STUDY OF THE ADVANCED BASELINE IMAGER (ABI) ON THE GOES-R AND BEYOND

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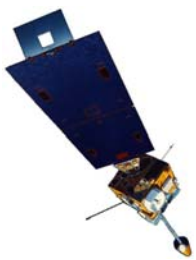
Madison, WI



IIPS, January 14, 2004
Seattle, Washington

UW-Madison

Outline

- What is the Advanced Baseline Imager (ABI)?
- Summary of the Spectral Bands
  - Visible/near infrared
  - Infrared
  - Recent changes
- Relationships between bands and select products
- Summary
- More information

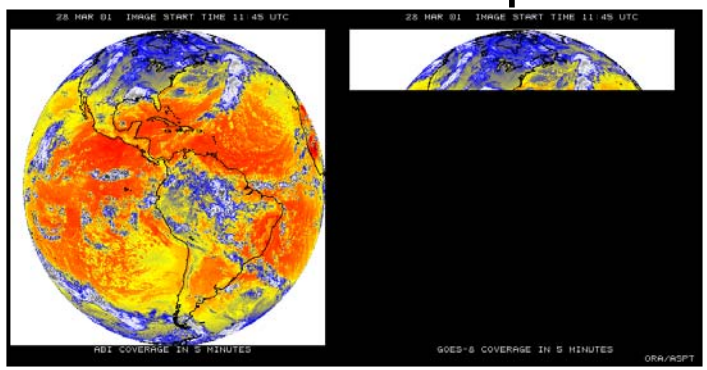
Limitations of Current GOES Imagers

- Missing spectral bands
- Low spatial resolution
- Regional/Hemispheric scan conflicts
- Eclipse and related outages

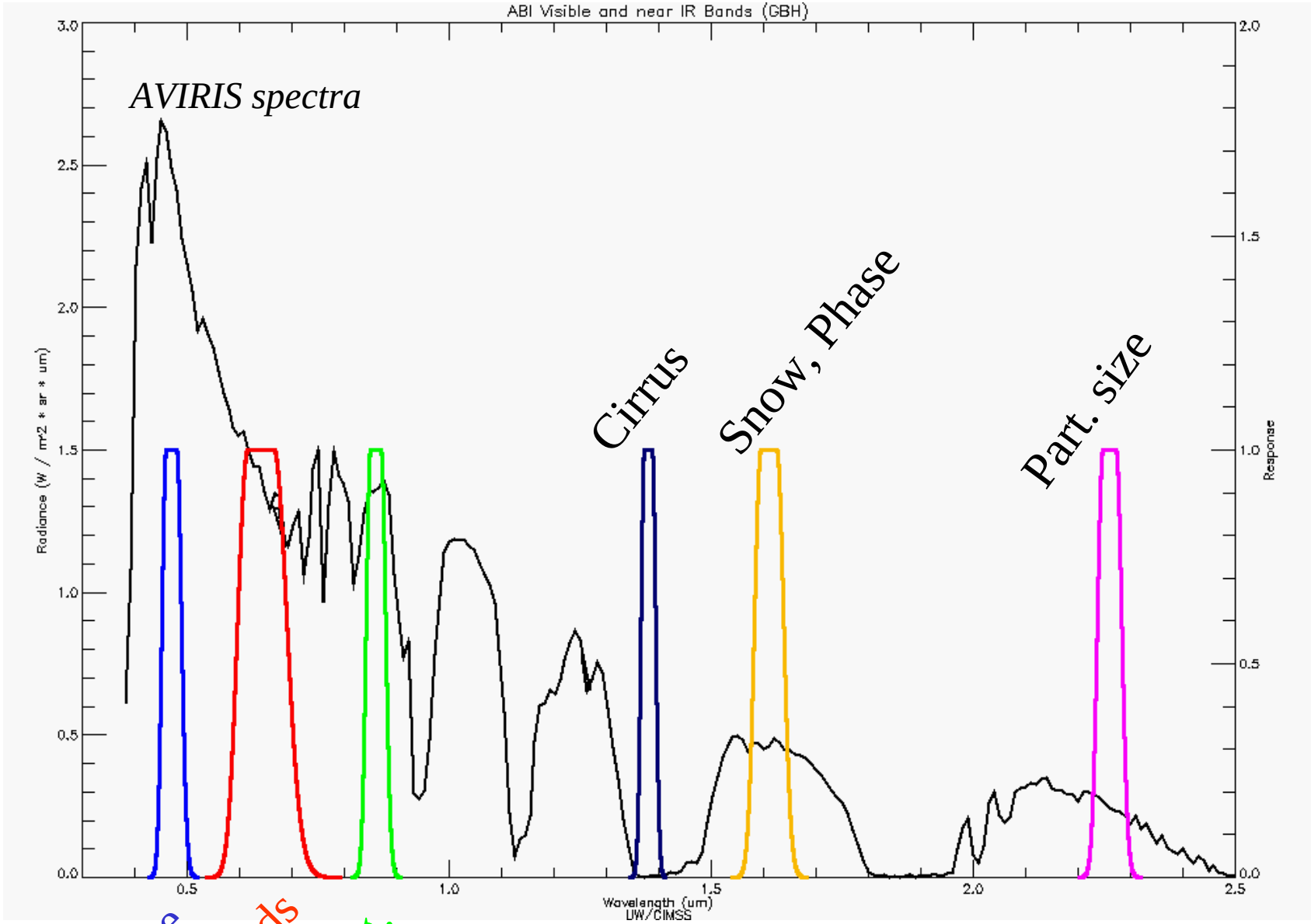
The ABI (Advanced Baseline Imager) is the next generation operational geostationary imager.
The GOES-R/ABI era will begin in 2012.

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/nearIR	1.0 km	n/a
Bands (>2 μm)	2 km	Approx. 4 km
Spatial coverage		
Full disk	4 per hour	Every 3 hours
CONUS	12 per hour	~4 per hour

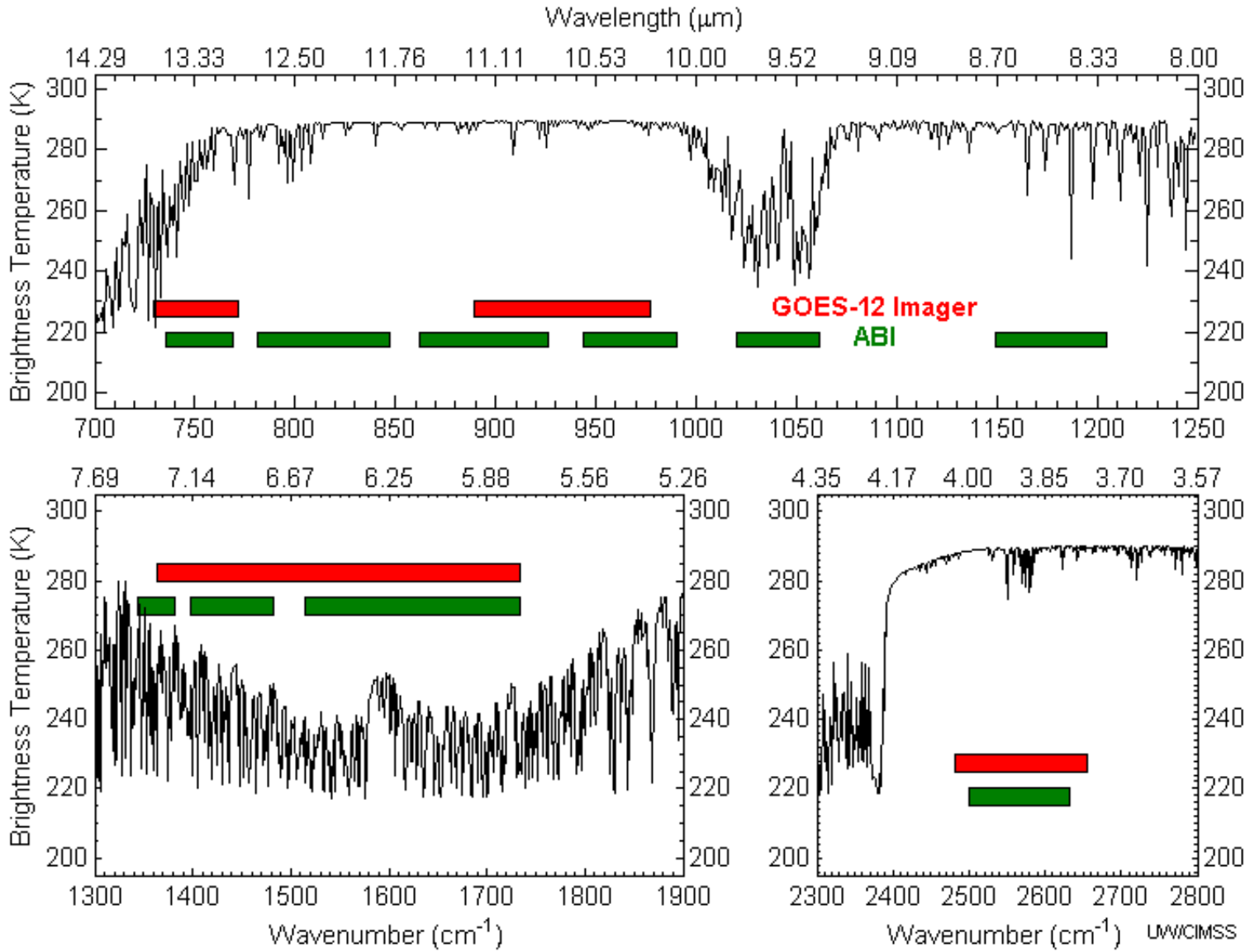


Visible and near-IR channels on the ABI



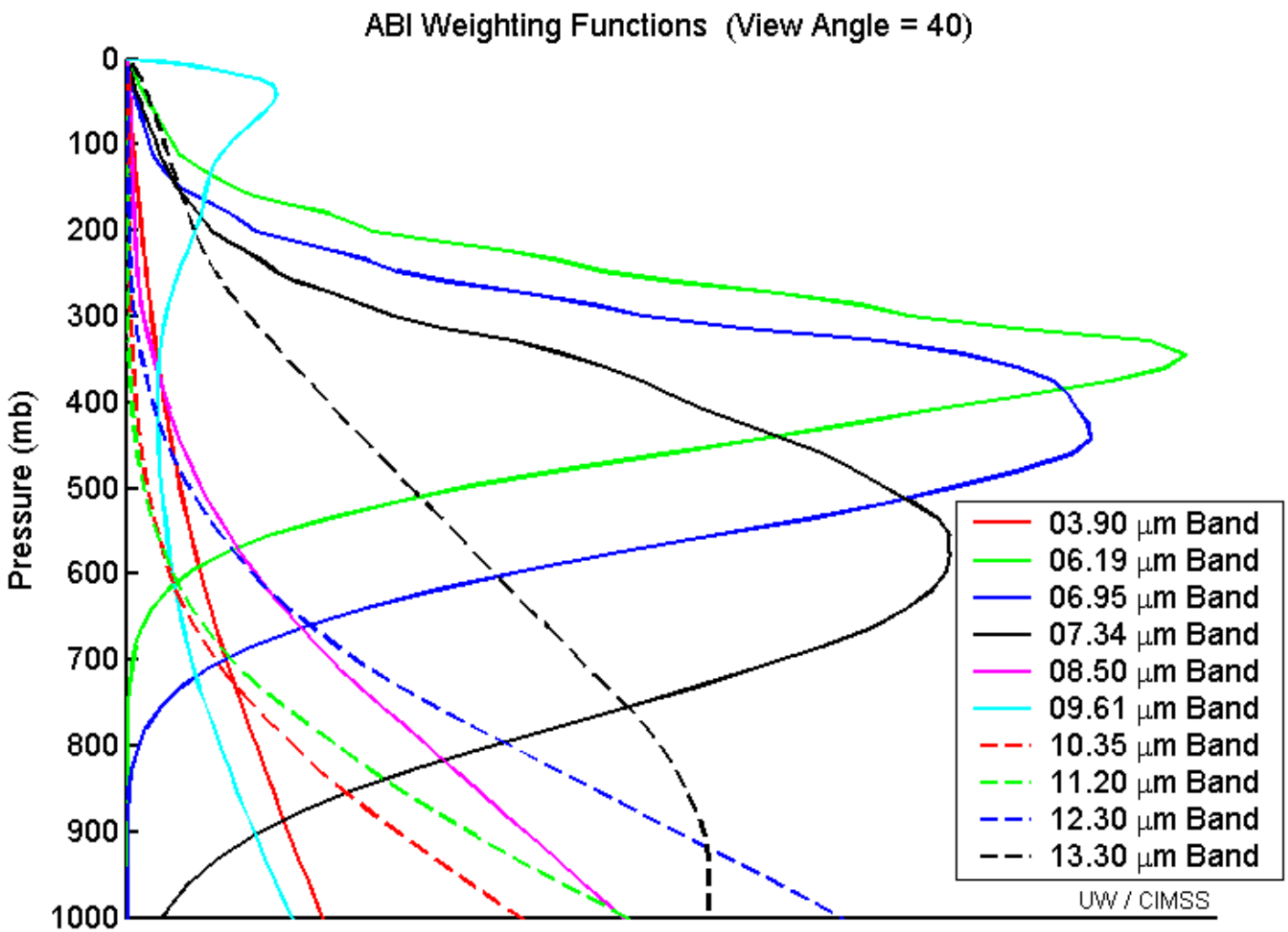
The current GOES has only one visible band.

IR channels on the current GOES and on the ABI



The spectral coverage of the ten IR ABI bands. Spectral coverage from the GOES-12 imager and a sample high-spectral resolution earth-emitted spectra.

Weighting Functions for the IR channels on the ABI



Weighting functions for the standard atmosphere at a local zenith angle of 40 degrees.

Data needed to realistically simulate the ABI

Attribute	*Instruments*
Spatial resolutions (IR)	**MODIS (no 10.35 µm)**
Spatial resolutions (Vis/nearIR)	**MODIS**
Spectral widths (IR)	**AIRS (no 8.5 µm, spectral gaps)**
Spectral widths (IR)	**Aircraft NAST-I**
Spectral widths (Vis/nearIR)	**Aircraft AVIRIS**
Temporal aspects	**Current GOES in special mode**
Spatial & spectral & temporal	***None.***

ABI Bands

Future GOES Imager (ABI) Band	Wavelength Range (μm)	Central Wavelength (μm)	Sample Objective(s)
1	0.45-0.49	**0.47**	Daytime aerosol-over-land, Color imagery
2	0.59-0.69	**0.64**	Daytime clouds fog, insolation, winds
3	0.84-0.88	**0.86**	Daytime vegetation & aerosol-over-water, winds
4	1.365-1.395	**1.38**	Daytime cirrus cloud
5	1.58-1.64	**1.61**	Daytime cloud water, snow
6	2.235 - 2.285	**2.26**	Day land/cloud properties, particle size, vegetation
7	3.80-4.00	**3.90**	Sfc. & cloud/fog at night, fire
8	5.77-6.6	**6.19**	High-level atmospheric water vapor, winds, rainfall
9	6.75-7.15	**6.95**	Mid-level atmospheric water vapor, winds, rainfall
10	7.24-7.44	**7.34**	Lower-level water vapor, winds & SO_2
11	8.3-8.7	**8.5**	Total water for stability, cloud phase, dust, SO_2
12	9.42-9.8	**9.61**	Total ozone, turbulence, winds
13	10.1-10.6	**10.35**	Surface properties, low-level moisture & cloud
14	10.8-11.6	**11.2**	Total water for SST, clouds, rainfall
15	11.8-12.8	**12.3**	Total water & ash, SST
16	13.0-13.6	**13.3**	Air temp & cloud heights and amounts

Based on experience from:

Current GOES Imagers

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Based on experience from:

Current GOES Imagers

MSG/AVHRR/ Sounder(s)

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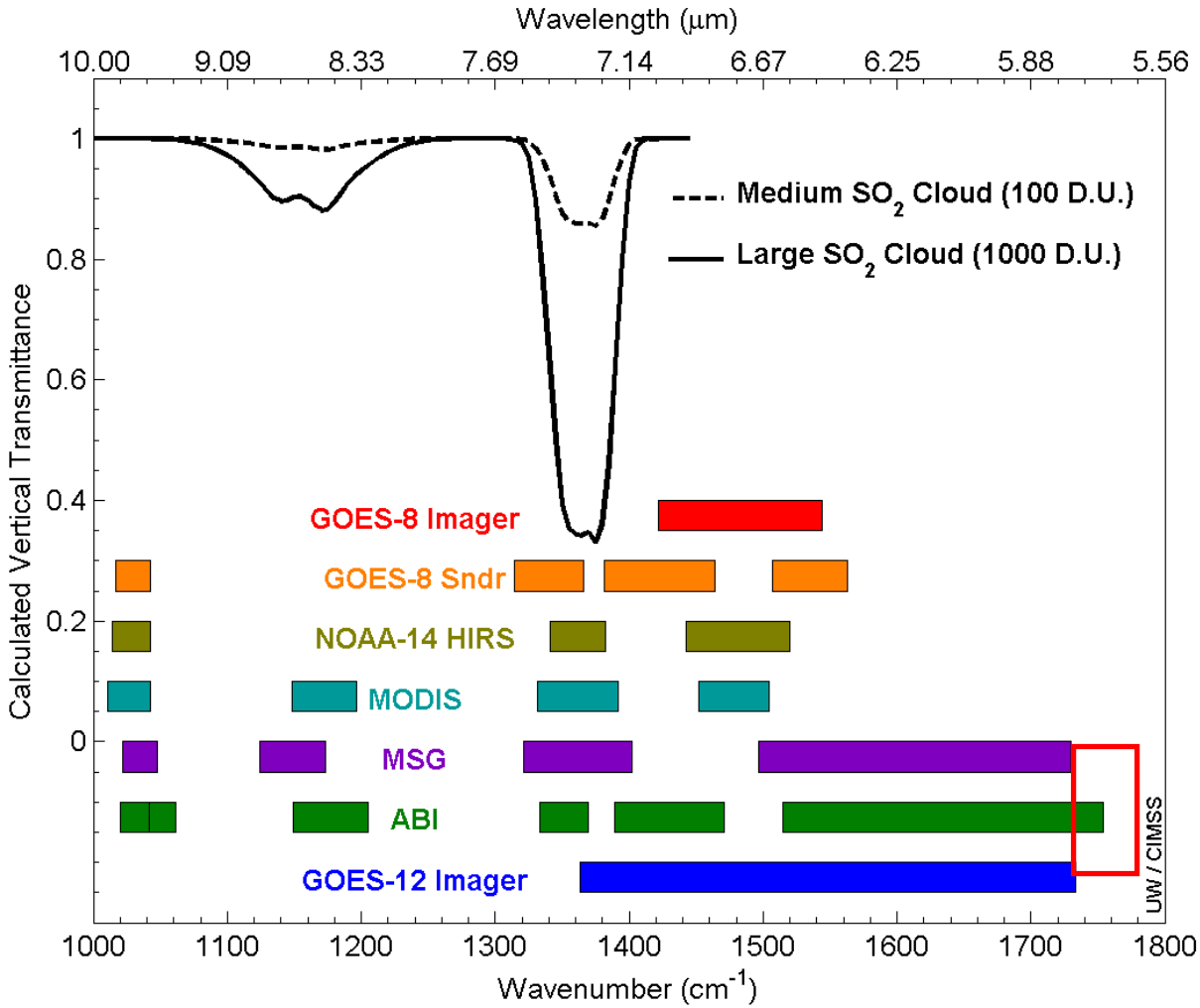
Based on experience from:

Current GOES Imagers

MSG/AVHRR/ Sounder(s)

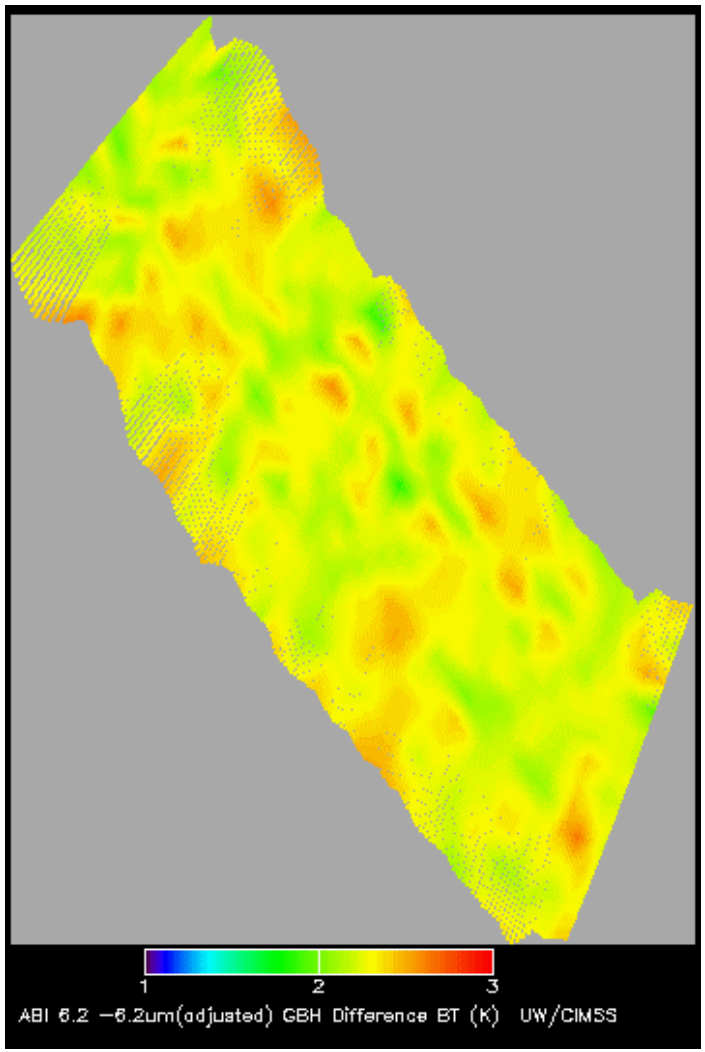
MODIS/MTG/ Aircraft, etc



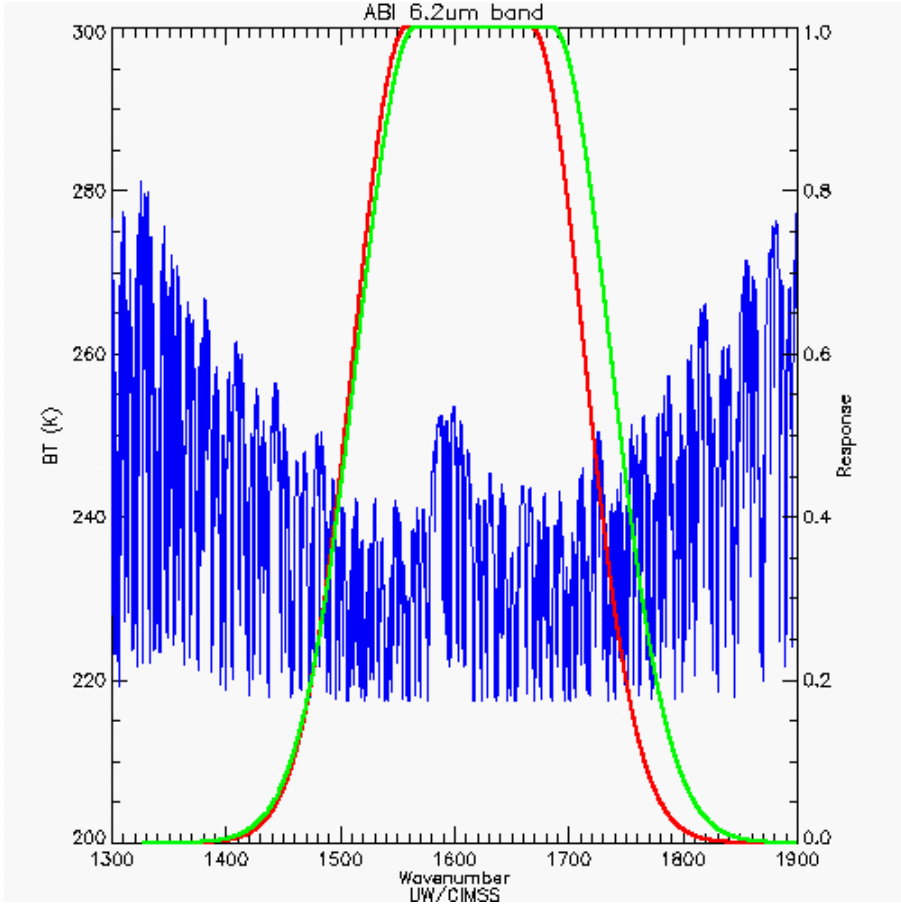
Shortened the shortwave side of the 6.15 μm (wide) water vapor band to be more consistent with GOES-12+ Imagers and MSG.

Changed from 5.7 – 6.6 μm to 5.77 to 6.6 μm.

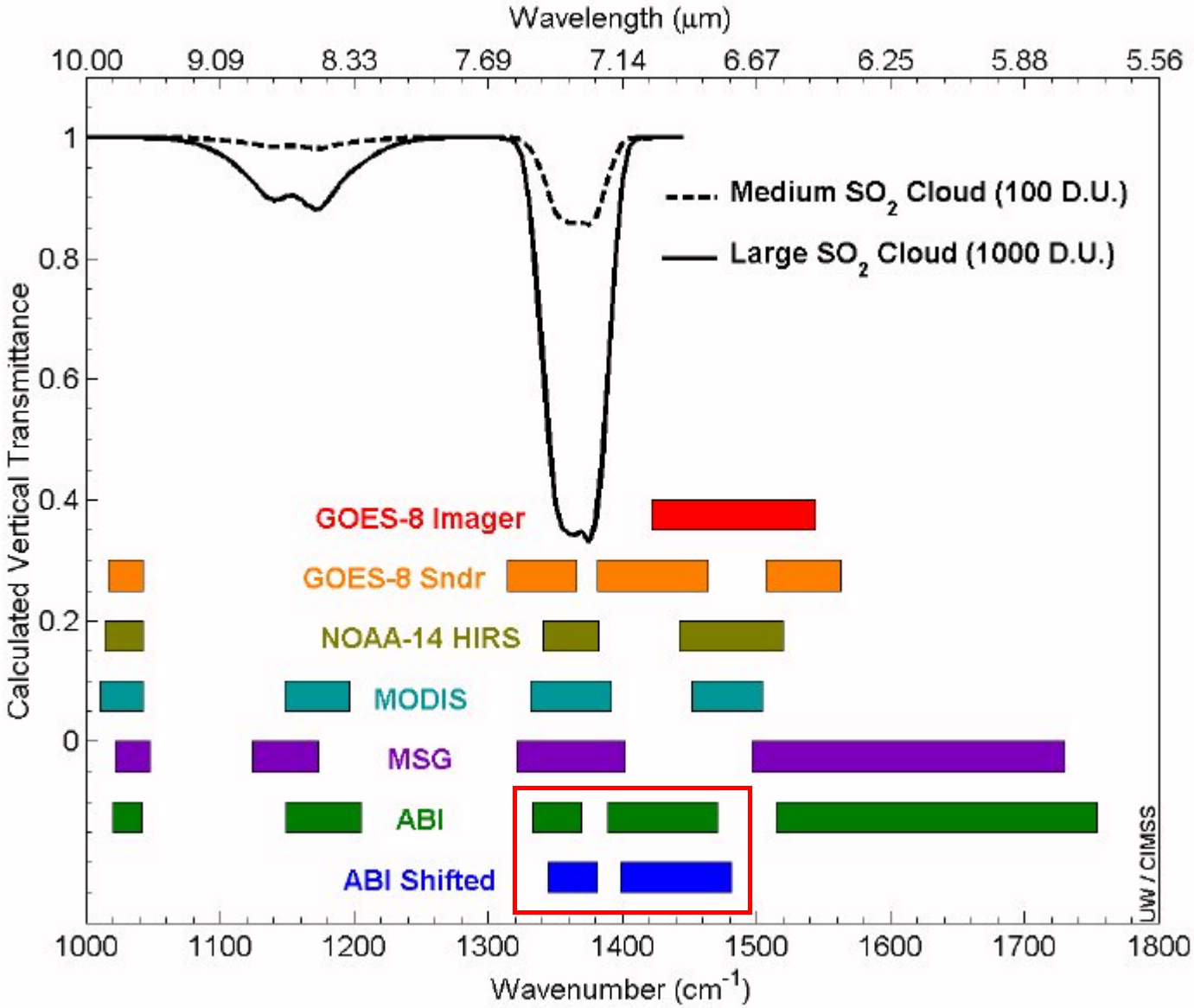
ABI 6.2 µm Band
(NASTI data)



ABI 6.2 µm - 6.2 µm adjusted
X 10



ABI 6.2 ABI 6.2 adjusted

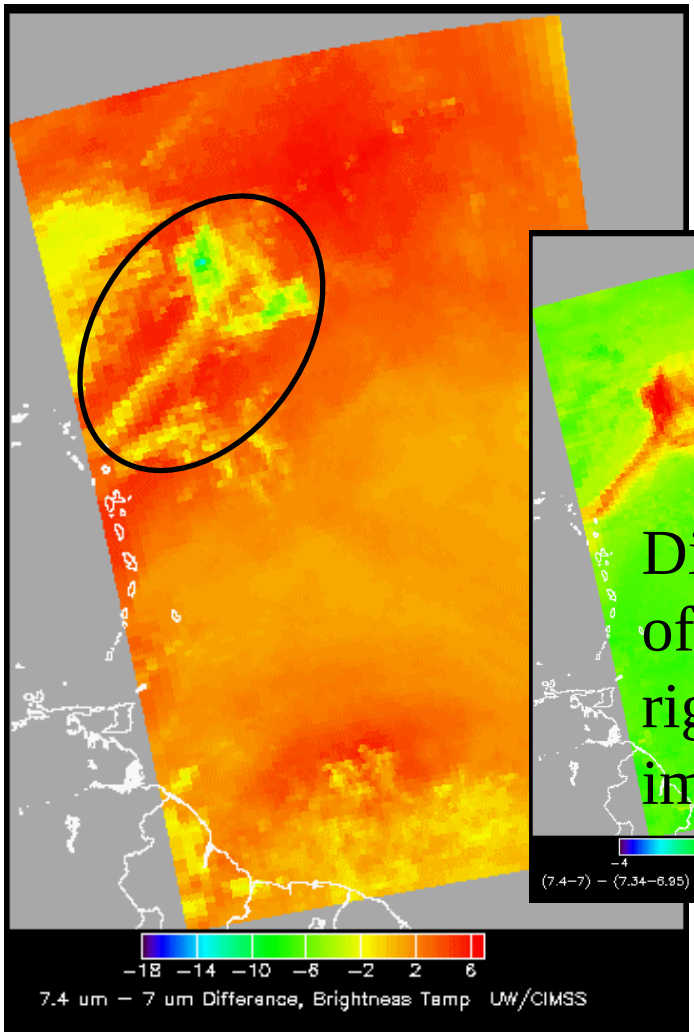


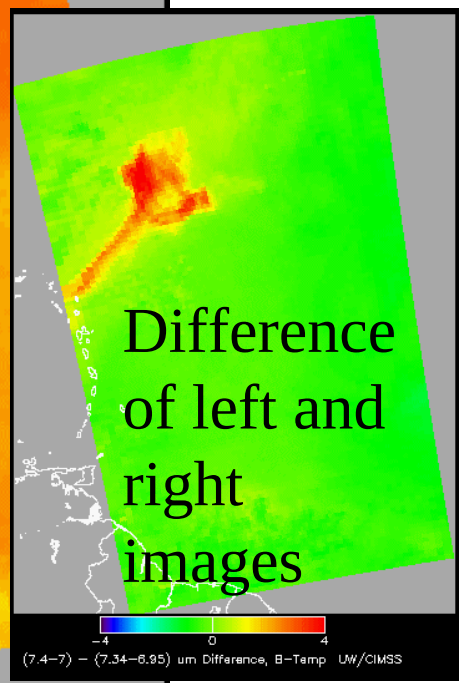
SO2 calculations from F. Prata

Slightly shift, toward larger wavenumbers, the two narrow ABI water vapor bands to better discriminate the SO_2 peak.

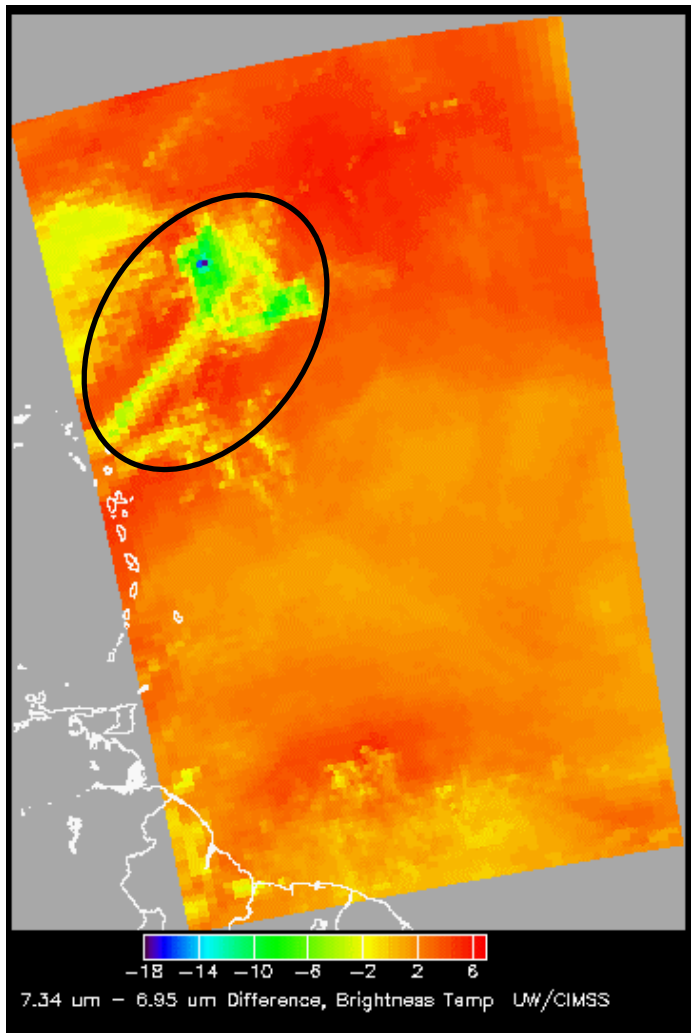
ABI Water Vapor Band Differences convolved from AIRS data

(SO_2 plume from Montserrat Island, West Indies)



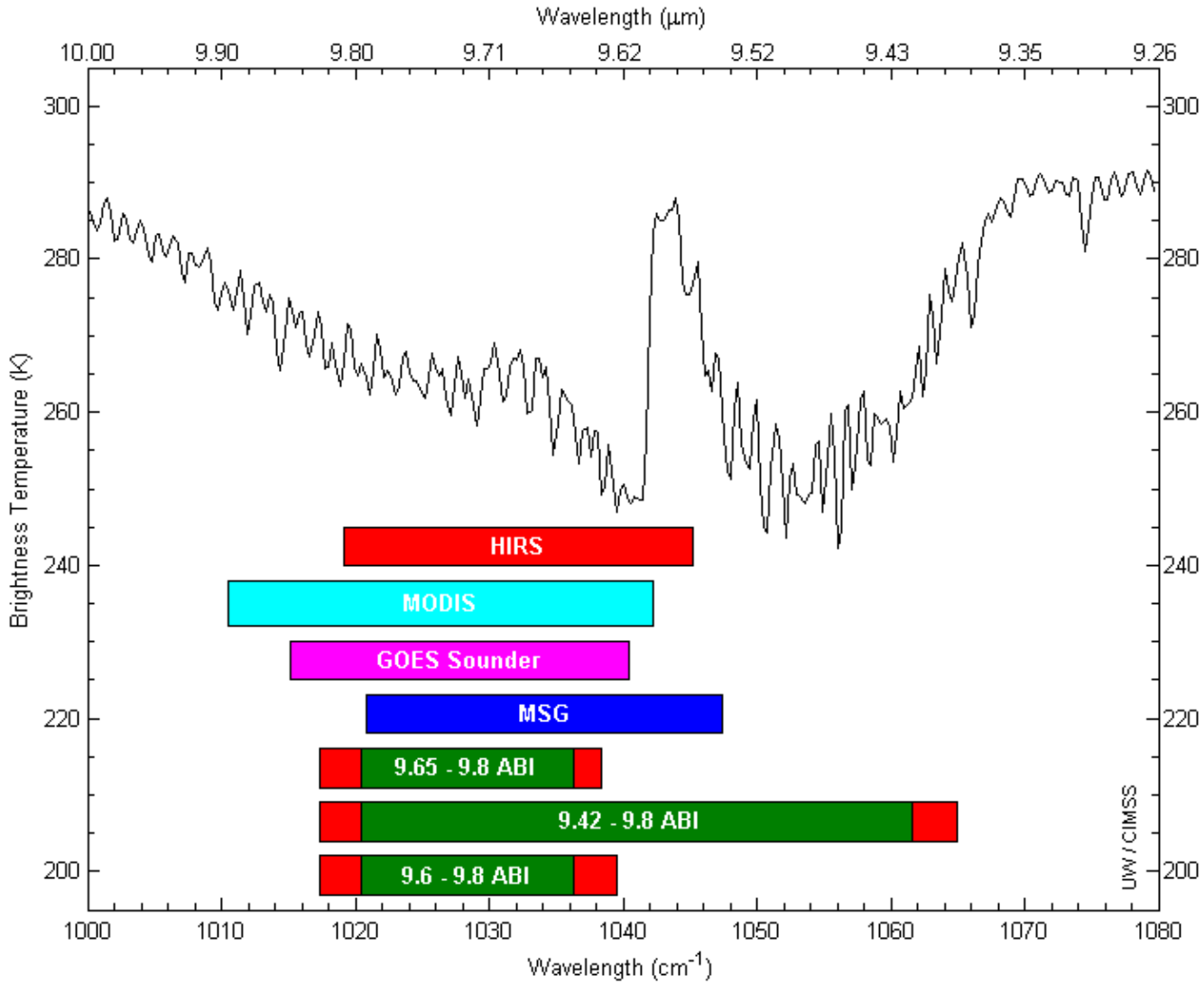


Difference of left and right images



ABI 7.4 µm - 7.0 µm

ABI 7.34 µm - 6.95 µm ("shifted")



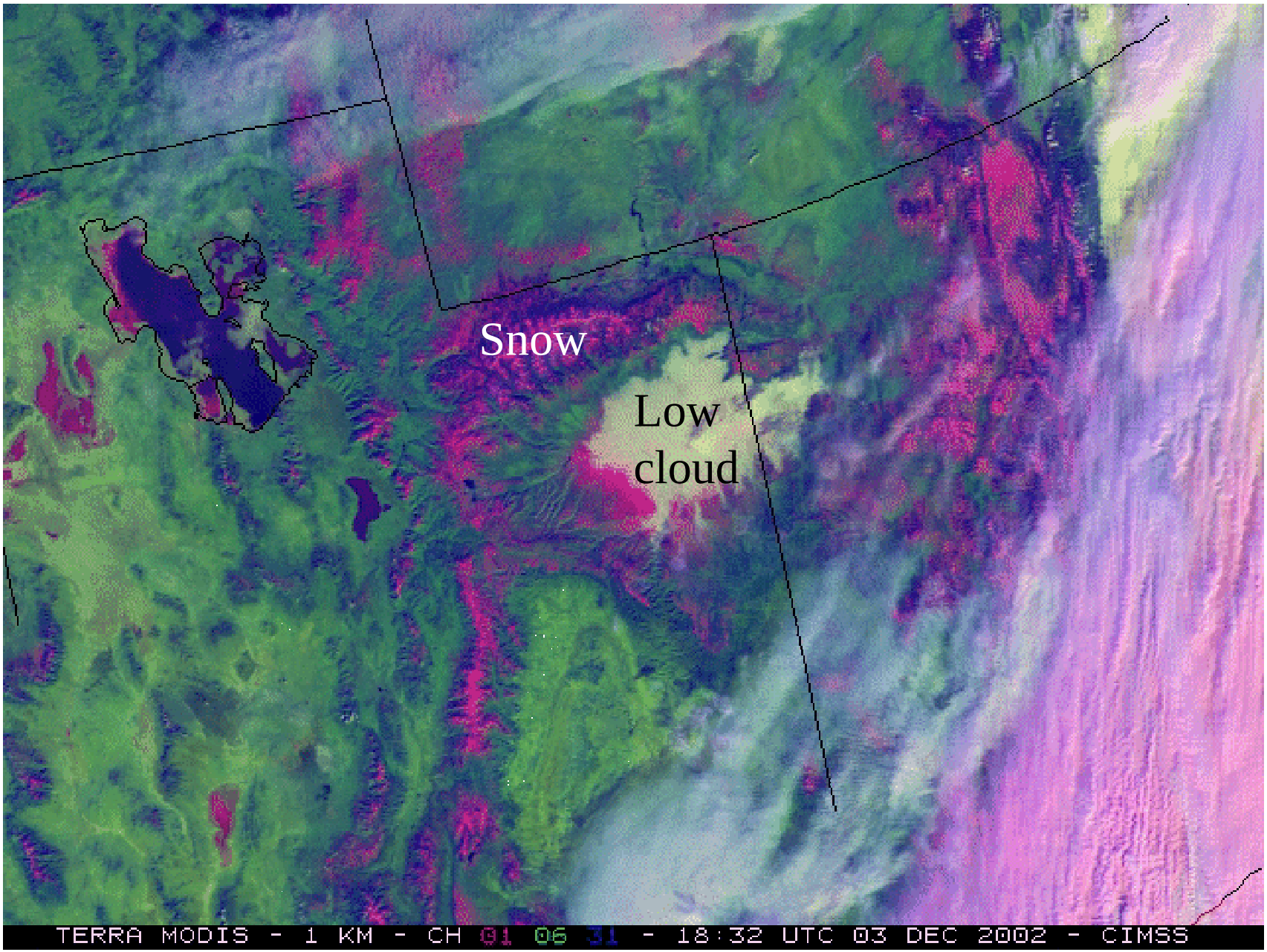
Spectral widths of the previous (narrow) and new (wide) ozone band on the ABI. The spectral tolerances are shown for the ABI. Spectral bandwidths from other sensors and an earth-emitted spectra are also plotted.

Select Products

clouds/**fog**
aerosol products
cloud phase, cloud particle size
snow, ice
volcanic ash/ SO_2
land/sea surface temperature
atmospheric motion
fires
cloud height/emissivity
haze/dust
NDVI (Normalized Difference Vegetation Index)
severe weather signatures
turbulence
ozone
radiances, cloud mask
rainfall

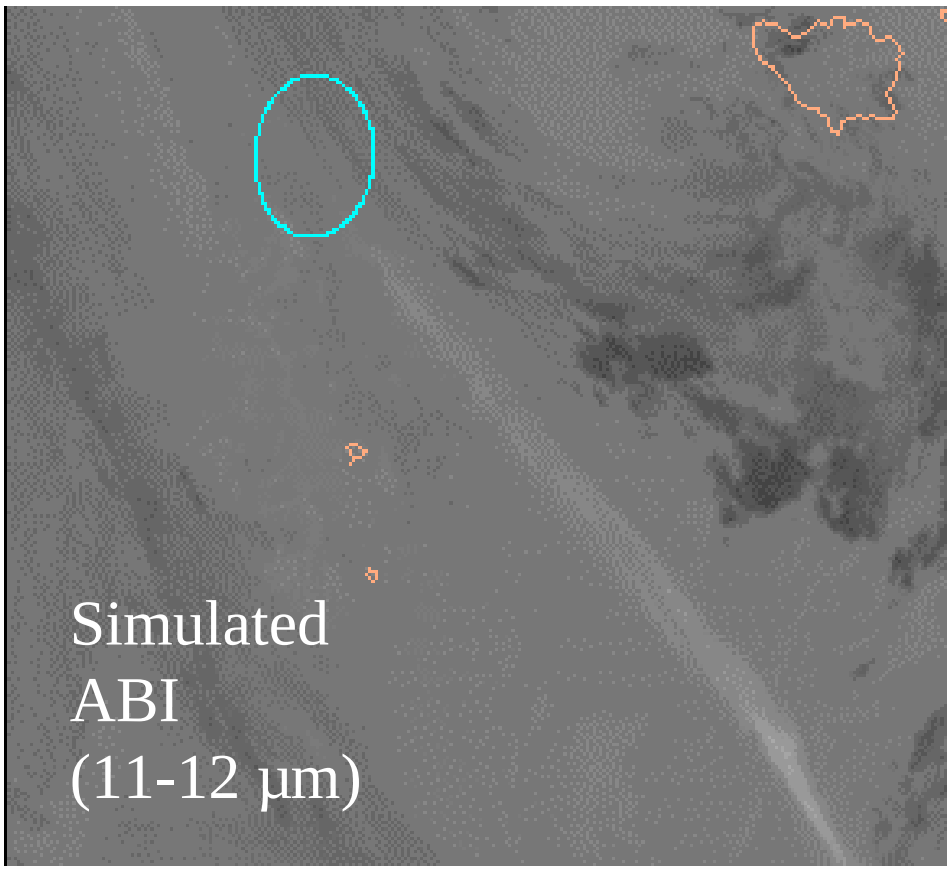
Products that are highlighted are included in this talk

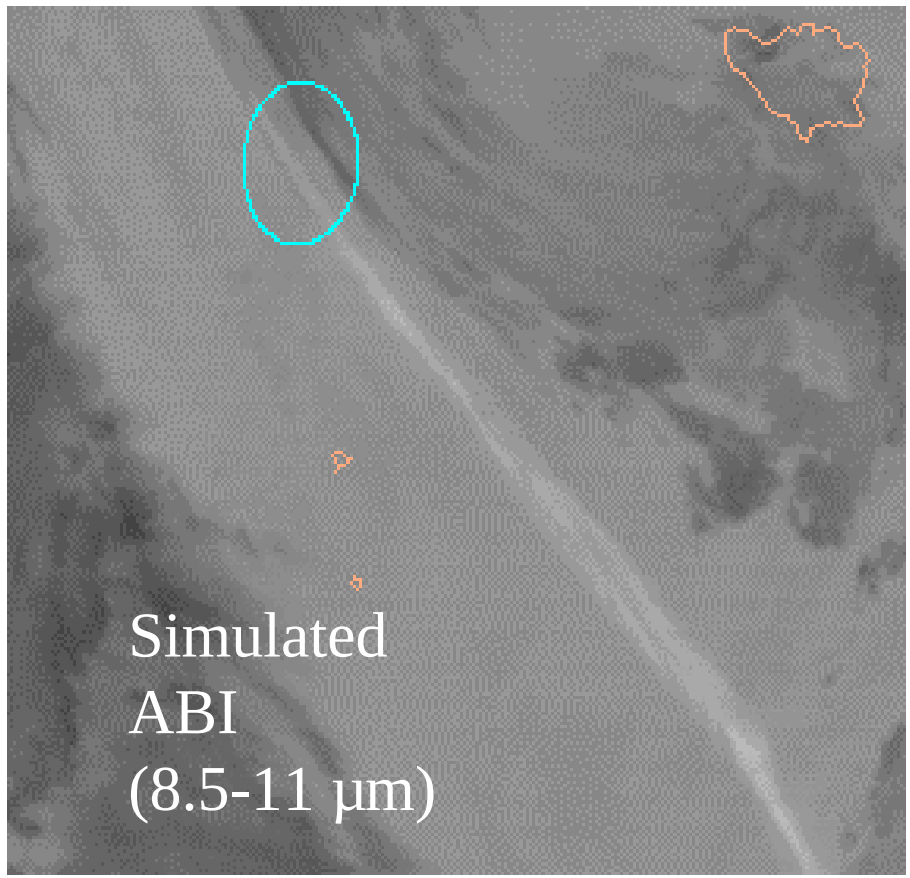
Three-color composite (0.64, 1.6 and 11 μm) shows the low cloud over the snow and the water versus ice clouds.



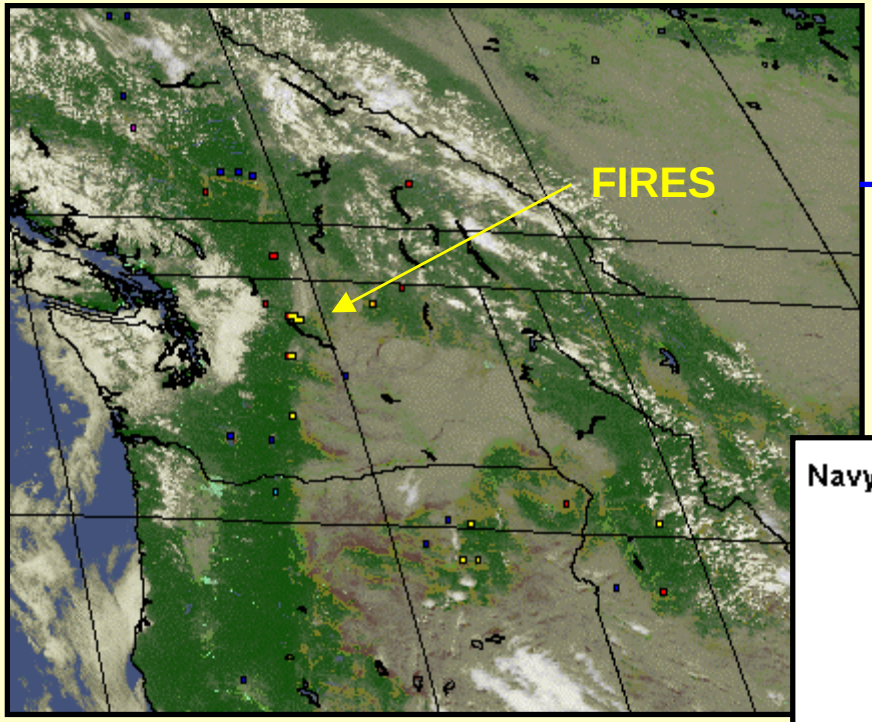
Volcanic Ash Plume: 11-12 and 8.5-11 µm images

One day after the Mt. Cleveland eruption
20 February 2001, 0845 UTC



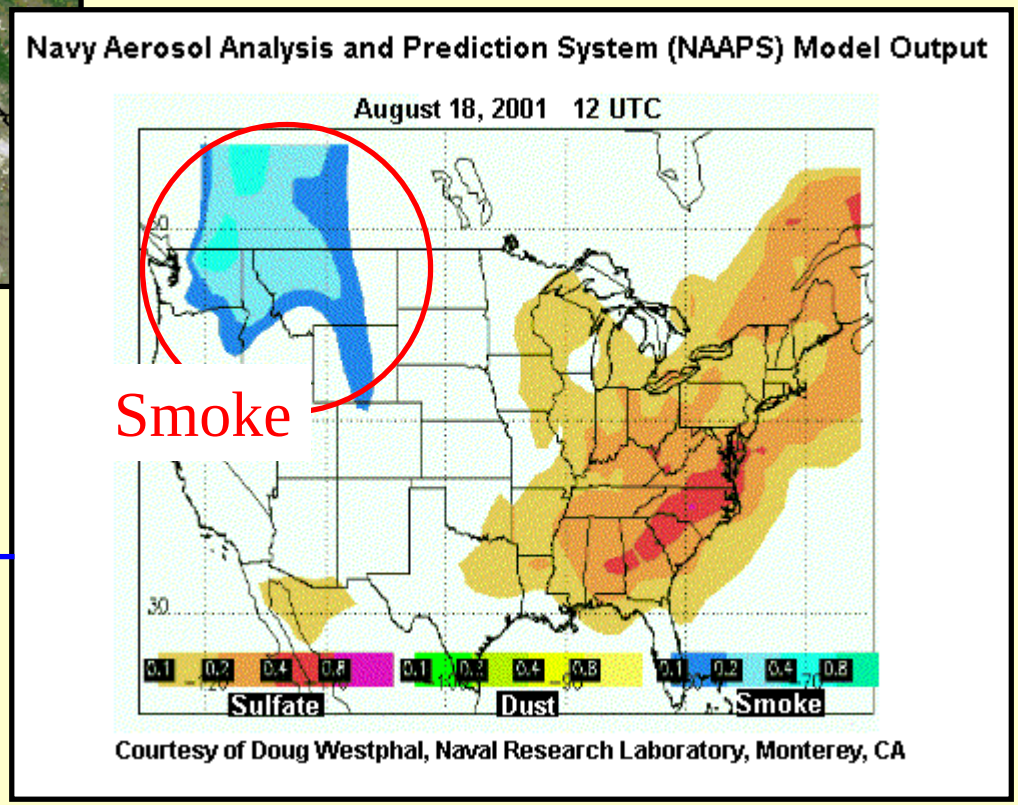


Aerosol Transport Model Assimilation of the Wildfire ABBA Fire Product Using the Navy Aerosol Analysis and Prediction System



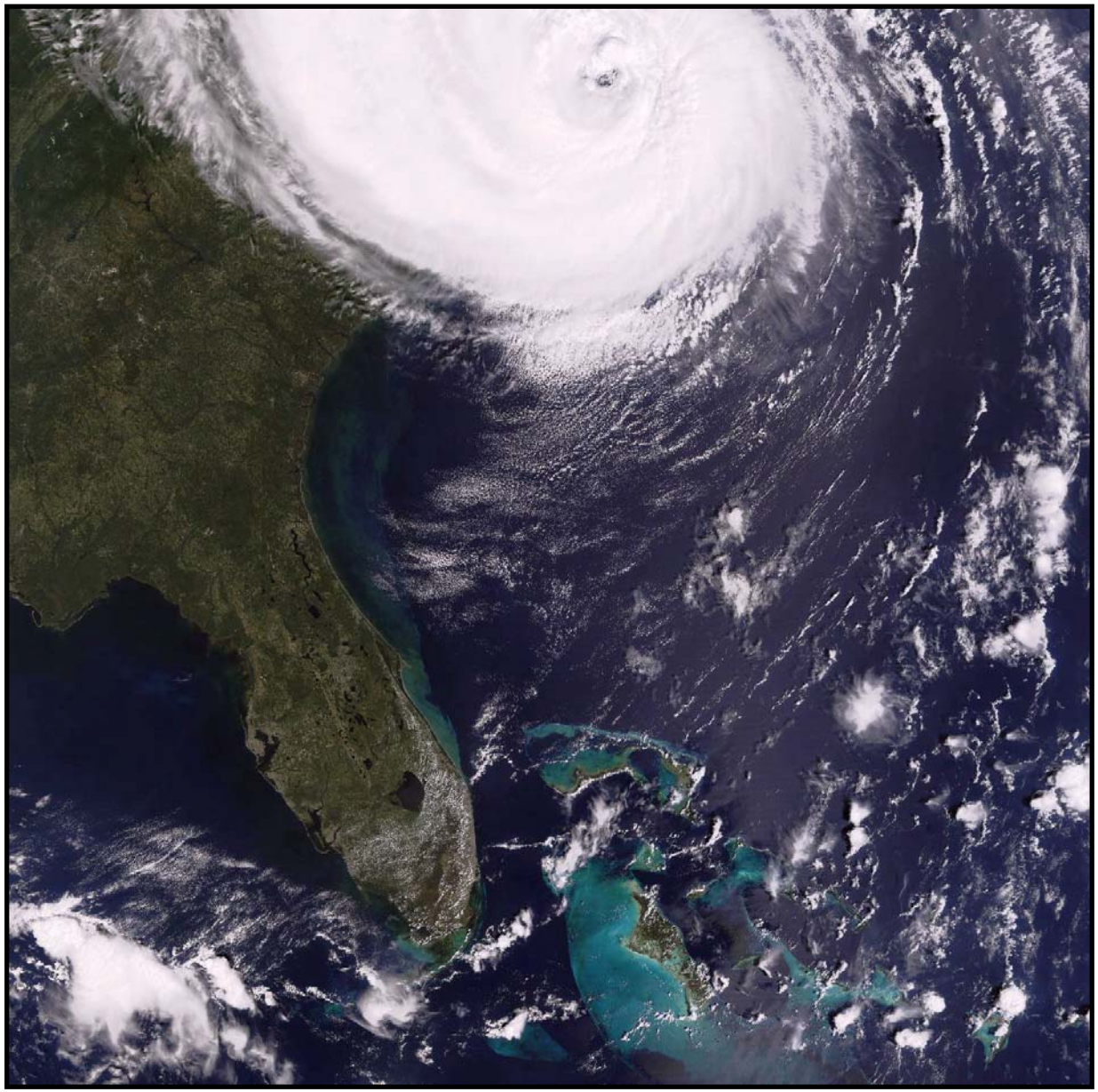
GOES-8 Wildfire ABBA fire product for the Pacific Northwest
Date: August 17, 2001
Time: 2200 UTC

NAAPS Model Aerosol Analysis for the continental U.S.
Date: August 18, 2001
Time: 1200 UTC



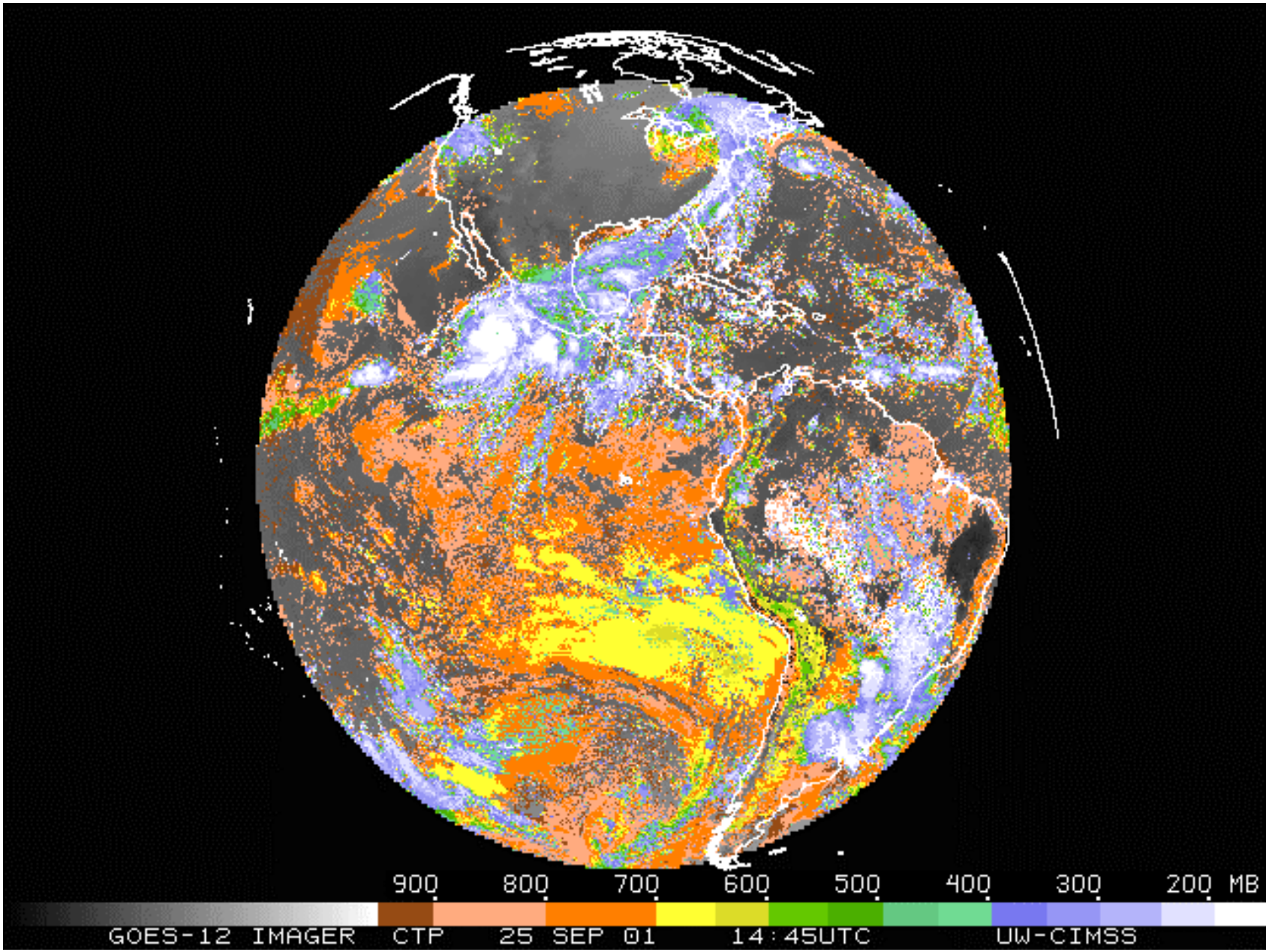
ABI “Natural Color” Image (from MODIS)

This represents a “best case” for generating an “natural color” Red-Green-Blue” composite image, given the MODIS 550 nm data from this image was used to build the Look Up Table (LUT) to simulate the “green” component from the other spectral bands. The HES-Coastal Water will have a 550 nm band.



Hurricane Isabel on September 18, 2003 from MODIS

13.3 μm allows for better cloud-top information estimates

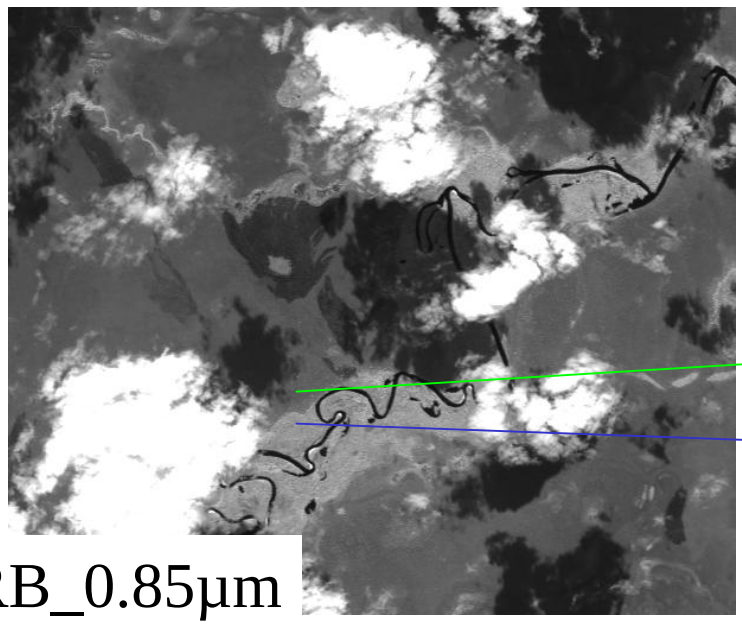


GOES-12 Imager -- Cloud Top Pressure

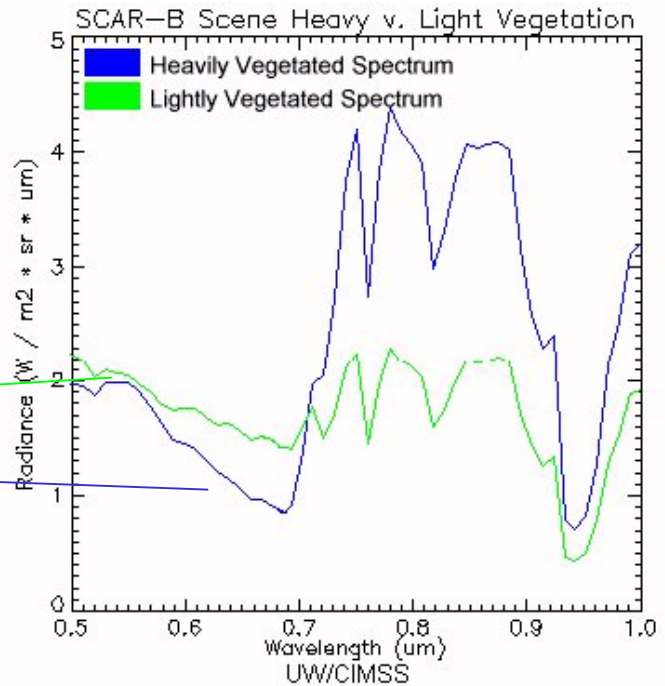
Utility of the 0.86 μm band

- Useful in determining vegetation amount, aerosols, and for ocean/land studies.
- Enables localized vegetation stress monitoring, fire danger monitoring, and albedo retrieval.
- Provides synergy with the AVHRR/3 and VIIRS.

AVIRIS data:



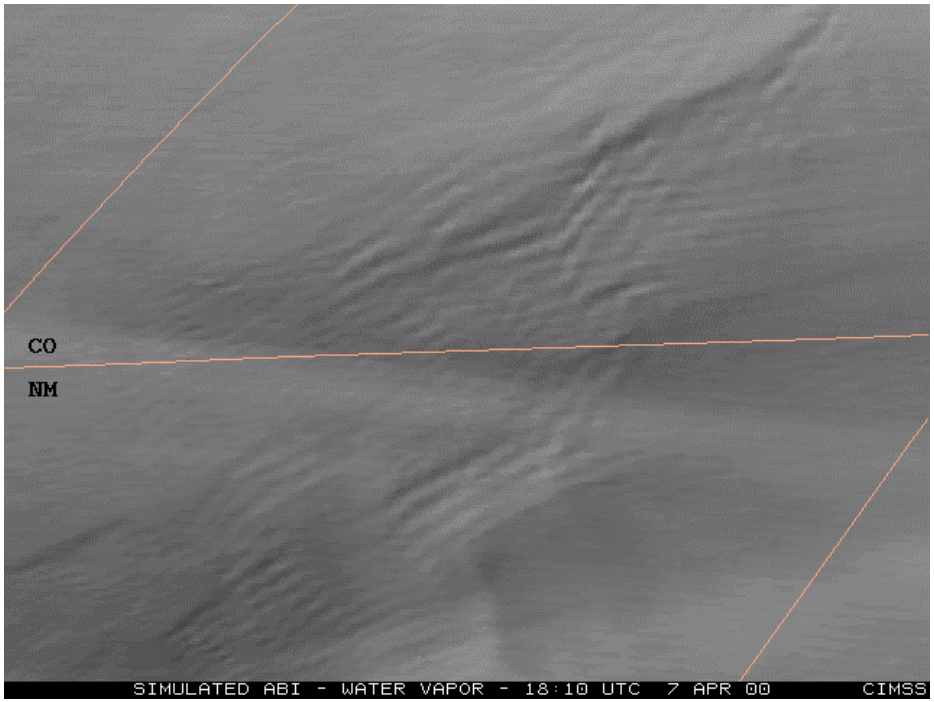
SCARB_0.85μm



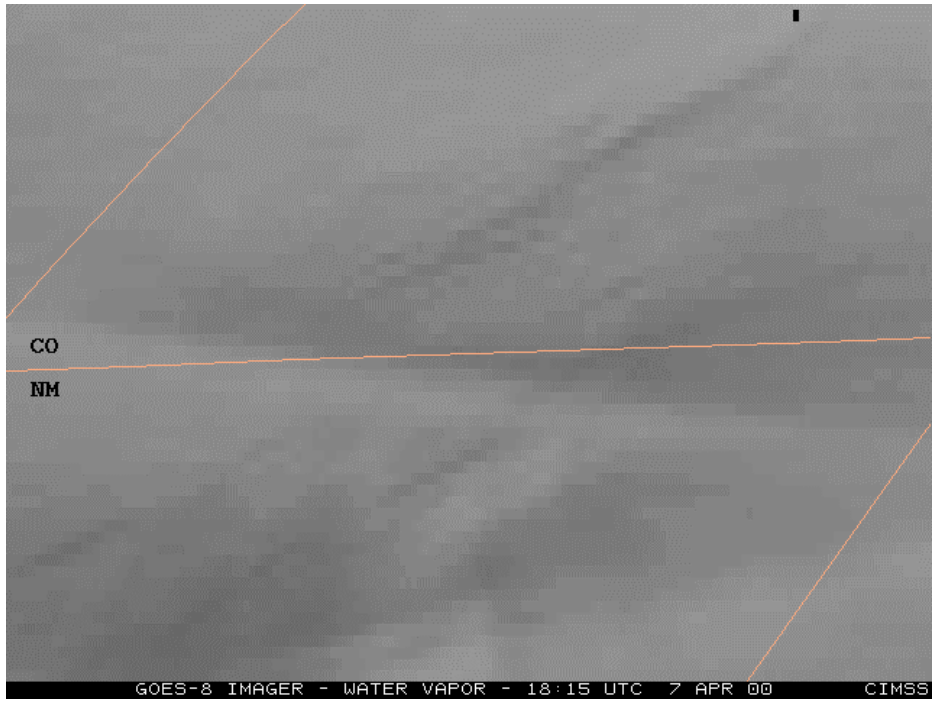
Mountain Waves in WV channel (6.7 µm)

7 April 2000, 1815 UTC

Simulated ABI



Actual GOES-8



Mountain waves over Colorado and New Mexico were induced by strong northwesterly flow associated with a pair of upper-tropospheric jet streaks moving across the elevated terrain of the southern and central Rocky Mountains. The mountain waves appear more well-defined over Colorado; in fact, several aircraft reported moderate to severe turbulence over that region.

Both images are shown in GOES projection.

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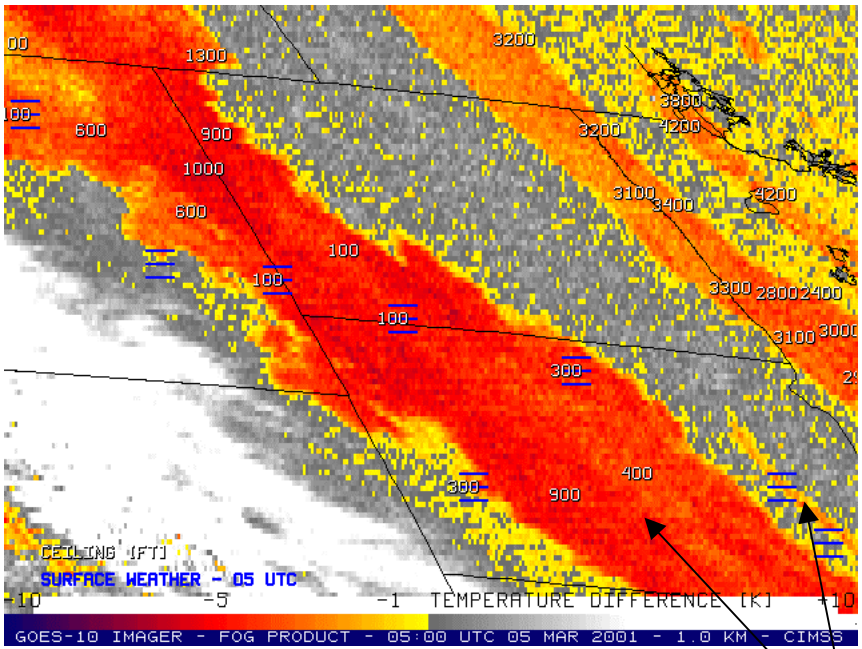
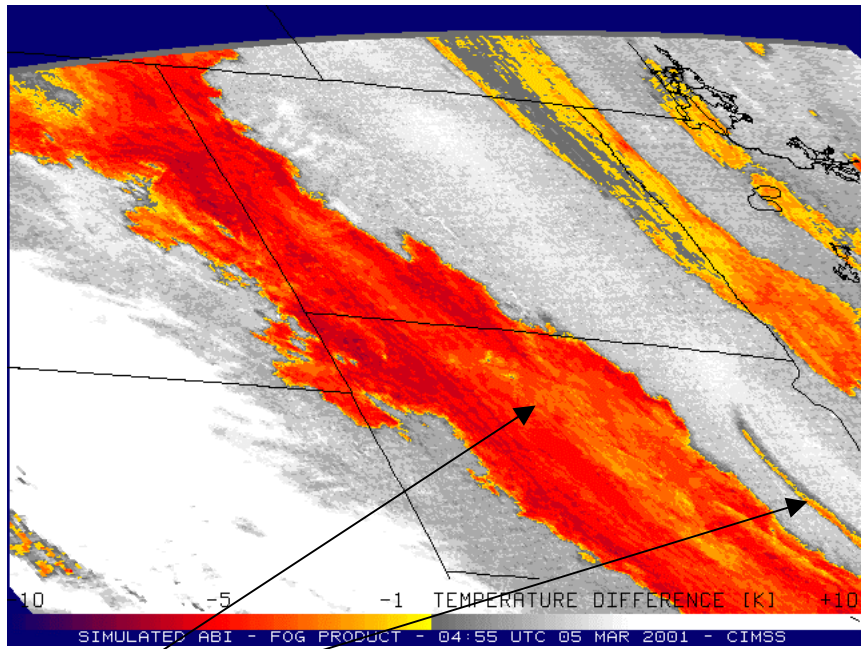
Fog -- Based on GOES Imager 3.9 µm

5 March 2001 - Nocturnal Fog/Stratus Over the Northern Plains

GOES-10 4 minus 11 µm Difference



ABI 4 minus 11 µm Difference



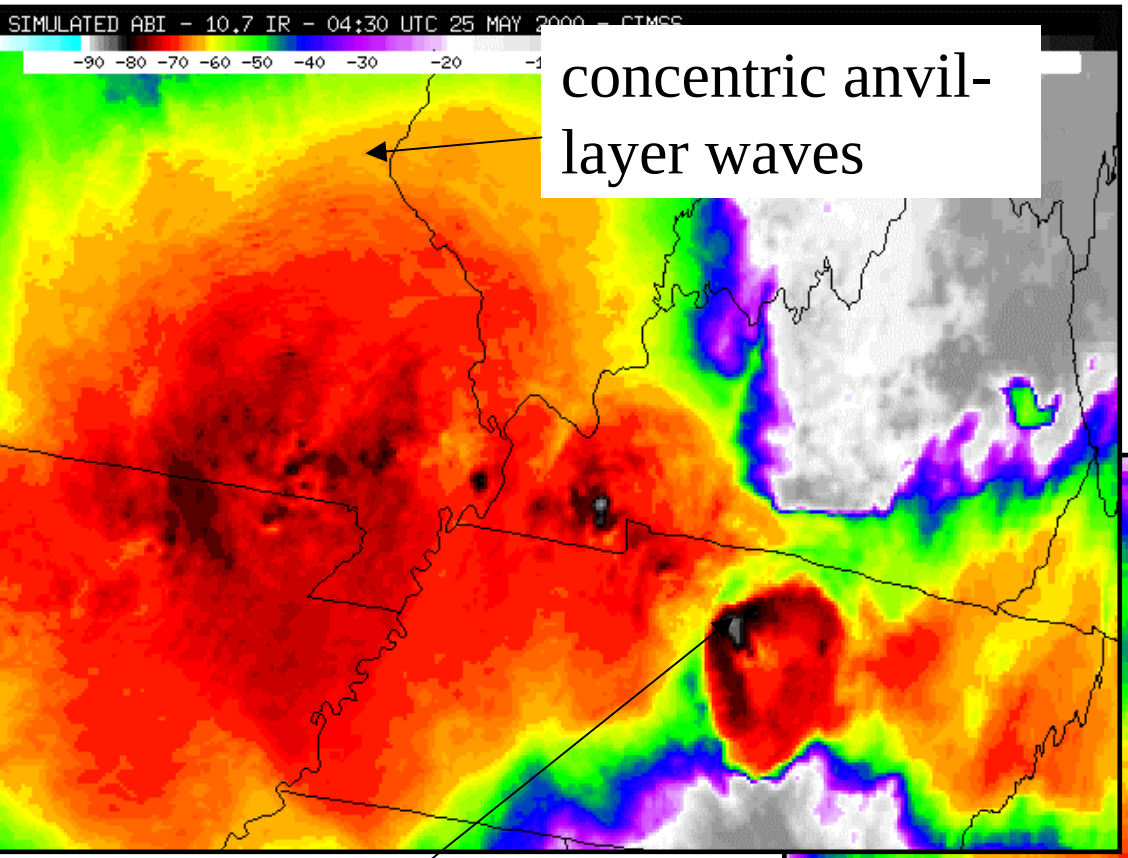
Both images are shown in the GOES projection.

Fog

UW/CIMSS

ABI image (from MODIS) shows greater detail in structure of fog.

Higher Spatial Resolution GOES Channels



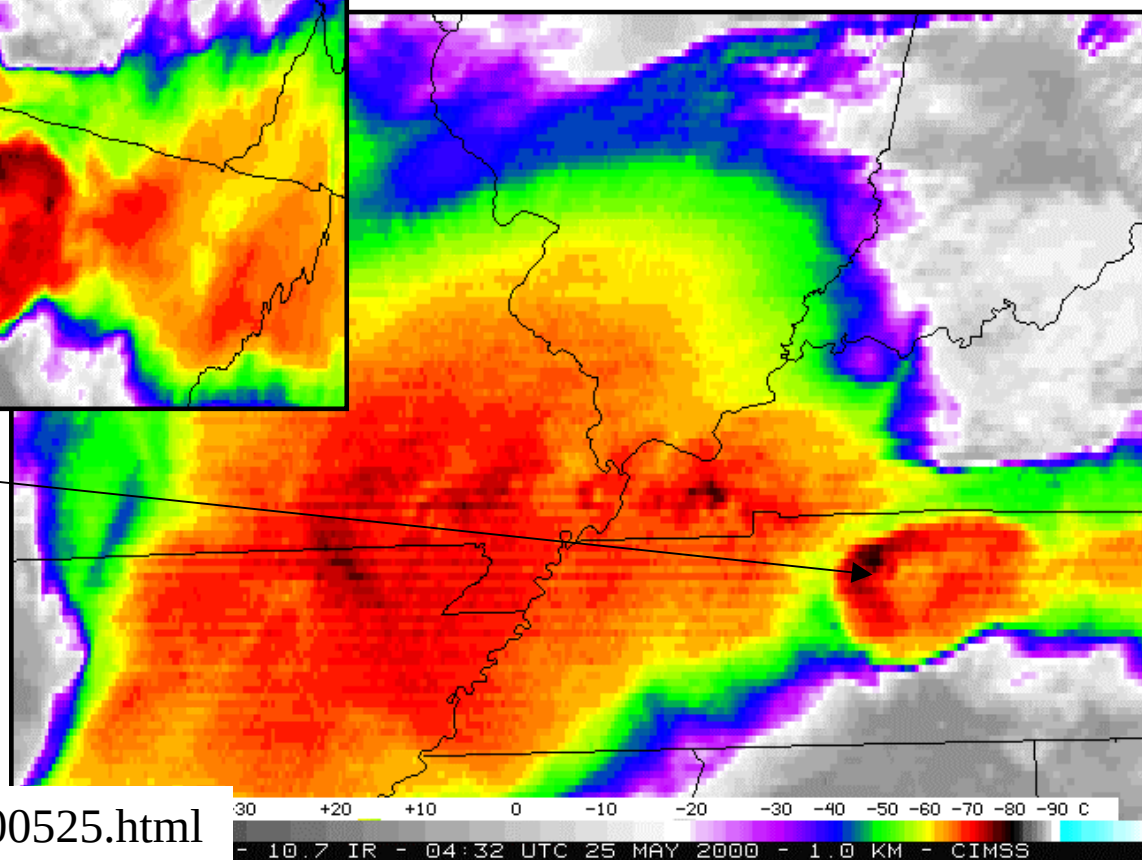
concentric anvil-layer waves

Simulated ABI (from MODIS)

Enhanced "V": IR windows May 25, 2000

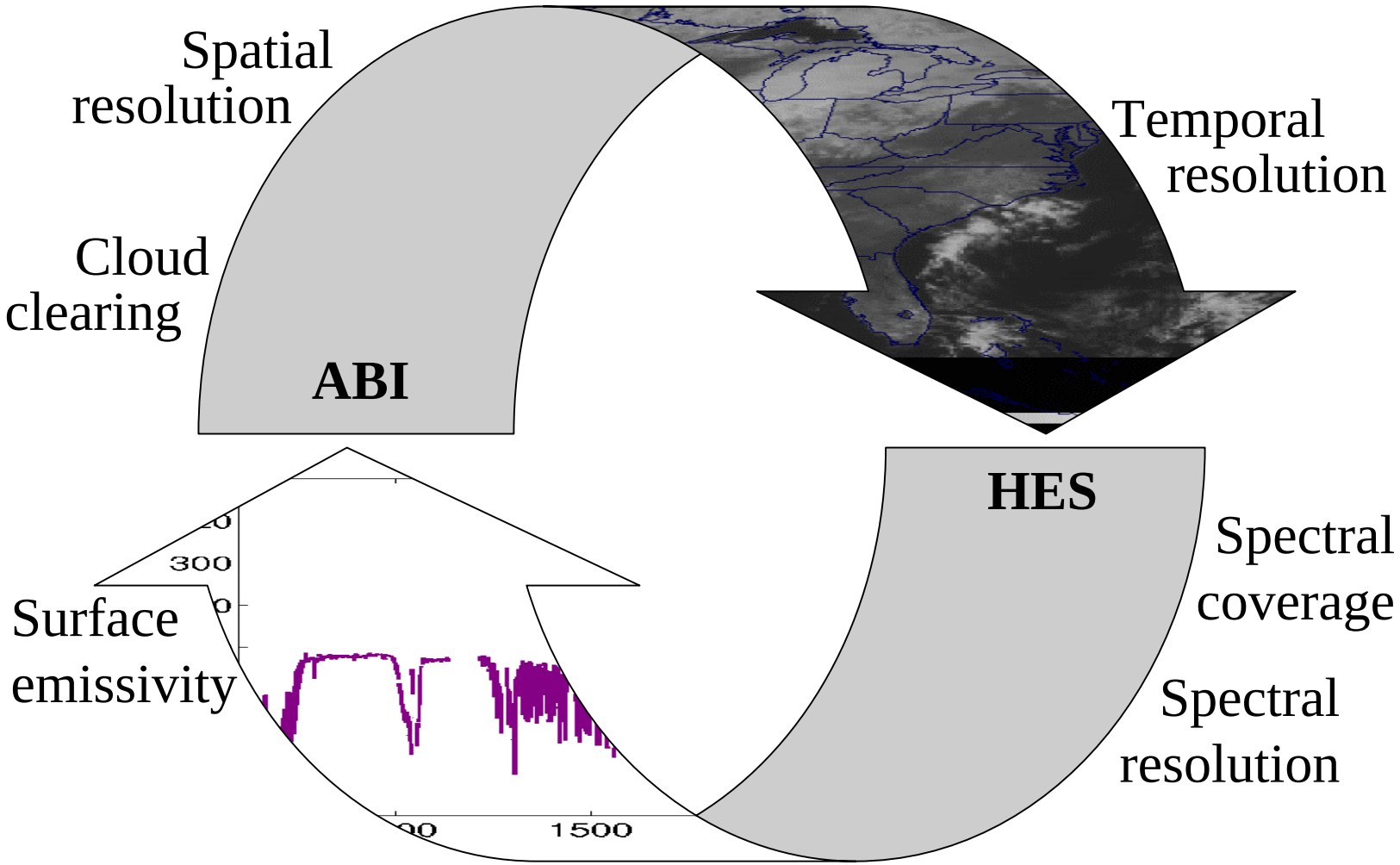
Enhanced "V"

Actual GOES



http://cimss.ssec.wisc.edu/goes/misc/000525.html

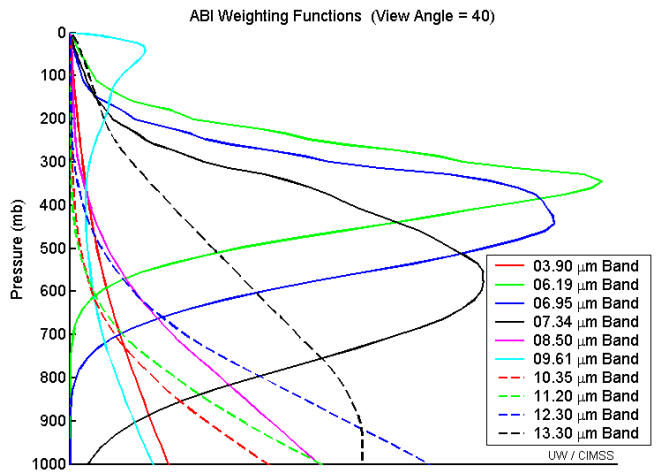
Best products will be realized from combinations of ABI *and* HES (Hyperspectral Environmental Suite) data (IR and Visible/near IR on the HES-Coastal Water)!



Summary -- ABI

ABI addresses Imager concerns by:

- increasing spatial resolution
  - closer to NWS goal of 0.5 km IR
- scanning faster
  - temporal sampling improved
  - more regions scanned
- adding bands
  - new and/or improved products enabled

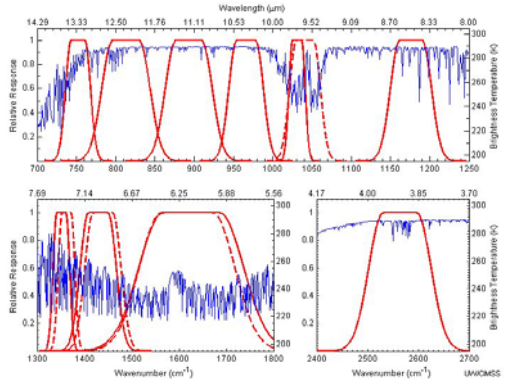


Simulations (from MODIS, AIRS, NAST-I and AVIRIS) show that the ABI addresses needs for cloud, moisture, and surface products.

Every product from the current GOES imager will be improved (for short-term weather, environmental and climate applications)!
Every band on the ABI will be used for a number of products.

ABI will allow exciting new products from geostationary orbit, especially when combined with data from the HES.

More information -- ABI



ABI Documentation from NASA:

- http://goes2.gsfc.nasa.gov/abihome.htm

ABI Research Home page:

- http://cimss.ssec.wisc.edu/goes/abi/

ABI Simulated images from NASA AIRS Direct Broadcast:

- http://cimss.ssec.wisc.edu/goes/abi/airs_broadcast/aniairs.html

GOES(-R) User Conferences (Third one will be May 10-13, 2004):

- http://www.osd.noaa.gov/announcement/index.htm

GOES and MODIS Galleries:

- http://cimss.ssec.wisc.edu/goes/misc/interesting_images.html
- http://terra.ssec.wisc.edu/~gumley/images.html

ABI Mock Spectral Response functions:

- ftp://ftp.ssec.wisc.edu/ABI/SRF

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