



Tools

- **Graphical Tools**
- **netCDF**
- **GRIB1 / GRIB2**
- **WPS**
- **Domain Wizard**
- **Verification Tools**

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
convert
convert
convert

file.pdf
file.png
file.pdf
file.ras

file.png
file.bmp
file.gif
file.png

graphics : ncgm2gif

- **ncgm2gif**

- <http://ngwww.ucar.edu/info/ncgm2gif>
- Can split into separate images
- Can create loops and movies (*not very good quality*)
- Optional libraries
 - gifmerge
(<http://the-labs.com/GIFMerge/>)
 - gifsicle
(<http://www.lcdf.org/~eddieltwo/gifsicle/>)

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 CF compliant*)/ binary/GRIB/HDF
 - Most support graphical packages currently only support netCDF file format
- <http://www.unidata.ucar.edu/>
 - Documentation available at this site

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'*)



netCDF : ncdump

- reads a netCDF dataset and prints information from the dataset

ncdump -h *file*

print header (inc. list of variables in the file)



```
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 ;
    DIM0008 = 5 ;
    soil_layers_stag = 5 ;
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 = "" ;
    float U(Time, bottom_top, south_north, west_east_stag) ;
        U:FieldType = 104 ;
        U:MemoryOrder = "XYZ" ;
        U:description = "x-wind component" ;
        U:units = "m s-1" ;
        U:stagger = "X" ;
```




// global attributes:

```
:TITLE = " OUTPUT FROM REAL_EM V2.1.2 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" ;  
:DYN_OPT = 2 ;  
:DIFF_OPT = 0 ;  
:KM_OPT = 1 ;  
:DAMP_OPT = 0 ;  
:KHDIF = 0.f ;  
:KVDIF = 0.f ;  
:MP_PHYSICS = 3 ;  
:RA_LW_PHYSICS = 1 ;  
:RA_SW_PHYSICS = 1 ;  
:SF_SFCLAY_PHYSICS = 1 ;  
:SF_SURFACE_PHYSICS = 1 ;  
:BL_PBL_PHYSICS = 1 ;  
:CU_PHYSICS = 1 ;  
:WEST-EAST_PATCH_START_UNSTAG = 1 ;  
:WEST-EAST_PATCH_END_UNSTAG = 73 ;  
:WEST-EAST_PATCH_START_STAG = 1 ;  
:WEST-EAST_PATCH_END_STAG = 74 ;
```



netCDF : ncdump

- reads a netCDF dataset and prints information from the dataset

ncdump -v *VAR file*

print data of the variable VAR

ncdump -v Times *file*



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

data:

```
Times =  
  "2000-01-24_12:00:00",  
  "2000-01-24_18:00:00",  
  "2000-01-25_00:00:00",  
  "2000-01-25_06:00:00" ;  
}
```

read_wrf_nc

<http://www.mmm.ucar.edu/wrf/users/utilities/util.htm>

- **Developed / Supported by NCAR**

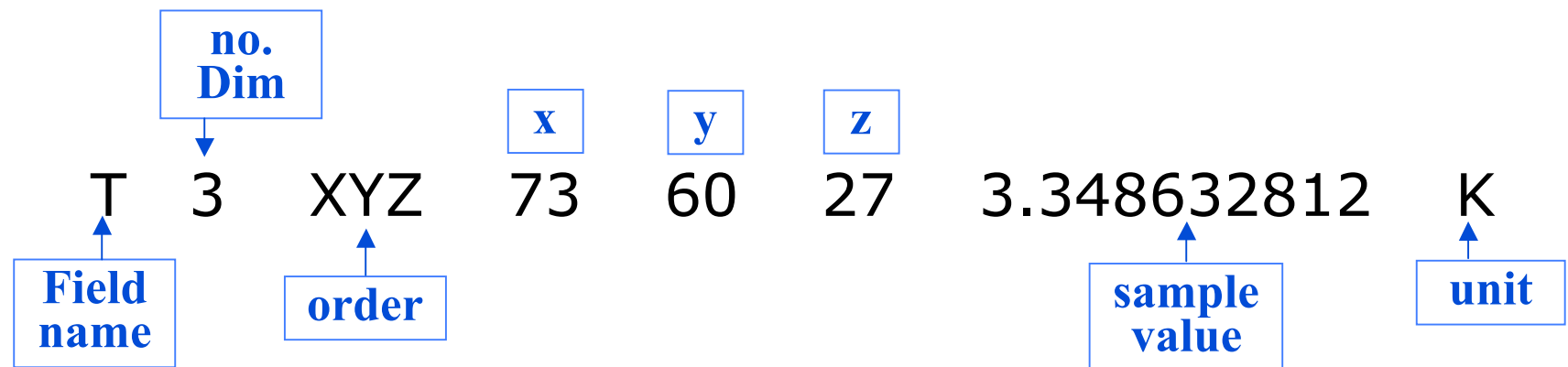
- **FORTRAN program**

Easy to use

Easy to add your own code

Only for netCDF datasets

- **Sample output**



read_wrf_nc : Options

- att*** Global Attributes
- m** Min/Max values for each field
- M z** Min/Max values for each field
(values for 3D fields @ **z** level)
- s** List of available fields + a sample value
- S x y z** List of available fields + value at point **x y z**
- times** List of times in file
- t t1 t2*** Act only on **t1** to **t2** (*t2 optional*)
- v VAR** Basic information about field **VAR**
- V VAR** Basic information about field **VAR**,
and dump the full field out to the screen
- w VAR** Write the full field out to a file **VAR.out**
- diag*** Add diagnostics **tk, pressure, height**
to any output option

read_wrf_nc : Options

- ts** Time Series (*output TIMESERIES.out*)
xy X Y VAR VAR ...
ll lat lon VAR VAR ...
- lev z** For a single vertical level (*time series*)
- rot** Rotate winds (*time series*)

SPECIAL option : **-EditData VAR**

**User is responsible for adding the code
to the subroutine USER_CODE
(inside read_wrf_nc.f)**

iowrf

<http://www.mmm.ucar.edu/wrf/users/utilities/util.htm>

- **Read and Create netCDF files**

- **FORTTRAN program**

Easy to use

Easy to add your own code

Only for netCDF datasets

- **Options**

[-thina X]

[-thin X]

[-box {}]

Upscaling by averaging X grid points

Upscaling with a X:1 ratio

Extract a box from the data file.

X/Y/Z can be controlled

independently. e.g.,

-box x 10 30 y 10 30 z 5 15

-box x 10 30 z 5 15

-box y 10 30

-box z 5 15

[-64bit]

[-A]

If large (>2GB) will be created

de-stagger data

p_interp

- Read netCDF files and interpolate to pressure level
- FORTRAN program
- Namelist Control

```
input_root_name = './wrfout_*00'  
debug = .TRUE.  
bit64 = .TRUE.
```

```
interp_levels = 1000., 800., 700., 500., 300., 100.,
```

```
extrapolate = 0    ;; below ground + above model top to  
                  missing (default)  
              = 1    ;; extrapolate below ground, set above  
                  model top to model top values
```

```
interp_method = 1  ;; linear in p interpolation (default)  
              = 2  ;; linear in log p interpolation
```

```
unstagger_grid = .TRUE.
```


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

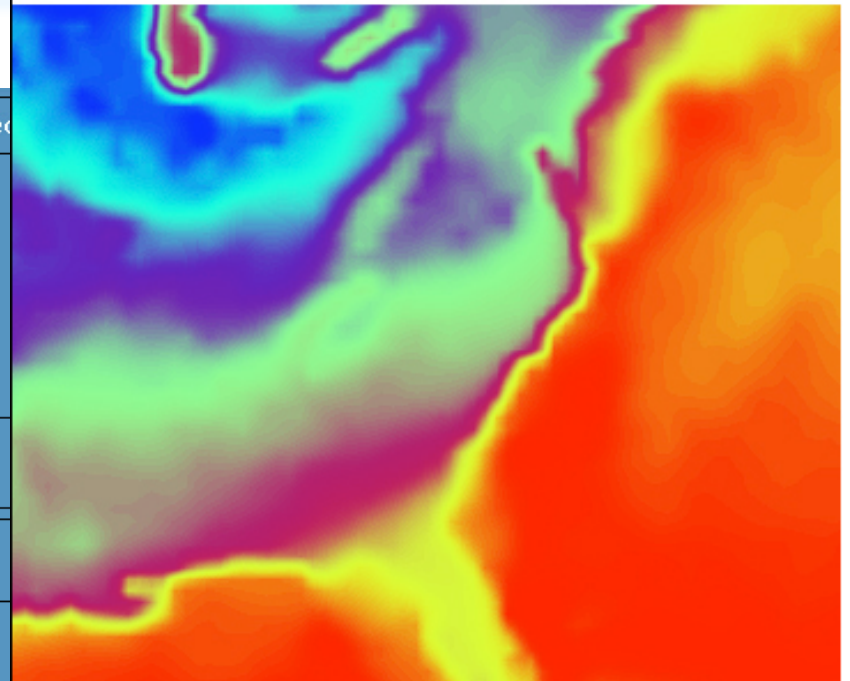
Dim:	Name:	Min:	Current:	Max:	Units:
------	-------	------	----------	------	--------

	Time	Min:	Current:	Max:	Units:
--	------	------	----------	------	--------

	bottom_top	Min:	Current:	Max:	Units:
--	------------	------	----------	------	--------

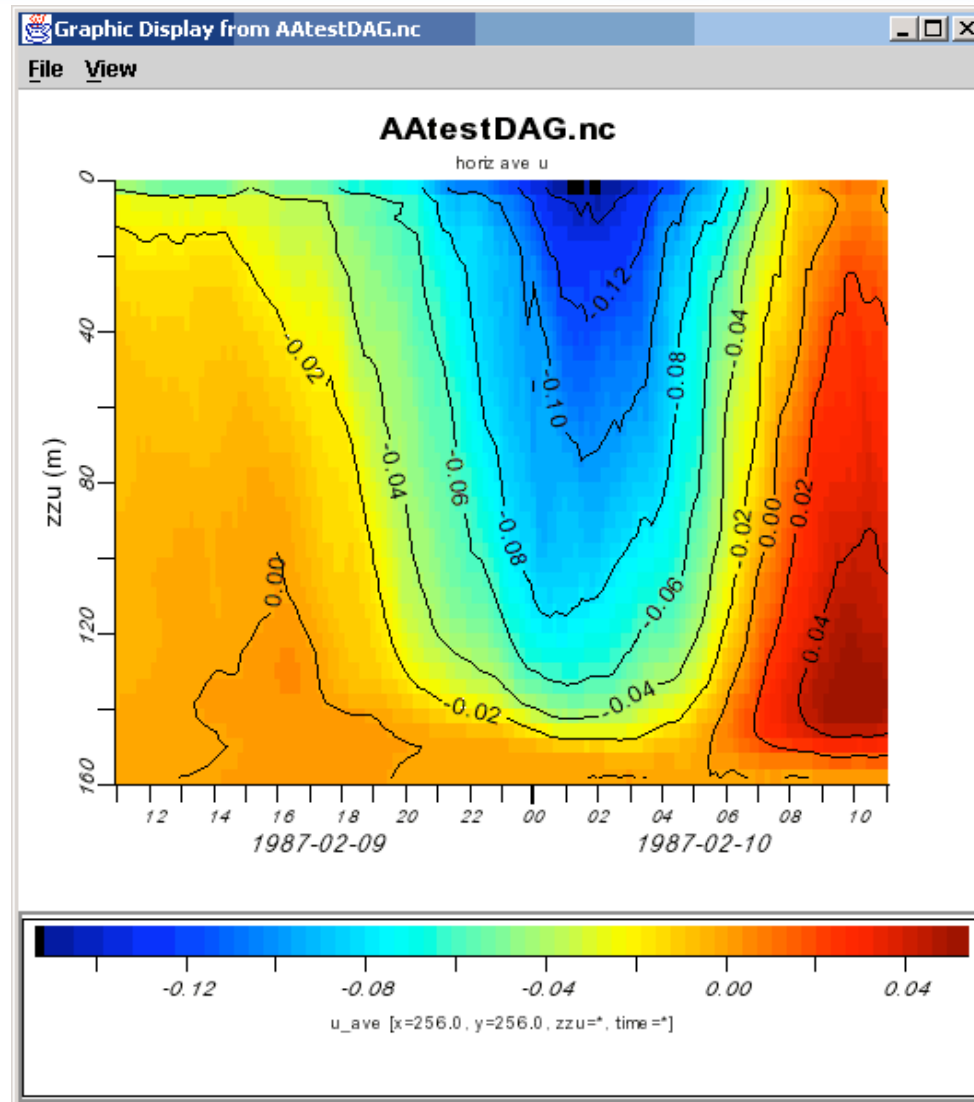
	south_north	Min:	Current:	Max:	Units:
--	-------------	------	----------	------	--------

	west_east_st	Min:	Current:	Max:	Units:
--	--------------	------	----------	------	--------



ncBrowse

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



NCO tools

<http://nco.sourceforge.net/>

- **ncdiff**

- Difference two file

ncdiff input1.nc input2.nc output.nc

- **ncrcat** (*nc cat*)

- Write specified variables / times to a new file

ncrcat -v RAINNC wrfout RAINNC.nc*

ncrcat -d Time,0,231 -v RAINNC wrfout RAINNC.nc*

- **ncra** (*nc average*)

- Average variables and write to a new file

ncra -v OLR wrfout OLR.nc*

- **ncks** (*nc kitchen sink*)

- Combination of NCO tools all in one (*handy: one tool for multiple operations*)

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**
 - wgrib -v file
 - wgrib -V file
 - <http://www.cpc.ncep.noaa.gov/products/wesley/wgrib.html>

GRIB : wgrib

-s/-v	<i>short/verbose inventory</i>
-V	<i>diagnostic output</i>
-PDS/-PDS10	<i>print PDS in hex/decimal</i>
-GDS/-GDS10	<i>print GDS in hex/decimal</i>
-verf	<i>print forecast verification time</i>
-4yr	<i>print year using 4 digits</i>
-d [record no]	<i>decode record number</i>
-text/-ieee/ -grib/-bin	<i>convert to text/ieee/grib/bin</i>
-nh/-h	<i>output will have no headers/headers</i>
-H	<i>output will include PDS and GDS</i>
-append	<i>append to output file</i>
-o [file]	<i>output file name</i>

GRIB : wgrib

122:3513554:D=2004123000:HGT:850
mb:kpds=7,100,850:anl:"Geopotential height [gpm]

123:3549446:D=2004123000:TMP:850
mb:kpds=11,100,850:anl:"Temp. [K]

125:3597364:D=2004123000:UGRD:850
mb:kpds=33,100,850:anl:"u wind [m/s]

126:3624306:D=2004123000:VGRD:850
mb:kpds=34,100,850:anl:"v wind [m/s]

5:152514:D=2004123000:TMP:2 m above
gnd:kpds=11,105,2:anl:"Temp. [K]

46:1242222:D=2004123000:SPFH:2 m above
gnd:kpds=51,105,2:anl:"Specific humidity [kg/kg]

Vtables

GRIB1 Param	Level Type	From Level1	To Level2	REGRID Name	REGRID Units	REGRID Description
11	100	*		T	K	Temperature
33	100	*		U	m s-1	U
34	100	*		V	m s-1	V
52	100	*		RH	%	Relative Humidity
7	100	*		HGT	m	Height
11	105	2		T	K	Temperature at 2 m
52	105	2		RH	%	Relative Humidity at 2 m

GRIB & NCL

- **ncl_filedump**
generates an ASCII representation of a supported file (netCDF, HDF, GRIB) on the standard output
- **ncl_grib2nc**
translates a GRIB file into a netCDF formatted file
- **<http://www.ncl.ucar.edu/Document/Tools>**

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/>

general netCDF data

- **NETCDF User's Guide for FORTRAN**
<http://www.unidata.ucar.edu/software/netcdf/fguide.pdf>
- **read_wrf_nc.f**
 - Good example of how to read NETCDF files
- **Create Intermediate files (MM5 sample)**
http://www.mmm.ucar.edu/wrf/OnLineTutorial/WPS/IM_mm5.htm

WPS tools

- **WPS util/ directory**

- **plotfmt.exe**

- graphical interface for intermediate file*

- **plotgrids.exe**

- quick look at domains you want to create
(reads namelist information to generate plot)*

Domain Wizard

- **GUI to create model domain and run WPS executables**
 - Created by Paula McCaslin - paula.mccaslin@noaa.gov and Jeff Smith - jeff.s.smith@noaa.gov (NOAA)
- **Tutorials and code are available from:**
<http://www.wrfportal.org/tutorial.html>
<http://www.wrfportal.org/DomainWizard.html>
- **Suggestion** – if you are interested in using Domain Wizard, **first get familiar with WPS by running it manually**
- **Currently MPI options not recommend**

Model Evaluation Tools (MET)

- **DTC are busy developing a Model Evaluation Tool kit**
 - Version 1.0 released January 2008
 - Optional talk this Friday afternoon
 - <http://www.dtcenter.org/met/users/>