

Free Data Analysis and Presentation Tools

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Meaning of “Free”

1. Free as in “free beer” (generally, but not necessarily true)
2. Free as in “freedom” (more important!)
 - (a) Freedom to inspect source code
 - (b) Freedom to change source code
 - (c) Freedom to redistribute modified source code

Candis (C-language Analysis and Display):

1. Standardized way to represent gridded numerical data
2. Contains data about the data (metadata)
3. Large collection of tools for analyzing and displaying data
4. Translators to and from other standard formats

Tools for data inspection:

- Cdflook – Notice use of standard input and output – Candis only works on Linux (or other Unix); Apple Mac; not on Windows!
- Cdfplot – A tool for making “quick-look” plots (other tools exist for making “pretty” plots)

Tools for data selection (use of pipes):

- Cdfrdim – Averages over a segment of a dimension
- Cdfwindow – Selects subranges of one or more dimensions
- Cdfisocut – Selects a subspace defined by a constant value of some variable
- Cdfextr – Extract or eliminate selected variables

Tools to combine files and slices:

- Cdfmerge – Combine dissimilar Candis files into one
- Cdfcatf – Combine variable slices from similar files
- Cdfcat – Merge multiple variable slices into a single variable slice
- Cdfuncat – The reverse of cdfcat

Tools for mathematics:

- Cdfmath – Reverse Polish notation math on fields (like a HP calculator)
- Cdfderiv – Take a derivative along a dimension
- Cdfinteg, cdfdefint – Take an integral along a dimension
- Cdffilter, cdfsmooth – High and low pass filtering

Atmospheric thermodynamics:

- Cdfmr – Compute mixing ratio
- Cdfentropy – Compute moist entropy

Data conversion:

- Uniget, uniput – Translate to and from NetCDF files
- Cdftable – Convert ASCII column data to Candis
- Specialized translators for radar, aircraft, satellite data, etc.

Shell scripts – Example to compute vorticity:

$$\zeta = \frac{1}{a \cos \phi} \left(\frac{\partial v_y}{\partial \lambda} - \frac{\partial v_x \cos \phi}{\partial \phi} \right)$$

```
#!/bin/sh  
  
#  
# fnlvortcalc.sh -- Calculate relative vorticity from fnl data.  
#  
cdfmath 'lat cos vx * vxcos =' | \  
cdfderiv dvxdlat vxcos lat | \  
cdfderiv dvydlon vy lon | \  
cdfmath 'dvydlon dvxdlat - lat cos / 6370 / 57.3 * vort ='
```

Documentation:

- Unix manual pages – Use the “man” command
- Tutorial – Somewhat dated, but still useful
- Publication –
Raymond, D. J., 1988: A C language-based modular system for analyzing and displaying gridded numerical data. *J. Atmos. Oceanic Tech.*, **5**, 501-511.

Other recommended free tools:

- NetCDF – Another, widely used, format for gridded numerical data –
<http://www.unidata.ucar.edu/software/netcdf/>
- GRI graphing language – Make pretty plots from ASCII and NetCDF data –
<http://gri.sourceforge.net/>
- NCL – NCAR Command Language; contains many tools for analyzing and presenting atmospheric science data; uses NetCDF (free for non-commercial use only) –
<http://www.ncl.ucar.edu/>

- Octave – A free (in both senses) alternative to Matlab –
<http://www.gnu.org/software/octave/>
- L_YX document processor – A free program far superior to Word etc. for writing scientific papers –
<http://www.lyx.org/>
- Debian Linux – Many packages of interest are included (NetCDF, GRI, Octave, L_YX, etc.); devoted to free software –
<http://www.debian.org/>

Website for 2008 Pacific tropical cyclones:

- East and west Pacific analyses of tropical cyclones from NCEP FNL and GFS data (Click on TCS08) – <http://merlin.nmt.edu/>