Unidata TDS Python Workshop

Overview

(Unidata, python, data)

24 July 2013

Unidata – Who are we?

- Funded primarily by the U.S. National Science Foundation
- Mission:

  To provide data, tools, and community leadership for improving Earth-system education and research

- At the Unidata Program Center, we
  - Provide access to data (via push and pull systems)
  - Develop open source tools and infrastructure for data access, analysis, visualization, and data management
  - Advance metadata standards for the Earth system science community
  - Support users of our technologies: faculty, students, and researchers
  - Help to build, represent, and advocate on behalf of our community

Unidata – What we provide

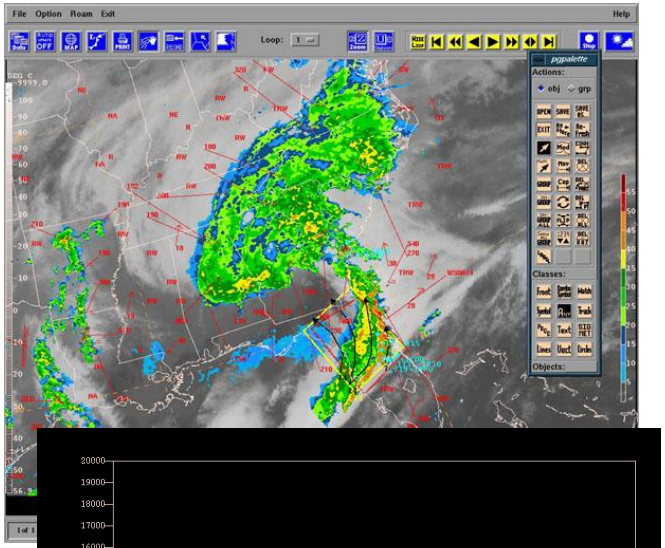
- Real-time data streams over IDD/LDM
  - Radar, satellite, model forecasts, station, etc.
- Visualization and analysis packages
  - IDV, GEMPAK, McIDAS, AWIPS-II
- Rolling archive of real-time data
  - thredds.ucar.edu
- NetCDF data format and libraries

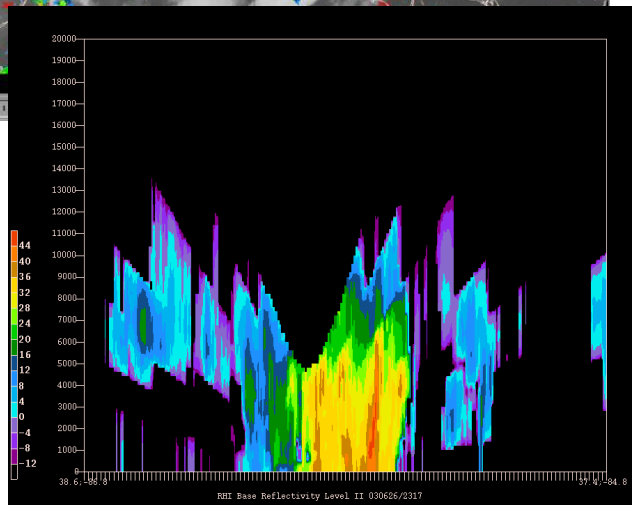
Real-time Data Streams

- IDD Real-time Data Flow
  - 30 data feeds provide radar, satellite, text bulletins, lightning, model forecasts, surface and upper air observations, …
  - LDM routinely handles 10 GB/hour input, with as many as 280,000 products/hour
  - Worldwide collaboration of over 250 institutions running LDM software
- Unidata's LDM
  - Protocol and client/server software
  - Event-driven data distribution
  - Supports subscription to subsets of data feeds

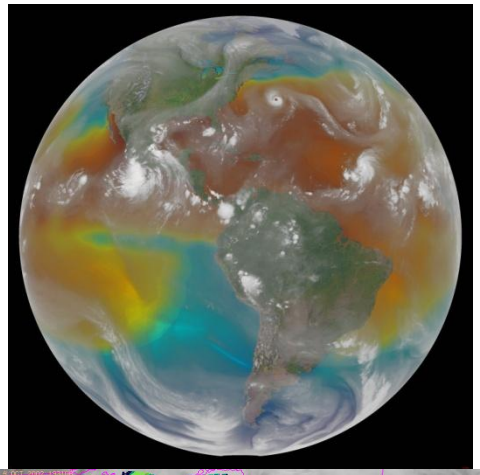
Visualizing and Analyzing Data

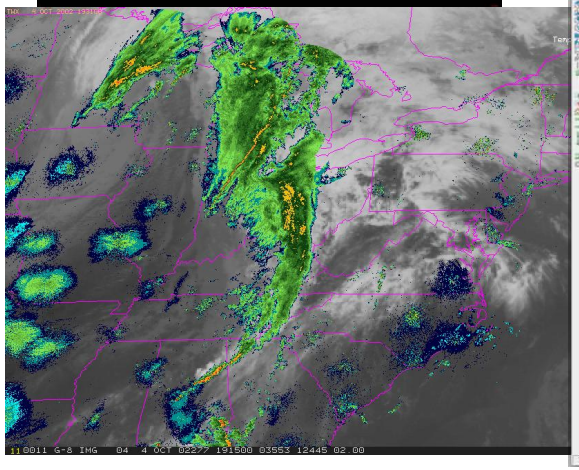
GEMPAK



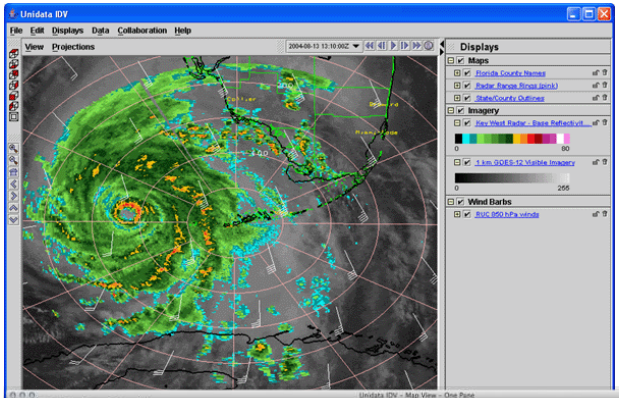


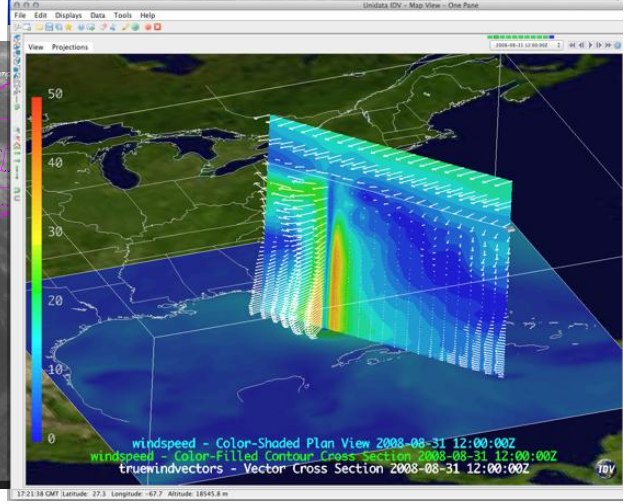
McIDAS-X





IDV



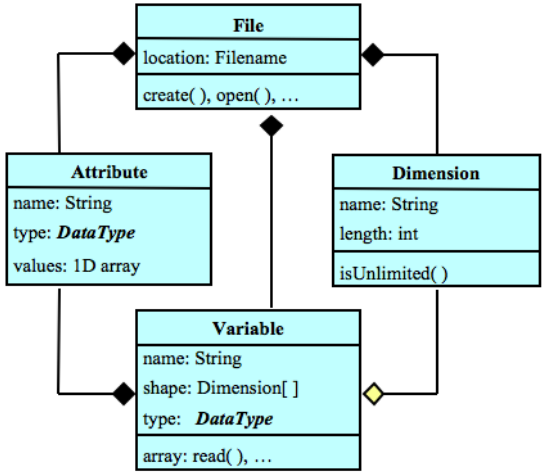


Access to Real-time Data

- Unidata TDS: thredds.ucar.edu
  - Serves the last month or so of IDD/LDM data streams
  - Services:
    - OPeNDAP
    - NCSS
    - OGC WCS and WMS
- Unidata ADDE server: adde.ucar.edu
  - Service: McIDAS ADDE

netCDF

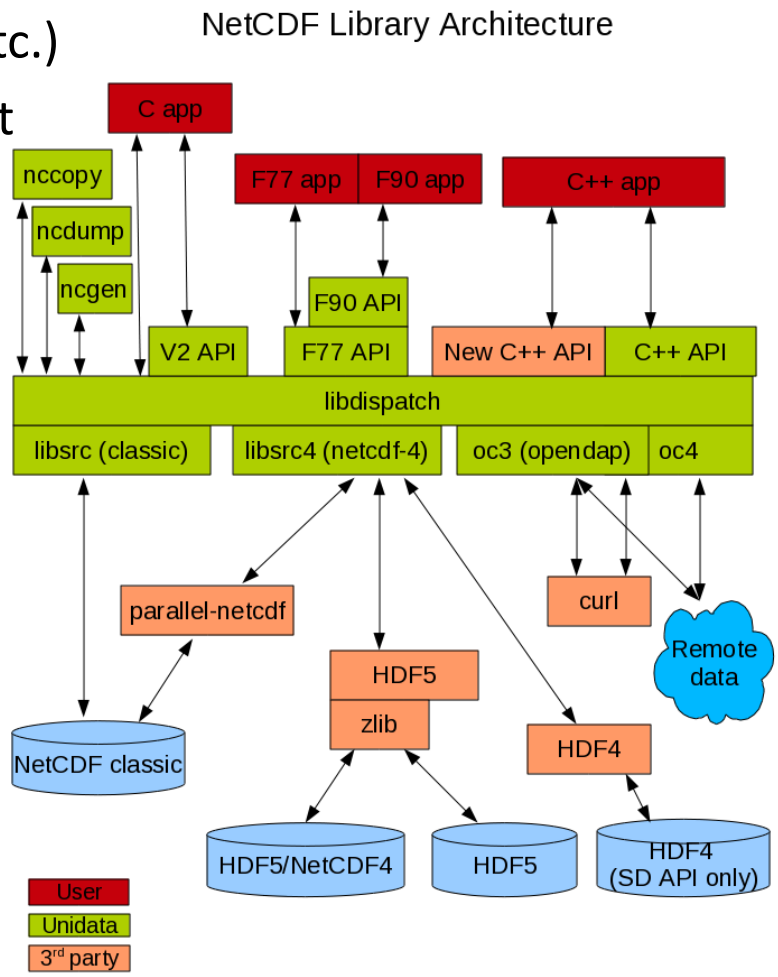
- Array-oriented scientific data:
  - Interface for access (C, Fortran, Java, etc.)
  - Machine-independent encoding format
  - Reference libraries (C and Java)



A file has named variables, dimensions, and attributes. Variables also have attributes. Variables may share dimensions, indicating a common grid. One dimension may be of unlimited length.

Variables and attributes have one of six primitive data types.

DataType
char
byte
short
int
float
double



Unidata User Community

- Support the community
  - User Workshops
  - Training Workshops
  - Mailing lists
    - For specific software packages
    - “community” email list – for Unidata community announcements
- Represent and advocate for the community
- More: http://www.unidata.ucar.edu/

Why Unidata and Python?

- Embraced by the earth science community
  - Language popularity measured by search hits on AMS web site

Year	Python	Java	Fortran
2011	19	2	4
2012	57	9	2
2013	60	12	9

- Requests from Unidata community for Python support

What is Python?

- General purpose, high-level language invented by Guido van Rossum.
- Multiple paradigms
- scripting
- object-oriented
- imperative
- functional
- "Python is executable pseudocode"

Unidata and Python

"I have used a combination of Perl, Fortran, NCL, Matlab, R and others for routine research, but found out this general-purpose language, Python, can handle almost all in an efficient way from requesting data from remote online sites to statistics, graphics." - UCAR Scientist

- Avenue for exploring, and leveraging netCDF and THREDDS Data Server technologies.
- Embraced by earth science community for analysis and exploration (see table).
- Publication quality graphics and visualization which are improving all the time.

Python Environment

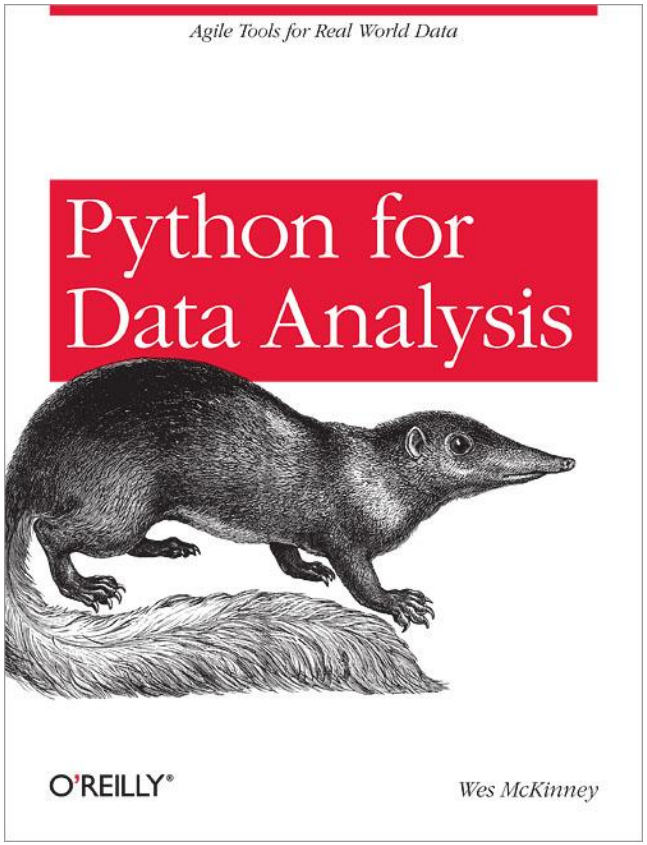
- Setting up a Python environment can be challenging. Some libraries require native dependencies. There are various solutions to this problem.
  - Use a commercial Python distribution with a package manager. Academic use is typically free. This is a good option for beginners but has limitations.
  - “Roll your own" Python library management strategy as you gain experience.
- For various reasons the scientific Python world is still at Python 2.7.x so that is what we will be using.

Python Editor

- Today, we will be using the ipython notebook. It is good for presentations and sharing finished code. It is not so good for code development. Here are some Python IDEs:
  - Python Tools for Visual Studio
  - Spyder (Scientific Python Developement EnviRonment)
  - Emacs Ipython Notebook
  - Enthought Canopy Editor
  - Wakari, a hosted Python data analysis environment

Python Background material

- A Hands-On Introduction to Using Python in the Atmospheric and Oceanic Sciences
- Lectures on scientific computing with Python
- Why Python is the Next Wave in Earth Sciences Computing
- Oceanographic Anaylsis with Python - Rich Signell
- Python Scientific Lecture Notes
- Enthought



Where to ask for Help

Tag your questions with python, netcdf, thredds, etc.

Let's Get Started
Today We Will …

- Read and write netCDF files
- Use matplotlib to visualization geoscience data
- Read model and station data from a TDS NCSS
- Accessing data with PyDAP
- Read Radar Level 2 data
- Request maps from an OGC WMS server