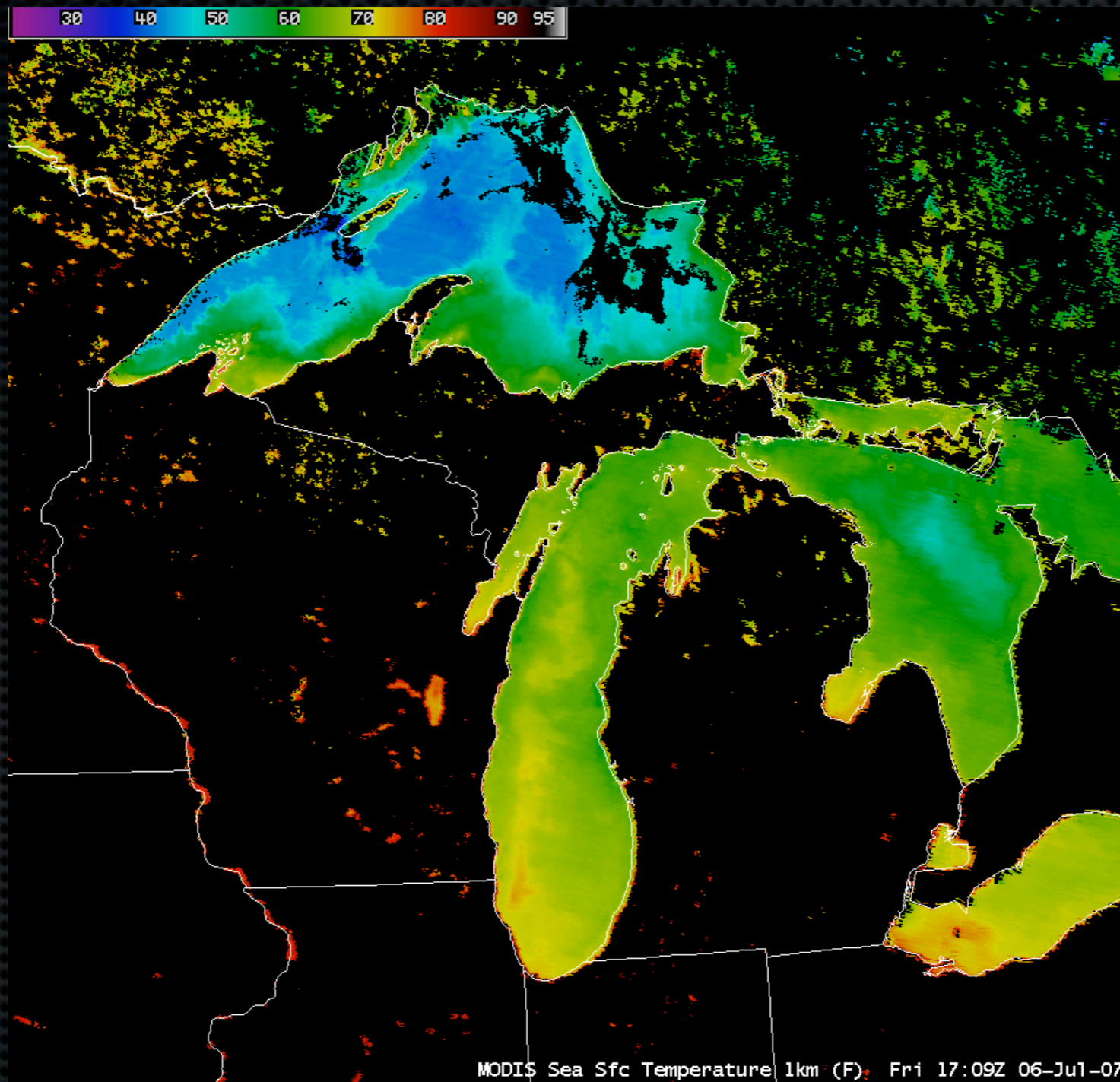


MODIS Products in AWIPS: Using Research Satellites in Operations



Scott Bachmeier, Jordan Gerth, Kathleen Strabala

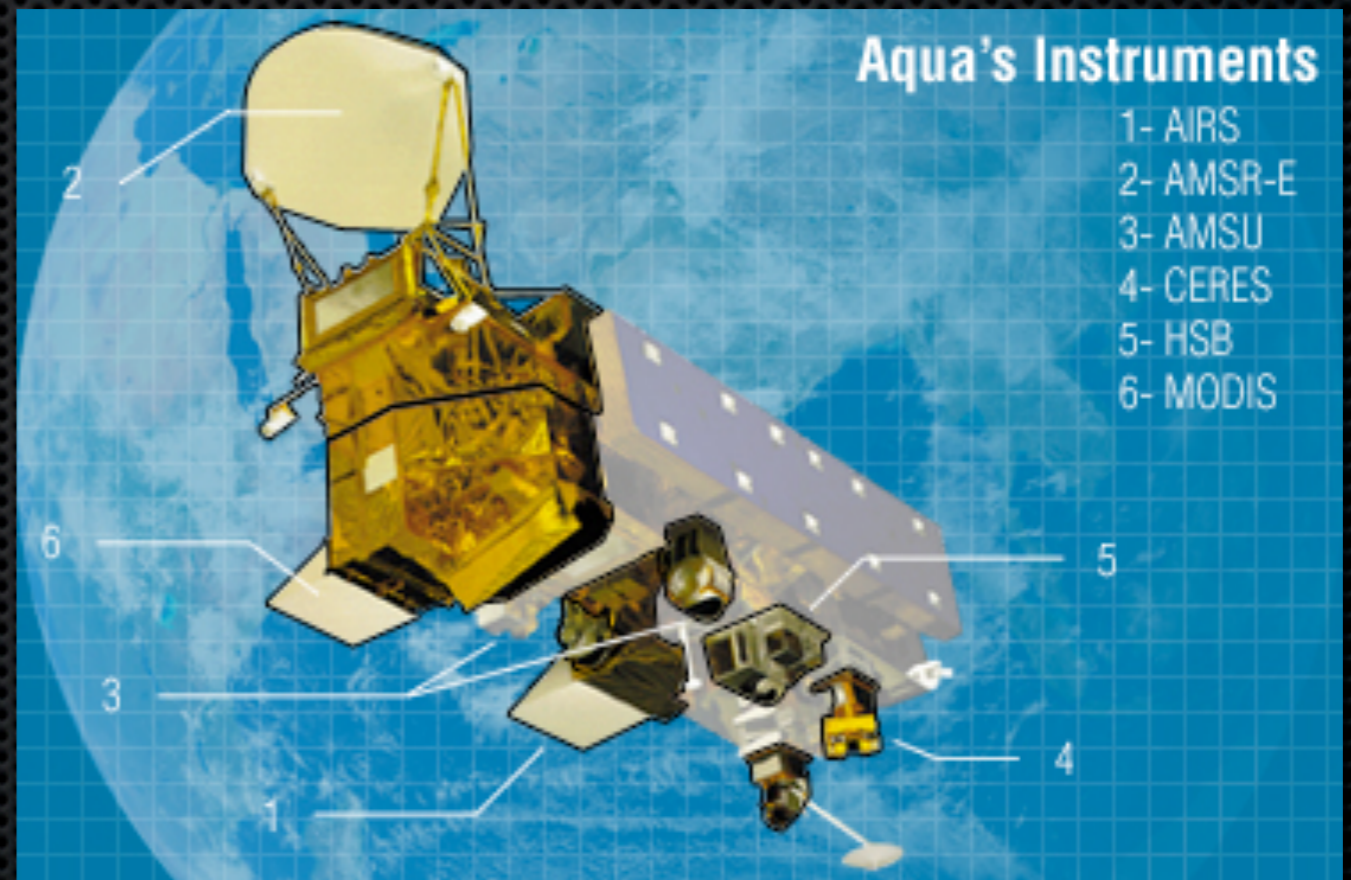
Cooperative Institute for Meteorological Satellite Studies (CIMSS) • University of Wisconsin - Madison

16th US-Canadian Great Lakes Operational Meteorology Workshop • September 2007

MODIS

MODerate resolution Imaging Spectroradiometer

- ✦ Terra/Aqua satellites
- ✦ 36 spectral bands
- ✦ Visible and InfraRed
- ✦ 250 / 500 / 1000 m spatial resolution



MODIS

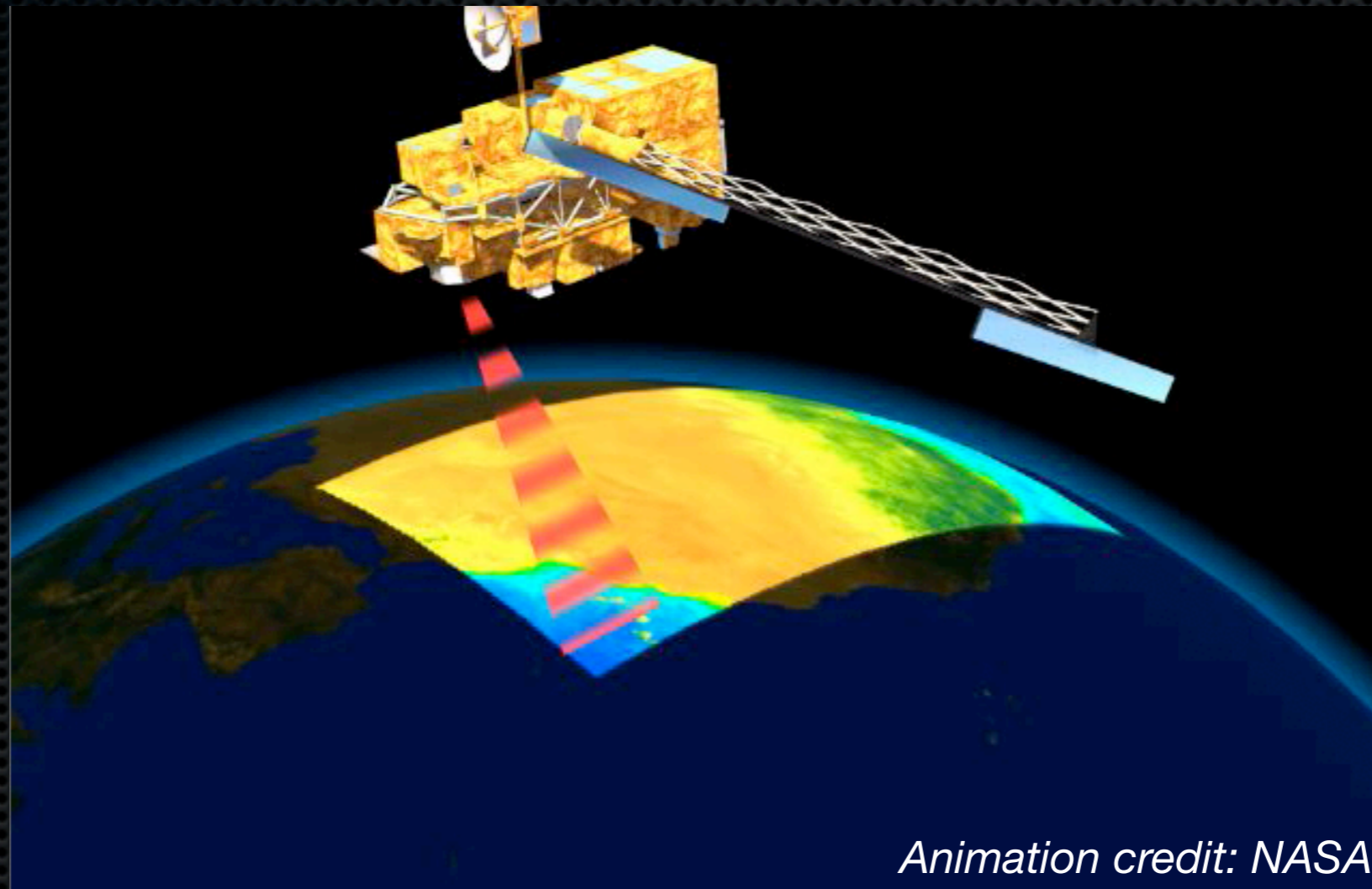
MODerate resolution Imaging Spectroradiometer

Primary Use	Band	Bandwidth ¹
Land/Cloud/Aerosols Boundaries	1	620 - 670
	2	841 - 876
Land/Cloud/Aerosols Properties	3	459 - 479
	4	545 - 565
	5	1230 - 1250
	6	1628 - 1652
	7	2105 - 2155
Ocean Color/ Phytoplankton/ Biogeochemistry	8	405 - 420
	9	438 - 448
	10	483 - 493
	11	526 - 536
	12	546 - 556
	13	662 - 672
	14	673 - 683
	15	743 - 753
Atmospheric Water Vapor	16	862 - 877
	17	890 - 920
	18	931 - 941
	19	915 - 965

Primary Use	Band	Bandwidth ¹
Surface/Cloud Temperature	20	3.660 - 3.840
	21	3.929 - 3.989
	22	3.929 - 3.989
	23	4.020 - 4.080
Atmospheric Temperature	24	4.433 - 4.498
	25	4.482 - 4.549
Cirrus Clouds Water Vapor	26	1.360 - 1.390
	27	6.535 - 6.895
	28	7.175 - 7.475
Cloud Properties	29	8.400 - 8.700
Ozone	30	9.580 - 9.880
Surface/Cloud Temperature	31	10.780 - 11.280
	32	11.770 - 12.270
Cloud Top Altitude	33	13.185 - 13.485
	34	13.485 - 13.785
	35	13.785 - 14.085
	36	14.085 - 14.385

Terra and Aqua Satellites

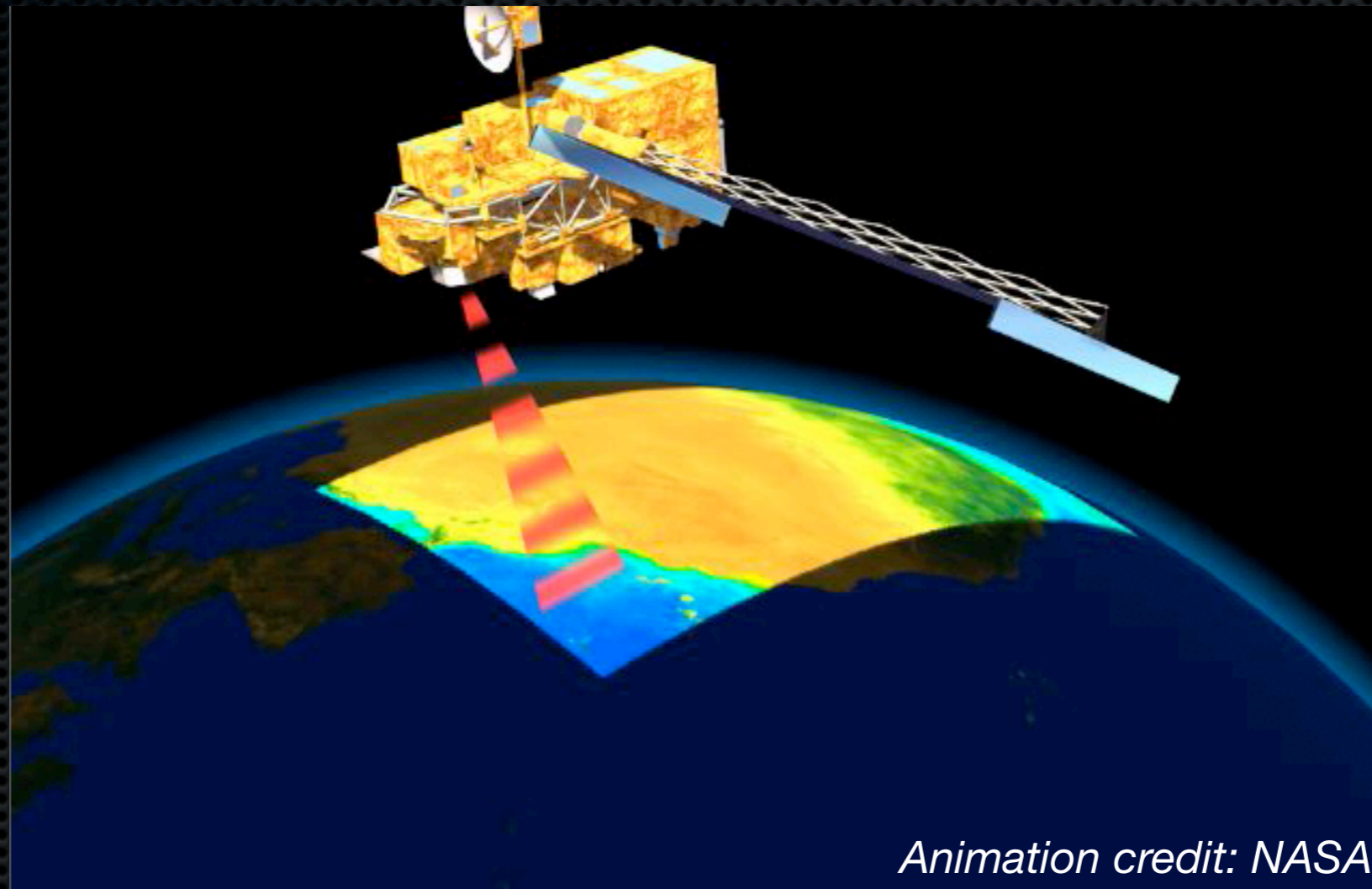
NASA Earth Observation System (EOS) Satellites



- Polar-orbit (702 km orbit altitude)
- 4 orbits per day over the Great Lakes
- 2330 km wide swath

Terra and Aqua Satellites

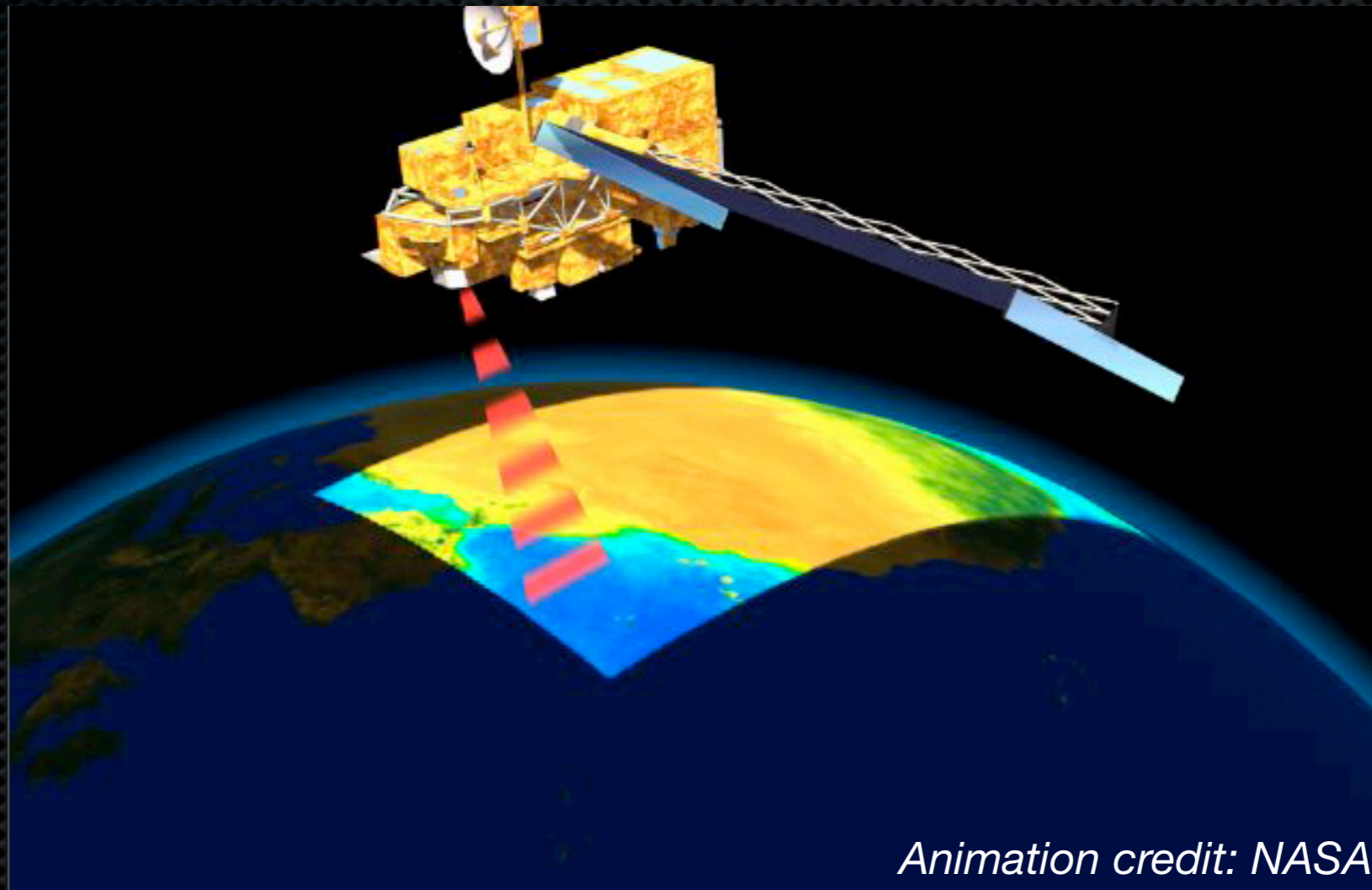
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Terra and Aqua Satellites

NASA Earth Observation System (EOS) Satellites

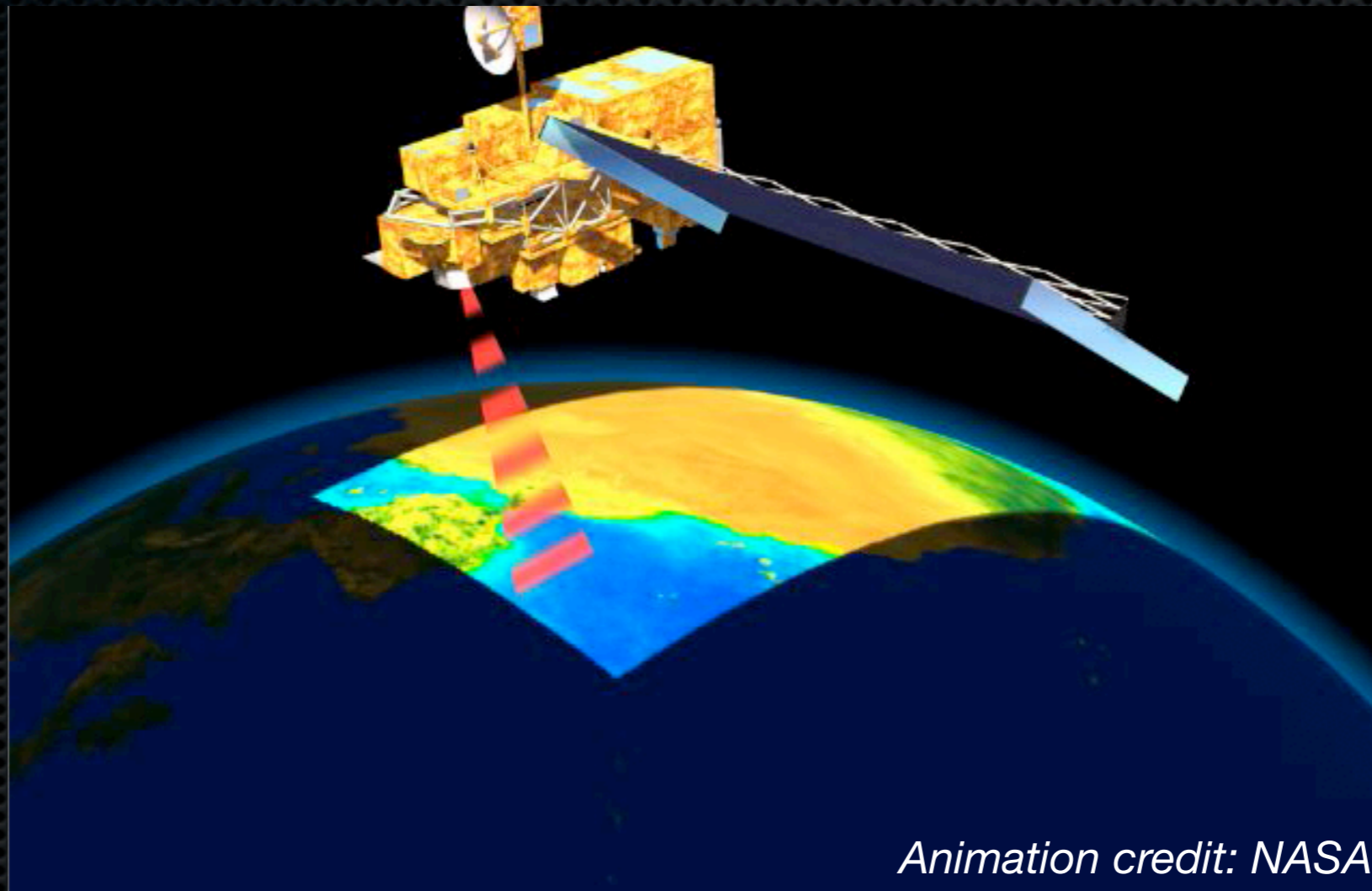


Animation credit: NASA

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Terra and Aqua Satellites

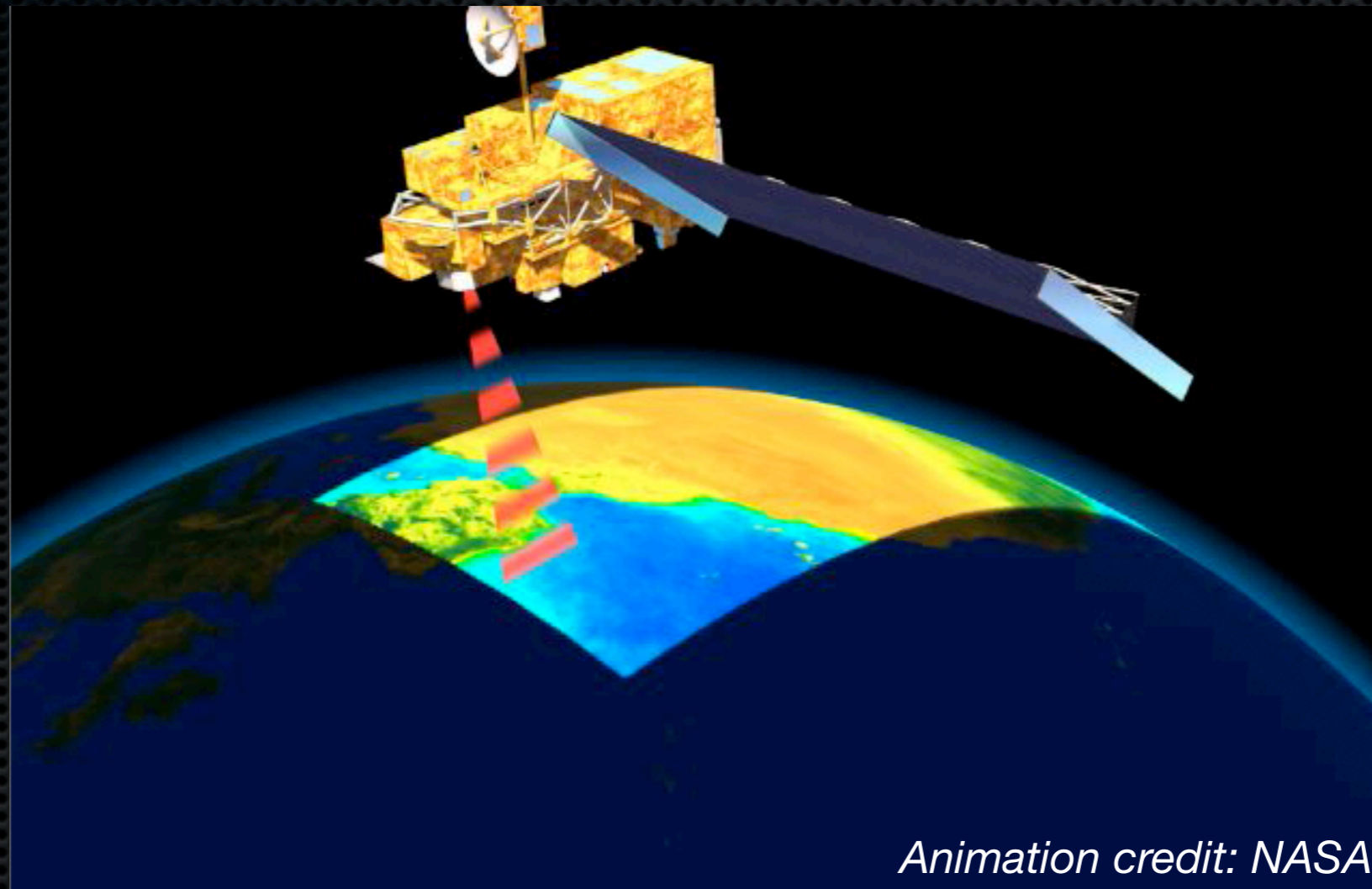
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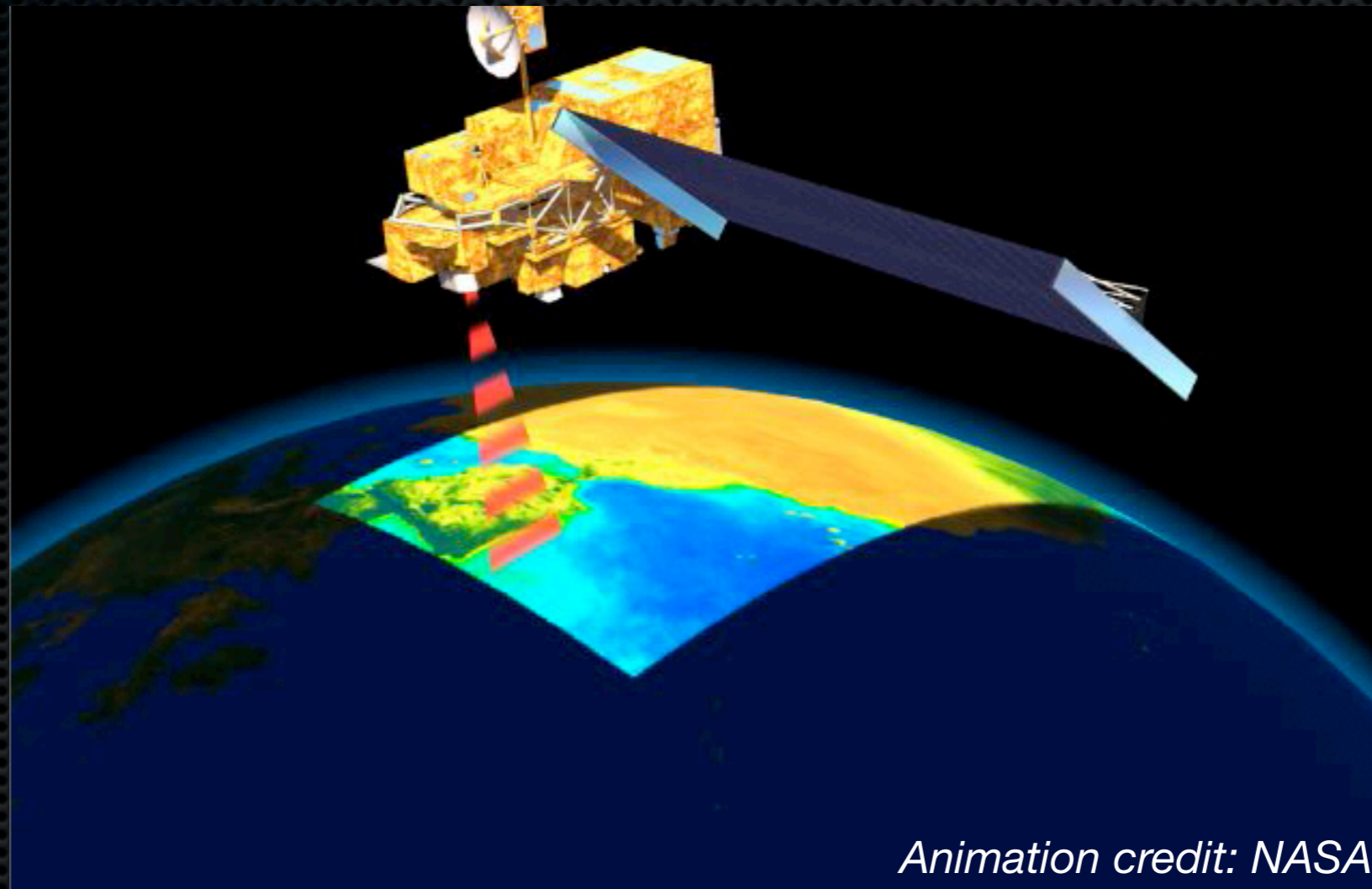
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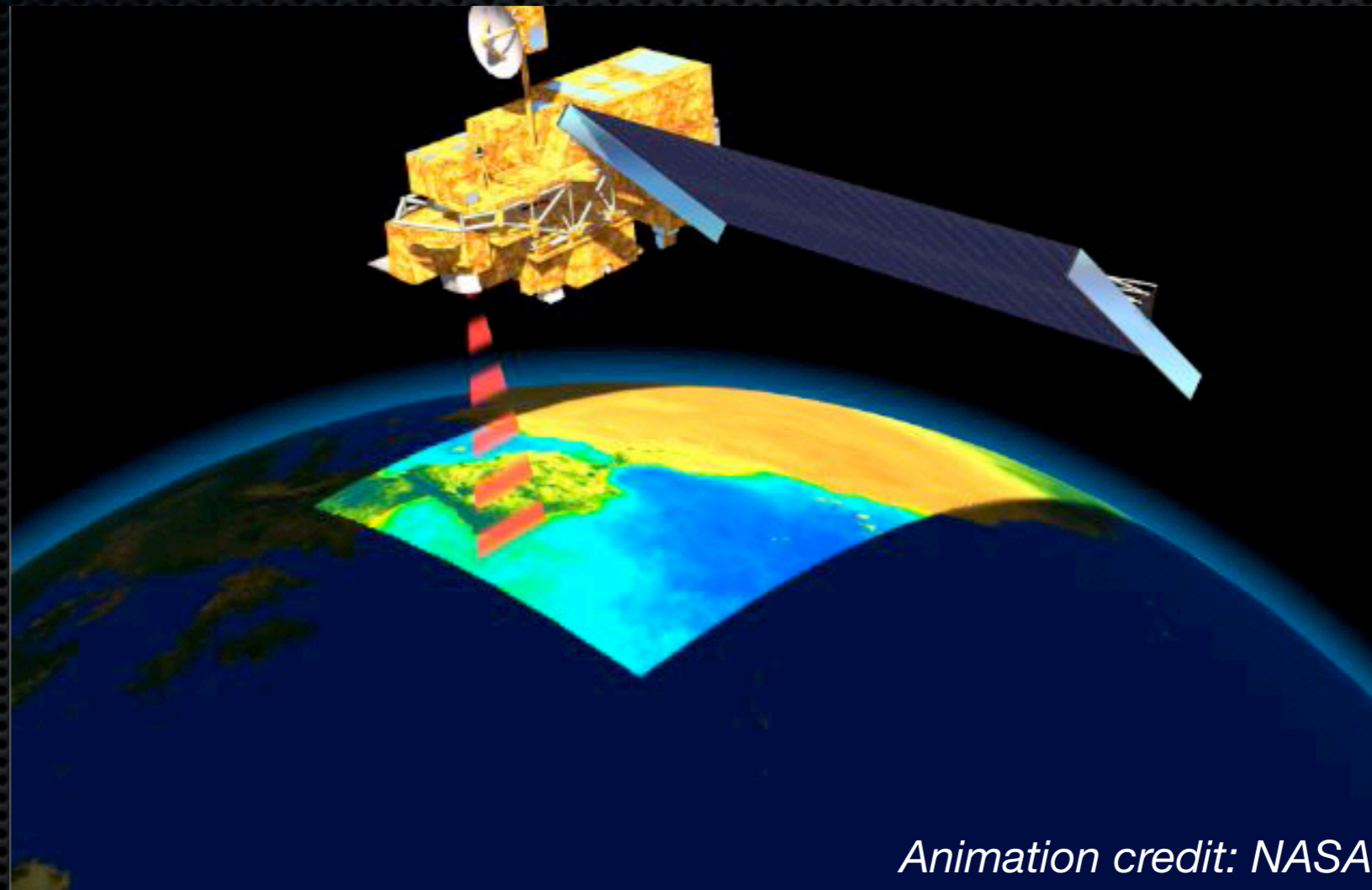
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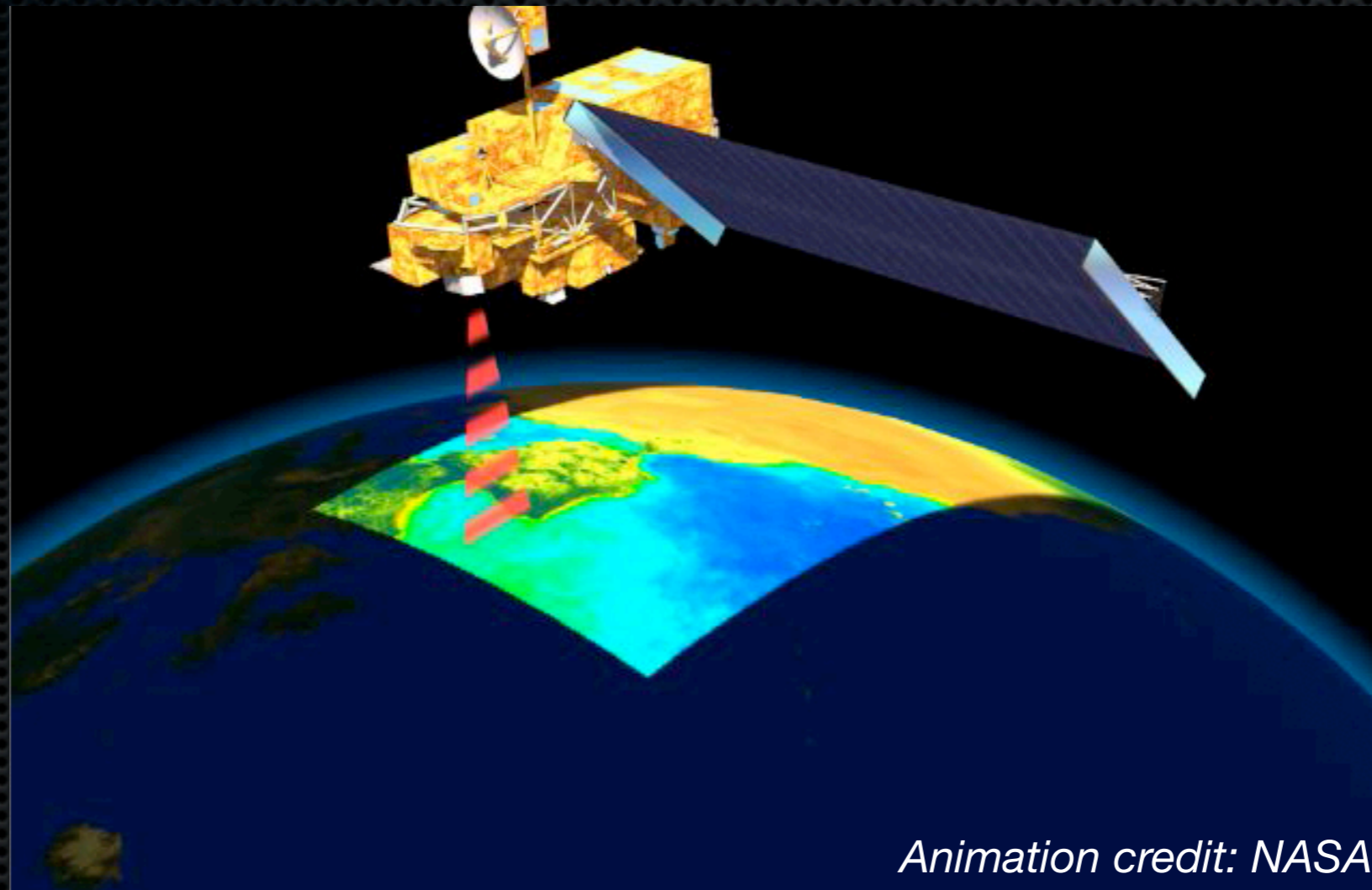


Animation credit: NASA

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Terra and Aqua Satellites

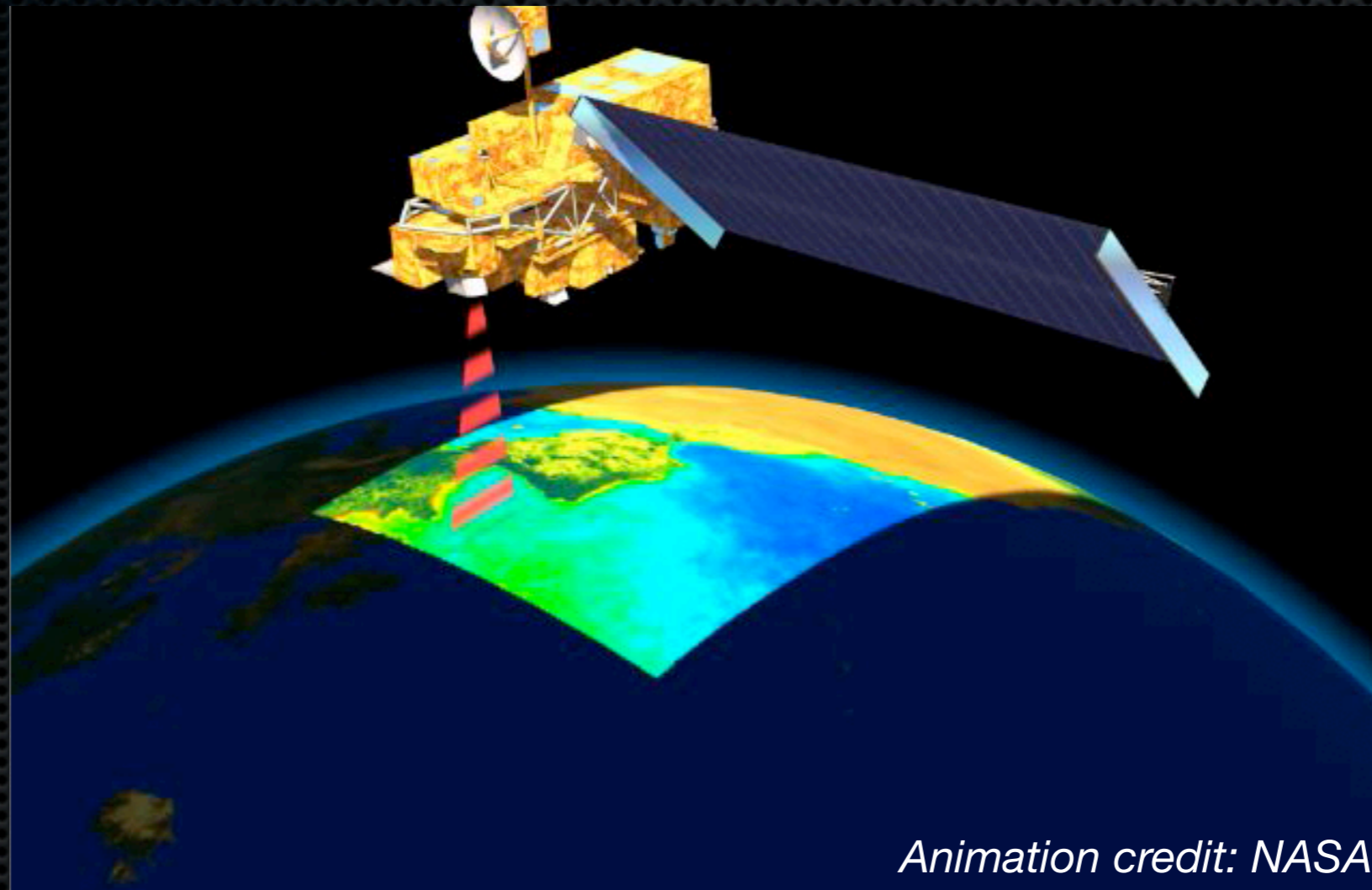
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Terra and Aqua Satellites

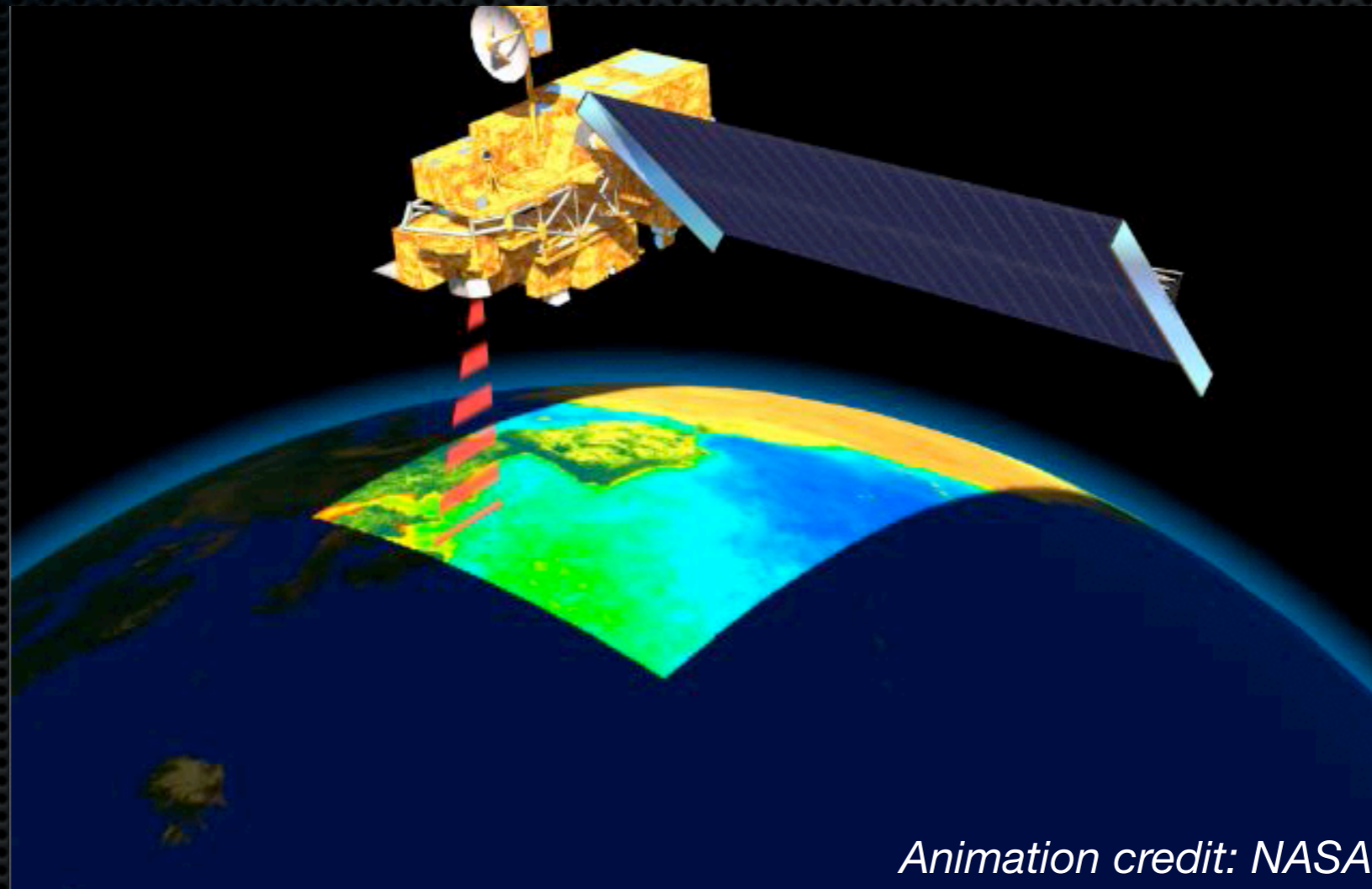
NASA Earth Observation System (EOS) Satellites



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Terra and Aqua Satellites

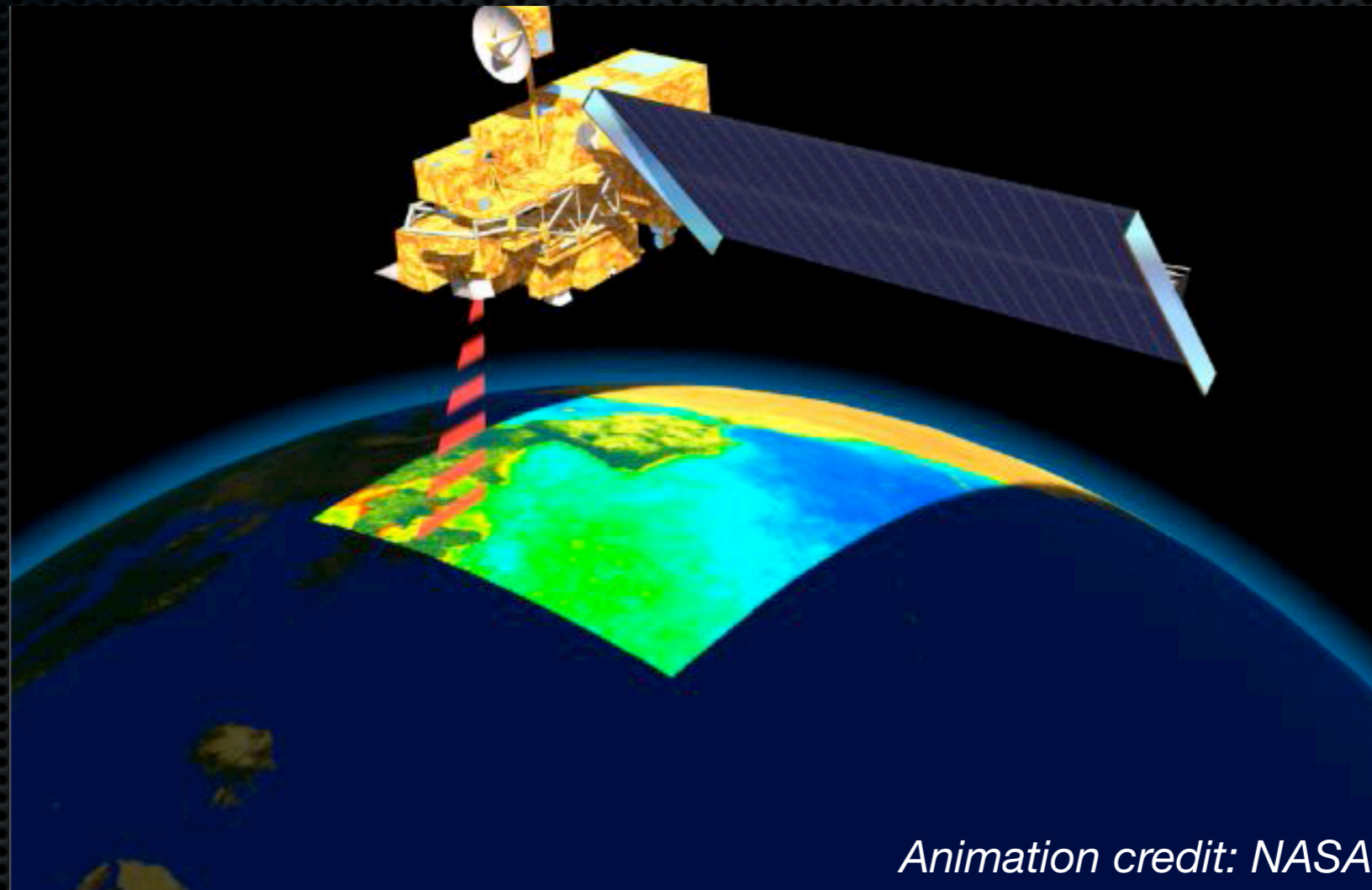
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NASA Earth Observation System (EOS) Satellites

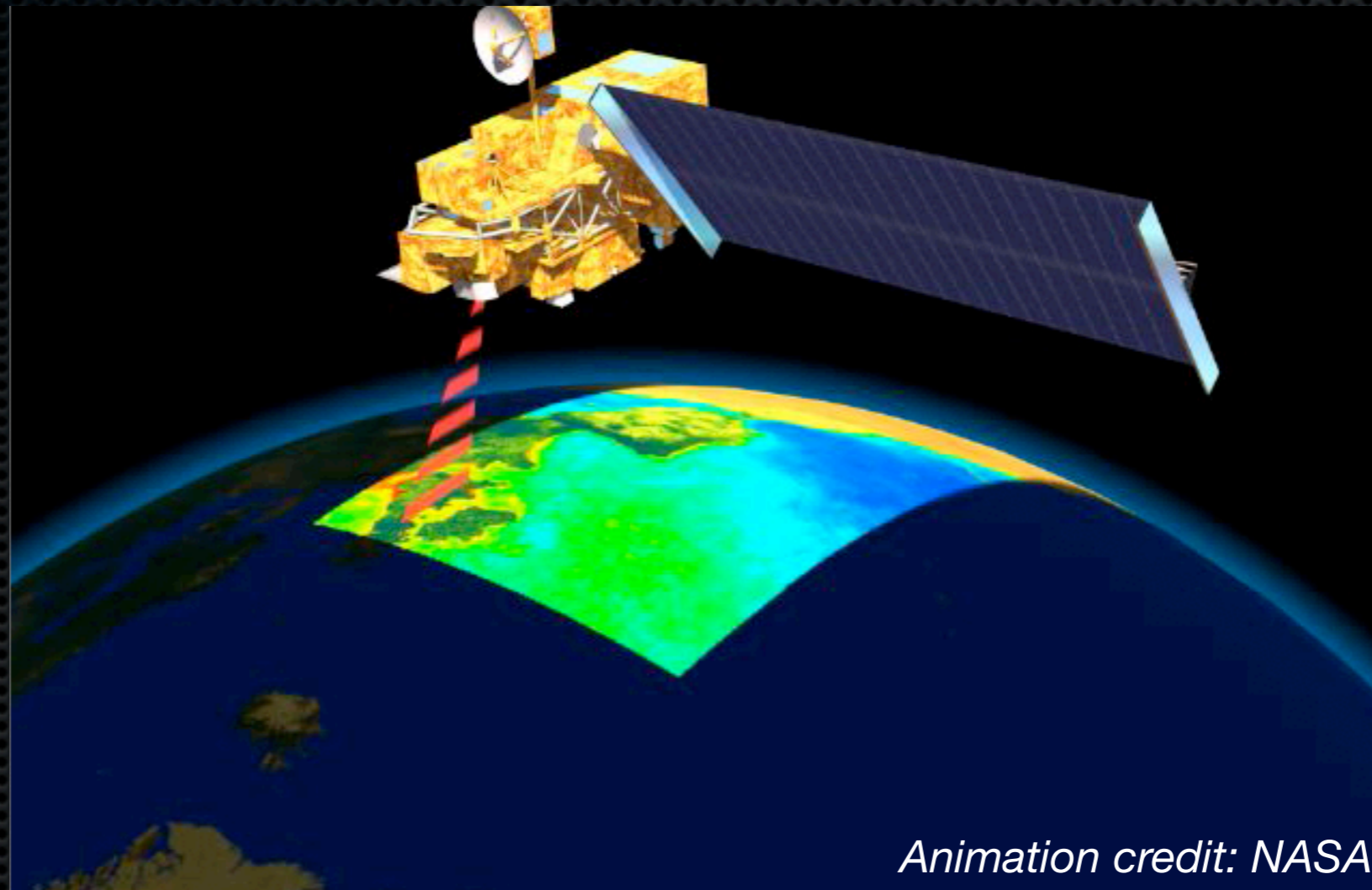


Animation credit: NASA

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Terra and Aqua Satellites

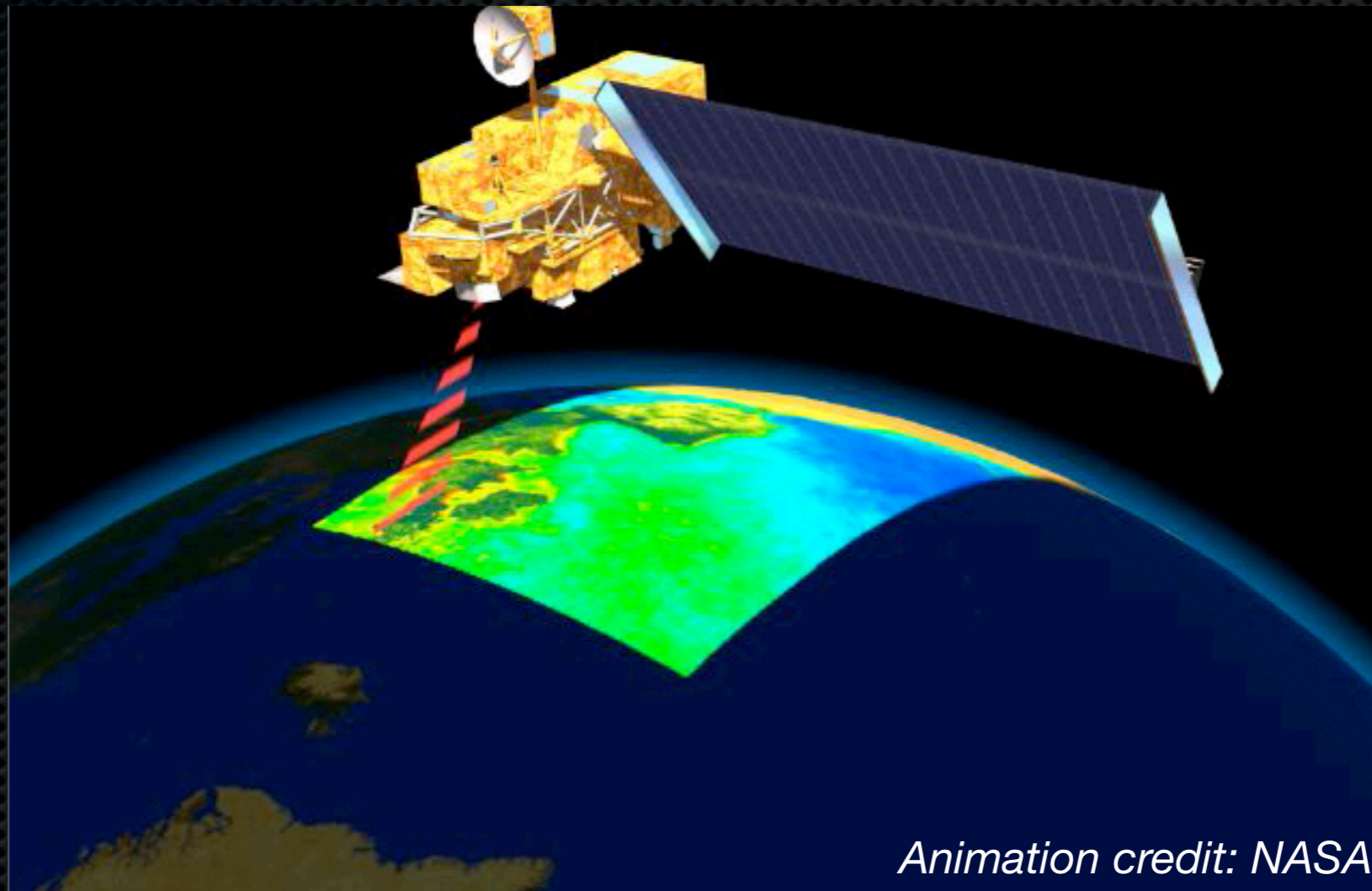
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Terra and Aqua Satellites

NASA Earth Observation System (EOS) Satellites

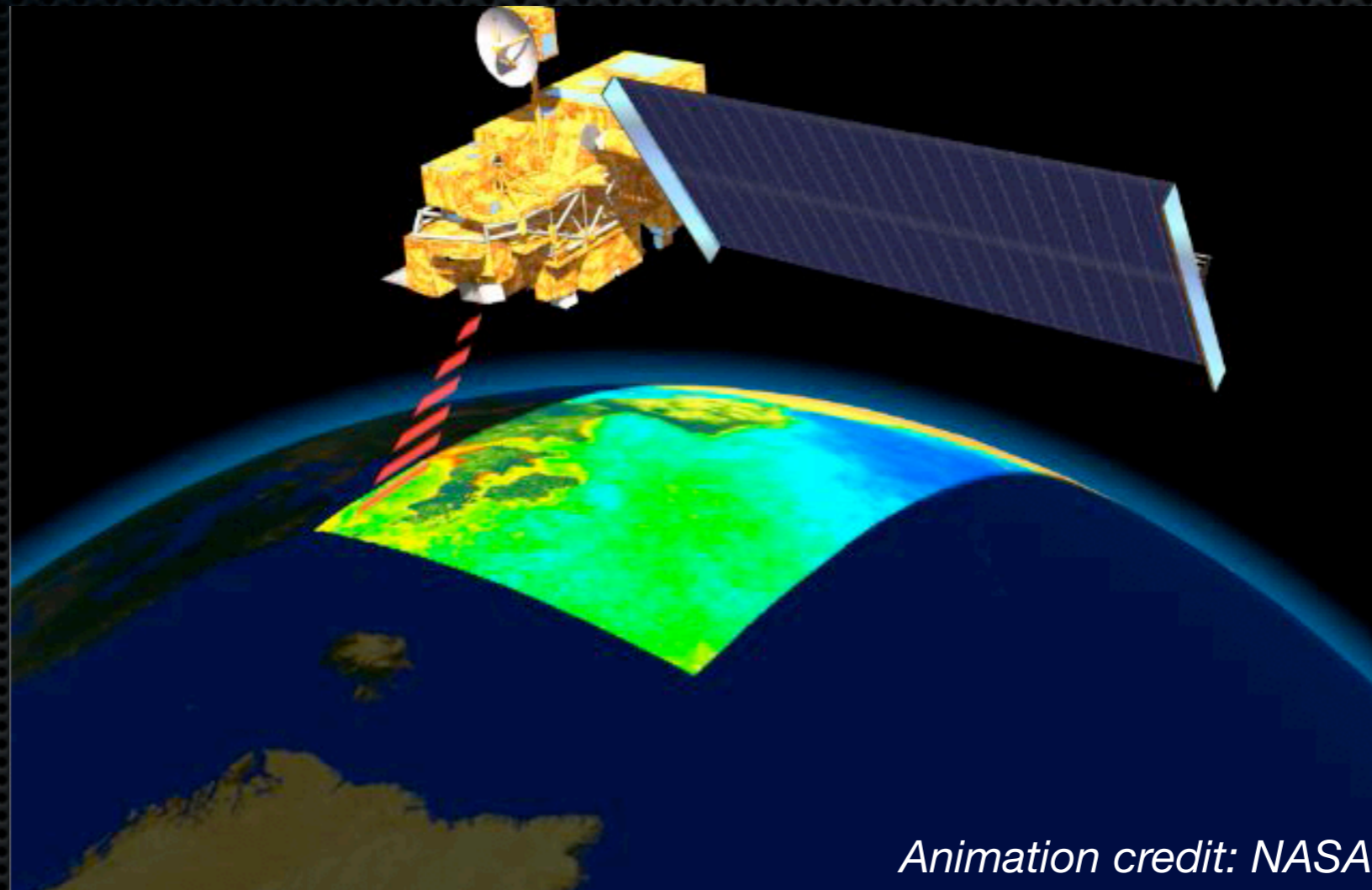


Animation credit: NASA

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Terra and Aqua Satellites

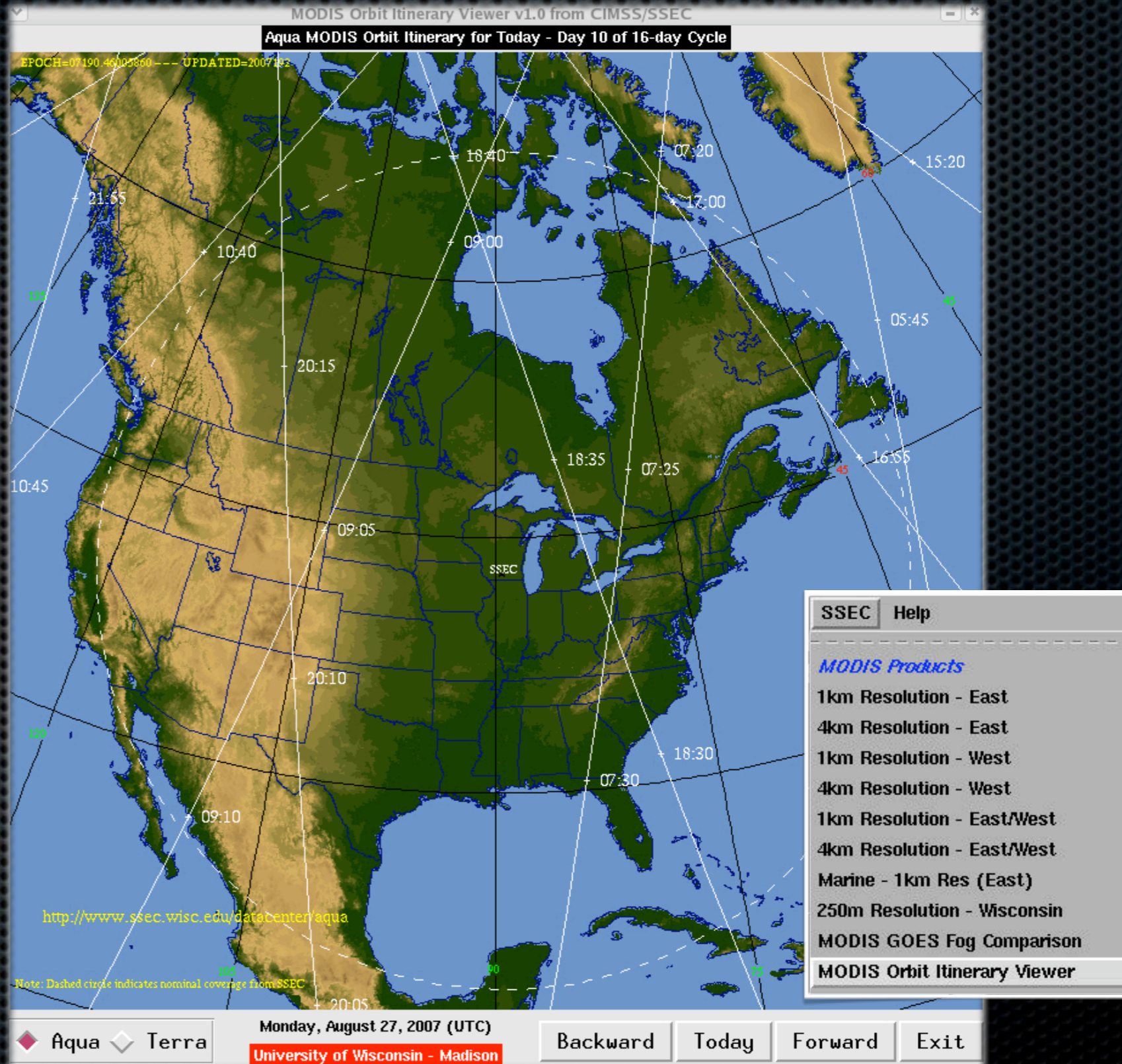
NASA Earth Observation System (EOS) Satellites



- Polar-orbit (702 km orbit altitude)
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MODIS Direct Broadcast Ground Station

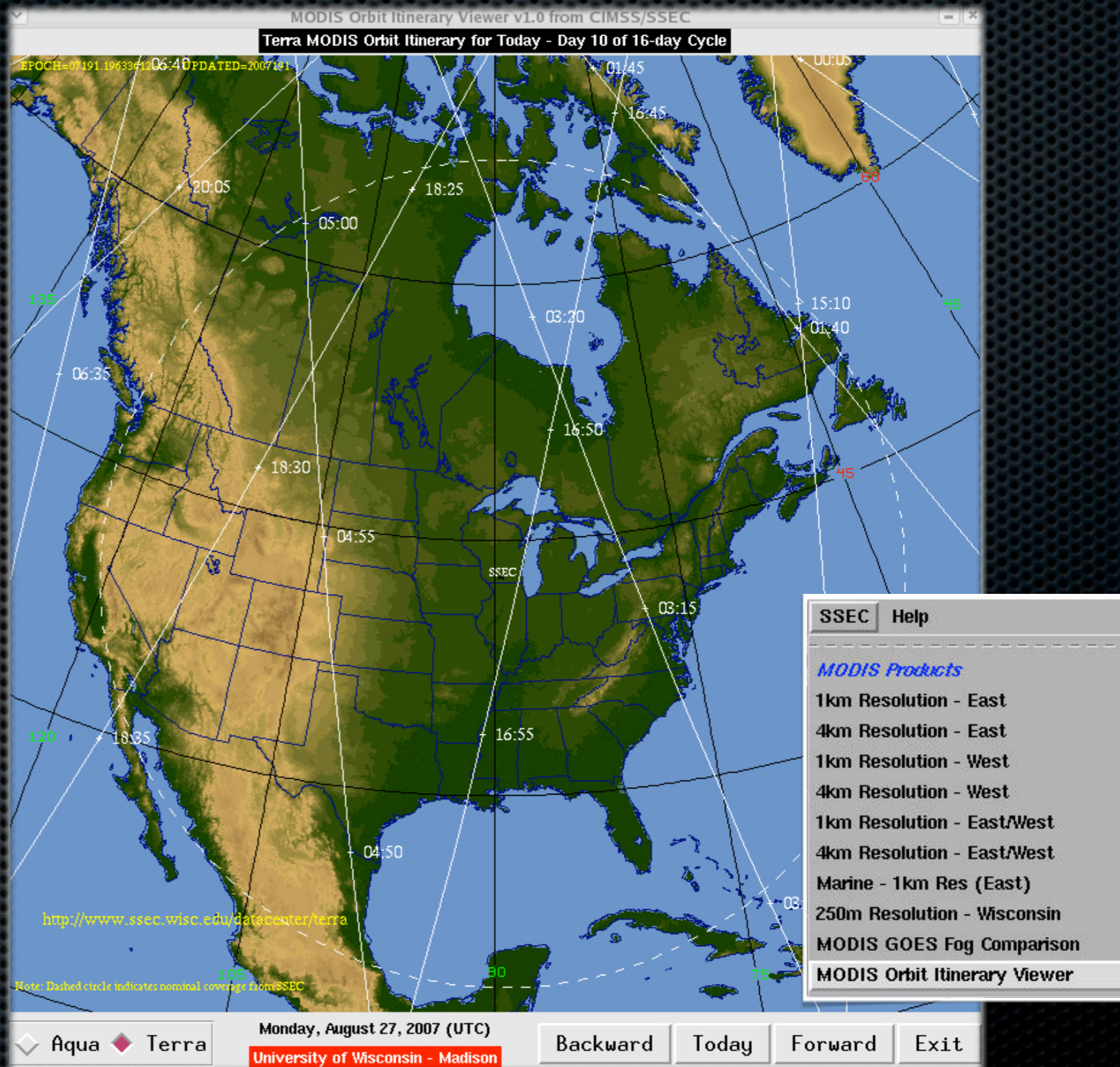
Space Science and Engineering Center (SSEC), UW-Madison



SSEC → NWS Regional Headquarters → LDM subscription at WFO

MODIS Direct Broadcast Ground Station

Space Science and Engineering Center (SSEC), UW-Madison



SSEC → NWS Regional Headquarters → LDM subscription at WFO

MODIS 1km Imagery and 4km Products in AWIPS

- ✦ Band 1 - (0.6 μ m) - Visible
- ✦ Band 7 - (2.1 μ m) - Snow/ice detection
- ✦ Band 20 - (3.7 μ m) - Shortwave IR
- ✦ Band 26 - (1.3 μ m) - Cirrus detection
- ✦ Band 27 - (6.7 μ m) - Water vapor
- ✦ Band 31 - (11.0 μ m) - IR window
- ✦ 11 μ m - 3.7 μ m - Fog/stratus product
- ✦ Total precipitable water (TPW)
- ✦ Cloud phase
- ✦ Cloud top temperature
- ✦ Sea surface temperature (SST)

The screenshot displays the AWIPS interface with a menu on the left and a map on the right. The menu is organized into several sections:

- MODIS Products**
 - 1km Resolution - East
 - 4km Resolution - East
 - 1km Resolution - West
 - 4km Resolution - West
 - 1km Resolution - East/West
 - 4km Resolution - East/West
 - Marine - 1km Res (East)
 - 250m Resolution - Wisconsin
 - MODIS GOES Fog Comparison
 - MODIS Orbit Itinerary Viewer
- CRAS Prediction**
 - Eastern CONUS
 - Western CONUS
 - Combination CONUS
 - Alaska
- GOES Sounder Extras**
 - Eastern CONUS
 - Western CONUS
- Convective Initiation**
 - Alabama Sector
 - Wisconsin Sector
 - High Density Winds
 - Upper Air Plots
- MADIS Experimental GOES Winds**
 - GOES 1h High Density Winds

On the right side, a pop-up window titled "MODIS Products" lists the following items with their corresponding IDs:

Product Name	ID
MODIS Visible 1km - Band 1	30.1539
MODIS Snow/Ice 1km - Band 7	30.1539
MODIS Cirrus 1km - Band 26	30.1539
MODIS 3.7um 1km - Band 20 (C)	30.1539
MODIS Water Vapor 1km - Band 27 (C)	30.1539
MODIS IR Window - Band 31 (C)	30.1539
MODIS 11um - 3.7um Product 1km (C)	30.0928
MODIS Derived 11um - 3.7um 1km (C)	30.1539

The map on the right shows a satellite view of the Eastern United States and the Gulf of Mexico, with a color-coded overlay representing a MODIS product, likely water vapor or cloud phase, showing higher values (yellow/orange) over the Gulf and lower values (black) over the land.

MODIS 1km Imagery and 4km Products in AWIPS

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- ✦ 11 μ m - 3.7 μ m - Fog/stratus product
- ✦ Total precipitable water (TPW)
- ✦ Cloud phase
- ✦ Cloud top temperature
- ✦ Sea surface temperature (SST)

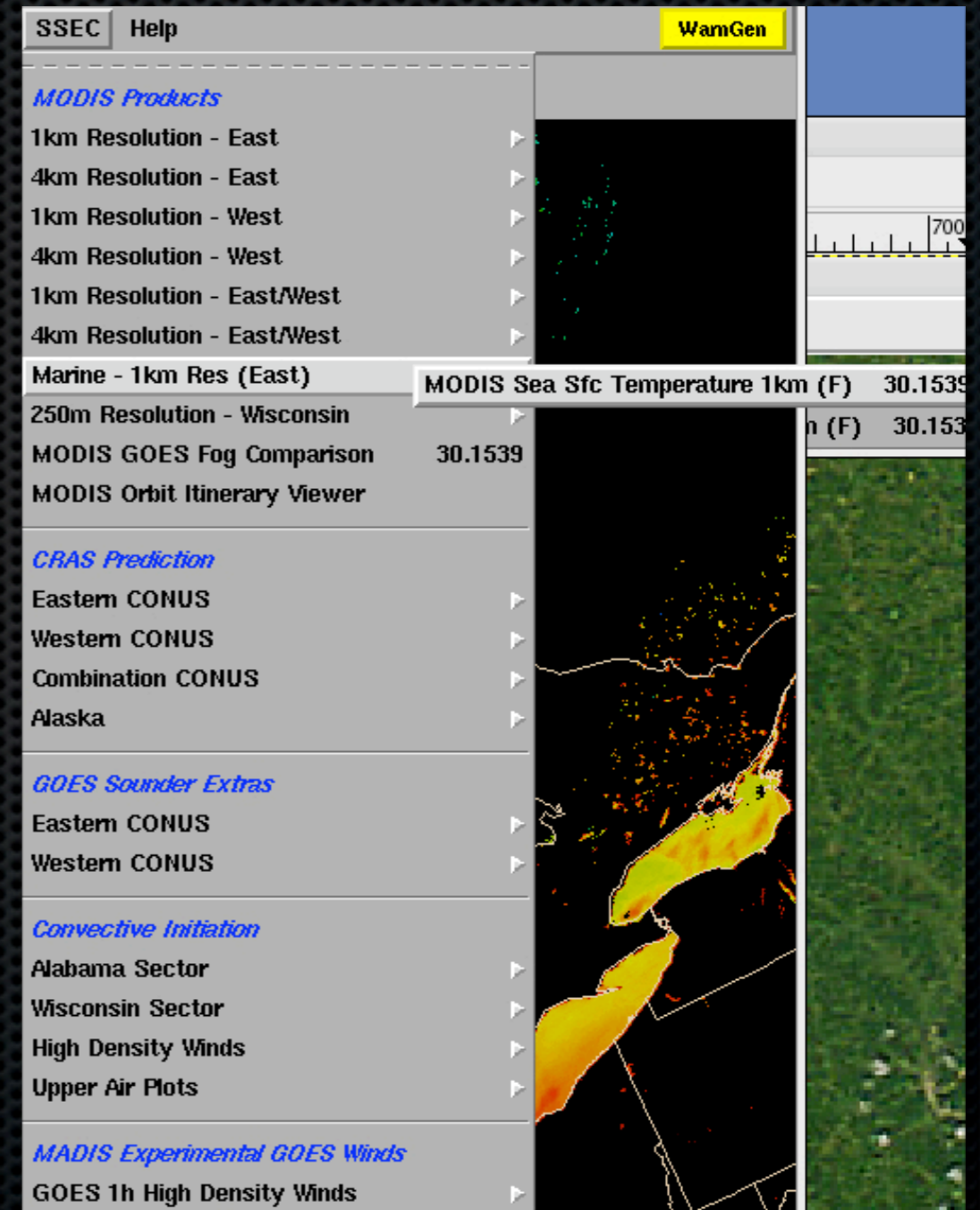
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 - Alaska
- GOES Sounder Extras**
 - Eastern CONUS
 - Western CONUS
- Convective Initiation**
 - Alabama Sector
 - Wisconsin Sector
 - High Density Winds
 - Upper Air Plots
- MADIS Experimental GOES Winds**
 - GOES 1h High Density Winds

The map on the right shows a satellite image of the Eastern CONUS region, with a yellow and orange overlay indicating cloud top temperature or other meteorological data. A vertical strip of a different image is visible on the far right edge.

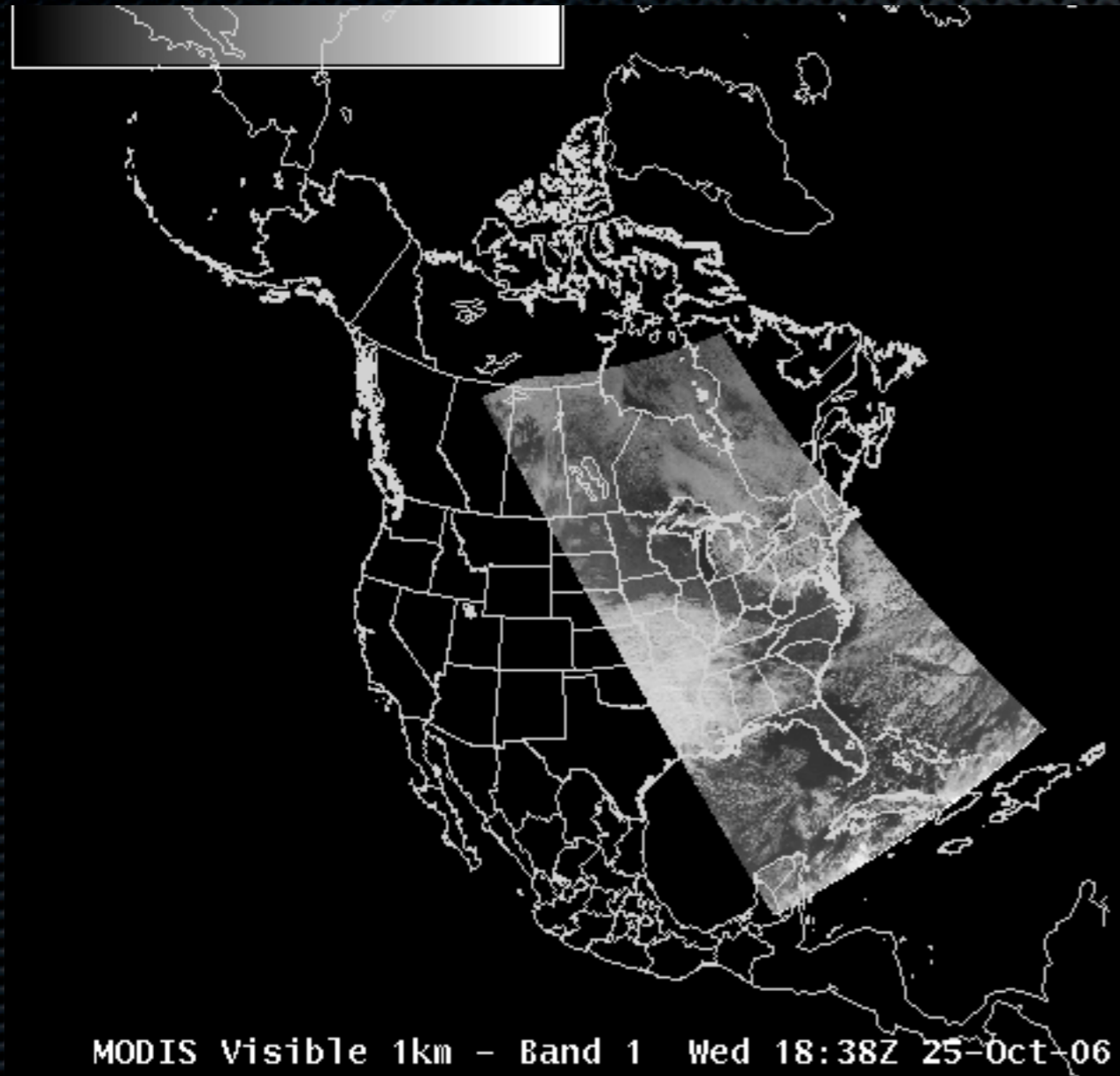
MODIS 1km Imagery and 4km Products in AWIPS

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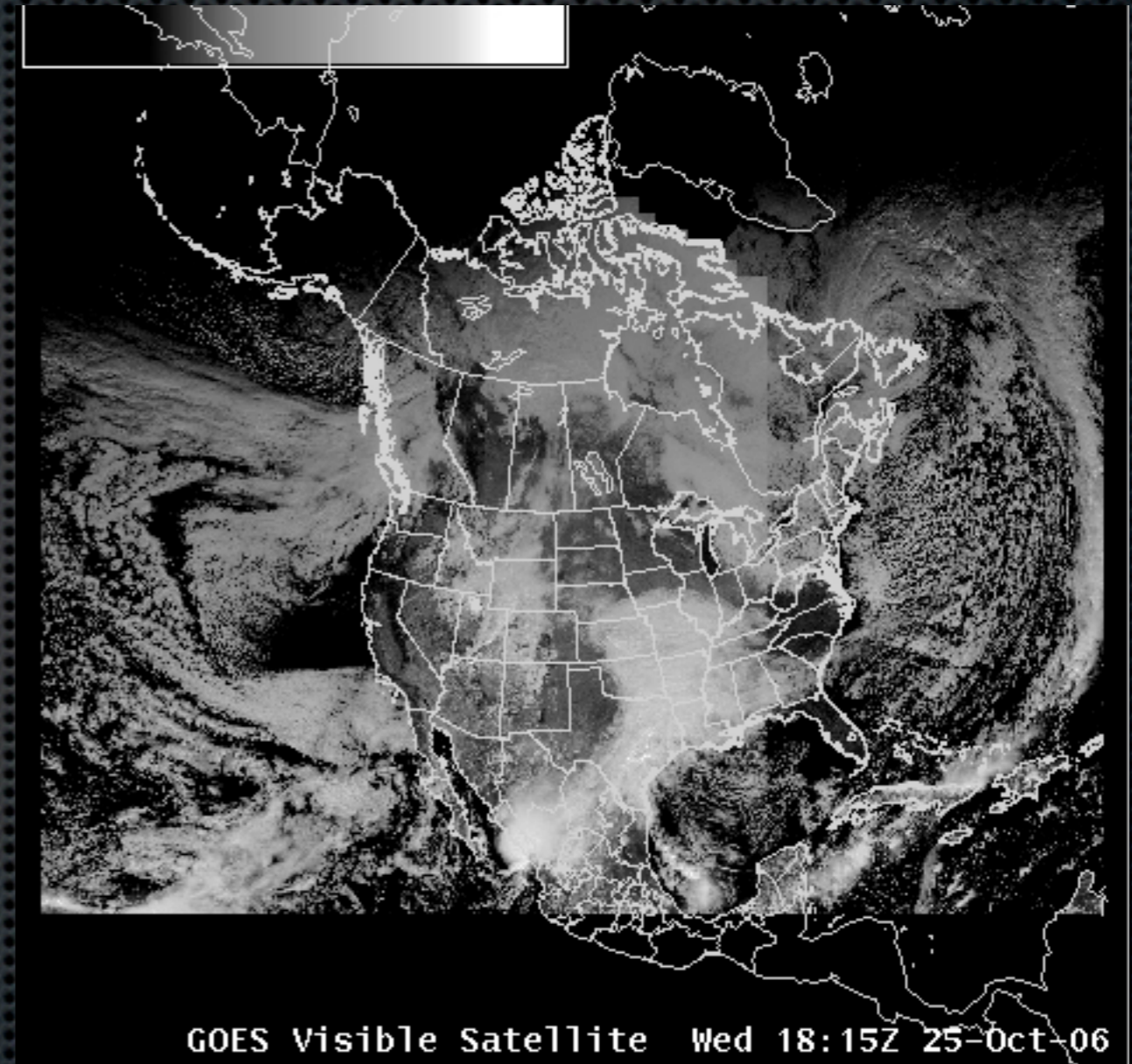


MODIS Imagery in AWIPS

Band 1: Visible channel (0.6 μ m)



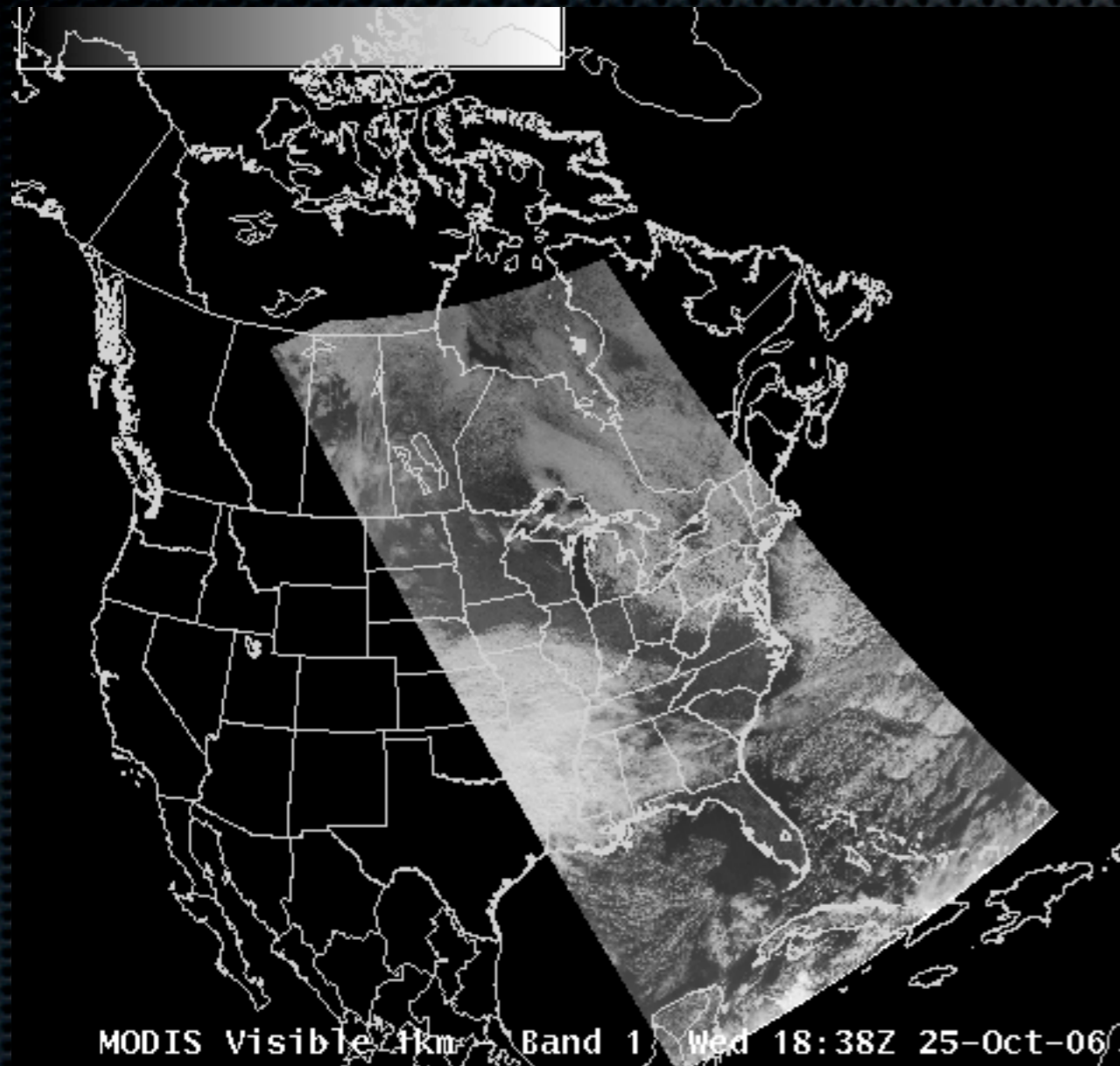
MODIS visible channel



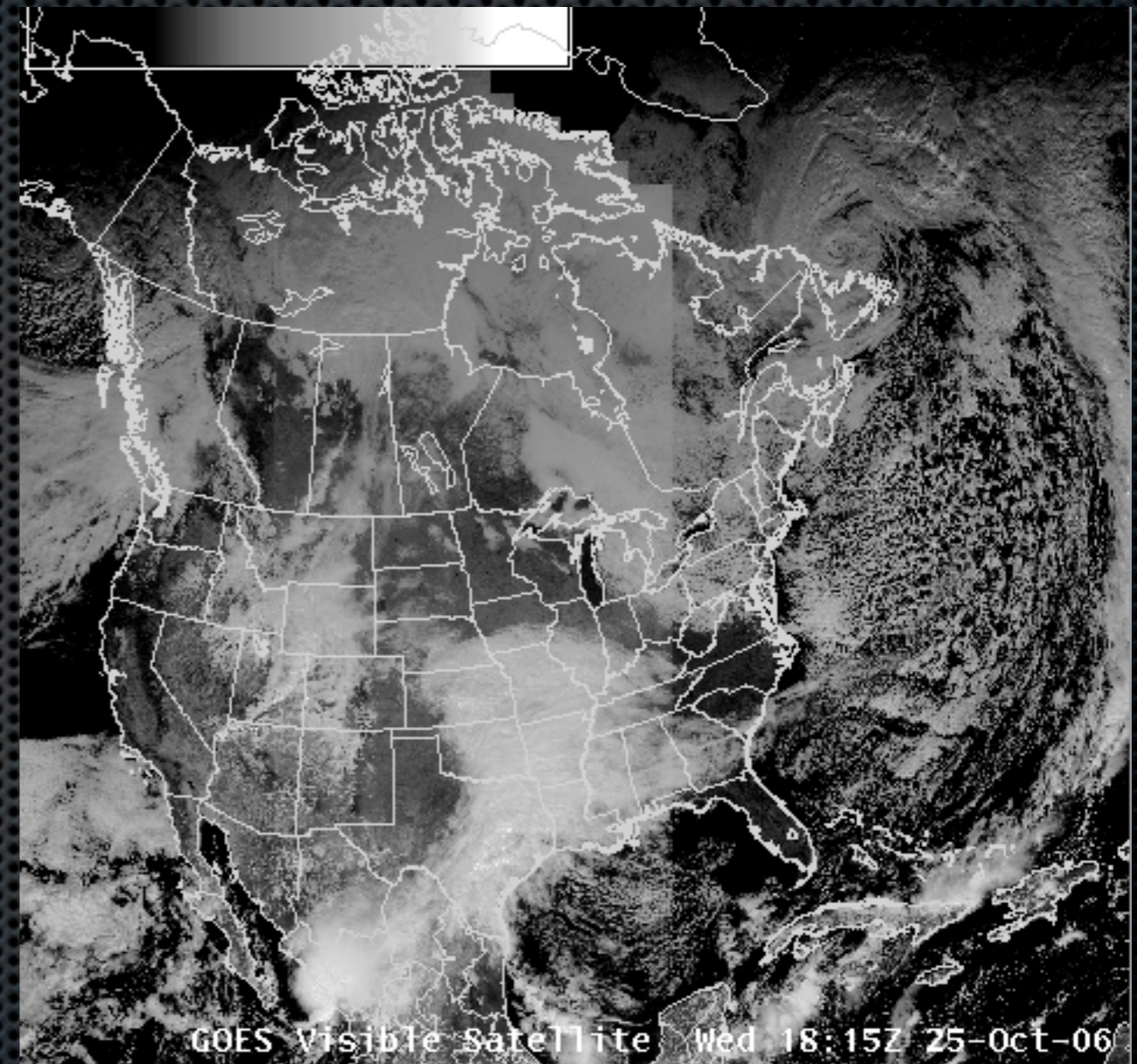
GOES visible channel

MODIS Imagery in AWIPS

Band 1: Visible channel (0.6 μ m)



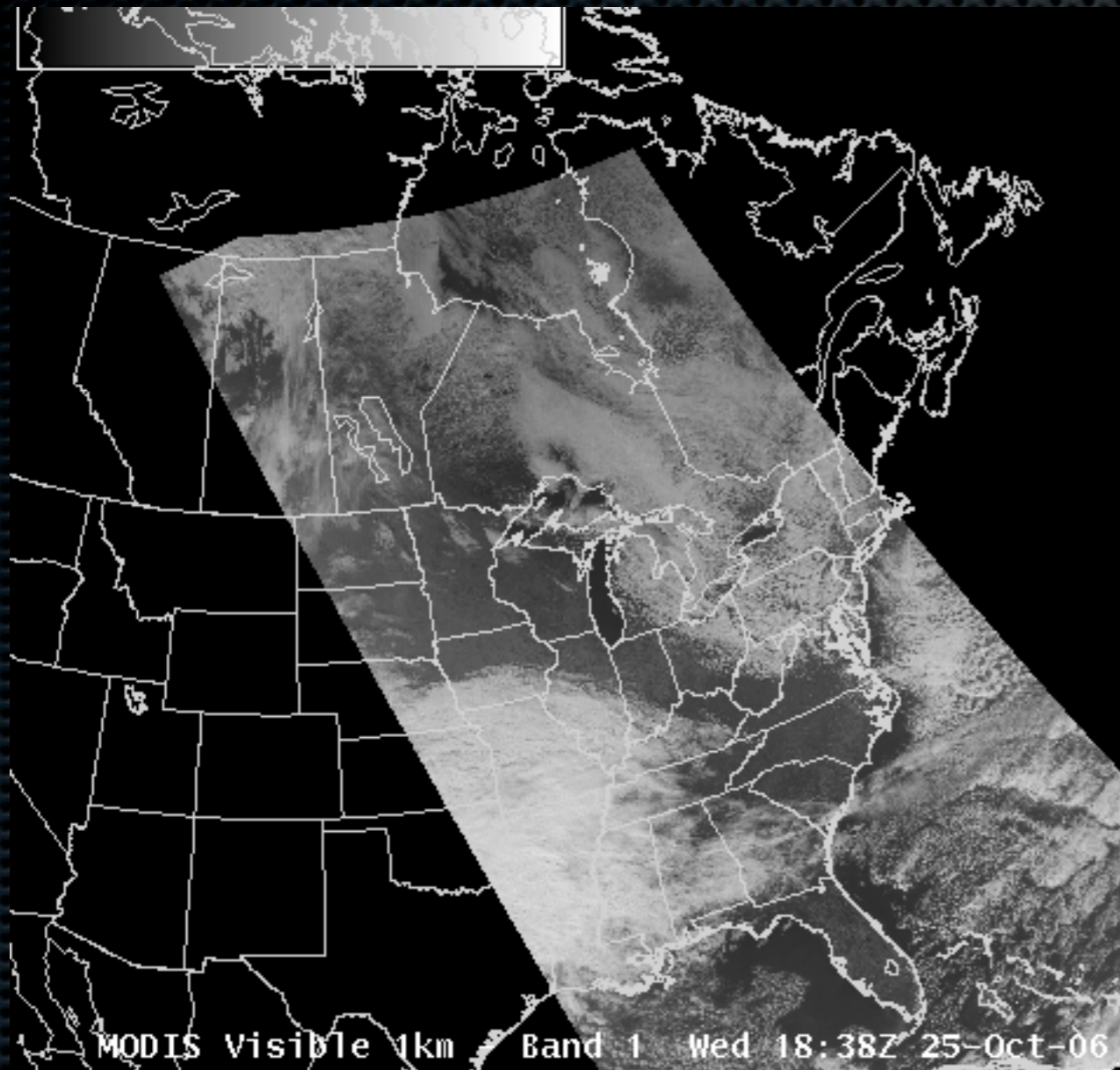
MODIS visible channel



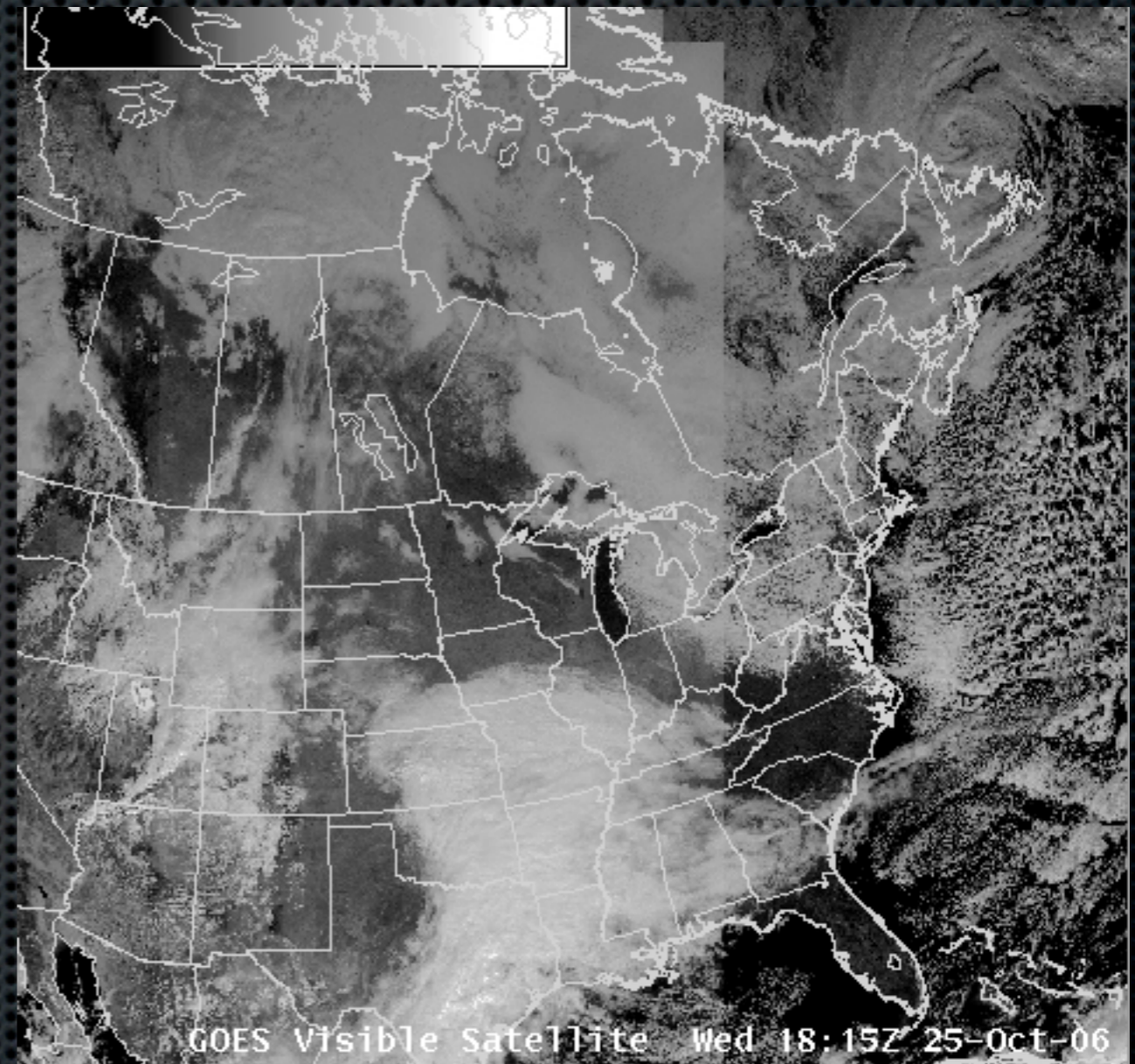
GOES visible channel

MODIS Imagery in AWIPS

Band 1: Visible channel (0.6 μ m)



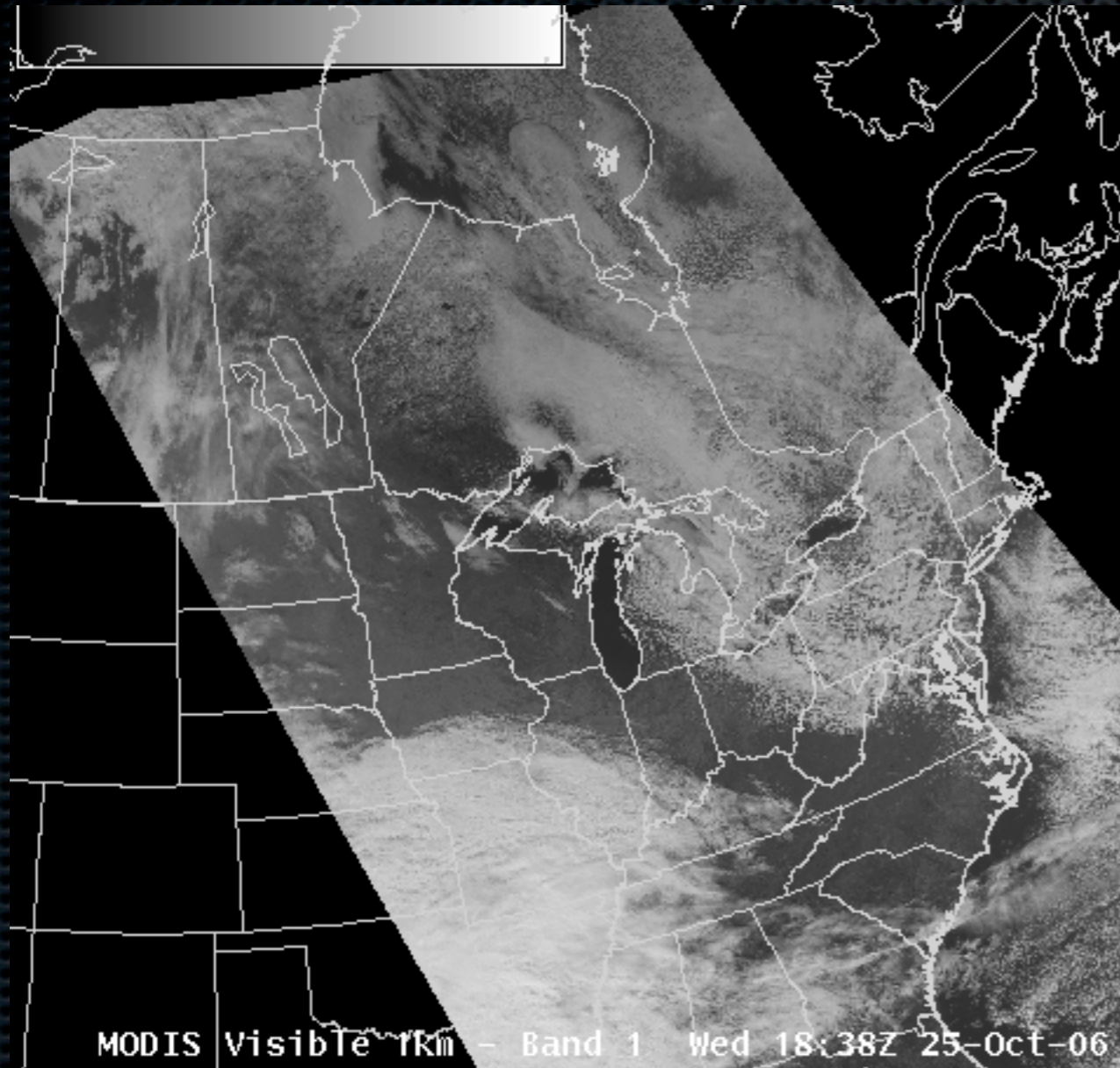
MODIS visible channel



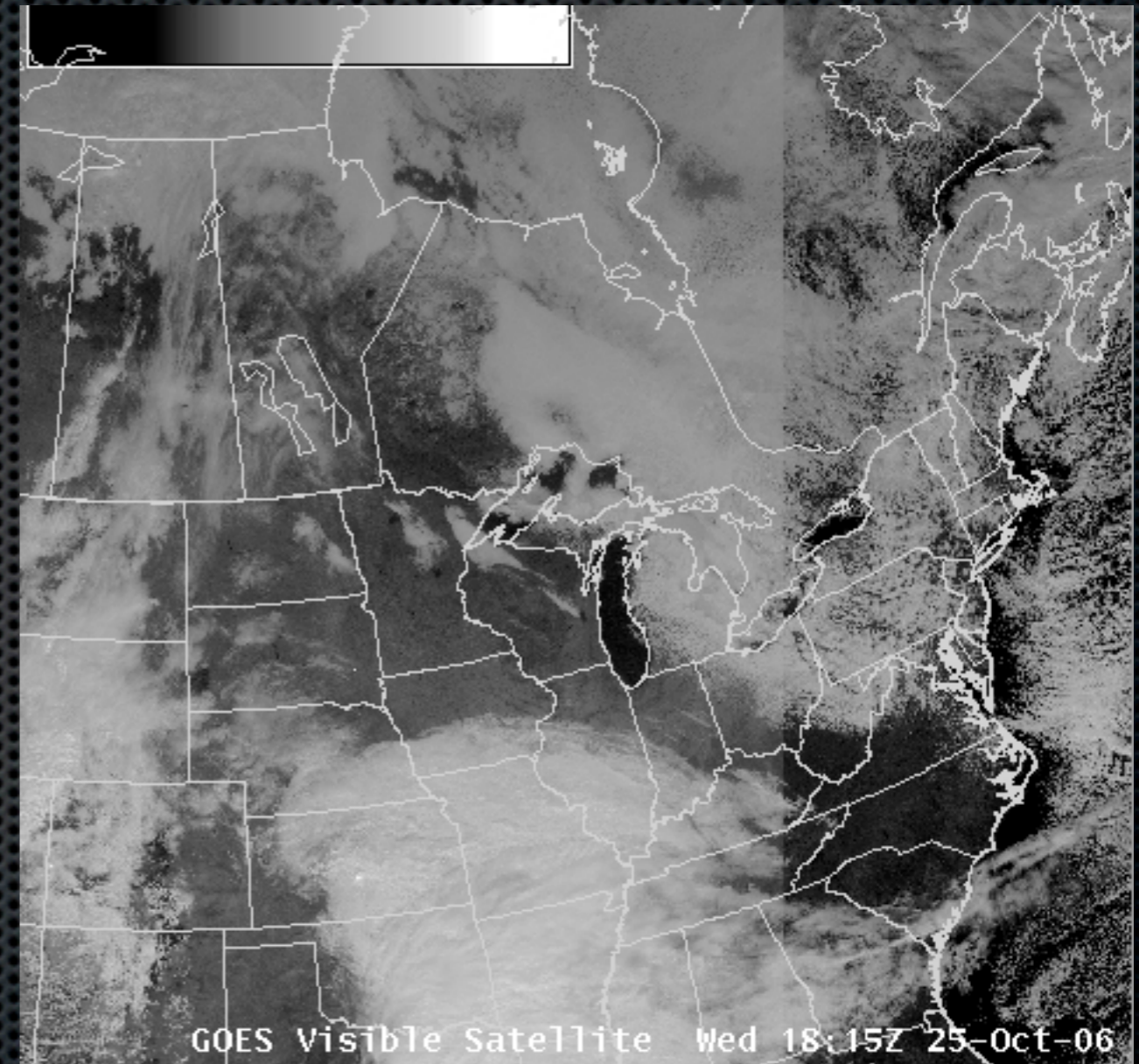
GOES visible channel

MODIS Imagery in AWIPS

Band 1: Visible channel (0.6 μ m)



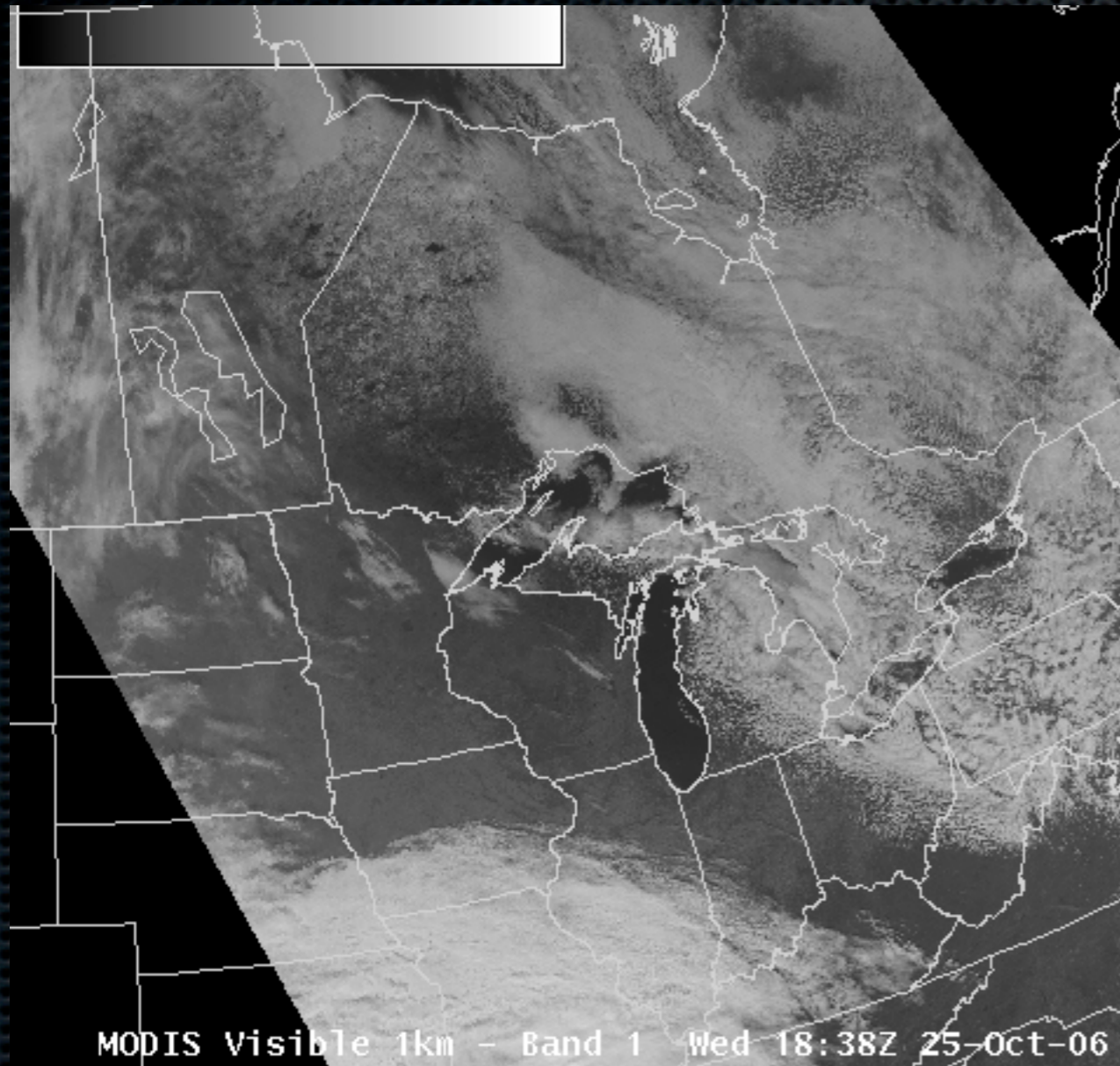
MODIS visible channel



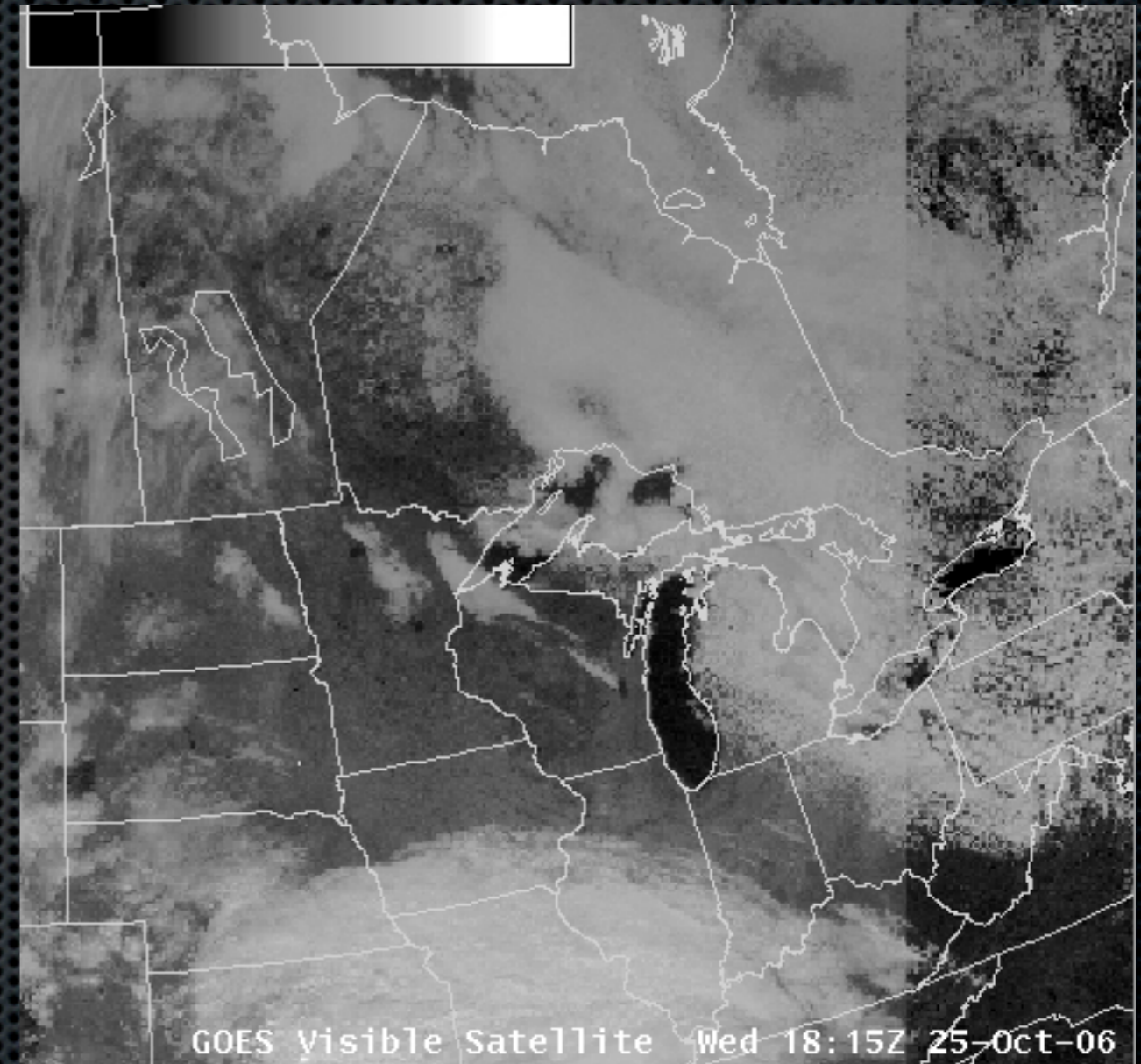
GOES visible channel

MODIS Imagery in AWIPS

Band 1: Visible channel (0.6 μ m)



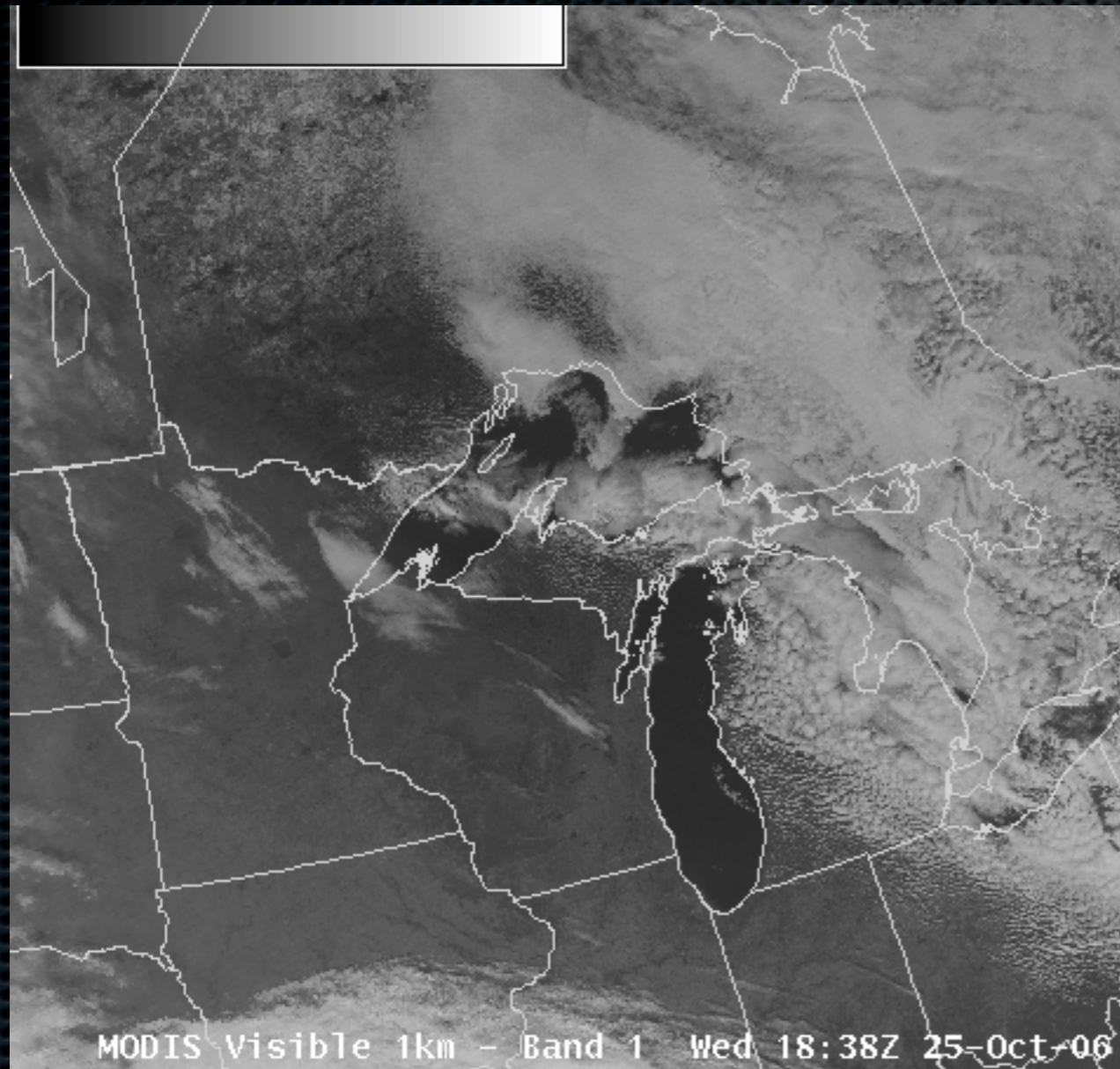
MODIS visible channel



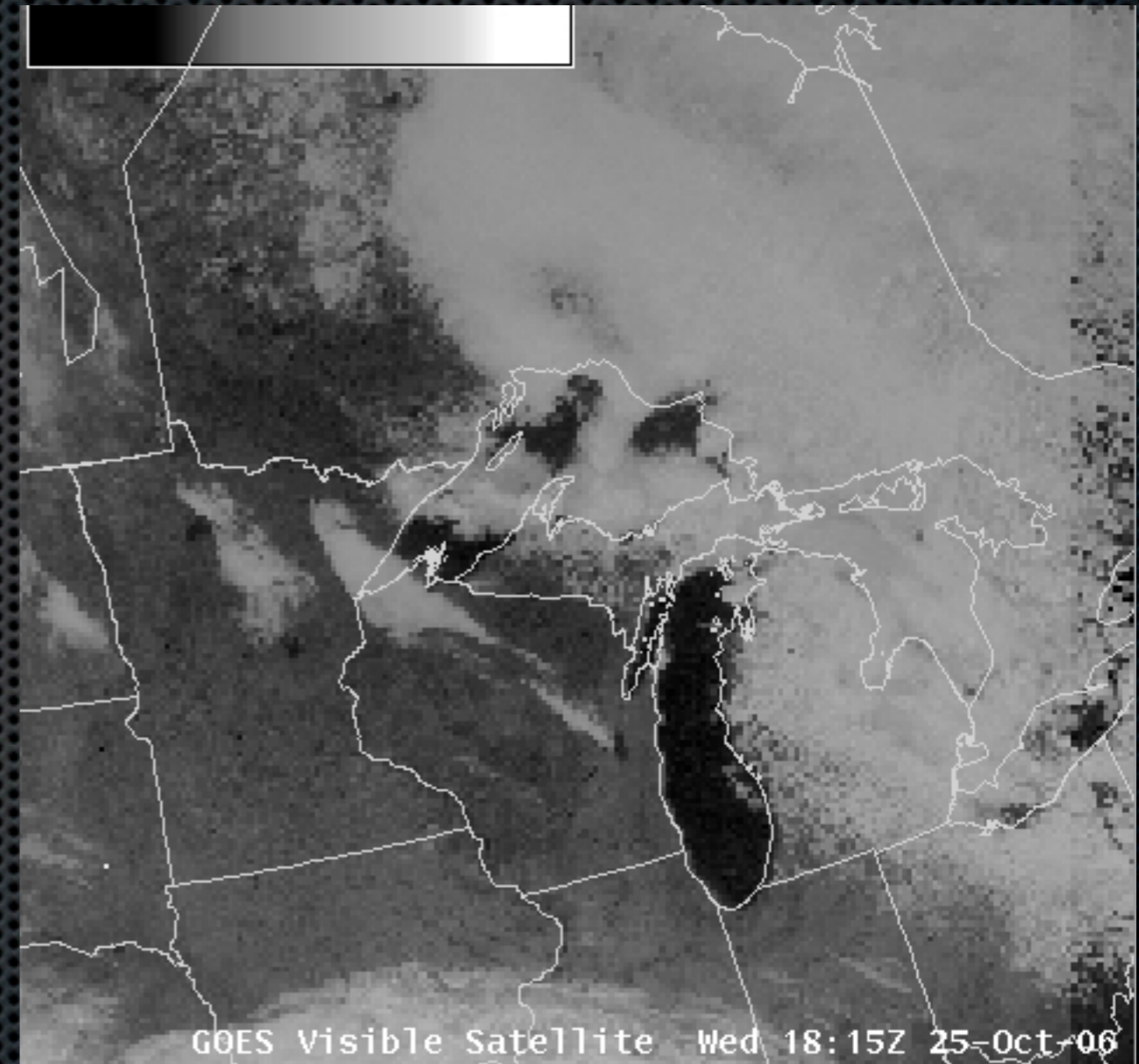
GOES visible channel

MODIS Imagery in AWIPS

Band 1: Visible channel (0.6 μ m)



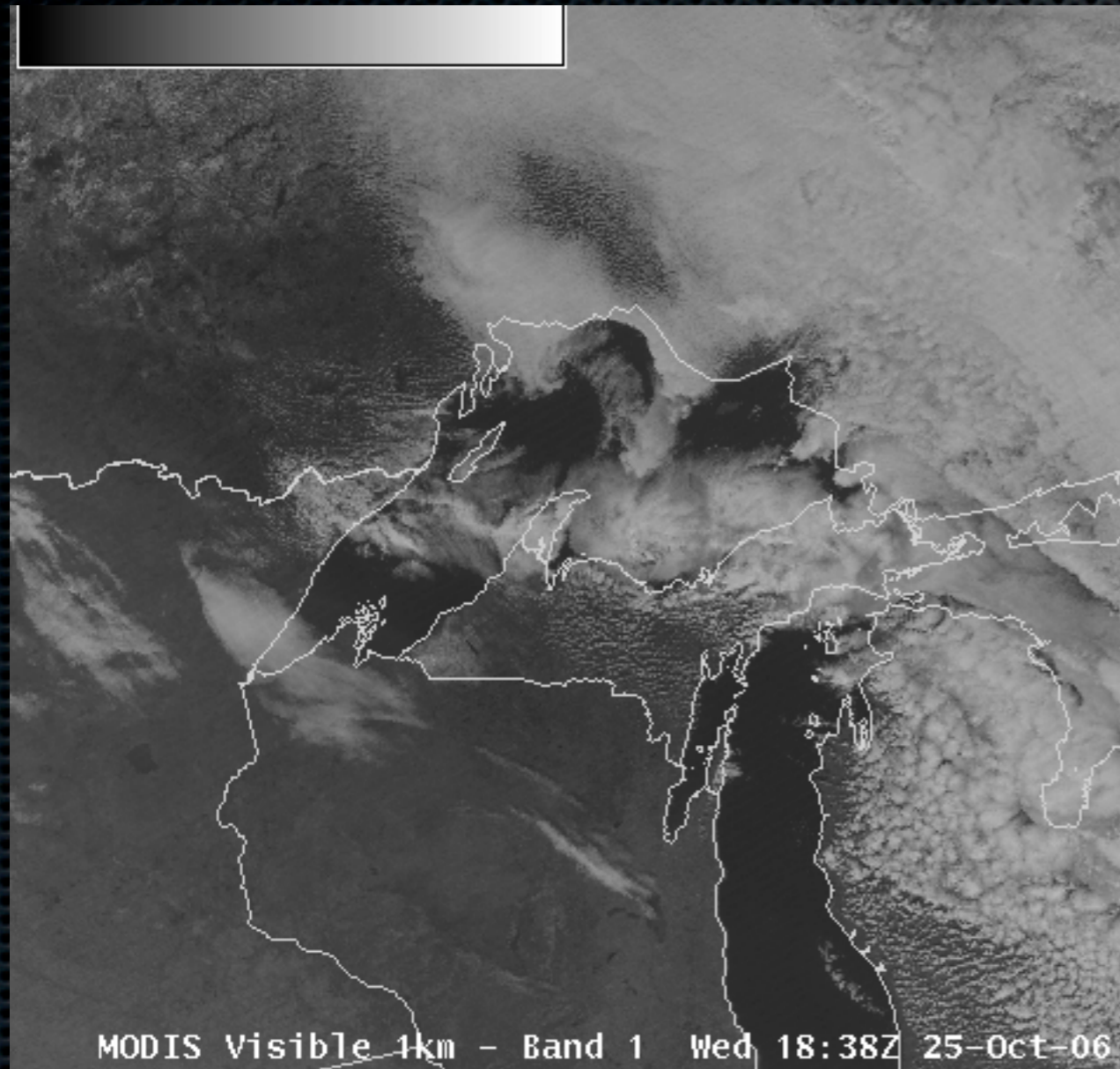
MODIS visible channel



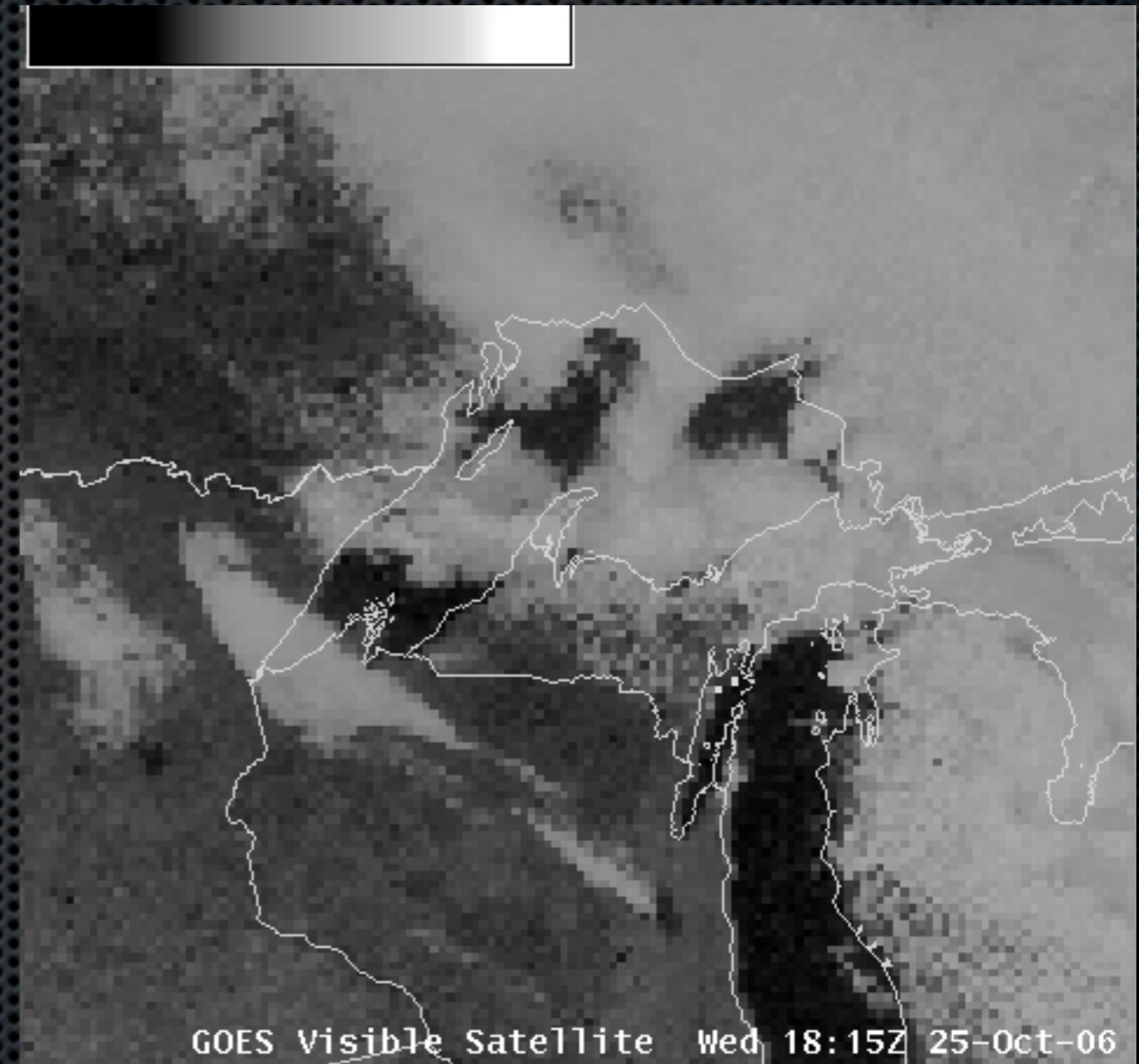
GOES visible channel

MODIS Imagery in AWIPS

Band 1: Visible channel (0.6 μm)



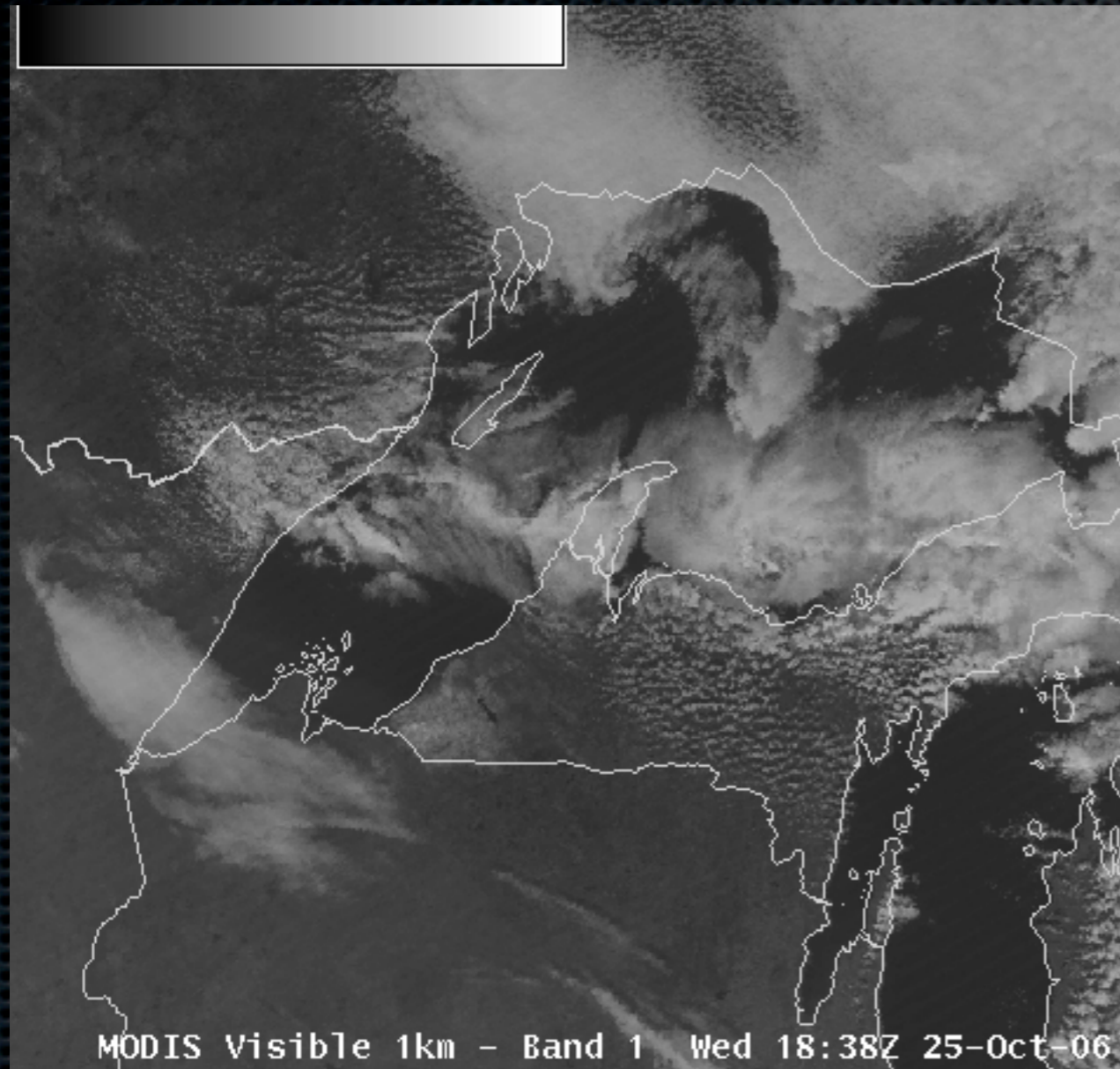
MODIS visible channel



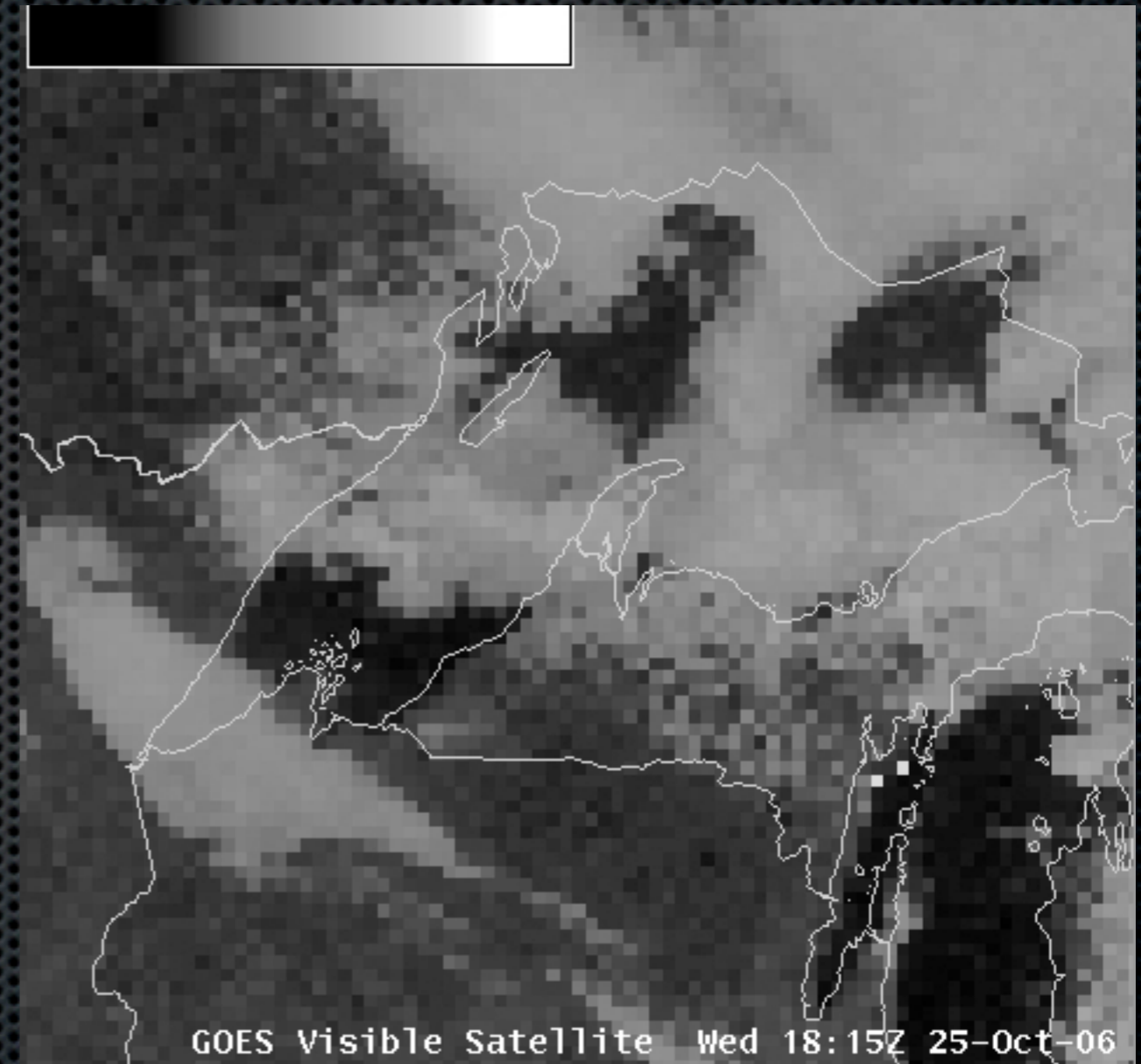
GOES visible channel

MODIS Imagery in AWIPS

Band 1: Visible channel (0.6 μ m)



MODIS visible channel



GOES visible channel

MODIS Imagery in AWIPS

Band 1: Visible channel (0.6 μm)



MODIS Imagery in AWIPS

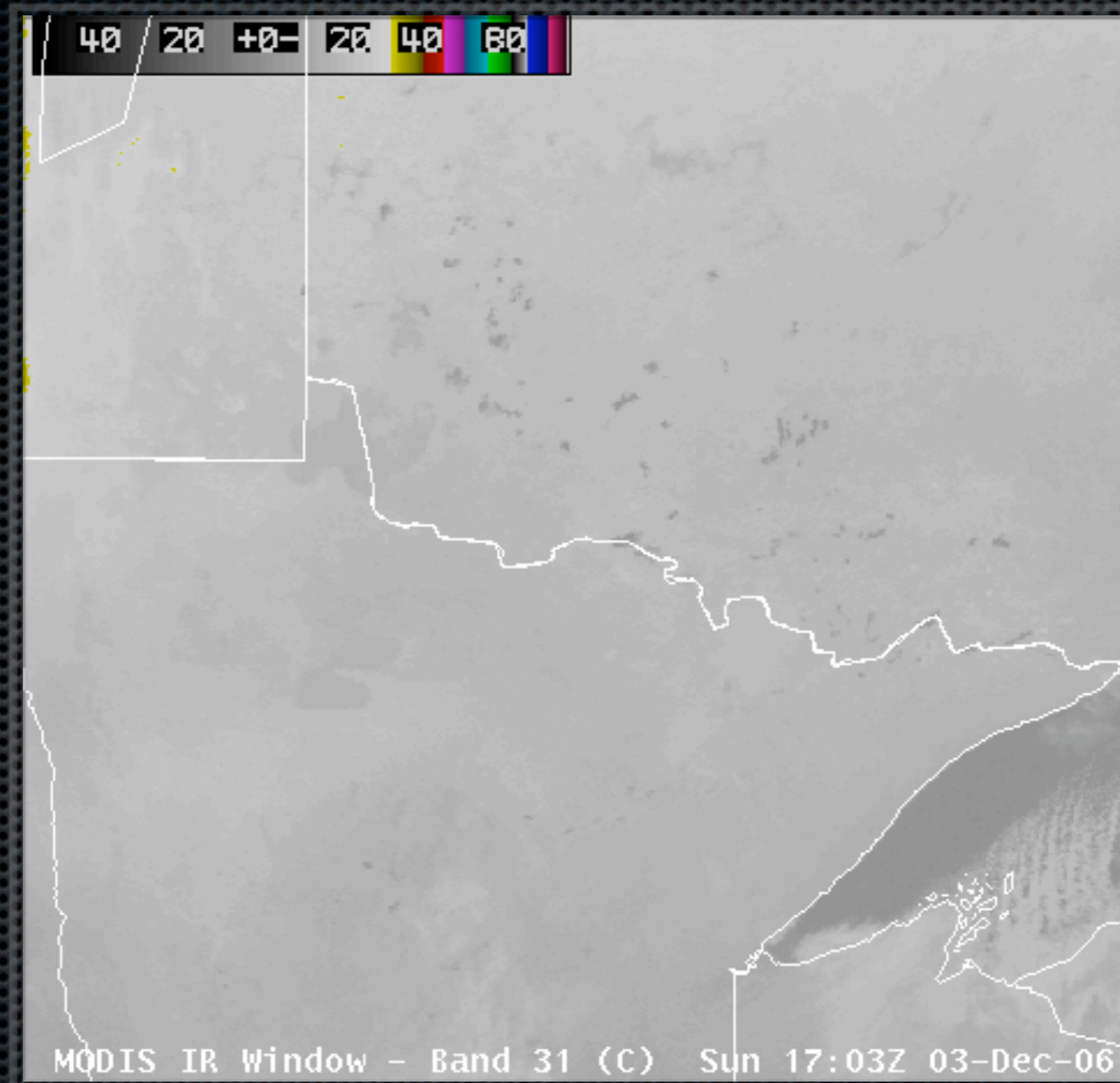
Band 7: Snow/Ice channel (2.1 μ m)



Snow/ice vs. supercooled water cloud discrimination

MODIS Imagery in AWIPS

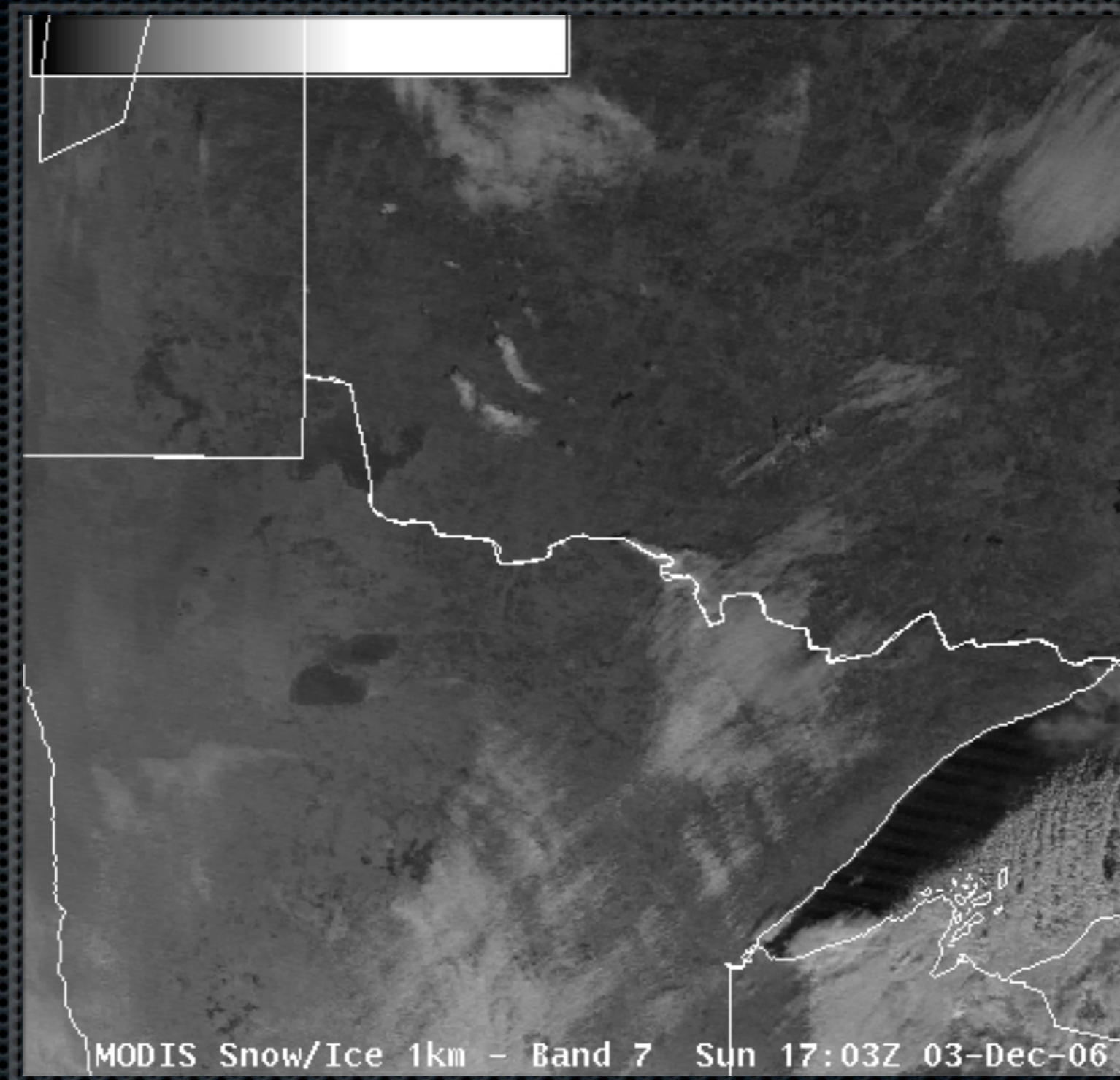
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Snow/ice vs. supercooled water cloud discrimination

MODIS Imagery in AWIPS

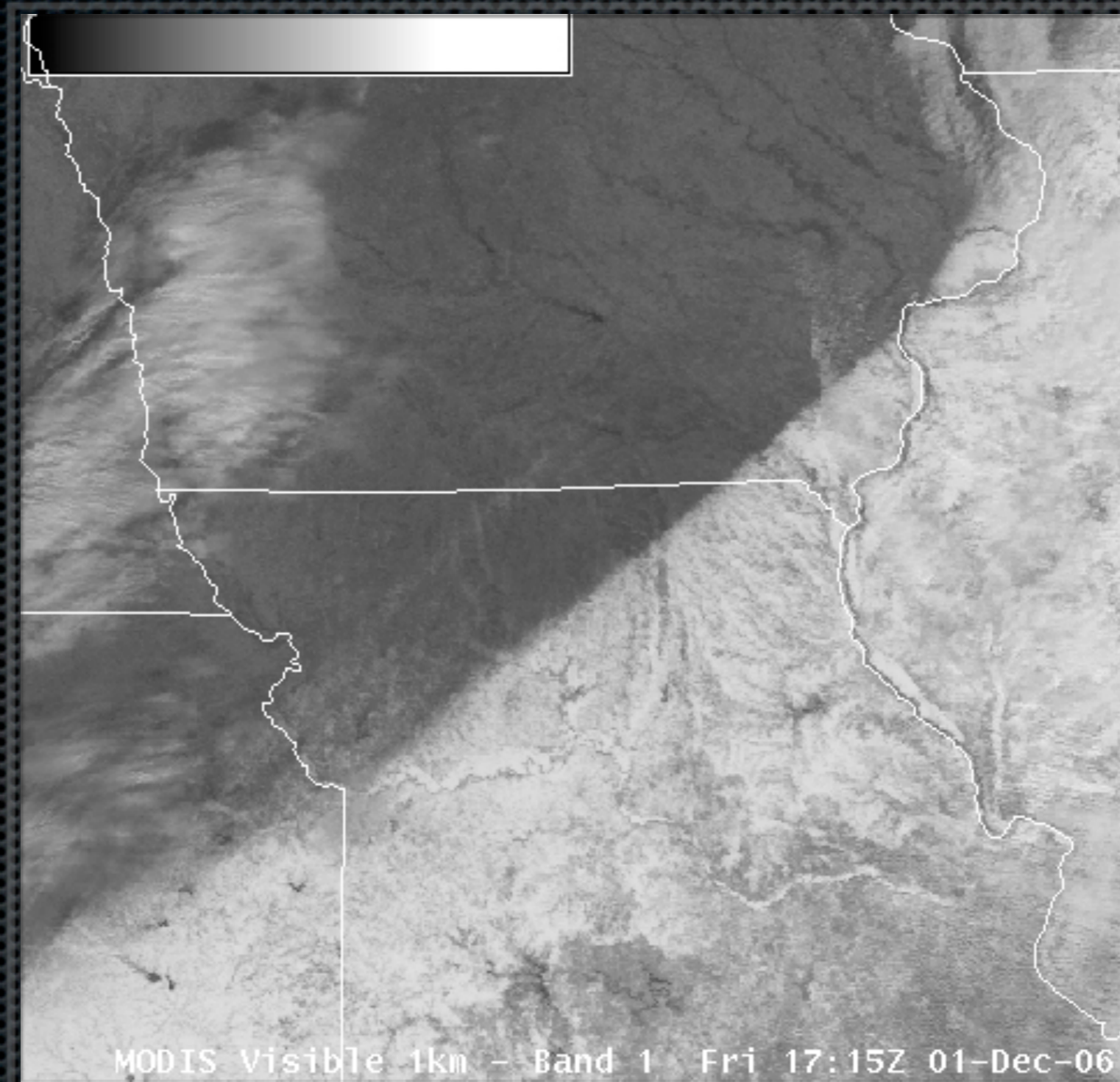
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Snow/ice vs. supercooled water cloud discrimination

MODIS Imagery in AWIPS

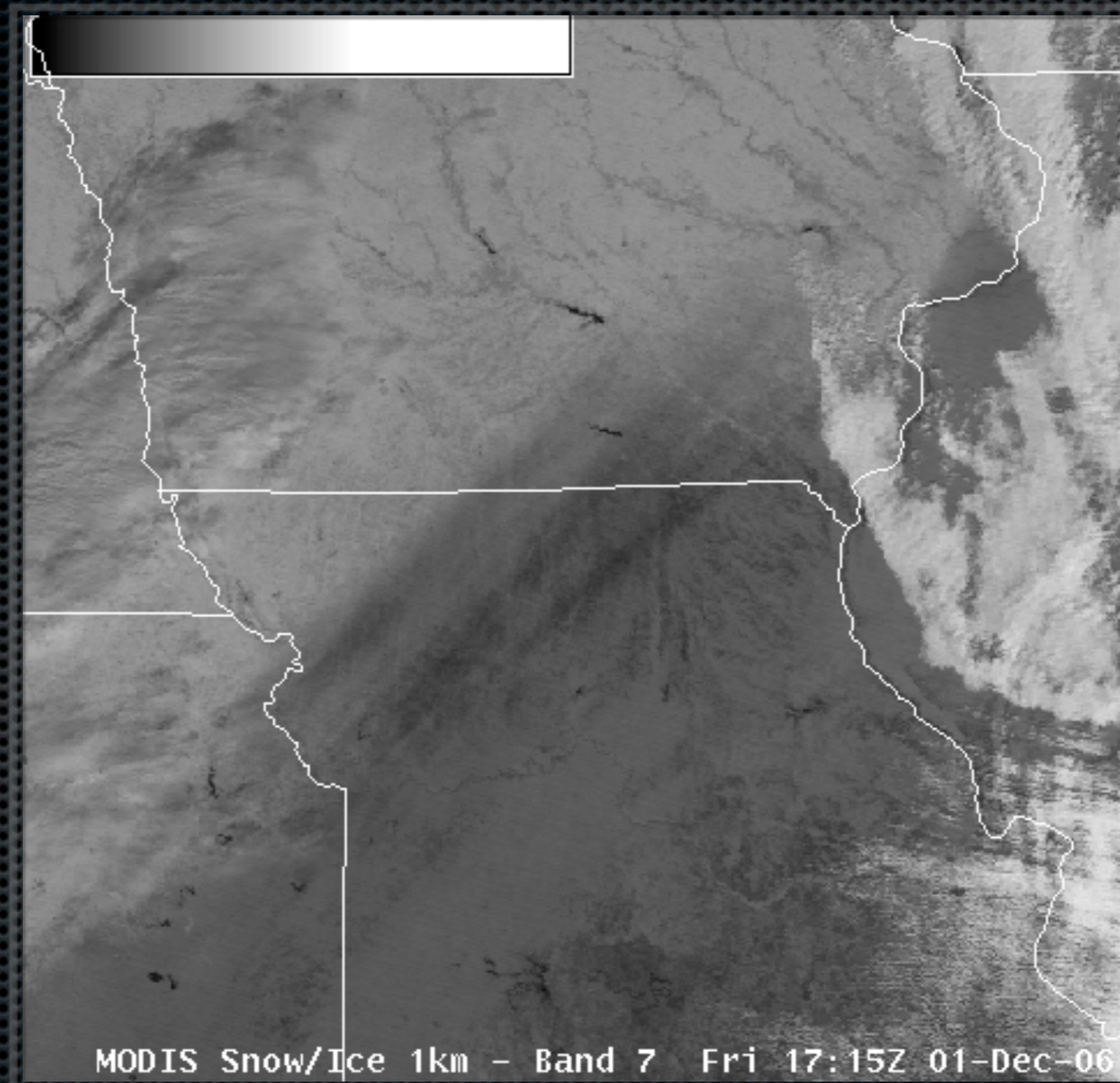
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Snow/ice vs. supercooled water cloud discrimination

MODIS Imagery in AWIPS

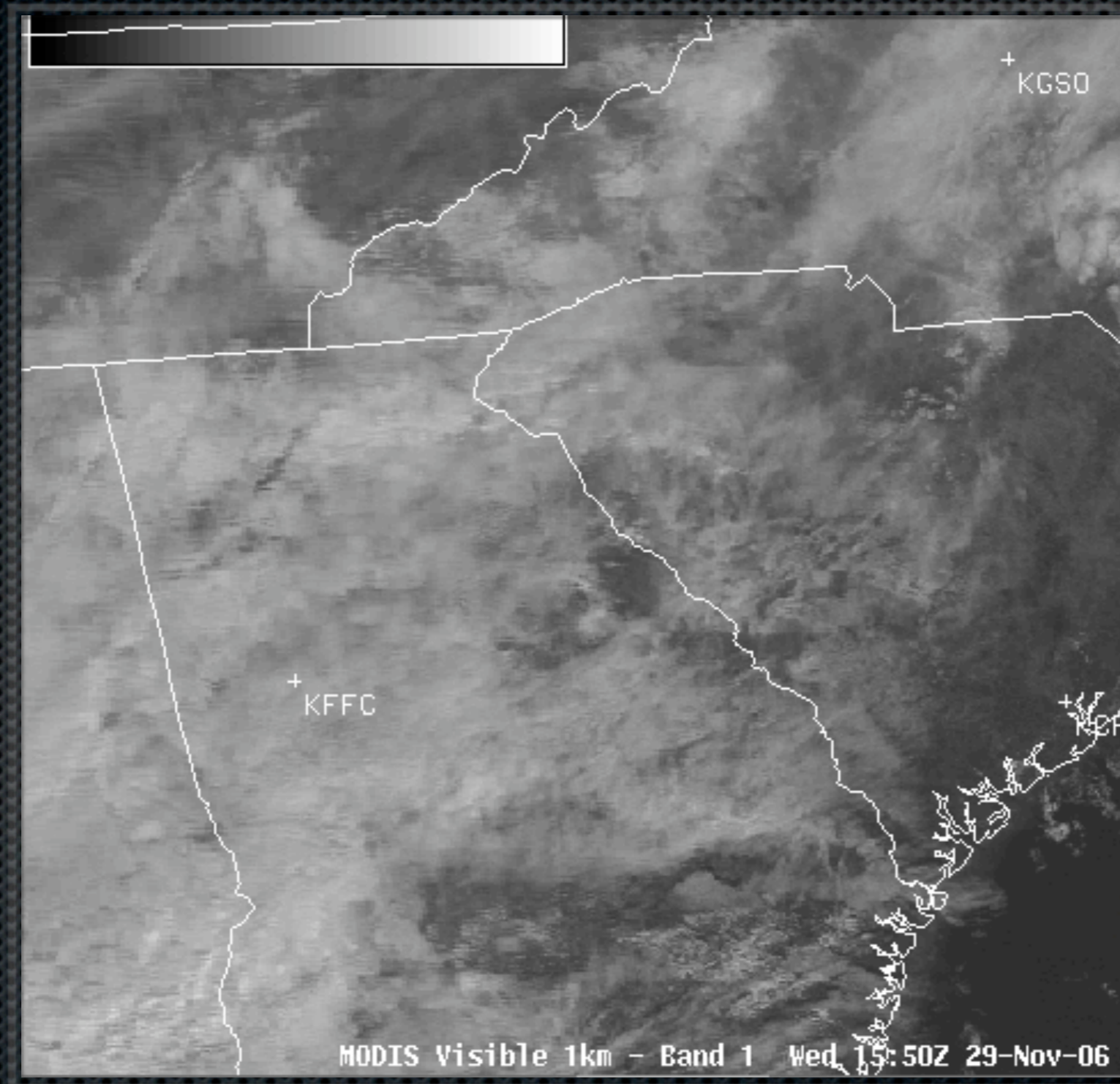
Band 7: Snow/Ice channel (2.1 μ m)



Snow/ice vs. supercooled water cloud discrimination

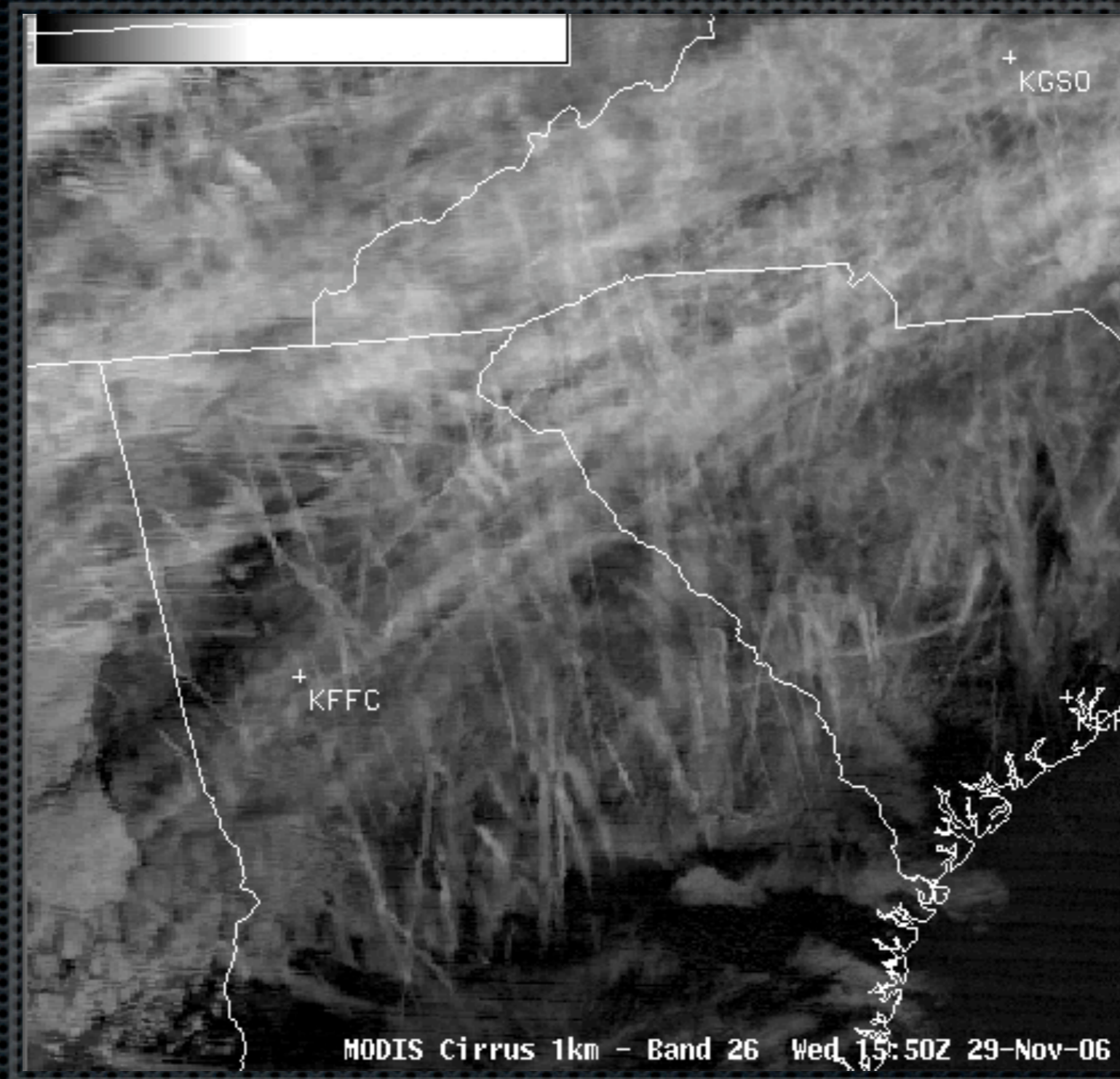
MODIS Imagery in AWIPS

Band 26: Cirrus detection ($1.3\mu\text{m}$)



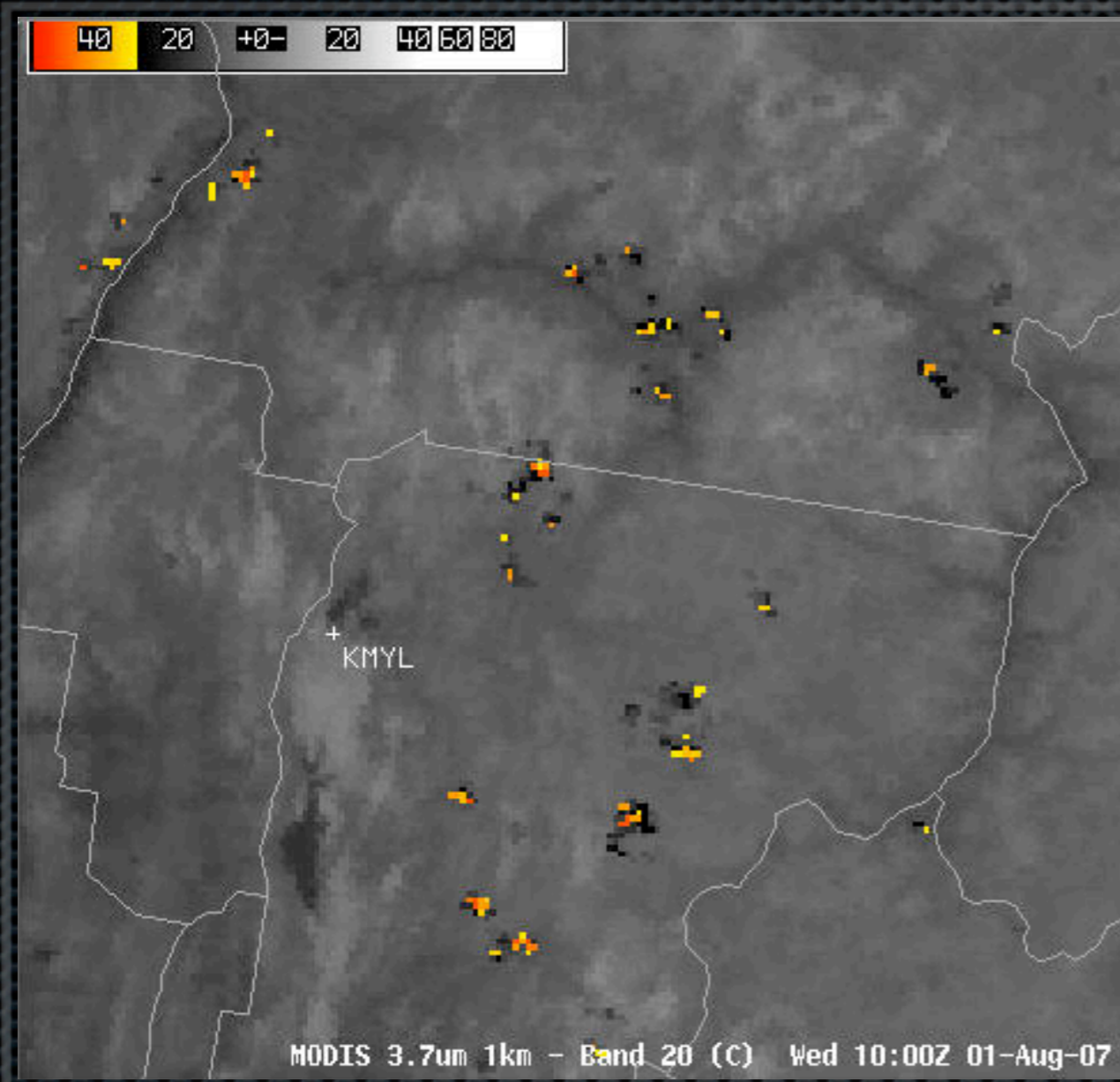
MODIS Imagery in AWIPS

Band 26: Cirrus detection ($1.3\mu\text{m}$)

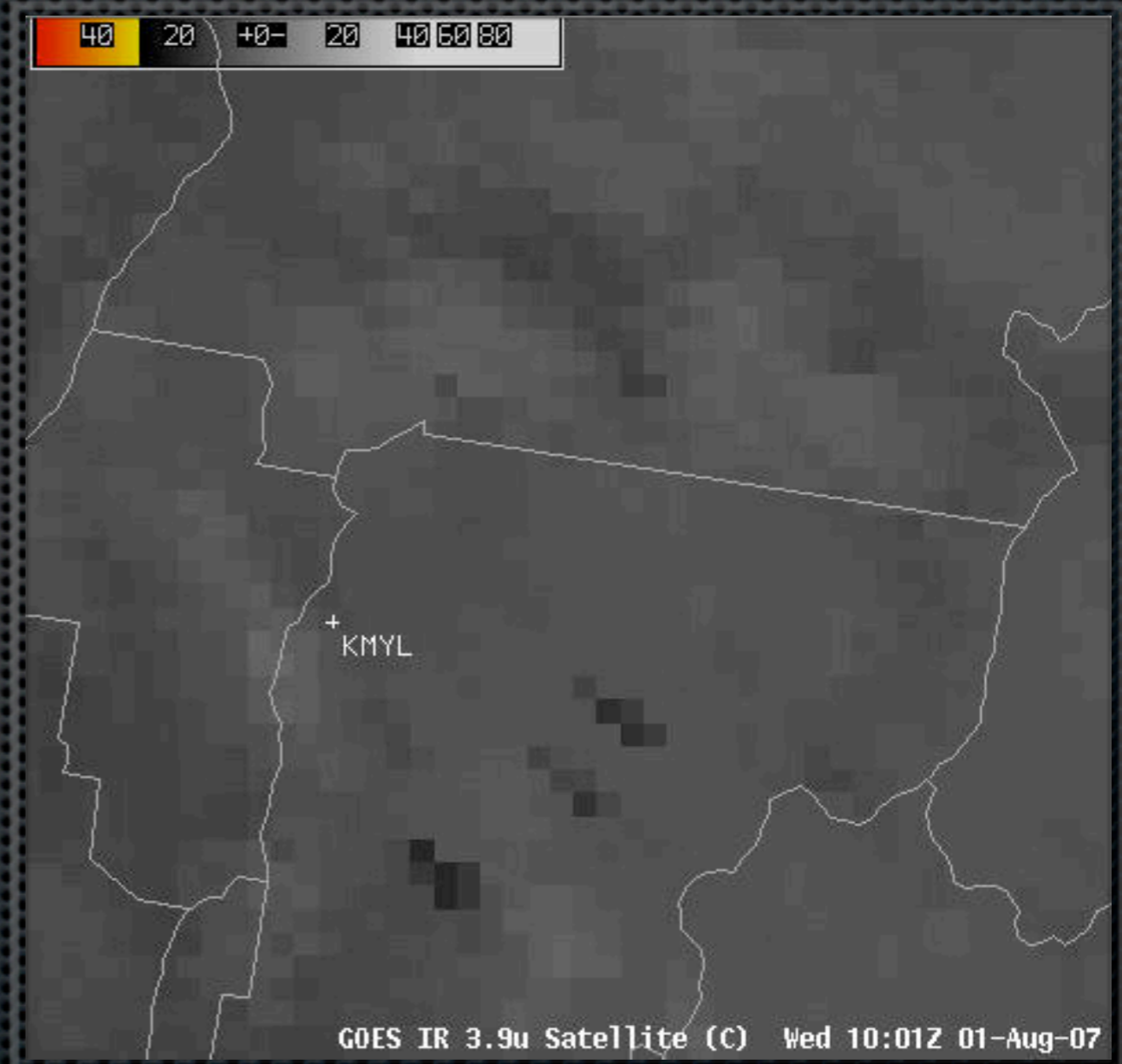


MODIS Imagery in AWIPS

Band 20: Shortwave IR (3.7 μ m)



1-km MODIS

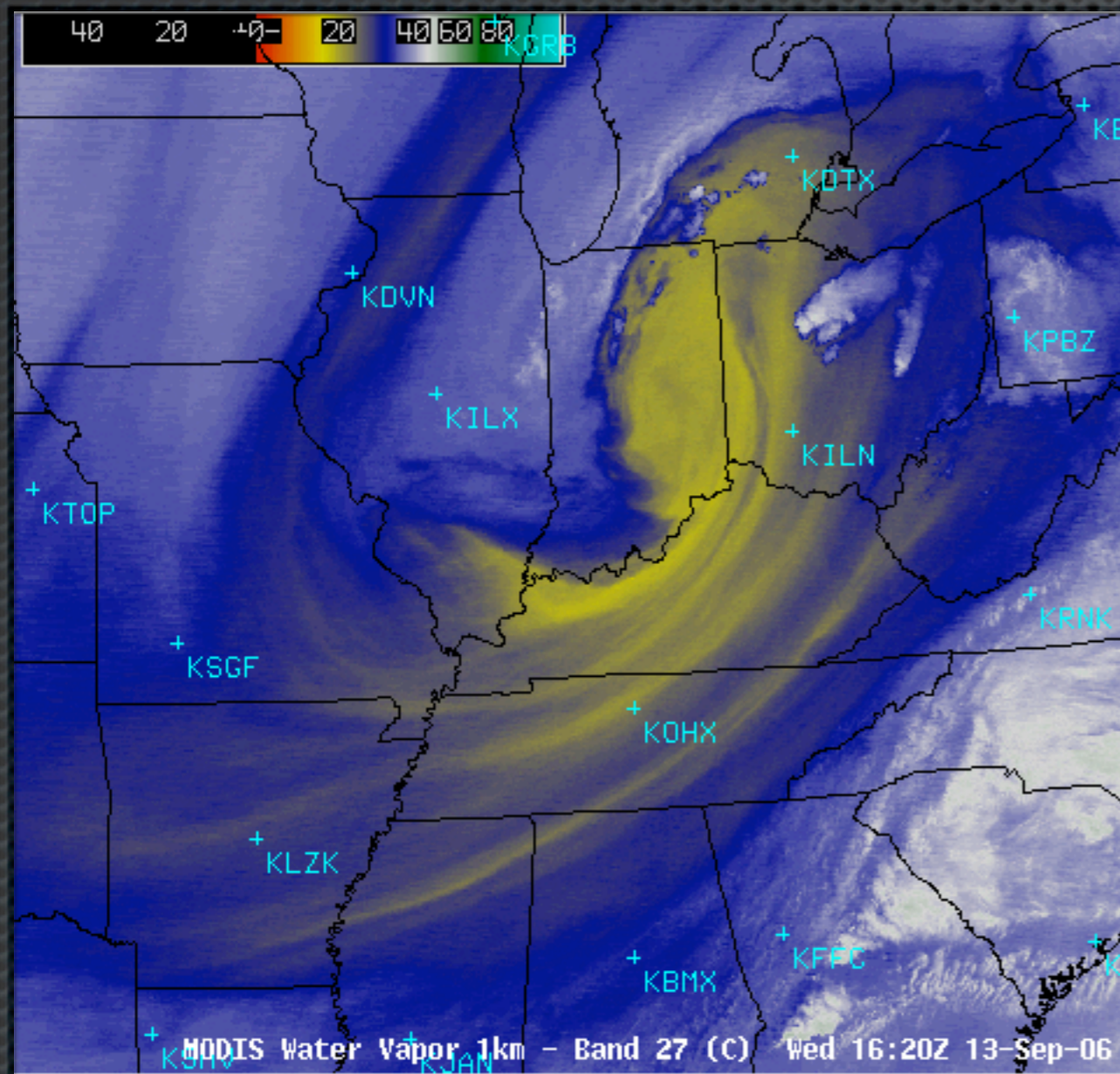


4-km GOES

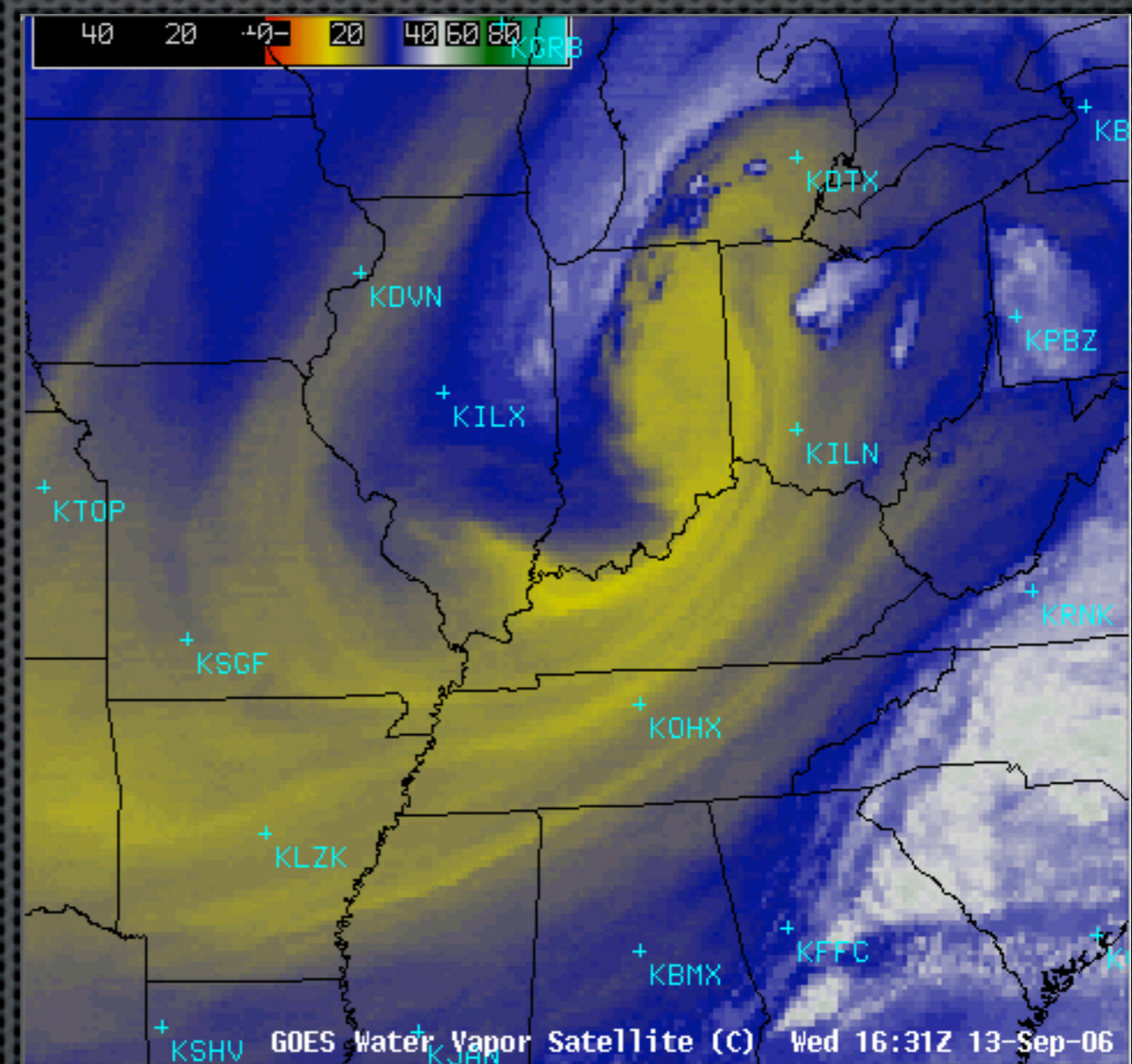
Improved fire detection capability

MODIS Imagery in AWIPS

Band 27: Water vapor ($6.7\mu\text{m}$)



1-km MODIS

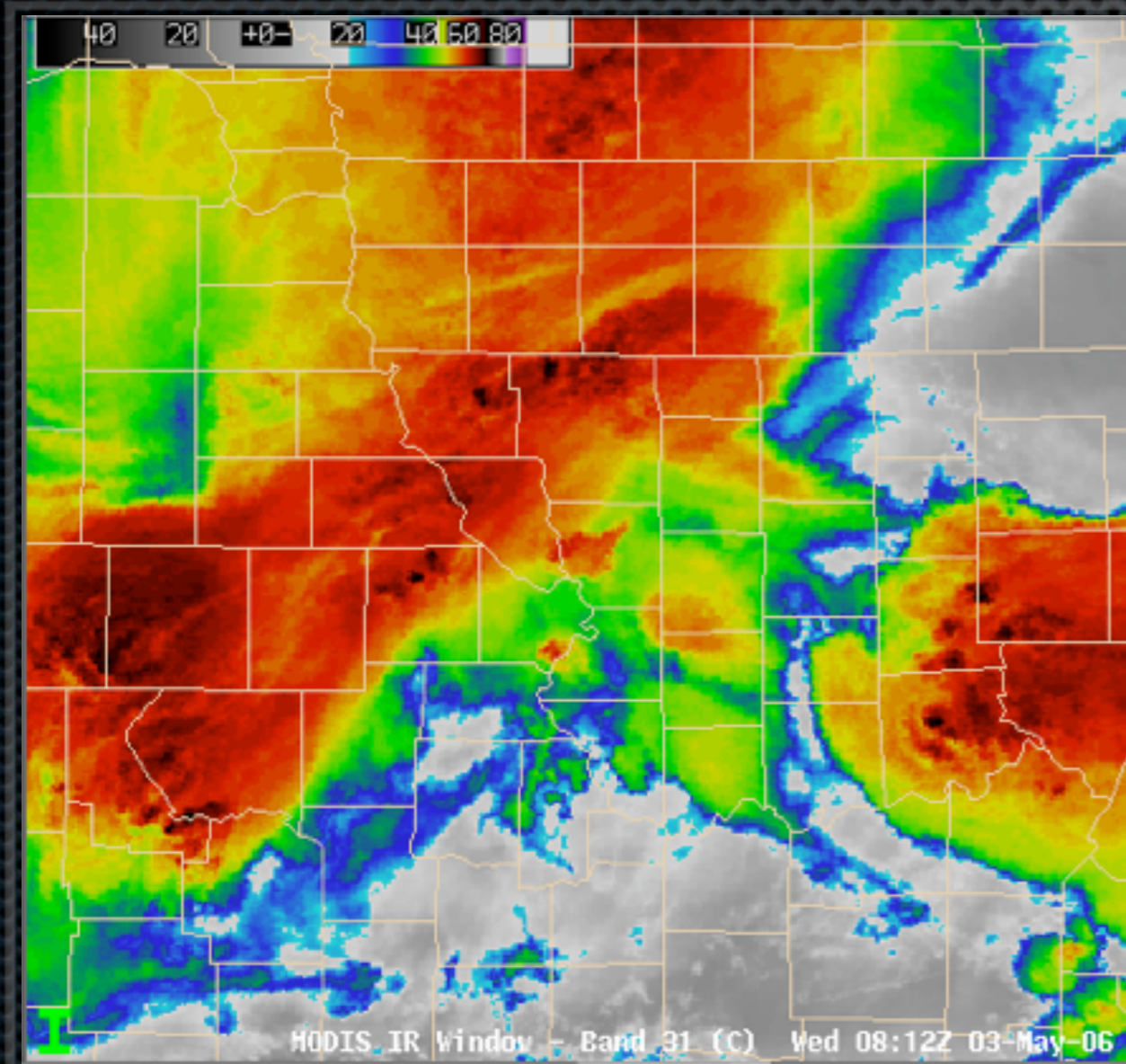


4-km GOES

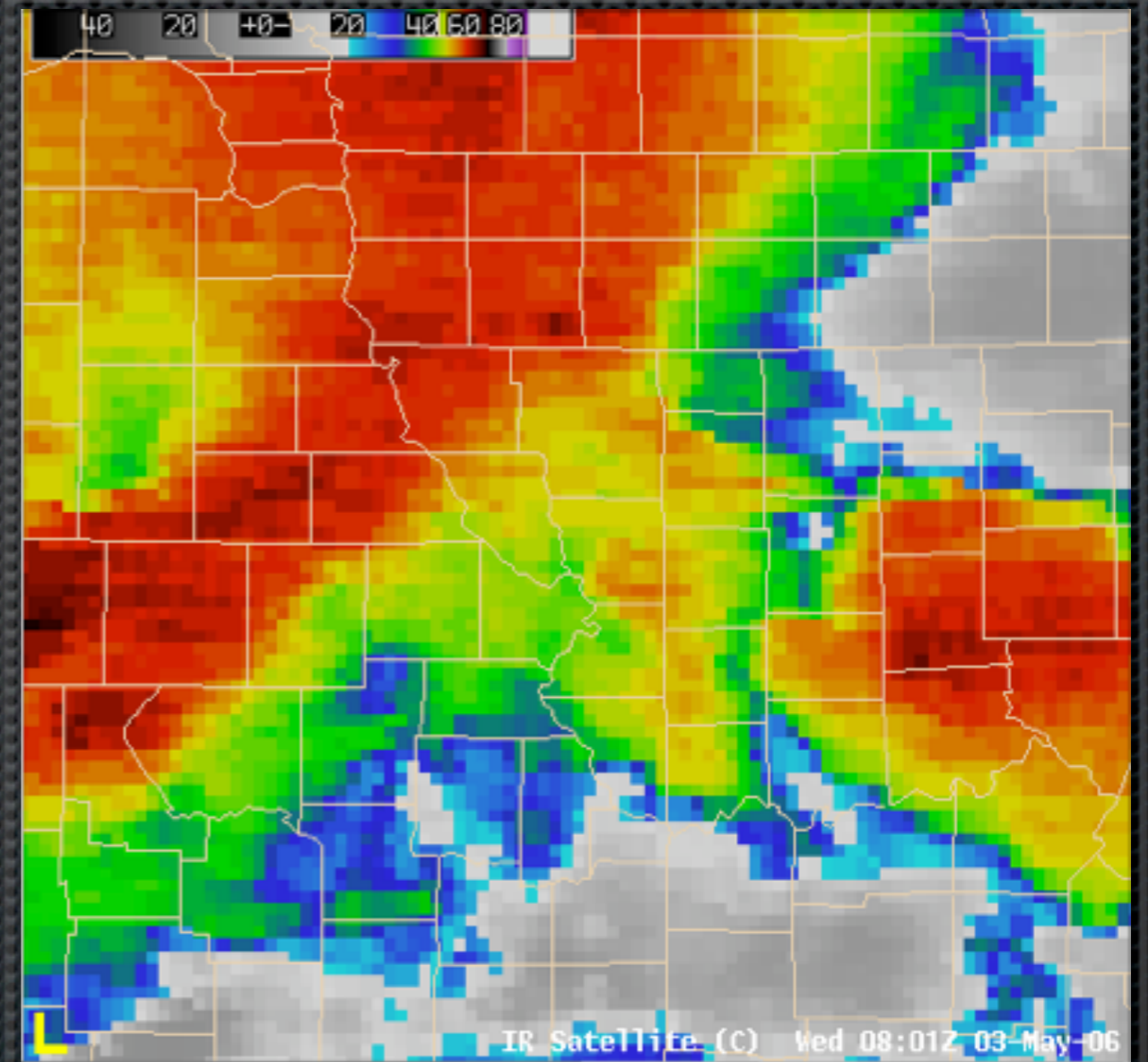
Improved feature identification (jet streaks, turbulence, etc)

MODIS Imagery in AWIPS

Band 31: IR window (11.0 μ m)



1-km MODIS

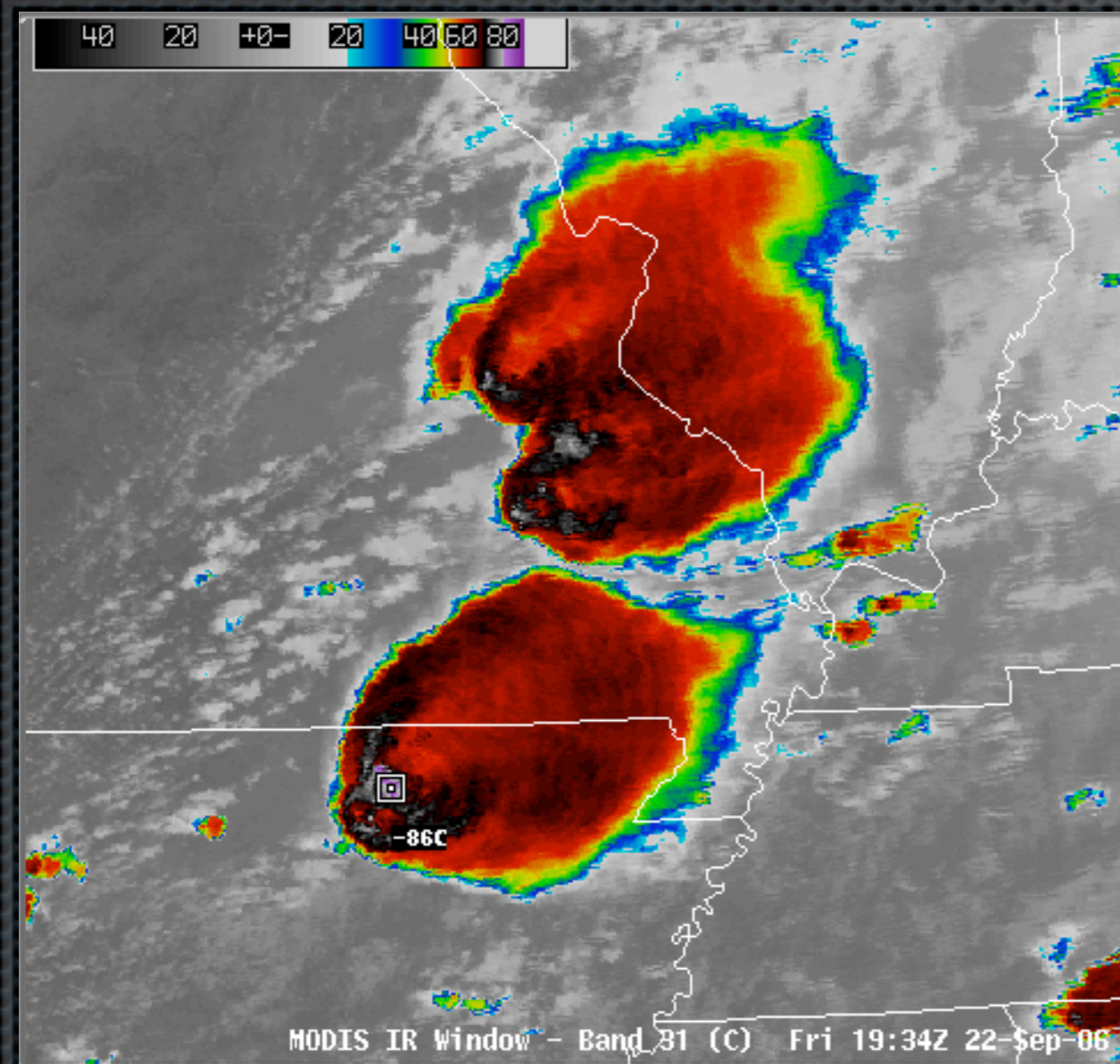


4-km GOES

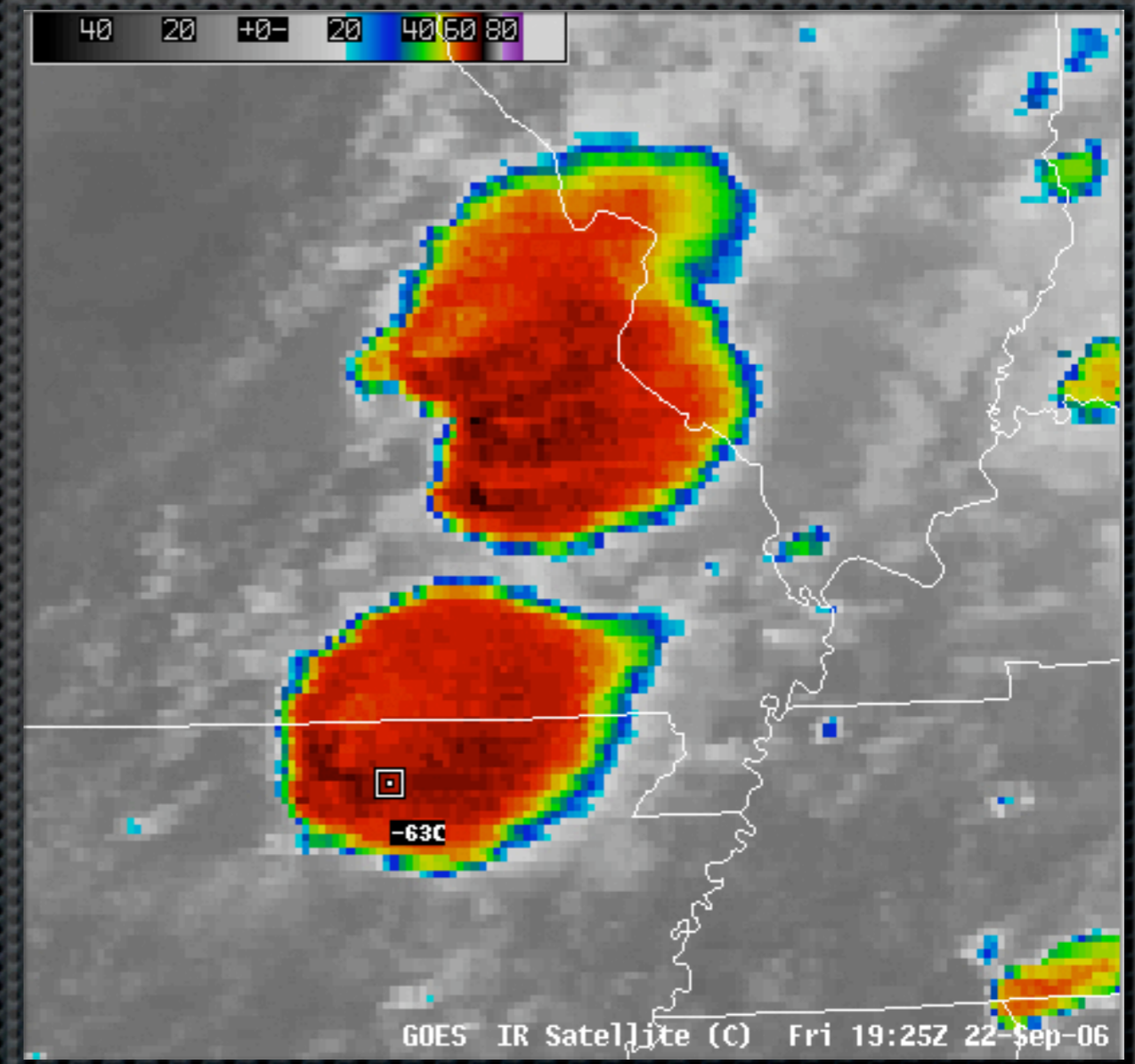
Improved feature identification (overshooting tops, enhanced-v)

MODIS Imagery in AWIPS

Band 31: IR window (11.0 μ m)



1-km MODIS

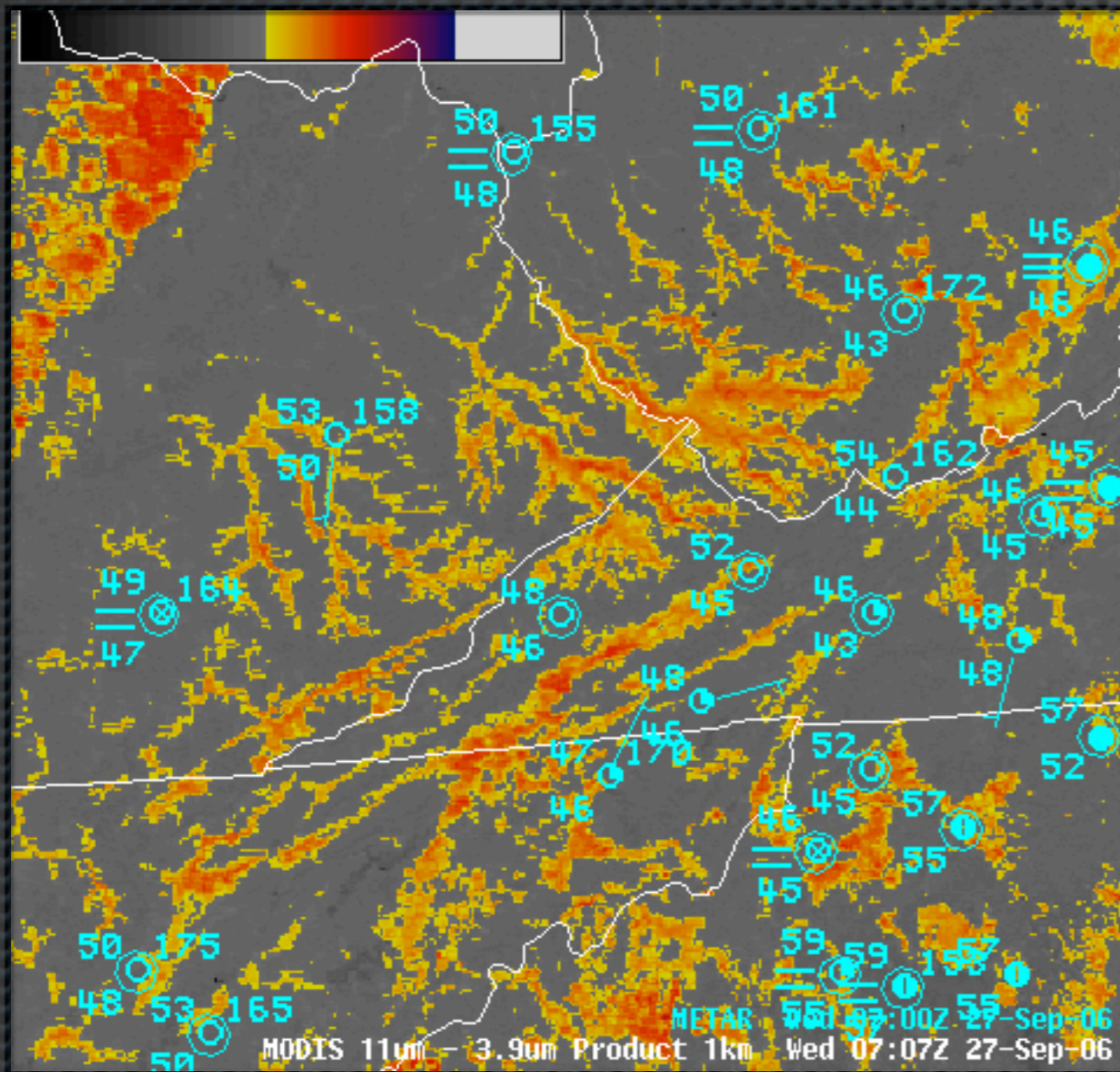


4-km GOES

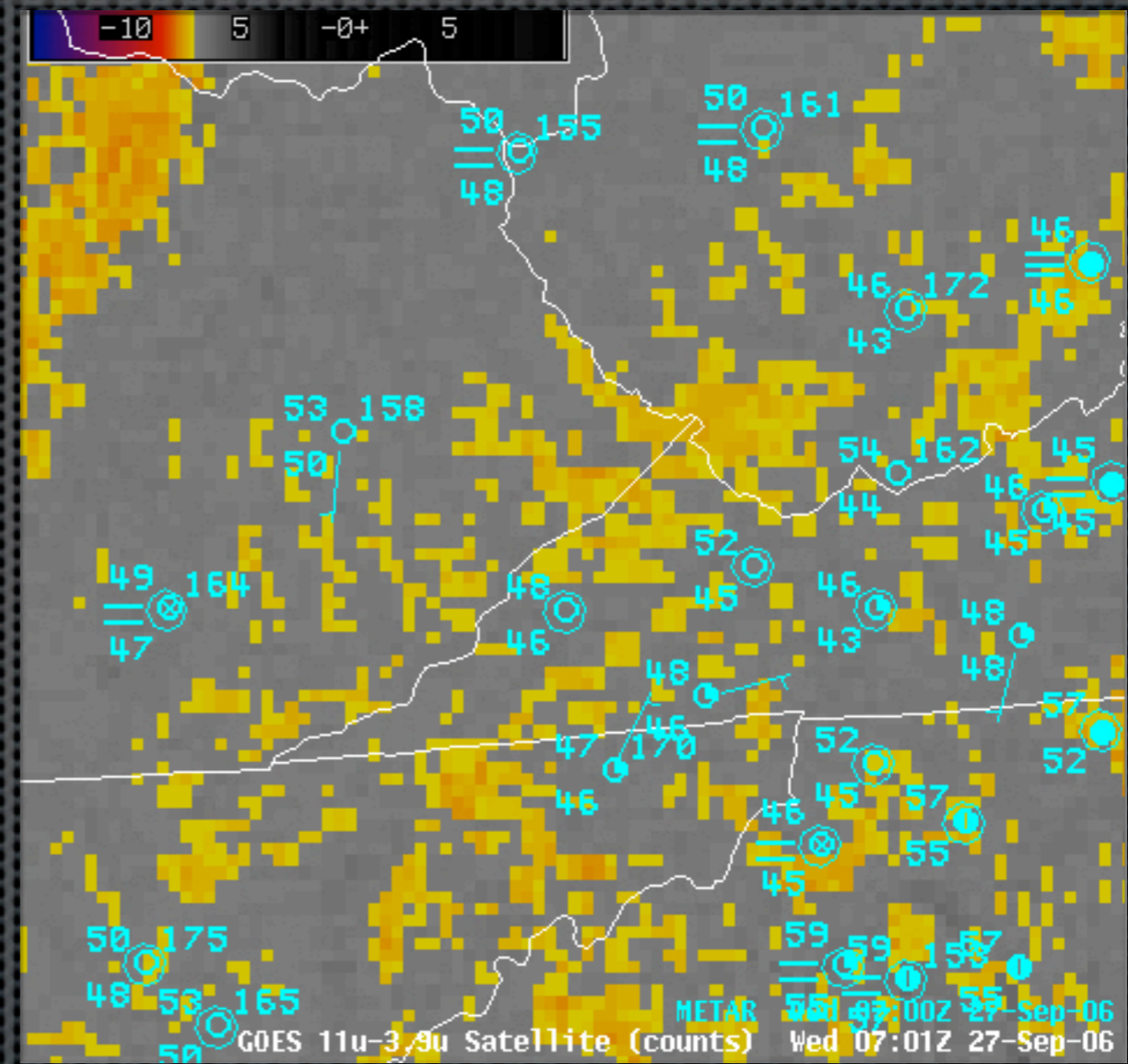
Improved feature identification (overshooting tops, enhanced-v)

MODIS Imagery in AWIPS

Fog/stratus product (11.0 μ m - 3.7 μ m)



1-km MODIS

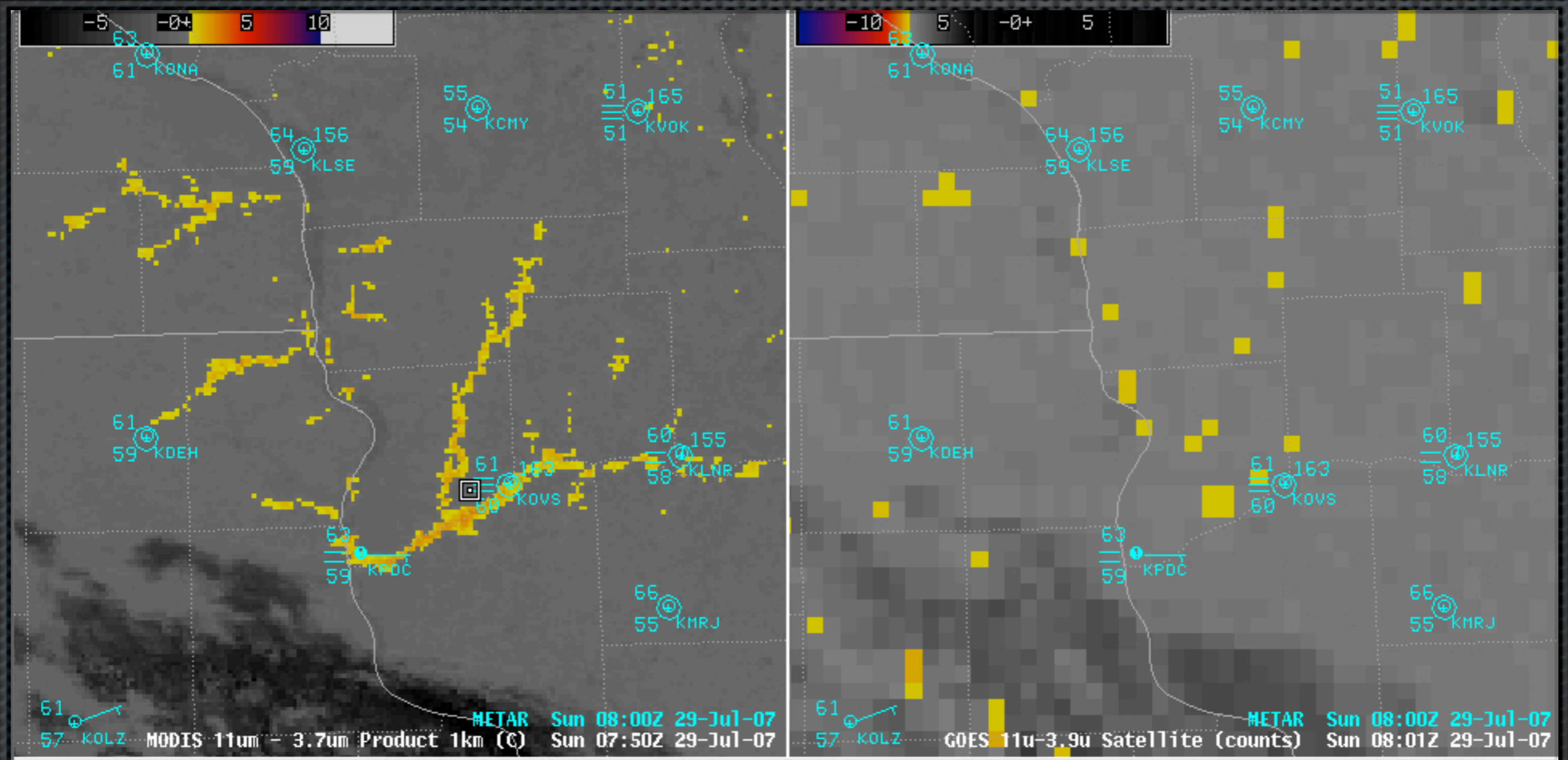


4-km GOES

Improved fog/stratus detection capability

MODIS Imagery in AWIPS

Fog/stratus product (11.0 μ m - 3.7 μ m)



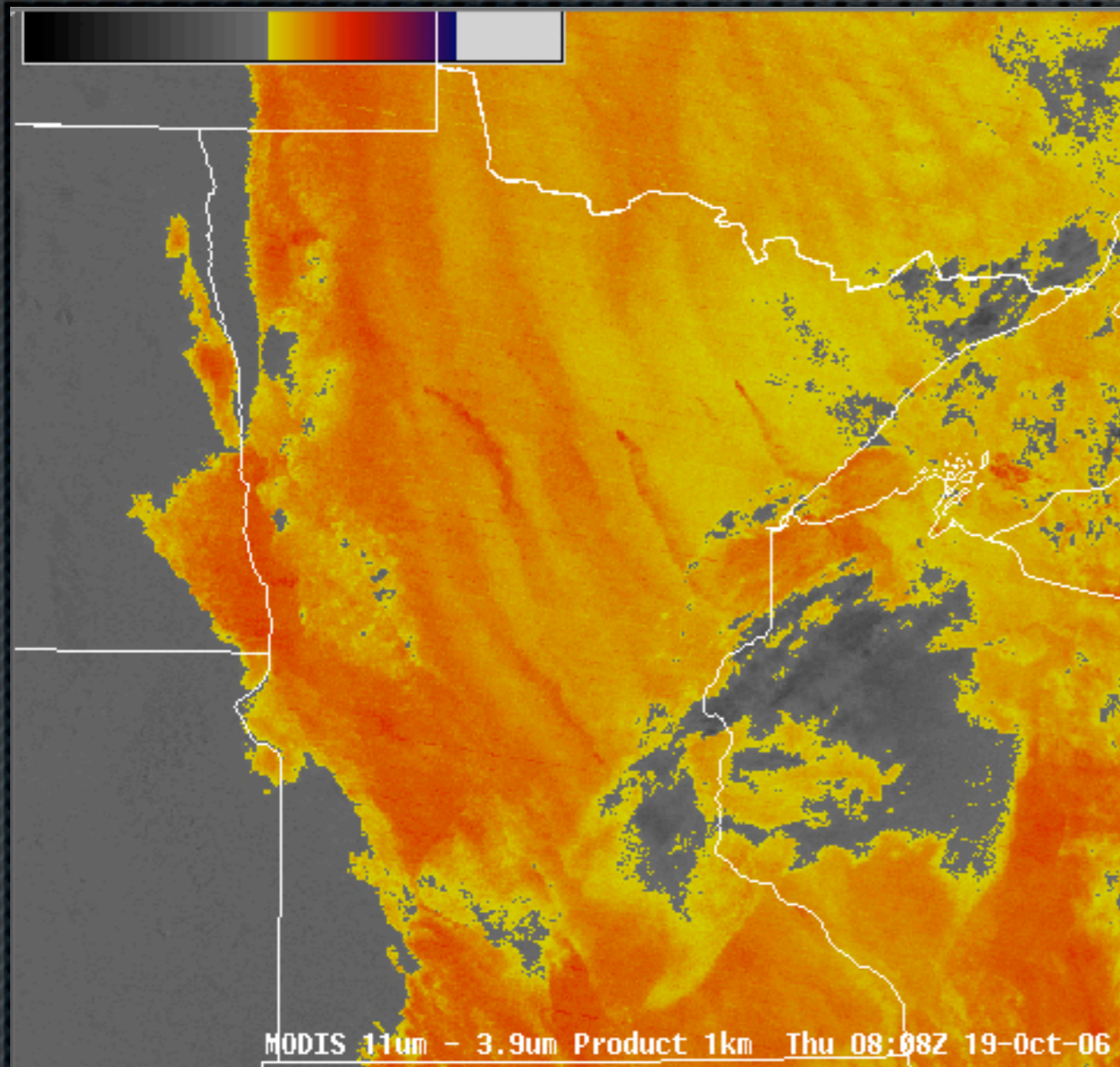
1-km MODIS

4-km GOES

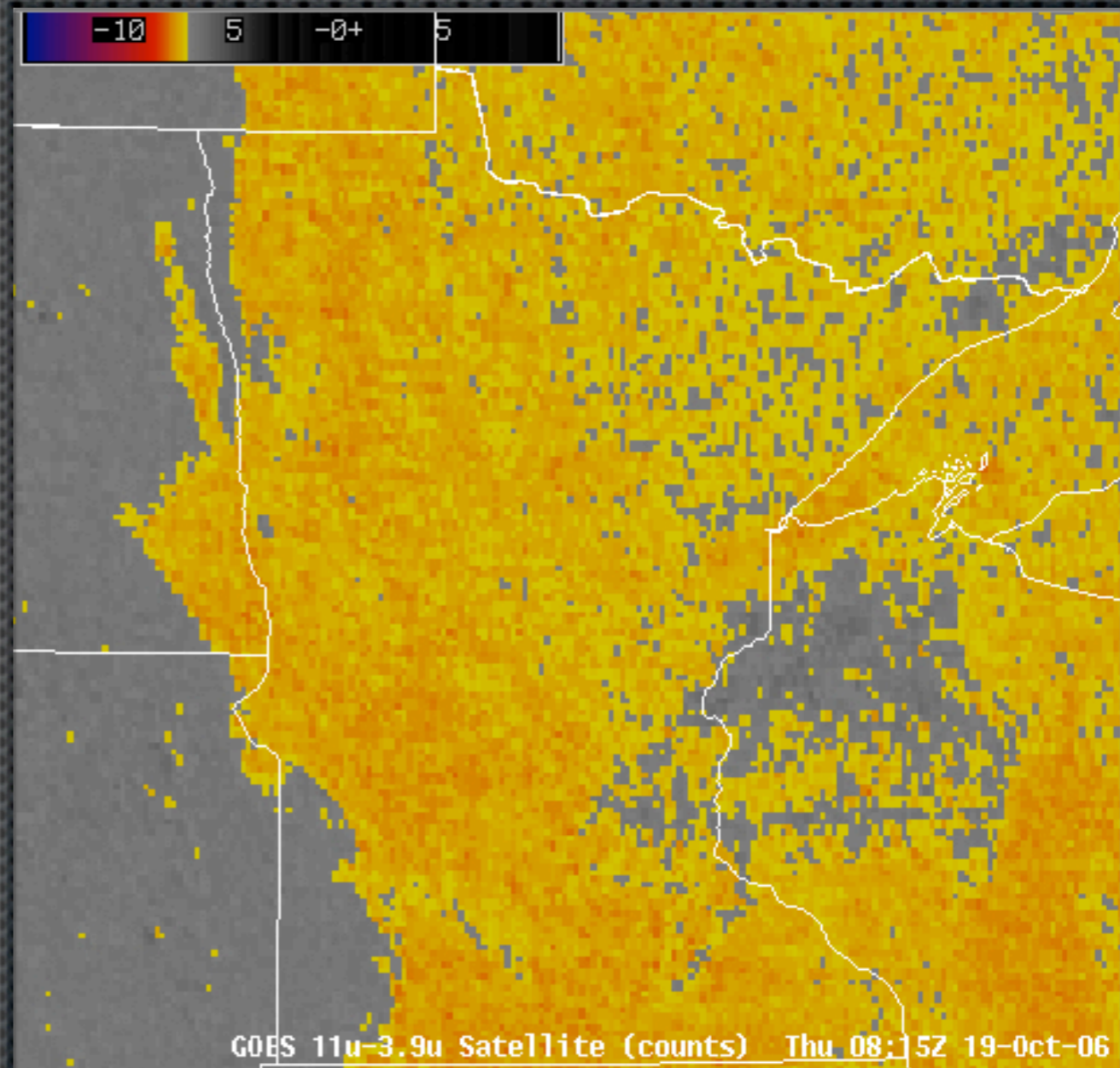
Improved fog/stratus detection capability

MODIS Imagery in AWIPS

Fog/stratus product (11.0 μ m - 3.7 μ m)



1-km MODIS

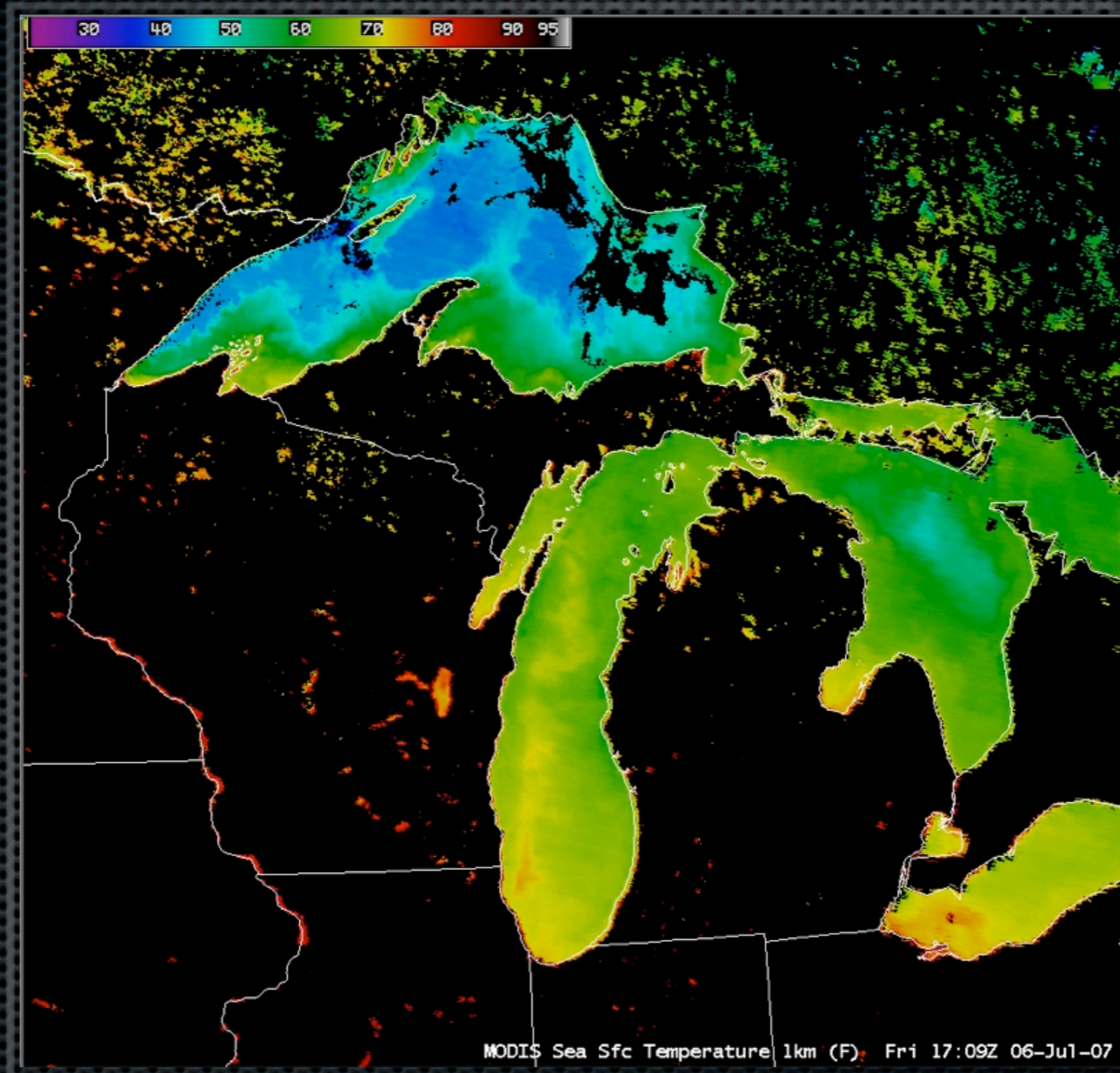


4-km GOES

Improved fog/stratus detection capability

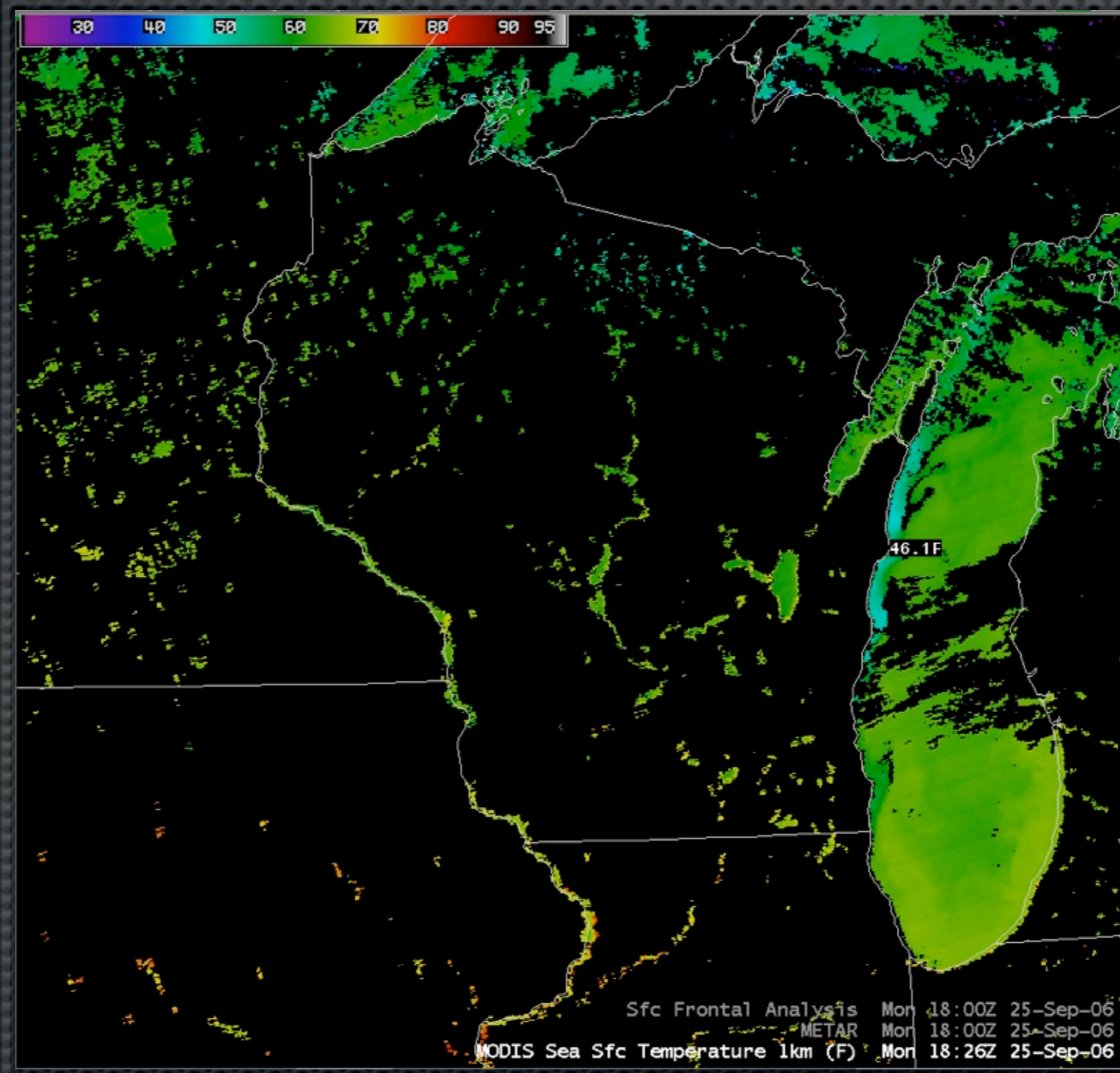
MODIS Imagery in AWIPS

Sea surface temperature



MODIS Imagery in AWIPS

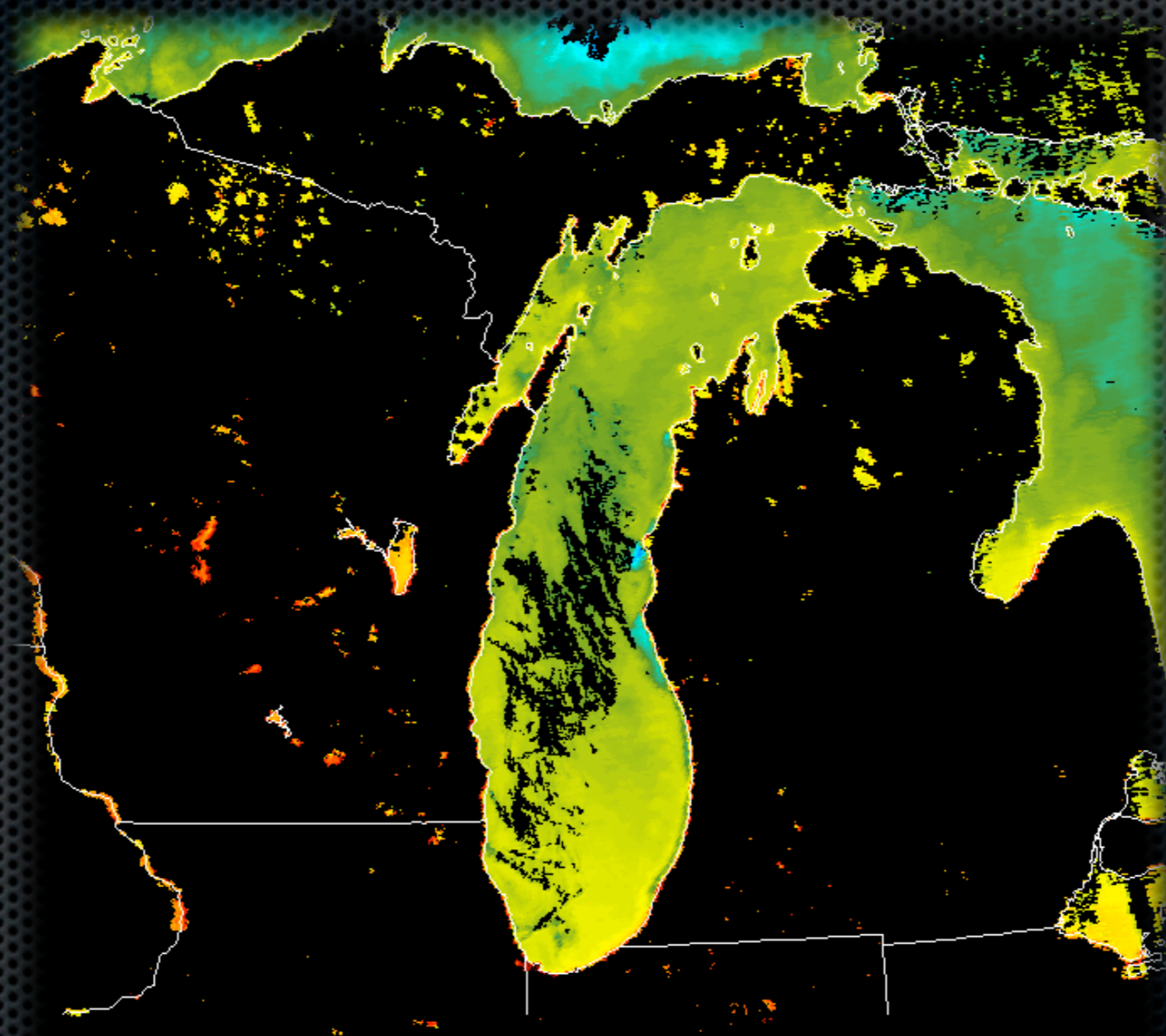
Sea surface temperature



Identify areas of upwelling

MODIS Imagery in AWIPS

Sea surface temperature

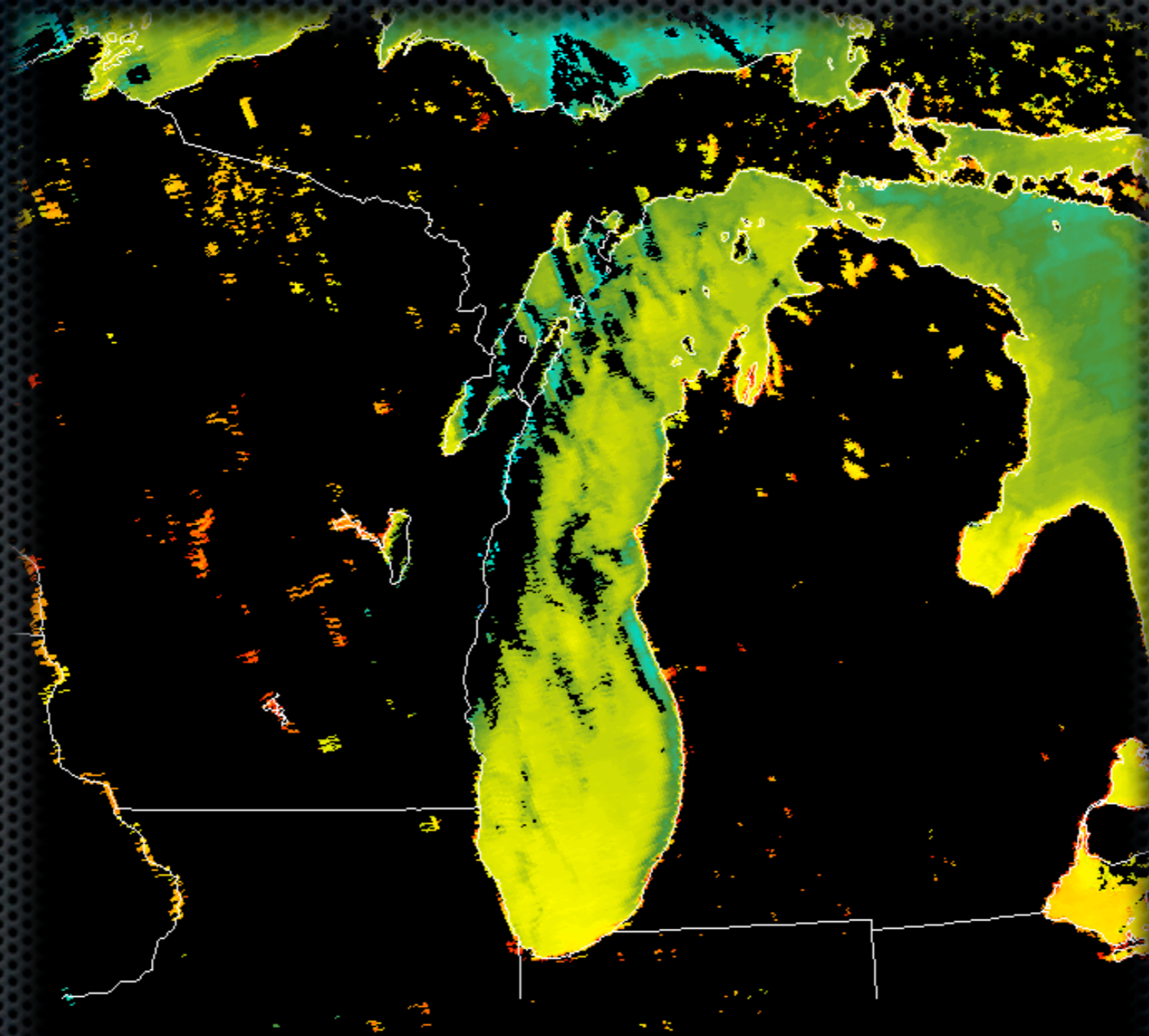


UW CIMSS **MODIS SEA SURFACE TEMPERATURES** AQUA 20_Jul_2007 1903 UTC
-5 0 5 10 15 20 25 30 35 C

Identify areas of rapid SST increase

MODIS Imagery in AWIPS

Sea surface temperature

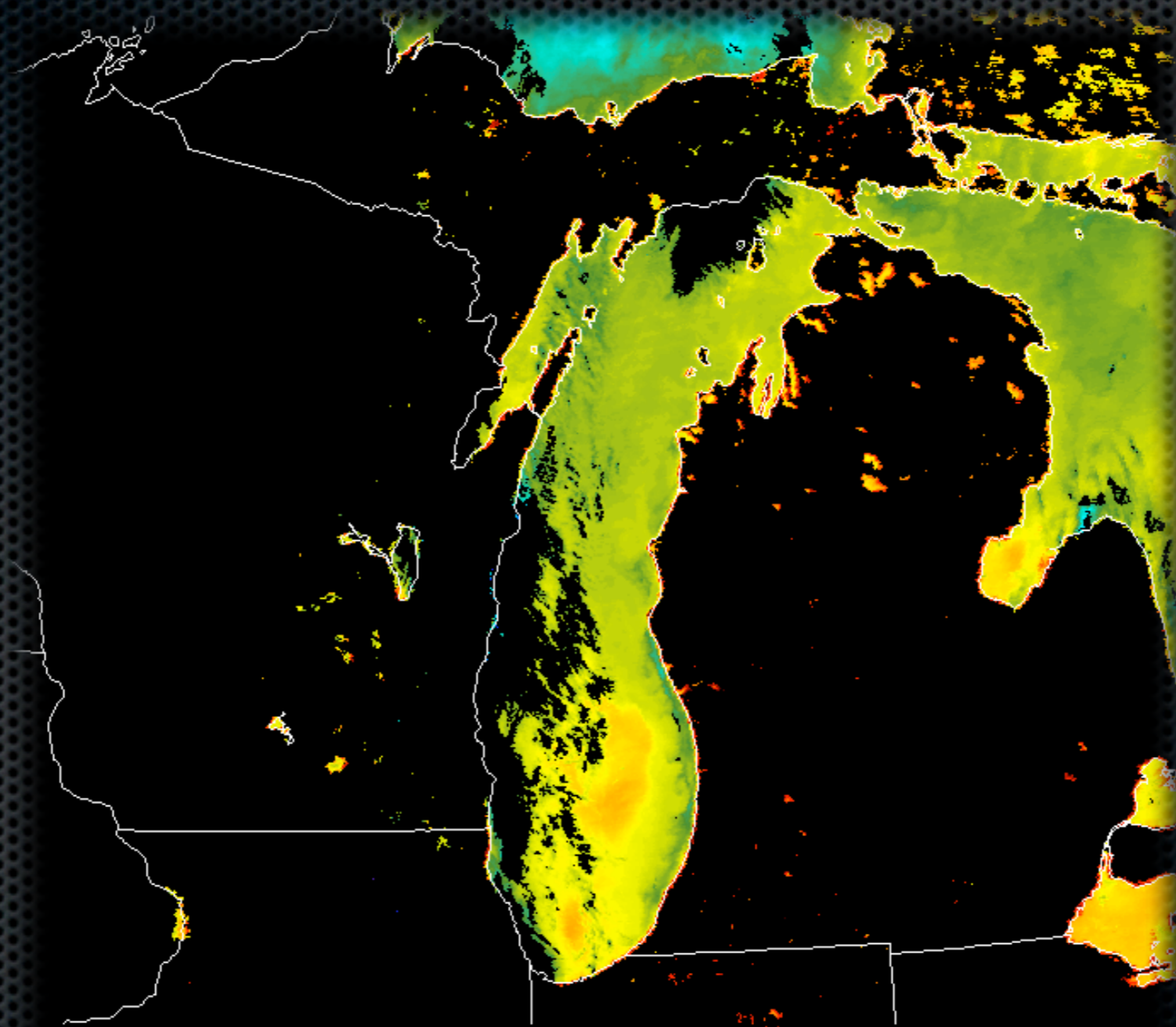


UW CIMSS **MODIS SEA SURFACE TEMPERATURES** AQUA 21_Jul_2007 1808 UTC
-5 0 5 10 15 20 25 30 35 C

Identify areas of rapid SST increase

MODIS Imagery in AWIPS

Sea surface temperature

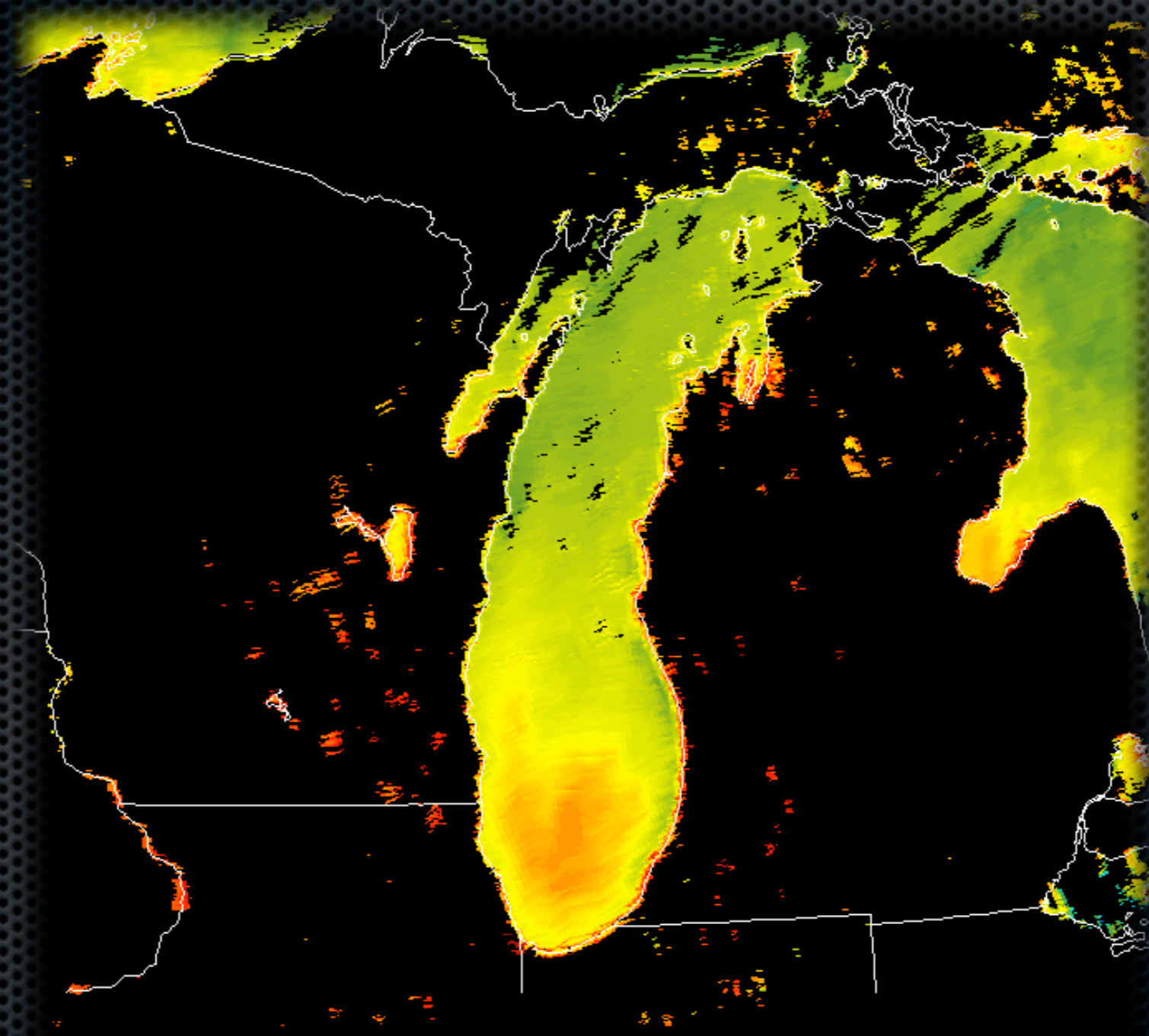


UW CIMSS **MODIS SEA SURFACE TEMPERATURES** AQUA 22_Jul_2007 1850 UTC
-5 0 5 10 15 20 25 30 35 C

Identify areas of rapid SST increase

MODIS Imagery in AWIPS

Sea surface temperature

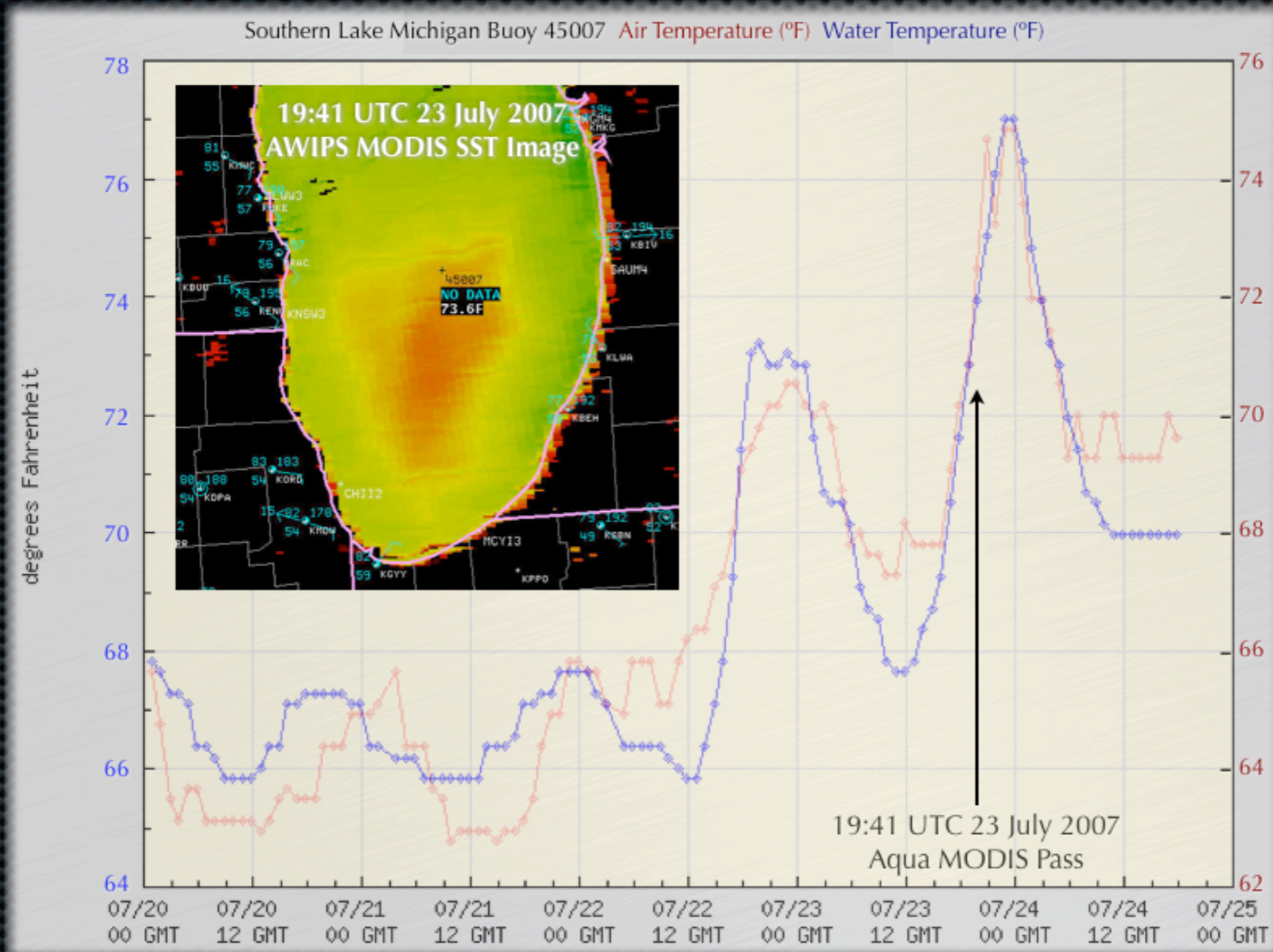


UW CIMSS **MODIS SEA SURFACE TEMPERATURES** AQUA 23_Jul_2007 1933 UTC
-5 0 5 10 15 20 25 30 35 C

Identify areas of rapid SST increase

MODIS Imagery in AWIPS

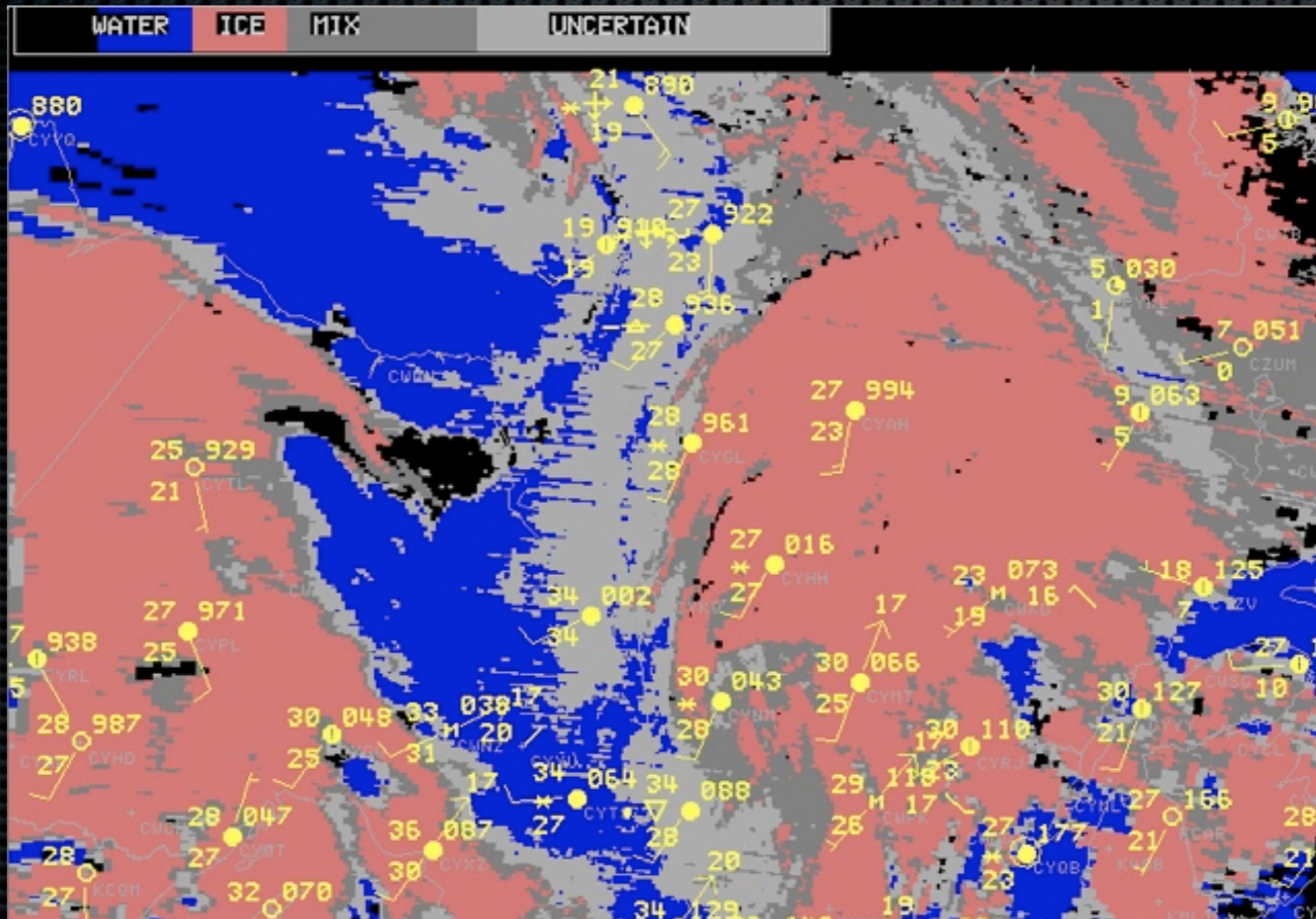
Sea surface temperature



Identify areas of rapid SST increase

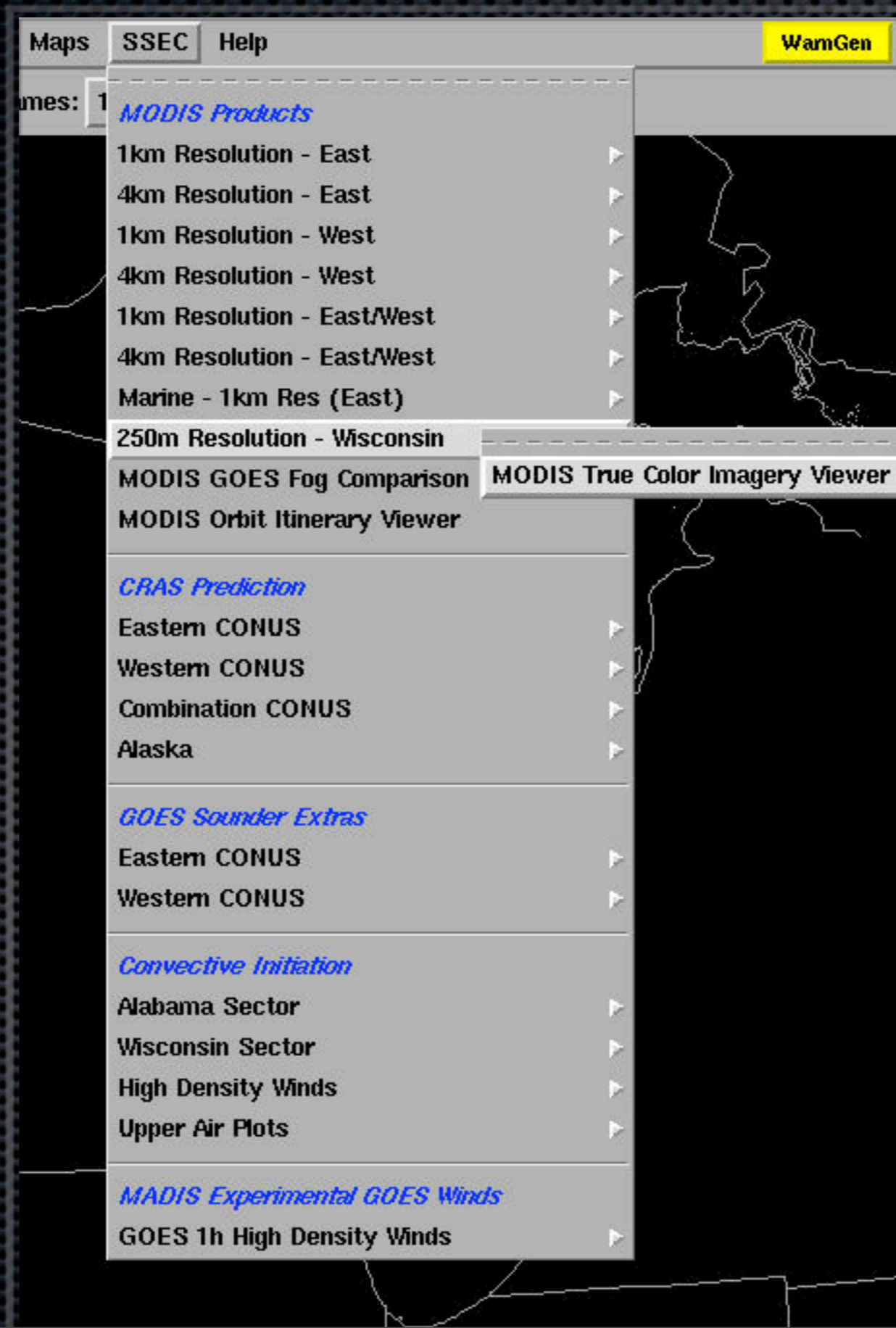
MODIS Imagery in AWIPS

Cloud phase product

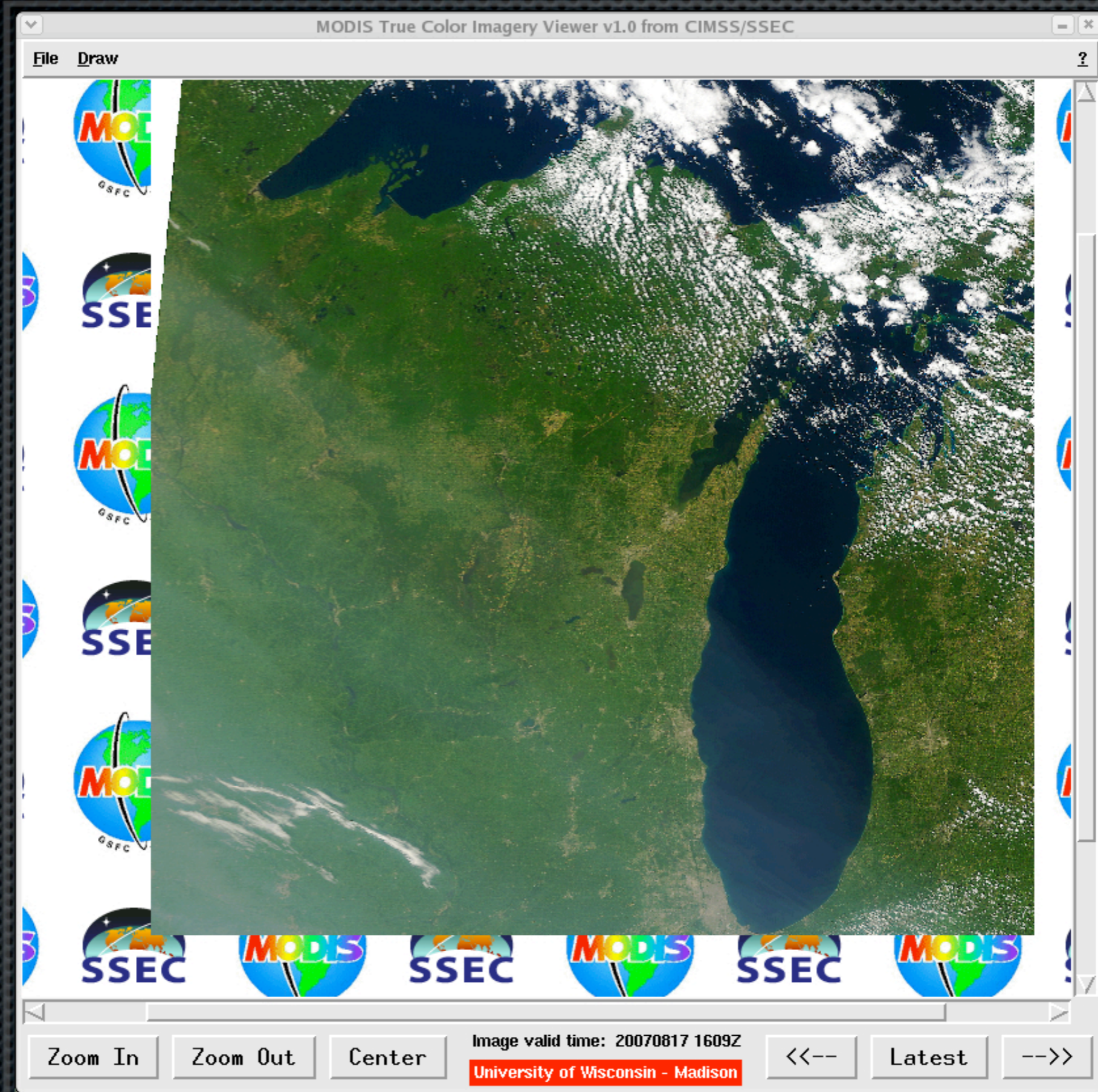


Can aid in the *precipitation type* forecast problem

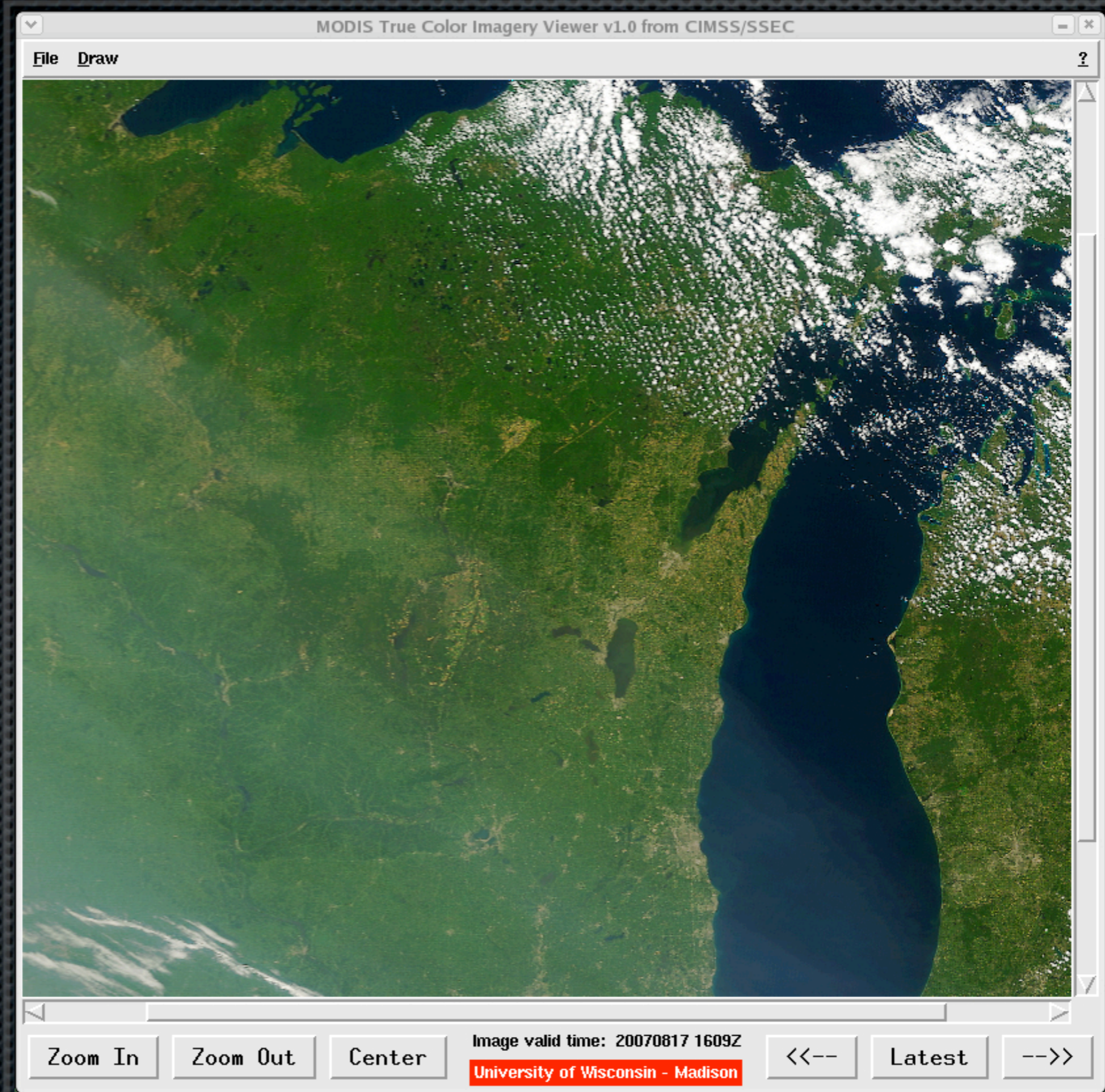
MODIS True Color Imagery Viewer



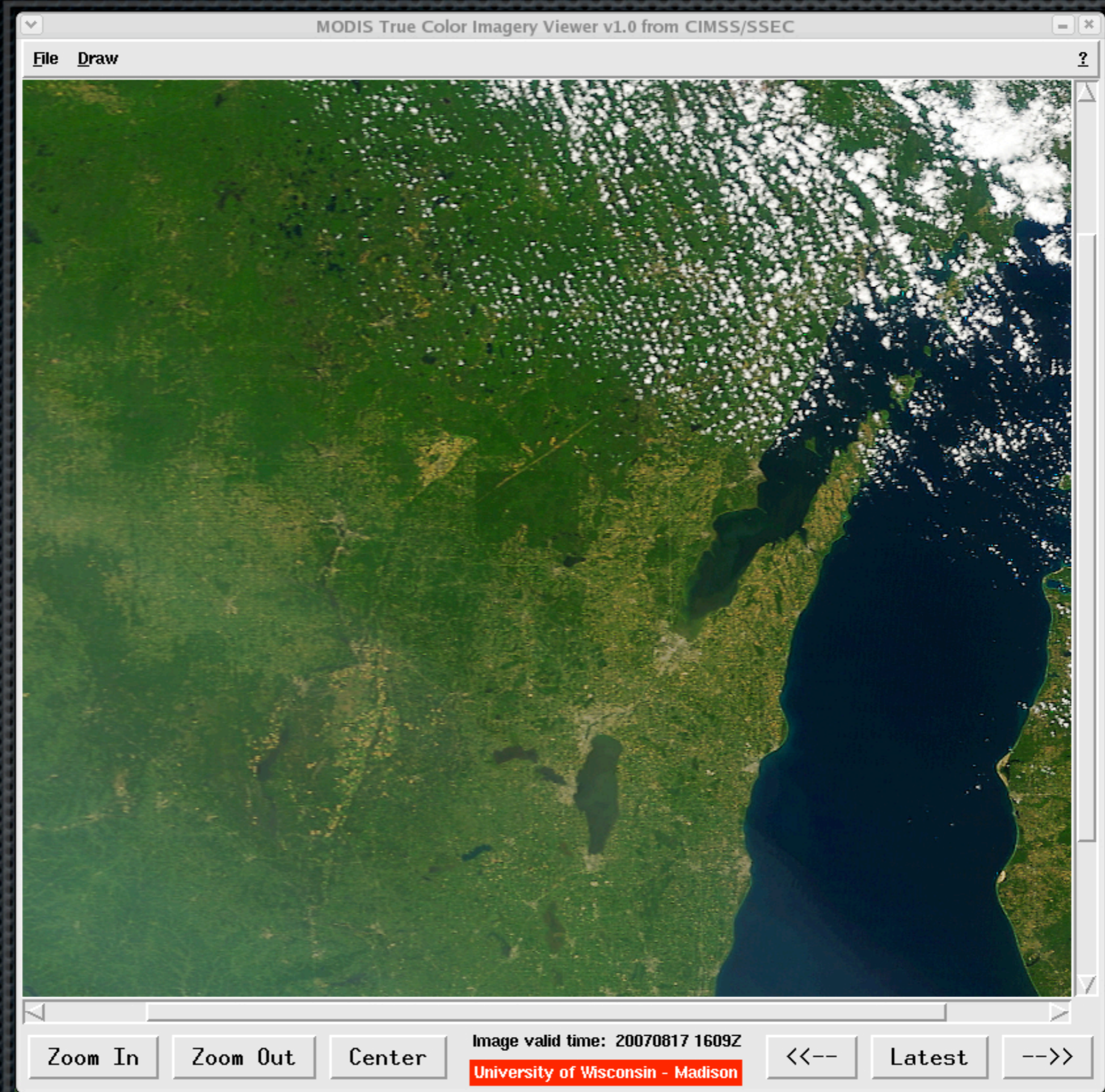
MODIS True Color Imagery Viewer



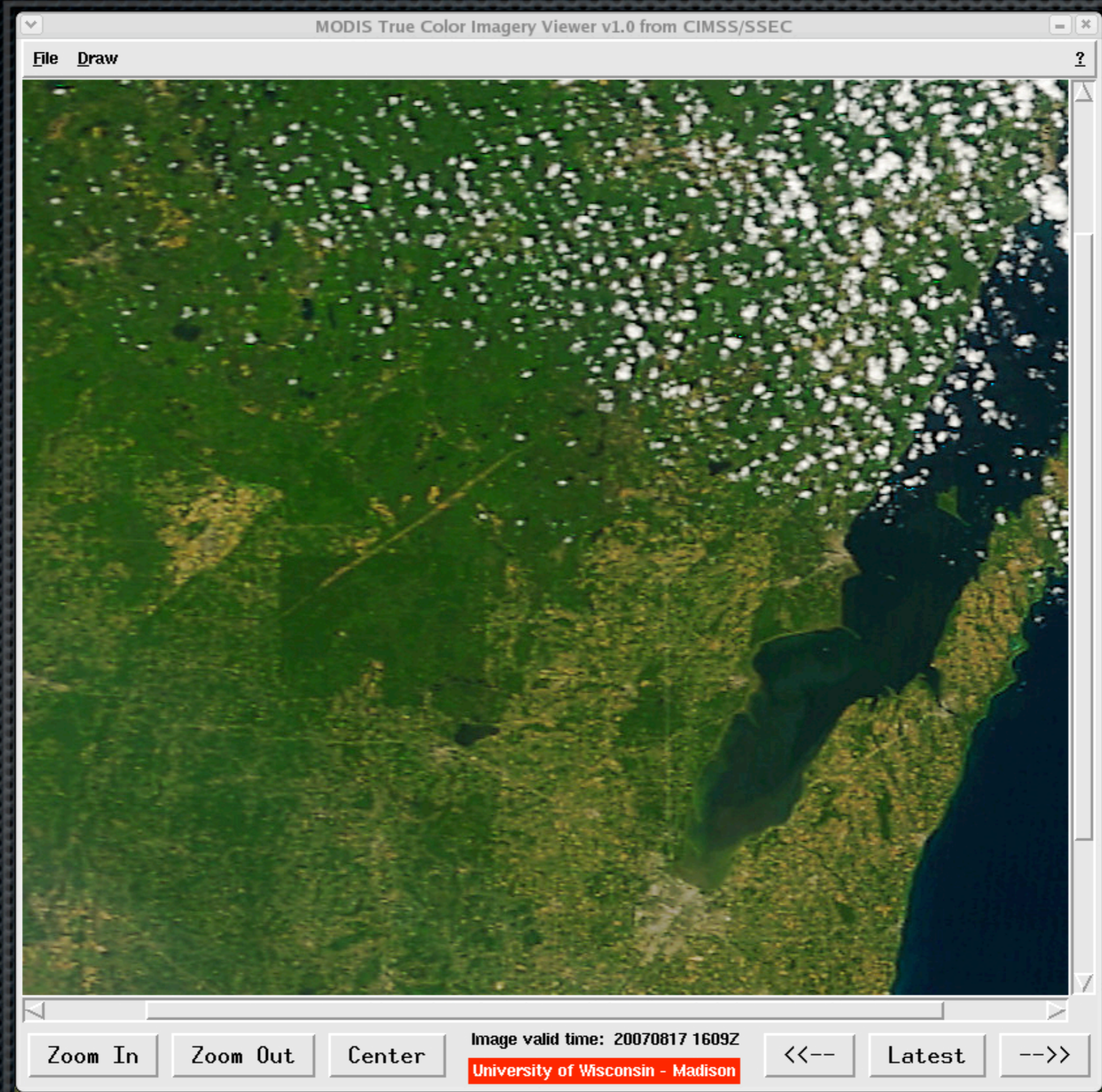
MODIS True Color Imagery Viewer



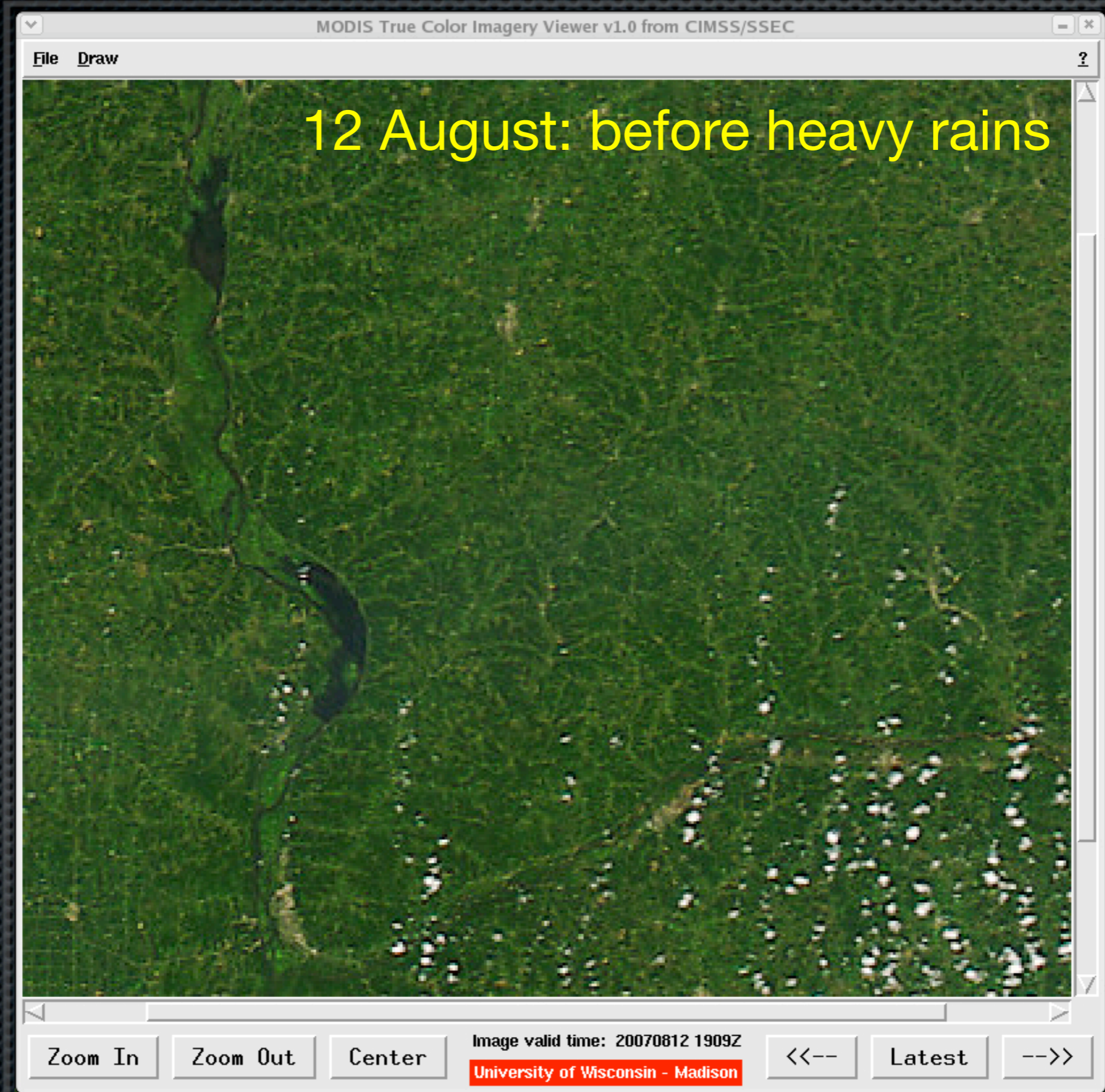
MODIS True Color Imagery Viewer



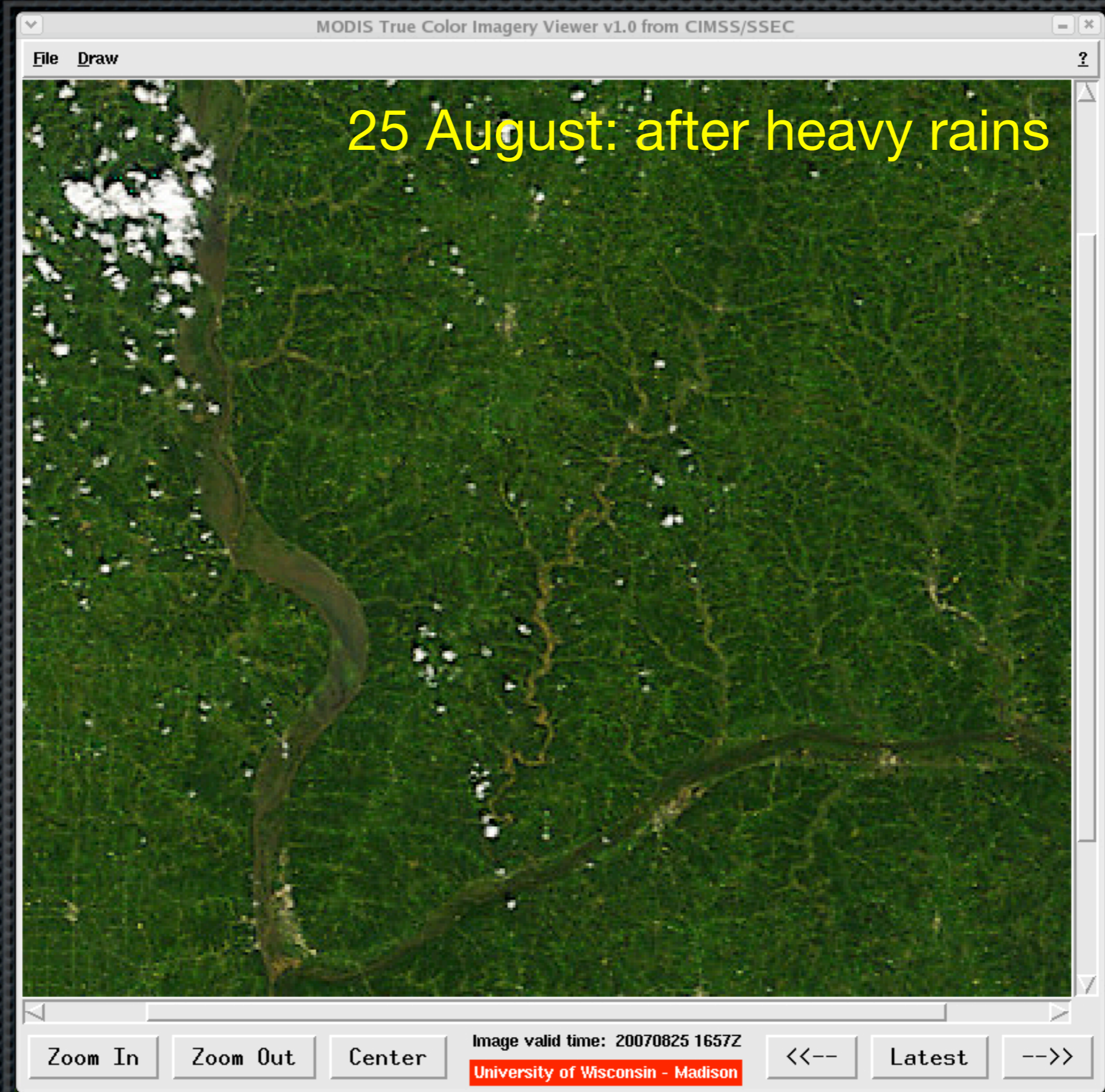
MODIS True Color Imagery Viewer



MODIS True Color Imagery Viewer



MODIS True Color Imagery Viewer



MODIS Products in AWIPS: Pros

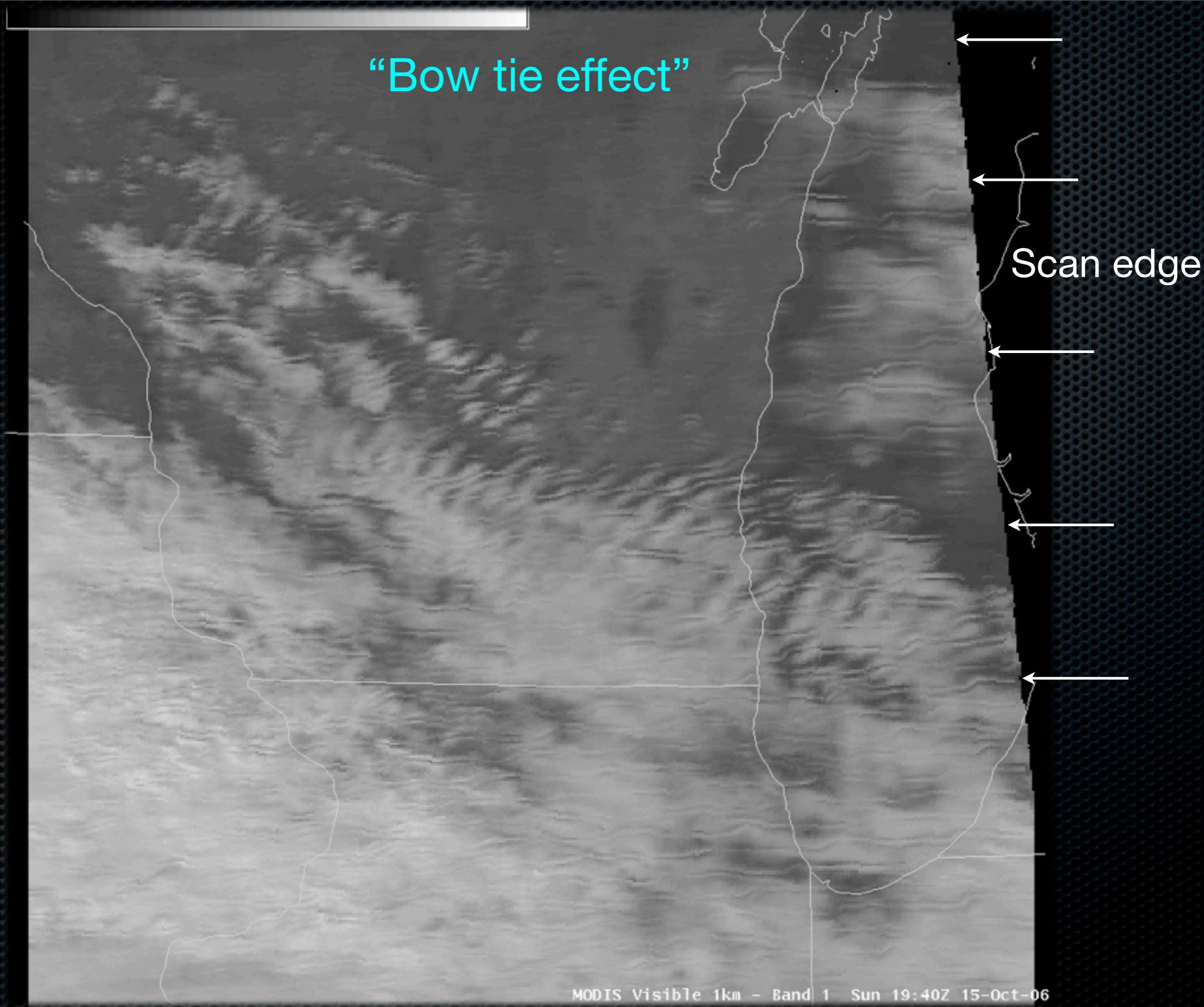
- ✦ New satellite channels and products not yet available on GOES; prepares forecasters for what will be available in the GOES-R era
- ✦ Better spatial resolution than comparable GOES channels
- ✦ MODIS imagery does not suffer resolution degradation when viewed at large scales (N. Hemisphere, North American, CONUS)
- ✦ Minimal parallax error

MODIS Products in AWIPS: Cons

- ✦ Polar orbit: inconsistent coverage (overpass time and geometry)
- ✦ Data latency: 15-45 minutes for individual 1km channels, 30-75 minutes for 4km products
- ✦ “Bow tie effect” along scan edges

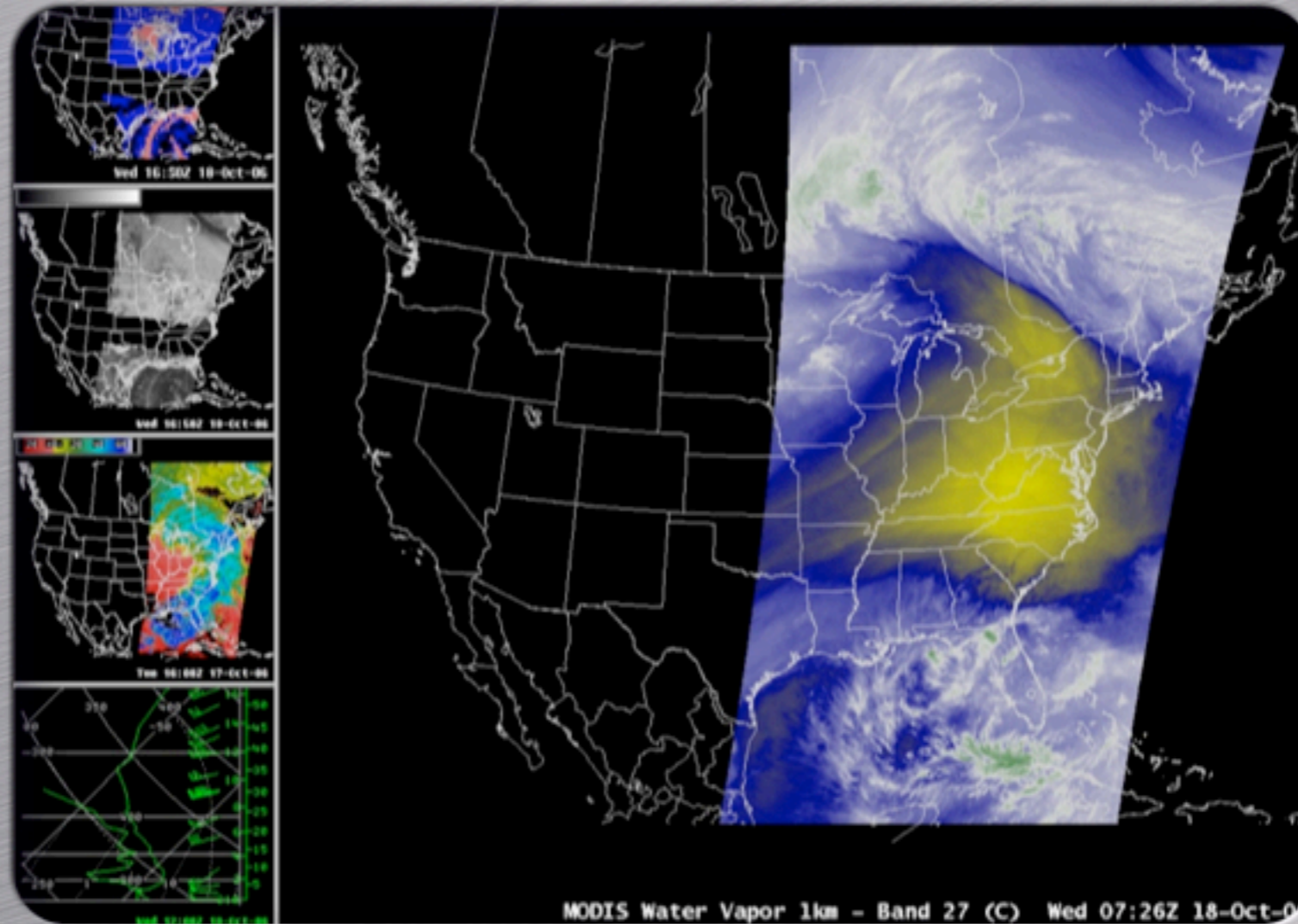
“Bow tie effect”

Scan edge



For more Information, see the VISIT lesson...

MODIS Products in AWIPS

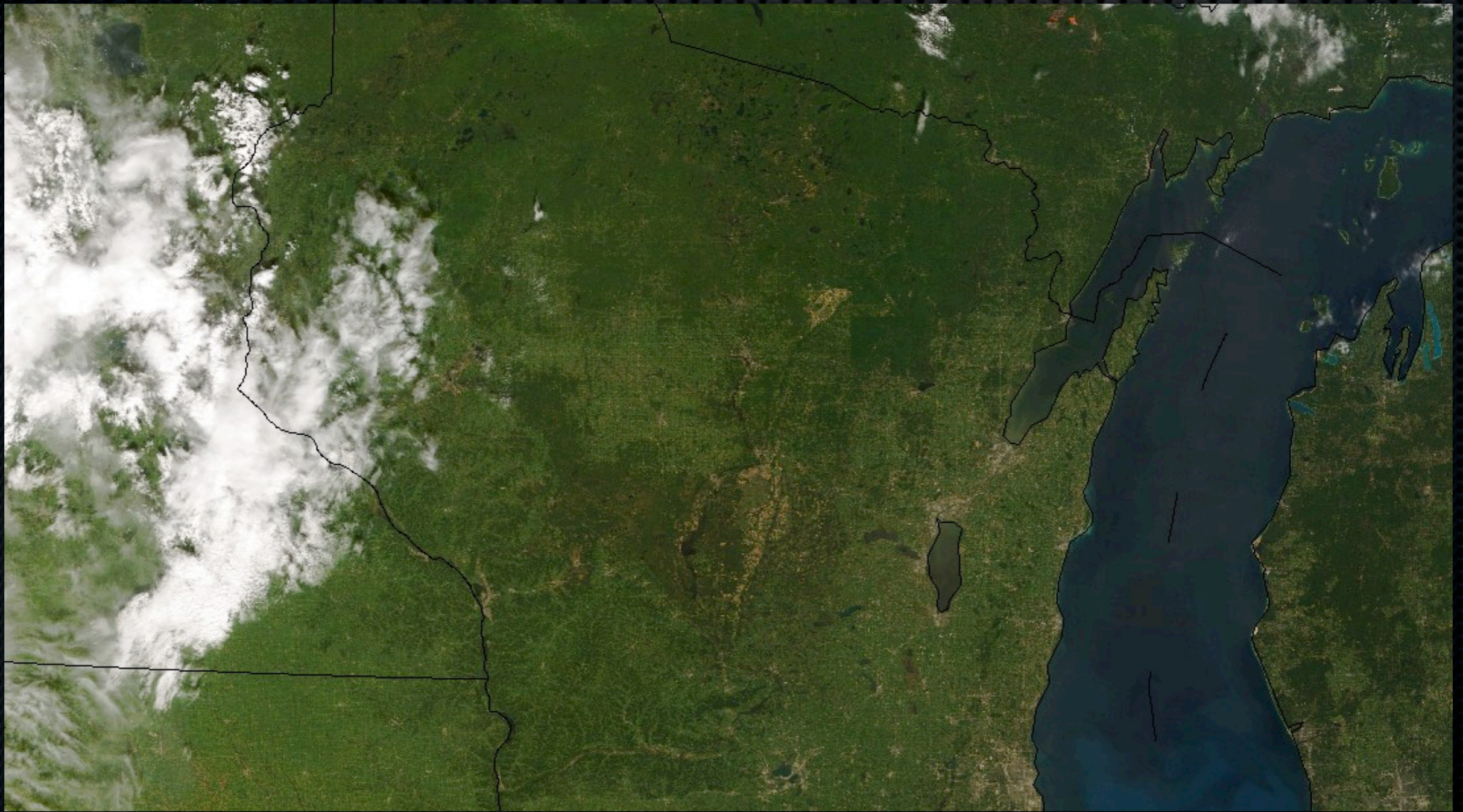


National Weather Service • Integrated Sensor Training Professional Development Series
Virtual Institute for Satellite Integration Training

<http://cimss.ssec.wisc.edu/goes/visit/modis.html>

Questions?

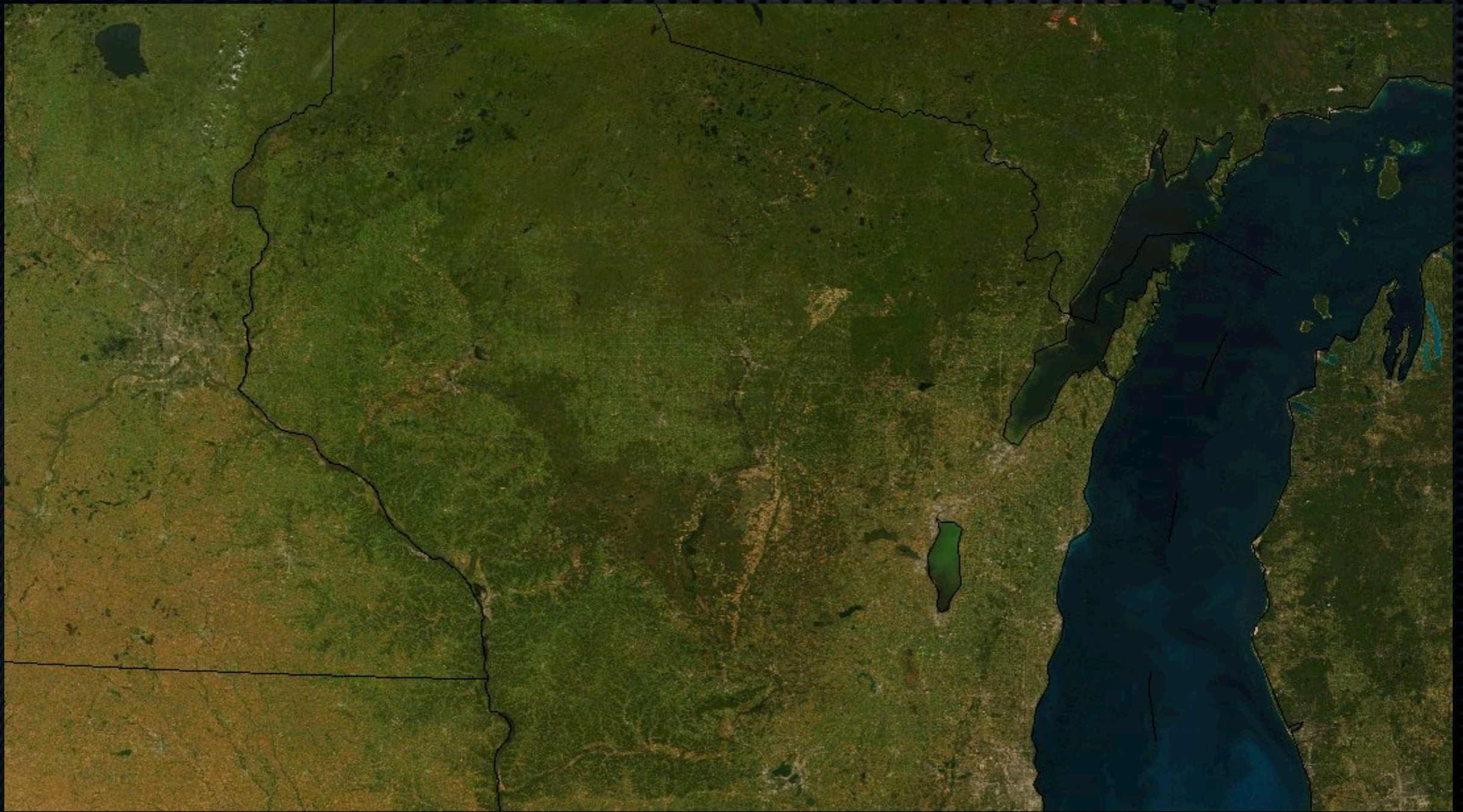
scott.bachmeier@noaa.gov



MODIS true color images - 10 September to 10 October 2004

Questions?

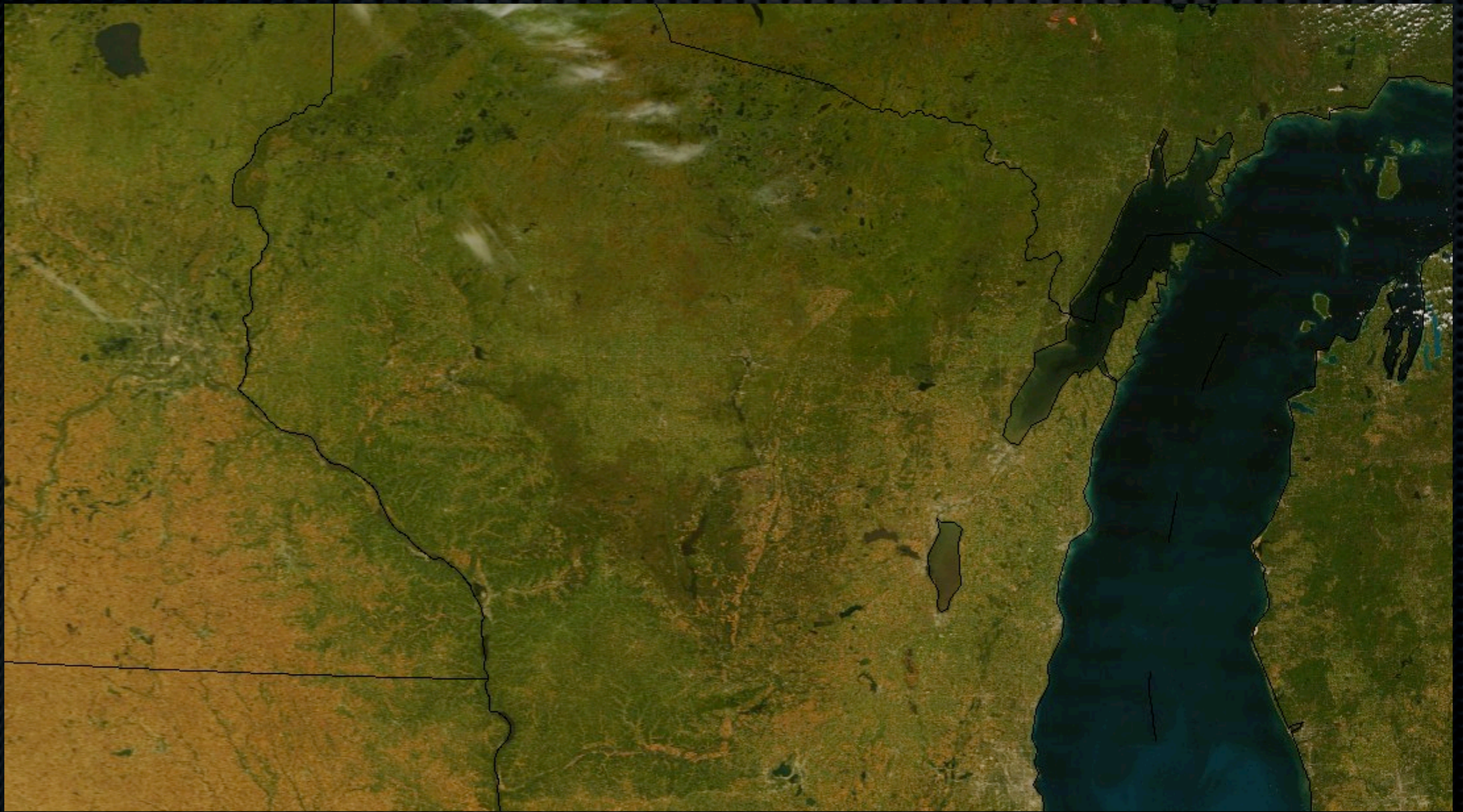
scott.bachmeier@noaa.gov



MODIS true color images - 10 September to 10 October 2004

Questions?

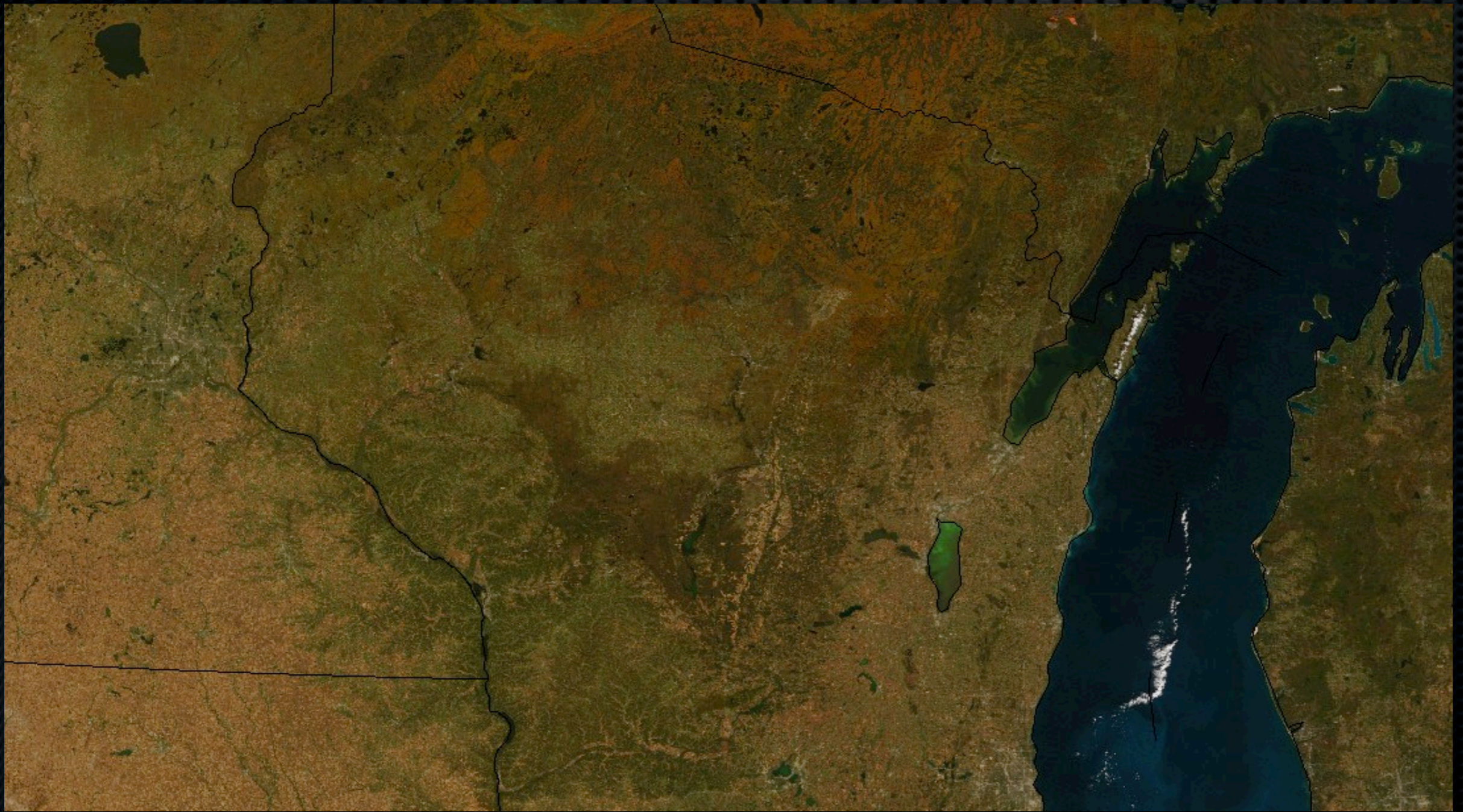
scott.bachmeier@noaa.gov



MODIS true color images - 10 September to 10 October 2004

Questions?

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MODIS true color images - 10 September to 10 October 2004