# Madison Area Technical College Interactive Processing Project

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**Madison, WI**

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Funded by Unidata Program
University Corporation for Atmospheric Research (UCAR)

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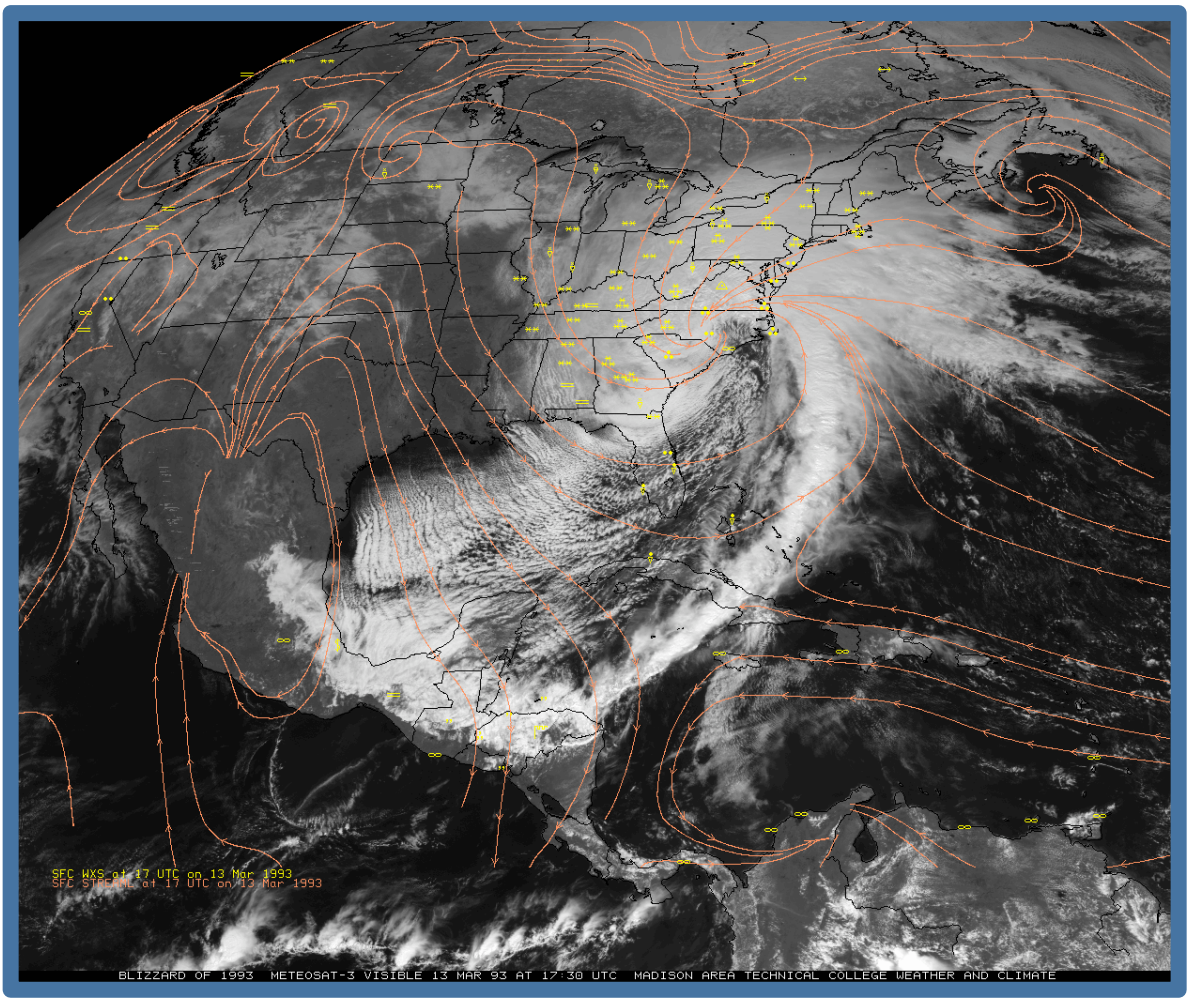

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## A. Executive Summary

With an increasing enrollment, and a Unidata equipment grant, Madison Area Technical College's Weather and Climate course, offered in the Department of Physical Sciences, Arts and Sciences Center, is now taking advantage of modern meteorological tools and data sets as a part of the course. The system is the Madison Area Technical College Interactive Processing Project (MATC IPP). This is one step of many in modernizing the Weather and Climate course at the College, and will give option for additional courses, and support of the existing course. Although more effort is needed, the foundation has been laid for future developments in meteorological education at Madison College.

## B. Introduction and Background

### 1. Background

Ed Addison III developed and taught the Madison Area Technical College Weather and Climate Course starting in approximately 1991. Taught as an evening course at the Truax campus, Weather and Climate transferred to the University of Wisconsin-Madison as well as other University of Wisconsin System colleges. Additional instructors following Ed included Mike Coe and Amanda Adams. In 2005, the offering increased to include a second evening class taught at the College's Downtown Educational Center, which was also remotely broadcast over Interactive Television (ITV) to the Reedsburg, Fort Atkinson, and Portage campuses. In 2008, the course continued to expand enrollment as well as delivery method with the ITV course being converted to an on-line course, and the first day time offering of the face-to-face course at the Truax campus. In 2011, at least 6 sections of the course are taught each semester, and a summer course is offered as well. Enrollment has increased roughly 5 fold, and the course is taught via face-to-face, on-line and hybrid delivery methods.

### 2. Project Objectives

Motivation for this project is multifold. The use of modern weather software in the classroom to introduce and document meteorological concepts is the main reason behind the effort. The addition of interactive processing to the curriculum keeps the course up-to-date and in line with instruction of equivalent courses at

peer institutions. The foundation built by this project will also benefit other courses such as Earth Science and Oceanography.

### 3. Funding and Support

Funding for this project comes from a subaward from the Unidata project, which project is a part of the University Corporation for Atmospheric Research (UCAR) in Boulder, Colorado (Sherretz and Fulker, 1998; Fulker et al. 1997). The Unidata program and UCAR are grantees of the Atmospheric and Geospatial Science directorate at the National Science Foundation (NSF). Funds from this award were for equipment purchase only. This specific project was funded under a call that especially targeted 2-year colleges, such as Madison College. Because this award was only for equipment, no funds were allocated towards labor. Thus, all labor efforts by the investigators were from their own time.

### 4. Wisconsin Connections

This effort includes a host of Wisconsin connections including the personnel involved, the primary software used and the benefit. All of the investigators and instructors have all been trained at the University of Wisconsin-Madison. The primary software used in the project, the Man-computer Interactive Data Access System (McIDAS), was developed and is maintained at the University of Wisconsin-Madison (Lazzara et al 1999). The Unidata project was born out of a conference held at the University of Wisconsin-Madison that focused on meteorological data, interactive processing systems and post-secondary education (Haig, 1977). These connections come together in this project to benefit students in South Central Wisconsin at Madison Area Technical College.

## C. Project Objective and Milestones

The prime objective of this project is employing grant-funded equipment to utilize Unidata software to aid in the instruction of the Weather and Climate Course and to participate in the Unidata community. The project has achieved the following milestones towards meeting this goal:

- Equipment purchased: 4 computer systems (Completed Fall 2009)
    - Two Mac Book Pro laptop systems
    - Two Mac Pro server/display systems

- Equipment installation, testing, and initial use (Completed Fall 2010)
    - Classroom use in Spring 2010 and Fall 2010 semesters
    - Expansion to additional department computing in progress for Spring 2011

- Project reporting
    - Article for the Unidata Newsletter (in progress)
    - Written report (this document)
    - Newspaper article in Madison College's Clarion (in progress)
    - Demonstration for interested parties at the College (May 2010)

Funding for this undertaking totaled $14,222, which included the College's 12 percent overhead.

## D. Project Equipment

The four computer systems purchased for this project were planned for and perform multiple uses. First and foremost, one Mac Pro system is used as a data server to feed data to the other computer display systems. A second Mac Pro system is installed in the primary classroom where Weather and Climate courses are taught. This system is also configured to serve as a backup to the main data server in case of failure of the prime system.

Two laptop systems have also been purchased. One laptop system, used primarily by an instructor, is for teaching the on-line version of the Weather and Climate class. The other laptop system servers multiple purposes, for in-class room use by students, for a test and development system for building displays used on the other systems by students, and for managing the two Mac Pro systems.

## E. Software

The primary display software systems employed in this project are the McIDAS-X system (Lazzara et al., 1999) and the McIDAS-V system (Achtor et al., 2008). McIDAS-V is a close sibling of the Interactive Data Viewer (IDV) system (e.g Murray et al, 2004).

Two data management software systems are used in the interactive processing system. The Local Data Manager (LDM) is used to capture real-time meteorological datasets from Unidata's Internet Data Distribution (IDD) (Davis and Rew, 1994). The IDD offers a variety of data feeds, two of which are captured at Madison College: the National Oceanic and Atmospheric Administration's Geostationary Operational Environmental Satellite (GOES) Ingest NOAAPORT Interface (GINI) satellite feed that originates at the National Environmental Satellite, Data and Information Service (NESDIS) in Washington, DC, and the McIDAS UNIWISC Feed that originates from the University of

Wisconsin-Madison's Space Science and Engineering Center (SSEC) Data Center. A third feed of data, the Antarctic-Internet Data Distribution, from the Antarctic Meteorological Research Center (also at SSEC, UW-Madison) is also captured.

The second data management system used is the McIDAS Abstract Data Distribution Environment (ADDE) (Taylor et al., 1995). ADDE servers are set up to provide quick access to both real-time and case study historical datasets. ADDE servers have been set up on both Madison College data servers on the primary and backup systems (snow.matcmadison.edu and rain.matcmadison.edu, respectively). Data provided on the IDD and Antarctic-IDD is made available via these local ADDE servers for classroom use. The Unidata community shares a variety of data sets also via ADDE servers as a distributed set of server systems across the United States. These data sources are also leveraged for classroom use.

Figure 1 diagrams the setup of the MATC IPP system. The configuration allows for the backup data server to take the place of the primary data server in the case of failure, maintenance, etc. The two systems are located on different sub-networks at the College. This ensures data flow and stability in the case of sub-network failures, maintenance, etc.

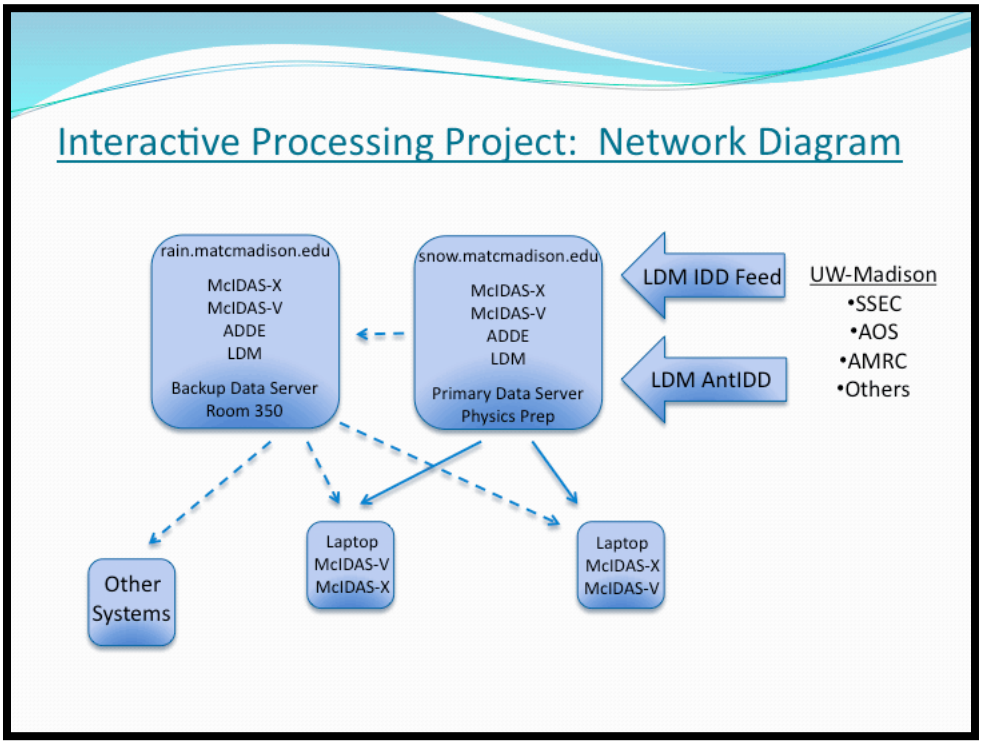


**Figure 1. Network configuration of the Madison Area Technical College Interactive Process Project shows both a primary and backup data system, both serving remote display systems.**

## F. Initial Applications

Three applications of the new MATC IPP system are outlined here. These are illustrative of the possible applications and future potential of how the system will be used. Although these examples are directly from the Weather and Climate course, there are potential applications to other courses as discussed in the last section of this report.

### 1. Weather of the Day Discussion

Over the last two semesters, the first application of the weather display system is for a weather discussion at the start of each class meeting. Here the "weather of the day" could focus on a developing tropical storm or reviewing the passing of a recent snowstorm system. There is emphasis on observational datasets in this application with satellite and surface observations featured predominantly (See Figure 2.).

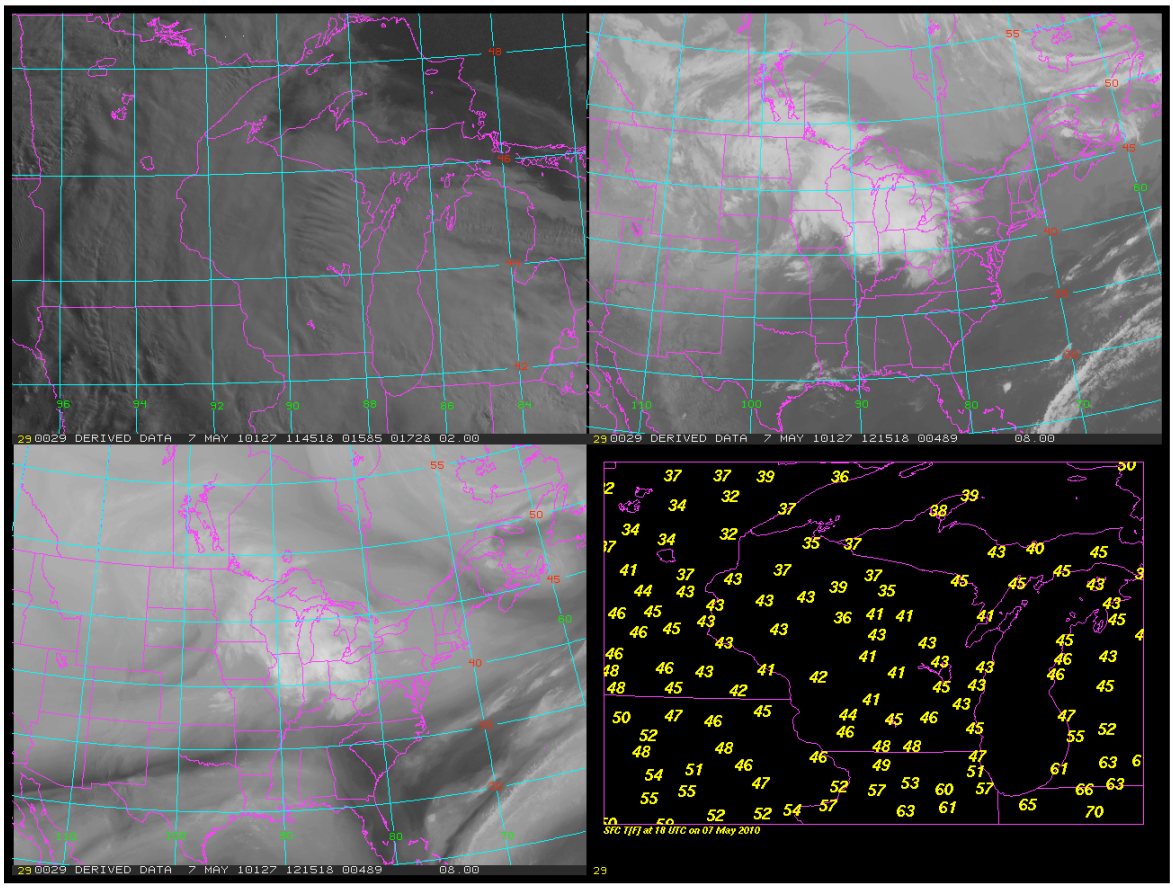


**Figure 2. A sample display from a in-class weather discussion demonstrating use of the McIDAS-X software and the emphasis on observations.**

## 2. Weather Forecasting

The first complete in-class activity to employ the MATC IPP system is a lesson on weather forecasting. Historically, this activity was completely accomplished using paper weather maps, printouts, etc. Now, all of the materials are on the computer. This activity was developed to use actual real-time weather information and data. This activity occurs during the later portion of the course, providing an opportunity for students to apply concepts taught in the class as well as giving the student an experience that allows them to appreciate, first hand, the forecasting process. A central objective is to guide a conceptual change: students change their preconceived notions of what weather forecasters do (e.g. guessing, using a dart board, etc.) to a far more realistic view (e.g. analyzing data, using meteorological concepts, etc.). The forecast activity is structured to have small groups of students work together using the computing and software resources to create a forecast. Key aspects to this lesson include justification and argumentation. The small groups are provided a set of written guidance in the forecasting project as well oral advice from the instructor (Figures 3 and 4 show photos of students in action). Students are challenged throughout the activity to justify their decisions and their answers to the guiding questions. They are also encouraged to discuss – in fact use argumentation – to defend and refine their forecasting. Individual, small group and whole class groups comprise the forecast discussions. While this cannot always fit into a class-meeting period, the goal is to meet as many of these qualities as possible.


**Figure 3. Students gather around the Mac Pro display, that is installed a part of room 350.**

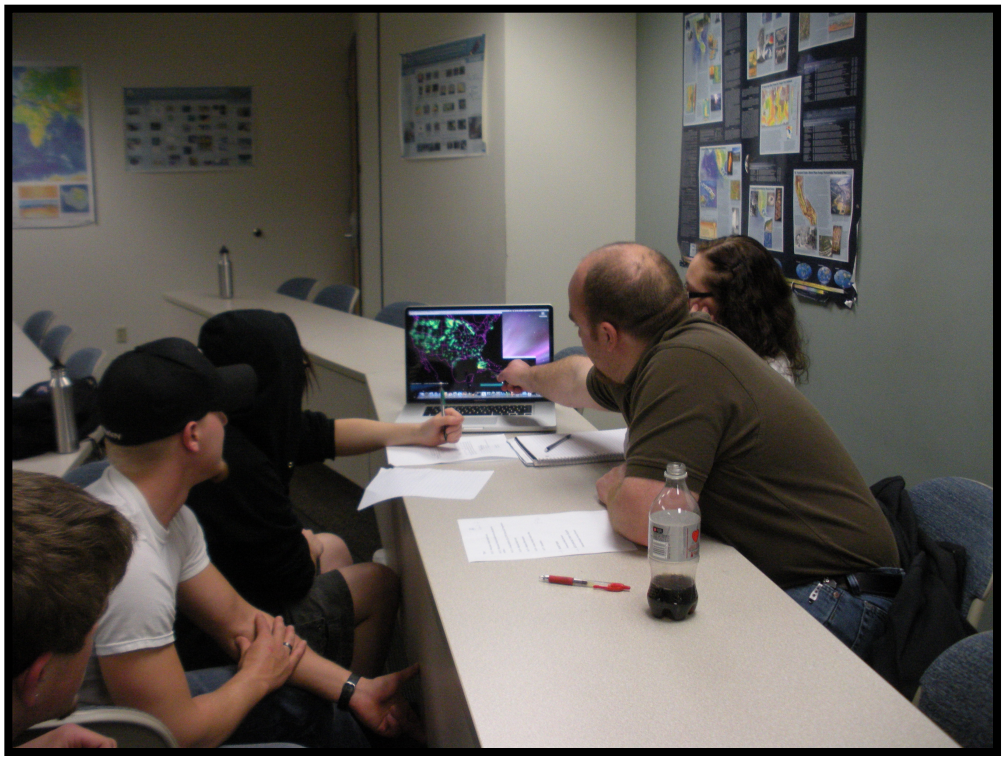

**Figure 4. Classroom use of one of the laptop computers purchased as a part of the grant. Here students can be seen working on a weather forecasting in-class activity.**

### 3. Conceptual Aid Display

An additional use of the equipment was to gather a year's worth of numerical weather prediction analysis output from the Cooperative Institute for Meteorological Satellite Studies (CIMSS) Regional Assimilation System (CRAS) model and from the Global Forecast System (GFS) run at the National Centers for Environmental Prediction (NCEP). Analyses on the 1st of the month were collected, archived and then rendered in McIDAS-V to display various parameters to illustrate different meteorological concepts for students. For example, a loop of the surface temperature was created showing the seasonal progression of warm air poleward in the summer and cold air equatorward in the winter. These temperatures are then related to incoming solar radiation and outgoing terrestrial radiation. In another example, displays of pressure surfaces are used to demonstrate the effect of cold air on the speed with which pressure falls off with height (as compared to the change in height in warm air), *i.e.*, the hypsometric equation. The use of McIDAS-V/IDV and equipment allows the MATC IPP to be a conceptual aid display system. It provides a vehicle to demonstrate atmospheric behavior to students. In addition, use of McIDAS-V/IDV with the collected CRAS (or GFS) analysis introduces the huge variety of model parameters that can be output from a numerical weather prediction system.

## G. Future

The MATC IPP will continue to play an increasingly expanding role in the College's Weather and Climate courses. Additional uses lie in wait. Additional data sets and uses within the Weather and Climate courses are planned or in preparation. Real-time displays of satellite observations of clouds will be exploited by the College's Astronomy course in planning outdoor star viewing sessions. Additional courses will also take advantage of the system, such as Survey of Earth Science which includes a weather and climate unit, and a new course recently added to the college's curriculum: Oceanography. It is expected that in the near future additional courses can now be added to the college's offerings, such as climate change, aviation weather and air pollution.

Additional challenges await this project. The use of Apple hardware, with recent versions of the Mac OSX operating system, has demonstrated a weakness in the use of the LDM software. While the core of the problem lies with the operating system, it does create a less reliable system. It is hoped that a Linux system can be acquired in the future to become the LDM relay system for the College, thereby allowing full participation in the Unidata IDD Community.

## H. Acknowledgements

A project such as this cannot be done in a vacuum, and it cannot be done alone. Thanks go to the Unidata Project Center and the proposal review committee for funding this effort. Thanks to a cast of many at Madison Area Technical College. Thanks to Learner Success – Dr. Terrance Webb, Vice President. Thanks to the Grants office – Dr. Ed Clark, Dana Maya, and Jan Van Keuren. Thanks to the Arts and Sciences Center, including Dr. Todd Stebbins, Dr. Shawna Carter, Vernoica Delcourt, and Mary Kuhn. Thanks to support from the Apple support section at the Department of Information Technology – Kay Lang and Mick Conners, and as well as sage advice from John Pigeon, Sue Dalton and James Russell. Thanks to the financial and budgeting office and specifically, Alane Spatola and Amy Brown. Thanks to everyone in the Physical Science Department for fostering the Weather and Climate course and instructors. Special thanks goes to Amy Limberg-Dzekute for her efforts in watching over our data server systems and being supportive of this project throughout its stages.

# I. References

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Sherretz, L.A and D.W. Fulker, 1988: Unidata: Enabling universities to acquire and analyze scientific data. Bulletin of the American Meteorological Society, Vol 69, Issue 4, pp. 373-376.

Taylor, W., J. Benson, T. Whittaker, and J. Rueden, 1995: Seamless access to local and distributed data. *11th International Conference on Interactive Information and Processing Systems for Meteorology, Oceanography and Hydrology*, Dallas, TX, American Meteorological Society. 349-352.

# J. Appendices

## Related web sites and server information

Web sites:

http://unidata.ucar.edu/
http://www.ssec.wisc.edu/mcidas
http://amrc.ssec.wisc.edu
http://faculty.matcmadison.edu/mlazzara/realtime/

MATC ADDE servers:

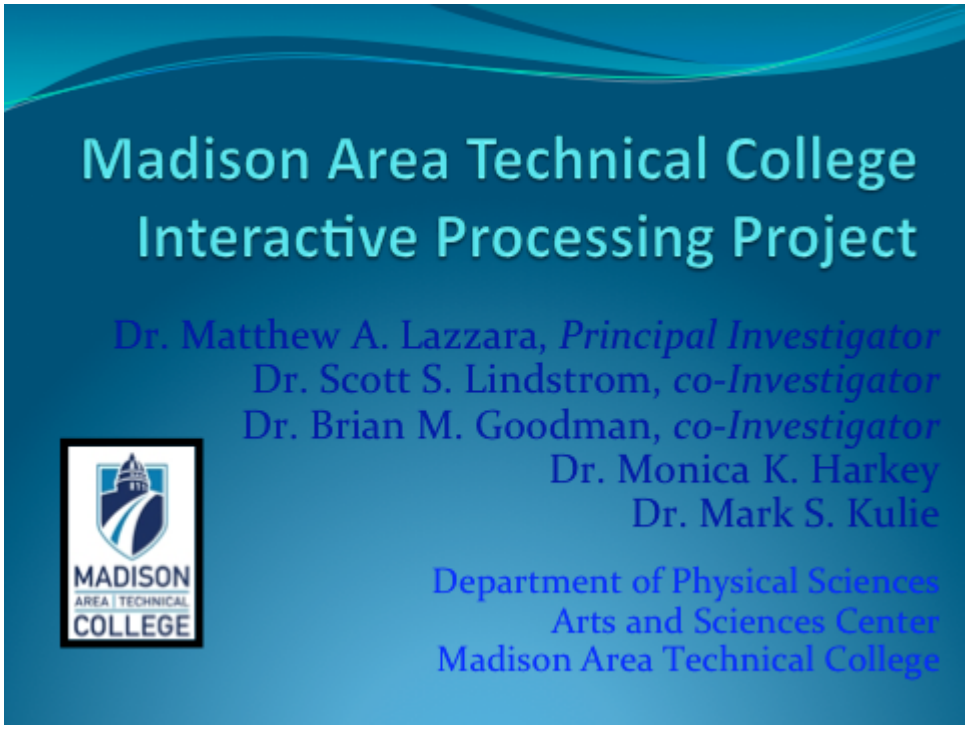
Server: SNOW.MATCMADISON.EDU
Group Name: SNOW

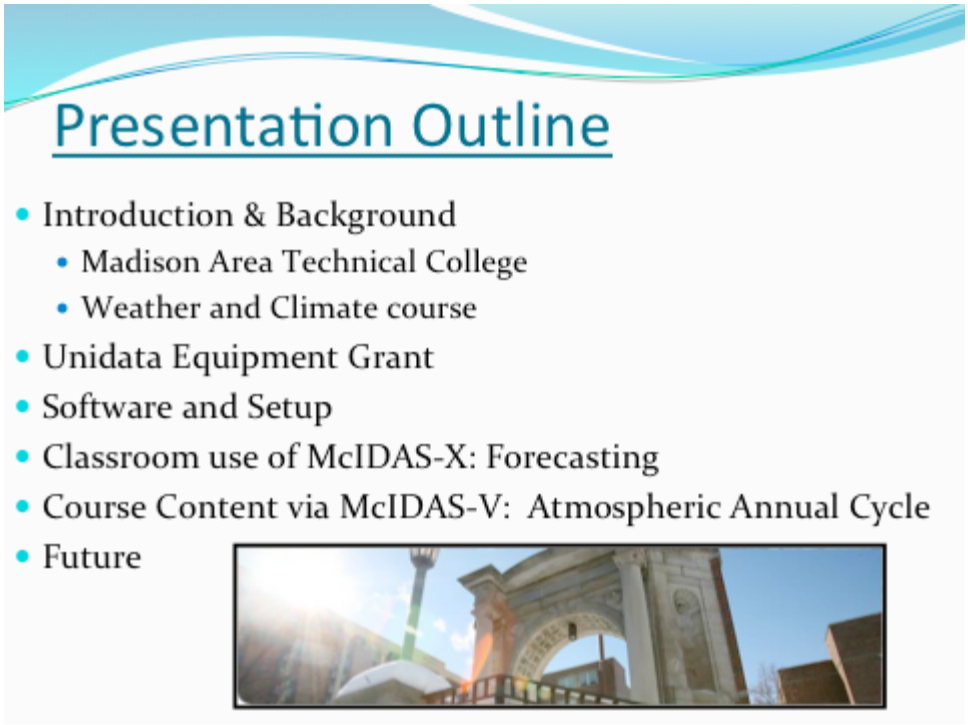
Server: RAIN.MATCMADISON.EDU
Group Name: RAIN

## Acronyms

ADDE – Abstract Data Distribution Environment
AMRC – Antarctic Meteorological Research Center
CIMSS – Cooperative Institute for Meteorological Satellite Studies
CRAS – CIMSS Regional Assimilation System
IDD – Internet Data Distribution system
IDV – Interactive Data Viewer
IPP – Interactive Processing Project
ITV – Interactive Television
GOES – Geostationary Operational Environmental Satellite
GFS – Global Forecast System
GINI – GOES Ingest NOAAPORT Interface
LDM – Local Data Manager
McIDAS – Man computer Interactive Data Access System
NCEP – National Center for Environmental Prediction
NESDIS – National Environmental Satellite and Data Information Service
NOAA – National Oceanic and Atmospheric Administration
NSF – National Science Foundation
SSEC – Space Science and Engineering Center (UW-Madison)
UCAR – University Corporation Atmospheric Research

**Presentation at the McIDAS User Group Meeting**
(October 2010)



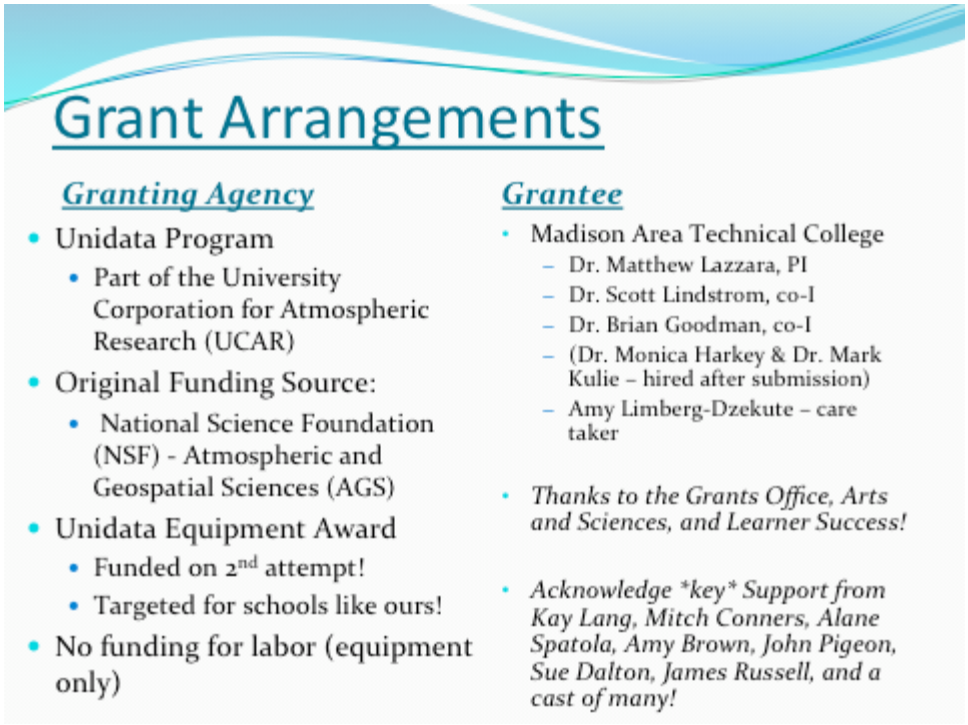



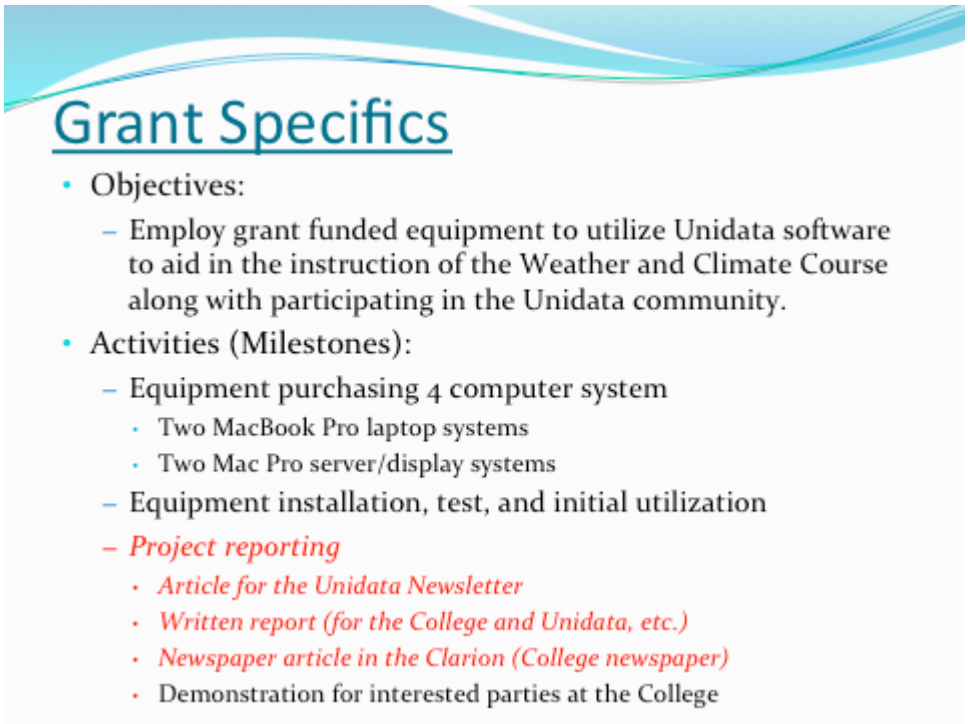
## Background and Introduction

- About Madison Area Technical College (Madison College)
- 4 regional campus locations
- 8 locations in Madison
- 12 county district
- 3200+ graduates per year

## Weather and Climate Course

- History
  - Established circa 1991 (Ed Addison III)
  - One class at Truax Campus
  - Other prior instructors: Mike Coe and Amanda Adams
- Current Status
  - 3 classes at Truax Campus
  - 1 class at Downtown Educational Center Campus
  - 2 classes on-line
  - 1 class in the summer
- Transfers to the UW System at AOS 100/101

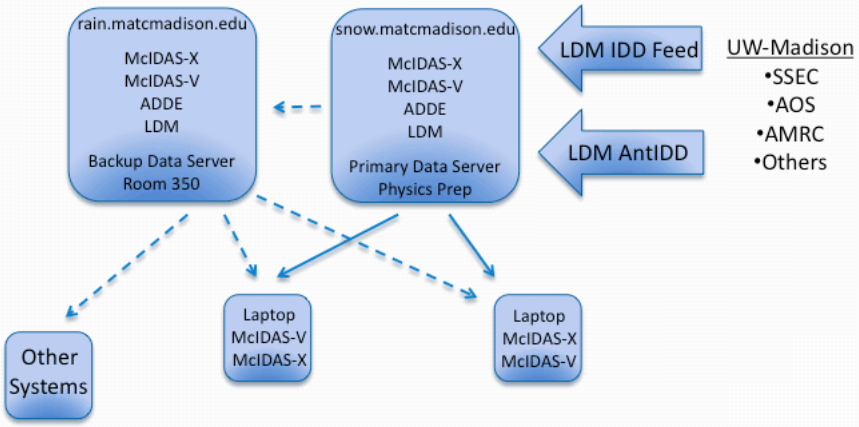

Grant Arrangements
Granting Agency
Unidata Program
Part of the University Corporation for Atmospheric Research (UCAR)
Original Funding Source:
National Science Foundation (NSF) - Atmospheric and Geospatial Sciences (AGS)
Unidata Equipment Award
Funded on 2nd attempt!
Targeted for schools like ours!
No funding for labor (equipment only)
Grantee
Madison Area Technical College
Dr. Matthew Lazzara, PI
Dr. Scott Lindstrom, co-I
Dr. Brian Goodman, co-I
(Dr. Monica Harkey & Dr. Mark Kulie – hired after submission)
Amy Limberg-Dzekute – care taker
Thanks to the Grants Office, Arts and Sciences, and Learner Success!
Acknowledge *key* Support from Kay Lang, Mitch Conners, Alane Spatola, Amy Brown, John Pigeon, Sue Dalton, James Russell, and a cast of many!


Grant Specifics
Objectives:
Employ grant funded equipment to utilize Unidata software to aid in the instruction of the Weather and Climate Course along with participating in the Unidata community.
Activities (Milestones):
Equipment purchasing 4 computer system
Two MacBook Pro laptop systems
Two Mac Pro server/display systems
Equipment installation, test, and initial utilization
Project reporting
Article for the Unidata Newsletter
Written report (for the College and Unidata, etc.)
Newspaper article in the Clarion (College newspaper)
Demonstration for interested parties at the College

## Software

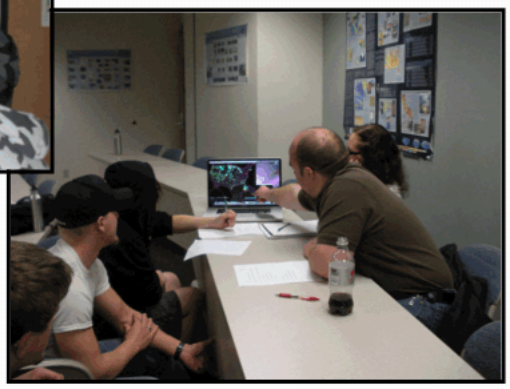
- Application Software - Data Display/Analysis:
  - McIDAS-X
    - Two dimensional display, animations, 'paperless' weather display – satellite, surface observations, text, etc.
  - McIDAS-V (IDV)
    - Multi-demensional display, animations, numerical model output, satellite observations, surface observations, on the fly zooming, etc.
- Data Server Software – Data Access:
  - LDM – Data "feeds"
  - McIDAS ADDE (OpenADDE) – Data servers: remote and local

## Interactive Processing Project: Network Diagram



## Classroom Use: Weather Forecasting

- ✓In-Class Activity
- ✓Using real-time weather information
- ✓Applying course concepts
- ✓Appreciation for forecast process



- ✓Working with ***real*** data
- ✓Teaching for conceptual change:
  - ✓Justification
  - ✓Argumentation
  - ✓Single, small & large groups

## Using McIDAS-V to show Annual Cycles in the Atmosphere

- Motivation: A picture is worth a 1000 words!
- Data
  - Grib Data are from model output saved near the 1st of each month (Nov 1st, Dec 1st, Jan 2nd, Feb 1st, Mar 1st, . . . , Oct 1st ) over the course of one year (finally done)

## First Movie: Surface Temperature

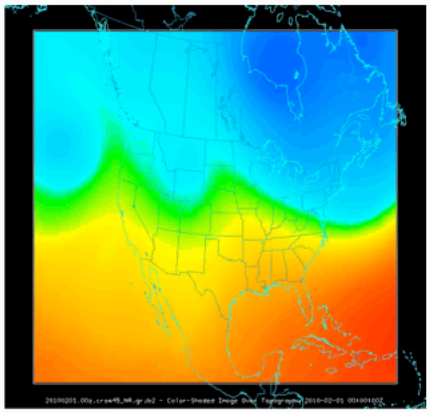
- Annual cycle of temperature
  - Data are from 00z – closer to the warmest part of the day than to the coldest part of the day
  - Note colorbar scale on the right: from 240.8 K to 319.2 K -- -32 C to 46 C, or -25 F to 115 F
  - Ocean is cooler in summer, warmer in winter; Great Lakes warm in winter, cool in summer.
  - Rocky Mountain tops stay cool all year long!
  - Warm water of Gulf Stream is visible for most months.
  - Movie would look different in spots if you used a different year's data, but overall patterns would be similar

## Second Movie: Mean Sea Level Pressure

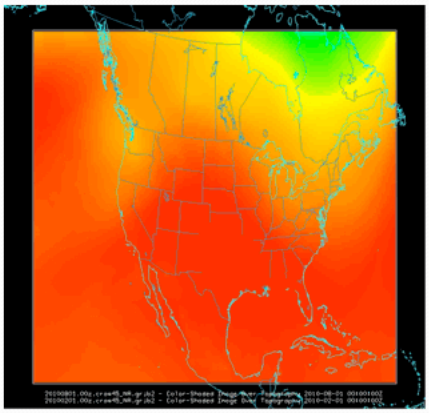
- Annual cycle of Mean Sea Level Pressure
  - Note colorbar scale on the right: from 965.93 mb to 1038.38 mb.
    - Hurricane Earl is in one of the maps.
      - 1038 mb is the central pressure of a fairly strong high pressure system
  - Position of high and low pressure systems is pretty random; however:
    - Note how the position of the subtropical high off the west coast of the US drifts northward in summer, then southward again starting in September. This reflects the seasonal change in the General Circulation: features move towards the Poles in Spring and Summer, and back towards the Equator in Fall and winter.

# 500-mb heights

**February** – note the variability – from red (5800) to blue (4800). Biggest change over central US – that's where the jet is



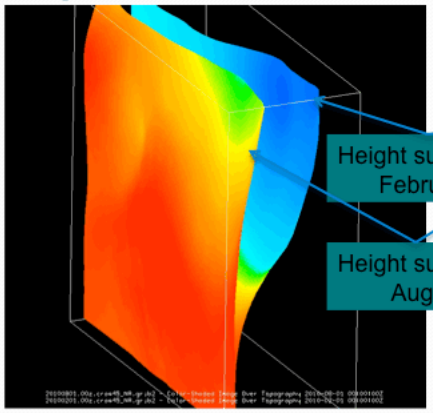
**August** – much less variability – from red (5900) to green (5200). No big gradients, no strong jets



# 500-MB HEIGHT COMPARISON

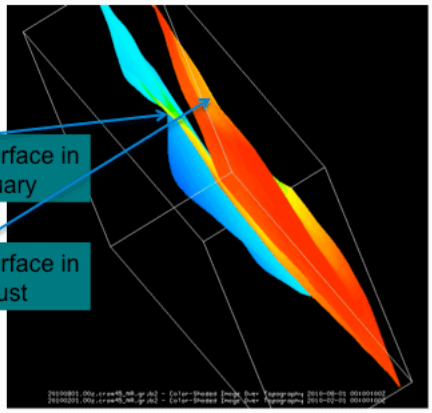
**February and August, viewed from northeast –**

500 mb surface much closer to surface when atmosphere is cold, and it's much higher when atmosphere is warm




**February and August, viewed from southwest –**

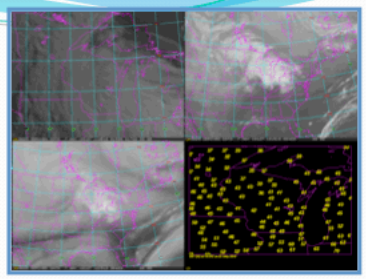
500 mb surface much closer to surface when atmosphere is cold, and it's much higher when atmosphere is warm



## What's Next?

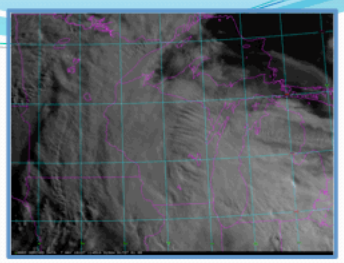
- Continue saving model output files, compare one monthly data from one year to the next (that is: November 2009 vs. November 2010)
  - Interannual variability – compare annual cycle this year to annual cycle next year; what is common to both and what varies?
  - Climate normals

## Courses



- Existing:
  - Weather and Climate – In progress
  - Earth Science – Weather and climate section
  - Astronomy – Nowcasting observing conditions
  - Geology – Earthquakes (?)
- Future:
  - Oceanography – Planned for Spring 2011

## Life after the grant…



- Care taker
  - Amy Limberg-Dtzeuke
  - Role to keep up with the system, care for it, etc.
- Equipment in the refresh list
  - Integrated into the Physical Science Department
- Use of sunset displays (?):
  - Outreach to College community
  - Broadcast to community to take the weather and climate course or other related course…

## Future

- Additional setup needed:
  - LDM capture and Datasets
  - Weather software integration into Physical Science Mac laptop pool
  - McIDAS-X display creation
  - McIDAS-V bundle creation
- Continue integration into weather and climate courses:
  - Place displays on web site
  - Use in on-line forecast discussions
  - Use in future courses (Oceanography, etc.)
- Real-time Weather displays
  - Hallway in display cases
  - Physics Prep Room
    - Nowcasting Astronomy observing sessions
    - Testing displays
- Participate in the IDD (?)
  - Requires stable LDM system (Mac OSX 10.5 issues)