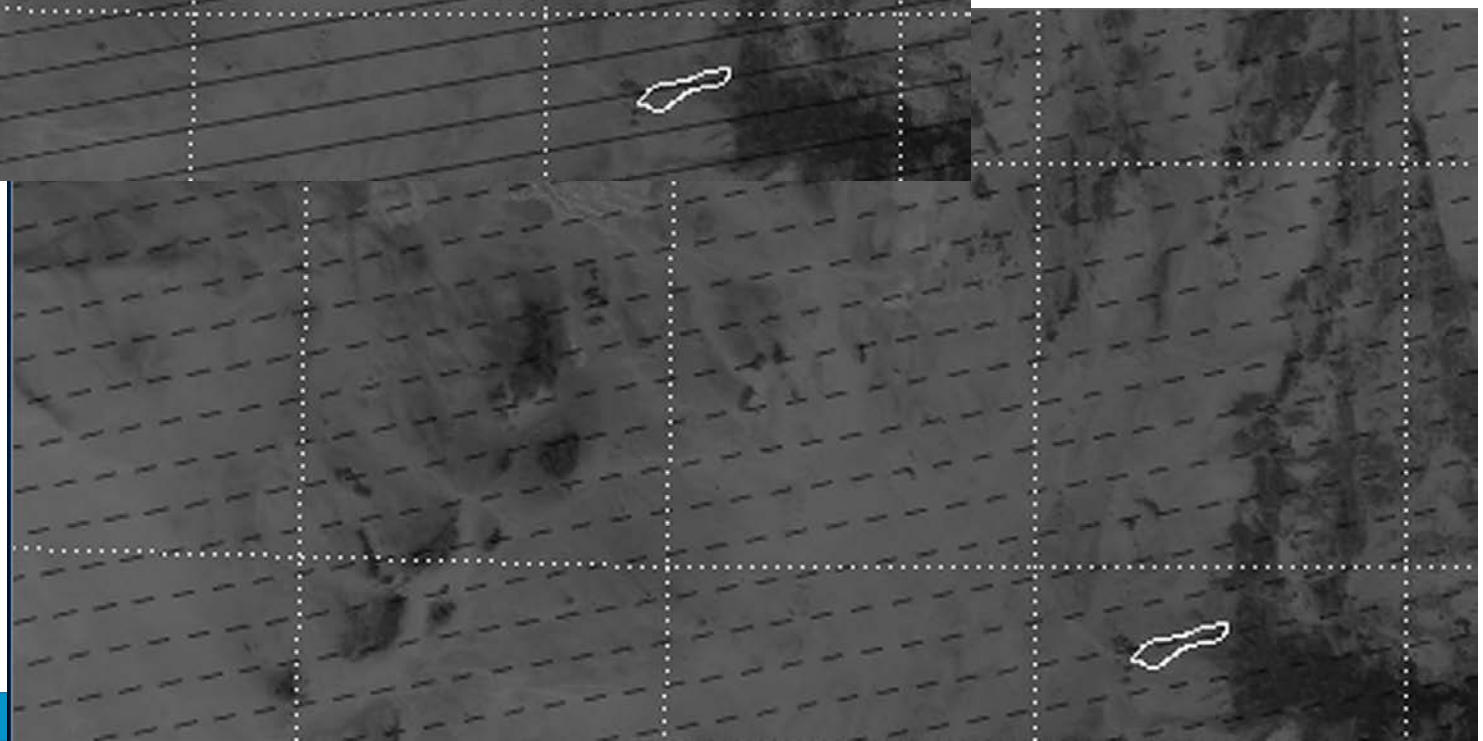


blowup from above

I3 bad detector/striping (now fixed!)
(remapped over Sahara Desert) (2018-01-22)

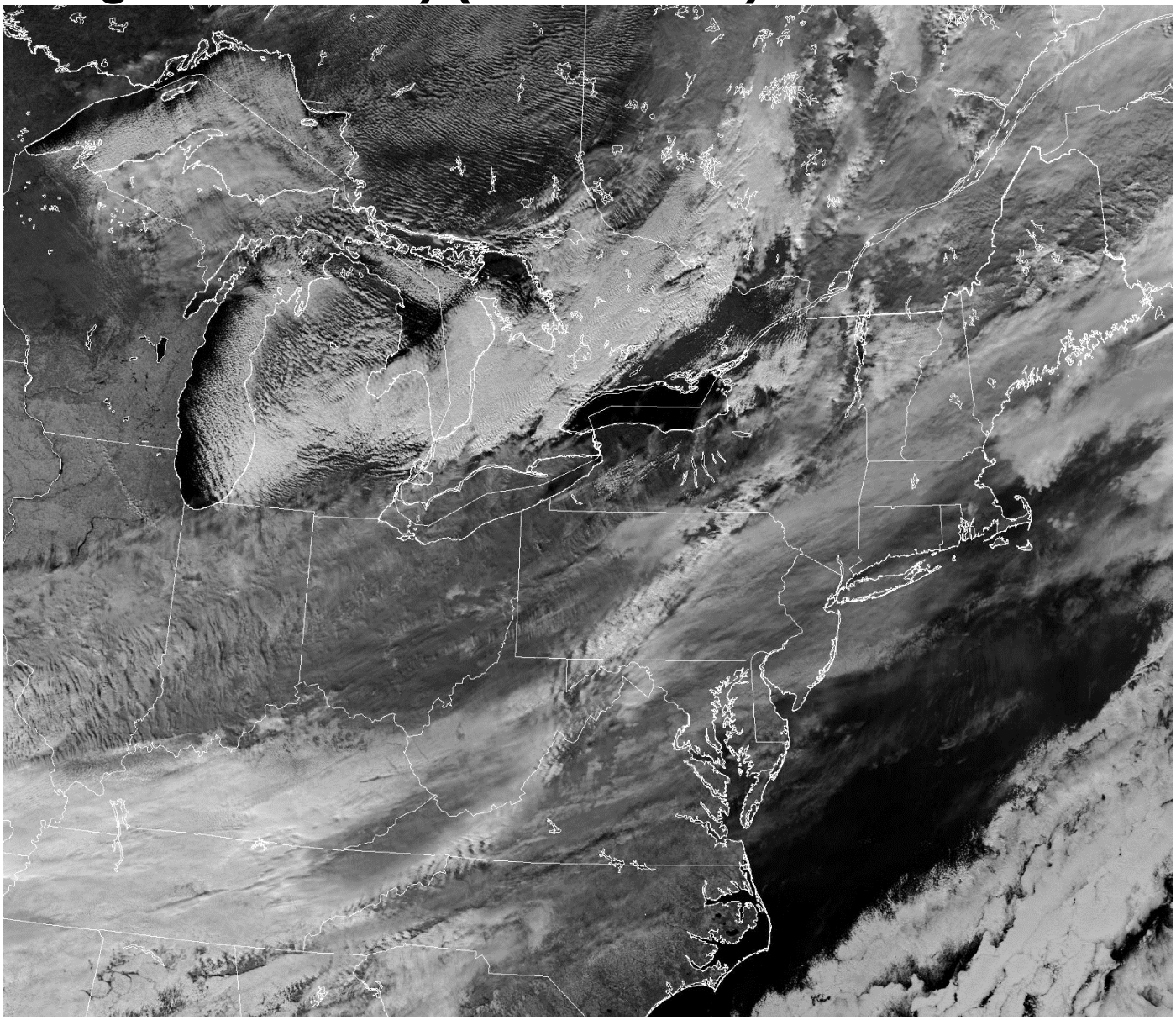


SDR
I3



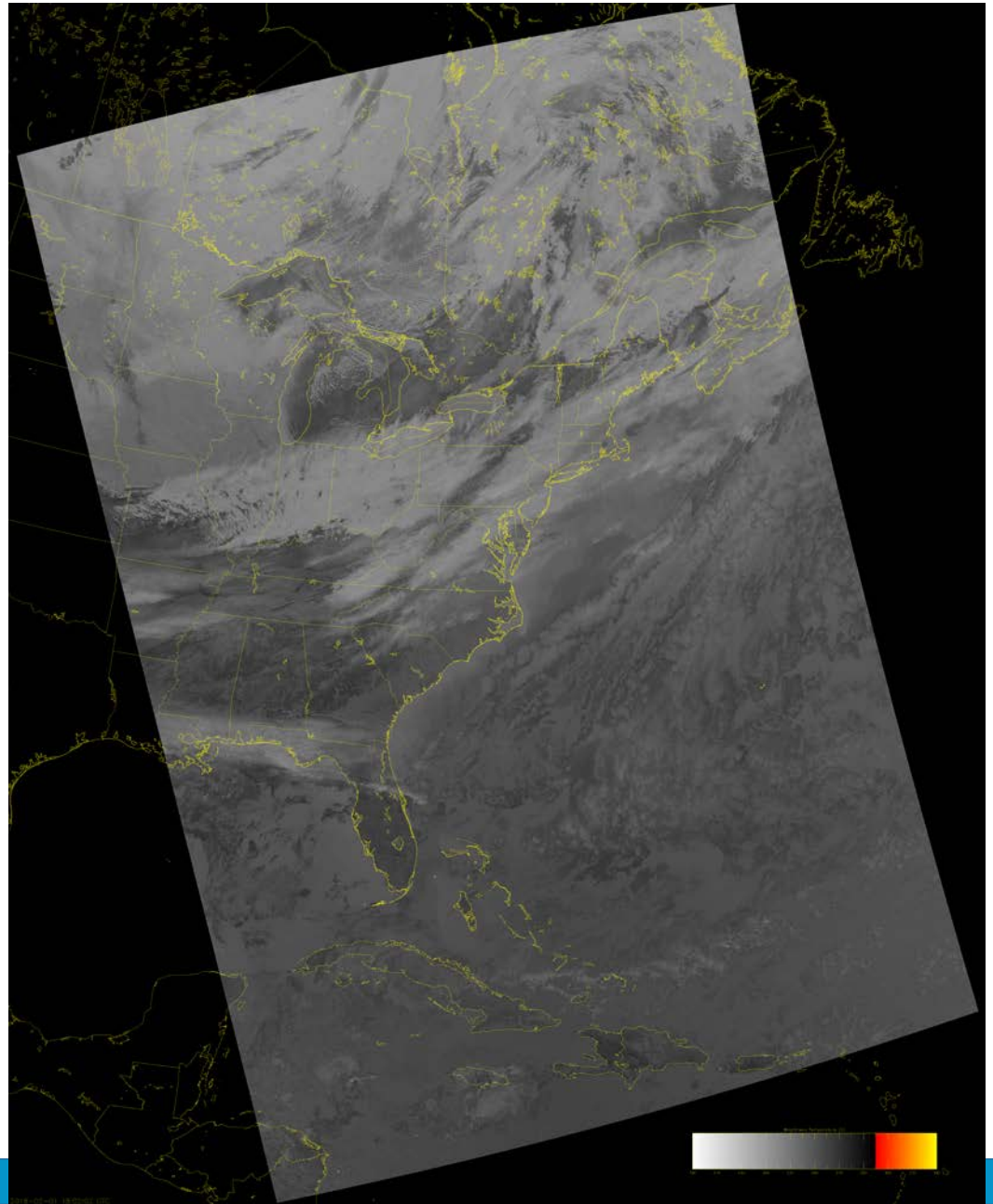
EDR
I3

I3 EDR (LUT now flags bad detector, and repairs navigation offset) (2018-02-01)

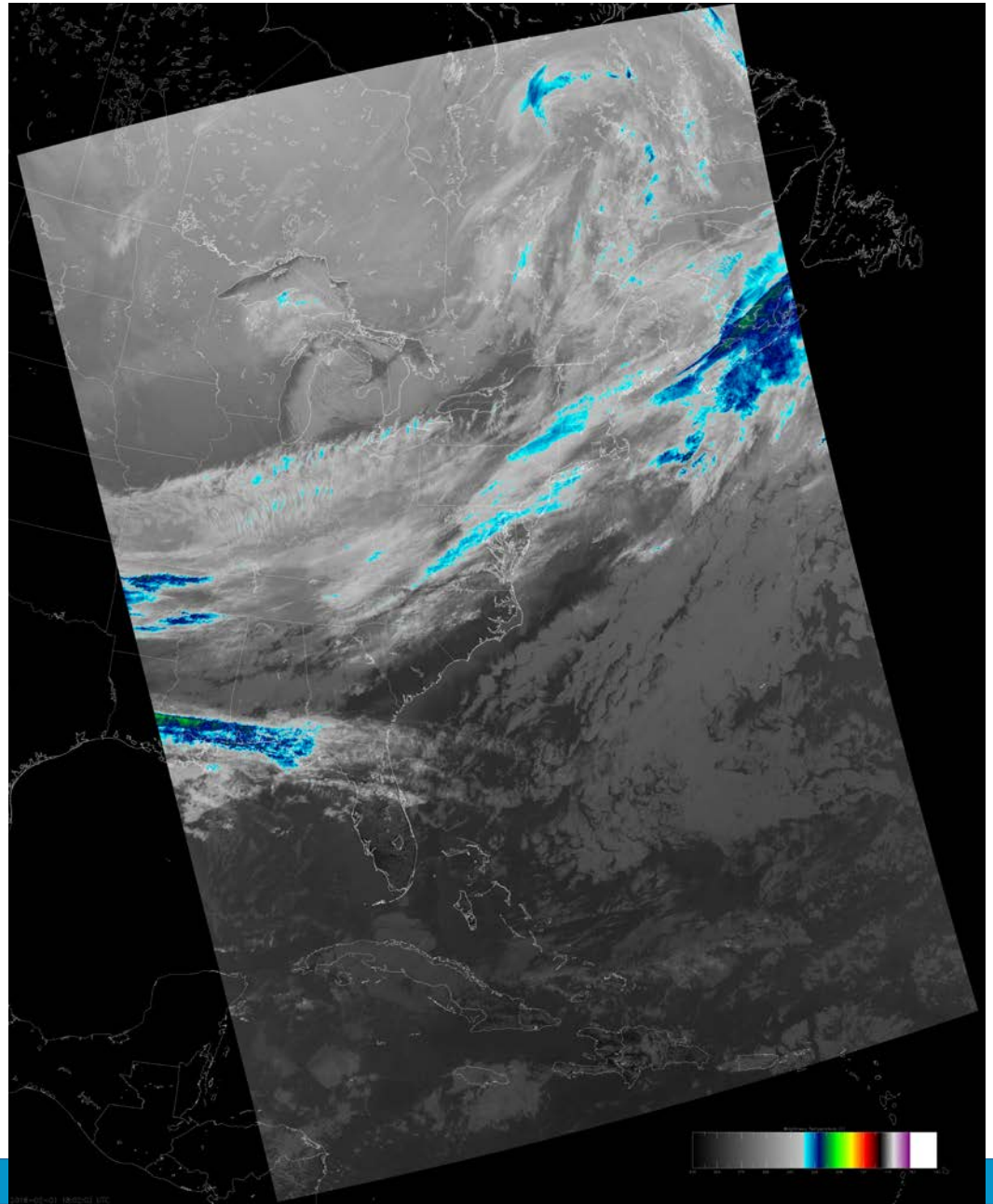


I4 and I5 missing/fill values (now fixed!)
(large amount of fill is now valid data)

I4 EDR (LUT now allows valid data) (2018-02-01)



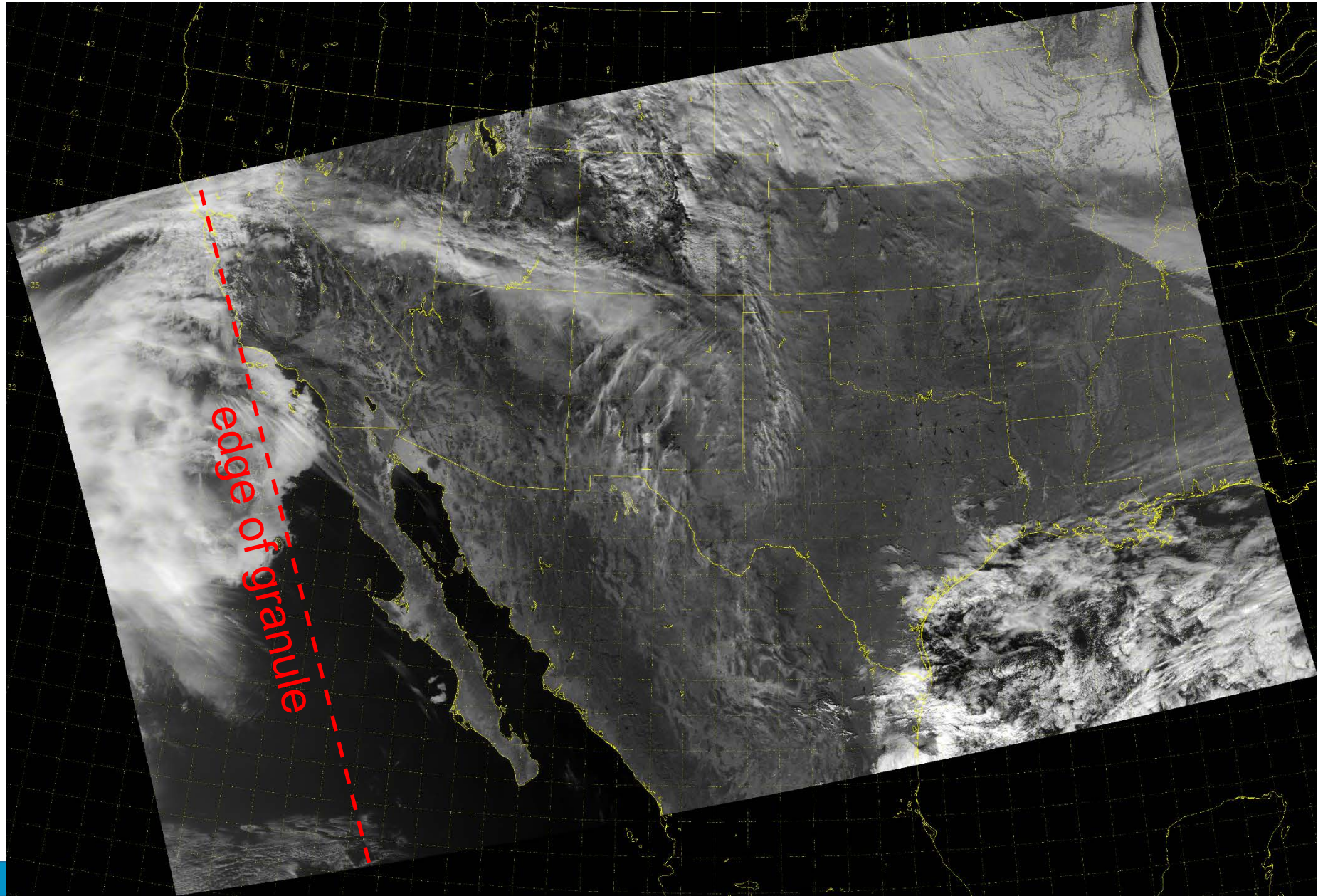
I5 EDR (LUT now allows valid data) (2018-02-01)



NOAA-20 DNB extended granule

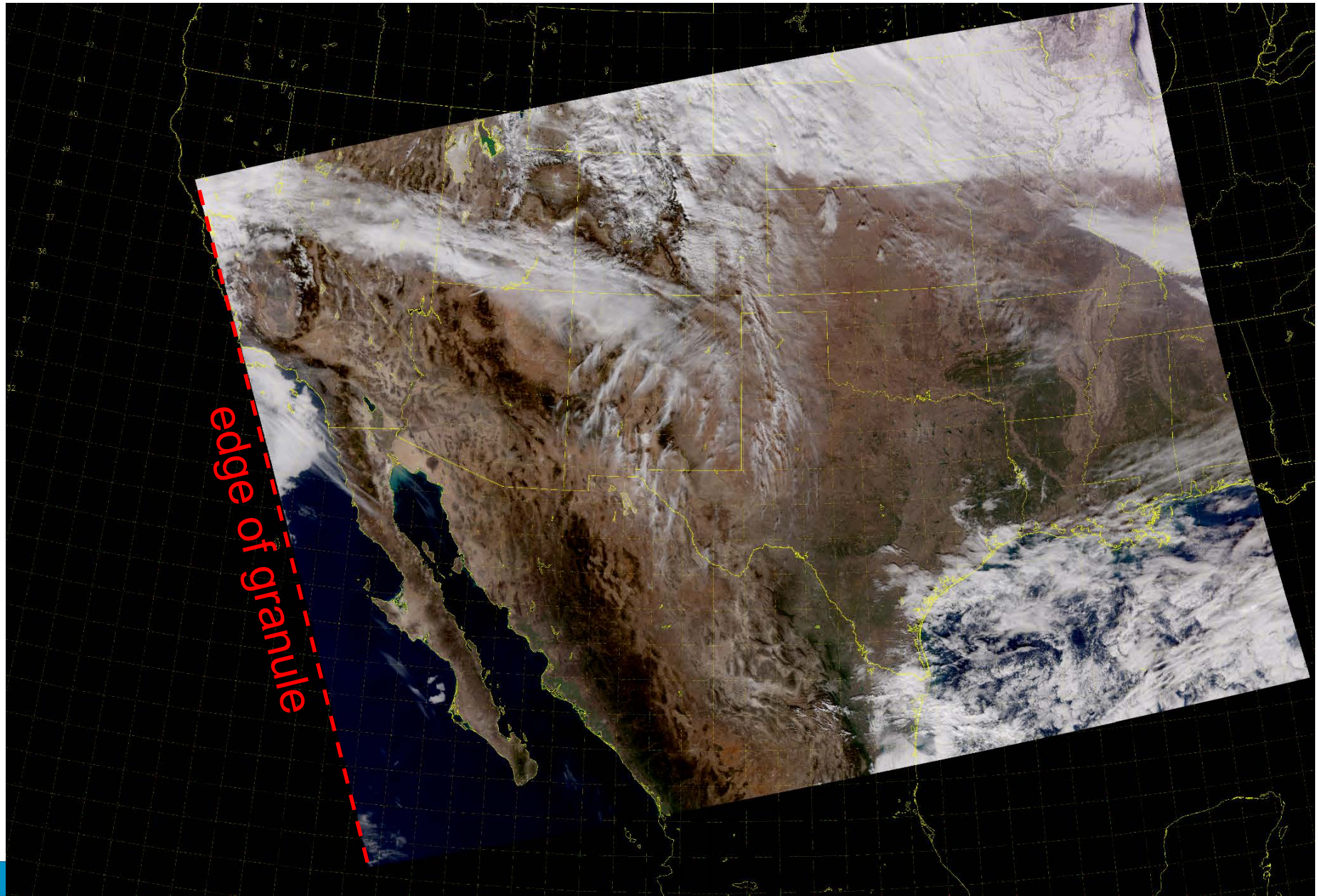
DNB Extended Granule – SW USA (2018-01-05)

(C. Seaman, CIRA)

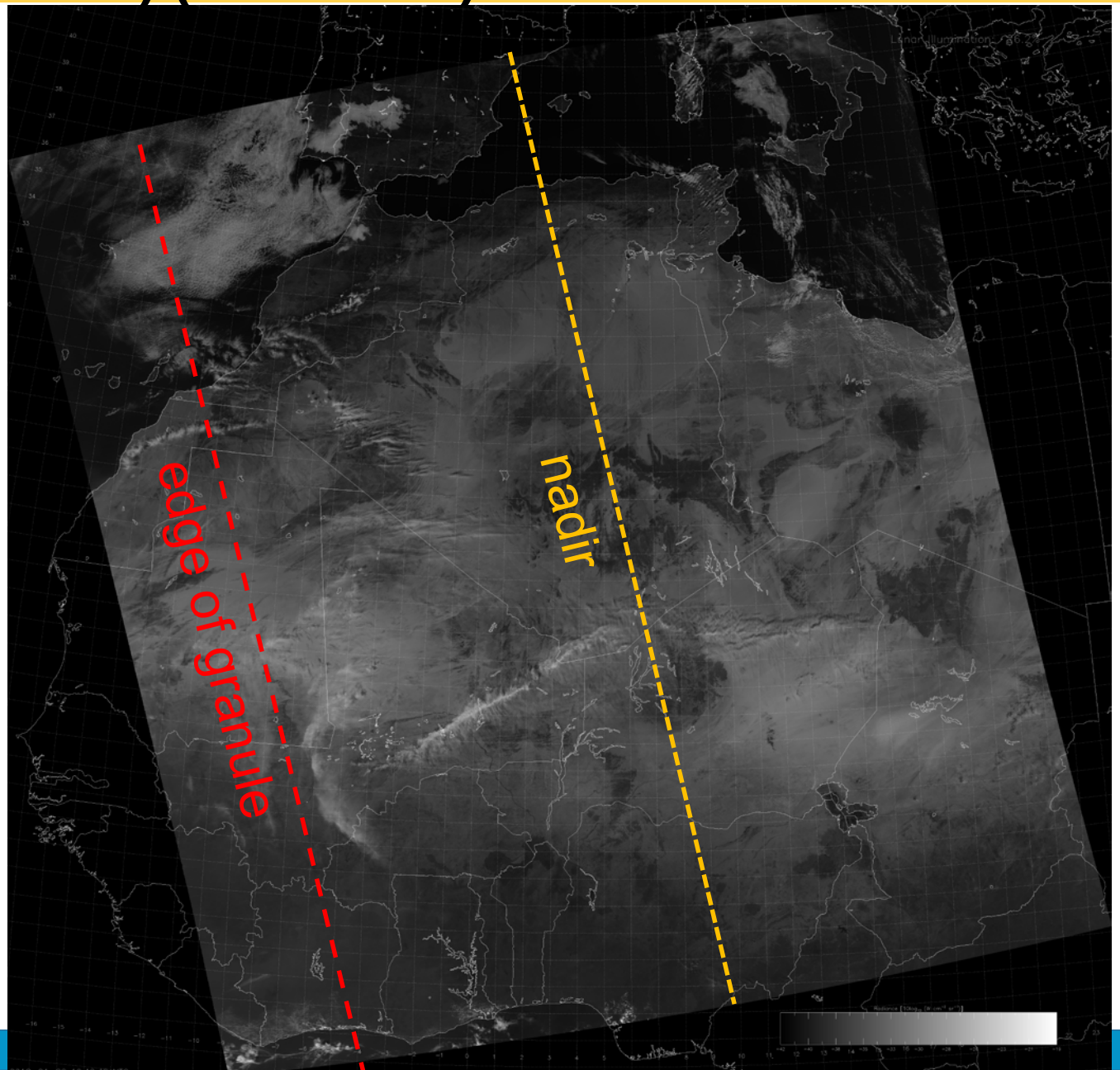


True-color RGB – SW USA (2018-01-05)

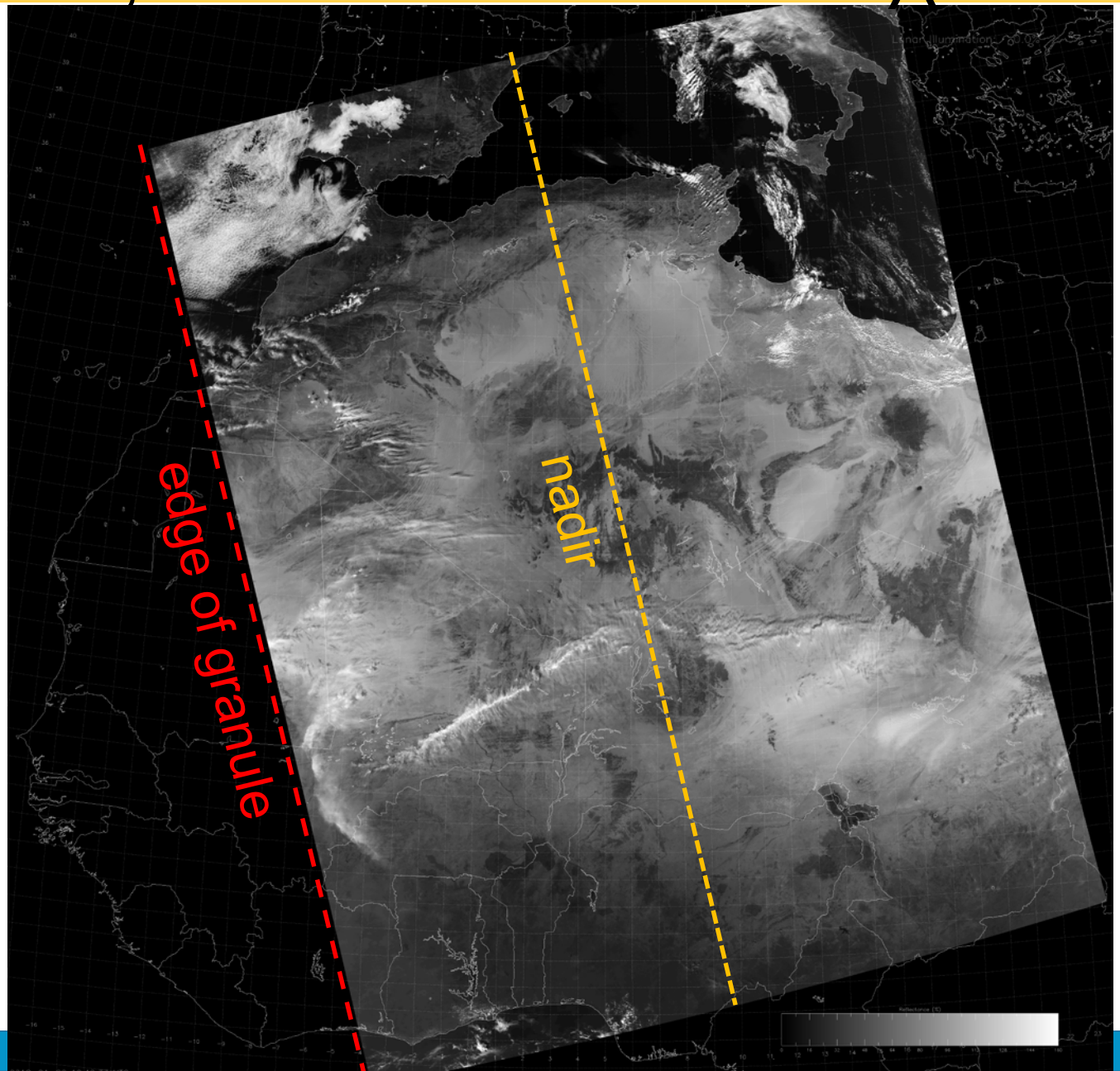
(C. Seaman, CIRA)



DNB (extended granule on left and nadir not at center) (2018-01-22)

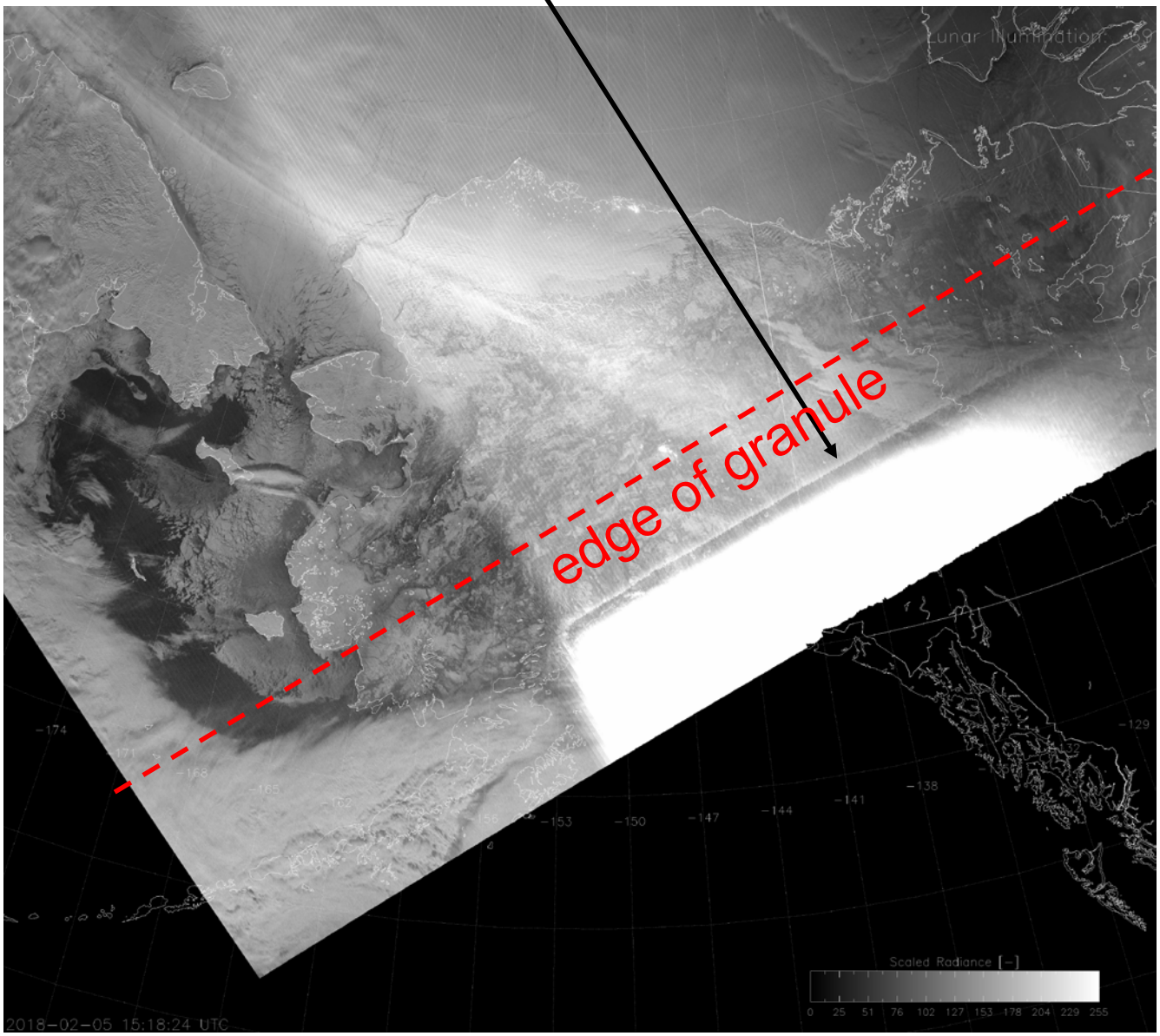


NCC (extended granule not included, and nadir at center, and better contrast than DNB) (2018-01-22)

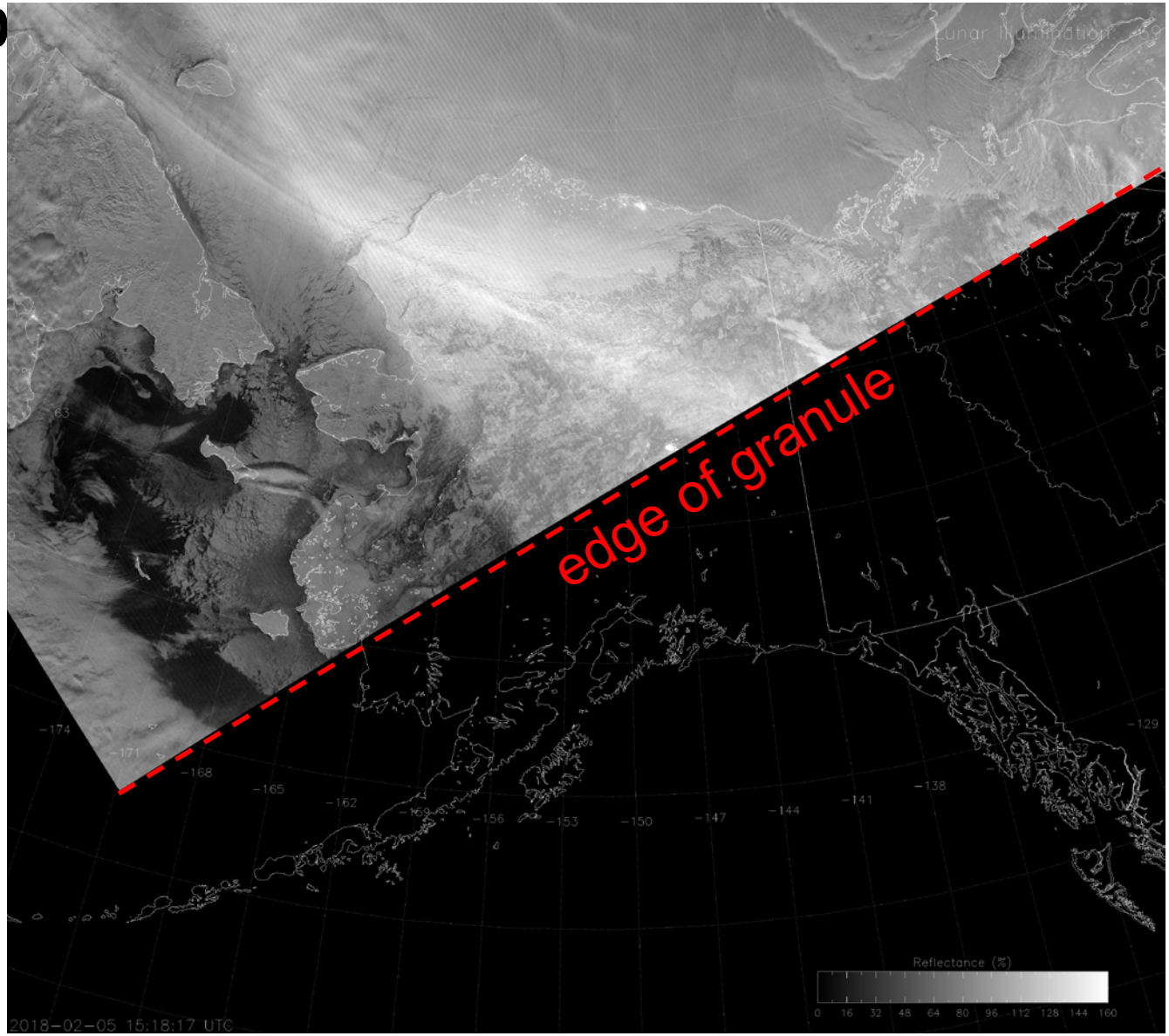


NOAA-20 DNB stray light

Extra strong patch of stray light in extended DNB granule (2018-02-05)



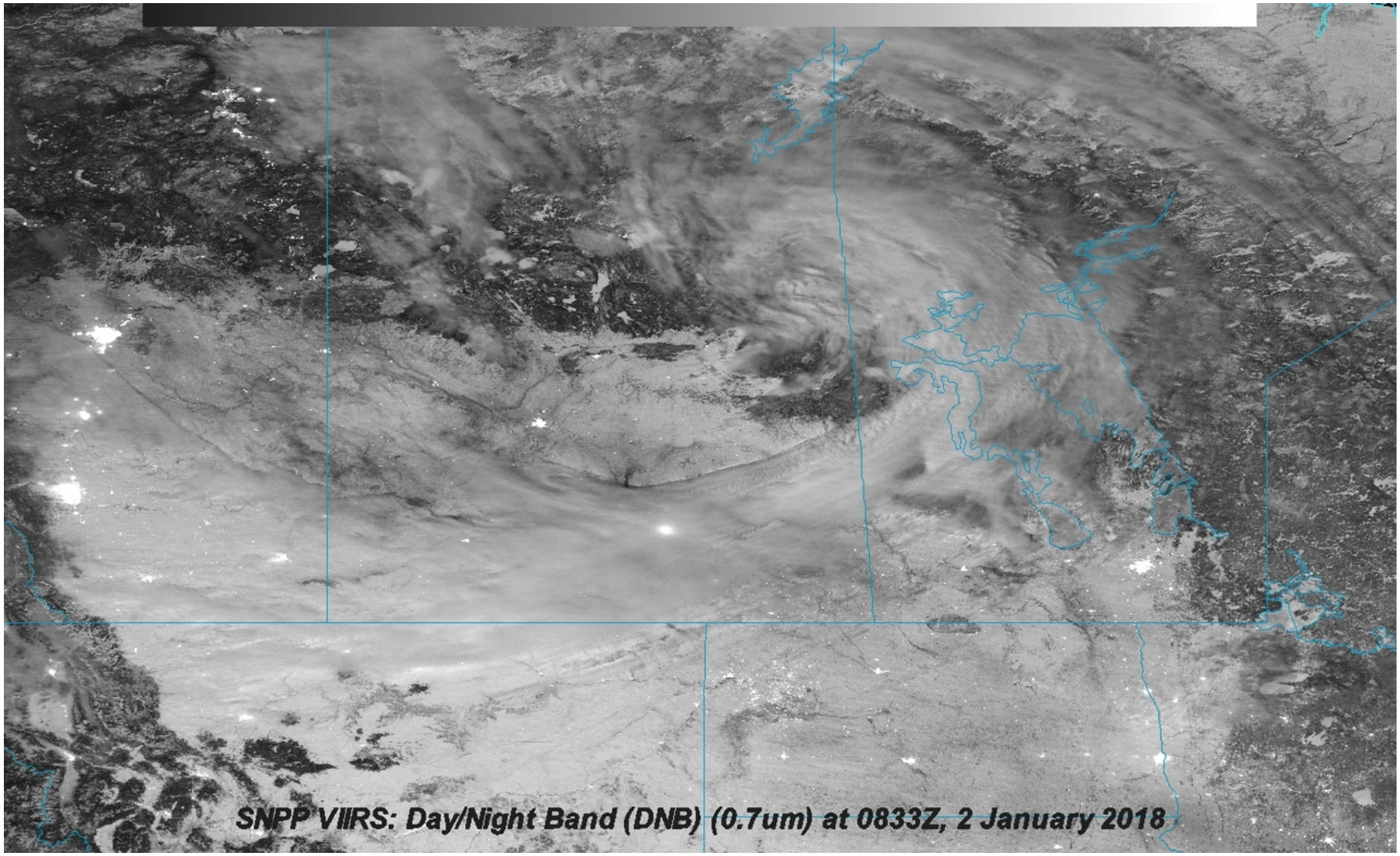
Extra strong patch of stray light not in NCC granule which cuts off extended portion of DNB (2018-02-0



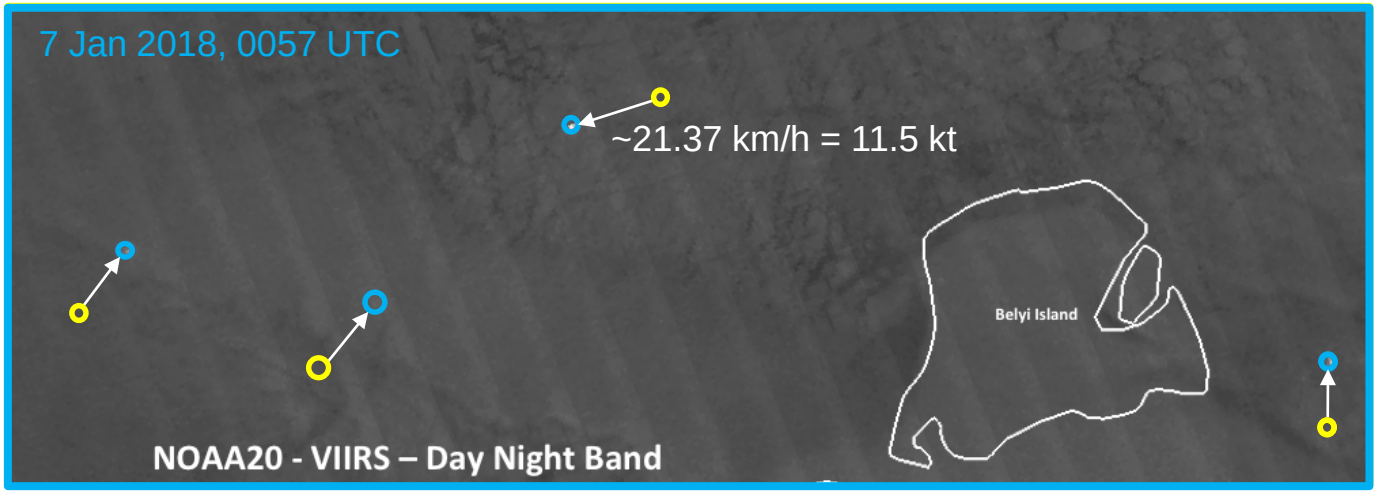
SNPP and NOAA-20 DNB comparisons (@ ~50 minutes separation)

Animation of VIIRS DNB between SNPP and NOAA-20/JPSS-1

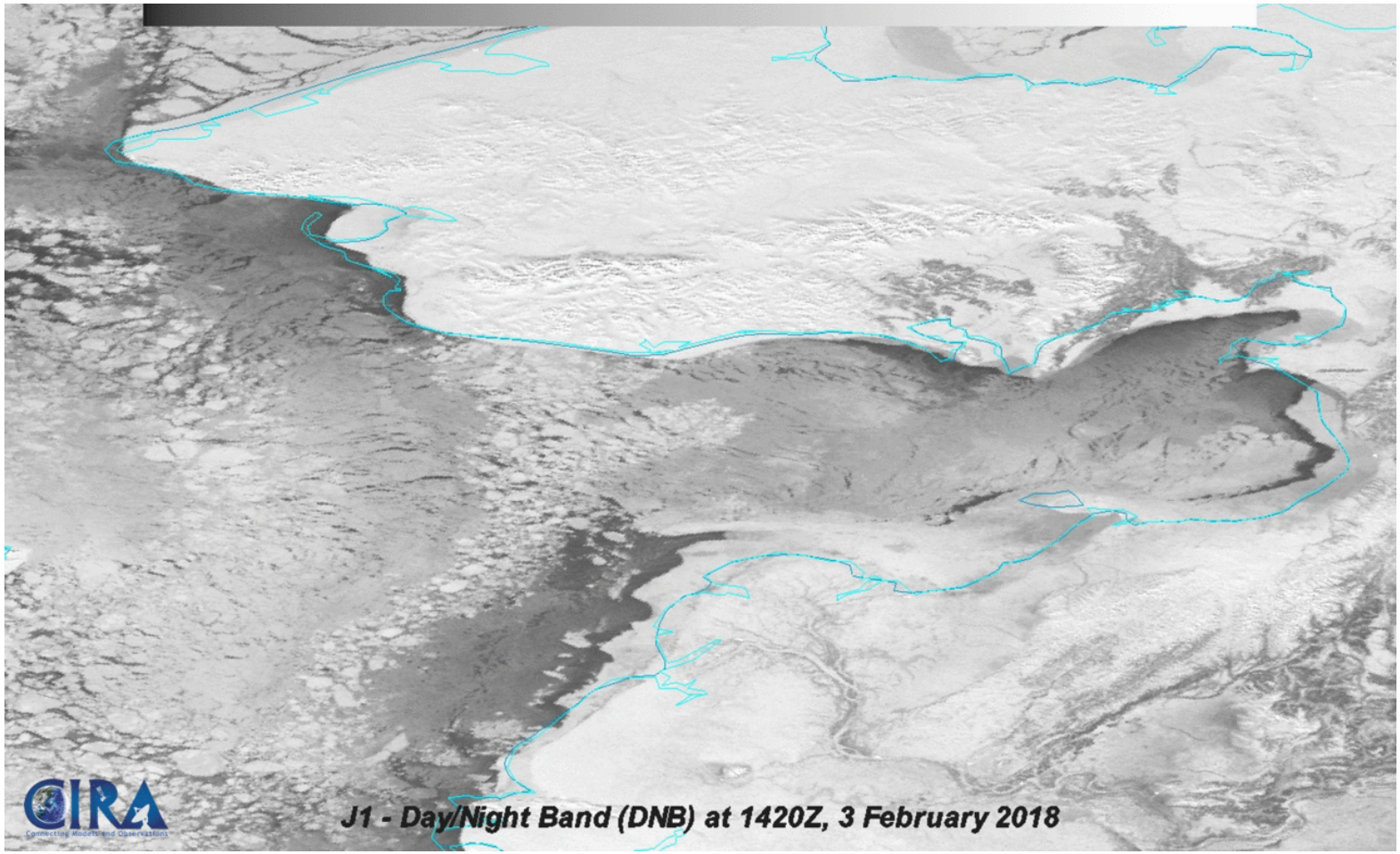
(J. Torres, CIRA)



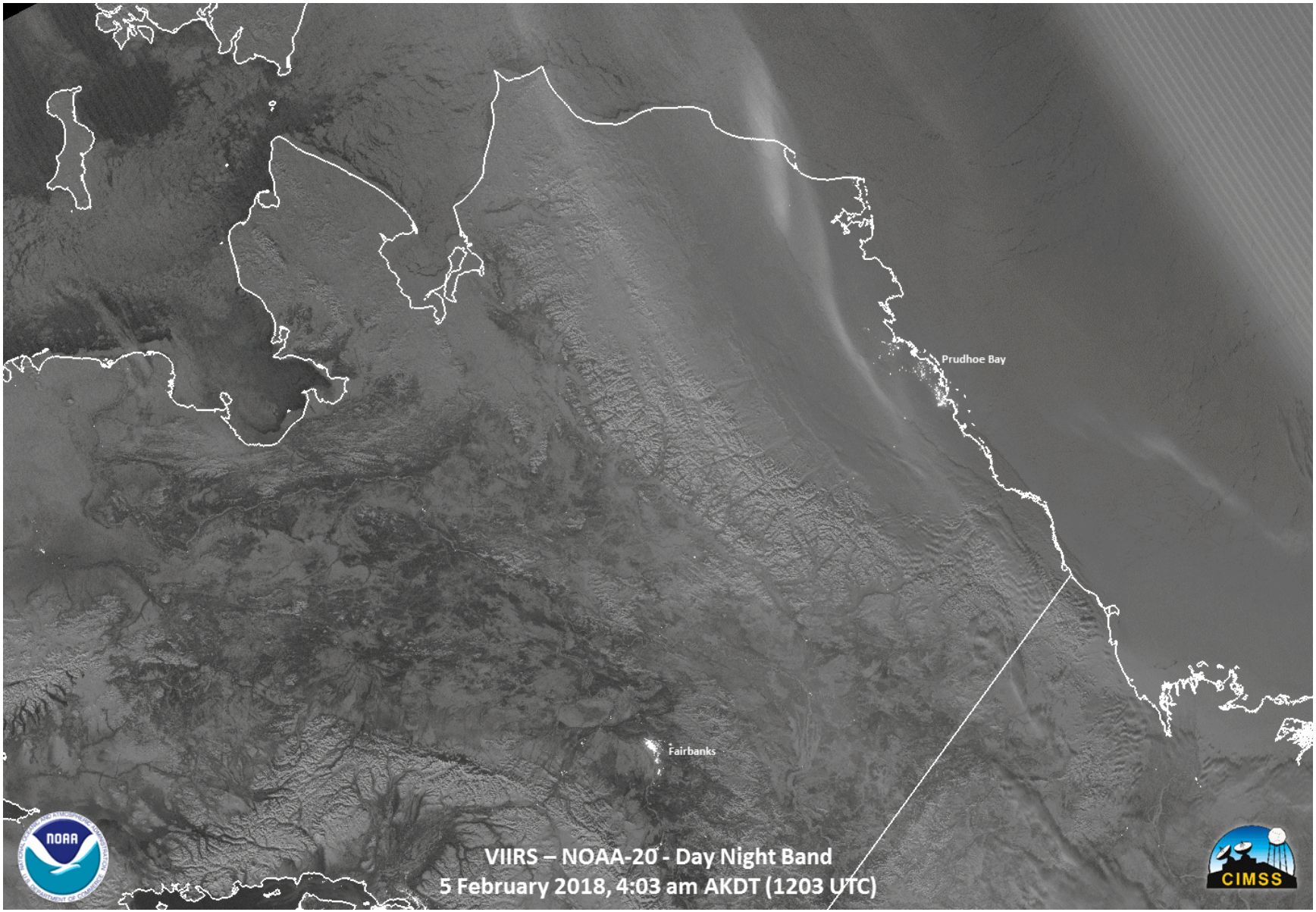
Improved Ship Tracking with Dual (SNPP/NOAA-20) DNB System (S. Miller, CIRA)



NOAA-20 DNB animation shows NW Alaska (near Nome, AK) of snow-covered areas, sea-ice edges and sea-ice motion over a period of 3 days: 3-5 February 2018. (J. Torres, CIRA)



NOAA-20/SNPP DNB animation of aurora – note how quickly the light show changes! (W. Straka, CIMSS/SSEC)



Documents (Check List)

Science Maturity Check List	Yes ?
ReadMe for Data Product Users	Accompanies this presentation
Algorithm Theoretical Basis Document (ATBD)	Yes (SNPP)
Algorithm Calibration/Validation Plan	Yes (NOAA-20)
(External/Internal) Users Manual	Yes (SNPP)
System Maintenance Manual (for ESPC products)	NA
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	Yes (SNPP)
Regular Validation Reports (at least annually) (Demonstrates long-term performance of the algorithm)	At JPSS Annual Meetings

Conclusions

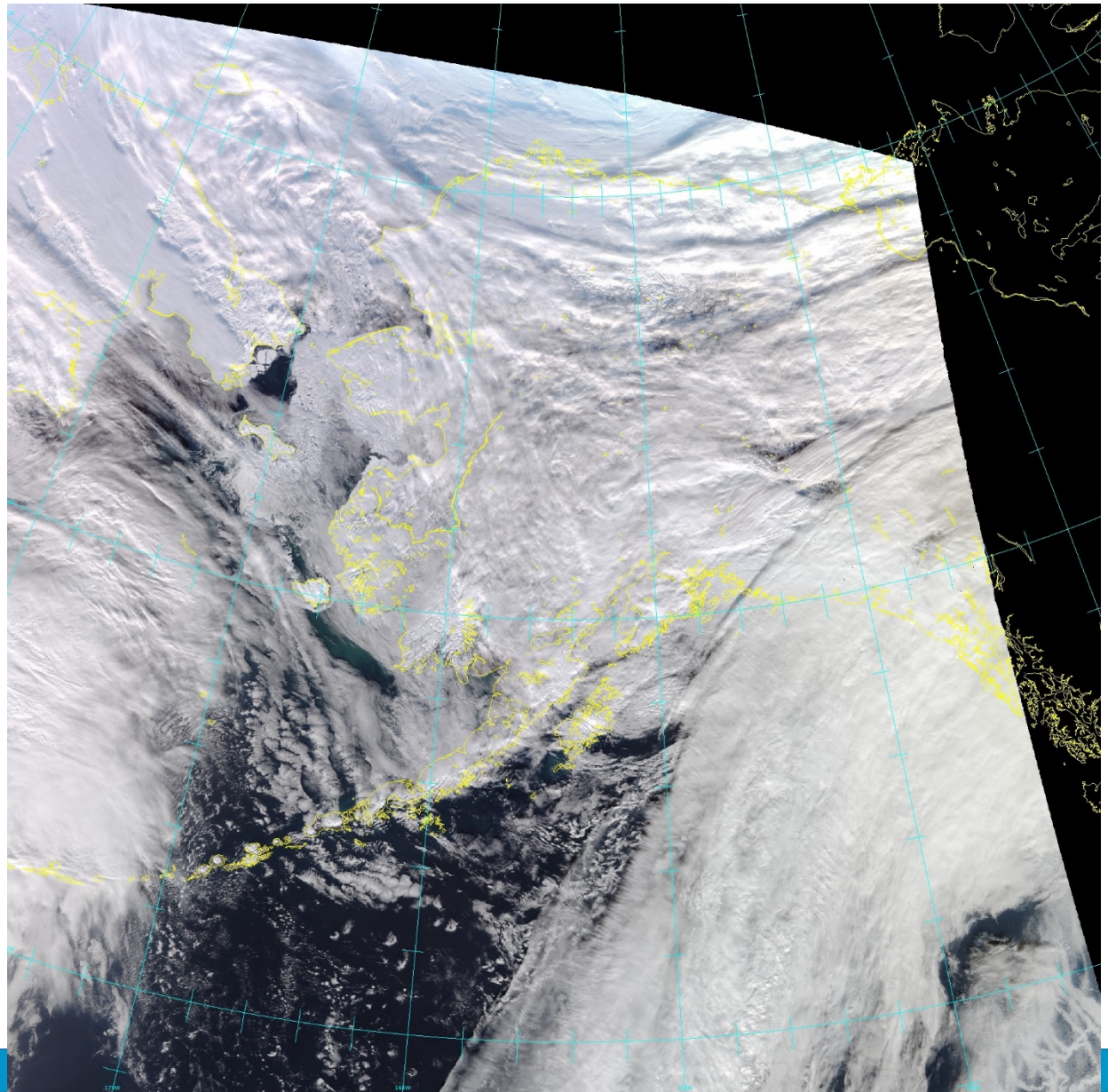
- Cal/Val results summary:
  - Team recommends **Provisional** maturity for **EDR Imagery** based on:
    - LUT updates took place ~1 February 2018
      - I3 striping fixed by flagging bad detector
      - I4/I5 Imagery restored with proper temperature thresholds.
    - Expect DNB stray light corrections in February 2018
    - On schedule with NOAA-20 checkout!

Path Forward

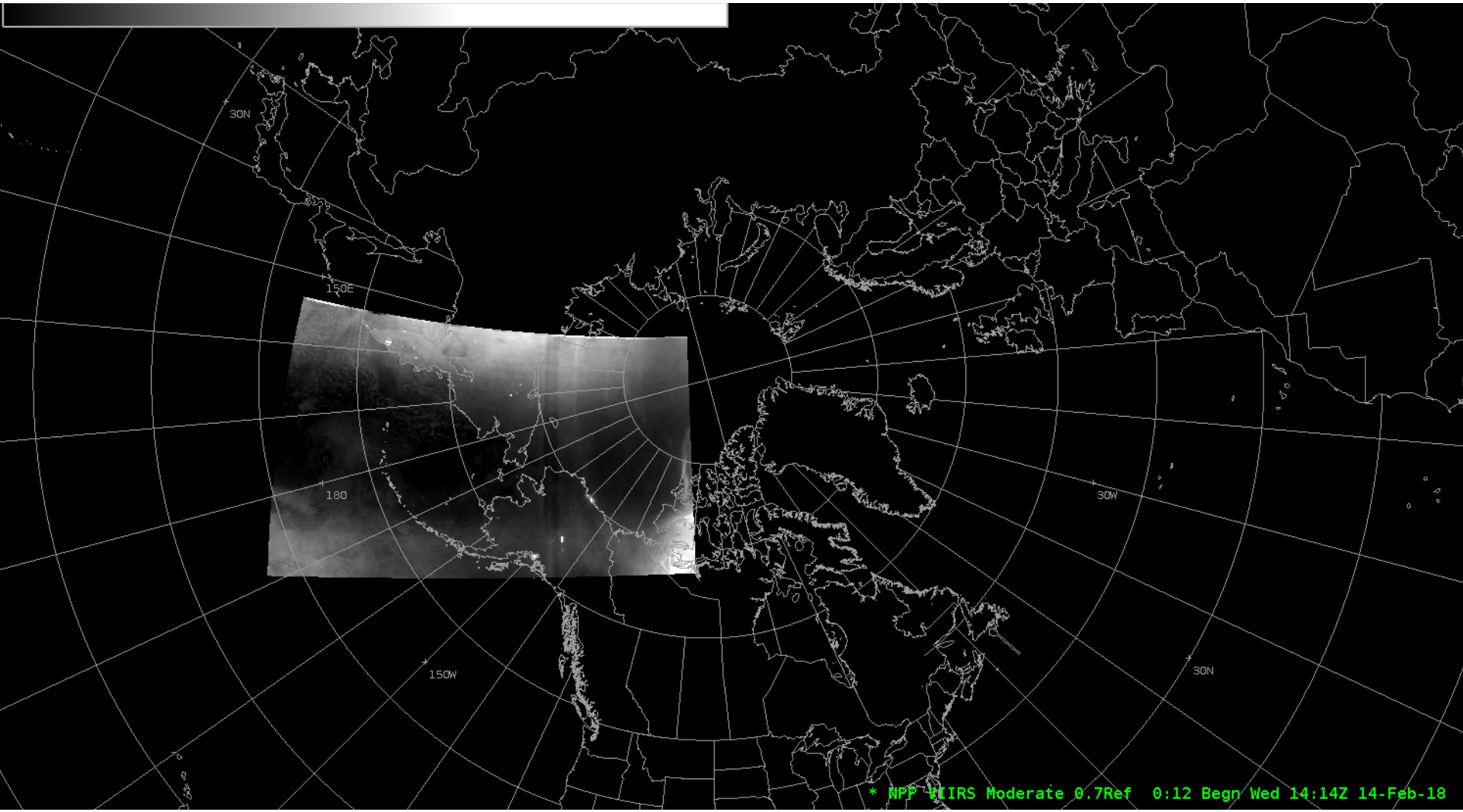
- Planned improvements:
  - LUT changes for I3/I4/I5 and DNB stray light on IDPS need to be implemented for CSPP users.
- Future Cal/Val activities / milestones:
  - **Validated** Maturity – Launch+9months – August 2018
  - Continue interface with users in Alaska and elsewhere (NWS/AWIPS users in particular)
  - NCC LUT update when DNB stray light fixes are stable

NOAA-20 Applications by Users (Alaska and OCONUS)

NOAA-20 VIIRS True-color native resolution RGB (2018-02-12) (E. Stevens, GINA, AK)

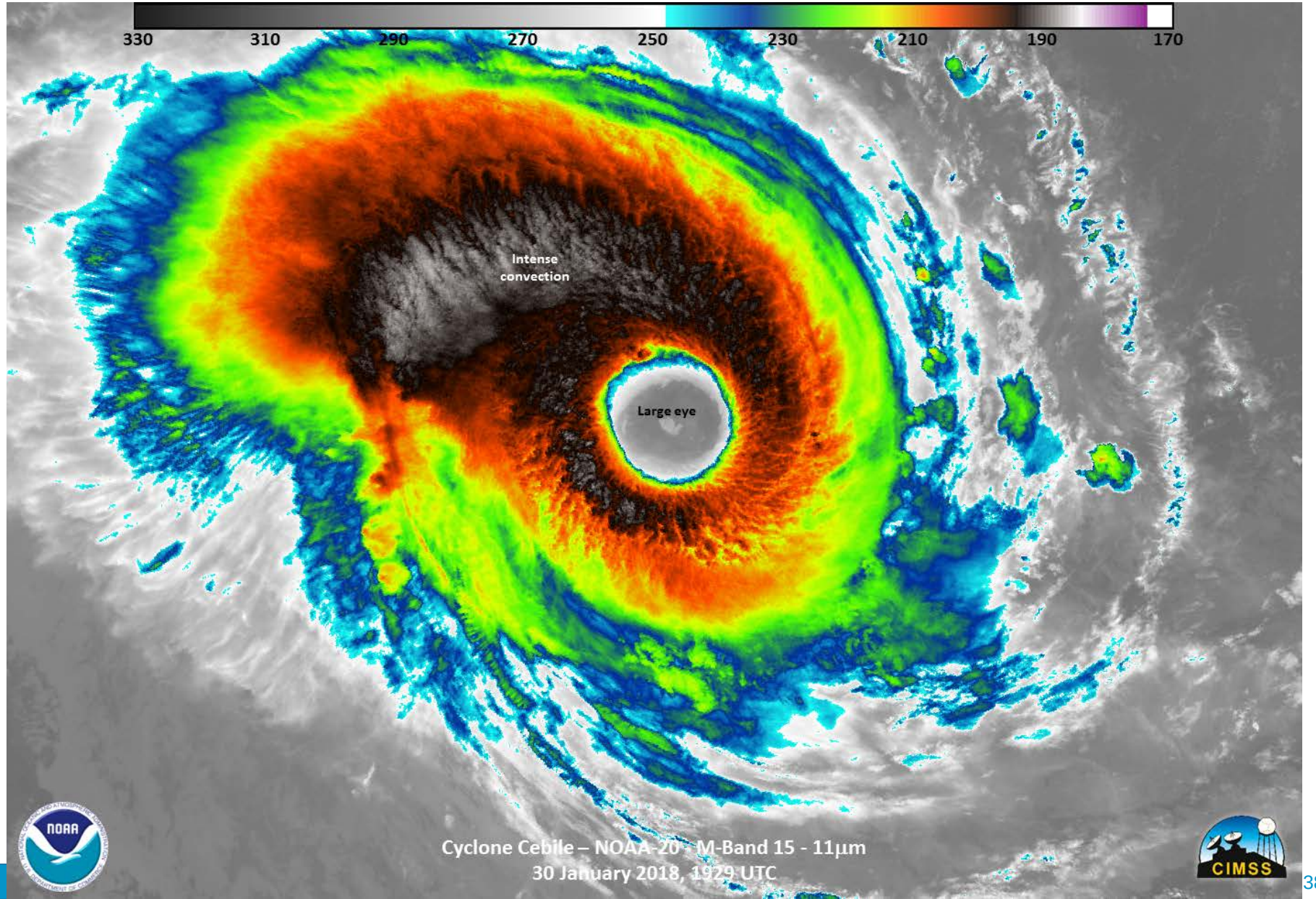


24 h Alaska-sector NCC (2018-02-14) (John Evans, GST; and Joe Anderson, NWS VLab, Silver Spring)

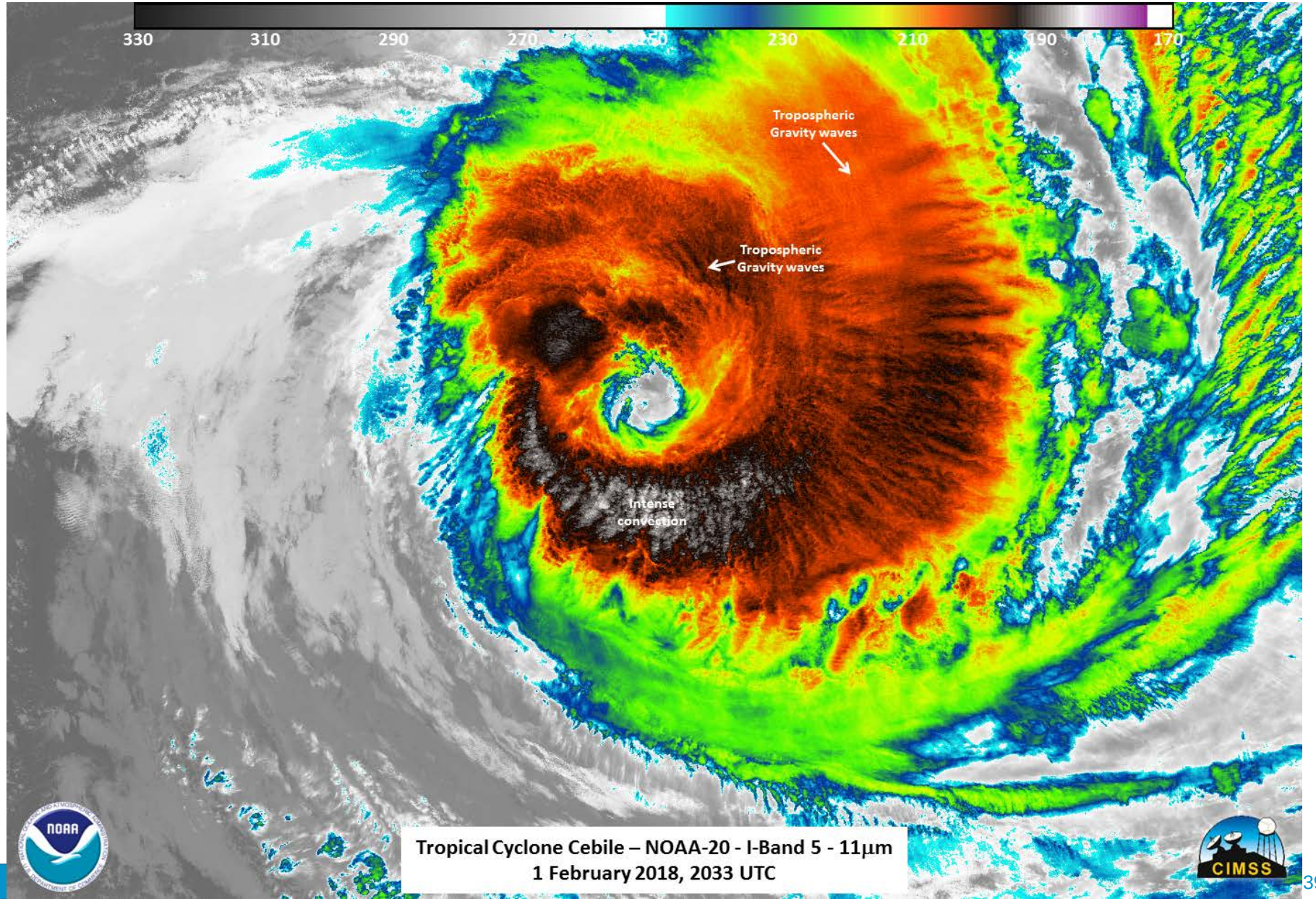


NOAA-20, even though NPP is incorrectly noted in the label

NOAA-20 I5 Cyclone Cebile (2018-01-30) (W. Straka, CIMSS)



NOAA-20 I5 Cyclone Cebile (2018-02-01) (W. Straka, CIMSS)



NOAA-20 Mayon in the Philippines (C. Seaman, CIRA)

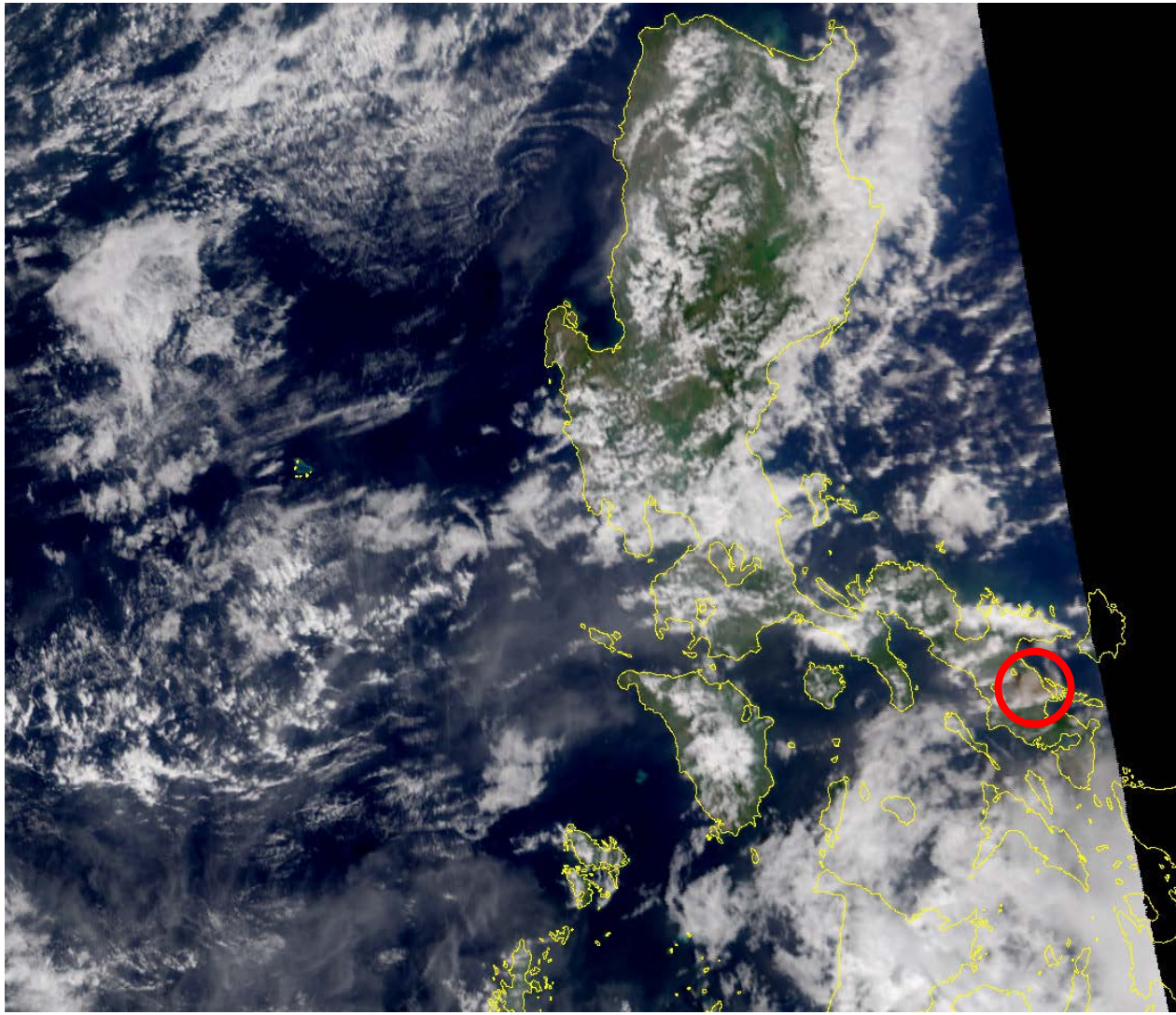
True Color

M-3, M-4, M-5

SDRs only since M-3 and M-5 are not converted to EDR

Volcanic ash plume visible inside red circle

05:52 UTC 22 January 2018



NOAA-20 Mayon in the Philippines (C. Seaman, CIRA)

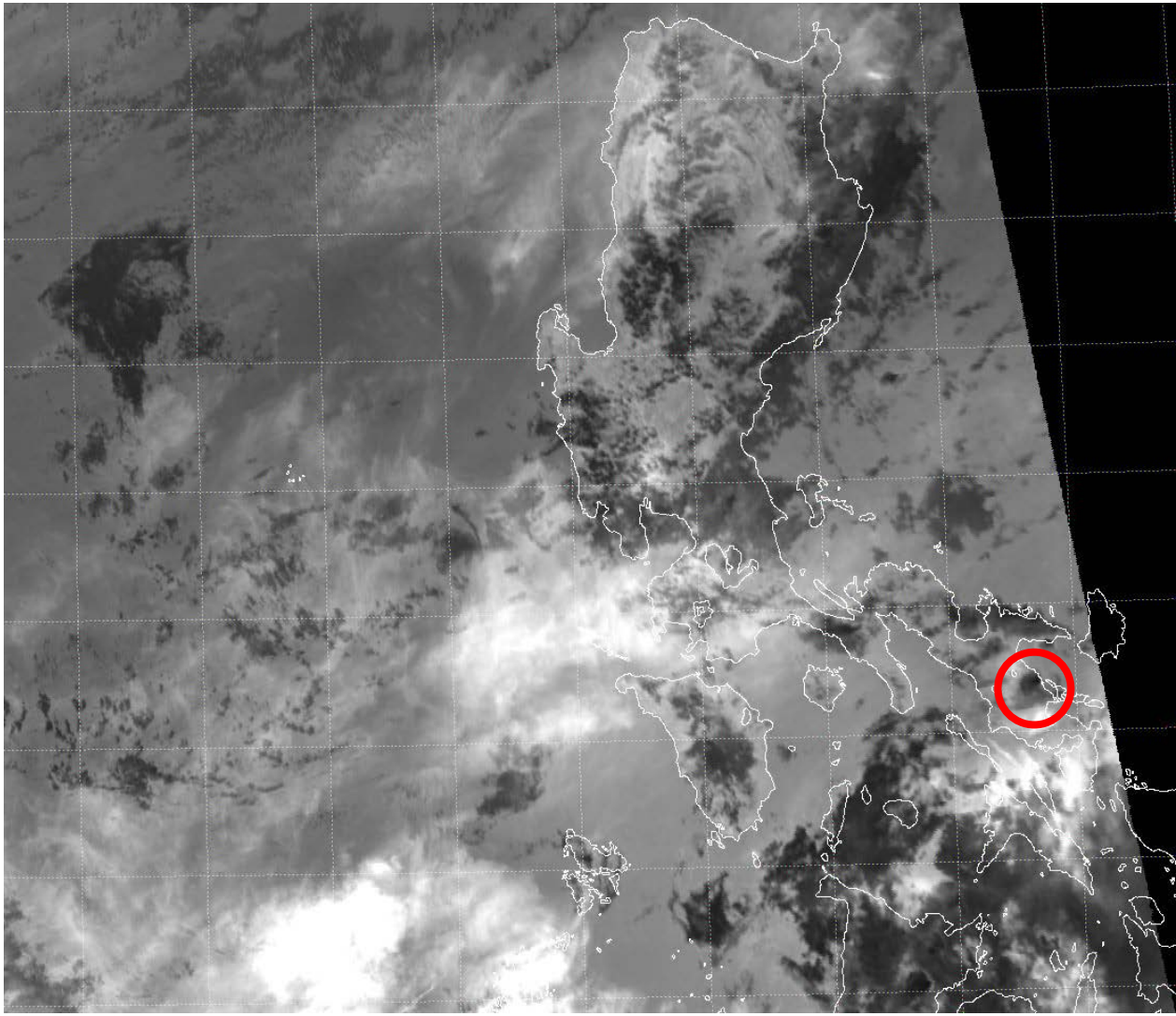
Split Window Difference - SDR

M-15 – M-16 brightness temperature difference

Used to detect thin cirrus, volcanic ash and more

Volcanic ash plume visible in red circle

05:52 UTC 22 January 2018



NOAA-20 Mayon in the Philippines (C. Seaman, CIRA)

Split Window Difference - EDR

M-15 – M-16 brightness temperature difference

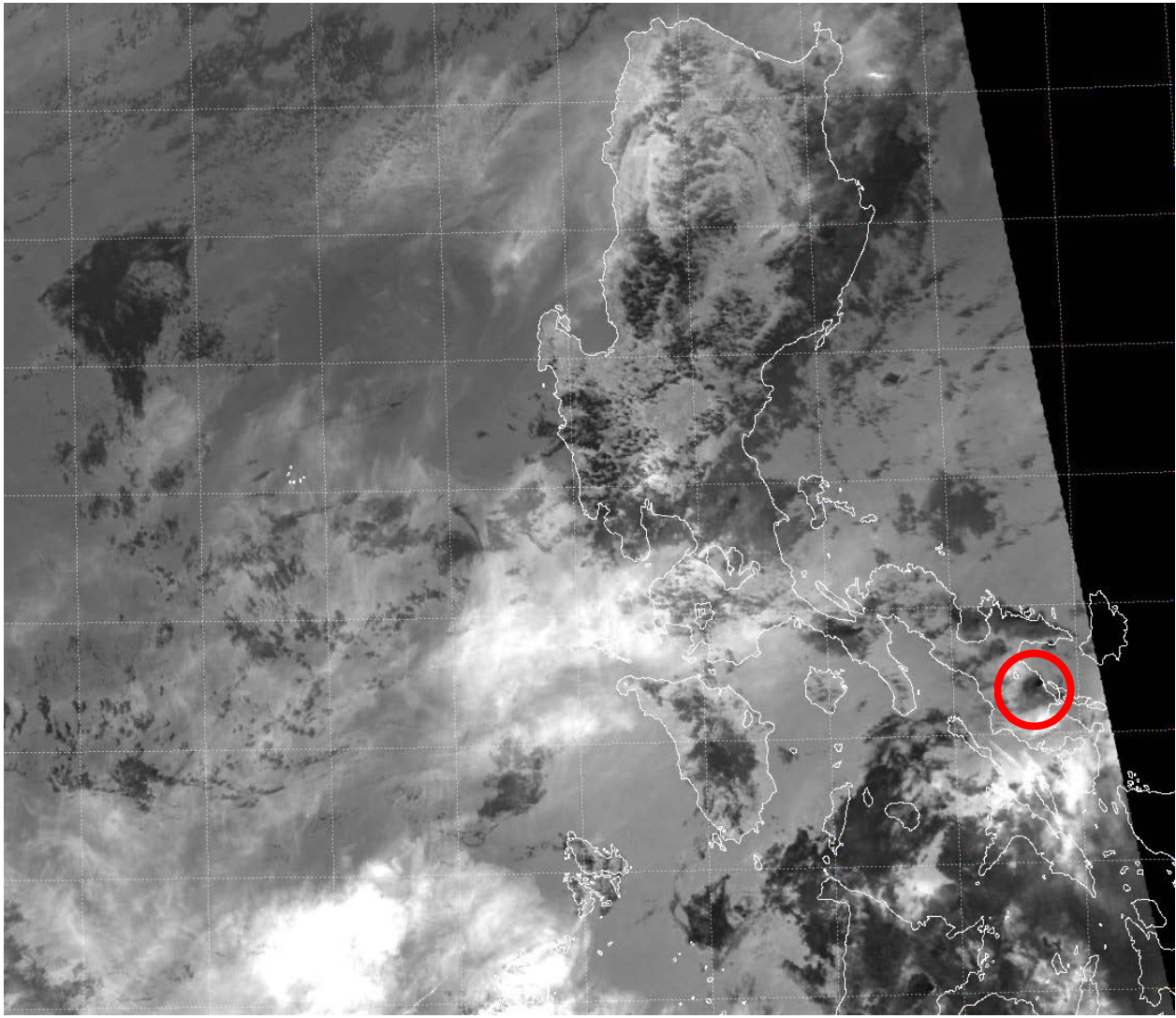
M-15 and M-16 are among the default set of EDRs

Toggle back and forth with previous image:

--Non-terrain-corrected geolocation used in EDRs causes shift in higher terrain

--EDRs reduce artifacts caused by bowtie effect near swath edge, improving sharpness of cloud features

05:52 UTC 22 January 2018



NOAA-20 Volcán de Fuego in Guatemala (C. Seaman, CIRA)

True Color

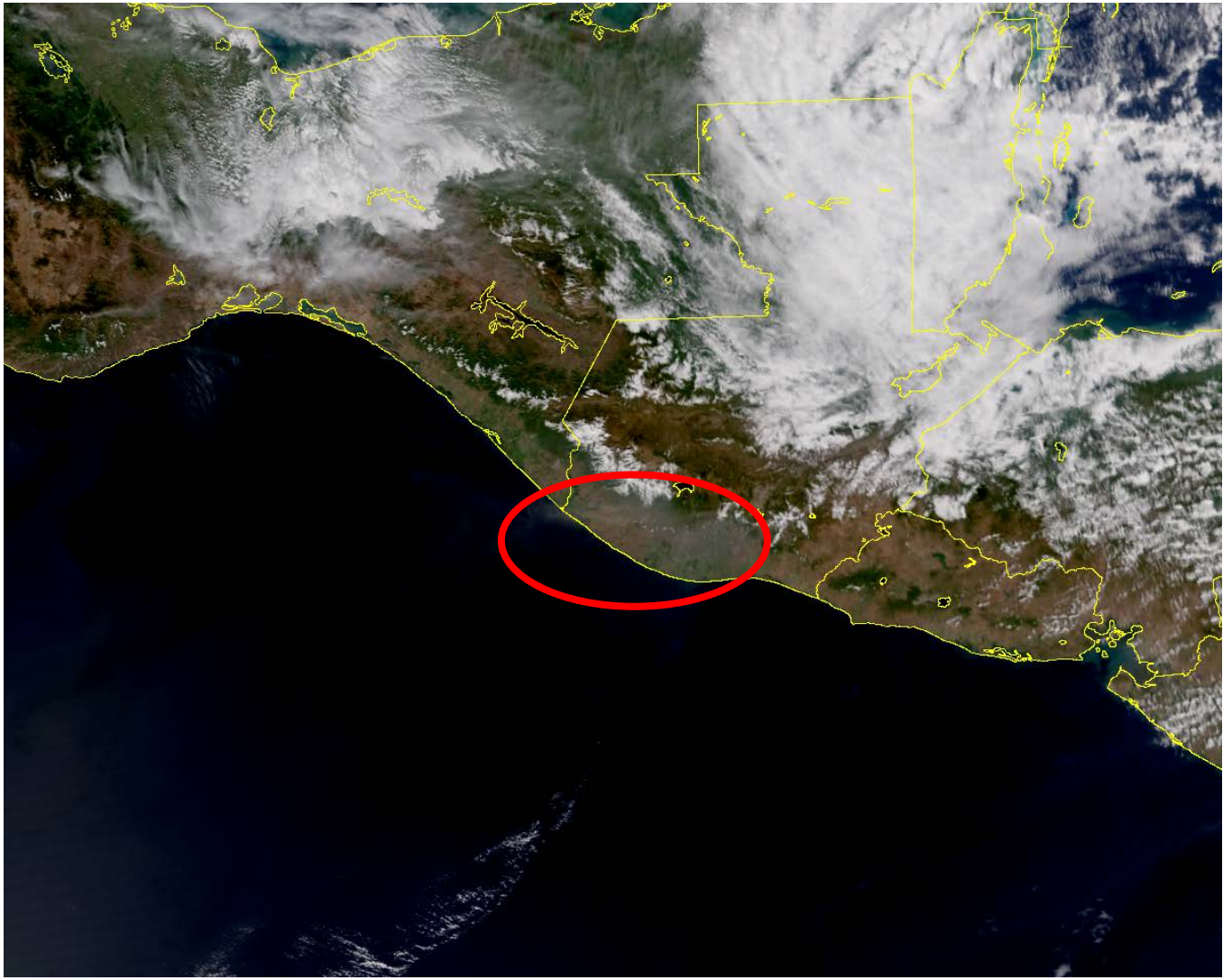
M-3, M-4, M-5

SDRs only since M-3 and M-5 are not converted to EDR

Volcanic ash plume barely visible inside red circle

Some striping noted in the sunglint region (lower left corner)

19:40 UTC 1 February 2018



NOAA-20 Volcán de Fuego in Guatemala (C. Seaman, CIRA)

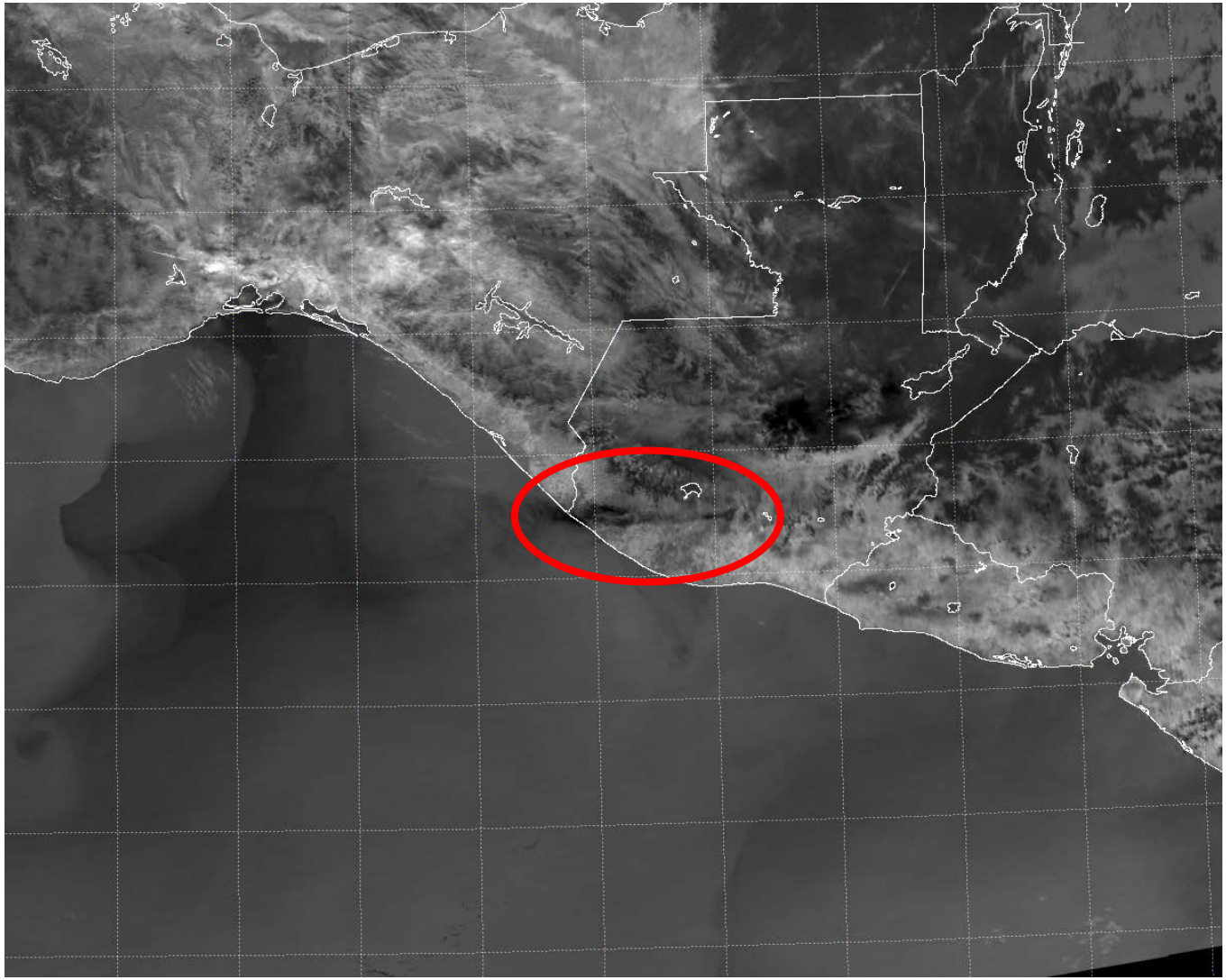
Split Window Difference - SDR

M-15 – M-16 brightness temperature difference

Volcanic ash plume visible in red circle

Some striping noted in SST-related features

19:40 UTC 1 February 2018



NOAA-20 Volcán de Fuego in Guatemala (C. Seaman, CIRA)

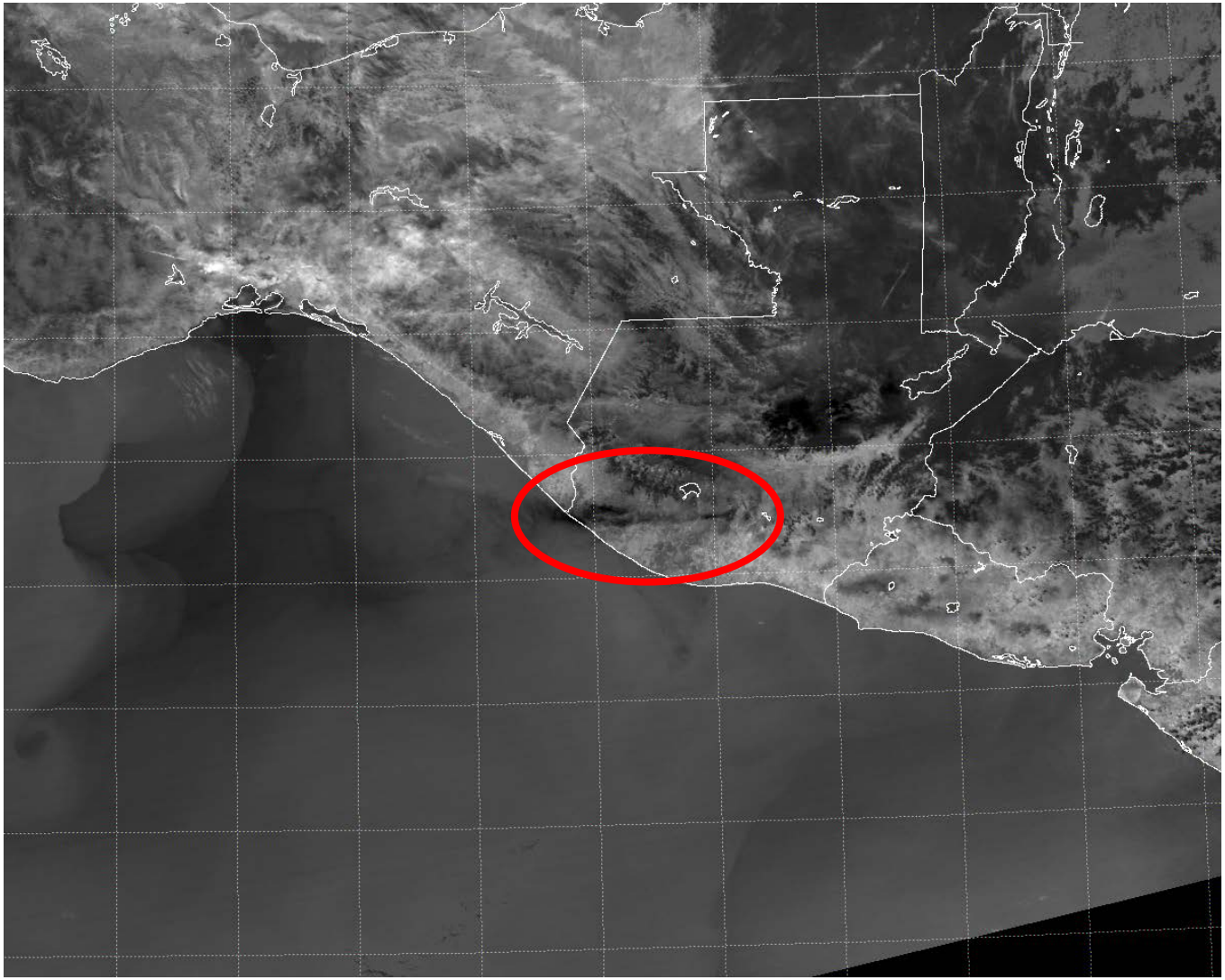
Split Window Difference - EDR

M-15 – M-16 brightness temperature difference

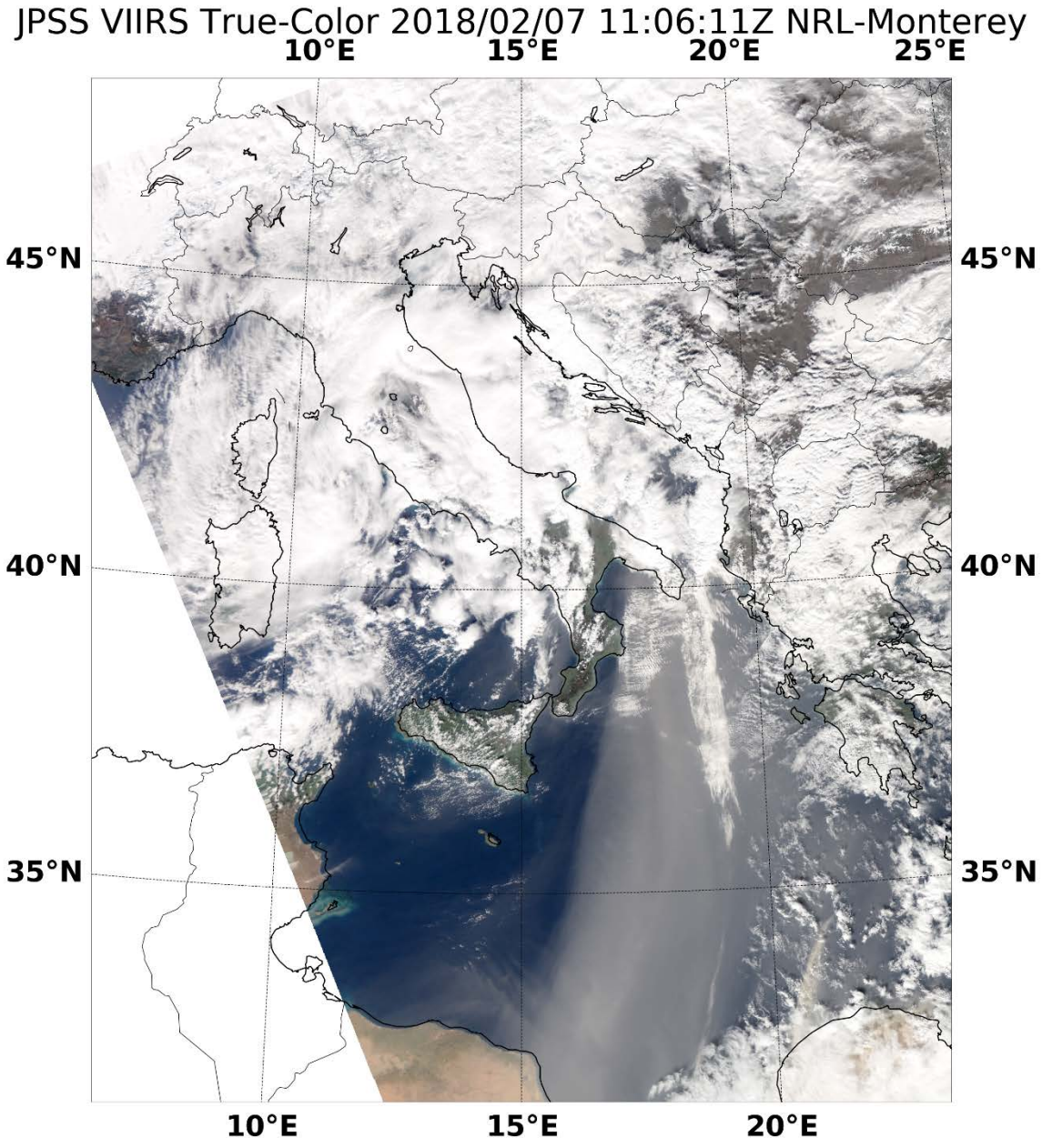
Striping in SDRs also transfers to EDRs

Otherwise, similar results to Mayon Volcano case

19:40 UTC 1 February 2018



NOAA-20 True-color: Sirocco dust into Italy and Adriatic Sea (2018-02-07) (A. Kuciauskas, NRL)



NOAA-20 Applications by Users (more to come at Validated Review)