USING MCIDAS TO PREPARE USERS FOR THE ABI

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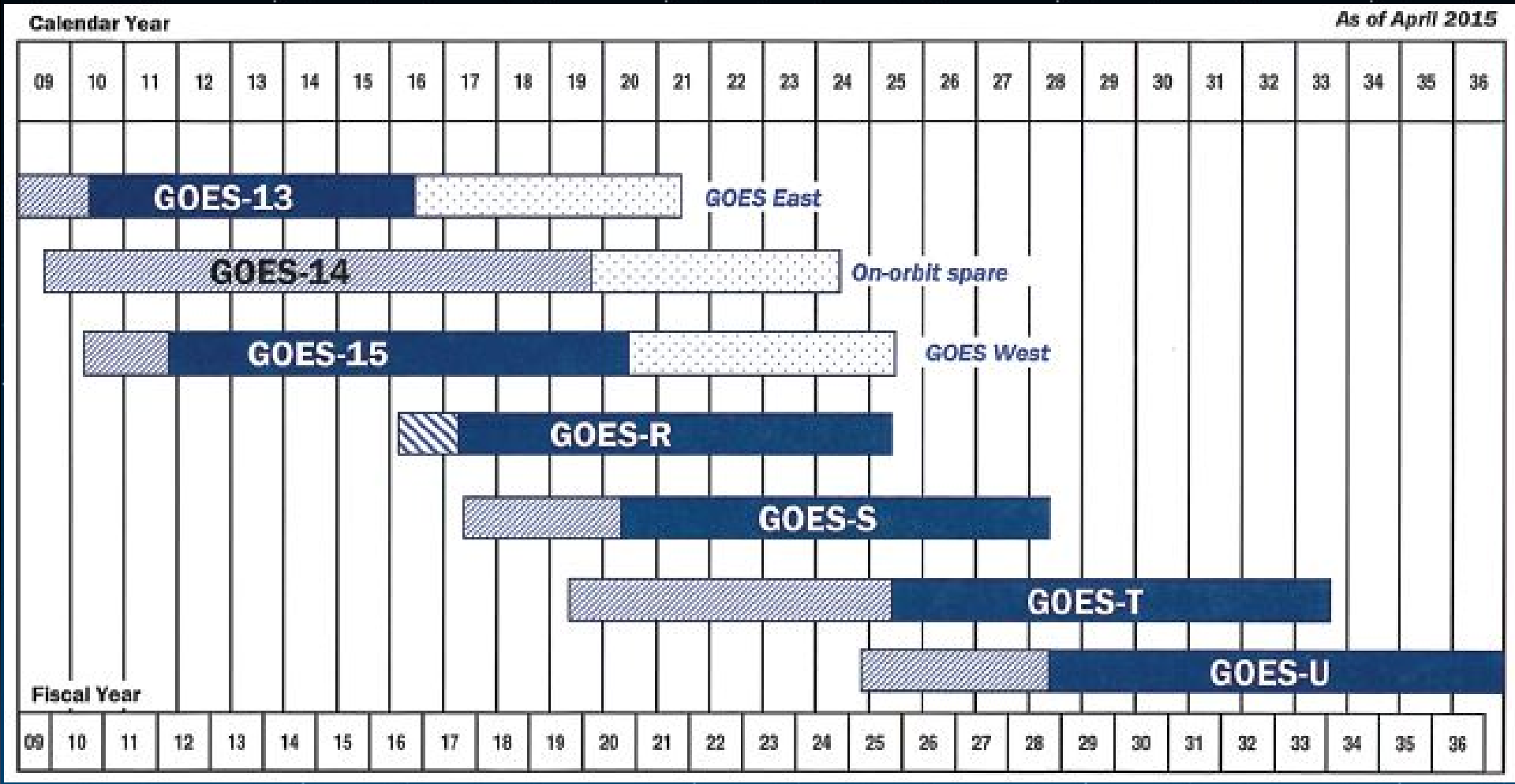
1. CIMSS/SSEC
2. NOAA/NESDIS/ASPB
3. Retired! Formerly CIMSS/SSEC

Overview

- GOES-R ABI represents a major shift in geostationary environmental satellite capability.
- We have developed some ABI "Webapps" - tools that anyone can use to educate users and students on a host of topics.
  - Spatial, Spectral, & Temporal Improvements of ABI.
  - RGB Generation
  - Uses of GOES data and Products.
    - Fires, hurricanes, convection, fog, winds, etc.
- We are prolific McIDAS users both "operationally" but also for image generation going into educational applications and as a hands-on tool.

GOES Flyout Chart



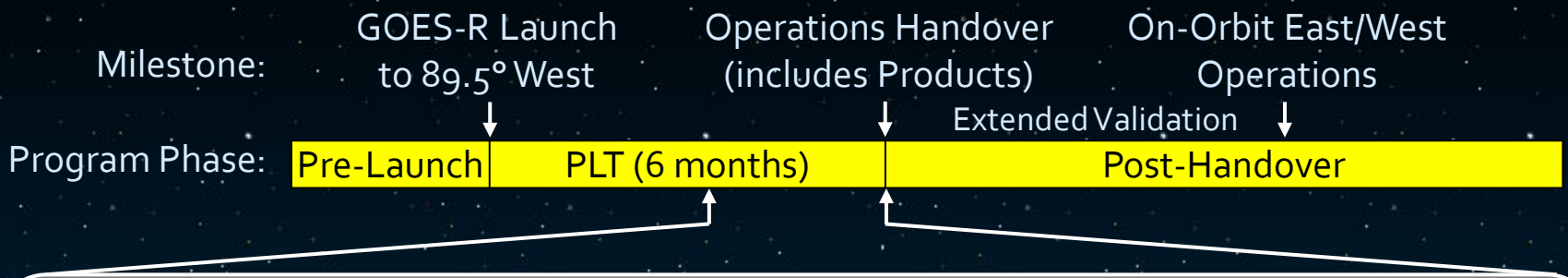
Approved: 4/21/2015
Assistant Administrator for Satellite and Information Services

GOES: Geostationary Operational Environmental Satellite

- On-orbit Storage
- Test & Checkout
- Operational
- Fuel-Limited Lifetime

CIMSS

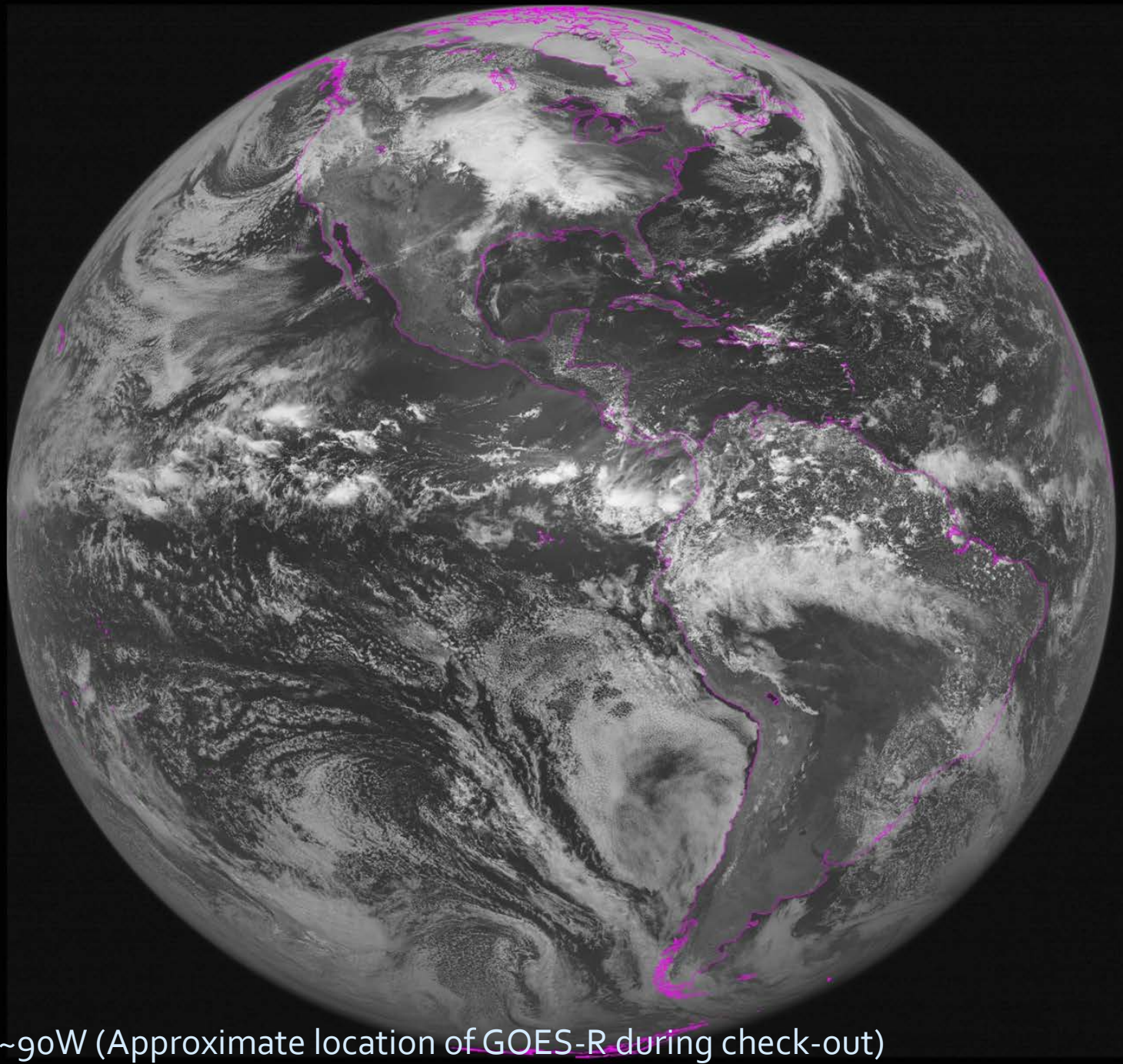
Validation and Availability for GOES-R Baseline Products



L1b Product Activities

- L1b Validation - Products recertified against pre-launch instrument performance
- 'First Light' Data captures shared from Instruments
- Insertion of L1b products into GRB service is controlled by ground system and will occur as products are certified

- (Figure from Matt Seybold from NOAA Satellite Conference)



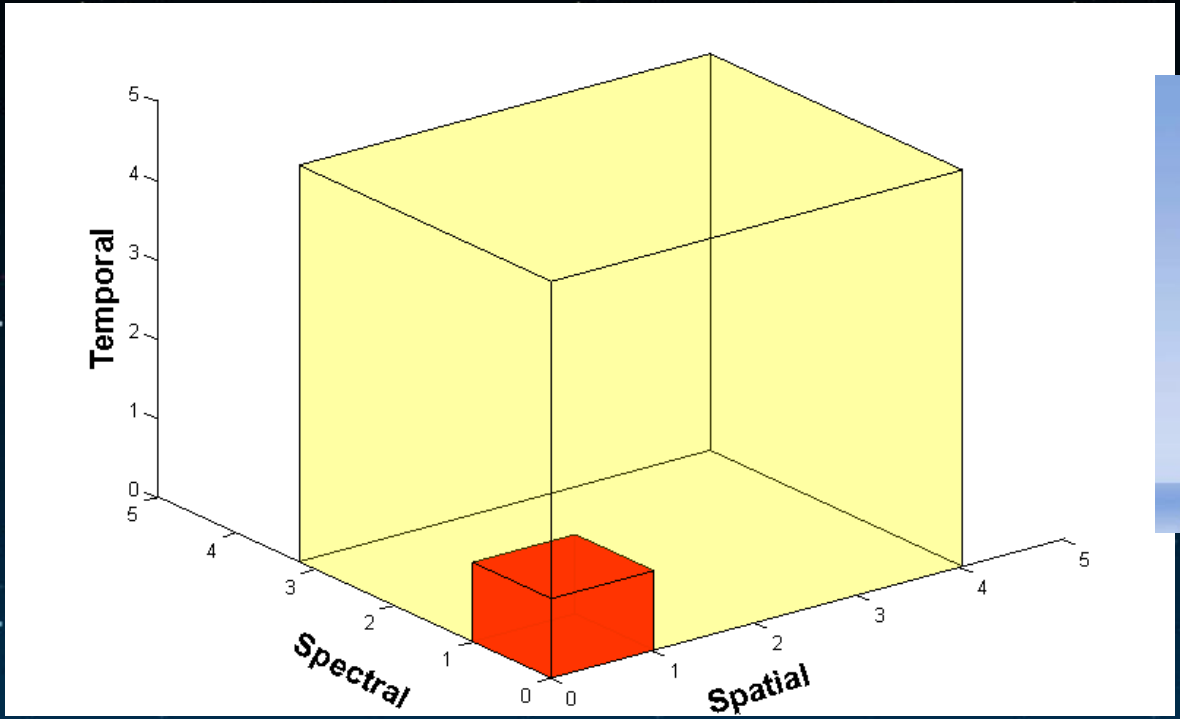
~90W (Approximate location of GOES-R during check-out)

The Advanced Baseline Imager:

	ABI	Current
Spectral Coverage		
	16 bands 6 VIS/NIR & 10 IR	5 bands 1 VIS & 4 IR
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/Temporal Coverage		
Full disk	Every 15 min	Scheduled (3 hrly)
CONUS	Every 5 min	~4 per hour
Mesoscale	Every 30 sec	n/a
Visible (reflective bands)		
On-orbit calibration	Yes	No

CIMSS

Advanced Baseline Imager

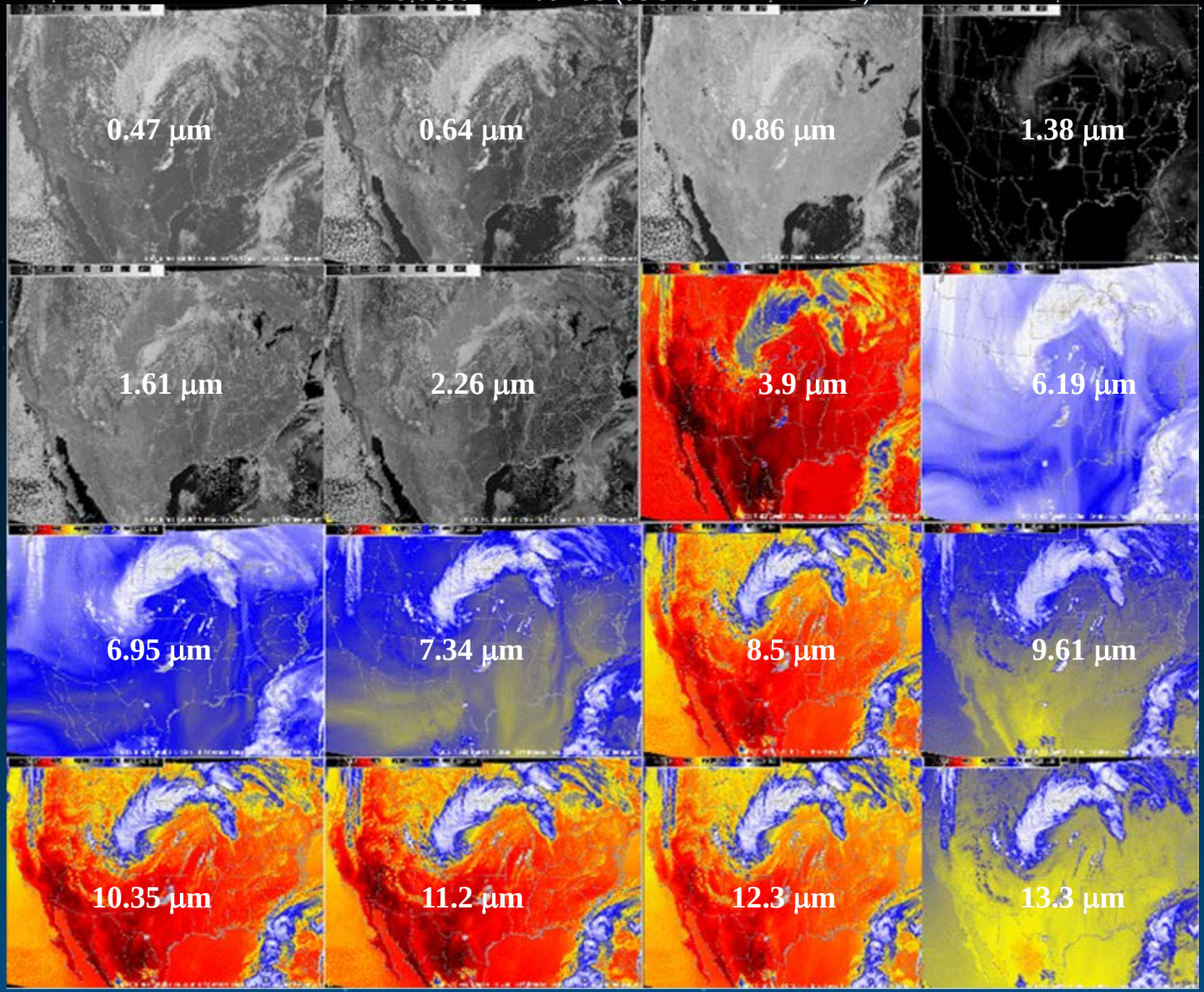


5X Faster coverage (5-minute full disk vs. 25-minute)

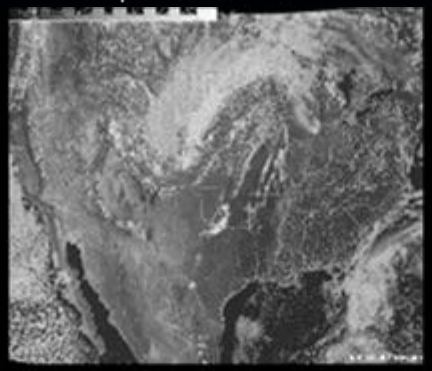
4X Improved spatial resolution (2 km IR vs. 4 km)

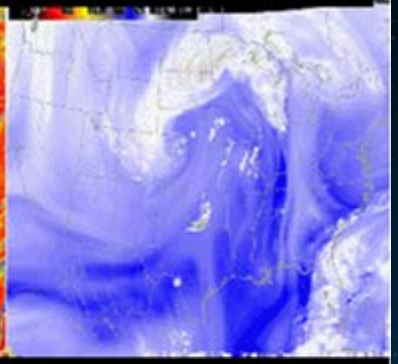
3X More spectral bands (16 on ABI vs. 5 on the current imager)

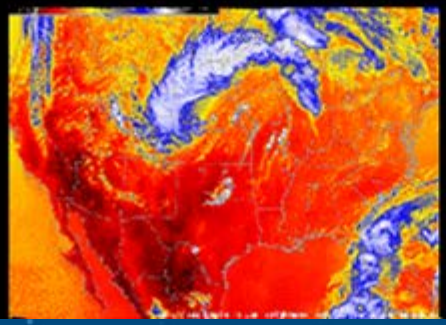
Simulated ABI bands (as shown in AWIPS)

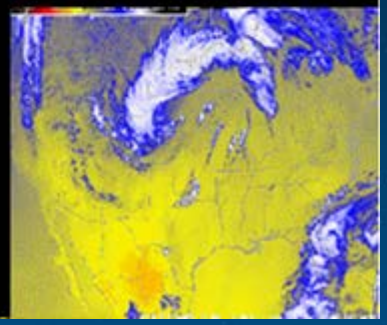


Current GOES Imager band selection









ABI bands 1-6

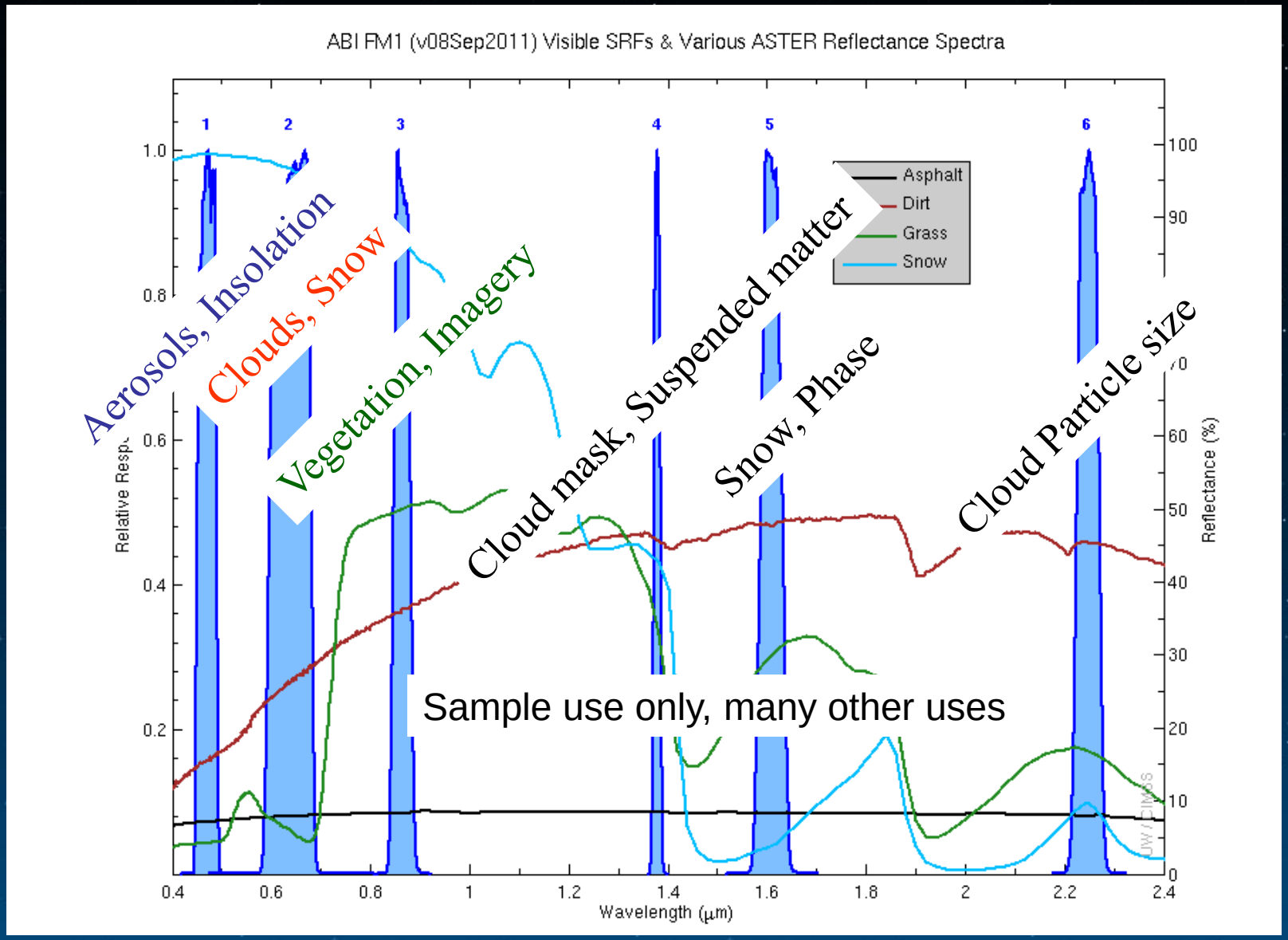
Approximate:

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

2 visible bands and 4 near infrared bands on the ABI, compared to only one on today's imager

CIMSS

Visible and near-IR channels on the ABI



The ABI visible and near-IR bands have many uses.

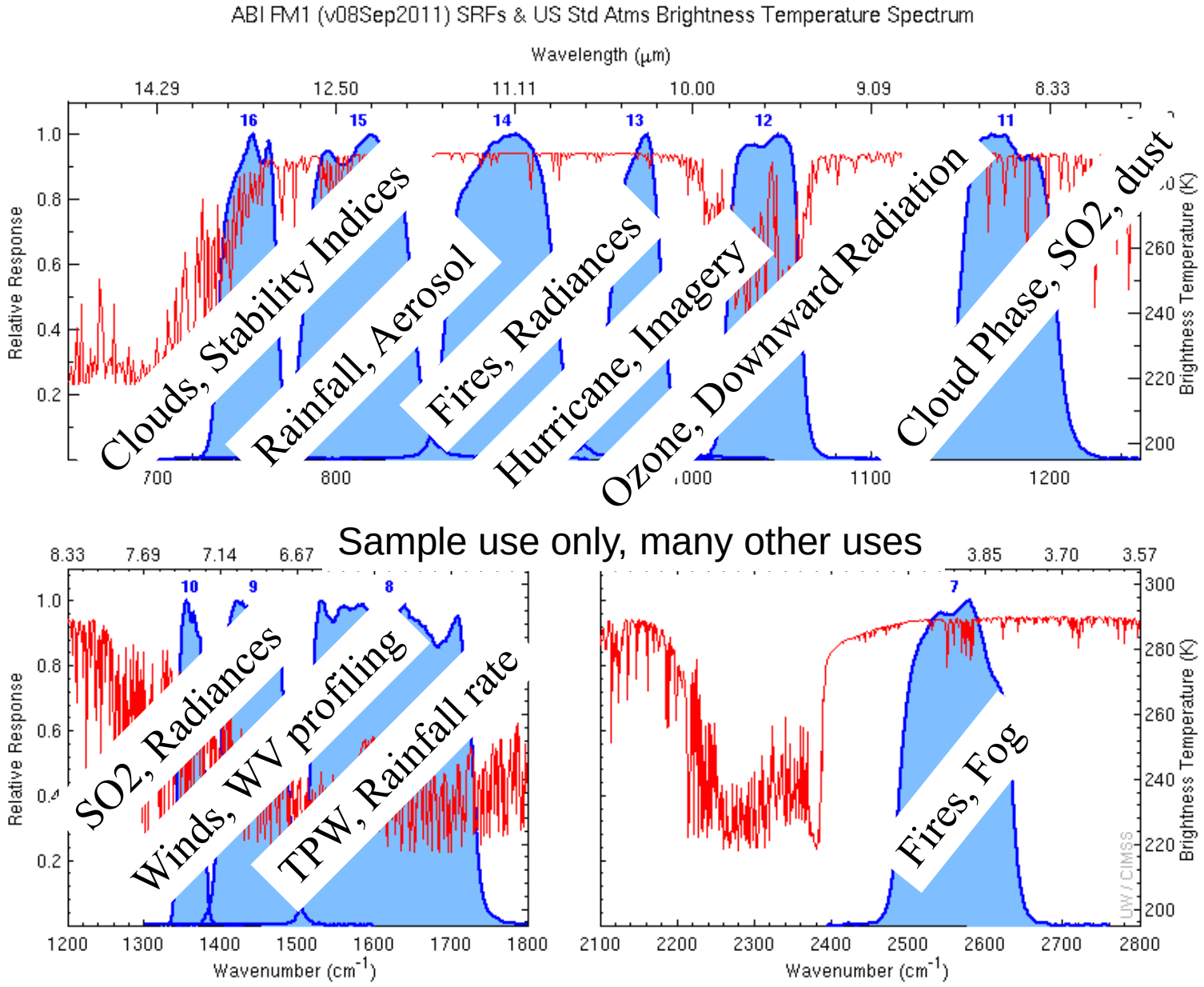
ABI bands 7-16

Future GOES imager (ABI) band	Wavelength range (μm)	Central wavelength (μm)	Nominal subsatellite IGFOV (km)	Sample use	Heritage instrument(s)
7	3.80–4.00	3.90	2	Surface and cloud, fog at night, fire, winds	Current GOES imager
8	5.77–6.6	6.19	2	High-level atmospheric water vapor, winds, rainfall	Current GOES imager
9	6.75–7.15	6.95	2	Midlevel atmospheric water vapor, winds, rainfall	Current GOES sounder
10	7.24–7.44	7.34	2	Lower-level water vapor, winds, and SO_2	Spectrally modified current GOES sounder
11	8.3–8.7	8.5	2	Total water for stability, cloud phase, dust, SO_2 rainfall	MAS
12	9.42–9.8	9.61	2	Total ozone, turbulence, and winds	Spectrally modified current sounder
13	10.1–10.6	10.35	2	Surface and cloud	MAS
14	10.8–11.6	11.2	2	Imagery, SST, clouds, rainfall	Current GOES sounder
15	11.8–12.8	12.3	2	Total water, ash, and SST	Current GOES sounder
16	13.0–13.6	13.3	2	Air temperature, cloud heights and amounts	Current GOES sounder/ *GOES-12+* imager

Approximate:

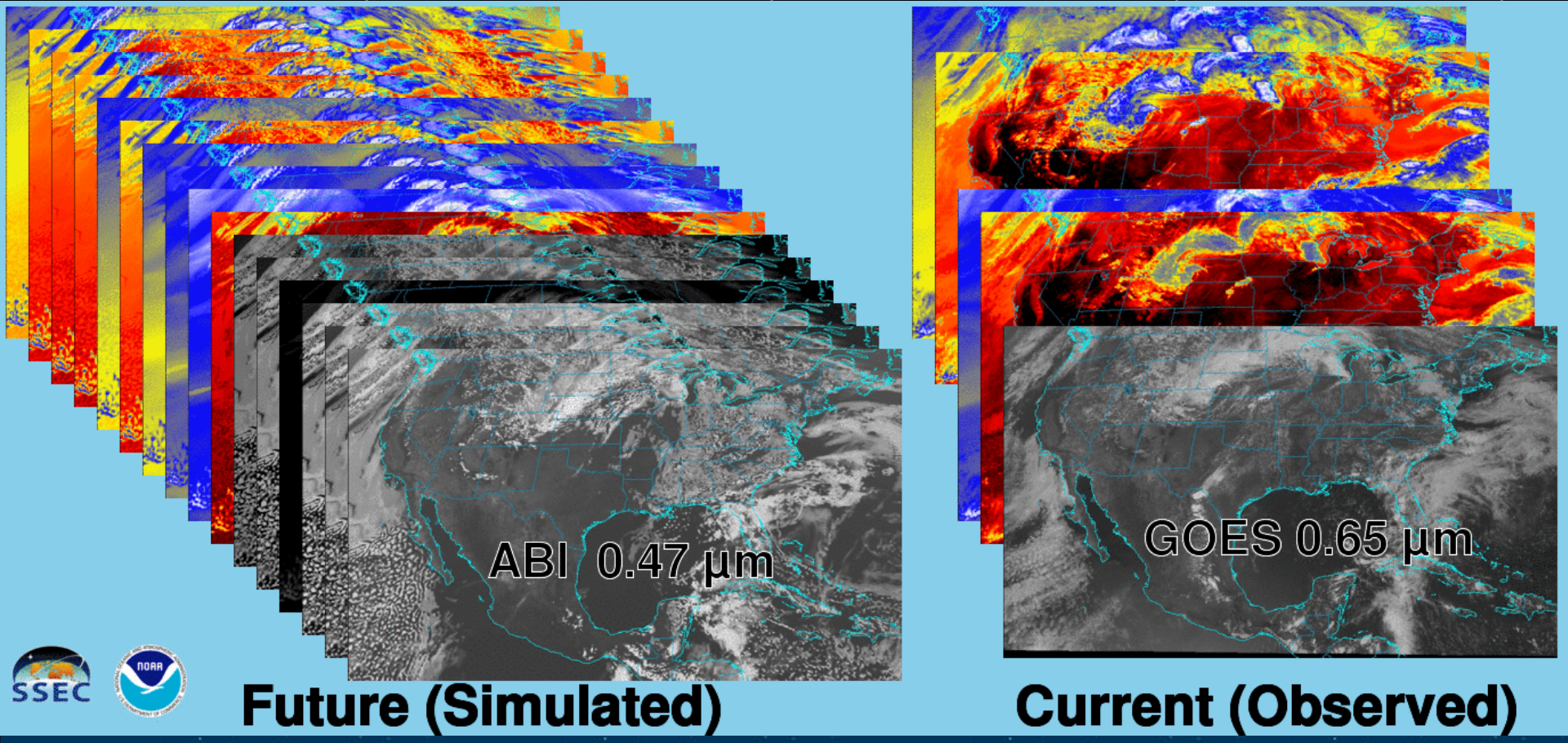
10 infrared bands on the ABI, compared to four on today's imager

The IR channels on the ABI



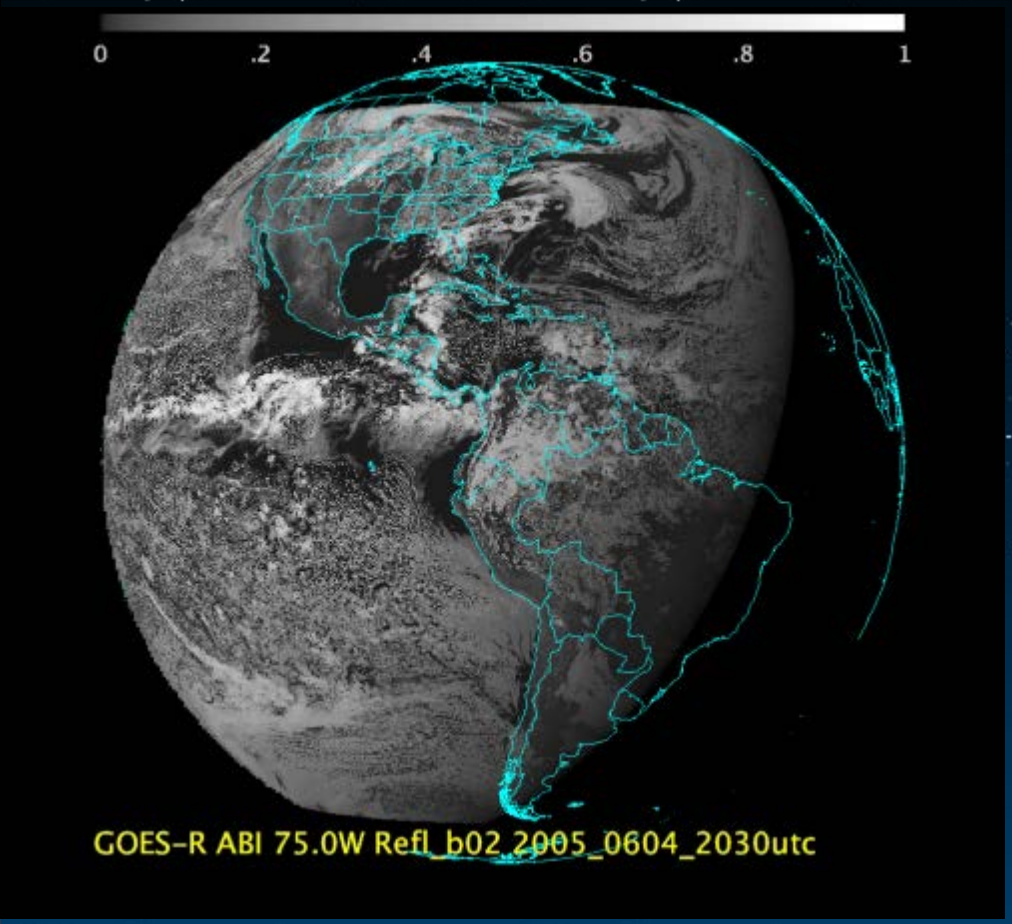
ABI has many more bands than the current operational GOES imagers.

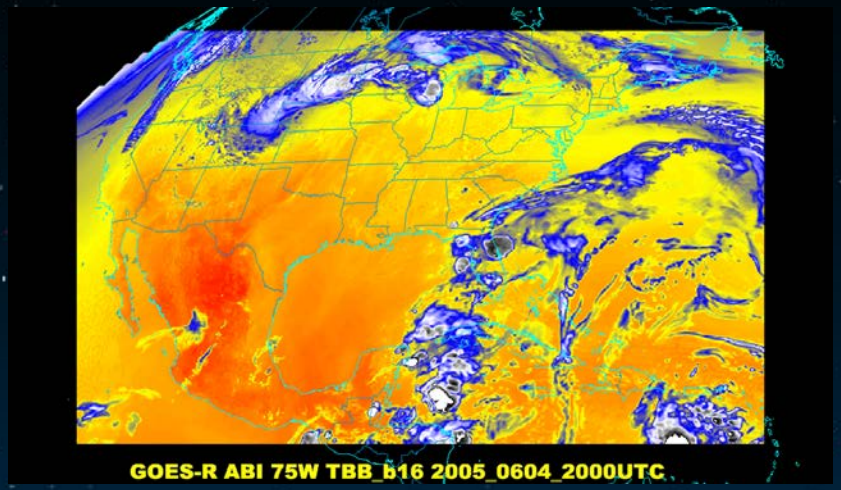
Future vs. Current Spectral Bands

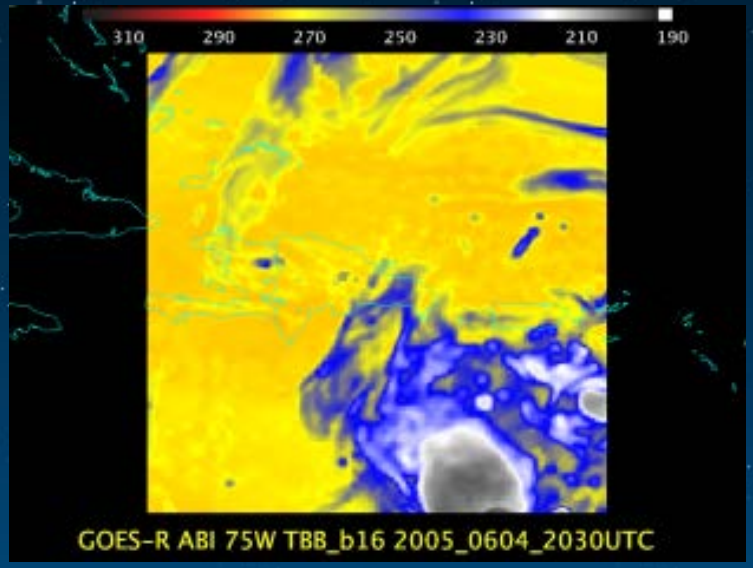


The current GOES (right) has 5 spectral bands, while the GOES-R series ABI (left) will have 16 spectral bands.

Baseline ABI Scan Modes







Scan mode (3) or 'flex mode' for the ABI:
- Full disk every 15 minutes + 5 min CONUS
  + 1-min mesoscales (2 locations).

[Scan mode (4) or 'Continuous Full Disk' (CFD) is a full disk every 5 min]

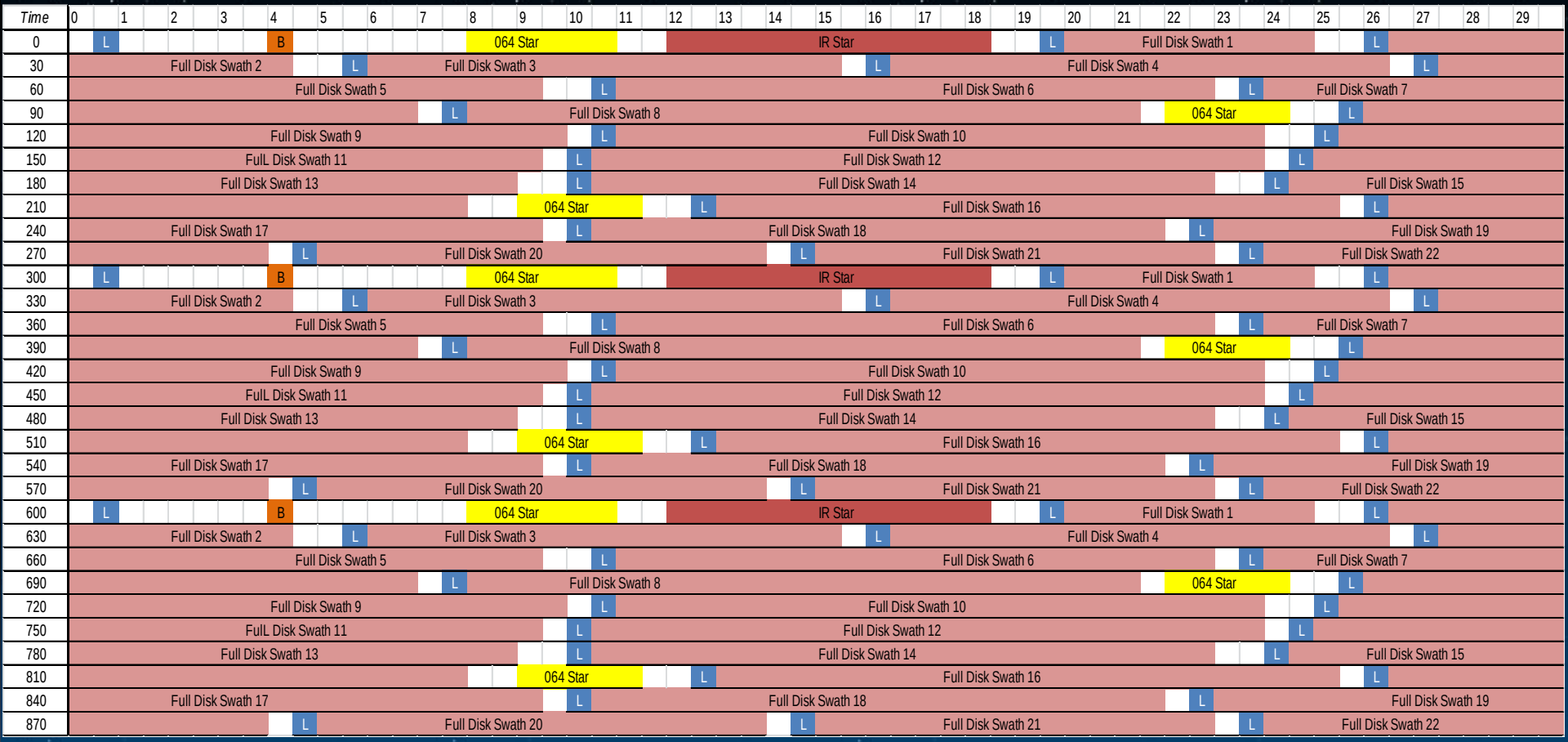
Recent Mode 3 (Flex mode) "Time-Time" chart

Time	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
0		L				B			064 Star				064 Star				IR Star									Meso 1 -1			Meso 1 -2	
30						L		Full Disk Swath 1																		Meso 2 -1			Meso 2 -2	
60					L			Full Disk Swath 2							IR Star											Meso 3 -1			Meso 3 -2	
90				L				Full Disk Swath 3							064 Star				064 Star							Meso 4 -1			Meso 4 -2	
120			L					Full Disk Swath 4									CONUS 1 - Swath 1									Meso 5 -1			Meso 5 -2	
150				L				Full Disk Swath 5									CONUS 1 - Swath 2									Meso 6 -1			Meso 6 -2	
180					L			Full Disk Swath 6									CONUS 1 - Swath 3									Meso 7 -1			Meso 7 -2	
210					L			Full Disk Swath 7									CONUS 1 - Swath 4									Meso 8 -1			Meso 8 -2	
240			L					Full Disk Swath 8									CONUS 1 - Swath 5									Meso 9 -1			Meso 9 -2	
270			L					Full Disk Swath 9									CONUS 1 - Swath 6									Meso 10 -1			Meso 10 -2	
300			L					Full Disk Swath 10									064 Star			064 Star						Meso 11 -1			Meso 11 -2	
330			L					Full Disk Swath 11									064 Star			064 Star						Meso 12 -1			Meso 12 -2	
360			L					Full Disk Swath 12									IR Star									Meso 13 -1			Meso 13 -2	
390			L					Full Disk Swath 13									064 Star			064 Star						Meso 14 -1			Meso 14 -2	
420			L					Full Disk Swath 14									CONUS 2 - Swath 1									Meso 15 -1			Meso 15 -2	
450			L					Full Disk Swath 15									CONUS 2 - Swath 2									Meso 16 -1			Meso 16 -2	
480				L				Full Disk Swath 16									CONUS 2 - Swath 3									Meso 17 -1			Meso 17 -2	
510				L				Full Disk Swath 17									CONUS 2 - Swath 4									Meso 18 -1			Meso 18 -2	
540					L			Full Disk Swath 18									CONUS 2 - Swath 5									Meso 19 -1			Meso 19 -2	
570						L		Full Disk Swath 19									CONUS 2 - Swath 6									Meso 20 -1			Meso 20 -2	
600					L			Full Disk Swath 20							064 Star				064 Star						Meso 21 -1			Meso 21 -2	
630						L		Full Disk Swath 21							064 Star				064 Star						Meso 22 -1			Meso 22 -2	
660							L	Full Disk Swath 22							IR Star											Meso 23 -1			Meso 23 -2	
690		L						IR Star							IR Star											Meso 24 -1			Meso 24 -2	
720		L						064 Star					064 Star				CONUS 3 - Swath 1									Meso 25 -1			Meso 25 -2	
750		L															CONUS 3 - Swath 2									Meso 26 -1			Meso 26 -2	
780		L															CONUS 3 - Swath 3									Meso 27 -1			Meso 27 -2	
810		L						064 Star					064 Star				CONUS 3 - Swath 4									Meso 28 -1			Meso 28 -2	
840		L															CONUS 3 - Swath 5									Meso 29 -1			Meso 29 -2	
870		L															CONUS 3 - Swath 6									Meso 30 -1			Meso 30 -2	

Note the 'white' space is instrument idle time.

Draft

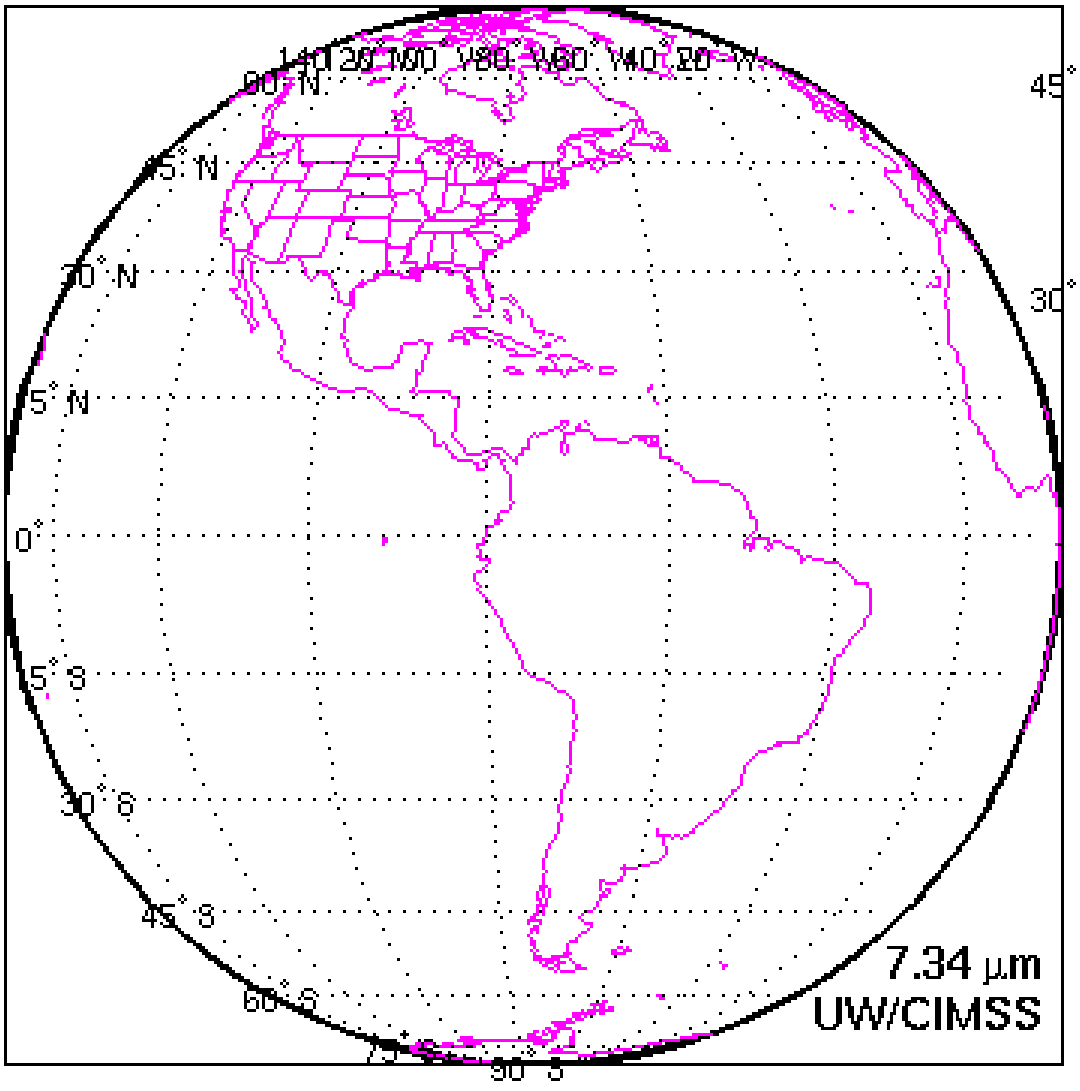
Baseline Time-Time Mode 4 (Continuous Full Disk)

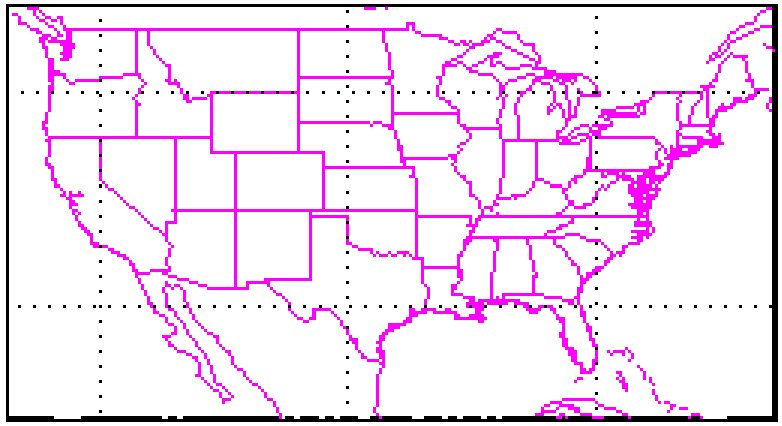


This is the Continuous Full Disk (every 5 min) mode

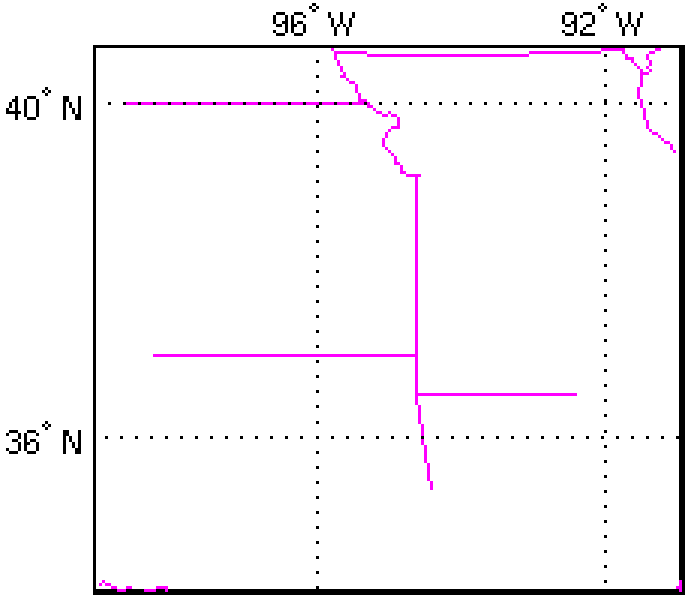
This is the highest data rate.

4 JUNE 2005
23:00:00.000 UTC





CONUS



MESOSCALE

Draft Scan Mode "6" with 10-min FD

- In **10**-min:
  - 1 Full Disk +
  - 2 CONUS +
  - 20 Meso-scale

- The 10-min Full Disk would offer synergy with other geos and improved AMVs outside of CONUS, plus still allow for meso-scale observations.

- This draft mode 6 ideally could be tested during PLPT (Post Launch Products Test).

- This mode should be easier to implement at the Ground System, sense the scan sectors are the same size/locations as in mode 3.

DRAFT!

Draft Scan Mode "6" with 10-min FD

NOTE : This depiciton of the timeline is only to 1/10 sec. resolution.

Figure 1 Scan Mode 6 Time-Time Diagram

Note less 'white space' than scan mode 3 (flex mode)
Matches EUMETSAT, JMA, and others for full disk cadence

Time-time diagram from Exelis

GOES-14 Super Rapid Scan Operations to Prepare for GOES-R (SRSOR)

SRSOR for 2015 include May 18-June 12, and August 10-22:

http://cimss.ssec.wisc.edu/goes/srsor2015/GOES-14_SRSOR.html

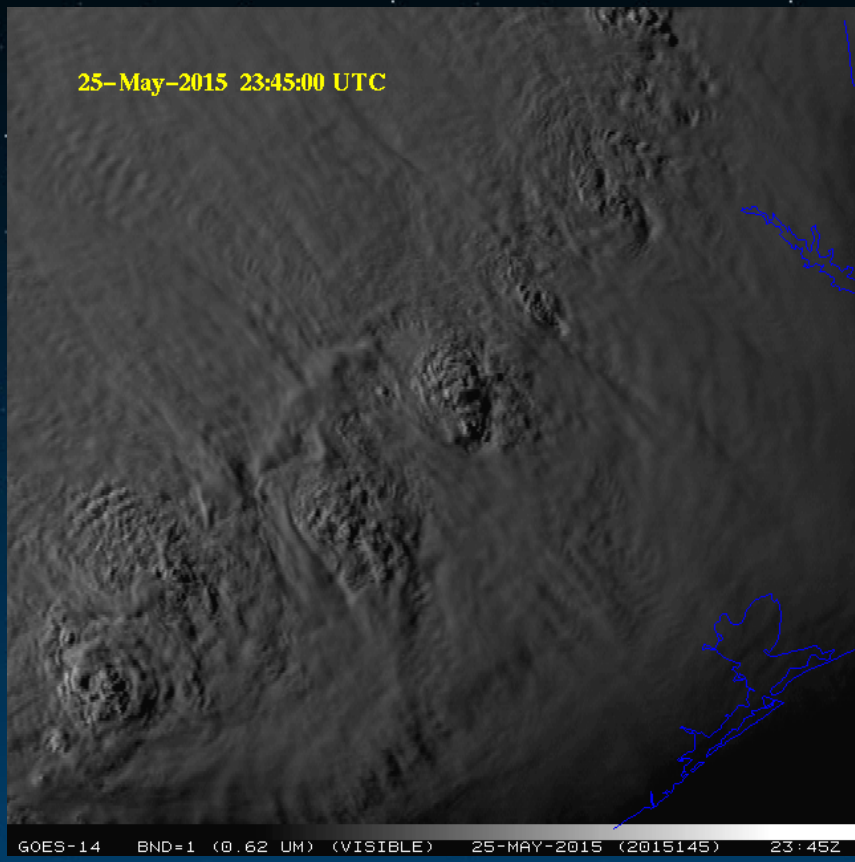
Data during parts of 2012 (Hurricane Sandy, convection), 2013 (CA Rim Fire, convection) and 2014 (Hurricane Marie, convection):

http://cimss.ssec.wisc.edu/goes/srsor/GOES-14_SRSOR.html

http://cimss.ssec.wisc.edu/goes/srsor2013/GOES-14_SRSOR.html

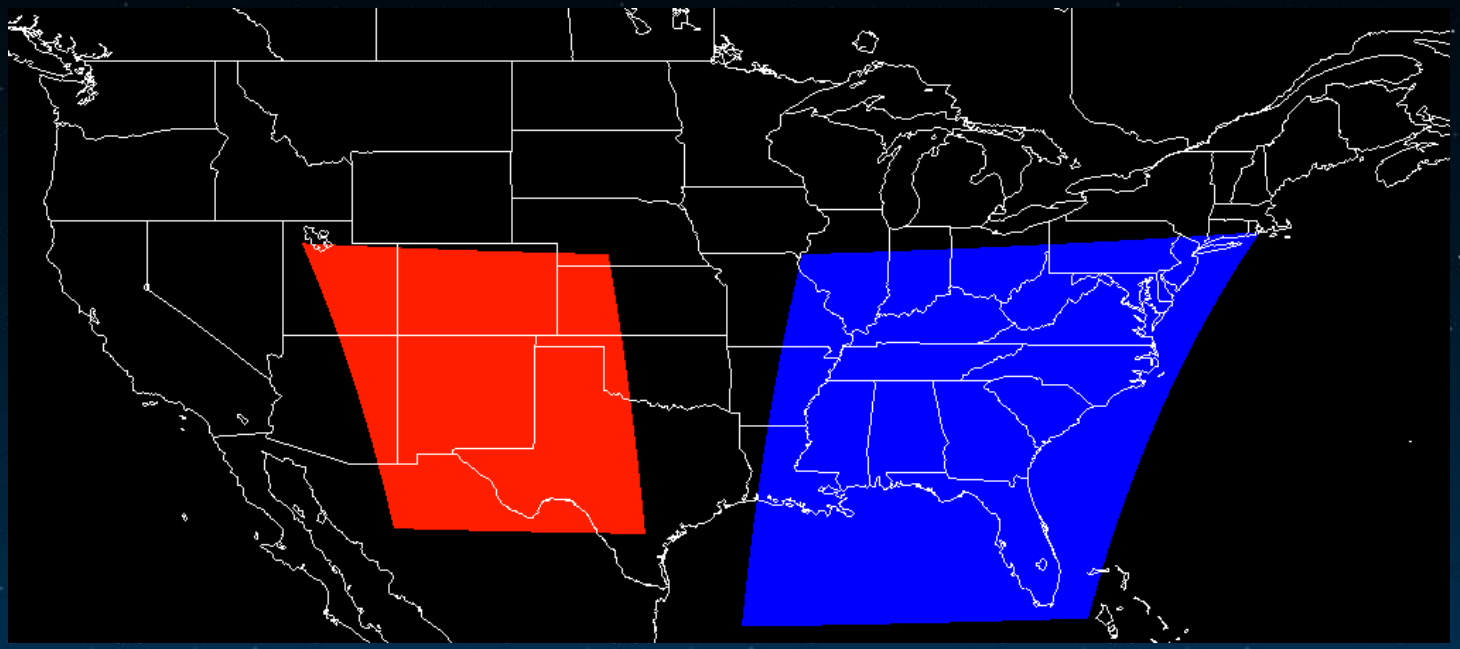
http://cimss.ssec.wisc.edu/goes/srsor2014/GOES-14_SRSOR.html

GOES-14 provided very unique data and offered a glimpse into the possibilities that will be provided by the ABI on GOES-R in one minute mesoscale imagery



GOES-14 visible image showing rapid convection (loops over just half an hour)

SRSOR vs Meso



GOES-R ABI (Meso)
1 per minute for 2 locations
Operational
(with FD + CONUS)

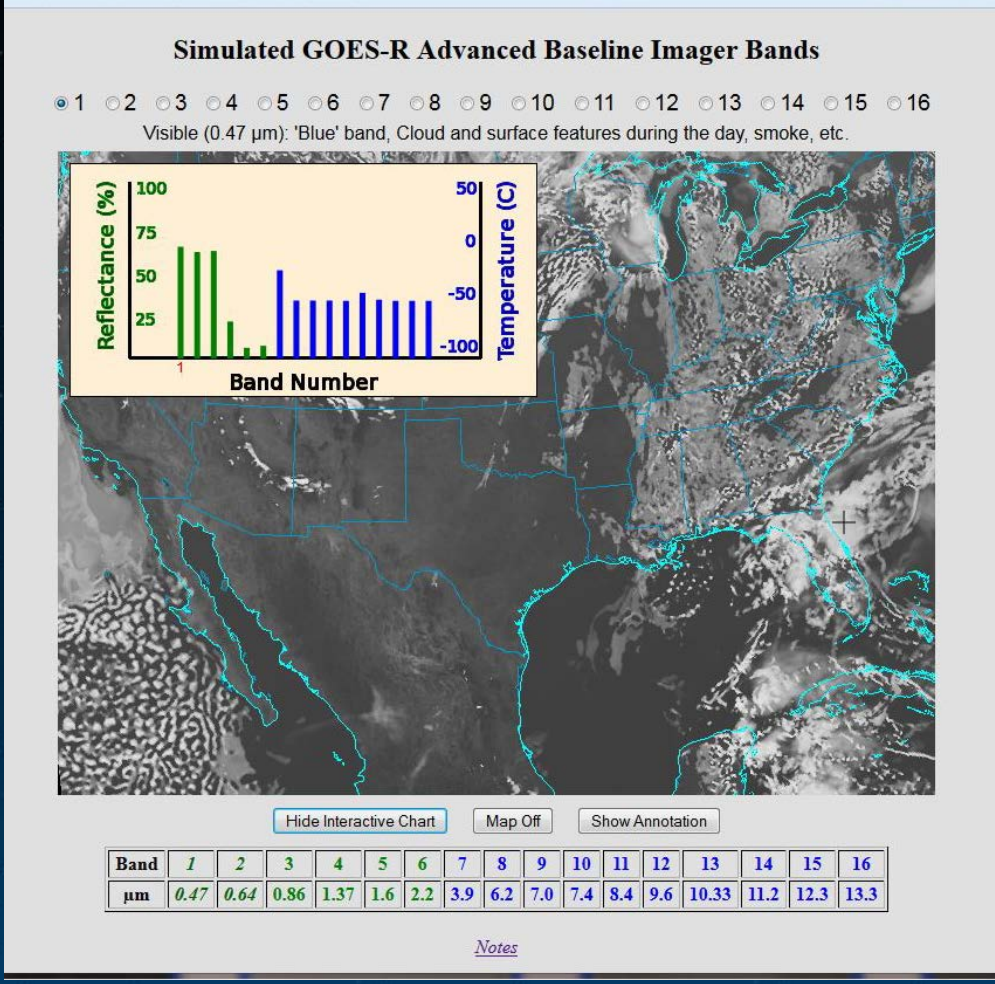
GOES (SRSOR)
~1 per minute
Experimental
(no other imagery)

Educational Webapps Developed

- NOAA NESDIS ASPB teamed up with CIMSS researchers to develop three educational WebApps to explore space, time and spectral resolutions of satellite imagery.

- Part of the **GOES-R Educational Proving Ground at CIMSS:**
- *http://cimss.ssec.wisc.edu/education/goesr*

- Teacher feedback:
  "…. Wow!! This is awesome!! This is impressive. Thank you for sharing. This is great. Thanks for all your hard work and help!!!!
  We are honored and will use it next week … Earth SySTEM Teacher Academy"



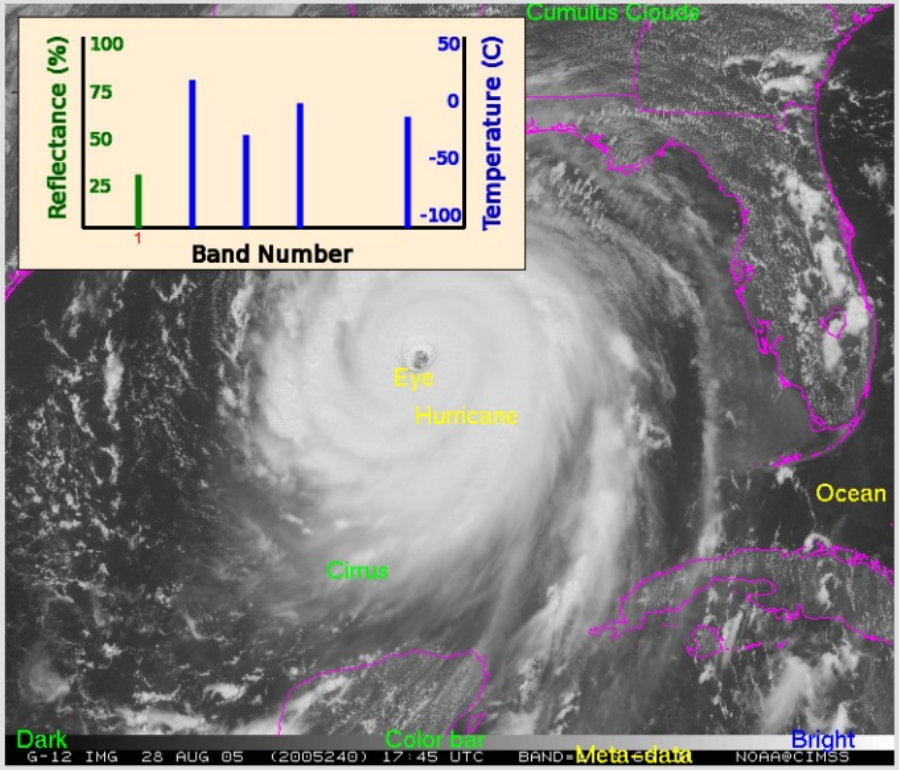
Sample interactive "Bandapp" educational webapp using simulated ABI images: *http://cimss.ssec.wisc.edu/goes/webapps/bandapp/*

There are also several case studies using current GOES imagery (5 spectral bands) with the option to add descriptive annotations, or add map outlines.

GOES Imager Bands

1 2 3 4 6

Visible band (0.63 μm): Cloud cover and surface features during the day, smoke, etc.



Hide Interactive Chart | Map Off | Hide Annotation

Band	1	2	3	4	5	6
μm	0.63	3.9	6.5	10.7	N/A	13.3

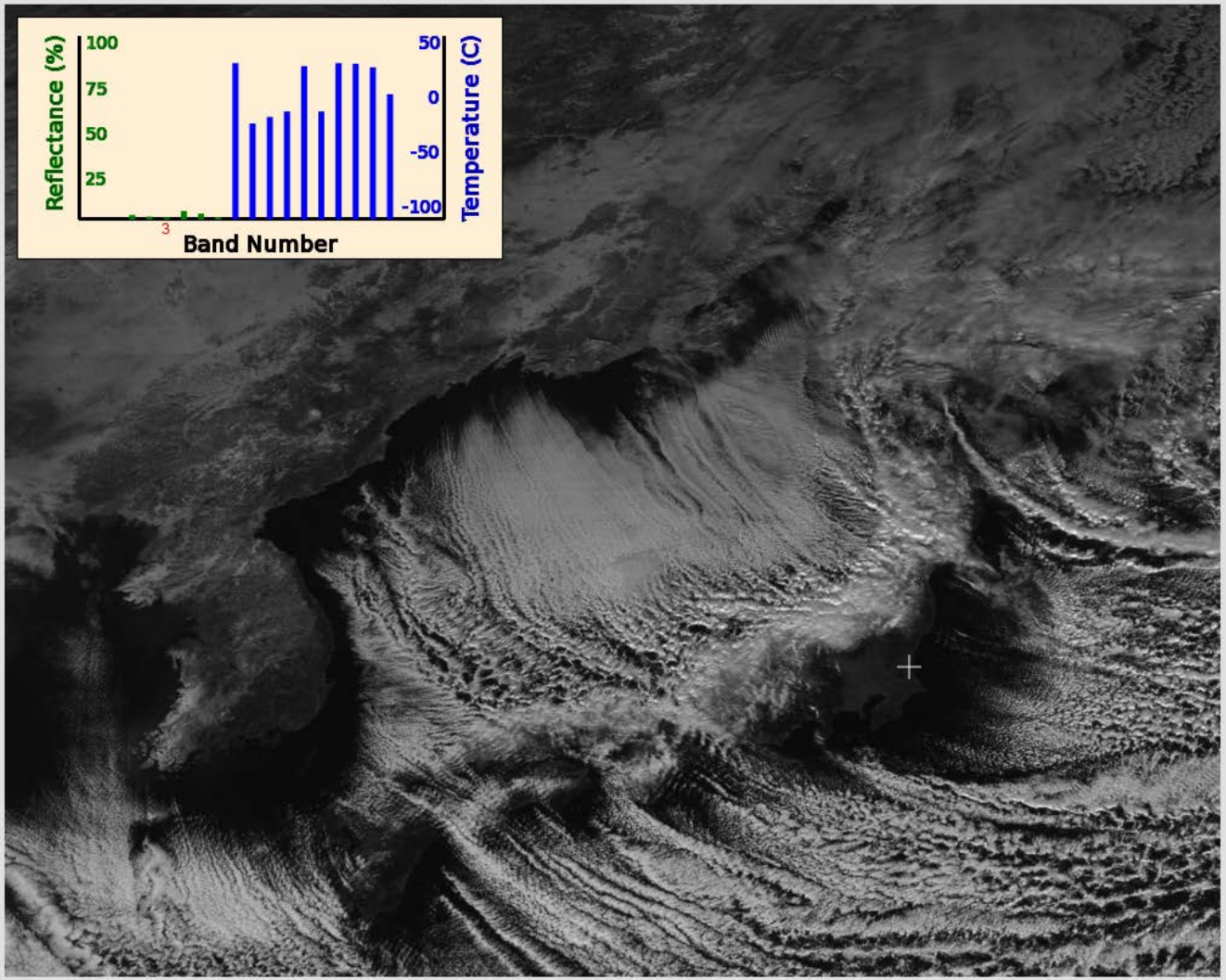
Notes

Controls:

- To step through the **bands** click on the image, click one of the radio buttons, or use the arrow keys
- To **activate** the Interactive Chart: click the show button
- To **move** the Interactive Chart: drag to other positions within or touching the main image

Band=val at x=15, y=70 1=138/29 2=92/11 3=152/-34 4=130/-8 6=152/-19

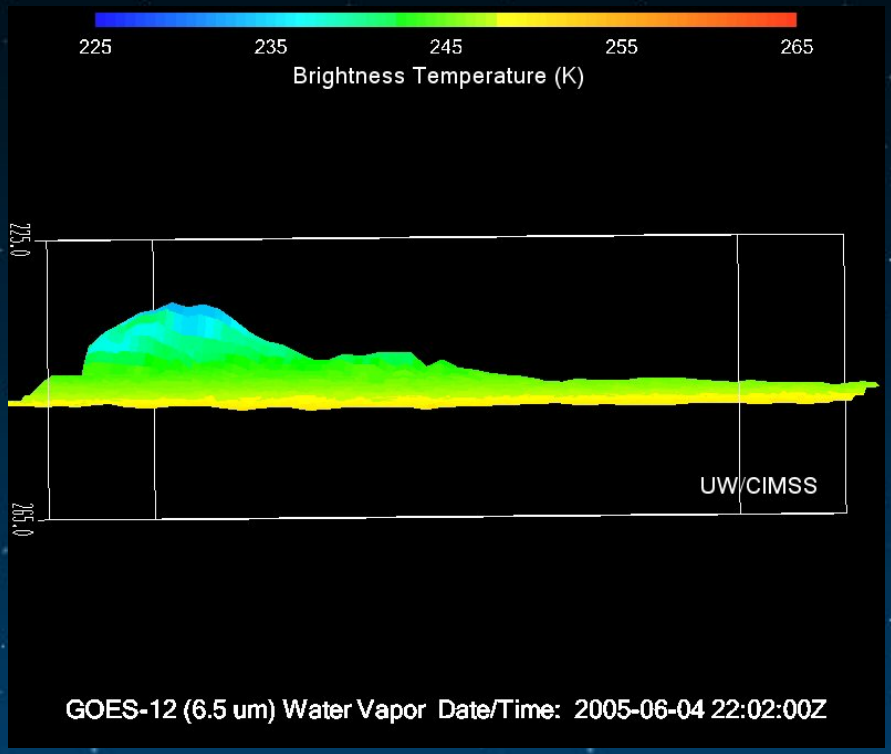
Mouse over anywhere in the image to get an interactive pop-up chart that provides data (reflectance & temperature) for each band at that location.



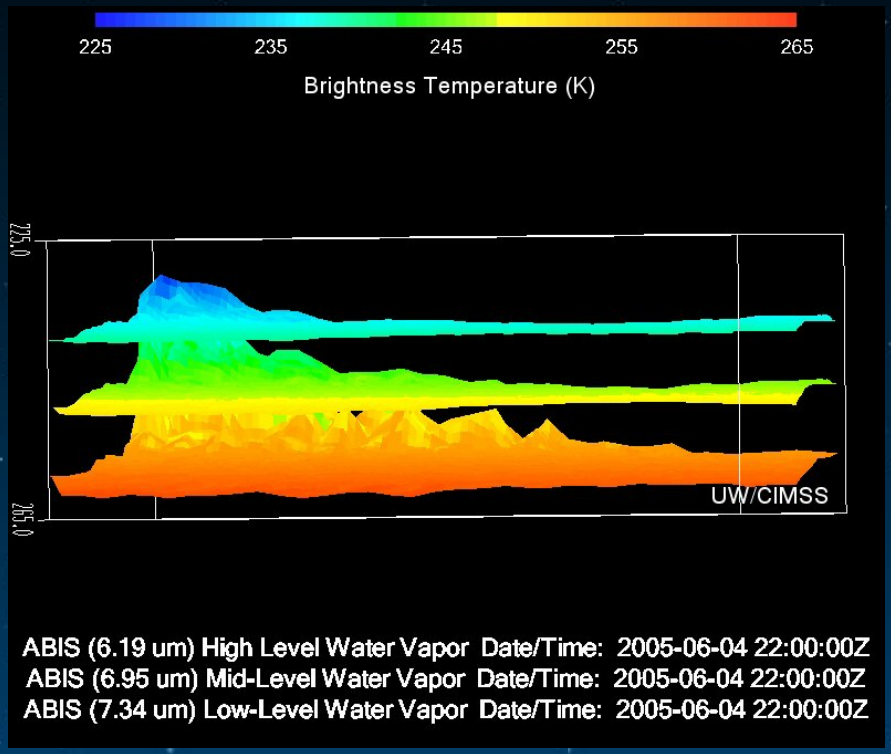
Hands-on…Spectral

- Step through the ABI spectral bands (and turn on the interactive chart)
  - One of the simulated cases
  - http://cimss.ssec.wisc.edu/education/apps/bandapp/overview_goes-r.html
  - or
  - http://cimss.ssec.wisc.edu/goes/webapps/bandapp/
- Or step through the AHI spectral bands (and turn on the interactive chart)
  - One of the observed cases
  - http://cimss.ssec.wisc.edu/education/apps/bandapp/overview_ahi_first_images.html
  - or
  - http://cimss.ssec.wisc.edu/goes/webapps/bandapp/overview_ahi_first_images.html

Three ABI water vapor bands

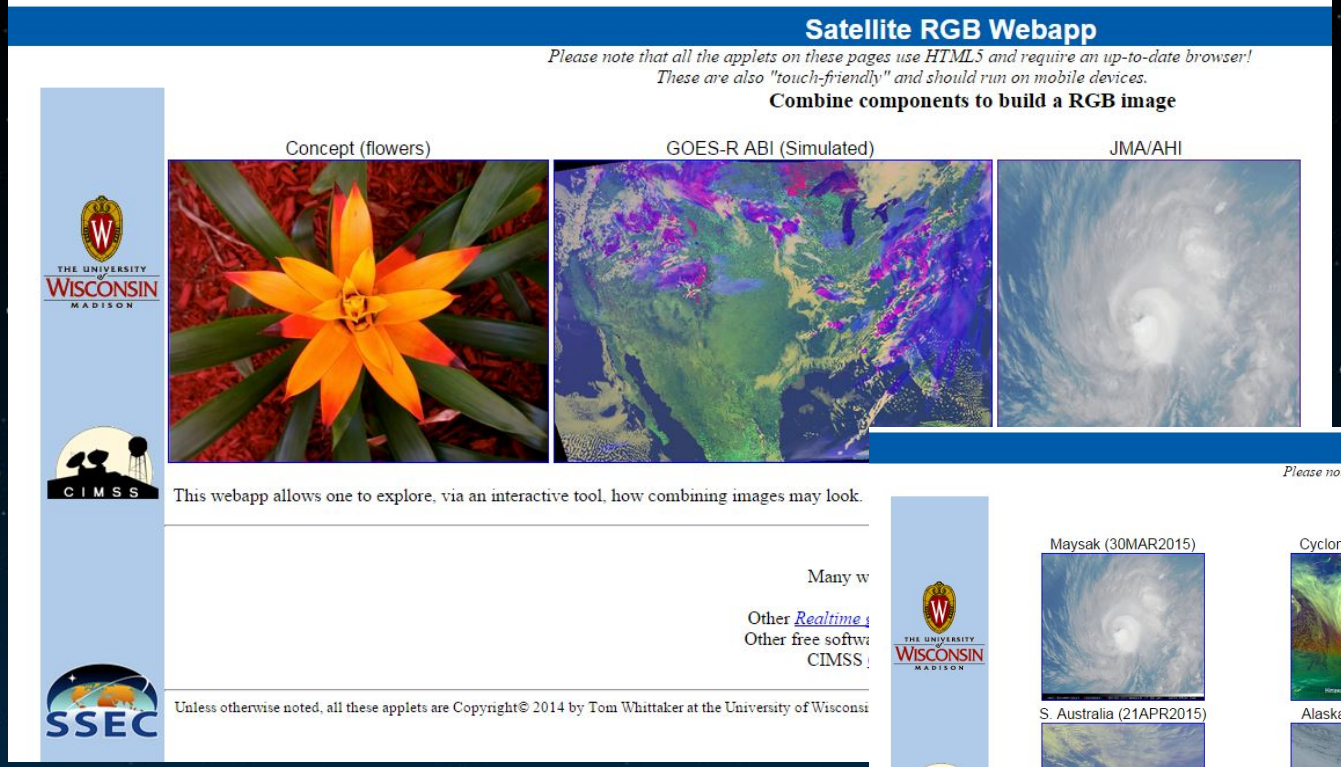


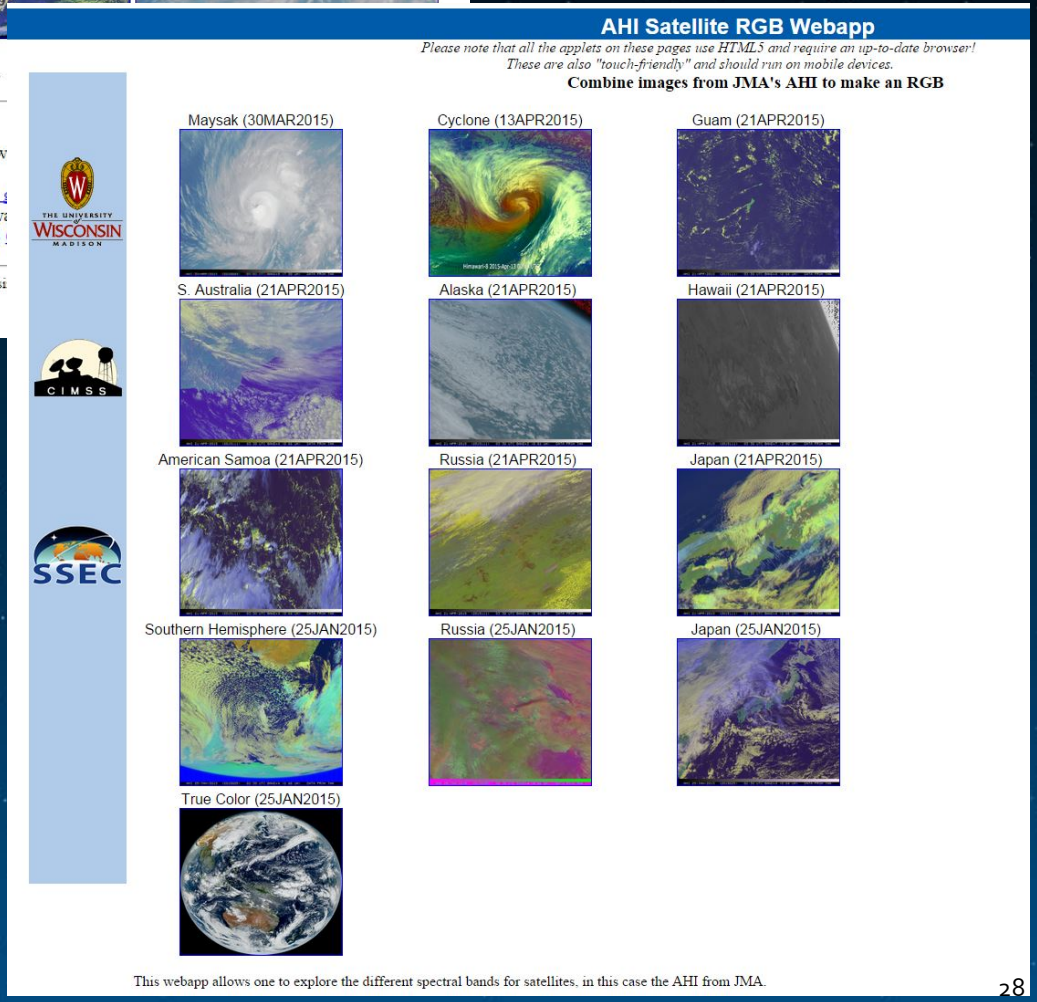
Current GOES



Future GOES

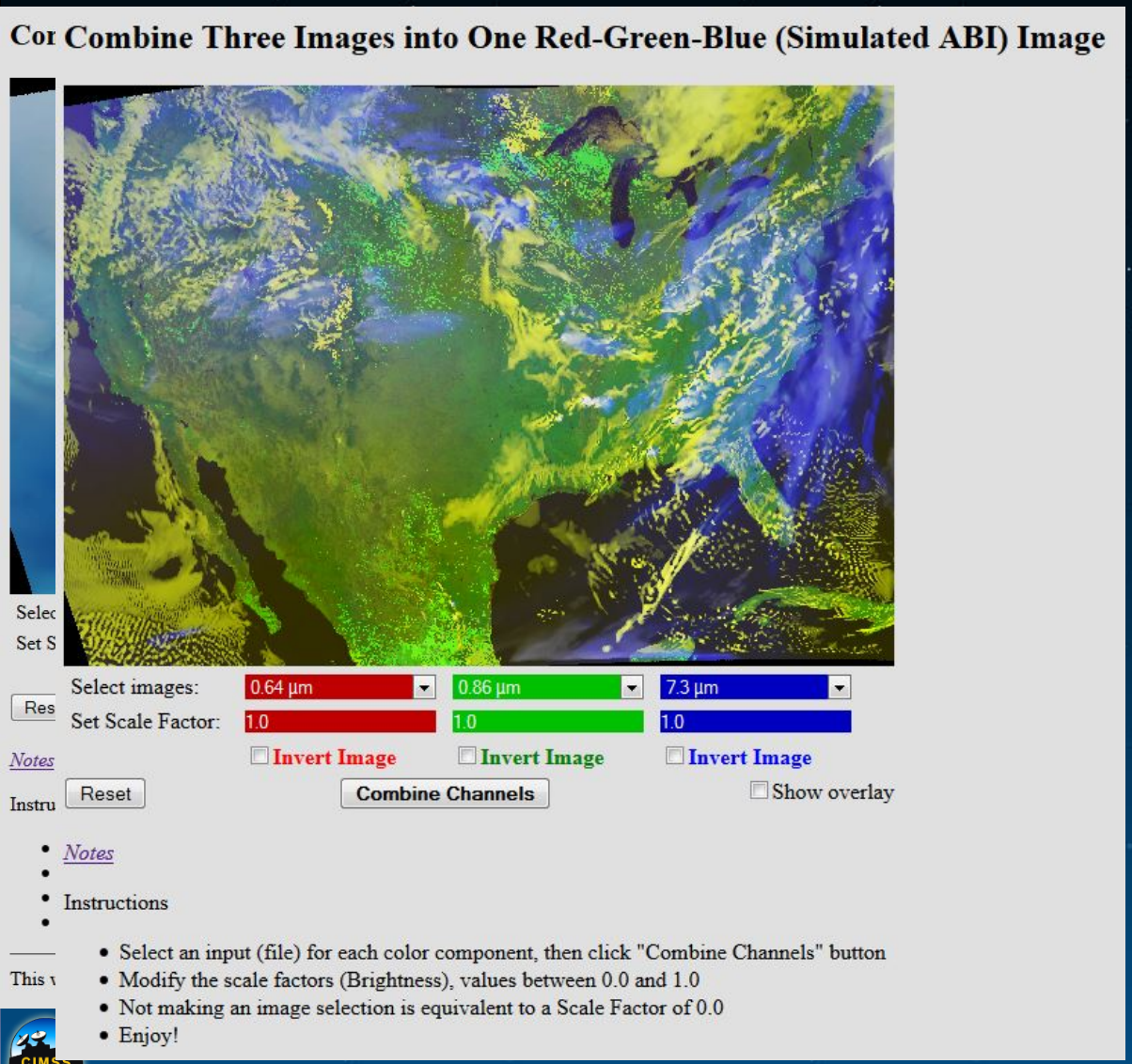
Images from J. Feltz


Satellite RGB Webapp
Please note that all the applets on these pages use HTML5 and require an up-to-date browser!
These are also "touch-friendly" and should run on mobile devices.
Combine components to build a RGB image
Concept (flowers)
GOES-R ABI (Simulated)
JMA/AHI
This webapp allows one to explore, via an interactive tool, how combining images may look.
Many w
Other Realtime
Other free softw
CIMSS
Unless otherwise noted, all these applets are Copyright© 2014 by Tom Whittaker at the University of Wisconsi


AHI Satellite RGB Webapp
Please note that all the applets on these pages use HTML5 and require an up-to-date browser!
These are also "touch-friendly" and should run on mobile devices.
Combine images from JMA's AHI to make an RGB
Maysak (30MAR2015)
Cyclone (13APR2015)
Guam (21APR2015)
S. Australia (21APR2015)
Alaska (21APR2015)
Hawaii (21APR2015)
American Samoa (21APR2015)
Russia (21APR2015)
Japan (21APR2015)
Southern Hemisphere (25JAN2015)
Russia (25JAN2015)
Japan (25JAN2015)
True Color (25JAN2015)
This webapp allows one to explore the different spectral bands for satellites, in this case the AHI from JMA.

RGB WEB APP

Sat RGB



i) Select an input for each band
ii) Click "Combine Channels"

Hands-on….Red-Green-Blue

- Combine the bands to bring out a feature of interest
  - http://cimss.ssec.wisc.edu/goes/webapps/satrgb/overview.html
  - One of the simulated ABI cases
  - http://cimss.ssec.wisc.edu/education/apps/bandapp/overview_goes-r.html
  - One of the observed AHI cases
  - http://cimss.ssec.wisc.edu/goes/webapps/satrgb/overview_ahi.html

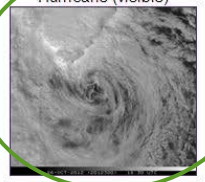
CIMSS ASPB Satellite Appl

cimss.ssec.wisc.edu/goes/applets/overview.html

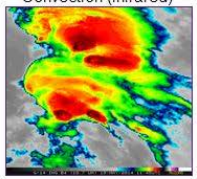
Satellite Activities to explore the effects that *time and spatial resolutions* can have when interpreting satellite images

Please note that all the applets on these pages use HTML5 and require an up-to-date browser!
These are also "touch-friendly" and should run on mobile devices.

Hurricane (visible)

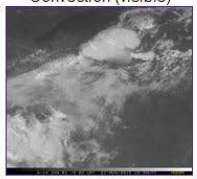


Convection (infrared)

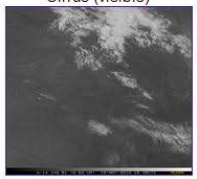


Fires (shortwave window)

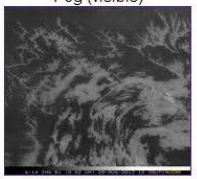
Convection (visible)



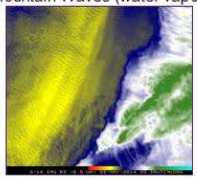
Cirrus (visible)



Fog (visible)



Mountain Waves (water vapor)



Pyrocumulus (visible)

Smoke (visible)

These cases each allow one to change the temporal spacing as well as the spatial resoultion for a series of satellite images.

Other Sites

Many weather related *applets*
GOES-R *web page*
Other *Rapid Scan imagery* from GOES-14

CIMSS *Satellite blog* from GOES-14

http://cimss.ssec.wisc.edu/goes/applets/overview.html

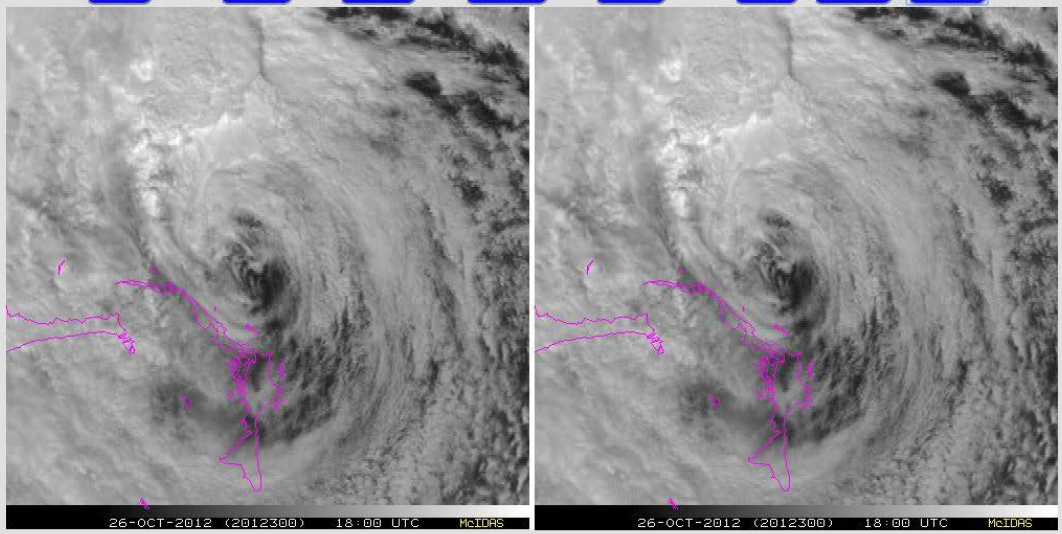
Explore the effect of time

cimss.ssec.wisc.edu/goes/applets/satsquash_sandy_vis.html

Hurricane *Sandy* Visible GOES Imagery

Explore the effects that time and spatial resolutions can have when interpreting satellite images

- Res | 1:1 | + Res | - Time | 4 | + Time | Reset | Loop | < Step | Step >



***Changeable* imagery** **GOES-R like (temporal) imagery**

Can you get the hurricane to appear to rotate the other way (anticyclonic)? *(Hint: use the + Time button)*

Controls:

- - **Res** decreases the resolution; that is, fewer pixels cover the same geographic region, providing less detail.
- + **Res** increases the resolution; that is, more pixels cover the same geographic region, providing more detail.
- - **Time** decreases the time interval between images, in effect providing images more often.
- + **Time** increases the time interval between images, thus providing images less often.
- **Reset** resets the *resolution* and *time* increments to the default values.
- **Pause/Loop** will stop and start the animation (looping).
- < **Step** steps one time step backward (this will stop the animation if it is running)
- > **Step** steps one time step forward (stopping the animation if it is running)

NOAA Satellites and Information
National Environmental Satellite, Data, and Information Service

SSEC CIMSS

Main GOES-14 1-minute SRSOR 'explore the effects of time and space' web page

Special GOES-14 1-minute SRSOR Web Pages from 2012 and 2013 and 2014

CIMSS

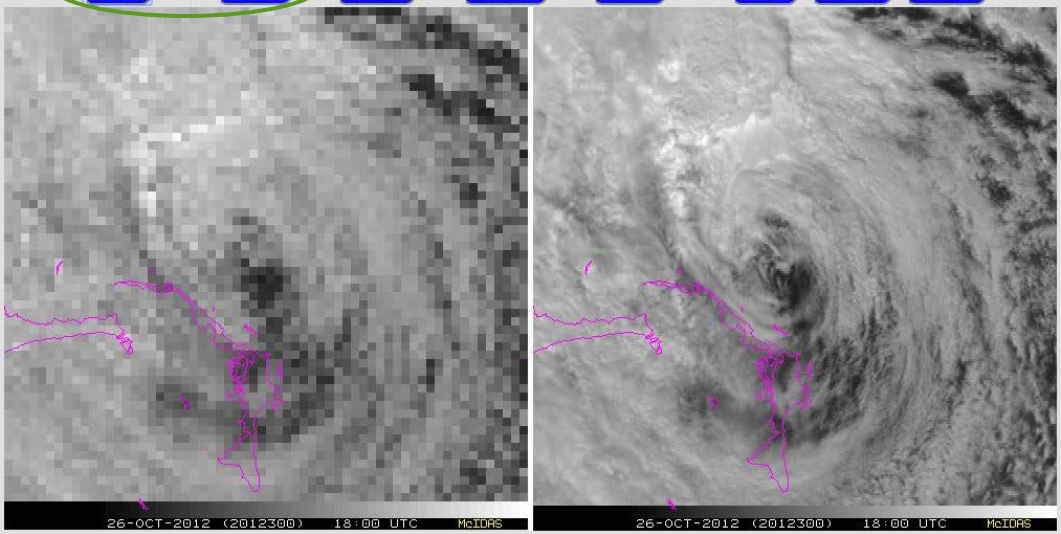
Explore the effect of time

cimss.ssec.wisc.edu/goes/applets/satsquash_sandy_vis.html

Hurricane *Sandy* Visible GOES Imagery

Explore the effects that time and spatial resolutions can have when interpreting satellite images

- Res | 1:8 | + Res | - Time | 4 | + Time | Reset | Loop | < Step | Step >



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CIMSS

Hands-on….Temporal/Spatial

- Choose a case to example the temporal and/or spatial resolutions:
  - http://cimss.ssec.wisc.edu/goes/applets/overview.html
  - or
  - http://cimss.ssec.wisc.edu/education/apps/abi/
- Via temporal sampling, can you get Hurricane Sandy to appear to rotate backwards?
- Can you observe an enhanced v signature in the IR case over MN?

Summary

- GOES-R ABI represents a major shift in capability that users need to be preparing for.
  - Currently focused on Broadcast Meteorologists
  - Tim Schmit, Scott Lindstrom, Chris Schmidt and others are in Raleigh, NC at the AMS Broadcaster's Conference giving an all-day Short Course.
- ABI "Webapps" are terrific "hands-on" tools that anyone can use to educate users and students on a host of topics.
  - Spatial, Spectral, & Temporal Improvements of ABI.
  - RGB
  - Uses of GOES data and Products.
    - Fires, hurricanes, convection, fog, winds, etc.
  - Educational imagery produced with McIDAS-X and –V.