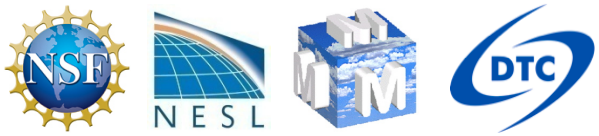
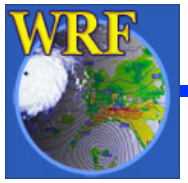


WRF Utilities

Cindy Bruyère



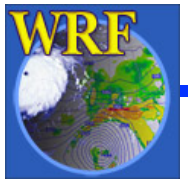
Utilities

UG: Chapter 3 & 10

- Graphics
- Designing a model domain
- Data

Input	Intermediate	Output
grib 1&2	intermediate format	netcdf
netcdf		

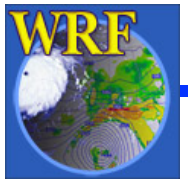
- netCDF tools
- Other utilities
- MET



Graphics : ImageMagick

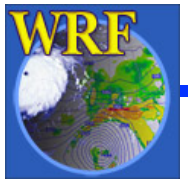
- **Convert graphical files from one format to another**
  - Many options available (*rotate* frames, *trim* white space, etc.)
  - Can be used for files with single or multiple frames
  - Cannot deal with **.ncgm** files
  - http://www.imagemagick.org

convert	*file*.pdf	*file*.png
convert	*file*.png	*file*.bmp
convert	*file*.pdf	*file*.gif
convert	*file*.ras	*file*.png



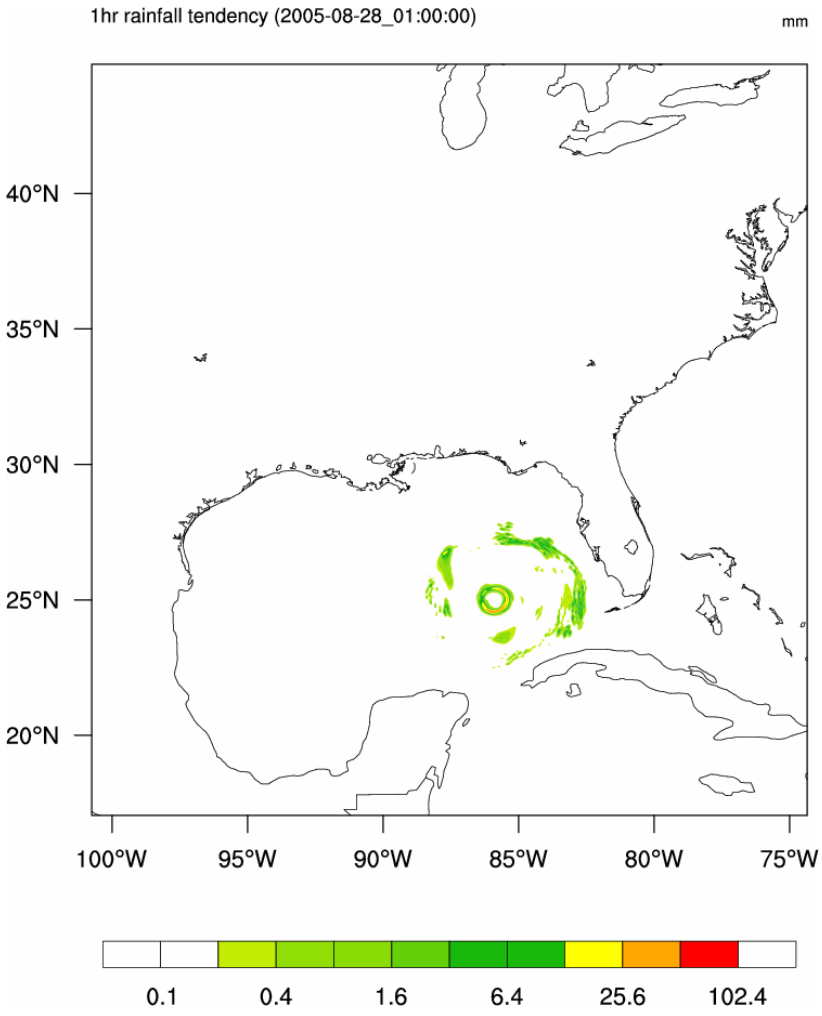
Graphics : *ctrans*

- **Convert NCAR Graphics files (.ncgm) to ras format**
  - Single Frame in **.ncgm** file
    ctrans -d sun *file*.**ncgm** > *file*.**ras**
  - Multiple Frames in **.ncgm** file
    (med = metafile frame editor)
    med -e '1,$ split $' *file*.cgm
    ctrans -d sun *med001*.**ncgm** > *med001*.**ras**



Making Movies

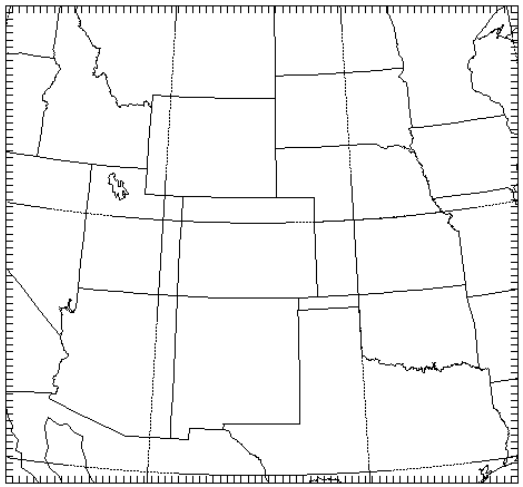
- Run graphical package
- Create individual frames for each image
  - Either directly from graphical package;
  - Or with a tool like ImageMagick
- Use a movie making tool to create movie
  - {GIF Movie Gear ; Windows ; commercial software }
- convert –delay 20 *png movie.gif

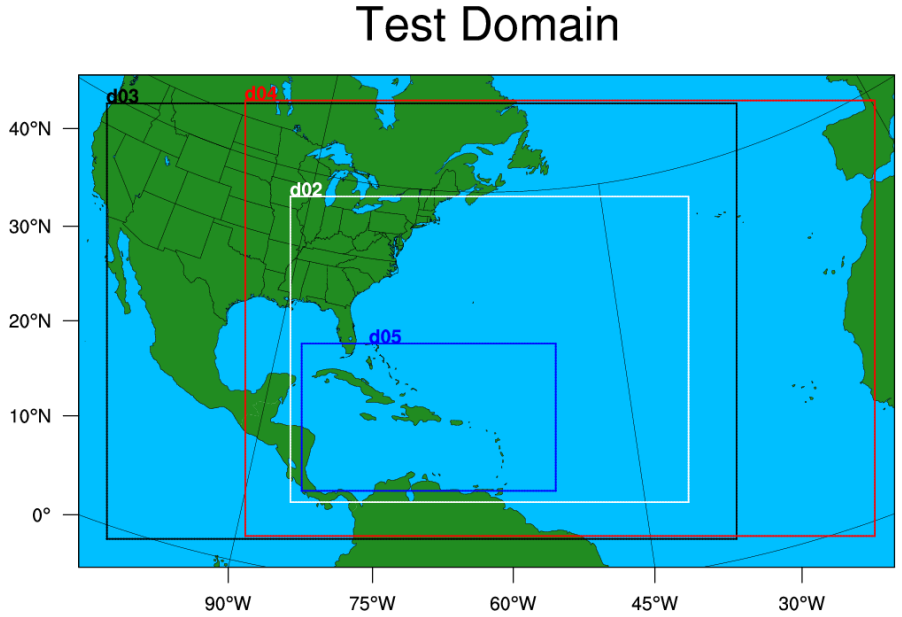


WRF Model Domain Design

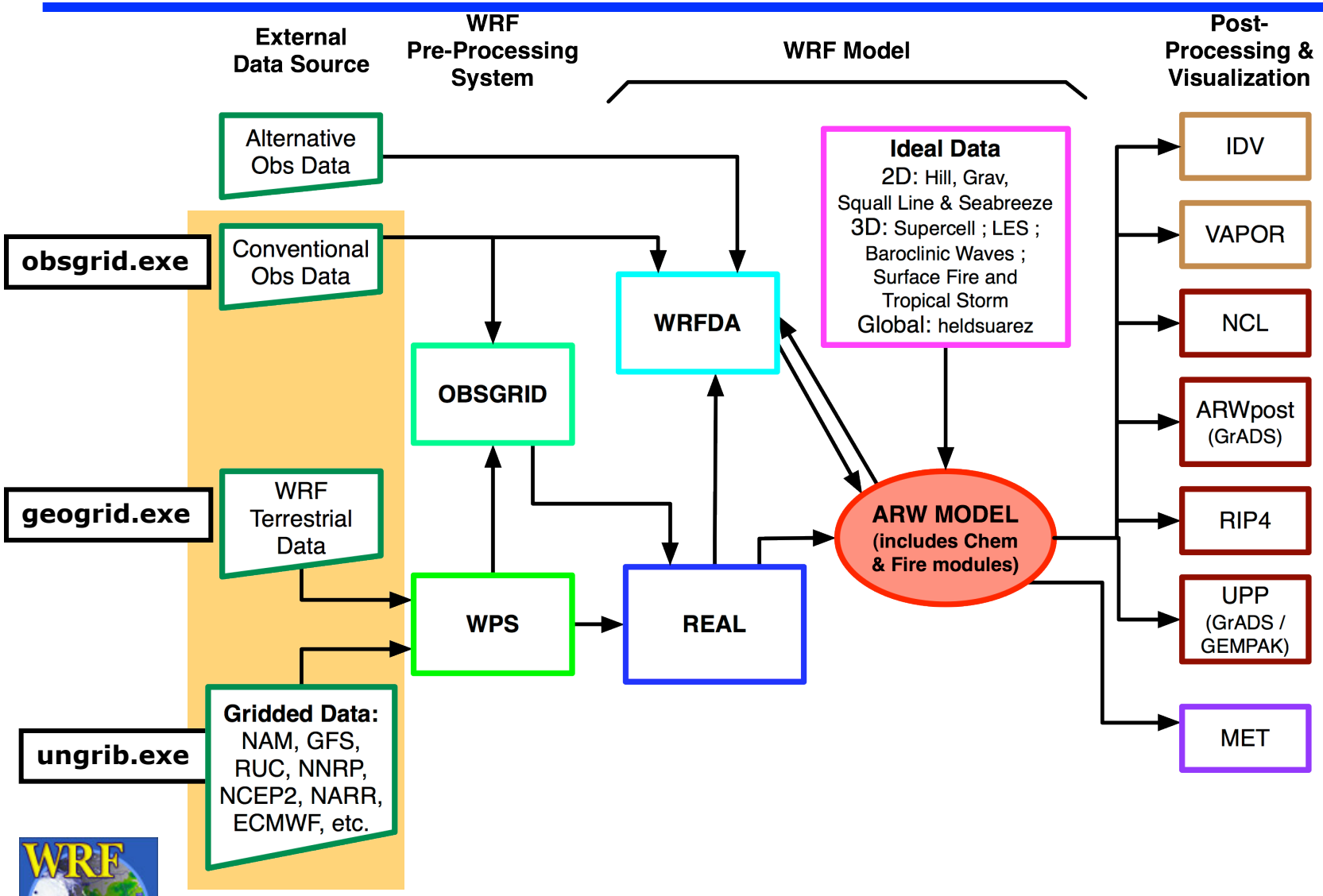
- **Fortran Code**
  - **WPS/util/plotgrids.exe**
  - reads namelist information to generate plot
  - create an NCAR Graphics file called 'gmeta'
  - use 'idt' to view

- **NCL**
  - **WPS/util/plotgrids.ncl**
  - **mp = wrf_wps_dom (wks, \ mpres, lnres, txres)**
  - reads namelist information to generate plot





WRF Modeling System Flow Chart



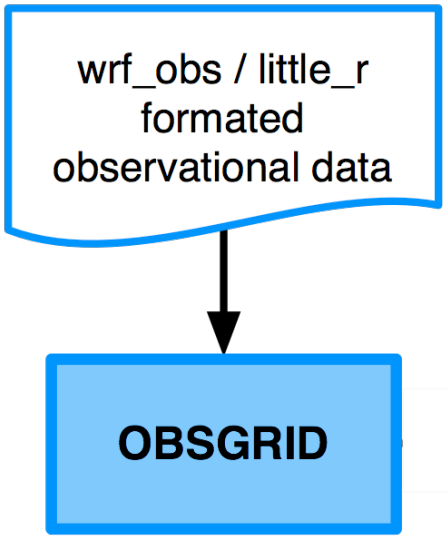
Observational Data

- http://dss.ucar.edu/datasets/ds353.4/
- http://dss.ucar.edu/datasets/ds464.0/

ADP or ON29

- http://dss.ucar.edu/datasets/ds351.0/
  BUFRdecode_ADPuprair_littlr.tar is available at: http://dss.ucar.edu/datasets/ds351.0/software/
- http://dss.ucar.edu/datasets/ds461.0/
  BUFRdecode_ADPsfc_littlr.tar is available at: http://dss.ucar.edu/datasets/ds461.0/software/

NCEP dump-bufr



http://www.mmm.ucar.edu/wrf/OnLineTutorial/index.htm

ungrib.exe

WRF ARW OnLineTutorial

Home | Introduction | Compilation | Basics | Case Studies | Graphics | Tools | Data

Available test data sets for the Online Tutorial:

North American data sets

- AWIP
- NAM
- NARR

•http://dss.ucar.edu/datasets/ds609.2/
•http://www.emc.ncep.noaa.gov/
•http://dss.ucar.edu/pub/narr/

Global data sets

- GFS
- FNL
- NNRP

•http://www.emc.ncep.noaa.gov/
•http://dss.ucar.edu/datasets/ds083.2
•http://dss.ucar.edu/datasets/ds090.0/

Global SST data

- SST

•http://polar.ncep.noaa.gov/sst/oper/Welcome.html

Other Commonly used Data from DSS

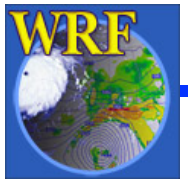
•ungrib.exe

- NCEP / DOE Reanalysis II *(Jan 1979 to Dec 2010)*
  http://search.dss.ucar.edu/datasets/ds091.0/

- GFS 0.5° Global data *(Dec 2002 to present)*
  http://dss.ucar.edu/datasets/ds335.0/

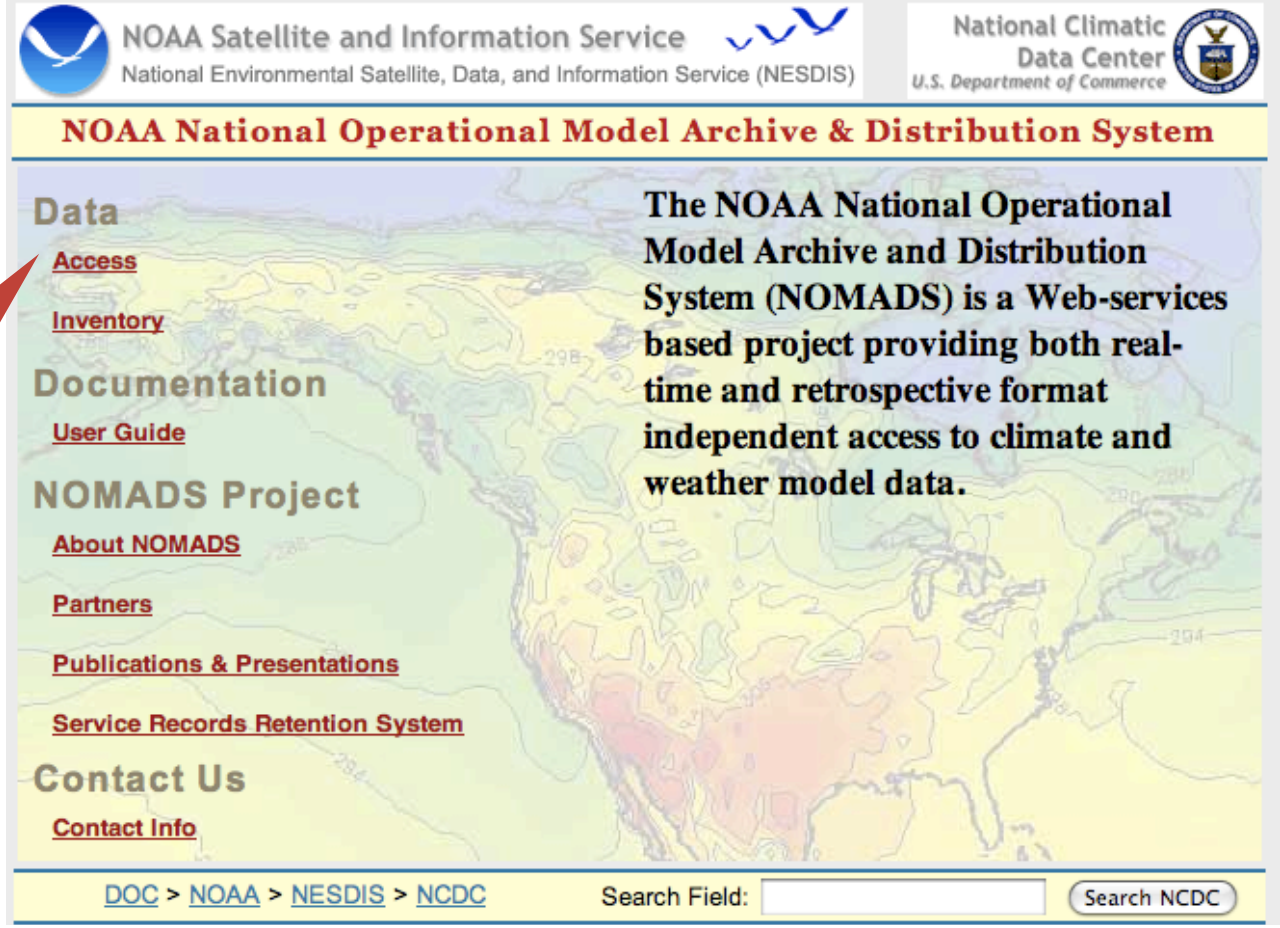
- ERA Interim Data *(~ 0.7° Global data; Jan 1979 to Sep 2011)*
  http://search.dss.ucar.edu/datasets/ds627.0/

- NCEP Climate Forecast System Reanalysis (CFSR)
  (~38km, global data; Jan 1979 to Dec 2010)
  http://dss.ucar.edu/pub/cfsr.html



http://nomads.ncdc.noaa.gov

•ungrib.exe



- NAM
- GFS
- RUC
- CFS
- NARR
- R1/R2
- SST

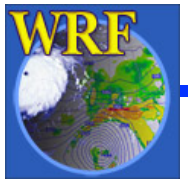
GRIB

- http://dss.ucar.edu/docs/formats/grib/gribdoc/ (GRIB1)
  http://www.nco.ncep.noaa.gov/pmb/docs/grib2/grib2_doc.shtml (GRIB2)

- g1print.exe & g2print.exe
  - Show data available in GRIB1 & GRIB2 files
  - Available from util/ directory in WPS

- grib2ctl.pl
  - Create .ctl and .idx files, so one can plot GRIB files with GrADS (available on web)

- wgrib *(for GRIB 1 data files)*
  http://www.cpc.ncep.noaa.gov/products/wesley/wgrib.html
- wgrib2
  http://www.cpc.ncep.noaa.gov/products/wesley/wgrib2/

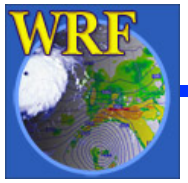


WPS Intermediate Files

- **Output format of ungrid**

- **WPS util/ directory**
  - plotfmt.exe *(graphical interface to view intermediate file)*
  - rd_intermediate

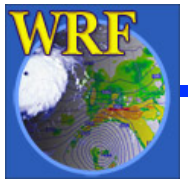
- **Create your own intermediate files**
  - example if you have input data in netCDF format
  - http://www.mmm.ucar.edu/wrf/OnLineTutorial/WPS/IM_files.htm



Utility: rd_intermediate

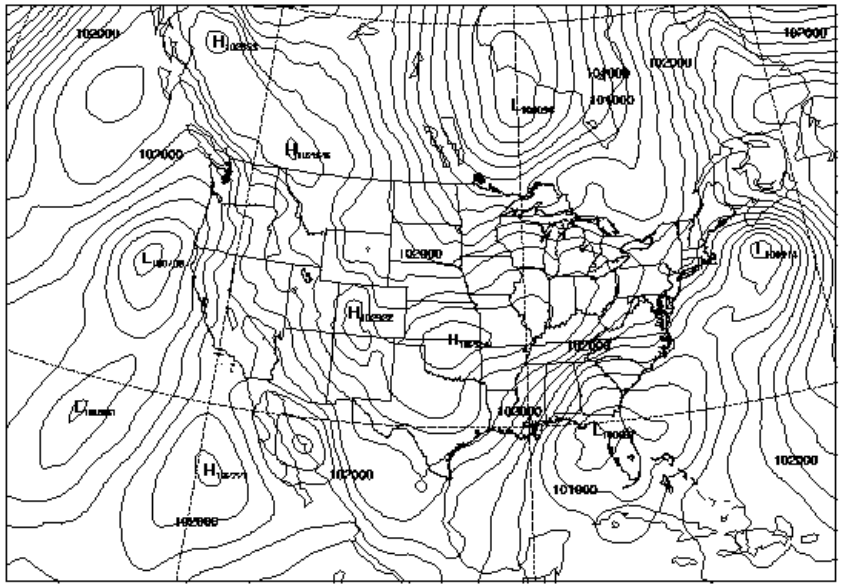
The rd_intermediate lists information about the fields found in an intermediate-format file

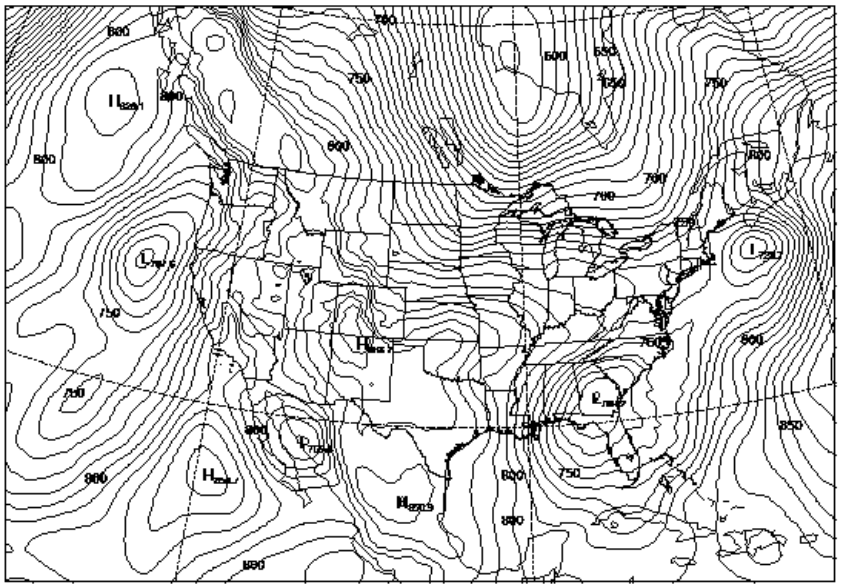
```
================================================
FIELD = TT
UNITS = K DESCRIPTION = Temperature
DATE = 2000-01-24_12:00:00 FCST = 0.000000
SOURCE = unknown model from NCEP GRID 212
LEVEL = 200100.000000
I,J DIMS = 185, 129
IPROJ = 1
  REF_X, REF_Y = 1.000000, 1.000000
  REF_LAT, REF_LON = 12.190000, -133.459000
  DX, DY = 40.635250, 40.635250
  TRUELAT1 = 25.000002
DATA(1,1)=295.910950
================================================
```

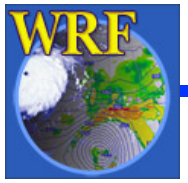


Utility: plotfmt

The plotfmt program plots the fields in the ungrib intermediate-formatted files







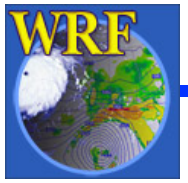
netCDF

- netCDF stands for ***net**work **C**ommon **D**ata **F**orm*

- netCDF is one of the current supported data formats chosen for WRF I/O API
  - WRF I/O supports netCDF *(not fully CF compliant - `Climate and Forecast Metadata Convention`)*/ binary/GRIB/HDF
  - Most support graphical packages currently only support netCDF file format

- ***http://www.unidata.ucar.edu*** (*documentation*)

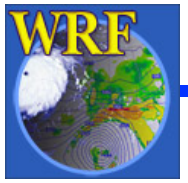
- http://www.unidata.ucar.edu/software/netcdf/docs/netcdf-f77.pdf
  http://www.unidata.ucar.edu/software/netcdf/docs/netcdf-f90.pdf
  (writing Fortran programs to read/write netCDF files)



NCO tools

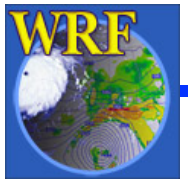
http://nco.sourceforge.net/

- **ncdiff**
  - Difference two file
    ncdiff input1.nc input2.nc -o output.nc
- **ncrcat (nc cat)**
  - Write specified variables / times to a new file
    ncrcat -v RAINNC wrfout* -o RAINNC.nc
    ncrcat -d Time,0,231 -v RAINNC wrfout* -o RAINNC.nc
- **ncra (nc average)**
  - Average variables and write to a new file
    ncra -v OLR wrfout* -o OLR.nc
- **ncks (nc kitchen sink)**
  - Combination of NCO tools all in one (handy: one tool for multiple operations)
    Specifically handy to split files
    ncks -d Time,1,1 wrfout -o wrfout1.nc

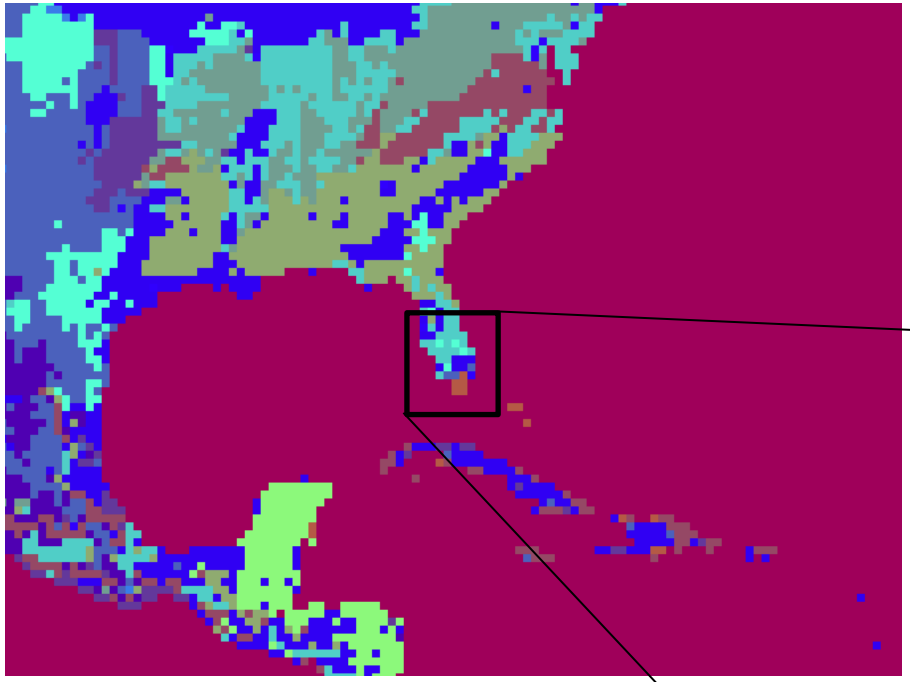


Change fields in netCDF file

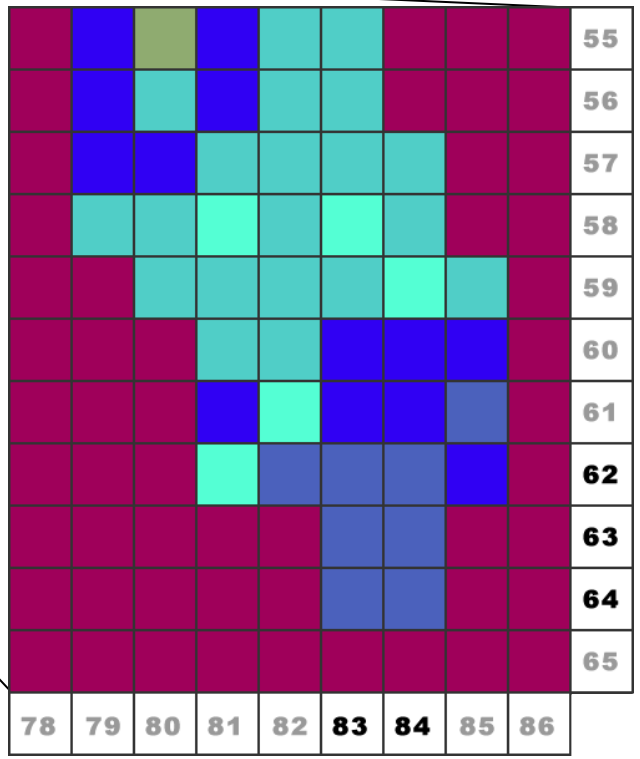
```
load "$NCARG_ROOT/lib/ncarg/nclscripts/csm/gsn_code.ncl"


Begin


  a = addfile("./met_em.d01.2000-01-24_12:00:00.nc",”w")


  sst = a->SST       ; read a field
  sst = sst + 10; change the field
  a->SST = sst       ; write the field


end
```

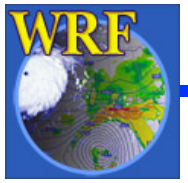


Change fields in netCDF file



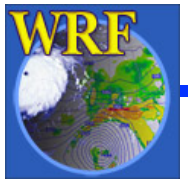
```
a = addfile("./geo_em.d01.nc","w")
var= a->LANDUSE

var(:,63:64,83:84) = 7
var(:,62,84) = 7

a->LANDUSE = var
```





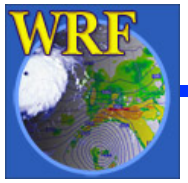
netCDF : Utilities

- **ncdump**
  - reads a netCDF dataset and prints information from the dataset
  - ncdump -h *file*
    print header (inc. list of variables in the file)
  - ncdump -v *VAR file*
    print data of the variable VAR
    ncdump -v Times *file*



netCDF : *ncdump -v Times*

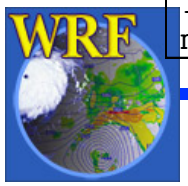
```
netcdf wrfout_d01_2000-01-24_12:00:00 {
dimensions:
        Time = UNLIMITED ; // (3 currently)
        DateStrLen = 19 ;
        west_east = 73 ;
        south_north = 60 ;
        west_east_stag = 74 ;
        bottom_top = 27 ;
        south_north_stag = 61 ;
        bottom_top_stag = 28 ;
variables:
        char Times(Time, DateStrLen) ;
        float LU_INDEX(Time, south_north, west_east) ;
                LU_INDEX:FieldType = 104 ;
                LU_INDEX:MemoryOrder = "XY " ;
         LU_INDEX:description = "LAND USE CATEGORY" ;
                LU_INDEX:units = "" ;
                LU_INDEX:stagger = "" ;
.....
.....

global attributes:

                :TITLE = " OUTPUT FROM WRF V3.0.1.1 MODEL";
                :START_DATE = "2000-01-24_12:00:00" ;
                :WEST-EAST_GRID_DIMENSION = 74 ;
                :SOUTH-NORTH_GRID_DIMENSION = 61 ;
                :BOTTOM-TOP_GRID_DIMENSION = 28 ;
                :DX = 30000.f ;
                :DY = 30000.f ;
.....
.....

data:
 Times =
  "2000-01-24_12:00:00",
  "2000-01-24_18:00:00",
  "2000-01-25_00:00:00"
```



Wrfout output fields *(ncdump -h)*

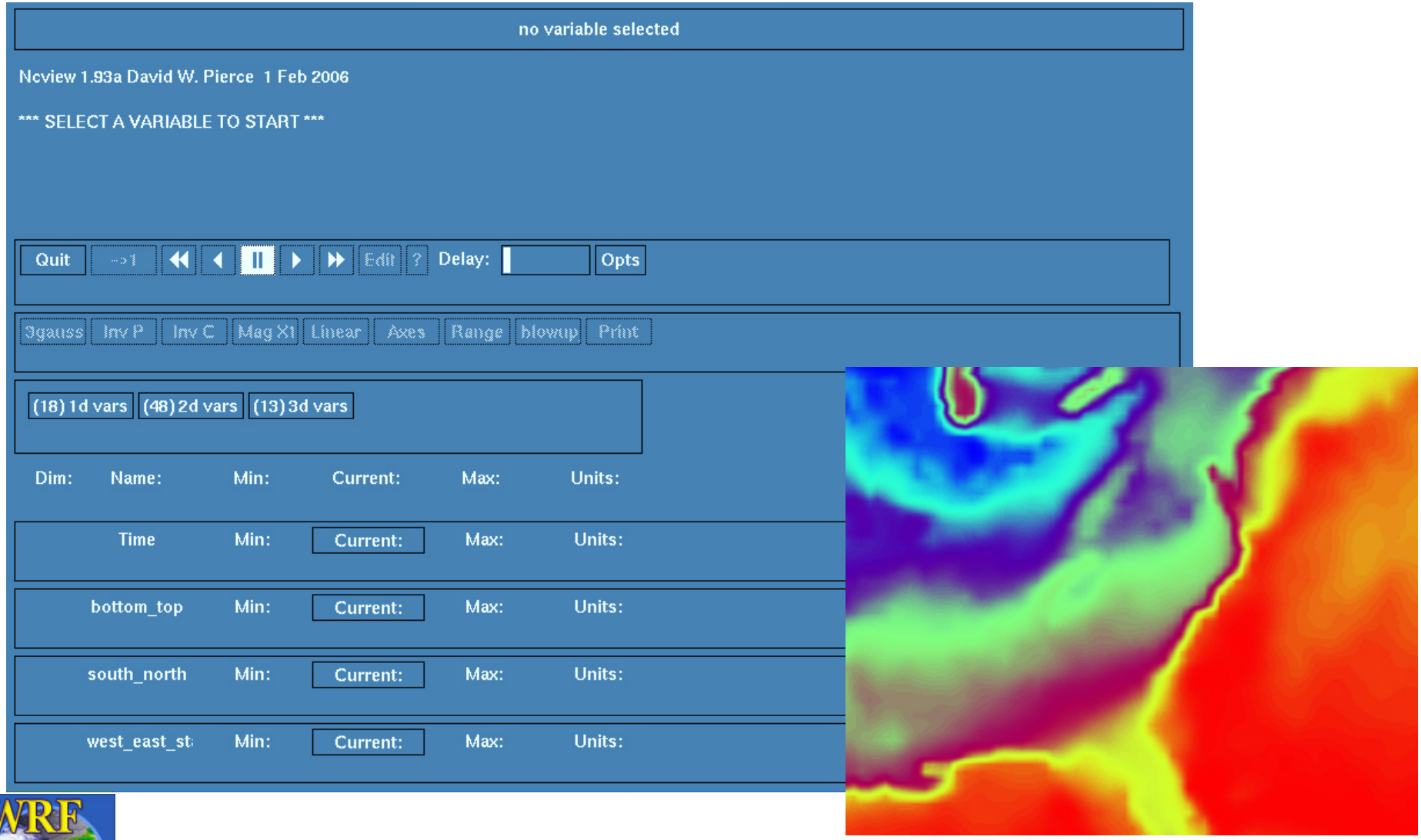
ALBBCK	ALBEDO	CANWAT	CF1	CF2
CF3	CFN	CFN1	COSALPHA	DN
DNW	DZS	E	EDT_OUT	EMISS
F	FNM	FNP	GLW	GRAUPELNC
GRDFLX	HFX	HGT	HGT_SHAD	ISLTYP
ISTEP	IVGTYP	LANDMASK	LH	LU_INDEX
MAPFAC_M	MAPFAC_MX	MAPFAC_MY	MAPFAC_U	MAPFAC_UX
MAPFAC_UY	MAPFAC_V	MAPFAC_VX	MAPFAC_VY	MAX_MSTFX
MAX_MSTFY	MF_VX_INV	MU	MUB	NEST_POS
OLR	P_TOP	**P**	**PB**	PBLH
PH	**PHB**	POTEVP	PRATEC	PSFC
Q2	QCLOUD	QFX	QNDROPSOURCE	QRAIN
QVAPOR	RAINC	RAINCV	RAINNC	RDN
RDNW	RDX	RDY	RESM	RHOSN
SEAICE	SFROFF	SH2O	SINALPHA	SMOIS
SNOPCX	SNOW	SNOWC	SNOWH	SNOWNC
SOILTB	SR	SST	SWDOWN	**T**
T2	TH2	Times	TMN	TSK
TSLB	**U**	**U10**	UDROFF	UST
V	**V10**	VEGFRA	**W**	X
XICEM	XLAND	XLAT	XLAT_U	XLAT_V
XLONG	XLONG_U	XLONG_V	ZETATOP	ZNU
ZNW	ZS			

`Total Geopotential, staggered (PH+PHB)`	`Total Pressure in Pa (P+PB)`
`Wind components, grid relative, staggered (U & V)`	`Total Potential Temperature (T+300)`
`10m wind components, grid relative, mass points (U10 & V10)`	`Surface temperature in K (T2)`



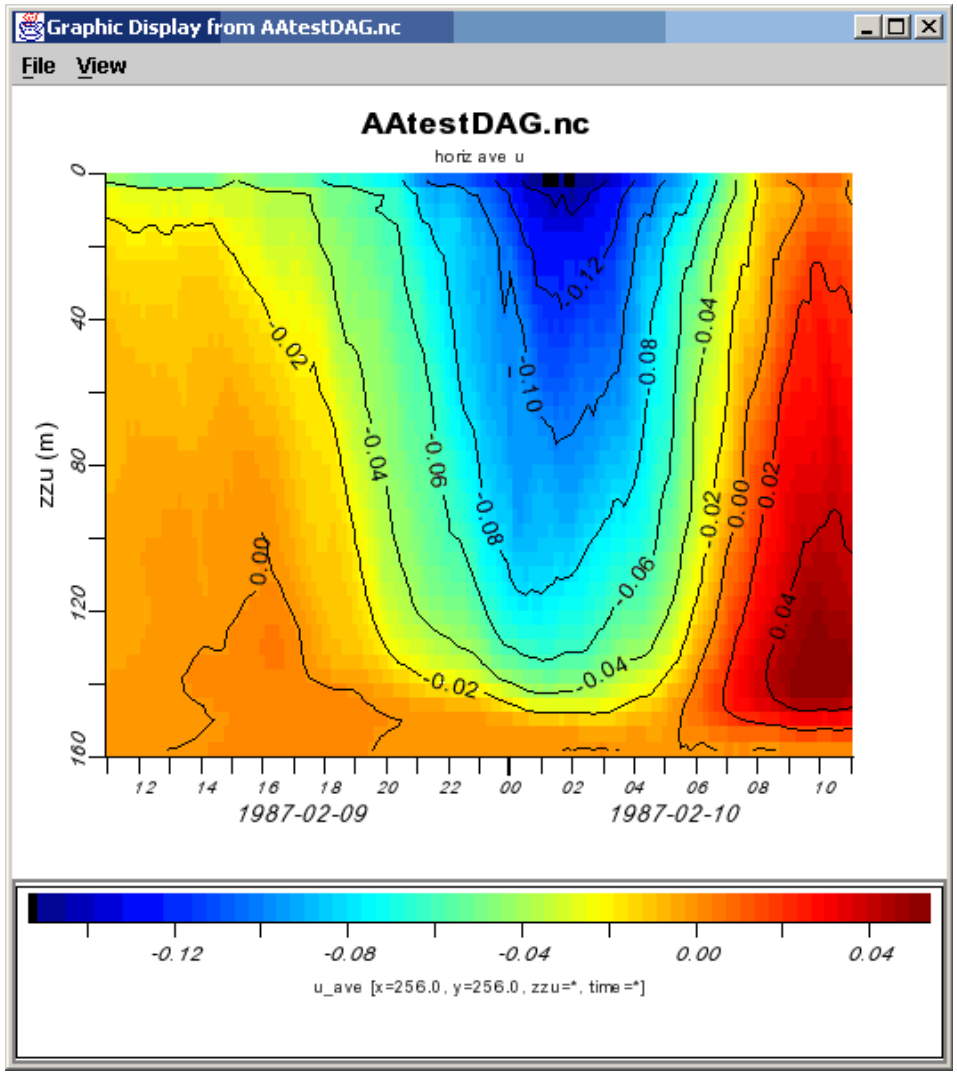
ncview

http://meteora.ucsd.edu/~pierce/ncview_home_page.html



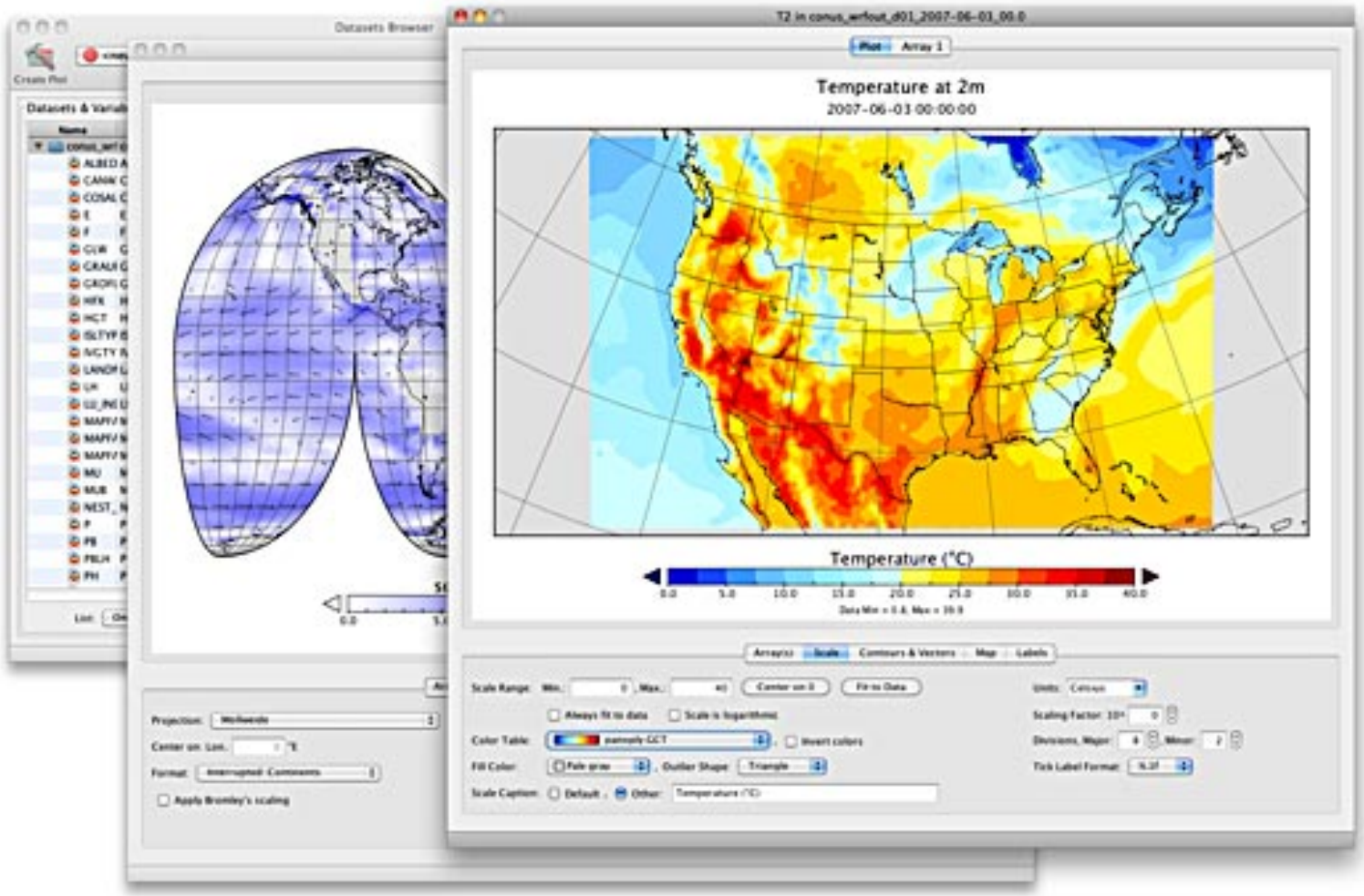
ncBrowse

http://www.epic.noaa.gov/java/ncBrowse/



Panoply

http://www.giss.nasa.gov/tools/panoply/

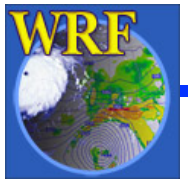


Other Utilities

- Developed / Supported by NCAR
- FORTRAN program
  - Easy to use ; Easy to add your own code ; Only for netCDF datasets
- http://www.mmm.ucar.edu/wrf/users/utilities/util.htm

- read_wrf_nc
  - Display data in a wrfout netCDF file
  - Specific points; min/max of fields; time series; edit data in file (NCL better)
- iowrf
  - Thinning ofnetCDF data; extracting a area; destaggering grid

- p_interp
  - Interpolate to pressure levels
  - Output CF compliant
  - Can be used as direct input to MET
- v_interp
  - Add vertical levels in wrf input and boundary files
  - For use with ndown
- wrf_to_cf
  - User contributed code *(not fully supported)*



MET verification software

- Model Evaluation Tools
- All the basics (e.g. RMSE, bias, skill scores)
- Plus
  - advanced spatial methods (wavelets, objects)
  - confidence intervals

- Get it here: http://www.dtcenter.org/met/users/downloads/
- Get help from met_help@ucar.edu or the documentation