Earth System & Geoinformation Sciences Colloquium
Depart. Of Geography and Geoinformation Science

Invited Speaker: Dr. Miguel O. Román NASA/GSFC

Time: Sept. 11, 2013, Wed. , 4:30-6:30 PM,
Location: Innovation Hall 215G

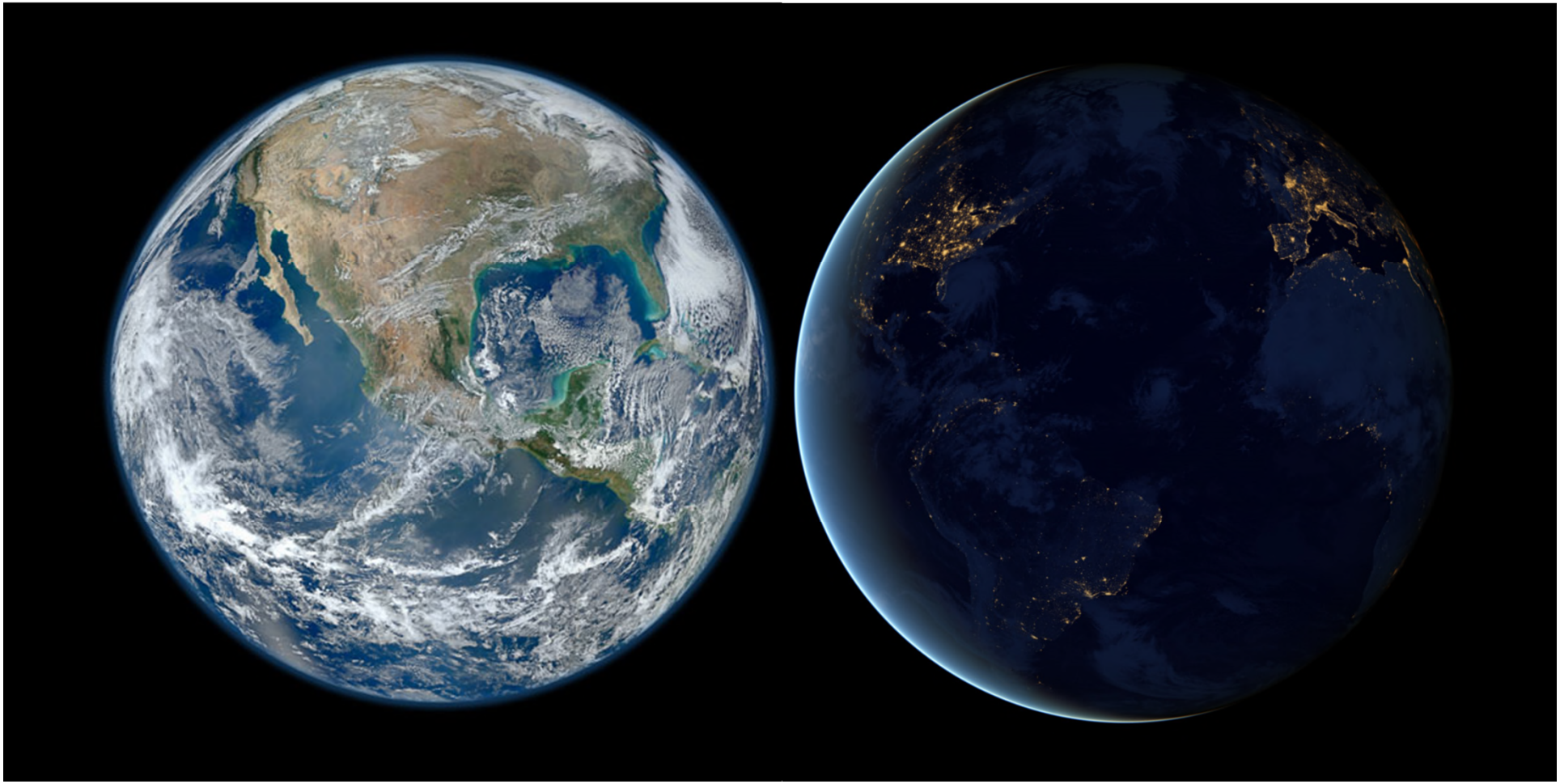
Land, Cryosphere, and Nighttime Environmental Monitoring Capabilities from Suomi NPP VIIRS: Overview and Status

Abstract

The Visible Infrared Imaging Radiometer Suite (VIIRS) instrument was launched in October 2011 as part of the Suomi National Polar-orbiting Partnership (S-NPP: http://npp.gsfc.nasa.gov/). The VIIRS instrument was designed to improve upon the capabilities of the operational Advanced Very High Resolution Radiometer (AVHRR) and provide observation continuity with NASA's Earth Observing System's (EOS) Moderate Resolution Imaging Spectroradiometer (MODIS). Since the VIIRS first-light images were received in November 2011, NASA and NOAA funded scientists have been working to evaluate the instrument performance and derived products to meet the needs of the NOAA operational users and the NASA science community. NOAA's focus has been on refining a suite of operational products known as Environmental Data Records (EDRs: http://www.star.nesdis.noaa.gov/jpss/EDRTeam.php), which were developed according to project specifications under the former National Polar-orbiting Environmental Satellite System (NPOESS). The NASA S-NPP Science Team has focused on evaluating the EDRs for science use, developing and testing additional products to meet science data needs and providing MODIS data product continuity. This seminar will present to-date findings of the NASA Science Team's evaluation of the VIIRS Land and Cryosphere EDRs, specifically Surface Reflectance, Land Surface Temperature, Surface Albedo, Vegetation Indices, Surface Type, Active Fires, Snow Cover, Ice Surface Temperature, and Sea Ice Characterization (http://viirsland.gsfc.nasa.gov/index.html).

The seminar will also discuss new capabilities being developed at NASA's Land Product Evaluation and Test Element (http://landweb.nascom.nasa.gov/NPP_QA/), with a particular emphasis on downstream data and products from the VIIRS Day/Night Band (DNB). In land research and applications, the VIIRS DNB will advance the study of urbanization dynamics at regional and global scales. The availability of stable, well-calibrated, nighttime radiances is of particular value to improve understanding of urbanization trajectories through the explicit representation of urban land cover, urban population, and urban socio-economic activities. This seminar will present a demonstration of the VIIRS DNB's ability to: (1) identify change in total energy consumption both spatially and temporally; (2) distinguish between different types of energy use (e.g., residential, commercial, industrial, etc.); and (3) improve the temporal resolution of exposure assessments from natural hazards.

Land, Cryosphere, and Nighttime Environmental Monitoring Capabilities from Suomi NPP VIIRS: Overview and Status



Miguel O. Román, PhD
Department of Geography and Geoinformation Science
George Mason University, September 11, 2013.

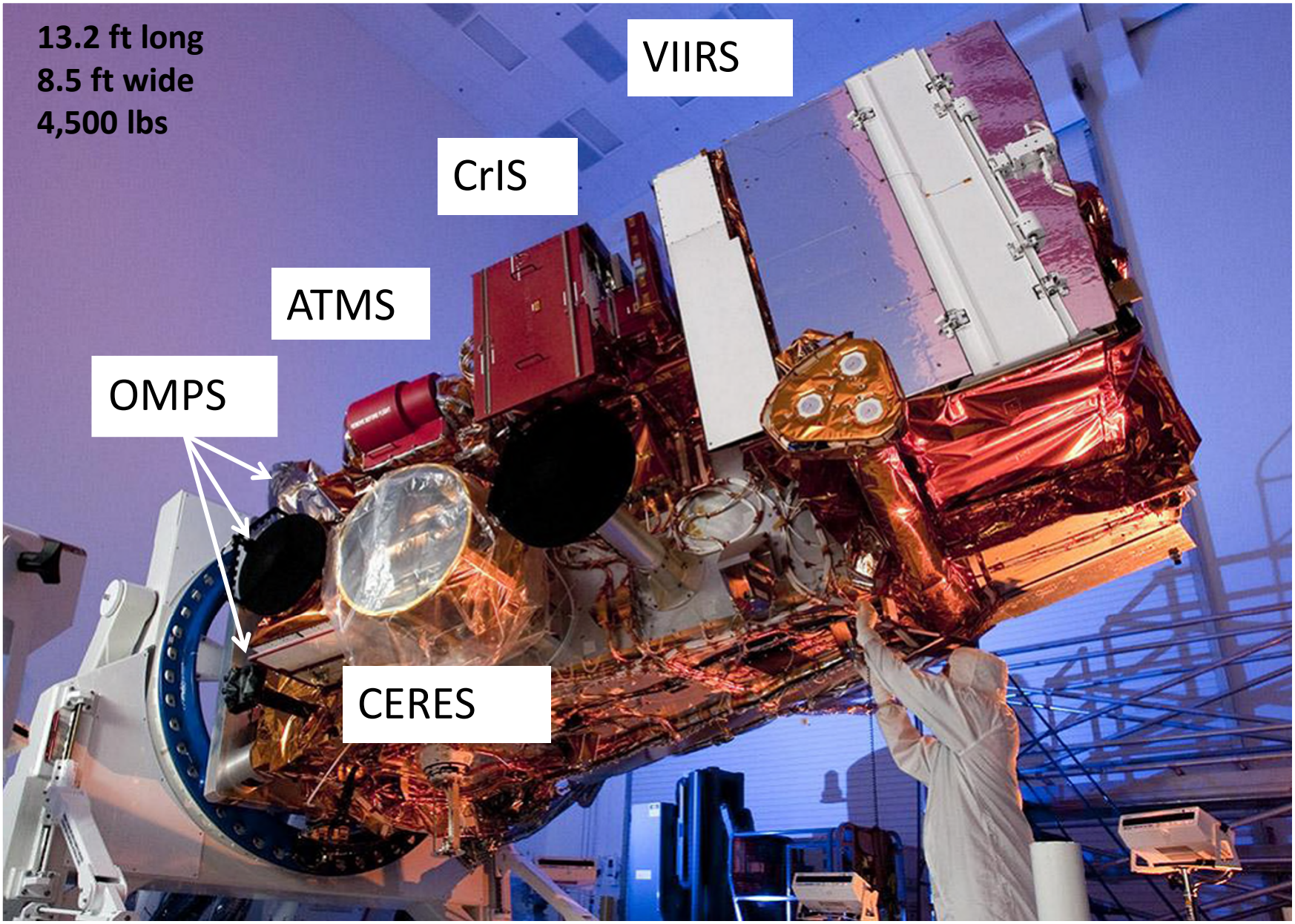
Overview

- **The Suomi National Polar-Orbiting Partnership's Visible Infrared Imaging Radiometer Suite (VIIRS)**
  - Instrument Overview
  - VIIRS Land EDRs (Early Cal/Val Period)
  - **VIIRS Day/Night Band**

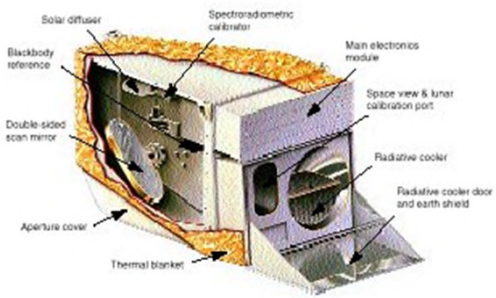
Our focus is on global validation of moderate-resolution (> 30 m) land products and the development of long-term data records for studying ecosystem change.

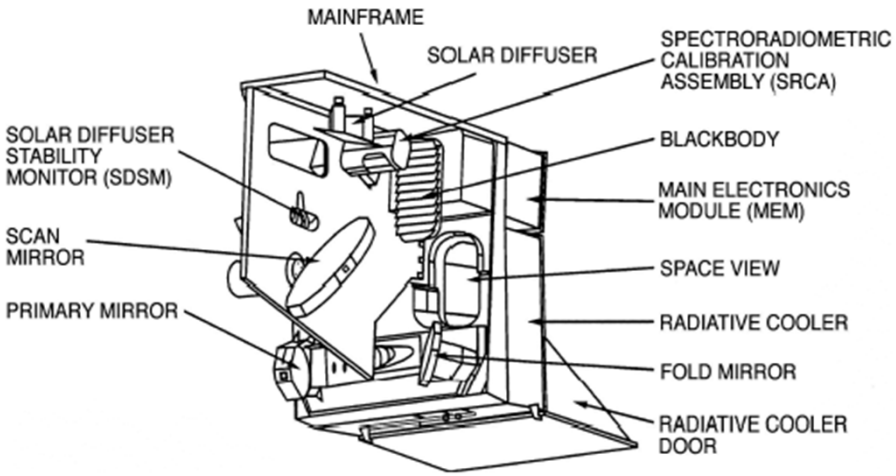
http://viirsland.gsfc.nasa.gov/index.html

Suomi-NPP with 5 instruments

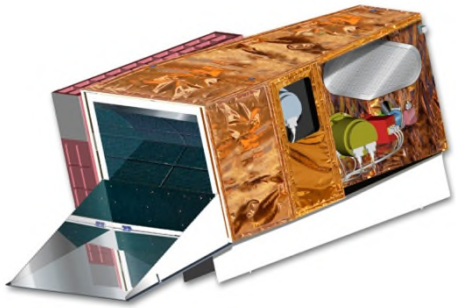


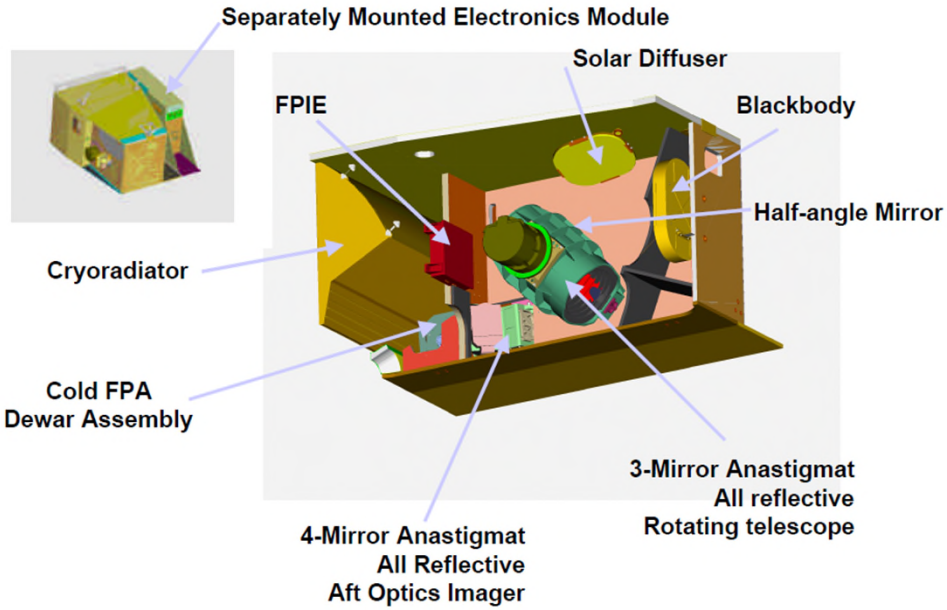
MODIS





VIIRS





from Wolfe et al.

VIIRS Spectral Channels vs. MODIS

VIIRS Radiometric					VIIRS Geometric		
Band Name	Band Ctr		Band Width		GSD Nadir (m)	850 km (m)	GSD EOS (m)
M1	412	nm	20	nm	742	1093	1597
M2	445	nm	18	nm	742	1093	1597
M3	488	nm	20	nm	742	1093	1597
M4	555	nm	20	nm	742	1093	1597
I1	645	nm	50	nm	371	547	799
M5	672	nm	20	nm	742	1093	1597
M6	751	nm	15	nm	742	1093	1597
M7	865	nm	39	nm	742	1093	1597
I2	865	nm	39	nm	371	547	799
M8	1.24	µ	0.020	µ	742	1093	1597
M9	1.378	µ	0.015	µ	742	1093	1597
M10	1.61	µ	.06	µ	742	1093	1597
I3	1.61	µ	.06	µ	371	547	799
M11	2.25	µ	.05	µ	742	1093	1597
M12	3.70	µ	.18	µ	742	1093	1597
I4	3.74	µ	.38	µ	371	547	799
M13	4.05	µ	.16	µ	742	1093	1597
M14	8.55	µ	0.3	µ	742	1093	1597
M15	10.8	µ	1.0	µ	742	1093	1597
M16	12.0	µ	1.0	µ	742	1093	1597
I5	11.5	µ	1.9	µ	371	547	799
DNB							

MODIS Radiometric											
MODIS Band #	Band Ctr		Band Width		MODIS Band #	Band Ctr		Band Width	
8	412	nm	15	nm					
9	443	nm	10	nm					
10	488	nm	10	nm	3	469	nm	20	nm
12	551	nm	10	nm	4	555	nm	20	nm
1	645	nm	50	nm					
13*	667	nm	10	nm					
15	748	nm	10	nm					
16	870	nm	15	nm					
2	859	nm	36	nm					
5	1.24	µ	0.02	µ					
26	1.375	µ	0.030	µ					
6	1.64	µ	0.02	µ					
7	2.13	µ	0.05	µ					
20	3.75	µ	0.18	µ					
23	4.05	µ	0.06	µ	21	3.96	µ	0.06	µ
29	8.55	µ	0.30	µ					
31	11.03	µ	0.50	µ					
32	12.02	µ	0.50	µ					

Red=Imaging Band # or Property
Blue = Ocean Band # or Property
Black= All other Band # or Property
VIIRS Data are from PDR
MODIS Data are Spec

* VIIRS does not do fluorescence

AGI Bands Not Included (4)

#	Band Ctr	Purpose
8	915 nm	Precipatable Water
15	6.535 m	Cloud Mask
17	10.3 m	Snow/Cloud Discrimination
20	13.2 m	CO2 Cloud Slicing

MODIS Bands Not Included (15)

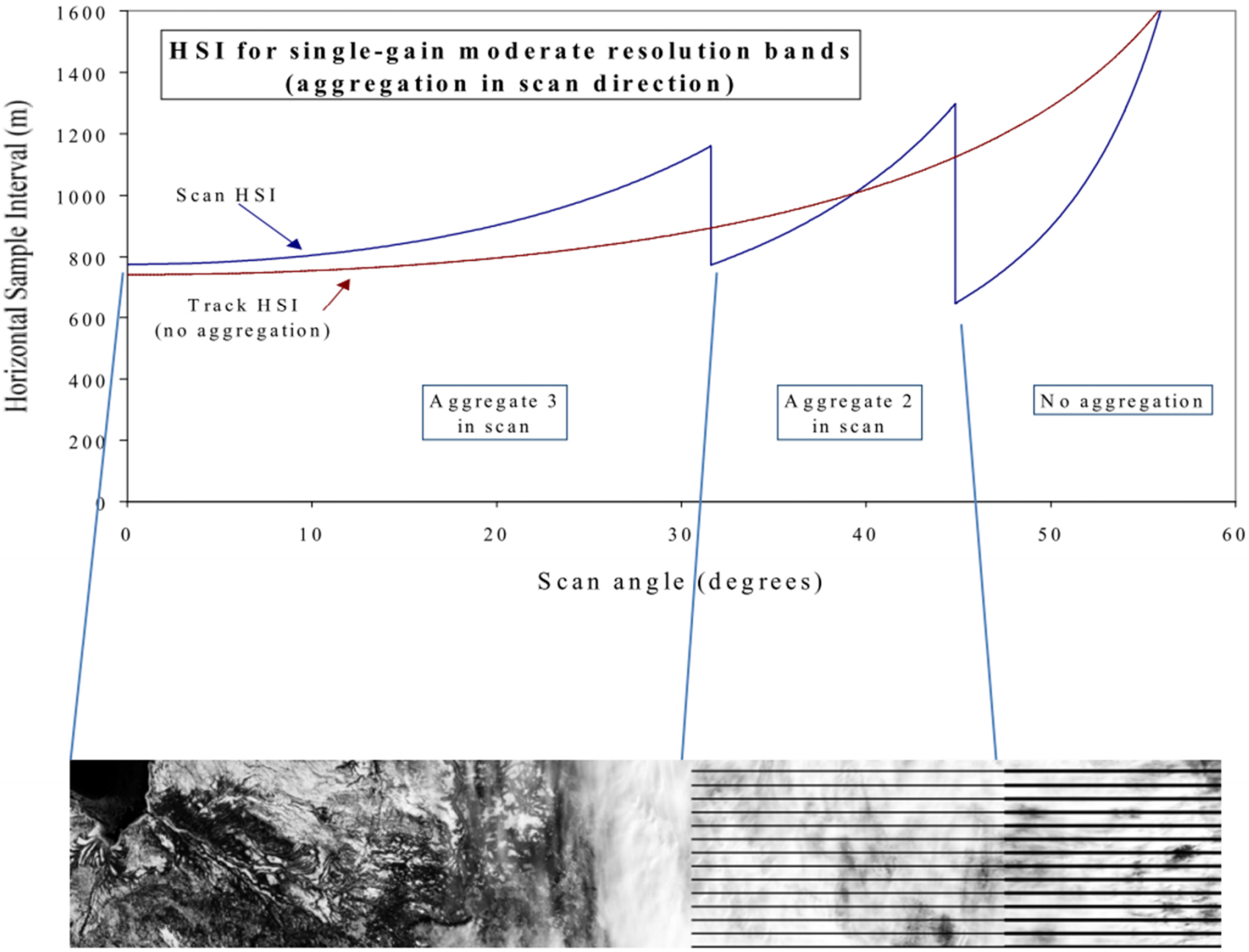
#	Band Ctr		Band Wic		Purpose	#	Band Ctr		Band Width		Purpose
11	531	nm	10	nm	Ocean Color	25	4.52	µ	0.07	µ	Sounding
14	678	nm	10	nm	Fluorescence	27	6.72	µ	0.36	µ	Sounding
17	905	nm	30	nm	Precip Wate	28	7.33	µ	0.30	µ	Sounding
18	936	nm	10	nm	Precip Wate	30	9.73	µ	0.30	µ	Sounding
19	940	nm	50	nm	Precip Wate	33	13.3	µ	0.3	µ	Sounding
22	3.96	µ	0.06	µ	SST	34	13.6	µ	0.3	µ	Sounding
24	4.47	µ	0.07	µ	Sounding	35	13.9	µ	0.3	µ	Sounding
						36	14.2	µ	0.3	µ	Sounding

Instrument characteristics

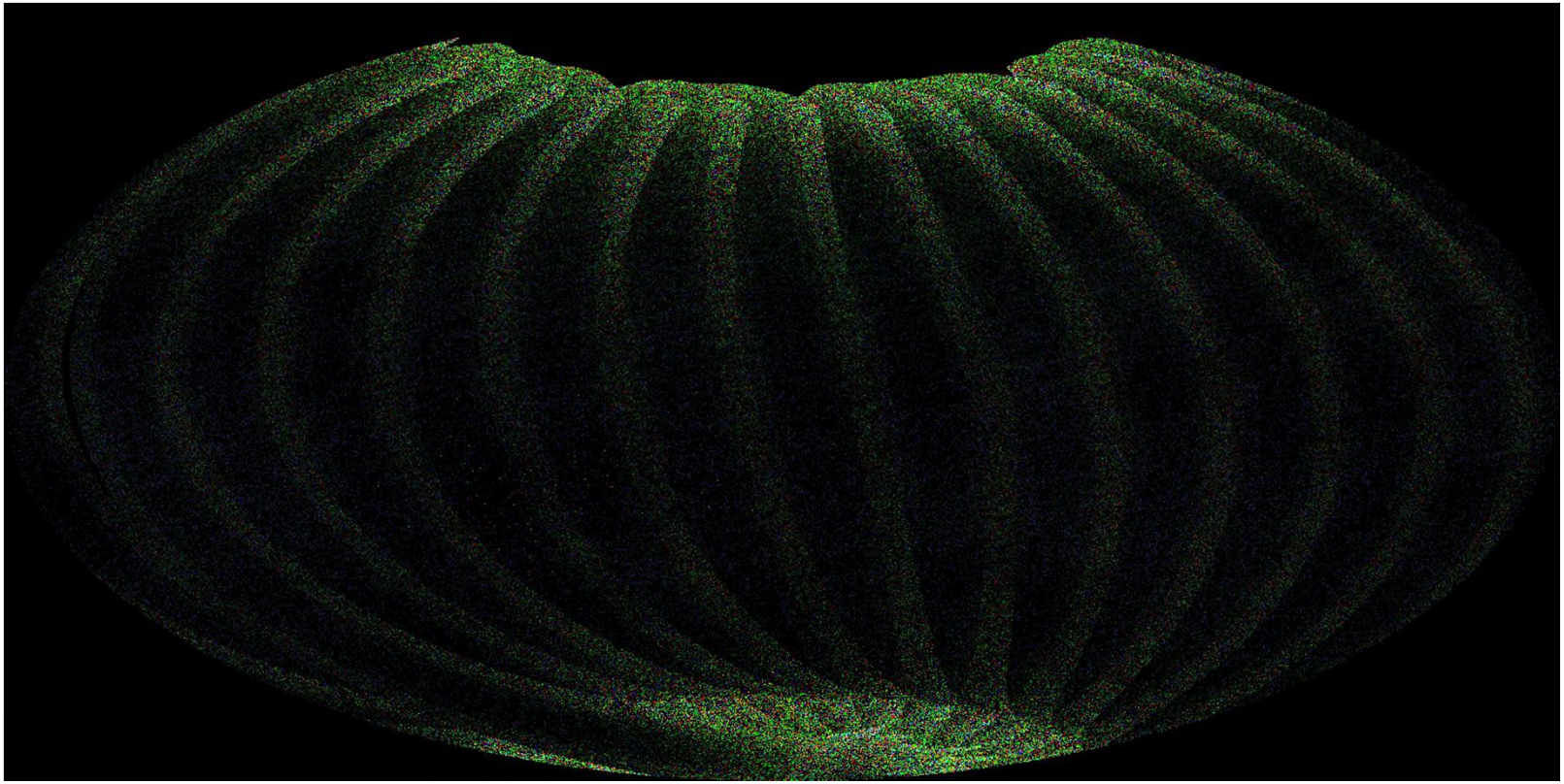
Characteristic	MODIS	VIIRS
Swath width	2340 km	3040 km
Altitude	705 km	824 km
Spectral Bands	36	22
Focal planes	4 (VIS, NIR, MWIR, LWIR)	3 (VIS/NIR, S/MWIR, LWIR)
VIS/NIR	B1, B2 @ 250 m B3, B4 @ 500 m B8 – B12 @ 1 km	I1, I2 @ 375 m M1 – M7 @ 750 m
S/MWIR	B5 – B7 @ 500 m B20 – B26 @ 1 km	I3, I4 @ 375 m M8 – M12 @ 750 m
LWIR	B27 – B36 @ 1 km	I5 @ 375 m M13 – M16 @ 750 m
DNB		DNB @ 750 m

from Wolfe et al.

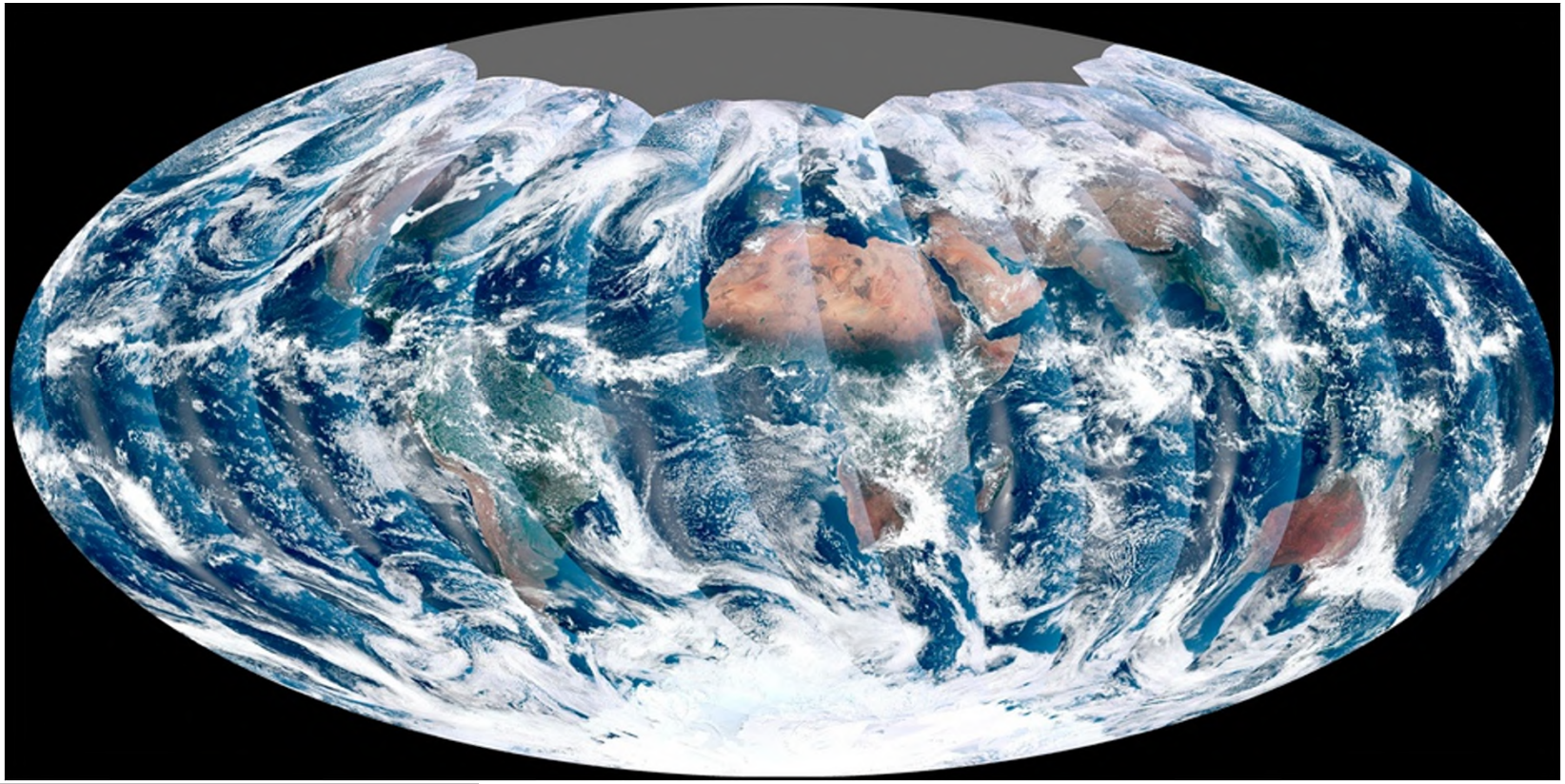
VIIRS Geometry (Moderate Resolution Channels)

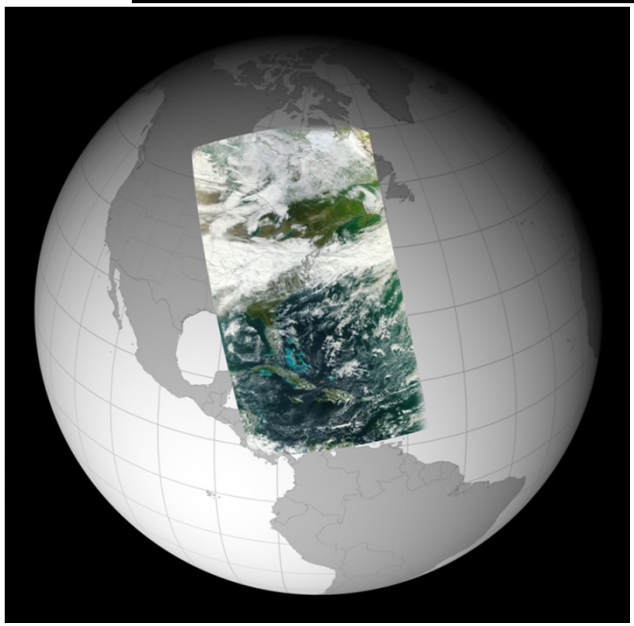


- 10/28/2011: Launched on NPP from VAFB

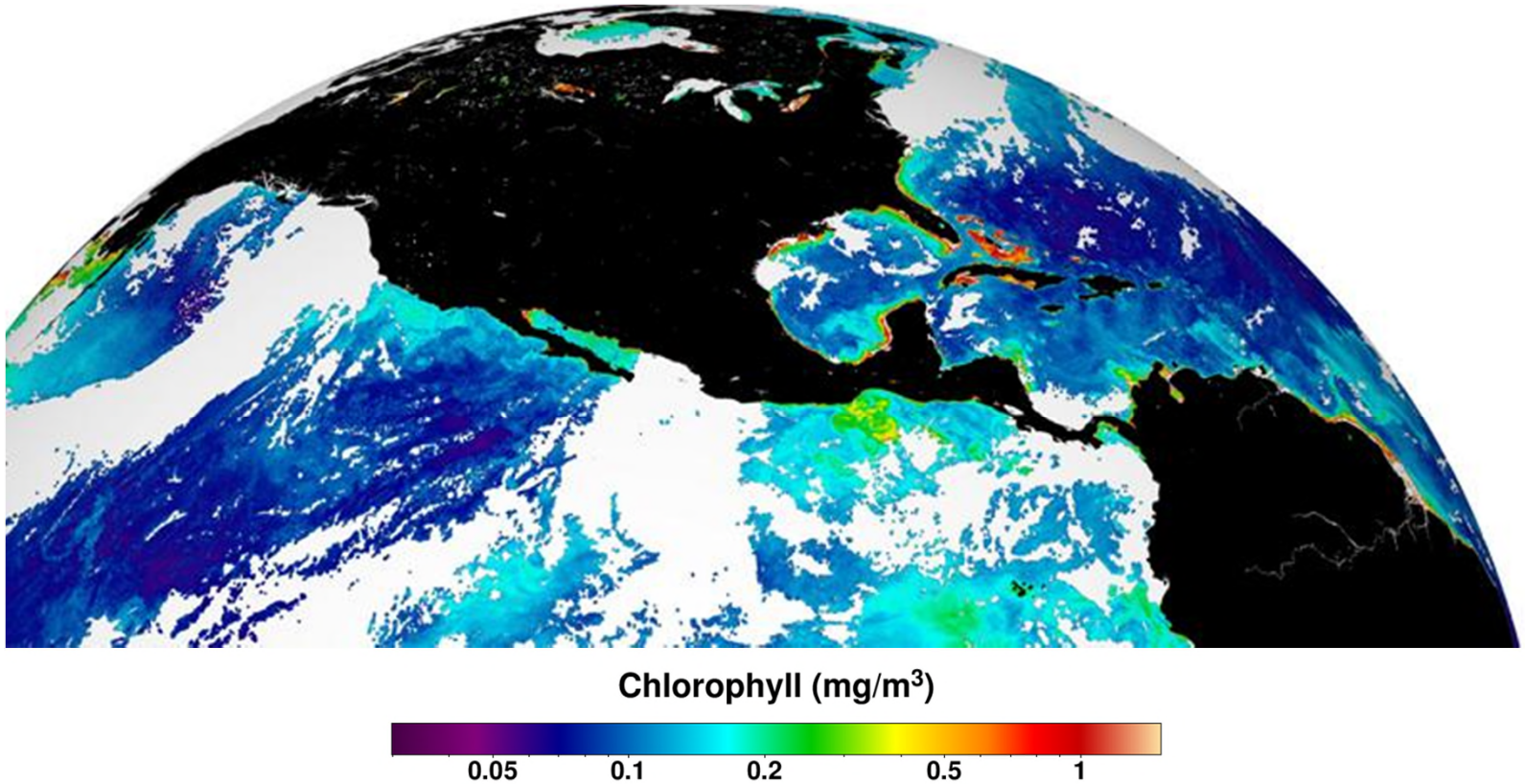


- 10/28/2011: Launched on NPP from VAFB.
- 11/08/2011: VIIRS instrument powered on.



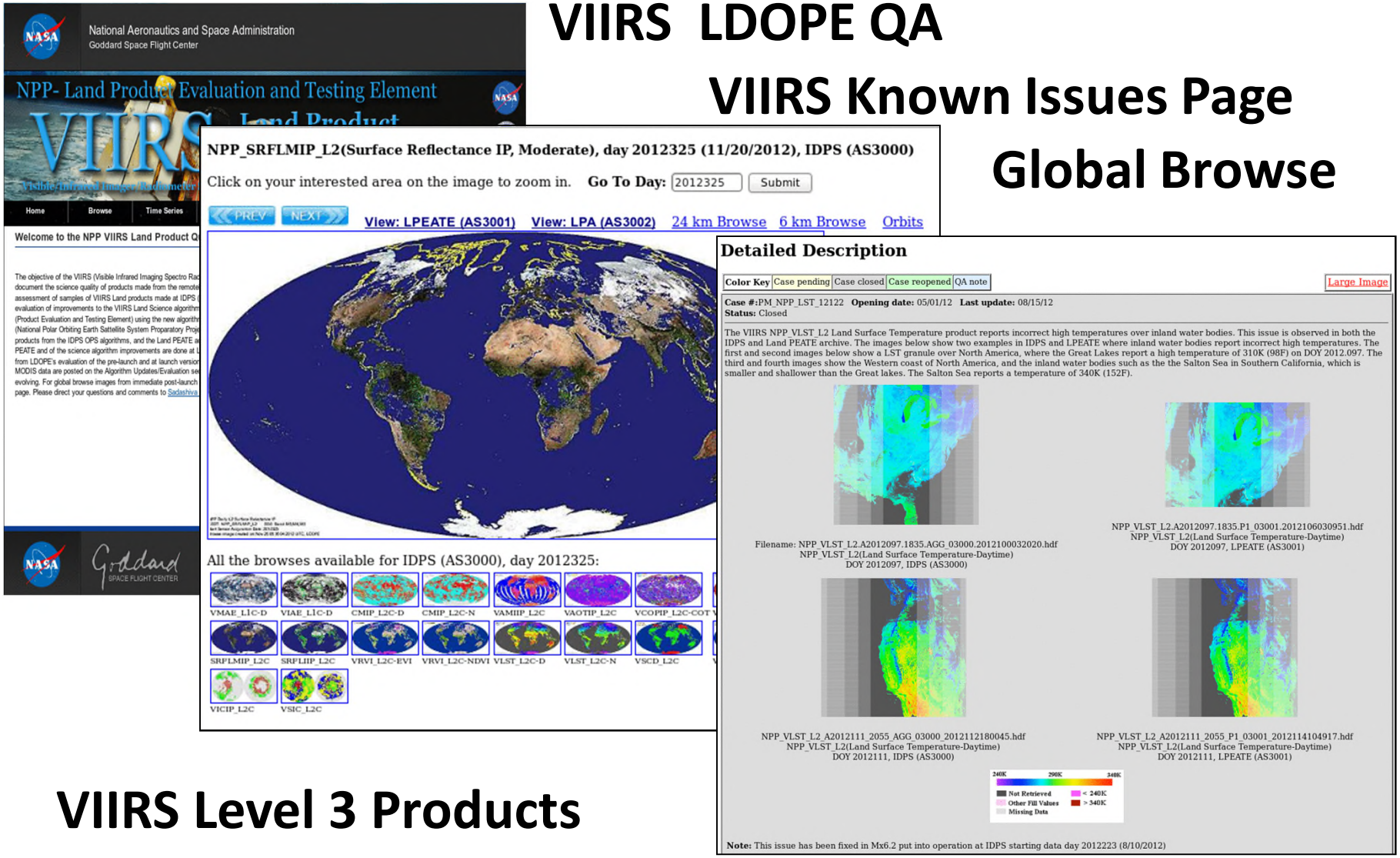


- 10/28/2011: Launched on NPP from VAFB.
- 11/08/2011: VIIRS instrument powered on.
- 11/16/2011: NPP reaches Mission Orbit. All burns are done.
- 11/21/2011: VIIRS Nadir Door opened.



- 10/28/2011: Launched on NPP from VAFB.
- 11/08/2011: VIIRS instrument powered on.
- 11/16/2011: NPP reaches Mission Orbit. All burns are done.
- 11/21/2011: VIIRS Nadir Door opened.
- 11/22/2011: First Ocean Chlorophyll image (from Gene Feldman).

The Land PEATE: meeting the needs of the NASA science team and helping the NOAA IDPS



VIIRS LDOPE QA

VIIRS Known Issues Page

Global Browse

VIIRS Level 3 Products

National Aeronautics and Space Administration
Goddard Space Flight Center

GO

Sciences and Exploration

NPP- Land Product Evaluation and Testing Element

VIIRS Land Product Quality Assessment

Visible/Infrared Imager/Radiometer Suite

Home | Browse | Time Series | Land Products | QA Info | Alg Updates/Eval | Links | Early Images

Welcome to the NPP VIIRS Land Product Quality Assessment

The objective of the VIIRS (Visible Infrared Imaging Spectro Radiometer Suite) Land Product QA is to evaluate and document the science quality of products made from the remotely sensed data acquired using VIIRS. Results of quality assessment of samples of VIIRS Land products made at IDPS (Interface Data Processing System) and results of evaluation of improvements to the VIIRS Land Science algorithms derived by analyzing the products made at Land PEATE (Product Evaluation and Testing Element) using the new algorithms are placed on the web pages located at this site. NPP (National Polar Orbiting Earth Sattellite System Proparatory Project) satellite was launched on Oct. 28, 2011. Evaluation of products from the IDPS OPS algorithms, and the Land PEATE adjusted version of the IDPS OPS algorithms run at Land PEATE and of the science algorithm improvements are done at LDOPE (Land Data Operational Product Evaluation). Results from LDOPE's evaluation of the pre-launch and at launch version of the IDPS algorithms done using simulated or proxy MODIS data are posted on the Algorithm Updates/Evaluation section of this web page. This web page is constantly evolving. For global browse images from immediate post-launch period please click on the Brows menu at the top of this page. Please direct your questions and comments to Sadashiva Devadiga.

What's New

- NPP Launch, Friday, Oct.28, 2011.
- VIIRS started acquiring earth view data on Nov 21, 2011
- The VIIRS cooler door opened on Jan 18, 2012. Thermal bands are now cooled down and the thermal data is useful starting after Jan. 20, 2012.
- VIIRS Beta quality products available from LAADS

Goddard SPACE FLIGHT CENTER

Responsible NASA Official : Edward Masuoka
Content Owner: Sadashiva Devadiga
Web Curator: Demi Feng

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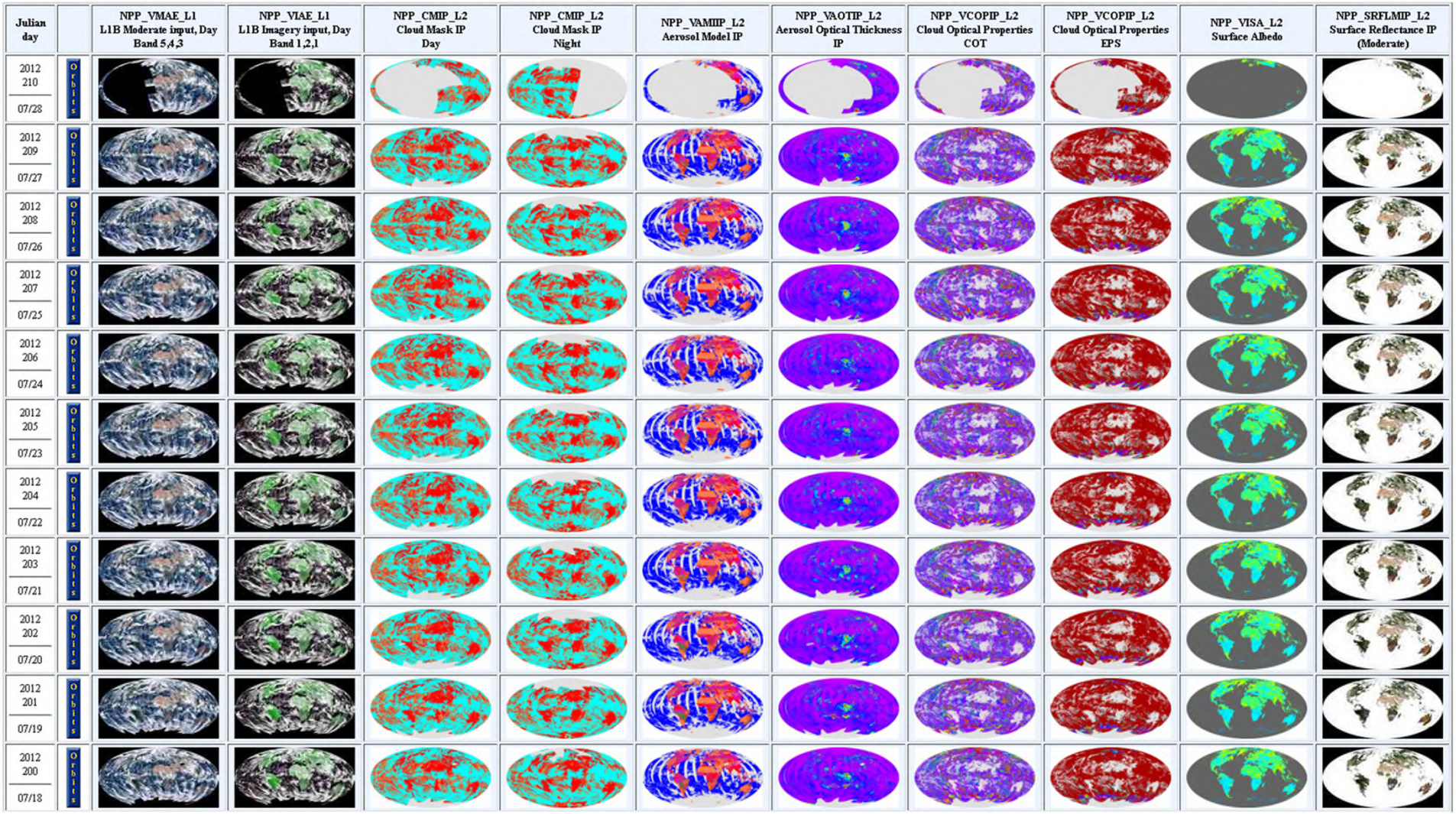
Suomi-NPP Global Browse (DOY 200-210, 2012)



http://landweb.nascom.nasa.gov/cgi-bin/NPP/browse/NPPbrowse.cgi

Land and cryosphere products from Suomi NPP VIIRS: Overview and Status

Miguel Román, Chris Justice, Ivan Csiszar, Eric Vermote, Robert Wolfe, Simon Hook, Mark Friedl, Zhuosen Wang, Crystal Schaaf, Tomoaki Miura, Mark Tschudi, George Riggs, Dorothy Hall, Alexei Lyapustin, Sadashiva Devadiga, Carol Davidson, and Ed Masuoka

http://onlinelibrary.wiley.com/doi/10.1002/jgrd.50771/abstract

EDR, IP, or ARP	Threshold	Objective	Estimate (Evaluation Scenario)
Land Surface Temperature[b]	1.4 K	0.8 K	~ 1.0 K (dense vegetation and water) > 2.5 K (semi-arid, seasonally varying landscapes)
Surface Reflectance[c]	± (0.01+10%)	± (0.005+5%)	≤ 0.015 (dense vegetation and dark surfaces) > 0.015 (bright surfaces)
Surface Albedo	0.08	0.0125	> 0.078 (CEOS LPV sites and desert sites)
Vegetation Index (TOA NDVI)	0.05	0.03	< 0.030 (nadir view over Western hemisphere vs. MODIS Aqua)
Vegetation Index (TOC EVI)	0.05	N/S	< 0.030[d] (nadir view over Western hemisphere vs. MODIS Aqua)
Active Fires[e]	[1.0, 5,000 MW]	[1.0, 10,000 MW]	N/S
Surface Type[f]	70% PCT	80% PCT	~ 70% PCT (IGBP Classes 0-5,10,12-13,15-16) < 70% PCT (IGBP Classes 6-9,11,14)
Snow Cover[g]	90% PCT	90% PCT	~ 90% PCT (Mid and High latitude regions)
Ice Age	70% PCT[h]	90% PCT[h]	> 70% PCT[i] (Polar Regions, All Seasons) < 70% PCT[h] (Polar Regions, All Seasons)
Ice Concentration	N/S[j]	N/S	Good Agreement vs. MODIS Sea Ice Extent (Polar Regions, All Seasons)
Ice Surface Temperature	1.0 Kelvin[k]	N/S	< 0.2 K (vs. MODIS IST) < 0.5 K (vs. KT-19 observations, Ice Bridge cal/val campaign)

Table 1: JPSS Accuracy Requirements (Threshold and Objective as Listed in Version 2.7 of the JPSS Level 1 Requirements Supplement) and Estimated Performance Based on NASA VIIRS Land Science Team Evaluations To-Date (**Red** = fails threshold; **Yellow** = meets threshold; **Green** = meets threshold + objective)[a].

Figure 1: Suomi NPP (S-NPP) VIIRS Global Climate Modeling Grid Surface Reflectance Intermediate Product for 26 October 2012.

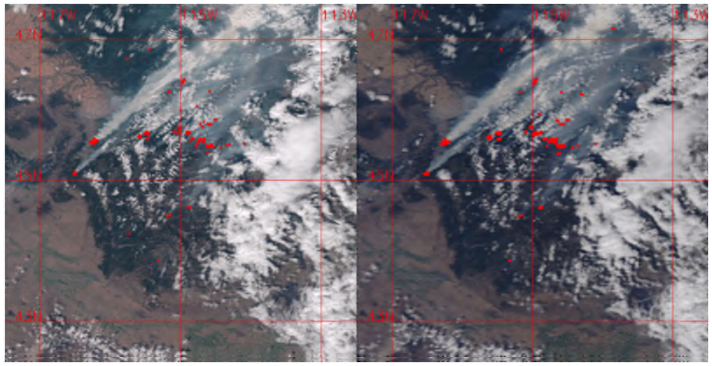


Figure 2: Comparison of S-NPP VIIRS (left) and EOS-Aqua MODIS (right) fire detections on 9 September, 2012 in the Western US (ID,MT,WY).

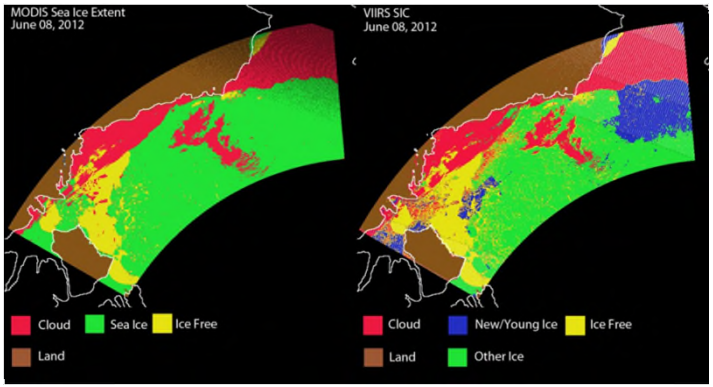
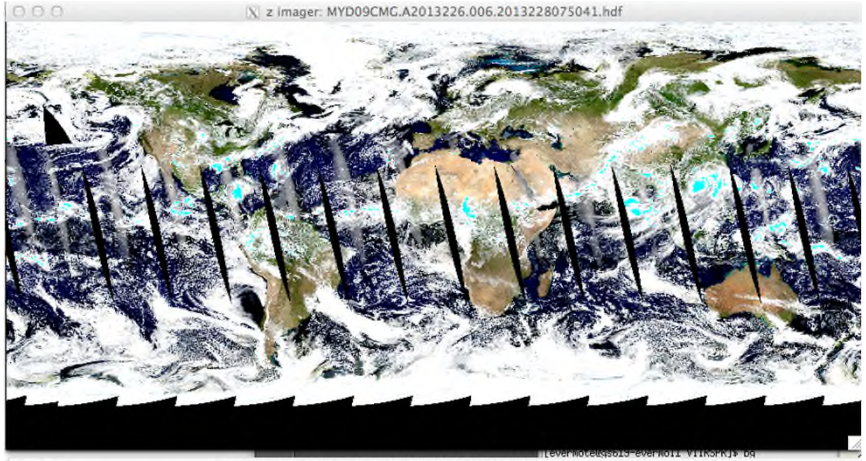


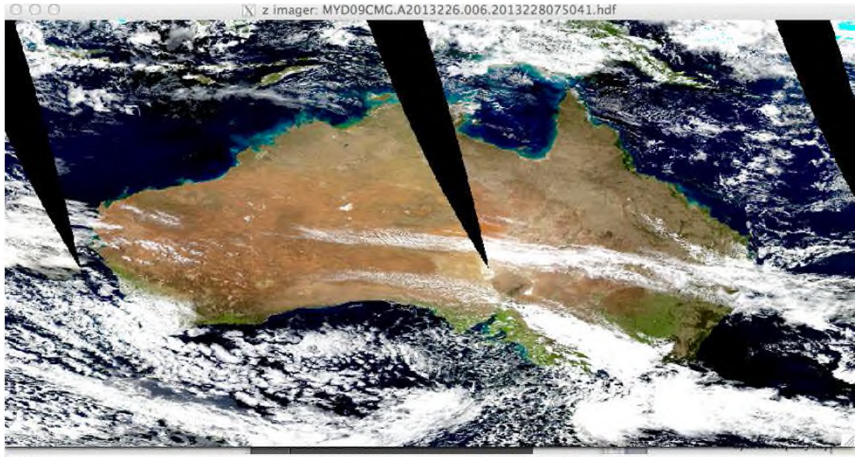
Figure 3: MODIS Sea Ice Extent (Left) and S-NPP VIIRS Sea Ice Characterization (Right) for 8 June, 2012 over the Beaufort Sea.

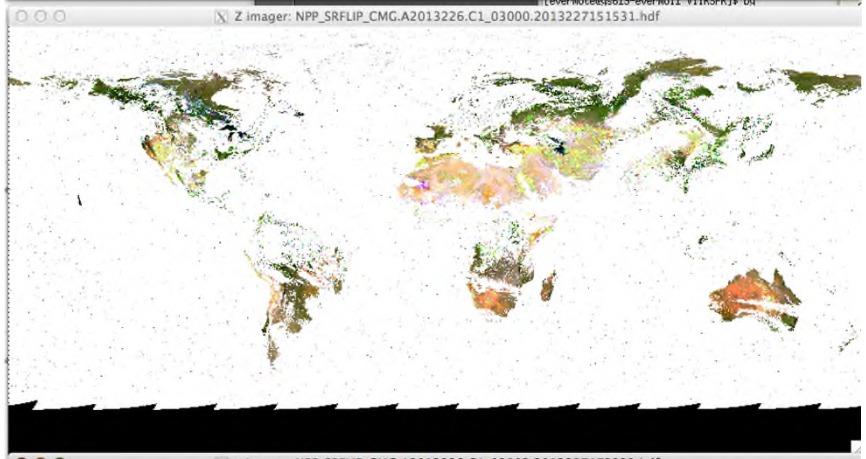
Eric Vermote (NASA)

Surface Reflectance IP

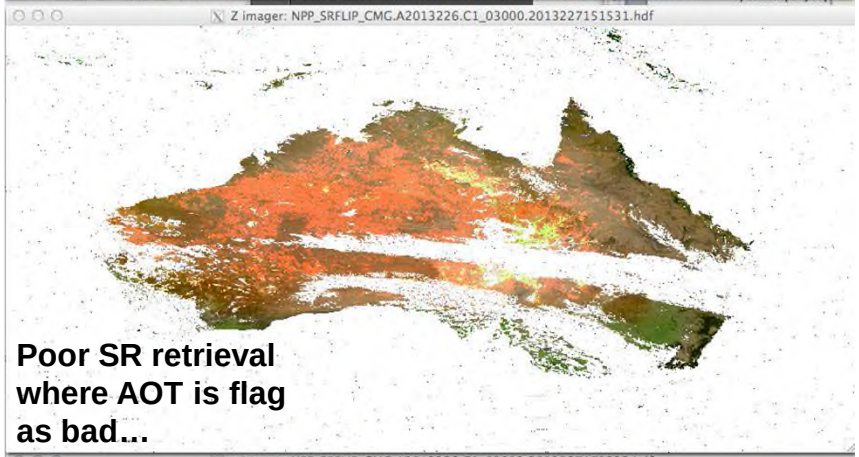


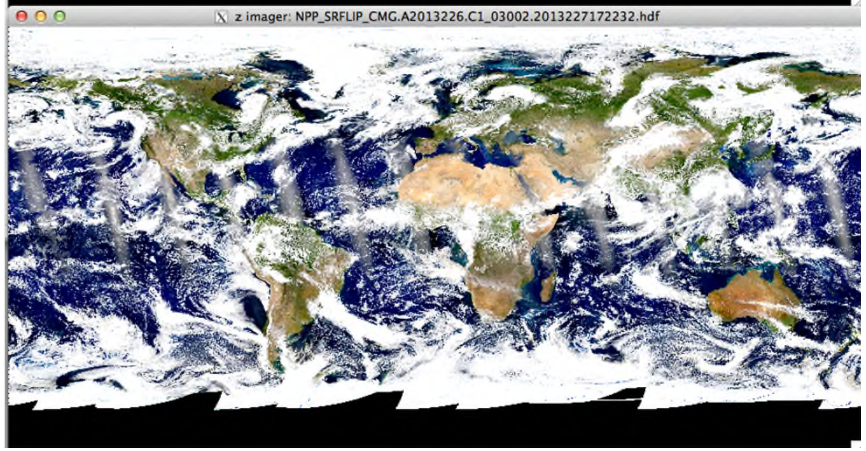
MODIS
Aqua



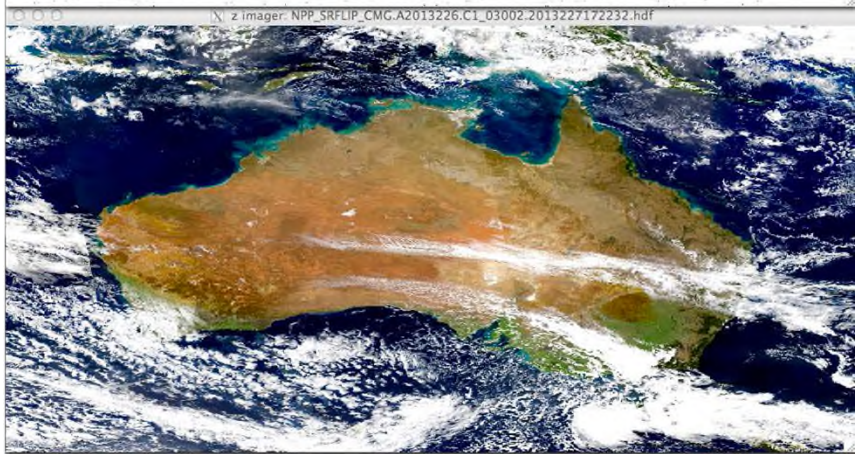


VIIRS
NOAA
IDPS



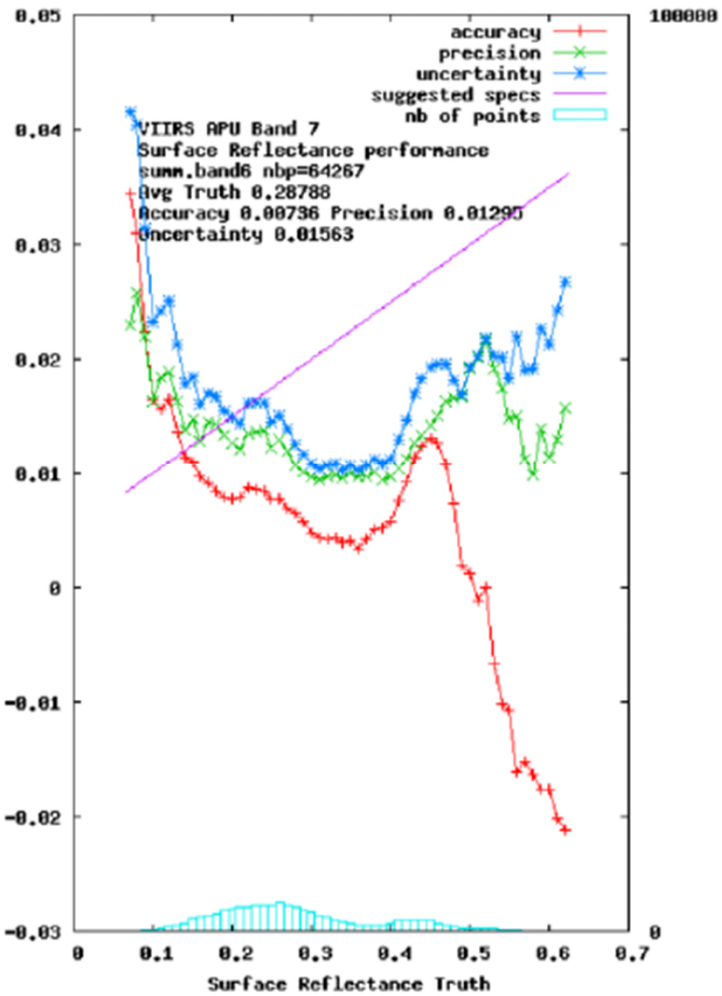


NASA
Land
PEATE

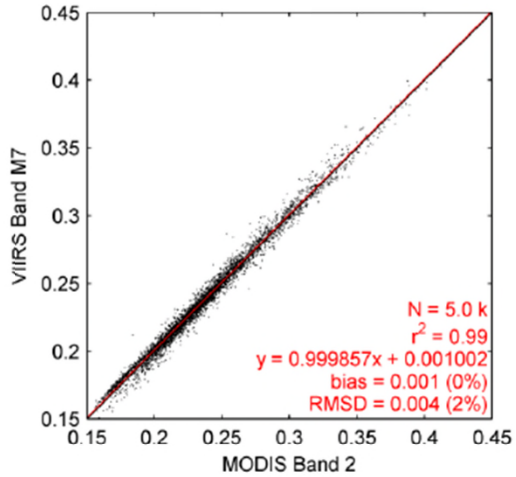


Surface Reflectance IP

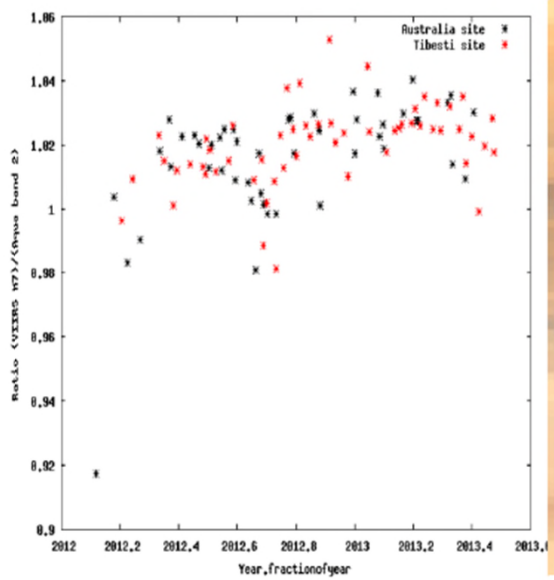
Instrument calibration is well under control (although a reprocessing is necessary)

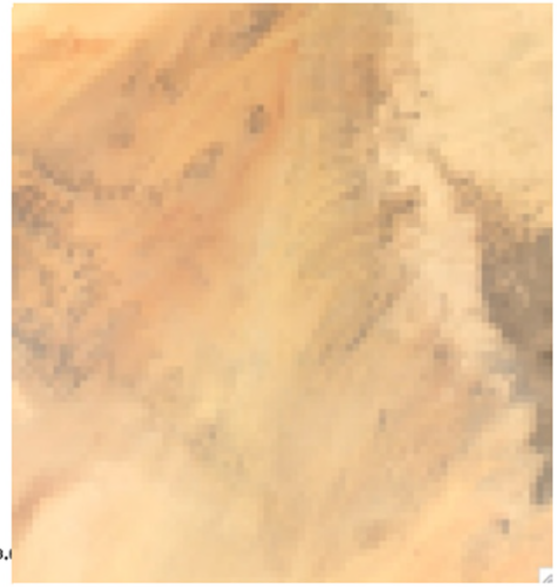


Eric Vermote (NASA)



MODIS/VIIRS cross calibration over a 50km x 50km site in Australia (left), true color image of the site (right). The agreement between the two reflectance products is excellent. VIIRS and MODIS Aqua reflectance were normalized for directional effects. Data were acquired on 3/6/2012 after a calibration update of the VIIRS.

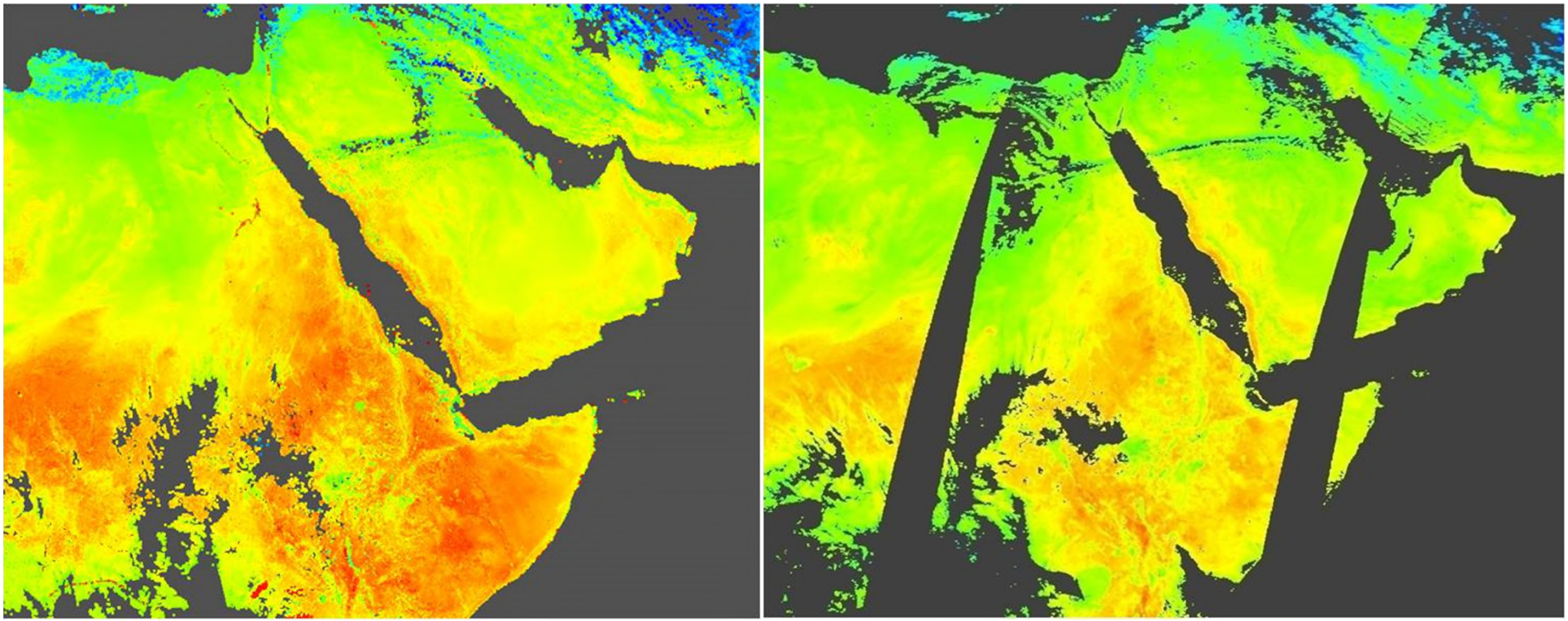




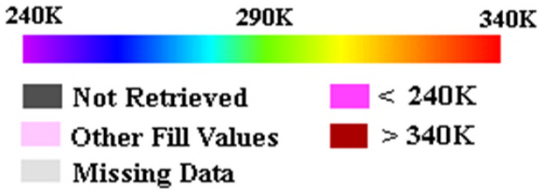
VIIRS continuous calibration monitoring in band M7 (Near-Infrared) over two sites one over Australia (black symbol) and one over Tibesti (~40km x 40km) (red symbol) (left side). The true color image of the Tibesti calibration site is shown on the right side.

Land Surface Temperature (LST) EDR

- ***Description:*** Provides land surface skin temperature at the satellite overpass time under cloud-free conditions.
- ***Retrieval Strategy:*** ***Multichannel Linear Regression Approach; Surface Type Dependency***
- ***Current Challenges****:* LST EDR does not provide dynamic **land surface emissivity** per the current MODIS "day-night" algorithm. This is a valuable product and should be continued in the JPSS era.

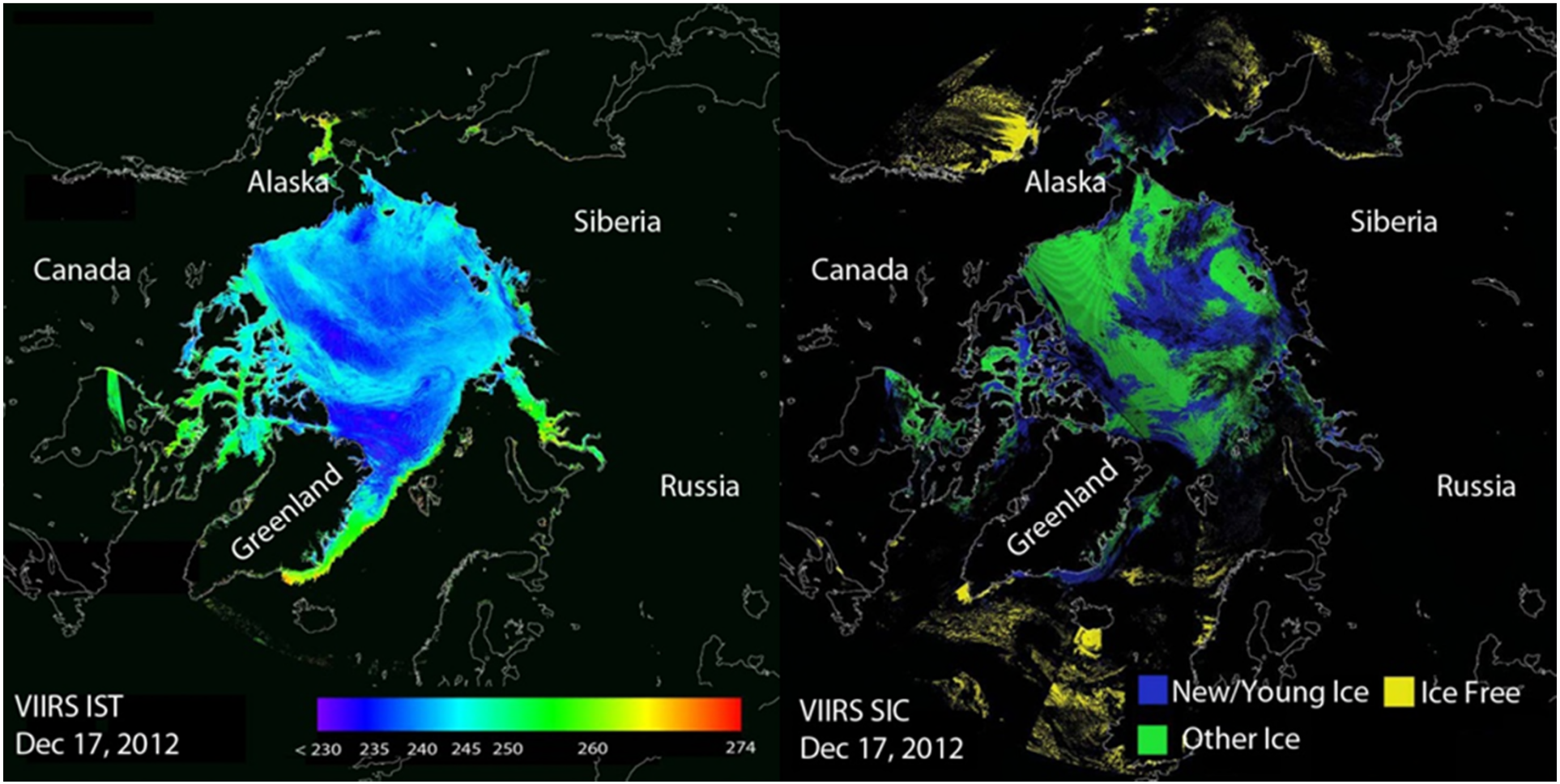


NPP_VLST_Level_2, (01/26/2012)
Land PEATE-Adjusted



MYD11C1D_Aqua_LST, (01/26/2012)
Collection V005

Ice Temperature (IST) and Sea Ice Characterization (SIC) EDRs



IST EDR is produced for clear skies both day and night over the oceans. It does not include areas of fresh-water ice.

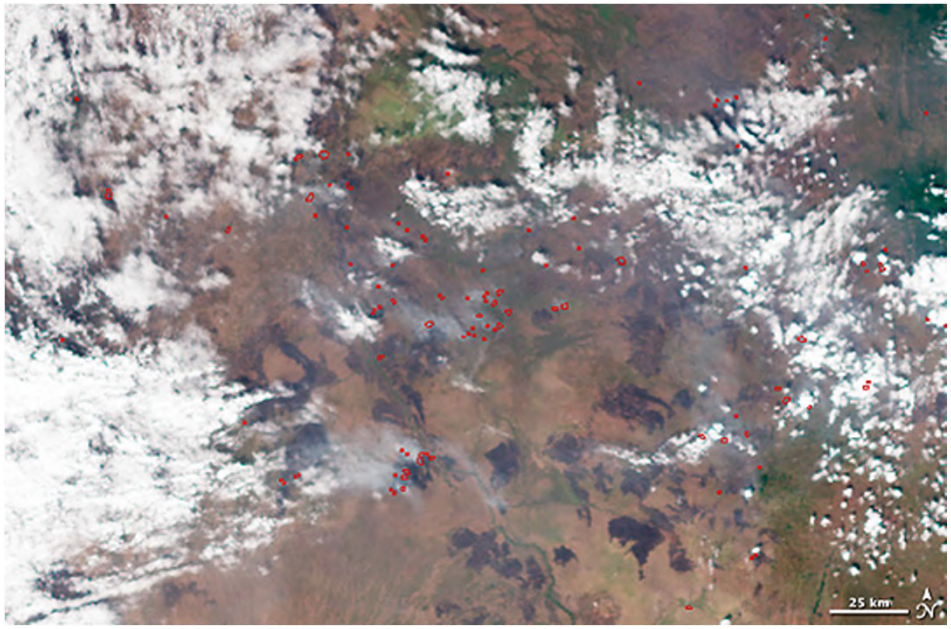
SIC EDR consists of an ice age classification map that contains classifications for ‘Ice-free’, ‘New/Young Ice’ and ‘All Other Ice’ categories.

First Fire Images from VIIRS

Description: Geolocation of pixels in which actively burning fires are detected.

Smoky fire burning in the mountains east of San Diego, California ▶

Widespread agricultural burning in South Sudan, East Africa. ▼

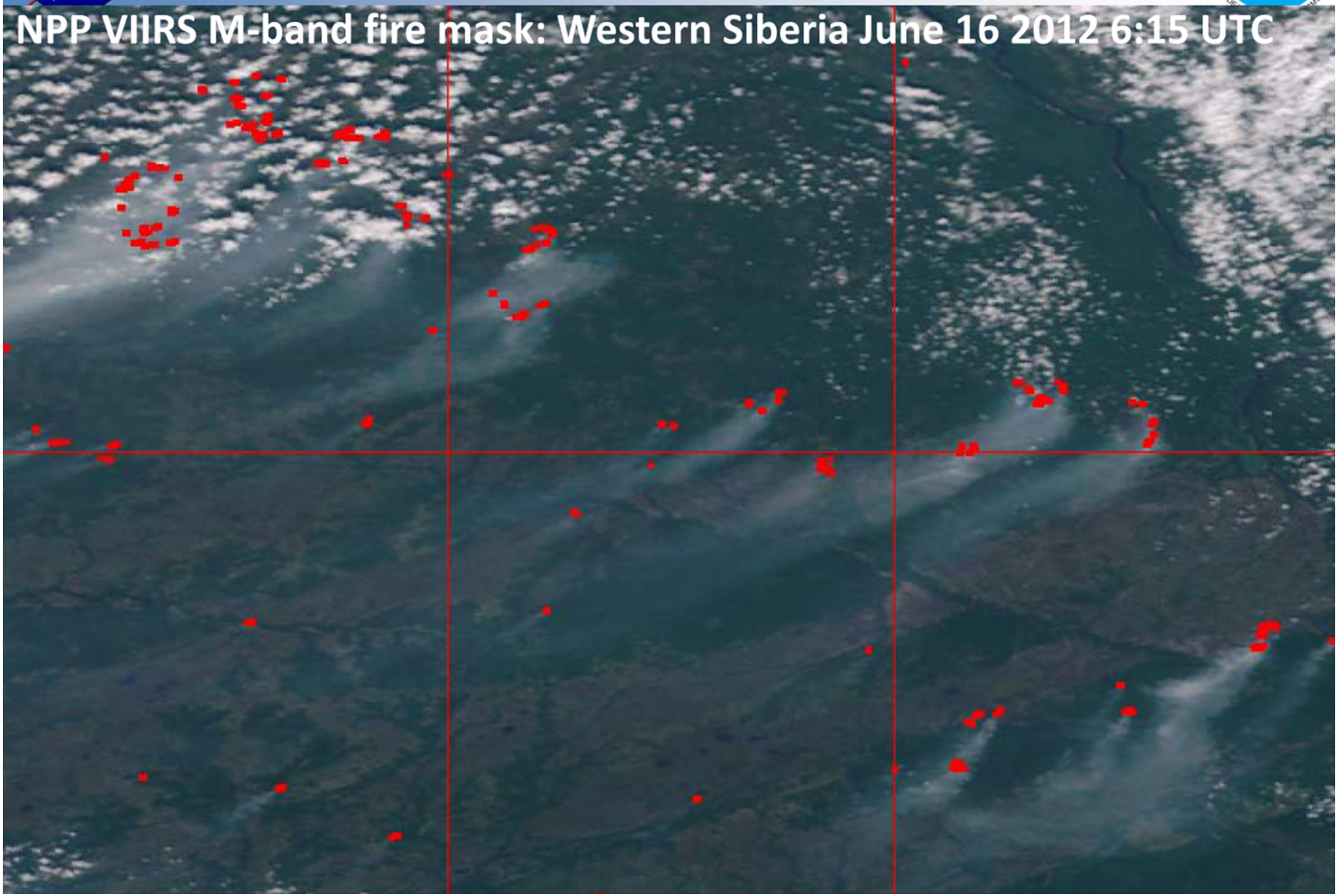


Current Challenges:

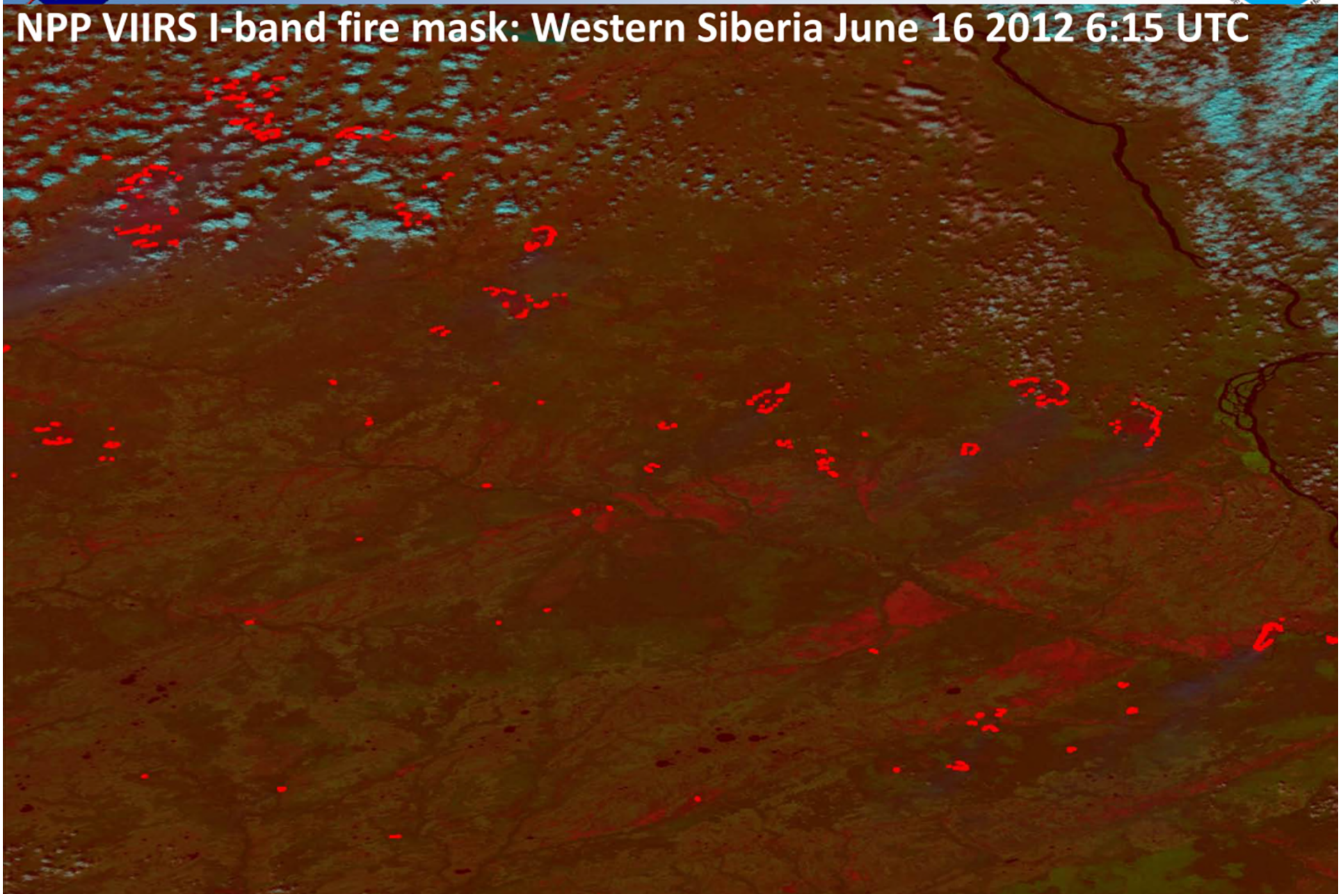
- *ARP output (based on MODIS V004 [2003]) lacks the contextual fire mask and fire radiative power (FRP) data layers.*
- *The science community addressing global fire emissions, air quality, aerosol studies, and ecosystem processes are currently utilizing (and expect data continuity for) the MODIS Burned Area Product.*

(*from* I. Csiszar and W. Schroeder NOAA)

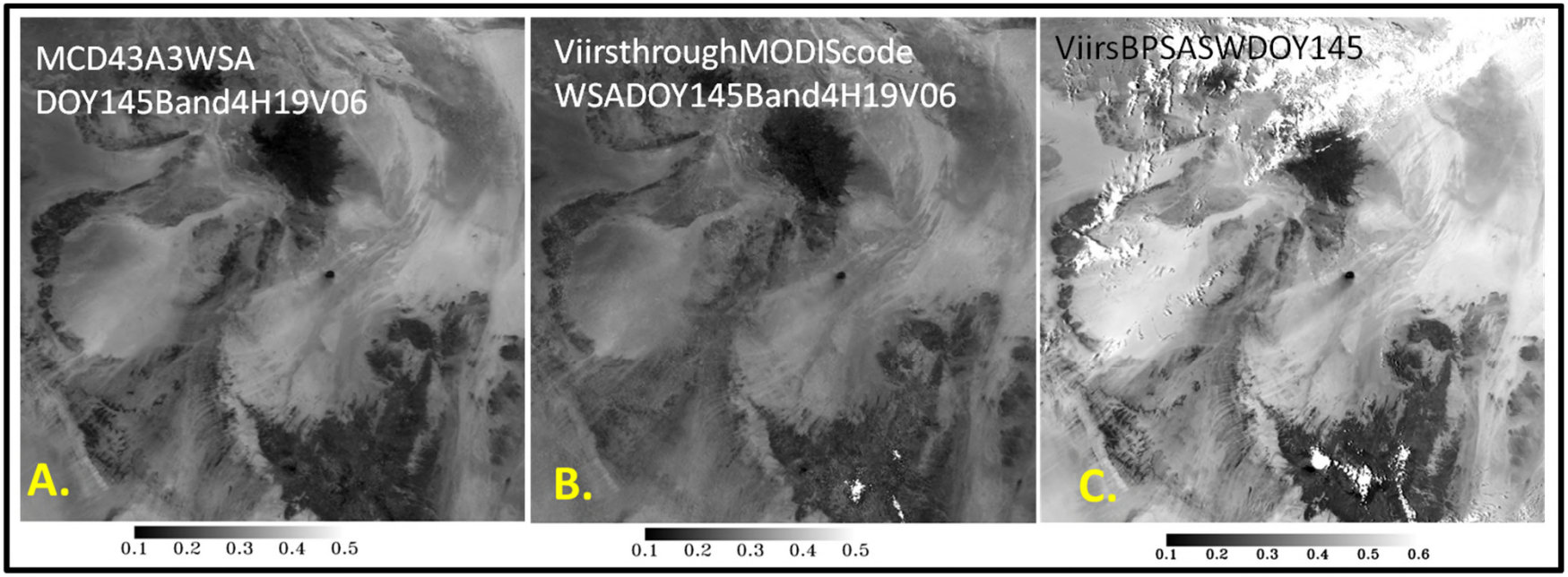
Use of VIIRS "I" bands



Use of VIIRS "I" bands



Land Surface Albedo EDR



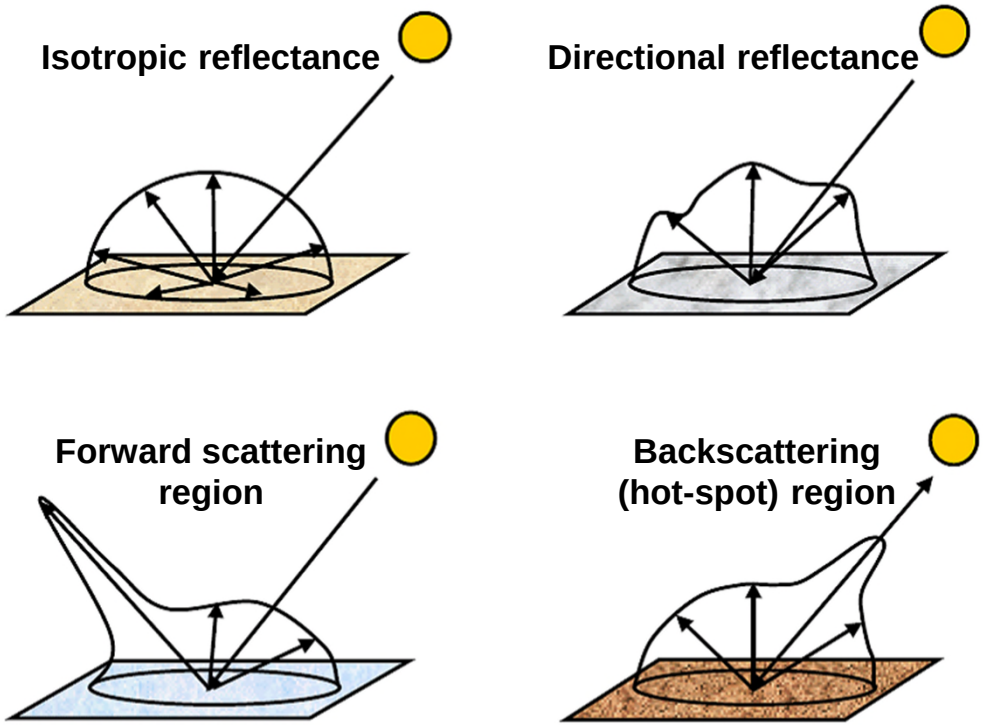
Surface Albedo EDR status:

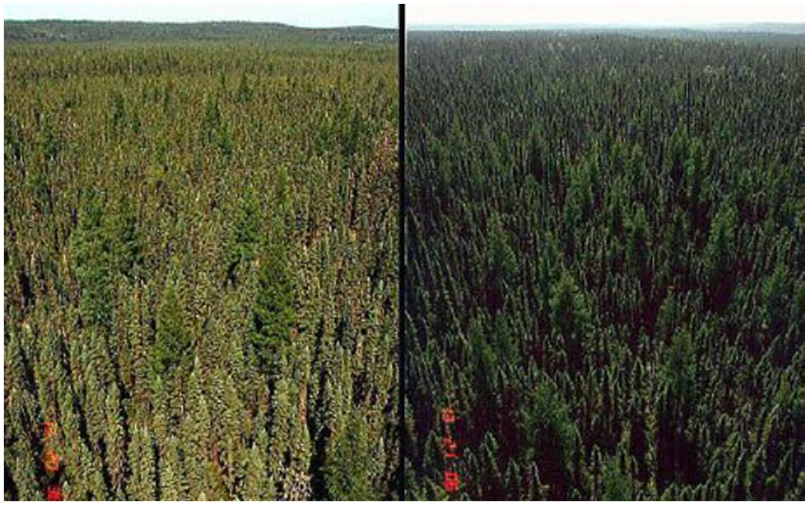
- Two algorithms have been implemented:
- Bright Pixel Surface Albedo (BPSA) uses a TOA LUT approach, and is designated as primary algorithm.
- Dark Pixel Surface Albedo (DPSA) MODIS heritage.
- Current VIIRS Albedo EDR produces only BPSA algorithm (i.e., a single daily broadband value at the time of overpass).

from C. Schaaf

(A.) MODIS Band 4 for 2012 DOY 145 compared against (B.) VIIRS spectral albedo retrievals run though the MODIS standard 16-day BRDF/Albedo algorithm at the Land PEATE. VIIRS spectral albedos can reproduce the multi-date 'MODIS-like' products with reasonable agreement. Results for the operational IDPS BPSA product (broadband SWIR) are shown (C.)

The Bidirectional Reflectance Distribution Function





Backscattering vs. Forward Scattering

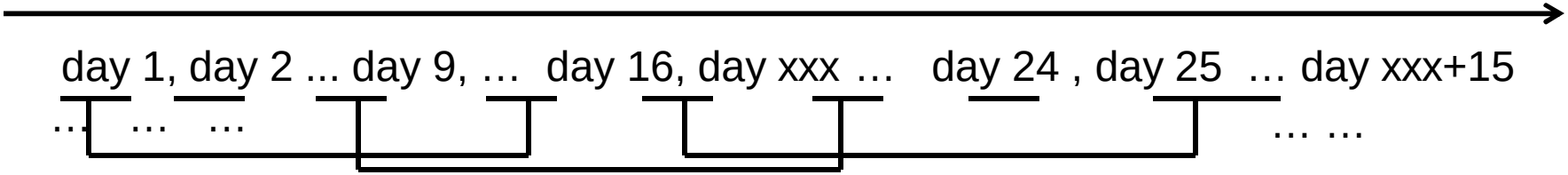
- Surface albedo can be accurately estimated from the BRDF.
- The '*shape*' of the BRDF contains information on the three-dimensional geometric structure of the surface.

Photographs by Don Deering.

BRDF/Albedo
Eight Day -> Daily

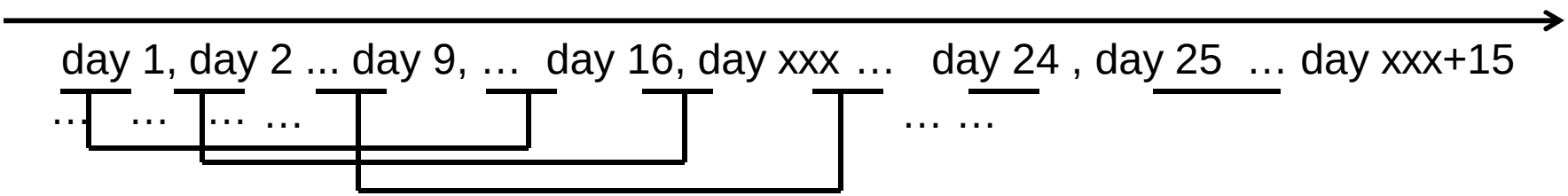
VIIRS (based on MODIS Collection 5 eight day product)

Dynamic observation stream



MODIS Collection 6 daily product

Dynamic observation stream



Observations weighted

Temporal, observation coverage, band quality

BRDF/Albedo: Magnitude Inversion

Back-up Database

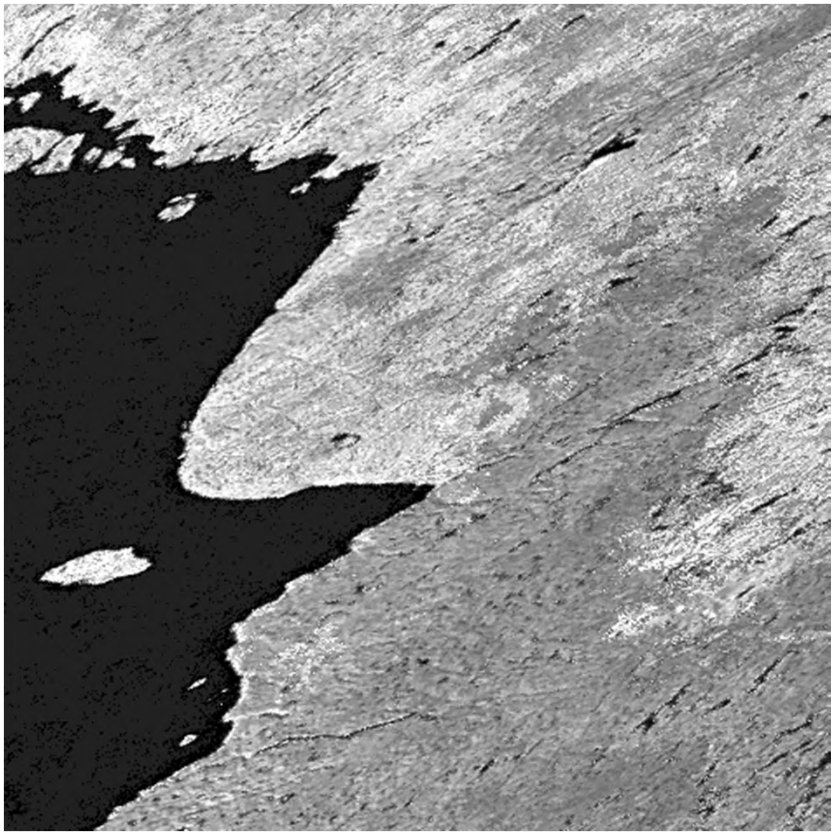
- VIIRS (based on MODIS Collection 5):

  Land cover based

- Collection 6:

  Pixel based

  Updated from the latest full inversion



C6 backup database

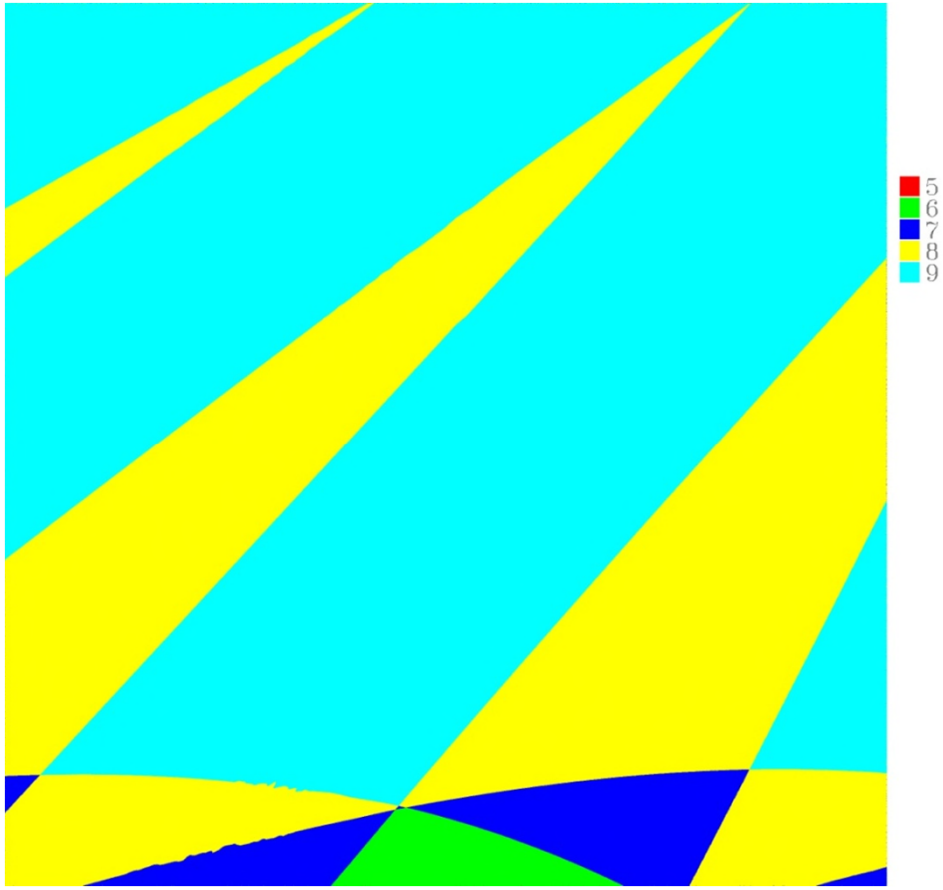
BRDF/Albedo: Number of input observations increased

- Collection 5:

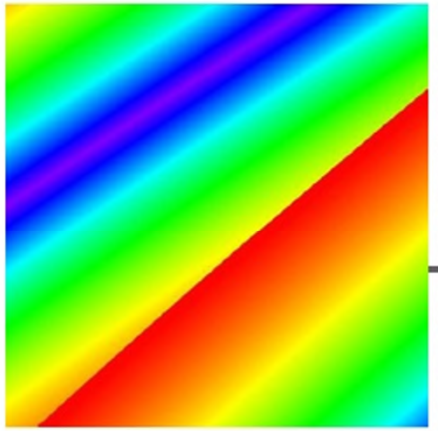
The first 4 layers

- Collection 6:

All the available observations



Tile h16v01 Number of observations, DOY 240



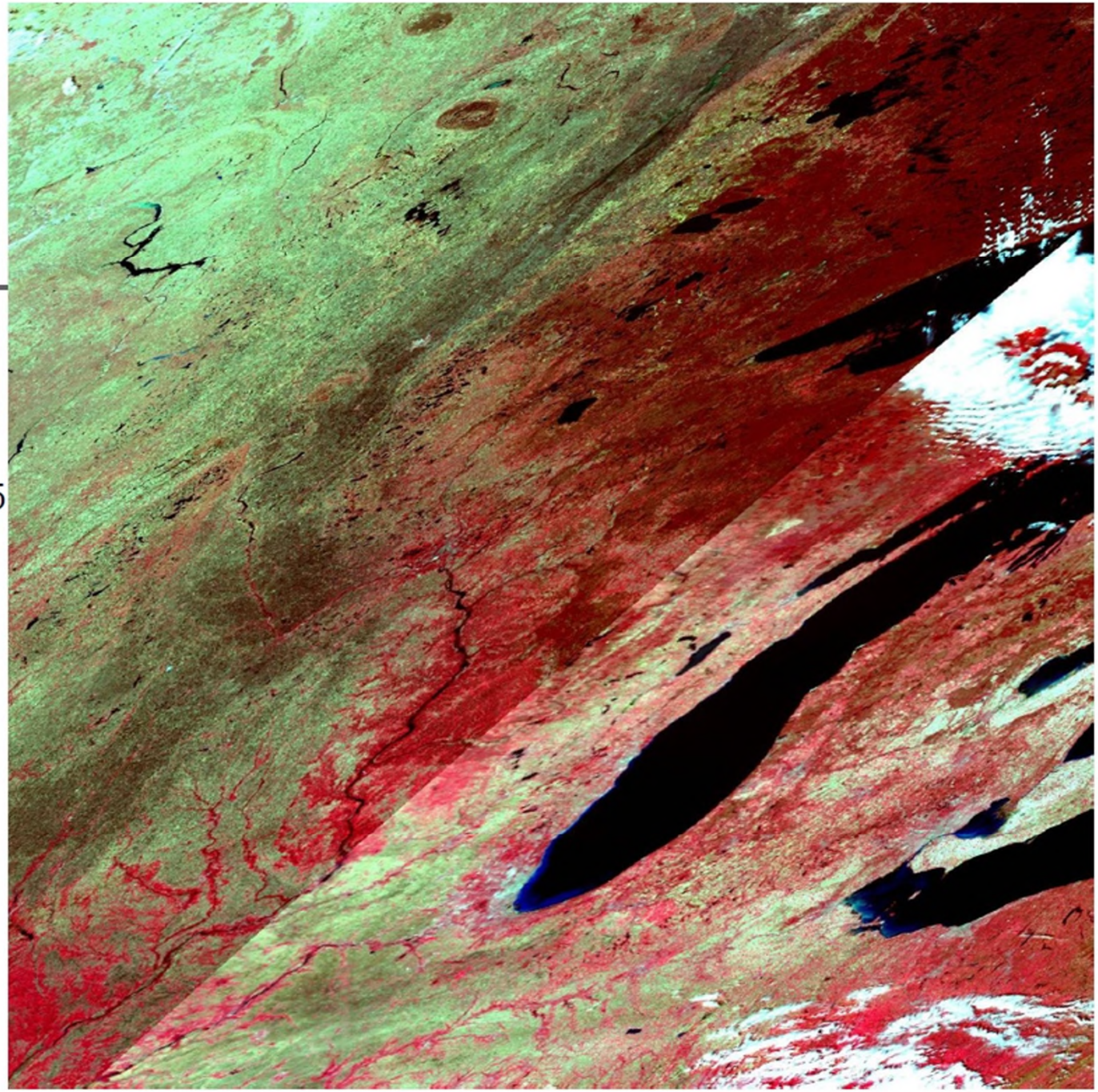
View Zenith Angle

0 32 65

MODIS Daily
Surface Reflectance
500m resolution
(MOD09GHK)

MODIS tile: h11v04

Acquired on
4/26/2006
(A2006116)

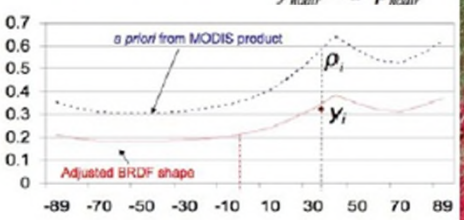


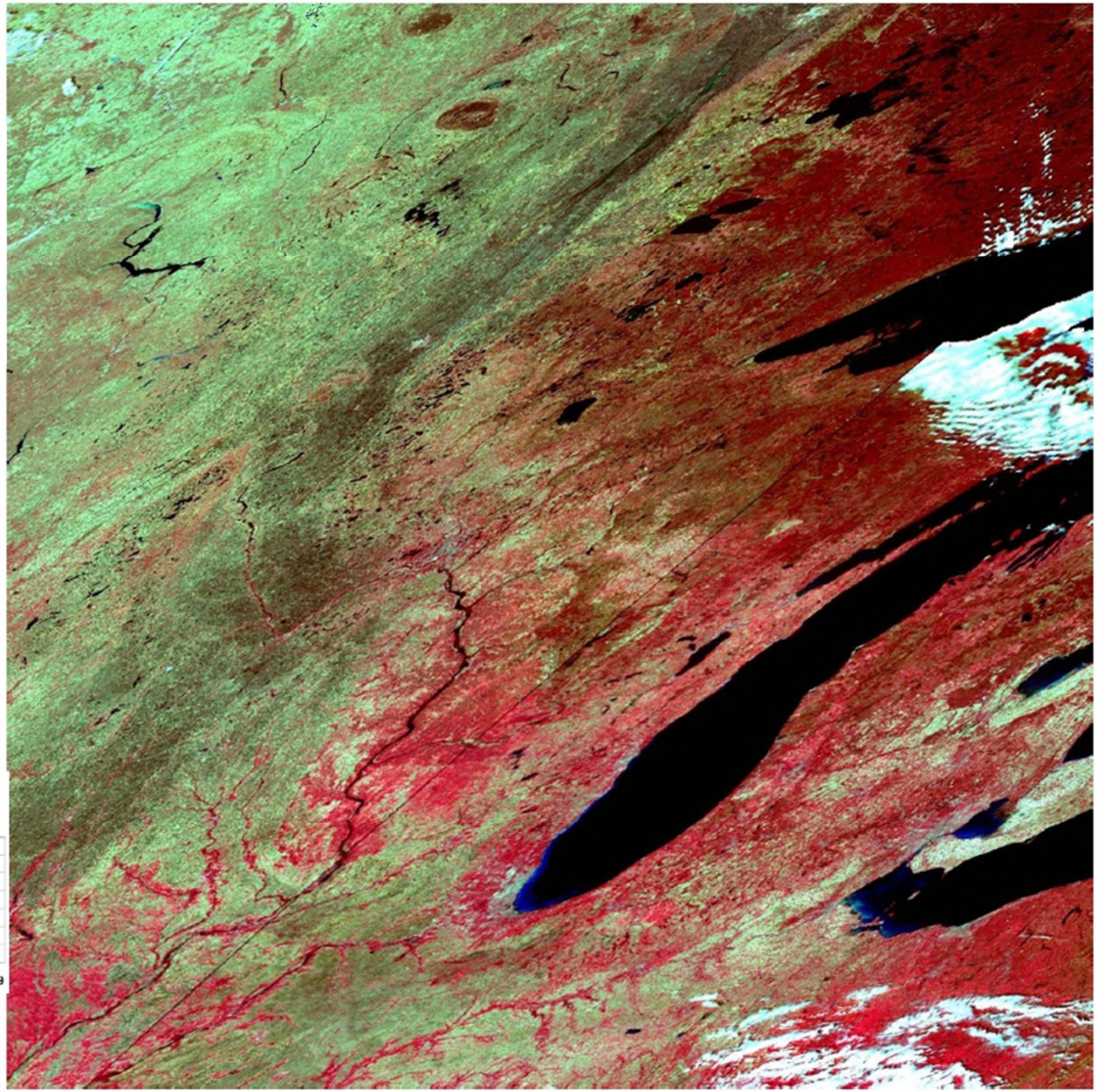
MODIS Daily
Nadir BRDF-adjusted
Surface Reflectance
Using Magnitude
Inversion Approach

4/26/2006

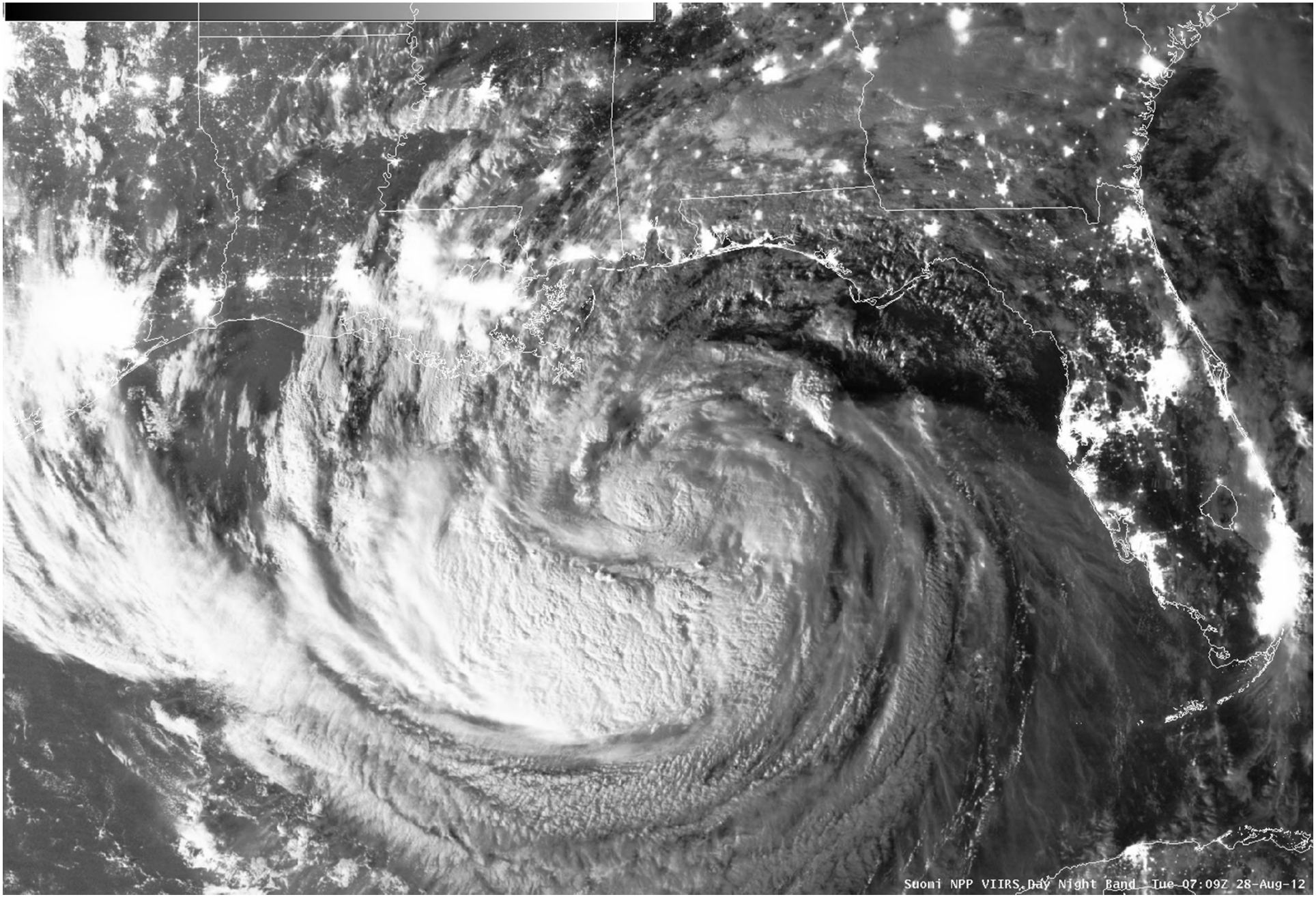
Magnitude inversion $y_i = a \cdot \rho_i$

$y_{nadir} = a \cdot \rho_{nadir}$

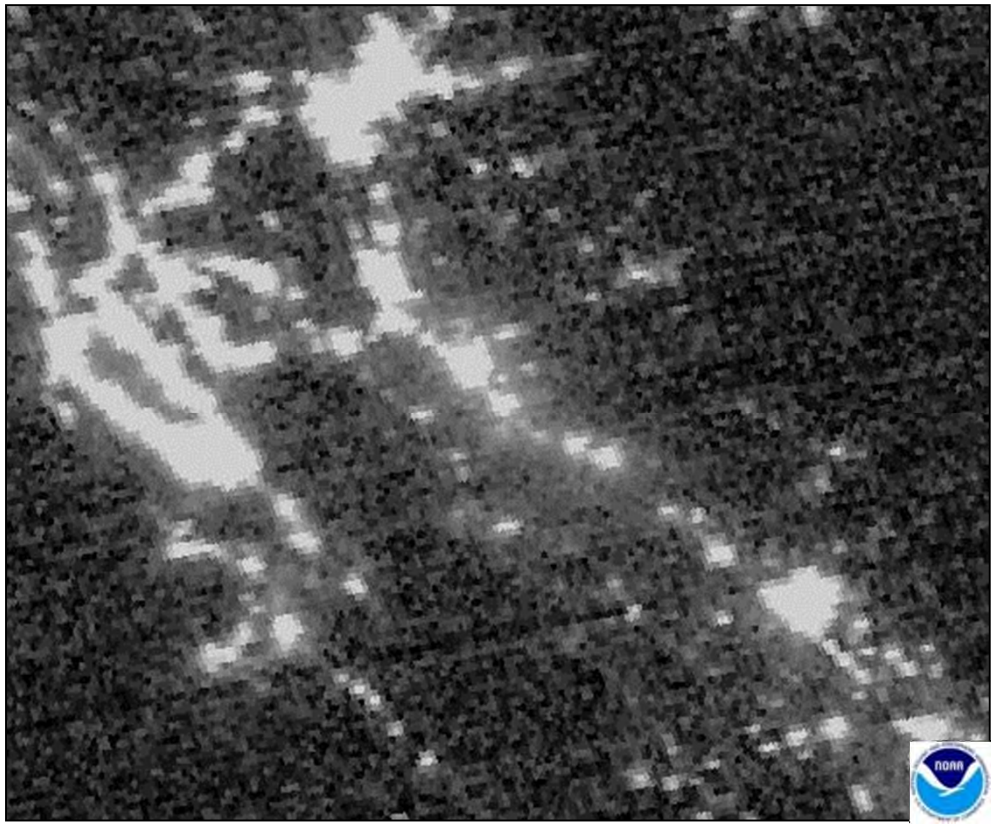


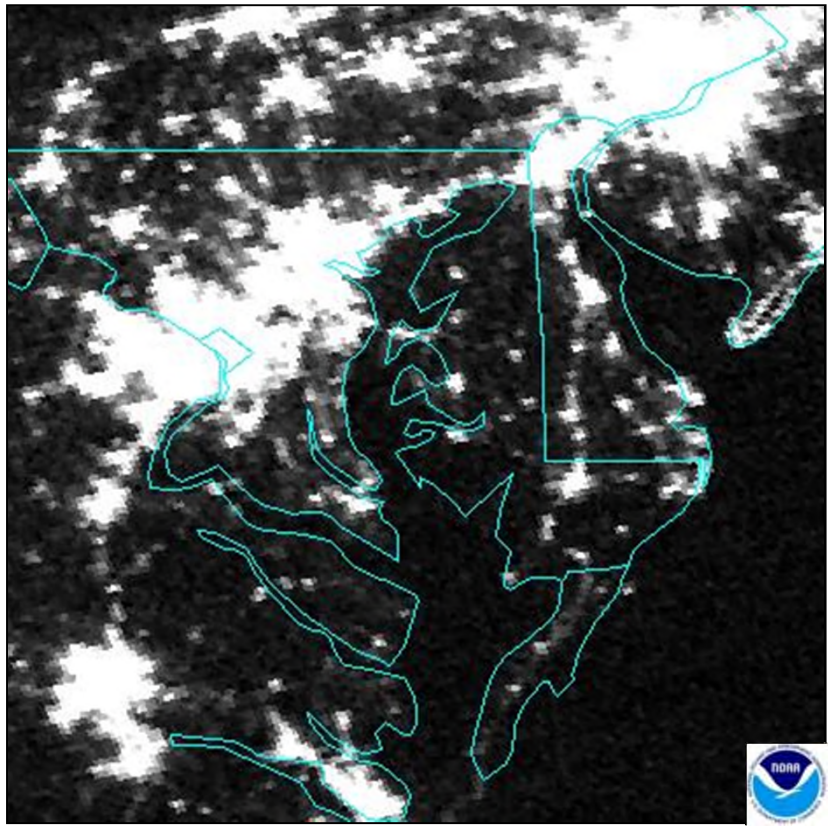


The Suomi-NPP VIIRS Day Night Band



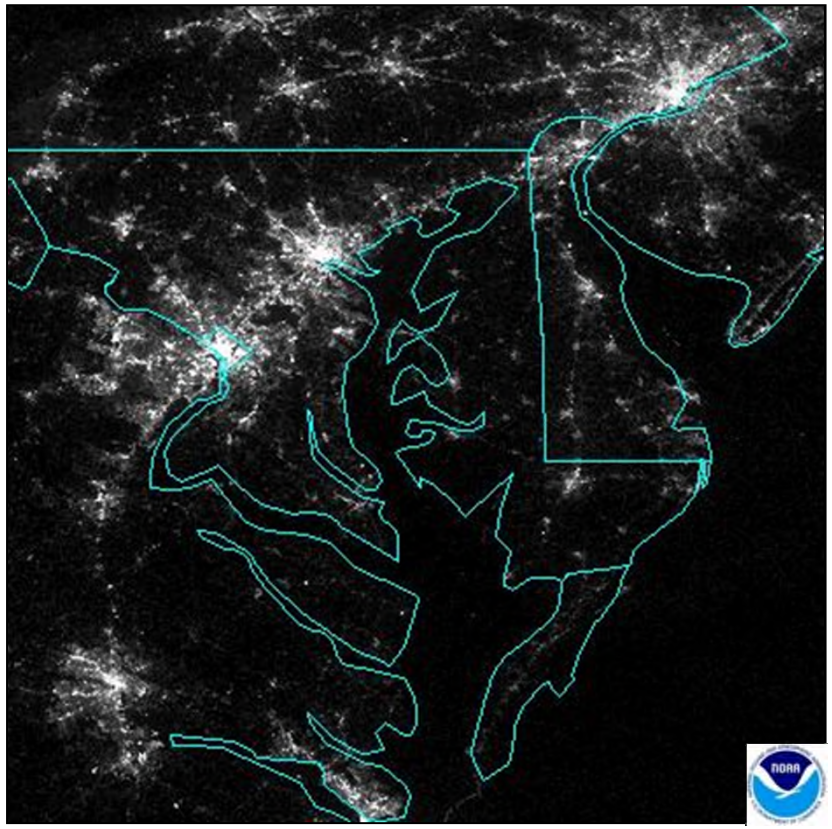
Resolution Improvements: DSMP/OLS vs. VIIRS DNB





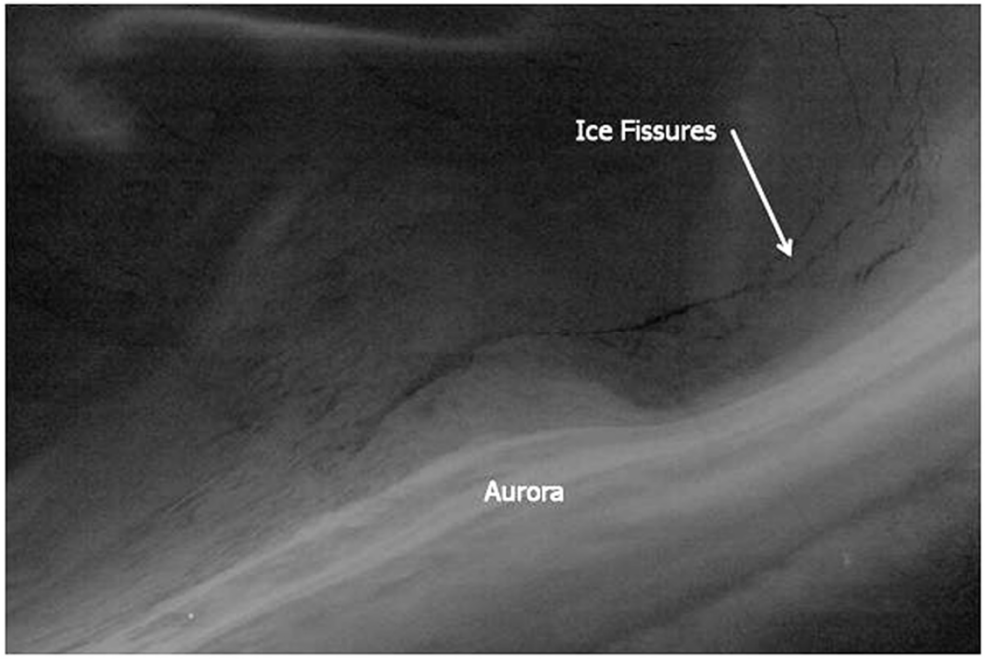
- 740 m instantaneous geometric field of view (DNB) vs. ~5 km for the OLS results in dramatic spatial resolution improvements.
- DNB Imagery courtesy of Steven Miller CIRA/CSU

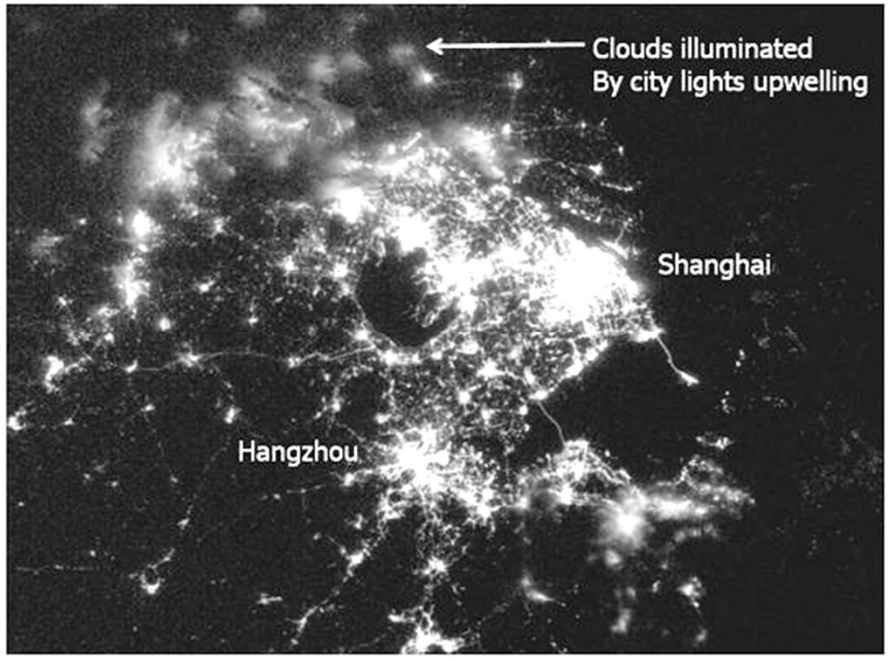
Resolution Improvements: DSMP/OLS vs. VIIRS DNB

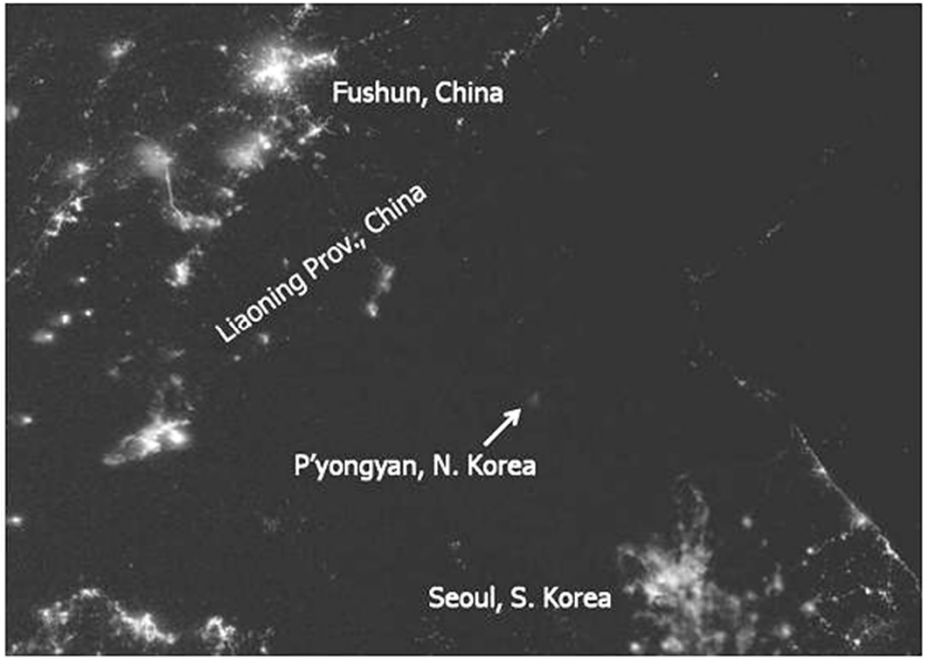


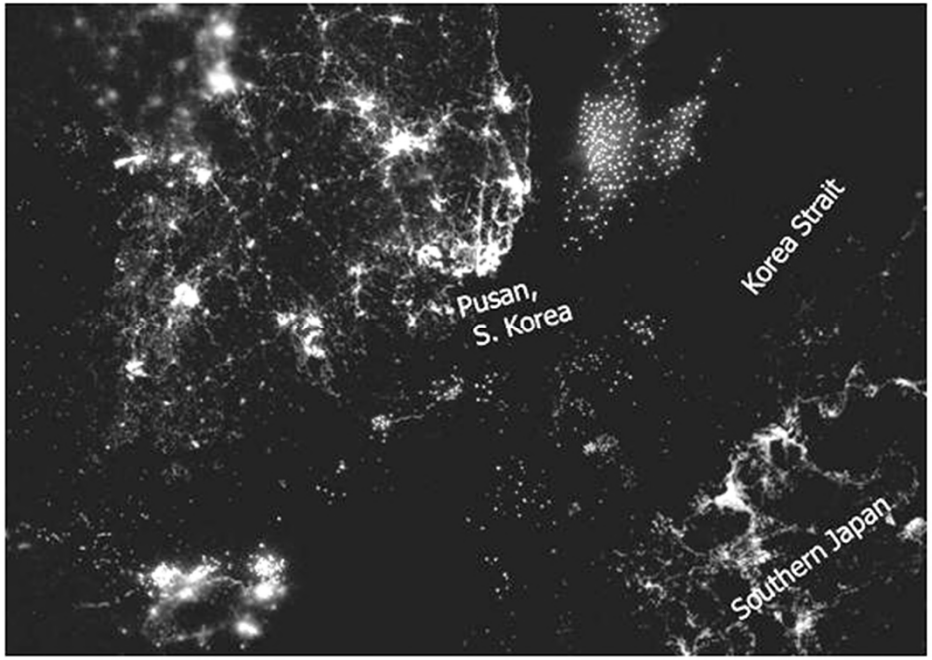
- VIIRS DNB spatial resolution is 14X at nadir and 53X at the edge of scan
- Radiometric resolution across the large dynamic range (7X) using three simultaneously collecting stages, choosing the most sensitive stage in which the pixel is not saturated.

11/28/2011: First Look at VIIRS Day Night Band (from NGAS)

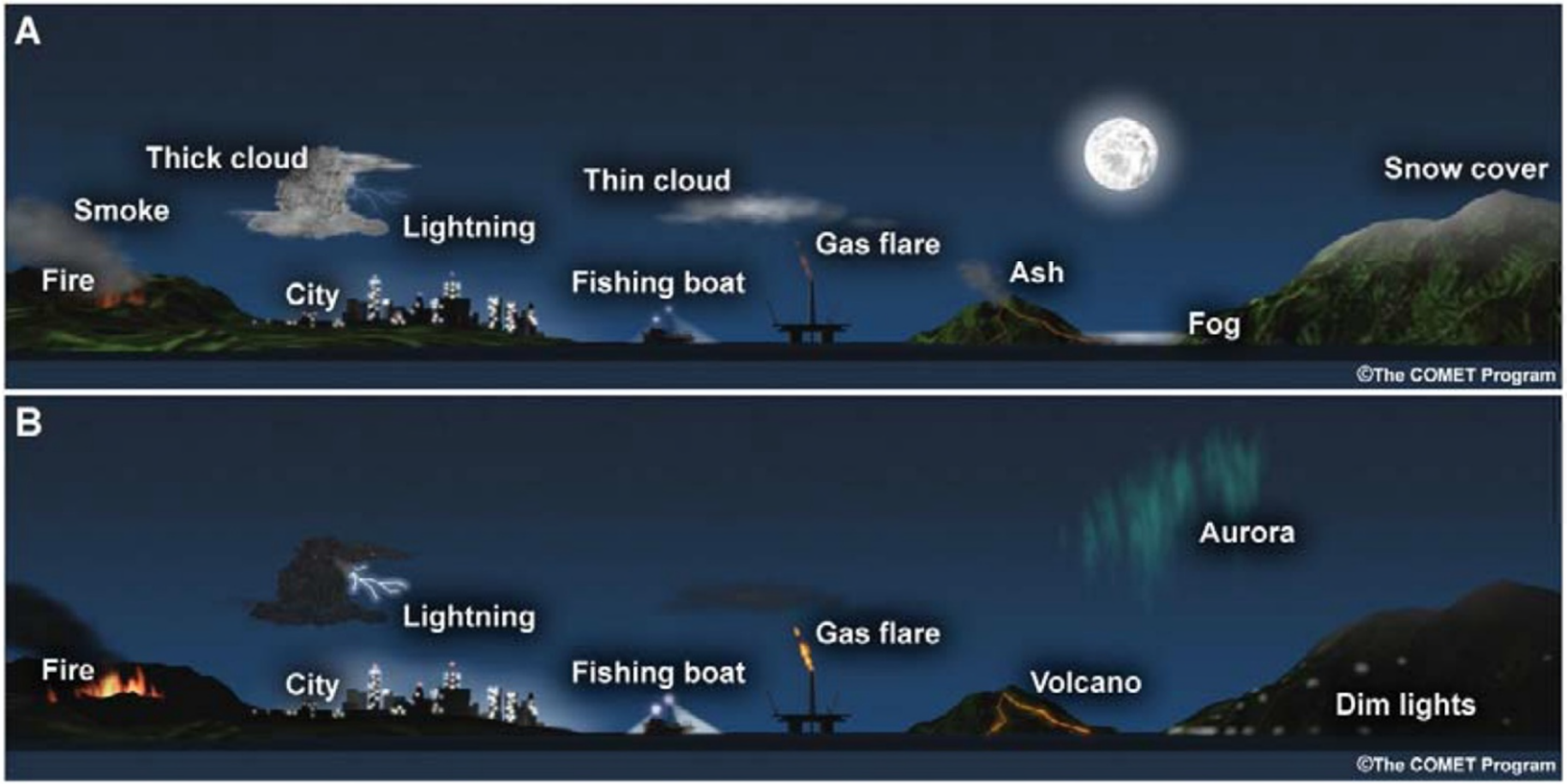




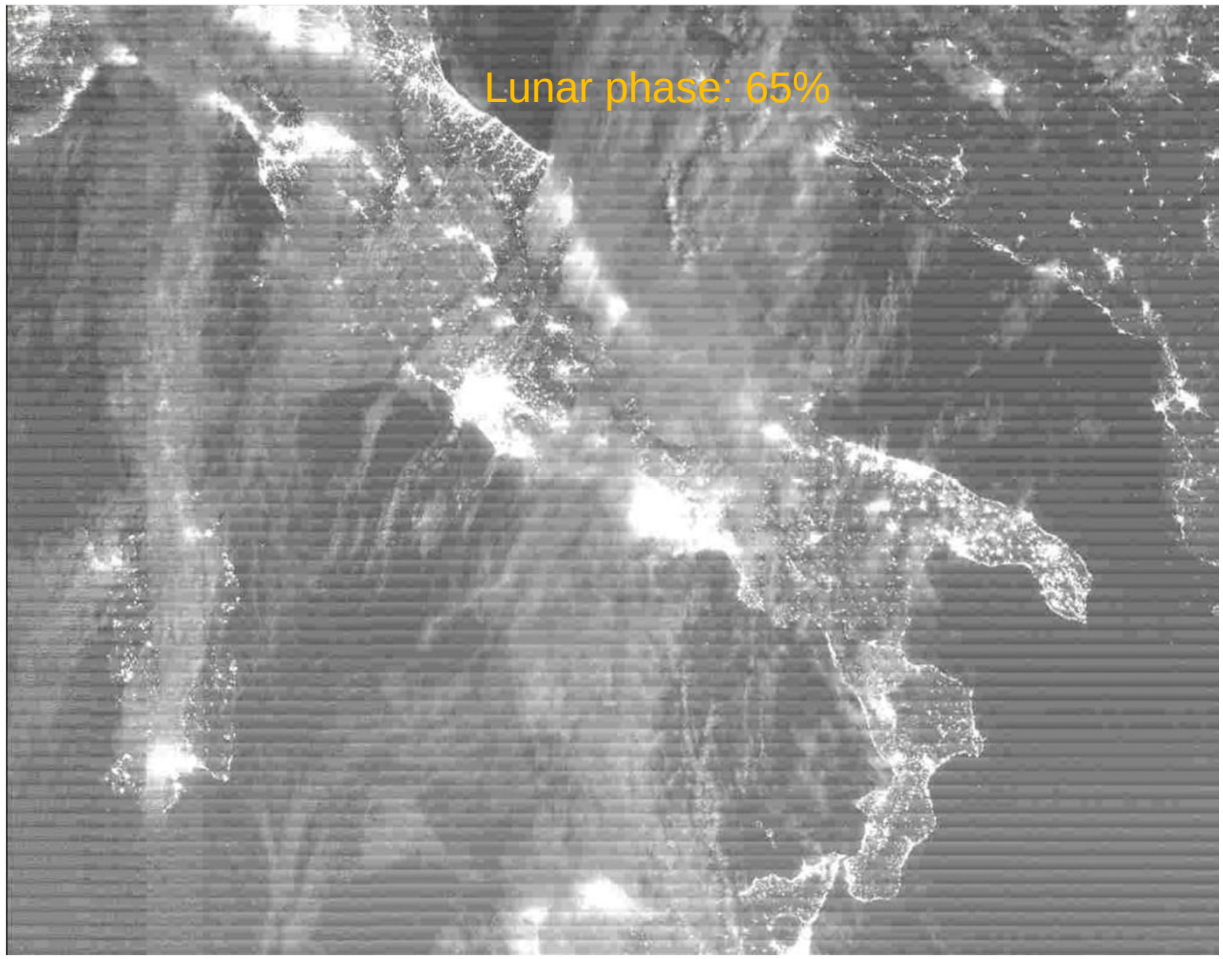




VIIRS DNB nighttime detection capabilities (A) with and (B) without lunar illumination*

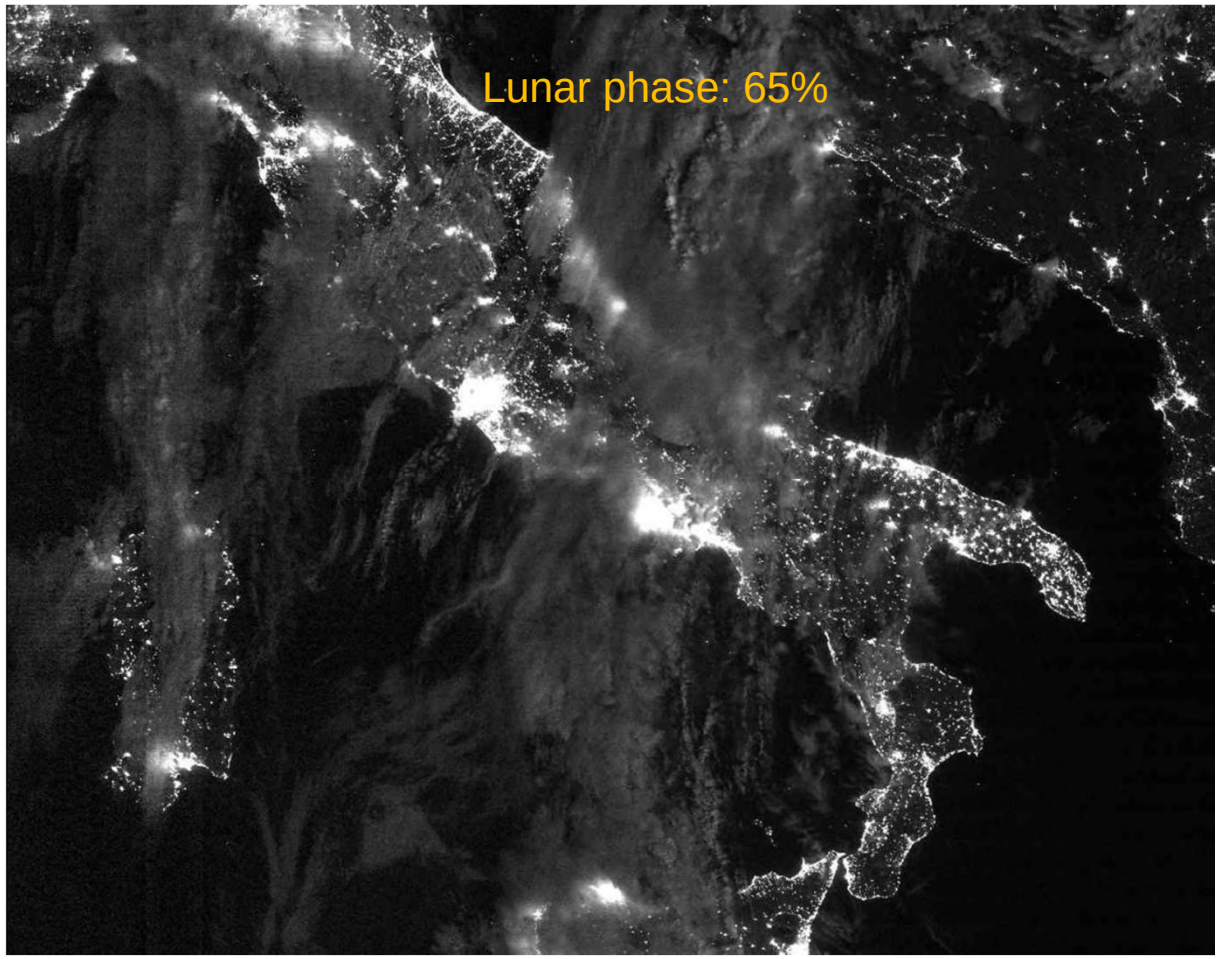


Detail of Italy 6/10/12, 00:02 UTC without correction



S. Mills, NGAS

Detail of Italy 6/10/12, 00:02 UTC with correction



S. Mills, NGAS

Event	Dates	Lon/Lat N	S	E	W	Order #	O	D	P	G	Priority	Notes
Christmas	11/01/2012 01/21/2013	39	29	-78	-99	6198, 6201	✓✓	198 201	✓		1	
Diwali, India	10/15/2012 12/15/2012	20	54	125	72	6209 ready 6210	✓ ✓	209 210	✓			
Diwali, Mauritius	11/15/2012 12/15/2012	-19	-22	58.2	54.8	6212 ready 6213	✓ ✓	212 213				
Diwali, Mal & Sing	10/15/2012 12/15/2012	3.4	0.0	105	101	6203 ready 6204 Kellie	✓ ✓	203 204	✓			
Diwali, Fiji	10/15/2012 12/15/2012	-16	-20	-179	176	6214 ready 6215	✓ ✓	214 215	Variable letter error			
Harbin Festival, China	12/05/2011 - 3/5/2012 12/05/2012 - 3/5/2013	50	30	143	124	6230 6231	✓ ✓	230				
India monsoons	5/01/2012 - 10/15/2012	37	5.4	100	67	6837 R 6838	✓	838				
Florida Snowbirds	6/21/2012 3/21/2013	30	24	-80	-84	6234 6235	✓ ✓	234 235	✓			Isaac 8/26 Debbie 6/25-6/27 + Annapolis Power Outage 12/20-21
DC	11/16/2012 01/30/2013	40	37	-76	-77	6236 6237	✓ ✓	236 237				
Lyon, Paris, London	11/01/2012 01/23/2013	53	44	8	-2	6240 6241	✓ ✓	240 241				
Oklahoma tornado	05/01/2013 - 06/13/2013	37	33	-99	-95	6847	✓	847				
Heat wave, Pakistan	04/01/2013 - 06/13/2013	35	25	75	62	6855 R, 6856	✓ ✓	855, 856				
Flooding, Germany	05/01/2013 - 06/13/2013	54	45	17	7	6852	✓	852				
Flooding Nigeria	05/01/2012 - 11/20/2012	15	4	15	4	6863 R, 6862	✓ ✓	863				
Phillipines typhoon	10/30/2012 - 04/01/2013	20	5	117	127	6864 R, 6865	✓ ✓	864, 865				

LAADS orders:

AS 3100

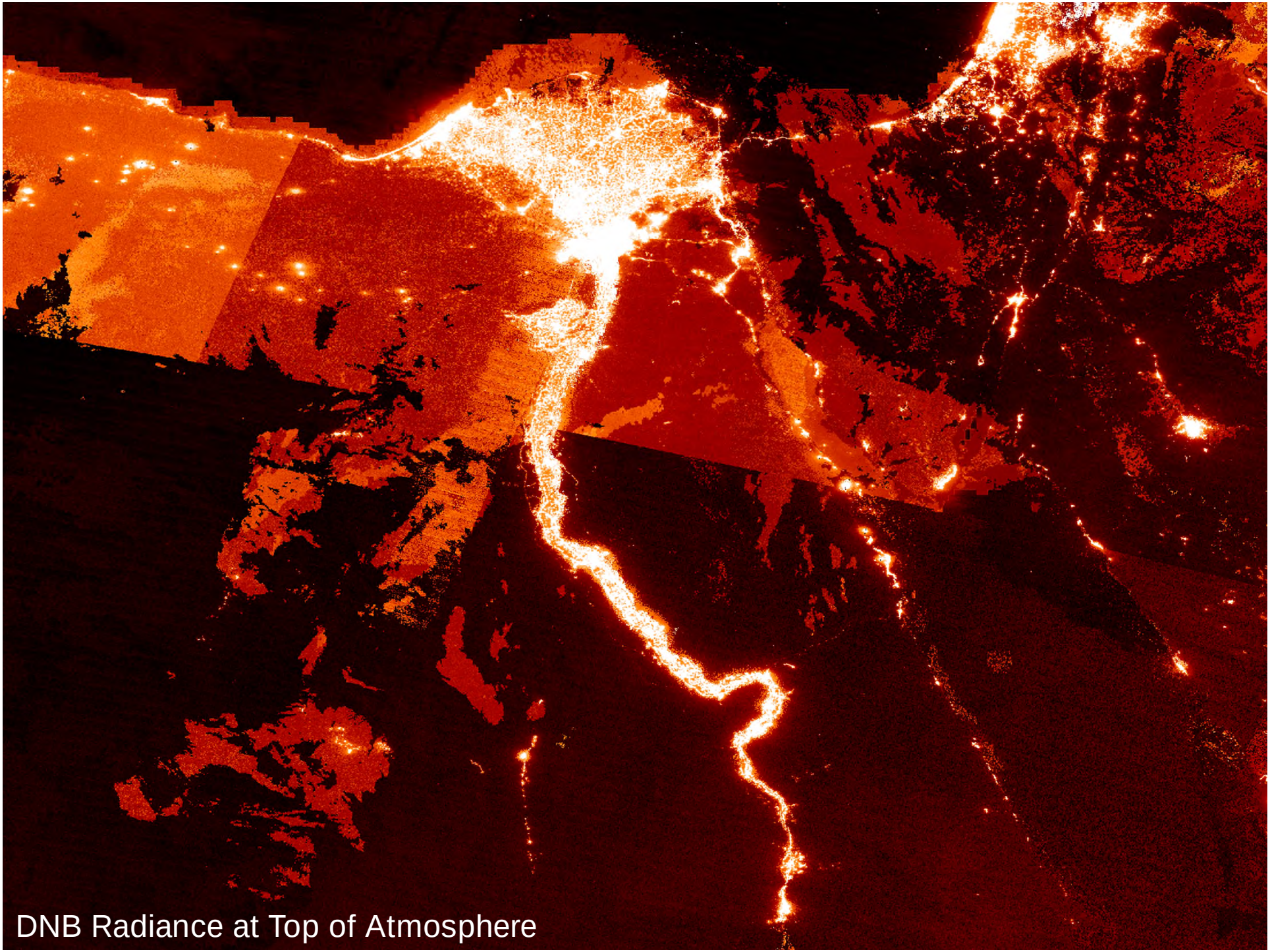
~15 Terabytes

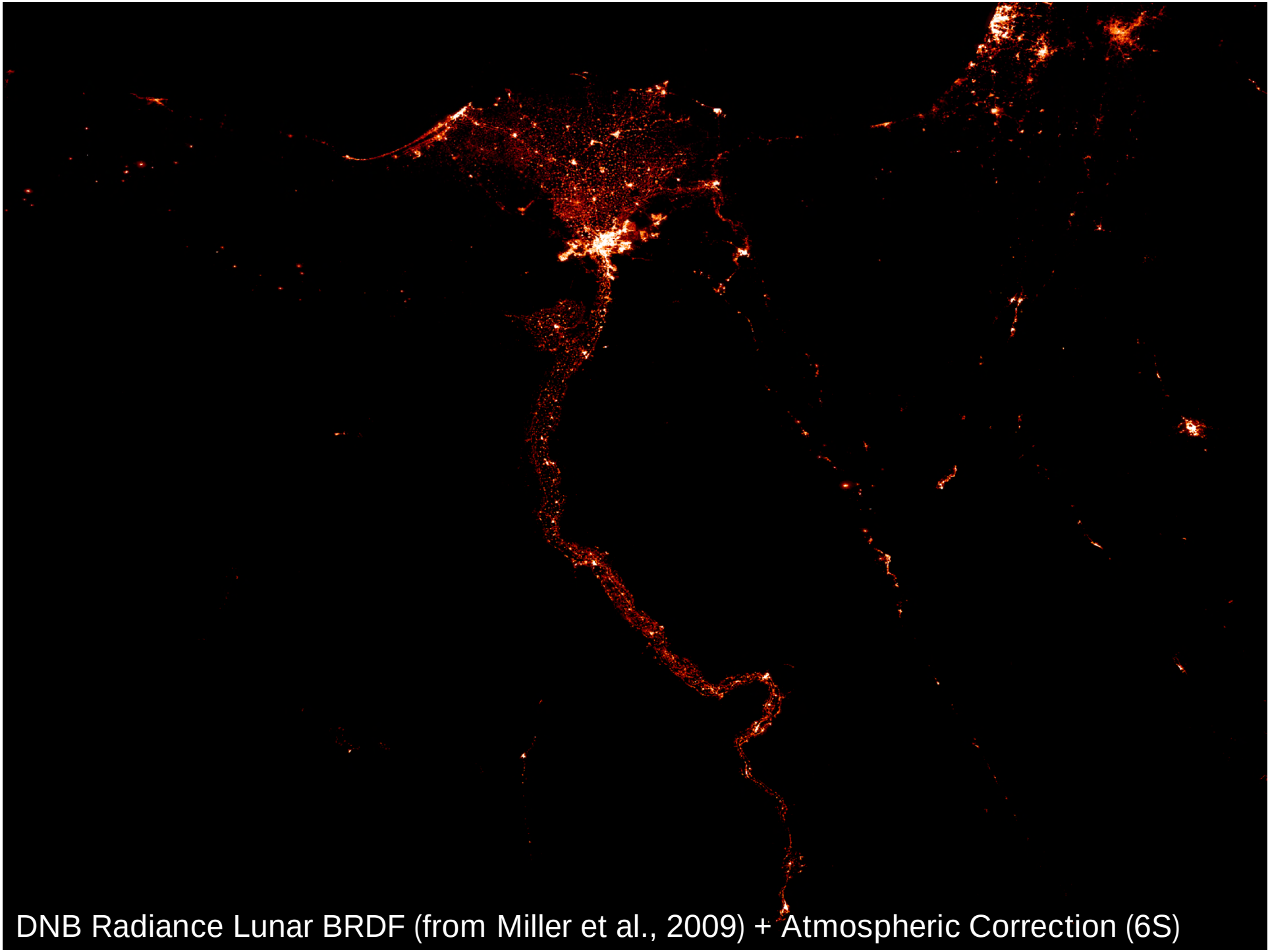
Large Scale Cultural Festivities and Their Impacts on Urban Light Energy Use

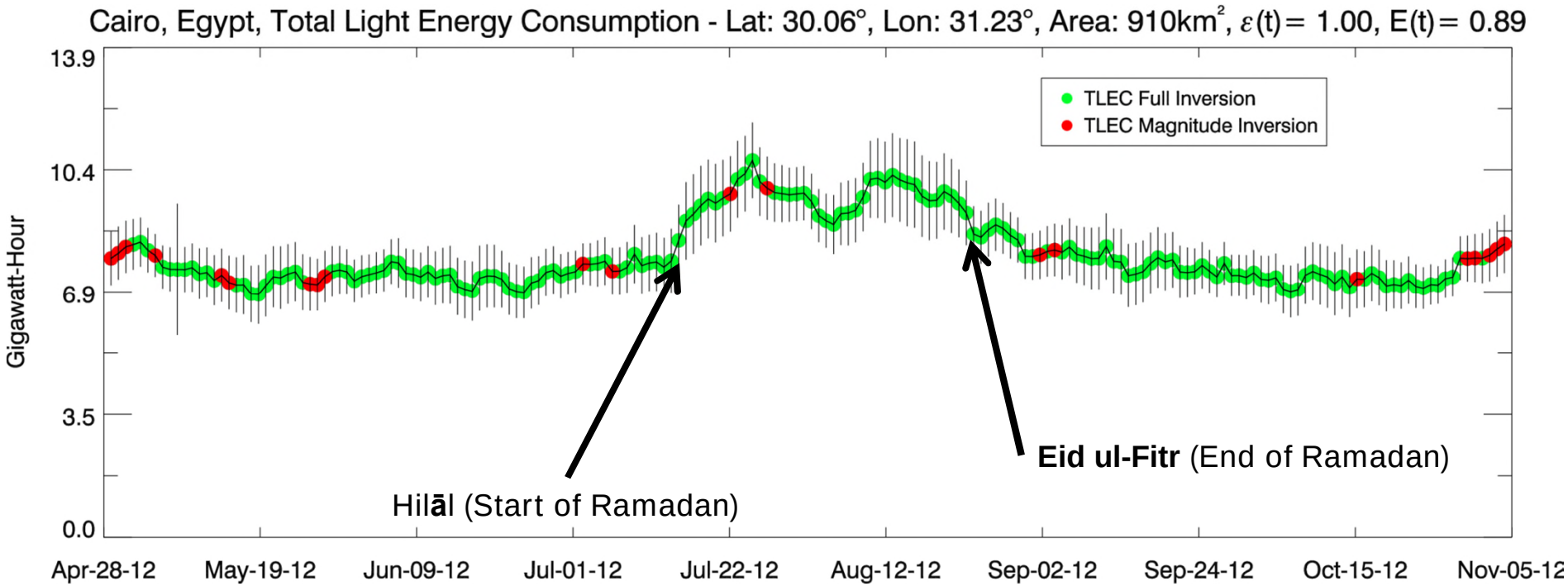
Román with GSFC summer interns

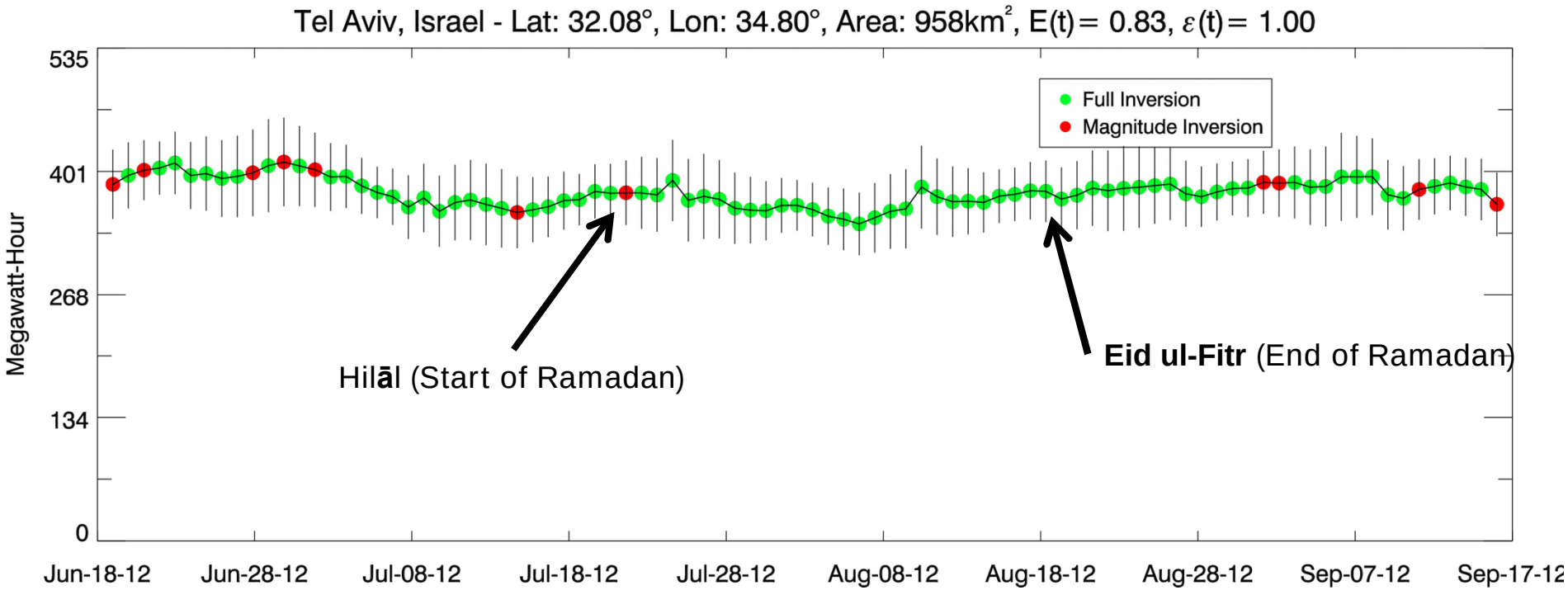
Ramadan, 2012 (Jul19 – Aug 18)

Qiyaam al-Layl (The Night Prayer)

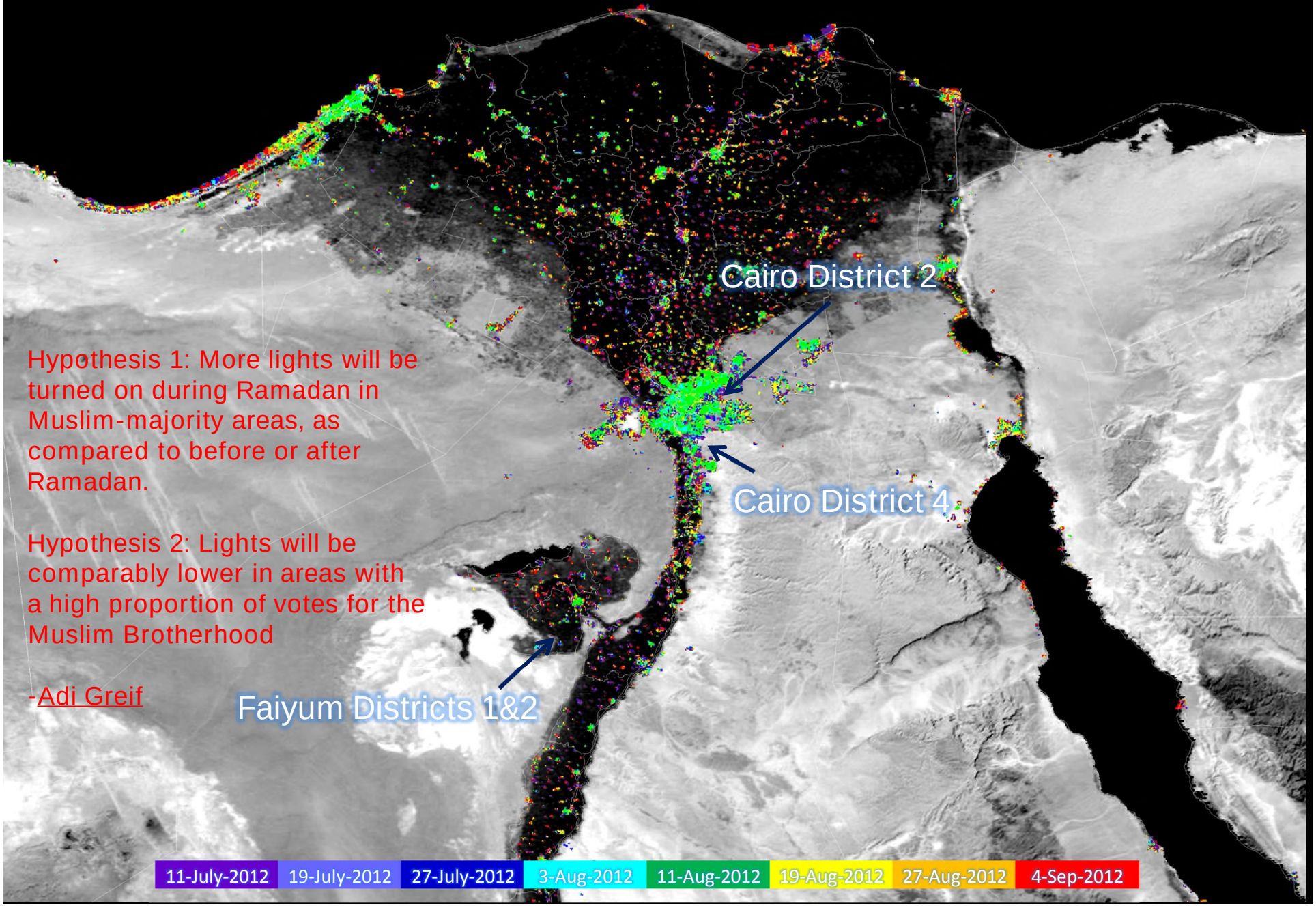

DNB Radiance at Top of Atmosphere


DNB Radiance Lunar BRDF (from Miller et al., 2009) + Atmospheric Correction (6S)


Cairo, Egypt, Total Light Energy Consumption - Lat: 30.06°, Lon: 31.23°, Area: 910km², ε(t) = 1.00, E(t) = 0.89
Gigawatt-Hour
13.9
10.4
6.9
3.5
0.0
TLEC Full Inversion
TLEC Magnitude Inversion
Hilāl (Start of Ramadan)
Eid ul-Fitr (End of Ramadan)
Apr-28-12
May-19-12
Jun-09-12
Jul-01-12
Jul-22-12
Aug-12-12
Sep-02-12
Sep-24-12
Oct-15-12
Nov-05-12


Tel Aviv, Israel - Lat: 32.08°, Lon: 34.80°, Area: 958km², E(t) = 0.83, ε(t) = 1.00
Megawatt-Hour
535
401
268
134
0
Full Inversion
Magnitude Inversion
Hilāl (Start of Ramadan)
Eid ul-Fitr (End of Ramadan)
Jun-18-12
Jun-28-12
Jul-08-12
Jul-18-12
Jul-28-12
Aug-08-12
Aug-18-12
Aug-28-12
Sep-07-12
Sep-17-12

Timing of Peak Energy Use: 2012 Ramadan Period (Jul 19 – Aug 18)



Hypothesis 1: More lights will be turned on during Ramadan in Muslim-majority areas, as compared to before or after Ramadan.

Hypothesis 2: Lights will be comparably lower in areas with a high proportion of votes for the Muslim Brotherhood

-Adi Greif

Egypt: Percentage of Votes Received out of Votes Cast in the District

District	FJP	Al-Nour	Al-Wafd	Egyptian Bloc	Total votes	Voting Age Population	Turnout
Cairo 1	39.4%	14.7%	6.6%	24.2%	832,590	1,252,539	66.5%
Cairo 2	35.7%	11.3%	14.4%	26.3%	875,785	2,060,283	42.5%
Faiyum 1	44.9%	29.1%	3.6%	2.3%	447,743	854,661	52.4%
Faiyum 2	45%	40%	0%	5.6%	291,143	557,048	52.3%

Source: Supreme Judicial Committee for Elections. (2011). Egypt Elections: Listing of Results on the Map. Retrieved from http://parliament2011.elections.eg/index.php/statistics/lists-results-on-map [Arabic]

Source for Voting Age Population: Ahmed, A. (2011). Districts: Proportional System. Retrieved from http://www.egyptelections.org/en/districts.php?type=PR

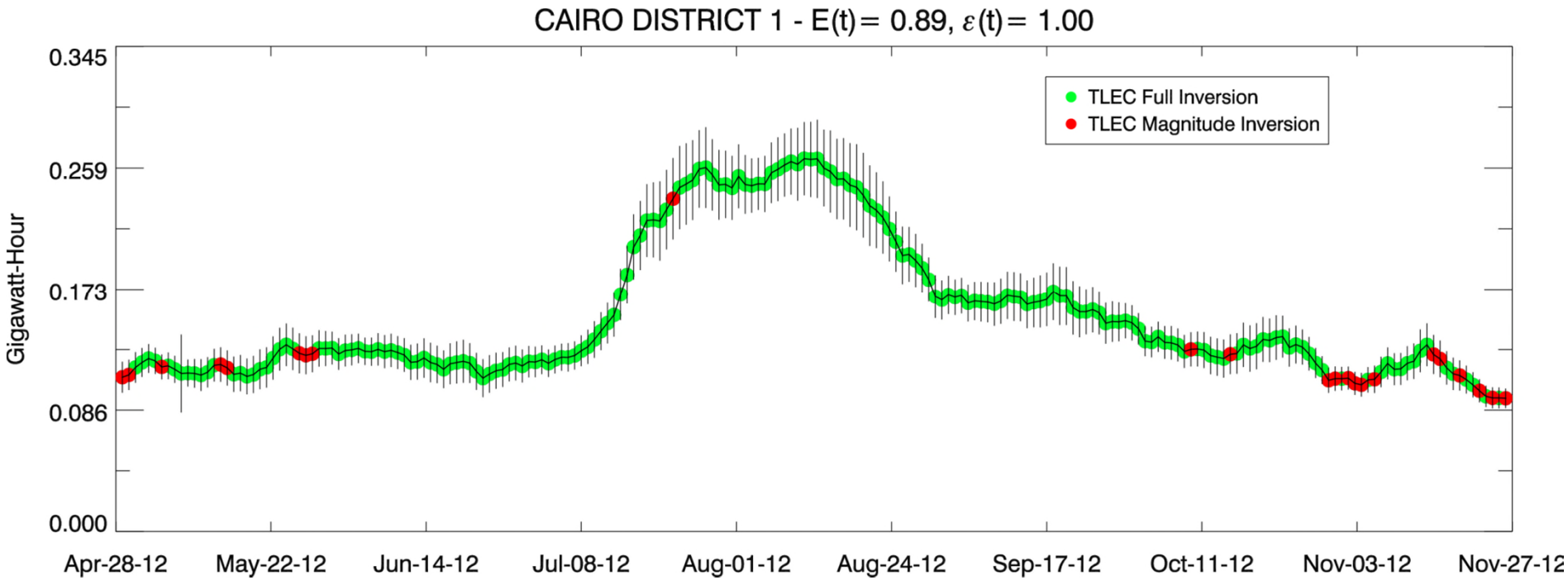
District Characteristics

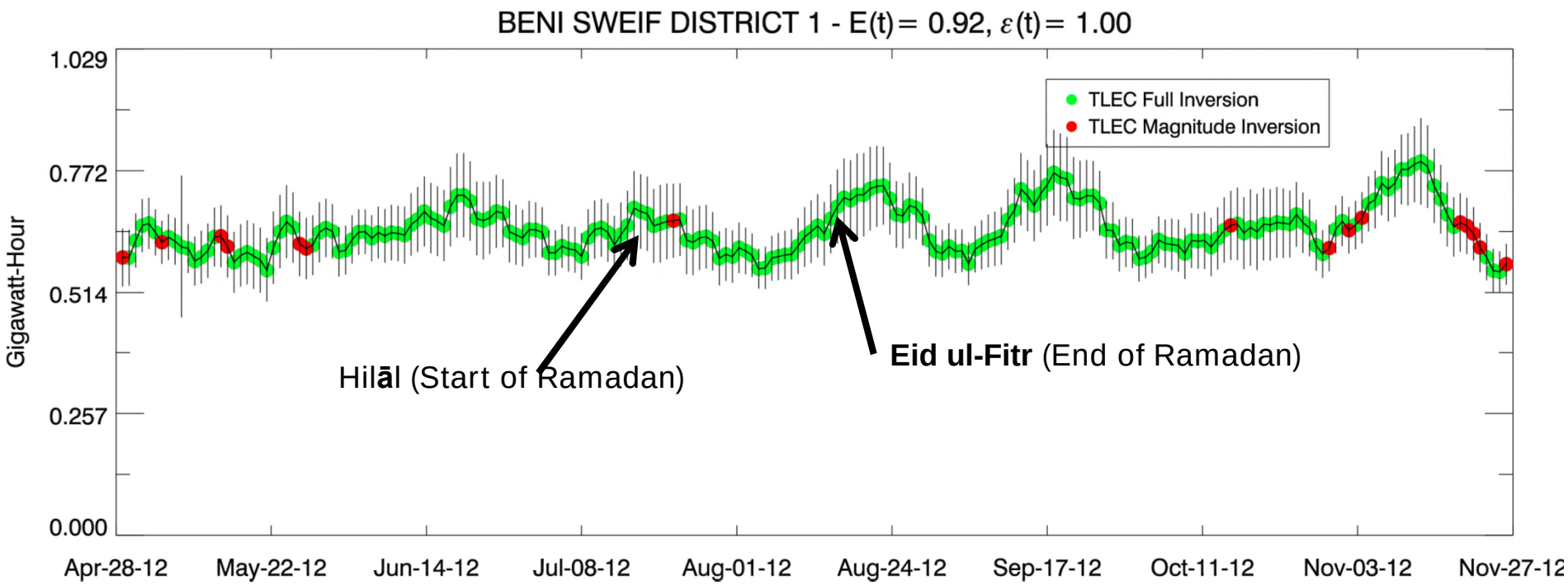
District	Unemployment	Socio-Economic Status	Illiteracy Rate	Share of Non-Public Sanitation
Cairo 1	13.1%	Rich	~22%	~4%
Cairo 2	10.4%	Rich	~18%	~0%
Faiyum 1	8.2%	Poor	~38%	~60%
Faiyum 2	4.9%	Very Poor	~43%	~75%

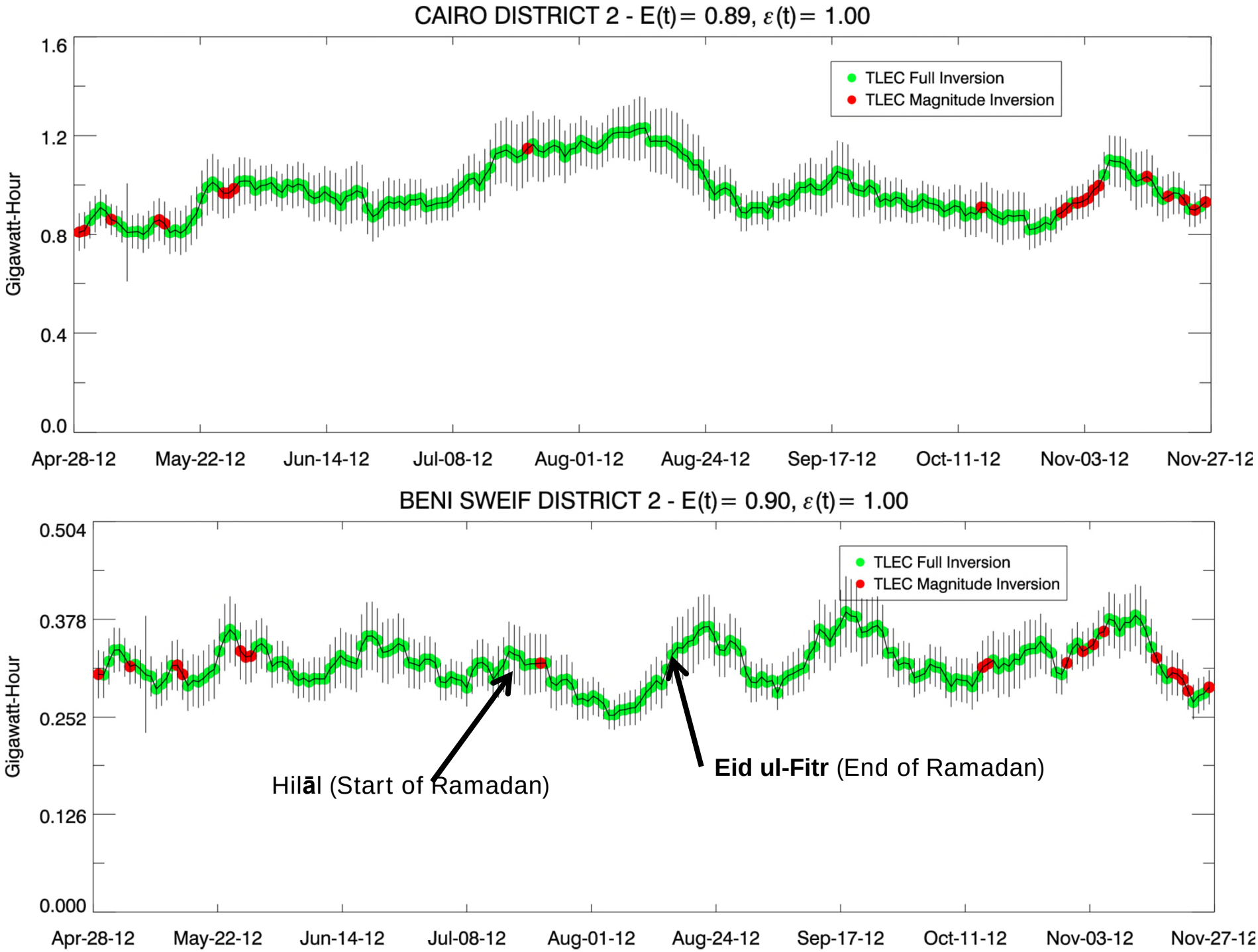
حزب الأصالة

حزب النور

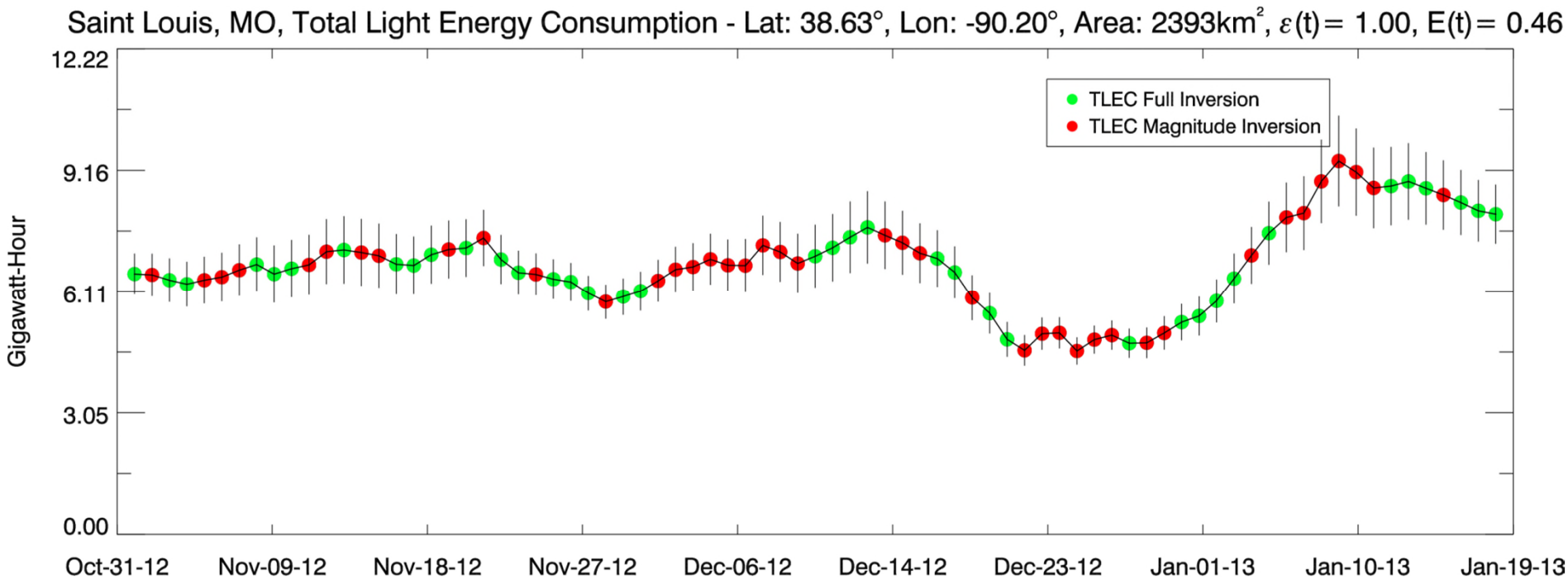
حزب البناء والتنمية

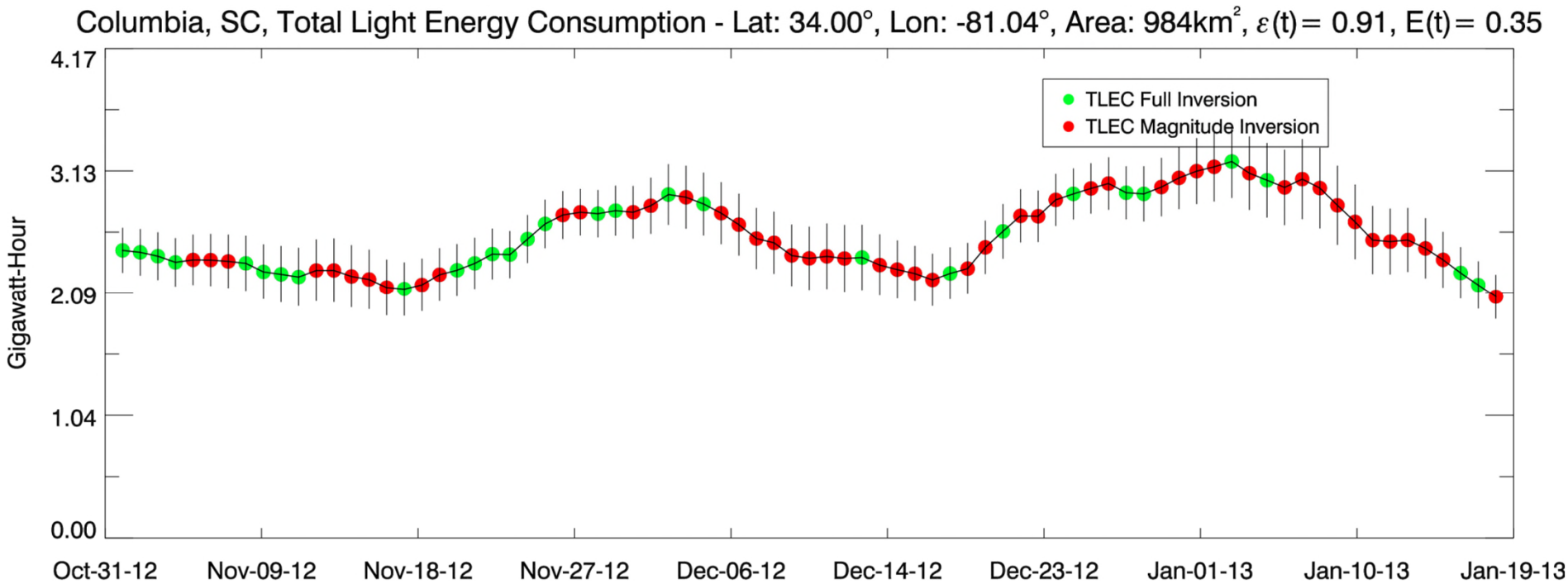

CAIRO DISTRICT 1 - E(t)= 0.89, ε(t)= 1.00
TLEC Full Inversion
TLEC Magnitude Inversion
Gigawatt-Hour
0.345
0.259
0.173
0.086
0.000
Apr-28-12
May-22-12
Jun-14-12
Jul-08-12
Aug-01-12
Aug-24-12
Sep-17-12
Oct-11-12
Nov-03-12
Nov-27-12


BENI SWEIF DISTRICT 1 - E(t)= 0.92, ε(t)= 1.00
TLEC Full Inversion
TLEC Magnitude Inversion
Gigawatt-Hour
1.029
0.772
0.514
0.257
0.000
Hilāl (Start of Ramadan)
Eid ul-Fitr (End of Ramadan)
Apr-28-12
May-22-12
Jun-14-12
Jul-08-12
Aug-01-12
Aug-24-12
Sep-17-12
Oct-11-12
Nov-03-12
Nov-27-12

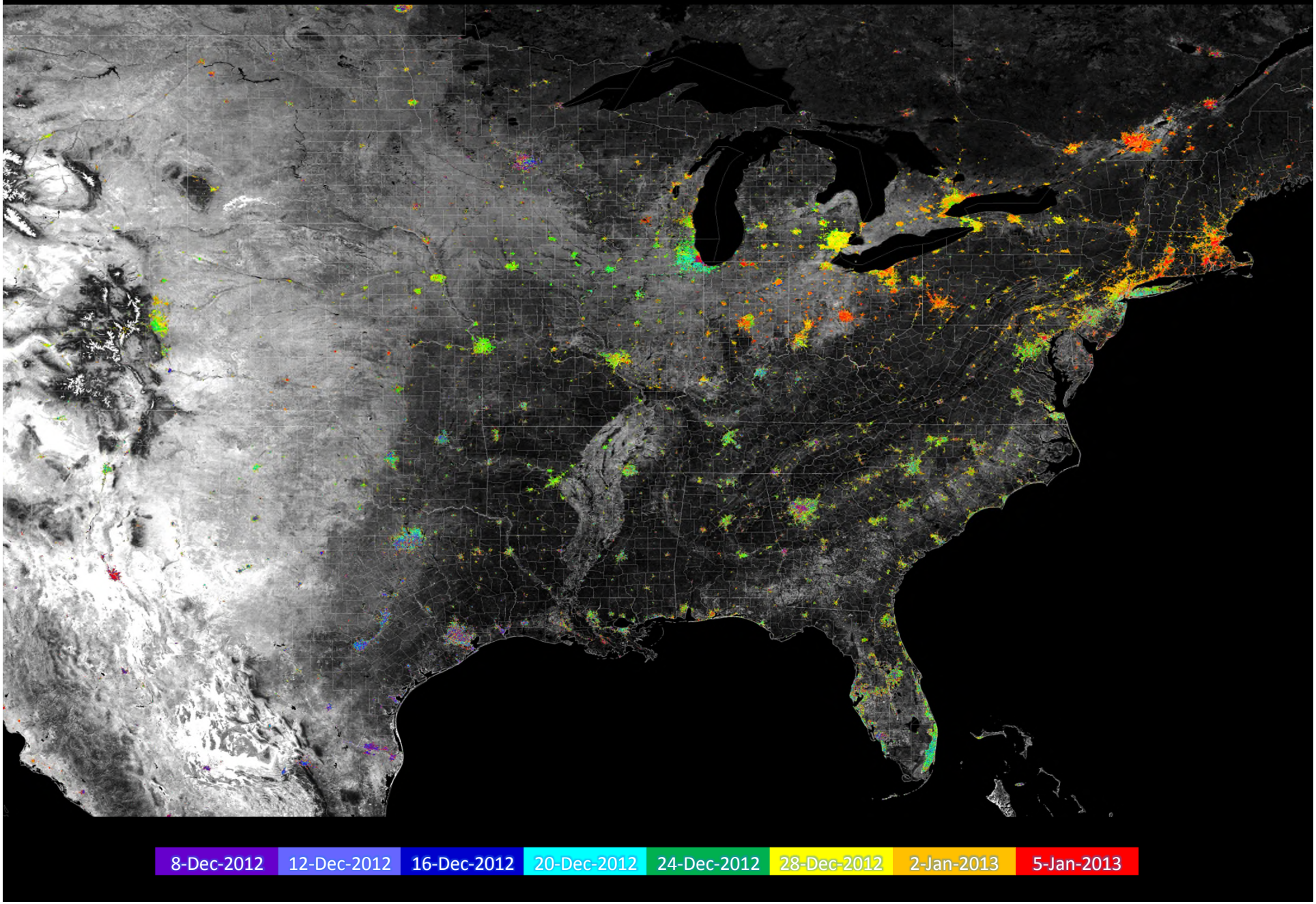

CAIRO DISTRICT 2 - E(t)= 0.89, ε(t)= 1.00
TLEC Full Inversion
TLEC Magnitude Inversion
Gigawatt-Hour
1.6
1.2
0.8
0.4
0.0
Apr-28-12
May-22-12
Jun-14-12
Jul-08-12
Aug-01-12
Aug-24-12
Sep-17-12
Oct-11-12
Nov-03-12
Nov-27-12
BENI SWEIF DISTRICT 2 - E(t)= 0.90, ε(t)= 1.00
TLEC Full Inversion
TLEC Magnitude Inversion
Gigawatt-Hour
0.504
0.378
0.252
0.126
0.000
Hilāl (Start of Ramadan)
Eid ul-Fitr (End of Ramadan)
Apr-28-12
May-22-12
Jun-14-12
Jul-08-12
Aug-01-12
Aug-24-12
Sep-17-12
Oct-11-12
Nov-03-12
Nov-27-12

Holiday Season in the USA

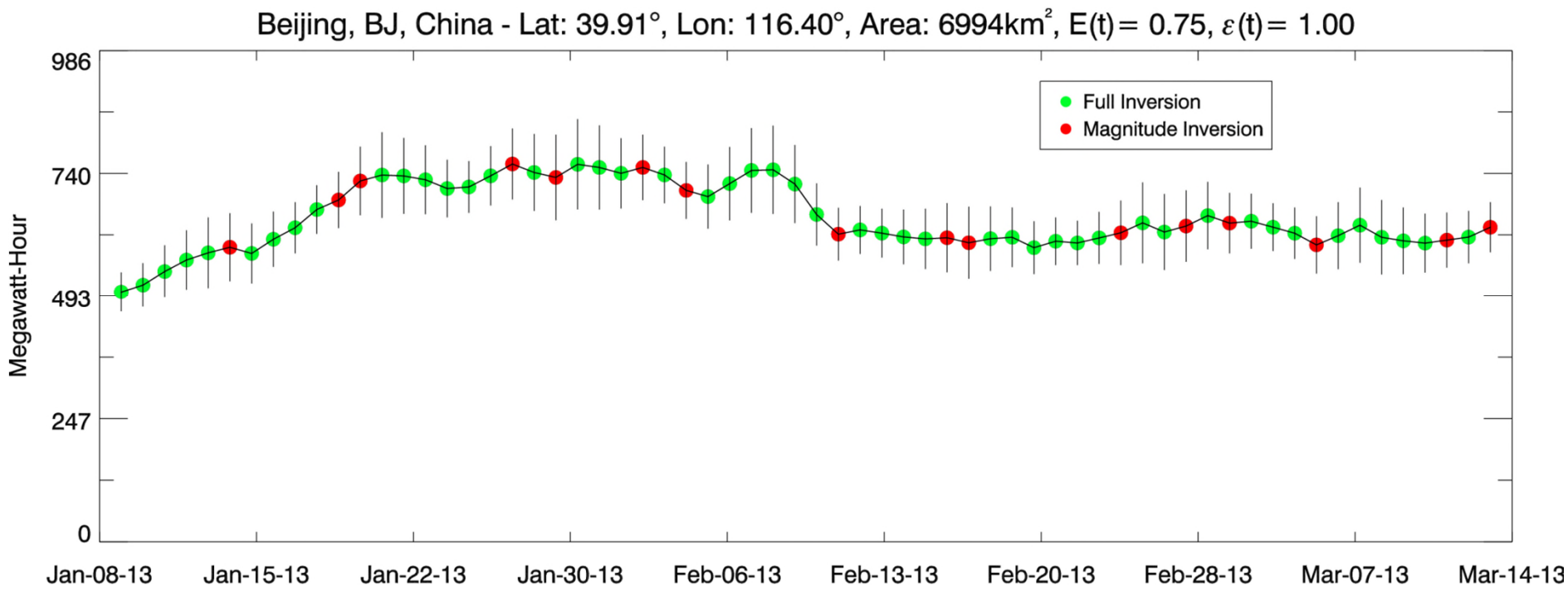

Saint Louis, MO, Total Light Energy Consumption - Lat: 38.63°, Lon: -90.20°, Area: 2393km², ε(t)= 1.00, E(t)= 0.46
TLEC Full Inversion
TLEC Magnitude Inversion
Gigawatt-Hour
12.22
9.16
6.11
3.05
0.00
Oct-31-12
Nov-09-12
Nov-18-12
Nov-27-12
Dec-06-12
Dec-14-12
Dec-23-12
Jan-01-13
Jan-10-13
Jan-19-13

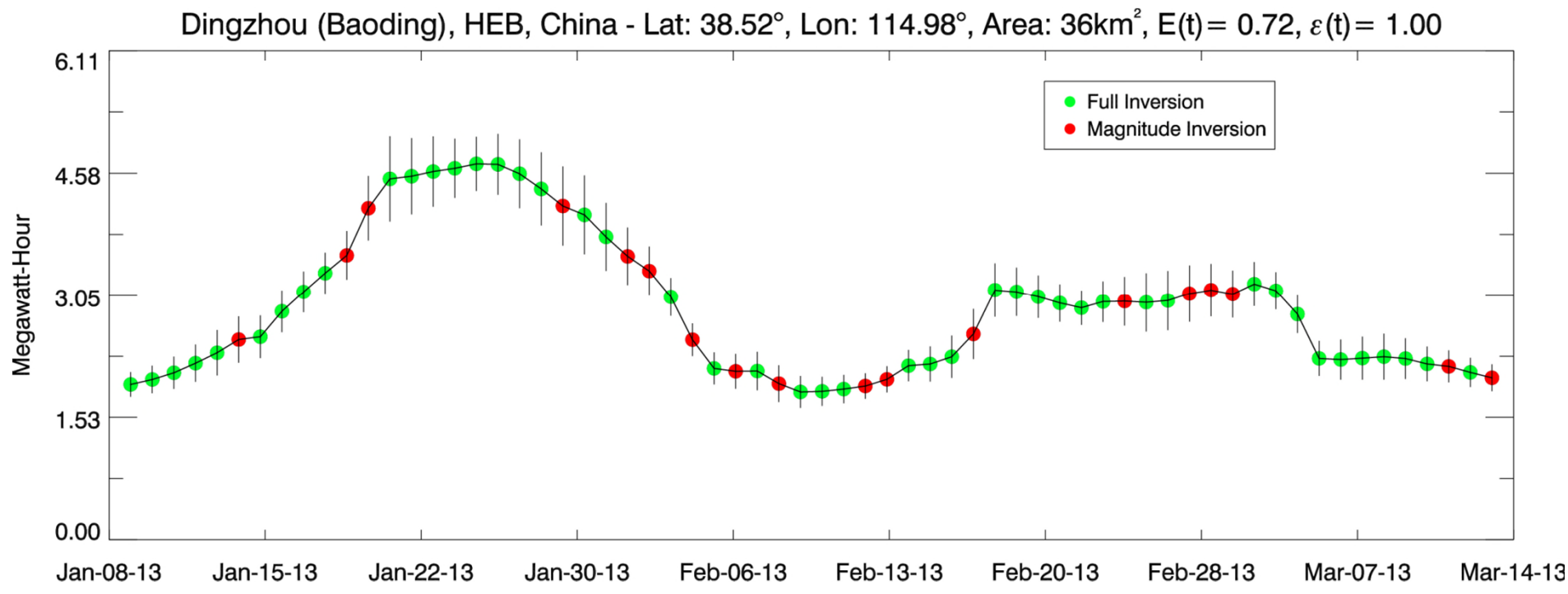

Columbia, SC, Total Light Energy Consumption - Lat: 34.00°, Lon: -81.04°, Area: 984km², ε(t)= 0.91, E(t)= 0.35
TLEC Full Inversion
TLEC Magnitude Inversion
Gigawatt-Hour
4.17
3.13
2.09
1.04
0.00
Oct-31-12
Nov-09-12
Nov-18-12
Nov-27-12
Dec-06-12
Dec-14-12
Dec-23-12
Jan-01-13
Jan-10-13
Jan-19-13

Timing of Peak Energy Use: 2012 Holiday Season

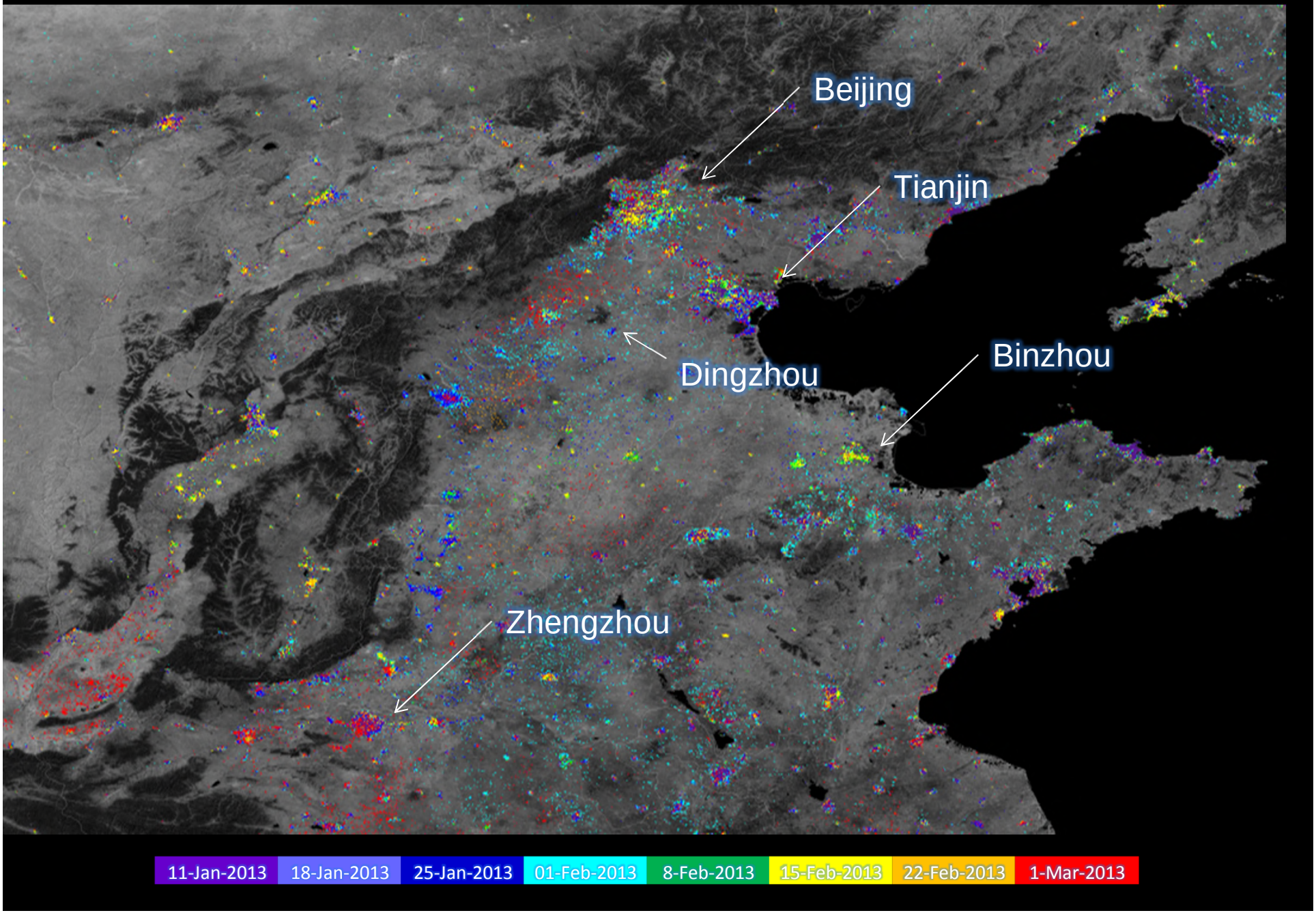


Chinese New Year


Beijing, BJ, China - Lat: 39.91°, Lon: 116.40°, Area: 6994km², E(t)= 0.75, ε(t)= 1.00
Full Inversion
Magnitude Inversion
Megawatt-Hour
986
740
493
247
0
Jan-08-13
Jan-15-13
Jan-22-13
Jan-30-13
Feb-06-13
Feb-13-13
Feb-20-13
Feb-28-13
Mar-07-13
Mar-14-13

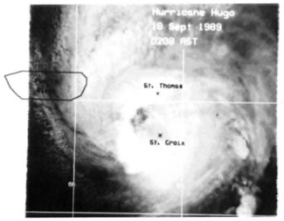

Dingzhou (Baoding), HEB, China - Lat: 38.52°, Lon: 114.98°, Area: 36km², E(t)= 0.72, ε(t)= 1.00
Full Inversion
Magnitude Inversion
Megawatt-Hour
6.11
4.58
3.05
1.53
0.00
Jan-08-13
Jan-15-13
Jan-22-13
Jan-30-13
Feb-06-13
Feb-13-13
Feb-20-13
Feb-28-13
Mar-07-13
Mar-14-13

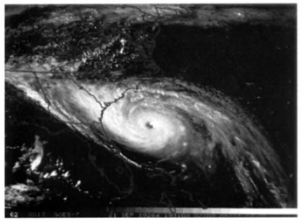
Timing of Peak Energy Use: Chinese New Year (January 23)

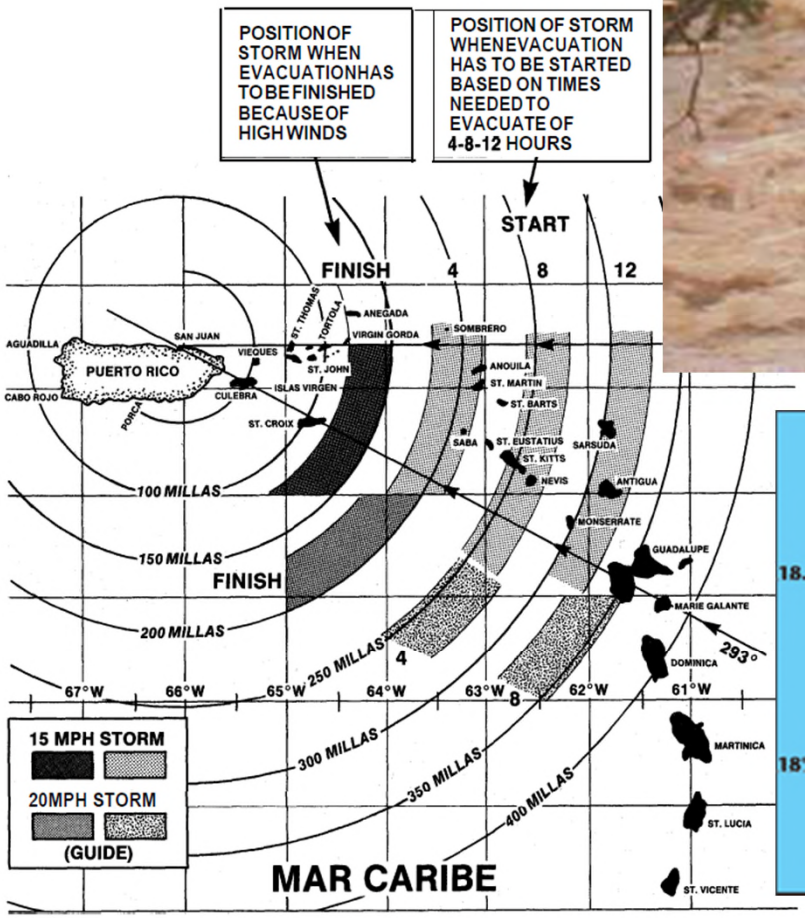


Using the VIIRS DNB to improve exposure assessments from natural hazards

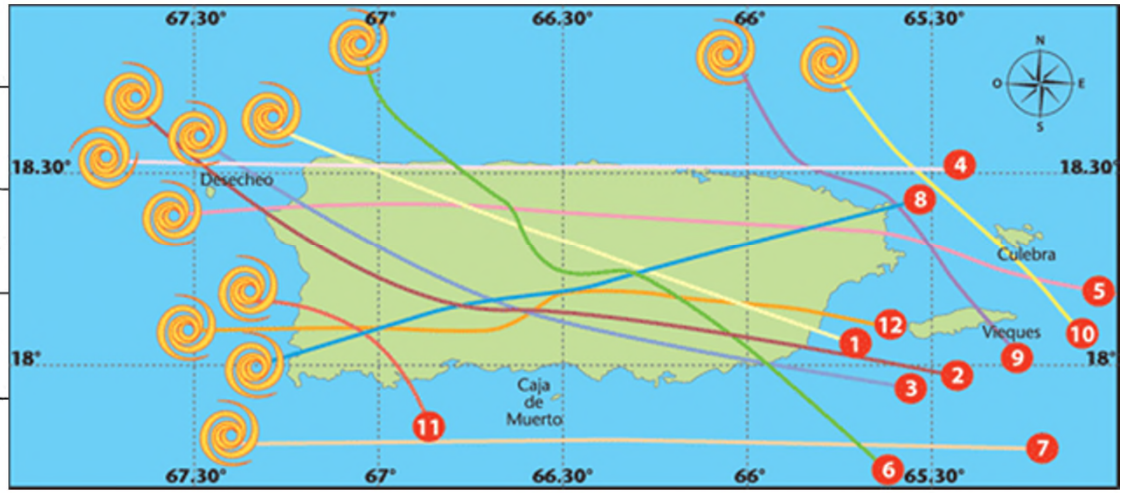
Hurricane Hugo
September 10-22, 1989







MUNICIPIO OF SAN JUAN



Major Hurricanes in Puerto Rico (1900-2000)

(Launch +8 months) DC/Derecho Storm

(Front Page Article on 7/5/2012)

The Washington Post

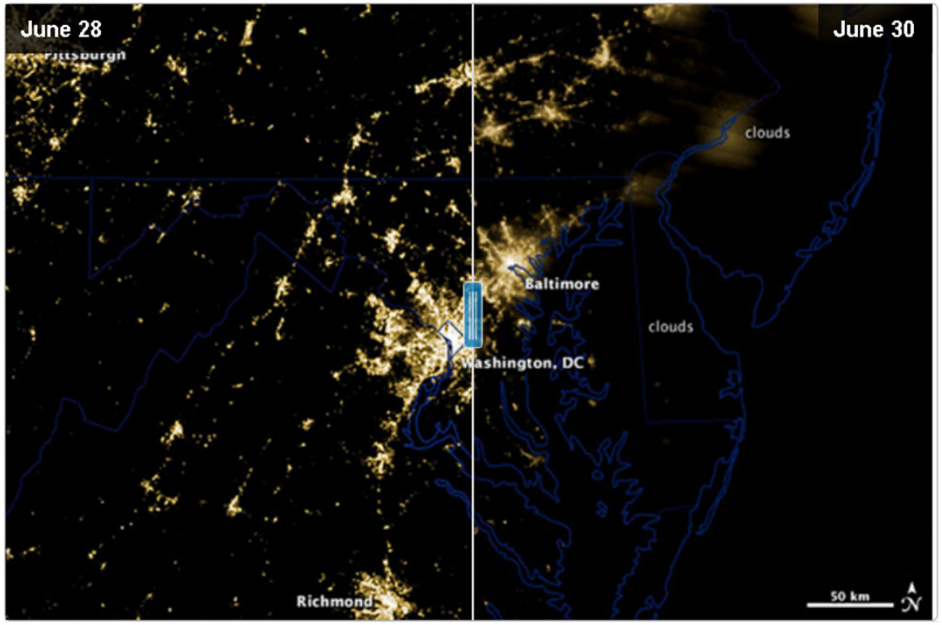
In the News MLB All-Star game Nicolas Cage photo Lance Armstrong Peter O'Toole retires

Tweet 129 Share Follow PostLocal:

D.C. storm's aftermath: A look from space

Use the slider to compare satellite images from NASA of the mid-Atlantic region before and after the derecho passed through, knocking out power to more than a million people in the D.C. region.

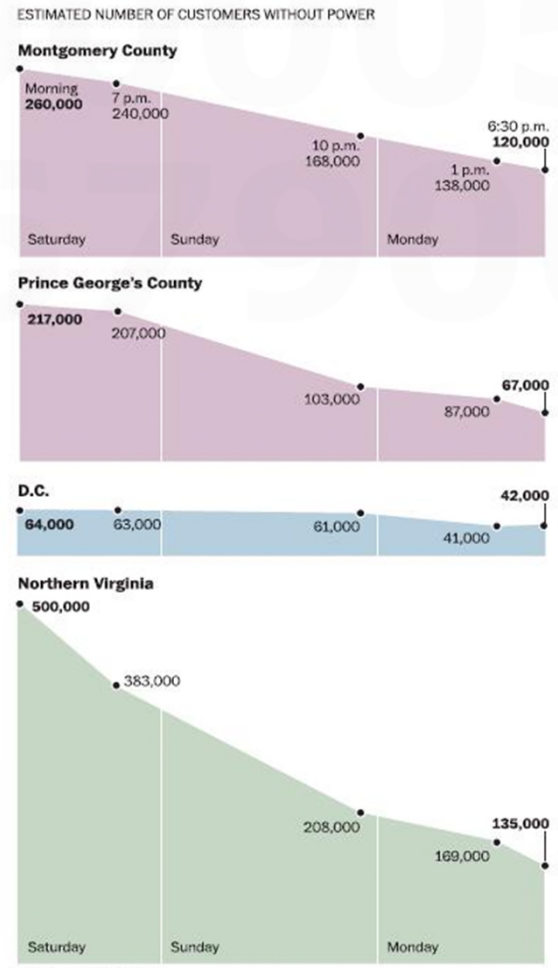
Drag the slider to the right to see the before image, and drag it to the left to see the after image.



SATELLITE IMAGES: NASA via AP. GRAPHIC: Wilson Andrews and Emily Ingram - The Washington Post. Published July 5, 2012.

Power to some people

Friday's storm knocked out power to more than 1 million customers in the Washington region. As of early Monday evening, hundreds of thousands remained without electricity.

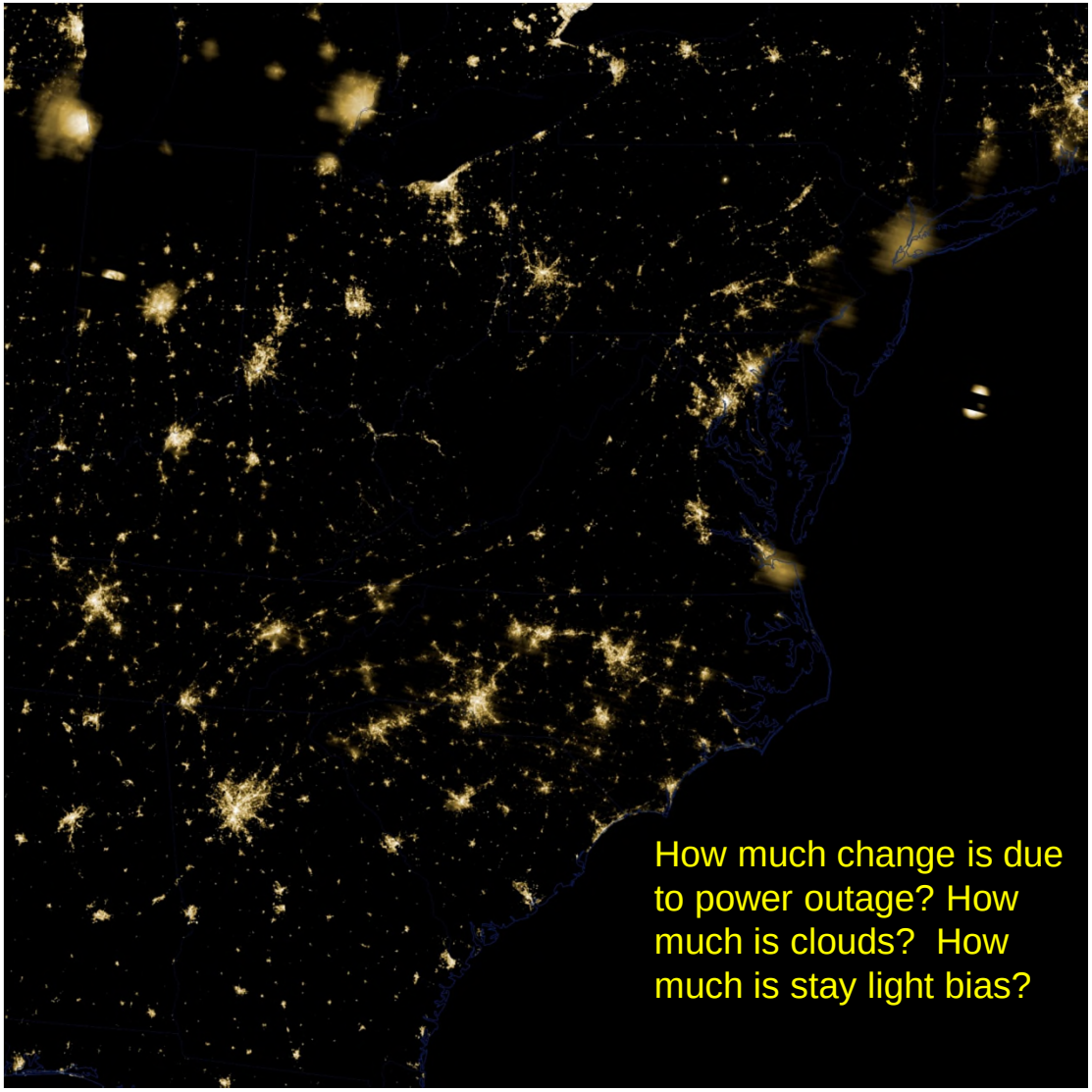


Note: Times are approximate
Source: The utilities

THE WASHINGTON POST

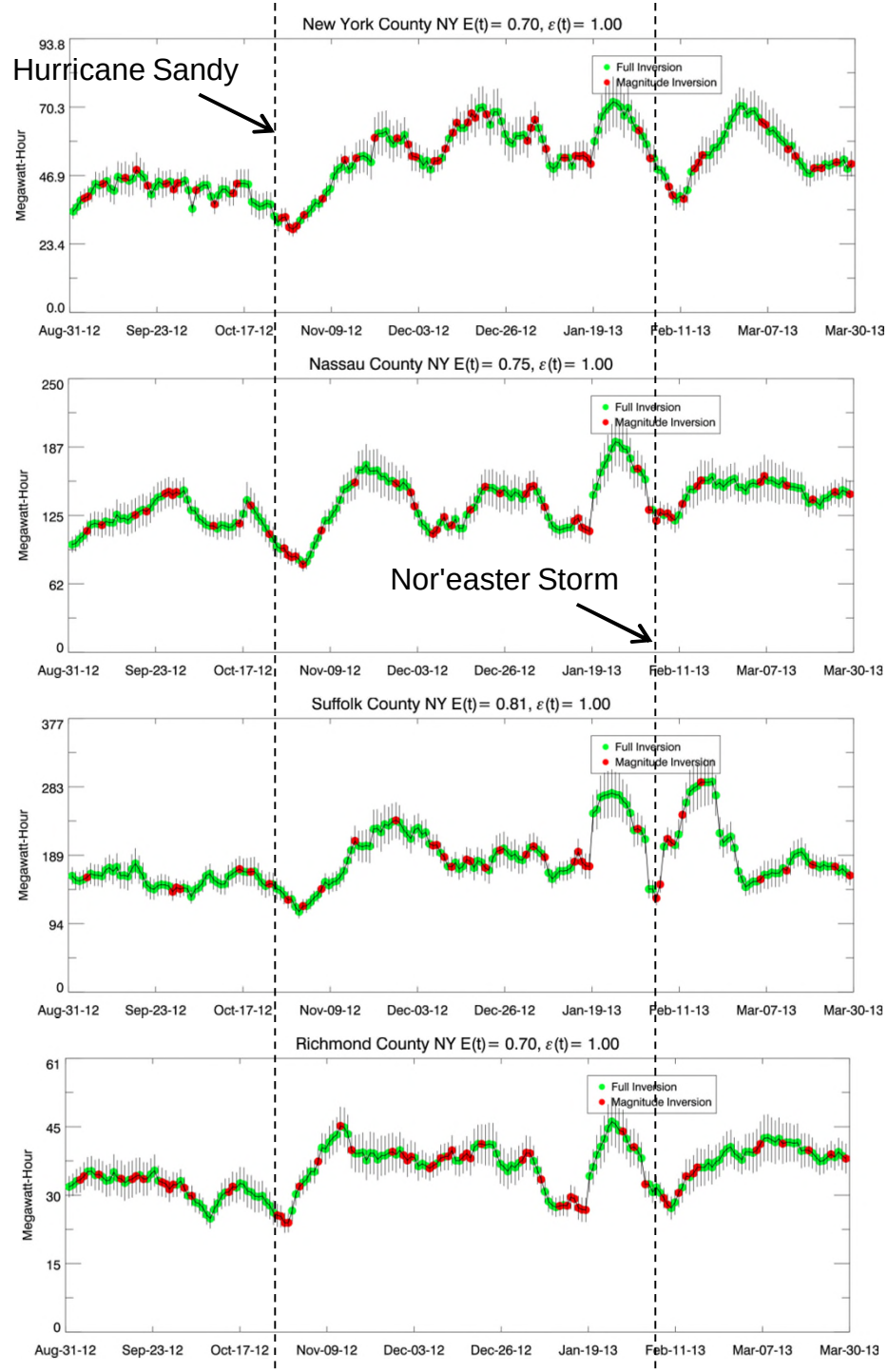
For outreach and disaster response, it is essential to produce images quickly...

Image from NASA Website, DNB night radiance 06/30/12

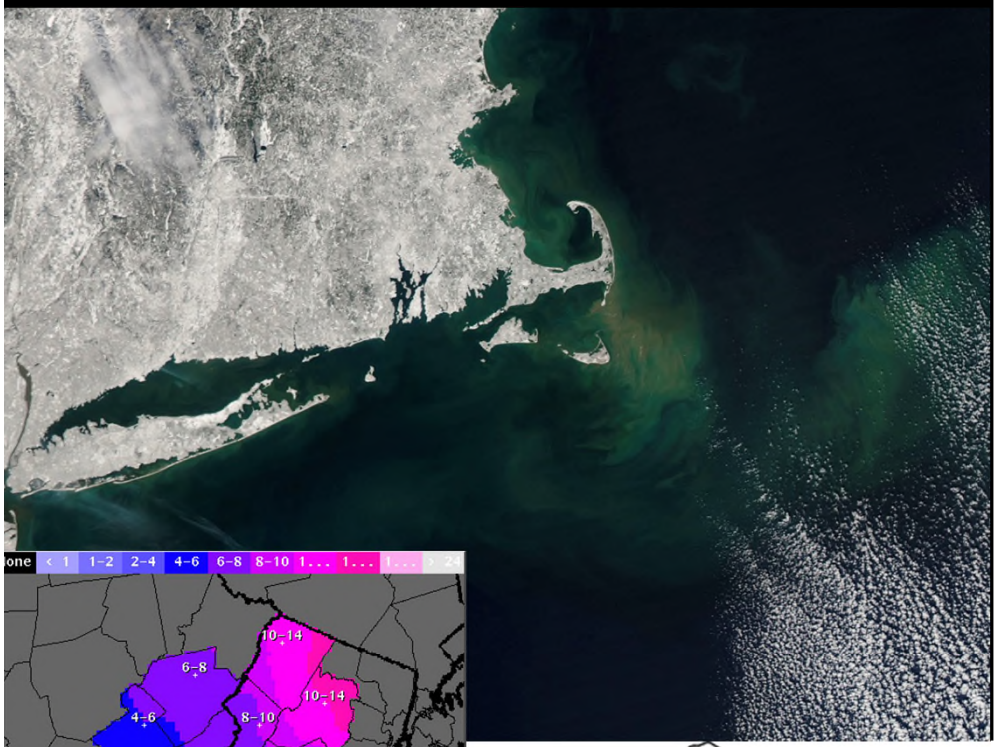


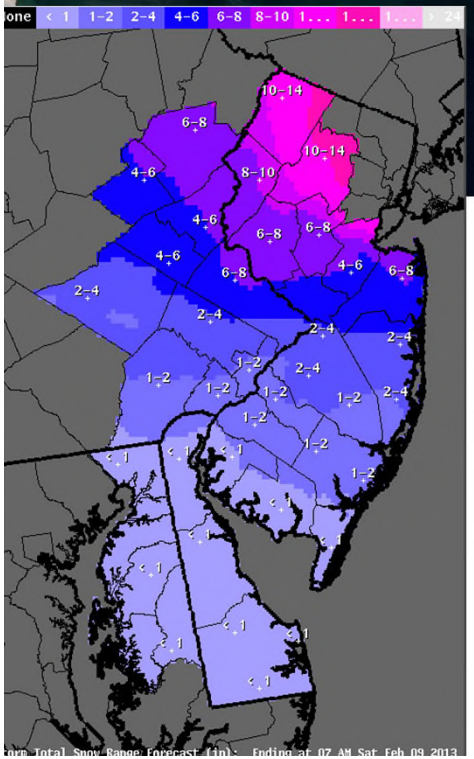
J. Allen and R. Simmon, NASA

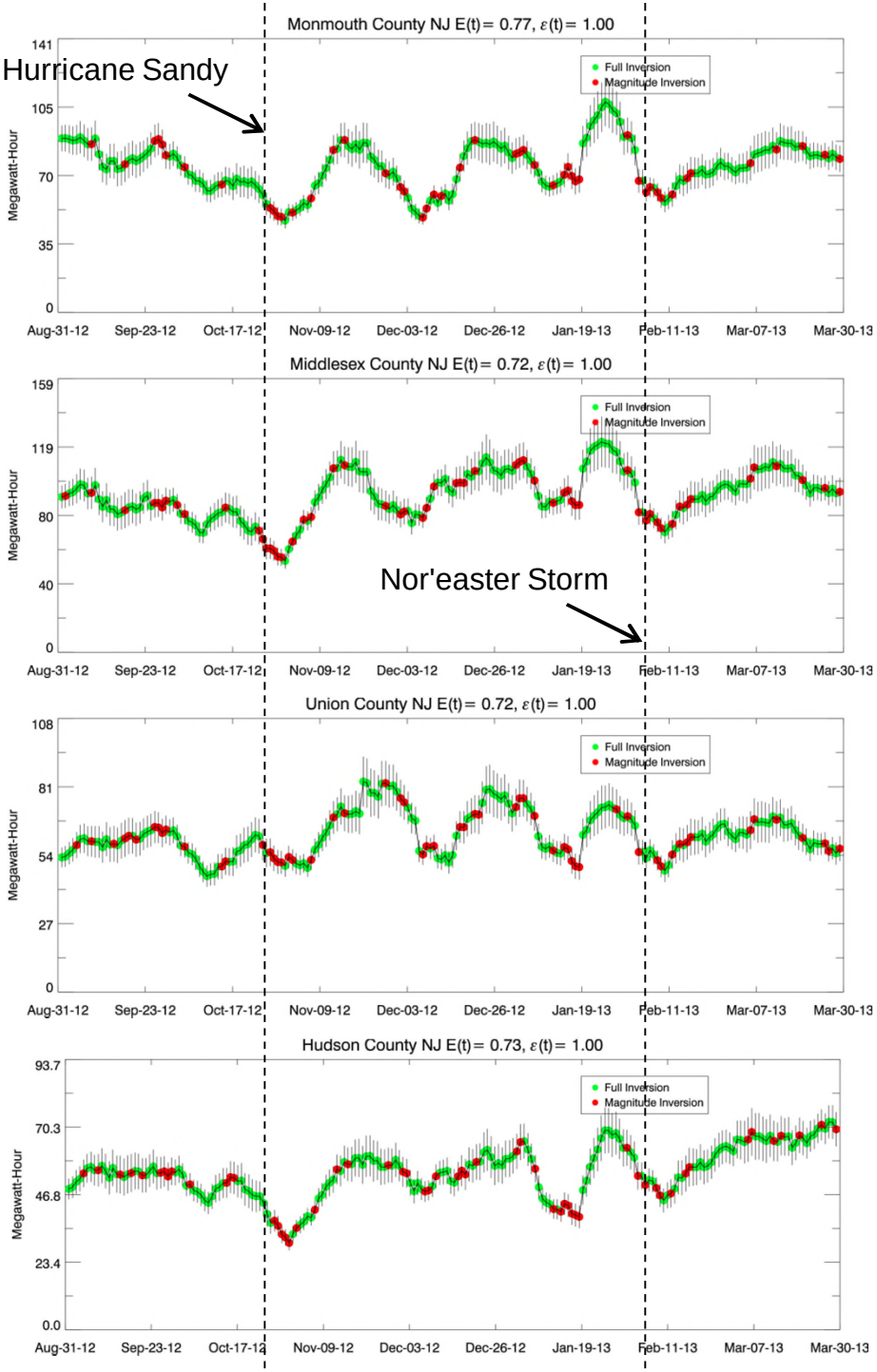
Hurricane Sandy and February Nor'easter (New York State)



Hurricane Sandy and February Nor'easter (New Jersey State)







Summary

- ***Integration is key*** -- i.e., algorithms, instrument characterizations, calibration/validation, data processing, etc. A perfect sensor suite would not by itself make for a useful climate data record. Likewise, a state-of-the-art retrieval algorithm does not ensure a useful science data record.