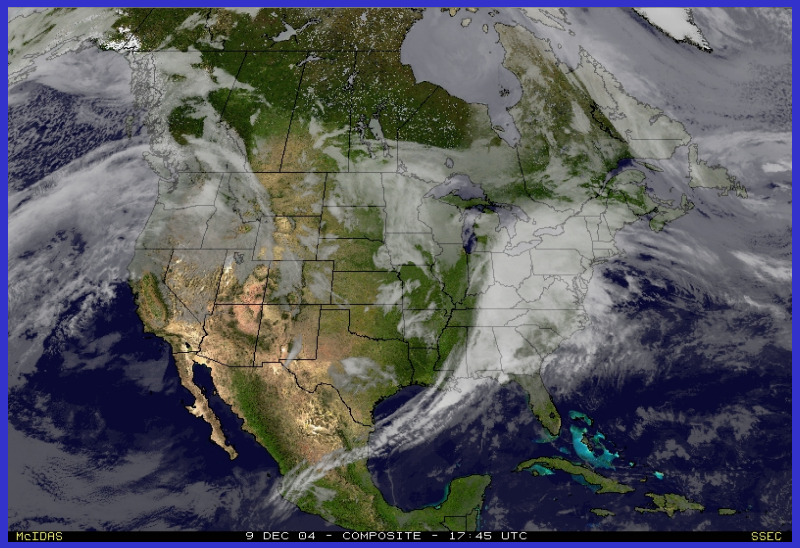
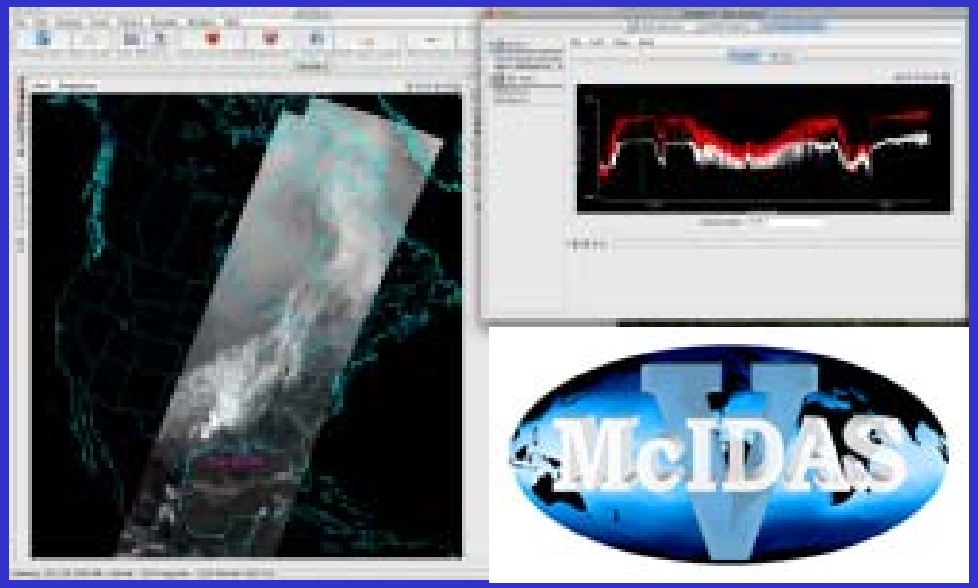
McIDAS-V: An open source data analysis and visualization tool for multi- and hyperspectral satellite data

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

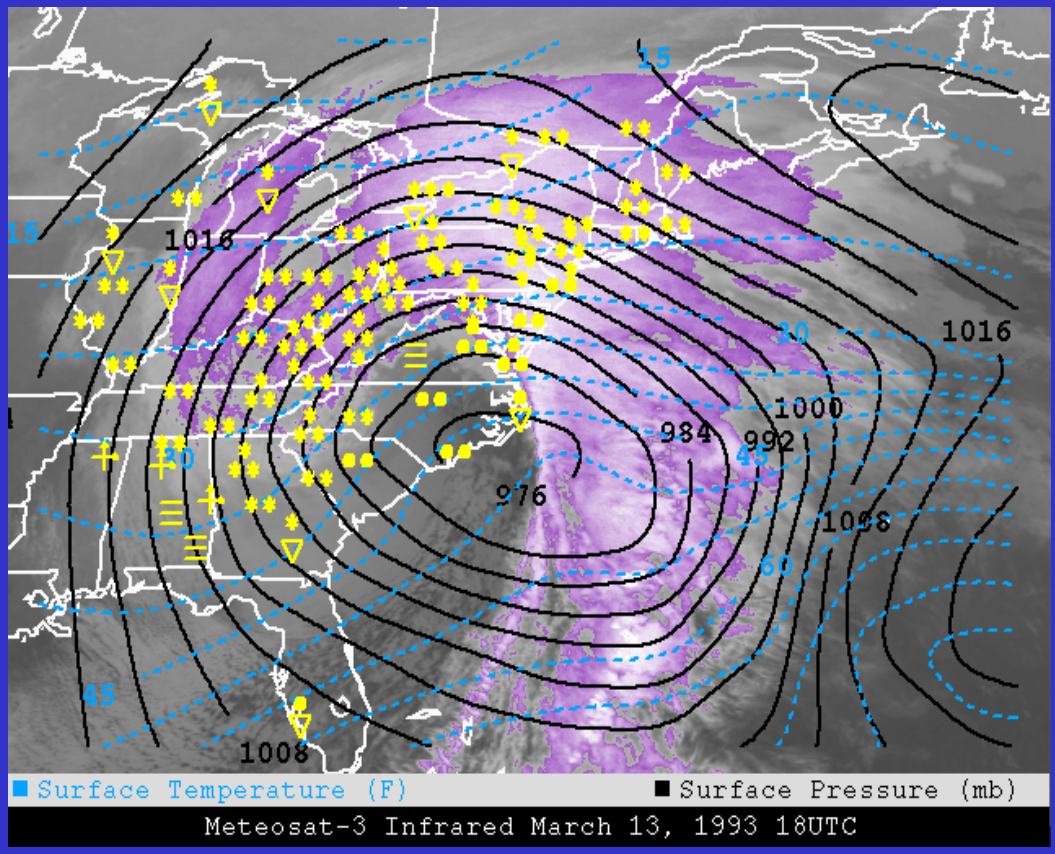
Space Science & Engineering Center (SSEC) at the University of Wisconsin - Madison



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 → VisAD + IDV + HYDRA = McIDAS-V

VisAD

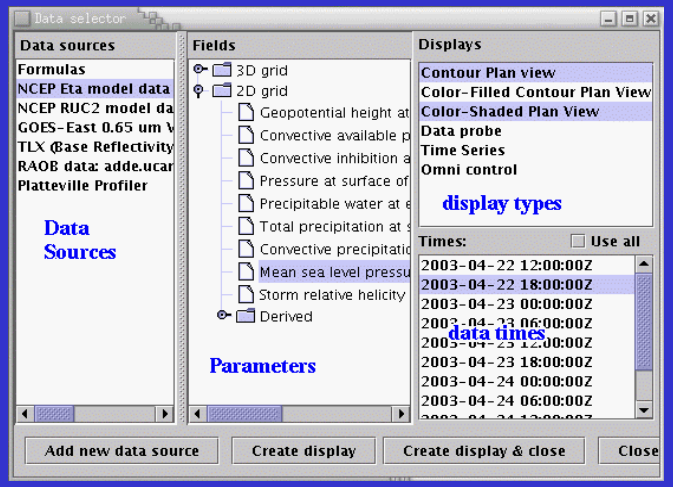
Developer: Bill Hibbard, UW SSEC

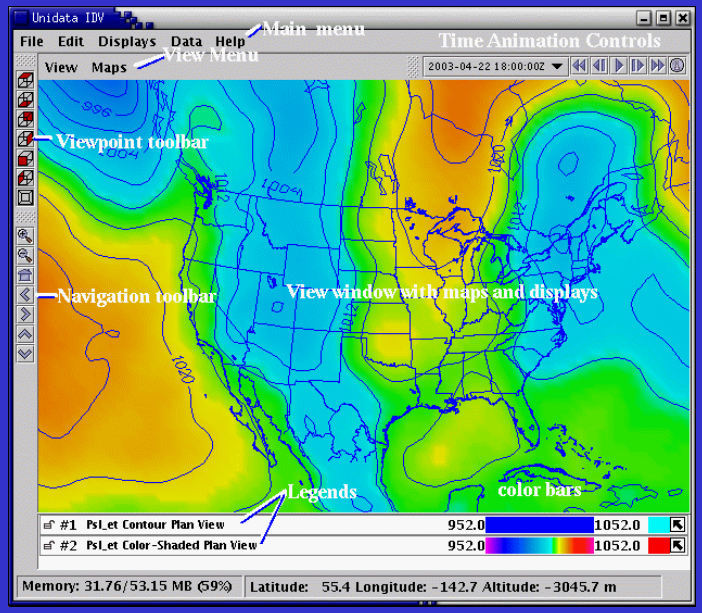
- Open-source, Java library for building interactive and collaborative visualization and analysis tools
- <u>Features include:</u>
  - Powerful mathematical data model that embraces virtually any numerical data set
  - General display model that supports 2- and 3-D displays, multiple data views, direct 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

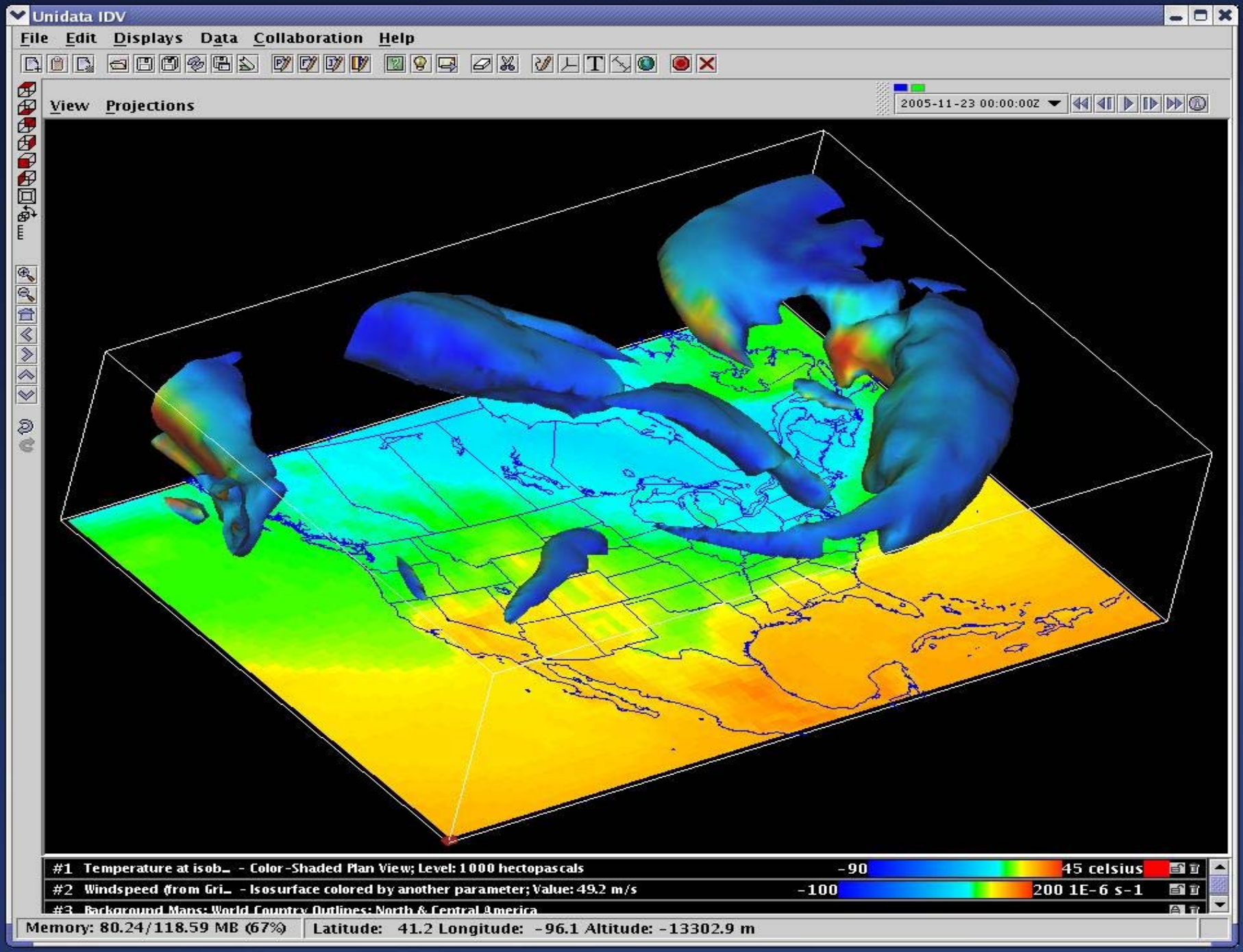


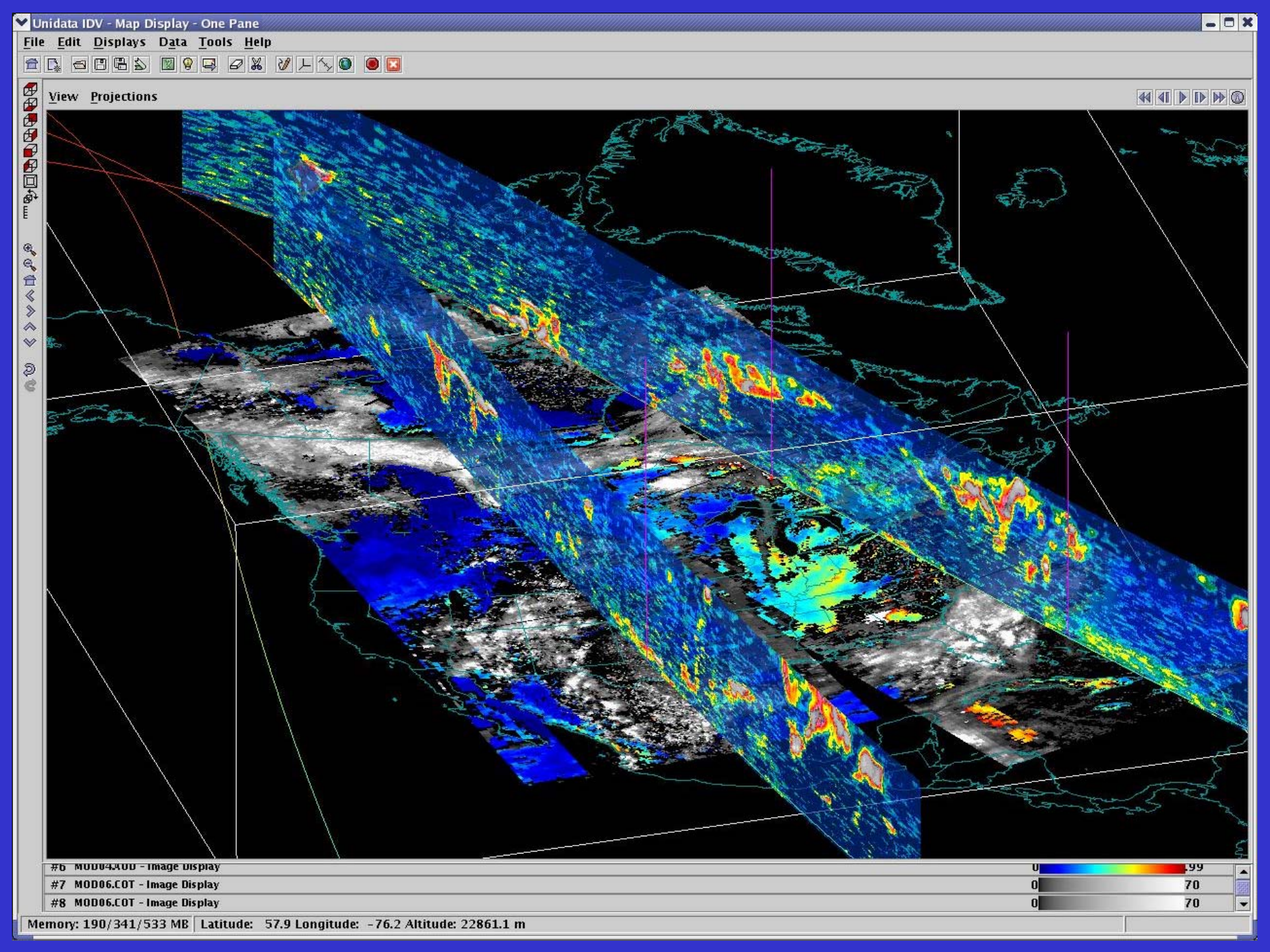


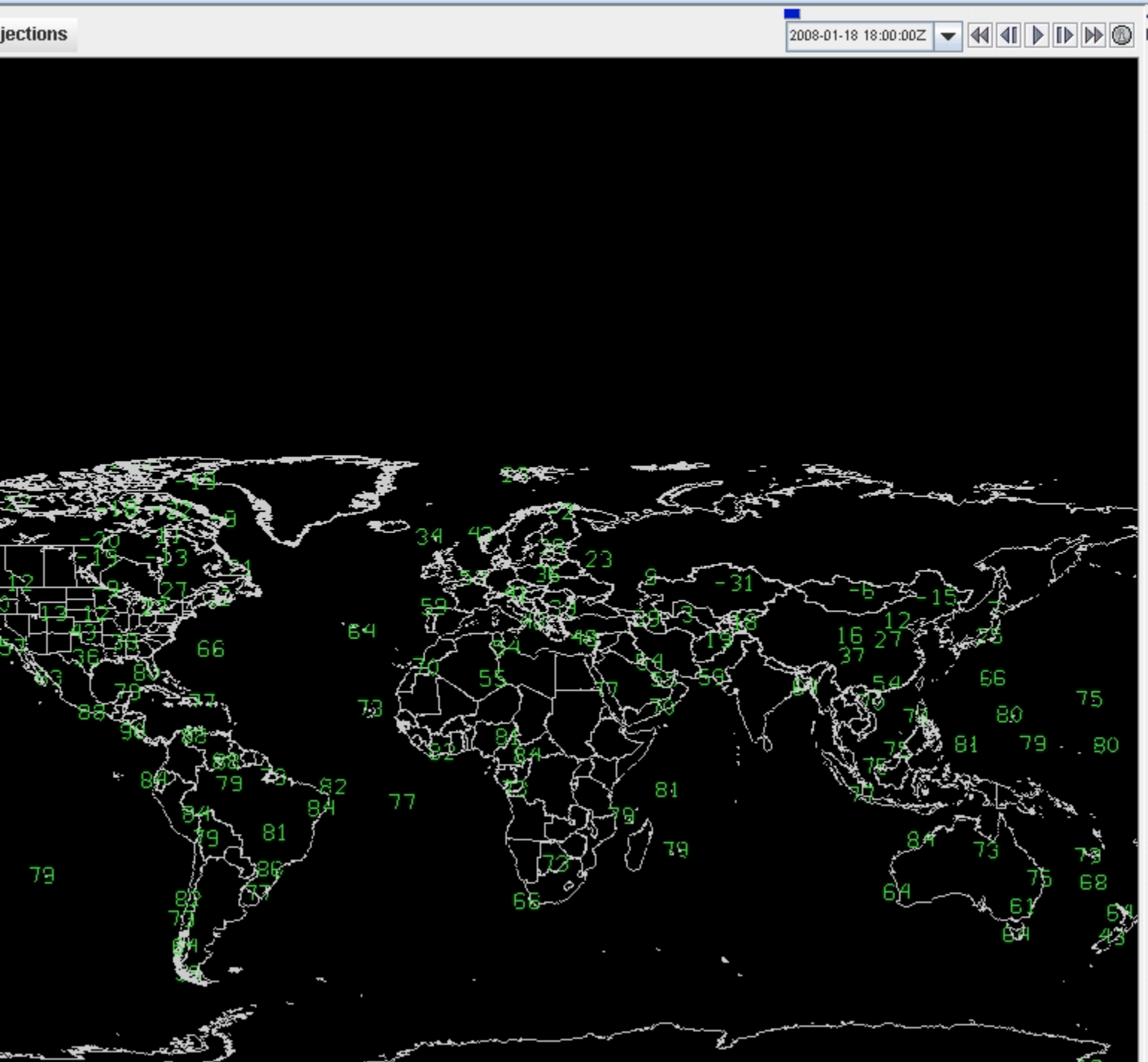
http://www.unidata.ucar.edu/idv

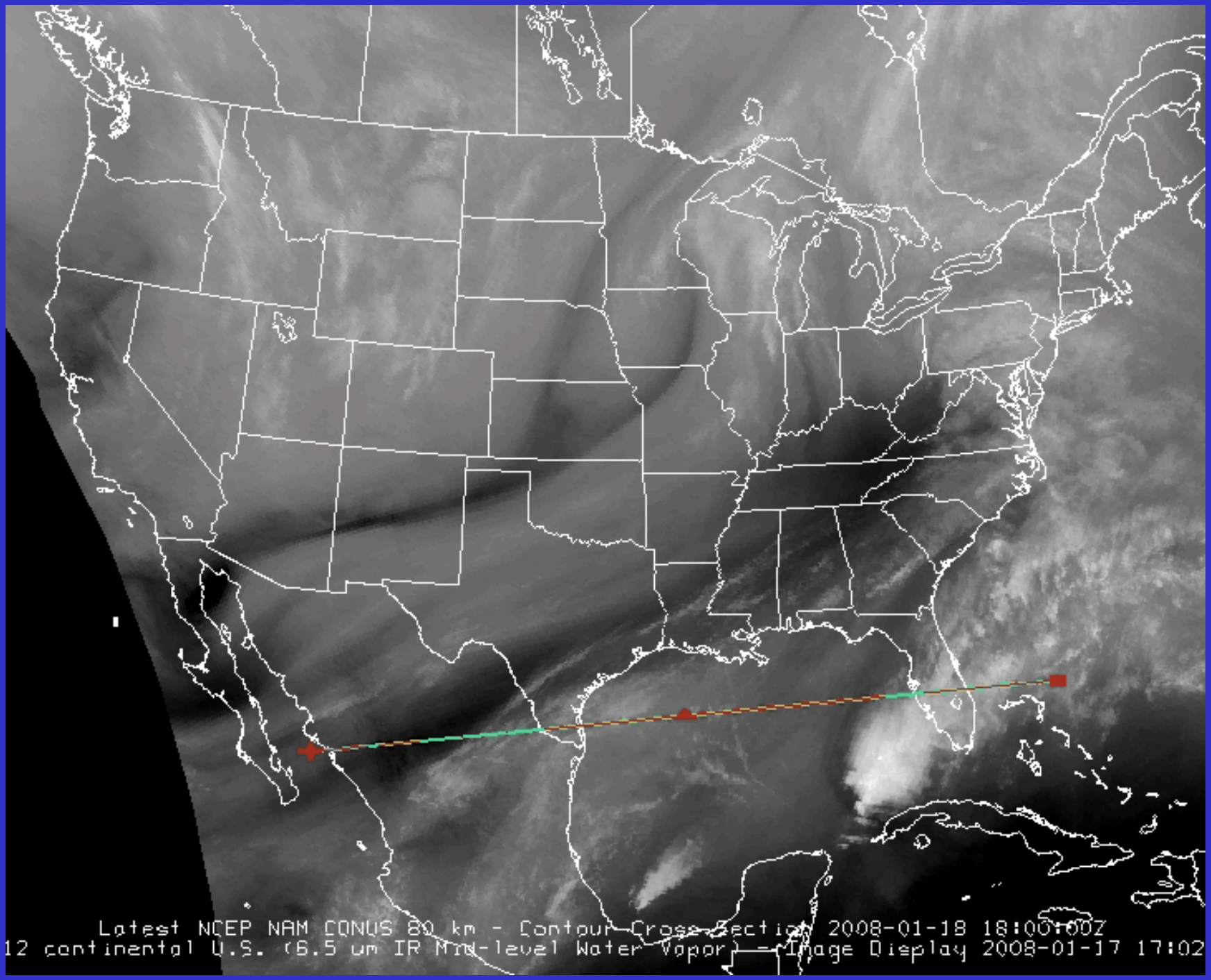
Why VisAD and IDV?

- 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


Unidata IDV
File Edit Displays Data Collaboration Help
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
Memory: 80.24/118.59 MB (67%)
Latitude: 41.2 Longitude: -96.1 Altitude: -13302.9 m


Unidata IDV - Map Display - One Pane
File Edit Displays Data Tools Help
View Projections
#6 MOD04.AOD - Image Display
#7 MOD06.COT - Image Display
#8 MOD06.COT - Image Display
Memory: 190/341/533 MB
Latitude: 57.9 Longitude: -76.2 Altitude: 22861.1 m

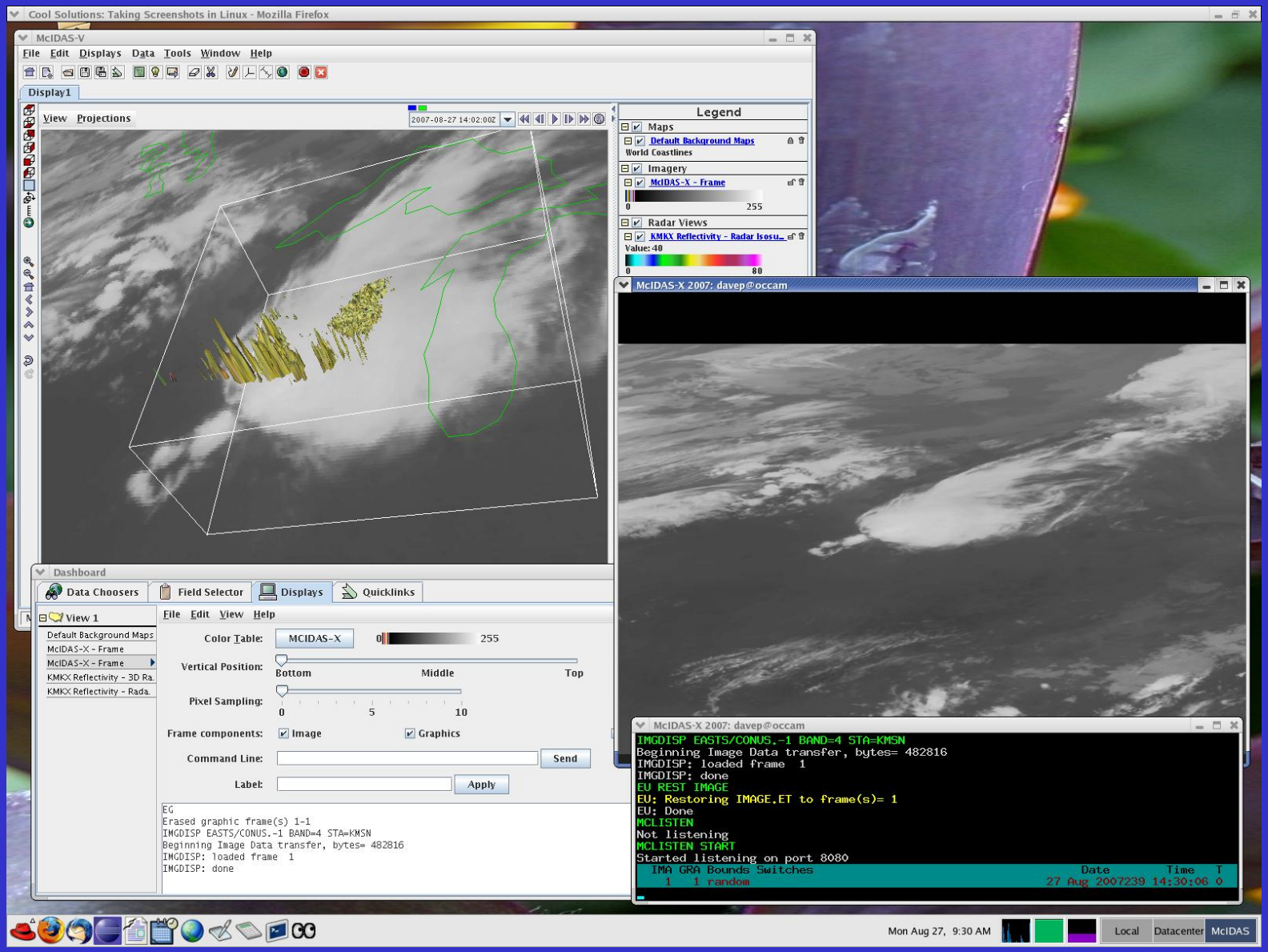

jections
2008-01-18 18:00:00Z
Legend
Maps
Default Background Maps
North & Central America
World Country Outlines
World Political Boundaries
Point Data
Surface (METAR) Data - Point
Layout model:Temperature


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

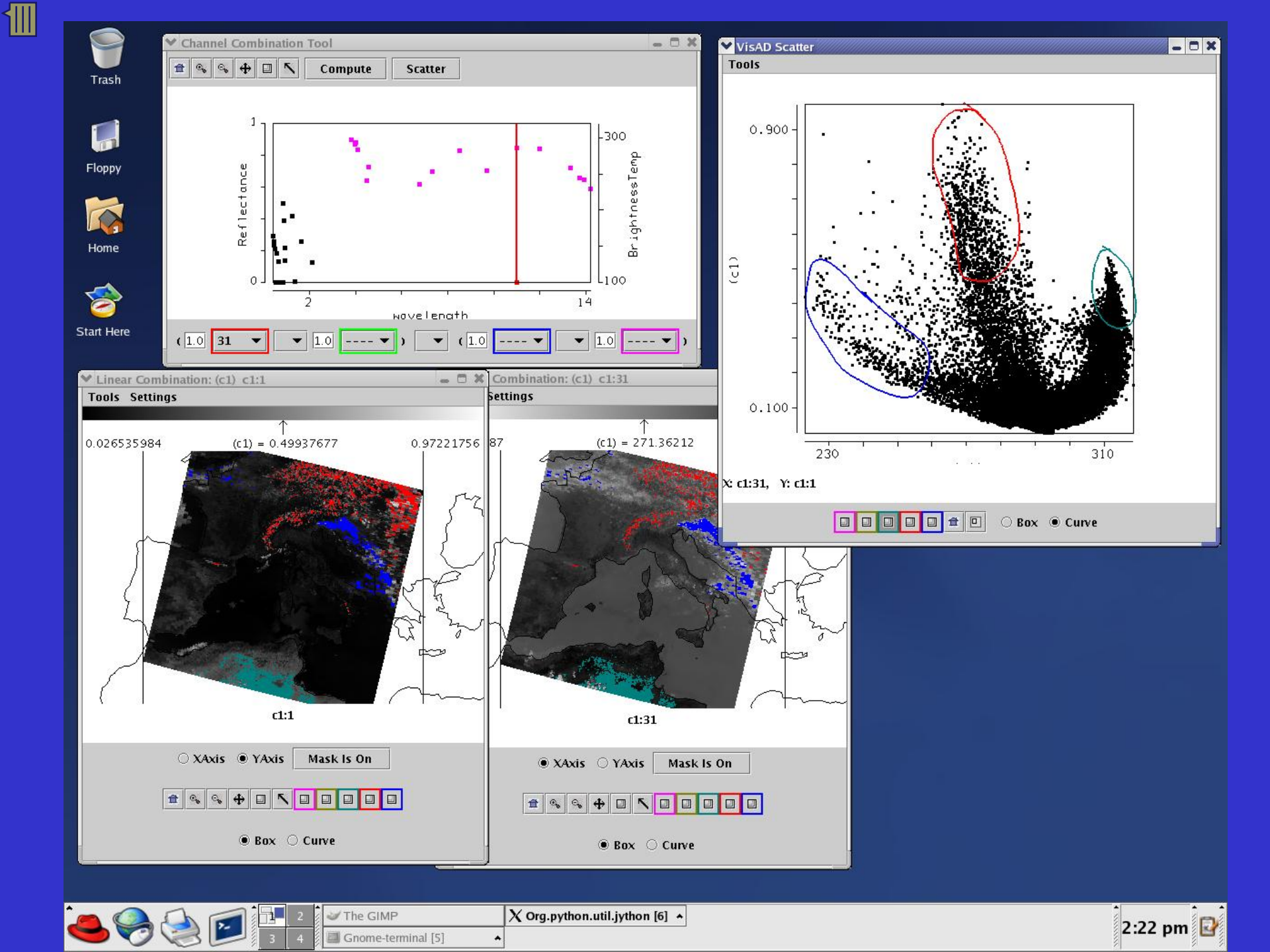


HYDRA

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


Trash
Floppy
Home
Start Here
Channel Combination Tool
Compute
Scatter
Reflectance
BrightnessTemp
wavelength
VisAD Scatter
Tools
(c1)
X: c1:31, Y: c1:1
Box
Curve
Linear Combination: (c1) c1:1
Tools Settings
0.026535984
(c1) = 0.49937677
0.97221756
c1:1
XAxis
YAxis
Mask Is On
Box
Curve
Combination: (c1) c1:31
Settings
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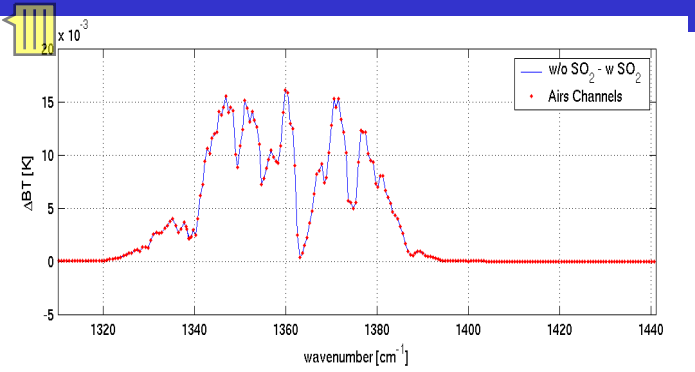
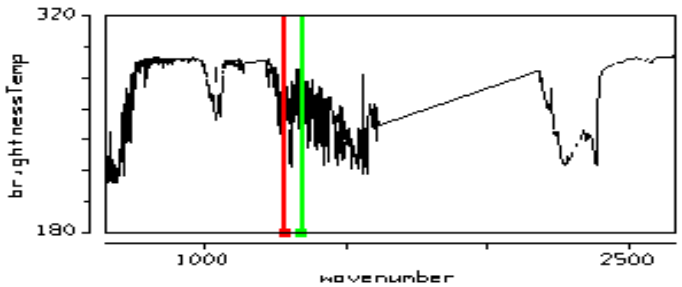
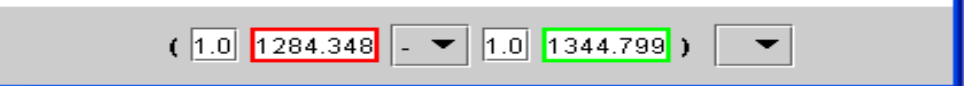
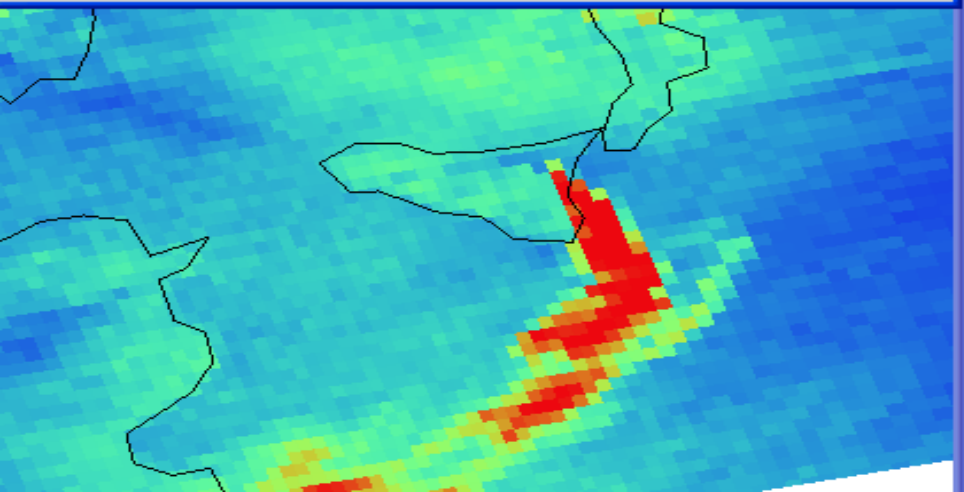


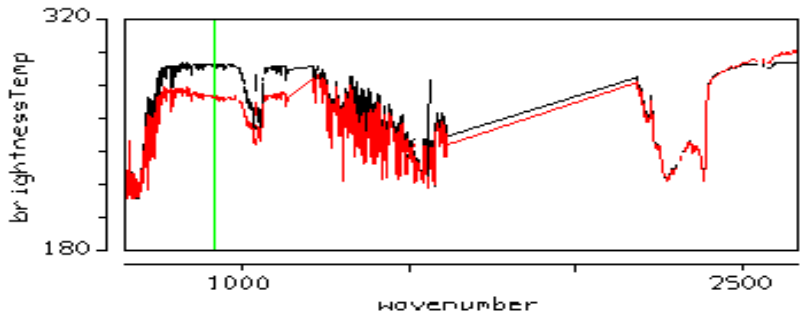
Mt Etna viewed by AIRS 28 Oct 2002

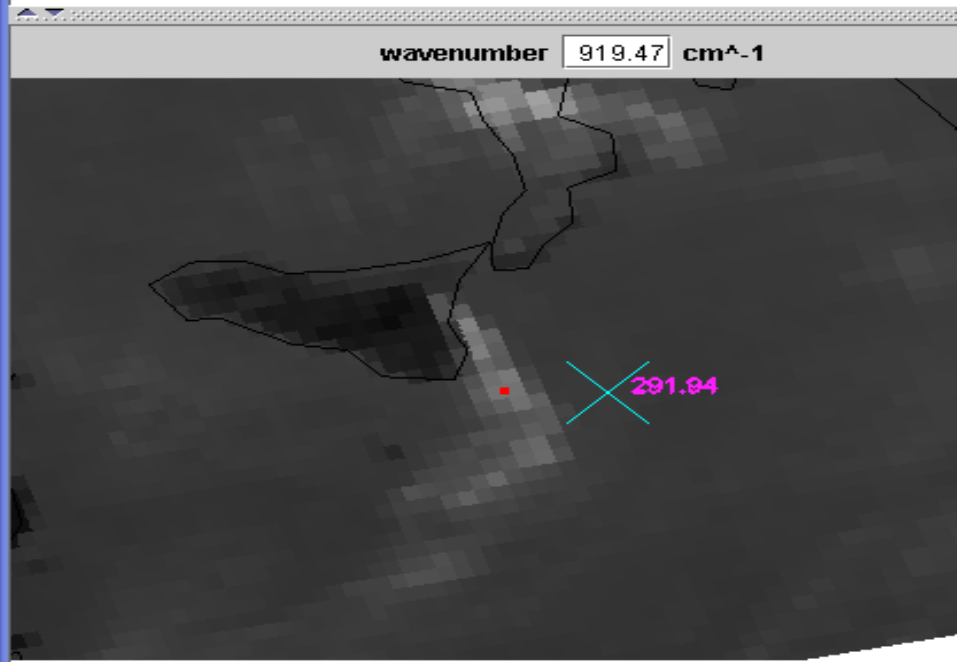
SO2 signal 1284-1345 cm-1





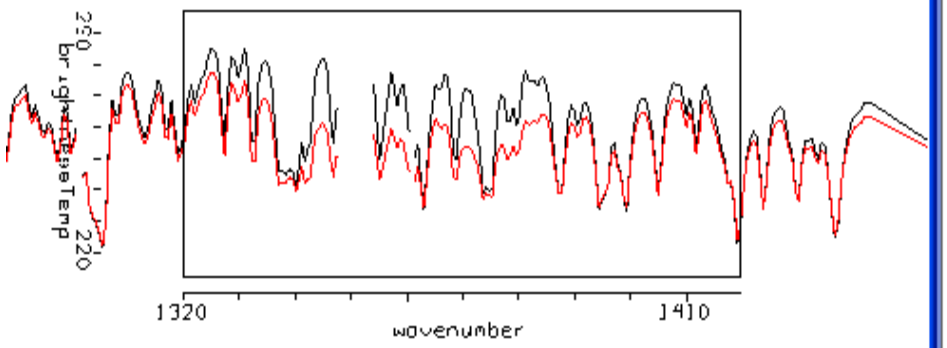


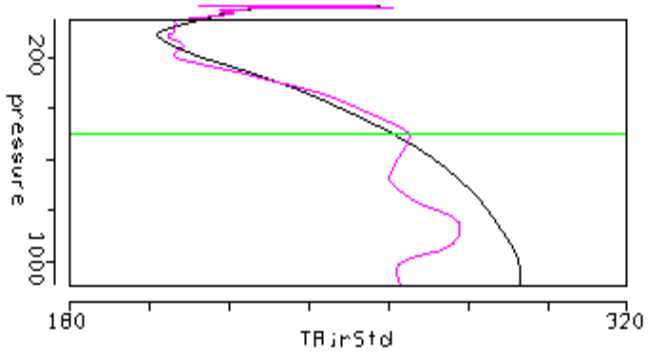


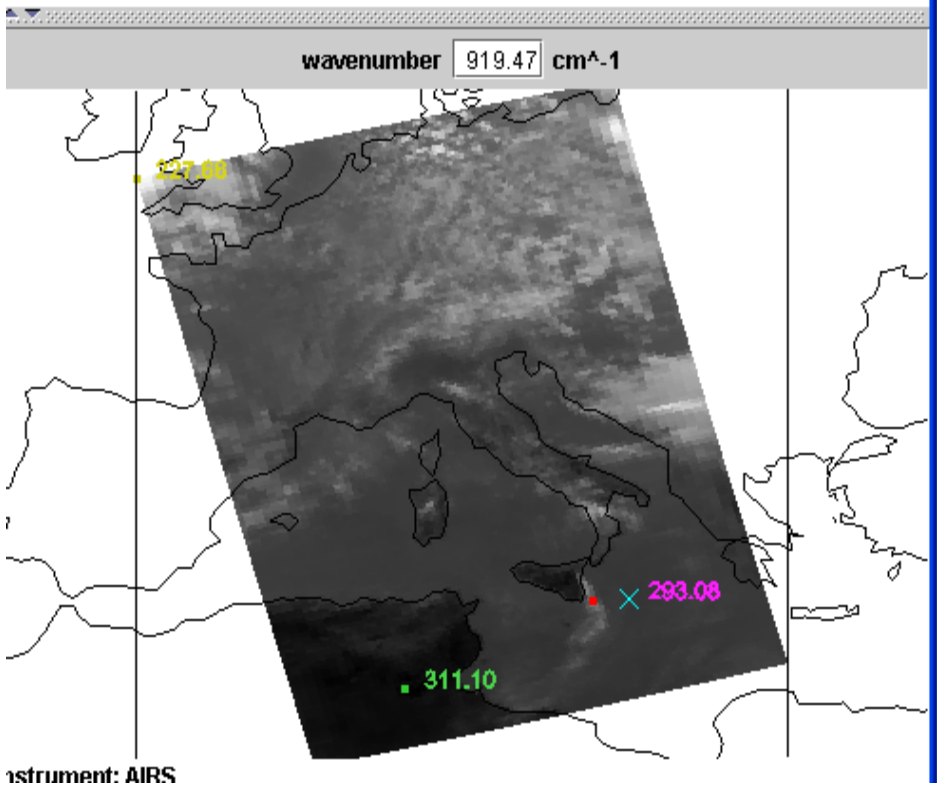


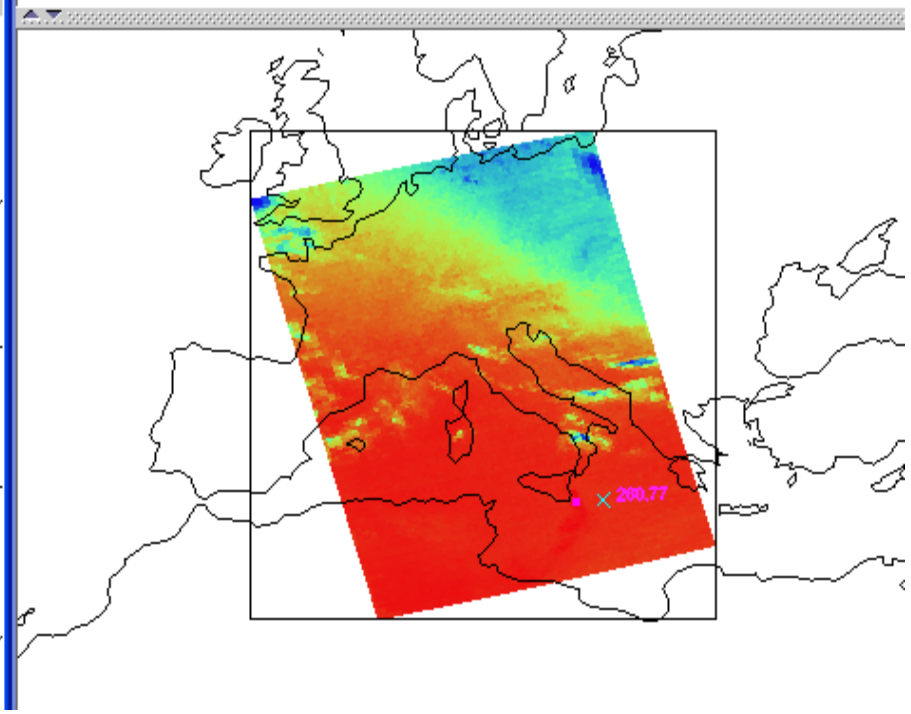
Inferring ash cloud height from AIRS clear sky and in ash soundings

Ash cloud and clear sky spectra

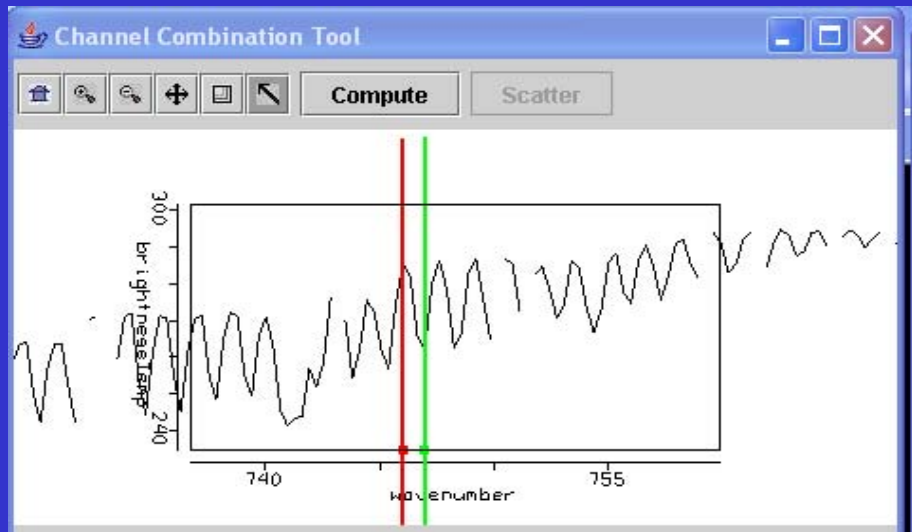


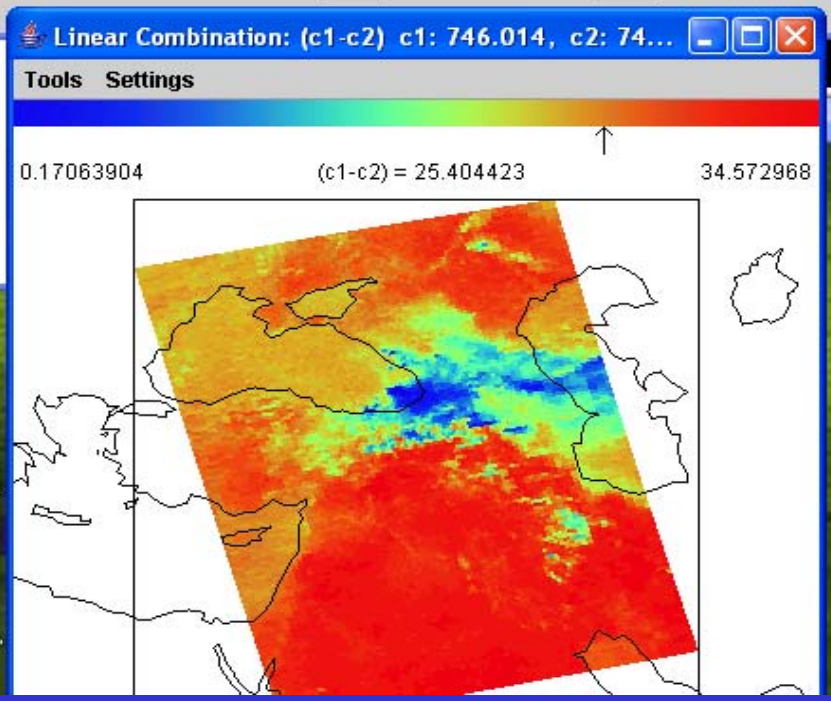


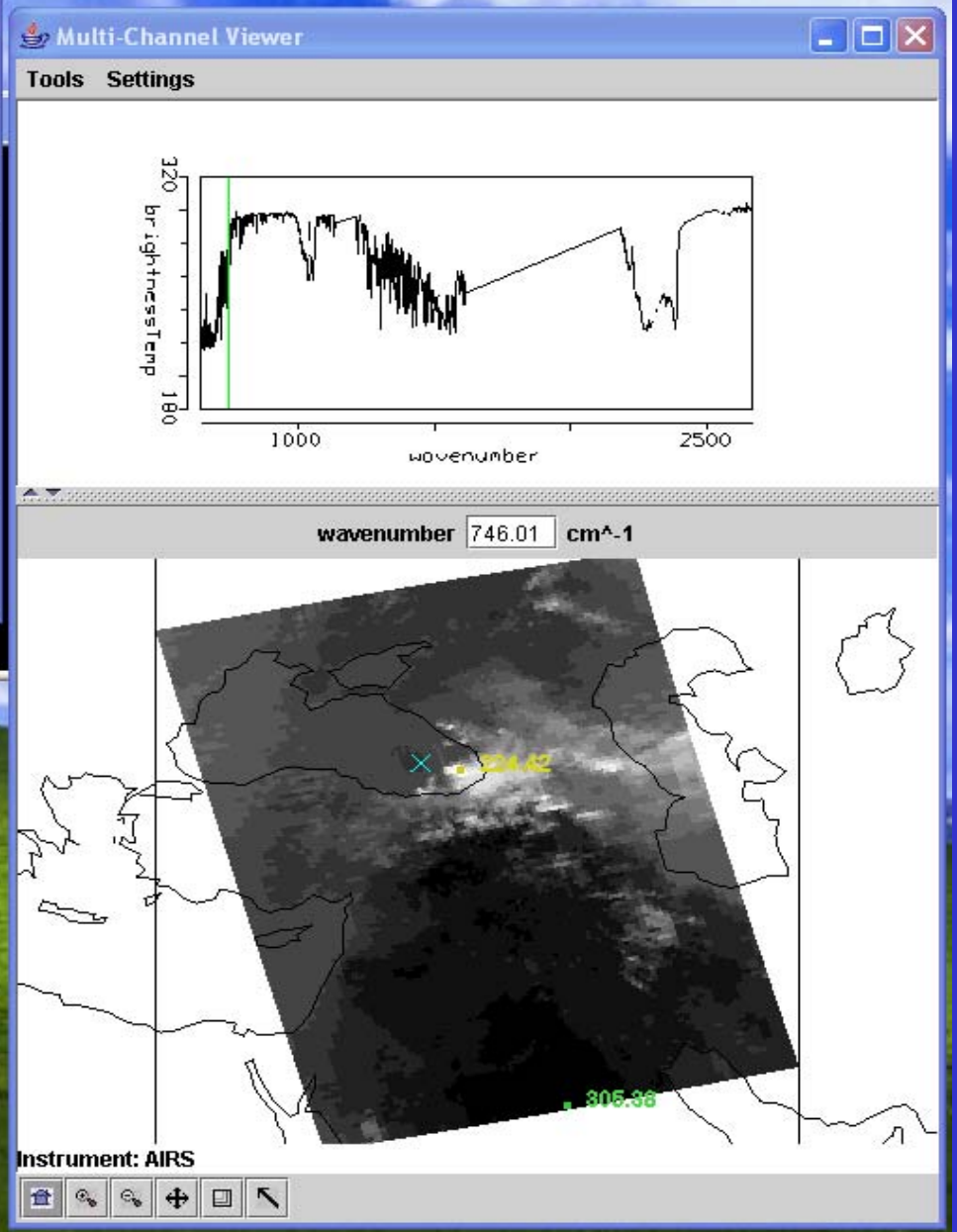




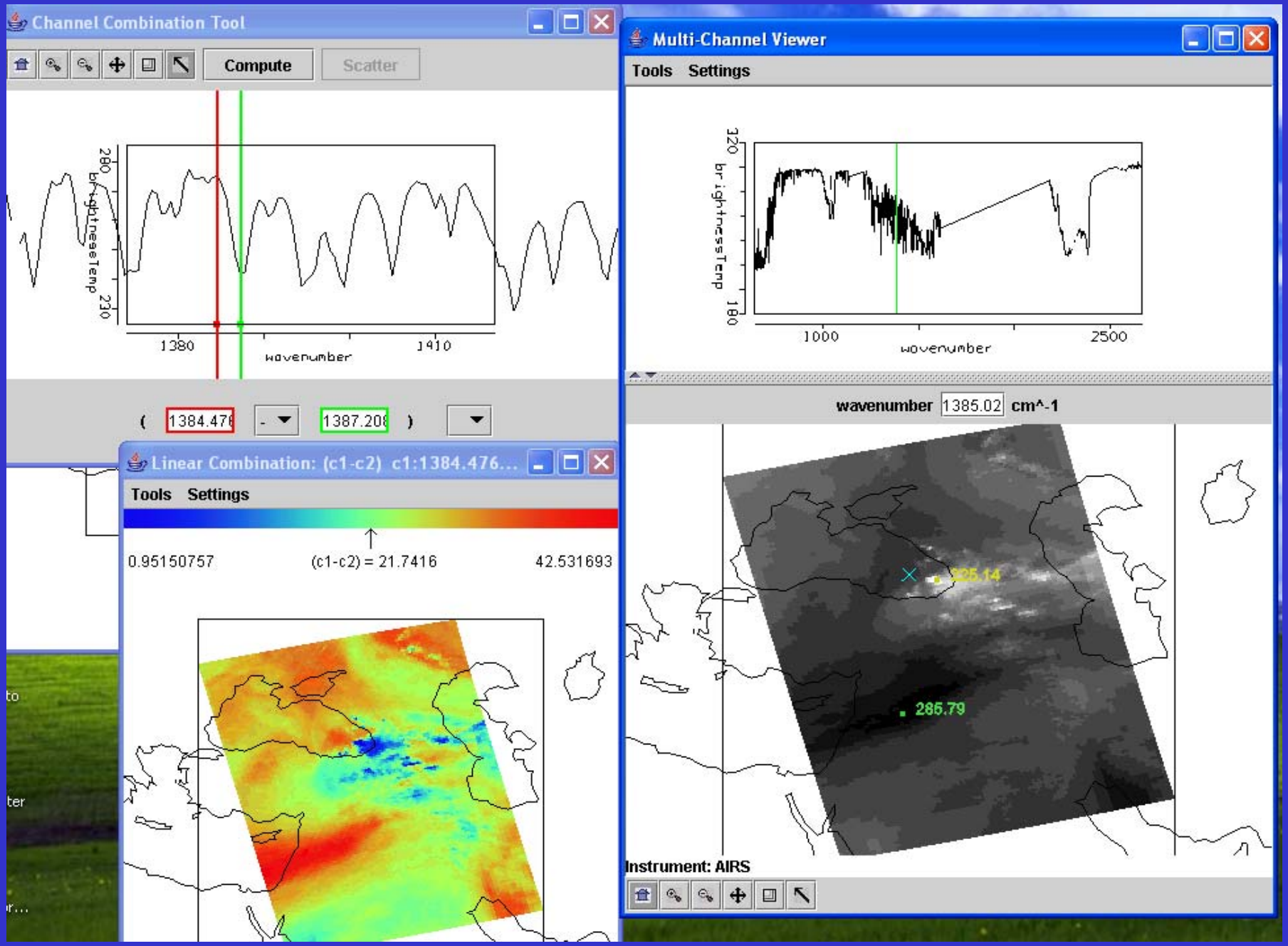
Offline-Online in LW CO_2



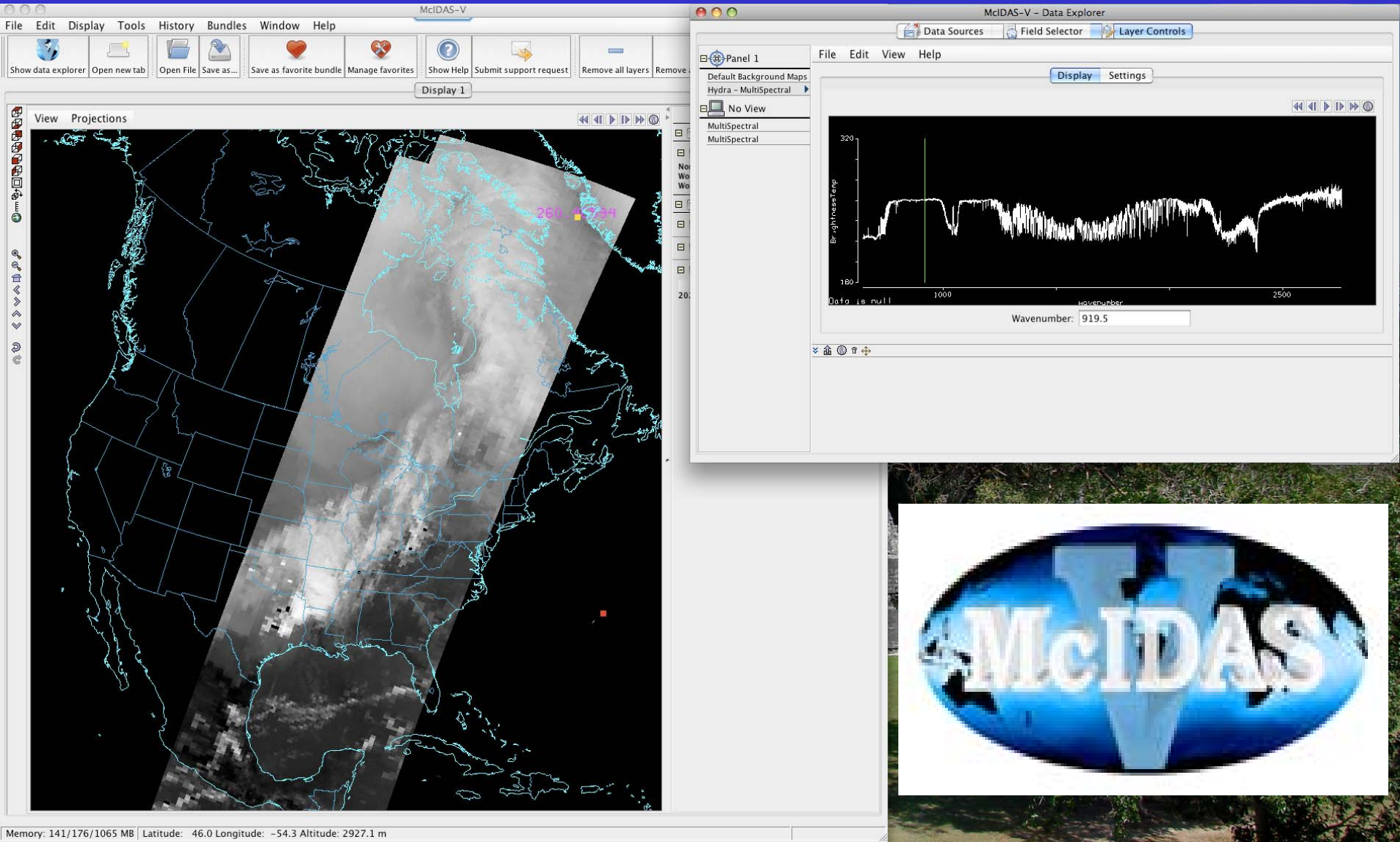




Offline-Online in H_2O

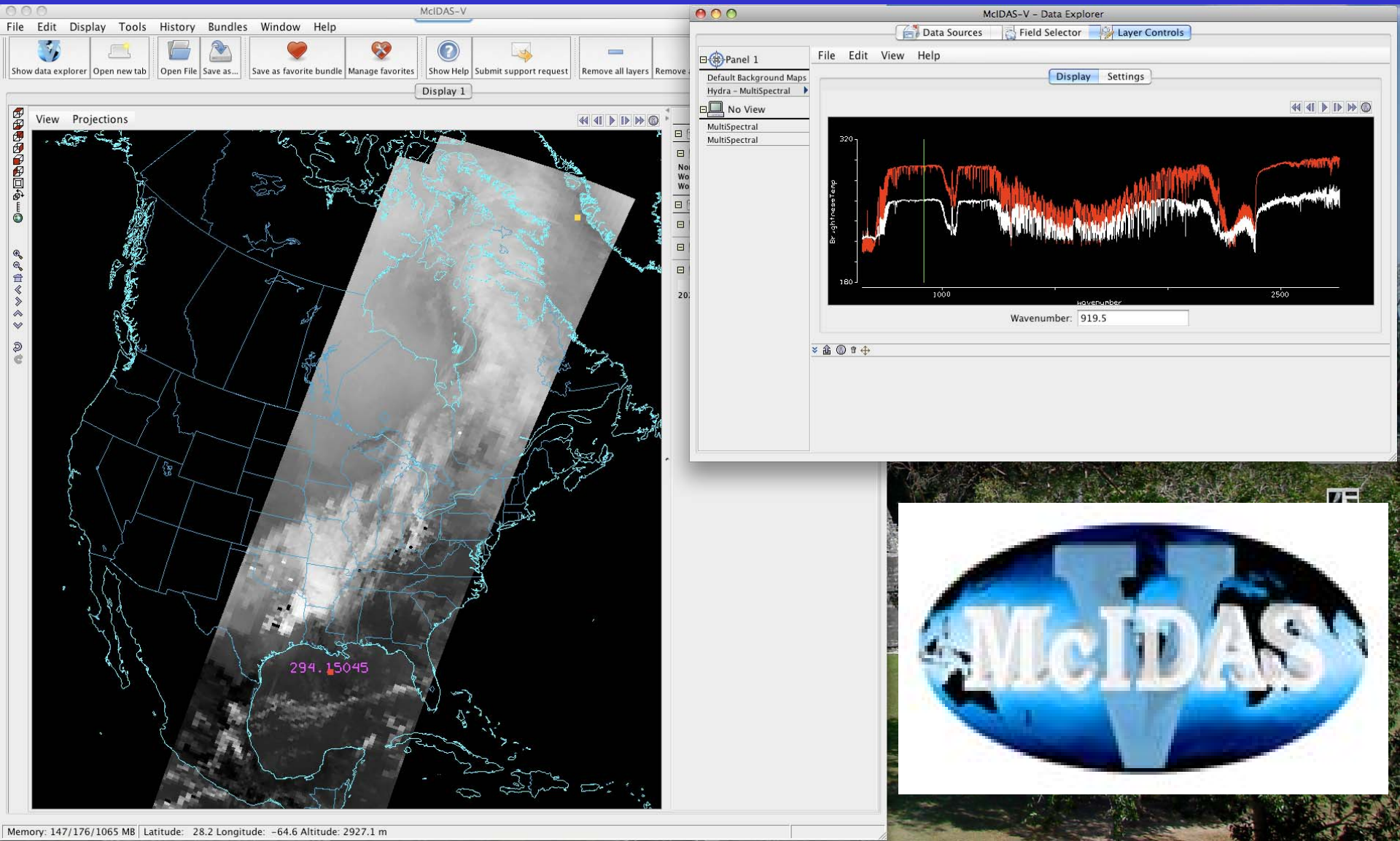


Hydra Integration into McIDAS-V
IASI granule



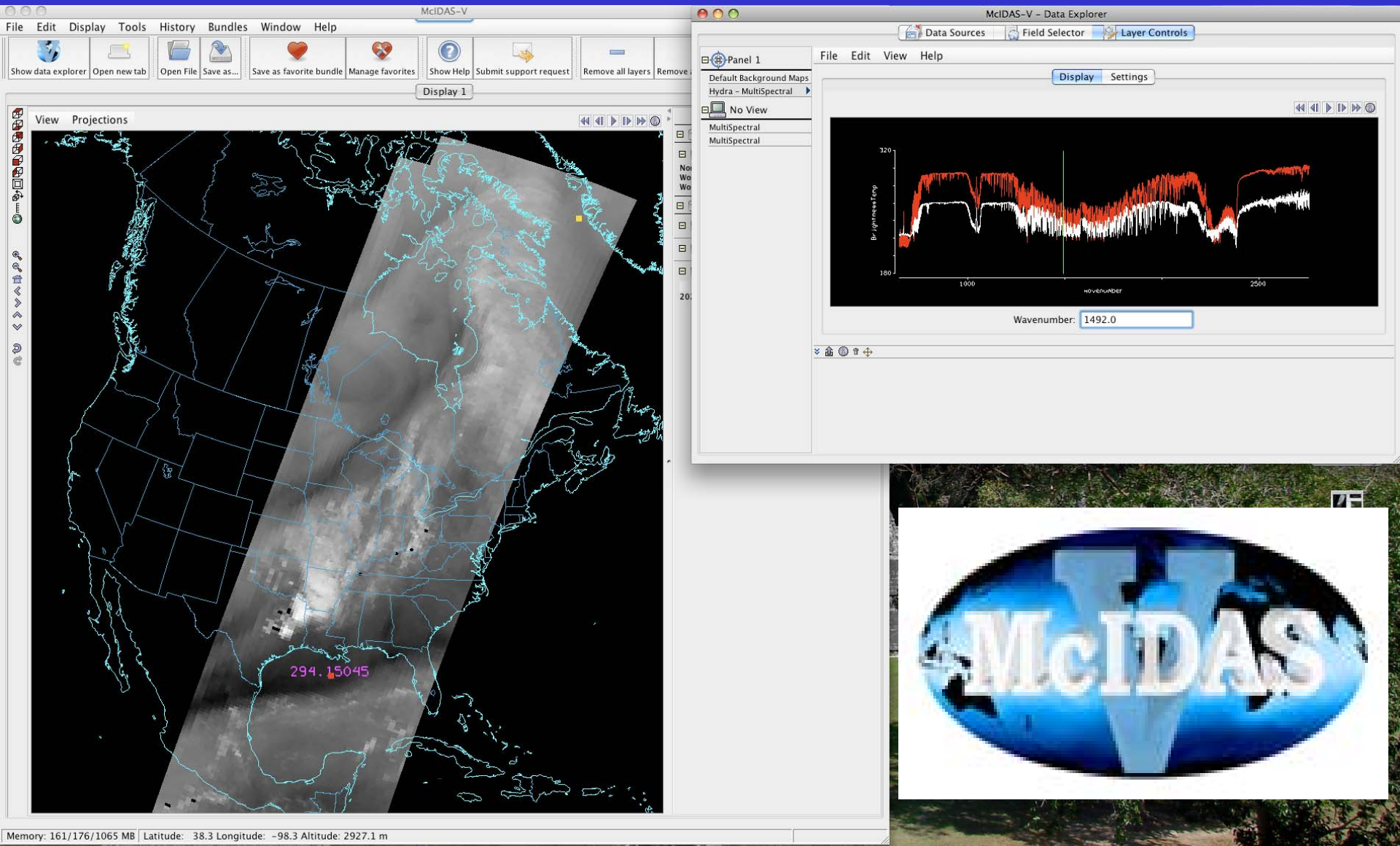
Hydra Integration into McIDAS-V

pointers select location of spectra



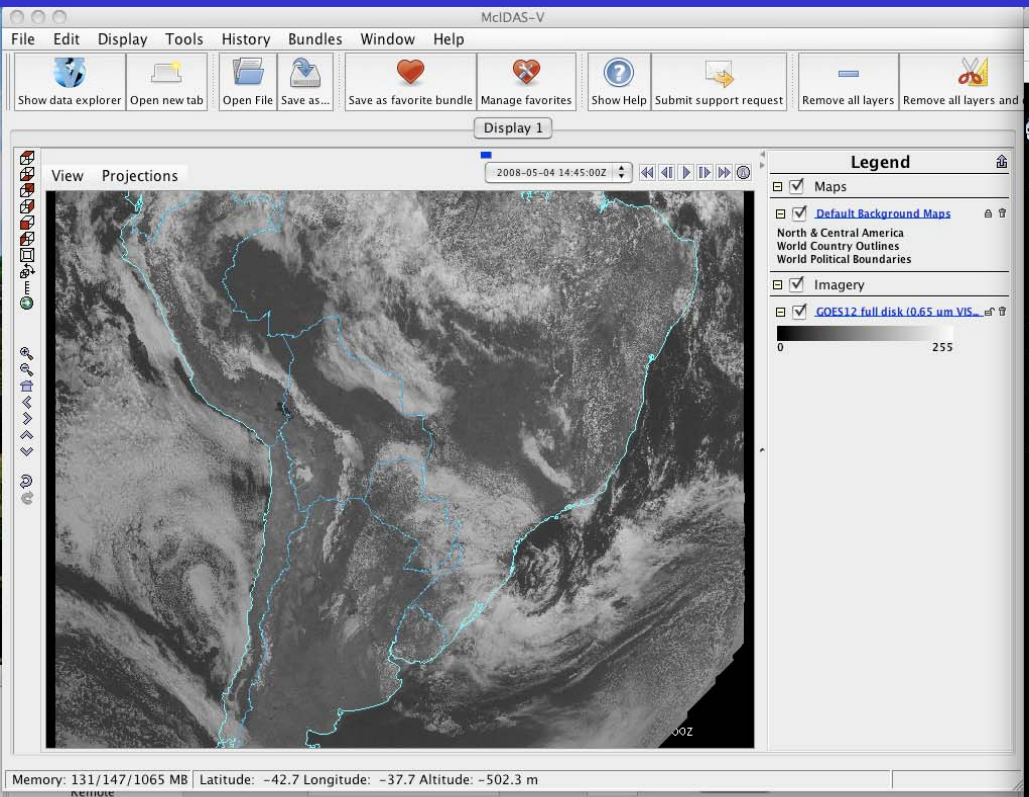
Hydra Integration into McIDAS-V

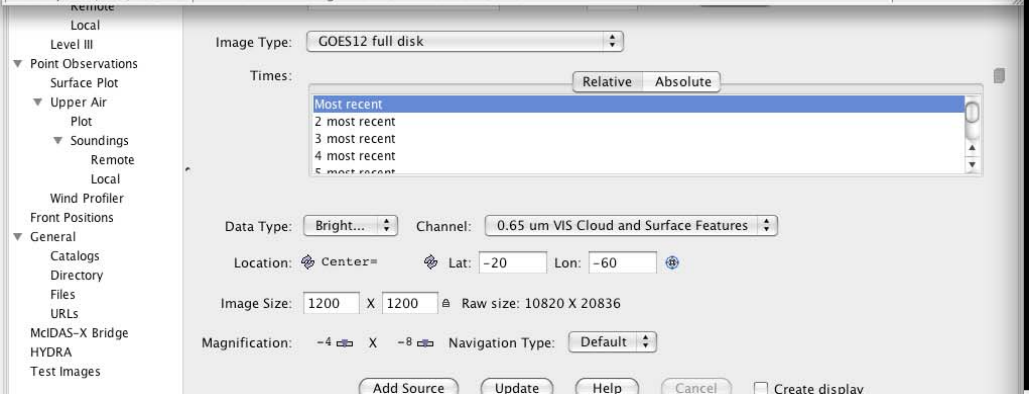
slider bar selects spectral band display

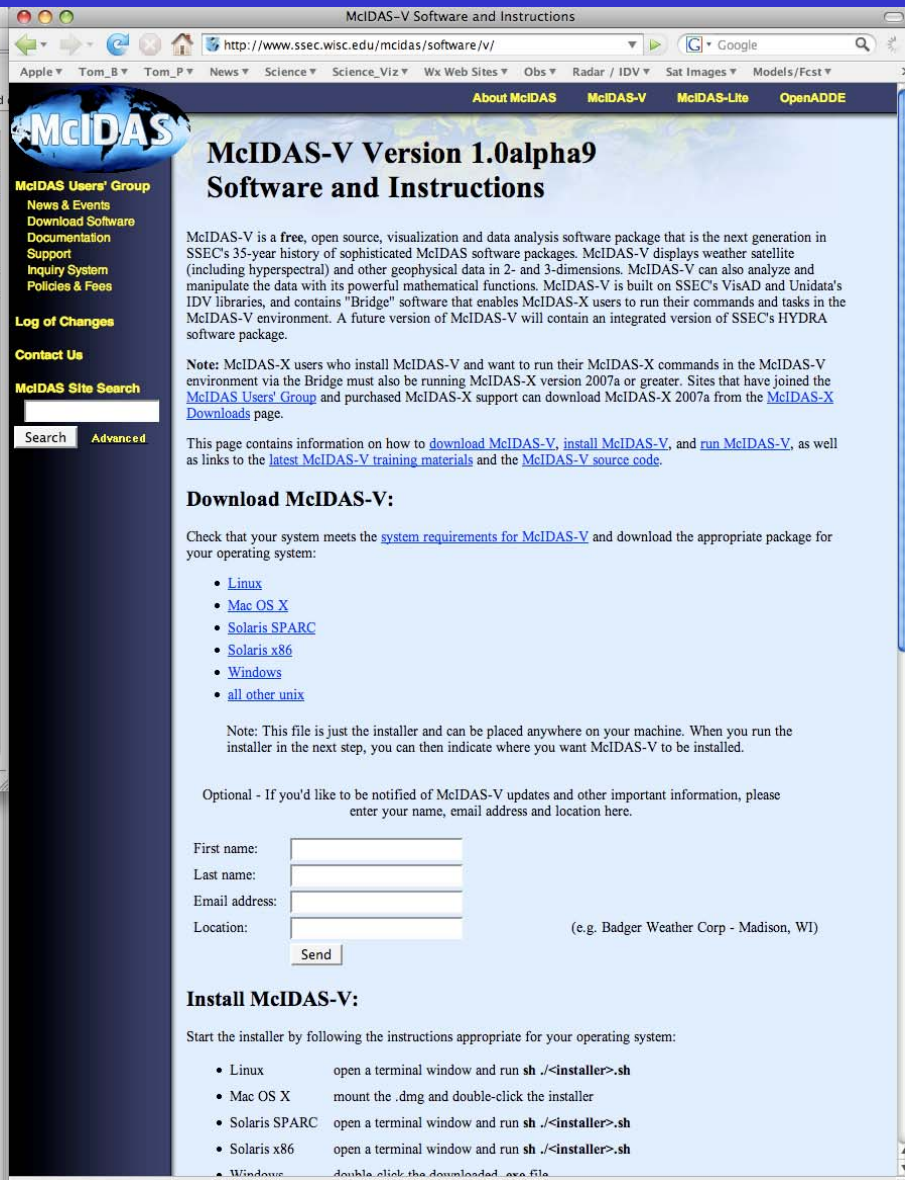


McIDAS-V web page

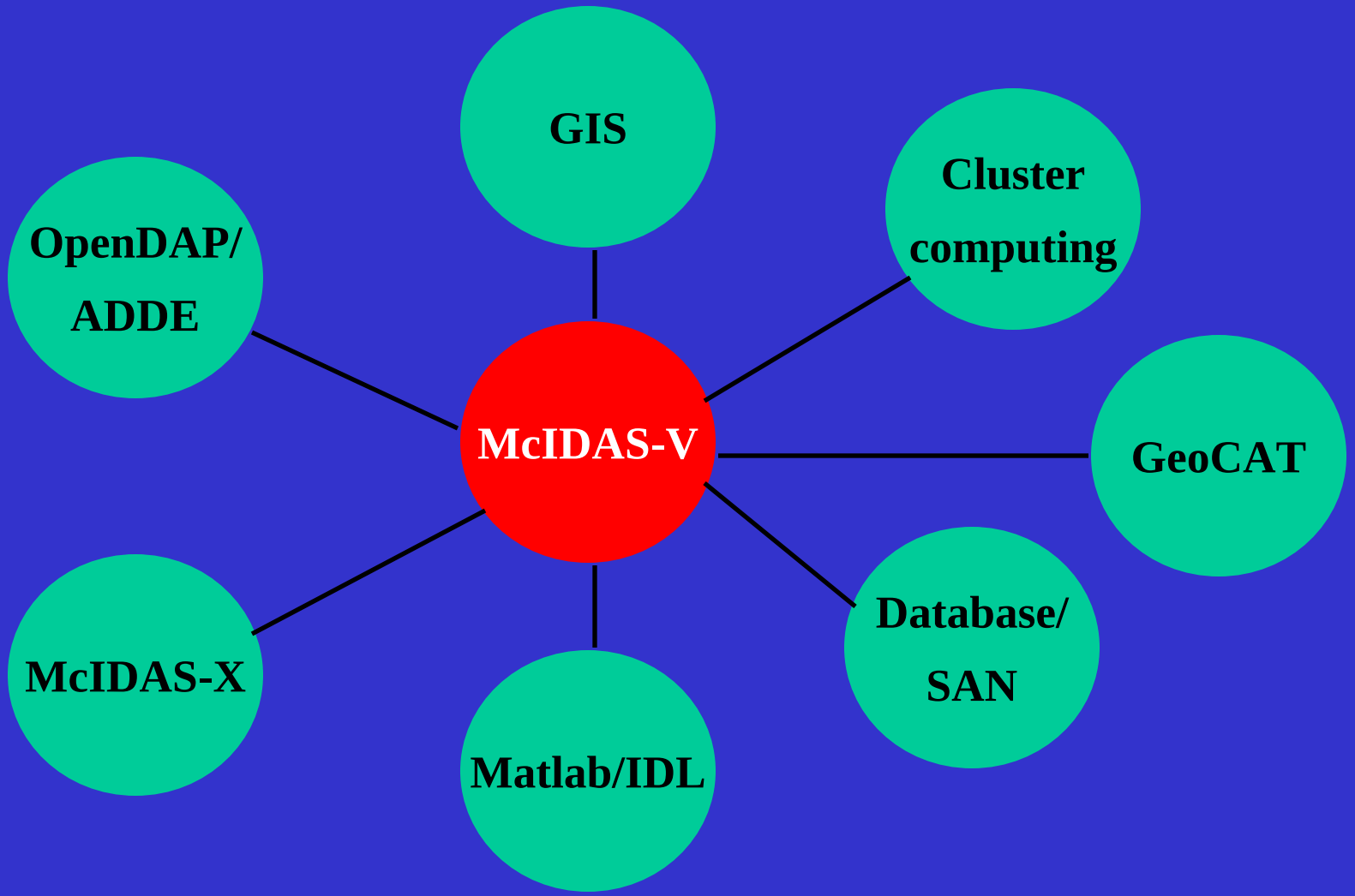
software, manuals







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

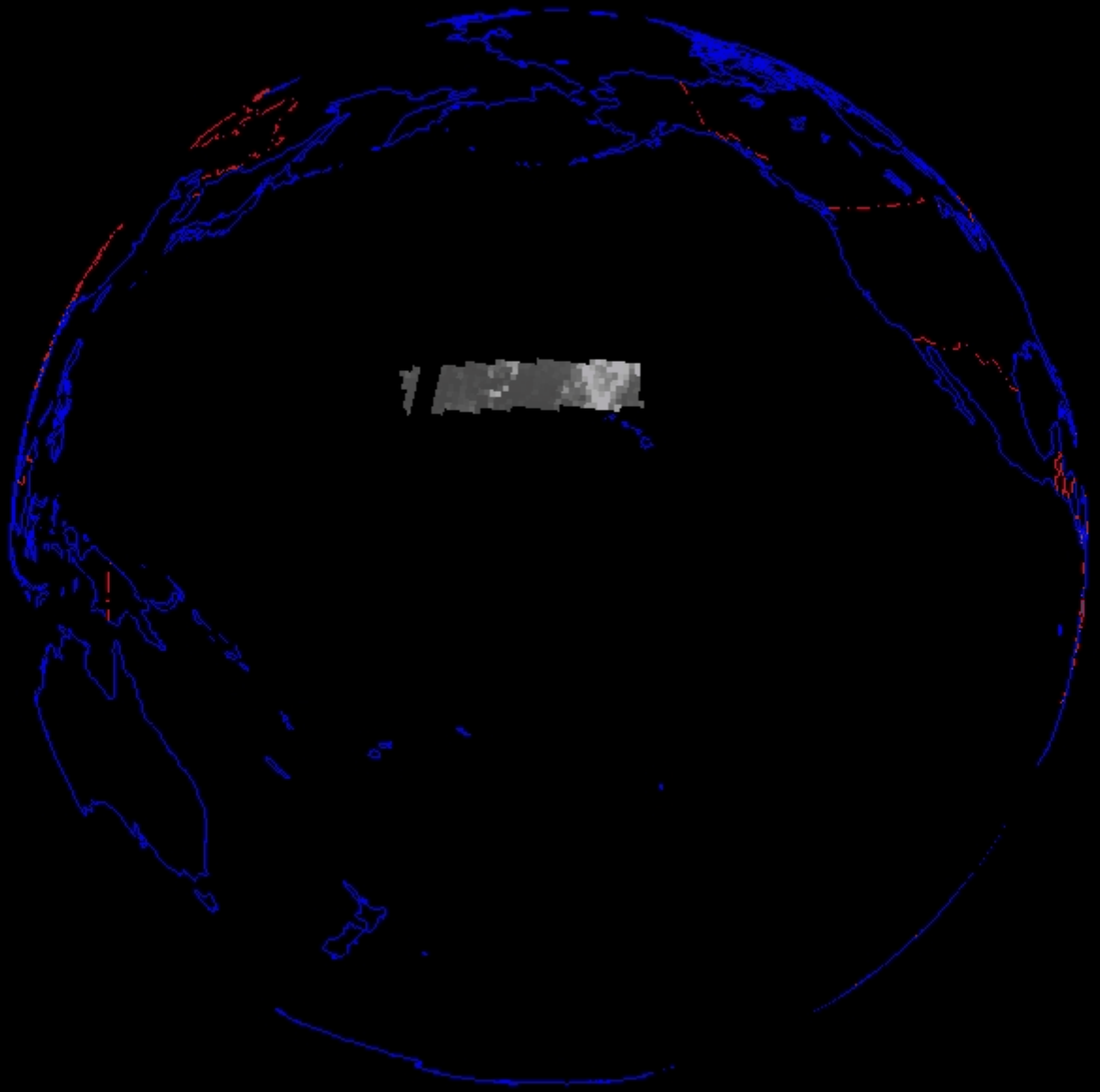
McIDAS-V software

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