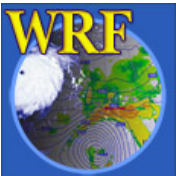




# WRF Utilities

*Cindy Bruyère*



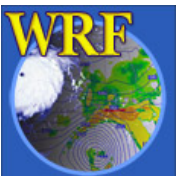
# Utilities

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

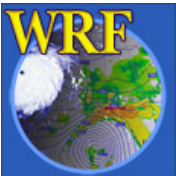


# Graphics : ImageMagick

---

- 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

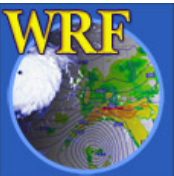
- Single Frame in .ncgm file

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

- Multiple Frames in .ncgm file  
(med = metafile frame editor)

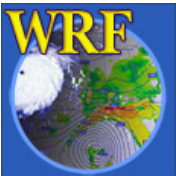
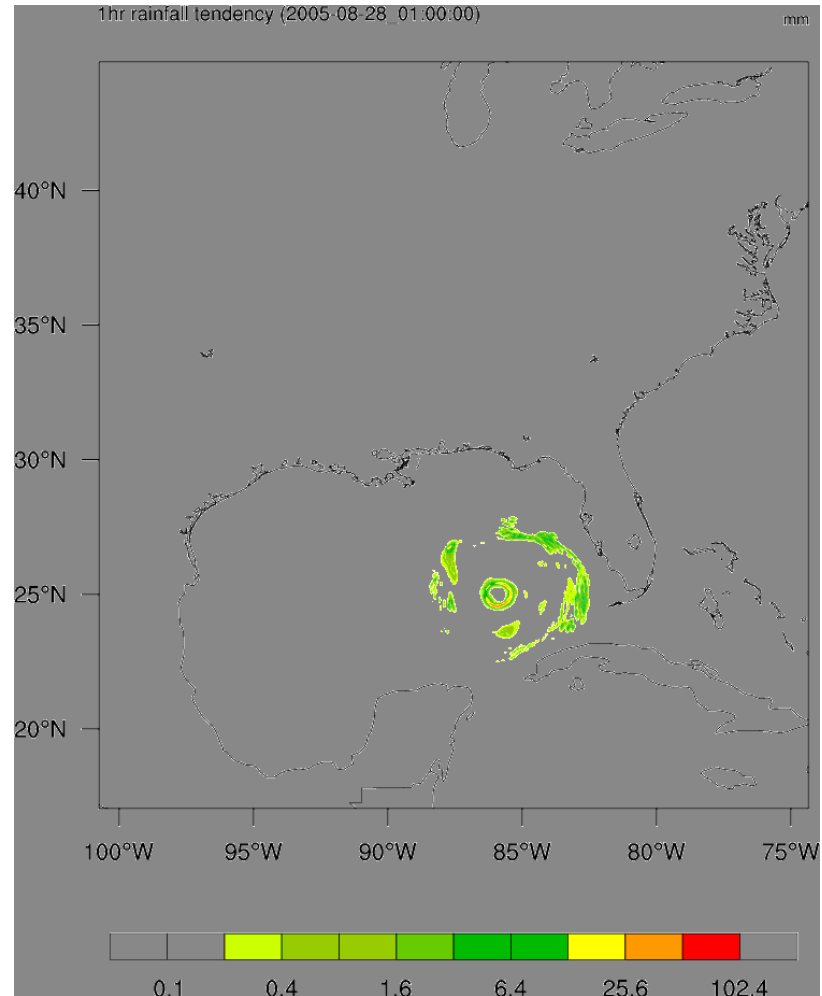
`med -e '1,$ split $' file.cgm`

`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 }



# WRF Model Domain Design

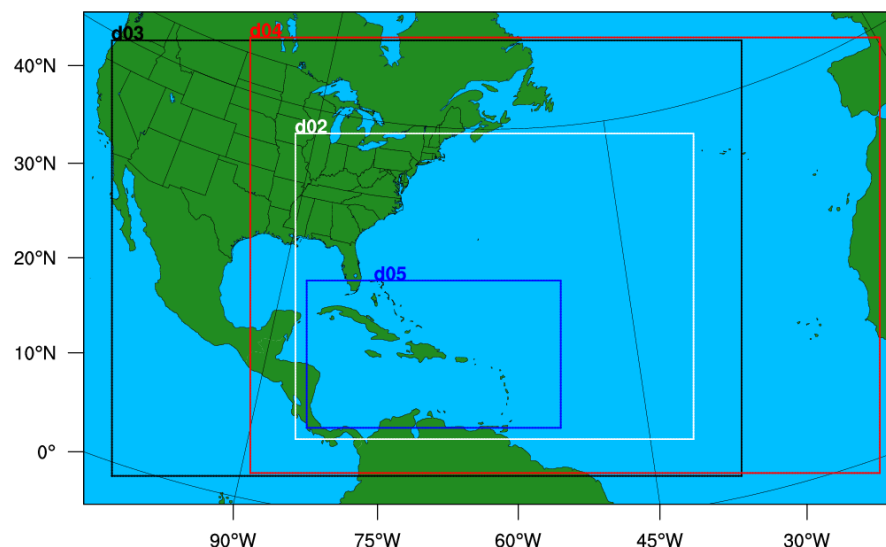
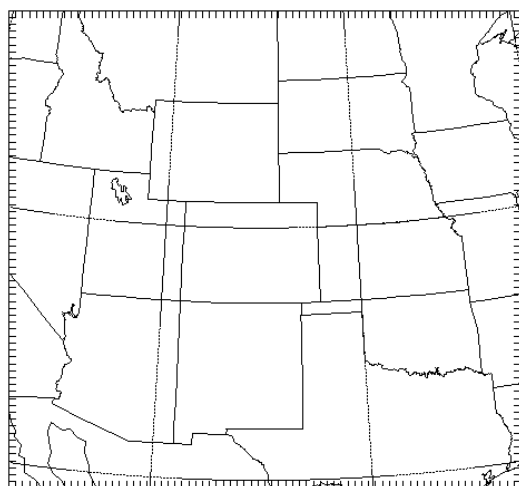
- Fortran Code

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

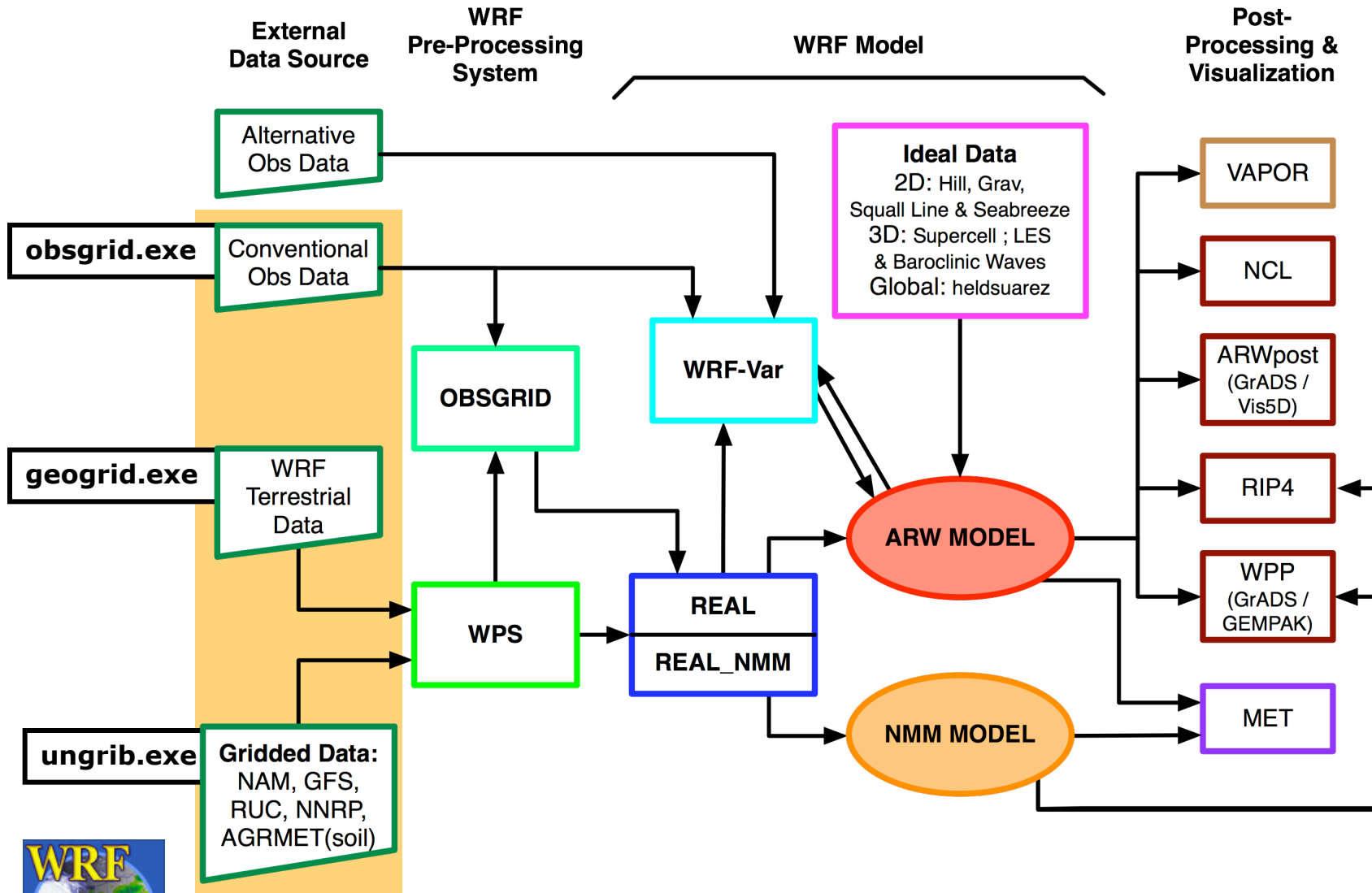
- NCL

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

Test Domain



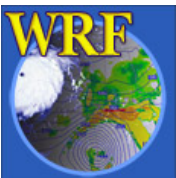
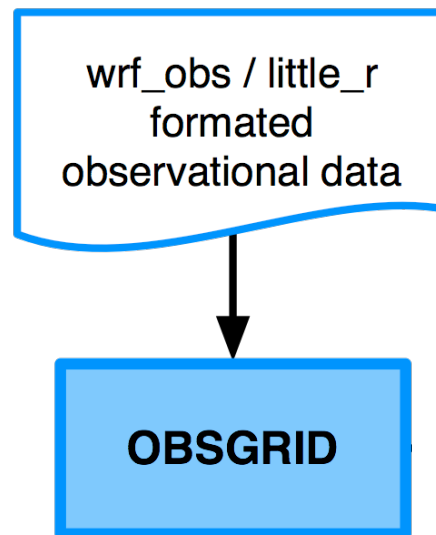
# WRF Modeling System Flow Chart



# Observational Data

---

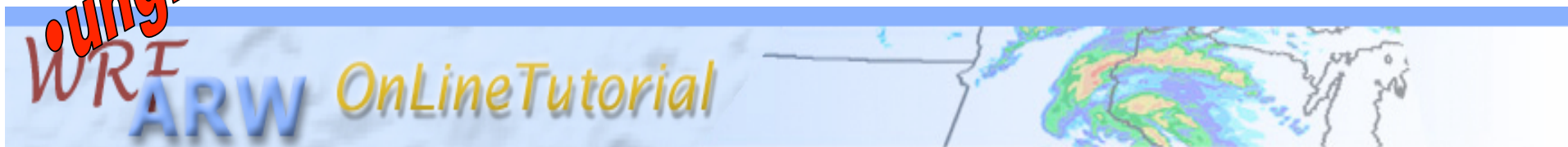
- <http://dss.ucar.edu/datasets/ds353.4/>
  - <http://dss.ucar.edu/datasets/ds464.0/>
  - <http://dss.ucar.edu/datasets/ds351.0/>
  - <http://dss.ucar.edu/datasets/ds461.0/>
- } ADP or ON29
- } NCEP dump-bufr





•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](#)

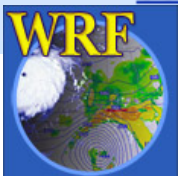
**Global data sets**

- [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](#)

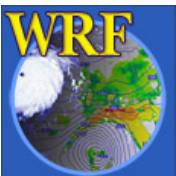
**NOMADS Project**  
[About NOMADS](#)  
[Partners](#)  
[Publications & Presentations](#)  
[Service Records Retention System](#)

**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

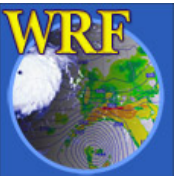
Search Field:



# GRIB

---

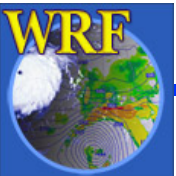
- <http://dss.ucar.edu/docs/formats/grib/gribdoc/> (GRIB1)  
[http://www.nco.ncep.noaa.gov/pmb/docs/grib2/grib2\\_doc.shtml](http://www.nco.ncep.noaa.gov/pmb/docs/grib2/grib2_doc.shtml) (GRIB2)
- g1print.exe & g2print.exe
  - Show data available in GRIB1 & GRIB2 files
  - Available from util/ directory 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](http://www.mmm.ucar.edu/wrf/OnLineTutorial/WPS/IM_files.htm)

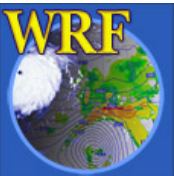


# Utility: rd\_intermediate

---

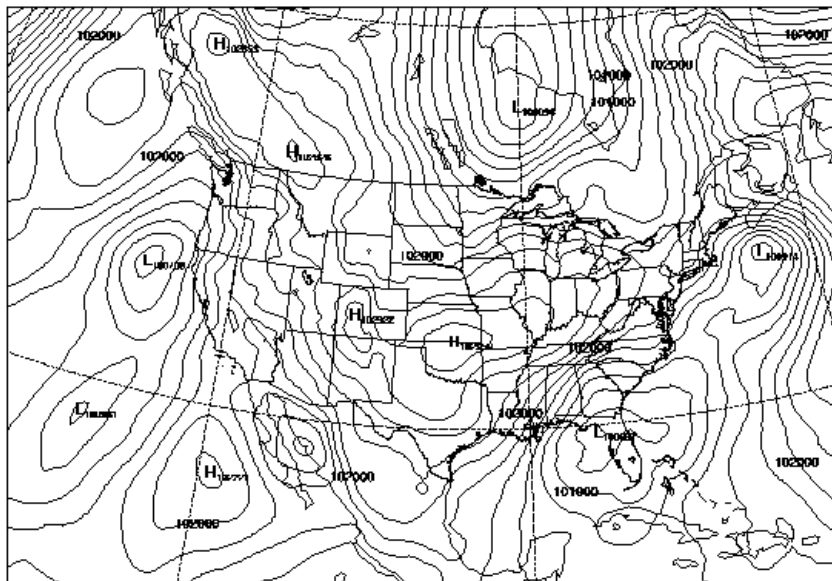
The rd\_intermediate lists information about the fields found in an intermediate-format file

```
=====
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

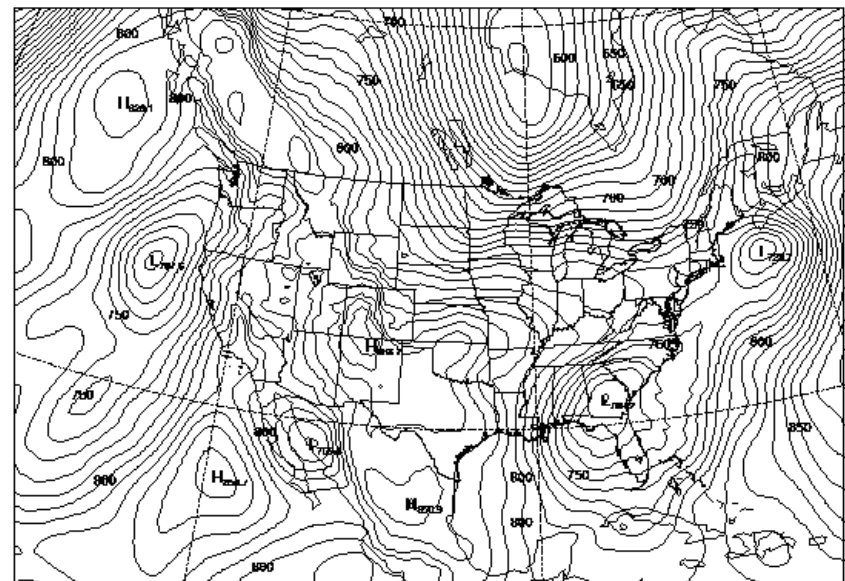
Pa

Sea-level Pressure

WPS intermediate format

CONTOUR FROM 100200 TO 103200 BY 200

unknown model from NCEP GRID 212



92500 GHT

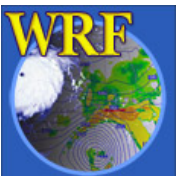
m

Height

WPS intermediate format

CONTOUR FROM 500 TO 880 BY 10

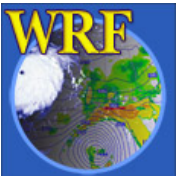
unknown model from NCEP GRID 212



# 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*)

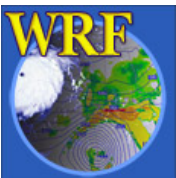


# NCO tools

<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

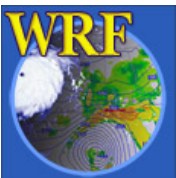
```
a = addfile("./met_em.d01.2000-01-24_12:00:00.nc","w")
```

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

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

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

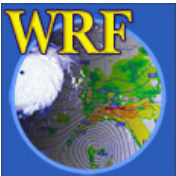
end



# 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 = "" ;

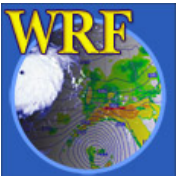
.....

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 ;

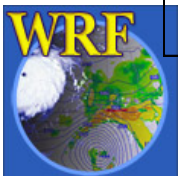
.....

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](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

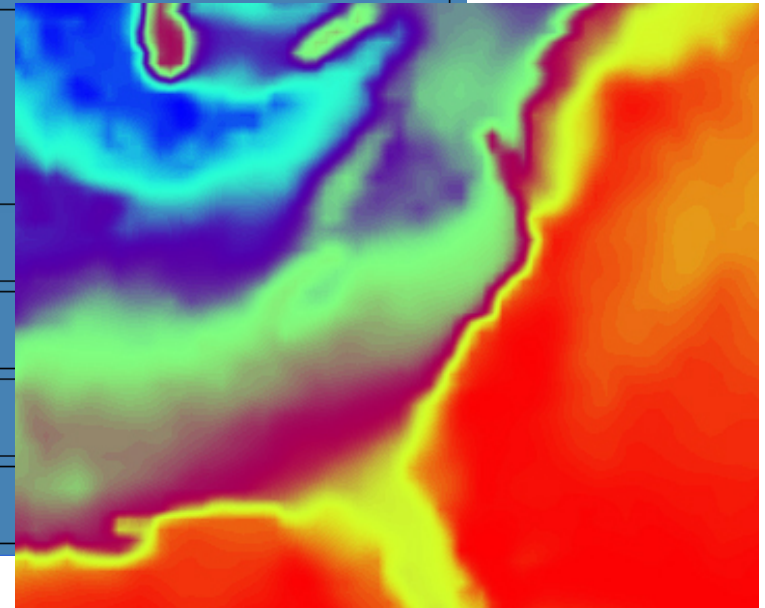
Print

(18) 1d vars

(48) 2d vars

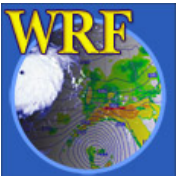
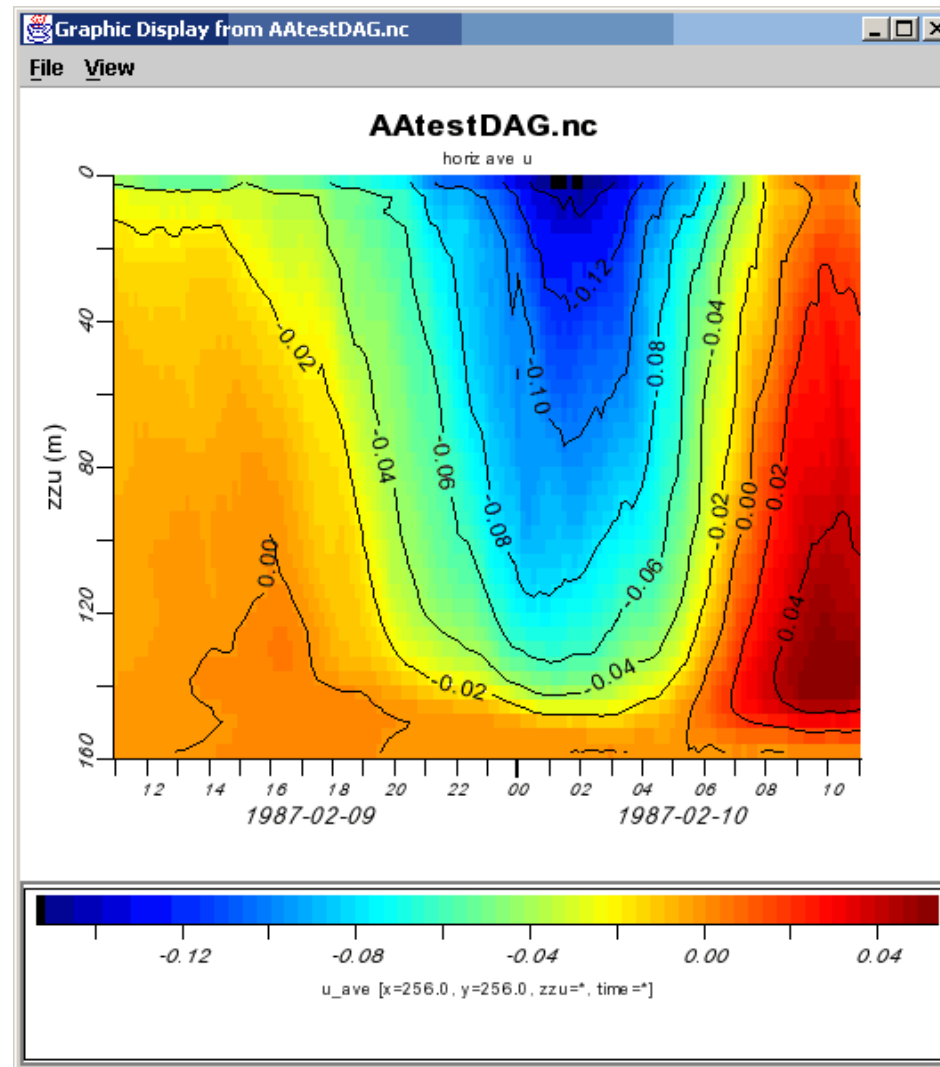
(13) 3d vars

| Dim: | Name:        | Min: | Current:             | Max: | Units: |
|------|--------------|------|----------------------|------|--------|
|      | Time         | Min: | <input type="text"/> | Max: | Units: |
|      | bottom_top   | Min: | <input type="text"/> | Max: | Units: |
|      | south_north  | Min: | <input type="text"/> | Max: | Units: |
|      | west_east_st | Min: | <input type="text"/> | Max: | Units: |



# ncBrowse

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



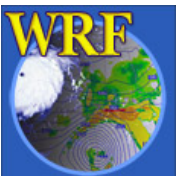
# Other Utilities

---

- 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](mailto:met_help@ucar.edu) or the documentation

