VIIRS Imagery
Validation 1 Stage

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Imagery Basics

- Fundamentally the Imagery **EDR** is the projection of Sensor Data Records (SDRs) on a **Ground Track Mercator (GTM)** layout
- The **Near Constant Contrast (NCC) EDR** is the only Imagery product that has additional calculations involved
  - That calculation is for a "**pseudo-albedo**" that accounts for variations in solar or lunar illumination across the scan
- Imagery is <u>defined</u> by JPSS as a "two-dimensional array of numbers, in digital format, each representing the brightness of a small elemental area" (JPSS-L1RD Supplemental, Appendix C)
- The applicable **JPSS Level 1 Requirements** sections, including the Supplemental, are the requirements we are considering today
  - This is our "target"
  - Numerous quantitative requirements from <u>NPOESS</u> that influenced the development of the Imagery EDR were <u>not</u> continued into JPSS
  - The **JPSS** requirements are <u>inadequate</u> to show the Imagery is a useful product, and the consequences of this will be noted

EDR Imagery Cal/Val Team

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

Validation 1 Stage

- A product at **Validation 1** stage will, using a <u>limited</u> set of samples, be shown to meet all threshold requirements
  - Evaluation factors include impacts from: SDRs, all quality flags, and inputs from other users
- **Documentation**, to include appropriate versions of all Look-Up Tables (LUTs), must be up-to-date
  - This is true for Imagery, details to follow
- All **DRs** should be accounted for
  - All <u>open DRs</u> deal with <u>documentation</u> or potential future <u>enhancements</u>
  - There are <u>no science-related open DRs</u>
- Imagery meets <u>all</u> of these conditions, as we will show

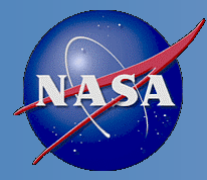# Imagery Requirements – Part 1

- The Imagery requirements are detailed in the **JPSS Level 1 Requirements Document**, section 5.0, and the **Supplemental**, section 5.3.5

- There are ***Key Performance Parameters*** tied to the Imagery EDR
  - **Six bands** (I1, I4, I5, M14, M15, M16) are required as Imagery "for latitudes greater than 60 North in the Alaskan region"
    - There is **no** explicitly written requirement that the Imagery is a global product
  - The **latency** must be 96 minutes or better
    - The Imagery Validation Team is not responsible for proving data latency

Imagery Requirements – Part 2

- Imagery is to be "delivered" under all weather conditions
  - No indication if this is tied to only Alaska or global
- Imagery contains **three horizontal spatial resolution requirements** for I-bands, and three for M-bands
  - **Nadir** is <u>0.4 km</u> (I-band) and <u>0.8 km</u> (M-band)
  - **Edge of Swath (EOS)** is <u>0.8 km</u> (I-band) and <u>1.6 km</u> (M-band)
  - **Nighttime visible** (DNB is not specifically mentioned, but assumed) is <u>2.6 km</u>, nadir only
- These requirements are met through the appropriate application of the **Ground Track Mercator (GTM)** layout
- Mapping requirements are not tied to the resolution of the bands, and are 1 km (nadir), 3 km (EOS)
  - We have deferred resolution issues to the **VIIRS SDR Team**, which has already shown this to be easily met

- The Imagery requirements represent a minimalist mentality which presents dilemmas for the Imagery Validation Team
- There are **no** requirements that relate to "quality" of any kind
  - By **quality** we mean features the imagery would be expected to identify and resolve
- There are no specific requirements tied to the creation or use of **NCC Imagery**
- The **current requirements** are a mix of heritage from the NPOESS era, what the operational system actually produces, and how the operational community actually applies imagery
- The "requirements" therefore state that properly mapped imagery over <u>Alaska</u> from <u>six specific bands</u> is all that is needed to pass the JPSS Imagery EDR requirements.
  - **However we all acknowledge the use of Imagery goes far beyond that limited case**

- The Imagery Team has therefore taken a <u>common sense approach</u> to the validation of the Imagery EDR
- The Imagery is validated **globally**
- The Imagery is validated with **all bands** produced operationally by the IDPS
  - We will also show <u>**any M-band Imagery**</u> may be produced using output produced on GRAVITE, as requested by the program
- **Examples** will be shown covering many potential applications, as an operational user would exploit them
- Imagery is a **fundamentally successful** product, that has not been fully exploited due to external forcing functions
  - Such as data latency (noted at the end of this briefing)

- **The most common question we get on the Imagery Team is "Why only 6 M-bands?"**
- The initial Imagery EDR requirements on **NPOESS** did not require M-band Imagery, only <u>I-band and NCC</u>
- The program realized circa 2005 that requirements to identify 17 cloud types and sea ice edge might not be met from the 6 Imagery products required (<u>I-band and NCC</u>)
  – Aside: these requirements did not propagate to JPSS
- After months of debate, key participants acknowledged additional Imagery products were needed to attain these requirements
  – However there was deep concern that the additional products would compromise the latency requirements
- In 2006 a **compromise solution of <u>6 M-bands</u> developed**
  – This solution has held to this day
  – It has never been reflected in any subsequent requirement documents from either NPOESS or JPSS
  – M-band Imagery is <u>not</u> archived (all others are)

VIIRS Bands Created as EDR Imagery

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

Bands highlighted in pale yellow are specifically-required Imagery EDRs.

Other Imagery EDRs are highlighted in grey.

M-band Imagery Products

- In the summer of 2013 the JPSS program requested, as part of the Validation 1 stage process, to <u>prove each of the 16 M-bands could be produced as imagery</u>
  - The request was tied to the IDPS capability that allowed a Central to choose which 6 M-bands would actually be created as Imagery
- All 16 M-band SDRs were **successfully processed** into Imagery EDRs
- The EDR software works as intended
  - **<u>Any set</u> of 6 M-band SDRs** may be converted to EDRs
  - Minimal effort required to change from the default set of 6.
- Theoretically, it would be easy to produce <u>all 16 M-bands</u> as EDRs on the operational system
  - Adding 10 extra EDRs to the operational stream would **<u>not produce a significant increase on the total operational data output (~2% increase in date volume)</u>**
  - <u>However, file names would need to be changed</u> to accommodate the additional EDRs
- Examples follow

Test #1: Bands M-1 through M-6 as EDRs.

Radiance values are shown. Error fill values are highlighted according to the color scale below.

Granule start time: 08:27:53.2 UTC 30 April 2013.

VDNE   N/A
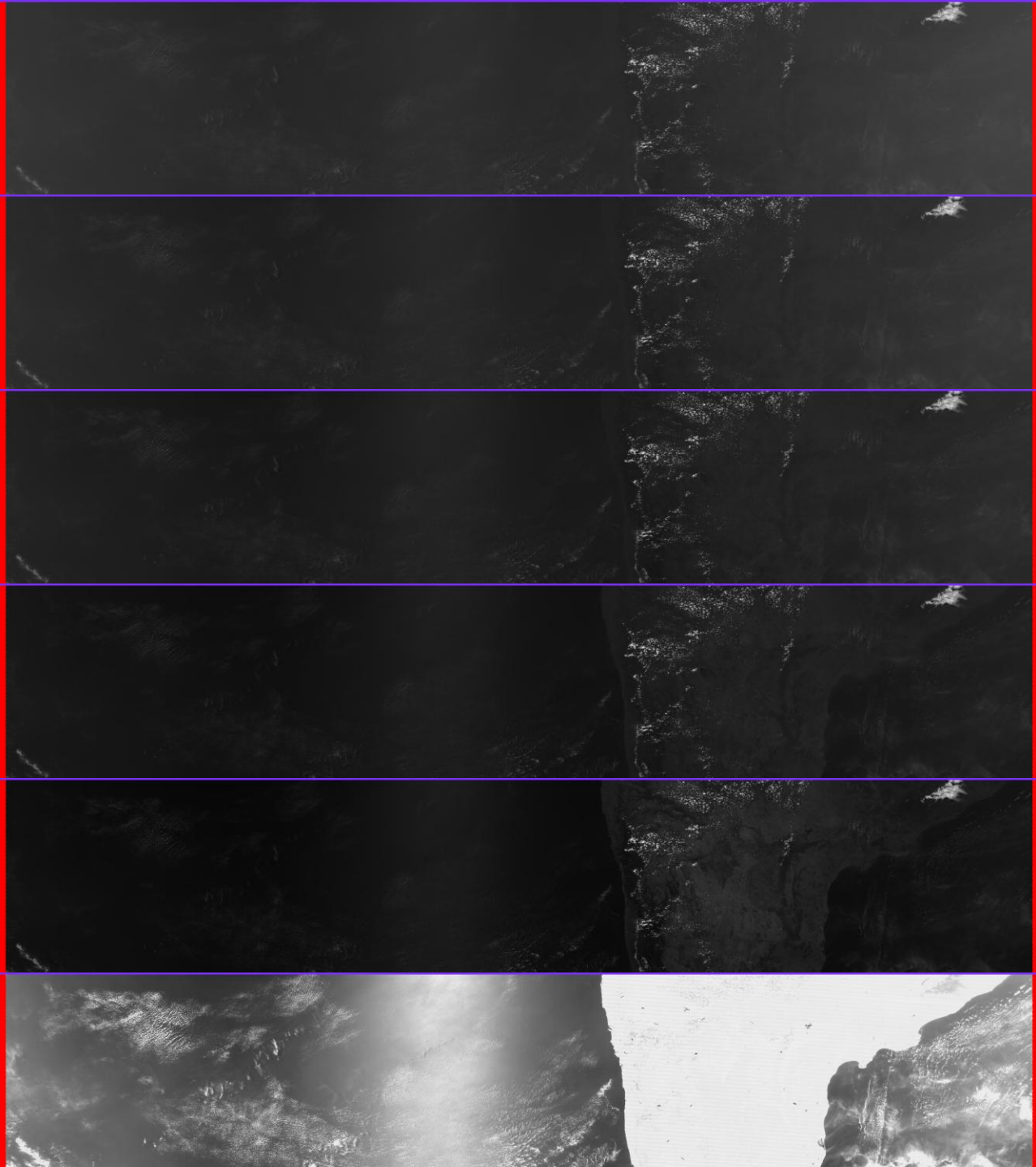
M-1 as 1st EDR

M-2 as 2nd EDR

M-3 as 3rd EDR

M-4 as 4th EDR

M-5 as 5th EDR

M-6 as 6th EDR

Test #2: Bands M-7 through M-12 as EDRs.

Radiance values are shown. Error fill values are highlighted according to the color scale below.

Granule start time: 08:27:53.2 UTC 30 April 2013.

VDNE   N/A
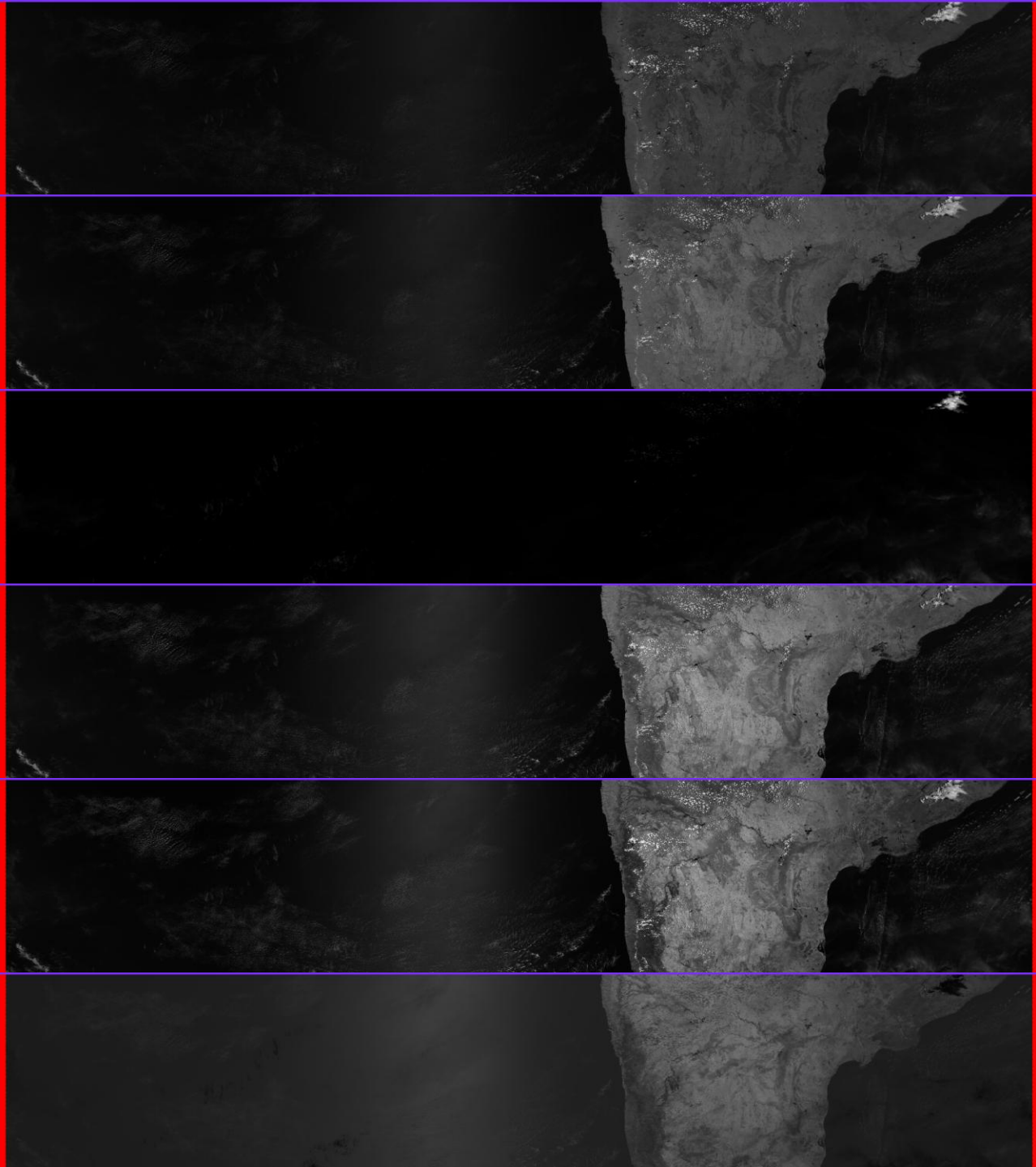
M-7 as 1st EDR

M-8 as 2nd EDR

M-9 as 3rd EDR

M-10 as 4th EDR

M-11 as 5th EDR

M-12 as 6th EDR

Test #3: Bands M-7, M-8, M-13, M-14, M-15, M-16 as EDRs.

Radiance values are shown. Error fill values are highlighted according to the color scale below.

Granule start time: 08:27:53.2 UTC 30 April 2013.

VDNE   N/A
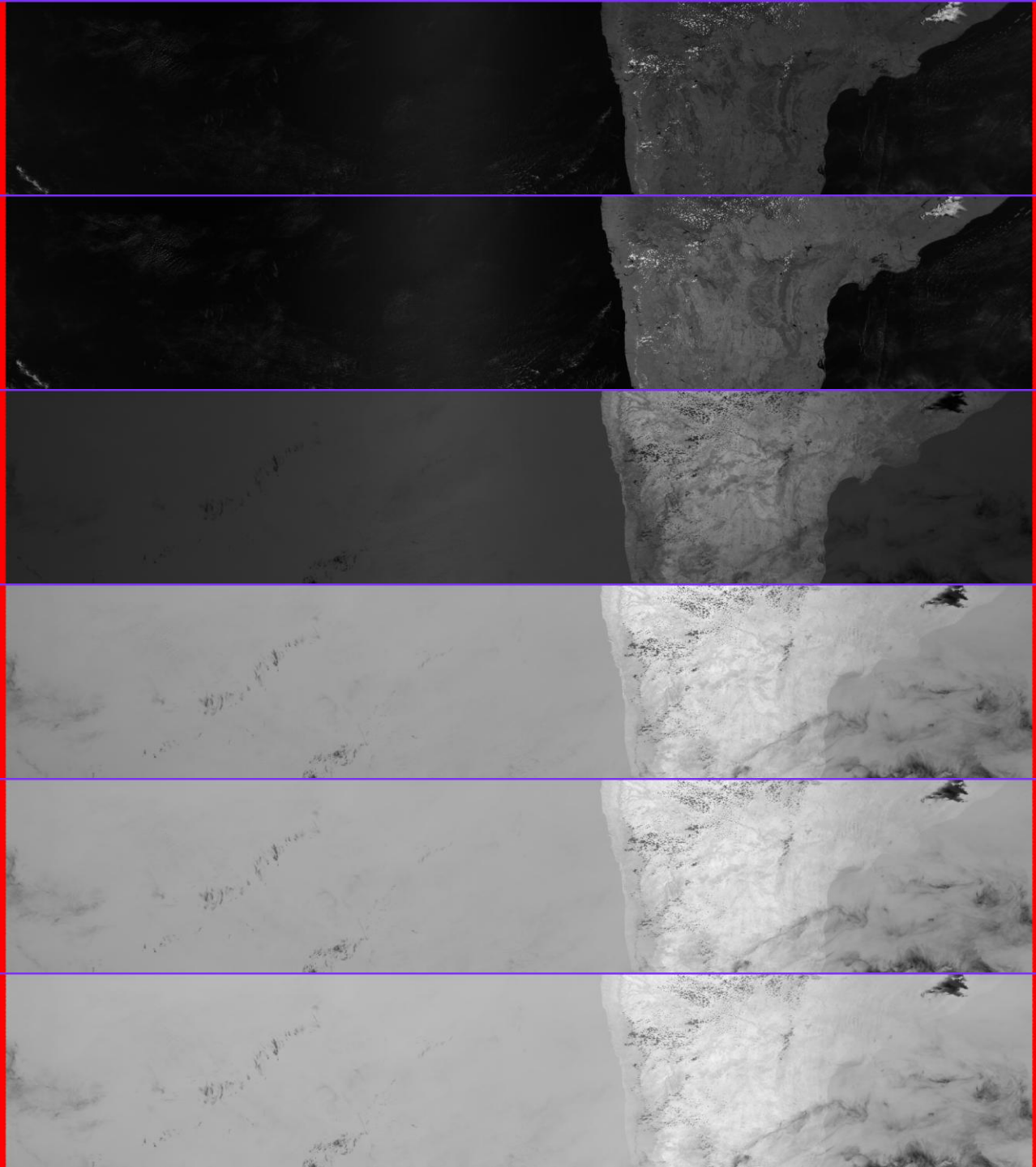
M-7 as 1st EDR

M-8 as 2nd EDR

M-13 as 3rd EDR

M-14 as 4th EDR

M-15 as 5th EDR

M-16 as 6th EDR

Pre-launch Work on Imagery

- Imagery was a **KPP (priority 1 requirement)** under NPOESS, but most work was limited to synthetic data or applications that used MODIS as a surrogate for VIIRS
  - This approach was a challenge of NCC Imagery, and significantly limited pre-launch work with that band
- Limited work was primarily done by Northrop Grumman, Aerospace, and NRL-Monterey
  - NRL-Monterey work was tied to applications being developed for their **NexSat** web site
- **The Imagery Team was expanded shortly before launch with the addition of the CIRA and McIDAS communities**

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- The usefulness of VIIRS Imagery was made evident within 24 hours of the activation of the VIIRS <u>visible/reflective</u> channels
  - See **example in the next slide**
- **Odd artifacts** were identified in a few of the Imagery EDRs that required correction
  - **Triangles** of FILL values in corners
  - **Missing geolocation values**
- **Beta** was declared for non-NCC Imagery in **Feb 2012** as these issues became fully understood
  - Note this was only one month after the activation of the emissive bands

VIIRS Visible Imagery Example

- True-color VIIRS image from Nov 2011 (first orbit after activation), off NE coast of South America
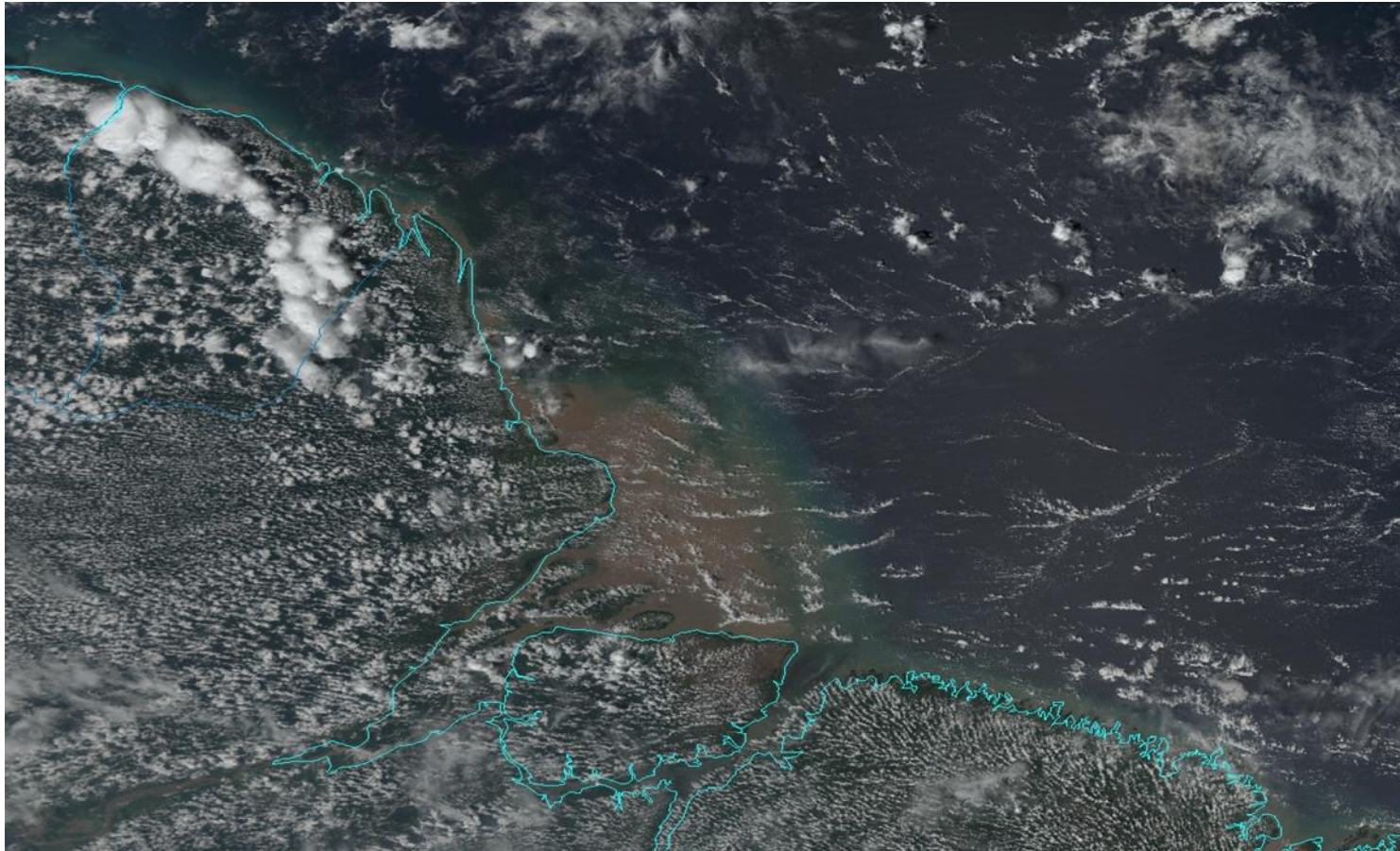
- **Provisional** for non-NCC Imagery was declared in January 2013 after all quality-related Discrepancy Reports (DRs) were resolved and closed

- **No quality-related DRs have been written** with regard to non-NCC Imagery since that date

- Work therefore has **focused on operational and unique applications** of Imagery from VIIRS

EDR	Beta (AERB)	Beta (Backdated)	Provisional (AERB)	Provisional (Backdated)
Non-NCC	2012-05-30	2012-02-07	2013-02-20	2013-01-18
NCC	2012-10-24	2012-07-18	2013-09-04	2013-08-21

- As expected from the difficulty of pre-launch testing, the **NCC Imagery** had more issues that needed resolution
  - **Nighttime** NCC imagery was initially non-fill only within 72 hours of the full moon
  - Aspects of the associated LUTs were initially <u>inadequate on the dark side of the terminator</u>
    - **Stray light** in the DNB existed in these locations
  - The NCC could not handle **negative DNB radiances**
- NCC was declared **Beta** as of 18 July 2012
- The NCC imagery had to resolve these issues, especially the fill issue at night, to attain **Provisional**

- Resolving the nighttime issues with NCC was successful after **a series of steps** taken by the Imagery Team
  - The initial **limits of the pseudo-albedo** were increased to account for very dark backgrounds
    - This included negative radiances
  - The **NCC algorithm was altered slightly** to create more appropriate results under low lunar illumination conditions
  - The appropriate **LUTs were updated**
  - The VIIRS SDR Team corrected for **stray light** in the DNB
    - Closing of this DR lies with the VIIRS SDR Team
- Once all of these were implemented (August 2013) the NCC Imagery was declared **Provisional**
- **All DRs** associated with the creation of NCC Imagery are **now closed**

NCC Imagery Advantages

- The following slides show **examples** of VIIRS NCC Imagery:
  - 1. Cross-terminator advantage of NCC Imagery EDR pseudo-albedos
  - 2. NCC Imagery at night with no lunar illumination (due to airglow illumination)
- NCC imagery is the **single most useful band of VIIRS Imagery,** with a huge advantage over heritage imagery from either MODIS or AVHRR!
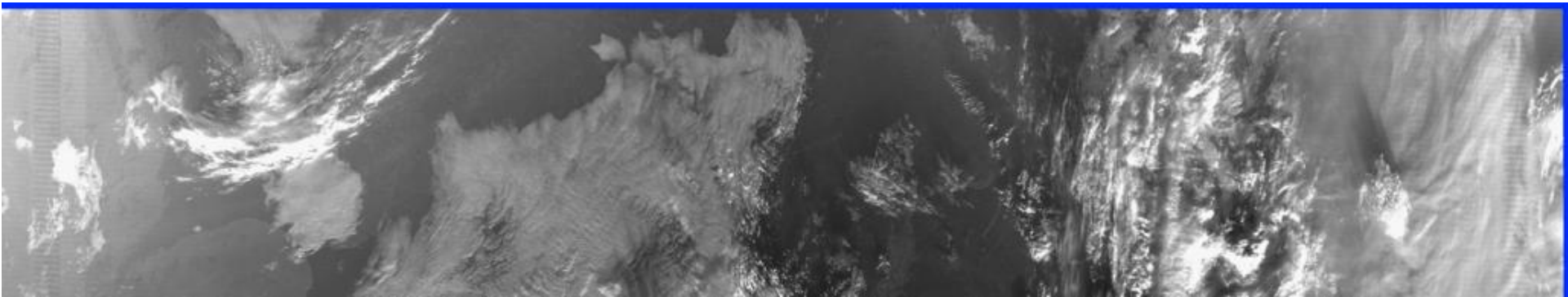
The top image shows a DNB (SDR) granule that crosses the day/night terminator. The lower image shows the associated NCC (EDR) granule (with edge fill values highlighted in blue). The normally-observed horizontal stripes in the DNB SDR (from the bow tie deletion process) have been filled (in the top image) to avoid being a distraction. The removal of these stripes is actually part of the GTM algorithm. The NCC process reduces the contrast from solar and lunar illumination gradients across the granule (which spans over 7 orders of magnitude between day and night) by converting it to a quantity with reduced dynamic range (i.e. pseudo-albedo). The result is images with nearly constant contrast across the entire scene. By this process, nighttime images of clouds should, in principle, appear very similar to solar reflectance-based daytime imagery

The NCC Imagery EDR is produced under all solar and lunar illumination conditions, including cases where there is no illumination from either the sun or moon (i.e. new moon phase). The DNB is sensitive enough that air glow is sufficient to create an image, although such an image appears quite noisy. Here is an example of NCC Imagery at night when the moon was below the horizon. The example is Super Typhoon Phielin taken on the night of 10 October 2013. The typhoon, along with convective elements and its eye, are evident despite the extremely low levels of radiance present in the DNB spectrum. This is, in essence, the "worst case" scenario for NCC Imagery. As lunar illumination increases, the SNR improves and the noisiness in the DNB SDR decreases, with subsequent benefits to the NCC Imagery EDR.

Major Imagery Issues resolved

- Imagery issues by example:
  - 1. (Non-NCC) Imagery I-band EDR from 25 January 2012 with an **all-fill triangular area** in the upper right – resolved in mid-year 2012

  - 2. **Stray light** in DNB: NCC Imagery before versus NCC after removal (bottom) – resolved in mid-year 2013
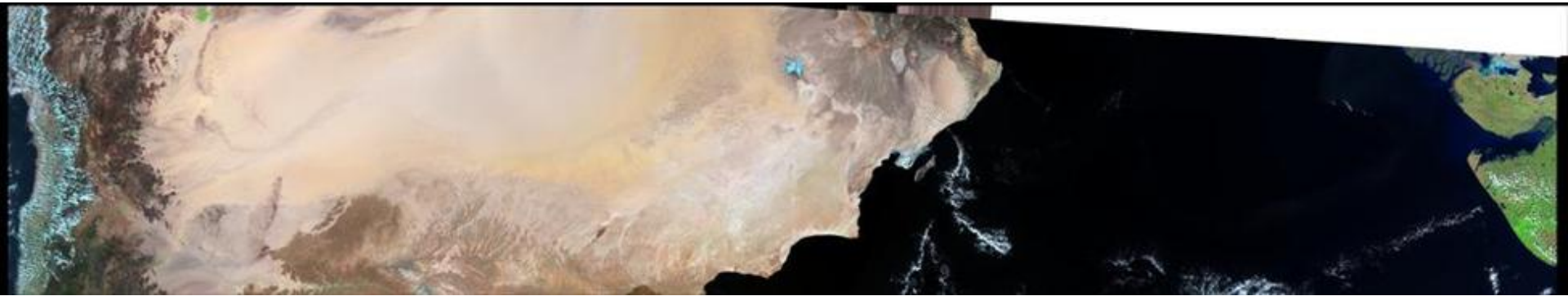
The only issues noted shortly after launch with the GTM process was fill values in the Imagery product tied to cross granule processing. The structure of the GTM grid was such that, near the edge of the granule, SDRs from pixels in the adjacent granule were required. If they were not available, an odd shaped triangle of fill would occur as shown in this figure. This granule was taken in the vicinity of New Zealand on 25 January 2012. The root cause of the fill data was determined not to be in the GTM processing but with so-called repair granules, a larger concern the program successfully addressed in mid-2012. The triangles no longer appear in the Imagery EDR output.

Artifacts in the DNB SDR are inherited by the NCC Imagery EDR. Before August 2013 the most significant of these was a stray light issue with the DNB on the dark side of the terminator. The DNB SDR algorithm was adjusted to correct for this error in August 2013. The impact on the NCC Imagery EDR was profound. The removal of the stray light is evident in the bottom image, taken from the granule over the upper Midwest of the United States on 9 August 2013. As a reference, Lake Michigan may be seen in the middle of the granule

Benefits of M-band Imagery

- The following slides show cases where **near-real-time imagery applications make a difference**:
    - 1. Subtropical Storm Melissa, 18-20 Nov 2013
    - 2. Tropical Storm Flossie, 28-29 July 2013
    - 3. Super Typhoon Haiyan (Yolanda), 7 Nov 2013
    - 4. Fire Detection, 11 June 2013
    - 5. Severe Weather in Argentina, 5 Dec 2013

- In each case the analysis of the VIIRS Imagery in **near-real-time (2 hours or less)** would have benefits to operational weather interests

1ˢᵗ Example: Subtropical Storm Melissa, 18-20 Nov 2013

- Chris Landsea, the Science and Operations Officer at the National Hurricane Center, sent email on 18 Nov asking why there is no access to the day-night band for storms in the central Atlantic.

- Landsea said that having the Day Night Band "in operations in a more timely fashion would be of considerable interest and assistance. For the nearly full moon conditions, having night-time visible imagery can help better determine the position of the tropical cyclone and, at times, also be relevant for the Dvorak intensity estimates."

VIIRS 2013-11-19 05:36:55 GMT.... - Image Display

VIIRS Day-Night Band of Subtropical Storm Melissa from 19 Nov 2013 at 0536 UTC

2nd Example: Tropical Storm Flossie, 28-29 July 2013

Central Pacific Hurricane Center discussion from 29 July 2013 at 0500 UTC:

THE CENTER OF FLOSSIE WAS HIDDEN BY HIGH CLOUDS MOST OF THE NIGHT BEFORE VIIRS NIGHTTIME VISUAL SATELLITE IMAGERY REVEALED AN EXPOSED LOW LEVEL CIRCULATION CENTER FARTHER NORTH THAN EXPECTED. WE RE-BESTED THE 0600 UTC POSITION BASED ON THE VISIBLE DATA.

http://www.prh.noaa.gov/cphc/tcpages/archive/2013/TCDCP1.EP062013.019.1307291511
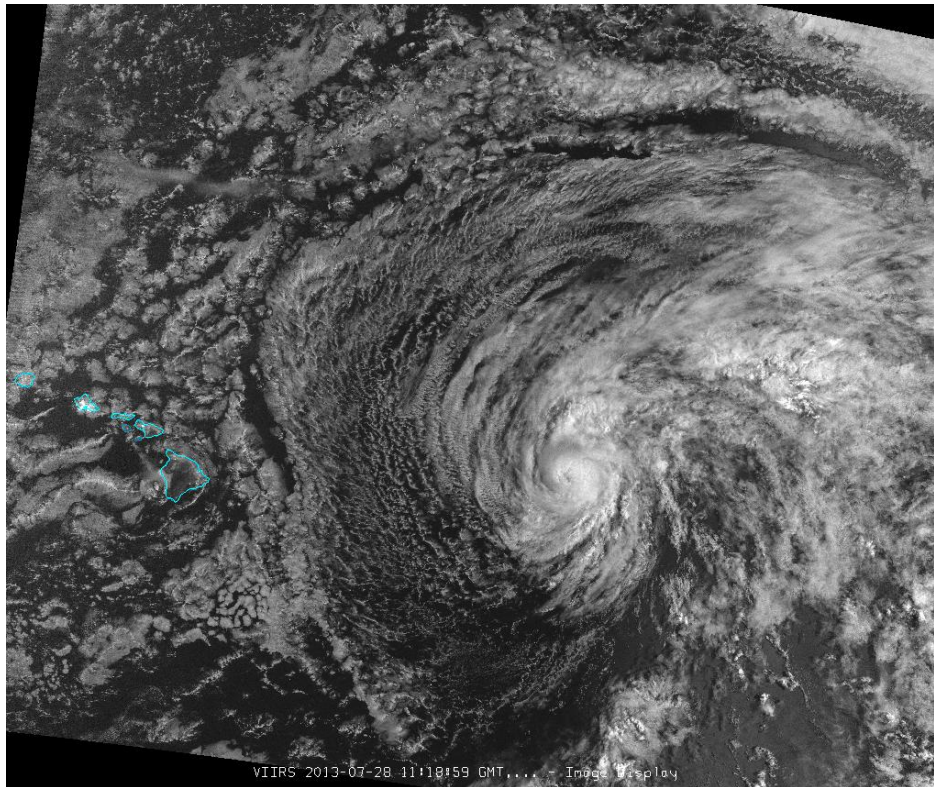
Day-Night Band, 28 July
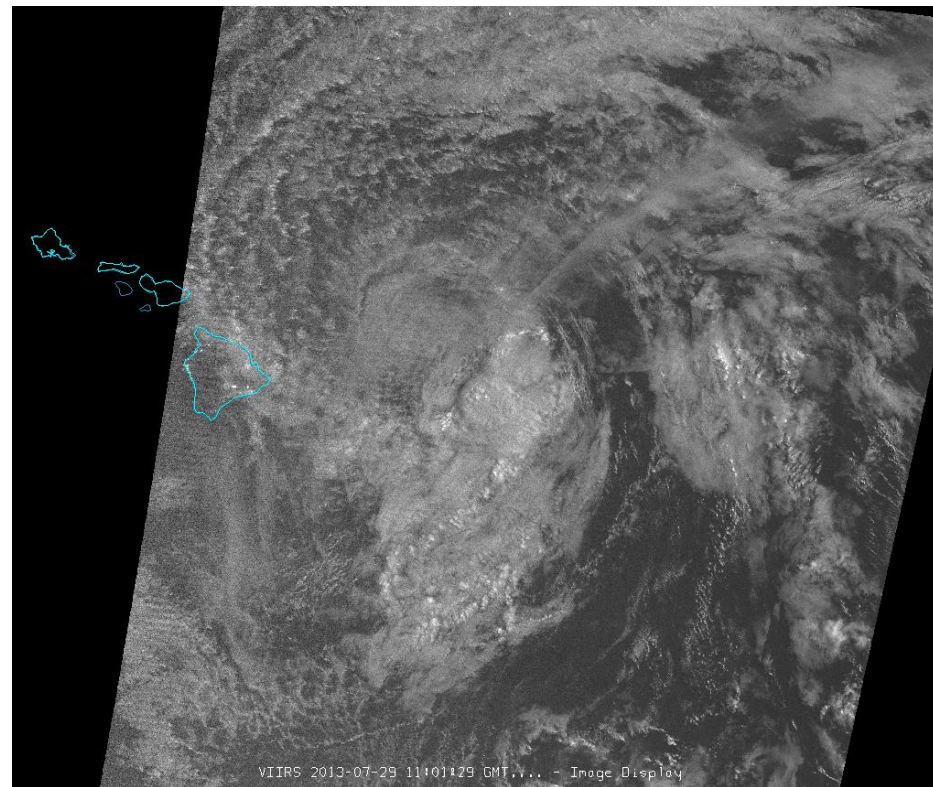
Day-Night Band, 29 July

3rd Example: Super Typhoon Haiyan (Yolanda), 7 Nov 2013

- Super Typhoon Haiyan (Yolanda) approached the Philippines on 7 Nov 2013, and VIIRS passed over at 1616 UTC, about 3 hours prior to landfall.
- The data required to generate the image below was obtained around 00 UTC on 8 Nov, a few hours after the storm had already made landfall.
- Had the Joint Typhoon Warning Center and other forecasters had access to this imagery in near real time, it may have provided for a better intensity analysis.
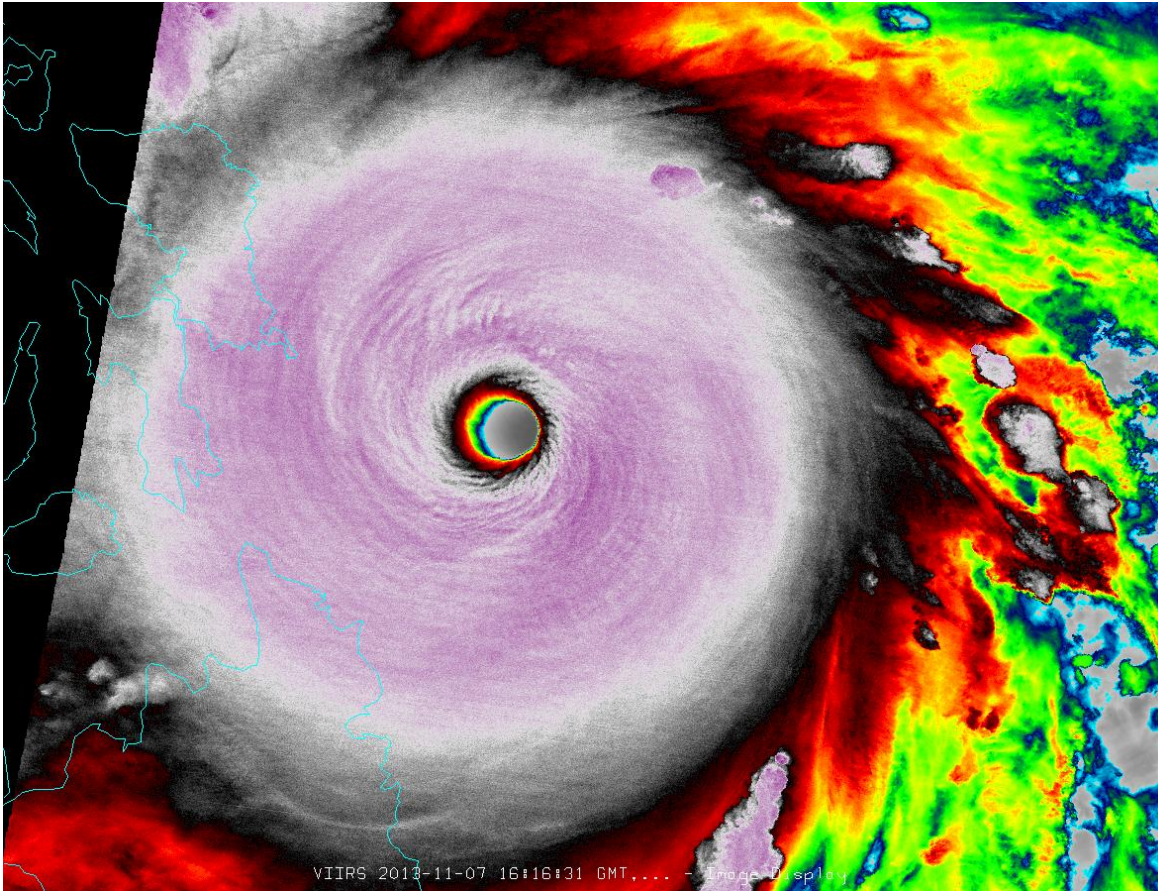
VIIRS I-band 5 IR image of Super Typhoon Haiyan (Yolanda) from 7 Nov 2013 at 1616 UTC

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4th Example: Fire Detection, 11 June 2013

- 12 wildfires were observed in VIIRS imagery over the southwestern US at 20:36 UTC. In GOES imagery from 20:30 UTC, only 7 of those fires could be discerned. (*details on next slide*)
- VIIRS has multiple channels sensitive to wildfire detection. The image below is an example of the "Fire Temperature" RGB composite currently in development at CIRA. GOES currently has only one channel useful in detecting fires.
- Operational fire monitoring activities (like the US Forest Service and NWS) would benefit from value-added VIIRS products. In order to demonstrate the utility of these products, developers at CIRA need access to near-real time VIIRS data.

VIIRS Fire Temperature RGB composite image from 20:36 UTC 11 June 2013
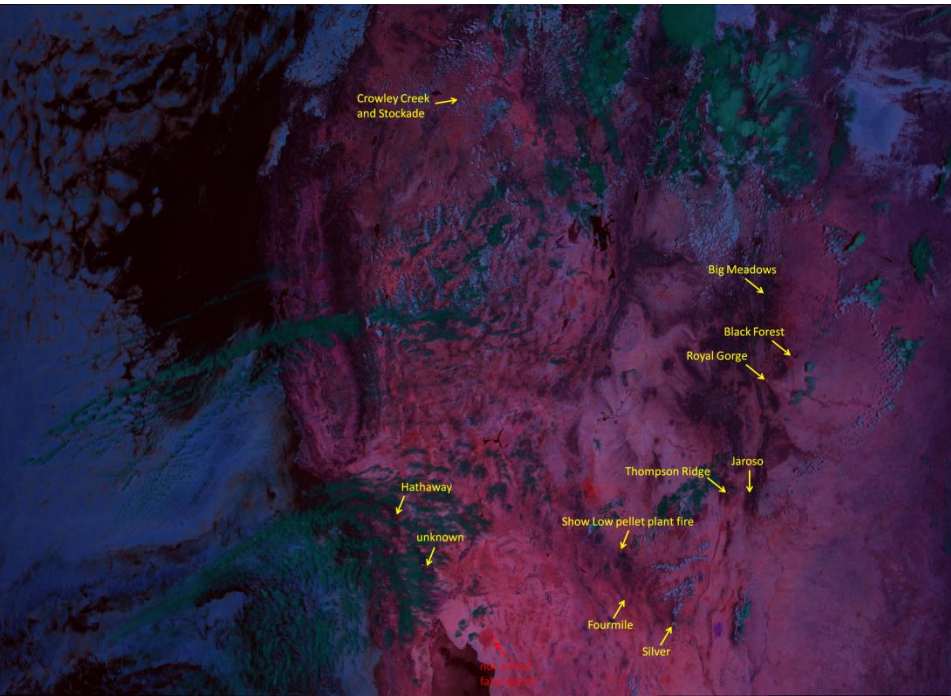
GOES Channel 3 image from 20:30 UTC 11 June 2013
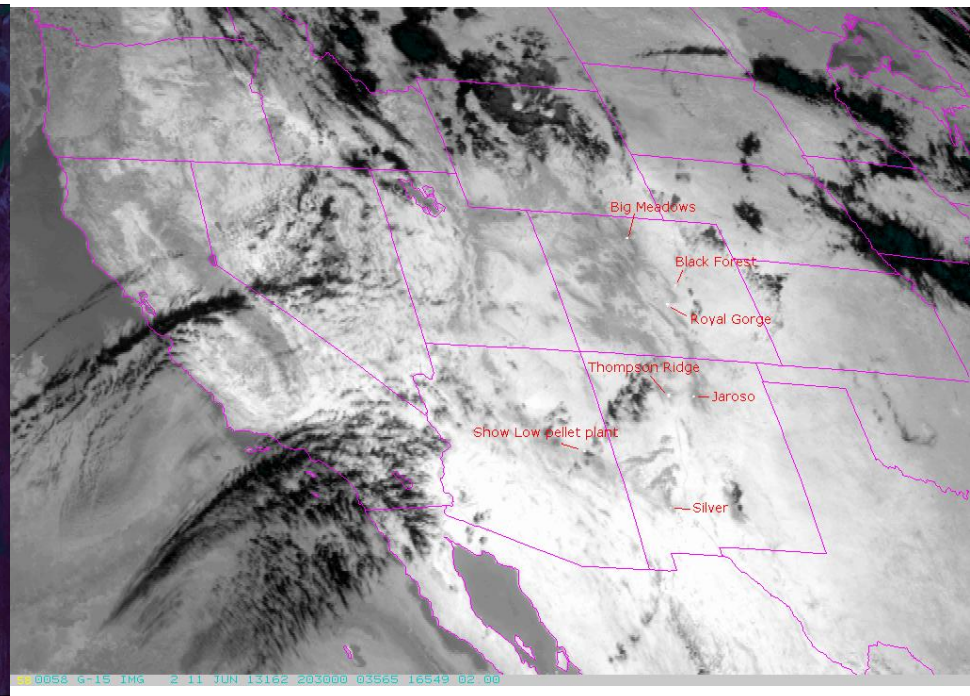
These images are zoomed in on several fires that were detected by both VIIRS and GOES identified on the previous slide. Bars in the lower right corner of each image identify the scale.

The resolution of VIIRS combines with the additional spectral information provided in the RGB composite to offer more information than GOES provides.

The RGB composite is sensitive to changes in the temperature of fires and more accurately identifies active fire lines.

5th Example: Severe Weather in Argentina – 5 Dec 2013

- VIIRS provides a significant improvement in resolution for infrared bands (375 m) compared to GOES (4 km at subpoint)
- This results is a clearer picture of storm-top features, such as overshooting tops and enhanced –V's
- The example below from northern Argentina shows a comparison of a thunderstorm from VIIRS vs. GOES. The minimum brightness temperature from VIIRS was -99°C, and from GOES -82°C
- When GOES-13 is in rapid scan, South America only gets 1 scan every 3 hours, so polar imagery is very useful for filling in time gaps and radar gaps (spatially)
- With real-time VIIRS data, imagery can be provided to forecasters in South America

VIIRS 375-m I-Band 5 - 1640 UTC
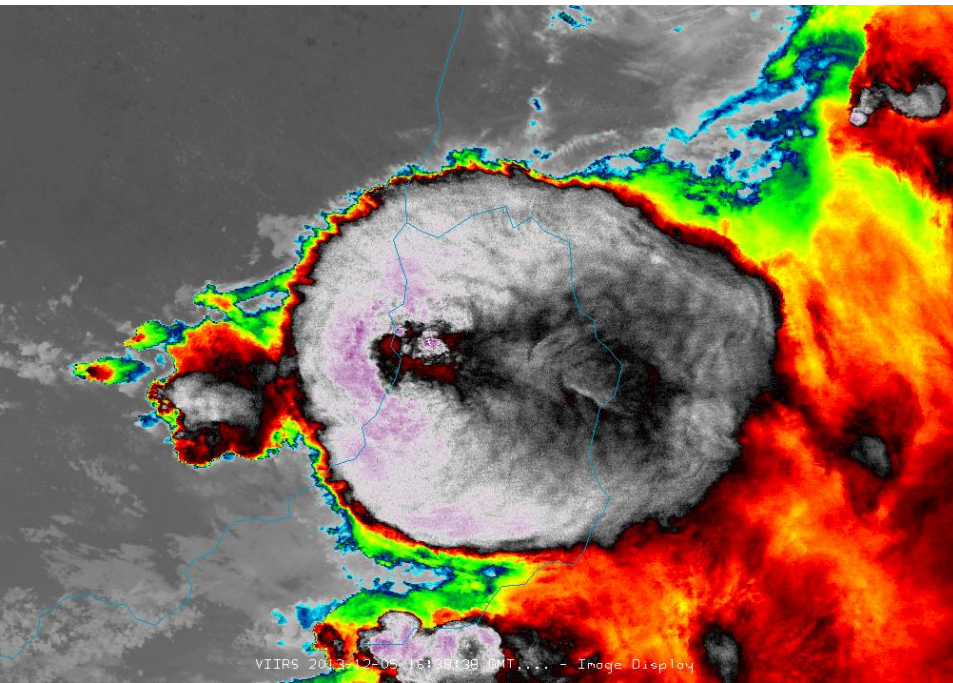
GOES 4-km Band 4 – 1639 UTC
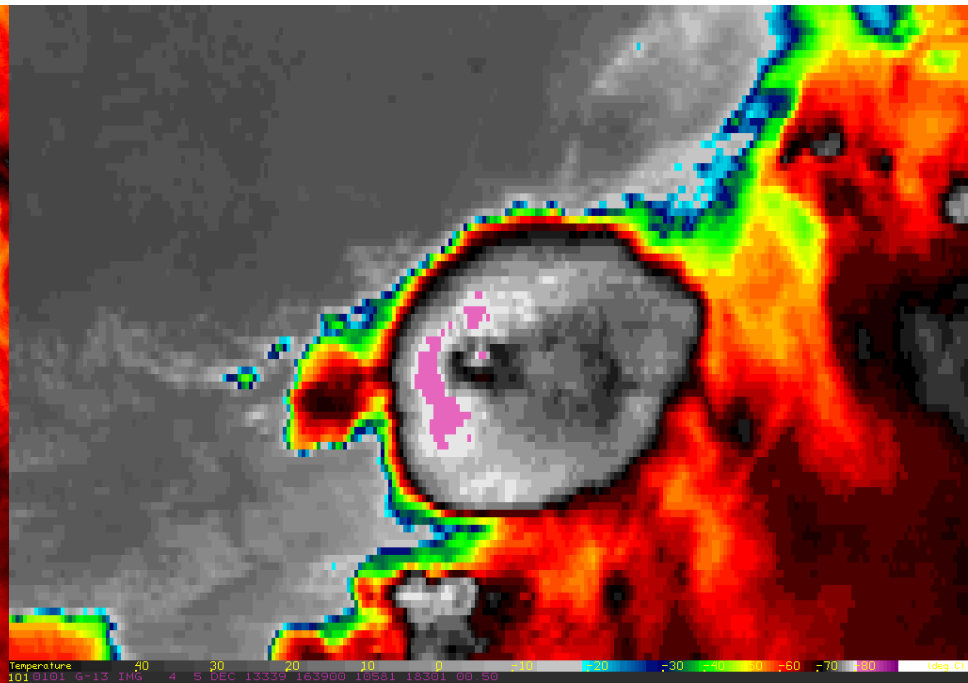
Additional Examples: Selected "Operational Relevance" Value-Added Applications of Multi-Spectral VIIRS Imagery
(The following slides address each point, courtesy S. Miller, CIRA)

- **Snow fields:** Alter the radiative cooling and moisture flux of the surface and can become focal points for nocturnal fog formation under clear sky conditions, which presents a significant transportation hazard.

- **Blowing dust**: Users can issue/revise visibility hazard warnings based on knowledge of incoming significant blowing dust.   These storms have been responsible for significant (fatality) multi-car accidents in recent years.

- **Dust storms:** Occur worldwide and can change dramatically over timescales < 1 h. Timely information is critical for making use of dust information in decision aids.

- **Sea ice**: All maritime commerce & transportation related activities, including crab fishing industry. Cloud cover is ubiquitous in the high latitude winter, and these clouds obscure views of the surface.

- **Tropical Cyclone tracking**: Avoiding the 'sunrise surprise' of a misplaced low-level center of circulation. In the case of Flossie, an adjustment was made based on the DNB information.

- **Nocturnal fire lines and biomass smoke**: Ability to observe active fires at night and the low-level wind direction via smoke plumes (realizing that large fires influence the local environmental flow) can help firefighters get an upper-hand on a blaze during the nighttime hours when it would generally be easier to fight due to lower temperatures, higher humidity, and lighter winds.

- **Power outages**: Assist emergency managers identify broad scale impacts of a disaster.   Depending on timing of the event, this information may provide a more complete picture of impacts than what can be put together from various surface-based reports.

The following examples are the types of VIIRS image products that are of potential use to NWS and other users.

Snow/Cloud Discrimination

26 November 2013 1944 UTC
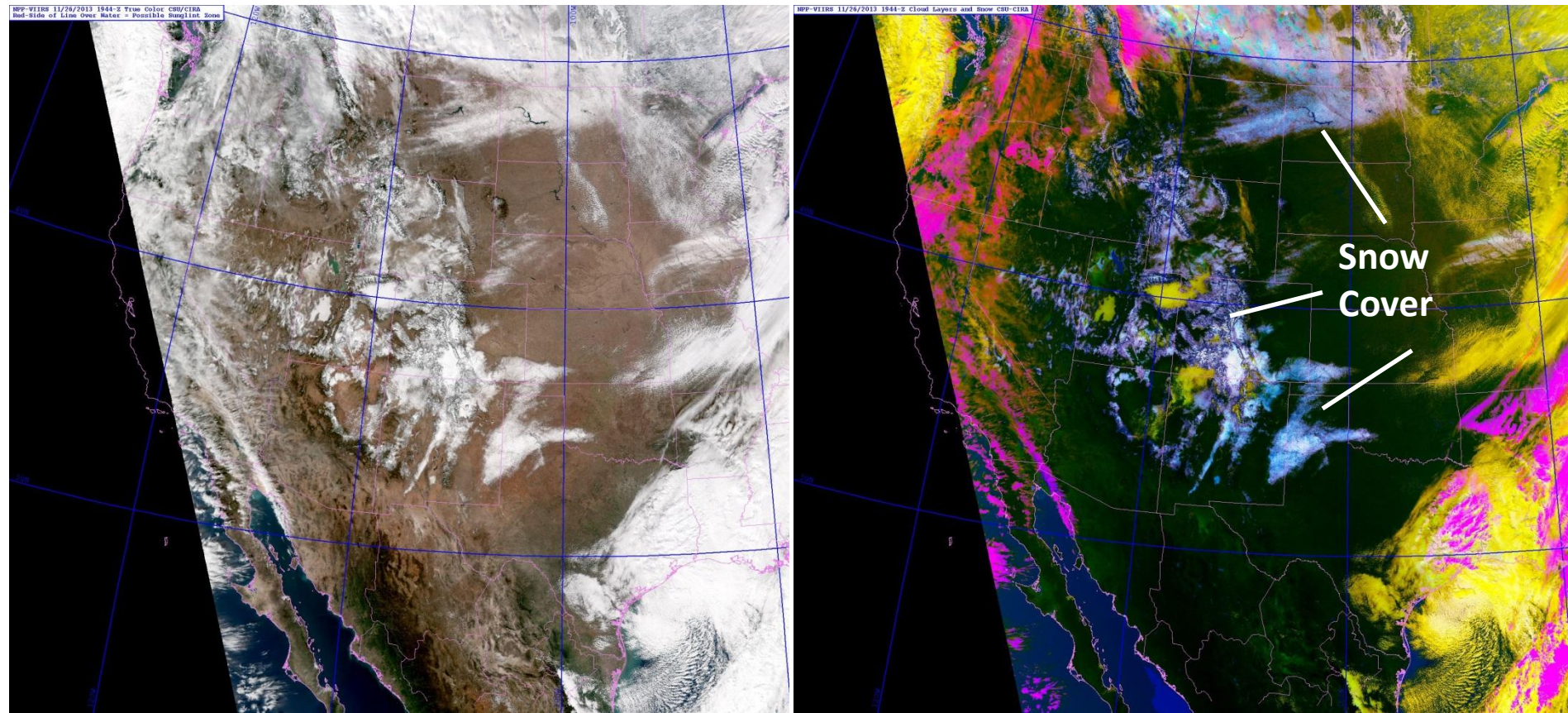
Despite the lack of a 6.7 µm water vapor band, the cloud/snow enhancement of Miller et al (JAM-C; 2005) has been adapted to work with VIIRS bands and shows comparable performance to MODIS versions of the algorithm.

Snow/Cloud Discrimination (Regional)

6 November 2013 1919 UTC
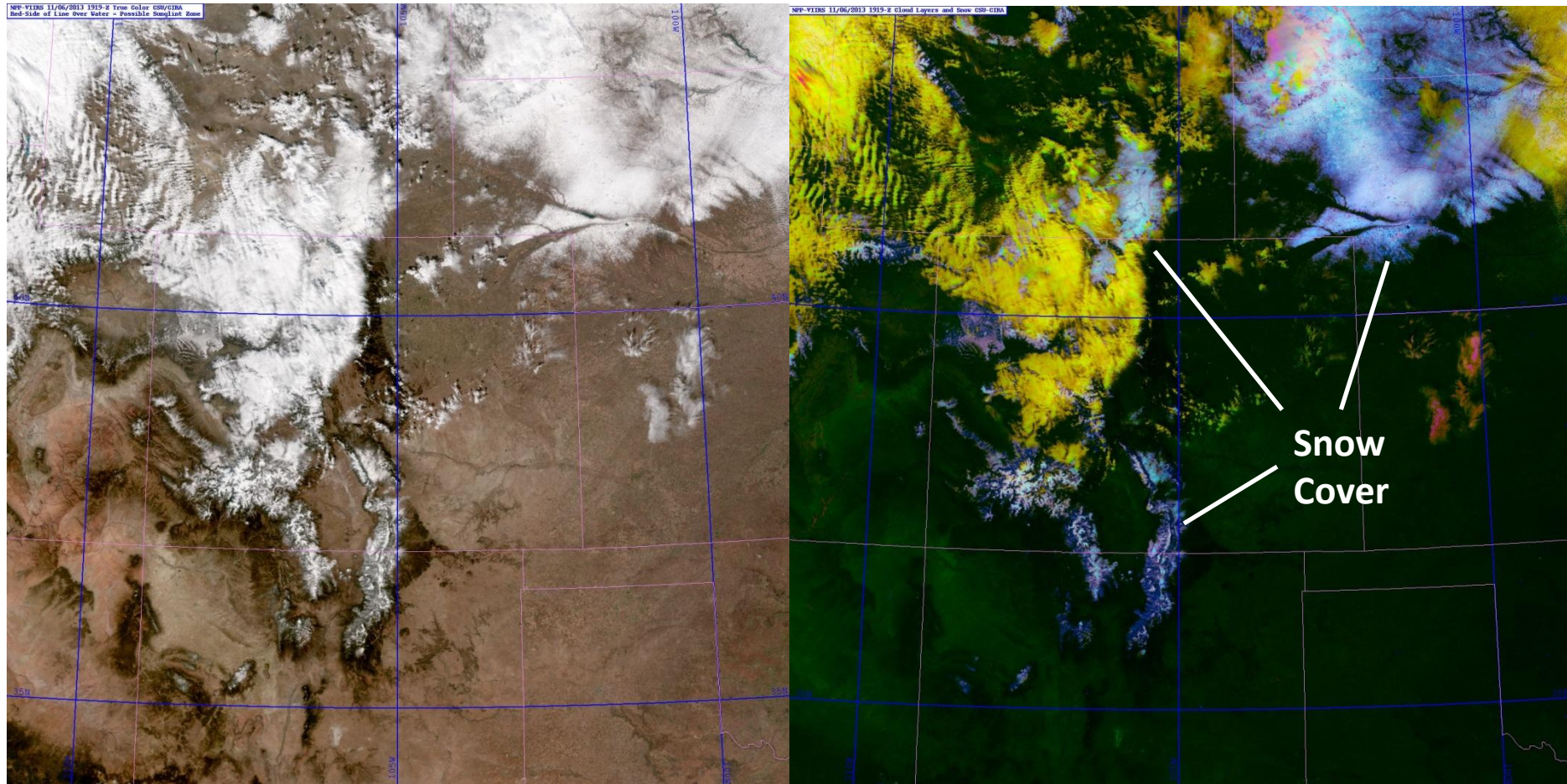
Translation of the MODIS cloud/snow enhancement of Miller et al (JAM-C; 2005) has to VIIRS bands has enabled visually intuitive identification of snow fields present within complex cloudy scenes.

Multi-Spectral Dust Storm Detection

18 October 2012 1914 UTC
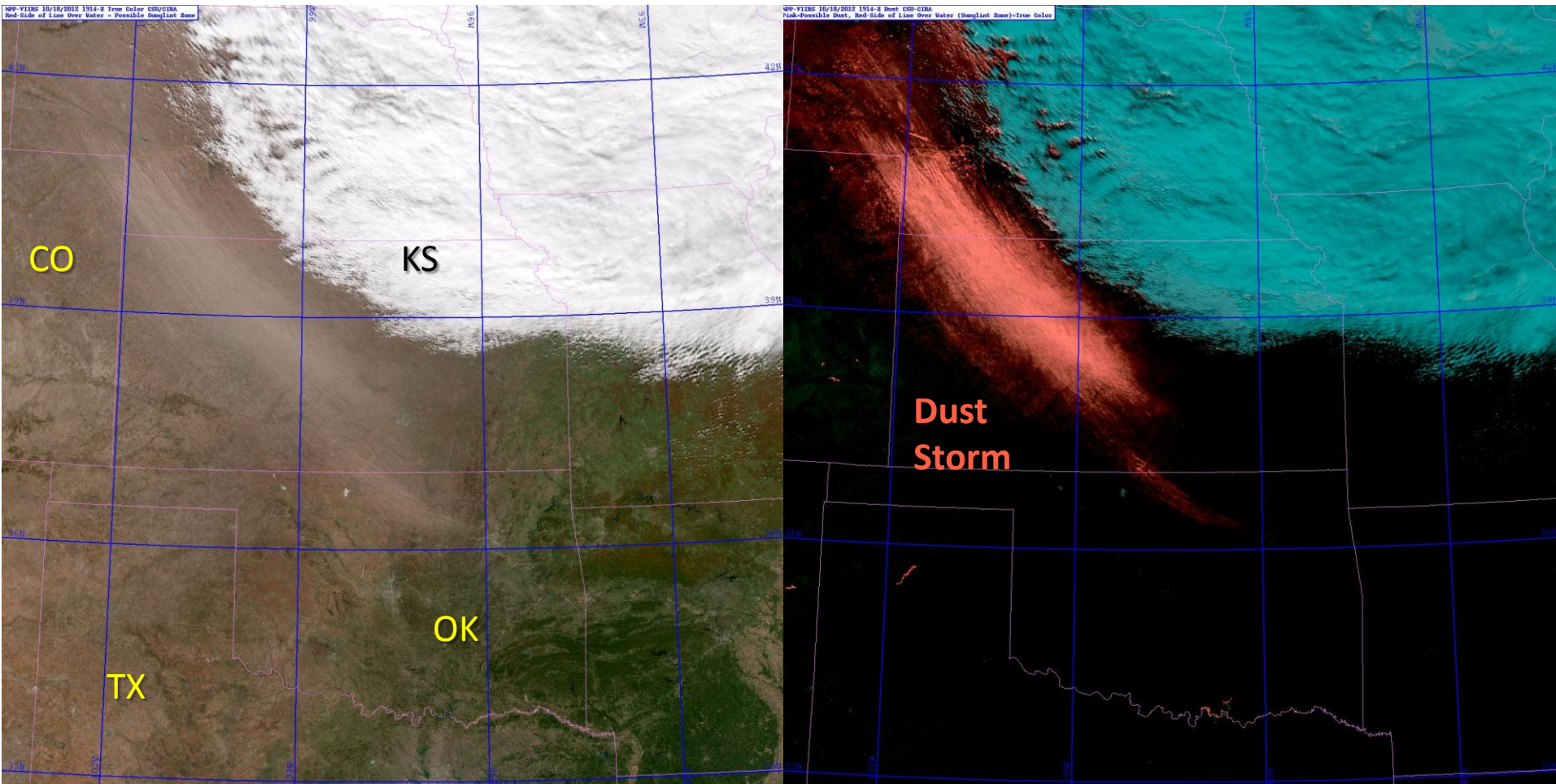
VIIRS provides a the required spectral suite of bands required to reproduce the MODIS 'blue light absorption' mineral dust enhancement algorithm of Miller(GRL; 2003).

Multi-Spectral Dust Storm Detection

2 October 2013 0957 UTC
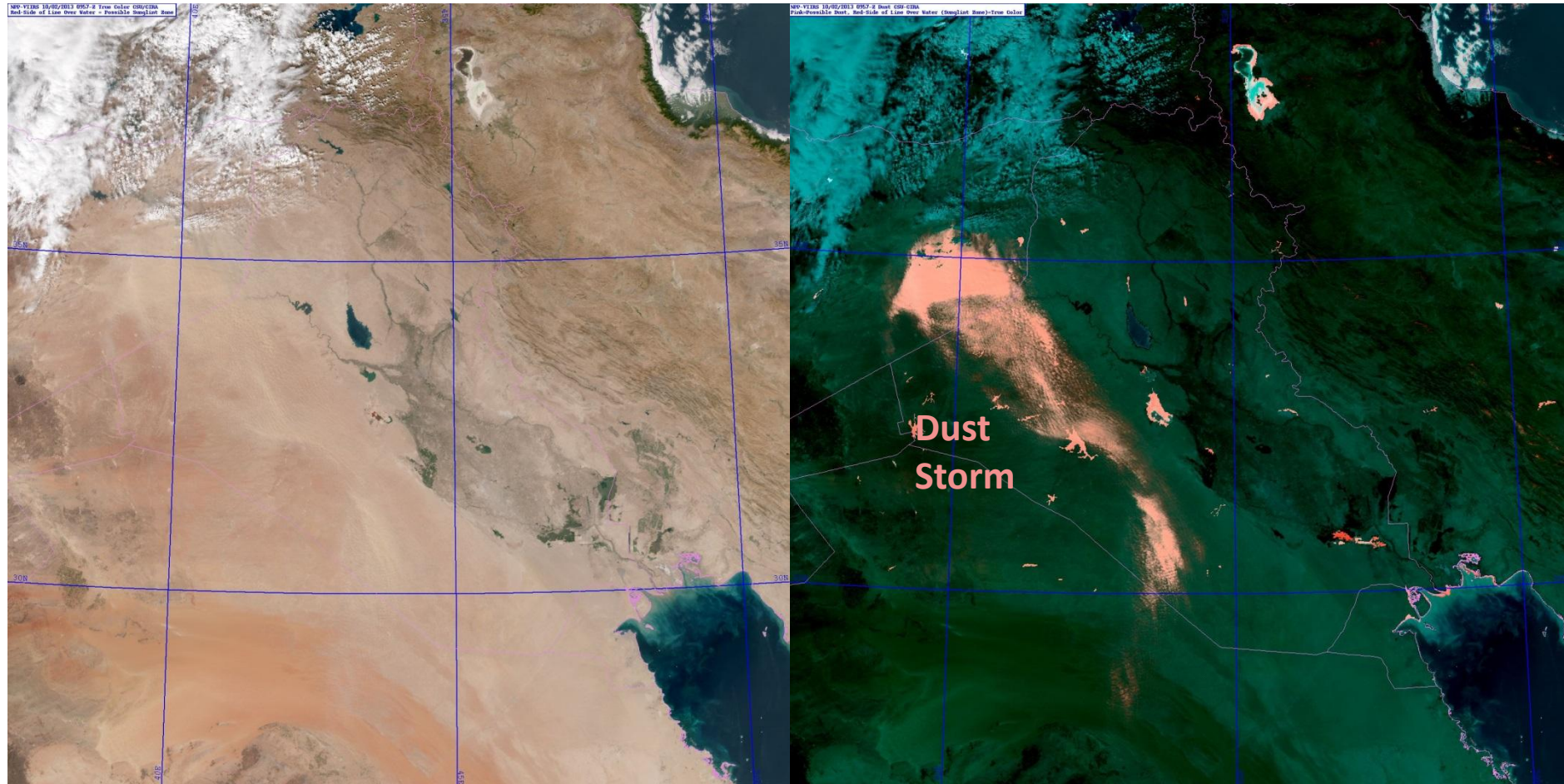
VIIRS provides a the required spectral suite of bands required to reproduce the MODIS 'blue light absorption' mineral dust enhancement algorithm of Miller(GRL; 2003).

Sea Ice

28 November 2012 1505 UTC
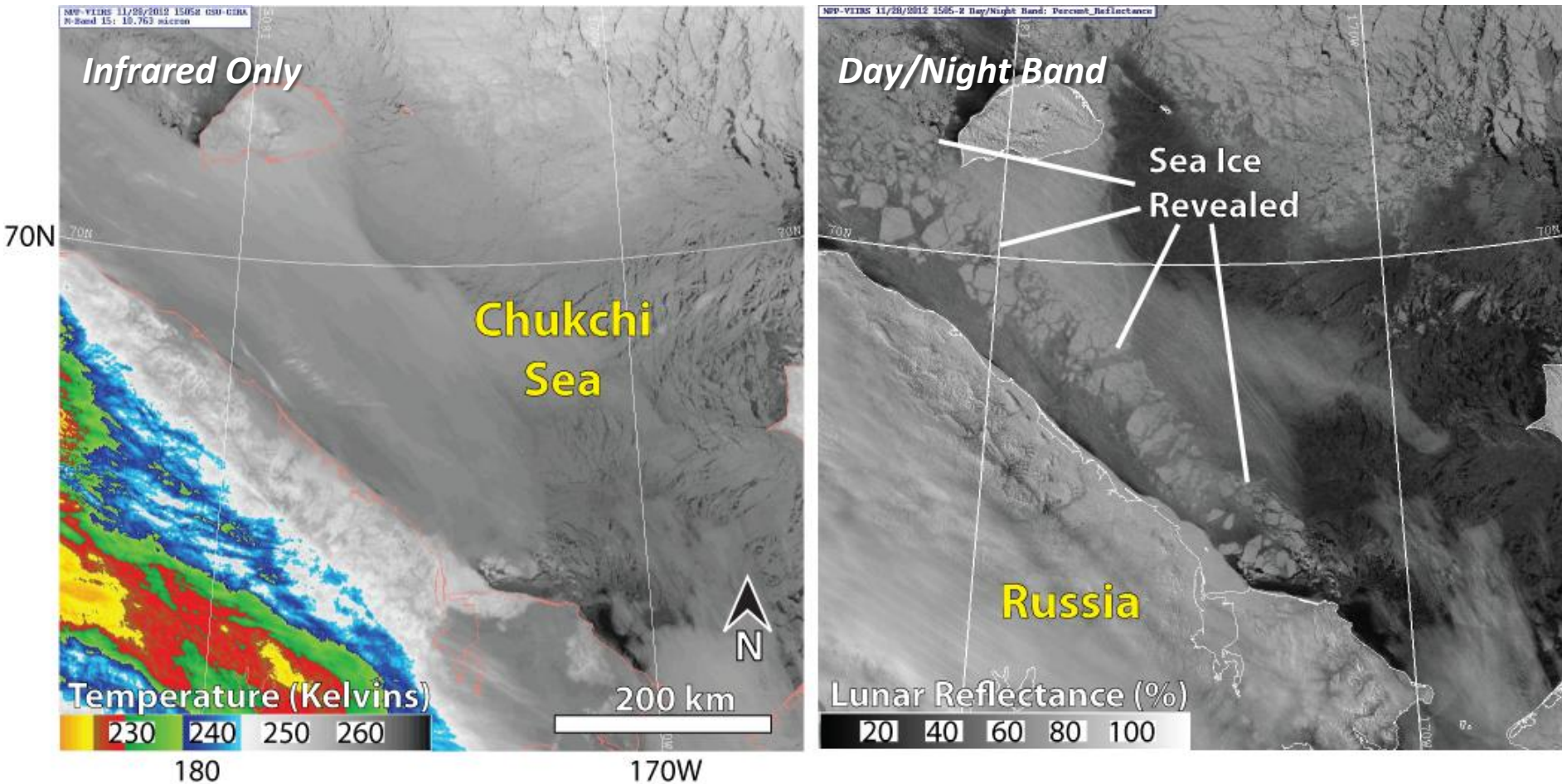
Similar to the Flossie example, using moonlight to probe clouds that are optically thin at visible wavelengths but opaque at conventional thermal infrared wavelengths helps to reveal the details of sea ice, particularly during periods of extended darkness in Winter months.

Nocturnal Tropical Cyclone Tracking

29 July 2013 11100 UTC
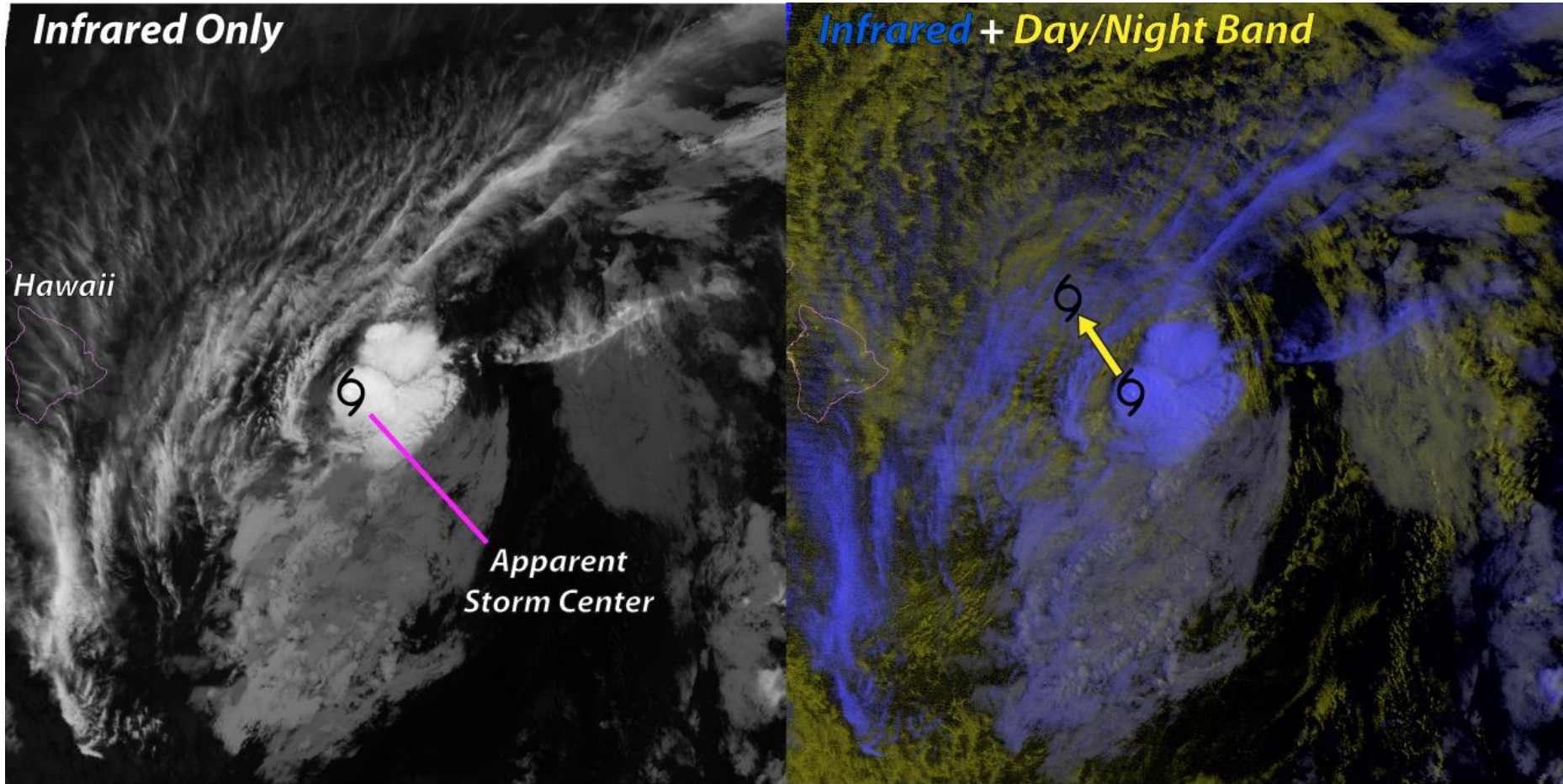
Moonlight provides a means to peering through cirrus, which are optically thin at visible light wavelengths. This enabled the VIIRS Day/Night band to detect low cloud structures that revealed the true center of low-level circulation associated with Hurricane Flossie.

Nocturnal Fire Lines & Biomass Smoke

22 August 2013 2124 UTC

23 August 2013 0943 UTC
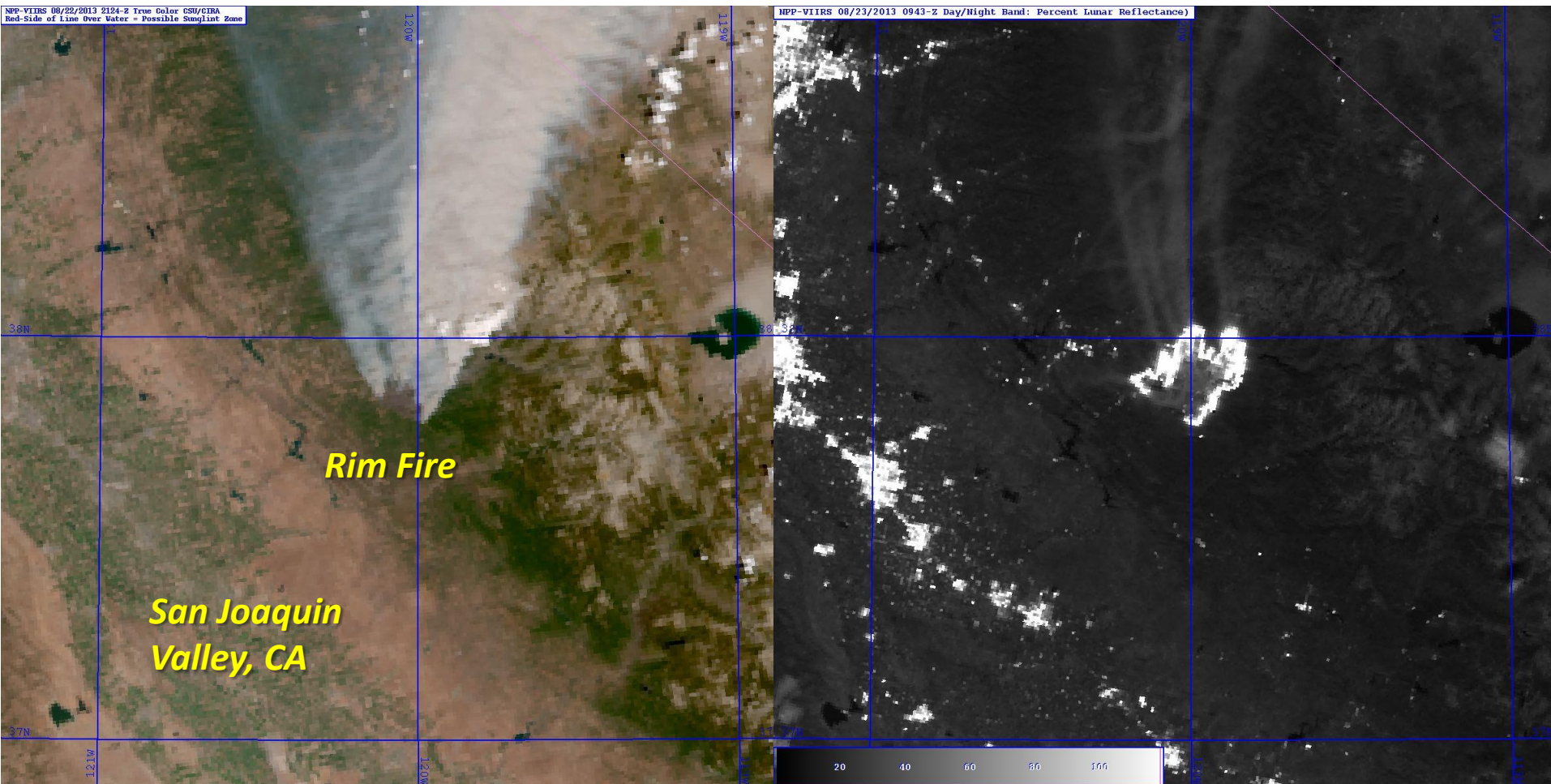
The VIIRS Day/Night Band provides a unique ability to detect visible light from active flames as well as smoke plumes via lunar reflectance (invisible to thermal IR bands).

Power Outages

1 November 2012 0653 UTC
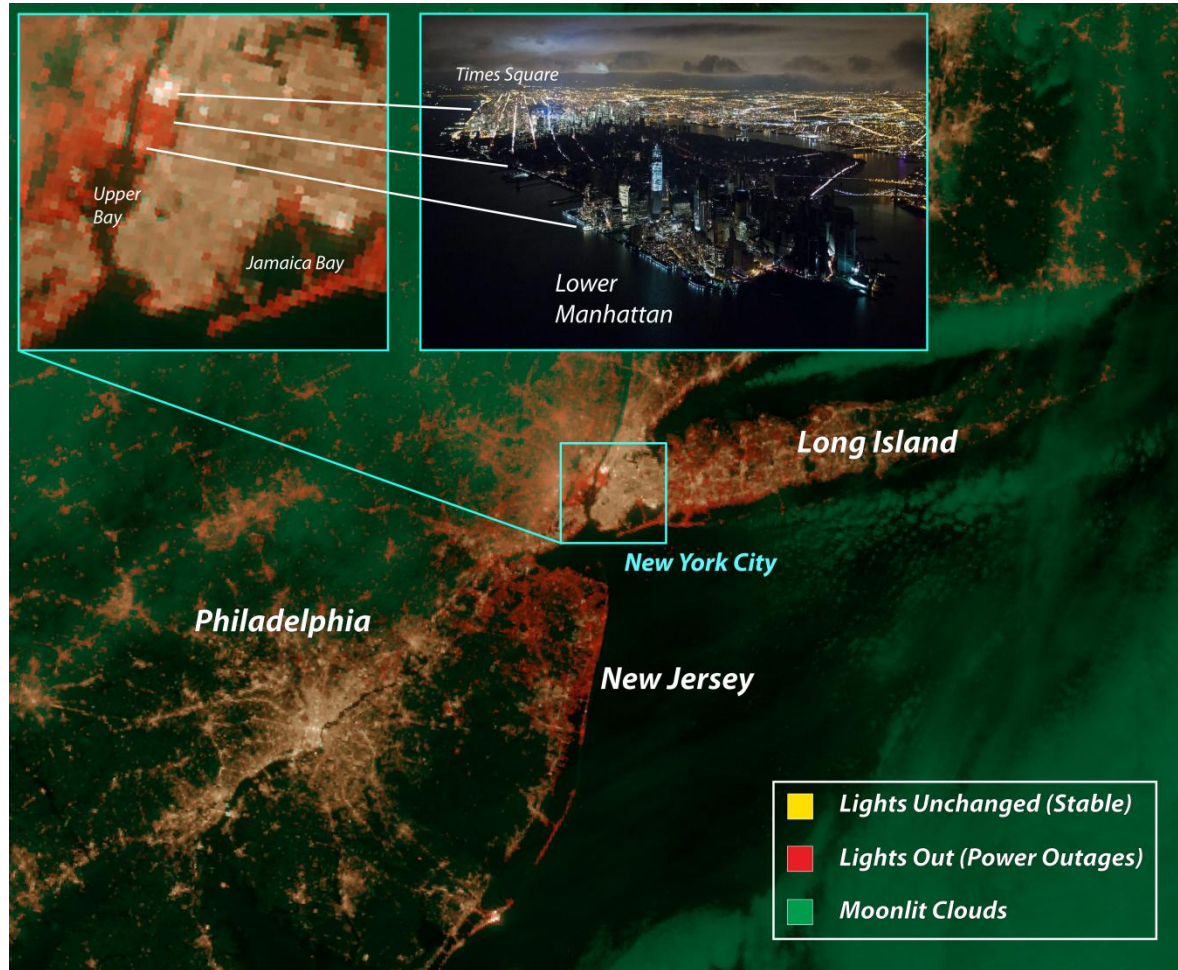
Comparing baseline stable light imagery with current imagery from the Day/Night Band offers a way to identify power outages, as shown in this example in the aftermath of Hurricane Sandy.

Open DRs

- With one exception, the **current list of open DRs** deals with documentation and Product Profile (PP) items
  - **DR 7426**: NCC PP does not reflect updated <u>pseudo-albedo limits</u> in the CDFCB - X
    - Being worked by Raytheon
  - **DR 7447**: Remove <u>I-band DQTT</u> tables
    - For the short term, the values within the DQTT will be set such that the function is essentially turned off
  - **DR 7453**: NCC <u>OAD</u> update
  - **DR 7459**: Imagery <u>ATBD</u> update
  - **DR 7489**: Establish <u>NCC DQTT</u> values
    - In coordination with Raytheon
  - **DR 7490**: Update <u>Product Profile</u> for M-band Imagery EDR
  - **DR 4653/7257**: Expand system to create 16 M-bands instead of the artificial limit of 6 M-bands as Imagery

Version Control - Documents

- All key <u>documents</u> are up-to-date
- <u>ATBD</u> and <u>OAD</u> both match the operational Imagery product
  - ATBD is version B and in coordination
  - The GTM OAD is version B and is complete
  - The NCC OAD is version C and is in coordination
- The format of the Imagery EDR (CDFCB-X) has not changed since before launch
- The format of the output is stable and not expected to change for Block 2.0
- A ***EDR Imagery User's Guide*** has been created for Imagery
  - To be produced as a *NOAA Technical Report*
- A major ***BAMS*** **article** has been published.
  - 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
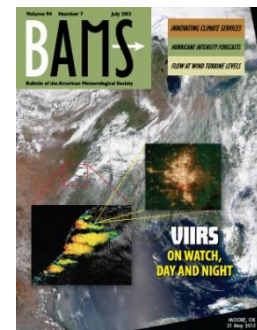
Version Control - Code

- The **non-NCC Imagery EDR** has not had any algorithm changes or LUT updates since provisional
  - Algorithm has been stable since Build 6.3
- **NCC Imagery** was updated in <u>Build 7.1</u>, both the code and the associated LUTs, to account for fill values under very low illumination conditions
  - This was the last direct change to any Imagery EDR
- A **stray light correction** to the DNB SDR was part of <u>Build 7.2</u> (20 August 2013)
  - This update to the SDR had direct benefits to NCC Imagery
  - The NCC Imagery EDR was declared provisional after this stray light correction was implemented
- In reality, **all Imagery EDRs met Validation 1 stage criteria with <u>Build 7.2</u>**
- Formally, the associated LUTs are at version 3 (CCR-13-806)

- Only two items were noted at the **Provisional** stage in the CLASS ReadMe document for Imagery
  - **Striping** is a rare occurrence in the Imagery product
    - In **non-NCC** Imagery it is all but non-existent, and only can be seen when <u>very high enhancement</u> curves are employed
    - In **NCC** Imagery striping can be found in <u>nighttime granules as the amount of lunar illumination decrease</u>s
      - This is consistent with expectations as the signal-to-noise ratio decreases and detector-to-detector variations become more evident
  - **Latency** of the data to operational users remains an extreme concern
    - Though the IDPS itself produces the Imagery product as required, the infrastructure at neither NESDIS (**<u>NDE</u>**) nor AFWA can support sending Imagery to most real-time users
    - The only users who can access Imagery within practical time frames today are the Alaskan Proving Ground, the Navy (via AFWA), and field terminal (**<u>direct broadcast</u>**) users

Conclusion

- Imagery has now achieved **Validation 1 stage**
  - All **requirements** have been met or exceeded
  - All **documentation** is up-to-date
  - All Imagery EDR quality-related **DRs** are closed
    - Note **stray light** is a DNB DR and not an Imagery DR
- The Imagery Team remains deeply concerned with the disconnects between the requirements themselves, the capabilities of today's IDPS, and the feedback we are receiving from those we interact with on a monthly basis
  - Non-NCC Imagery has **no "quality" requirements**
  - NCC Imagery has **no requirements**
  - Key products (such as **true-color imagery**) are not available from the operational system
  - The **number of KPP (priority 1) bands** (6), the number of bands created as Imagery from the operational system (12), and the total number of bands (22), do not match
- **Validation 2** stage will increase interactions with real-time operational users to the maximum extent possible

VIIRS Imagery outreach at RAMMB/CIRA

- VIIRS Imagery and image products outreach:
  - **VIIRS Imagery and Visualization Team Blog** (http://rammb.cira.colostate.edu/projects/npp/blog/)
  - **Seeing the Light: VIIRS in the Arctic** (http://rammb.cira.colostate.edu/projects/alaska/blog/)
  - **Suomi NPP VIIRS Online (including direct-broadcast imagery)** (http://rammb.cira.colostate.edu/ramsdis/online/npp_viirs.asp)

User (NRL) Presentation

- NRL-Monterey use of VIIRS in their NexSat websites:
- NexSat: http://www.nrlmry.navy.mil/NEXSAT.html
- VIIRS Cal/Val: http://www.nrlmry.navy.mil/VIIRS.html