Current Status Of NPP-VIIRS For CERES

S. Sun-Mack[1], P. Minnis[2], Y. Chen[1], S. Gibson[1], R. Smith[1], B. Scarino, W. Miller[1], F-L. Chang[1], Q. Trepte[1], P. Heck[3]

(1) SSAI, Hampton, VA, USA

(2) NASA Langley Research Center, Hampton, VA, USA

(3) CIMSS, U. Wisconsin, Madison, WI, USA

Newport News, VA

1-3 May 2012

Outline

- CERES VIIRS Subsetter
- Characteristics of NPP orbits (comparison with Aqua orbits)
- VIIRS first look gallery
- Channel Comparisons between VIIRS and Aqua-MODIS
    - Qualitative Case comparisons
    - Daily comparisons
- VIIRS Calibration Versions
    - Summary from VIIRS Cal/Val Team
    - NPP VIIRS Calibration versions and schedule
- Preliminary Results
- Future Plan

CERES VIIRS Subsetter

CLASS (Comprehensive Large Array-data Stewardship System):

Lots little files:

One file per channel (22 channels) for every 86 seconds.

To process an hour of data, need ~ 2500 VIIRS files

Land PEATE (Product Evaluation and Test Element):

Build 5-min granule:

Combining all channels and Geo info (~ 70 CLASS files) into one file

4 x 86 sec files --> 5.7 min (fat granule)

3 x 86 sec files --> 4.3 min (skinny granule)

Alternating

Three 5-min granules:

Moderate (VMAE)

Imagery (VIAE)

DayNight (VDNE)

CERES VIIRS Subsetter

Channel subset:

16 Moderate (~750 meter) channels → 12

5 Imagery (~375 meter) channels → 4

1 Day Night channel → 1

Channel Subsetting

Band No.	Wavelength (µm)	Radiance (W/m^2-sr-µm)	Reflectance	Brightness Temp (K)
M 1	0.412			
M 2	0.445			
M 3	0.488	✔	✔	
M 4	0.555	✔	✔	
M 5	0.672	✔	✔	
M 6	0.746			
M 7	0.865	✔	✔	
M 8	1.24		✔	
M 9	1.378		✔	
M 10	1.61	✔	✔	
M 11	2.25	✔	✔	
M 12	3.70	✔		✔
M 13	4.05			
M 14	8.55	✔		✔
M 15	10.763	✔		✔
M 16	12.013	✔		✔
I1	0.640	✔	✔	
I2	0.865			
I3	1.61	✔	✔	
I4	3.74	✔	✔	
I5	11.450	✔	✔	
DNB	0.7	✔		

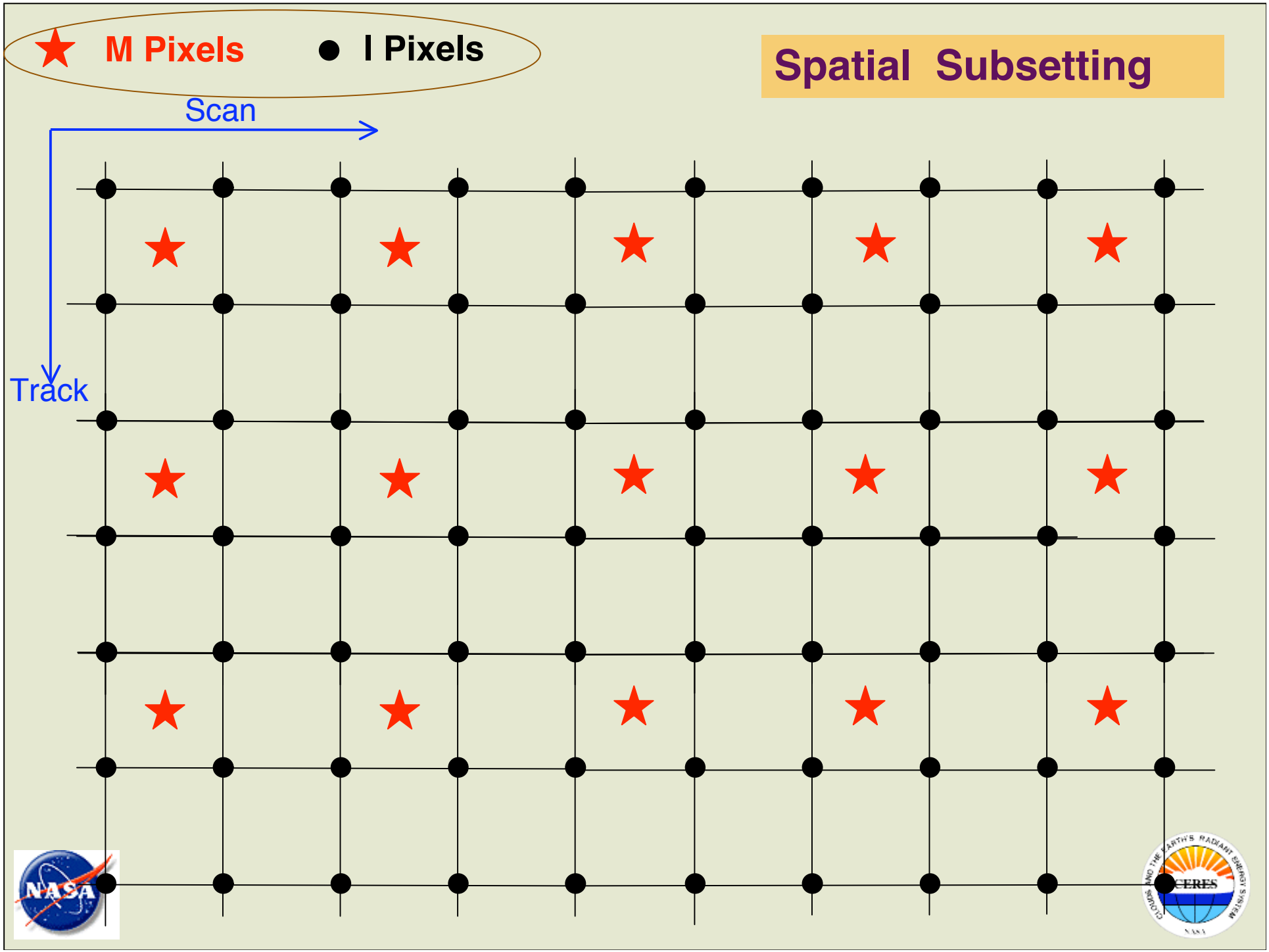
CERES VIIRS Subsetter – Cont'

Spatial Subset:

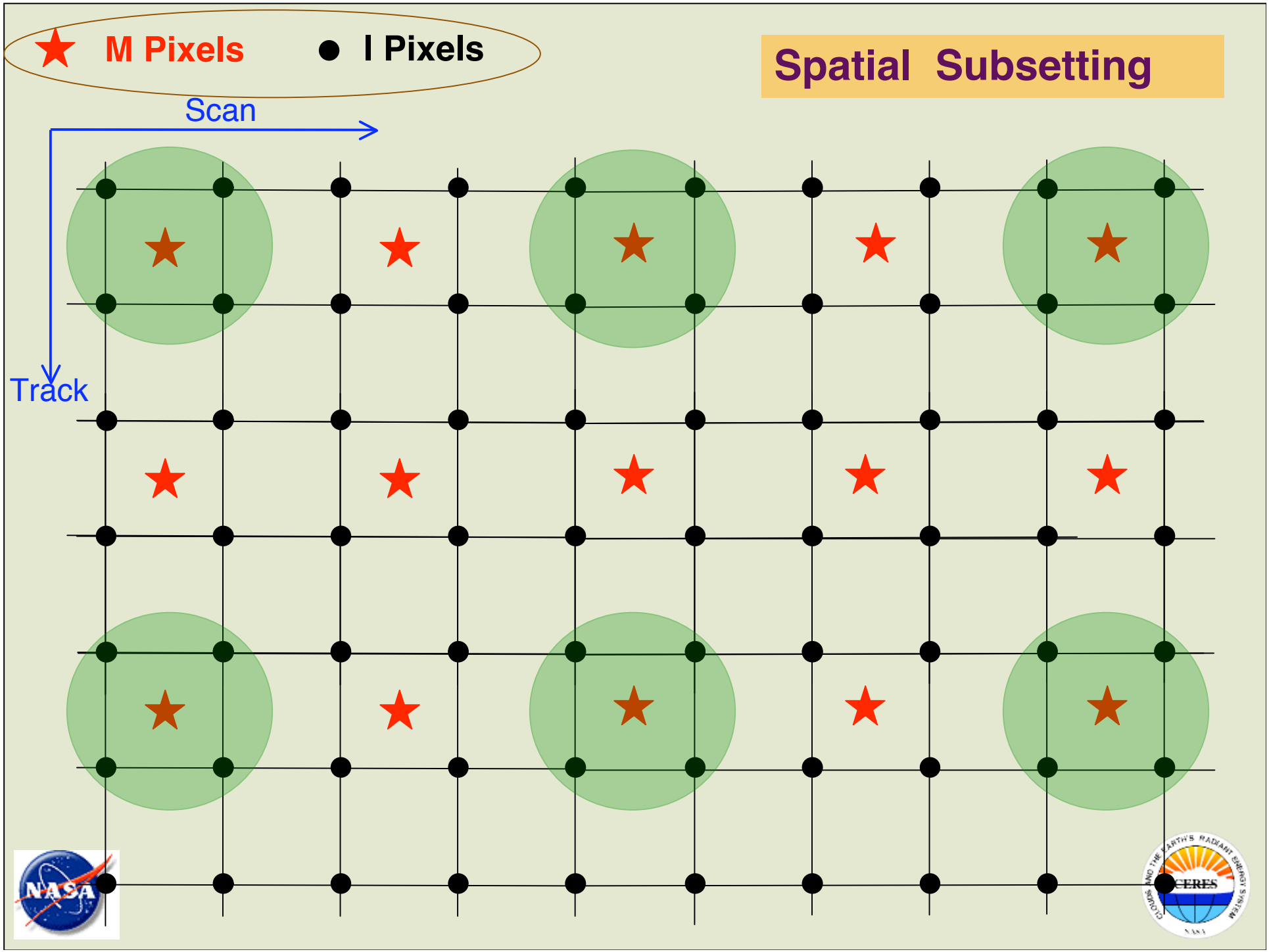
Scan Direction: Every other pixel, 3200 → 1600

Track Direction: Every other scan-line, 2700 → 1350

Spatial Subsetting



Spatial Subsetting



CERES VIIRS Subsetter – Cont'

Subsetted VIIRS Product (VIMD):

- **Reduce number of products:**
  Reduce three 5-min granules (LPEATE) to one

- **Reduce size:**
  Land PEATE VIIRS Products ~ 14 TB / month
  CERES Subsetted VIIRS Product: ~ 2.6 TB / month (~ 5+ times smaller)
  (Current MODIS at Langley: ~ 1 TB / month)

- **Written at LaRC and Delivered to Land PEATE at Goddard.**

- **To access VIMD:**
  (1) DPO at ASDC, Langley.
  (2) LAADS website: http://ladsweb.nascom.nasa.gov/
  (Search for VIMD)

Characteristics of NPP orbits (comparison with Aqua orbits)

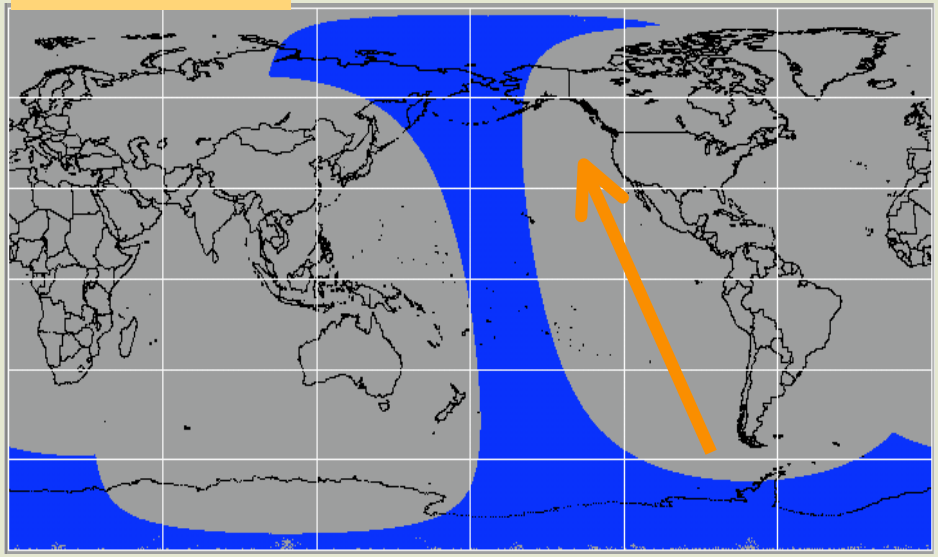
NPP	Aqua
Sun synchronous	Sun synchronous
1330 ascending note	1330 ascending note
16 days ground-track repeat	16 days ground-track repeat
• 227 revolutions	• 233 revolutions
824 km	705 km
101.5 min per orbit	98.9 min per orbit
3000 km swath width	2330 km swath width
full global coverage per day	near global coverage per day

Every 2 days and 16 hours, NPP is directly over Aqua (Simultaneous Nadir Overpass), offers an excellent calibration opportunity between VIIRS & Aqua-MODIS

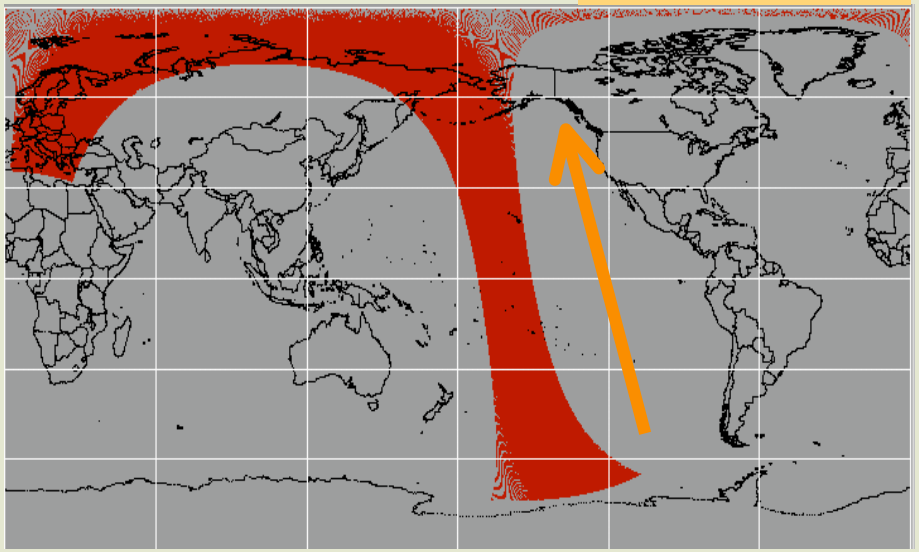
Characteristics of NPP orbits (comparison with Aqua orbits)-Cont'

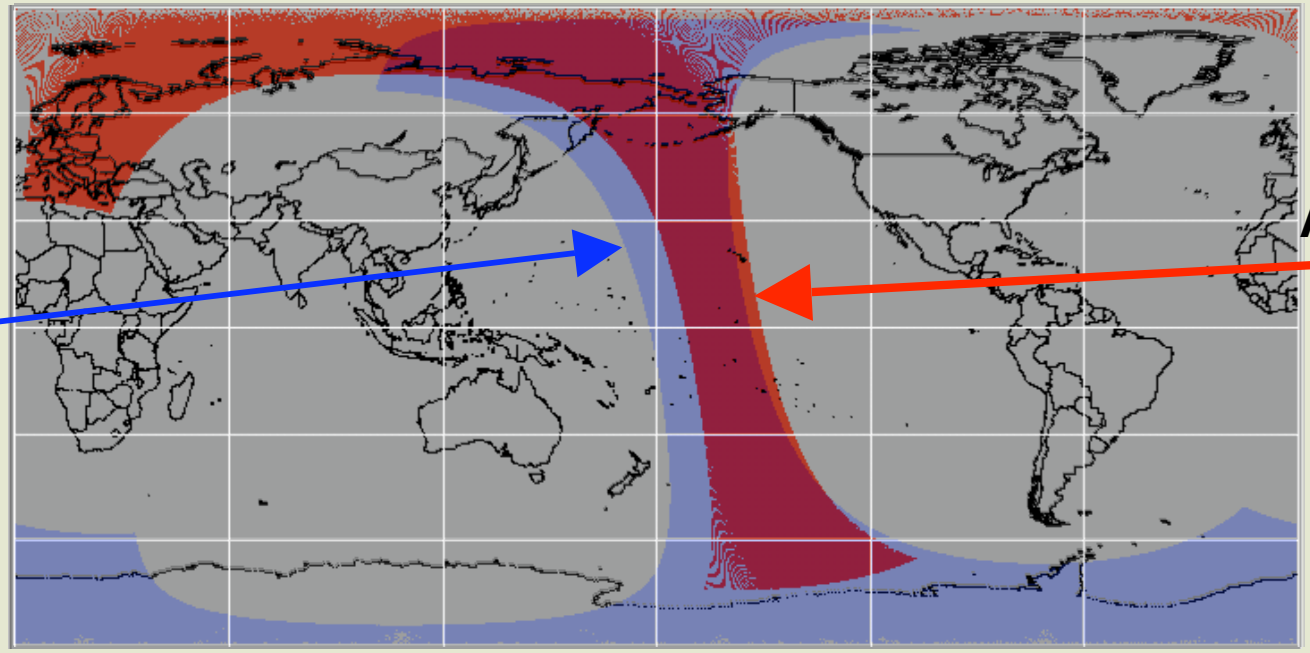
March 8, 2012, Hour 00

NPP-VIIRS

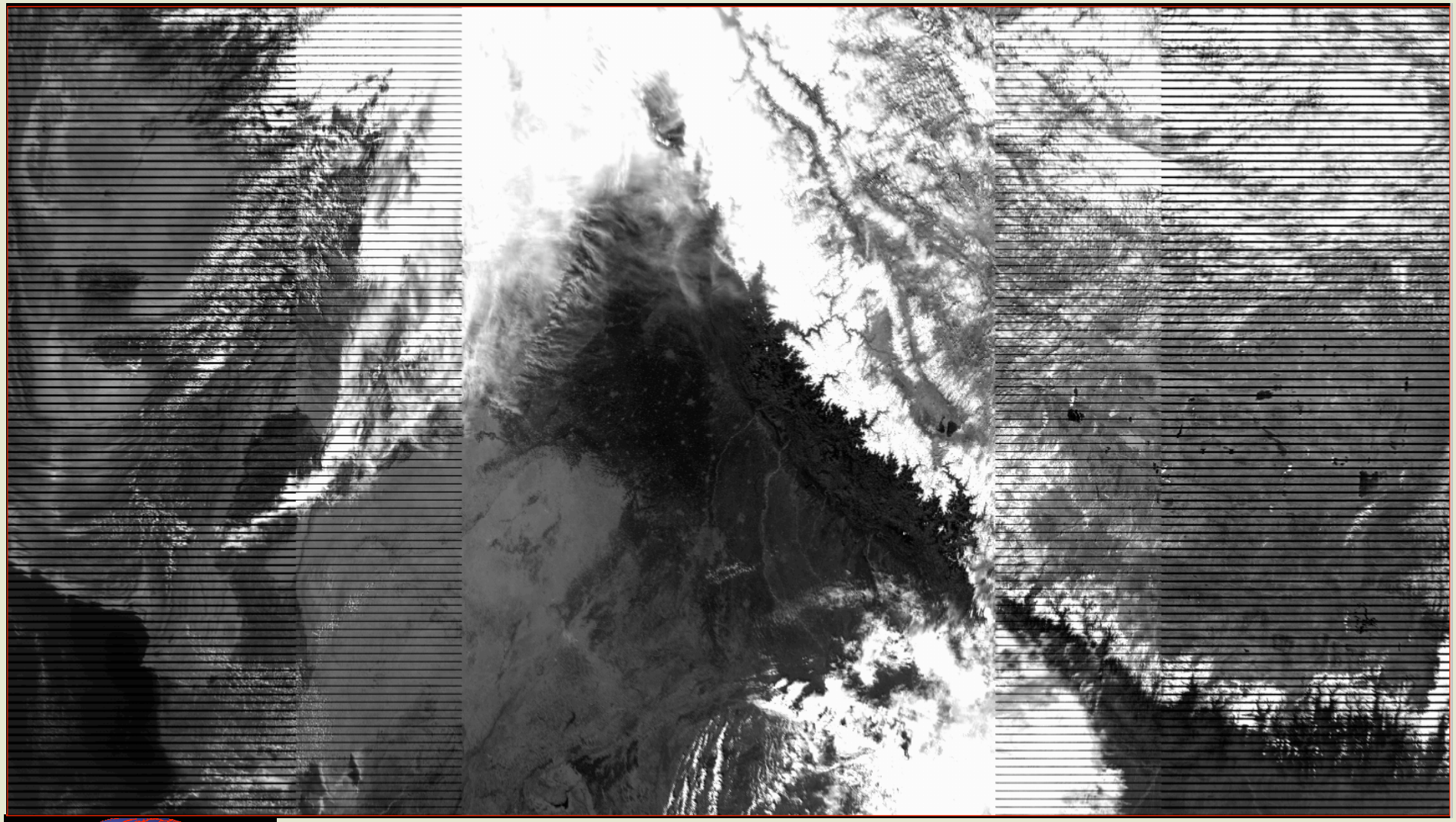


Aqua-MODIS





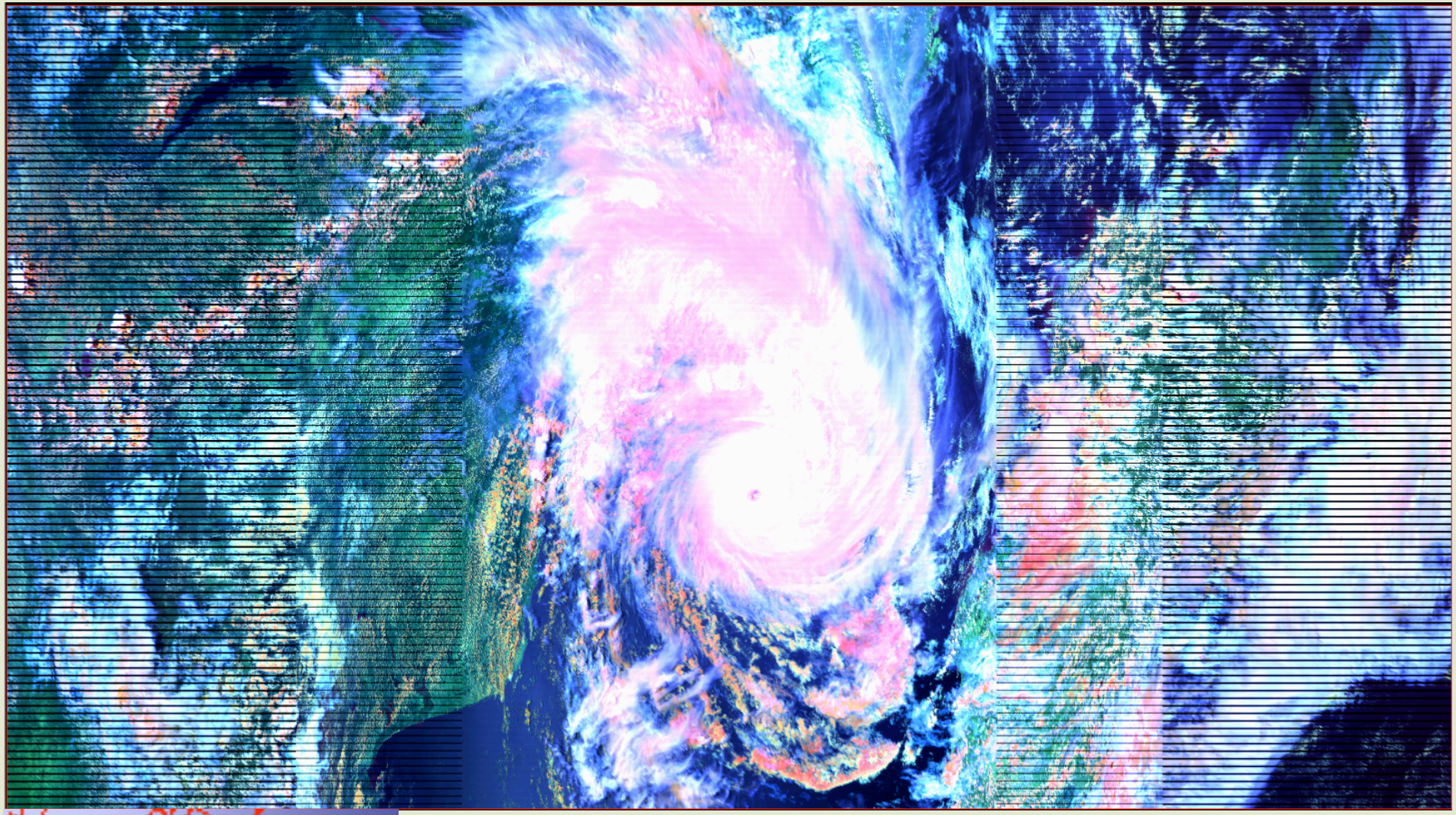
VIIRS First Look Gallery



No bow-tie near nadir
(1184 columns)
Grey Scale RGB 0.6 μm

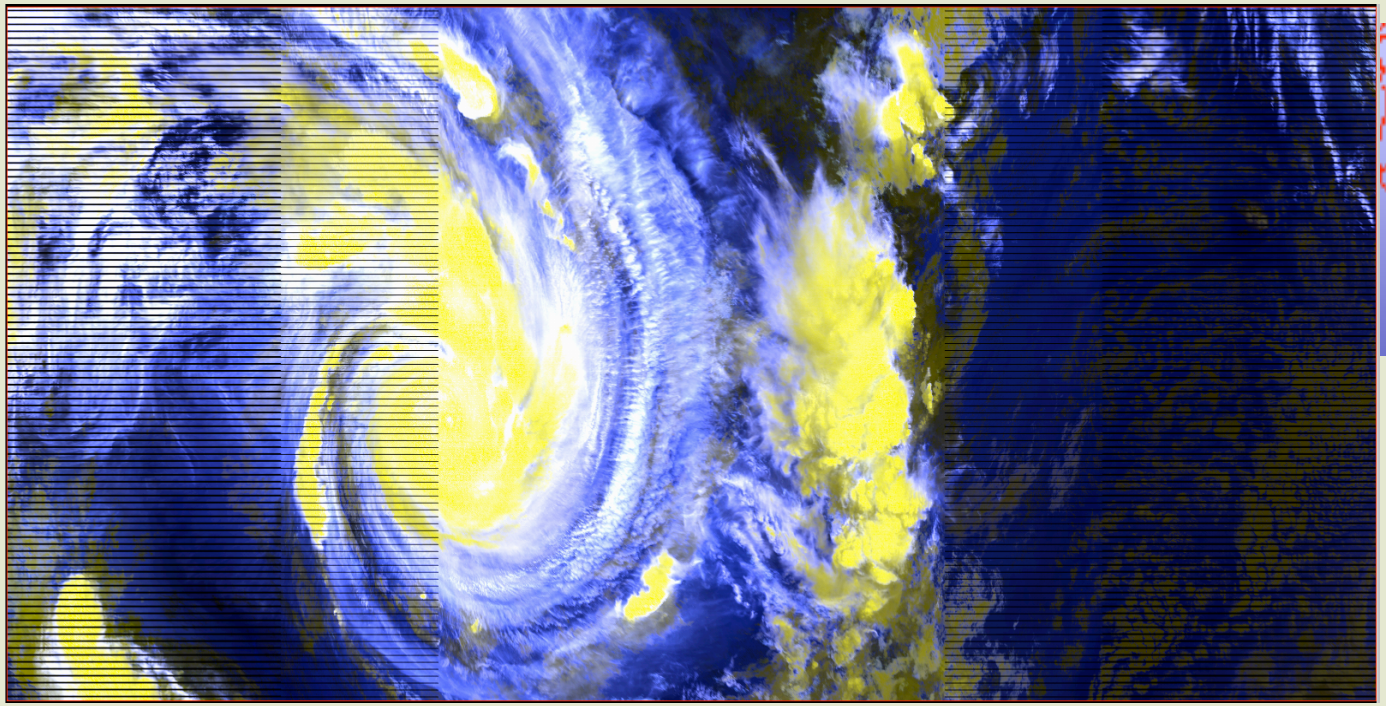
Bow-Tie deletion
(1008 columns on each side)

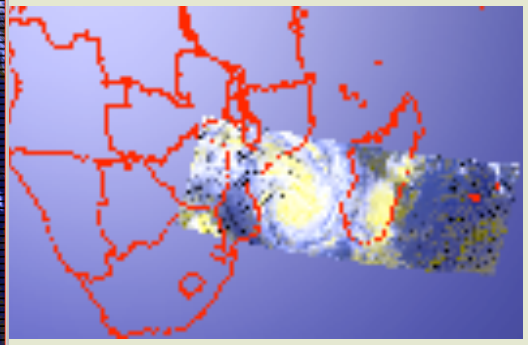
VIIRS: March 12, 2012. Hour 07, min 50 – 53



Tropical Cyclone, Funso

VIIRS: Jan 14, 2012, hour 11

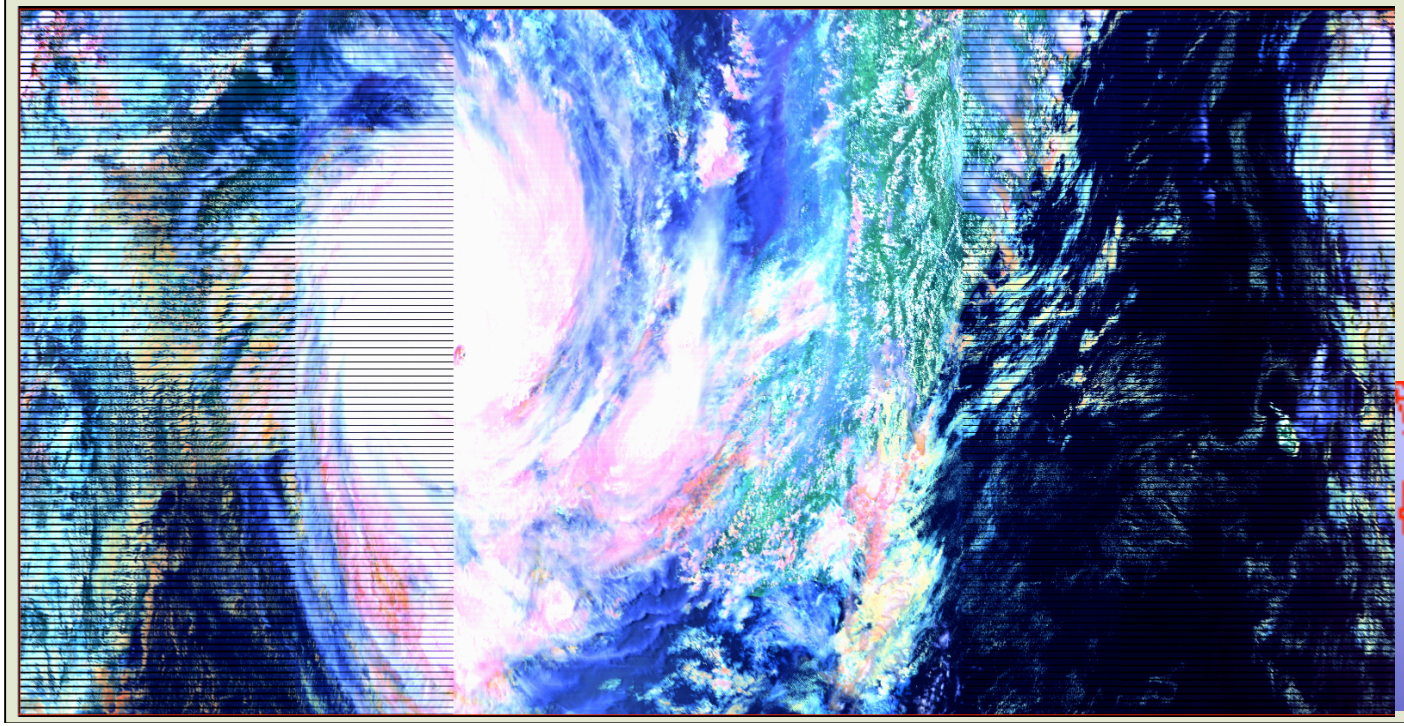




VIIRS: 2012 01 24 22

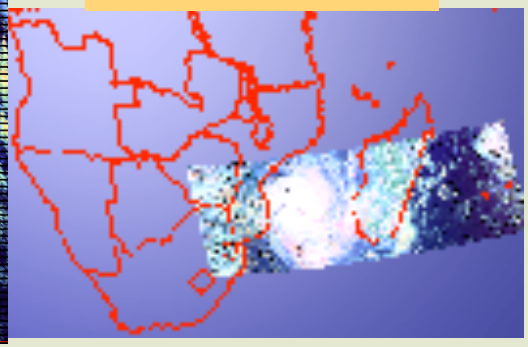
11 hours later

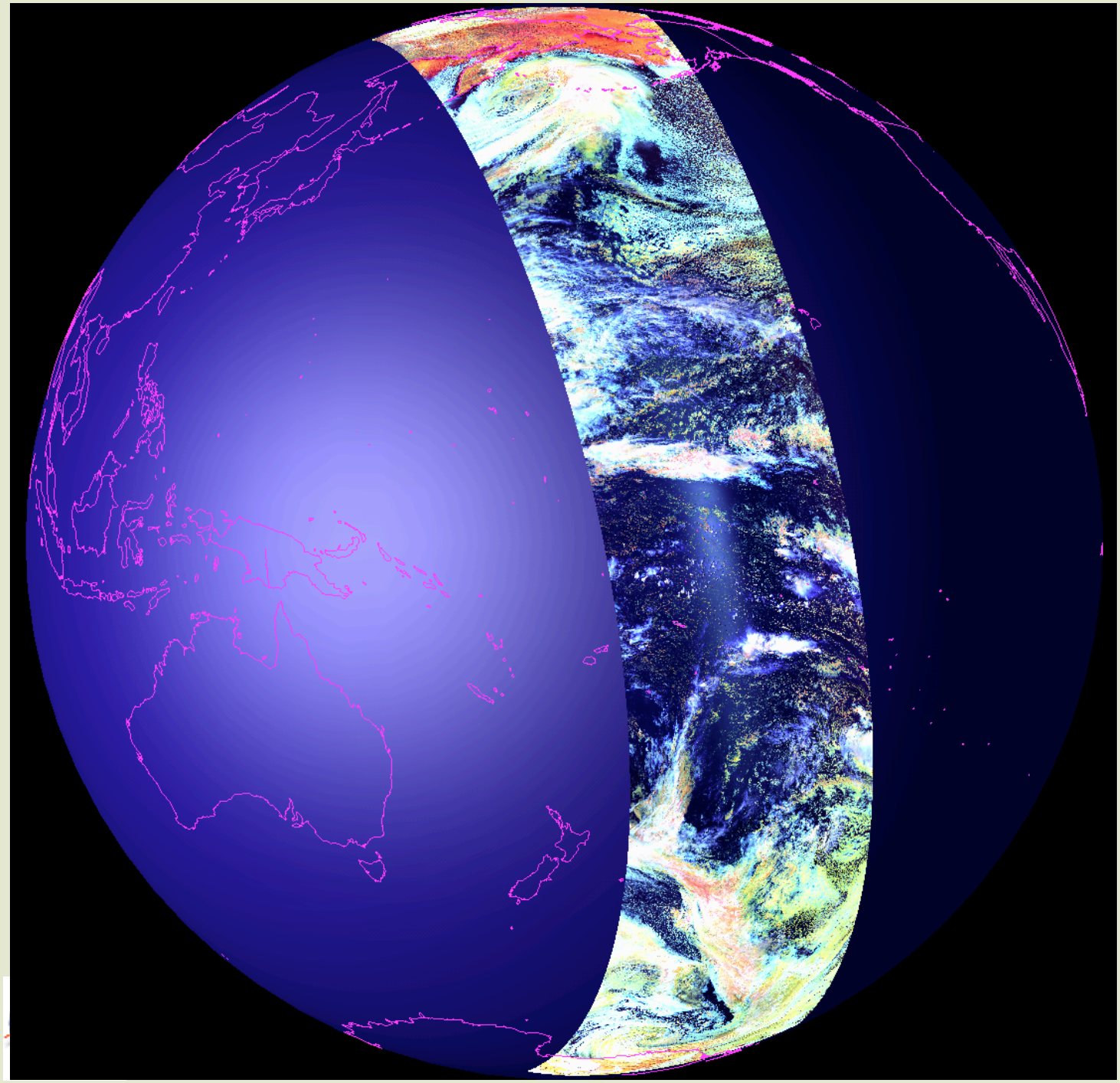
Tropical Cyclone, Funso



VIIRS: 2012 01 25 10

23 hours later





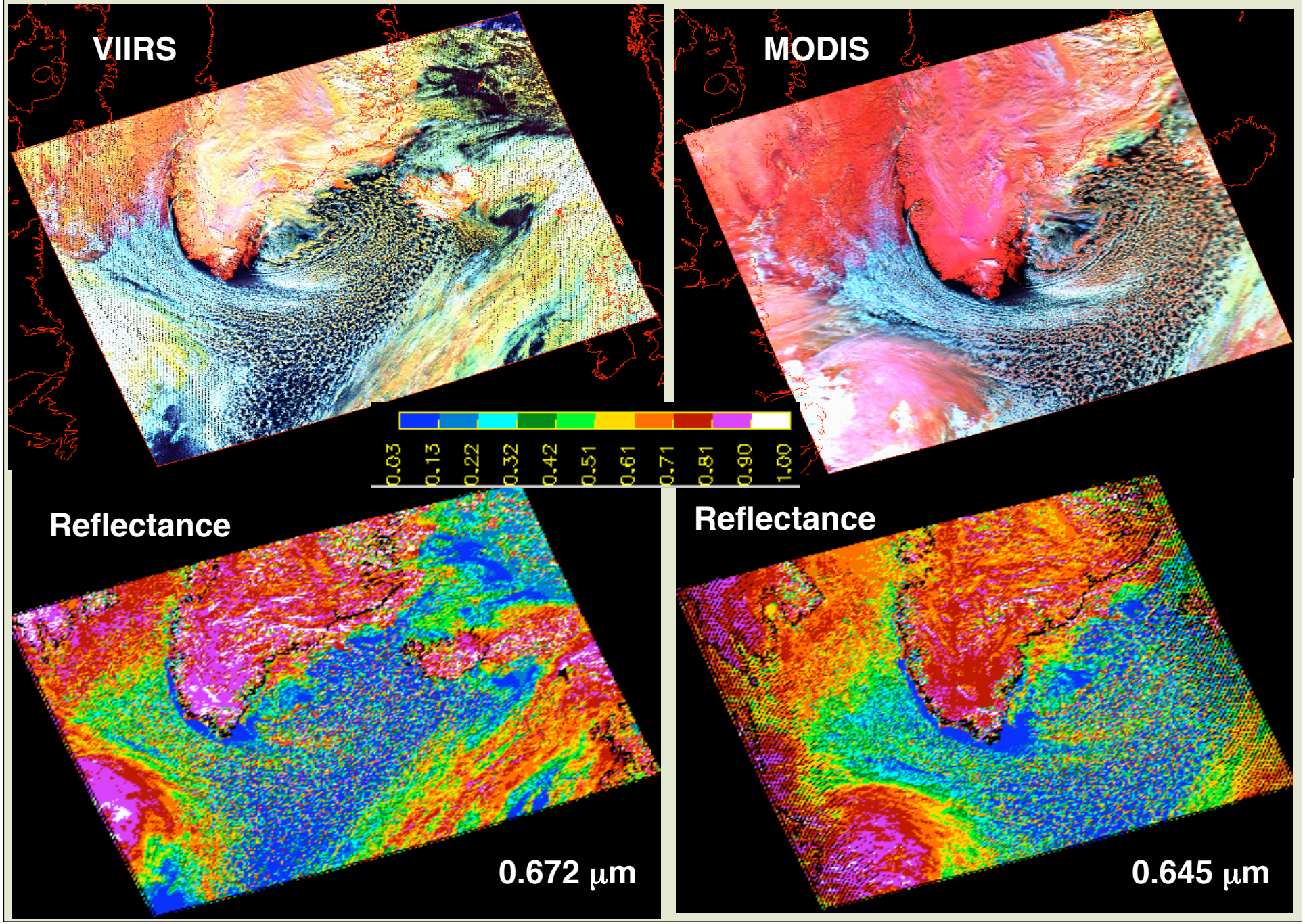
VIIRS
March 8, 2012
Hour 01

RGB:
Red: 0.6 μm
Green: 2.1 μm
Blue: 3.7-11 μm

Qualitative Case comparisons between VIIRS and Aqua-MODIS (reflectance and brightness temperature)

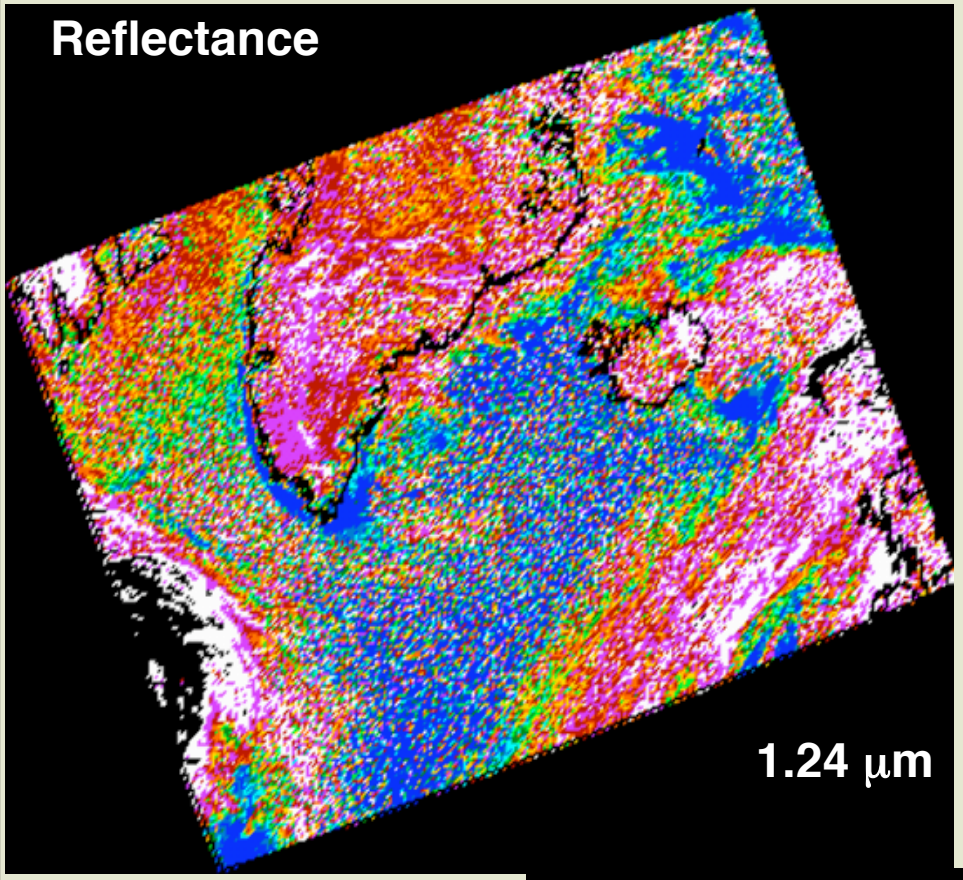
VIIRS: March 8, 2012, Hour 14, min 25

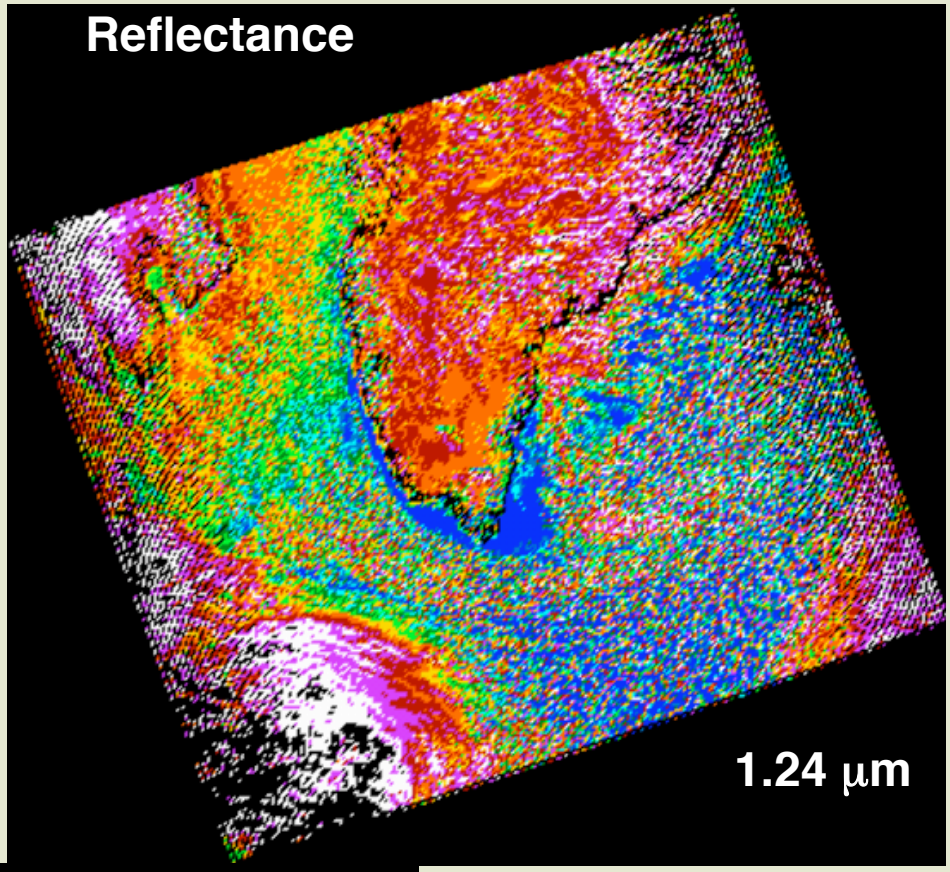
MODIS: 50 min later



VIIRS: March 8, 2012, Hour 14, min 25

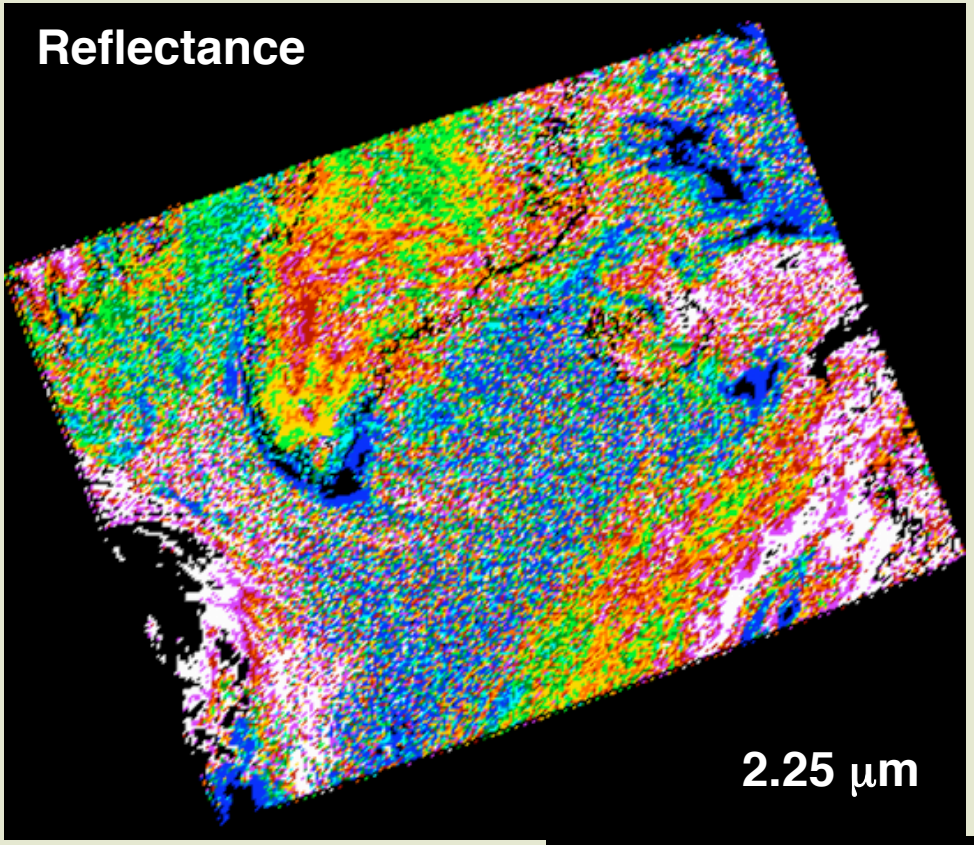
MODIS: 50 min later

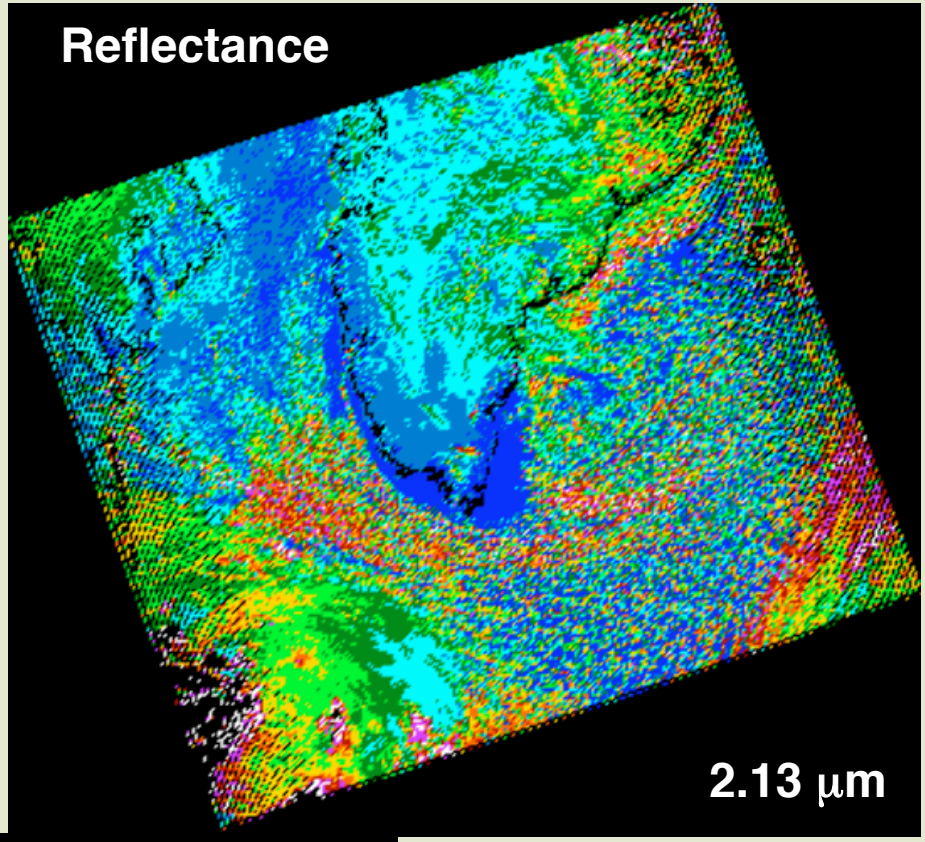




VIIRS: March 8, 2012, Hour 14, min 25

MODIS: 50 min later

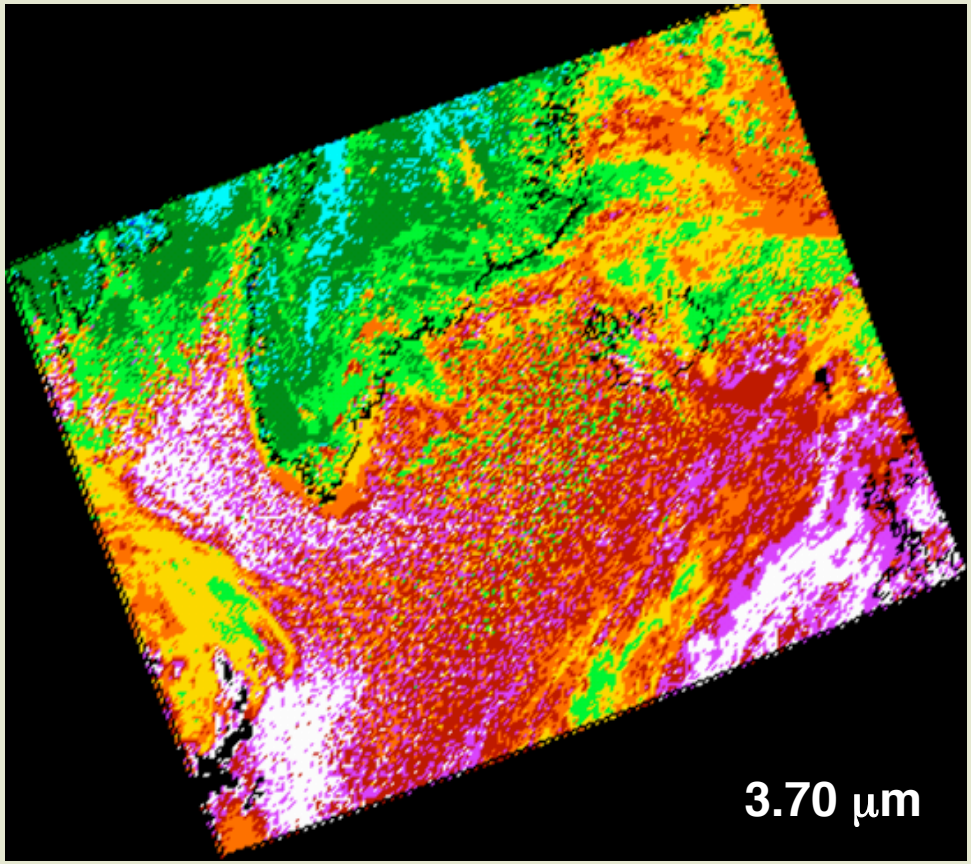




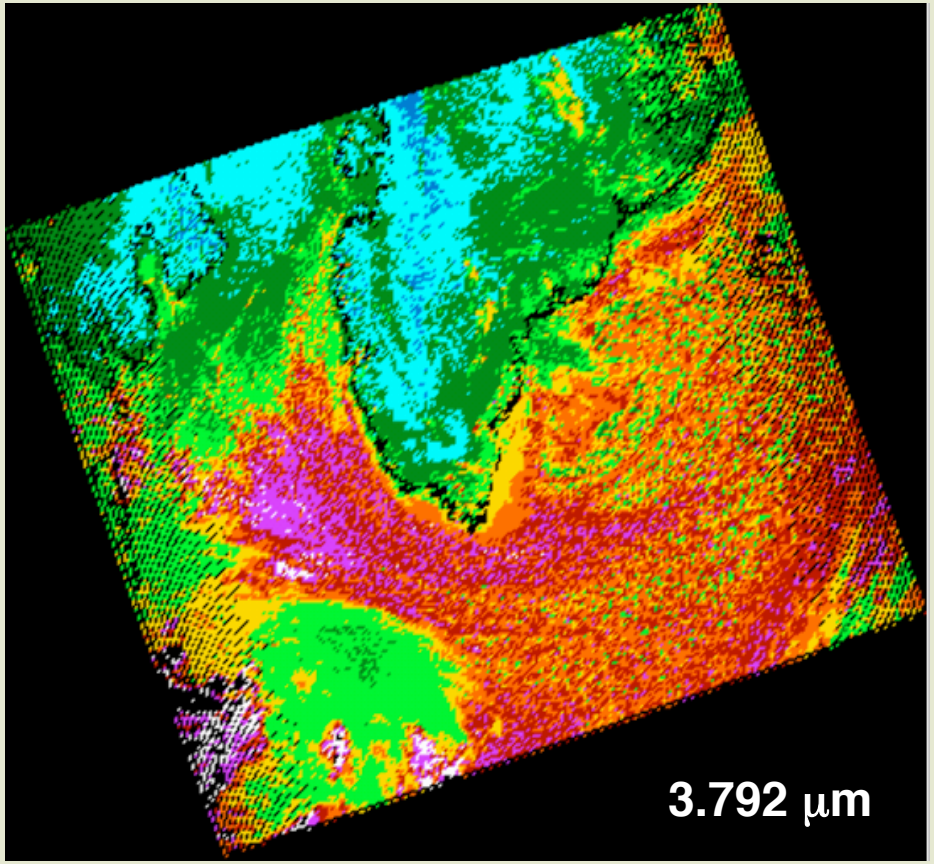
Reflectance for VIIRS >> MODIS, over snow / ice surfaces

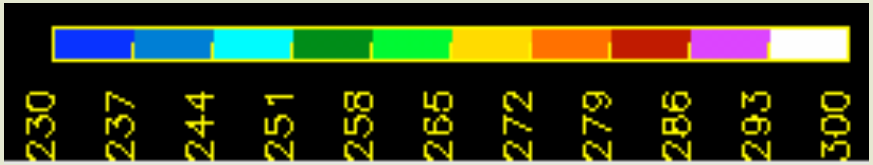
Brightness Temperature (K)

VIIRS: March 8, 2012, Hour 14, min 25



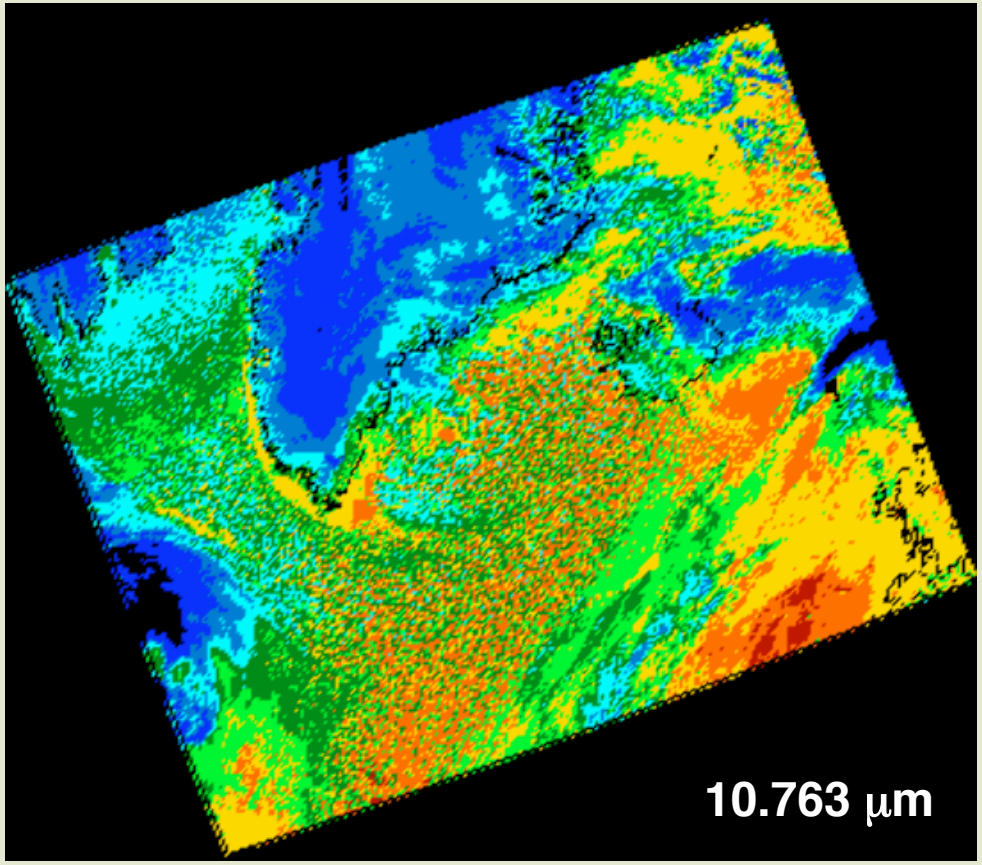
MODIS: 50 min later



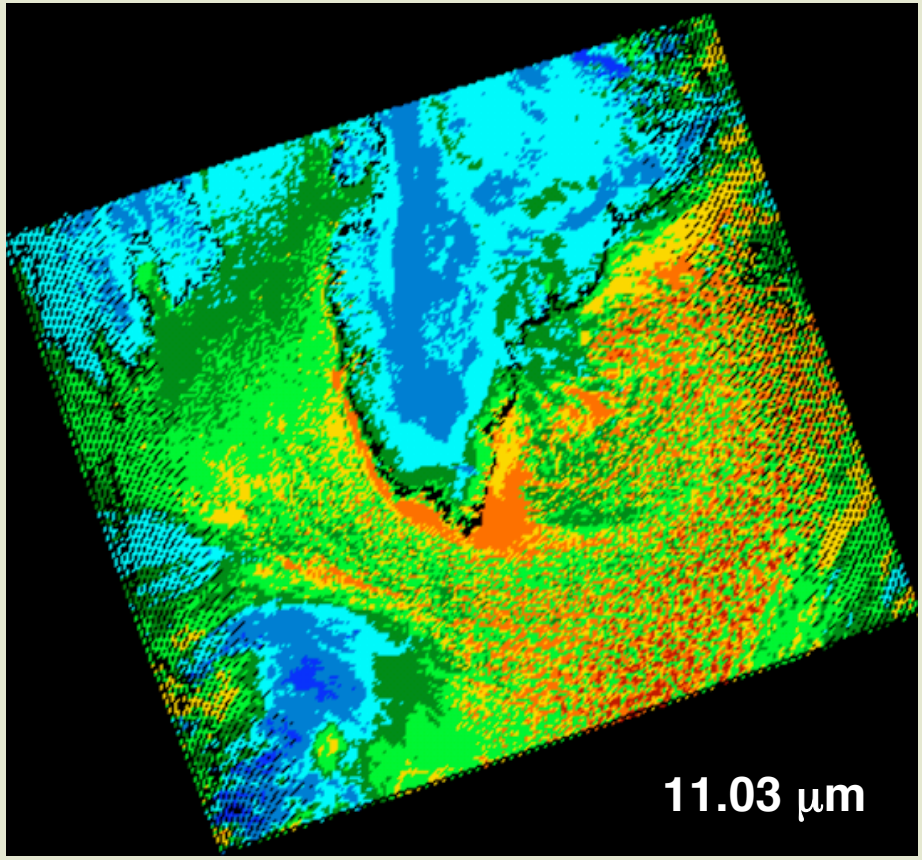


Brightness Temperature (K)

VIIRS: March 8, 2012, Hour 14, min 25



MODIS: 50 min later



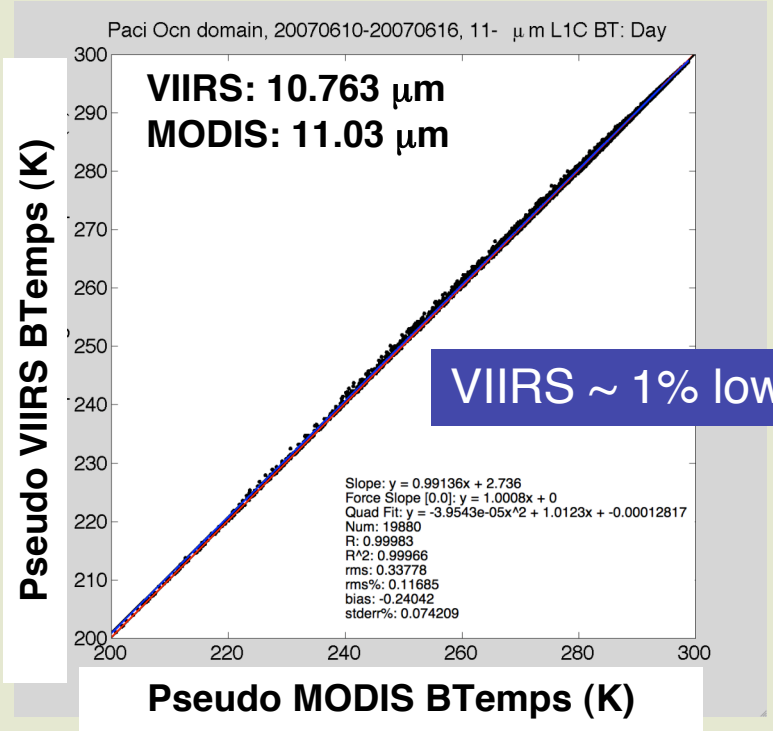
Relationship Between VIIRS Channels and MODIS Channels

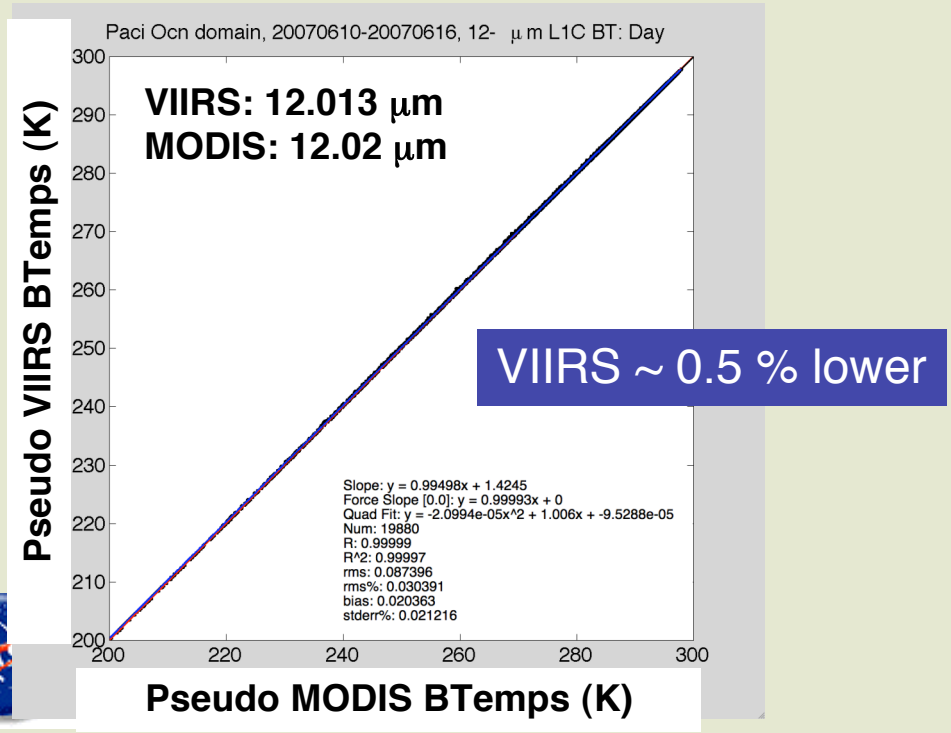
IASI-Based Pseudo Brightness Temperature

SCIAMACHY-Based Pseudo Reflectances

By integrating the IASI or SCIAMACHY data over the filter function for data taken over a lot of scenes to get the full range of surfaces, humidities, temps, etc.

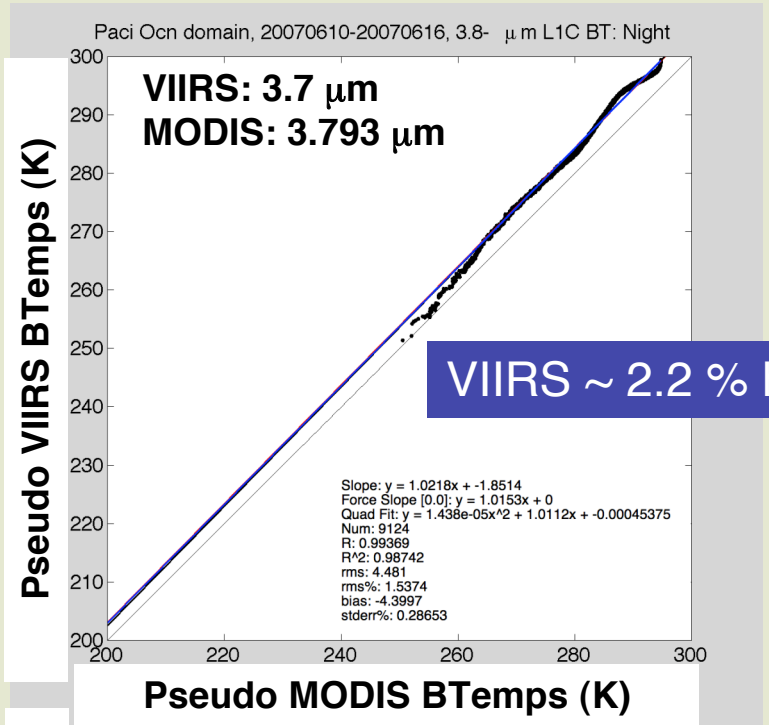
Scatter Plots of IASI-Based Pseudo Brightness Temperatures

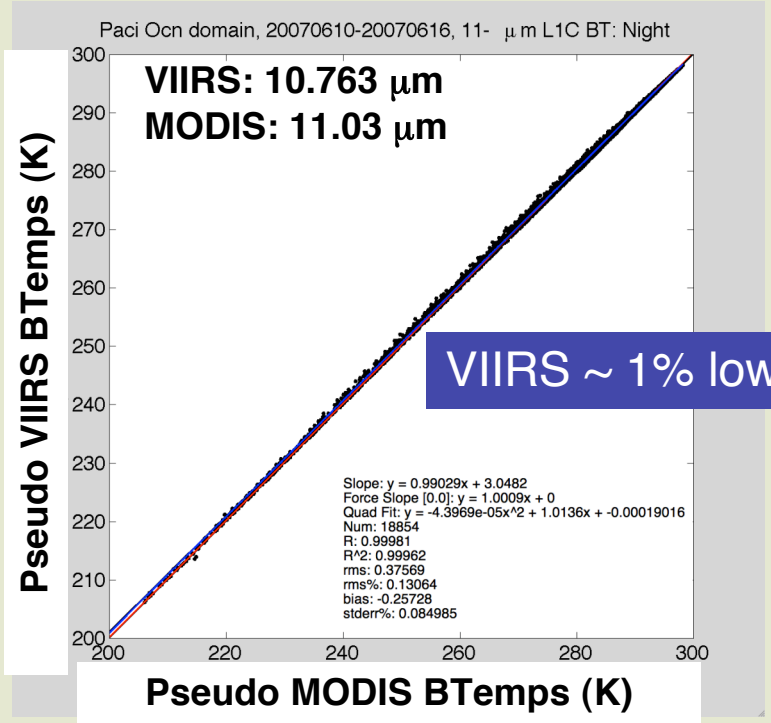


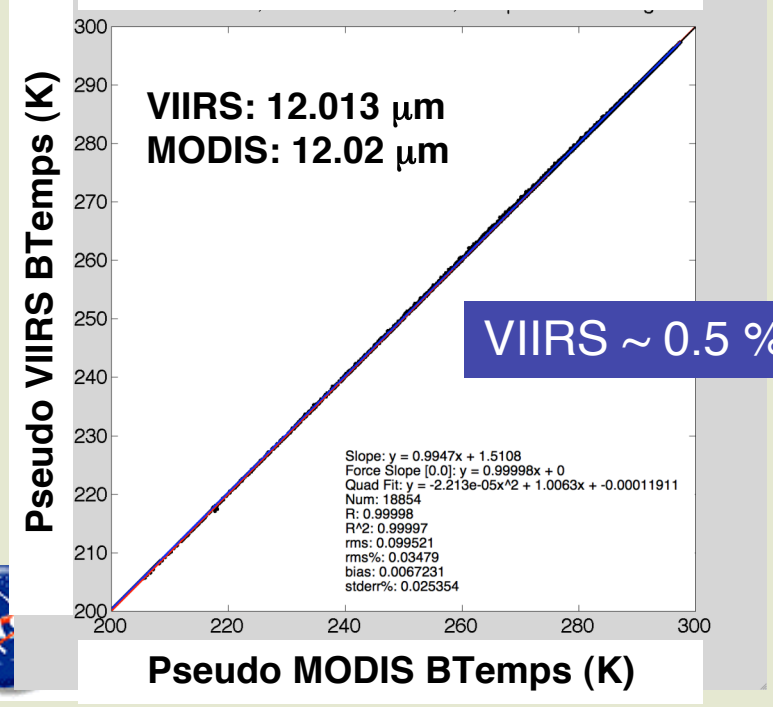


Day Time

IASI June 10 – 16, 2007



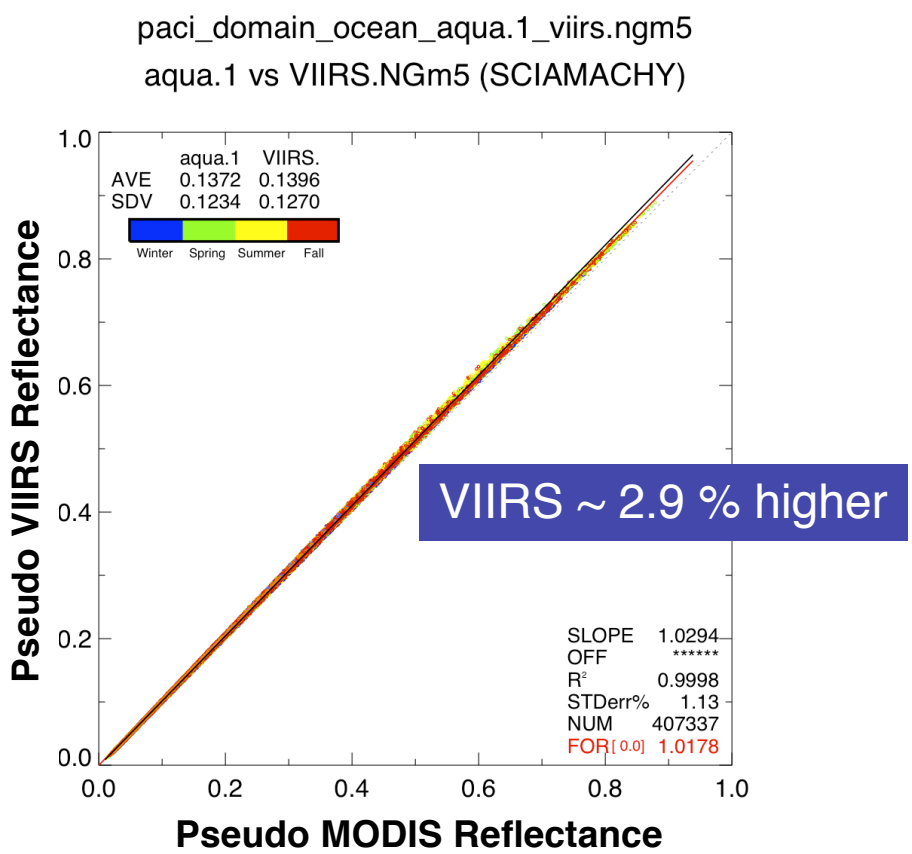




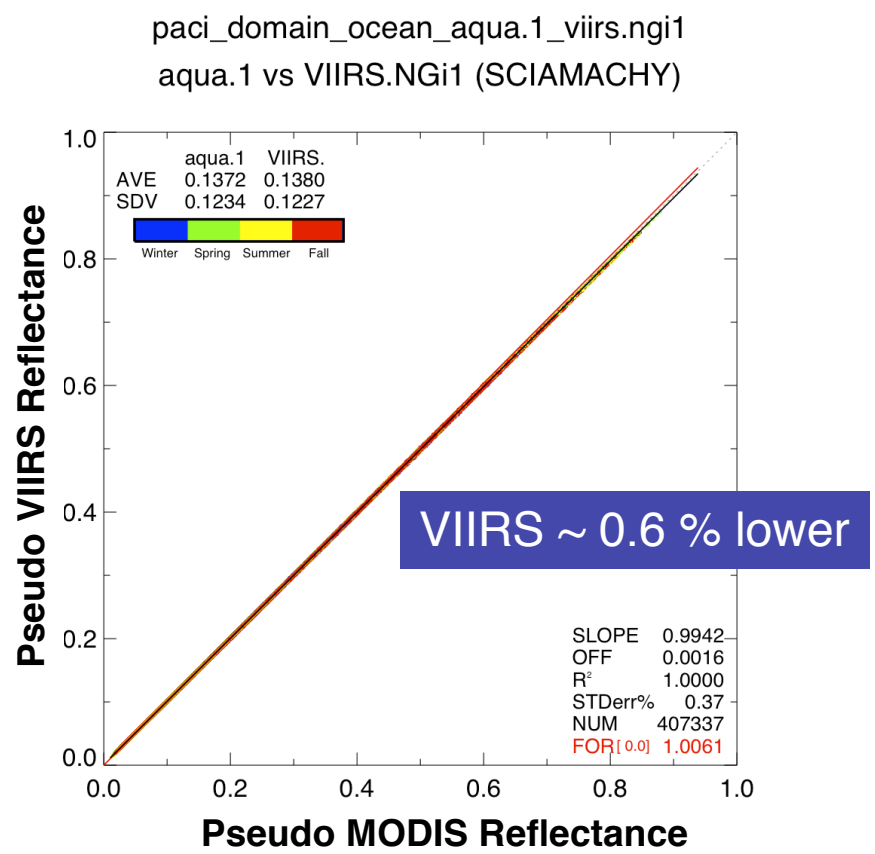
IASI-Based Pseudo Brightness Temperatures

Night Time

IASI June 10 – 16, 2007

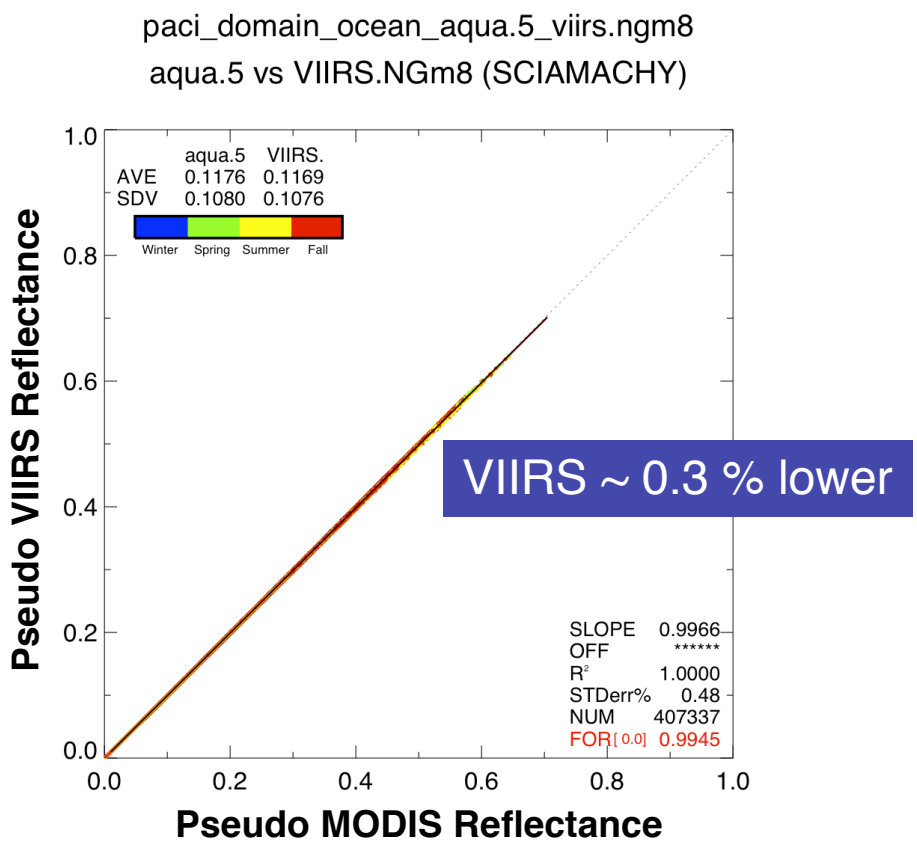


VIIRS: 0.672 μm (Moderate Res.)
MODIS: 0.645 μm

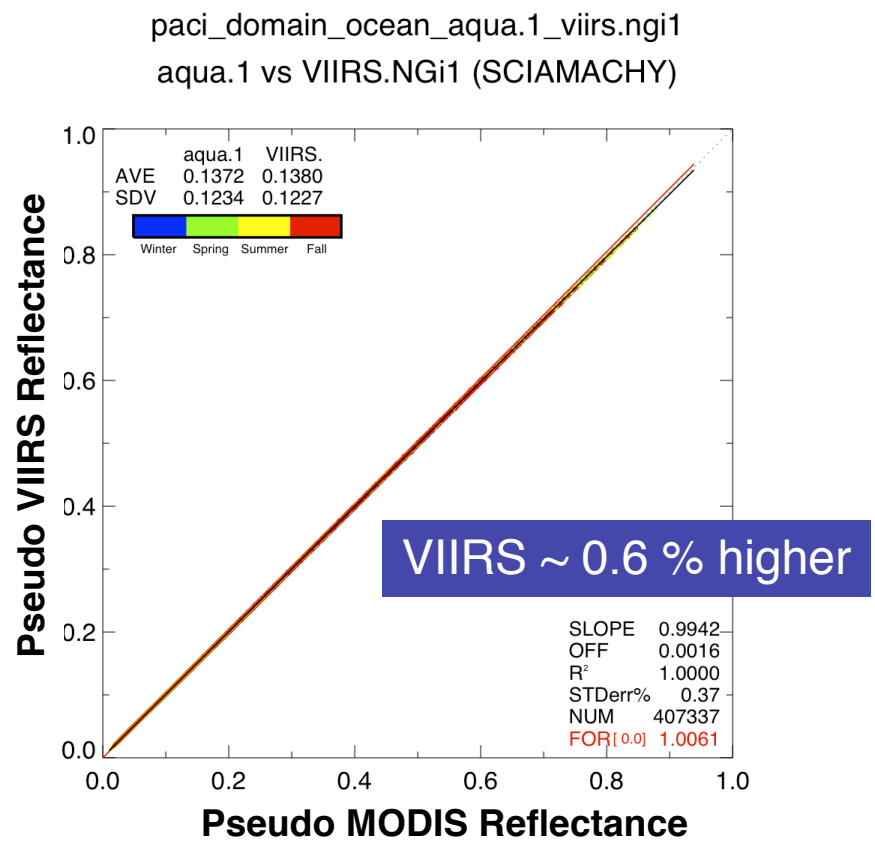


VIIRS: 0.64 μm (Imagery Res.)
MODIS: 0.645 μm

SCIAMACHY-Based Pseudo Reflectances



VIIRS: 1.24 μm
MODIS: 1.24 μm



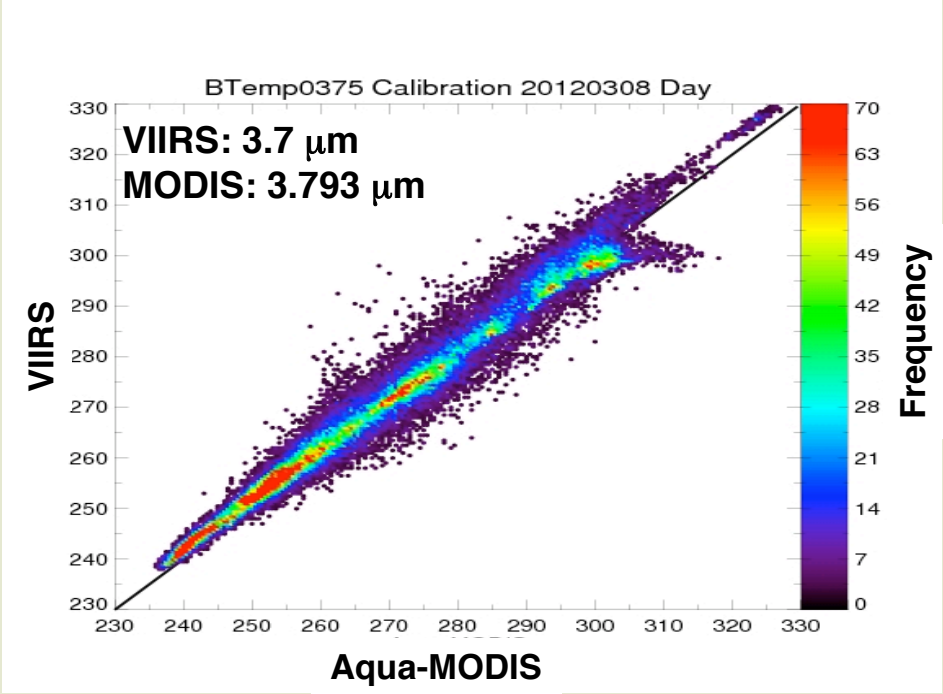
VIIRS: 1.38 μm
MODIS: 1.375 μm

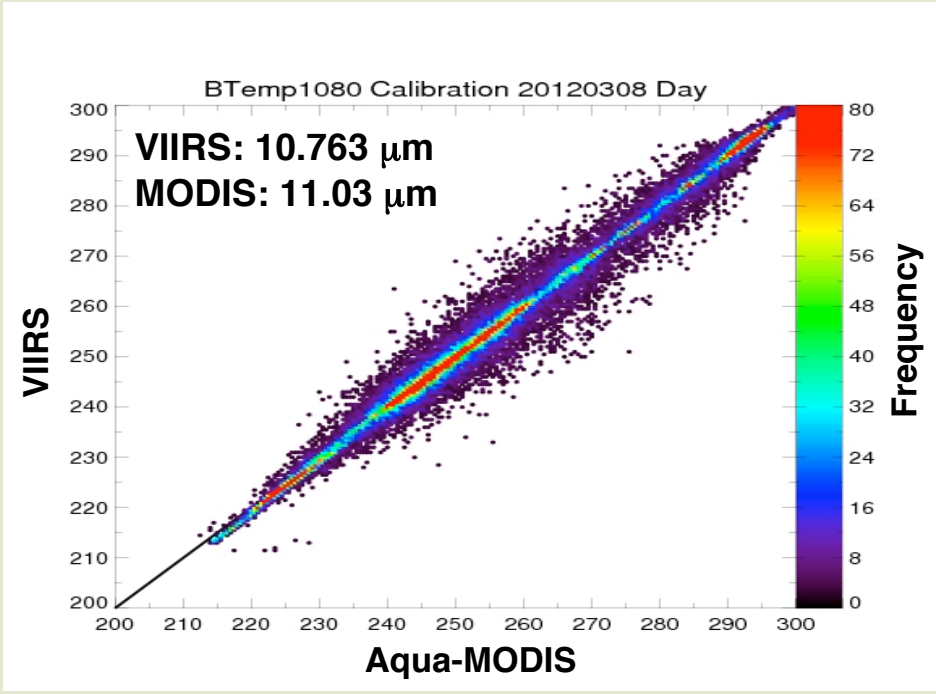
SCIAMACHY-Based Pseudo Reflectances

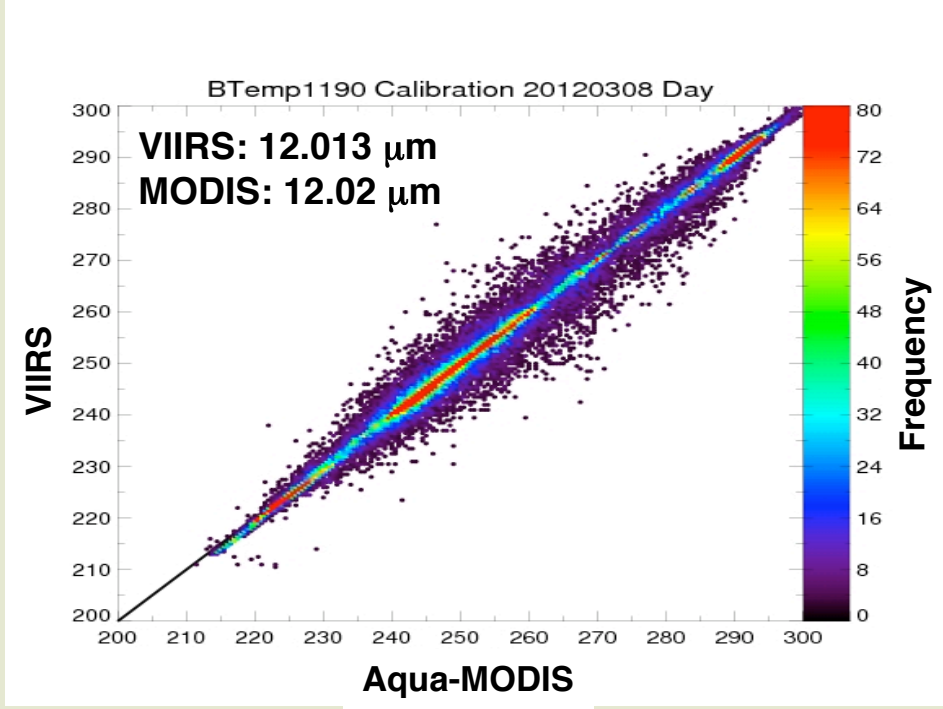
Daily Channel Comparisons Between VIIRS and Aqua-MODIS

VIIRS and Aqua-MODIS are matched within 1 hour and within 10 degree view angles

Comparison Date: March 8, 2012

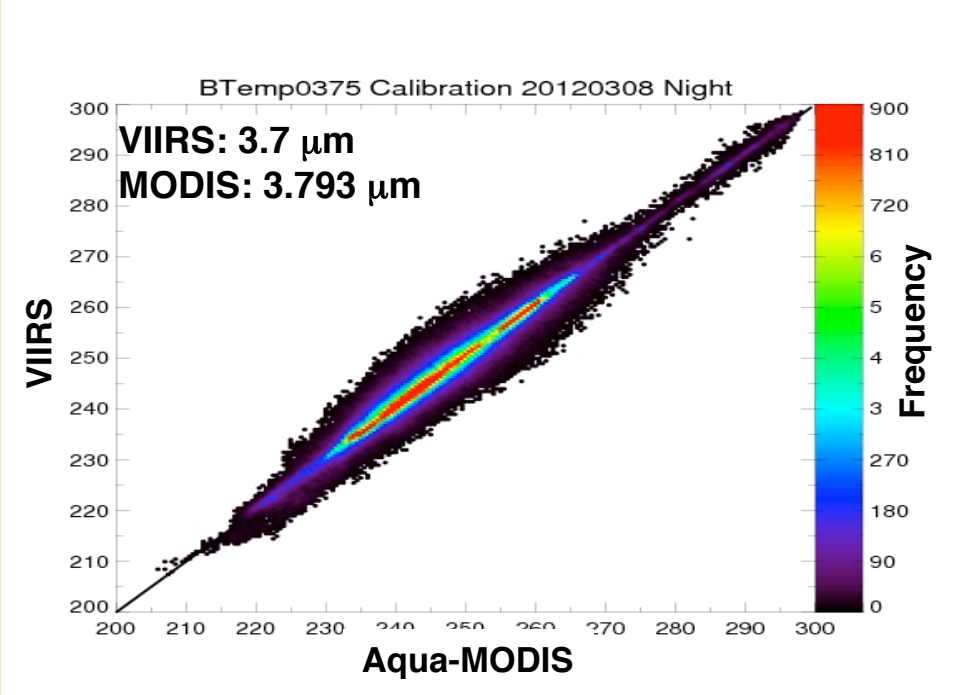


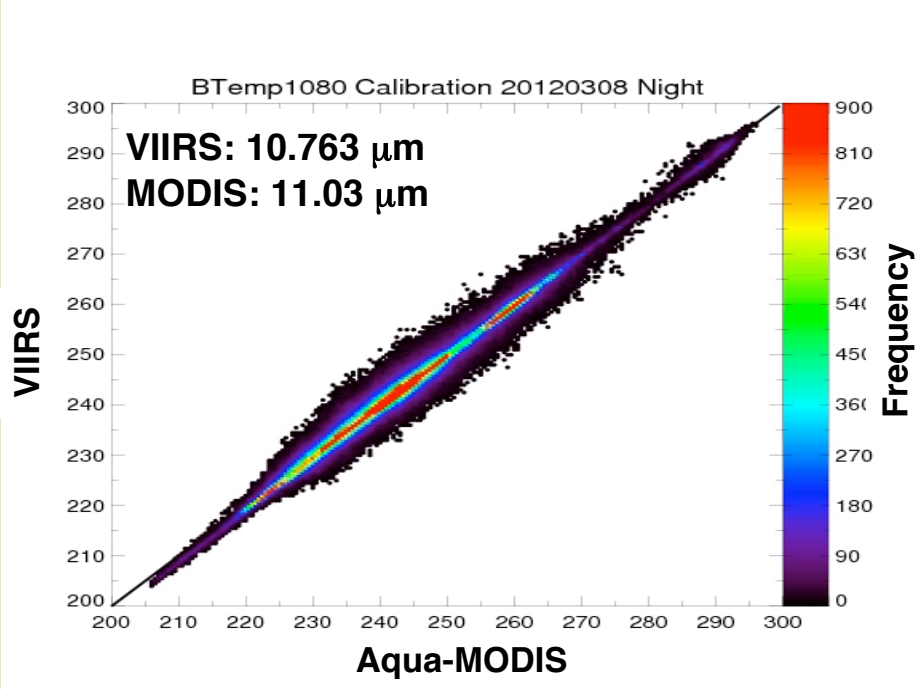


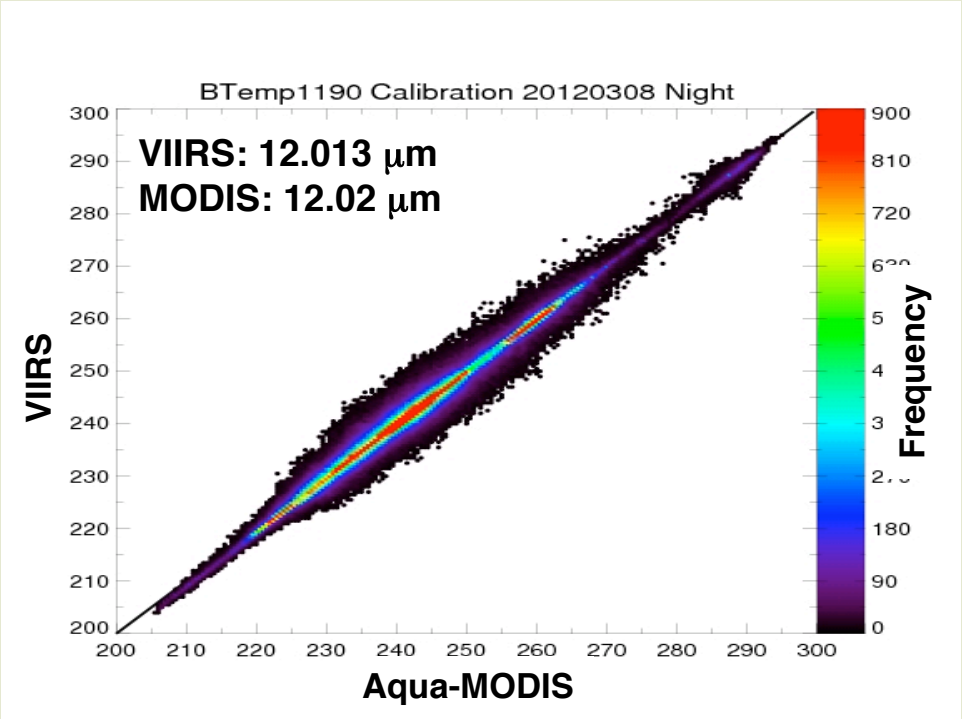


Scatter Plots of Brightness Temperatures between VIIRS and Aqua-MODIS

Day Time



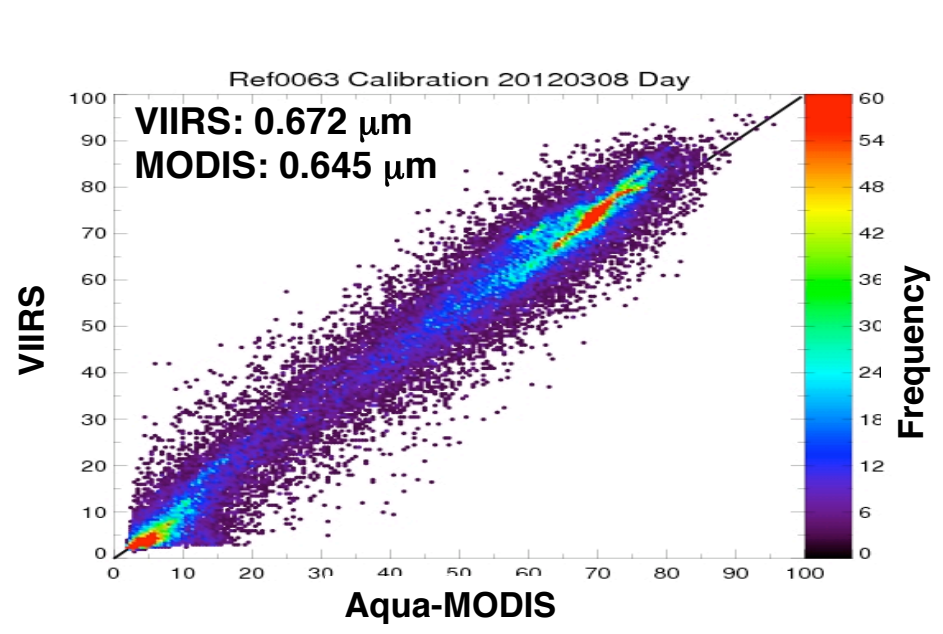


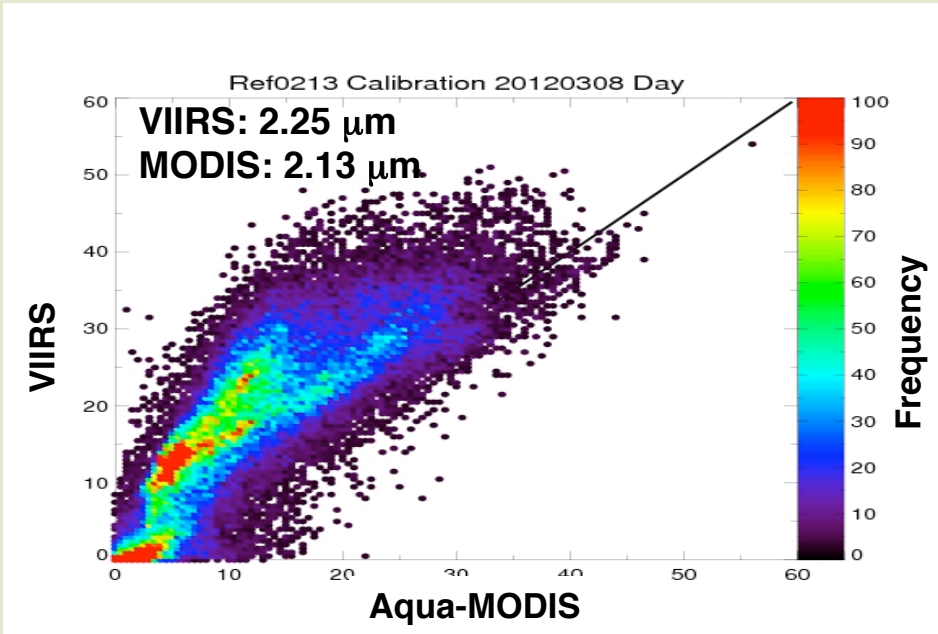


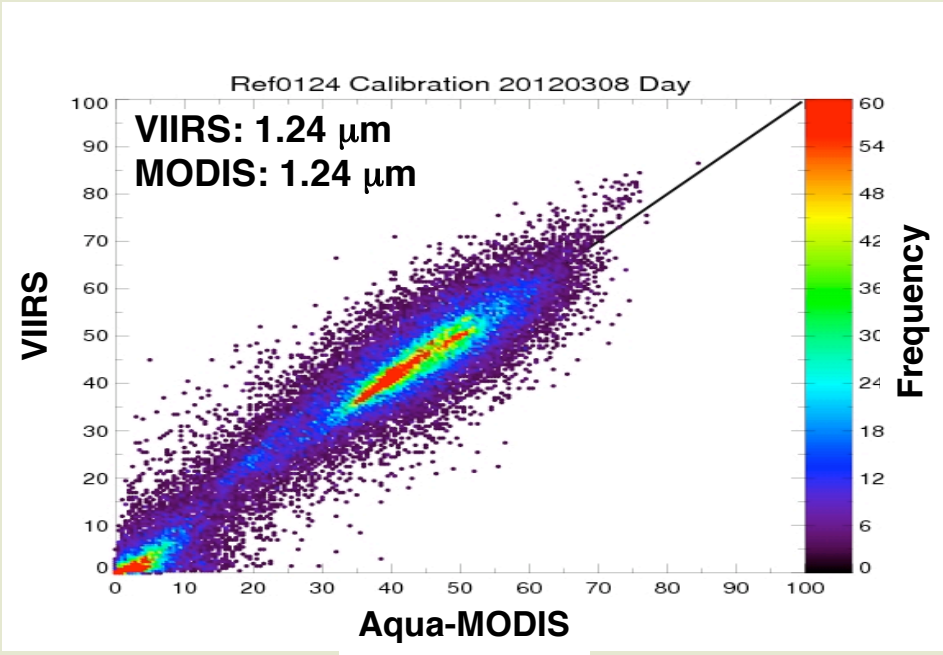
Scatter Plots of Brightness Temperatures between VIIRS and Aqua-MODIS

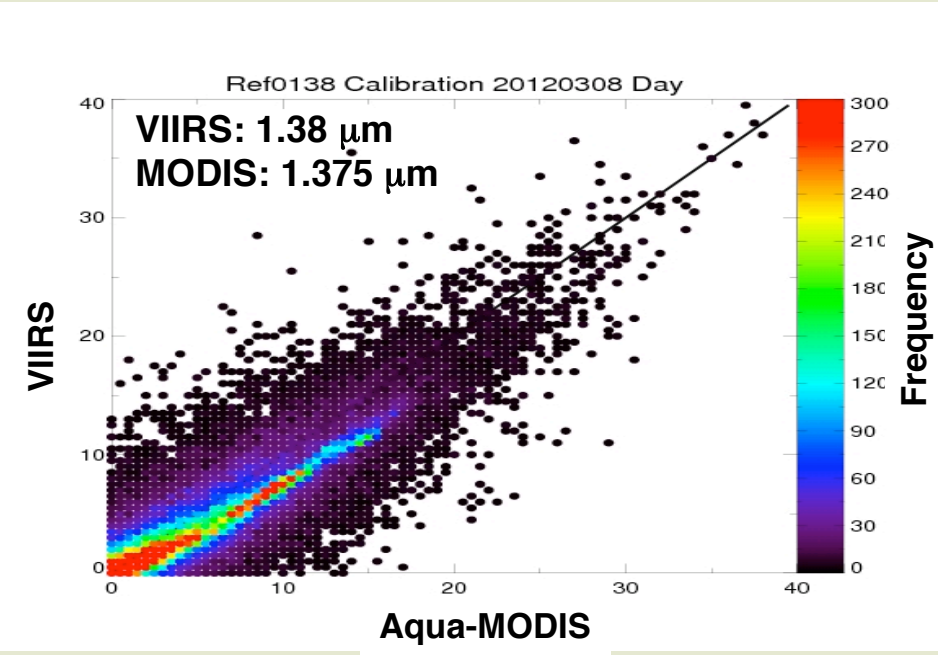
Night Time

Scatter Plots of Reflectance between VIIRS and Aqua-MODIS









Summary from VIIRS Cal/Val Team

- TEB (Thermal Emissive Bands) calibration appears comparable in quality to MODIS instruments

- Throughput anomaly due to tungsten contamination of RTA coatings continues to affect instrument response in VisNIR and SWIR bands

  ~ 0.8% degradation / week in worst case
  (0.64 μm (I1), 0.865 μm (I2), 1.24 μm (M8))

  Operational LUTs updated weekly, but insufficient to provide calibration continuity and stability desired by EDR teams

NPP VIIRS Calibration versions and schedule

Beta (Hopefully Soon)

– Early release product, initial calibration applied, minimally validated and may still contain significant Errors

– Product is not appropriate as the basis for quantitative scientific studies, applications and publications.

Provisional (July 2012?)

– Product quality may not be optimal

– General research community is encouraged to participate in the QA and validation of the product, but need to be aware that product validation and QA are ongoing

– Users are urged to contact NPP Cal/Val Team representatives prior to use of the data in publications

Validated/Calibrated (March 2013)

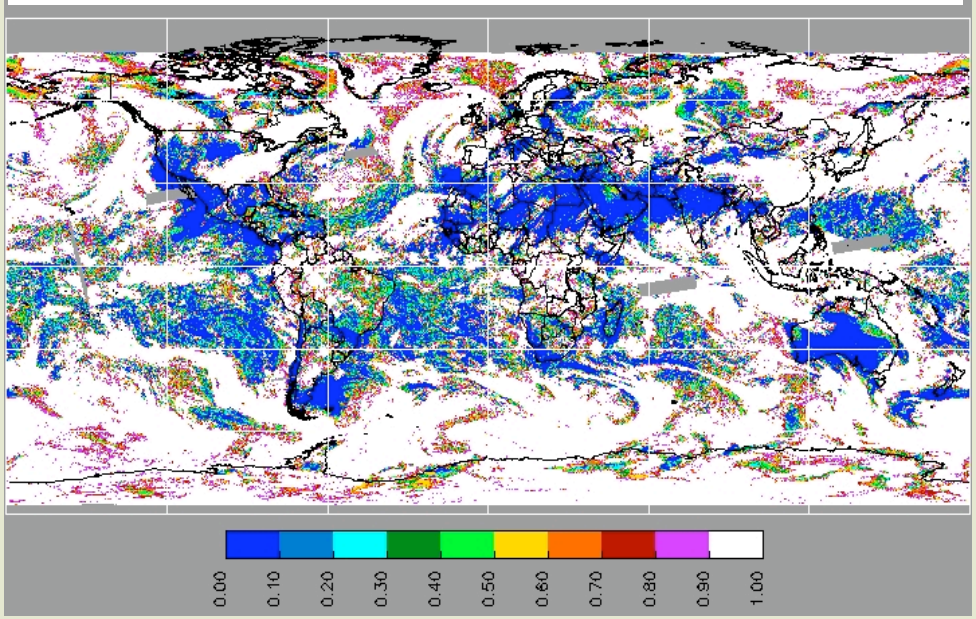
– On-orbit sensor performance characterized and calibration parameters adjusted accordingly

– Ready for use by the Centrals, and in scientific publications

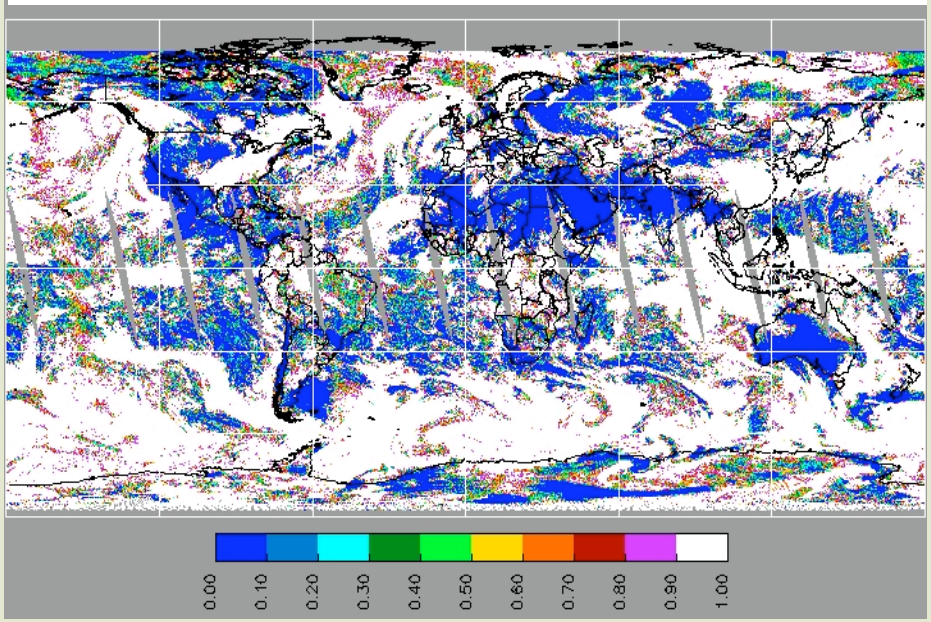
– There may be later improved versions

Preliminary Results

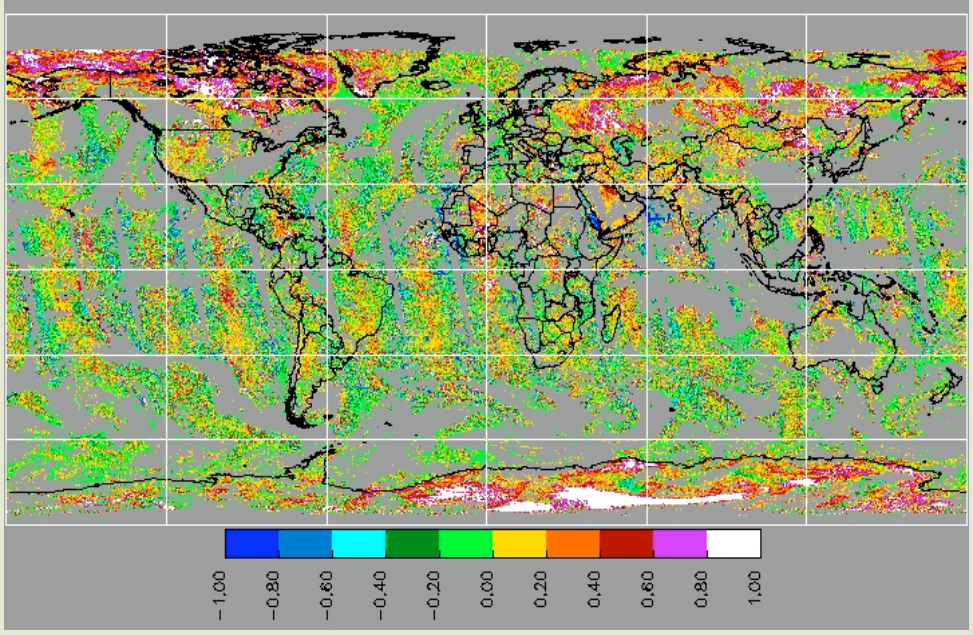
NPP-VIIRS



Aqua-MODIS



VIIRS - MODIS

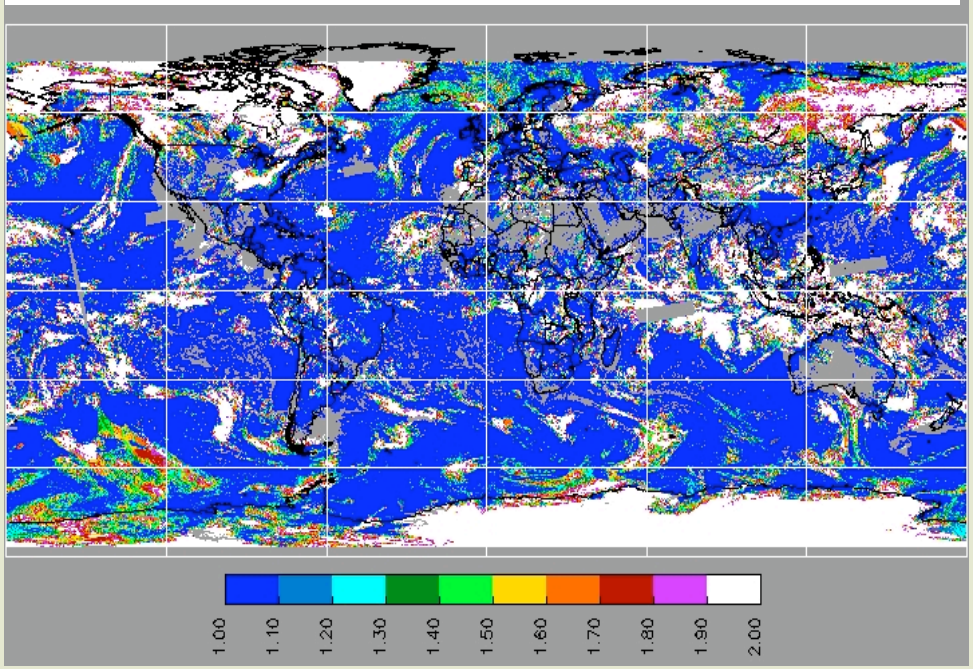


Cloud Fraction March 08, 2012 Day Time

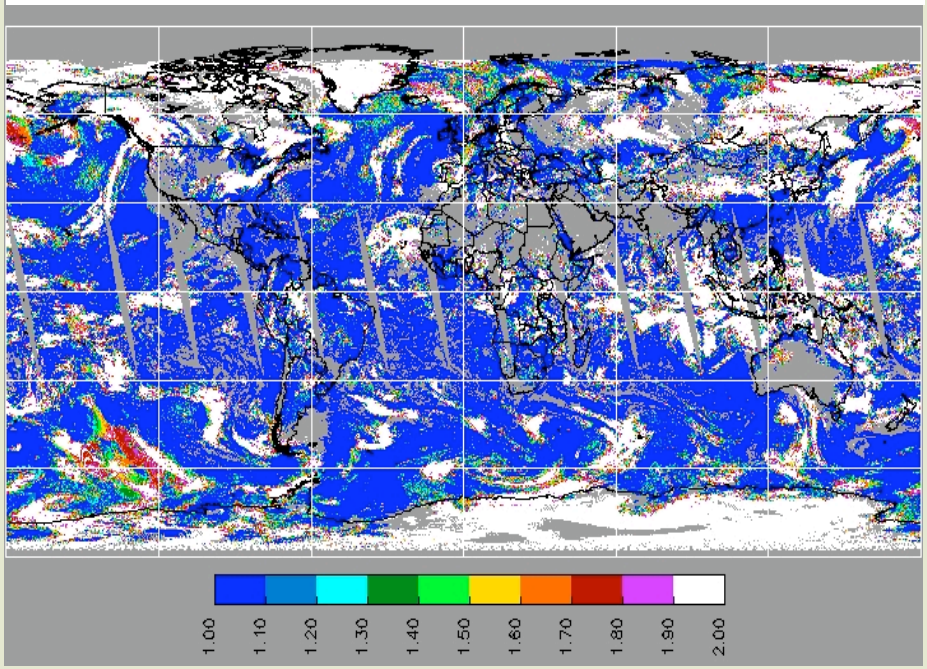
Most differences occur at polar regions, where channels behave differently the most

Much better coverage with VIIRS

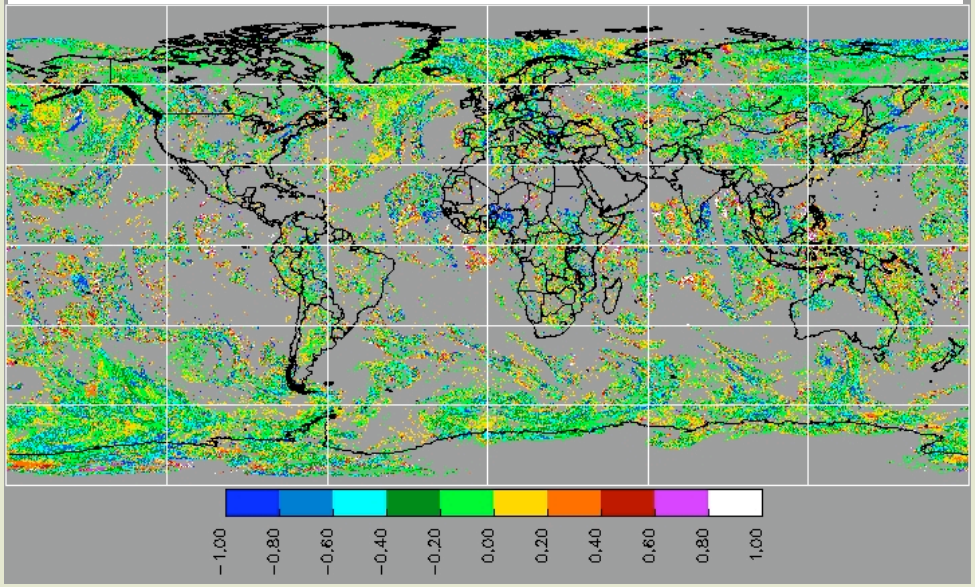
NPP-VIIRS



Aqua-MODIS



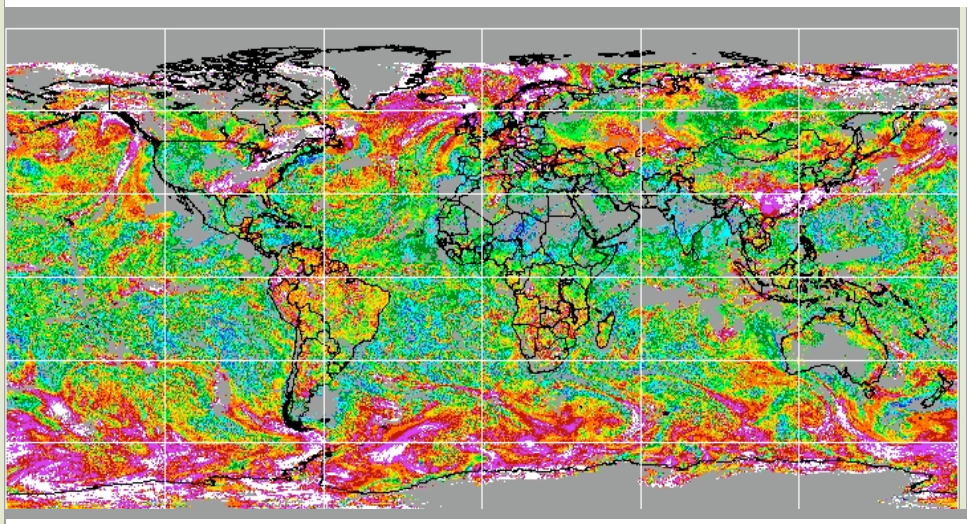
VIIRS - MODIS



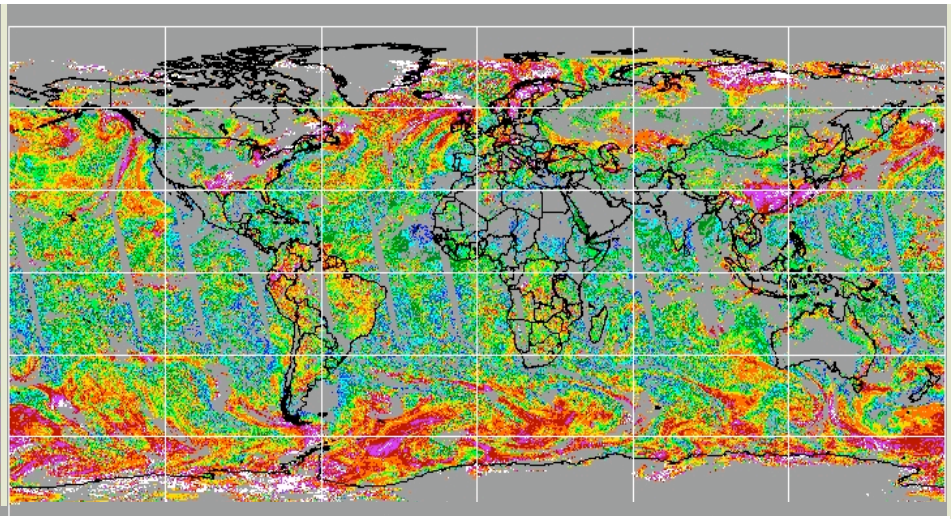
Cloud Phase Fraction (Water=1, Ice=2) March 08, 2012 Day Time

Optical Depth, March 08, 2012, Day Time

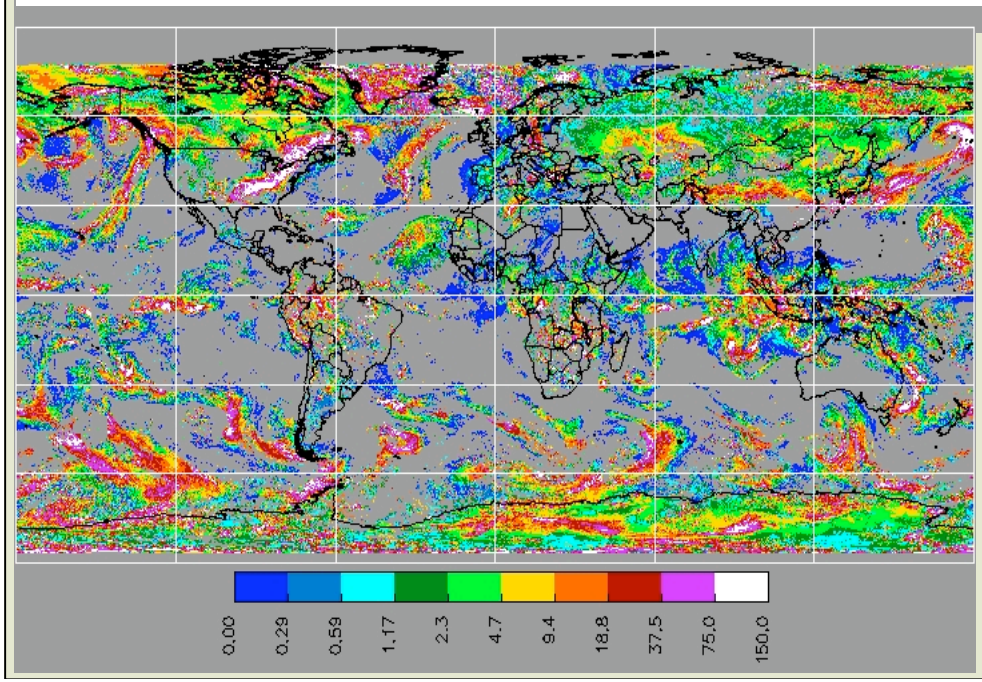
NPP-VIIRS (Liquid Water)



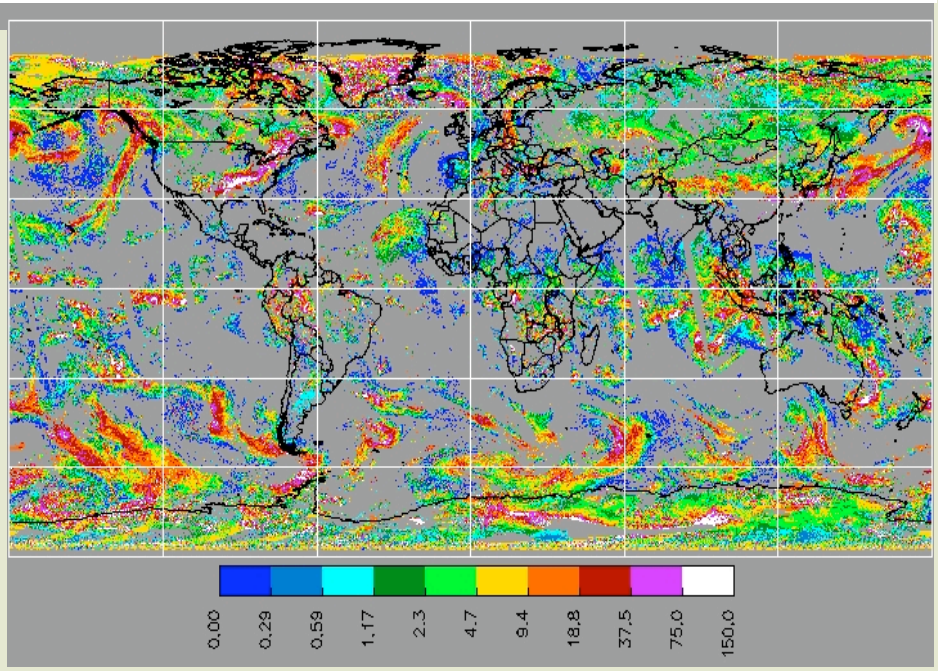
Aqua-MODIS (Liquid Water)



NPP-VIIRS (Ice)

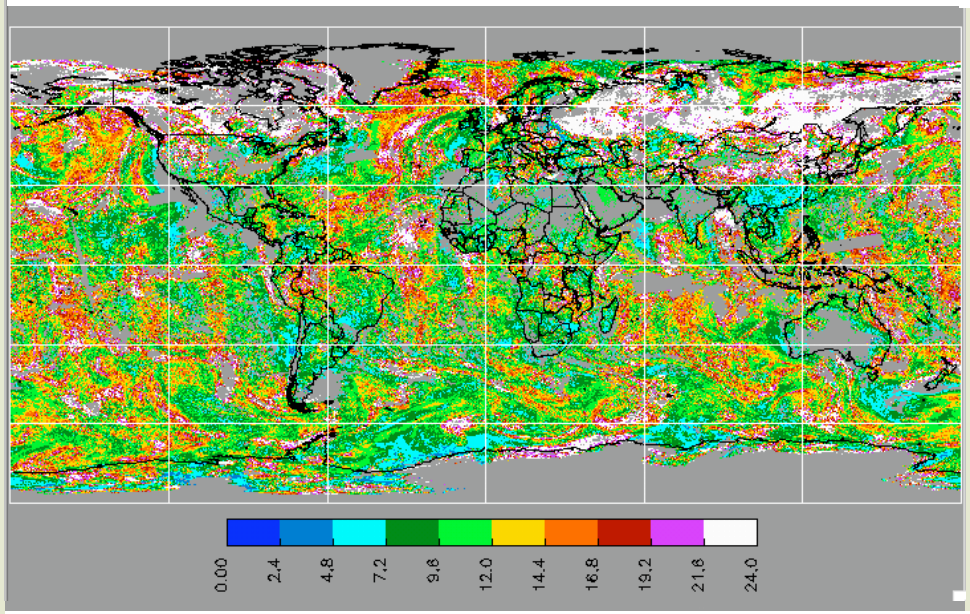


Aqua-MODIS (Ice)

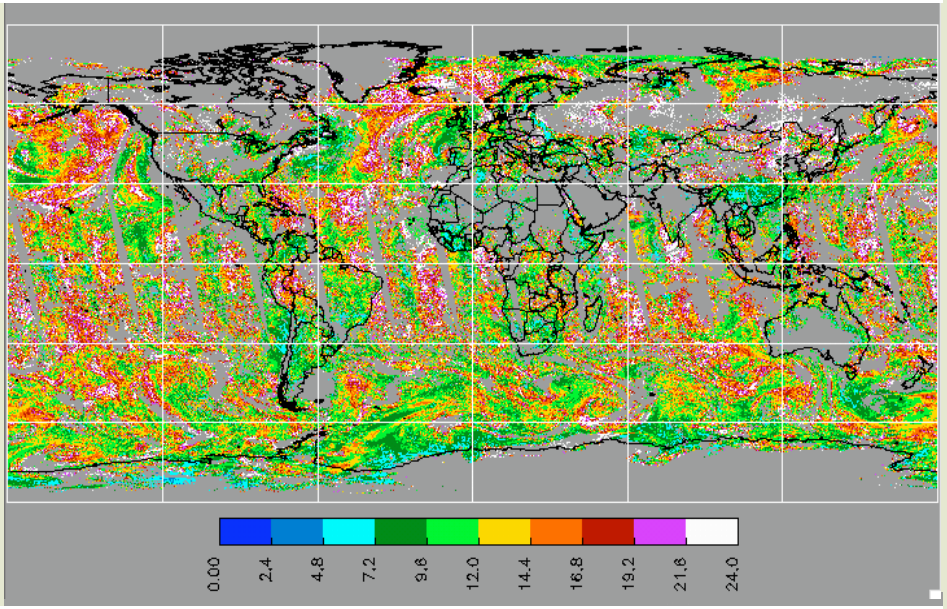


Cloud Effective Radius (μm), March 08, 2012, Day Time

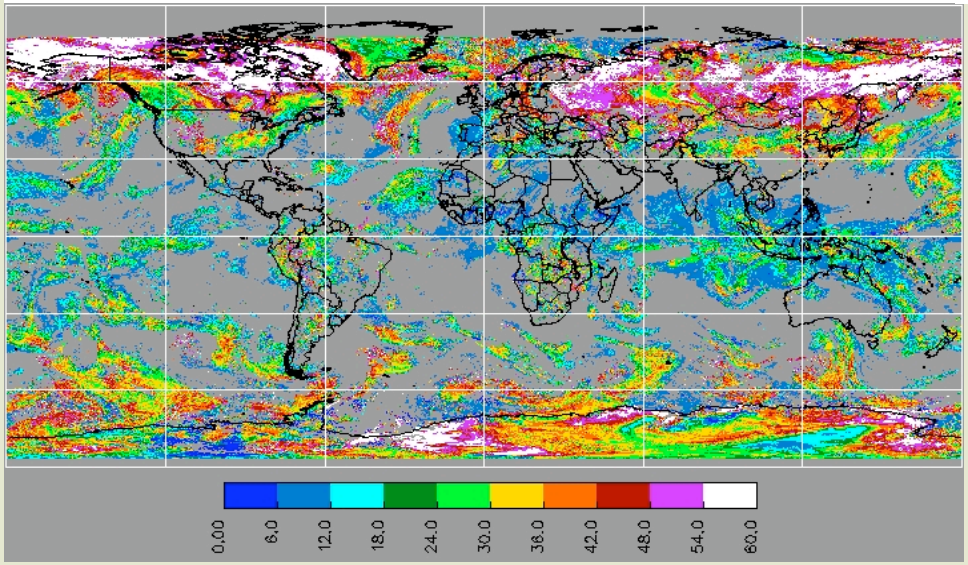
NPP-VIIRS (Liquid Water)



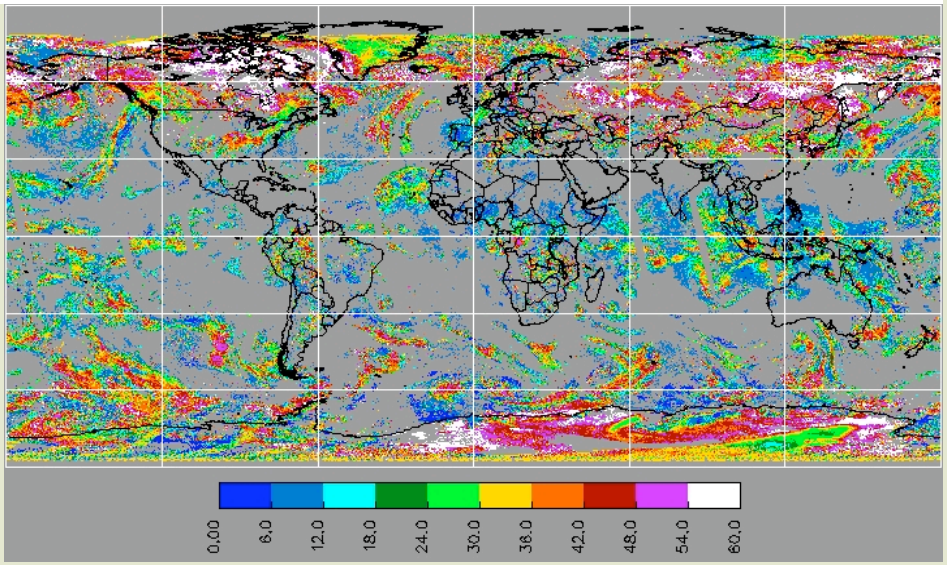
Aqua-MODIS (Liquid Water)



NPP-VIIRS (Ice)

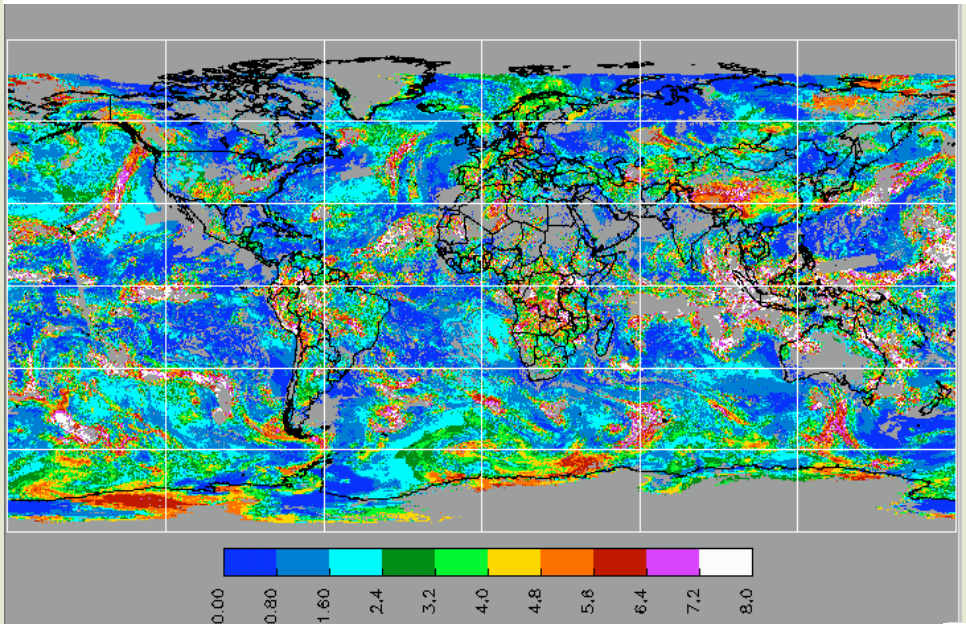


Aqua-MODIS (Ice)

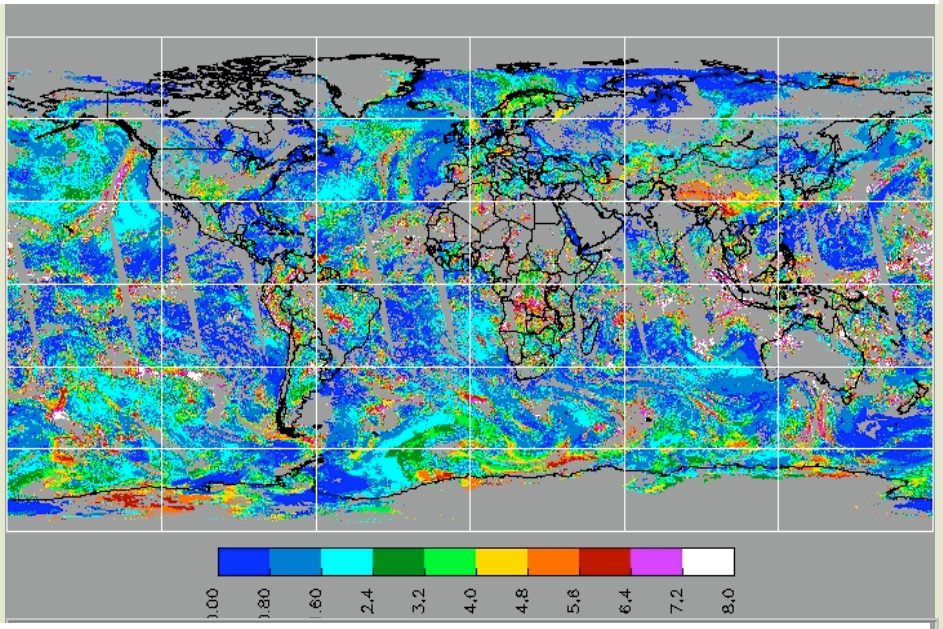


Cloud Effective Height (km), March 08, 2012, Day Time

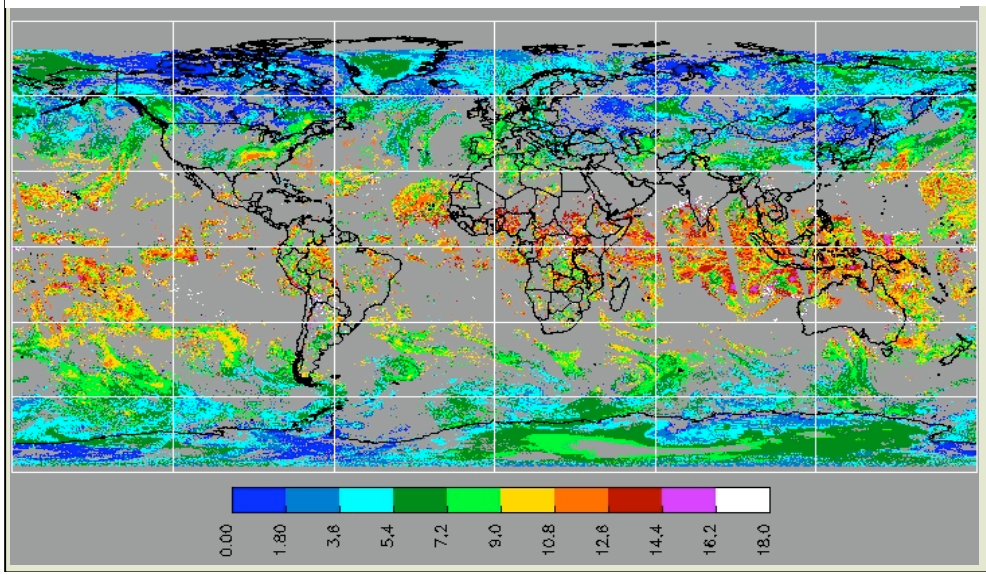
NPP-VIIRS (Liquid Water)



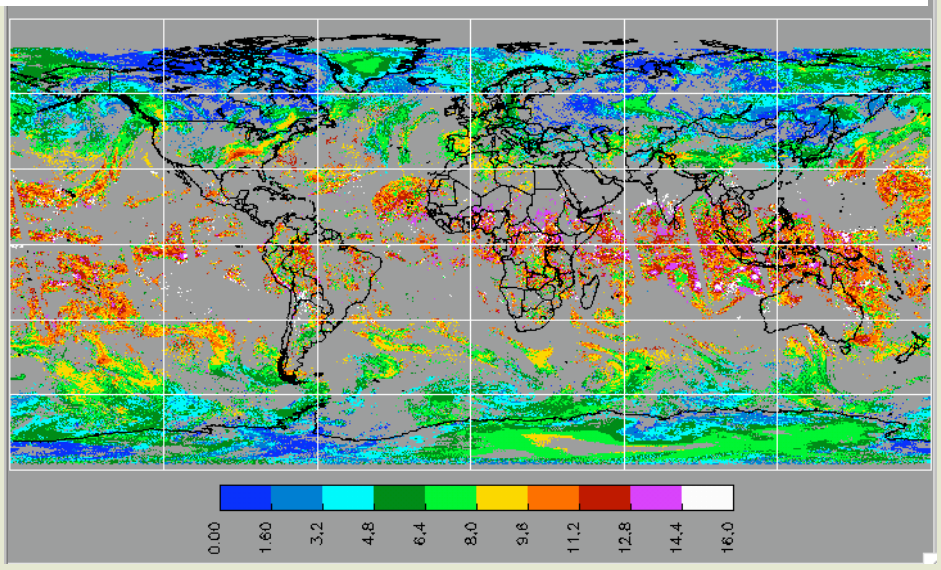
Aqua-MODIS (Liquid Water)



NPP-VIIRS (Ice)



Aqua-MODIS (Ice)



Future Plan

- Implementing Corrk for VIIRS channels
- Once the calibration is stable, tune the algorithms
- Create clear sky maps
- No CO2 slicing channels, multilayer replacement
- Parallel processing
  - VIIRS has 6.3 times of MODIS pixels
  - It takes 3 days to run a month of MODIS →
    ~ 20 days to run a month of VIIRS
  - Myles Baker:
    Graduate student in Computer Science, College of William & Mary
    NASA Co-op Program, mentor Jonathan Gleason