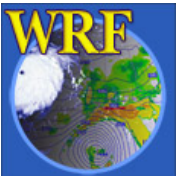




WRF Utilities

Cindy Bruyère



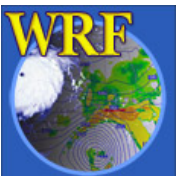
Utilities

UG: Chapter 3 & 10

- Graphics
- Designing a model domain
- Data

Input	Intermediate	Output
grib 1&2	intermediate format	netcdf
<i>netcdf</i>		

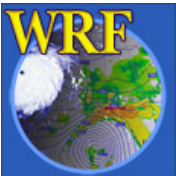
- netCDF tools
- Other utilities
- MET



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	<i>file.pdf</i>	<i>file.png</i>
convert	<i>file.png</i>	<i>file.bmp</i>
convert	<i>file.pdf</i>	<i>file.gif</i>
convert	<i>file.ras</i>	<i>file.png</i>



Graphics : *ctrans*

- Convert NCAR Graphics files (.ncgm) to ras format

- Single Frame in .ncgm file

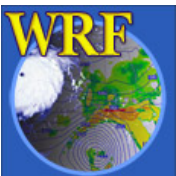
```
ctrans -d sun file.ncgm > file.ras
```

- Multiple Frames in .ncgm file

(med = metafile frame editor)

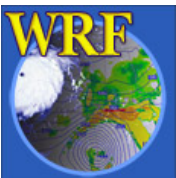
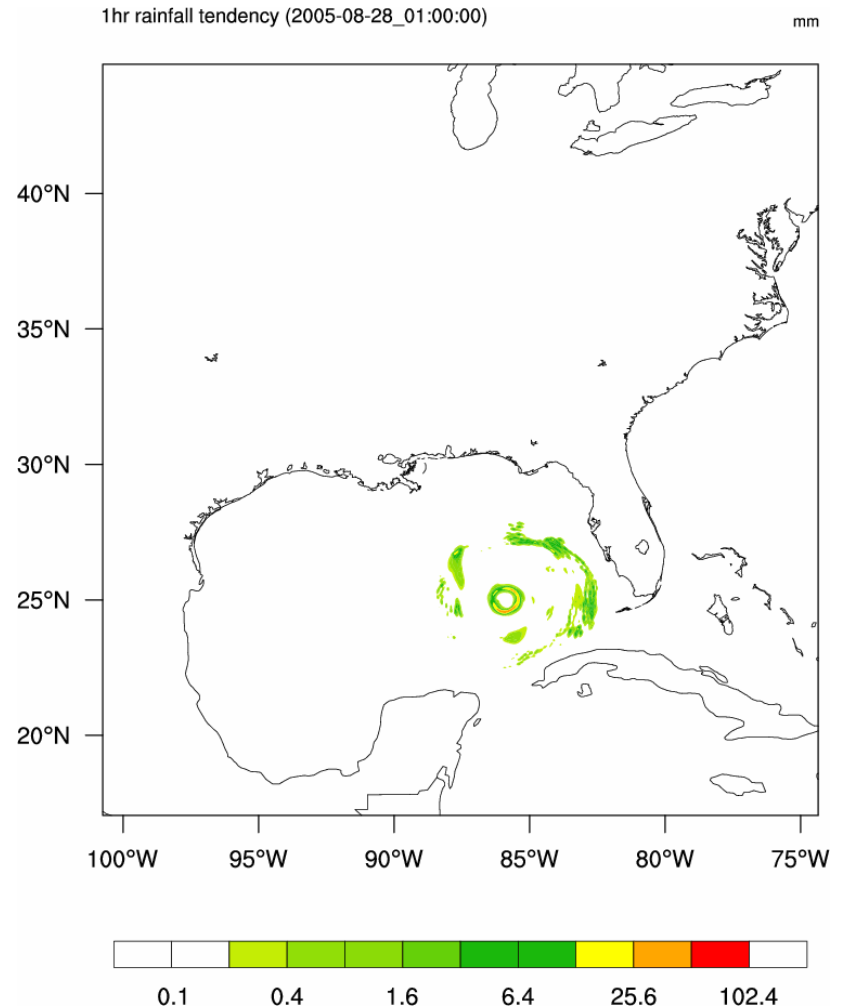
```
med -e '1,$ split $' file.cgm
```

```
ctrans -d sun med001.ncgm > med001.ras
```

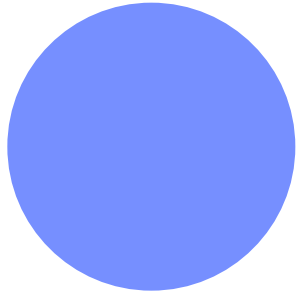


Making Movies

- 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

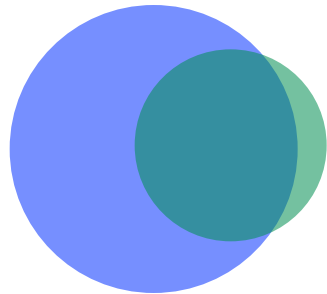
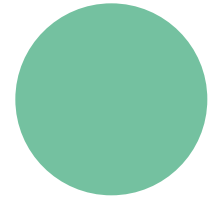


Compiling with ncl

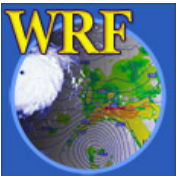


ncl myscript.ncl
NCARG_ROOT
/usr/local/ncl

compile <util>
NCARG_ROOT
/usr/local/ncarg



ncl myscript.ncl
compile <util>
NCARG_ROOT
/usr/local/ncl



Compiling with ncl

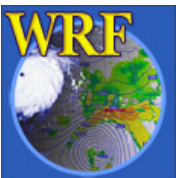
In function `write_png':

```
undefined reference to `png_create_write_struct'
undefined reference to `png_create_info_struct'
undefined reference to `png_destroy_write_struct'
undefined reference to `png_destroy_write_struct'
```

-L<path_to_png_lib> -lpng -L<path_to_z_lib> -lz

```
/usr/local/ncl/lib/libncarg.a(agcurv.o): In function `agcurv_':
agcurv.f:(.text+0x69): undefined reference to `_gfortran_copy_string'
/usr/local/ncl/lib/libncarg.a(aggtch.o): In function `aggtch_':
aggtch.f:(.text+0x3e): undefined reference to `_gfortran_copy_string'
aggtch.f:(.text+0x7b): undefined reference to `_gfortran_copy_string'
```

-L<path_to_gfortran_lib> -lgfortran



WRF Model Domain Design

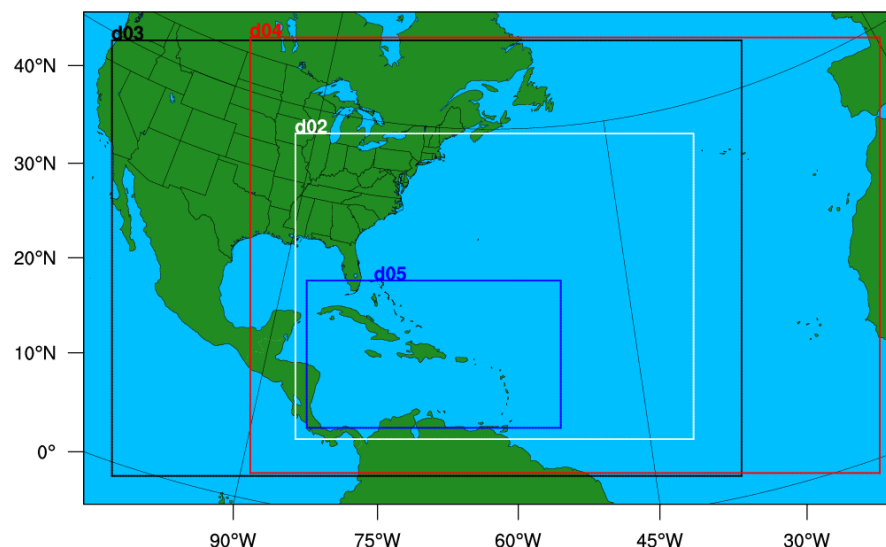
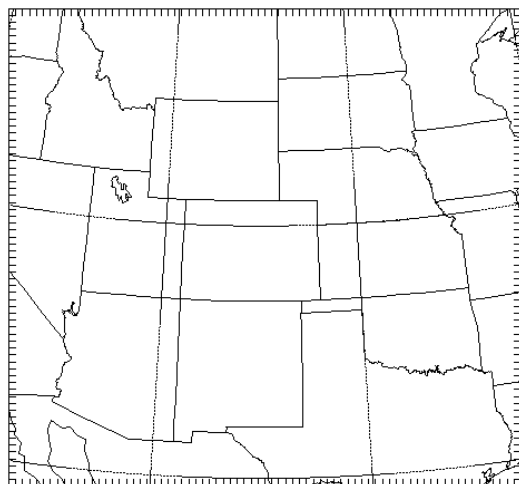
- Fortran Code

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

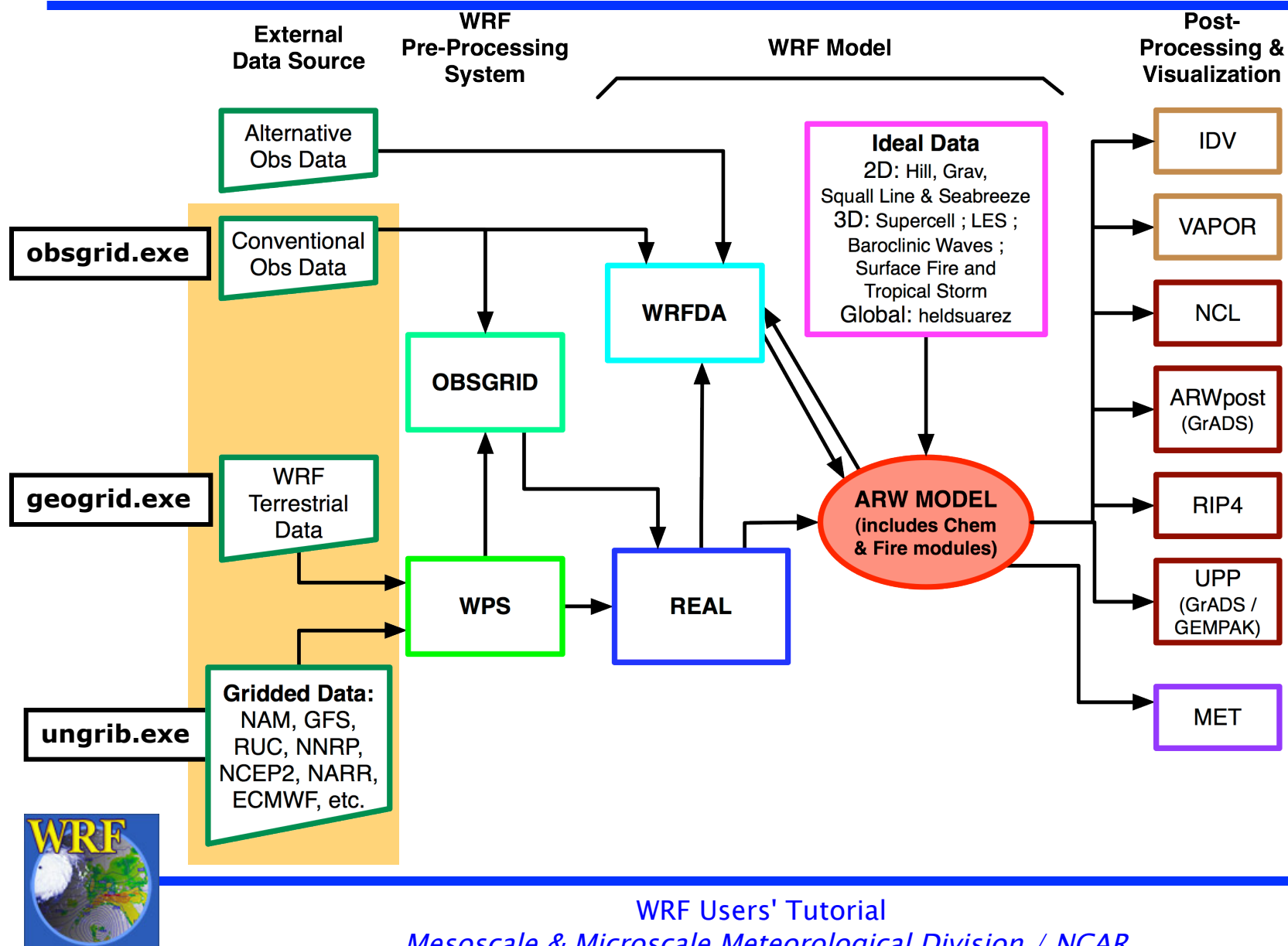
- NCL

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

Test Domain

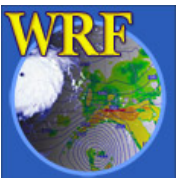
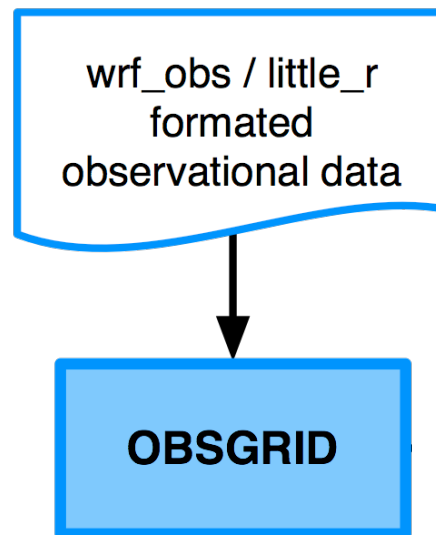


WRF Modeling System Flow Chart



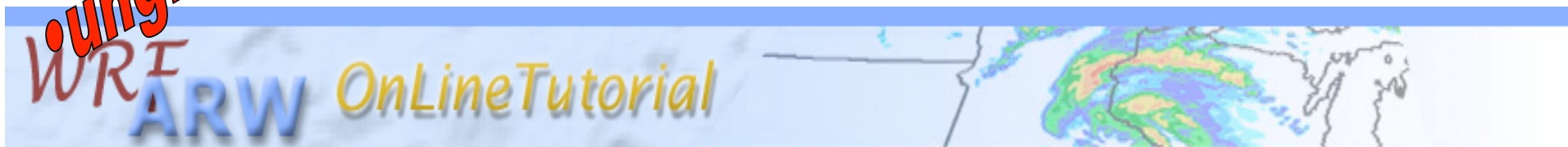
Observational Data

- <http://dss.ucar.edu/datasets/ds353.4/>
 - <http://dss.ucar.edu/datasets/ds464.0/>
 - <http://dss.ucar.edu/datasets/ds351.0/>
 - <http://dss.ucar.edu/datasets/ds461.0/>
- } ADP or ON29
- } NCEP dump-bufr



•ungrib.exe

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



WRF 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](#)

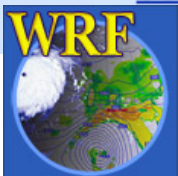
Global data sets

- [GFS](#)
- [FNL](#)
- [NNRP](#)

Global SST data

- [SST](#)

- <http://dss.ucar.edu/datasets/ds609.2/>
- <http://www.emc.ncep.noaa.gov/>
- <http://dss.ucar.edu/pub/narr/>
- <http://www.emc.ncep.noaa.gov/>
- <http://dss.ucar.edu/datasets/ds083.2>
- <http://dss.ucar.edu/datasets/ds090.0/>
- <http://polar.ncep.noaa.gov/sst/oper/Welcome.html>



• **ungrib.exe**

<http://nomads.ncdc.noaa.gov>

NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)

National Climatic Data Center
U.S. Department of Commerce

NOAA National Operational Model Archive & Distribution System

Data
[Access](#)
[Inventory](#)

Documentation
[User Guide](#)

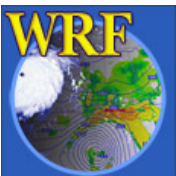
NOMADS Project
[About NOMADS](#)
[Partners](#)
[Publications & Presentations](#)
[Service Records Retention System](#)

Contact Us
[Contact Info](#)

The NOAA National Operational Model Archive and Distribution System (NOMADS) is a Web-services based project providing both real-time and retrospective format independent access to climate and weather model data.

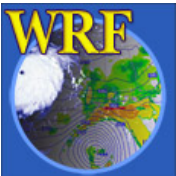
DOC > NOAA > NESDIS > NCDC

Search Field:



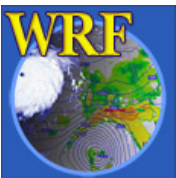
GRIB

- <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

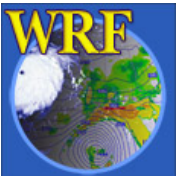
- Output format of ungrid
- WPS util/ directory
 - plotfmt.exe (*graphical interface to view intermediate file*)
 - rd_intermediate
- Create your own intermediate files
 - example if you have input data in netCDF format
 - http://www.mmm.ucar.edu/wrf/OnLineTutorial/WPS/IM_files.htm



Utility: rd_intermediate

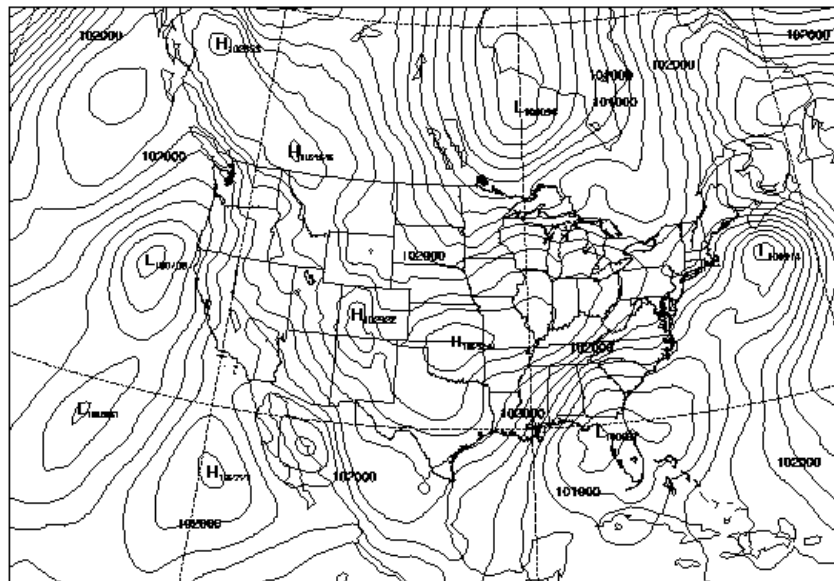
The rd_intermediate lists information about the fields found in an intermediate-format file

```
=====
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



201300 PMSL

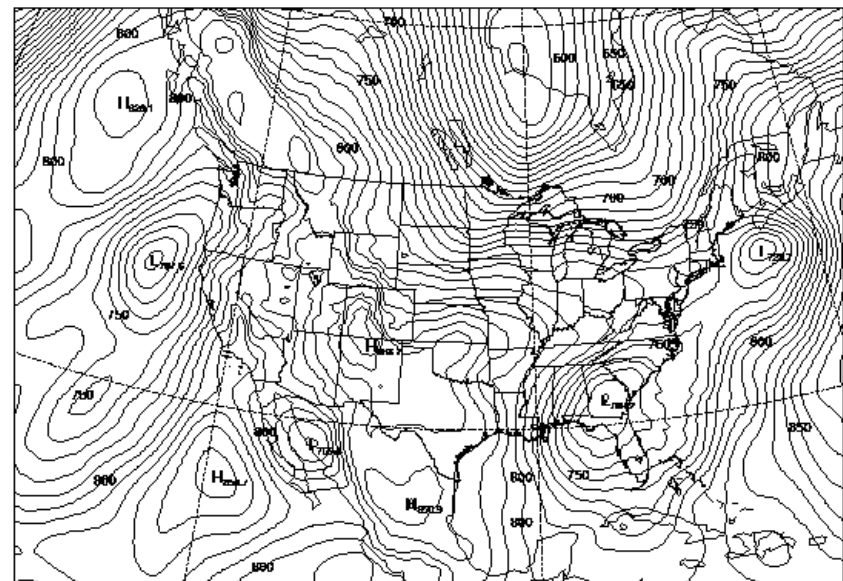
Pa

Sea-level Pressure

WPS intermediate format

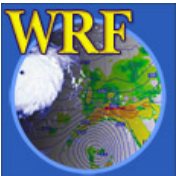
CONTOUR FROM 100200 TO 103200 BY 200

unknown model from NCEP GRID 212



netCDF

- netCDF stands for *network Common Data Form*
- 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

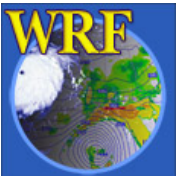
```
a = addfile("./met_em.d01.2000-01-24_12:00:00.nc","w")
```

```
sst = a->SST      ; read a field
```

```
sst = sst + 10; change the field
```

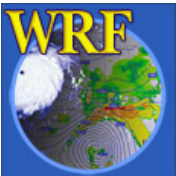
```
a->SST = sst      ; write the field
```

end



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 = "" ;

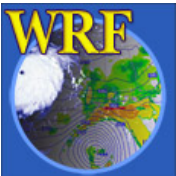
.....

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 ;

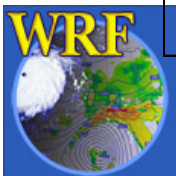
.....

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	FNPF	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	RAINC_V	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

no variable selected

Ncview 1.93a David W. Pierce 1 Feb 2006

*** SELECT A VARIABLE TO START ***

Quit

->|

◀

▶

⏏

▶▶

Edit

?

Delay:

Opts

3gauss

Inv P

Inv C

Mag X1

Linear

Axes

Range

blowup

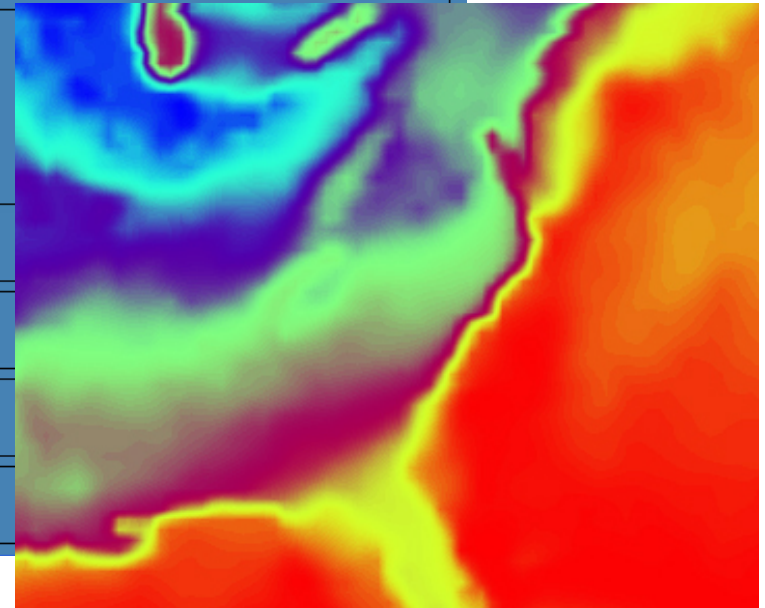
Print

(18) 1d vars

(48) 2d vars

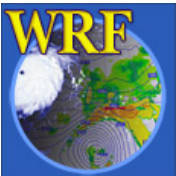
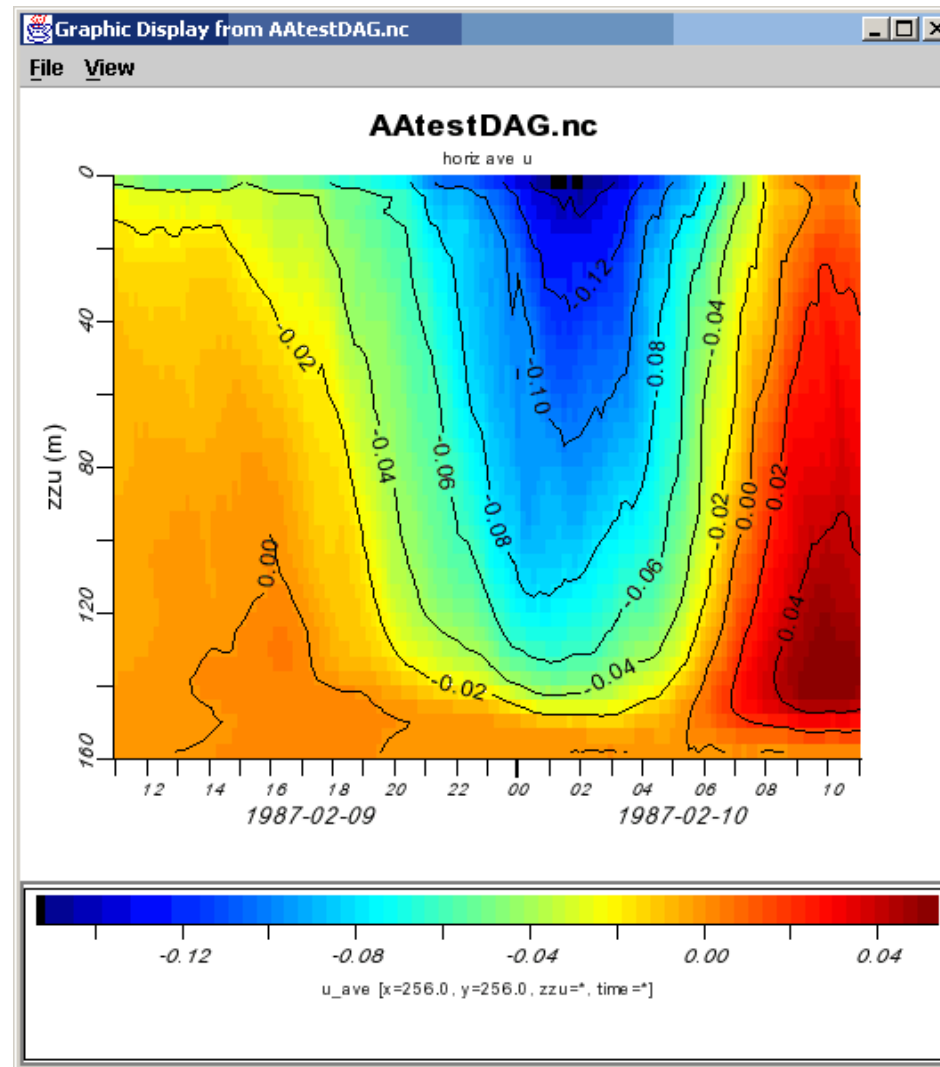
(13) 3d vars

Dim:	Name:	Min:	Current:	Max:	Units:
	Time	Min:		Max:	Units:
	bottom_top	Min:		Max:	Units:
	south_north	Min:		Max:	Units:
	west_east_st	Min:		Max:	Units:



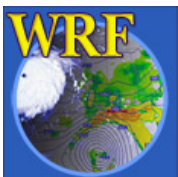
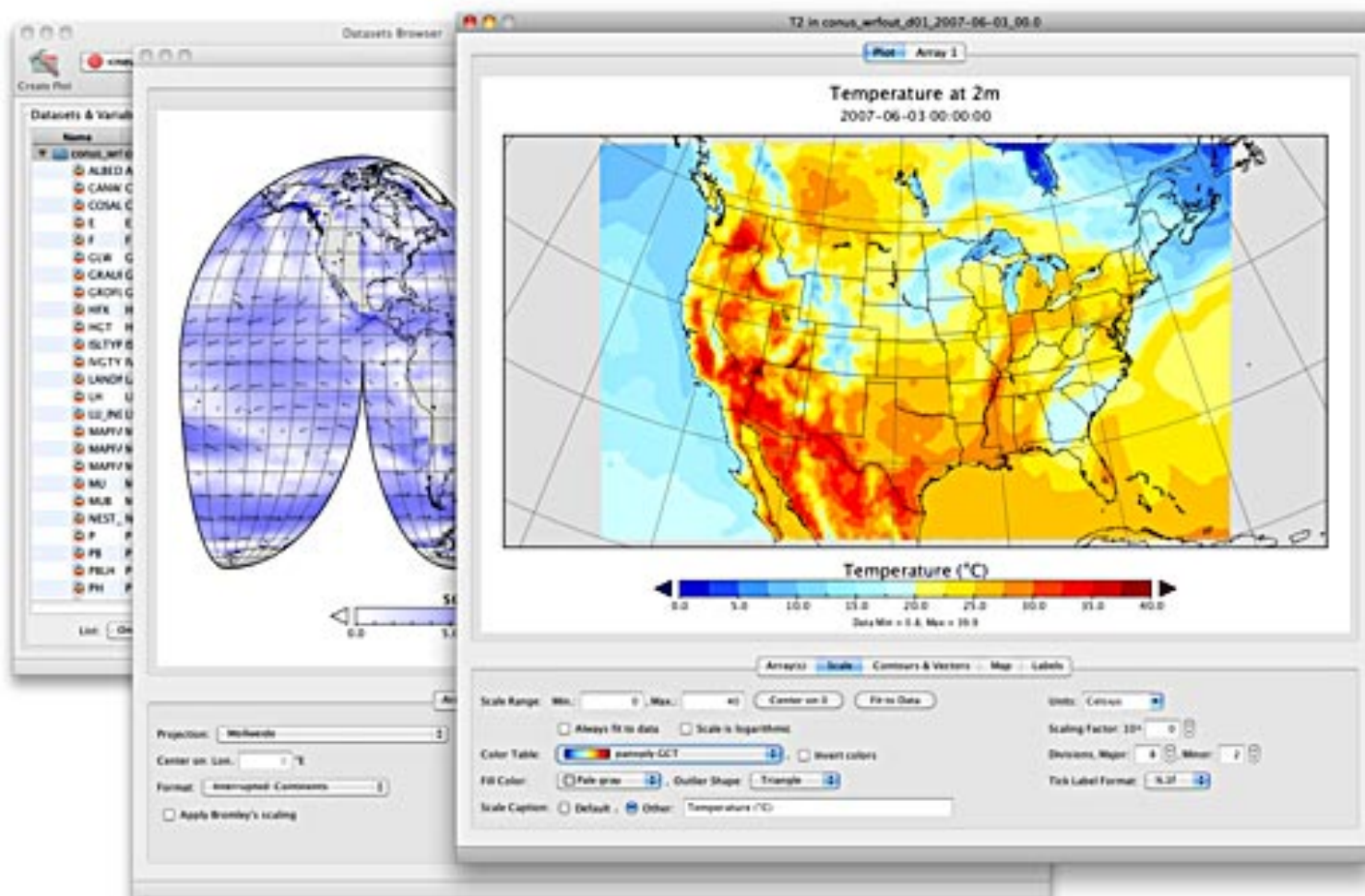
ncBrowse

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



Panoply

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

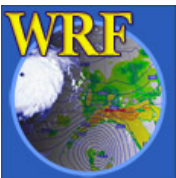


Other Utilities

- 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 of netCDF 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

