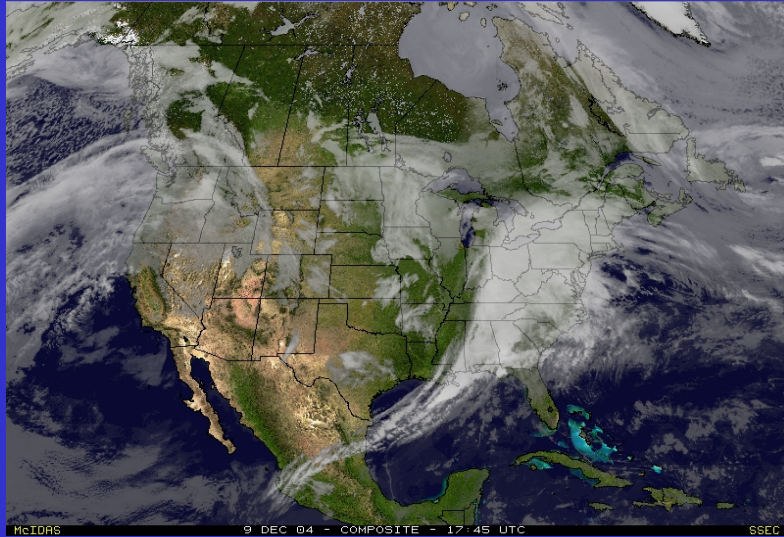




McIDAS-V: An open source data analysis and visualization tool for multi- and hyperspectral satellite data



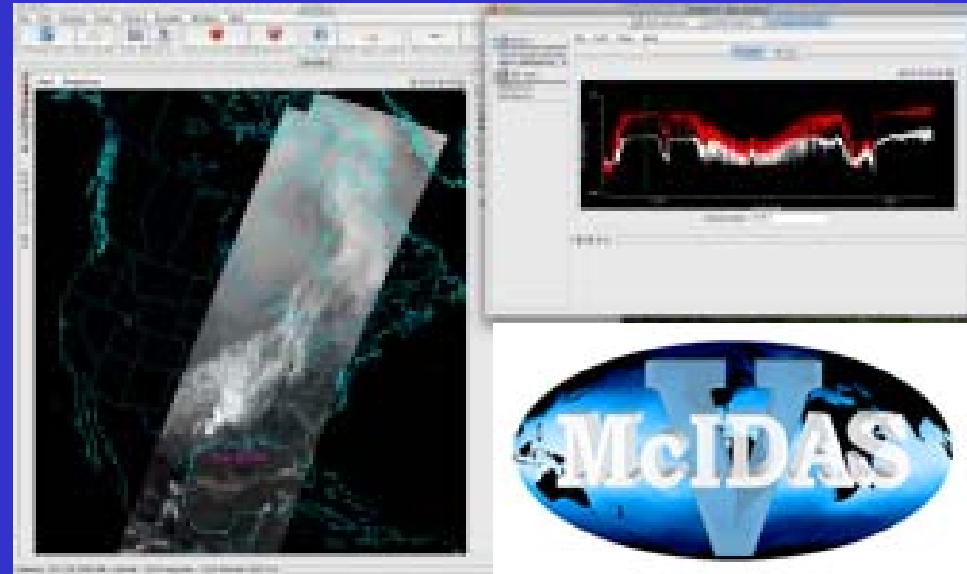
ITSC-XVI, Angra do Reis, Brazil, 7 May 2008



Tom Achtor, Tom Rink, Tom Whittaker,
Dave Parker, Gail Dengel, Jon Beavers,
Jessica Staude, Becky Schaffer, Ray Garcia,
Bruce Flynn, Dee Wade



Space Science &
Engineering Center
(SSEC) at the
University of
Wisconsin - Madison



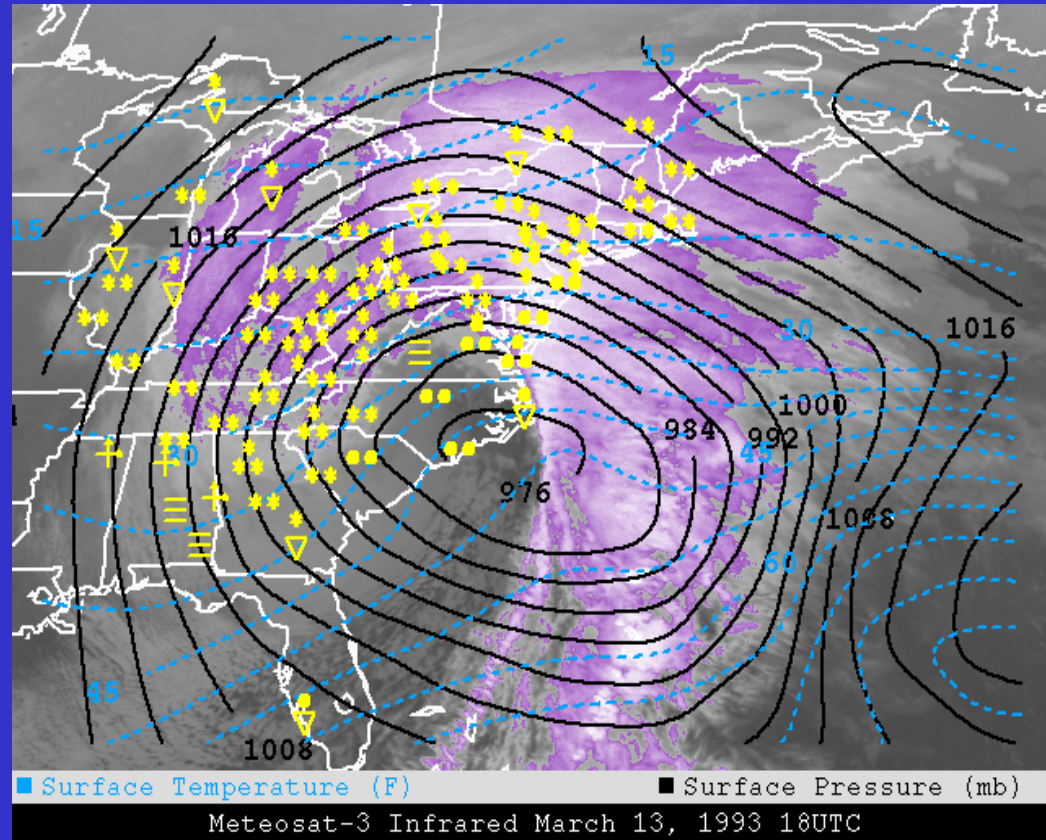


What is McIDAS ?

(Man computer Interactive Data Access System)



- Collection of user programs and libraries for visualizing and analyzing geophysical data (focus on environmental satellites)
 - UNIX, PC & Mac capable
- A synergistic tool that integrates numerous data types into one system
- First developed in the early 1970s
- Still in use world-wide at research, operational, educational, and commercial sites





McIDAS-X Users

(MUG has about 50 members)



- **NOAA – NESDIS, AWC, SPC, TPC, etc.**
- **NASA – STS, LaRC, MSFC, JPL**
- **Unidata – 130 universities, colleges and international educational collaborators**
- **International – EUMETSAT, Spain, Greece, Mexico, Australia**
- **Industry – Honeywell, Weathernews, Universal Weather, Meteorlogix, Weather Central, etc.**



Why the Change?

- **McIDAS software (written in Fortran 77 & C) has a 30+ year heritage resulting in limited potential**
- **METOP, NPOESS and GOES-R operational satellite data cannot be optimally utilized**
 - **great increase in data rates**
 - **new tools for working with these large data sets**
- **Platform / OS dependence**
- **New data analysis and visualization concepts are now available (e.g. 4-D)**



McIDAS-V Requirements



- Create a powerful and versatile software system for environmental data processing, analysis and visualization
- Continue to fully support McIDAS Users' Group (MUG) and McIDAS-X functionality as users transition to McIDAS-V
- Support existing and evolving needs of scientific research and algorithm/applications development for new programs
- Support operational users by providing frameworks in McIDAS-V, enabling a natural transition path for research results into operations
- Use system to educate students in remote sensing and physical sciences; involve students in its development, evolution and use



What is McIDAS-V

McIDAS-X \rightarrow VisAD + IDV + HYDRA = McIDAS-V





VisAD

Developer: Bill Hibbard, UW SSEC



- **Open-source, Java library for building interactive and collaborative visualization and analysis tools**
- **Features include:**
 - **Powerful mathematical data model that embraces virtually any numerical data set**
 - **General display model that supports 2- and 3-D displays, multiple data views, direct manipulation**
 - **Adapters for multiple data formats (netCDF, HDF-5, FITS, HDF-EOS, McIDAS, Vis5D, etc.) and access to remote data servers through HTTP, FTP, DODS/OpenDAP, and OpenADDE protocols**
 - **Metadata can be integrated into each data object**

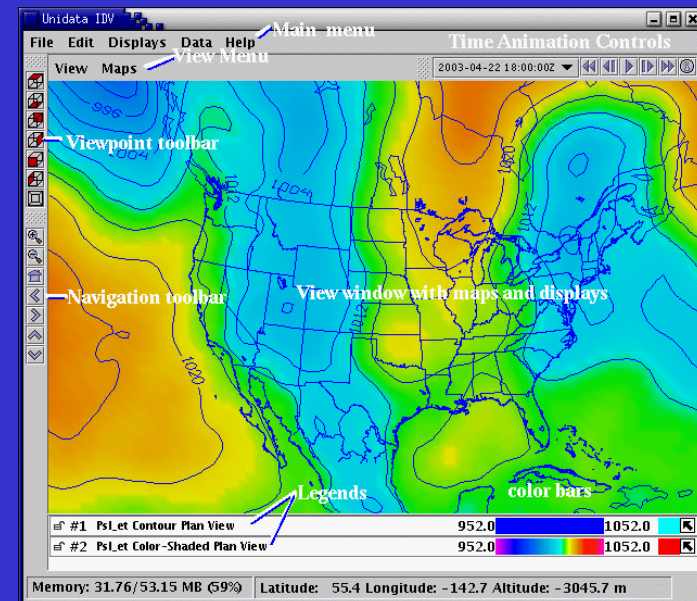
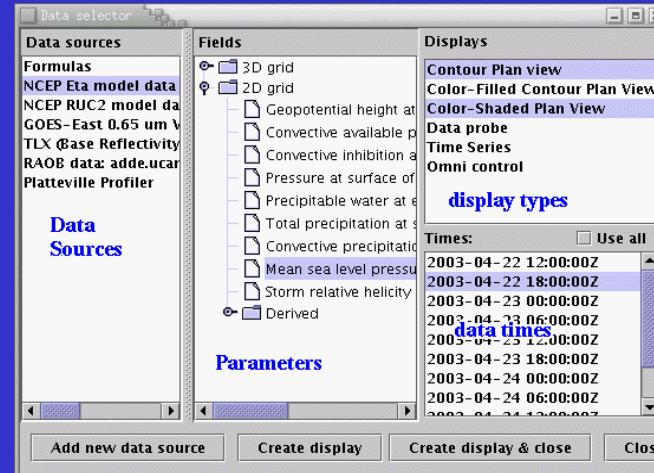


IDV-Integrated Data Viewer

Developers: Unidata (Don Murray/Jeff McWhirter)



- Unidata developed, VisAD-based, scientific analysis and visualization library and toolkit
- Open Source, Java™ framework and reference application
- Provides 2- and 3-D displays of geo-scientific data (plus, of course, animations)
- Stand-alone or networked application



<http://www.unidata.ucar.edu/idv>



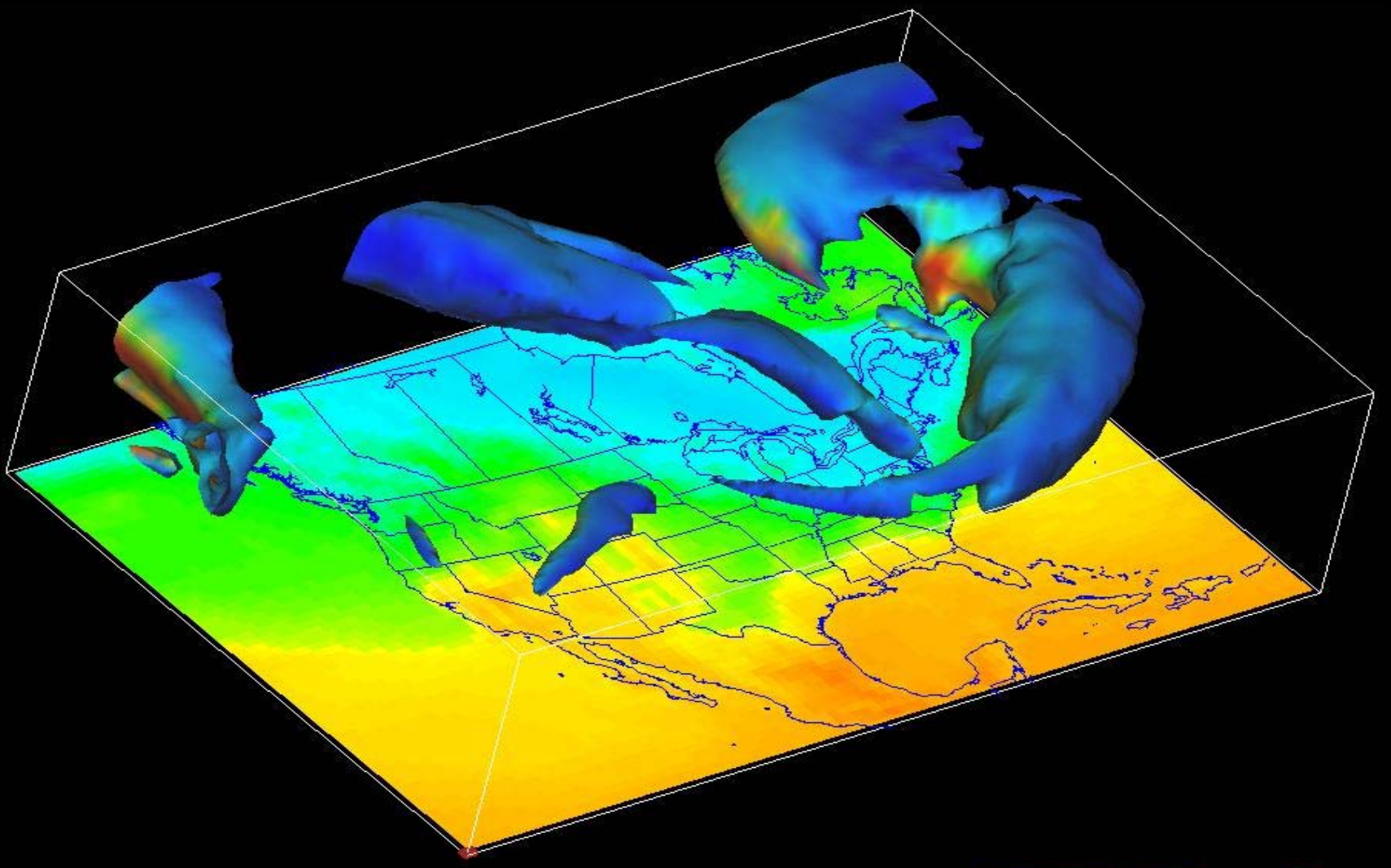
Why VisAD and IDV?

- **VisAD brings the Data Model and advanced display capabilities**
- **IDV is a “reference application” that provides a framework for fetching, selecting and displaying data**
- **Both in Java and Open Source**
- **Use Jython (Python running in Java) as scripting language**
- **Many other supporting libraries available**



View Projections

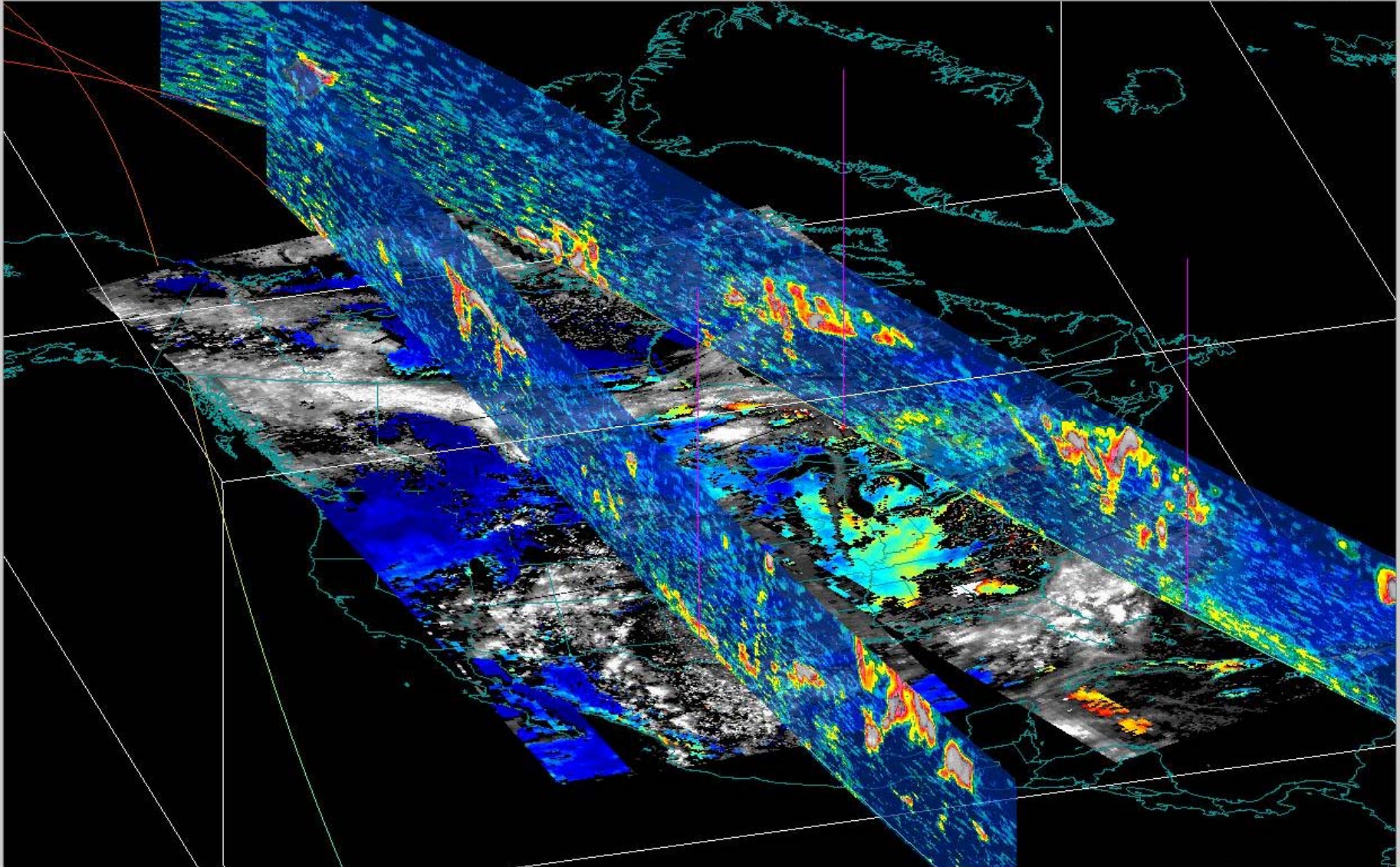
2005-11-23 00:00:00Z



- #1 Temperature at isob... - Color-Shaded Plan View; Level: 1000 hectopascals -90 45 celsius
- #2 Windspeed (from Gri... - Isosurface colored by another parameter; Value: 49.2 m/s -100 200 1E-6 s-1
- #3 Background Maps: World Country Outlines: North & Central America

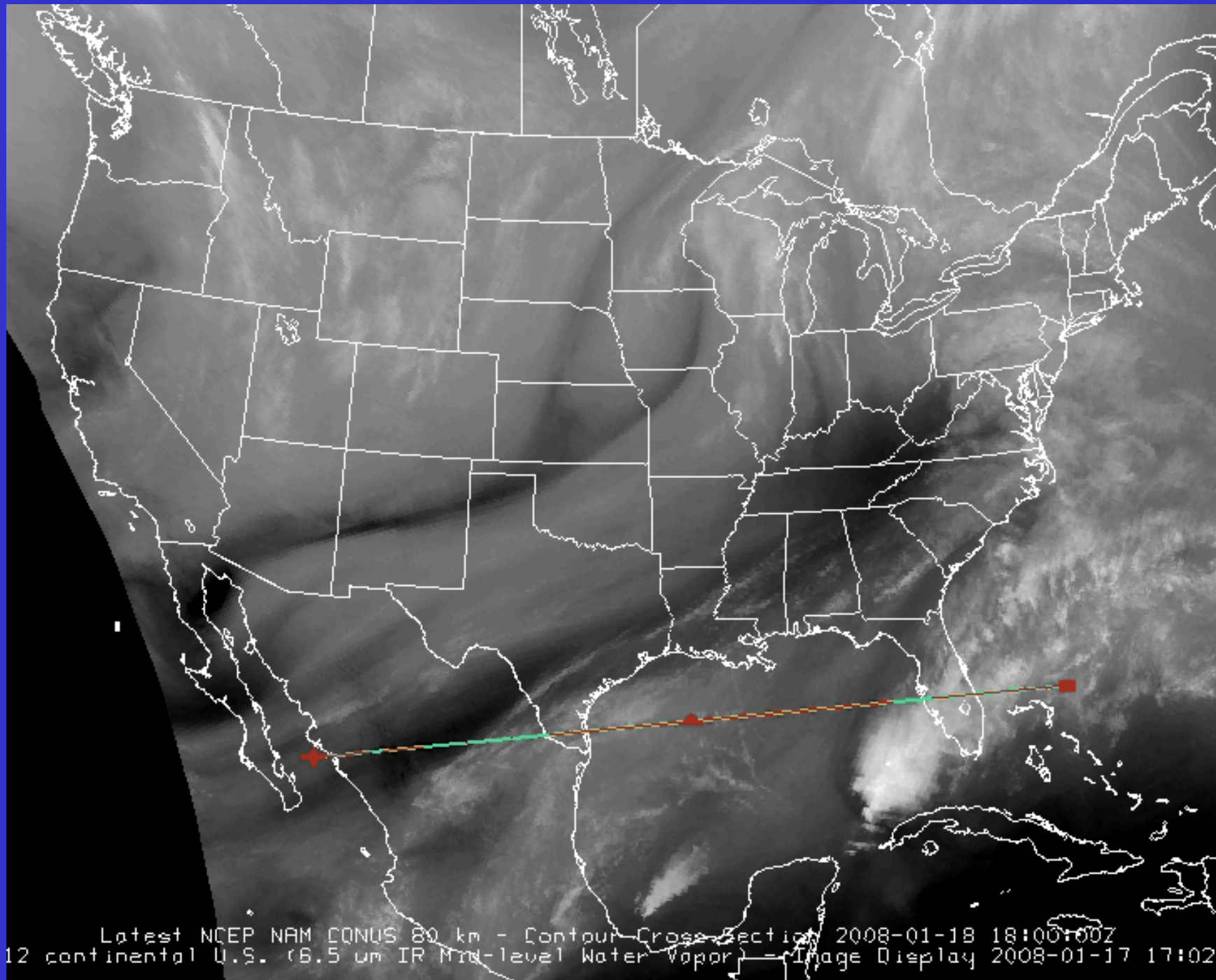


View Projections



- #6 MOD04X00 - Image Display
- #7 MOD06.COT - Image Display
- #8 MOD06.COT - Image Display





Latest NCEP NAM CONUS 80 km - Contour Cross Section 2008-01-18 18:00:00Z
12 continental U.S. (6.5 um IR Mid-level Water Vapor) - Image Display 2008-01-17 17:02



The “X to V” Bridge



- **Interacts with a McIDAS-X remote session**
- **Users provides command line input in a McIDAS-V Data Chooser that sends commands to a server running McIDAS-X**
- **Runs all McIDAS-X commands, including status, text, imagery and graphics**
 - **McIDAS-X output displayed in McIDAS-V**
- **Allows bi-directional interactive communication between McIDAS-V and McIDAS-X**



The "X to V" Bridge



The screenshot displays the McIDAS-V software interface, which is used for meteorological data visualization and analysis. The main window shows a 3D visualization of a radar volume, with a green outline indicating the volume's extent. The interface includes a menu bar (File, Edit, Displays, Data, Tools, Window, Help) and a toolbar. A legend panel on the right shows the current display settings, including the 'McIDAS-X - Frame' and 'KMKX Reflectivity - Radar Isosu...' options. A terminal window at the bottom right shows the following output:

```
McIDAS-X 2007: davep@occam
IMGDISP: EASTS/CONUS.-1 BAND=4 STA=KMSN
Beginning Image Data transfer, bytes= 482816
IMGDISP: loaded frame 1
IMGDISP: done
EU REST IMAGE
EU: Restoring IMAGE.ET to frame(s)= 1
EU: Done
MCLISTEN
Not listening
MCLISTEN START
Started listening on port 8080
IMA GRA Bounds Switches
1 1 random
Date Time T
27 Aug 2007 239 14:30:06 0
```

The interface also includes a 'Dashboard' section with 'Data Choosers', 'Field Selector', 'Displays', and 'Quicklinks'. The 'Field Selector' panel shows the 'Color Table' set to 'McIDAS-X' with a range from 0 to 255, and the 'Vertical Position' set to 'Bottom'. The 'Command Line' field is empty, and the 'Label' field is also empty. The 'Terminal' window shows the output of the 'IMGDISP' command, indicating that the image data has been loaded and displayed.



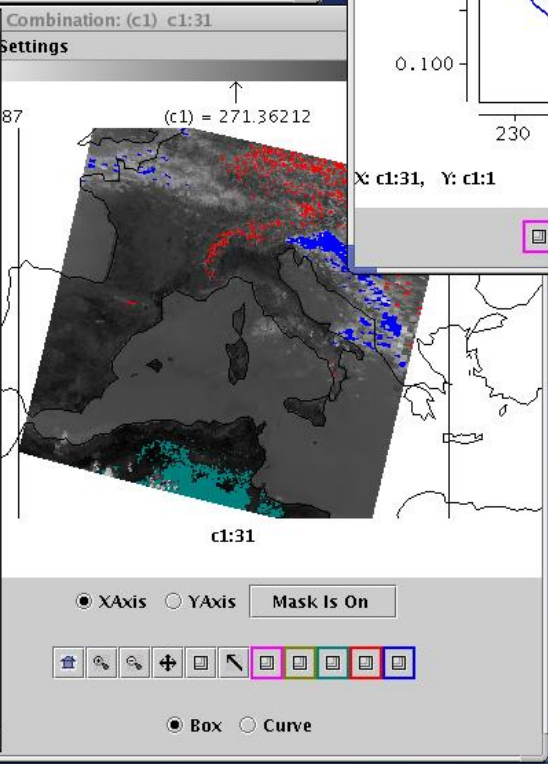
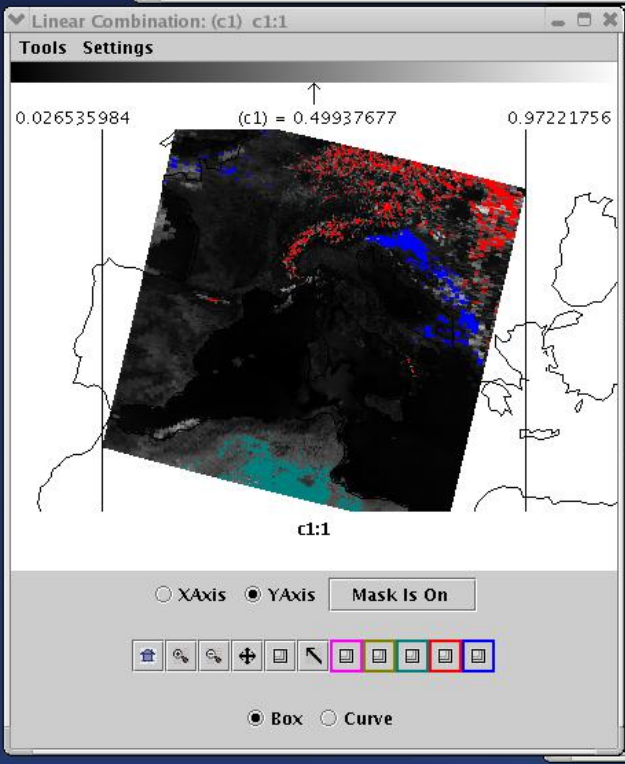
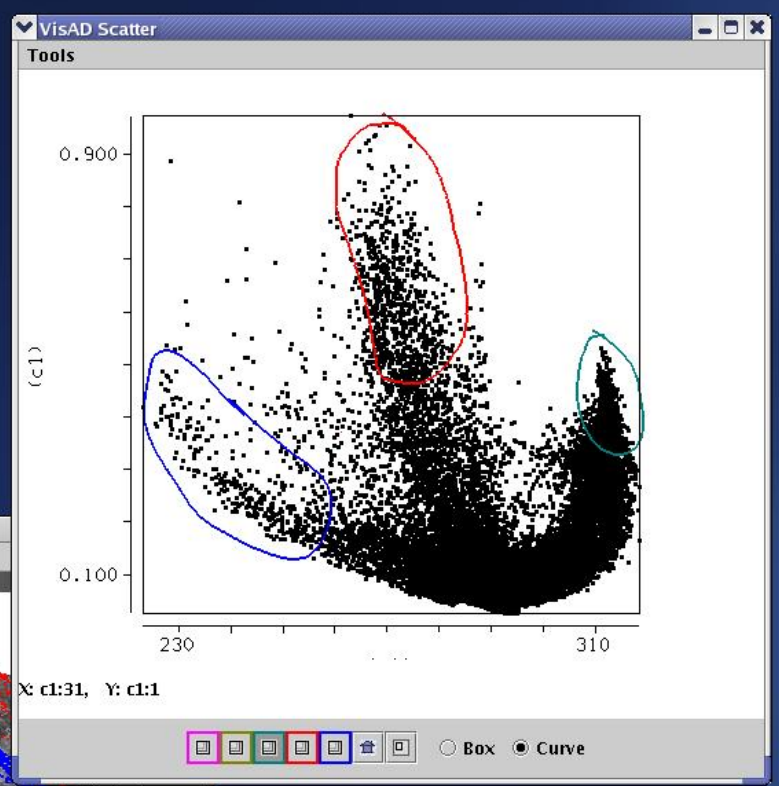
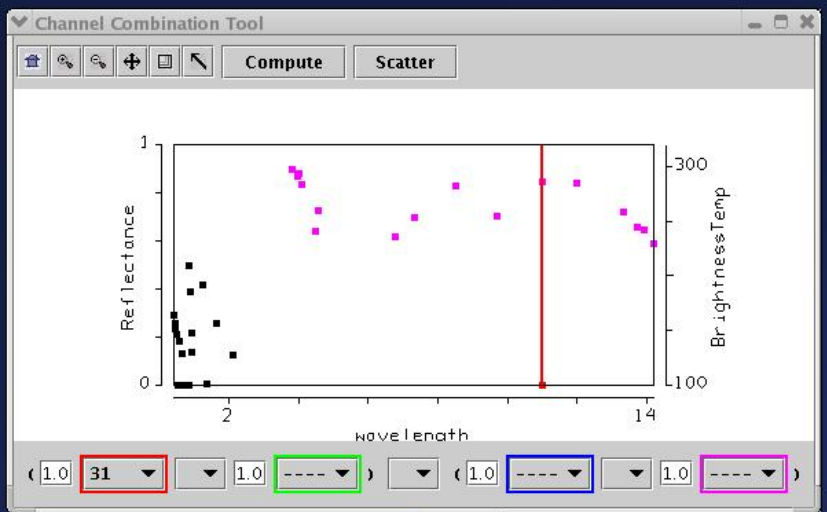
HYDRA



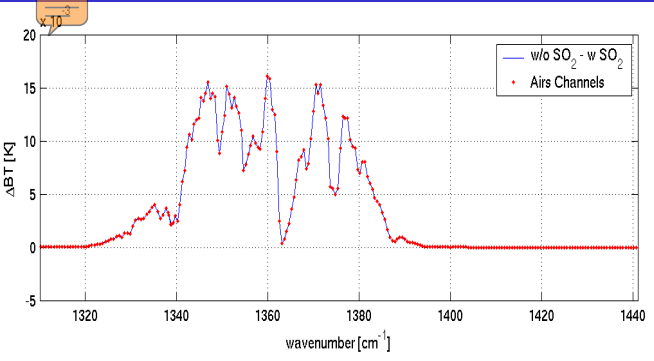
Interrogation of multi- and hyper-spectral data

Developer: Tom Rink SSEC

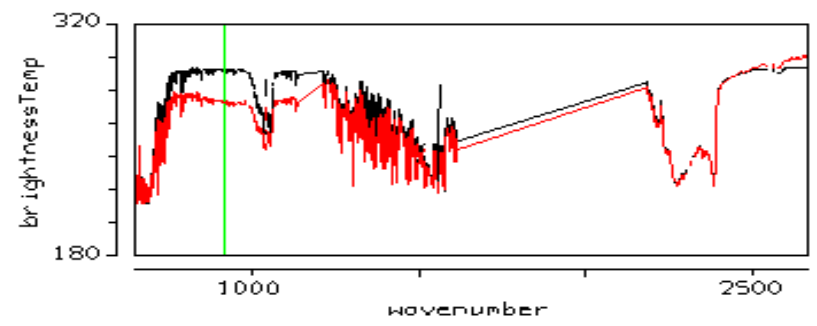
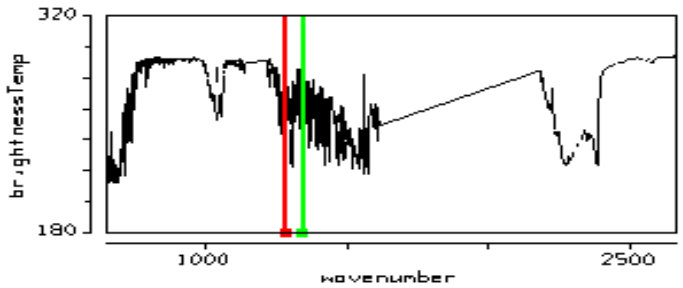
- **Display individual pixel location and spectral band measurements**
- **Combine spectral channels in linear functions and display resulting image products**
- **Construct false color images from multiple channel combinations**
- **Create scatter plots of spectral channel combinations**
- **Locate image pixels in scatter plots and vice versa**
- **Display transects of measurements**
- **Compare Level 2 products (e.g. soundings of temperature and moisture as well as spectra from selected pixels)**
- **Integrated data and product analysis/evaluation between Geostationary and Polar observing platforms**



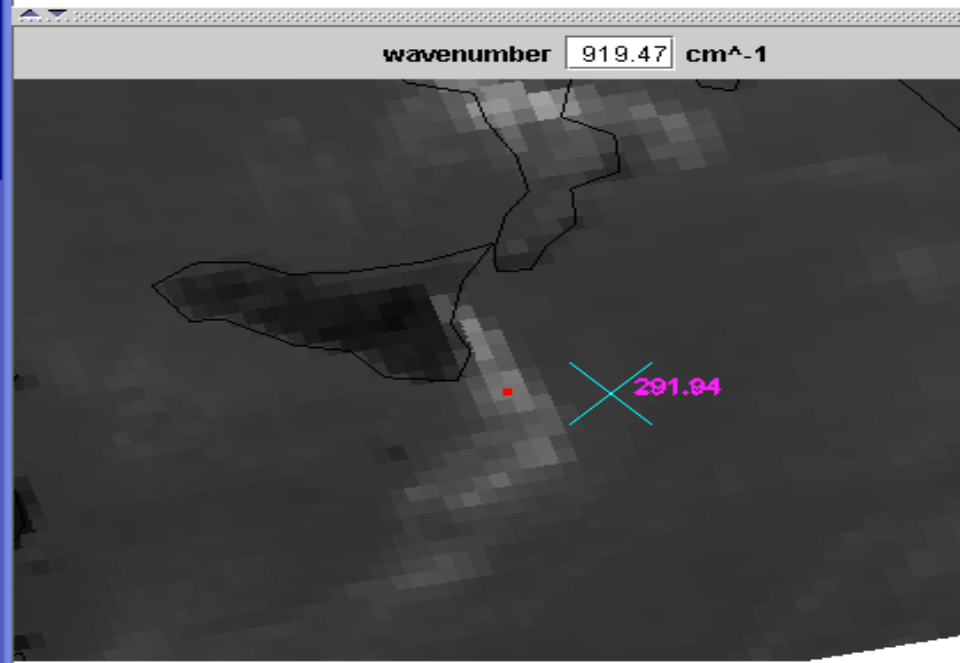
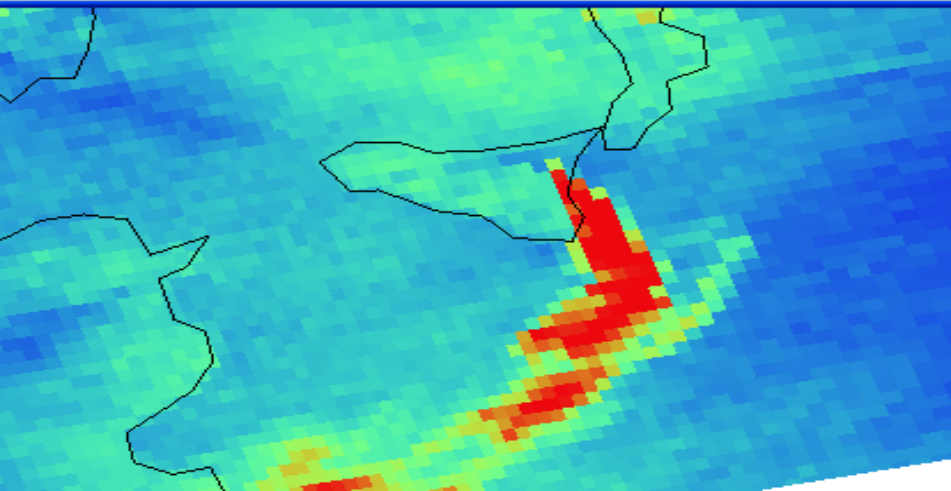
Mt Etna viewed by AIRS 28 Oct 2002



SO2 signal 1284-1345 cm-1

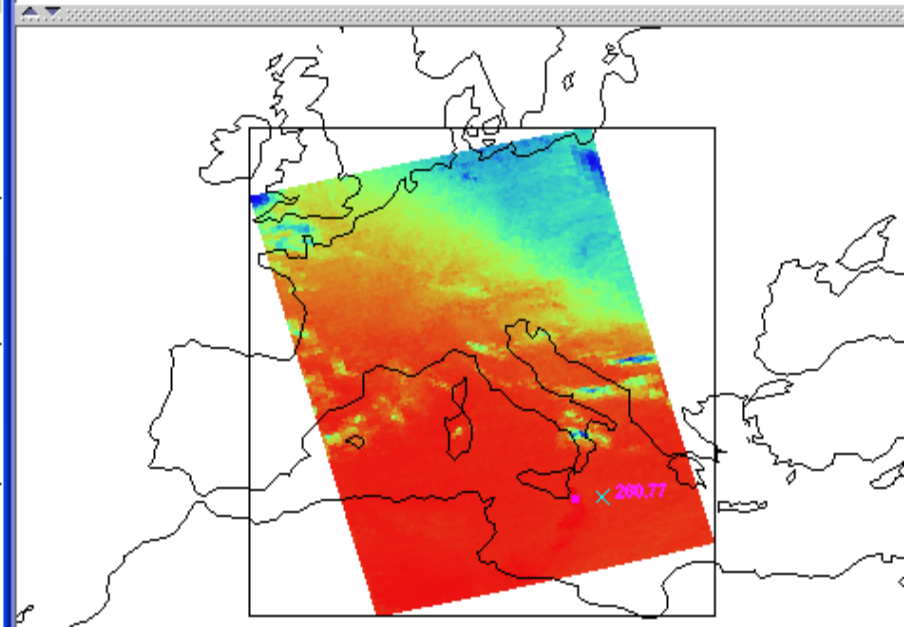
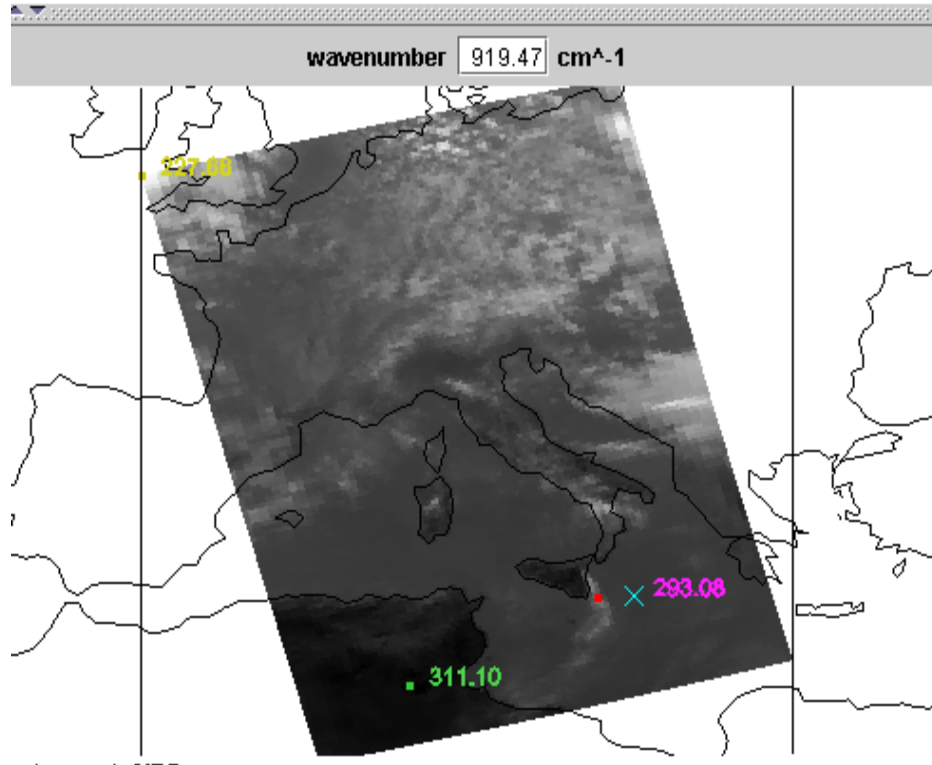
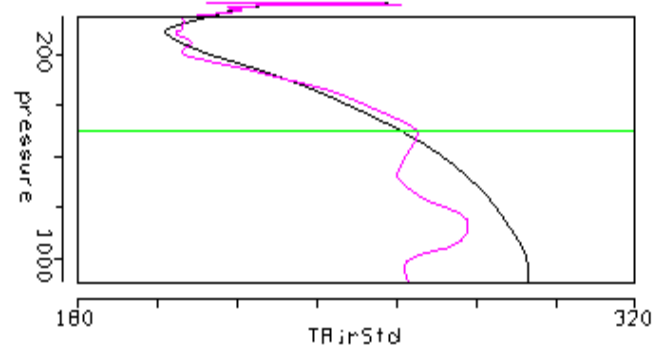
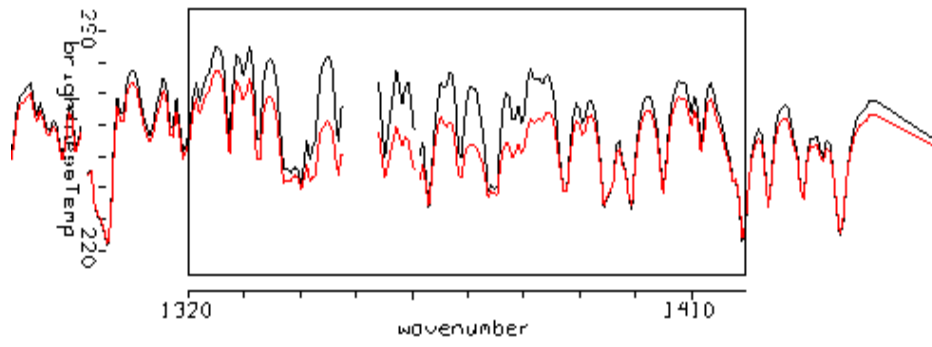


(1.0 1284.348 - 1.0 1344.799)



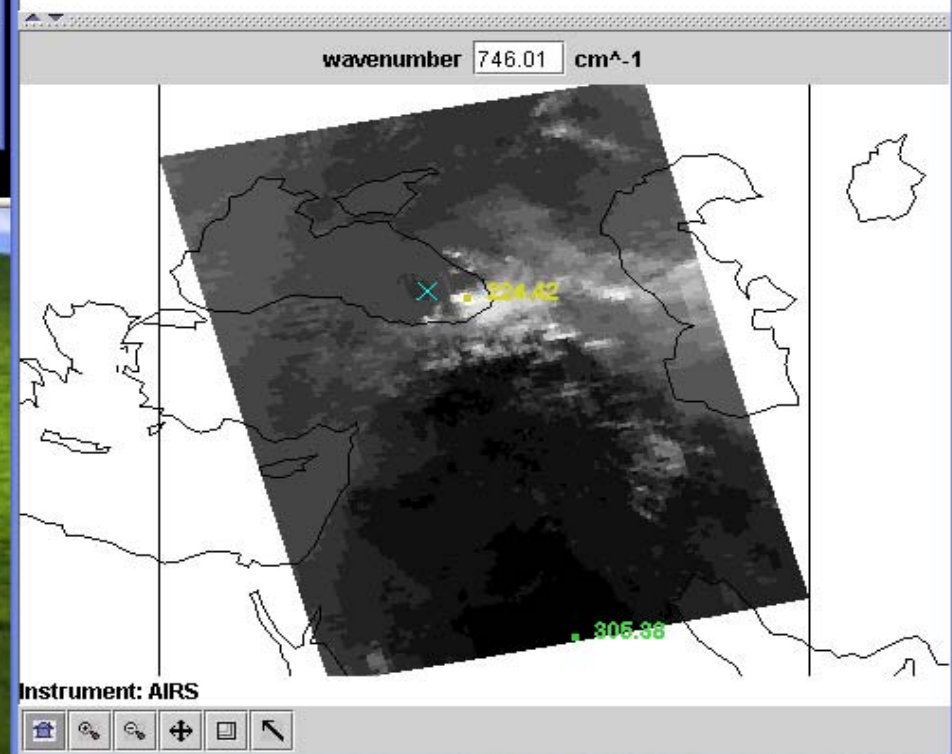
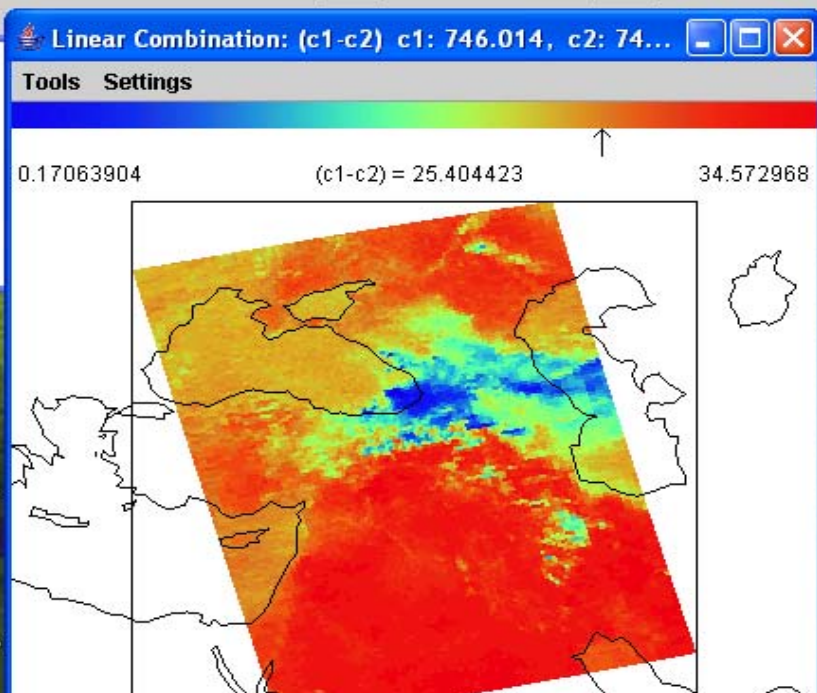
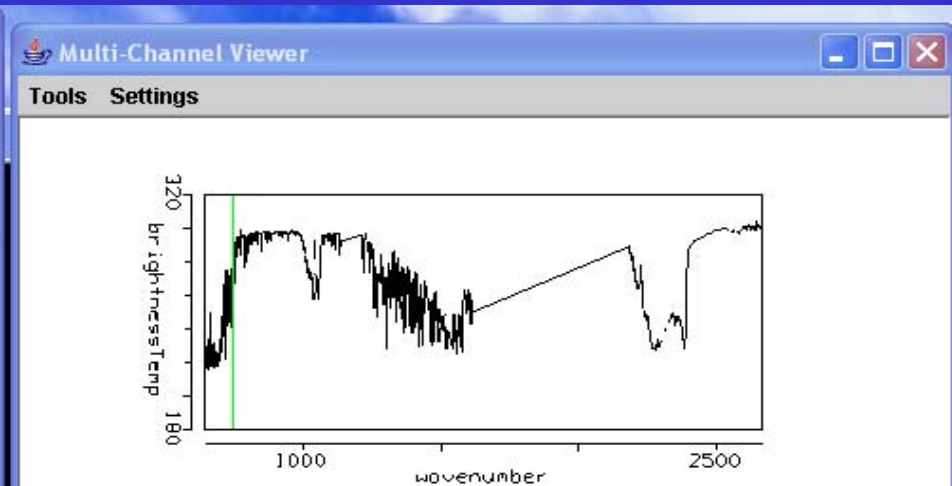
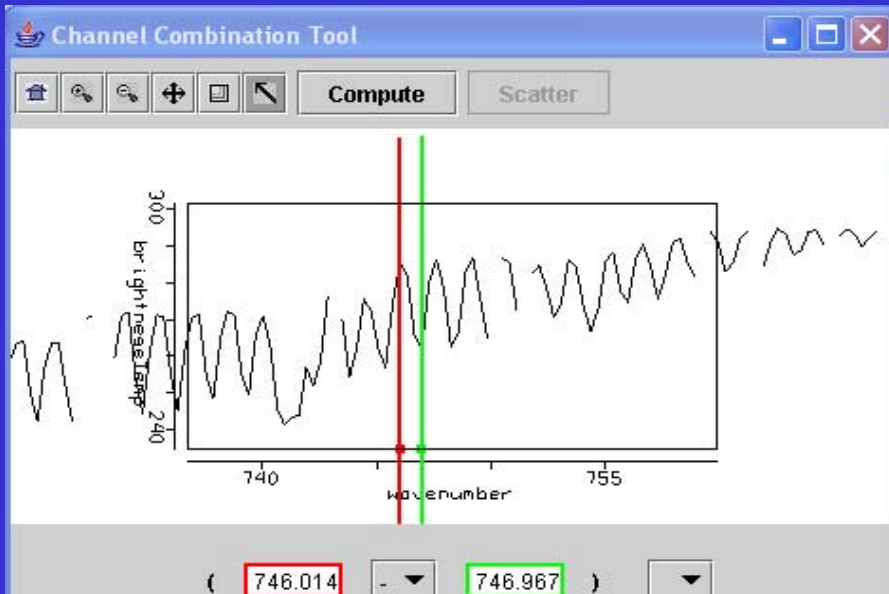
Inferring ash cloud height from AIRS clear sky and in ash soundings

Ash cloud and clear sky spectra

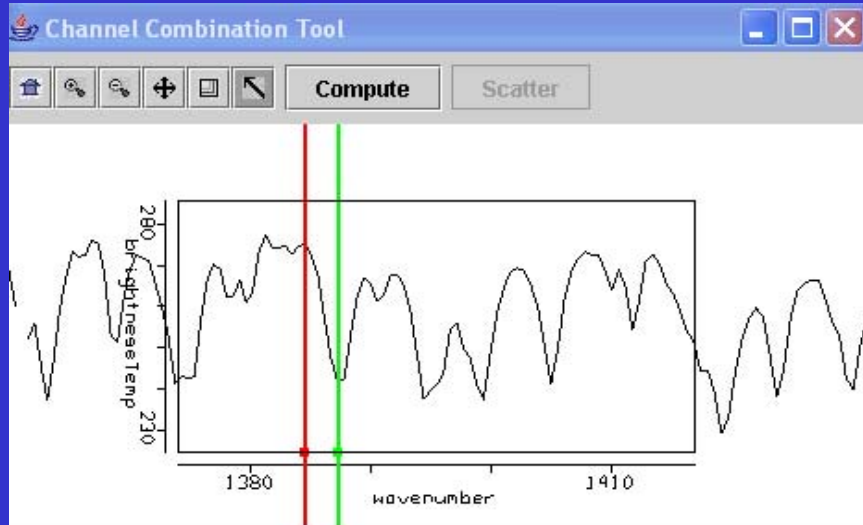


Instrument: AIRS

Offline-Online in LW CO₂



Offline-Online in H₂O



(1384.476 - 1387.200)

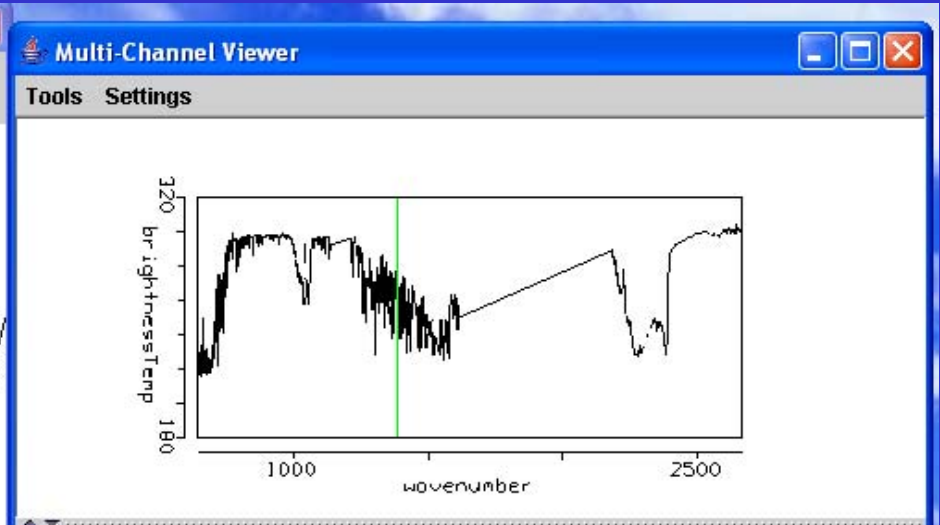
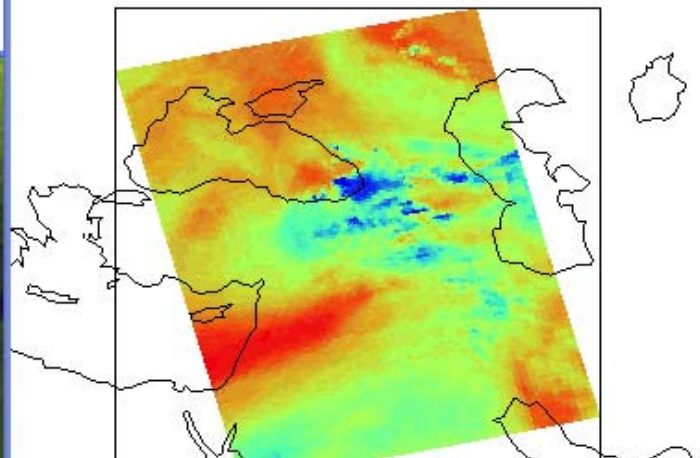
Linear Combination: (c1-c2) c1:1384.476...

Tools Settings

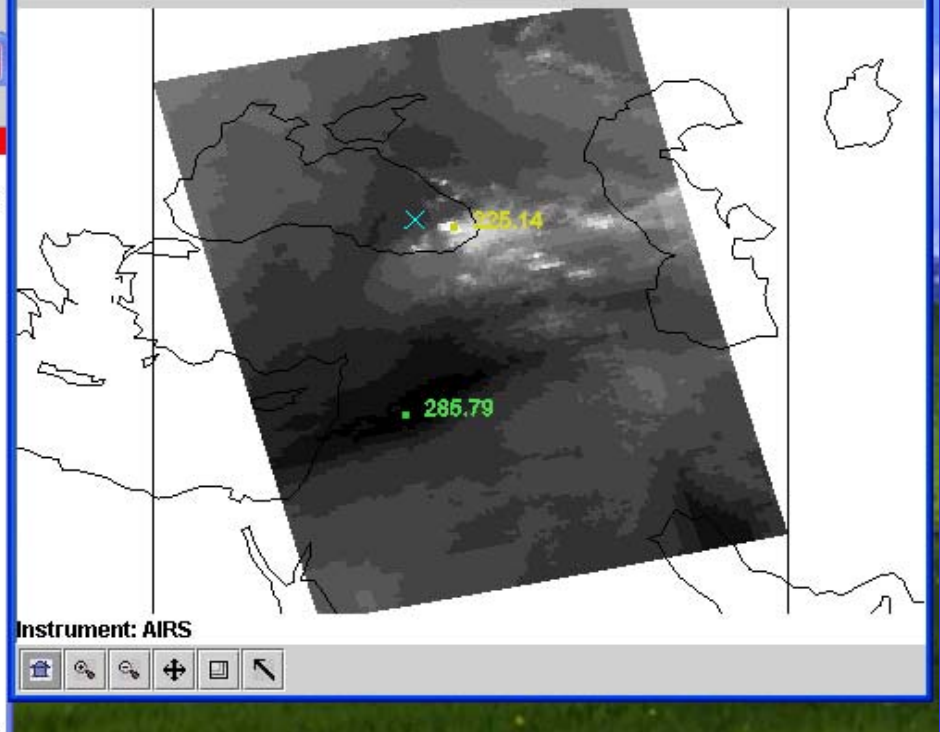
0.95150757

(c1-c2) = 21.7416

42.531693

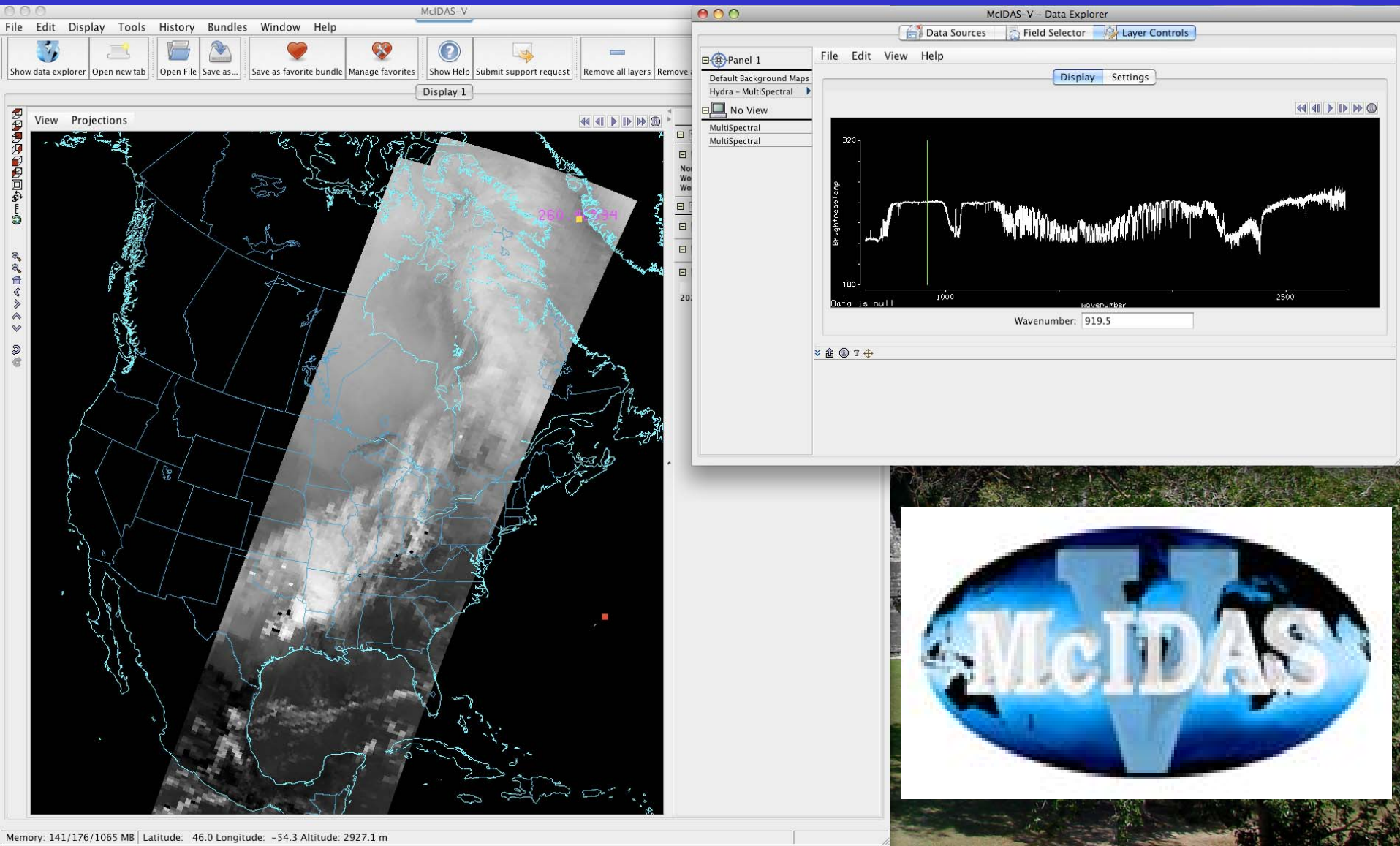


wavenumber 1385.02 cm⁻¹

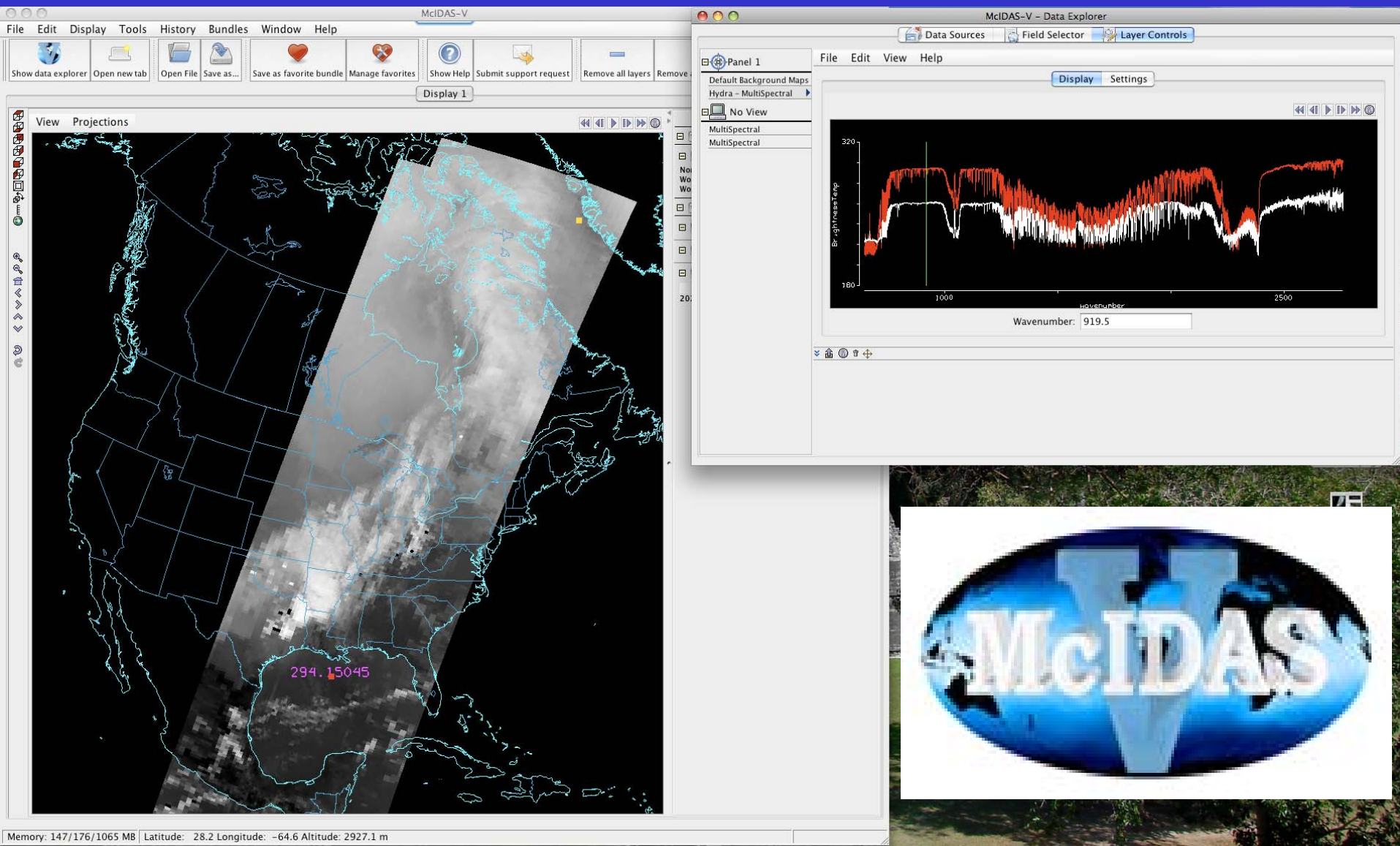


Hydra Integration into McIDAS-V

IASI granule



Hydra Integration into McIDAS-V pointers select location of spectra



Hydra Integration into McIDAS-V slider bar selects spectral band display

The image displays the McIDAS-V software interface. The main window, titled "McIDAS-V", features a menu bar (File, Edit, Display, Tools, History, Bundles, Window, Help) and a toolbar with icons for "Show data explorer", "Open new tab", "Open File", "Save as...", "Save as favorite bundle", "Manage favorites", "Show Help", "Submit support request", and "Remove all layers". Below the toolbar is a "Display 1" button. The main view area shows a map of the United States with a satellite image overlay. A purple label "294.15045" is visible on the map. To the right, a "Data Explorer" window is open, showing a "Panel 1" with "Default Background Maps" set to "Hydra - MultiSpectral". The "Data Explorer" window has its own menu bar (File, Edit, View, Help) and tabs for "Data Sources", "Field Selector", and "Layer Controls". The "Display" tab is active, showing a spectral plot of "Brightness Temp" vs "Wavenumber". The plot shows two traces, one red and one white, with a vertical line at "Wavenumber: 1492.0". The plot has a y-axis from 100 to 320 and an x-axis from 1000 to 2500. At the bottom of the main window, a status bar displays "Memory: 161/176/1065 MB | Latitude: 38.3 Longitude: -98.3 Altitude: 2927.1 m".



McIDAS-V web page software, manuals

McIDAS-V

File Edit Display Tools History Bundles Window Help

Show data explorer Open new tab Open File Save as... Save as favorite bundle Manage favorites Show Help Submit support request Remove all layers Remove all layers and

Display 1

View Projections

2008-05-04 14:45:00Z

Legend

- Maps
 - Default Background Maps
 - North & Central America
 - World Country Outlines
 - World Political Boundaries
- Imagery
 - GOES12 full disk (0.65 um VIS...)

0 255

Memory: 131/147/1065 MB Latitude: -42.7 Longitude: -37.7 Altitude: -502.3 m

Local Level III

- Point Observations
- Surface Plot
- Upper Air
 - Plot
 - Soundings
 - Remote
 - Local
- Wind Profiler
- Front Positions
- General
 - Catalogs
 - Directory
 - Files
 - URLs

McIDAS-X Bridge
HYDRA
Test Images

Image Type: GOES12 full disk

Times: Most recent 2 most recent 3 most recent 4 most recent 5 most recent

Relative Absolute

Data Type: Bright... Channel: 0.65 um VIS Cloud and Surface Features

Location: Center= Lat: -20 Lon: -60

Image Size: 1200 X 1200 Raw size: 10820 X 20836

Magnification: -4 X -8 Navigation Type: Default

Add Source Update Help Cancel Create display

McIDAS-V Software and Instructions

http://www.ssec.wisc.edu/mcidas/software/v/

Apple Tom_B Tom_P News Science Science_Viz Wx Web Sites Obs Radar / IDV Sat Images Models/Fcst

About McIDAS McIDAS-V McIDAS-Lite OpenADDE

McIDAS-V Version 1.0alpha9 Software and Instructions

McIDAS-V is a free, open source, visualization and data analysis software package that is the next generation in SSEC's 35-year history of sophisticated McIDAS software packages. McIDAS-V displays weather satellite (including hyperspectral) and other geophysical data in 2- and 3-dimensions. McIDAS-V can also analyze and manipulate the data with its powerful mathematical functions. McIDAS-V is built on SSEC's VisAD and Unidata's IDV libraries, and contains "Bridge" software that enables McIDAS-X users to run their commands and tasks in the McIDAS-V environment. A future version of McIDAS-V will contain an integrated version of SSEC's HYDRA software package.

Note: McIDAS-X users who install McIDAS-V and want to run their McIDAS-X commands in the McIDAS-V environment via the Bridge must also be running McIDAS-X version 2007a or greater. Sites that have joined the [McIDAS Users' Group](#) and purchased McIDAS-X support can download McIDAS-X 2007a from the [McIDAS-X Downloads](#) page.

This page contains information on how to [download McIDAS-V](#), [install McIDAS-V](#), and [run McIDAS-V](#), as well as links to the [latest McIDAS-V training materials](#) and the [McIDAS-V source code](#).

Download McIDAS-V:

Check that your system meets the [system requirements for McIDAS-V](#) and download the appropriate package for your operating system:

- Linux
- Mac OS X
- Solaris SPARC
- Solaris x86
- Windows
- all other unix

Note: This file is just the installer and can be placed anywhere on your machine. When you run the installer in the next step, you can then indicate where you want McIDAS-V to be installed.

Optional - If you'd like to be notified of McIDAS-V updates and other important information, please enter your name, email address and location here.

First name:

Last name:

Email address:

Location: (e.g. Badger Weather Corp - Madison, WI)

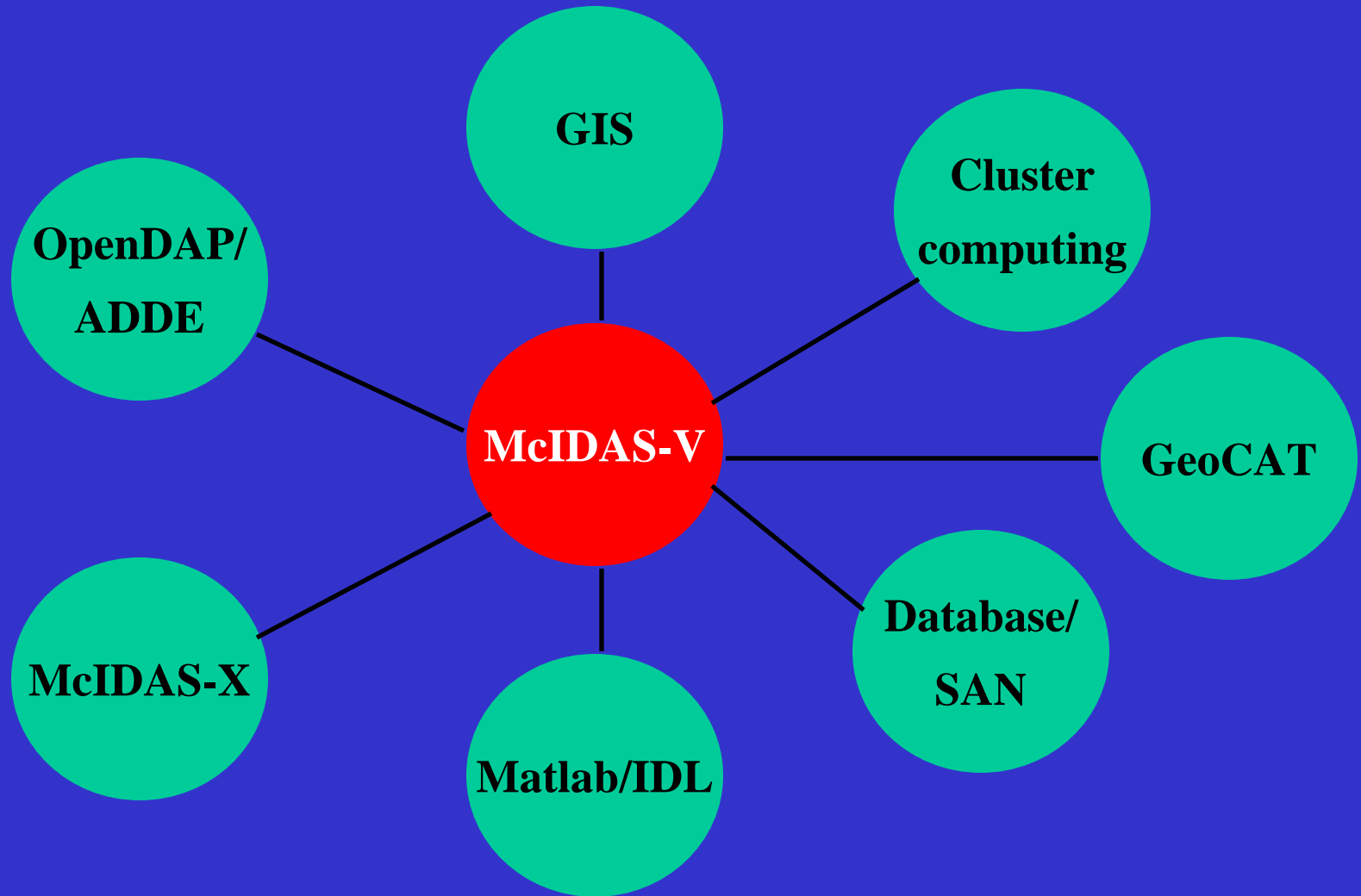
Send

Install McIDAS-V:

Start the installer by following the instructions appropriate for your operating system:

- Linux open a terminal window and run `sh ./<installer>.sh`
- Mac OS X mount the .dmg and double-click the installer
- Solaris SPARC open a terminal window and run `sh ./<installer>.sh`
- Solaris x86 open a terminal window and run `sh ./<installer>.sh`
- Windows double-click the downloaded .exe file

McIDAS-V is a collection of software tools, and networked services and data designed to take advantage of a scalable distributed computing environment to meet user needs





McIDAS-V Future Work



- **Complete HYDRA integration (summer '08)**
- **Further enhancement of the 'X to V Bridge'**
 - Alpha 0.6 release at 10/2007 MUG meeting
- **Provide full capabilities for Direct Broadcast data acquisition, analysis and display**
- **Support data analysis and visualization capabilities and applications for advanced satellite systems, including METOP, NPP/NPOESS and GOES R**
 - Innovative data analysis and visualization tools
 - Broad array of formats and services
 - Data management and accessibility



McIDAS-V software



McIDAS-V is free, open source software

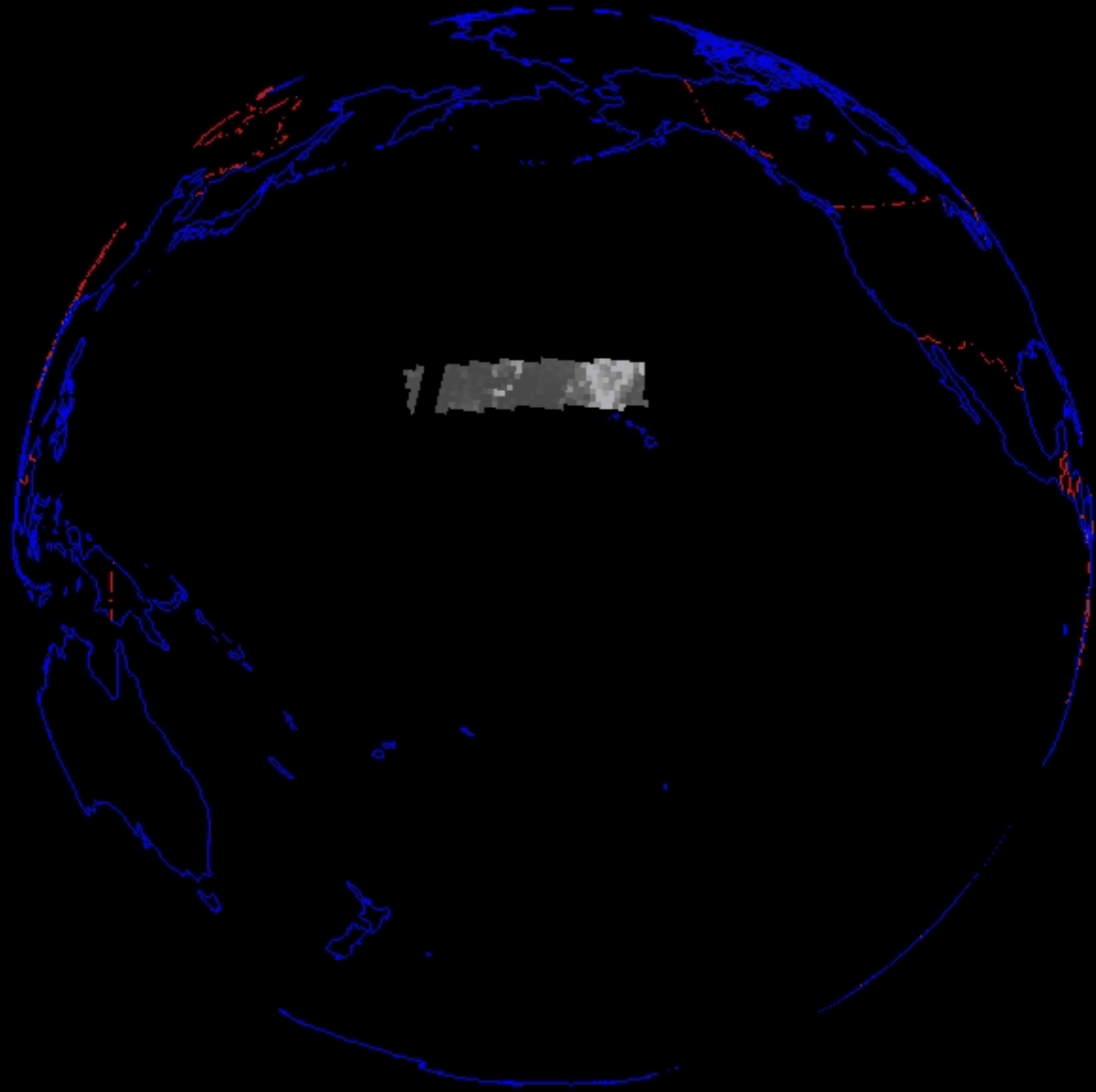
available at

<http://www.ssec.wisc.edu/mcidas/software/v/>

(google McIDAS-V)

or contact

tom.achtor@ssec.wisc.edu



International TOVS Study Conference, 16th, ITSC-16, Angra dos Reis, Brazil, 7-13 May 2008.
Madison, WI, University of Wisconsin-Madison, Space Science and Engineering Center,
Cooperative Institute for Meteorological Satellite Studies, 2008.