

WRF Tools

WRF Utilities

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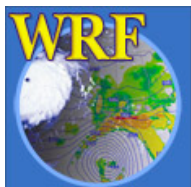
Utilities

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 : *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`



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>

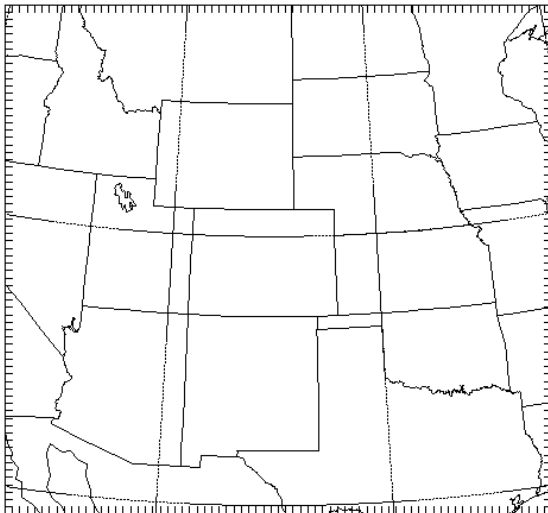
convert	<i>file.pdf</i>	<i>file.png</i>
convert	<i>file.png</i>	<i>file.bmp</i>
convert	<i>file.pdf</i>	<i>file.gif</i>
convert	<i>file.ras</i>	<i>file.png</i>



WRF Model Domain Design

- **WPS util/ directory**

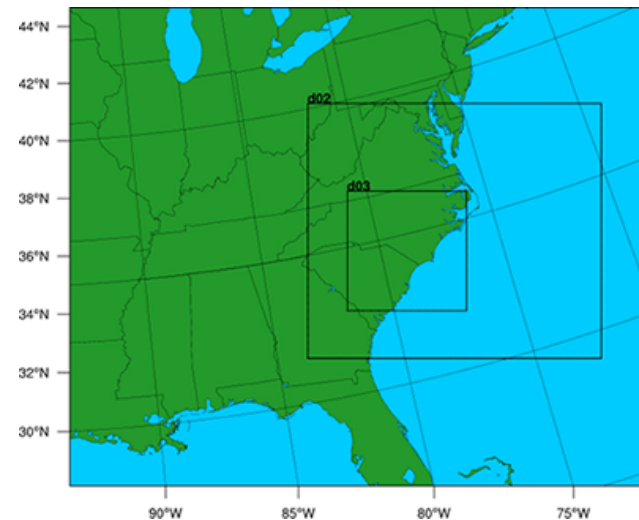
- **plotgrids.exe**
- reads namelist information to generate plot
- create an NCAR Graphics file called 'gmeta'
- use 'idt' to view



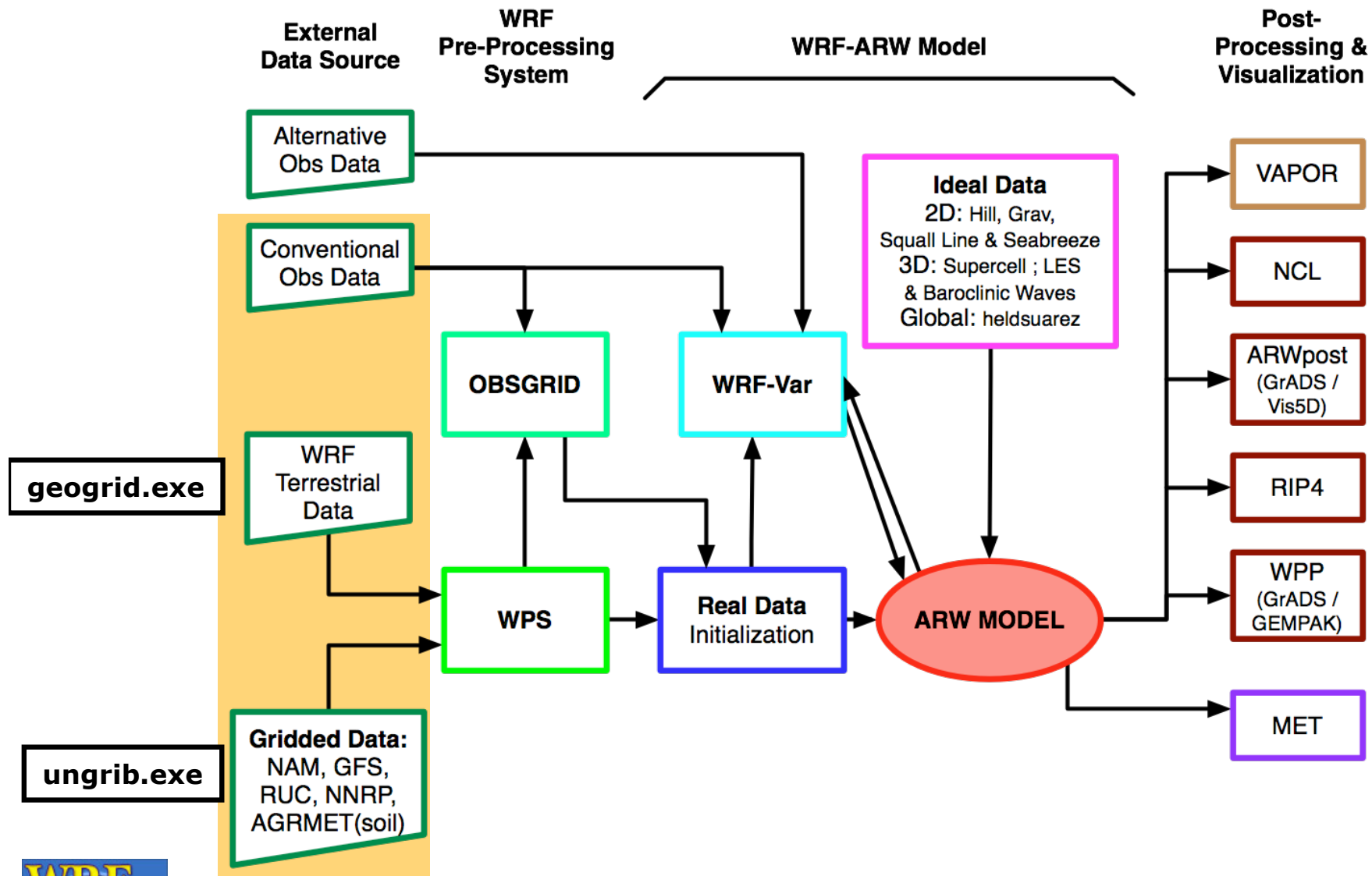
- **NCL**

```
mp = wrf_wps_dom (wks, mpres, \
                  lnres, txres)

mpres@max_dom   = 3
mpres@ref_lat   = 34.83
mpres@ref_lon   = -81.03
mpres@dx        = 30000.
mpres@dy        = 30000.
mpres@map_proj  = "lambert"
```

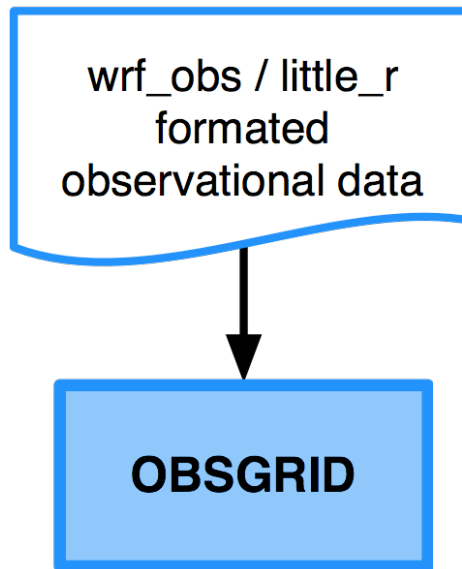


WRF-ARW Modeling System Flow Chart



Observational Data

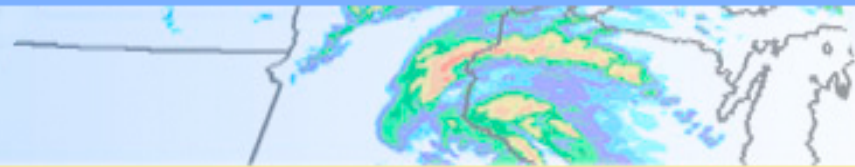
- <http://dss.ucar.edu/datasets/ds353.4/>
- <http://dss.ucar.edu/datasets/ds464.0/>



ungrib.exe

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

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>



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](#)

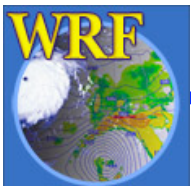
Documentation
[User Guide](#)

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

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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/>
- **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)**
 - wgrib -v file
 - wgrib -V file

<http://www.cpc.ncep.noaa.gov/products/wesley/wgrib.html>



GRIB2

- **Documentation**

http://www.nco.ncep.noaa.gov/pmb/docs/grib2/grib2_doc.shtml

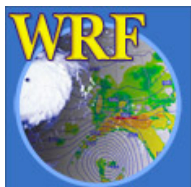
- **GRIB2 - GRIB1 parameter conversion table**

http://www.nco.ncep.noaa.gov/pmb/docs/grib2/GRIB2_parmeter_conversion_table.html

Product	Category	Parameter		Parameter
0	2	2	U	33
0	2	3	V	34

- **wgrib2**

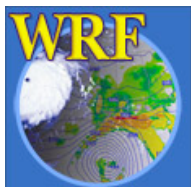
<http://www.cpc.ncep.noaa.gov/products/wesley/wgrib2/>



Utility: g1print and g2print

The *g1print* and *g2print* programs list the contents of a GRIB1 or GRIB2 file:

rec num	Prod Disc	Cat	Param num	Lvl code	Lvl one	Lvl two	Name	Time	Fcst hour
1	0	3	5	100	100000	0	HGT	2006-08-16_12:00:00	00
2	0	3	5	100	97500	0	HGT	2006-08-16_12:00:00	00
3	0	3	5	100	95000	0	HGT	2006-08-16_12:00:00	00
4	0	3	5	100	92500	0	HGT	2006-08-16_12:00:00	00
5	0	3	5	100	90000	0	HGT	2006-08-16_12:00:00	00
6	0	3	5	100	85000	0	HGT	2006-08-16_12:00:00	00
7	0	3	5	100	80000	0	HGT	2006-08-16_12:00:00	00
8	0	3	5	100	75000	0	HGT	2006-08-16_12:00:00	00
9	0	3	5	100	70000	0	HGT	2006-08-16_12:00:00	00
10	0	3	5	100	65000	0	HGT	2006-08-16_12:00:00	00



WPS Intermediate Files

- **Output format of ungrid**
- **WPS util/ directory**
 - plotfmt.exe
graphical interface to view intermediate file
- **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

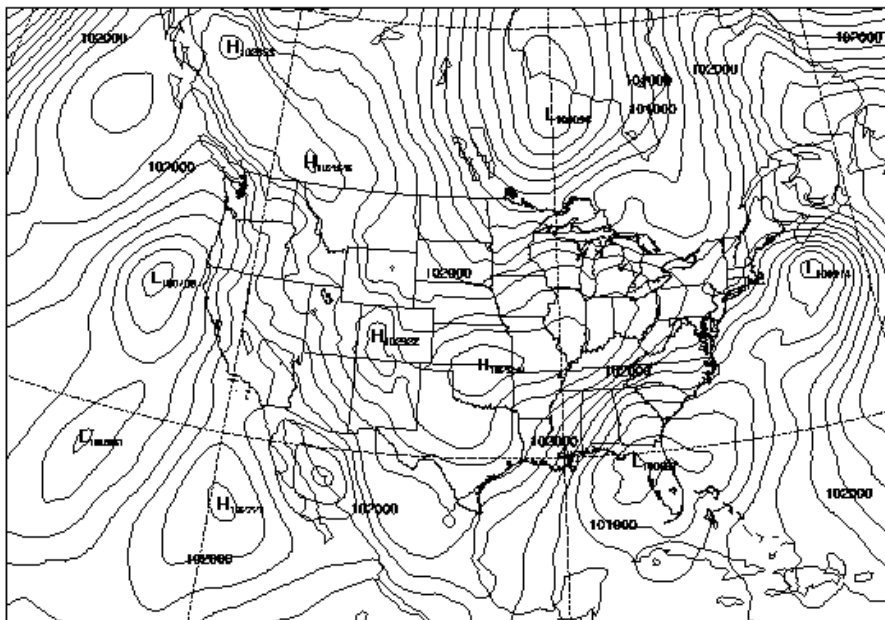
The rd_intermediate lists information about the fields found in an intermediate-format file

```
=====
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

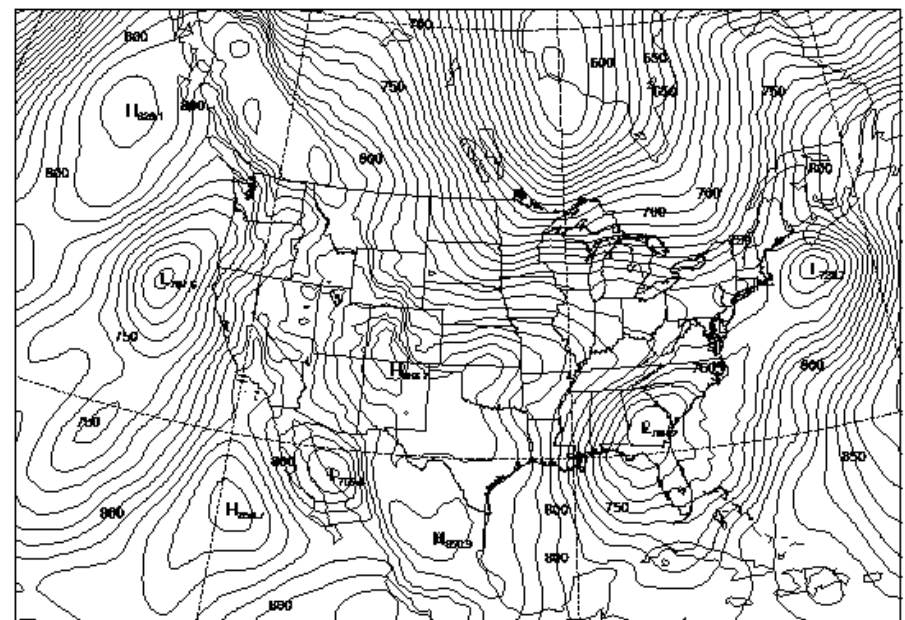
CONTOUR FROM 100200 TO 103200 BY 200

Pa

Sea-level Pressure

WPS intermediate format

unknown model from NCEP GRID 212



92500 GHT

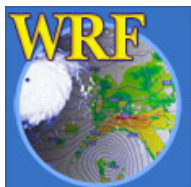
CONTOUR FROM 580 TO 880 BY 10

m

Height

WPS intermediate format

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/fguide.pdf>
(*writing Fortran programs to read/write netCDF files*)



netCDF

- **Advantages of using netCDF?**
 - Platform-independent (*big_endian* / *little_endian*)
 - A lot of software already exist which can be used to process netCDF data
- **netCDF operators**
 - <http://nco.sourceforge.net/>
 - Stand alone programs to, which can be used to manipulate data (*performing grid point averaging / file differencing / file 'appending'*)



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
```



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`



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 -h*

```
netcdf wrfinput_d01 {
dimensions:
    Time = UNLIMITED ; // (1 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 REAL EM V3.0 PREPROCESSOR";
    :START_DATE = "2000-01-24 12:00:00" ;
    :SIMULATION_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 ;
    :GRIDTYPE = "C" ; :MP_PHYSICS = 3 ;
    :SF_SFCLAY_PHYSICS = 1 ;
    :SF_SURFACE_PHYSICS = 1 ;
    :BL_PBL_PHYSICS = 1 ;
    :CU_PHYSICS = 1 ;

.....
.....
.....
```



netCDF : *ncdump -v Times*

```
netcdf wrfinput_d01 {
dimensions:
    Time = UNLIMITED ; // (1 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 REAL_EM V3.0 PREPROCESSOR";
    :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"
```



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

->1

◀

▶

⏸

▶

▶▶

Edit

?

Delay:

Opts

3gauss

Inv P

Inv C

Mag X1

Linear

Axes

Range

blowup

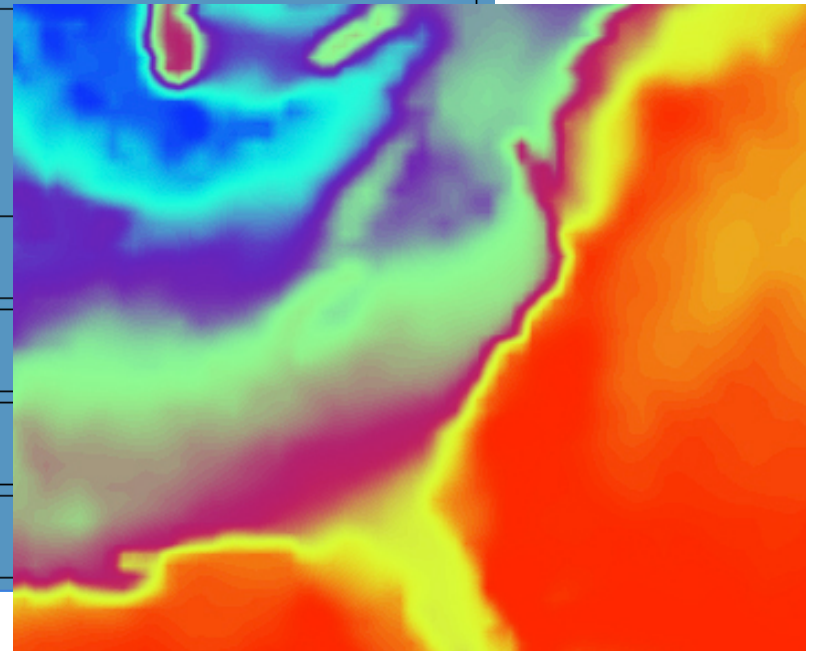
Print

(18) 1d vars

(48) 2d vars

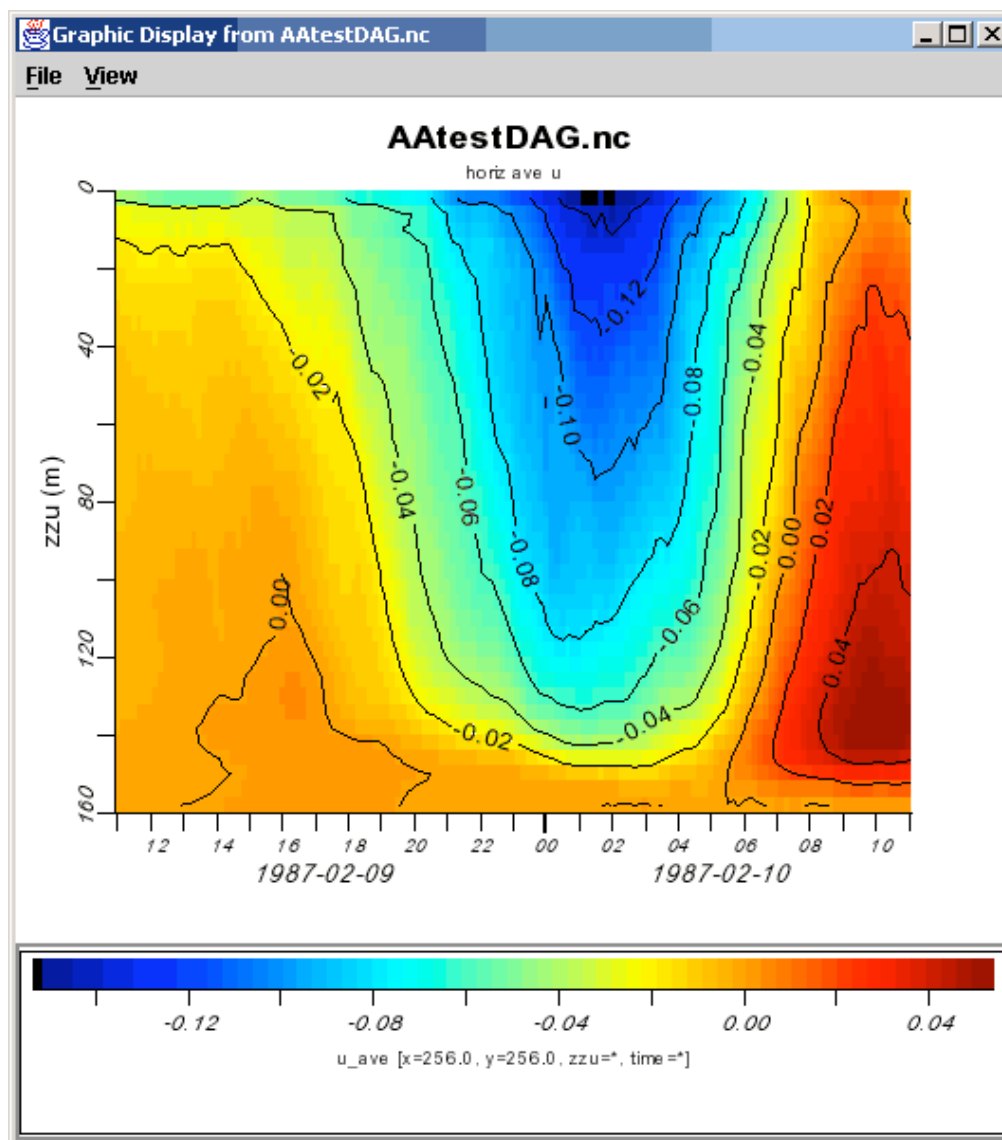
(13) 3d vars

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/>



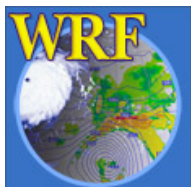
Other Utilities

- **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>



Other Utilities

- **read_wrf_nc**
 - Display data in a wrfout netCDF file
 - Specific points; min/max of fields; time series; edit data in file
- **iowrf**
 - Thinning of netCDF data; extracting a area; destaggering grid
- **p_interp**
 - Interpolate to pressure levels
- **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**

