Integrated Data Viewer (IDV)

a visualization framework

Yuan Ho

Unidata Program Center

Boulder, CO

unidata

Presentation Outline

- Integrated Data Viewer (IDV) overview
  - The IDV features
- IDV examples and customized IDV
- The future of the IDV
- Live IDV demo

UNIDATA

- Our Vision:

  Geoscience at the speed of thought through accelerated data discovery, access, analysis, and visualization.

- Our Mission:

  To transform the geosciences community, research, and education by providing innovative data services and tools

Data Access and Visualization

UNIDATA provides:

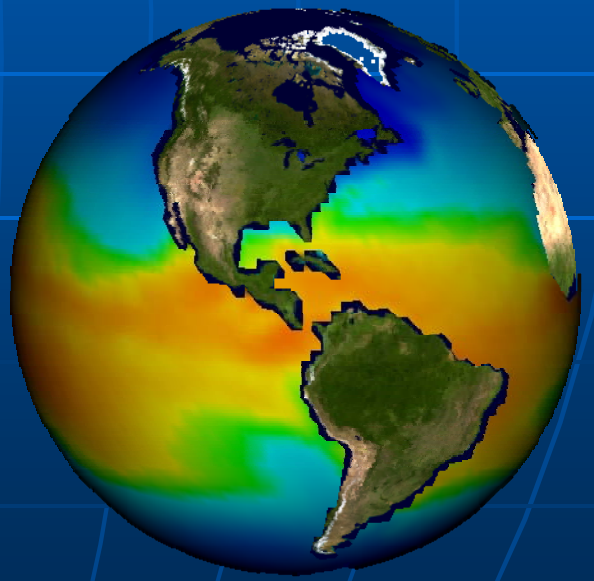
- Visualization:
  - Meteorological display and analysis tools from UW-Madison (McIDAS-X).
  - 2D visualization tools from NWS/NCEP (GEMPAK).
  - Java-based 2D and 3D visualization and next-generation collaborative data analyses tools (IDV)
- Data Access:
  - Internet Data Distribution and Management (IDD/LDM) system
  - Client/server data access model developed for McIDAS, but not limited to serving McIDAS data (ADDE)
  - THematic Realtime Environmental Data Distributed Services (THREDDS)
  - **R**epository for **A**rchiving, **M**anaging and **A**ccessing **D**iverse **Da**ta (RAMADDA)

Visualization of Geoscience

- General purpose 2D/3D displays
- Exploration of data details
- Quantitative analysis
- Integration of data from disparate data sources

Integrated Data Viewer (IDV)

- Unidata's visualization and analysis tool for geoscience data
- Freely available Java™ framework and application
- Integrated 2D/3D displays of a wide range of data
- Built on VisAD library



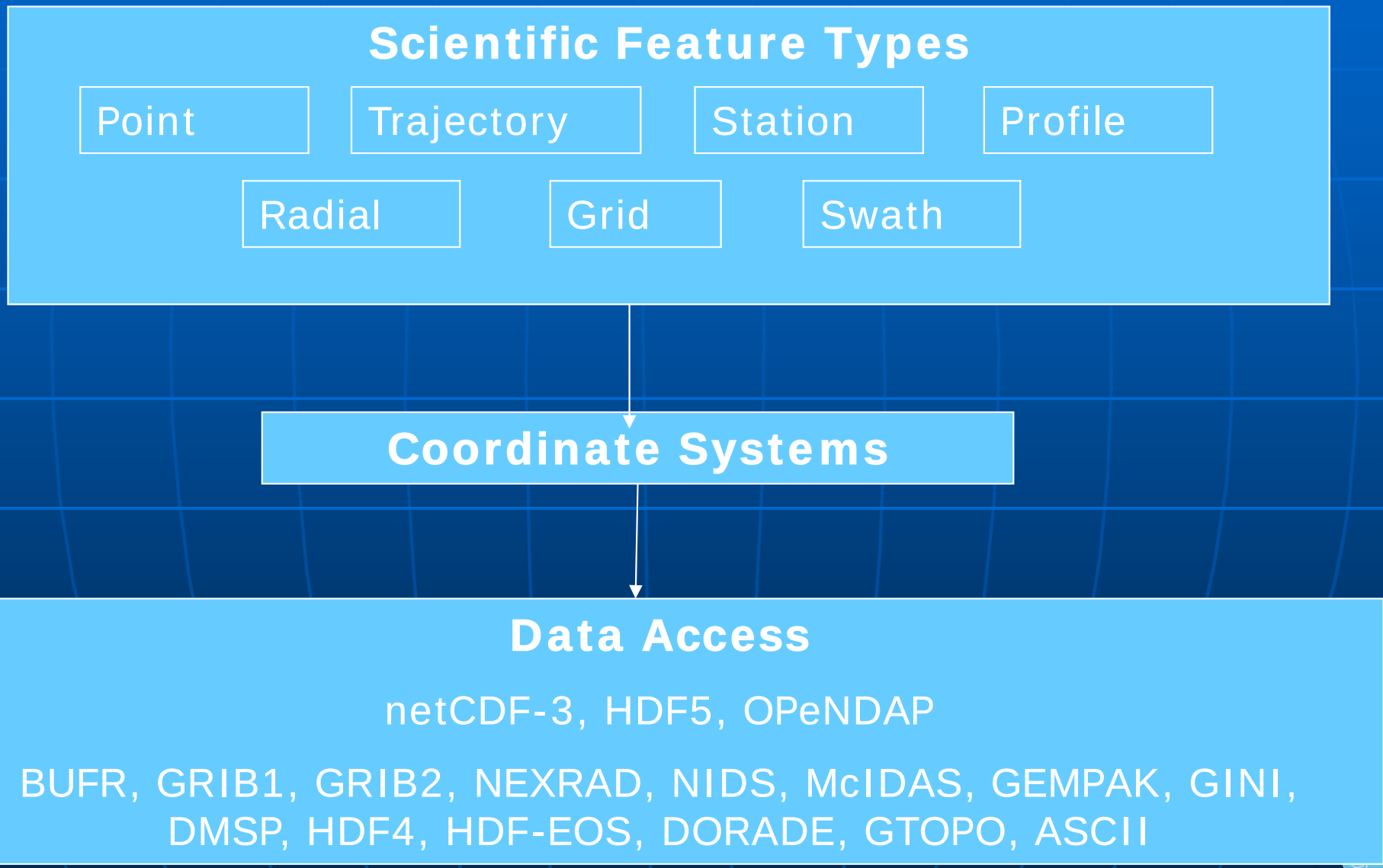
unidata

VisAD library Overview

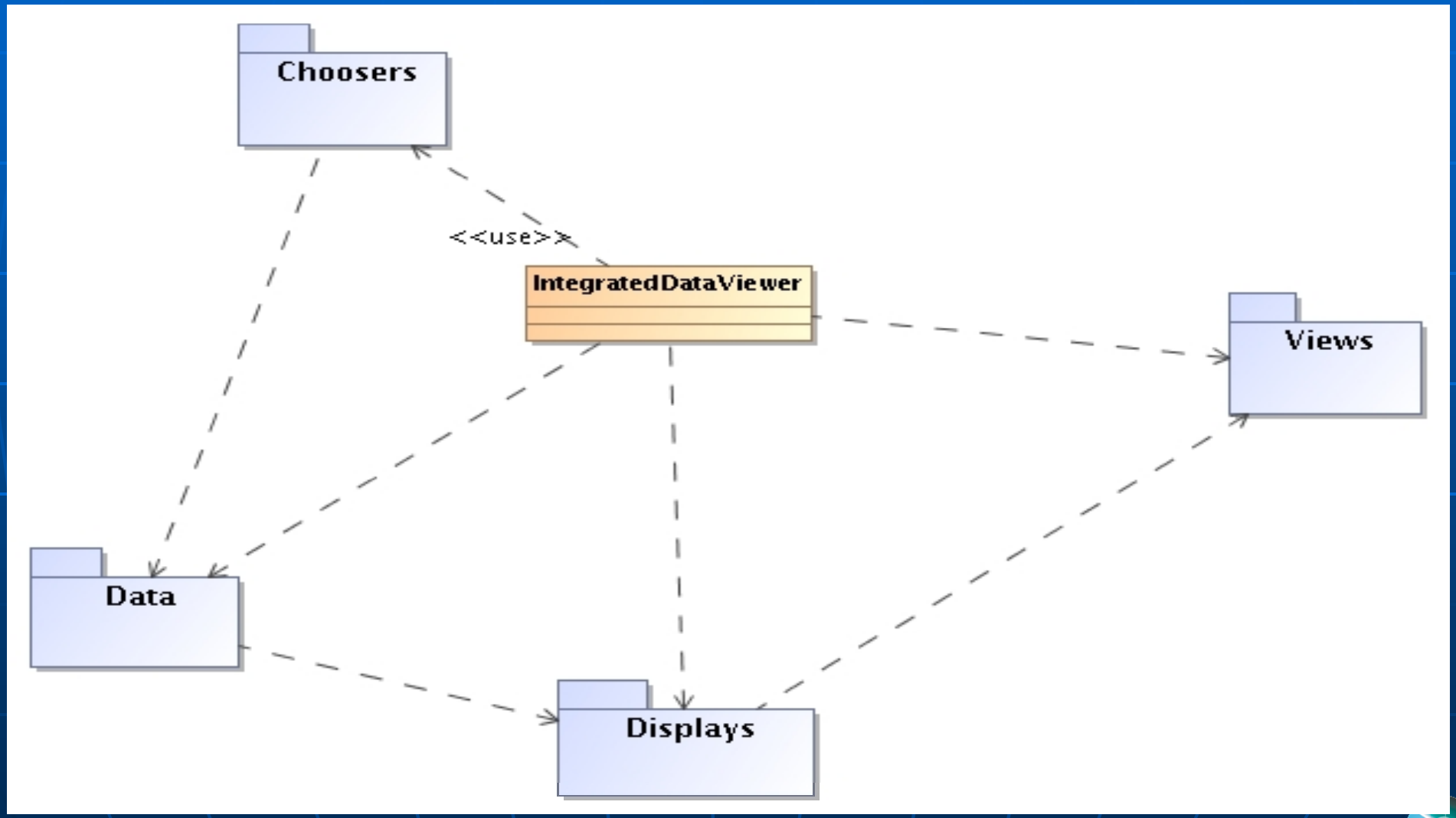
- A Java Component Library for interactive analysis and visualization of numerical data.
- VisAD objects: data object, display object, cell object, user interface object, and data reference object.
- All data objects have a MathType, which indicates the type of mathematical object that it approximates.
  - The output of a weather model may be described using the MathType:

    (time -> ((lat, lon, alt) ->(temperature, pressure, u, v, w)))
- Designing a Typical VisAD Application
  - Creation of the data object
  - Creation of the display object
  - Adding interaction and functionality

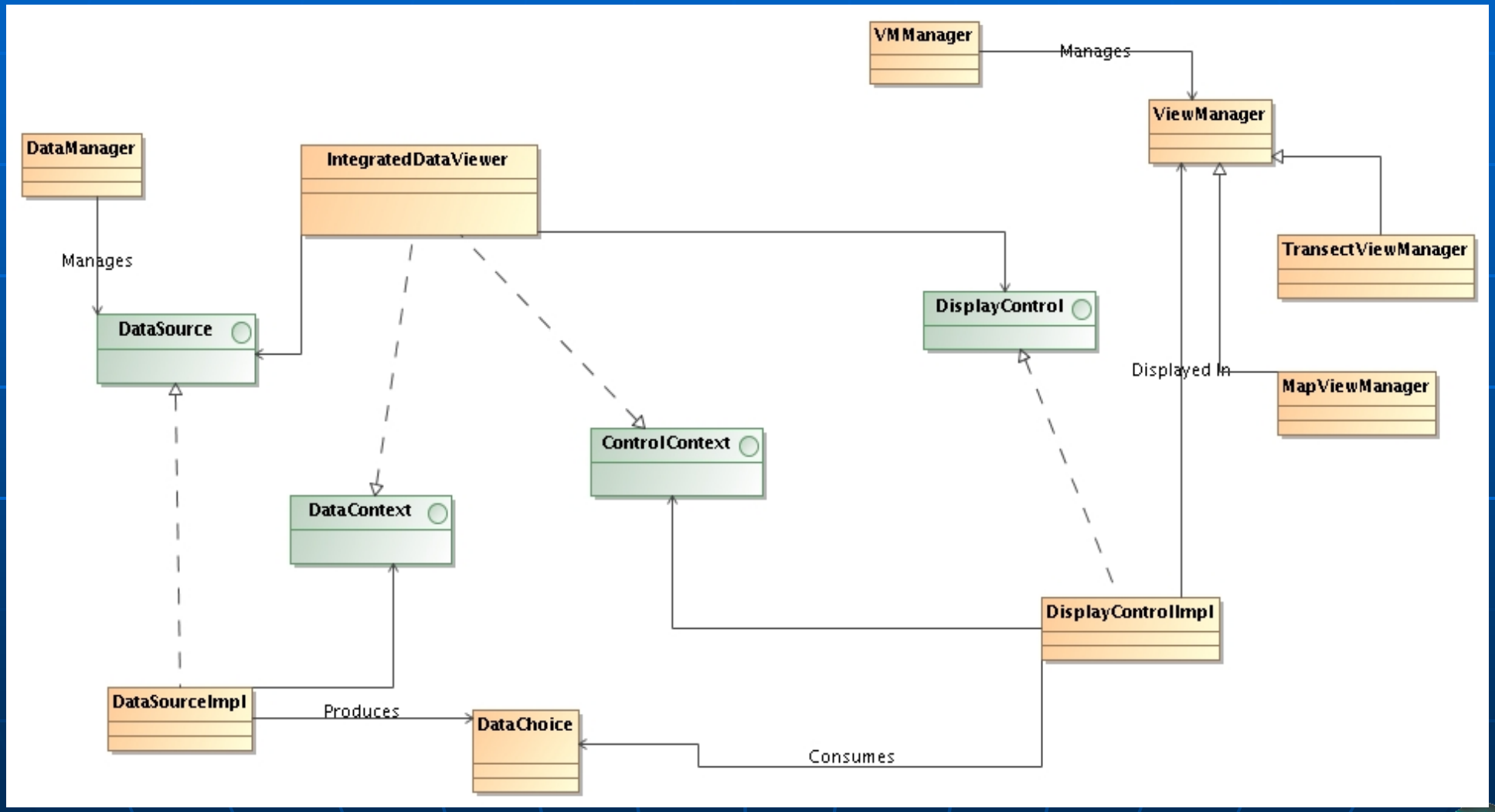
Common Data Model



IDV Architectural Overview



IDV Architectural Overview



VisAD Data objects in the IDV

- VisAD data model supports any numerical data
- VisAD data object can be manipulated without converting from one form to another
- The IDV uses the visad coordinateSystem class to provide the necessary transforms for geolocation. These provide on-the-fly coordinate transforms.
- Creating a new data source in the IDV is to transform raw data into VisAD data object

Supported Data Sources

- Data Types:
  - Gridded data
  - Satellite imagery
  - Radar data
  - Point observations
  - Balloon soundings
  - NOAA Profiler Network winds
  - ACTF tropical storm
  - GIS data (shape file, DEM, tiff)
  - Quick Time movies
  - Web Cams
  - Weather Text Products
  - Google Earth (kml, kmz)
- Supported Formats:
  - netCDF/HDF
  - GrADS
  - GRIB 1/2
  - ADDE
  - Vis5D
  - KML (Google Earth)
- Access Methods:
  - Local files
  - HTTP and FTP
  - ADDE and TDS servers
  - RAMADDA
  - WMS
  - Database

IDV Data Access Mechanisms

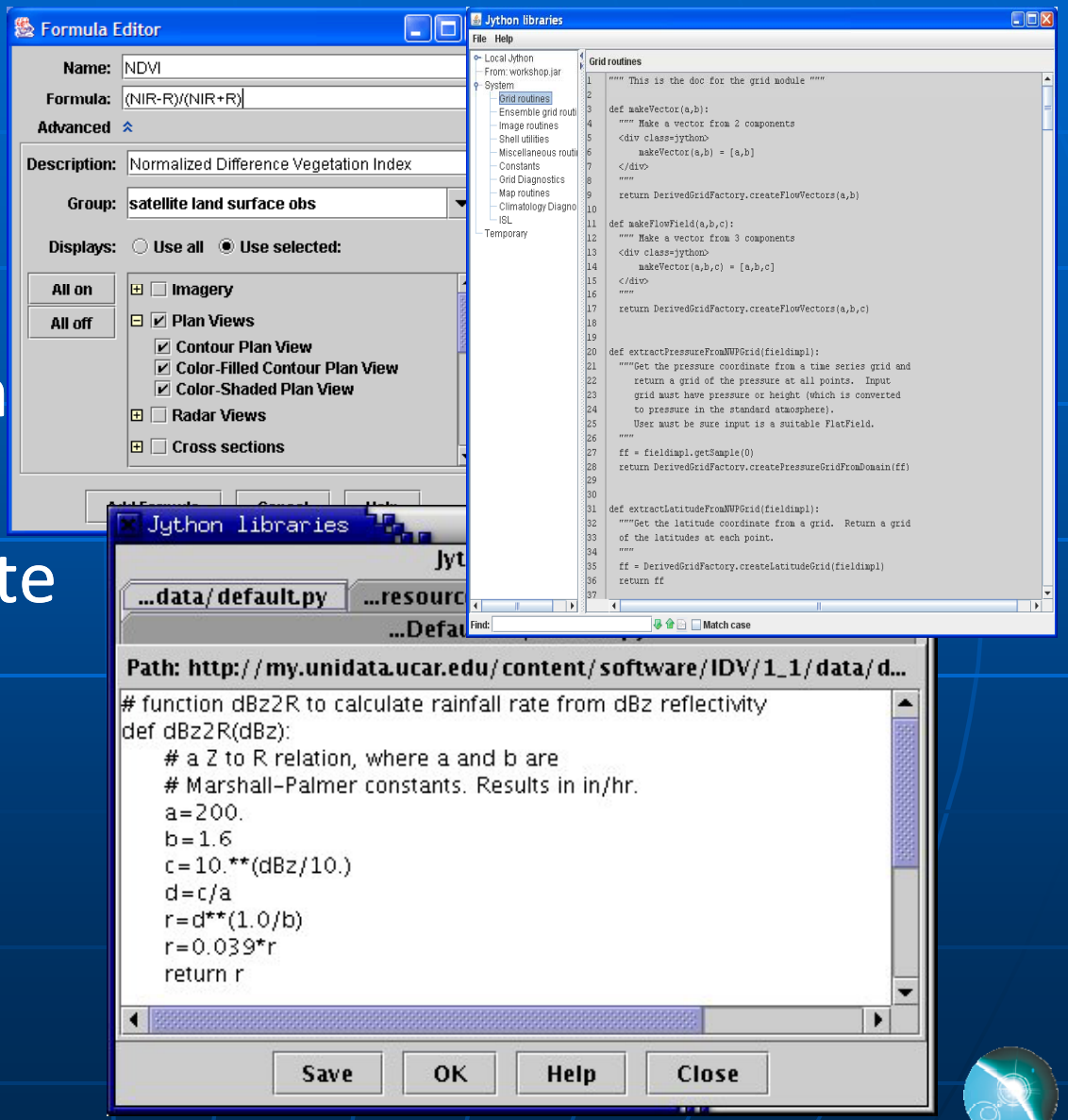
- Client/Server data access from OPeNDAP, ADDE or WMS servers, as well as local files, HTTP and FTP
- Can use THREDDS catalogs of data holdings for discovery and usage metadata
- Direct access to RAMADDA server holdings

IDV Features Overview

- Client-server data access from remote systems
- Suite of data probes for interactive exploration (slice and dice)
- Animations (temporal and spatial)
- XML configuration allows customization of UIs
- Bundling allows collaboration with others
- Java-based framework supports extensions built via plug-ins: for example, geosciences network (GEON) solid earth community

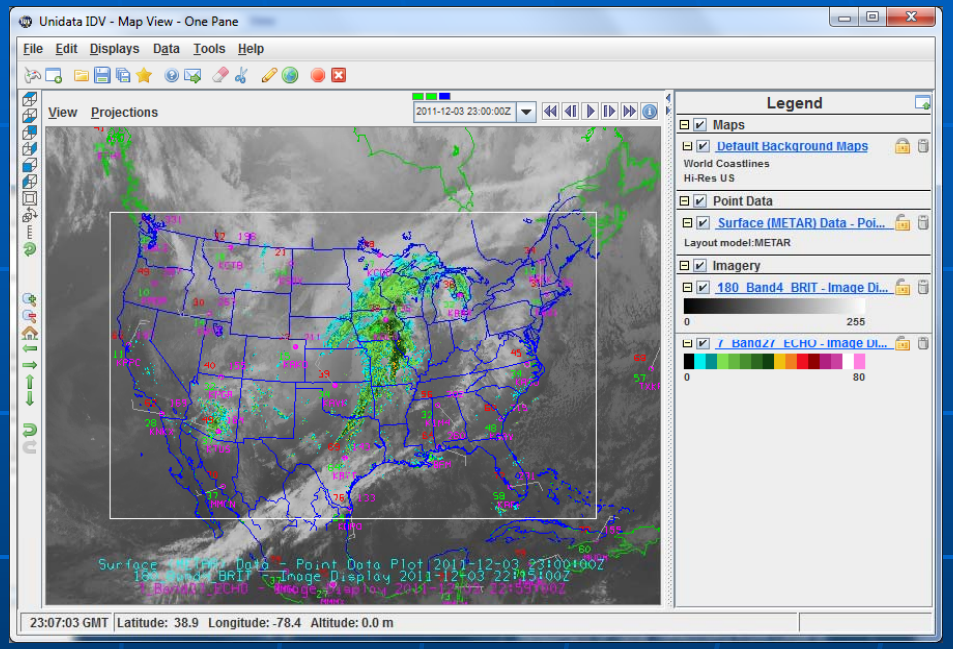
IDV Feature Data Analysis

- Formulas and computation using Jython
- Supports both system and local formulas
- Automatically generate derived variables
- Supports both Jython and ISL scripting languages



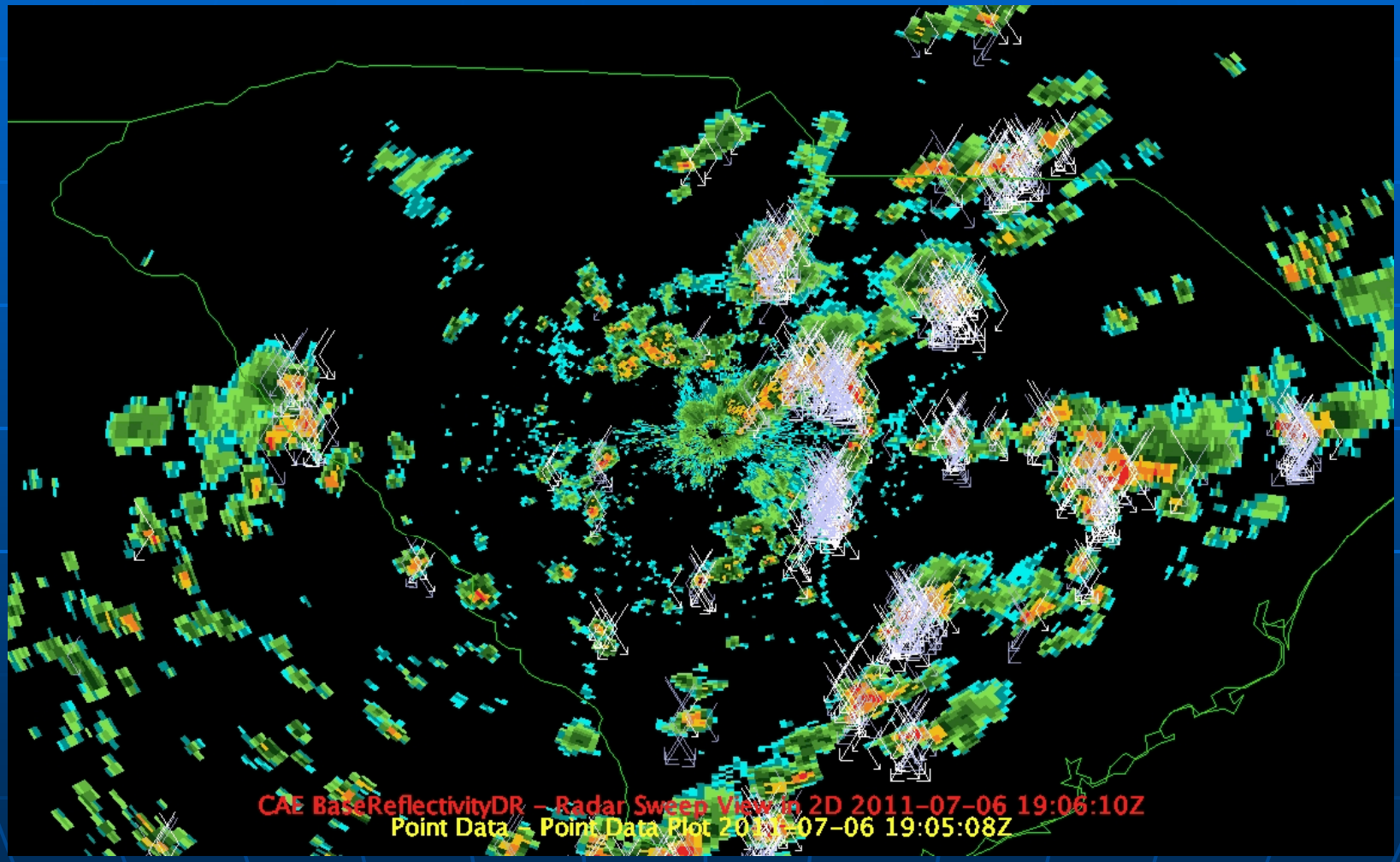
IDV Feature: Integrator

- Integrating data from disparate data sources is easy with the IDV
  - Data can come from local and remote locations
  - Data on different projections are automatically remapped
  - Data from different times are synced



Radar reflectivity Satellite IR, and Surface Observation.

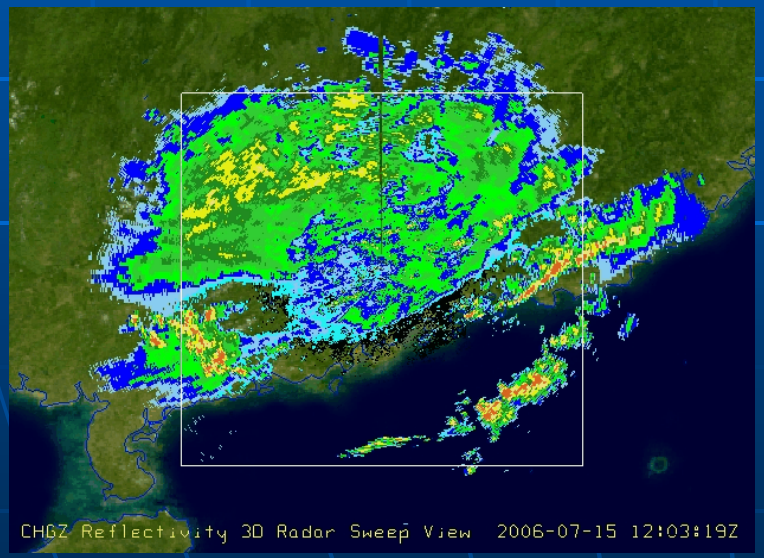
IDV Example: Integrator

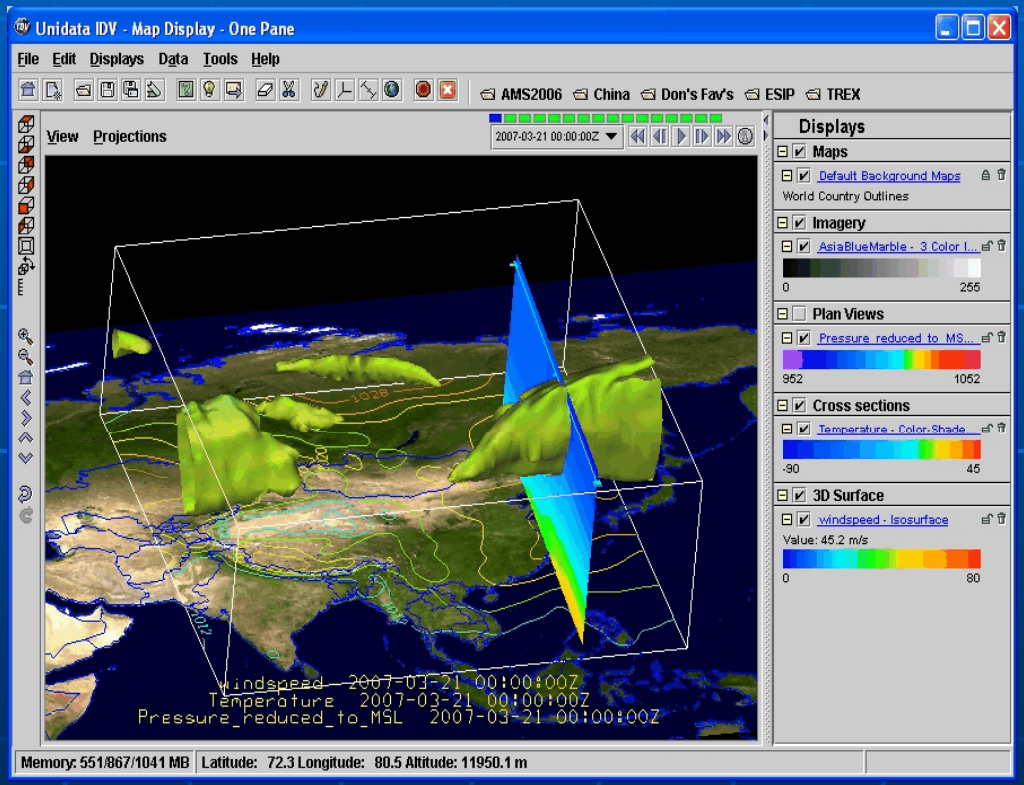


IDV Example: 3D Display

3D views of 3D data

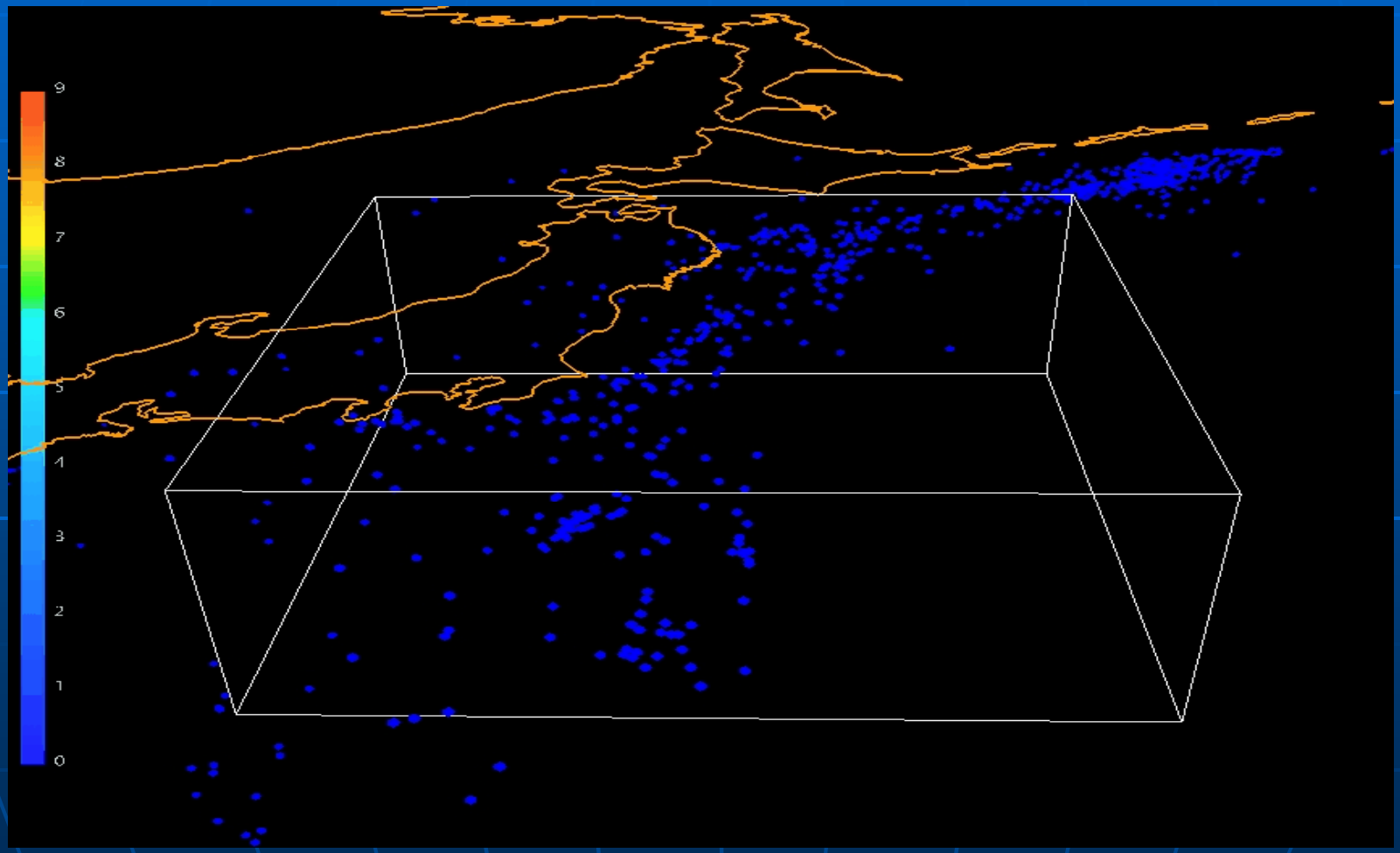
3D Map view





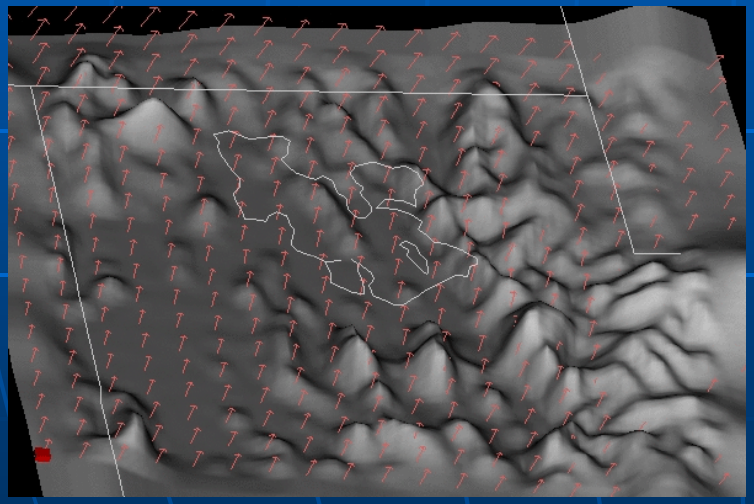
unidata

IDV Example: 3D Display

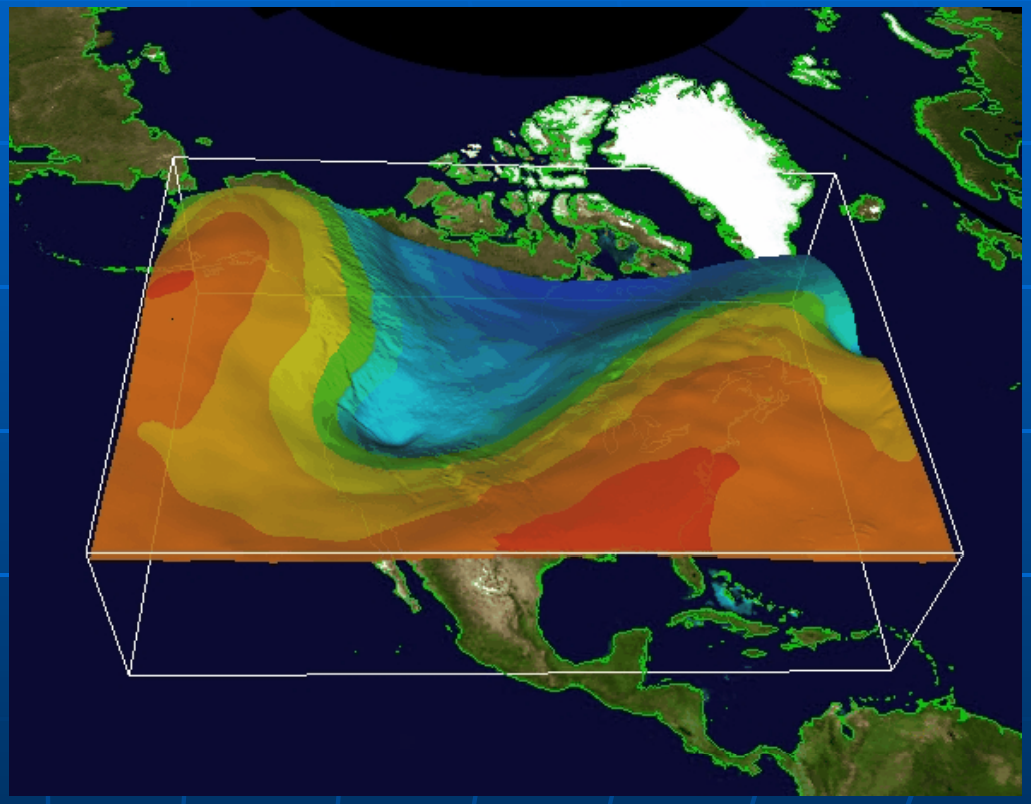


IDV Example: 3D Display

- 3D views of 2D/3D data
  - 3D Map view



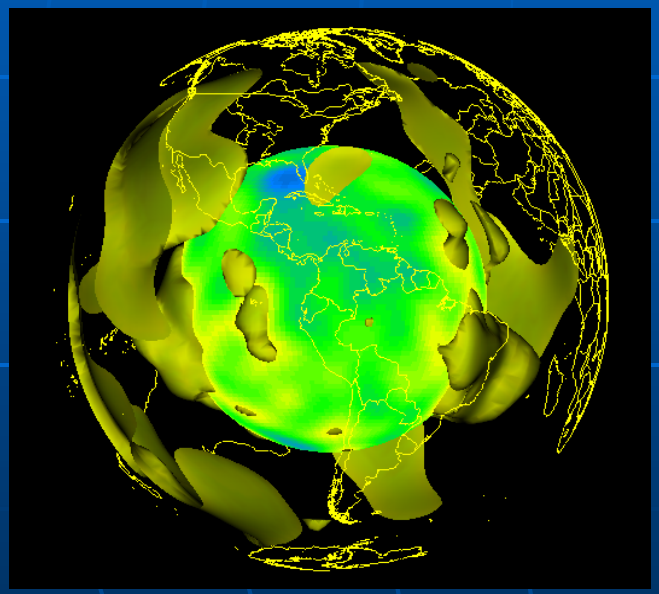
Model simulation of wind, isentropic potential vorticity and low level moisture flow over the Great Salt Lake basin



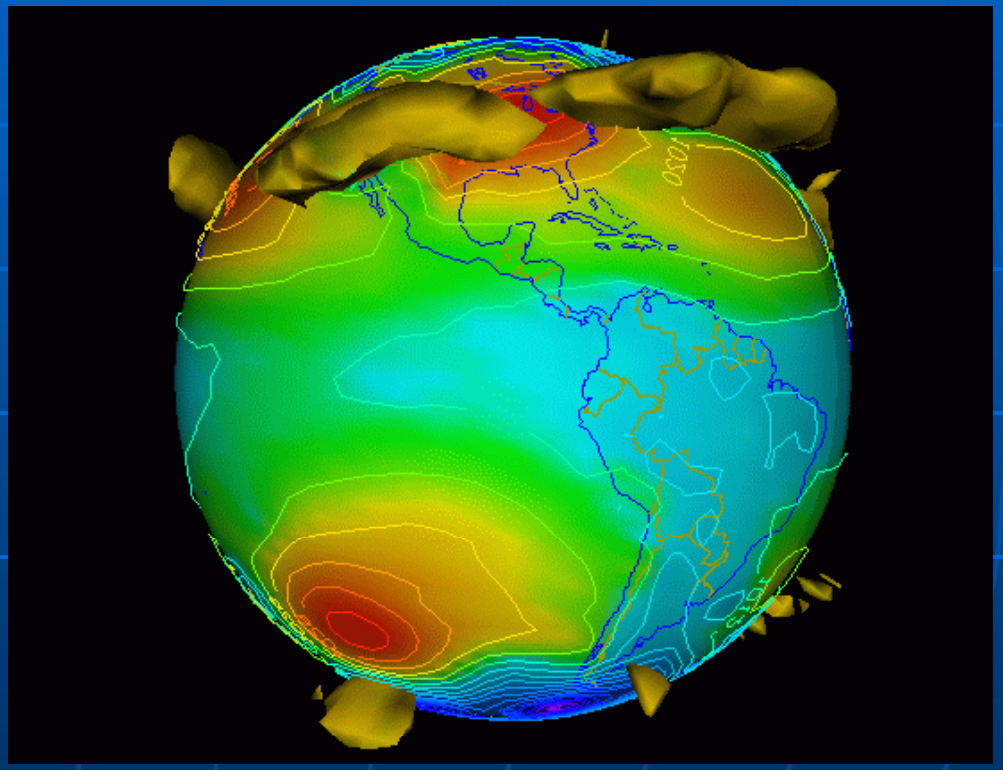
3D view of 500hPa level Geopotential Height

IDV Example: 3D Display

- 3D views of 3D data
  - 3D globe view



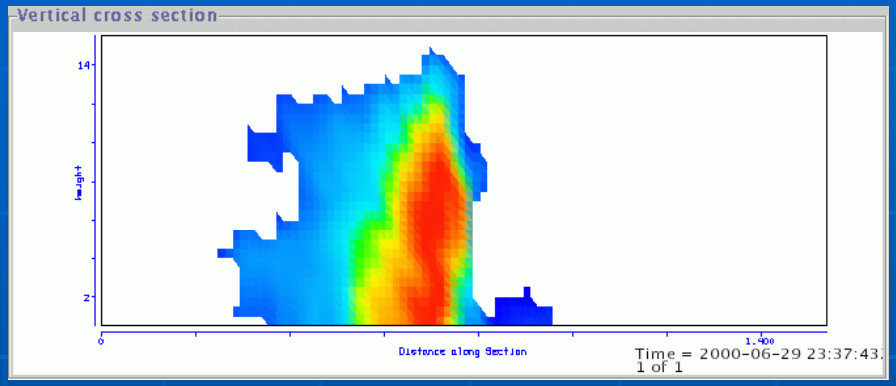
GeonIDV



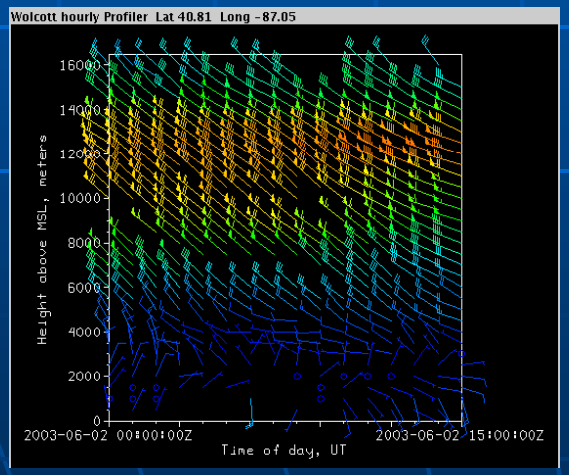
Sea level pressure and upper level jet

IDV Example: Data Interaction

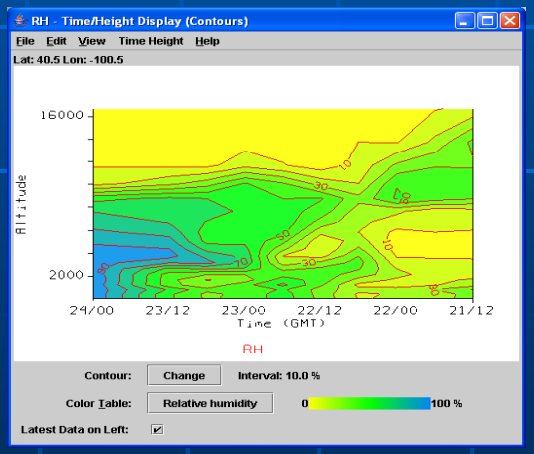
- Versatile data interaction
  - Probes to interrogate data – time series, vertical profiles, etc.



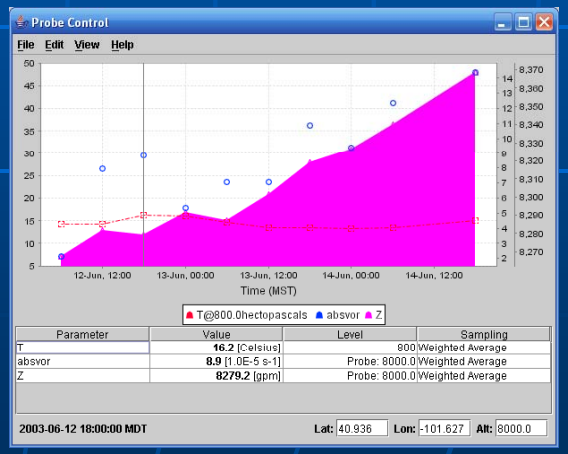
S-POL Radar Cross section



NOAA Profiler Network station (time height)



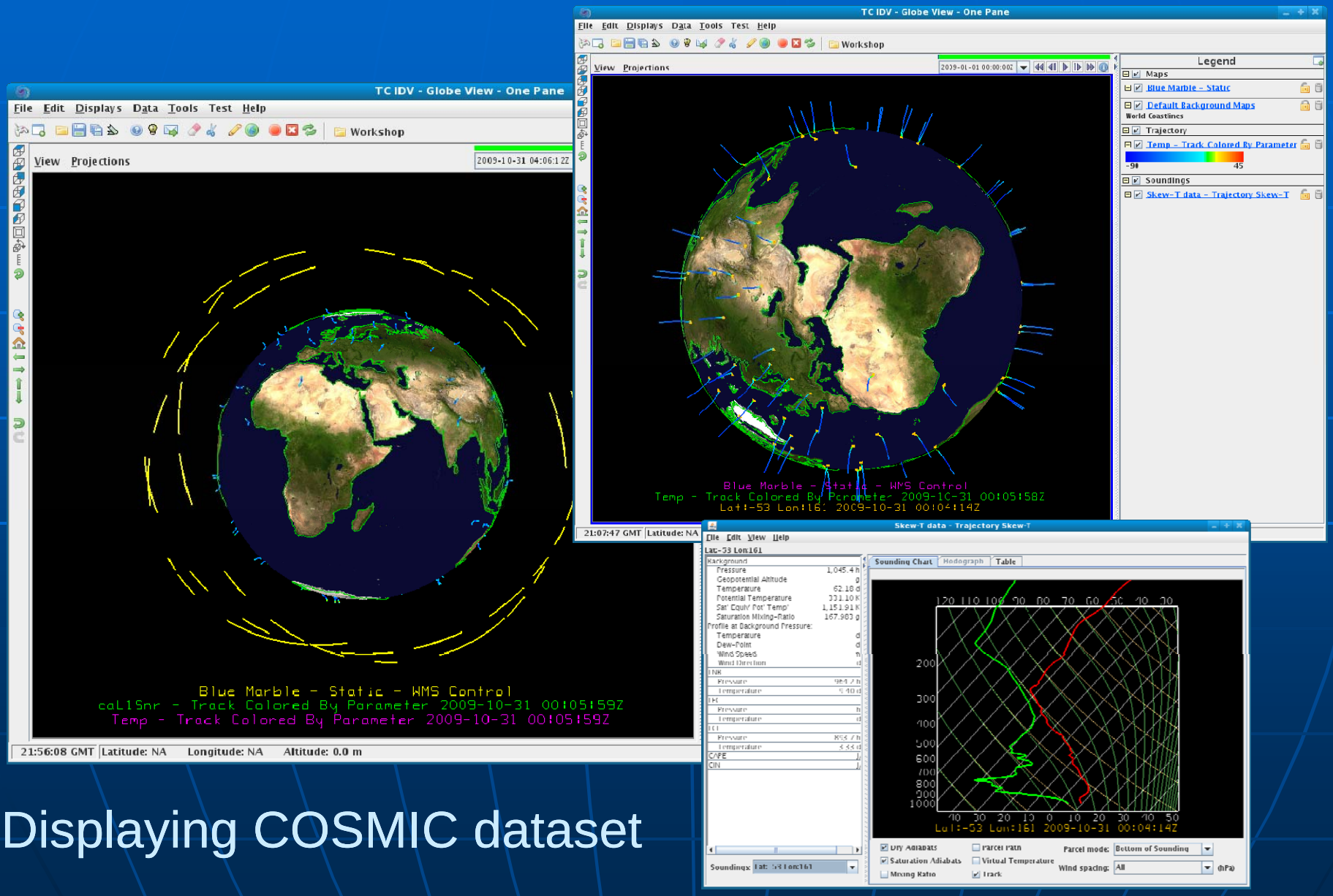
Time Height Cross section



Time Series Data Probe

unidata

IDV Example: Data Interaction

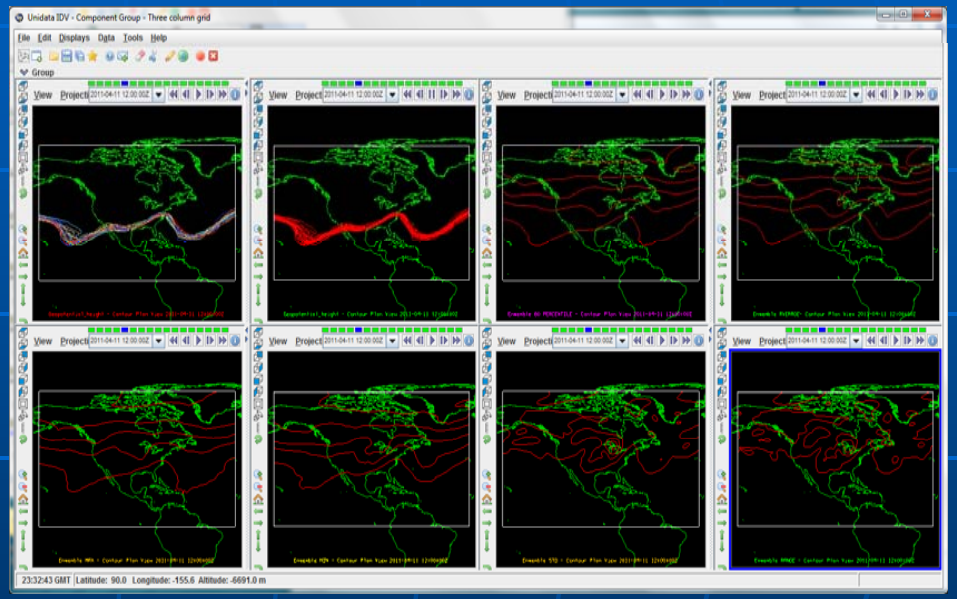


Displaying COSMIC dataset

unidata

IDV Example: Bundling

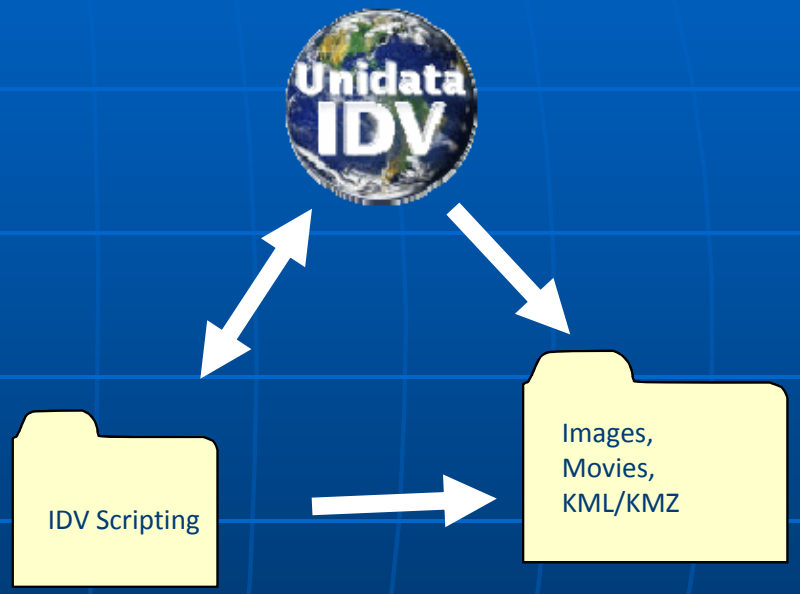
- State of the application (loaded data sources and data depictions) can be saved in XML “bundles”
- Bundles can be loaded at startup or imported on-the-fly
- Displays can be annotated and these can be saved in the bundle as explanations
- Bundles can be distributed around the Internet (on web servers or e-mail attachments)



GFS ensemble 8 panels Bundle

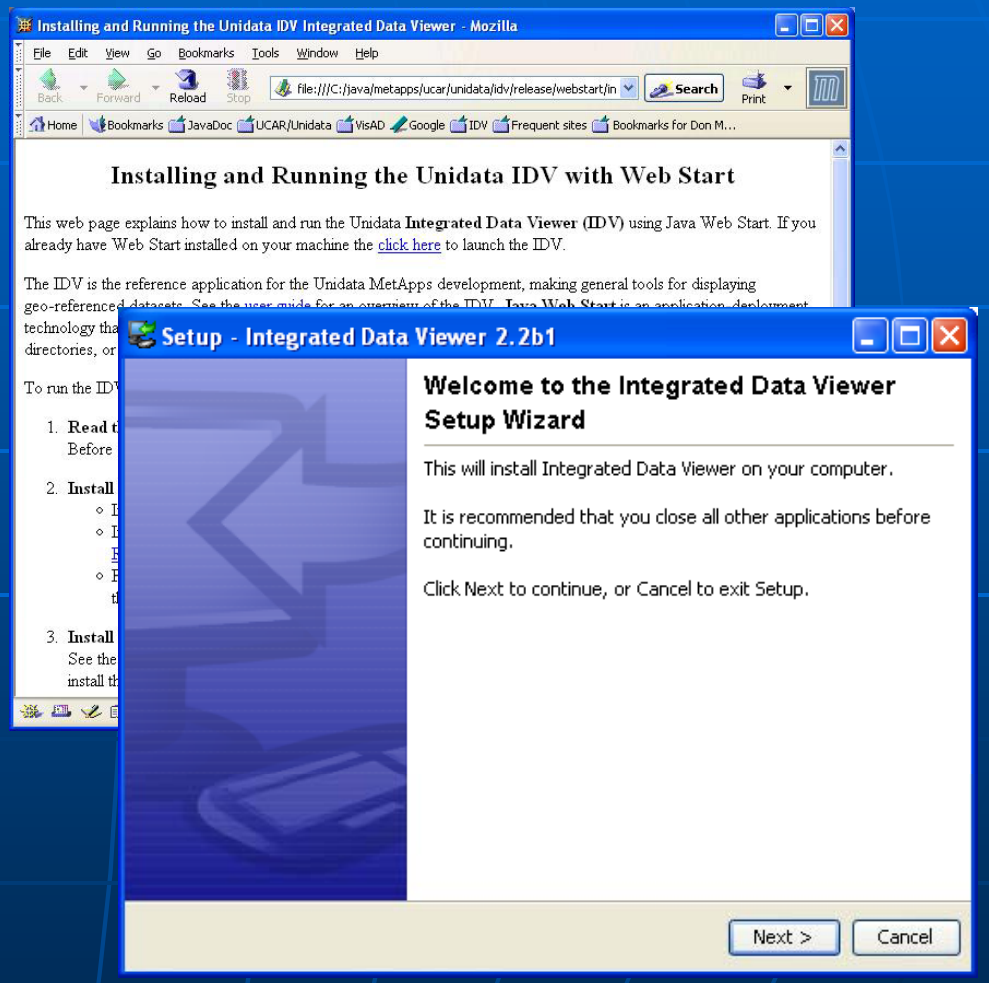
IDV Feature: Output

- Interactive and script based generation of:
  - Images - JPEG, GIF, PNG, PDF, PS
  - Movies - Quick Time, animated GIF
  - Google Earth KML/KMZ



IDV Features

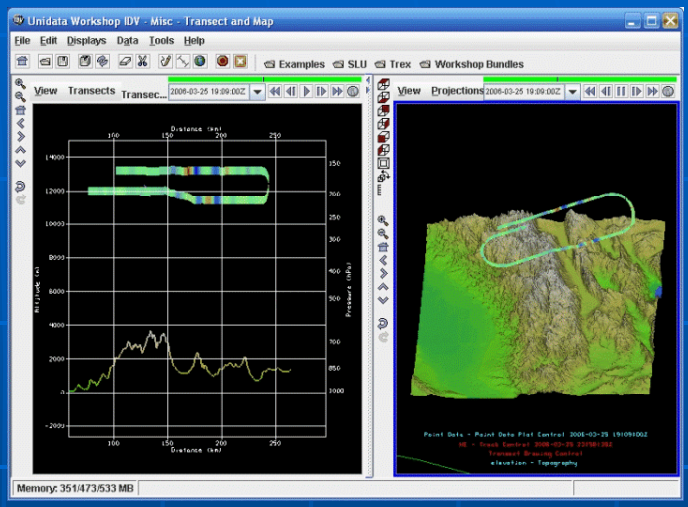
- Easy to install
- Out of the box data access
- Comprehensive user support
  - Integrated documentation
  - Training workshops
  - Mailing lists



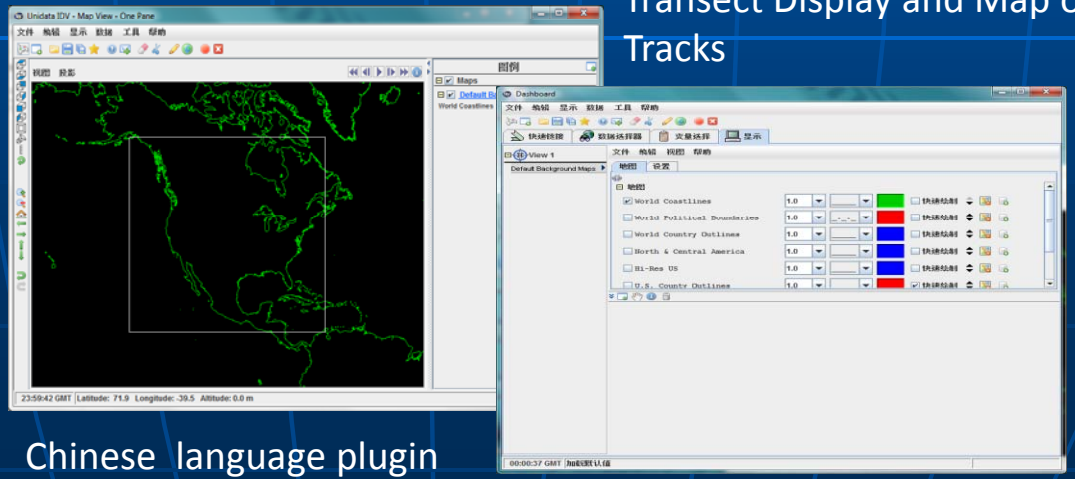
support-idv@unidata.ucar.edu

Configuration and Plugins Mechanisms

- Highly Configurable
  - Multiple UIs & displays – 3D Map, 2D Map, Globe, Transect
  - Plug-ins
    - New Features
    - Language Support



Transect Display and Map of Airplane Tracks



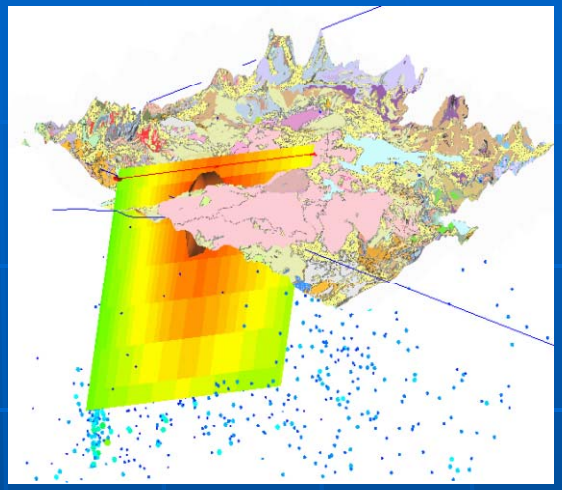
Chinese language plugin

Configuration and Customization

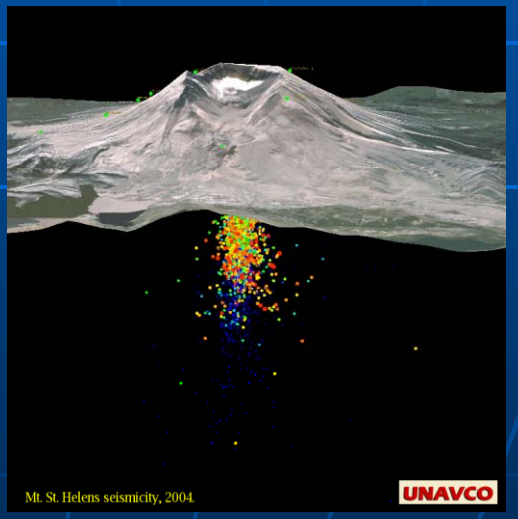
- IDV uses XML to configure the user experience
- Configuration files can be local or across the network
- Offers flexibility to adapt the interface to difference:
  - Learners
  - Tasks
  - Data sets
  - Content areas

Customized IDV: GEON-IDV

- GEON is building cyberinfrastructure to allow seamless data and tool interoperability for the geosciences.
- The GEON-IDV is an extension of the Unidata IDV
  - Supports 2 and 3D displays of subsurface phenomena
  - Uses plug-in facility to customize the user interface and add features
  - Additional features include GPS velocity vectors, earthquake focal mechanisms, ray path traces.



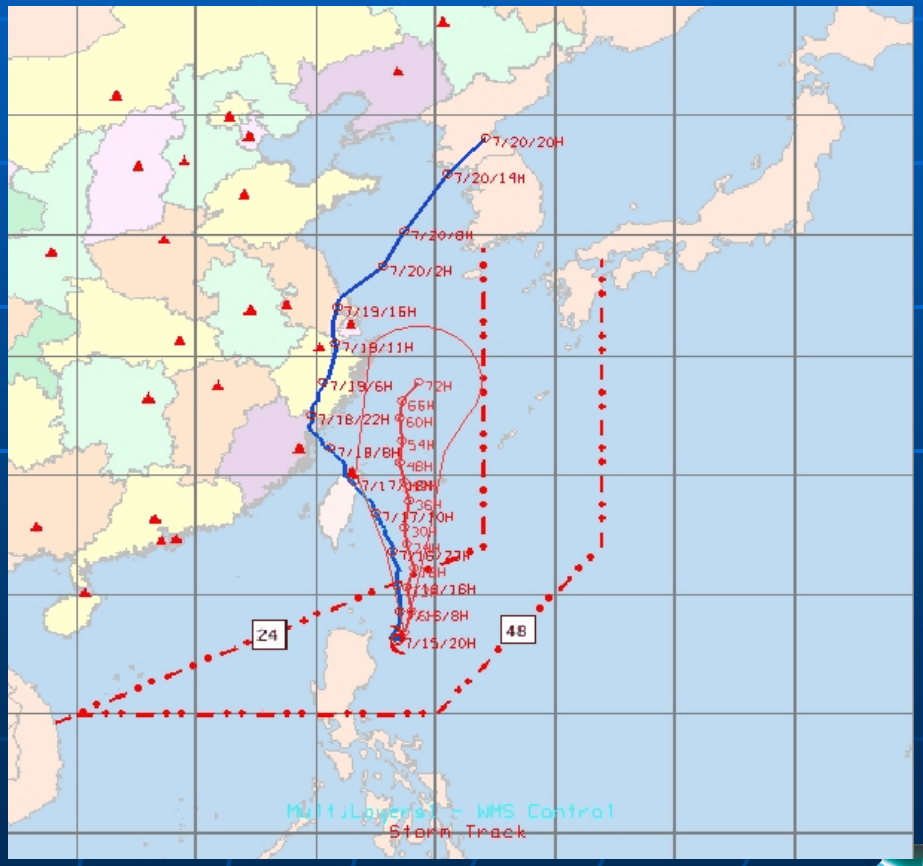
Yellowstone Geophiscs: Earthquakes and tomography by Univ. Utah; topography from USGS; geology map image provided by Robert L. Christiansentens (UNAVCO)



Mt. St. Helens siesmic activity 2004

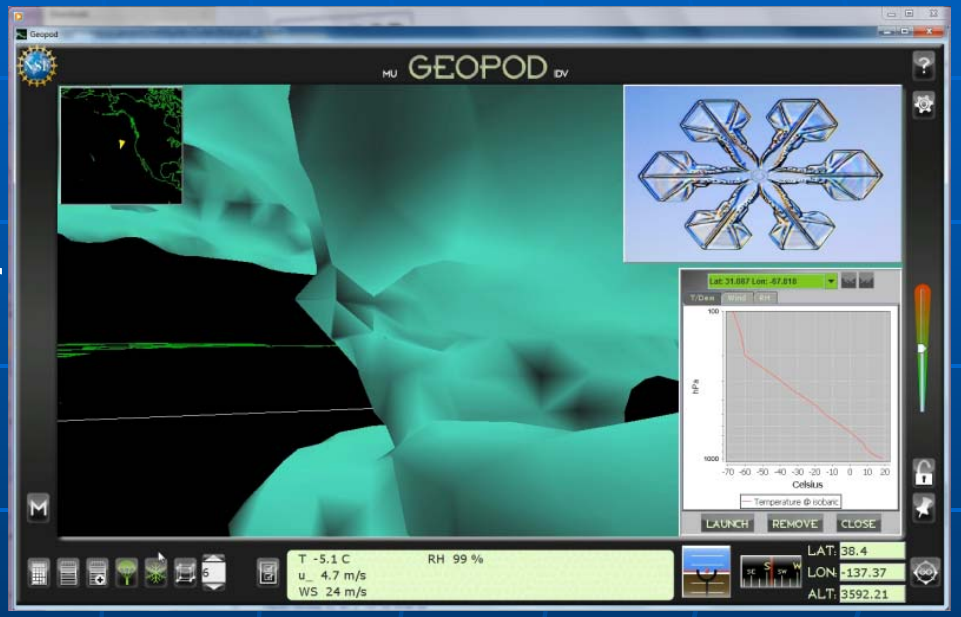
Customized IDV: TC-IDV

- TC-IDV is a customized version of IDV for typhoon tracking and analysis
- Being developed for Shanghai Typhoon Institute (STI)
- Access to database of storm tracks and forecasts
- Can be combined with satellite and model data



Customized IDV: Geopod

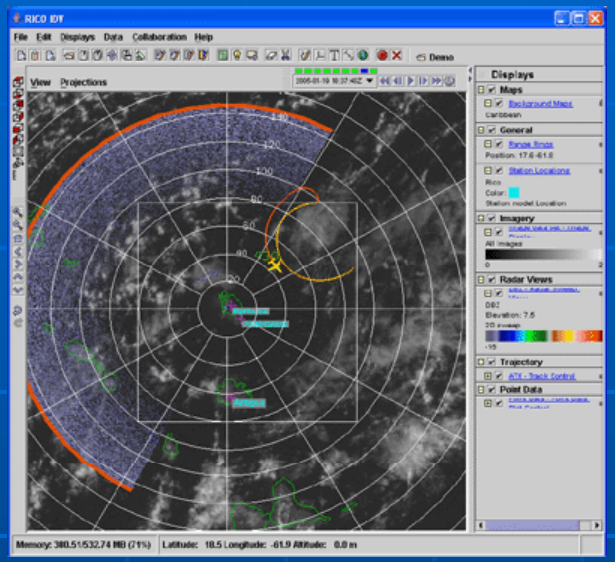
- The Geopod interface us geared toward data exploration and teaching
- An interactive module for navigating and probing geophysical data
- Allowing students to become part of the exploration process



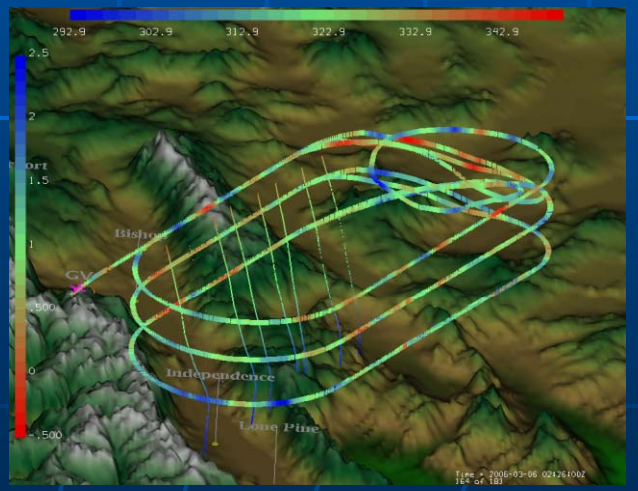
unidata

IDV in Field Projects

- Used to plot realtime aircraft tracks, radar, dropsondes, satellite and model data in operations center.
- Project specific customization
  - Specialized maps, locations, color tables
  - Specialized code for new functionality
- Support for real-time streaming data and remote access to additional datasets
- Post project analysis:
  - Access data directly from NCAR Community Data Portal or download and use locally
  - Share remote datasets and views through bundles
- Visualization tool in the proposed Virtual Operations Center (VOC)



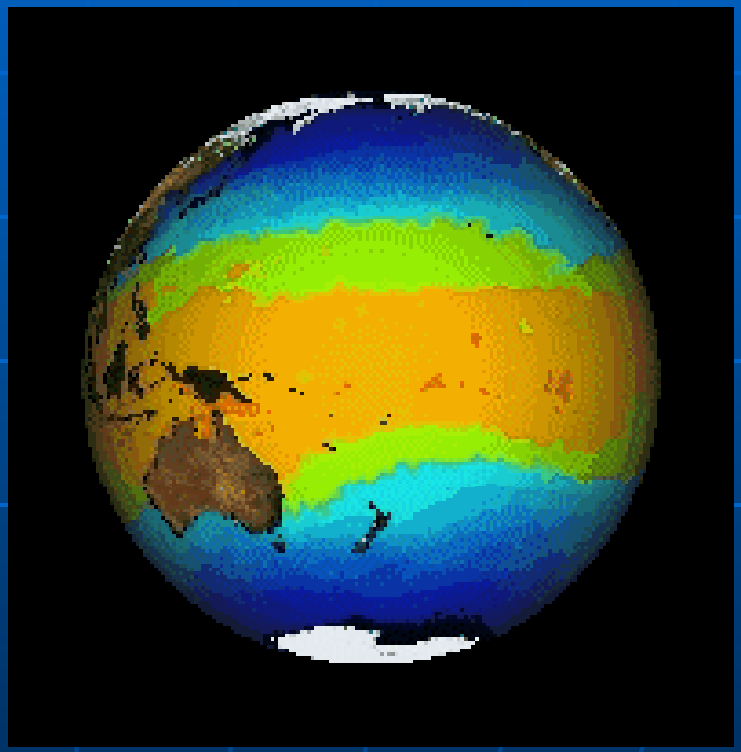
RICO: C130 track, SPOL radar and satellite



T-REX: G-V tracks and dropsondes

IDV Example

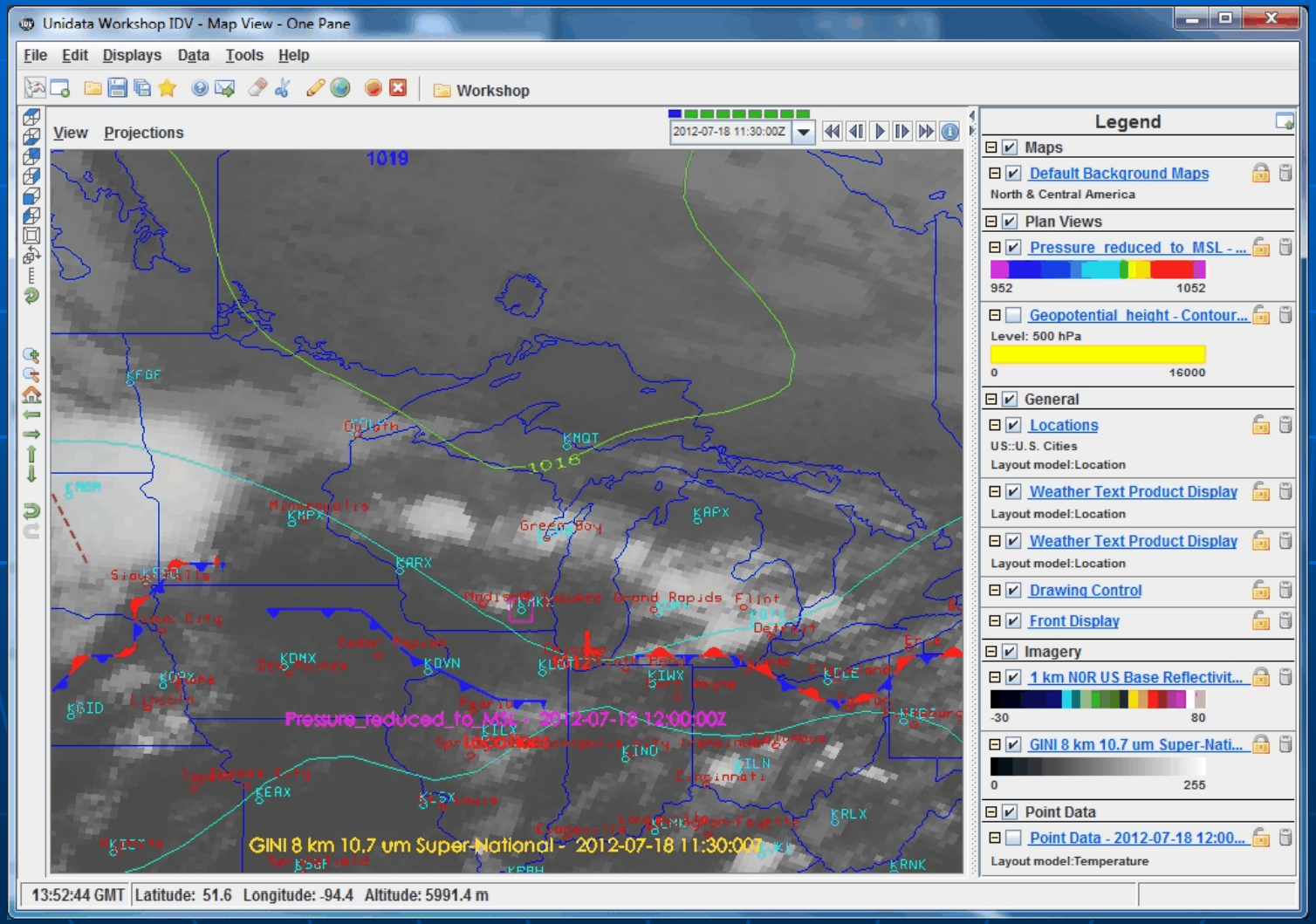
- Using the IDV to analyze Marine Coral Stress because it allowed them to easily integrate multidimensional data into a seamless global picture showing coral exposure to environmental stresses.



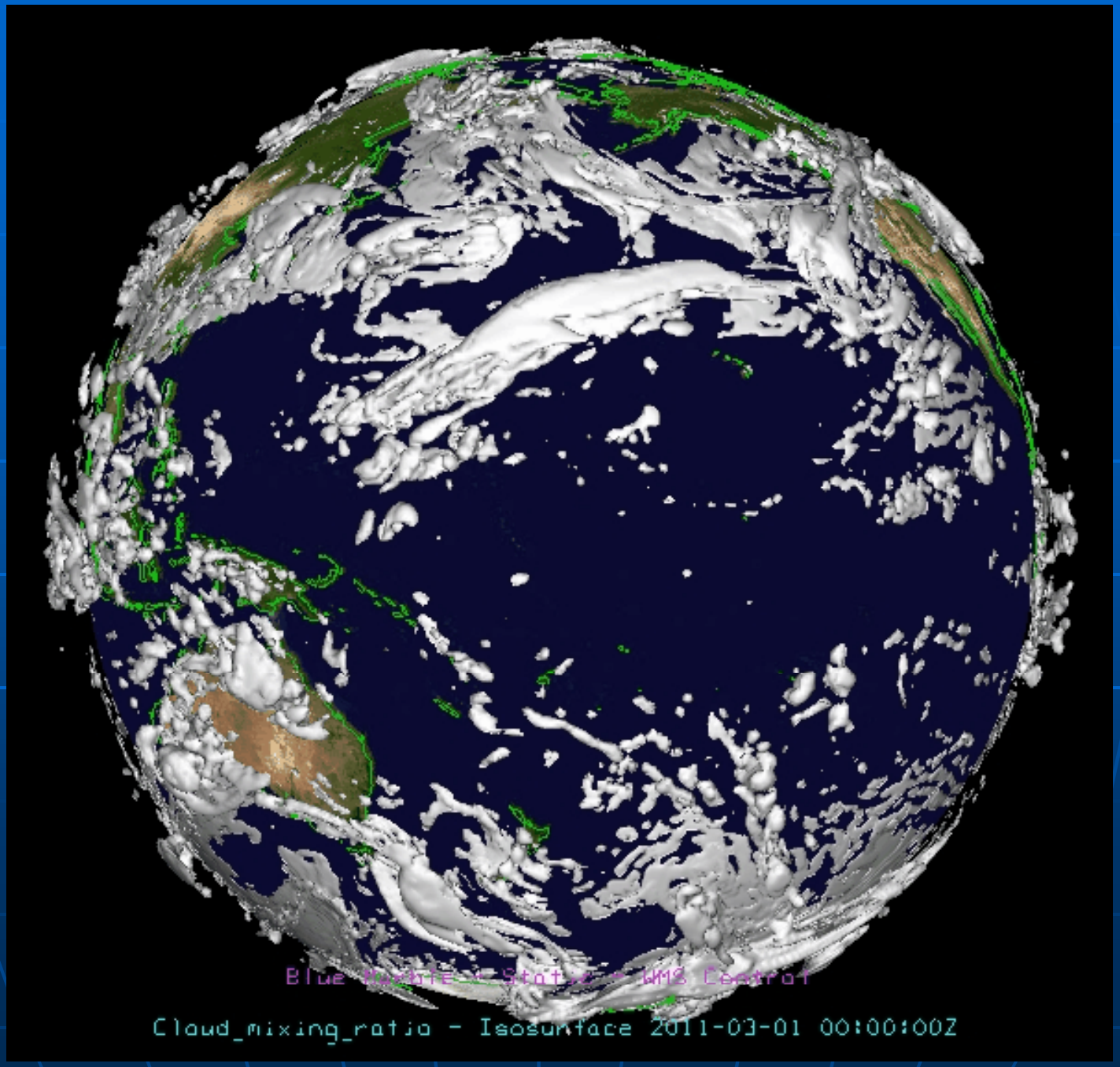
Who Uses the IDV?

- Atmospheric science students and faculty at Unidata institutions
- Researchers
- Weather enthusiasts
- Oceanographers
- Geophysicists
- Over 10,000 users around the World

Today's Weather



unidata


Cloud_mixing_ratio - Isosurface 2011-03-01 00:00:00Z

IDV Benefits

- In Classroom:
  - More sophisticated presentation of concepts with real data
  - Better prepares students entering the geoscience career field
- In Research:
  - Easy data accessibility
  - High level of interaction with data
  - Platform independence allows for real-time collaboration between researchers

Summary

- IDV, when combined with other Unidata technologies, provides efficient data access, effective data usage, and reduces data friction
- IDV enables analysis, integration, and visualization of heterogeneous geoscience data
- IDV enables real-time collaboration between researchers

For more information

- IDV Homepage:
  - http://www.unidata.ucar.edu/software/idv
- Download IDV package:
  - http://www.unidata.ucar.edu/downloads/idv/index.jsp
- IDV Support
  - Support-idv@unidata.ucar.edu