WRF Utilities

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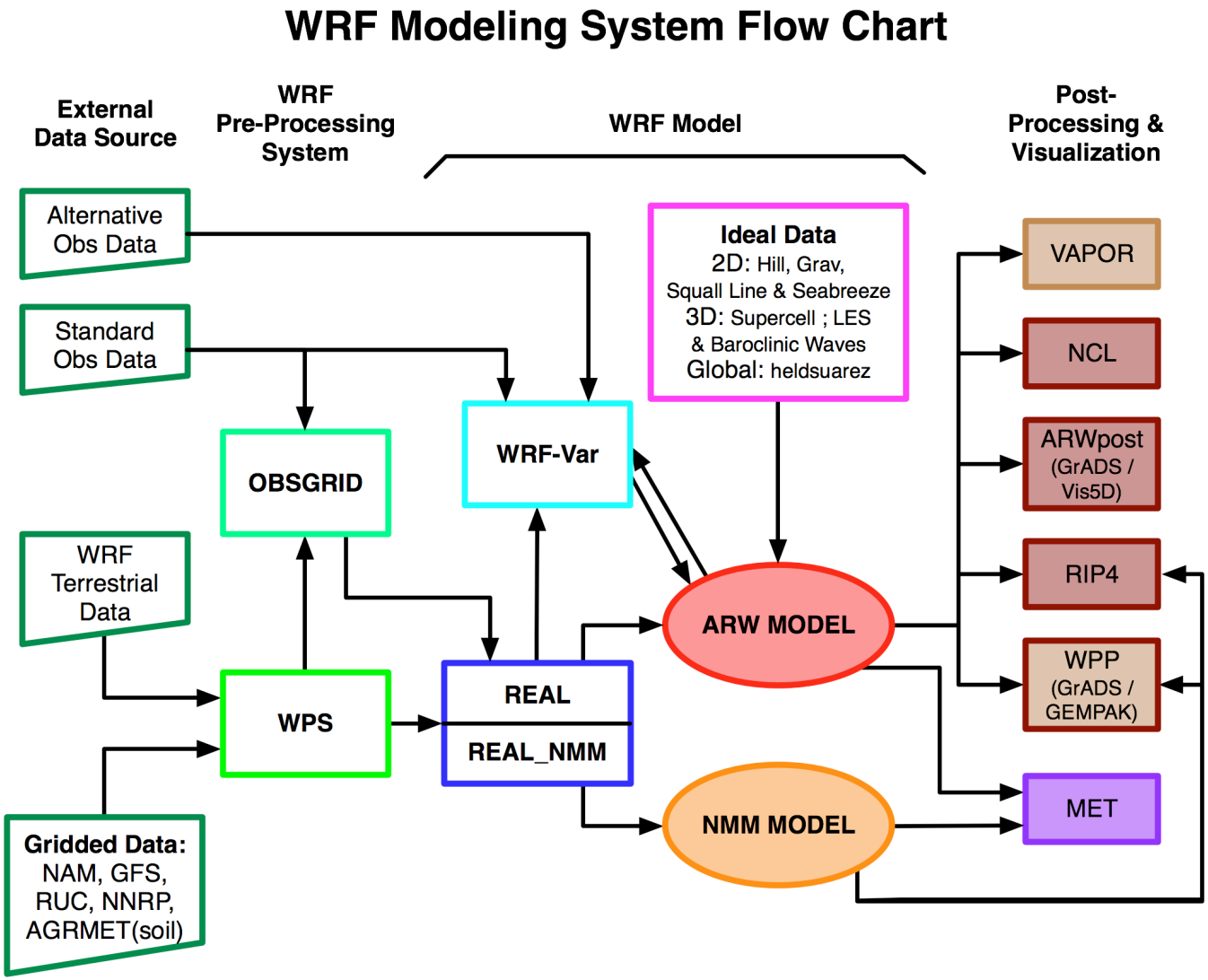
Overview

- Graphical Tools
- WRF Model Domain Design
- Intermediate Files
- netCDF
- GRIB1 / GRIB2
- Verification Tools
- Domain Wizard

Graphics


WRF Modeling System Flow Chart
External Data Source
WRF Pre-Processing System
WRF Model
Post-Processing & Visualization
Alternative Obs Data
Standard Obs Data
WRF Terrestrial Data
Gridded Data: NAM, GFS, RUC, NNRP, AGRMET(soil)
OBSGRID
WPS
WRF-Var
REAL
REAL_NMM
Ideal Data
2D: Hill, Grav, Squall Line & Seabreeze
3D: Supercell ; LES & Baroclinic Waves
Global: heldsuarez
ARW MODEL
NMM MODEL
VAPOR
NCL
ARWpost (GrADS / Vis5D)
RIP4
WPP (GrADS / GEMPAK)
MET

Graphics

- **NCL**
  - Graphical package
  - *WRF-ARW Only*
- **ARWpost**
  - Converter (GrADS & vis5d)
  - *WRF-ARW Only*
- **RIP4**
  - Converter and interface to graphical package NCAR Graphics
- **VAPOR**
  - Converter and graphical package
  - *WRF-ARW Only*
- **WPP**
  - Converter (GrADS & GEMPAK)
- **IDL**
- **IDV**
- **MatLab**
- **GEMPAK**

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

WRF Model Domain Design

- **WPS util/ directory**
  - **plotgrids.exe**

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

    create an NCAR Graphics file called 'gmeta'

    use 'idt' to view

WPS Intermediate Files

- **Output format of ungrid**
- **WPS util/ directory**
  - **plotfmt.exe**
    graphical interface to view intermediate file
- **Create your own intermediate files**
  - ***http://www.mmm.ucar.edu/wrf/OnLineTutorial/WPS/IM_files.htm***

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')*

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)*

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 = "" ;

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

netCDF : *ncdump -h*

```
.....

// 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" ;
            :DYN_OPT = 2 ;
            :DIFF_OPT = 0 ;
            :MP_PHYSICS = 3 ;
            :SF_SFCLAY_PHYSICS = 1 ;
            :SF_SURFACE_PHYSICS = 1 ;
            :BL_PBL_PHYSICS = 1 ;
            :CU_PHYSICS = 1 ;
```

netCDF : *ncdump -v Times*

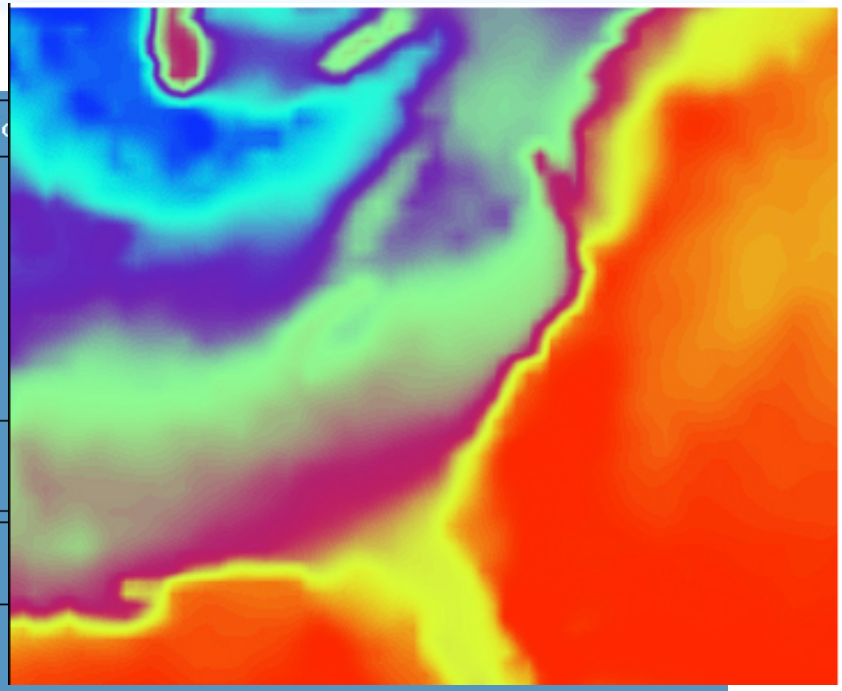
```
   ..............


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" ;
}
```

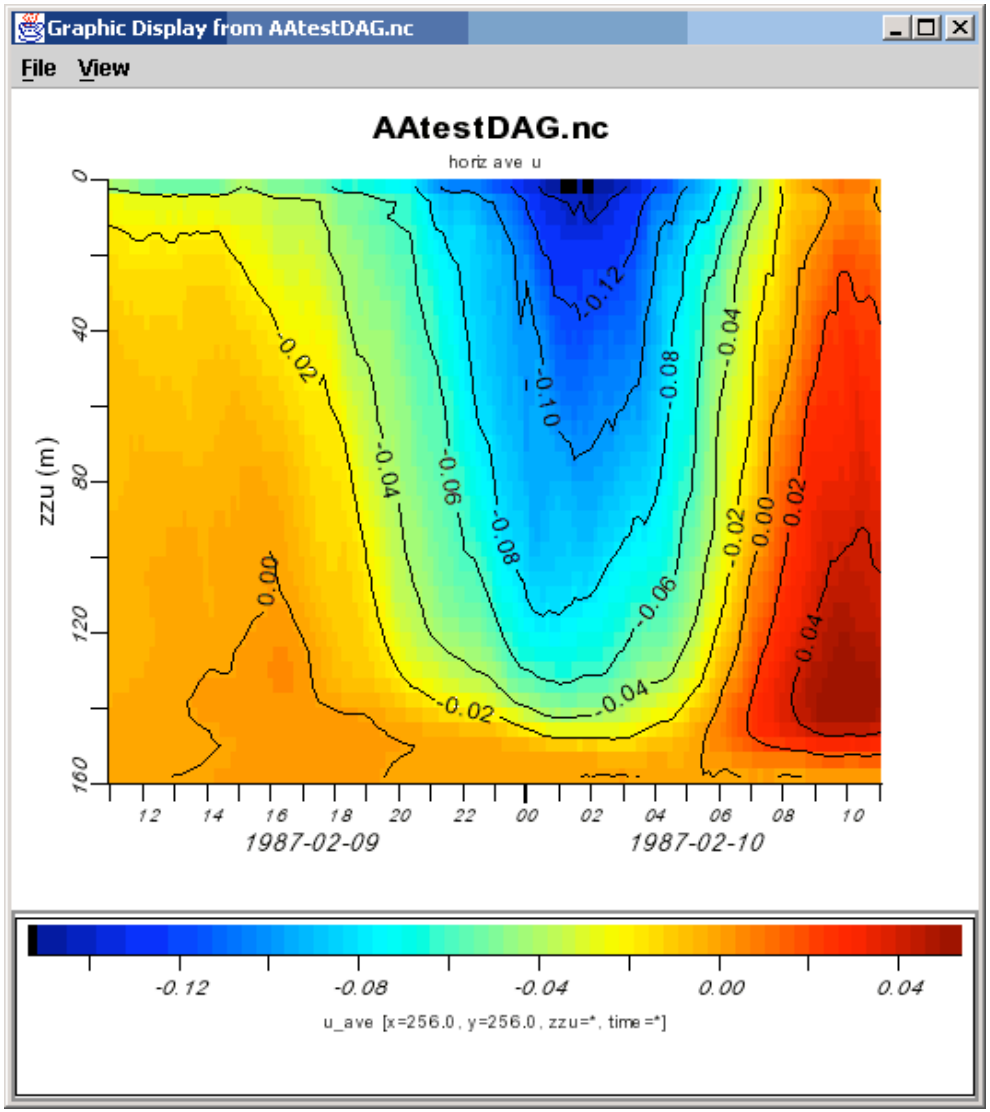
ncview

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



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** ***(ARW & NMM)***
  - Display data inside a wrfout netCDF file
  - Specific points; min/max of fields; time series; edit data in file
- **iowrf** ***(ARW)***
  - Thinning ofnetCDF data; extracting a area; destaggering grid
- **p_interp** ***(ARW)***
  - Interpolate to pressure levels
- **v_interp** ***(ARW)***
  - Add vertical levels in wrf input and boundary files
  - For use with ndown

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/

MET & Domain Wizard

- **DTC's Model Evaluation Tool Kit (MET)**
  - ***http://www.dtcenter.org/met/users/***

- **Domain Wizard**
  - GUI to create model domain and run WPS executables
  - 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