

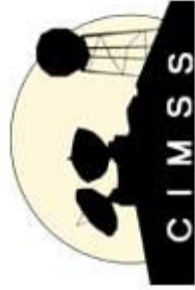
# MODIS Imagery and Products in an Operational Forecasting Environment

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Meteorological Satellite Studies

and

Space Science and Engineering Center  
University of Wisconsin at Madison

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University of Wisconsin-Madison Space Science and Engineering Center

Cooperative Institute for  
Meteorological Satellite Studies

# Overview

- ◆ Participating Offices
- ◆ AWIPS D-2D
- ◆ Types of Imagery and Products
- ◆ Processing and Delivery Mechanism
- ◆ Hurdles
- ◆ Most and Least Used
- ◆ Strengths and Weaknesses
- ◆ Value to Forecaster

# Overview

- ◆ There is an ongoing two-pronged effort in support of providing MODIS data to the National Weather Service:
  - MSFC SPORT project - Short-term Prediction Research and Transition Center whose goal is to use NASA Earth Science Enterprise (ESE) observations to improve short term (0-24hr) forecasts. They are using University of Wisconsin-Madison DB MODIS and AMSR-E products for distribution to forecast offices in the Southern Region.
  - UW-Madison - Supporting NWS MODIS Direct Broadcast data delivery into AWIPS for the Central Region forecast offices.

# Instructions Available Online

<http://cimss.ssec.wisc.edu/~jordang/awips-modis/>

**MODIS Imagery in D-2D**  
**Instructions for AWIPS Installation**  
Space and Science Engineering Center  
University of Wisconsin - Madison  
Released July 10, 2006  
Version 1.11 (September 8, 2006)

*Project members: Scott Beckmeier, Russ Dengel, Jordan Gerth, Scott Lindstrom, Jerrold Robaidek, Kathy Strabala, Steve Wanrong*

## Phase One (Flagship)

### Schedule

- June 5, 2006: Phase initiated
- June 7, 2006: Release of scripts for internal review
- June 15, 2006: Add screenshots below
- June 23, 2006: Assure data feed to CRH approved, running
- June 27, 2006: Final preparation of installation scripts
- June 30, 2006: Milwaukee/Sullivan Installation - Part I
- July 7, 2006: Milwaukee/Sullivan Installation - Part II
- **Install team: Jordan Gerth (SSEC), Steve Wanrong (SSEC), Kim Licitar (NWS)**
- **Screen Captures: Photographs**
- July 10, 2006: Official release of Version 1.0
- July 17, 2006: Version 1.0 testing finished
- August 1, 2006: Version 1.1 released (Mandatory)
- August 4, 2006: Deployment deadline for Version 1.1
- September 8, 2006: Version 1.11 upgrade released (Optional)
- September 8, 2006: Special memo about CRAS (V1.0,1.1 only)

**Offices are strongly encouraged to register with the Local Applications Database (LAD).**

The Space Science and Engineering is not staffed around the clock. Consequently, data outages and processing issues may result. **These images should be considered non-operational.**

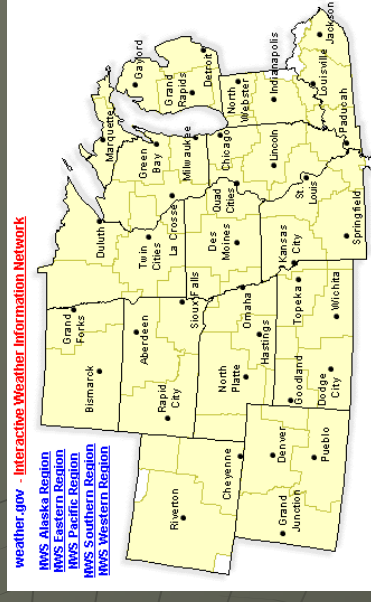
# Participating Offices

## Current

- ◆ Davenport, Iowa (DVN)
- ◆ La Crosse, Wisconsin (ARX)
- ◆ Milwaukee/Sullivan, Wisconsin (MKX)
- ◆ Riverton, Wyoming (RIW)

## Future

- ◆ Des Moines, Iowa (DMX)
- ◆ More



# AWIPS D-2D

- ◆ Advanced Weather Information Processing System
- ◆ Display Two-Dimensions
- ◆ GUI; no command line
- ◆ One-stop mechanism for gathering and viewing all operational weather data at National Weather Service field offices, including model data, satellite data, observations, lightning, local radar, etc.

# AWIPS D-2D

Forecast Systems Laboratory D-2D (fsla)

File View Options Tools Local Tools Volume Obs NCEP/Hydro Upper Air Satellite Konkr Radar SCAN Maps SSEC Help

Valid time seq: 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

WMO: 1800Z SURFACE ANALYSIS  
 DATE: MON OCT 23 2006  
 TIME: 1800Z  
 BASED ON: 1800Z  
 BY: [unreadable]

AWIPS  
 Mon 23 Oct 2006 20:43 UTC  
 Mon 23 Oct 2006 20:43 GMT

Alert  
 Text 1  
 Text 2  
 Text 3  
 Text 4

MSL Pressure Analysis  
 GOES IR Satellite (C)

Mon 15:00Z 23-Oct-06  
 Mon 14:45Z 23-Oct-06  
 Mon 14:45Z 23-Oct-06

Frames: 12 | Map: | Density: 1 |

Applications Actions [Icons] [Terminal] [fsla]Text Workstation [About to Start D2D] [Forecast Systems L]

Mon Oct 23, 8:43 PM

Panes

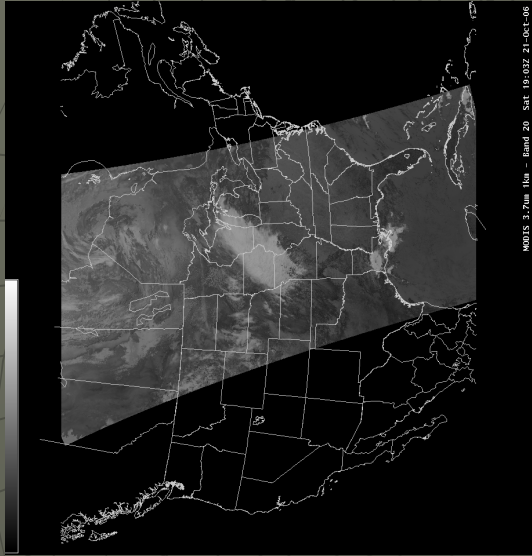
# Types of Imagery and Products

- ◆ 1 Kilometer Resolution
  - Visible (Band 1)
  - Snow/Ice (Band 7)
  - Cirrus (Band 26)
  - 3.7 $\mu\text{m}$  (Band 20)
  - Water Vapor (Band 27)
  - IR Window (Band 31)
  - 11 $\mu\text{m}$  - 3.7 $\mu\text{m}$  product

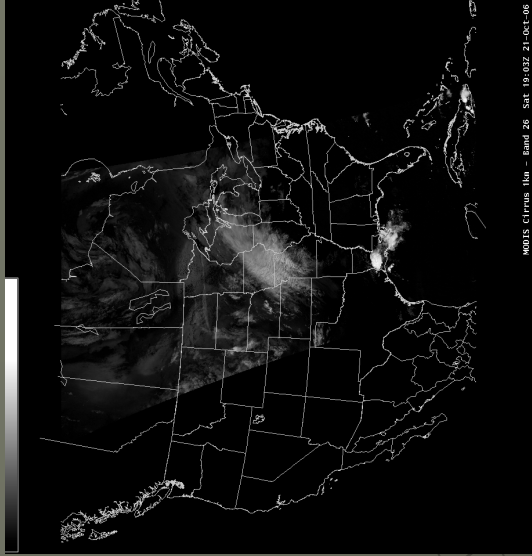




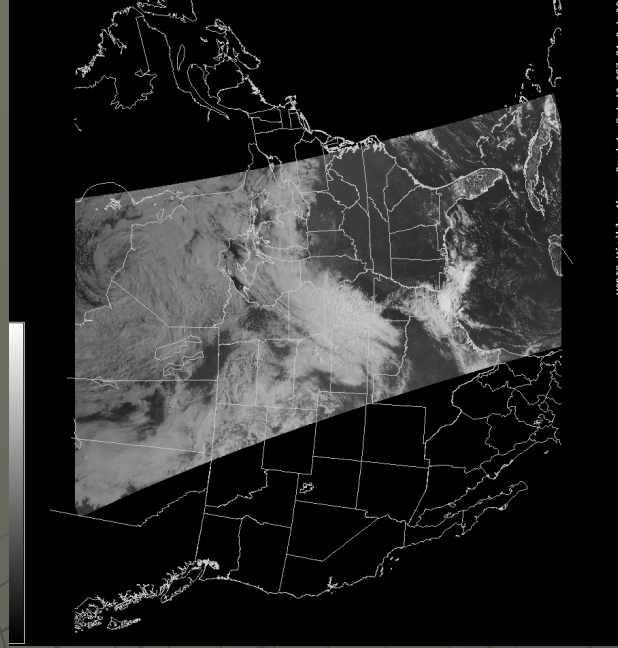
# Sample Images



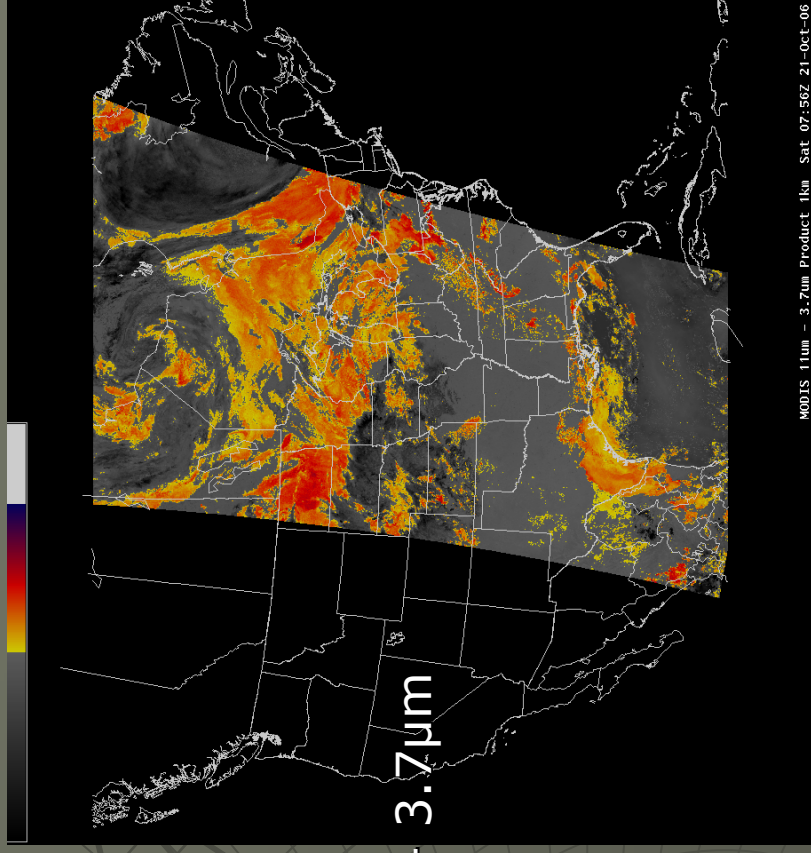
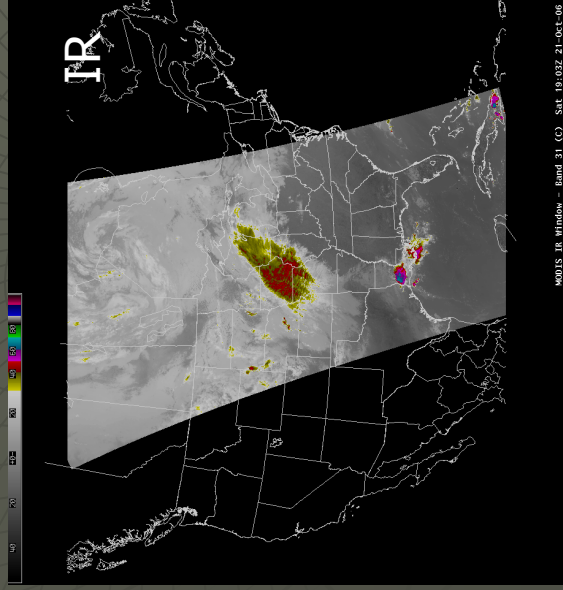
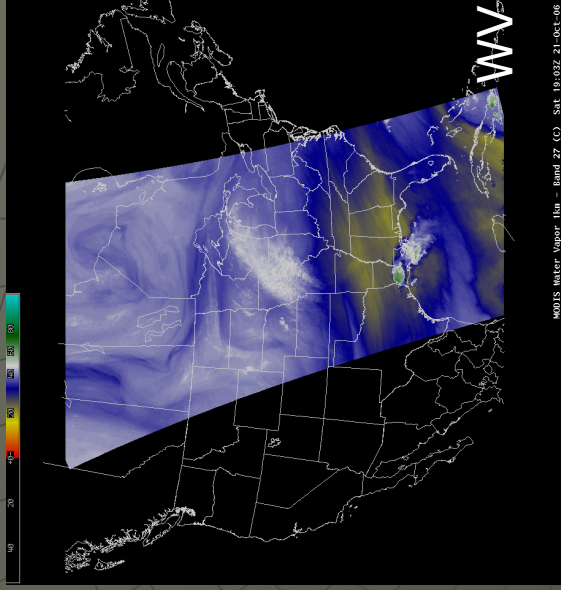
3.7µm Cirrus



Snow Visible

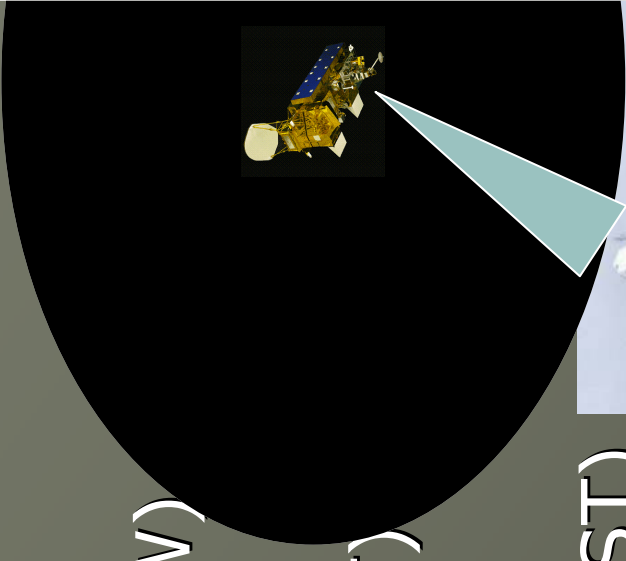


# Sample Images



# Types of Imagery and Products

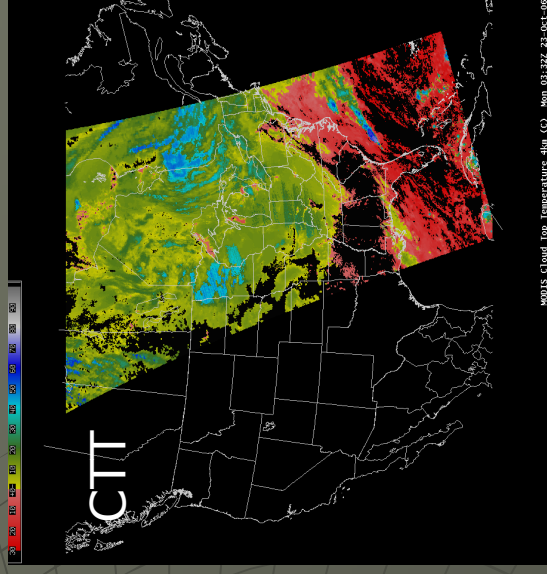
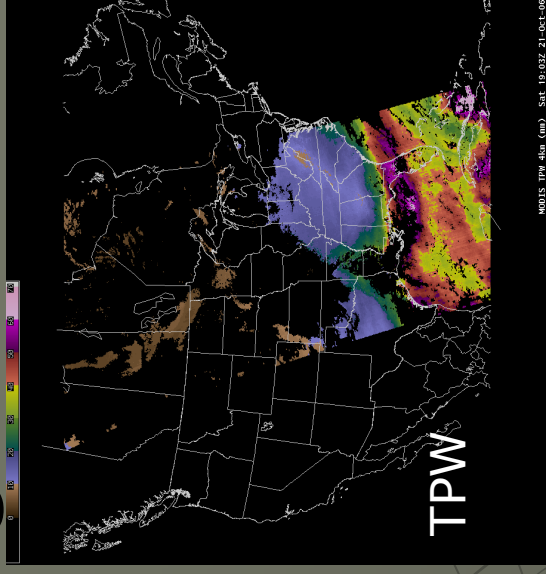
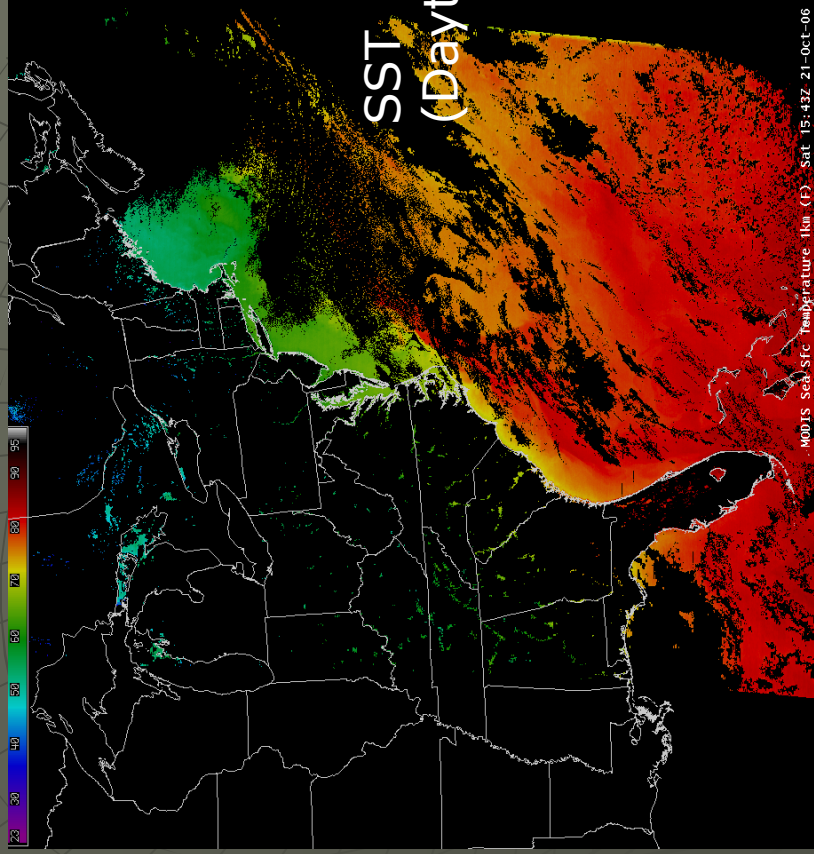
- ◆ 4 Kilometer Resolution
  - Total Precipitable Water (TPW)
  - Cloud Phase (CTP)
  - Cloud Top Temperature (CTT)
- ◆ Marine (1 Kilometer)
  - Sea Surface Temperature (SST)



Two sets: eastern and western  
United States



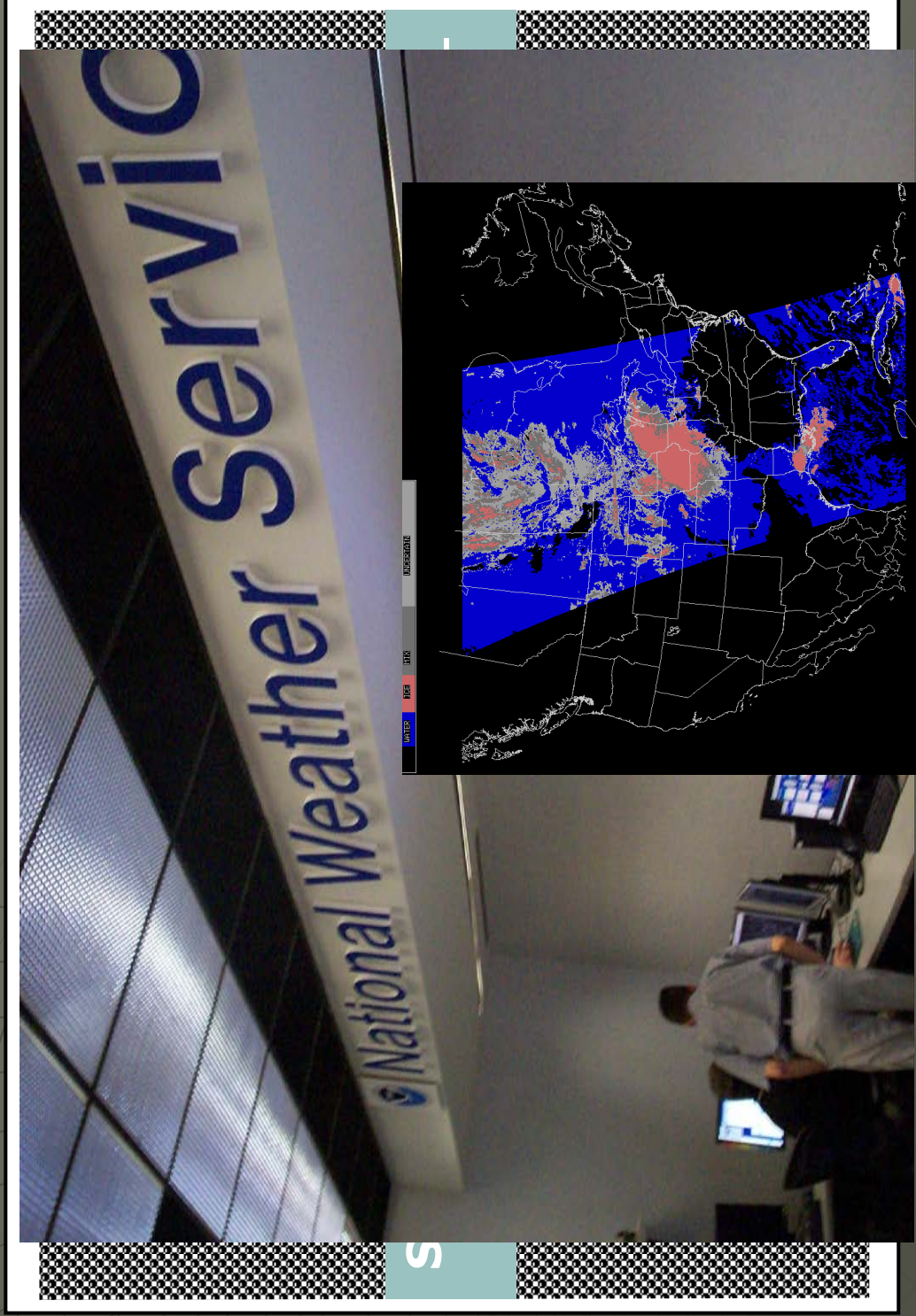
# Sample Images



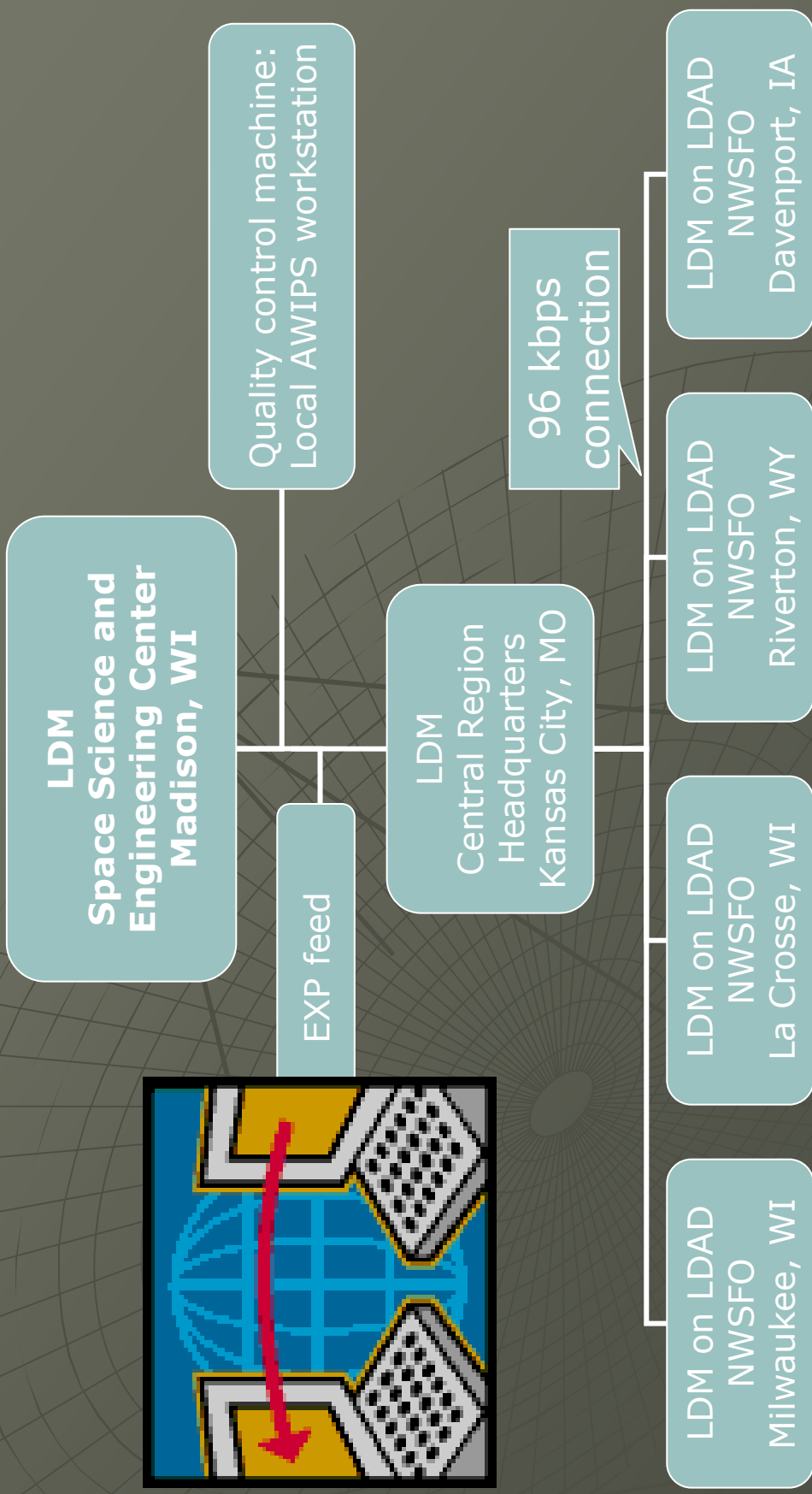
# Processing Mechanism

- ◆ Obtain a McIDAS (University of Wisconsin Visualization Tool) area file of image or product
- ◆ Fit to a predefined region used in AWIPS (eastConus, westConus)
- ◆ Zero-fill area of NetCDF where there is no subset of the MODIS pass
- ◆ Compress using zlib
- ◆ Apply naming convention

# Processing Mechanism



# Delivery Process



# Hurdles

- ◆ Local Data Manager (LDM)
  - Compatibility between LDM5 and LDM6
  - Size of queue
- ◆ Local Data and Dissemination (LDAD)
  - Receiving machine at NWS field offices is not Linux; slow
- ◆ Bandwidth
- ◆ Load time
  - Loops







SBN/  
NOAA  
PORT

LDAD

LDAD

HEWLETT  
PACKARD  
5000

5000

# Weaknesses

- ◆ Delayed
  - Processing and delivery takes over an hour
    - ◆ Working to improve
- ◆ Lack of Consistency
  - Forecasters have difficulty memorizing Terra and Aqua pass schedules
- ◆ Similarity to other satellites
  - Since GOES visible imagery is available in a timely manner, there is not much benefit to using MODIS visible
  - Addition of POES in upcoming builds

# MODIS Imagery Usage

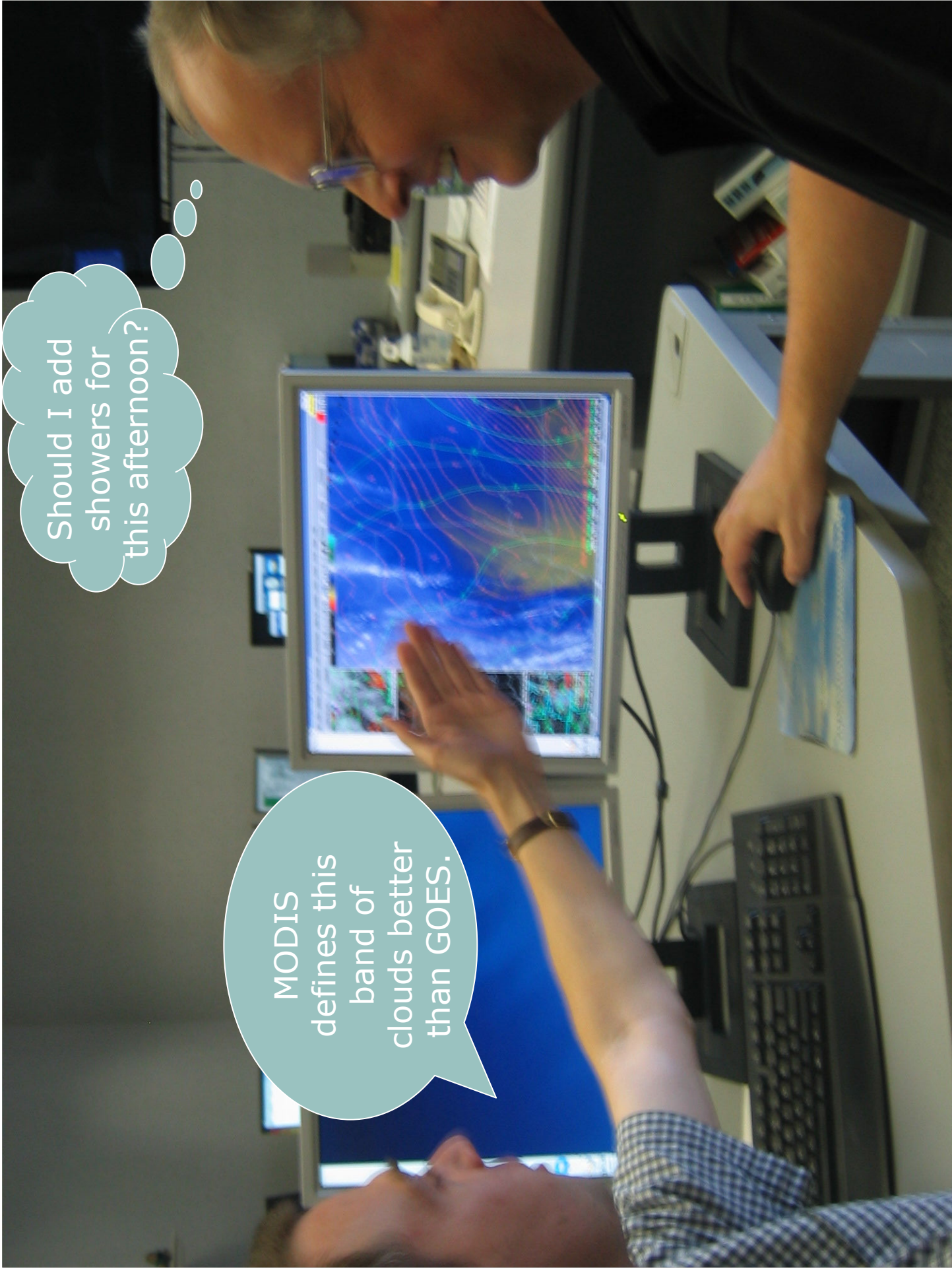
During forecast preparation:

- ◆ Least Used
  - Visible
  - Cirrus
- ◆ Growing Use
  - Snow/Ice
  - Cloud Phase

◆ Most Used

- 11 $\mu$ m - 3.7 $\mu$ m Product (Fog)
- Total Precipitable Water (TPW)
- Sea Surface Temperature (SST)
- Water Vapor (WV)





Should I add showers for this afternoon?

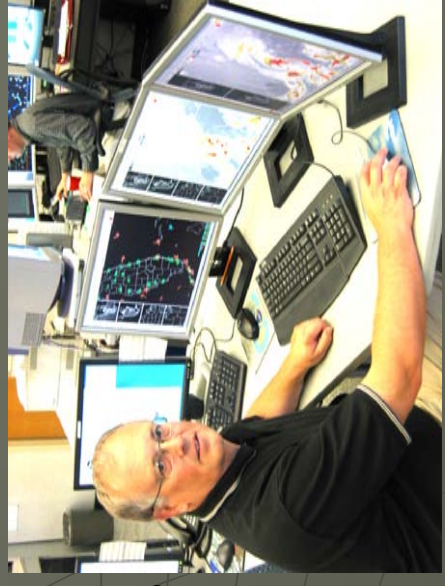
MODIS defines this band of clouds better than GOES.

# Strengths

- ◆ Creates viable connection between research environment and National Weather Service field offices
- ◆ High resolution, better quality
  - Depiction of small-scale features
- ◆ New products
  - Cloud Phase
  - Sea Surface Temperature
    - ◆ Upwelling

# Value to Forecaster

- ◆ Near-term (less than 12 hours) forecasts
  - Diagnosing heavy precipitation potential
    - ◆ Total Precipitable Water (TPW)
  - Determining precipitation type
    - ◆ Snow or freezing drizzle?
- ◆ Short-term (12 to 36 hours) forecasts
  - Areas of fog formation
  - Temperatures in lakeshore areas
- ◆ Post-event analysis
  - Temperature of significant convective cells

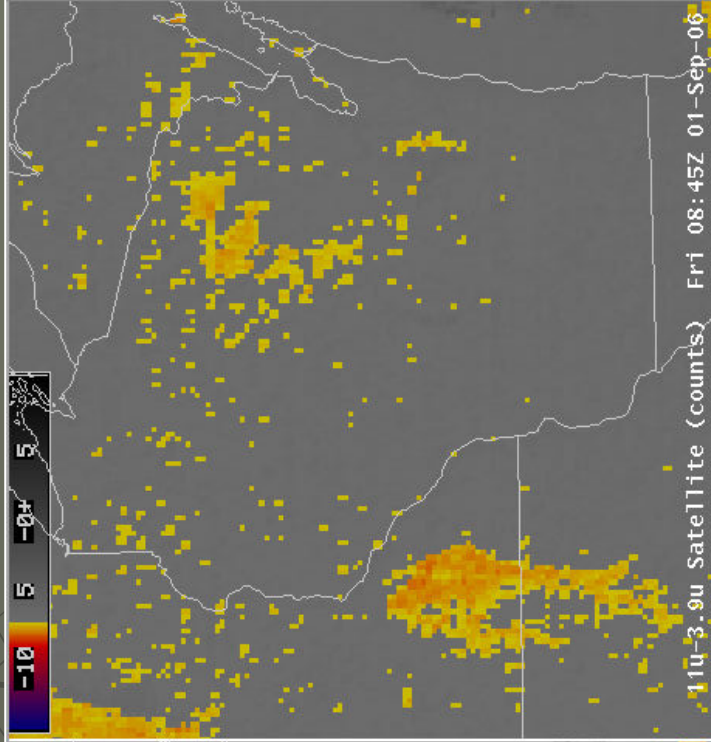
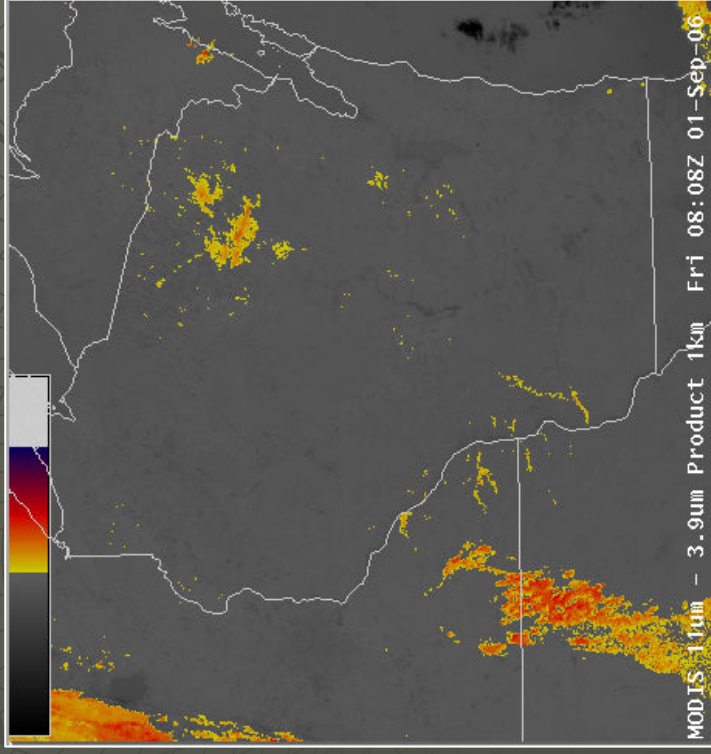


# Value to Forecaster

- ◆ Aviation
  - Small-scale orographic turbulence
- ◆ Climatology
  - Diagnosing areas of accumulated snow
  - Formation of ice on sizeable lakes and other waterways
- ◆ Marine
  - Wind shift on Great Lakes
- ◆ Local phenomena

# Area Forecast Discussion

MAIN SHORT TERM FORECAST PROBLEM IS EAST FLOW AND MARINE LAYER INFLUENCE OVER EASTERN WISCONSIN...AND DENSE FOG POTENTIAL IN THE WEST. THINK MOST OF THE DENSE FOG WOULD BE IN THE RIVER VALLEYS...WITH A TENDENCY FOR PATCHY FOG AND SOME STRATUS AGAIN IN THE EAST WITH MORE OF A GRADIENT. MODIS 1 KM IMAGERY LAST NIGHT SHOWED THE DENSE FOG IN LONE ROCK AND BOSCOBEL WAS CONFINED TO THE IMMEDIATE WISCONSIN RIVER VALLEY...IMPORTANT INFORMATION. THE LOCAL RIVER VALLEY DENSE FOG IS NOT SEEN IN THE NORMAL 2 KM GOES. (HENTZ/MKX)

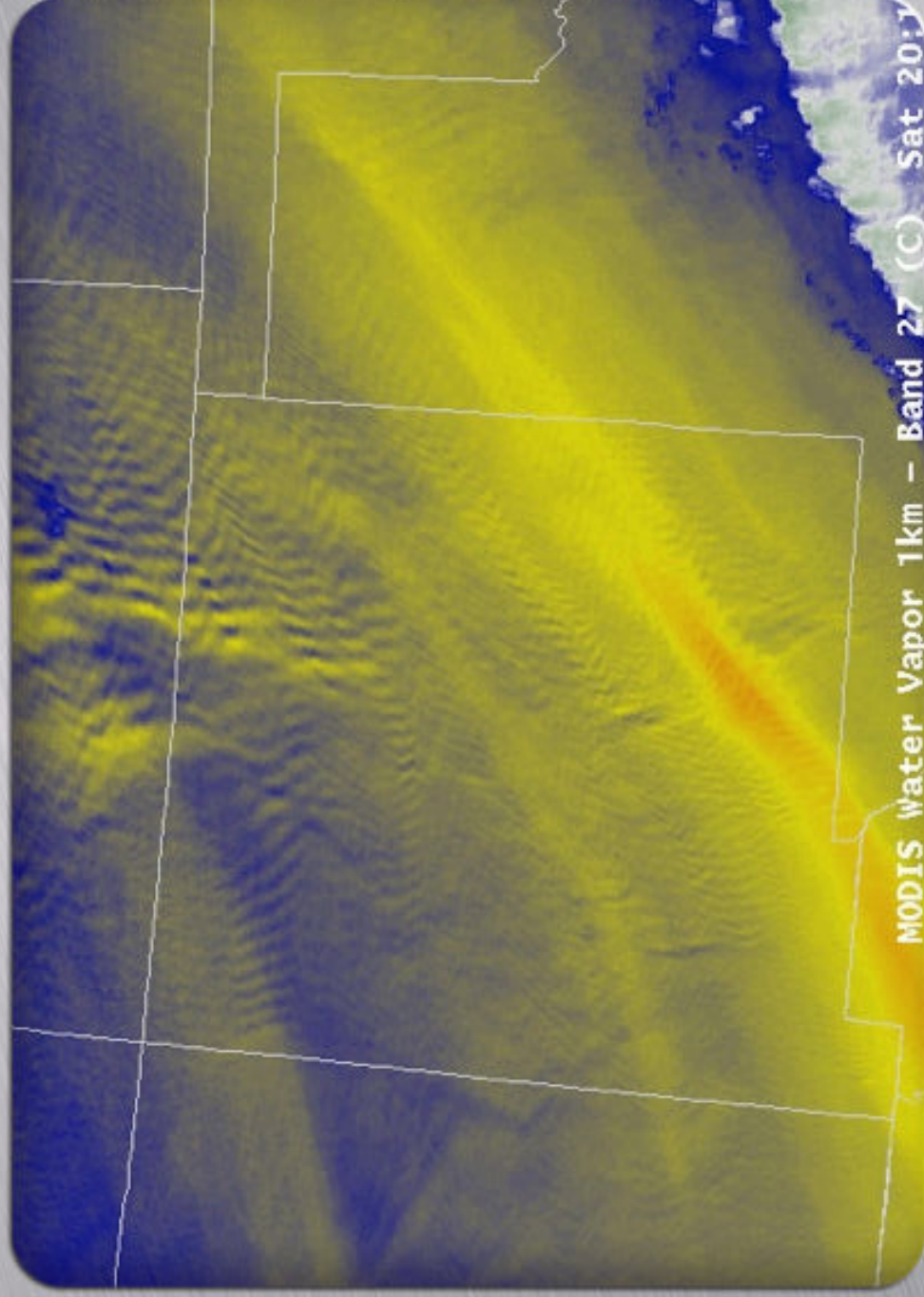




# Interesting Examples

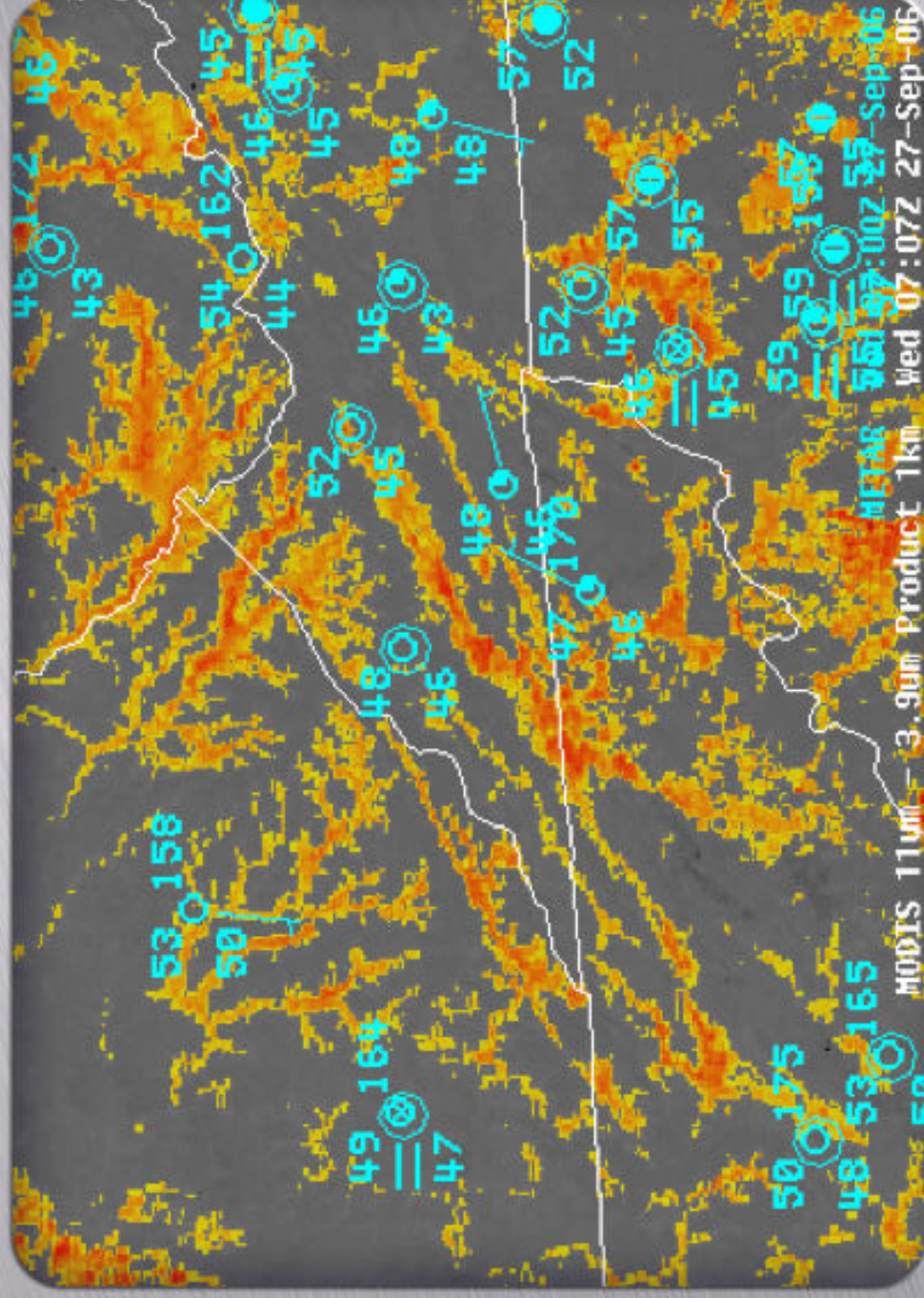
Courtesy of  
Scott Bachmeier  
(CIMSS/SSEC)

# MODIS Imagery in AWIPS



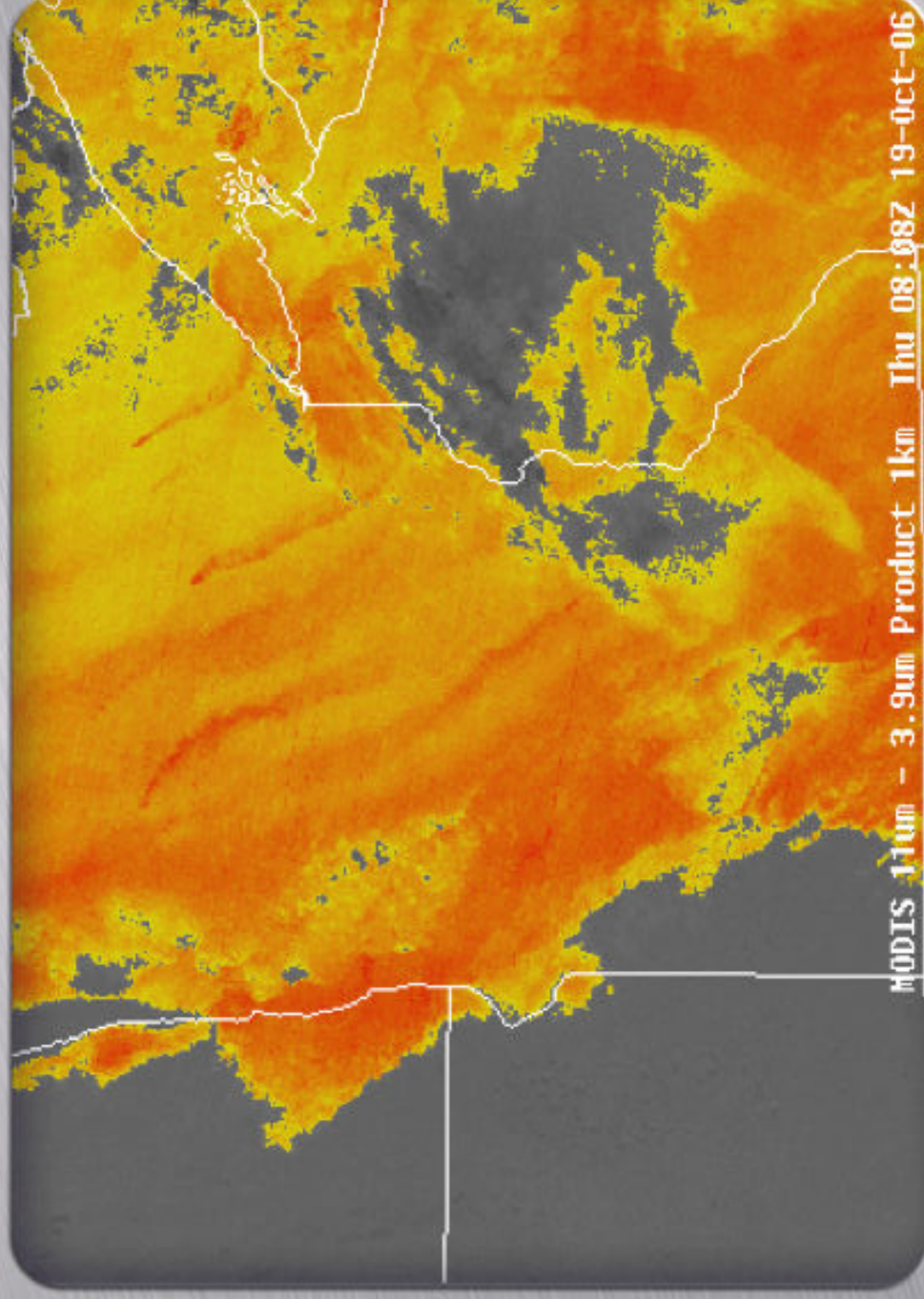
**Band 27 (6.7  $\mu\text{m}$ ) - Water Vapor**

# MODIS Imagery in AWIPS



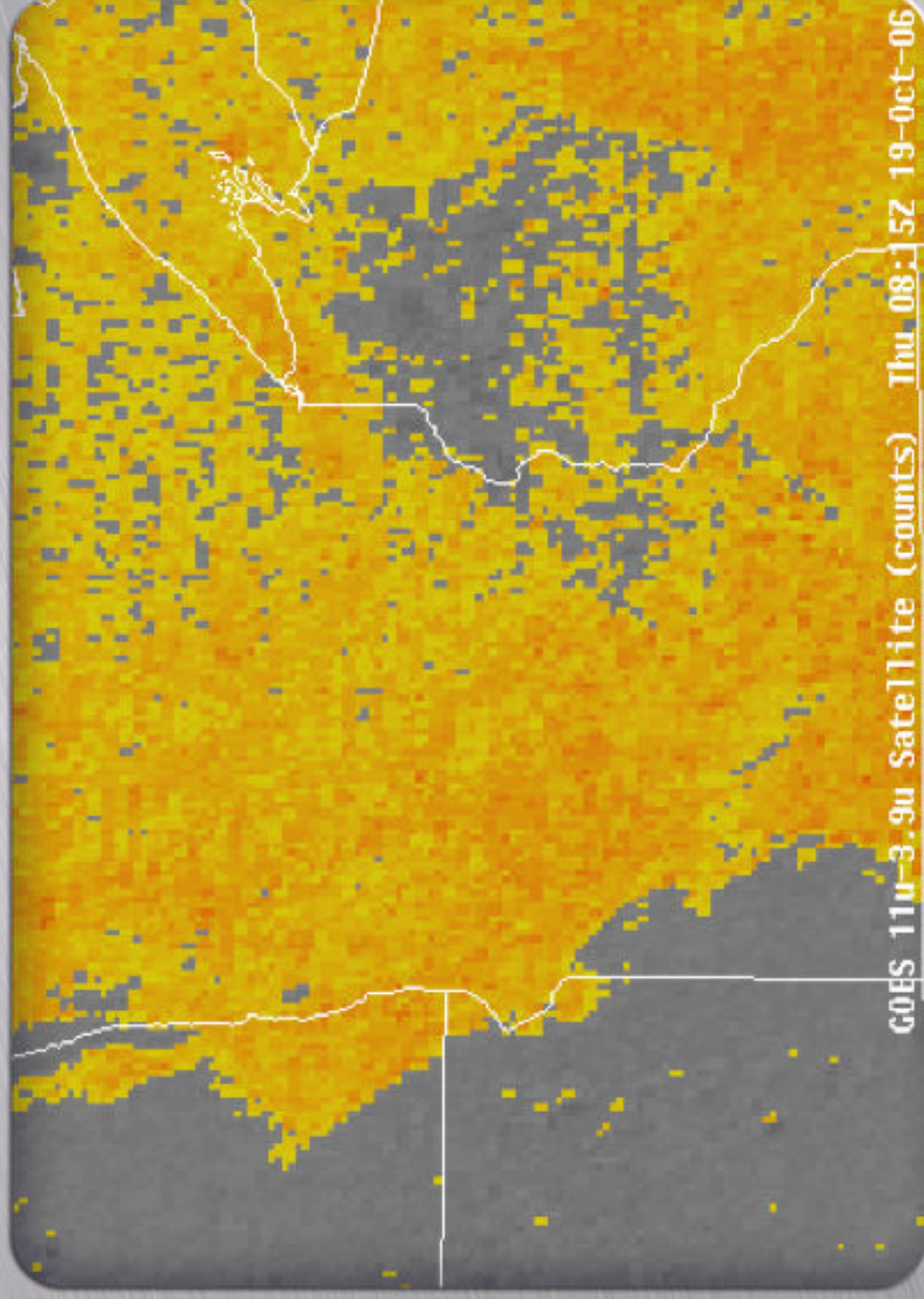
Fog/stratus product (11-3.9 µm): Improved fog detection

# MODIS Imagery in AWIPS



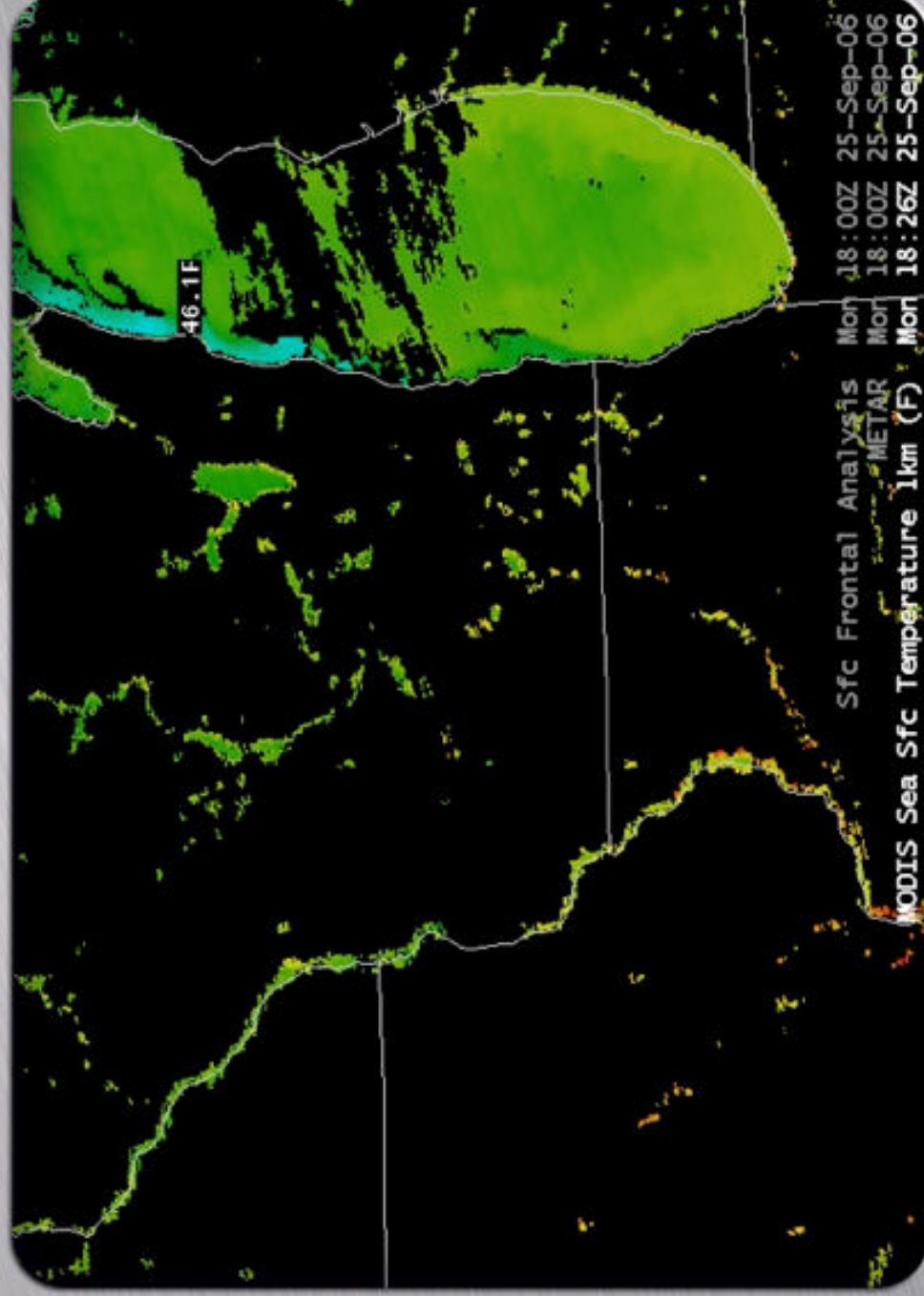
**Fog/stratus product (11-3.9  $\mu\text{m}$ ): Improved stratus edge detection**

# MODIS Imagery in AWIPS



**Fog/stratus product (11-3.9  $\mu$ m): Improved stratus edge detection**

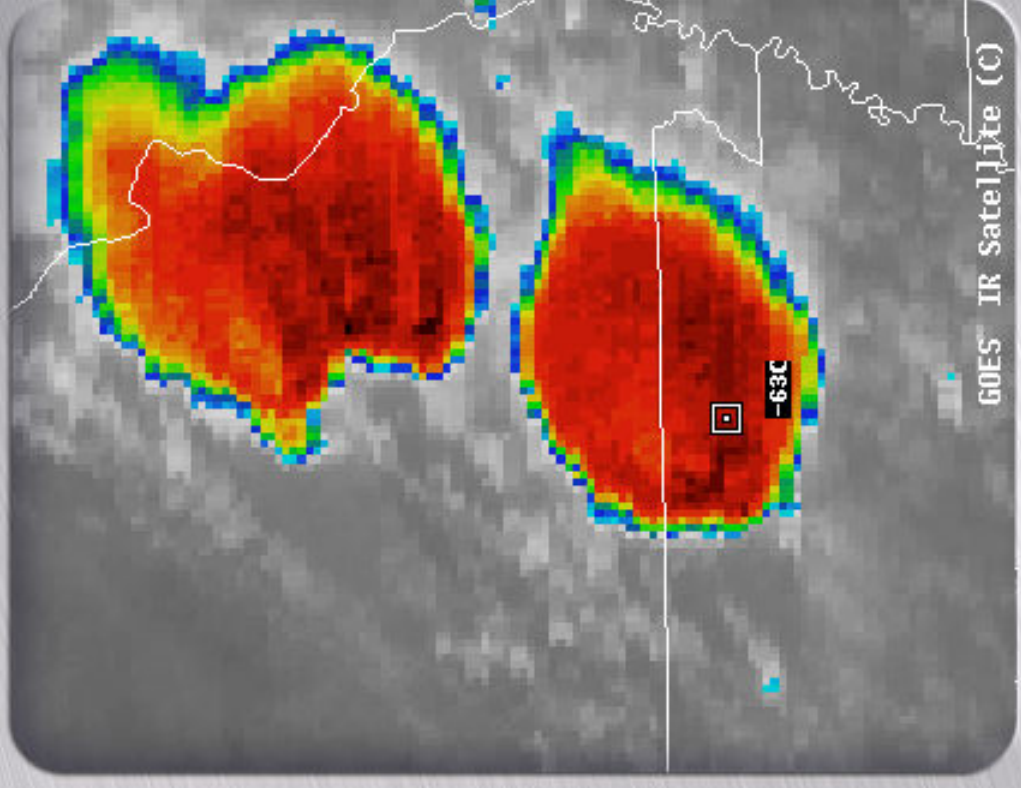
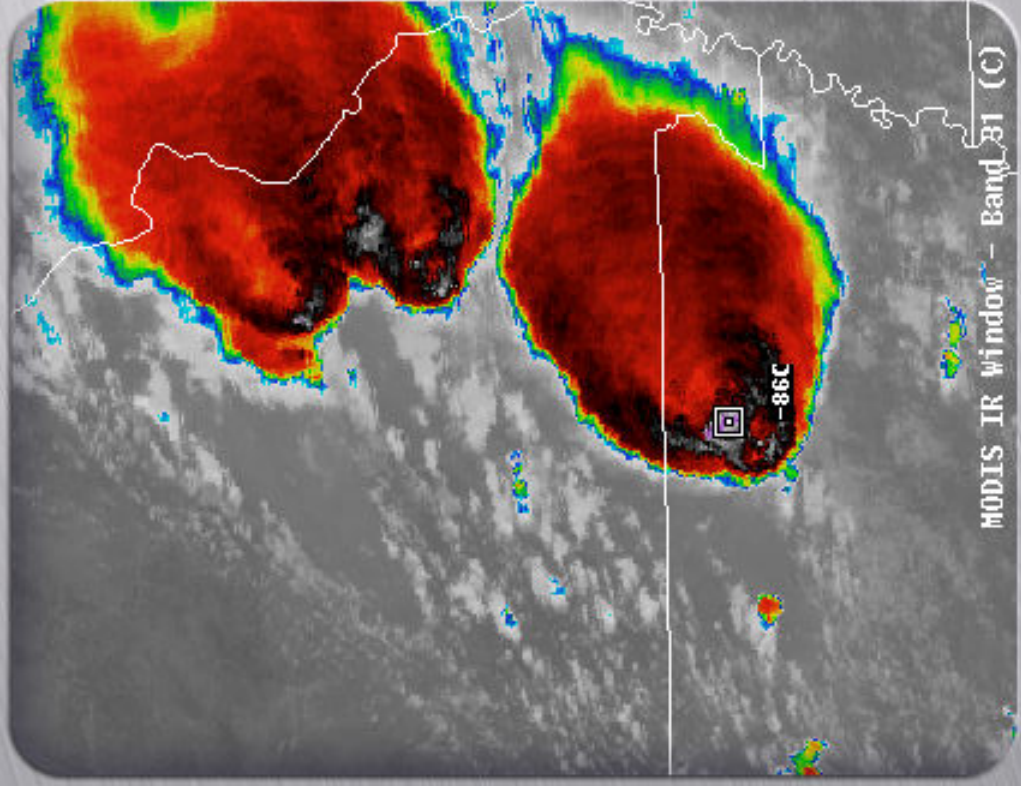
# MODIS Imagery in AWIPS



Sea Surface Temperature

# MODIS Imagery in AWIPS

MODIS vs GOES IR Window Channel



Improved enhanced-v signature detection

# Future Developments

- ◆ Guided by needs of the forecasters
  - Constrained by bandwidth
- ◆ True color imagery
  - Fixed enhancement of 256 colors
- ◆ 250 m visible imagery
  - Weigh operational significance against interesting aspects and size (bandwidth usage) of the product
- ◆ Normalized Difference Vegetation Index (NDVI)



# Conclusion

- ◆ With the duties of the forecaster in mind, the MODIS in AWIPS project can be successful
  - “How can MODIS imagery enhance the forecasting process?”
- ◆ Questions?

