Imagery EDR Team

JPSS DPA Program Planning Meeting

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Overview of Data Products

EDR Imagery:

- **6 of 16 M-bands** (default: M1, M4, M9, M14, M15, M16: selection of visible and IR bands) [750 m] remapped* (only) from SDR to EDR
- **5 I-bands** [375 m] remapped* (only) from SDR to EDR.
- **Day-Night-Band** (DNB, SDR) remapped* and re-normalized** to **Near-Constant-Contrast** (NCC, EDR) imagery

***Remapping**

Ground Track Mercator (GTM) projection to EDR of same radiances in SDR.

****Re-normalization**

GTM projection, and re-normalization of numerous detectors/gain states to produce images that reduce the impact of reflectance differences across the scan caused solely by solar/lunar viewing angle variations in the granule

(Probably the most astounding VIIRS characteristic has been the ability to collect visible/reflected energy at night even under no-moon conditions.)

Team Members' Roles & Responsibilities (1)

EDR	Name	Organization	Funding Agency	Task
Imagery	Don Hillger	NOAA/NESDIS/StAR	StAR	STAR Lead
"	Tom Kopp	Aerospace Corp.	Aerospace	Cal/Val Lead
"	Dan Lindsey, Deb Molenar	NOAA NESDIS/StAR	StAR	Imagery applications, NDE liaison
"	Curtis Seaman, Steven Miller, Steve Finley, Stan Kidder, Renate Brummer	CIRA	StAR	NPP VIIRS Blog, DNB/NCC, IT support Imagery analysis, Project supervision
"	Tim Schmit	NOAA/NESDIS/StAR	StAR	GOES-R liaison
"	Jeff Cetola	AFWA	AFWA	Applications
"	Tommy Jasmin, Tom Rink	CIMSS	StAR	McIDAS-V
"	Keith Hutchinson, Robert Mahoney, Calvin Liang, Steve Mills	NGAS	NGAS	GTM software
"	Ryan Williams, Marina Tsidulko	NOAA/NESDIS/StAR AIT	StAR	ADP
"	And others!			

Team Members' Roles & Responsibilities (2)

EDR	Name	Organization	Funding Agency	Task
Imagery	Jeff Hawkins, Kim Richardson, Jeremy Solbrig, Tom Lee	NRL, Monterey	NOAA	NexSat
"	Chris Elvidge	NOAA/NGDC, Boulder	NOAA	DNB/NCC

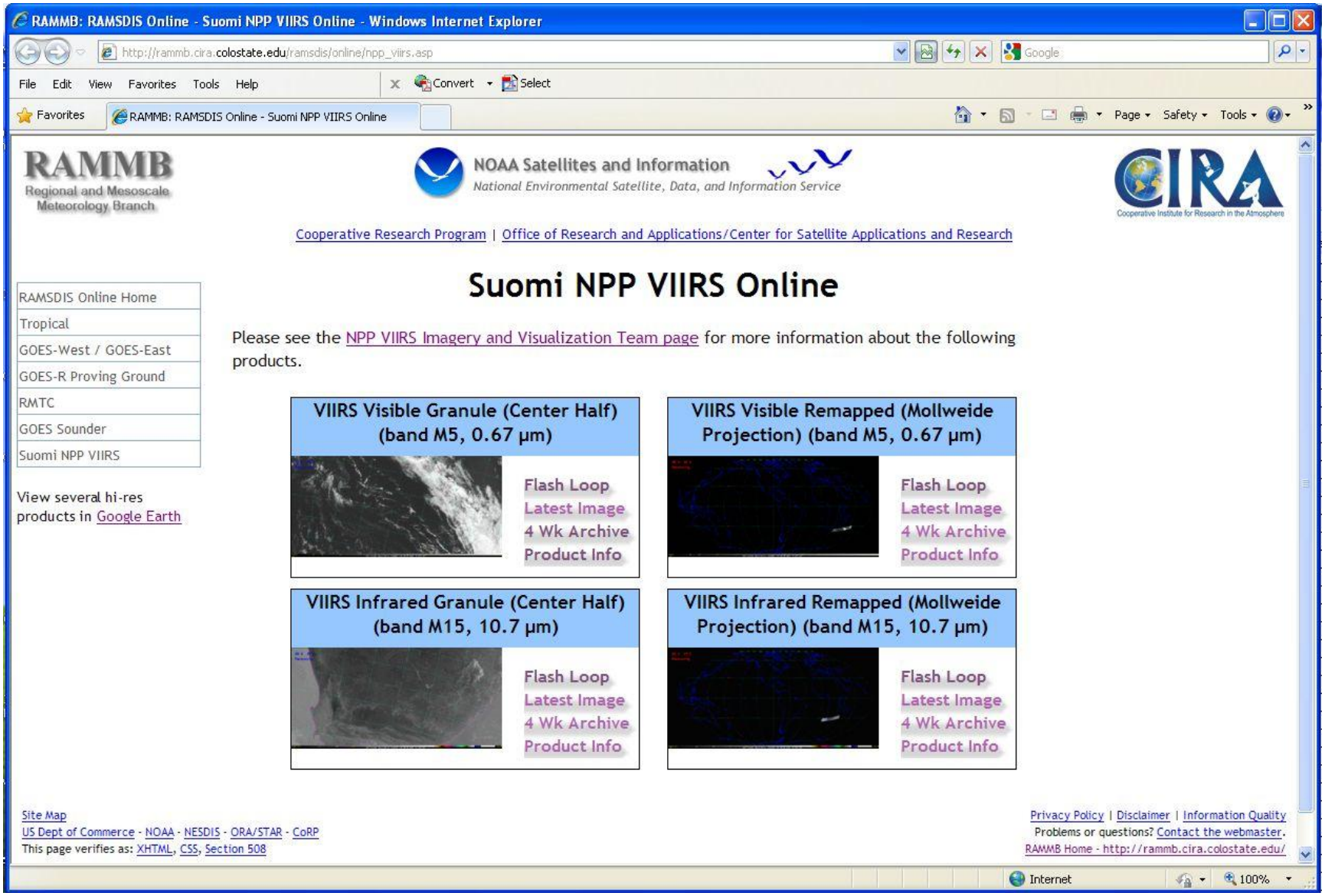
FY-12 Accomplishments (quality)

- **Non-NCC Imagery** declared "**Beta**" in June 2012:
  - The AERB (Algorithm Engineering Requirements Board) approved non-NCC imagery to the "Beta" level, the first EDRs to be officially declared as such.
  - Imagery were declared "Beta" back thru February 2012.
  - Imagery is currently being considered for "Provisional" status.
  - First operation use of Imagery in place at NRL-Monterey (NexSat for VIIRS, http://www.nrlmry.navy.mil/VIIRS.html)
- **NCC imagery** is being considered for a "**Beta**" designation, though it has issues with too many fill values in certain nighttime granules
  - Progress has been made in resolving this issue.
  - Still under study: not-fully-understood issues in the software.

FY-12 Accomplishments (outreach)

- **EDR Imagery and Visualization Team website:**
  - http://rammb.cira.colostate.edu/projects/npp/
- **EDR Imagery and Visualization Team blog:**
  - **http://rammb.cira.colostate.edu/projects/npp/blog/**
  - **Thanks to Curtis Seaman, many examples of imagery applications, as well as comparisons to other imagery.**
- **NPP VIIRS online display:**
  - **http://rammb.cira.colostate.edu/ramsdis/online/npp_viirs.asp**
  - **On-the-fly imagery (subject to 7 hour delay inherent in current data sources.**
- **Imagery Team manuscript submitted to *BAMS*:**
  - **Hillger et al, 2013: First-Light Imagery from Suomi NPP VIIRS.**

FY-12 Accomplishments (outreach)



FY12 Accomplishments: DRs (1)

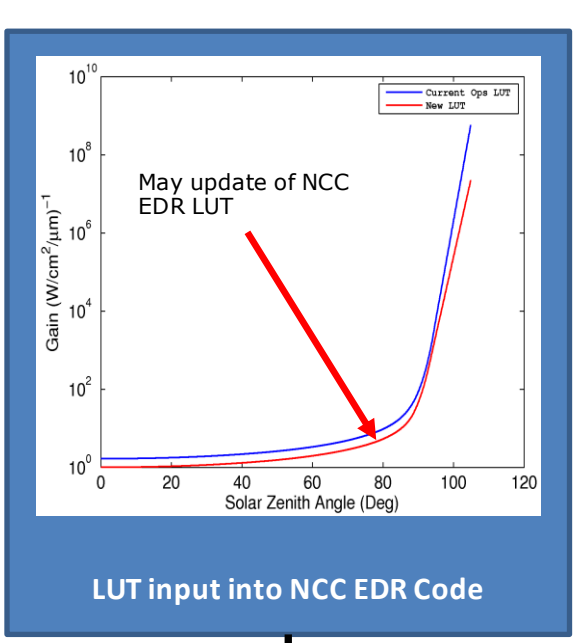
DR number	Short Description
4594	ATDR 42: Imagery EDR processing maneuver for extended granules – Accepted and closed
4545	Non NCC imagery Beta – Closed
4301	Missing Imagery pixels in GTM output – Fixed and closed
4277	SZA 85 to 89 degrees – Fix done by VIIRS SDR and in mx6.2 – Closed
4470	No NCC Imagery for nighttime granules – PCR was rejected – For our purposes, differently worded duplicate for DR 4484
4270	ATDR 23: Imagery EDR behavior in maneuver – Accepted and closed
4264	VIIRS Imagery directions – Rejected
4116	OAD updates – Approved and closed
2680	SDR Even/odd Imagery gain differences – Fixed and closed
Scheduled for MX 6.3	
4765	M13 PP to include min/max for radiance and reflectance
Scheduled for MX 7	
4525	OAD changes to both GTM and NCC OADs. 6 changes for proper units given as W/(m2·sr·m).
4468	Imagery EDR and GTM GEO products need to have DNE fill in bottom few rows – This is scheduled for MX7. PCR is awaiting verification.

FY12 Accomplishments: DRs (2)

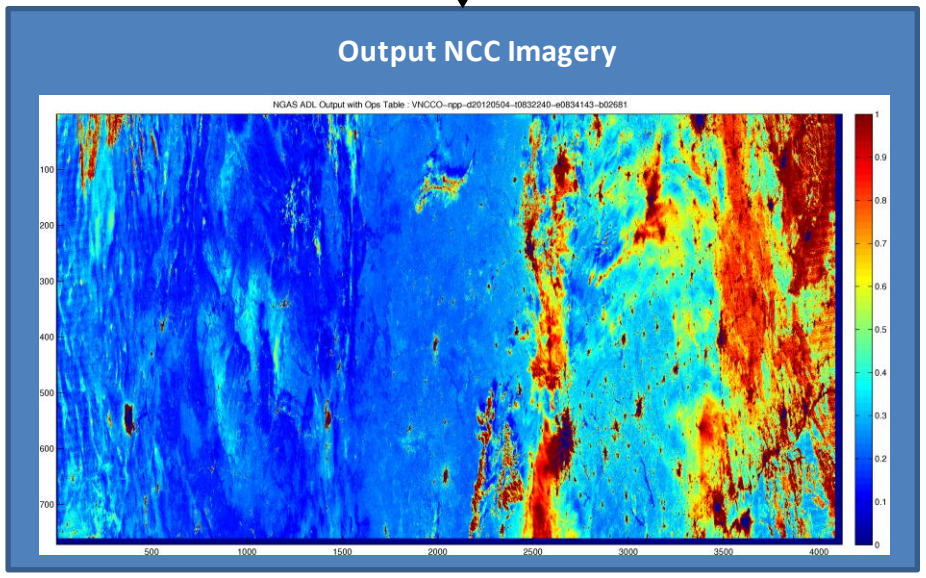
DR number	Short Description
4859	**NCC Beta** – Waiting for decision from team that it is at beta and then presentation and paperwork to file the CCR.
4775	**Non-NCC Provisional** – Waiting for SDR to go provisional.
4484	**DNB Threshold** – Tests conducted, may require further testing or changes. Decision has not been made to push this change through.
4867	**SZA 105** – The Near Constant Contrast (NCC) Imagery is produced based on the Day Night Band (DNB) and uses either solar or lunar reflectance. This transition occurs at a solar angle of 105 degrees. However, in the granules where this transition occurs, a sharp diagonal line can be seen which closely follows this angle. The root cause is unknown, the best estimate at this time is the discontinuity is being caused by a granule level quality flag.
4579	**Triangular Fill** – Was a result of A2 granules not being present at the time a neighboring A1 was created. Work by C3S has significantly reduced the number of occurrences. Depending on how prevalent this continues to be it may need a fix for provisional. The Imagery team is monitoring.
4653	Allow the IDPS to **produce all 16 M-bands** as Imagery EDRs. Being discussed as part of NOAA L1 data product requirements redefinition. Should see an interim revision available soon but not anticipated anytime soon.
4332	DR approved for future re-evaluation – **What to do if there is a bad detector**? This has been transferred to VIIRS SDR and will be addressed when it happens. Options are to either recalculate based upon new position or average radiance. This was written by Neal Baker.

FY-12 Accomplishments

- NCC EDR
  - **April**: NGAS installed the NCC LUT algorithm support function (ASF) tool on the GRAVITE ICF; tool has been turned over to DPE
  - **May**: NGAS delivered the first NCC input LUT derived from VIIRS DNB SDRs using April new moon data



NCC EDR algorithm

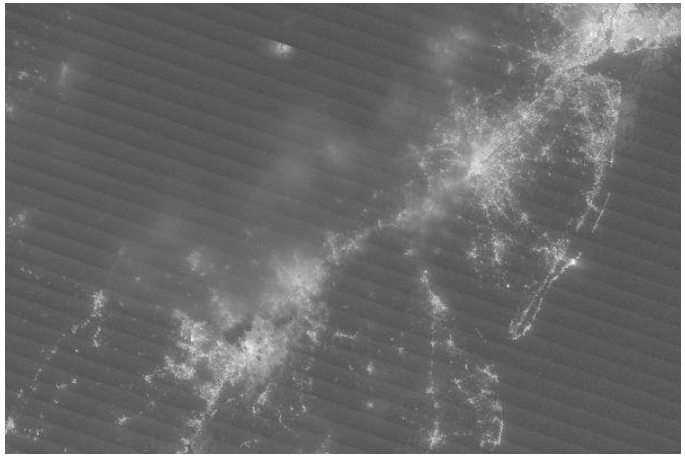


C. Liang, NGAS

FY-12 Accomplishments

- SDR stray light removal
  - NGAS developed an algorithm to remove stray light from the DNB SDRs that will be used to derive the NCC LUT and ultimately the NCC imagery product
  - NGAS is now investigating why NCC EDRs are not being produced for all lunar conditions

Before Stray Light Removal

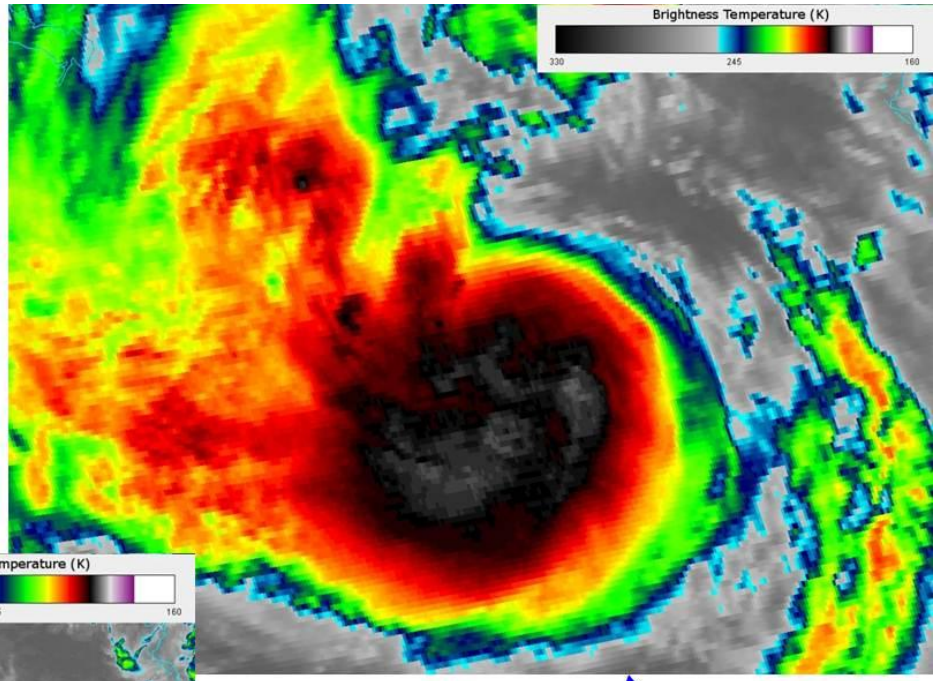


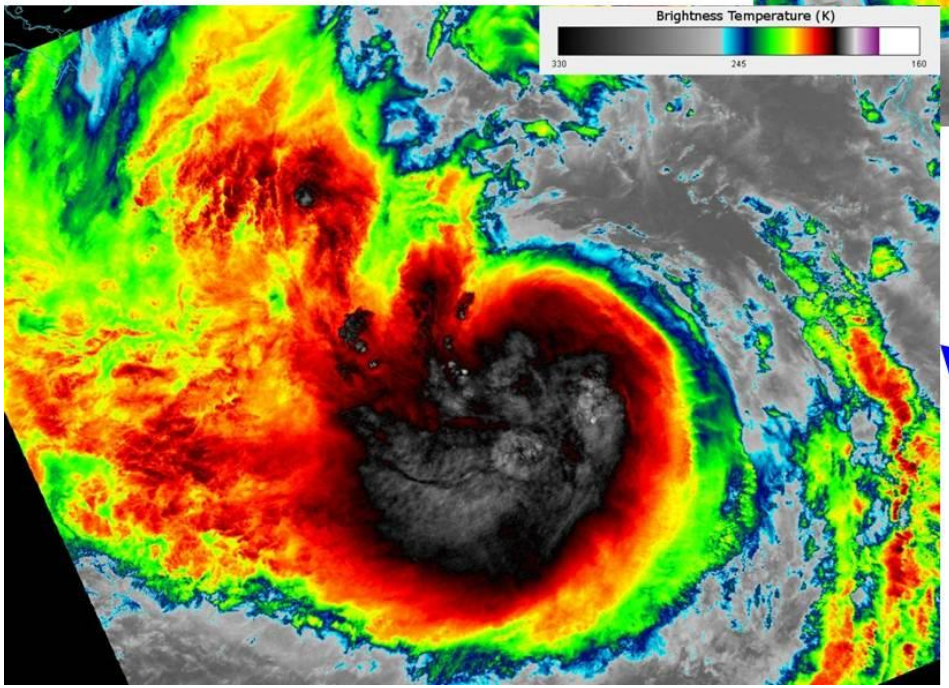
After Stray Light Removal

S. Mills & R. Mahoney, NGAS

Scientific Advancements

Tropical Storm Isaac
27 August 2012

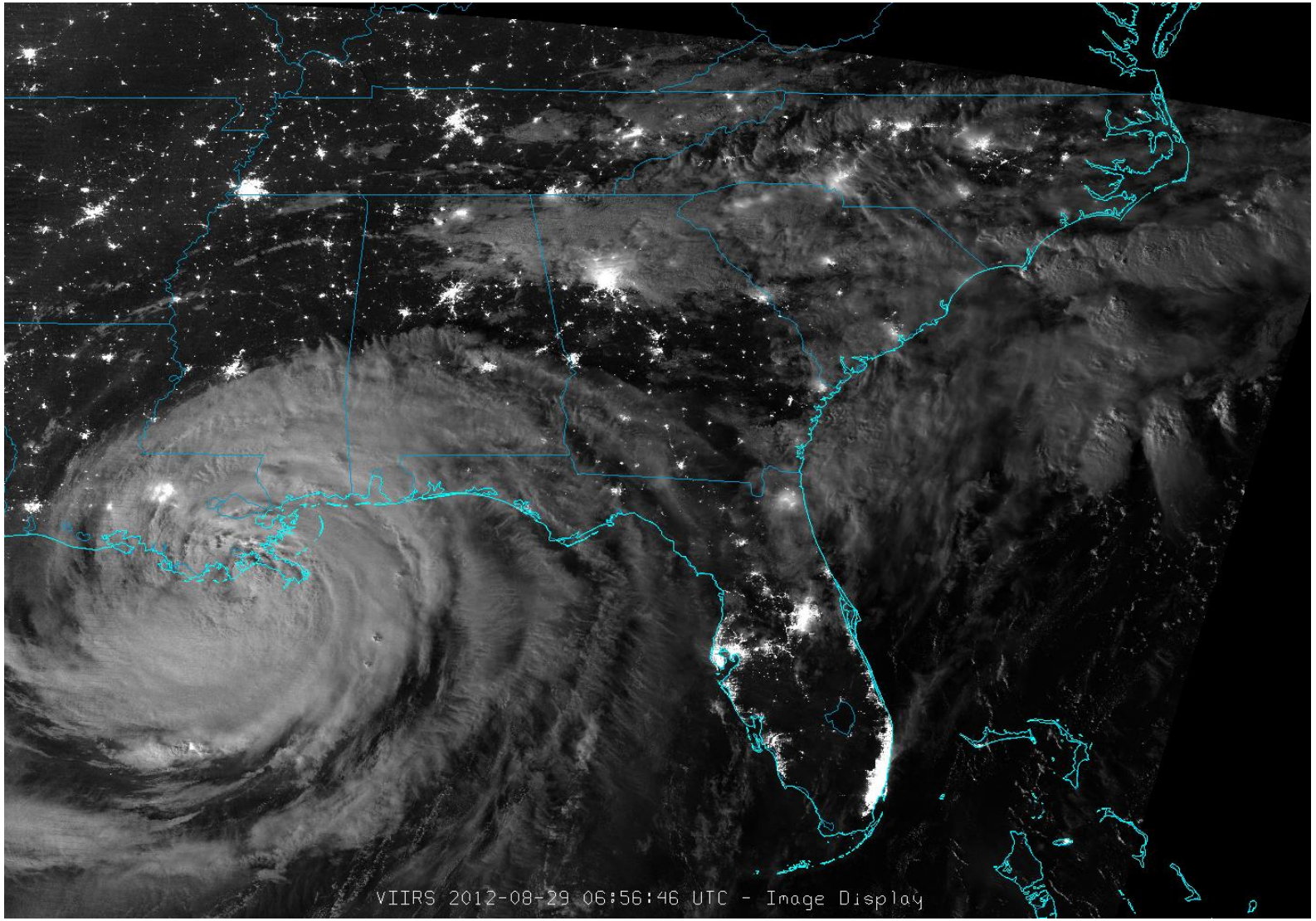




GOES Imager
channel 4 (10.7 µm)
taken at 18:45 UTC

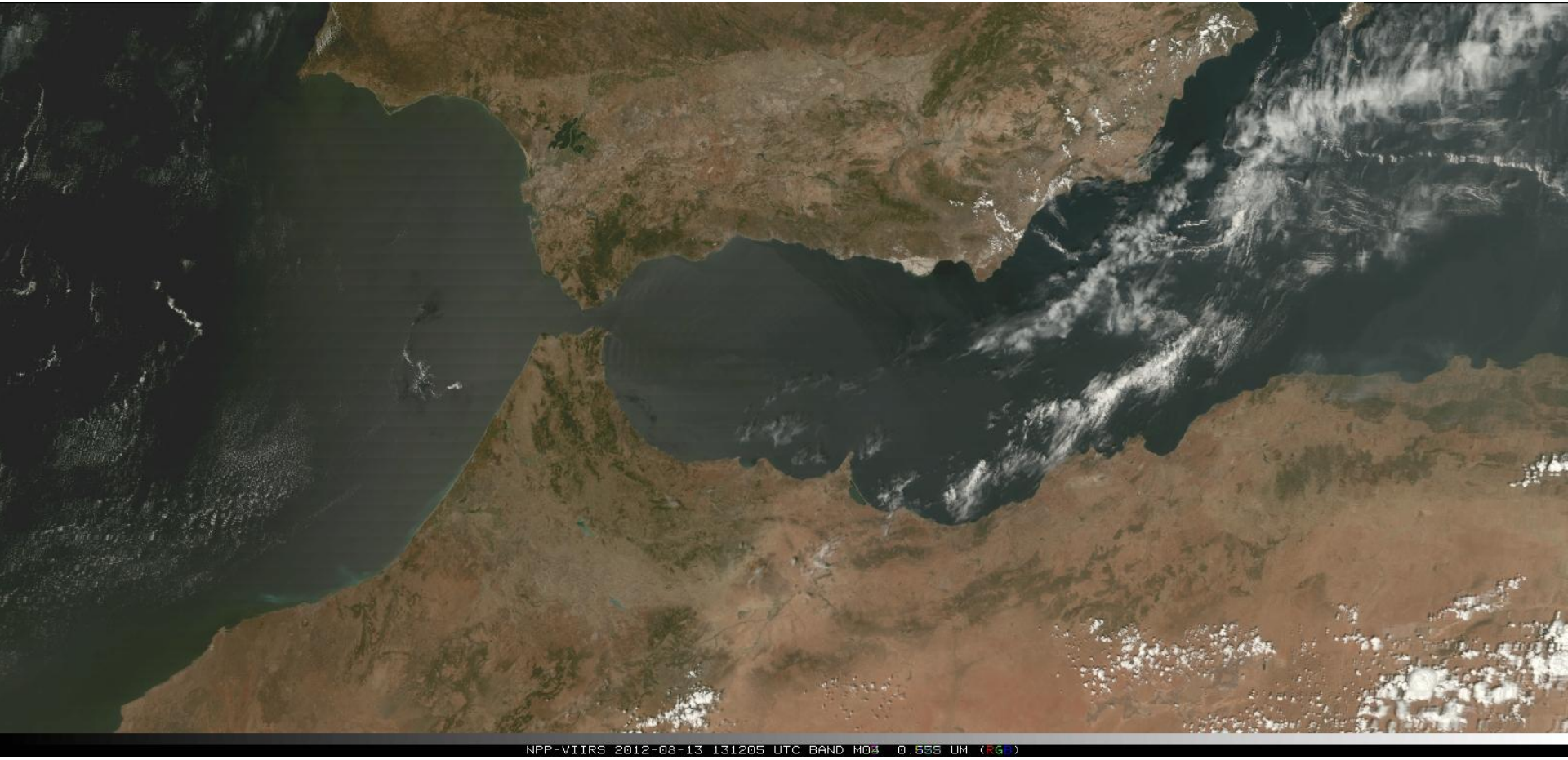
VIIRS Imager
channel I-05 (11.45 µm)
taken at 18:50 UTC

Scientific Advancements



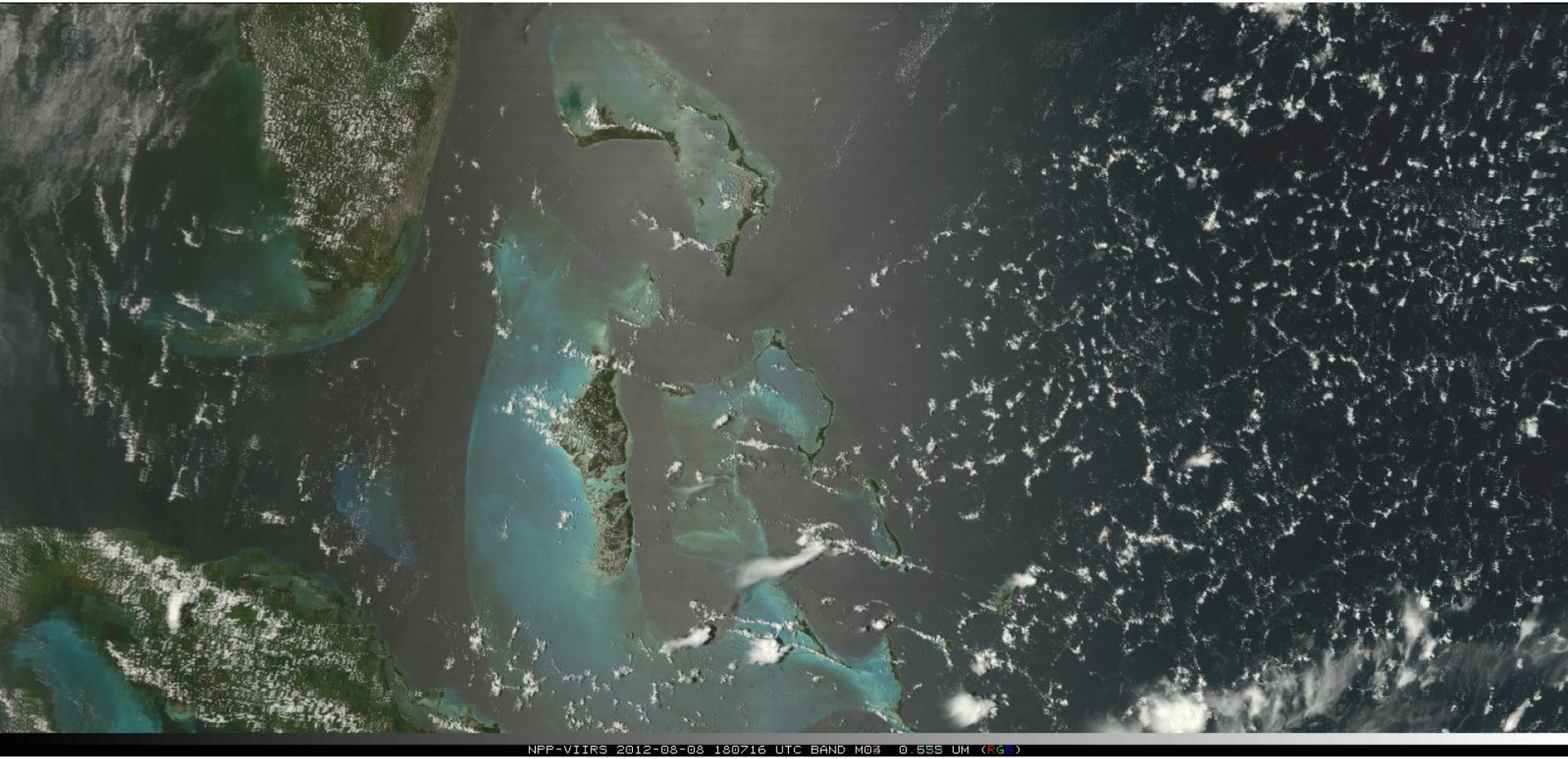
DNB imagery – Hurricane Isaac – 2012-08-29 @ 06:56 UTC

Scientific Advancements



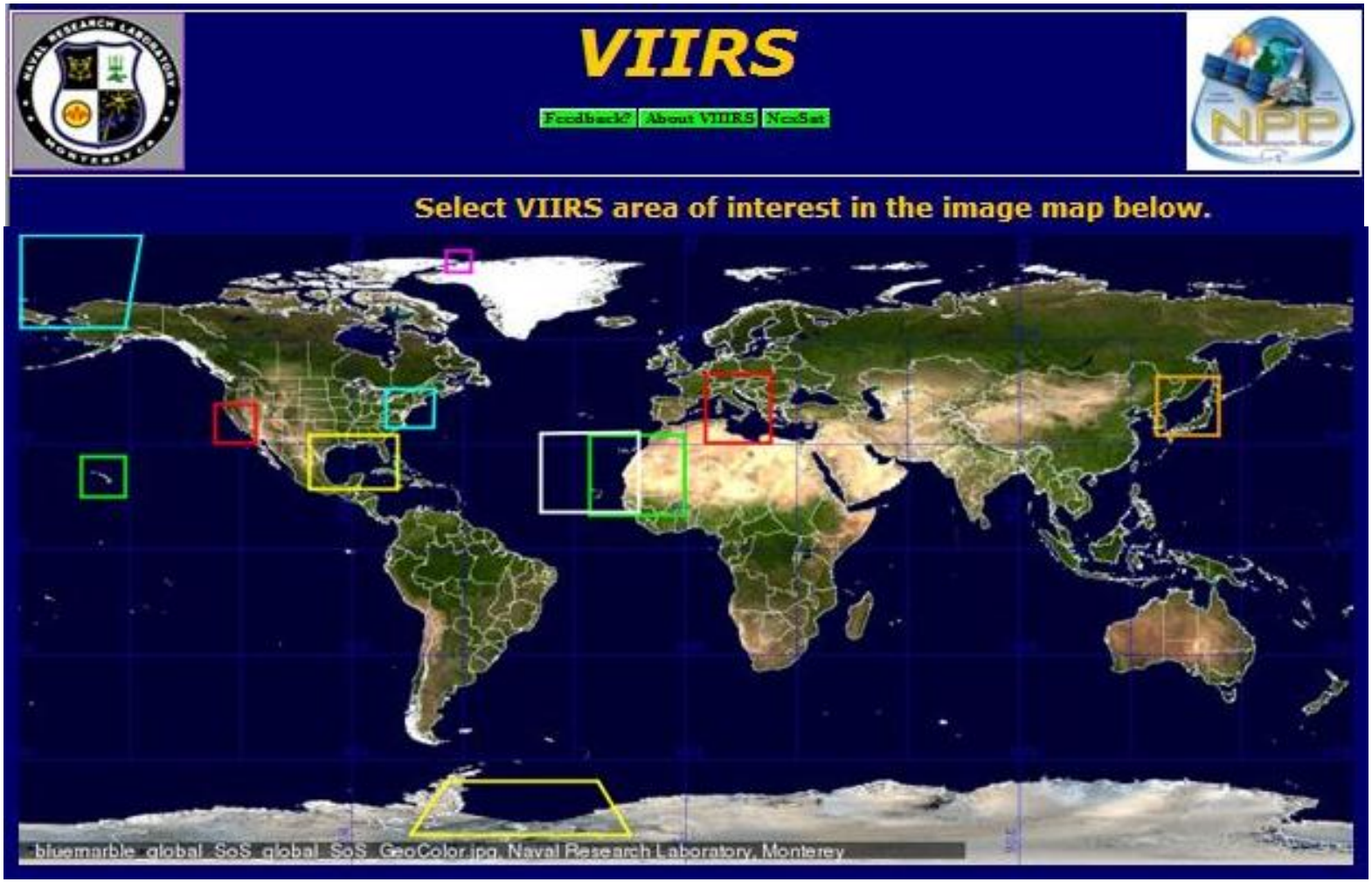
Rayleigh-corrected true-color M-band imagery – Strait of Gibraltar
2012-08-13 @ 13:12 UTC

Scientific Advancements



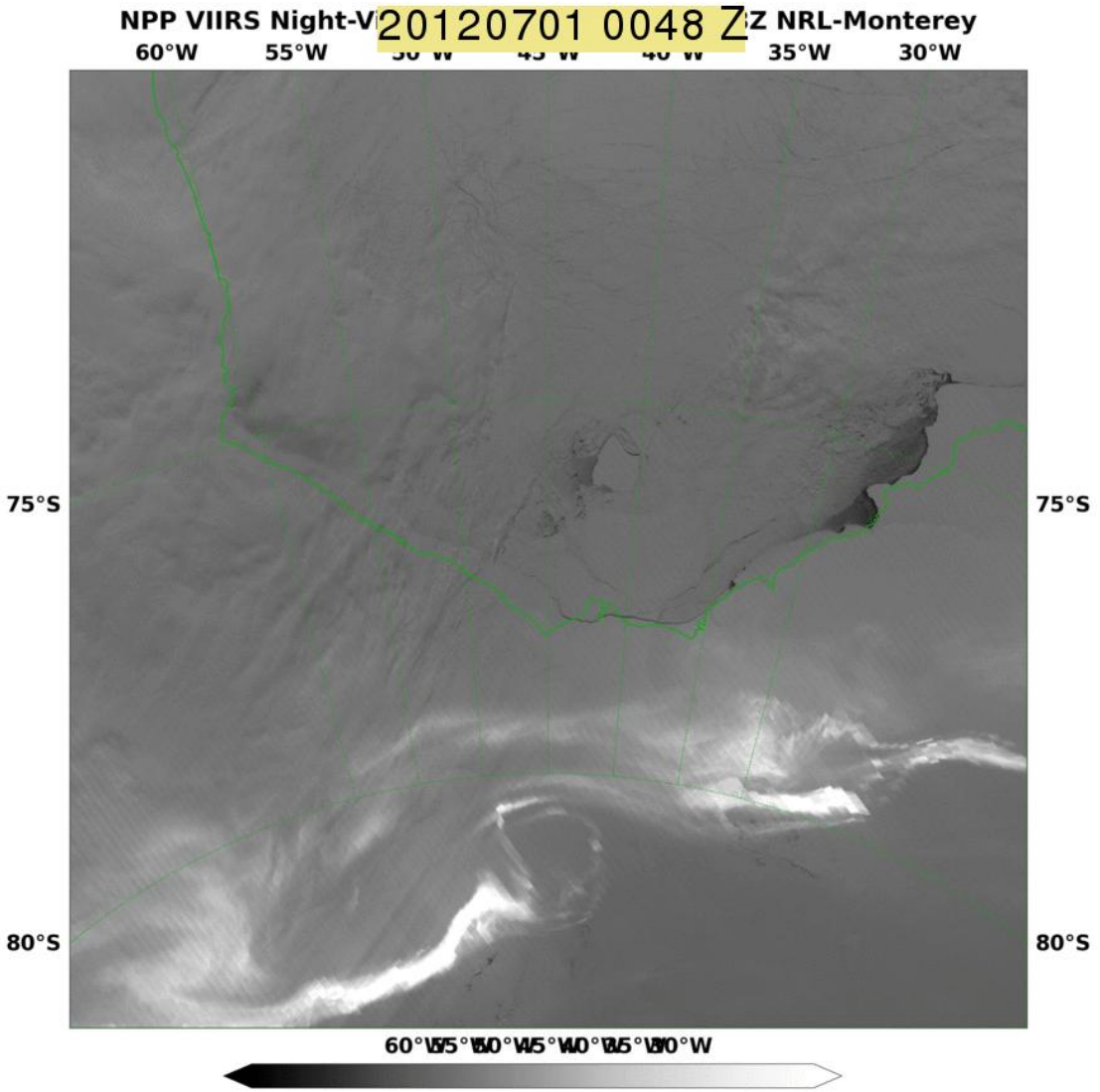
Rayleigh-corrected true-color M-band imagery – Bahamas
2012-08-08 @ 18:07 UTC

NRL VIIRS Cal/Val Web Page



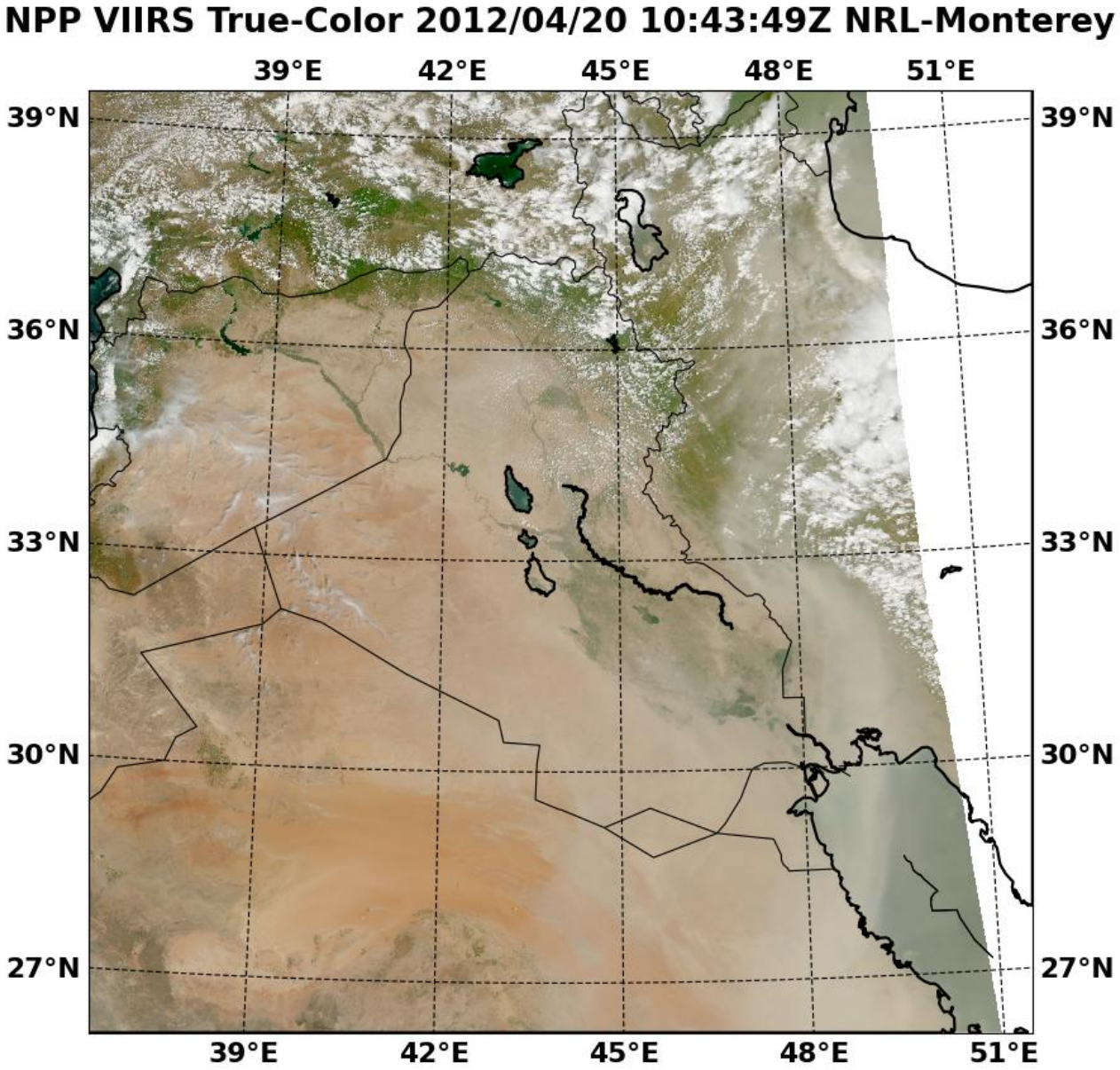
http://www.nrlmry.navy.mil/VIIRS.html

Day Night Band Cloud/Aurora Views

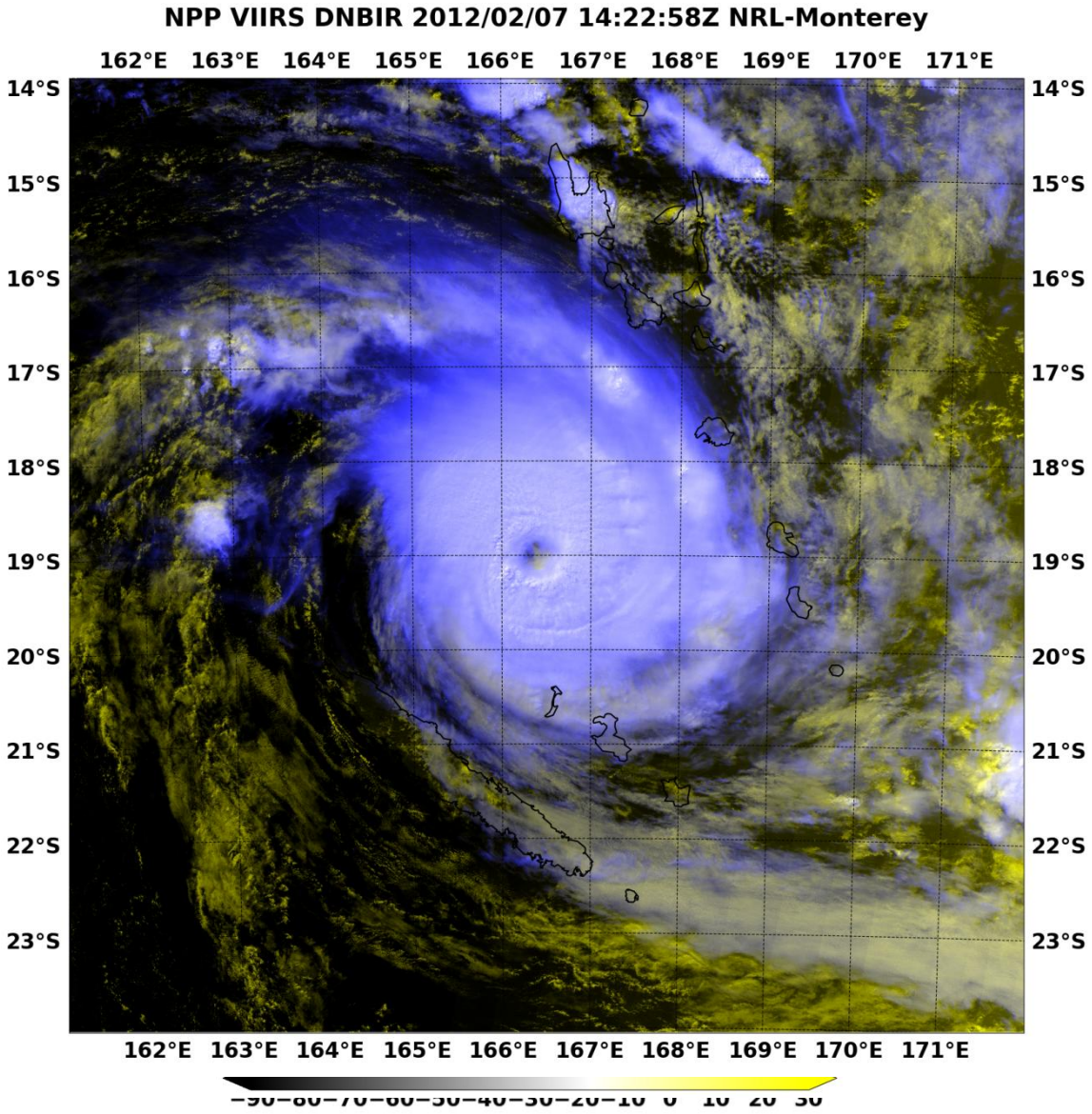


VIIRS Day Night Band (DNB) Animation

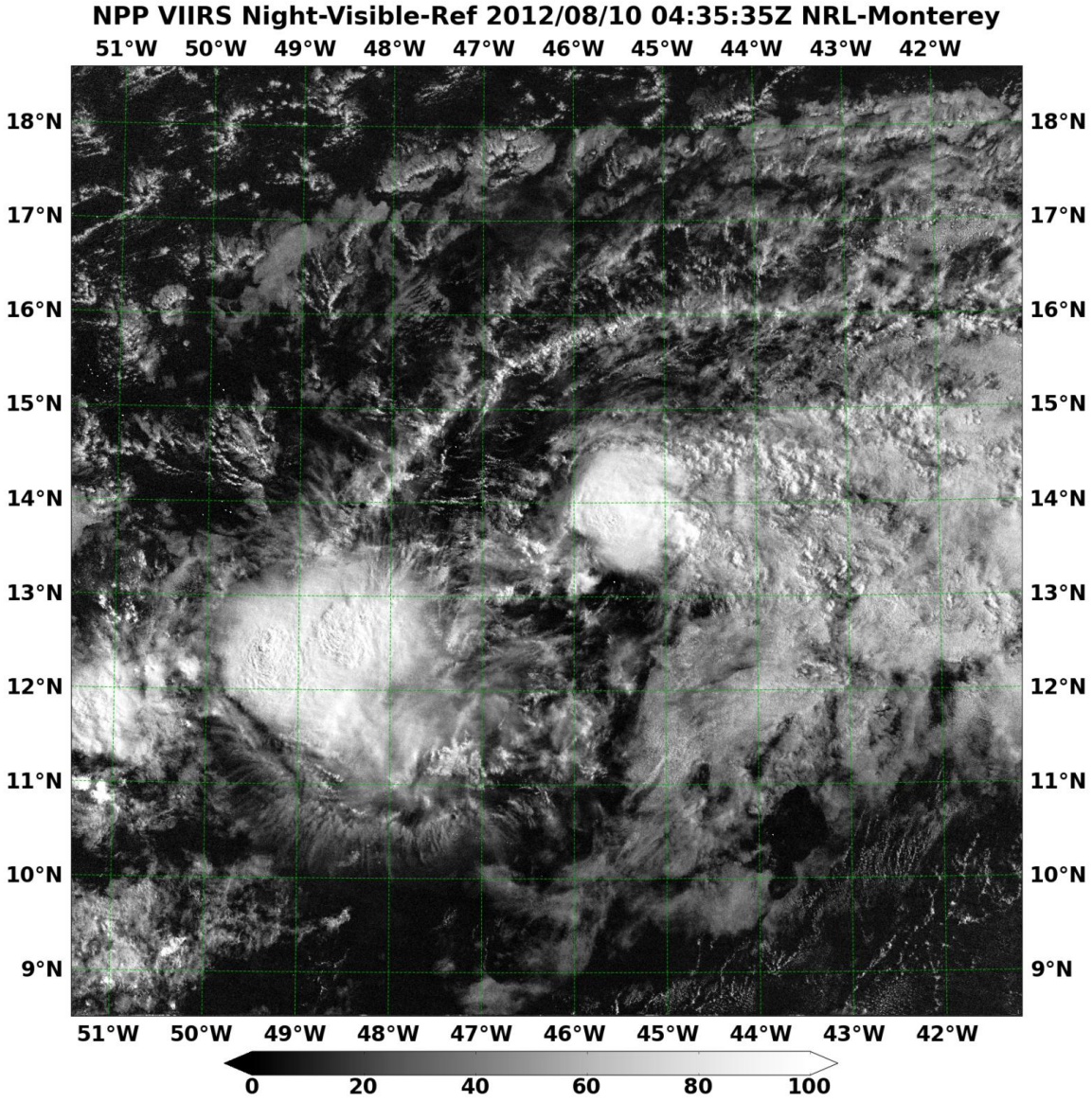
VIIRS Dust Detection



VIIRS Day Night Band Views TC



Radiances Converted to Reflectances



Lunar Zenith Angle:
about 66°
Lunar Phase Angle:
95.012°

First image:
Day Night Band radiances with gamma correction of 2.0.

Second image:
Day Night Band reflectance from lunar reflectance model. No gamma correction.

Issues, Challenges, Setbacks

- **Issue: 7-hour latency** is a detriment to real-time use of VIIRS from GRAVITE and PEATE.
  - Looking for NDE to solve the latency issue
  - Unsure of timing NDE implementation
- **Setback: lack of NCC imagery** causes fallback to DNB SDRs for many imagery applications
  - Complicated NCC software is hard to decipher
  - NGAS and AIT are helping solve this problem
- NCC Imagery **stray light hardware issue** appears to have a software fix (NGAS), but looking forward to permanent hardware fix with JPSS-1.

Changes in Strategy (due to funding constraints)

- **McIDAS-V** display software capabilities for VIIRS are being developed and issue resolved more slowly than originally planned.
- **McIDAS-X** lags greatly in image manipulation and display capabilities.
  - Had to write many programs and scripts to work around the lack of software package tools.
  - Capabilities are not expected to be fully ready even during FY13.
  - This tool has many heritage applications within NESDIS, including for future GOES-R ABI.

FY-13 Schedule and Milestones (1)

- **Maturity level advances**:
  - Non-NCC Imagery to "Provisional" (early FY13)
  - NCC imagery to "Beta" (early FY13)
- **NCC LUT fix** for lack of full complement of NCC imagery (mid FY13)
- **NCC software fix implemented for stray light hardware issue** (late FY13)
- VIIRS **display software improvements**:
  - McIDAS-V improvements (continuous challenge, as needed)
  - McIDAS-X improvements (provided funding is available)
- Closer to **real-time analysis:**
  - Looking to NDE to lessen latency issues (FY13)

FY-13 Schedule and Milestones (2)

Tasks of **STAR** NPP/JPSS Imagery EDR Team Members

a. **Setup imagery test environments and visualization tools** for verification of the EDRs produced by the IDPS code.

b. **Incorporate performance constants** upon the imagery obtained from the ADL code, including both quantitative statistical tests and qualitative imagery "viewability" measures.

c. **Interact with JPSS** in the formal algorithm change process if algorithm changes are suggested.

Tasks of **non-STAR** NPP/JPSS Imagery EDR Team Members

a. Gather the information on real/observed data sets and continue the **improvement of display/visualization tools (such as McIDAS-V and McIDAS-X)** needed for checkout.

b. Work with Team members to **receive and display data sets from available sources** (e.g. GRAVITE, Atmos PEATE, and CLASS).

c. VIIRS Imagery EDR Team members will **coordinate activities to accomplish the checkout of imagery and image product quality**. (Quality of the imagery includes such things as: noise levels, detector-to-detector striping, sensor saturation levels, navigation and registration, and inter-satellite calibration.)

d. During in-orbit sensor checkout, data and **imagery will be analyzed and image products will be generated** at major research and application locations (civilian and/or military). (Image products include image combinations, such as those used in the detection of fog/stratus, blowing dust, fires and smoke plumes, volcanic ash, aerosols, etc.)

e. Explore **true-color/RGB applications** for assessing land and atmospheric phenomena (such as vegetation, blowing dust, smoke, ash, haze, etc.). NPP VIIRS true-color/RGB imagery will also be used as training/proxy data for the application of true-color/RGB techniques to geostationary data (considering that the GOES-R series will lack the Green band to directly produce true-color imagery).

f. **Real-time web displays of VIIRS imagery and image products** will also be a source of material for training of NWS and other meteorologists, especially for those spectral bands that are new to the operational satellite datastream.

FY-13 Schedule and Milestones (2)

FY13 DELIVERABLES

a. **Report on the analysis of the VIIRS Imagery EDR software, imagery, and image product**s produced from that imagery – Either as discovered, or end of term.

b. **Document any EDR software and imagery issues** that might be discovered, whether in the image data, or products derived from that imagery – Either as discovered, or end of term.

c. Weekly and quarterly reports on the VIIRS Imagery EDR Team activities.

Path Forward (FY-13 thru FY-17)

(assume "FYxx" runs from April 1, 20xx to March 31, 20xx+1)

	Suomi NPP	JPSS J1
FY13	Attain provisional and, by late FY13, validation stage one for non-NCC Imagery. Attain beta for NCC Imagery.	Begin analysis for JPSS-1 Cal/Val plan
FY14	Complete validation of non-NCC Imagery. Reach validation stage 1 for NCC Imagery.	Complete first draft of JPSS-1 Cal/Val plan
FY15	Complete all Imagery validation activities for SNPP	Finish JPSS-1Cal/Val plan. Begin updating/developing any required tools
FY16		Finish any and all preparation for JPSS-1 Cal/Val activities
FY17		Begin JPSS-1 Imagery Cal/Val

Summary

- VIIRS imagery is both **spectacular and excellent quality**
  - Better spatially and radiometrically
  - NCC imagery even possible in no-moon lighting!
- NCC Imagery **issues are being worked out**
  - Leading to delay in “Beta” declaration
- **Data latency is a major drawback** to forecaster use of VIIRS
  - Looking to NDE for promise of near real-time imagery