STAR Center for Satellite Applications and Research
formerly ORA — Office of Research and Applications

The ABI (Advanced Baseline Imager) on the GOES-R series

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NOAA/NESDIS/Satellite Applications and Research

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Kaba Bah, Mathew M. Gunshor, Jun Li, Scott Bachmeier, etc.

CIMSS, Madison, WI

James J. Gurka, Steve Goodman, etc.

GOES-R Program Office

MUG Meeting
Madison, WI
26-October-2010

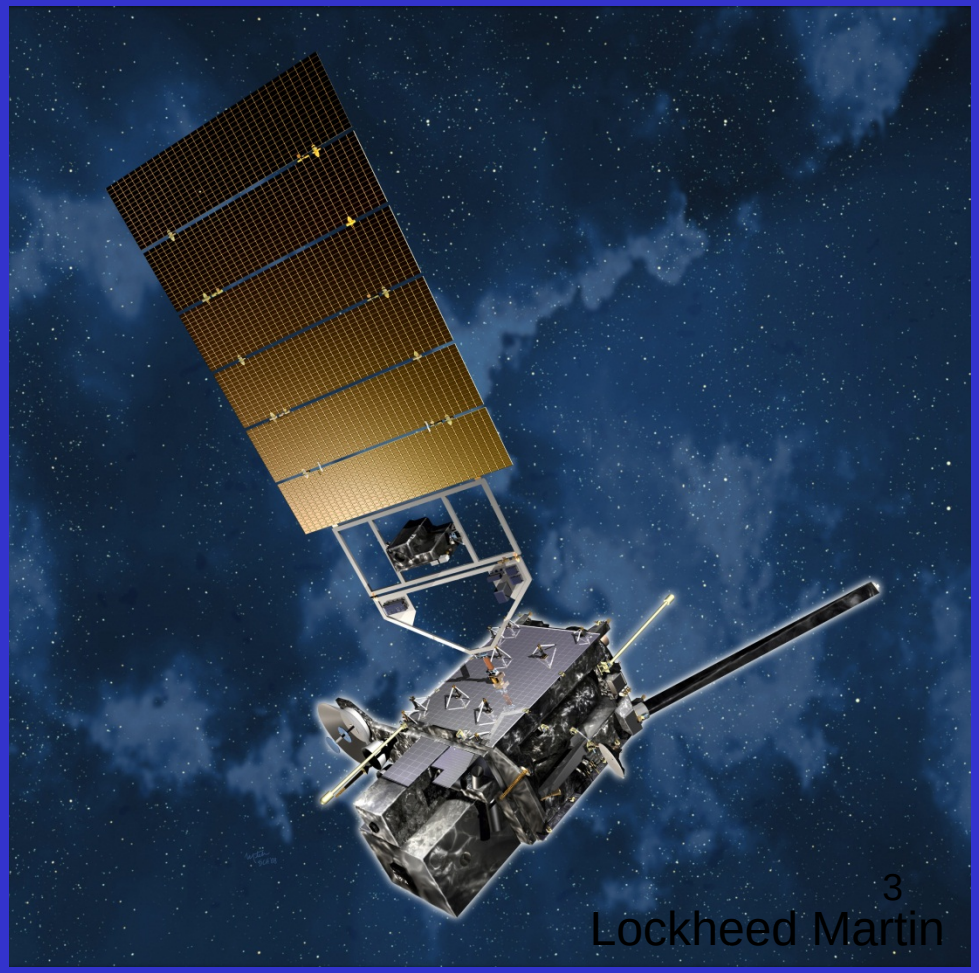
UW-Madison

Also Thanks to…

- Achtor, Tom; Ackerman, Steve; Antonelli, Paolo; Aune, Bob; Baggett, Kevin; Baum, Bryan; Ellrod, Gary; Feltz, Joleen; Feltz, Wayne; Frey, Rich; Griffin, Michael K.; Gumley, Liam; Heymann, Roger; Hillger, Don; Huang, Allen; Key, Jeff; Knuteson, Bob; Mecikalski, John; Menzel, Paul; Moeller, Chris; Mosher, Fred; Nelson, James; Nasiri, Shaima; Olander, Tim; Plokhenko, Youri; Prins, Elaine; Rabin, Bob; Revercomb, Hank; Schmidt, Chris; Schreiner, Tony; Seemann-Wetzel, Suzanne; Sieglaff, Justin; Strabala, Kathy; Sun, Fengying; Tobin, Dave; Velden, Chris; Wade, Gary; Whittaker, Tom; Woolf, Hal, Jason Oktin, William Straka, etc.
- Mitch Goldberg, AWG co-chairs, AWG Leads, GPO, GUC committee team(s), Jordan Gerth, Chian-Yi Liu, Jason Otkin, Thomas Greenwald, Monica Coakley, Bill Smith, ASPB, PG, SSEC data center, CWG, etc.

Overview

- GOES-14/15
- ABI (Advanced Baseline Imager)
  - Temporal
  - Spatial
  - Spectral
  - Imagery
- Summary
  - More information



Lockheed Martin

GOES-13/14/15

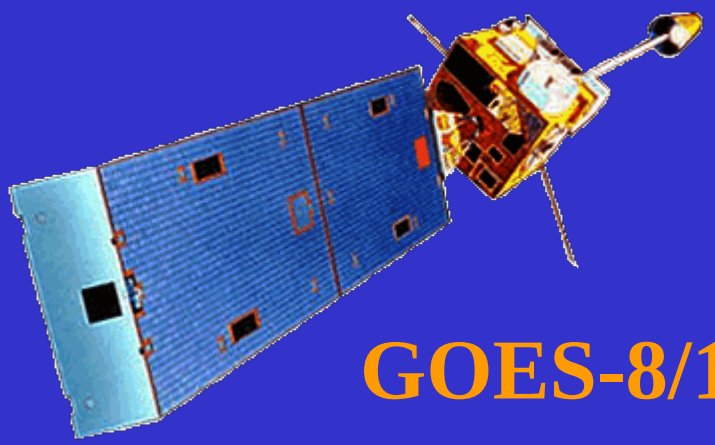
GOES-13/14/15 have similar instruments to GOES-8-12, but on a different spacecraft bus.

Spring and fall eclipse outages will be avoided by larger onboard batteries.

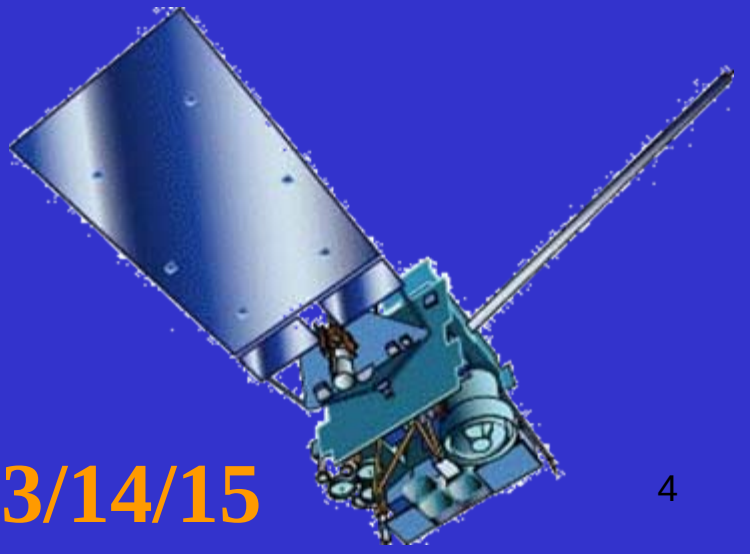
Improved navigation

Improved radiometrics

Similar stray light to GOES-13/14

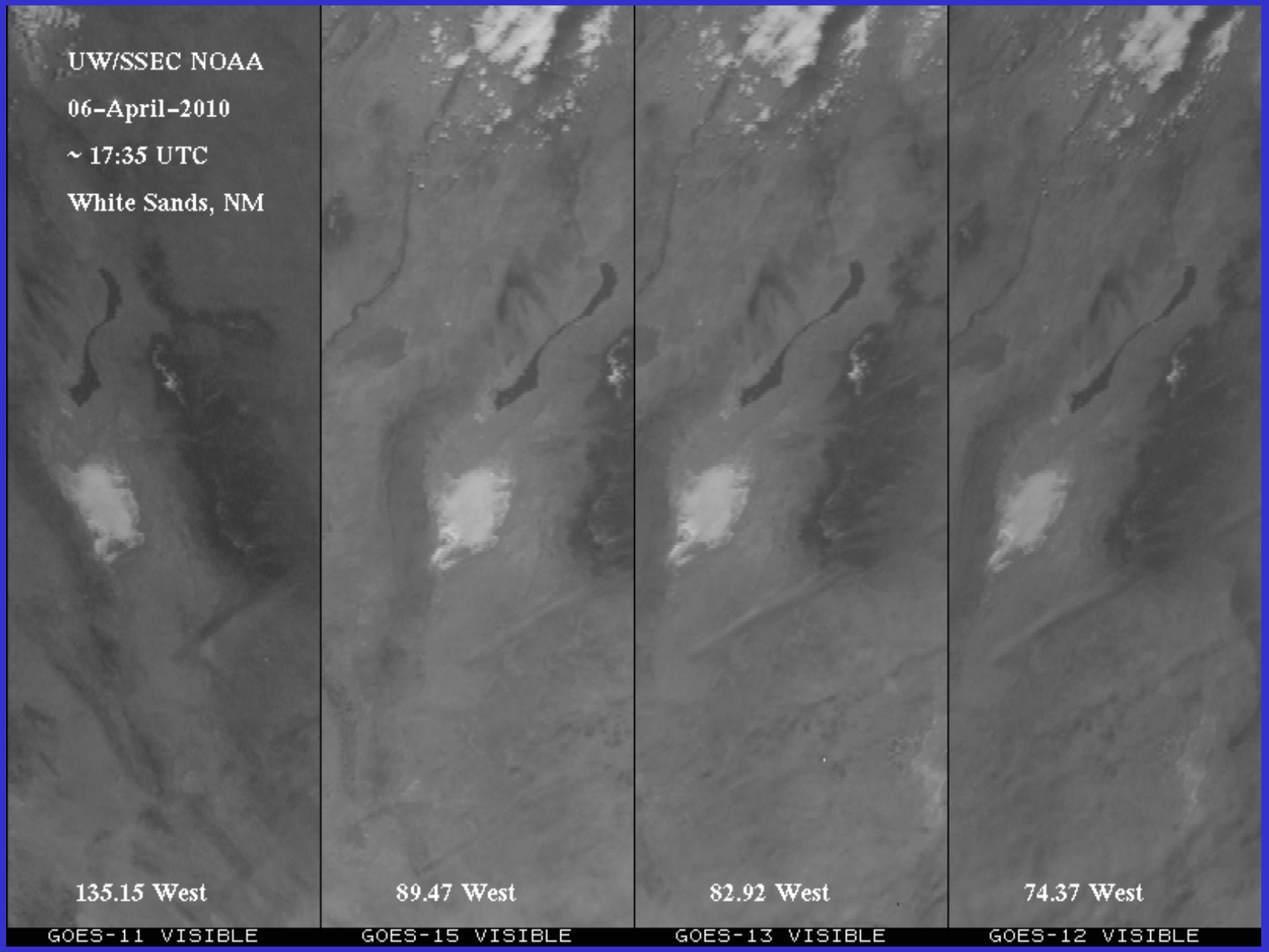


GOES-8/12

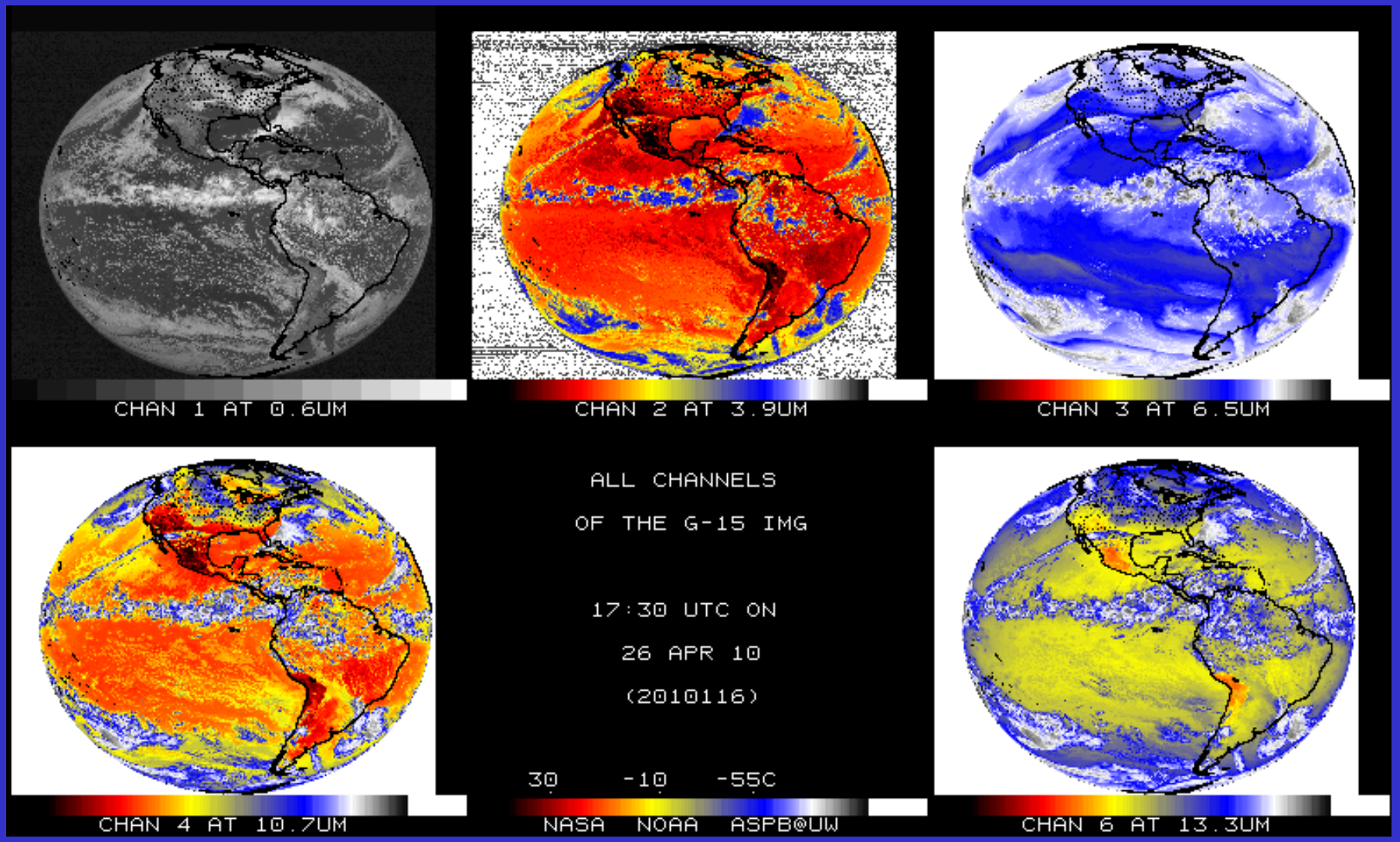


GOES-13/14/15

Visible


UW/SSEC NOAA
06-April-2010
~ 17:35 UTC
White Sands, NM
135.15 West
89.47 West
82.92 West
74.37 West
GOES-11 VISIBLE
GOES-15 VISIBLE
GOES-13 VISIBLE
GOES-12 VISIBLE

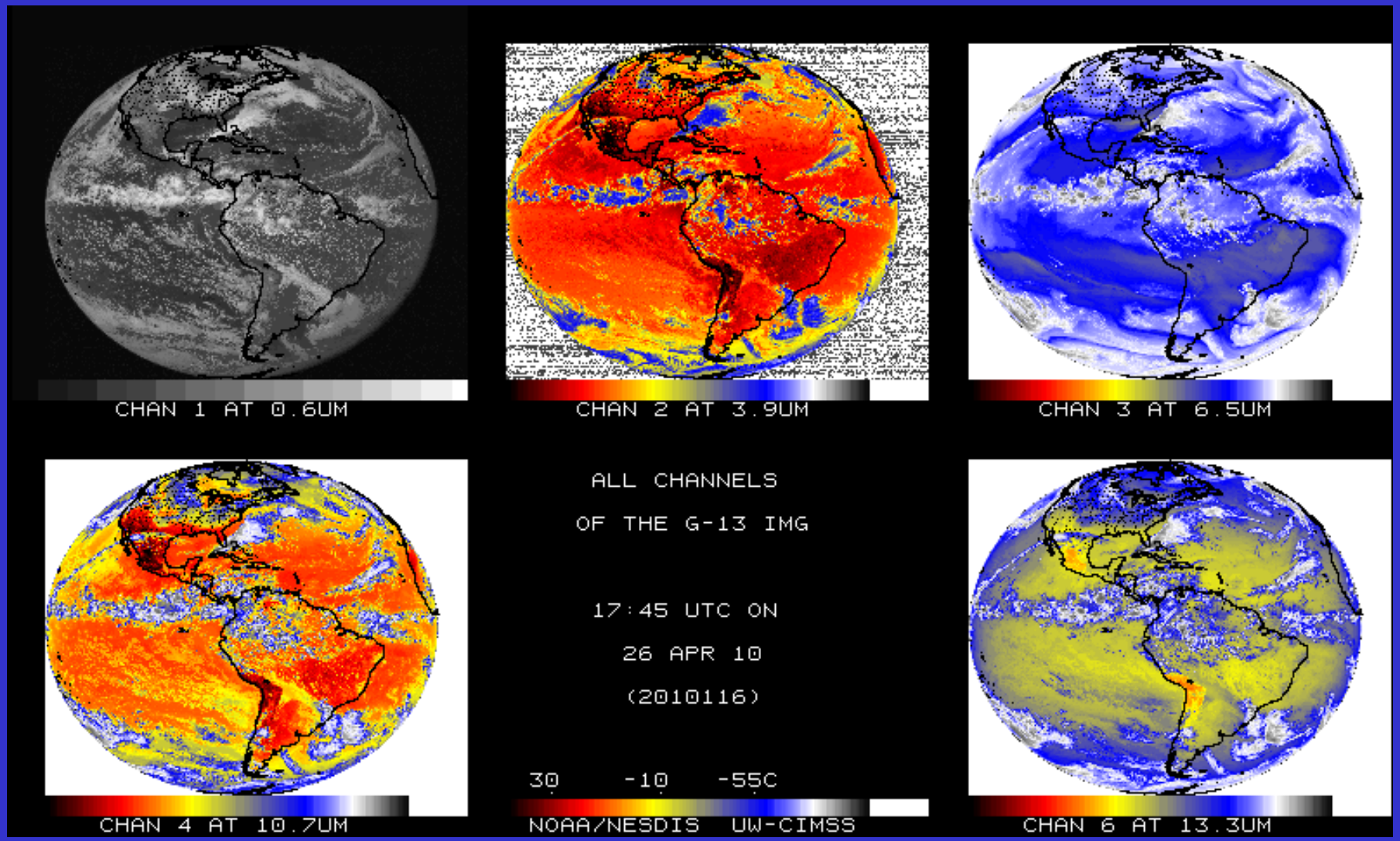
First GOES-15 Images



Native projection

From NOAA ASPB

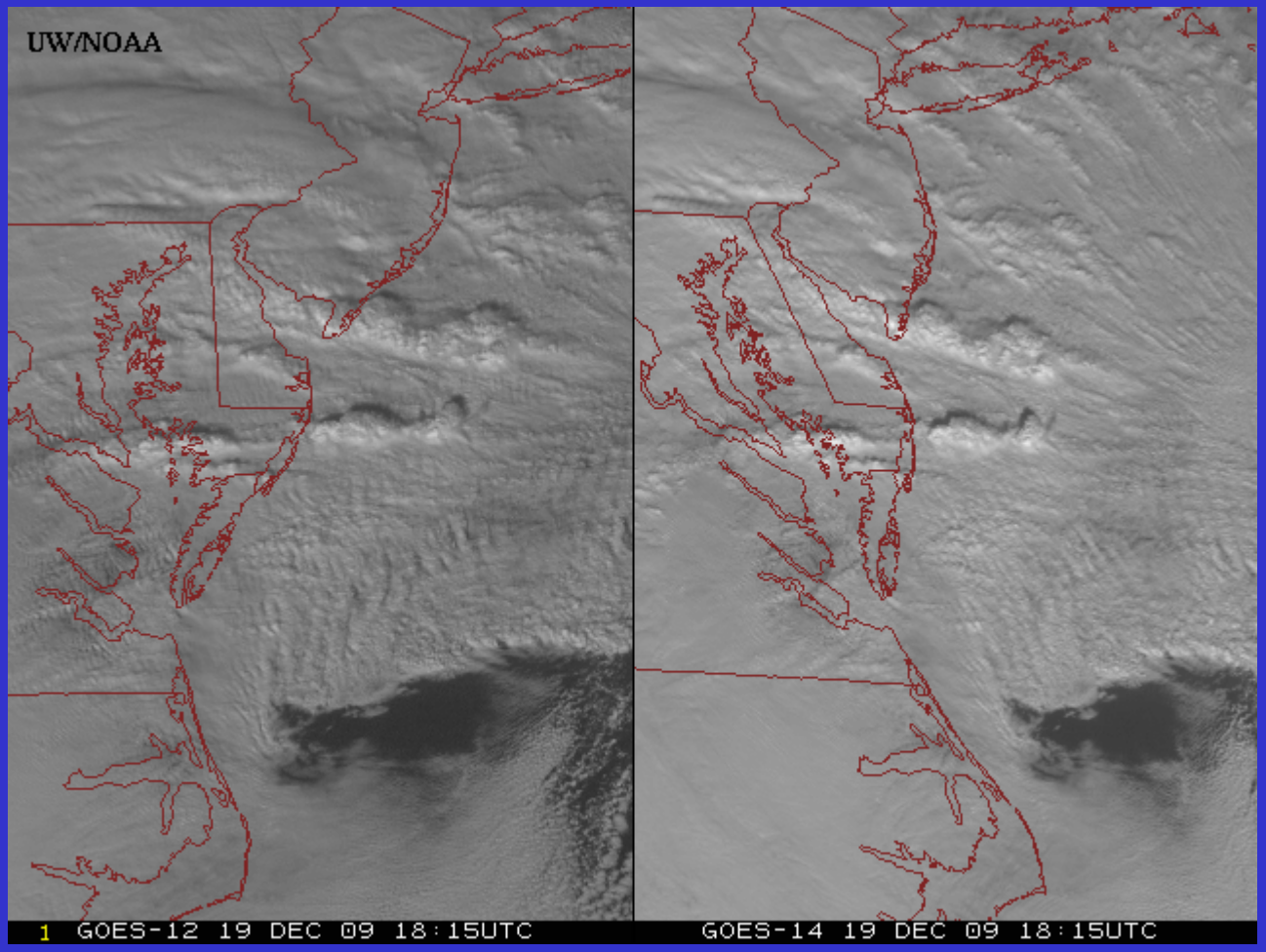
GOES-13 Images



Native projection

From NOAA ASPB

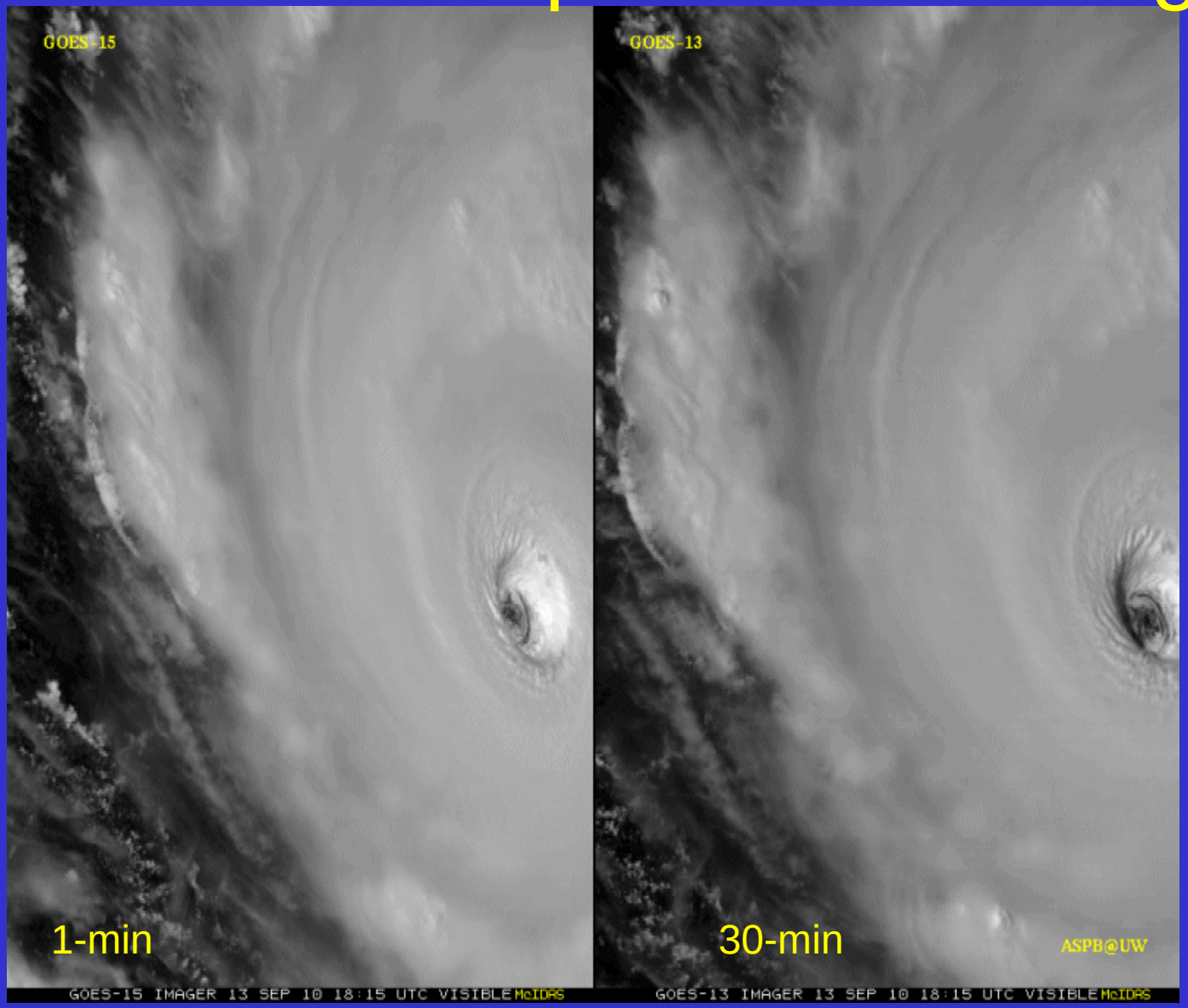
GOES-14: Special “1-min” imagery



GOES-12 GOES-14

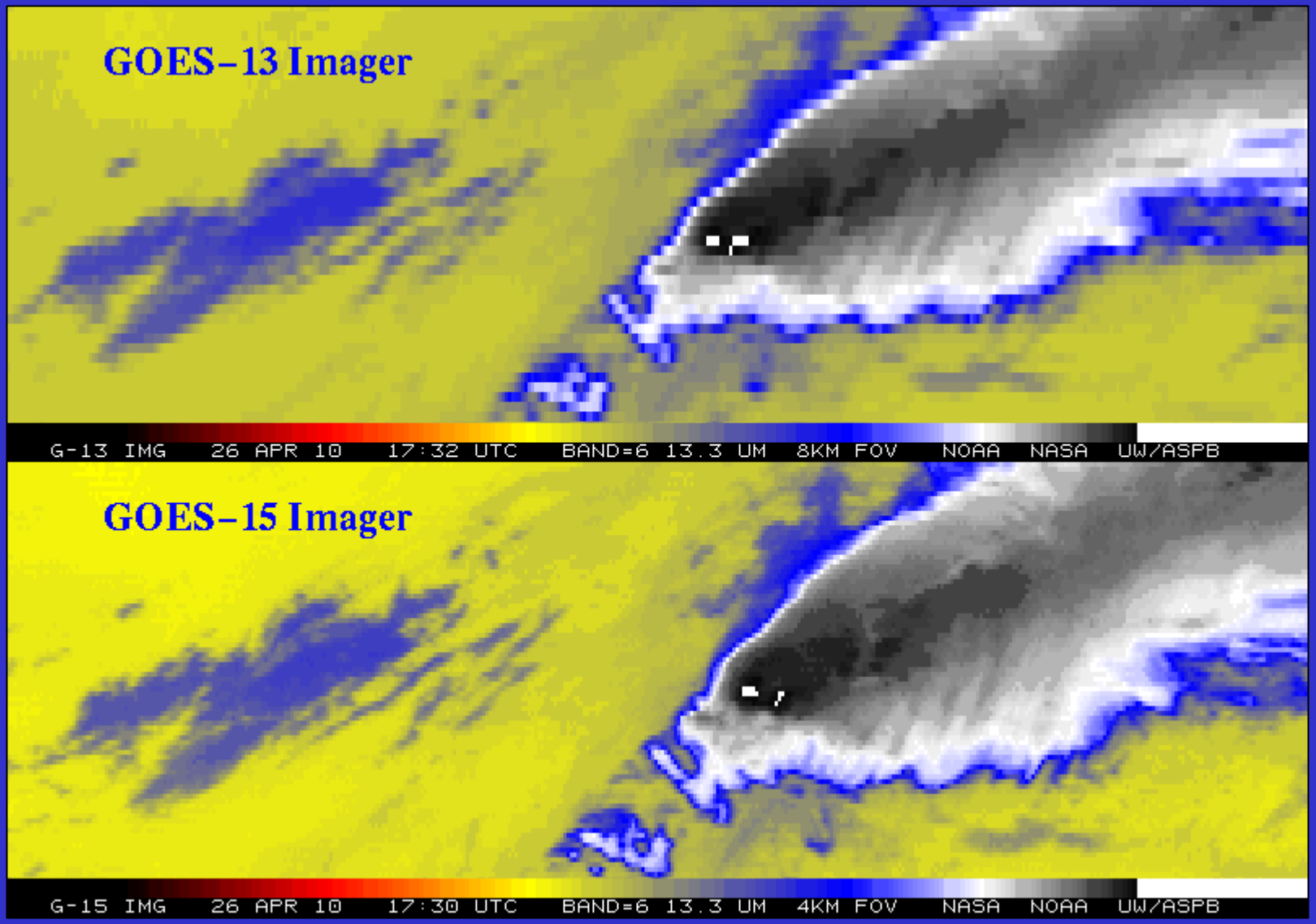
“See changes as they happen – routinely available from the ABI”

GOES-15: Sample “1-min” imagery



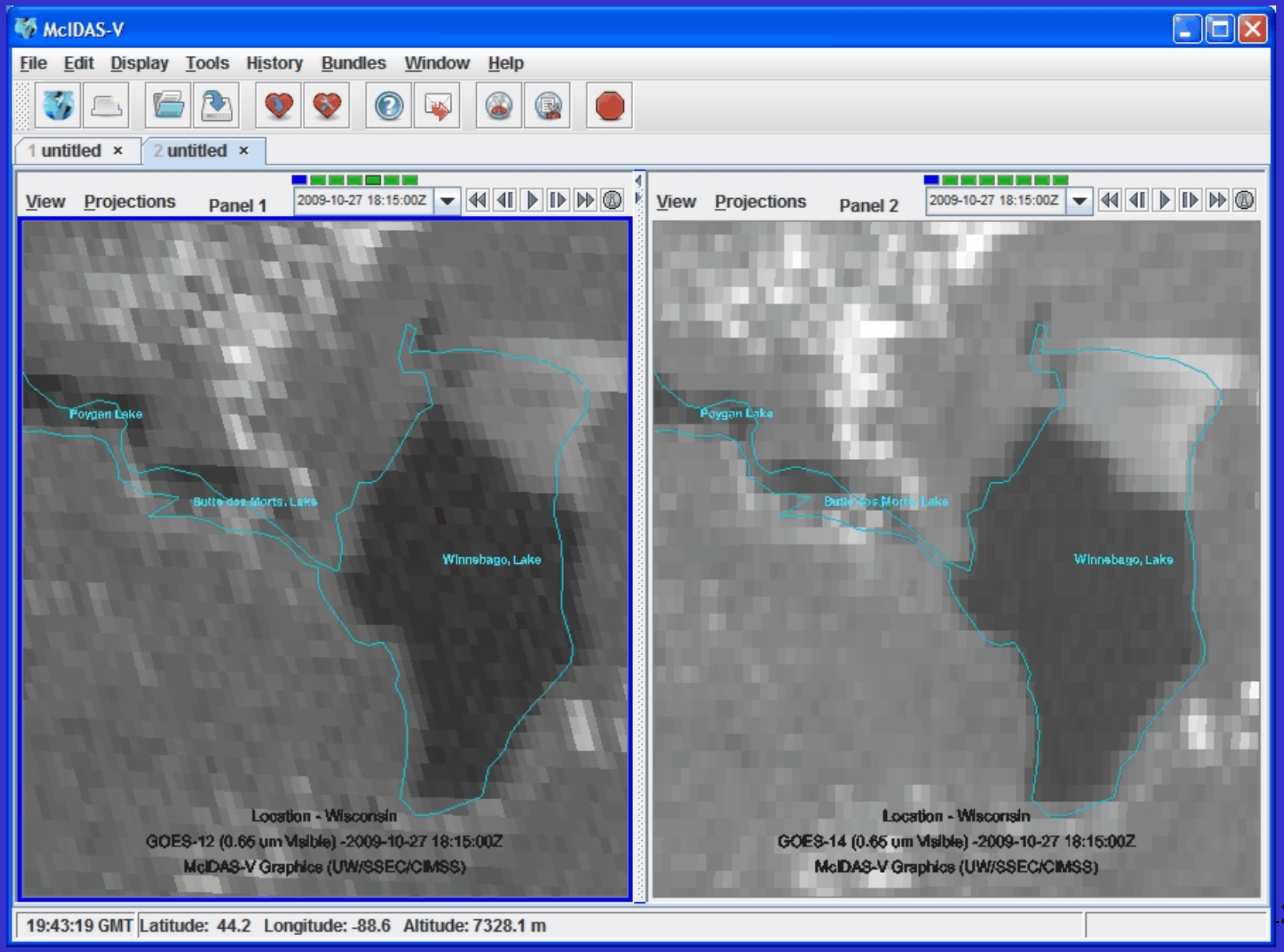
Visible data from the recent NOAA Science Test, lead by Hillger and Schmit

Improved spatial resolution of GOES-15 Imager band 6

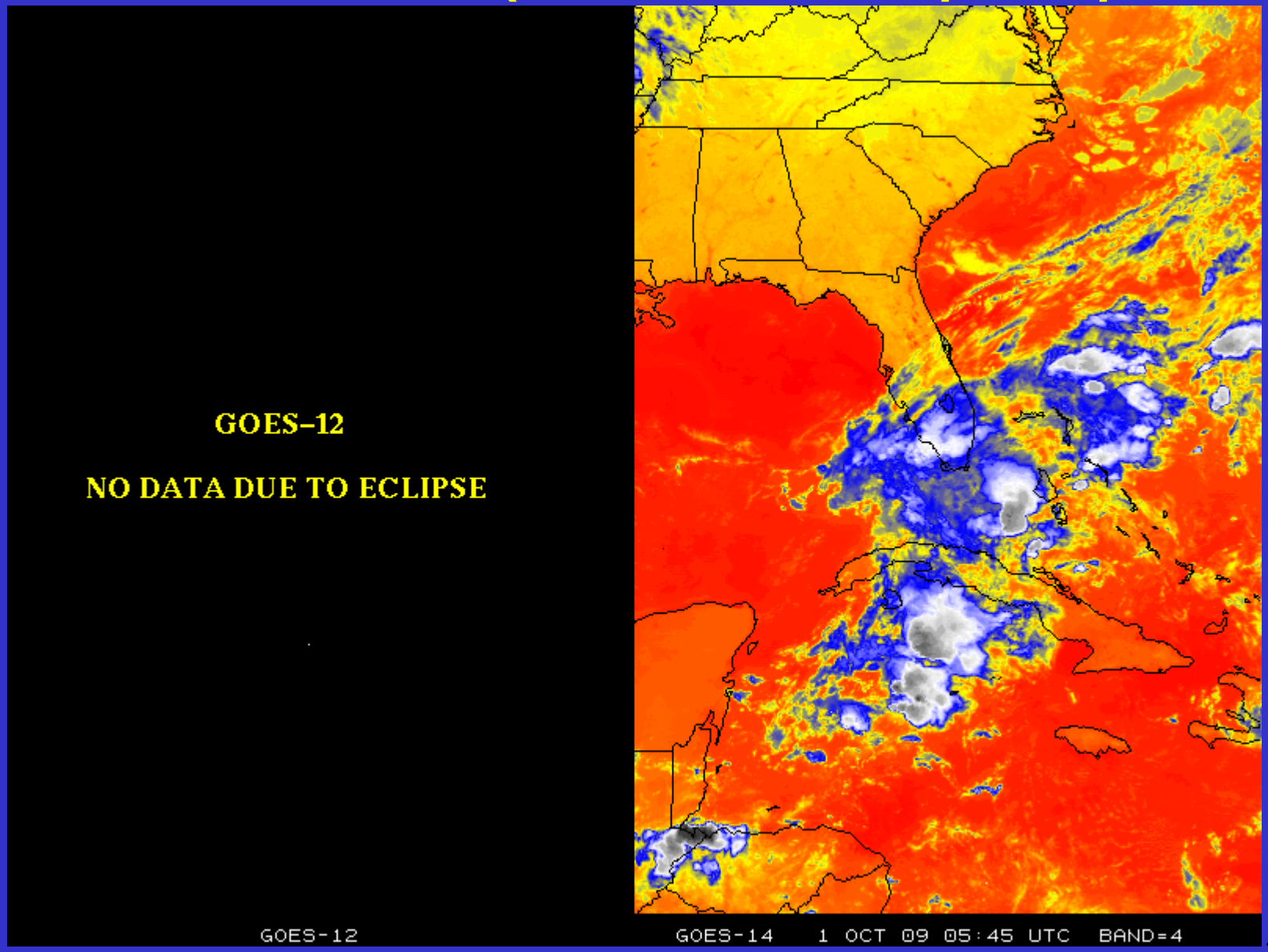


The 13.3 um band 6 of the GOES-13 (top panel) has an 8 km IGFOV (Instantaneous Geometric Field of View); while the same band on the GOES-15 (lower panel) has a 4 km IGFOV. Note the finer resolution of the cloud edges and the 'cleaner' image.

Improved INR



GOES-12/14 (Around eclipse period)



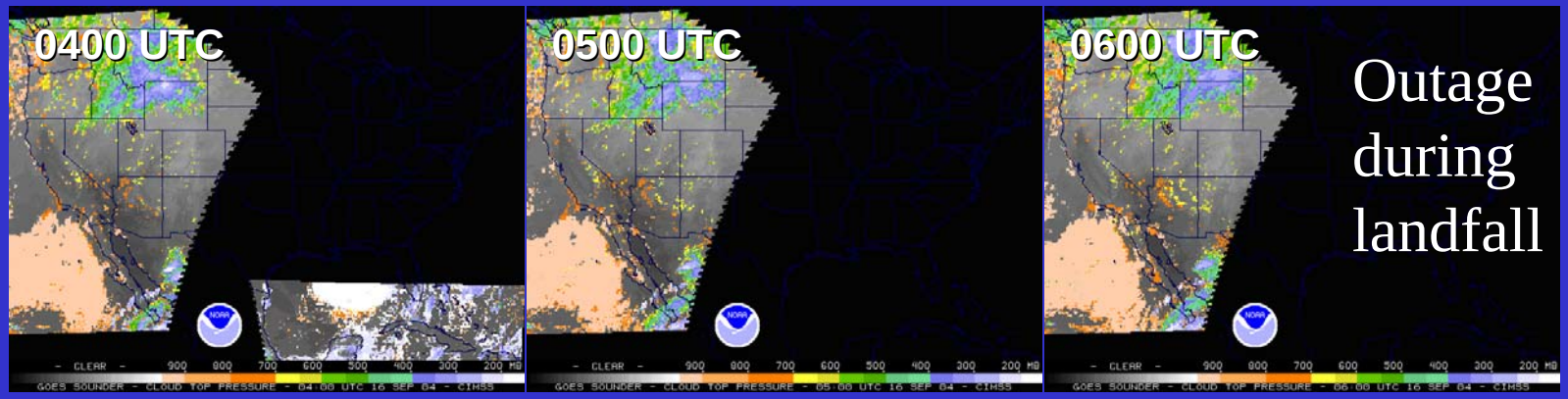
GOES-12

GOES-14

GOES Outages -- approximate hours/year

Satellite Series	KOZ, Eclipse and Stray Light (spring and fall)	Housekeeping, SEM calibration, Maneuvers and Yaw-flip
GOES-8 thru -12	420	211
GOES-13/14/15 (may be reduced)	220	107
GOES-R ABI	~6 - 40	~2 - 6

Hurricane Ivan:



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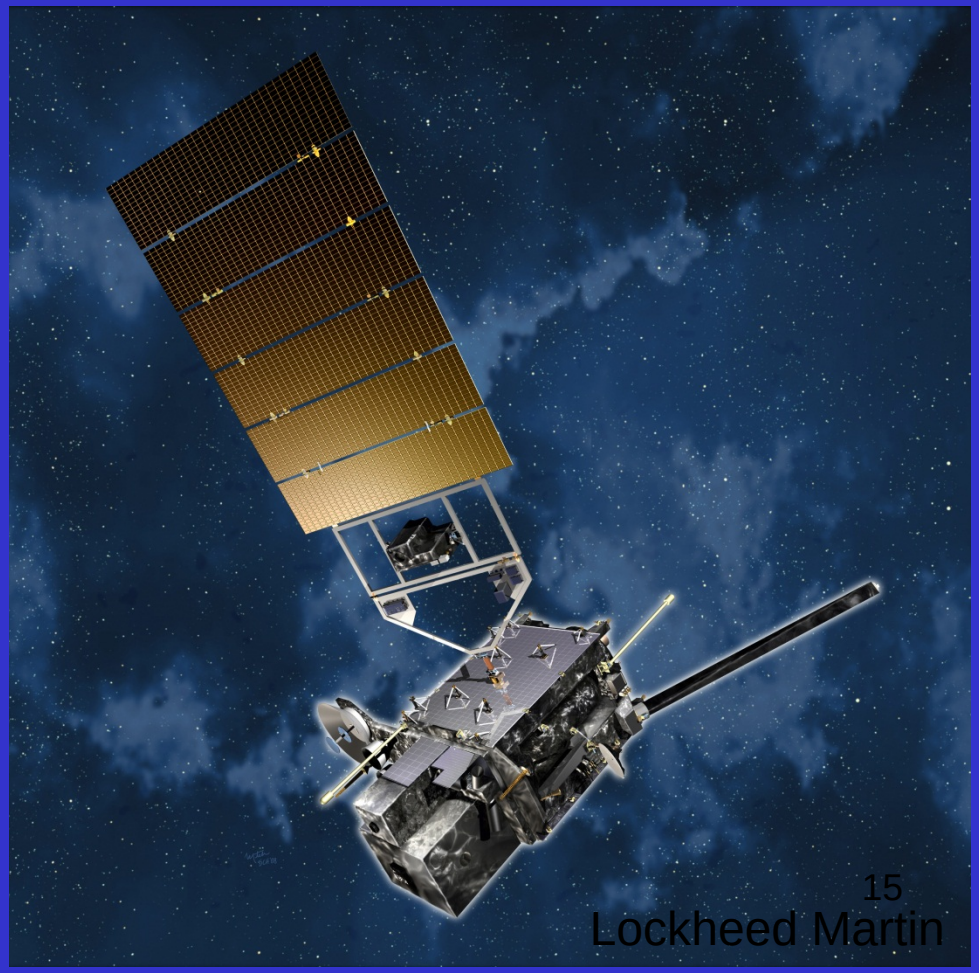


Lockheed Martin

GOES-R Overview

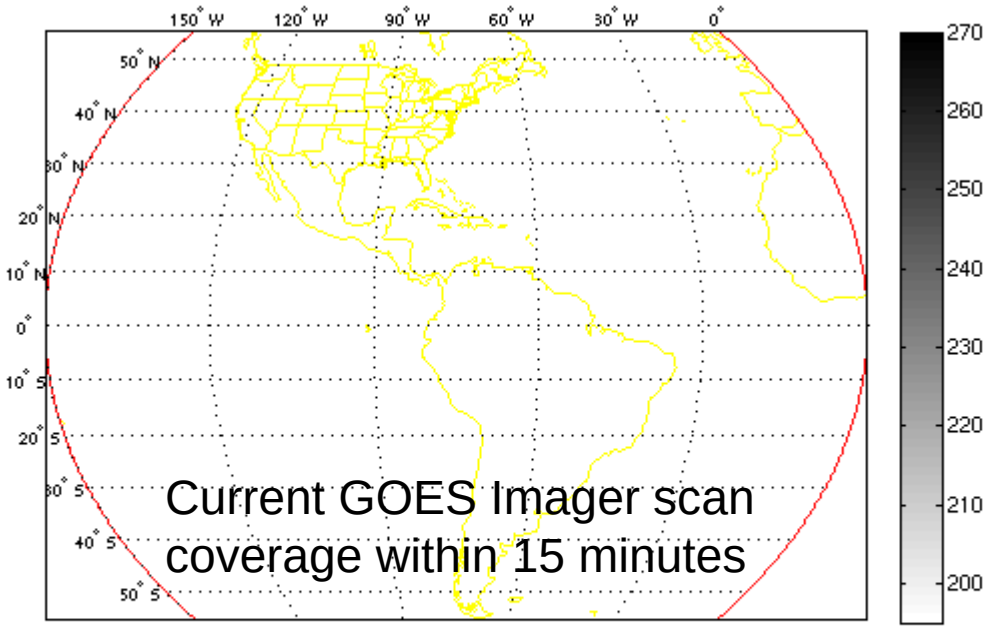
- Advanced Baseline Imager (ABI)
- Space Weather
  - Space Environmental In-Situ Suite (SEISS)
  - Solar Ultra Violet Imager (SUVI)
  - Extreme Ultra Violet/X-Ray Irradiance Sensor (EXIS)
  - Magnetometer
- Geostationary Lightning Mapper (GLM)
- Communications
  - GOES Rebroadcast (GRB)
  - Low Rate Information Transmissions (LRIT)
  - Emergency Managers Weather Information Network (EMWIN)
  - Search and Rescue (SAR)
  - Data Collection System (DCS)

The Advanced Baseline Imager:

	ABI	Current
Spectral Coverage		
	16 bands	5 bands
Spatial resolution		
0.64 μm Visible	0.5 km	Approx. 1 km
Other Visible/near-IR	1.0 km	n/a
Bands (>2 μm)	2 km	Approx. 4 km
Spatial coverage		
Full disk	4 per hour	Scheduled (3 hrly)
CONUS	12 per hour	~4 per hour
Mesoscale	Every 30 sec	n/a
Visible (reflective bands)		
On-orbit calibration	Yes	No

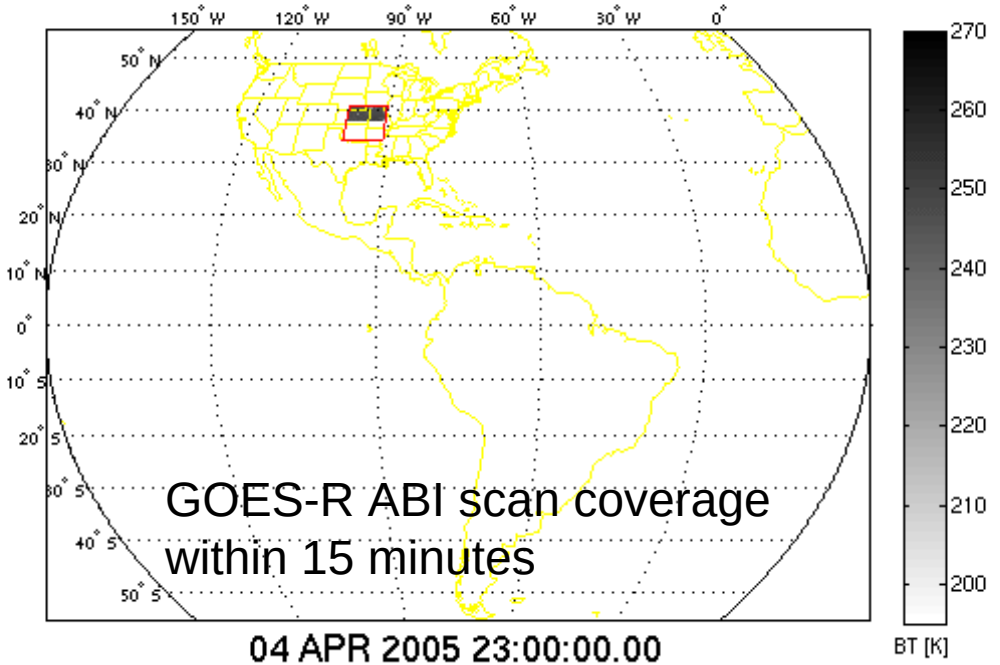
In 15 Minutes Current GOES Imager can scan:

- Most (3/5) of a Full Disk Image



In 15 Minutes ABI (Flex Mode) will scan:

- 30 Mesoscale Images
- 3 CONUS Images
- 1 Full Disk Image



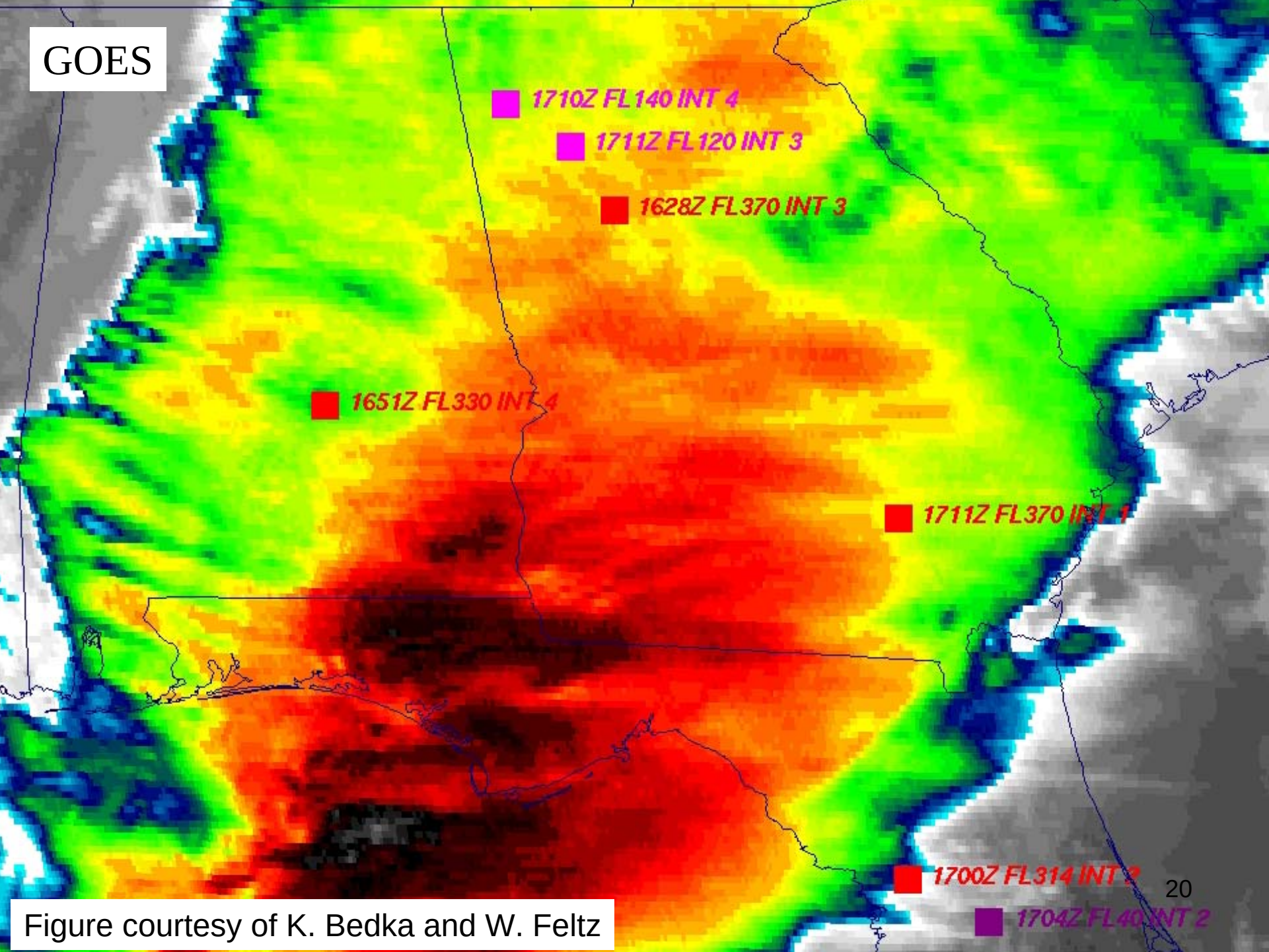


Figure courtesy of K. Bedka and W. Feltz

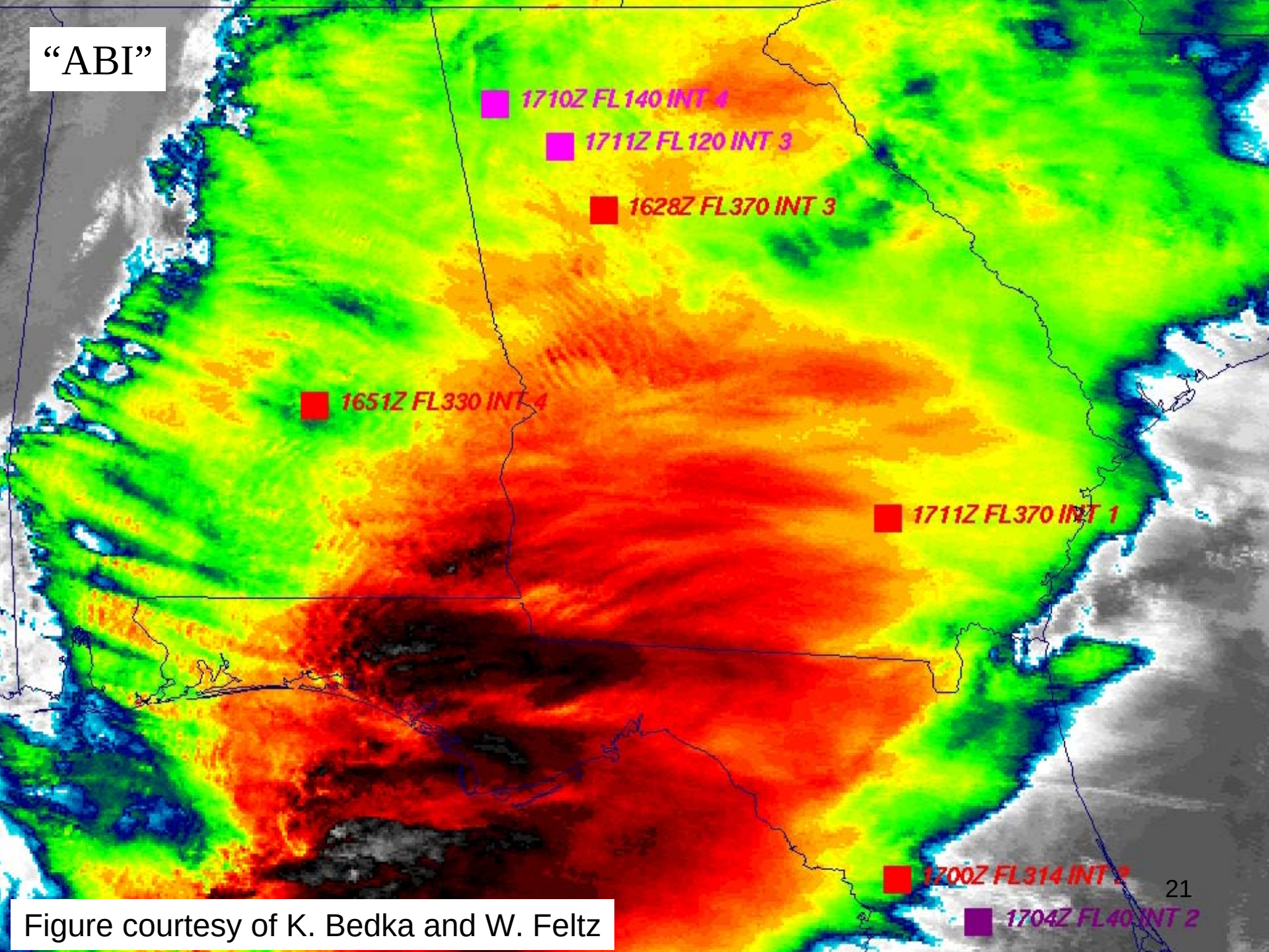


Figure courtesy of K. Bedka and W. Feltz

ABI Visible/Near-IR Bands

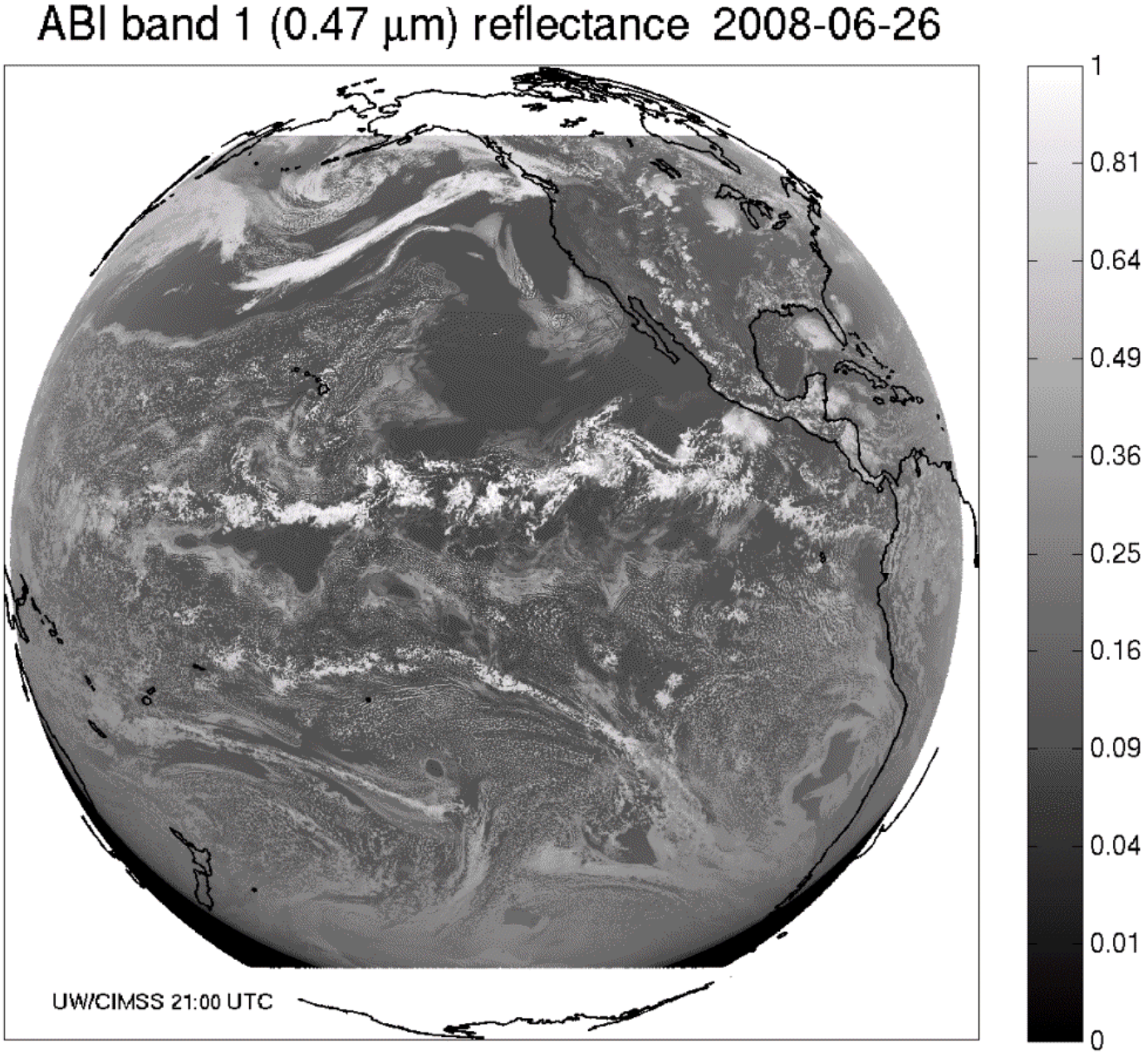
Future GOES imager (ABI) band	Wavelength range (μm)	Central wavelength (μm)	Nominal subsatellite IGFOV (km)	Sample use
1	0.45–0.49	0.47	1	Daytime aerosol over land, coastal water mapping
2	0.59–0.69	0.64	0.5	Daytime clouds fog, inso-lation, winds
3	0.846–0.885	0.865	1	Daytime vegetation/burn scar and aerosol over water, winds
4	1.371–1.386	1.378	2	Daytime cirrus cloud
5	1.58–1.64	1.61	1	Daytime cloud-top phase and particle size, snow
6	2.225–2.275	2.25	2	Daytime land/cloud properties, particle size, vegetation, snow

Schmit et al., 2005

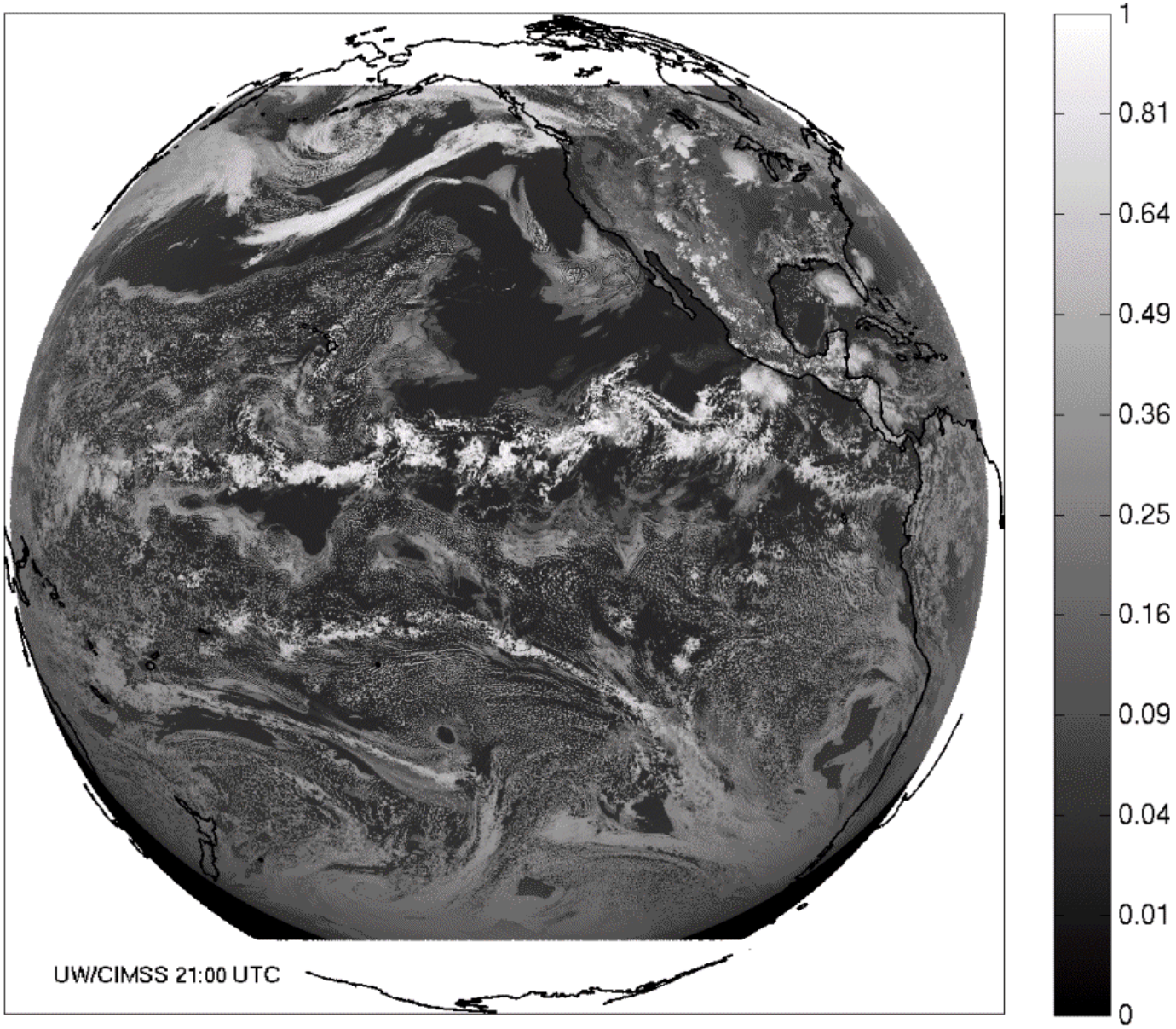
ABI IR Bands

7	3.80–4.00	3.90	2	Surface and cloud, fog at night, fire, winds
8	5.77–6.6	6.19	2	High-level atmospheric water vapor, winds, rainfall
9	6.75–7.15	6.95	2	Midlevel atmospheric water vapor, winds, rainfall
10	7.24–7.44	7.34	2	Lower-level water vapor, winds, and SO_2
11	8.3–8.7	8.5	2	Total water for stability, cloud phase, dust, SO_2 rainfall
12	9.42–9.8	9.61	2	Total ozone, turbulence, and winds
13	10.1–10.6	10.35	2	Surface and cloud
14	10.8–11.6	11.2	2	Imagery, SST, clouds, rainfall
15	11.8–12.8	12.3	2	Total water, ash, and SST
16	13.0–13.6	13.3	2	Air temperature, cloud heights and amounts

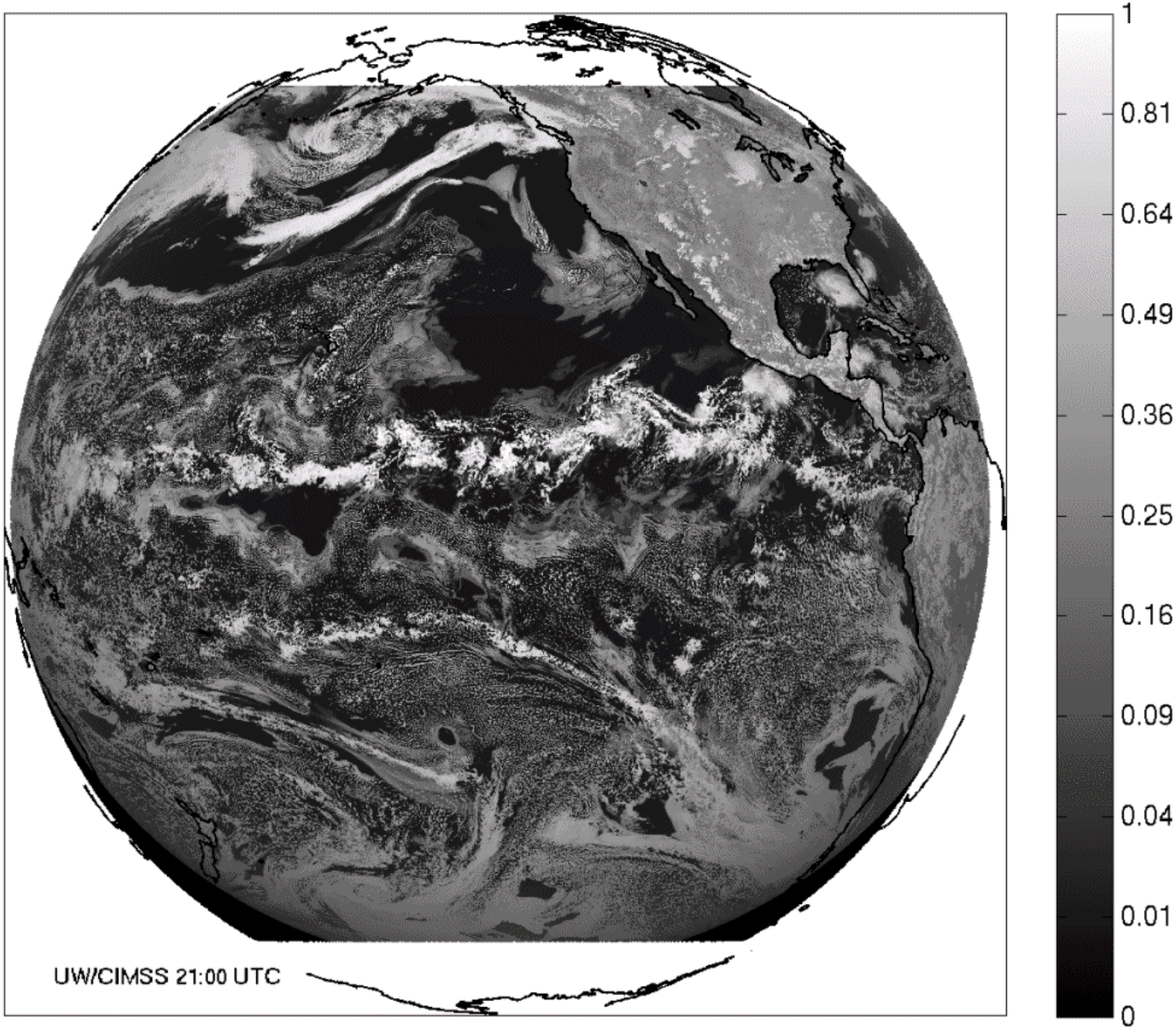
Schmit et al., 2005



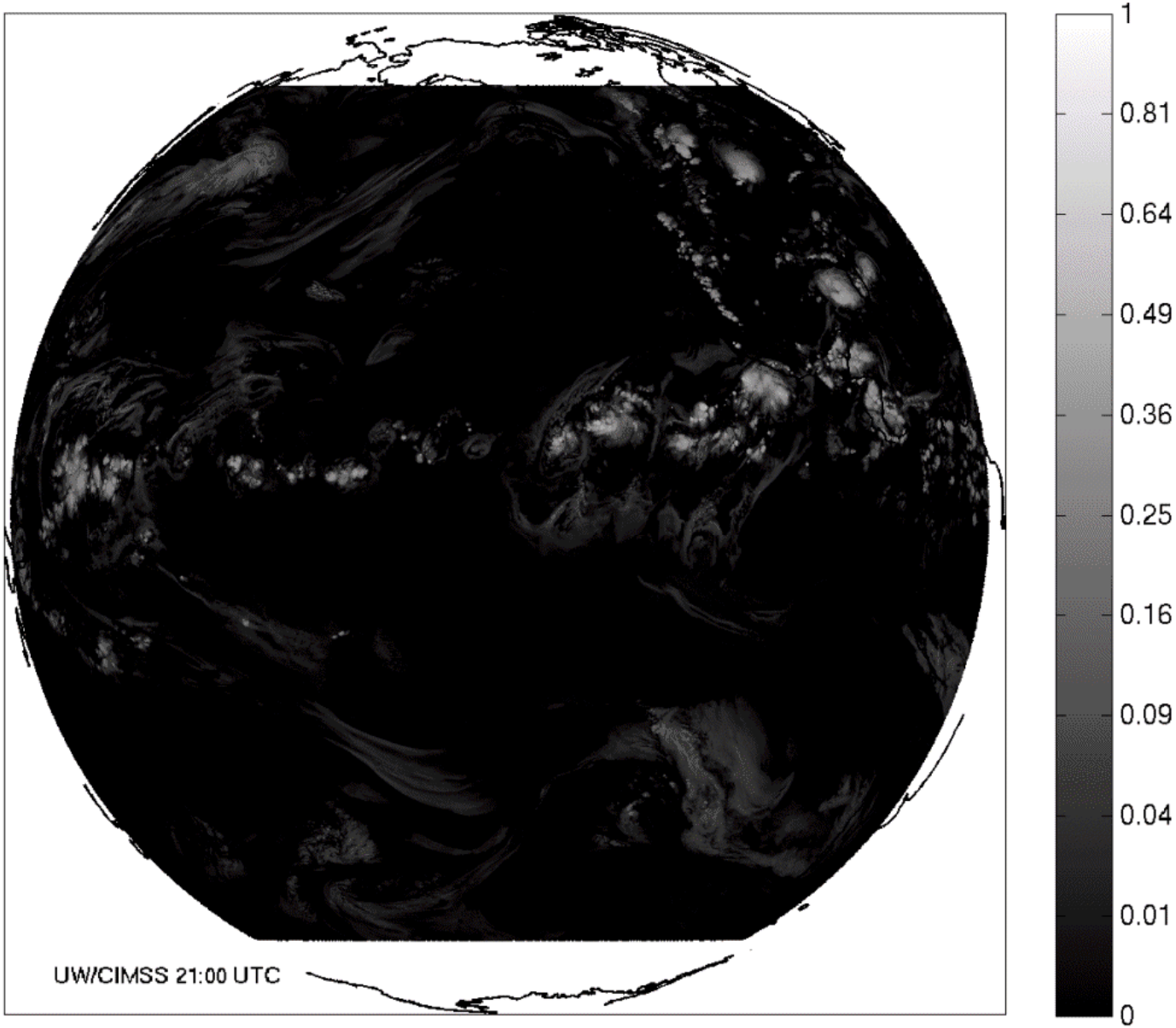
These NWP model simulations were performed on the 'cobalt' supercomputer at the National Center for Supercomputing Applications at the University of Illinois.

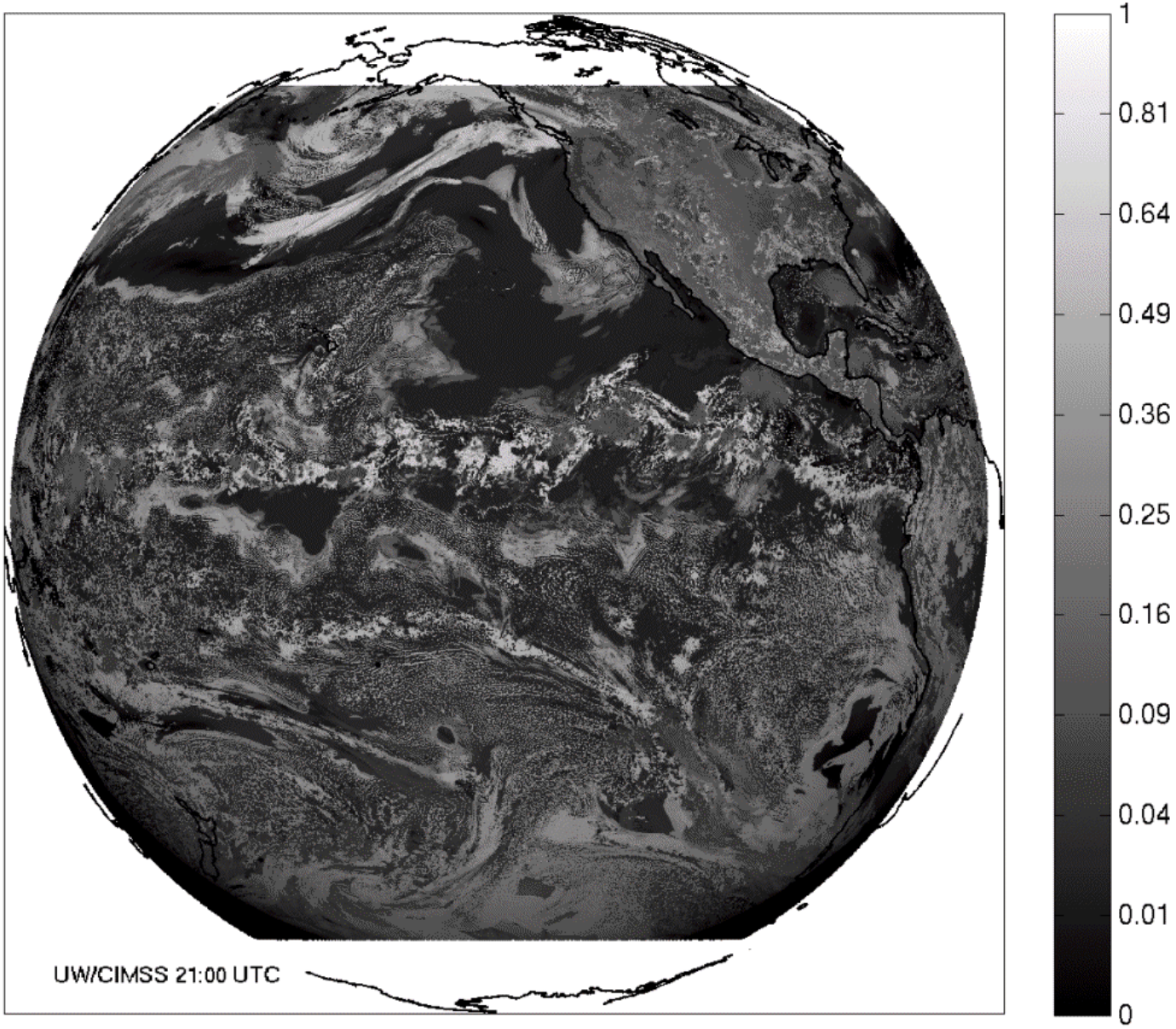

ABI band 2 (0.64 µm) reflectance 2008-06-26
UW/CIMSS 21:00 UTC
1
0.81
0.64
0.49
0.36
0.25
0.16
0.09
0.04
0.01
0

ABI band 3 (0.87 μm) reflectance 2008-06-26

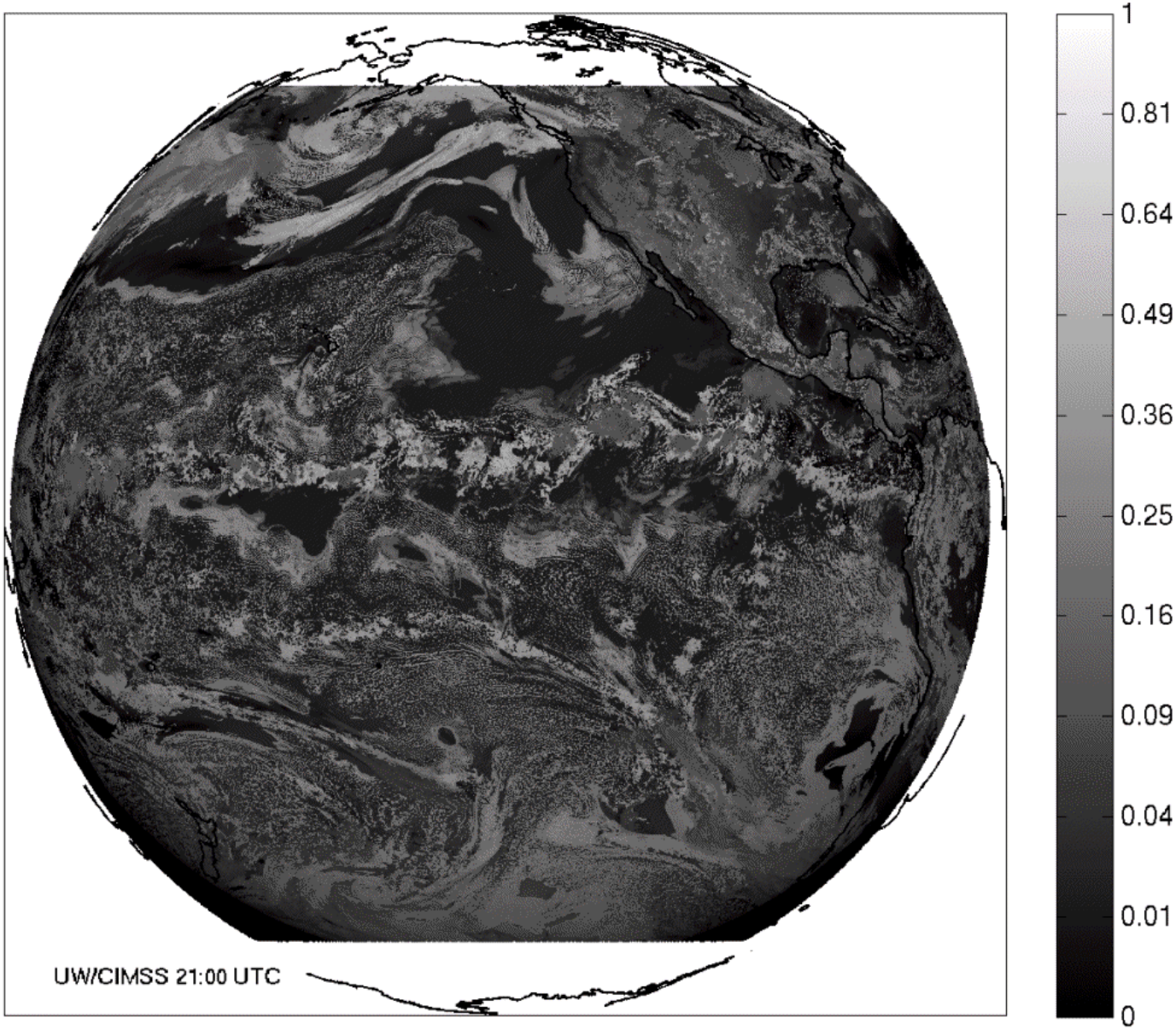


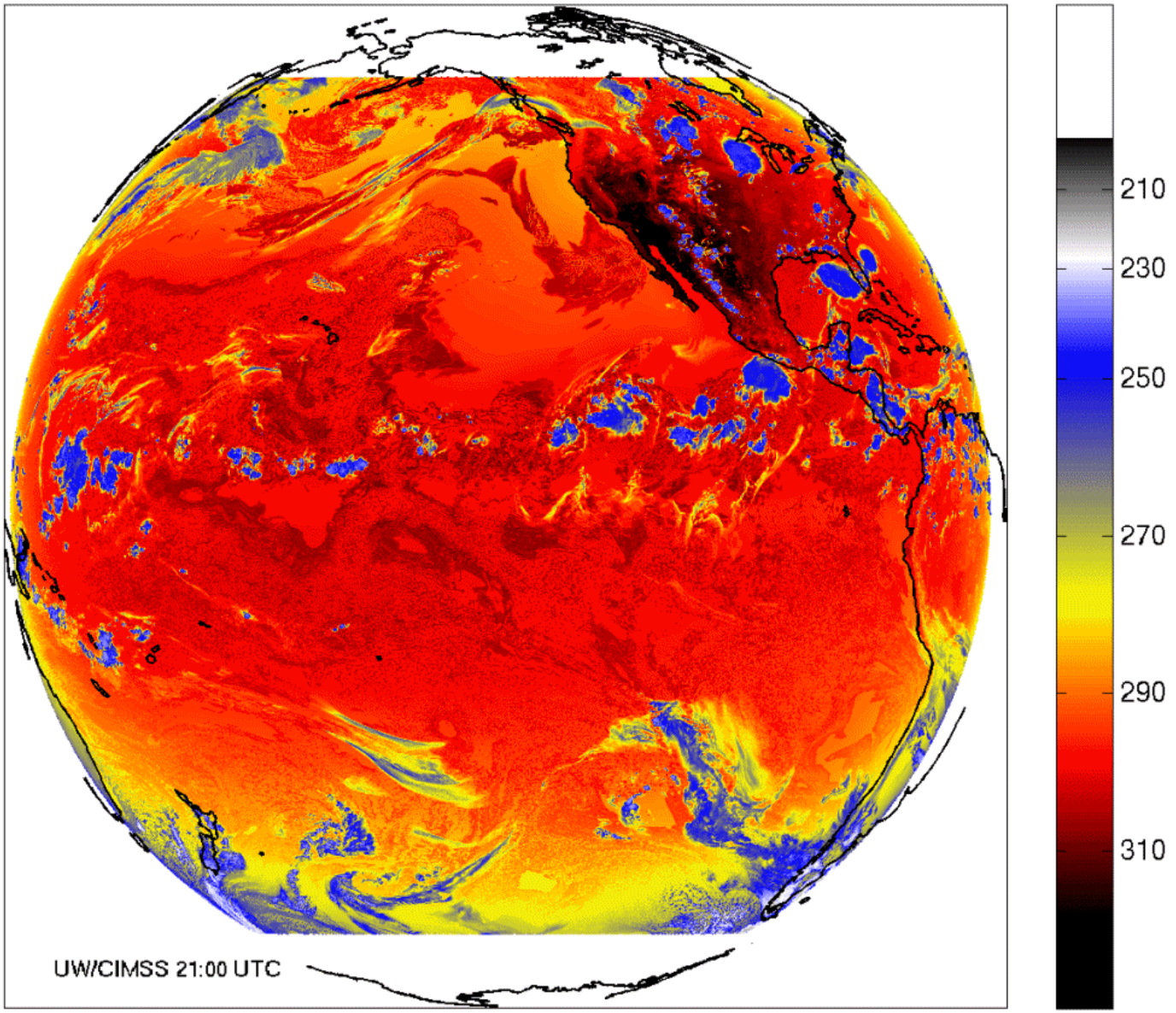
ABI band 4 (1.38 μm) reflectance 2008-06-26

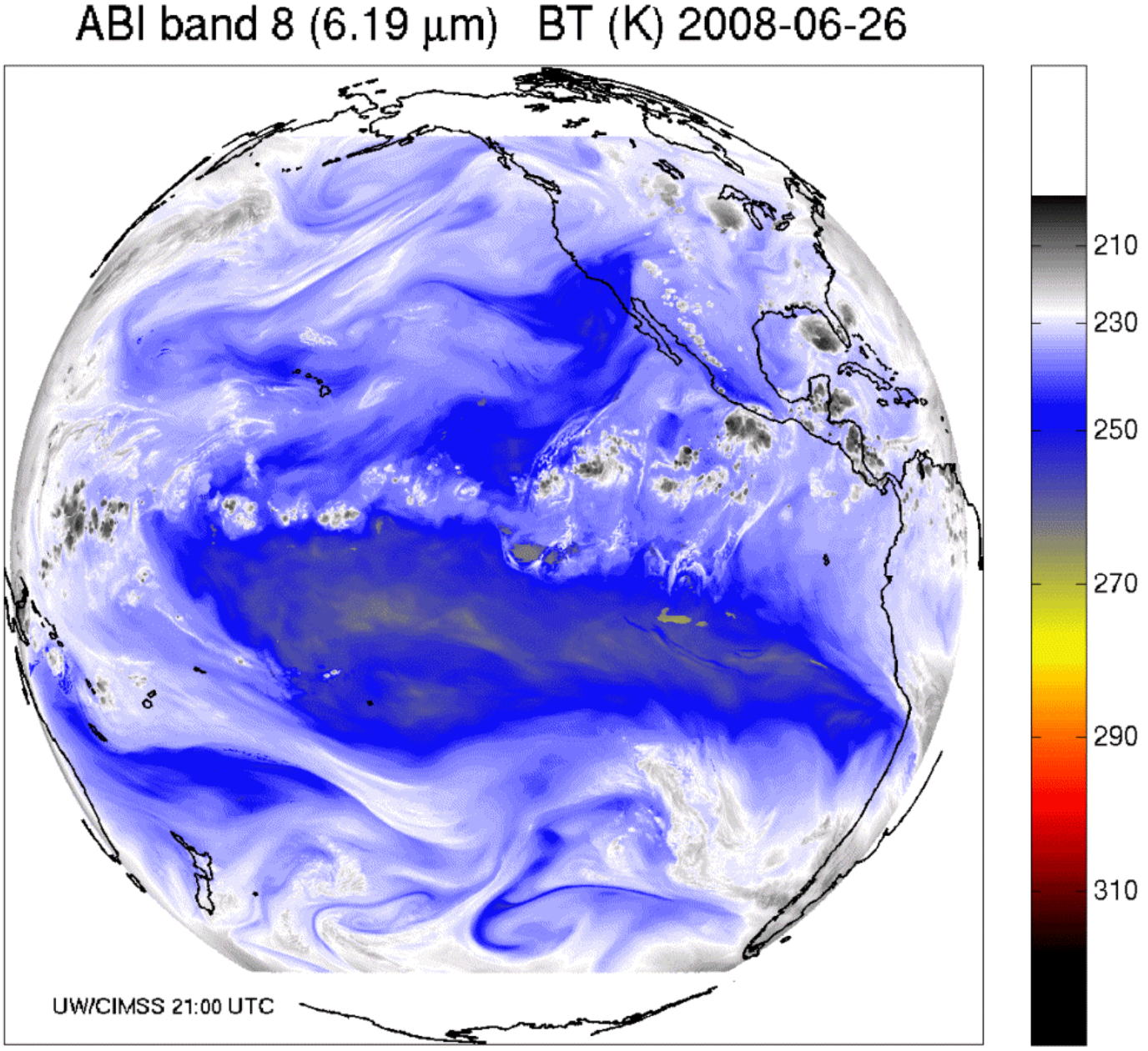


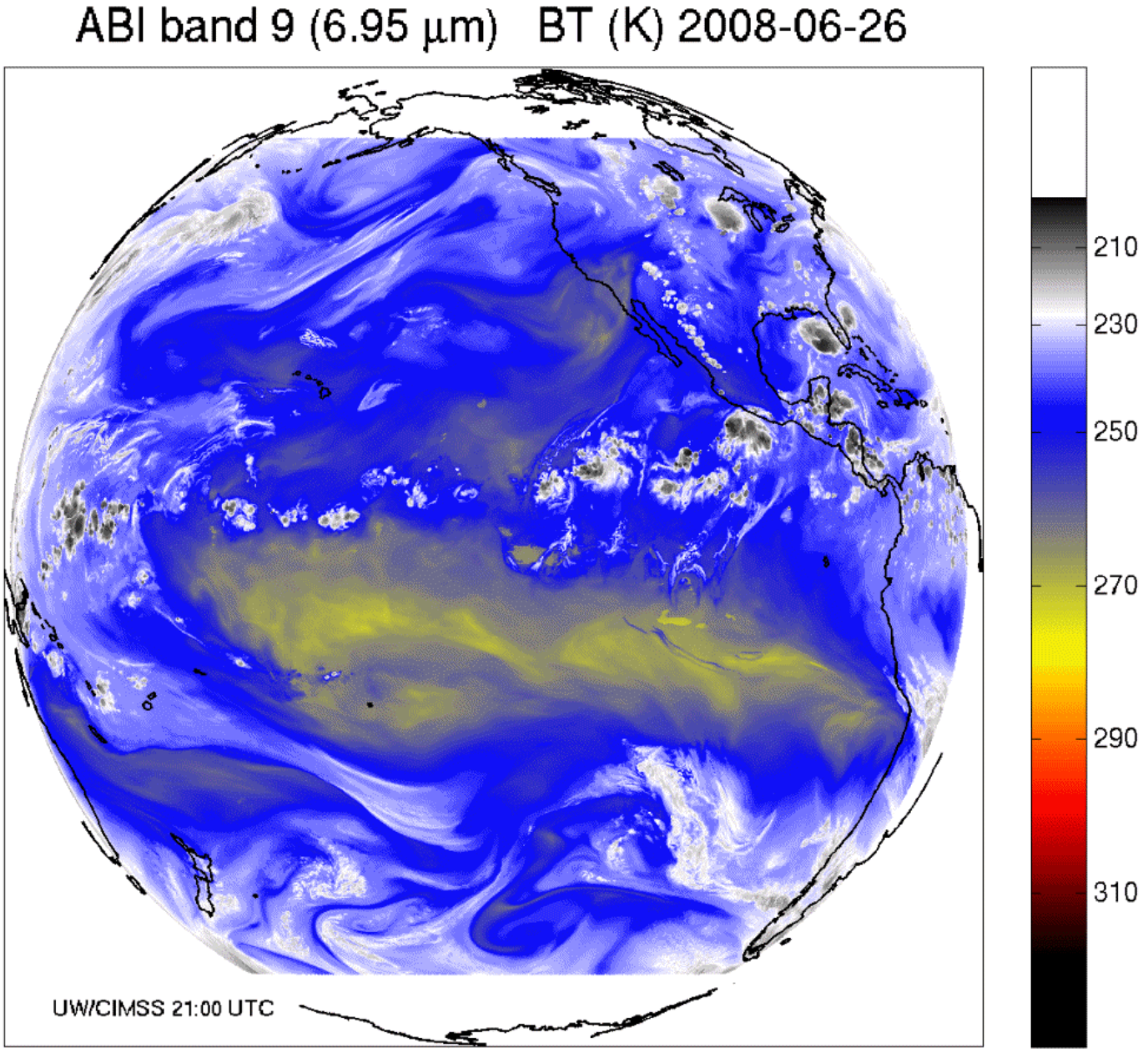

ABI band 5 (1.61 µm) reflectance 2008-06-26
UW/CIMSS 21:00 UTC
1
0.81
0.64
0.49
0.36
0.25
0.16
0.09
0.04
0.01
0

ABI band 6 (2.25 μm) reflectance 2008-06-26




ABI band 7 (3.90 µm) BT (K) 2008-06-26
UW/CIMSS 21:00 UTC
210
230
250
270
290
310


ABI band 8 (6.19 µm) BT (K) 2008-06-26
UW/CIMSS 21:00 UTC
210
230
250
270
290
310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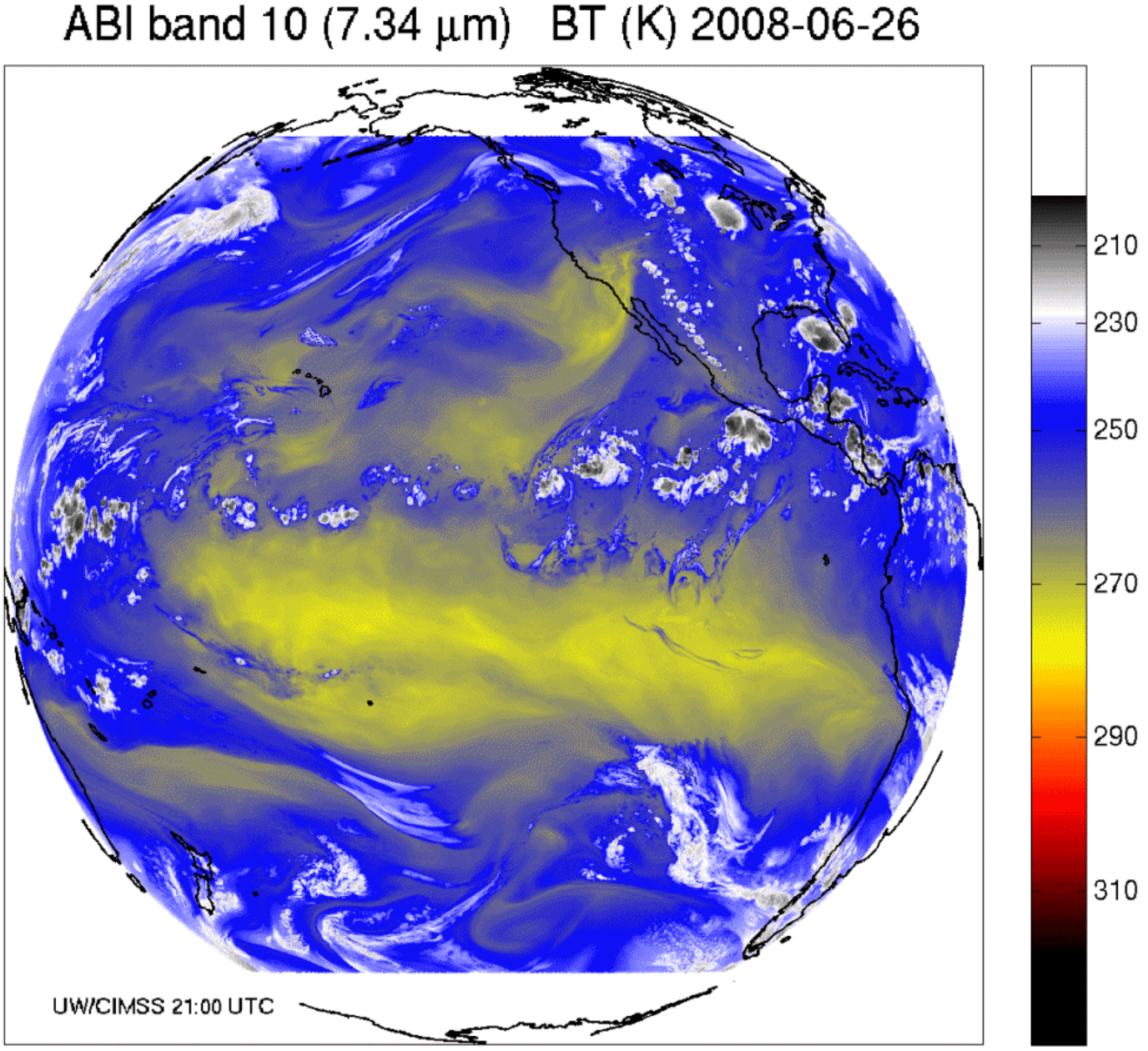
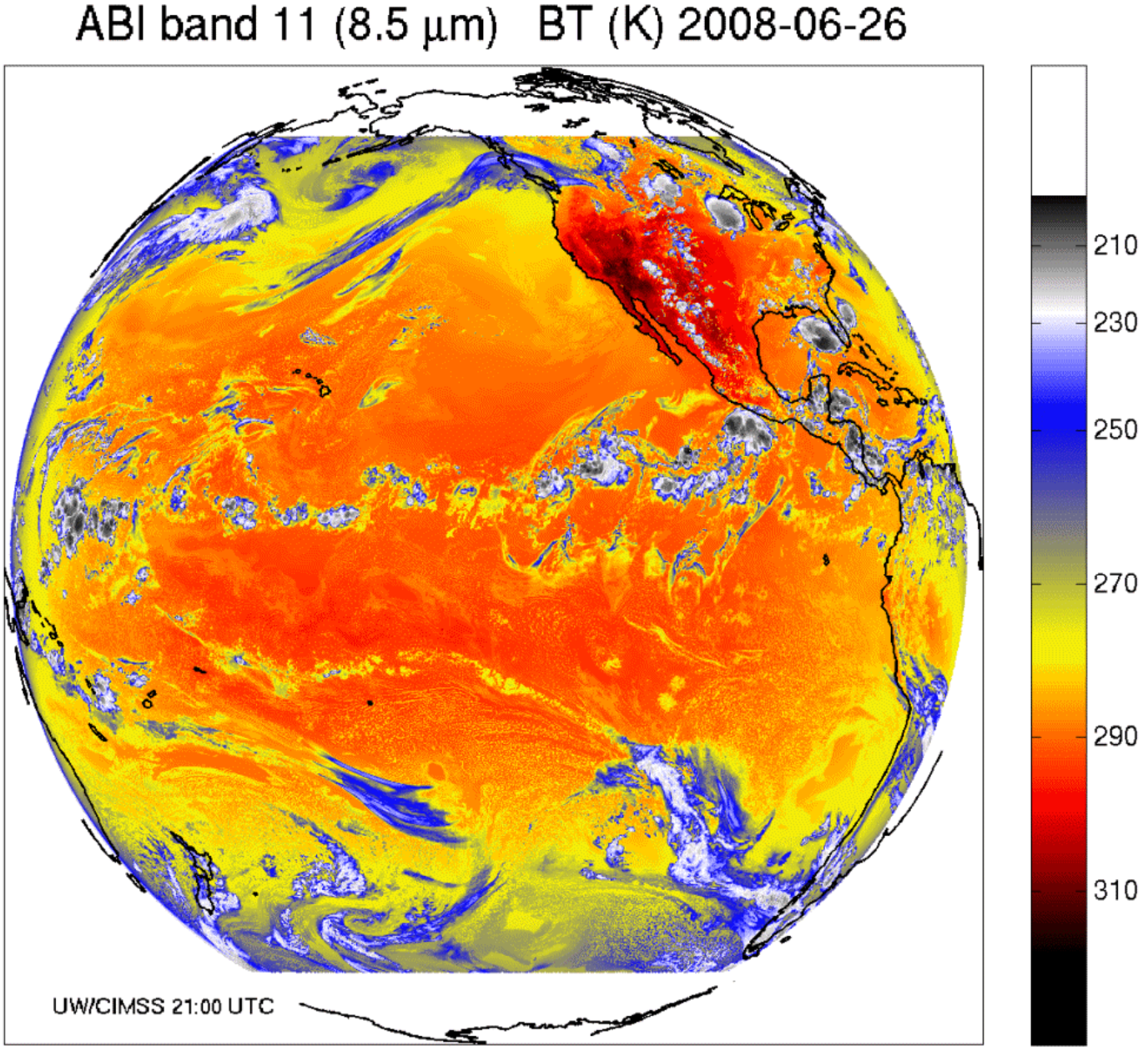
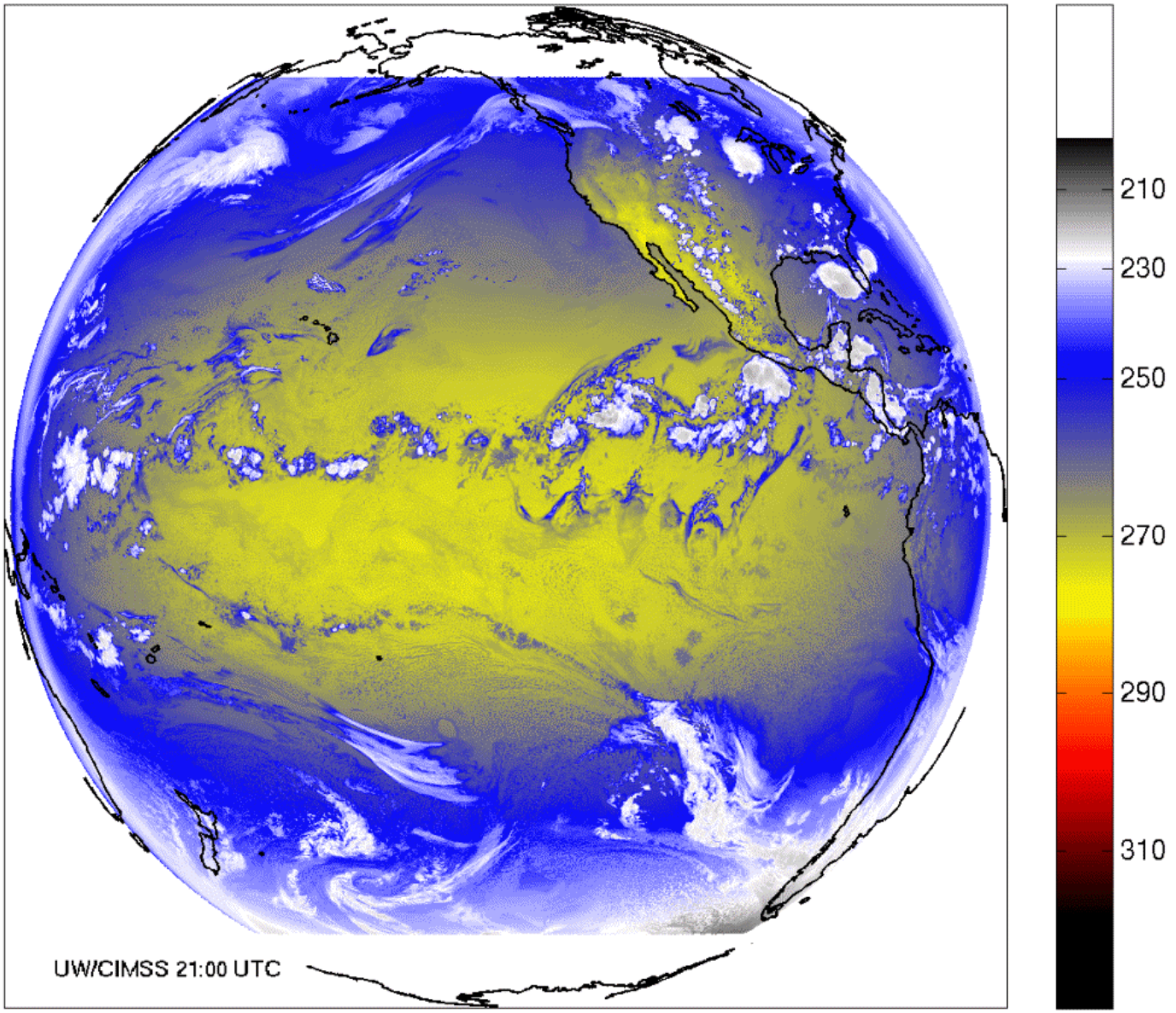
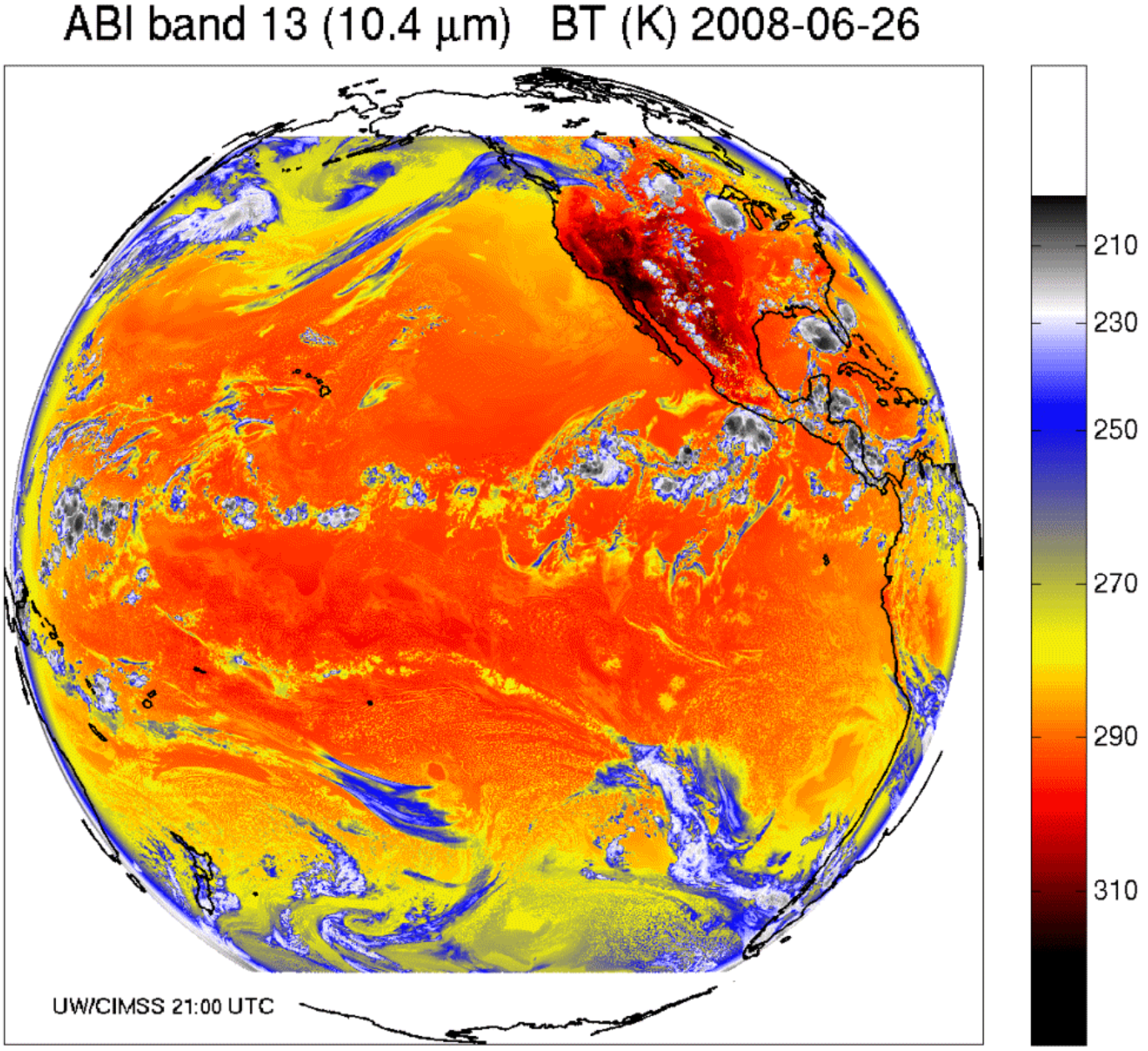
210
230
250
270
290
310


ABI band 10 (7.34 µm) BT (K) 2008-06-26
UW/CIMSS 21:00 UTC
210
230
250
270
290
310


ABI band 11 (8.5 µm) BT (K) 2008-06-26
UW/CIMSS 21:00 UTC
210
230
250
270
290
310


ABI band 12 (9.6 µm) BT (K) 2008-06-26
UW/CIMSS 21:00 UTC
210
230
250
270
290
310


ABI band 13 (10.4 µm) BT (K) 2008-06-26
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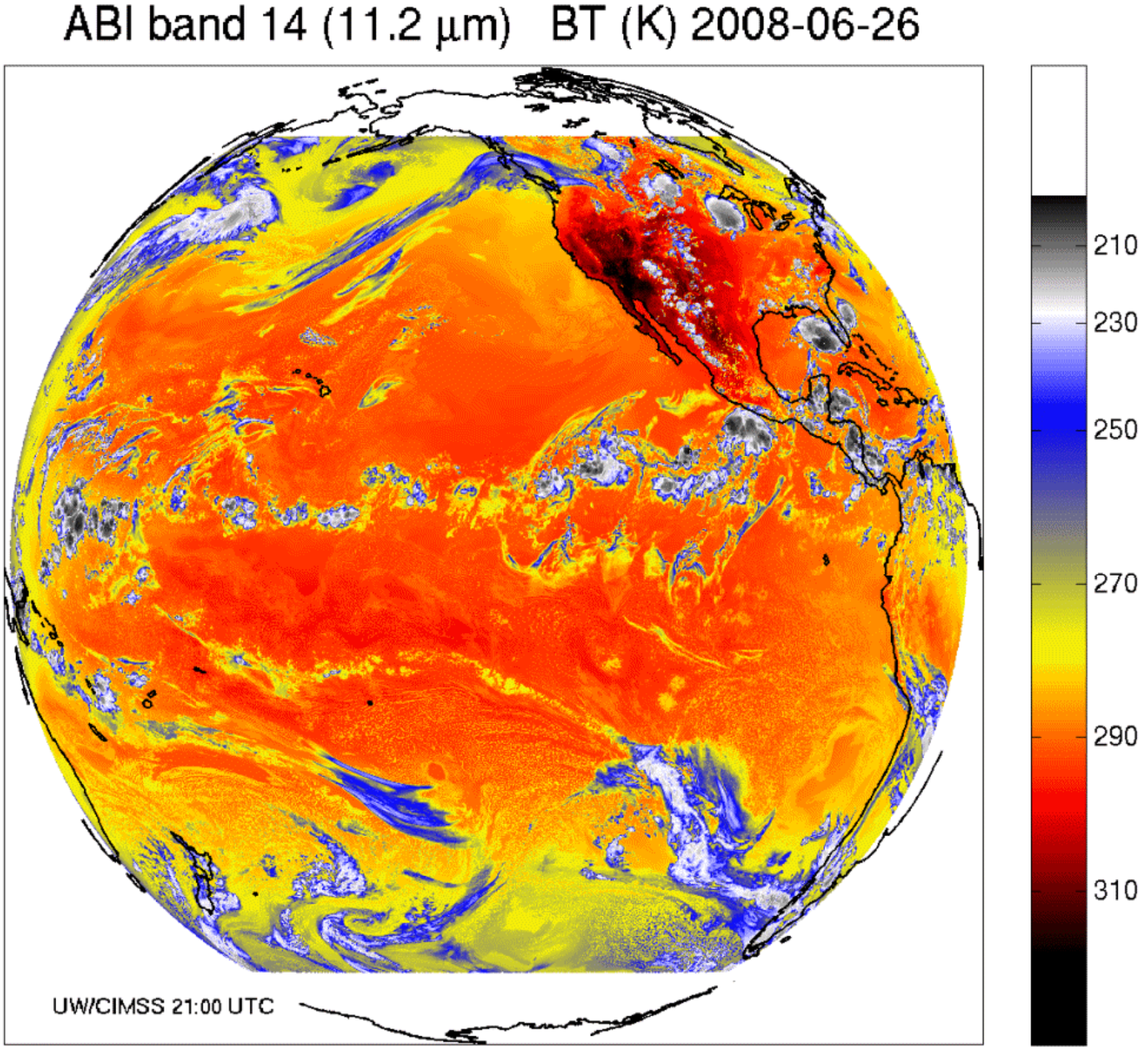
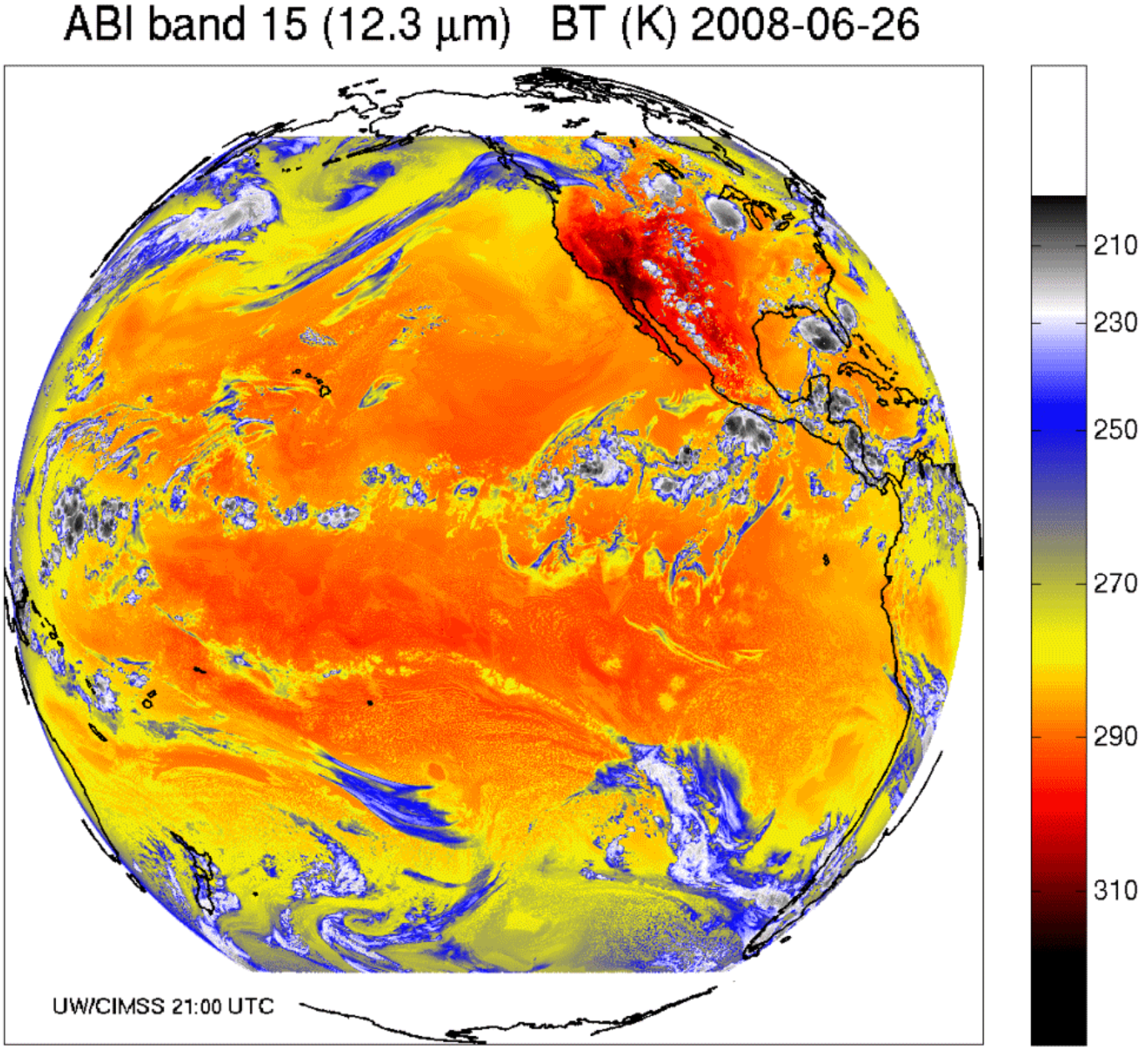
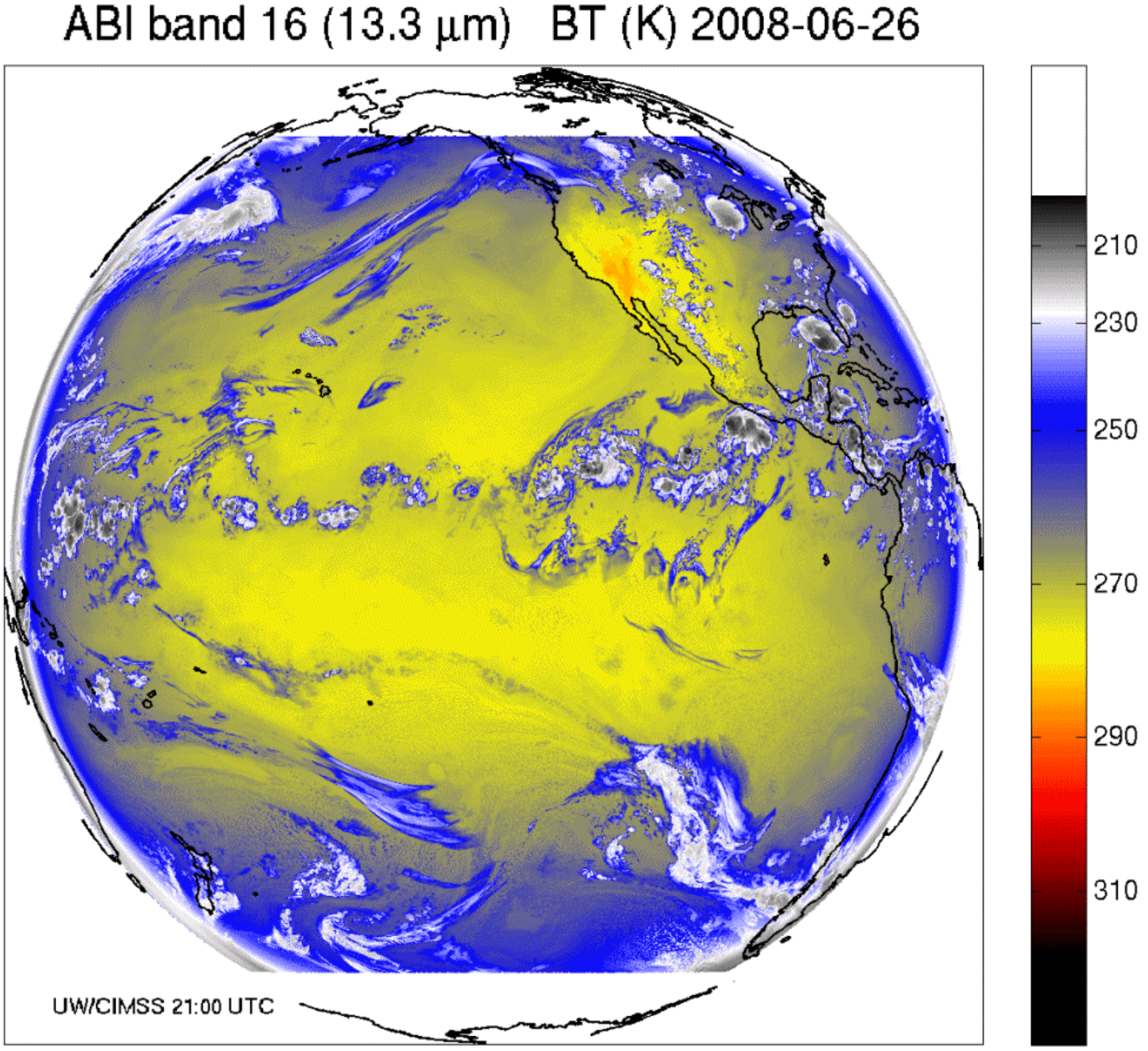
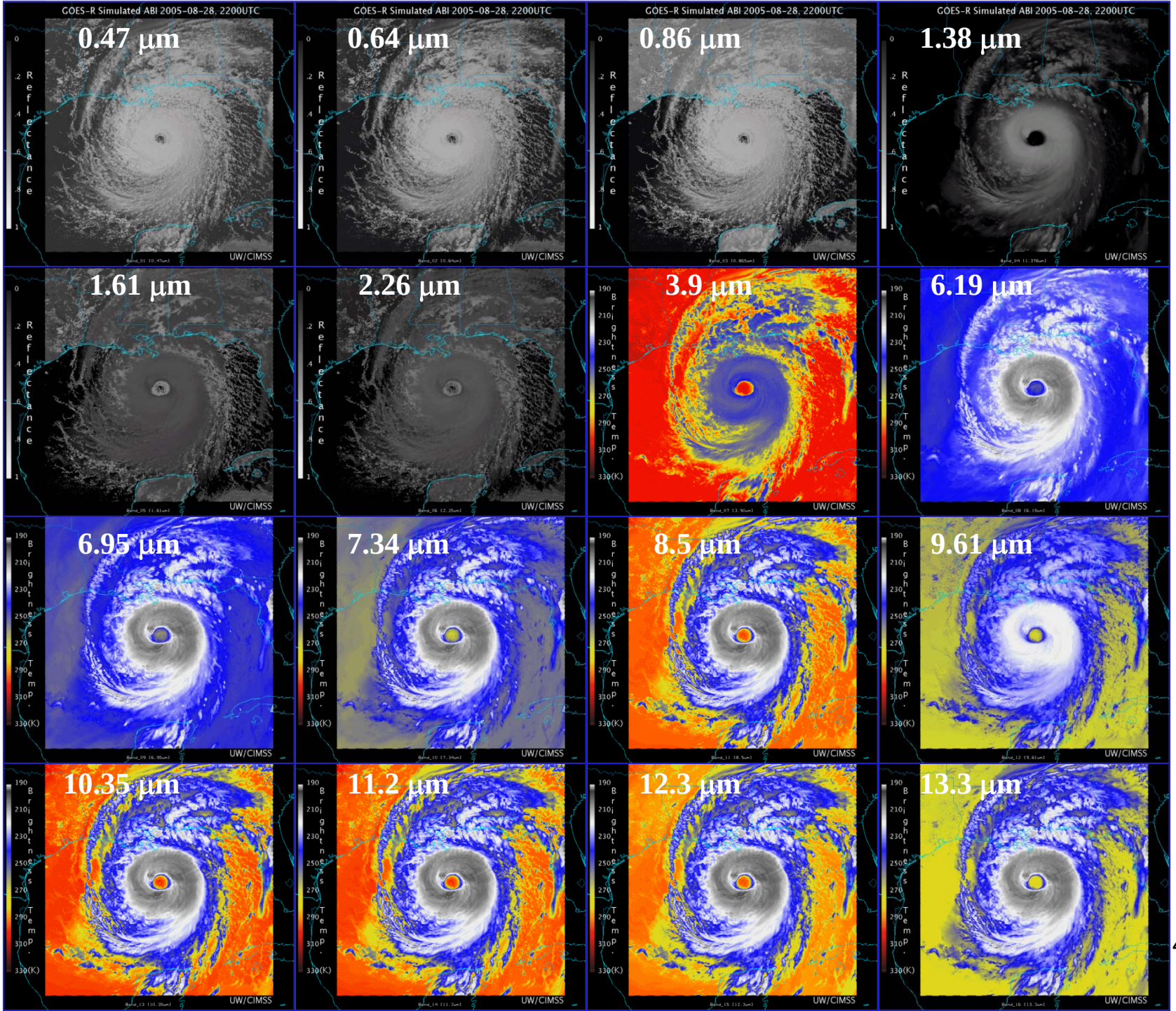
210
230
250
270
290
310


ABI band 14 (11.2 µm) BT (K) 2008-06-26
UW/CIMSS 21:00 UTC
210
230
250
270
290
310


ABI band 15 (12.3 µm) BT (K) 2008-06-26
UW/CIMSS 21:00 UTC
210
230
250
270
290
310

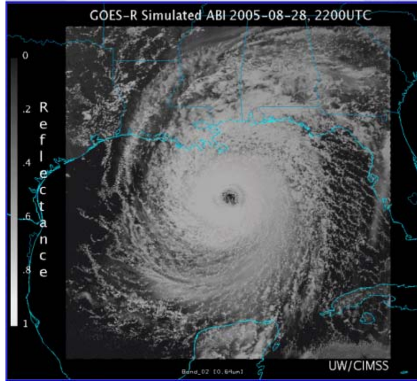

ABI band 16 (13.3 µm) BT (K) 2008-06-26
210
230
250
270
290
310
UW/CIMSS 21:00 UTC

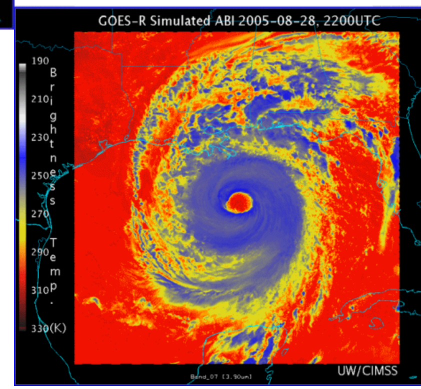
AWG Proxy ABI Simulations of Hurricane Katrina

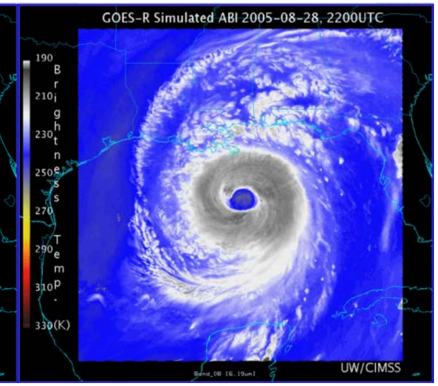


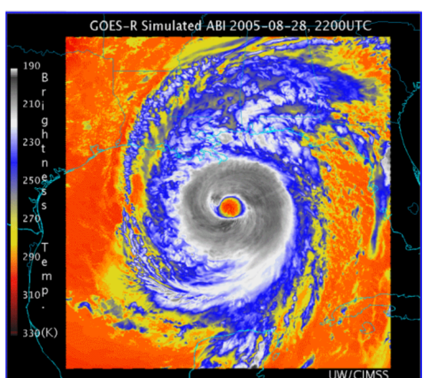
NOAA/NESDIS STAR and GOES-R Imagery Team

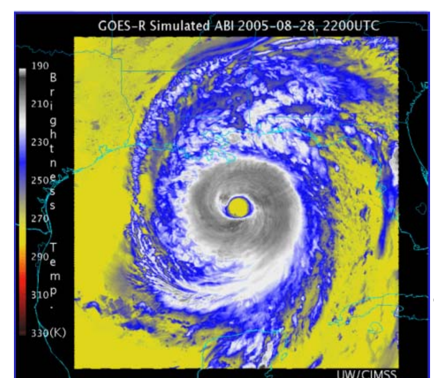
Corresponding current Imager bands of Hurricane Katrina





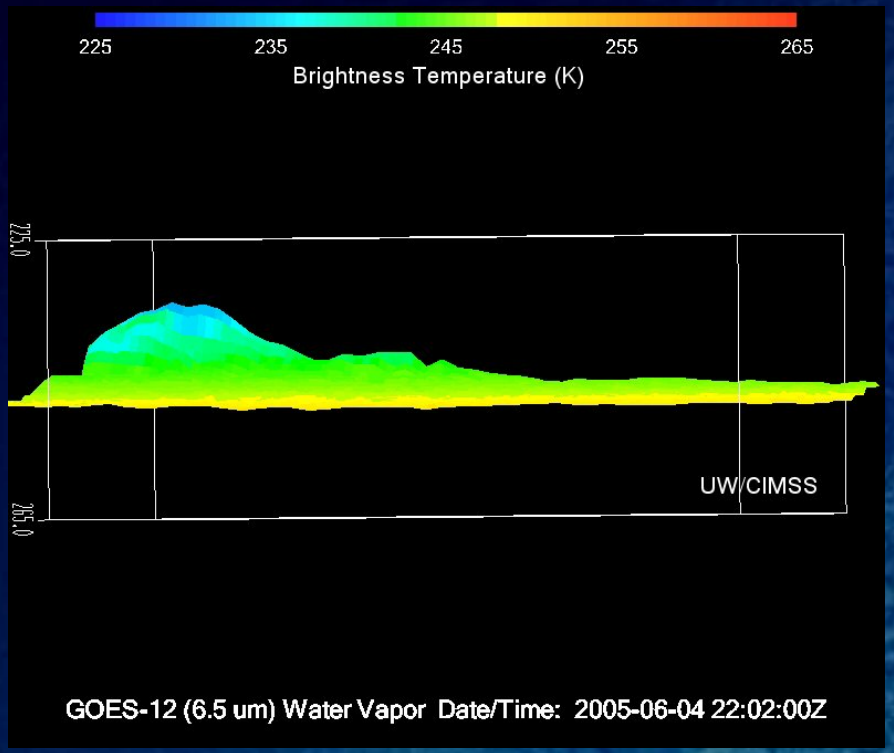




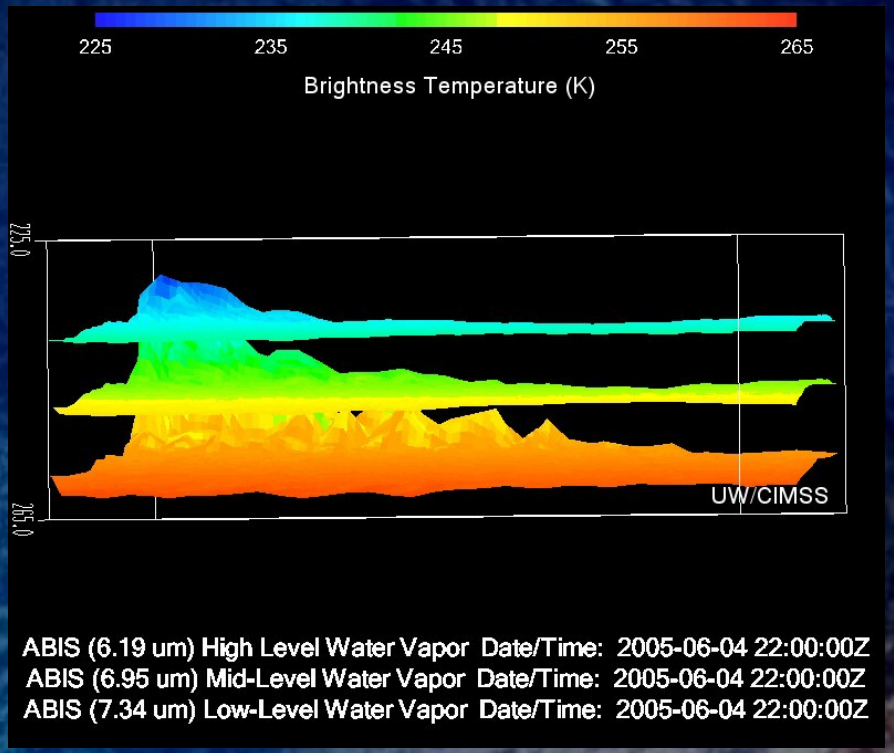


McIDAS-V

http://www.ssec.wisc.edu/mcidas/software/v/



Current GOES

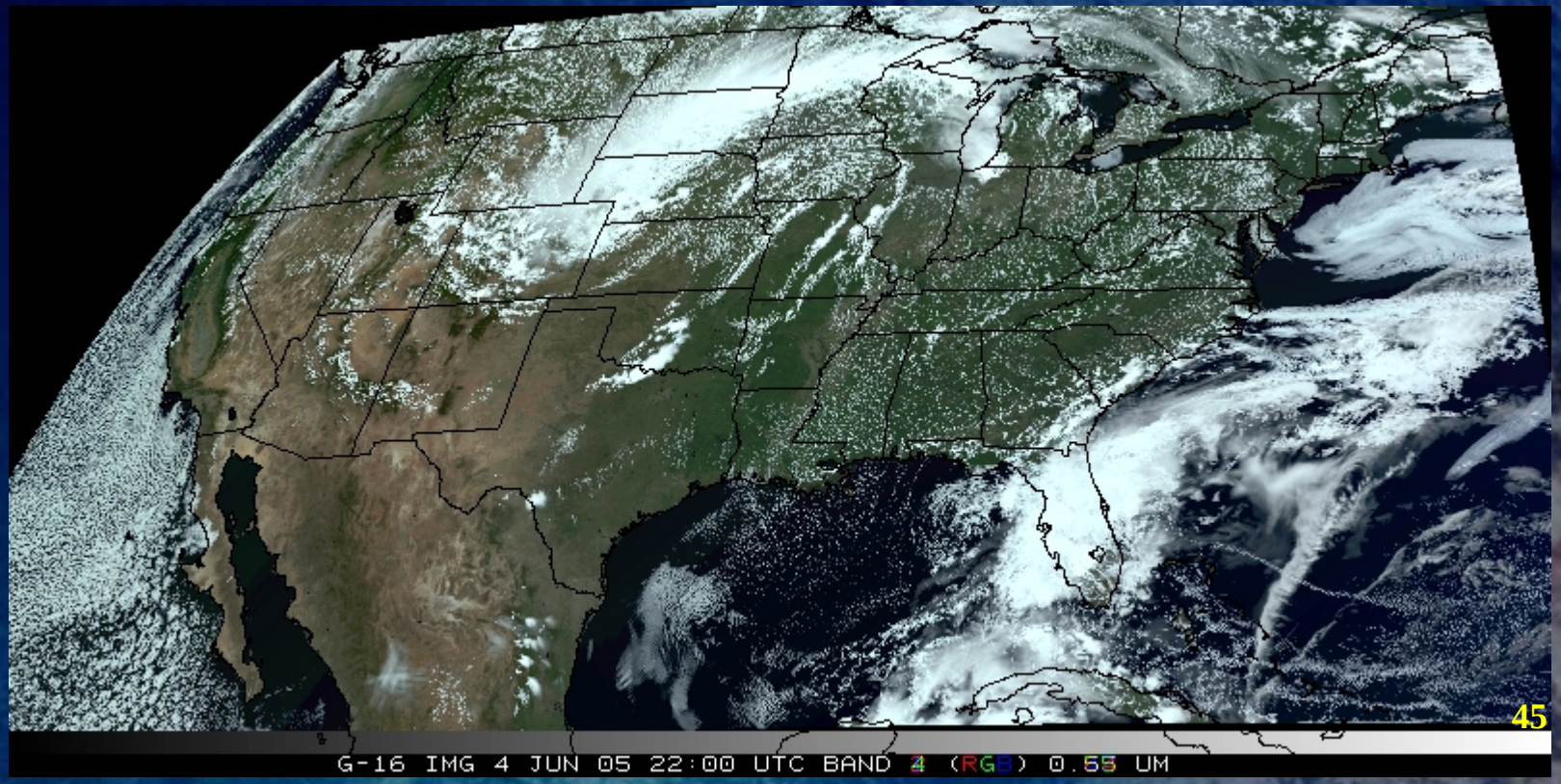


Future GOES

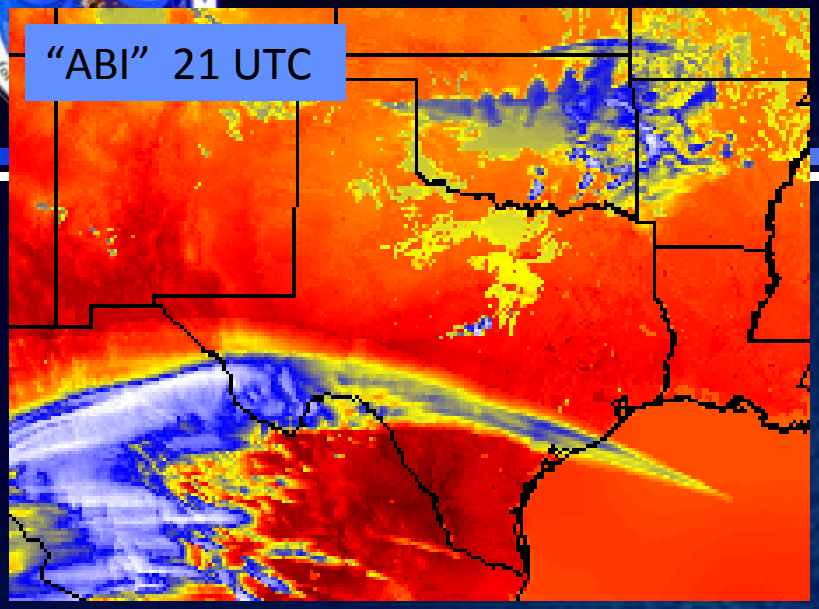
Images from J. Feltz, SSEC

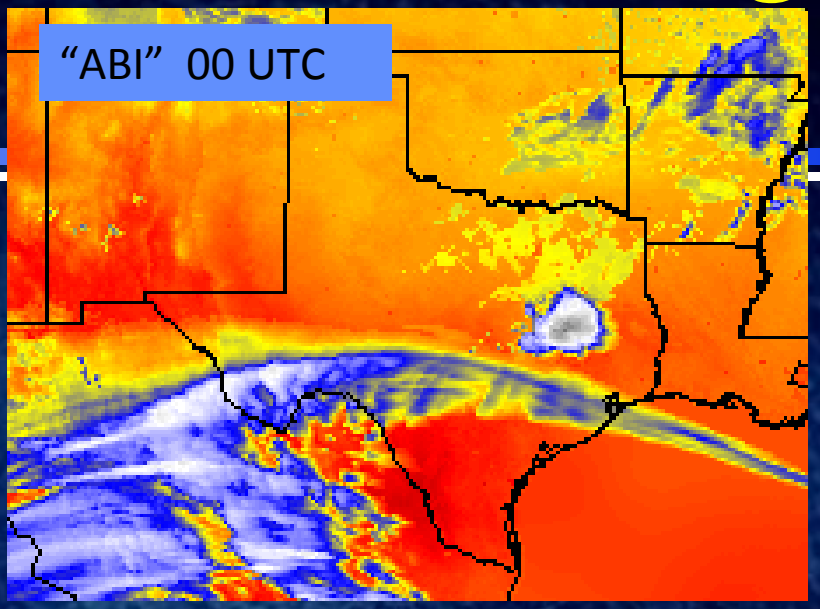
Visualization ("decision aid")

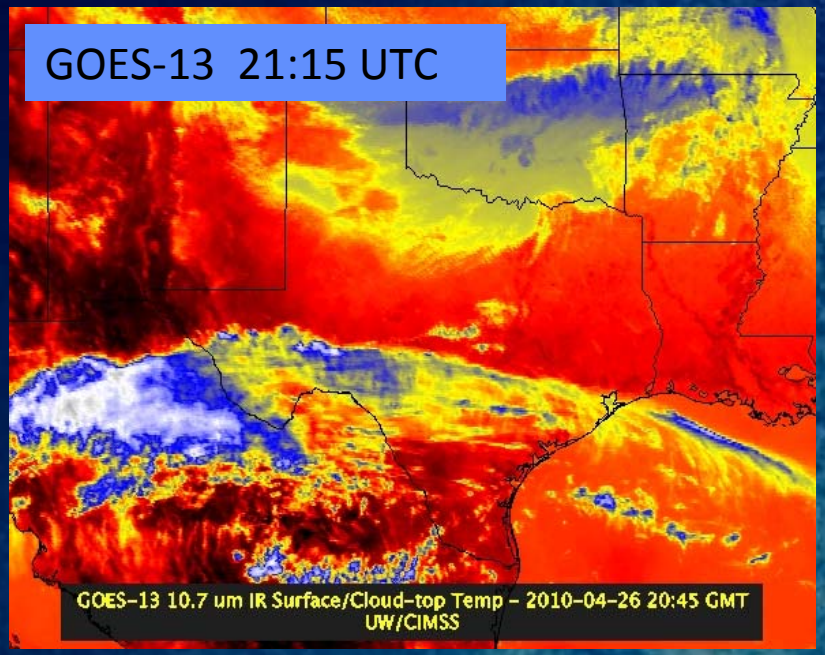
- "True Color" with "synthetic" green from ABI simulated data (from CIMSS); image from Don Hillger, RAMMB.

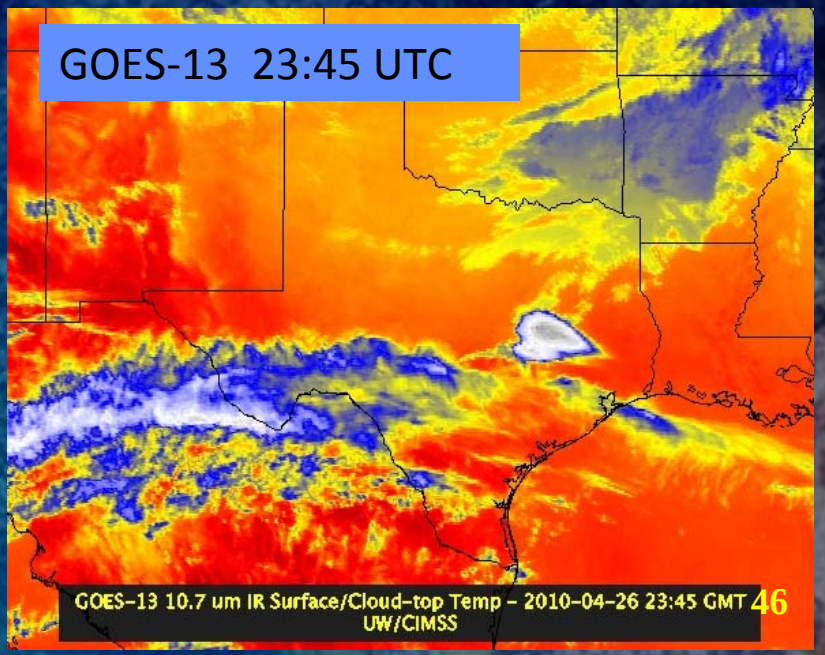


NSSL WRF and GOES Imager



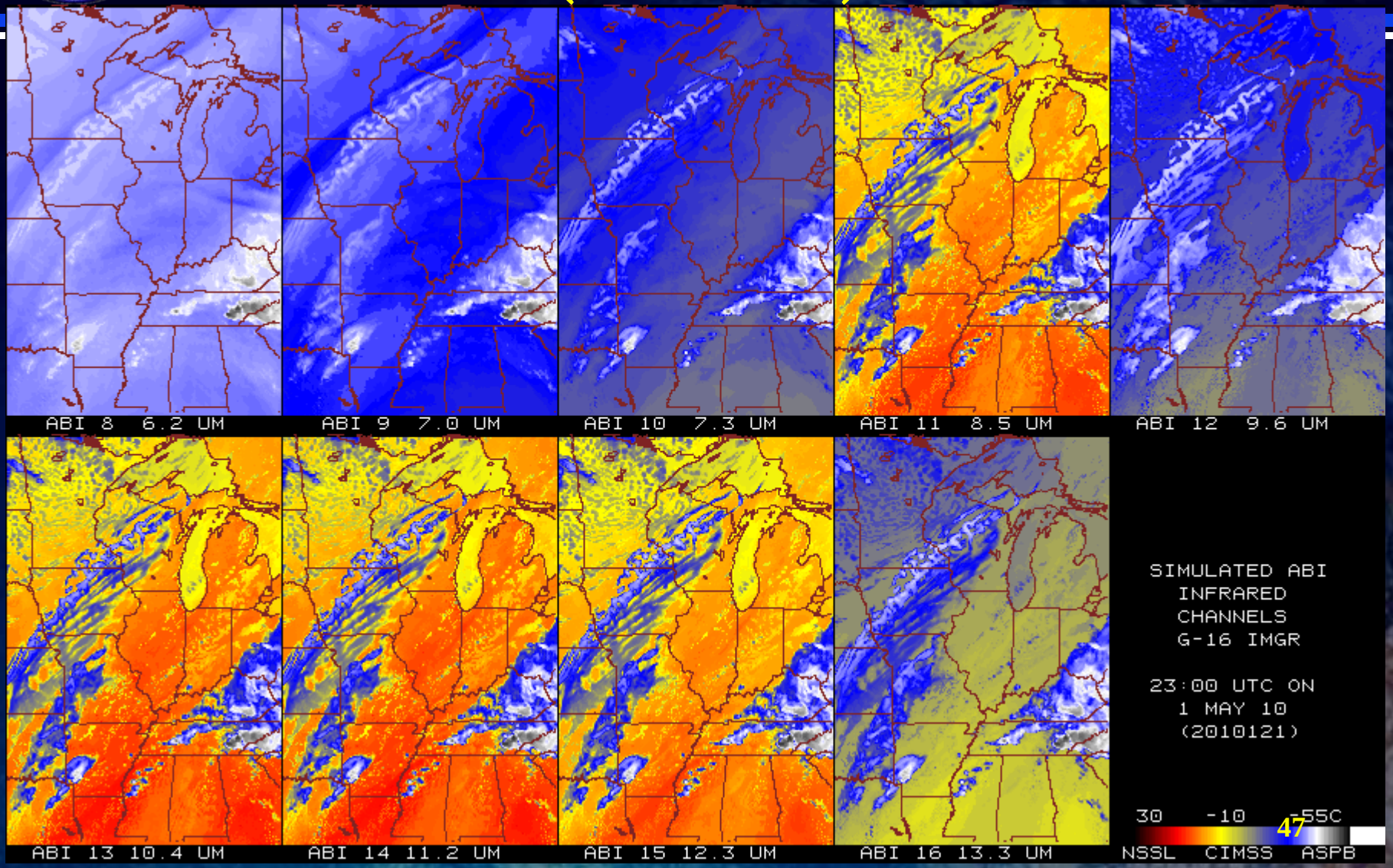




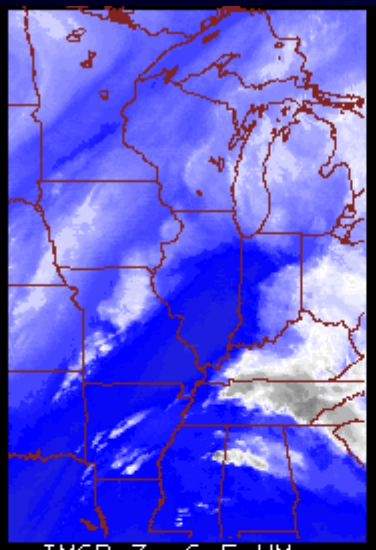


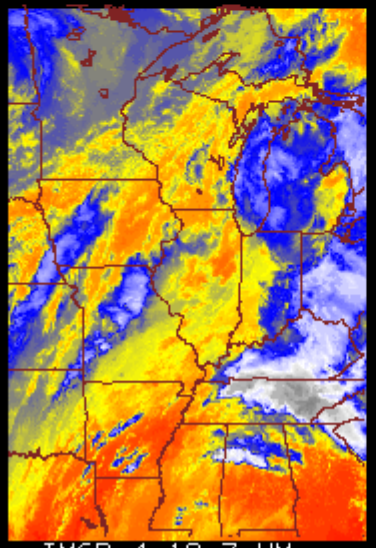
Calculated ABI bands (subset)

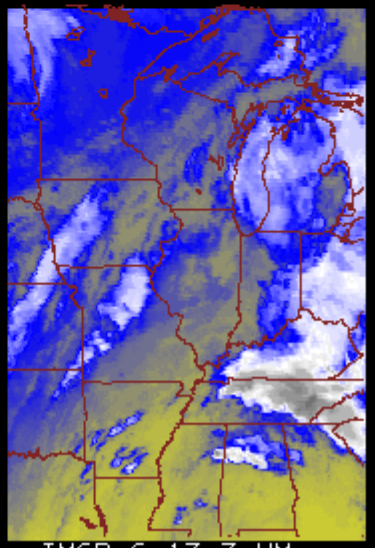
From NSSL WRF



Observed GOES-13 Imager







REMAPPED

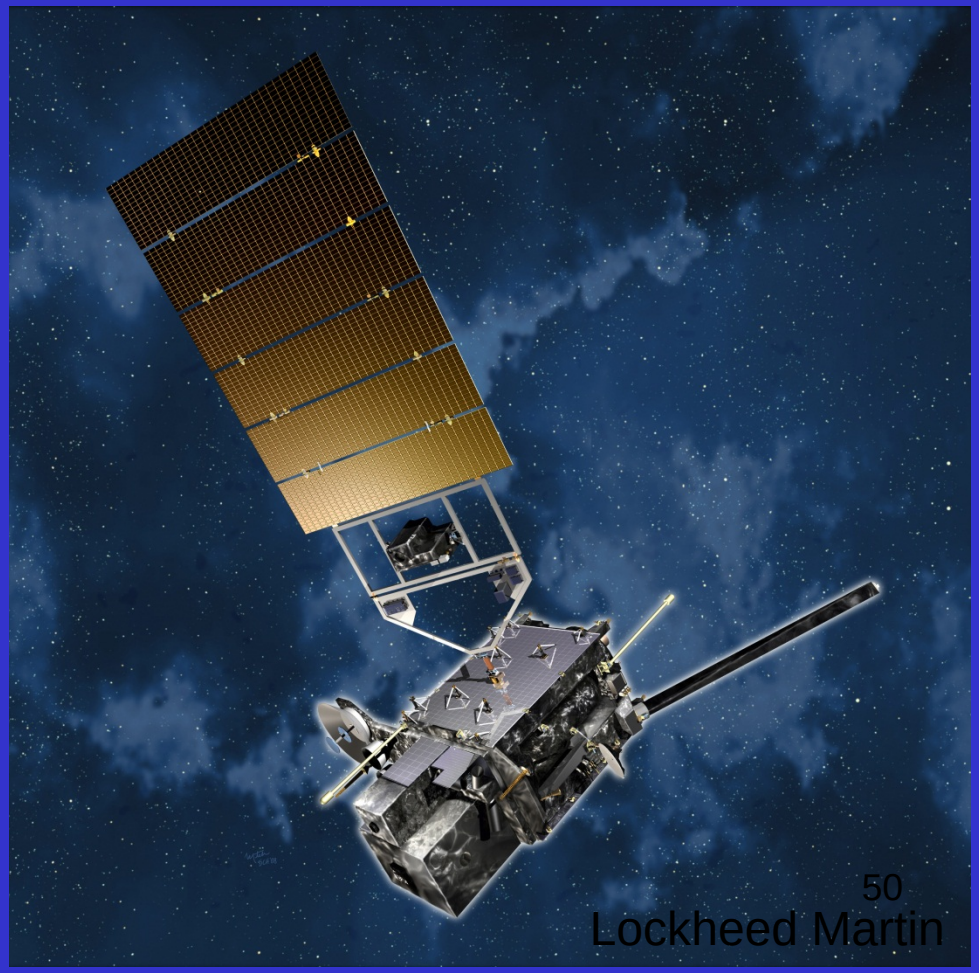
INFRARED
CHANNELS
G-13 IMGR

23:03 UTC ON
1 MAY 10
(2010121)

30 -10 -55C
UW CIMSS ASPB

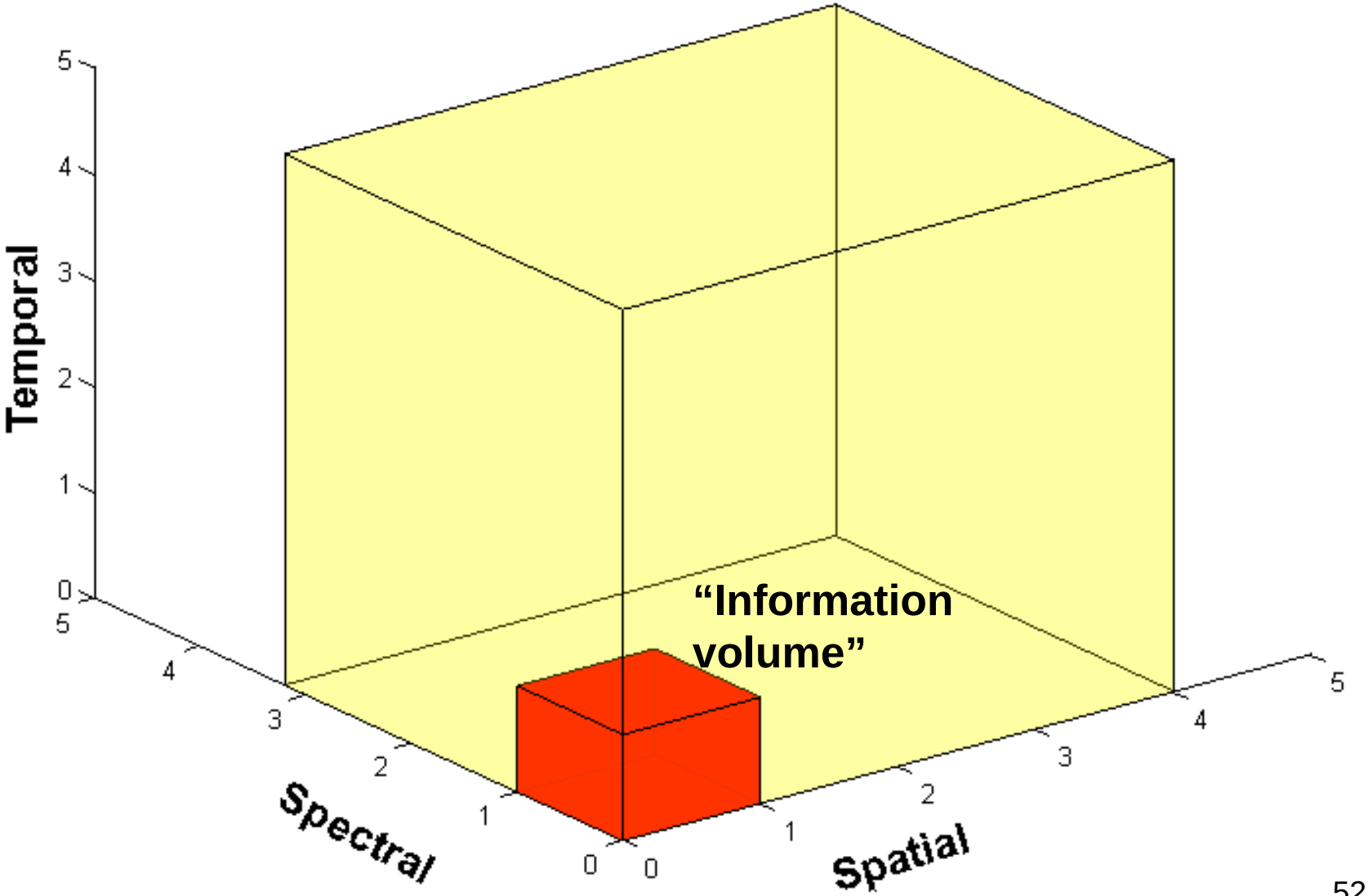
Overview

- GOES-14/15
- ABI (Advanced Baseline Imager)
  - Temporal
  - Spatial
  - Spectral
  - Imagery
- Summary
  - More information

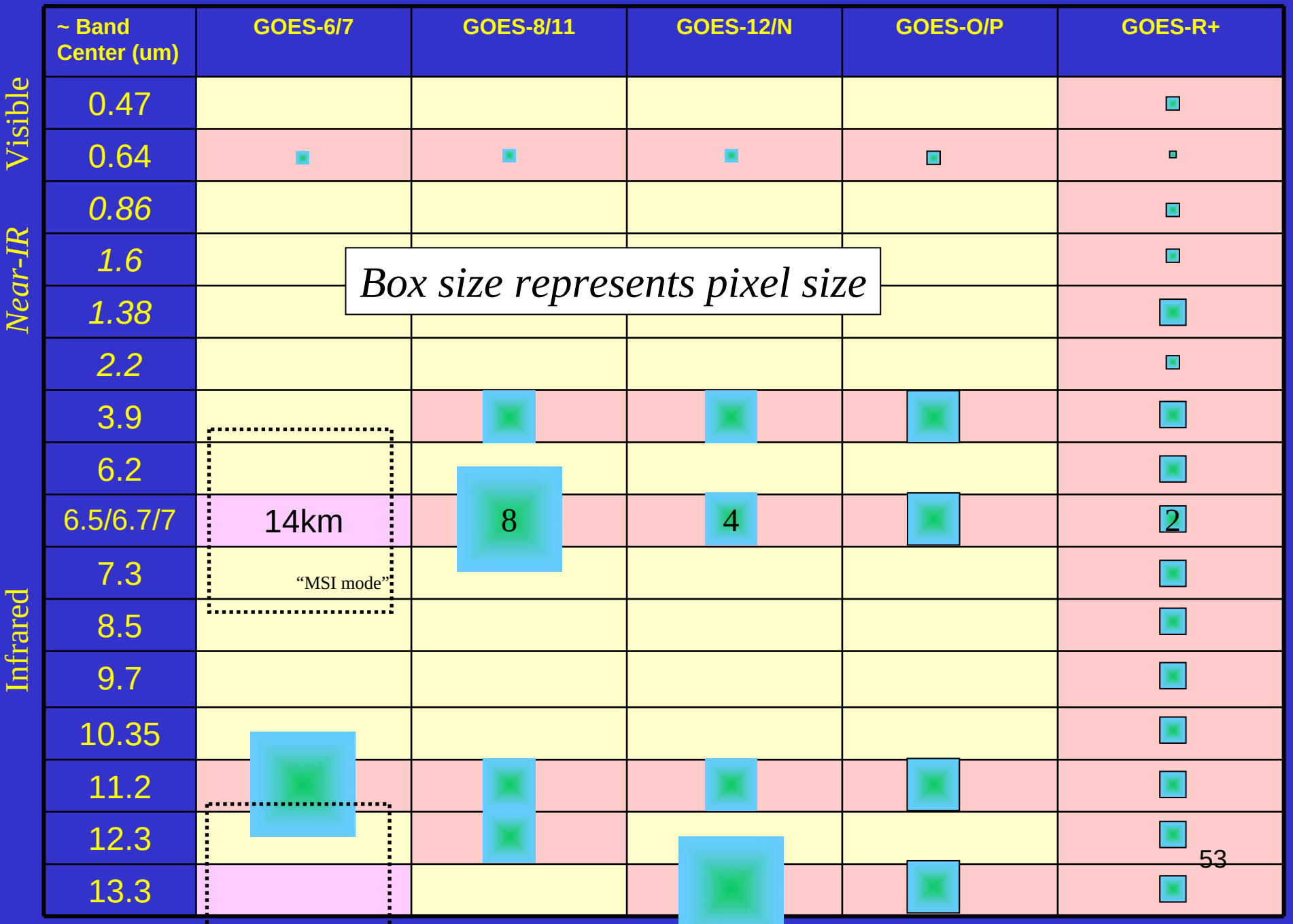


Lockheed Martin

Improved attributes with the Future GOES Imagers



Approximate spectral and spatial resolutions of US GOES Imagers



GOES-R Series End-Product List

Cloud & Moisture Imagery (KPP)	Lightning Det: Events, Flashes, Groups*	Upward Longwave Radiation: Surface
Radiances*	Energetic Heavy Ions*	Convective Initiation
Aerosol Detection (including Smoke & Dust)	Magnetospheric Electrons and Protons: Low Energy*	Enhanced "V"/ Overshooting Top Detection
Aerosol Optical Depth	Magnetospheric Electrons and Protons: Medium & High Energy*	Tropopause Folding Turbulence Prediction
Volcanic Ash: Detection & Height	Solar and Galactic Protons*	Upward Longwave Radiation: TOA
Cloud Optical Depth	Geomagnetic Field*	Absorbed Shortwave Rad.: Surface
Cloud Particle Size Distribution	Solar Flux: EUV*	Downward Longwave Rad.: Surface
Cloud Top Phase	Solar Flux: X-Ray*	Flood / Standing Water
Cloud Top Height	Solar Imagery: UV*	Ice Cover
Cloud Top Pressure	Aerosol Particle Size	Snow Depth (over Plains)
Cloud Top Temperature	Aircraft Icing Threat	Surface Albedo
Hurricane Intensity	Cloud Type	Surface Emissivity
Rainfall Rate / QPE	Ozone Total	Vegetation Fraction: Green
Legacy Vertical Moisture Profile	Visibility	Vegetation Index
Legacy Vertical Temperature Profile	Cloud Ice Water Path	Currents
Derived Stability Indices	Cloud Layers / Heights	Currents: Offshore
Total Precipitable Water	Cloud Liquid Water	Sea and Lake Ice: Age
Clear Sky Masks	SO_2 Detection	Sea and Lake Ice: Concentration
Downward Shortwave Rad.: Surface	Low Cloud and Fog	Sea and Lake Ice: Motion
Fire / Hot Spot Characterization	Reflected Shortwave Rad.: TOA	Probability of Rainfall
Land Surface (Skin) Temperature	Snow Cover	Rainfall Potential
Sea Surface Temperature (skin)	Derived Motion Winds	

ABI (Baseline Products)	GLM	SUVI
ABI (Option 2 Products)	EXIS	Magnetometer
SEISS	*** Included in GRB**	

More information

GOES-R:

- http://www.goes-r.gov
- http://www.meted.ucar.edu/index.htm
- http://cimss.ssec.wisc.edu/goes_r/proving-ground.html

GOES and NASA:

- http://goespoes.gsfc.nasa.gov/goes/index.html
- http://goes.gsfc.nasa.gov/text/goes.databookn.html

UW/SSEC/CIMSS/ASPB:

- http://cimss.ssec.wisc.edu/goes_r/awg/proxy/nwp/
- http://cimss.ssec.wisc.edu/goes/abi/
- http://cimss.ssec.wisc.edu/goes/abi/wf
- http://cimss.ssec.wisc.edu/goes/blog/
- http://www.ssec.wisc.edu/data/geo/

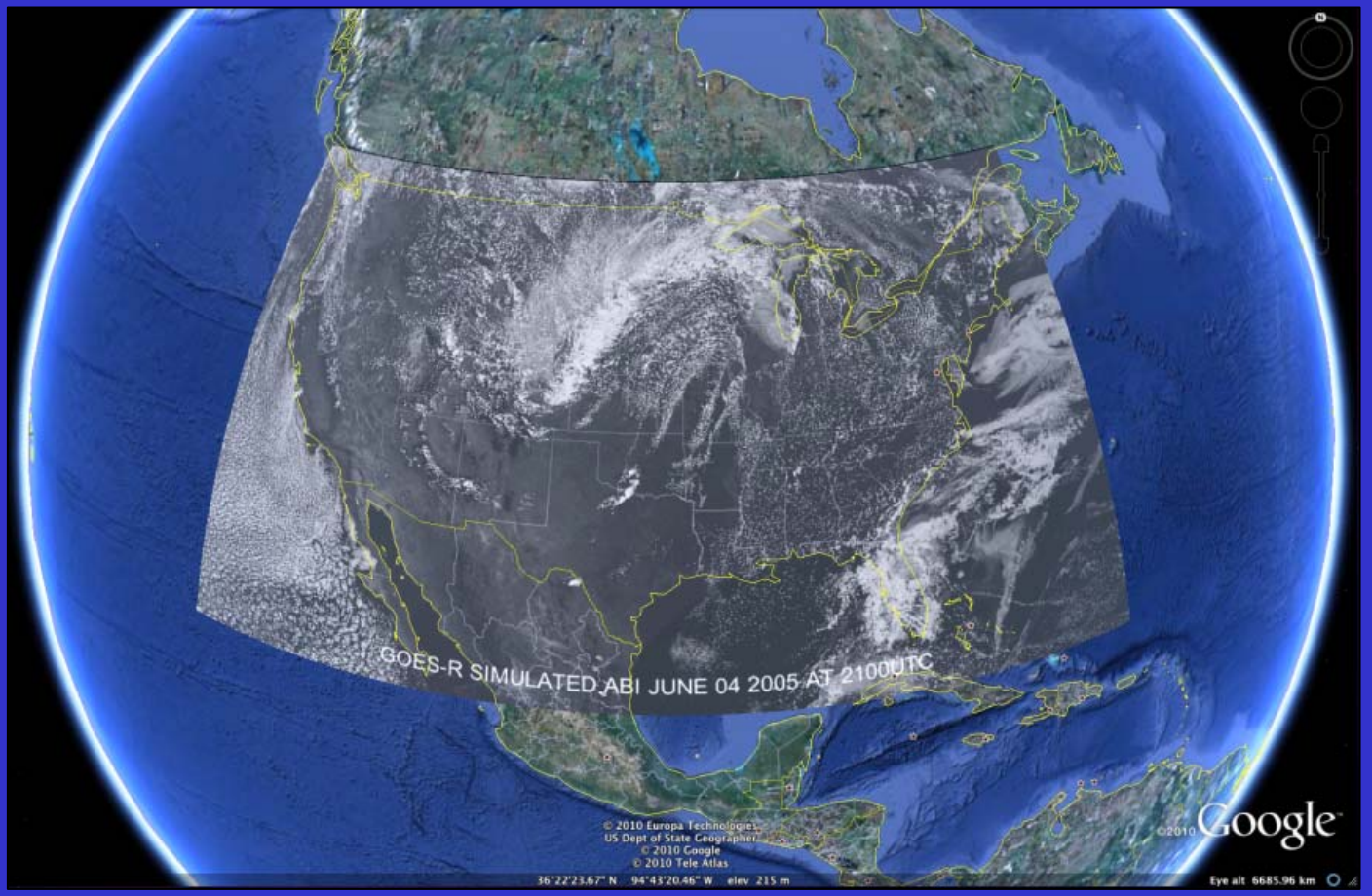

ARTICLES

INTRODUCING THE NEXT-GENERATION ADVANCED BASELINE IMAGER ON GOES-R

AMS BAMS Article on the ABI (Aug. 2005)

Google Earth

- Sample ABI simulated data are available in several formats (google earth, netcdf, McIDAS area & png):
  - *http://cimss.ssec.wisc.edu/goes/abi/loops/links.html*



Summary

- The ABI on GOES-R will improve over the current imager in many aspects (spectral, spatial, and temporal on orders of 3, 4 and 5, respectively), plus improved image navigation and registration and radiometer performance.
- These improvements will greatly assist a host of applications and new products.
- McIDAS will be key wrt visualization
- Contact information:
  - tim.j.schmit@noaa.gov

Acknowledgements

- The authors would like to thank the entire GOES-R team; both within the government, industry and academia.

- The views, opinions, and findings contained in this presentation are those of the authors and should not be construed as an official National Oceanic and Atmospheric Administration or U.S. Government position, policy, or decision.