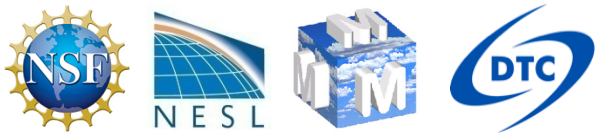
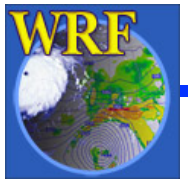



# Post-processing Tools

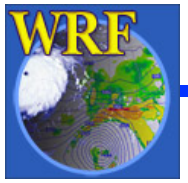
*Cindy Bruyère*



# Graphical Packages

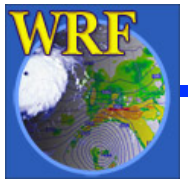
- **NCL** — UG: 9-2
  - Graphical package
- **ARWpost** — UG: 9-28
  - Converter (GrADS & vis5d)
- **RIP4** — UG: 9-19
  - Converter and interface to graphical package NCAR Graphics
- **UPP** — UG: 9-35
  - Converter (GrADS & GEMPAK)
- **VAPOR** — UG: 9-50
  - Converter and graphical package
  - *Support: VAPOR*
- **IDV** — unidata.ucar.edu
  - GRIB (from WPP)
  - GEMPAK (from wrf2gem)
  - vis5d (from ARWpost)
  - CF complaint data (from wrf_to_cf)
  - *Support: unidata*
- **GEMPAK**
  - Data from wrf2gem or WPP
  - *Support: unidata*

**MatLab / IDL / R / ferret**



# RIP4

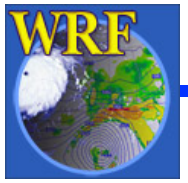
- Read Interpolate Plot version 4
- Develop by Mark Stoelinga (3TIER/UW/NCAR) & MMM/NCAR Staff
- Originally developed for the MM5 model
- Generate a number of graphical plots
  - Horizontal, cross-section, skewT
- Current Version: 4.6
  - configure / compile



# RIP4 - General Information

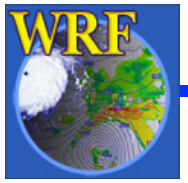
- **Documentation**
  - In program tar file under the Doc/ directory
  - *http://www.mmm.ucar.edu/wrf/users/docs/ripug.htm*
  - *http://www.dtcenter.org/wrf-nmm/users/docs/user_guide/RIP/ripug.htm*

- **OnLine Tutorial:**
  - *http://www.mmm.ucar.edu/wrf/users/graphics/RIP4/RIP4.htm*
  - *http://www.dtcenter.org/wrf-nmm/users/OnLineTutorial/NMM/RIP/index.php*

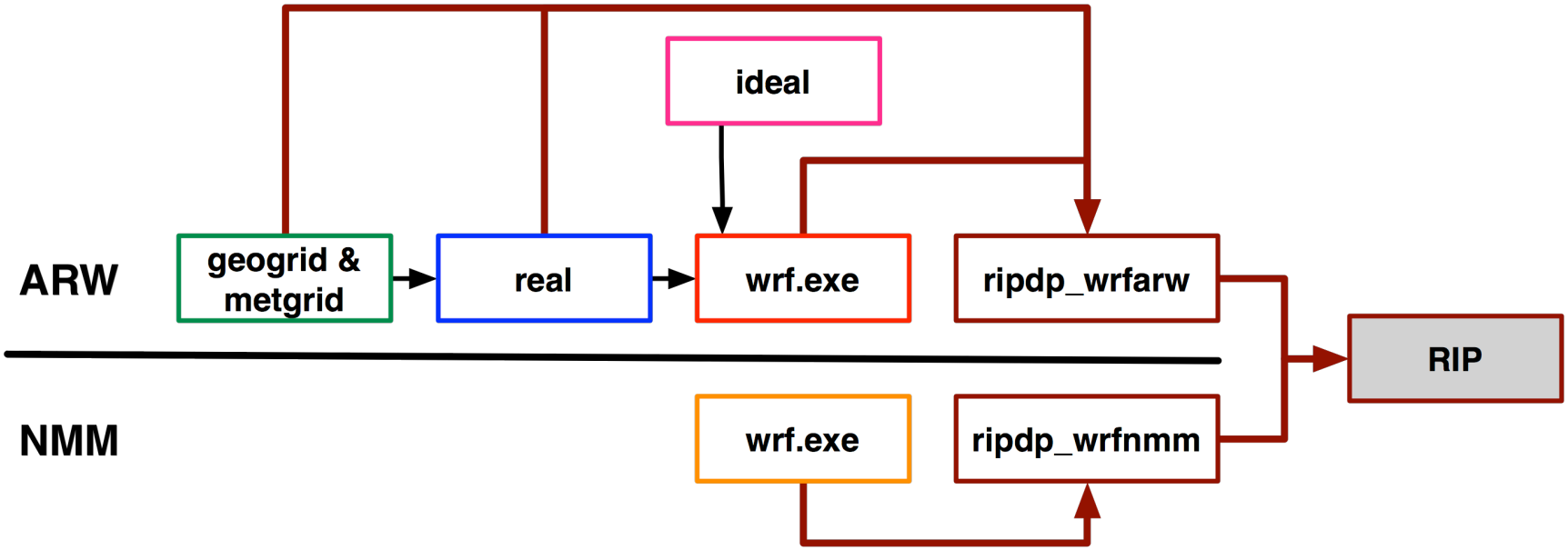


# RIP4 - General Information

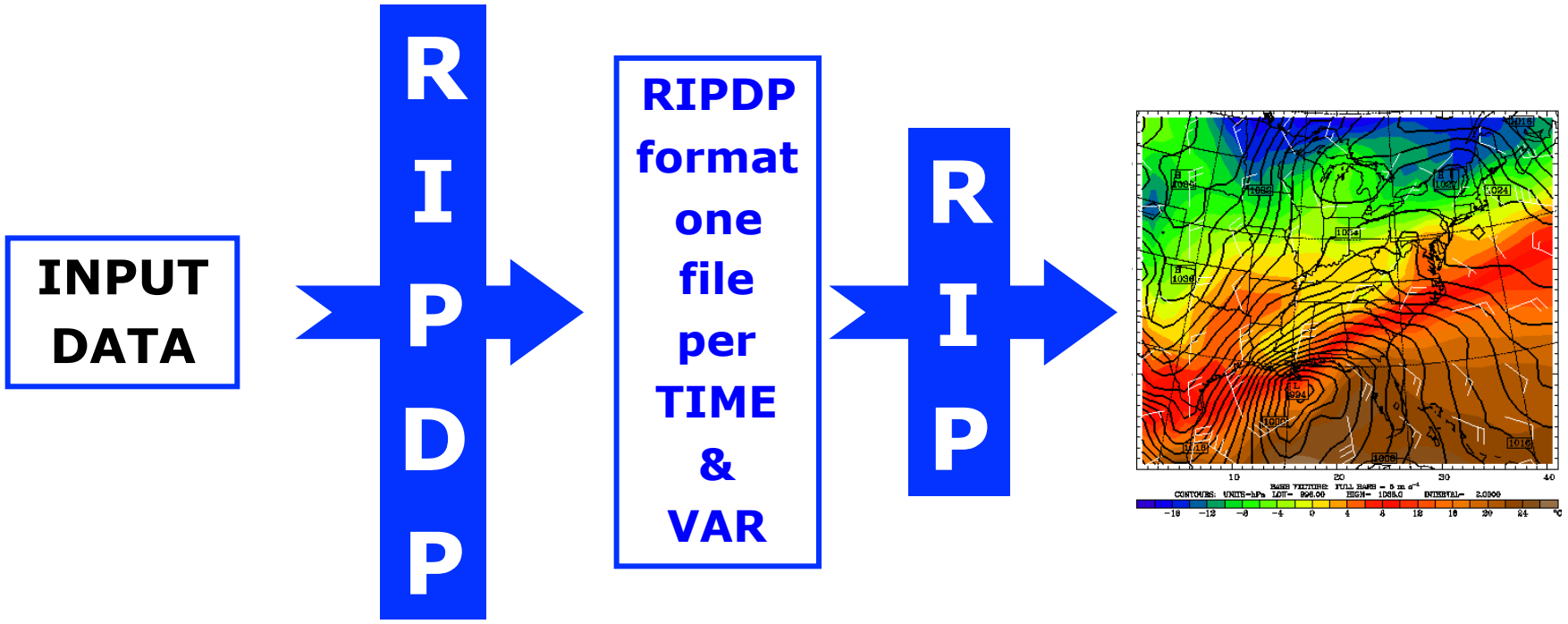
- Requires NCAR Graphics low-level routines
  - *http://ngwww.ucar.edu*
- NCL Version 5 / 6:
  - *http://www.ncl.ucar.edu*
  - Released November 2007
  - Combine NCL and NCAR Graphics
  - Open Source
  - Recommended
- Download Code:
  - *http://www.mmm.ucar.edu/wrf/users/download/get_source.html*
  - *http://www.dtcenter.org/wrf-nmm/users/downloads/index.php*



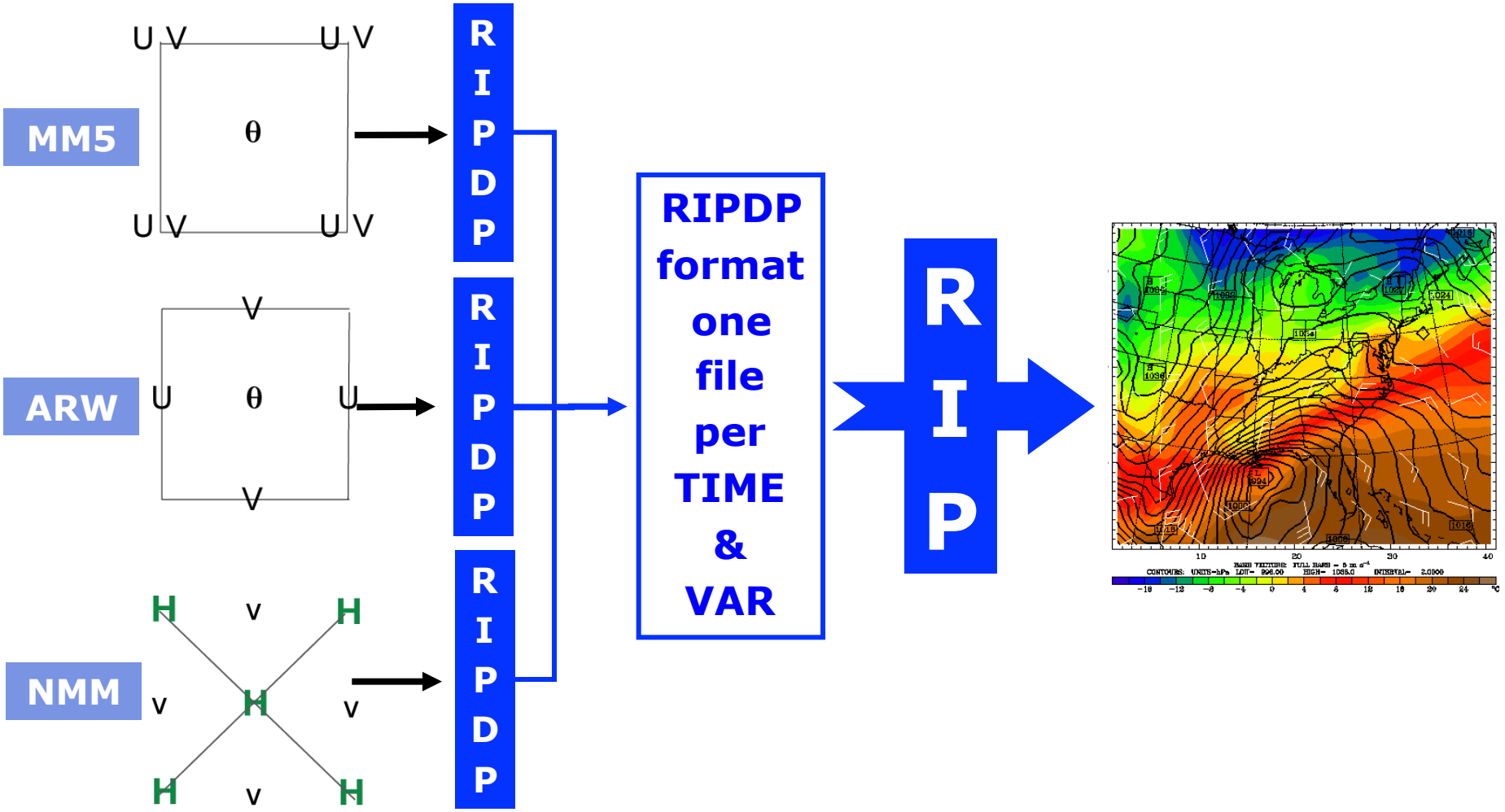
# RIP4 Input Data



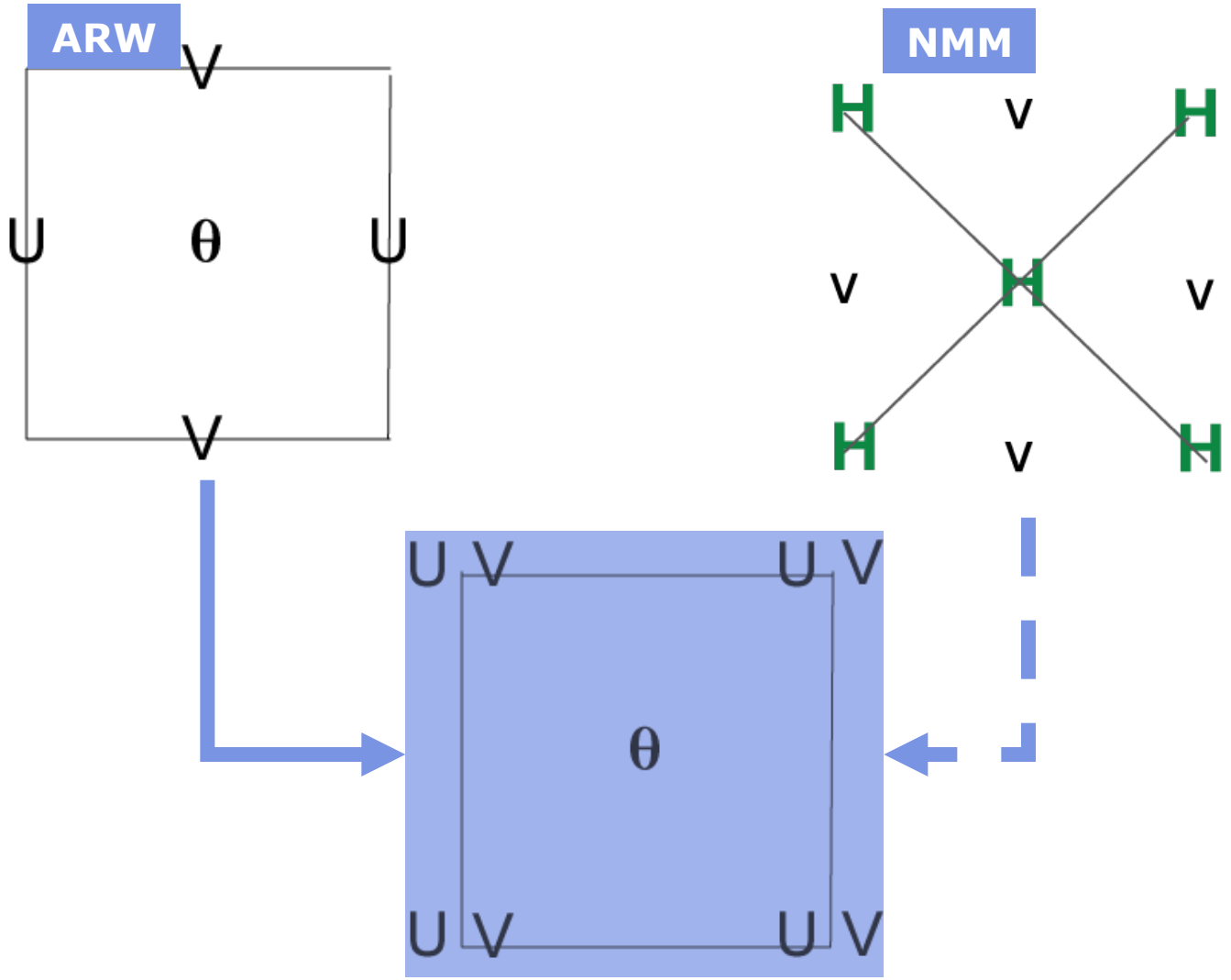
# RIP4



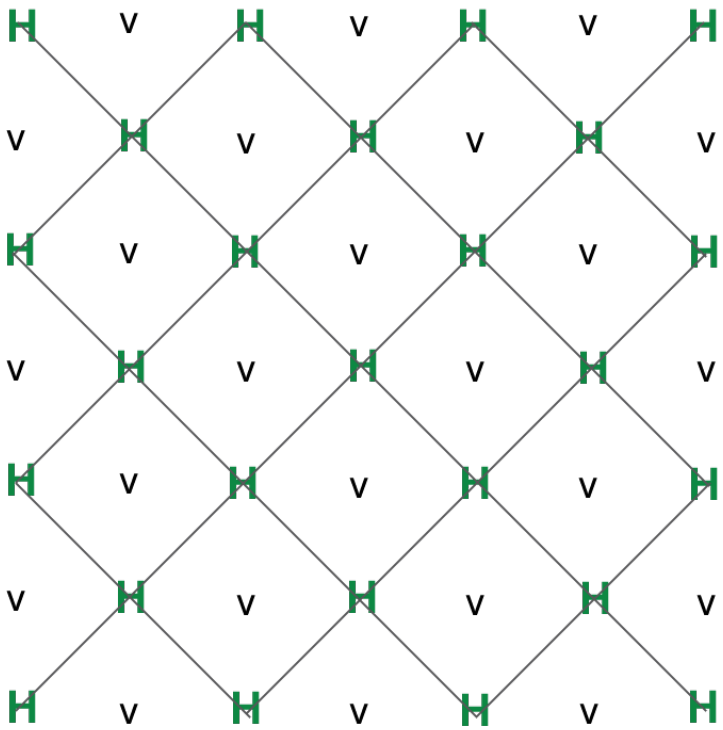
# RIP4 - Grids

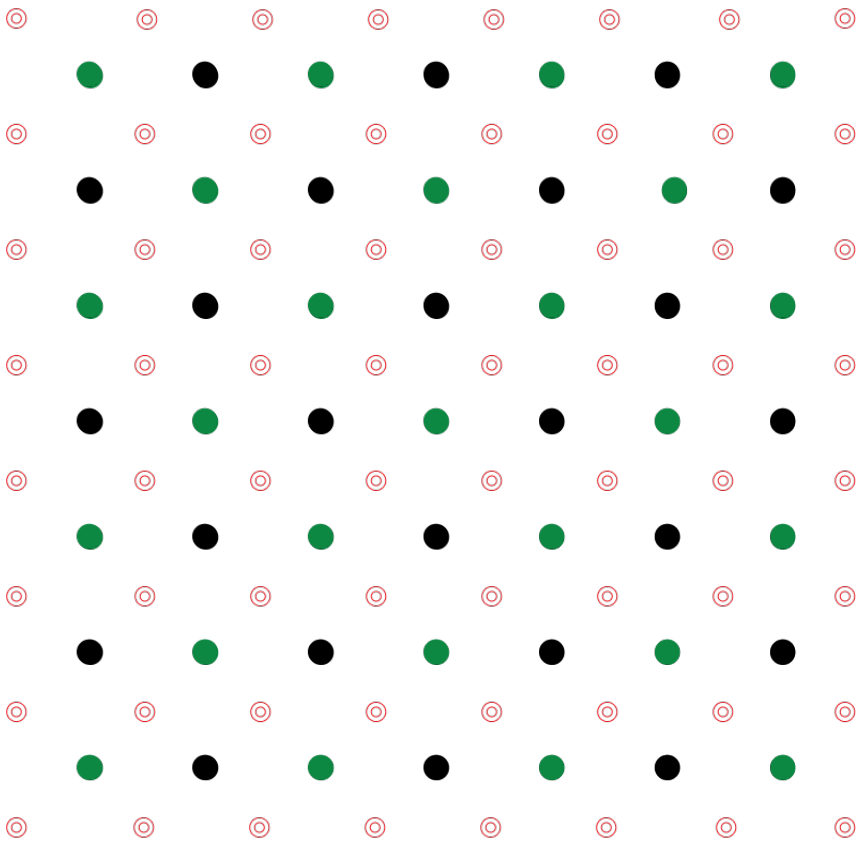

MM5
U V
θ
ARW
V
U θ U
V
NMM
H v H
v H v
H v H
RIPDP
RIPDP
RIPDP
RIPDP format one file per TIME & VAR
RIP

# RIP4 - WRF Grids

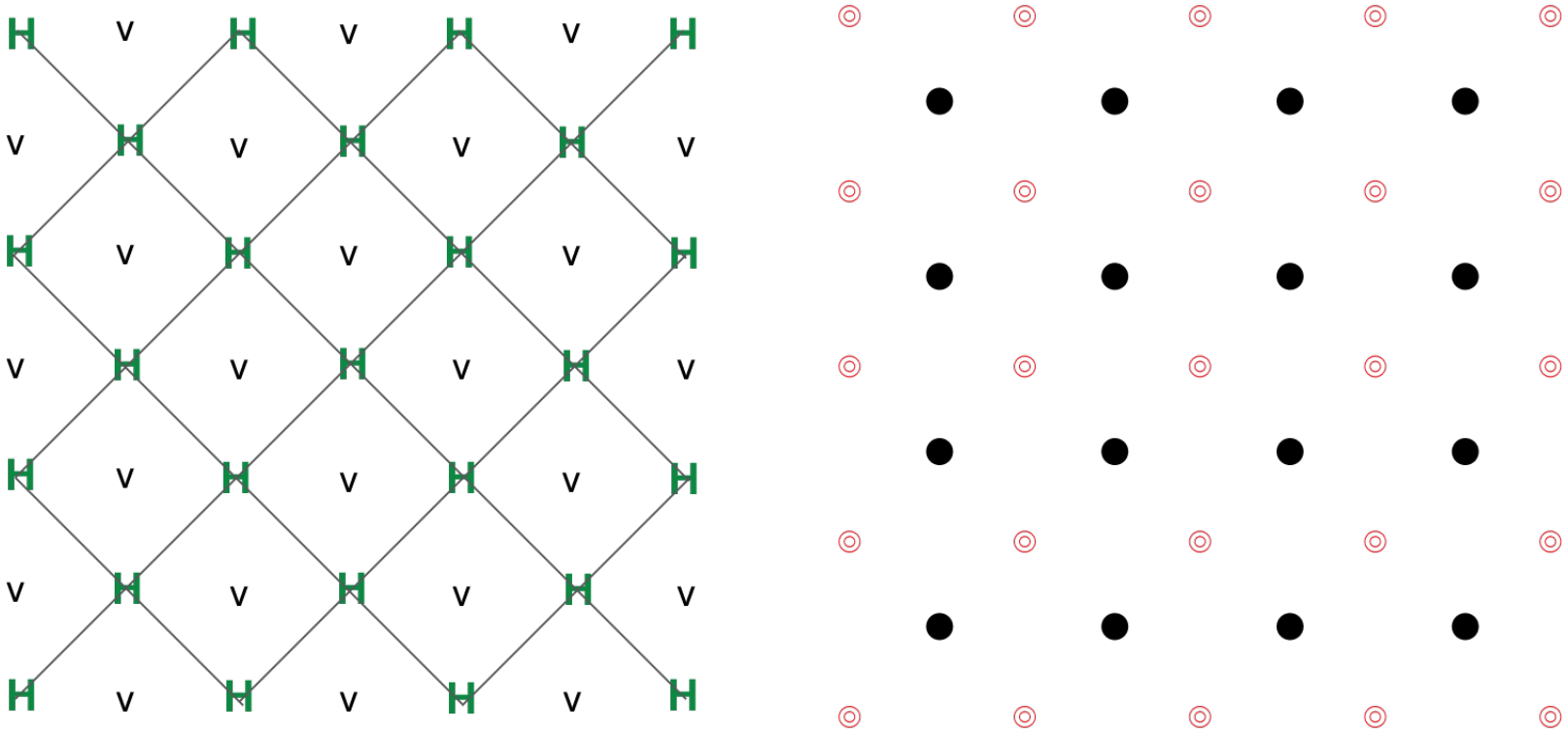


# RIP4 - NMM Grid *(iinterp 0)*



# RIP4 - NMM Grid *(iinterp 1)*




**new projection ; no direct relationship**

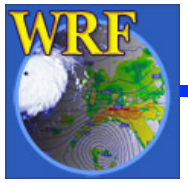
# RIP4 on your computer

- **set environment variables**
  setenv RIP_ROOT /usr/$USER/RIP4 *(rip_root)*
  setenv NCARG_ROOT /usr/local/ncl *(/usr/local/ncarg)*

- **Configure**
  *./configure*
  *(check configure.rip to ensure netCDF paths are correct)*

- **Compile**
  *./compile*

- **RIP4 has 2 parts (RIPDP and RIP)**

# Compiling with ncl

*ncl myscript.ncl*

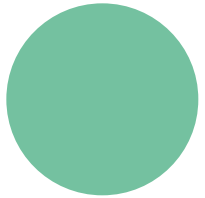
**NCARG_ROOT**

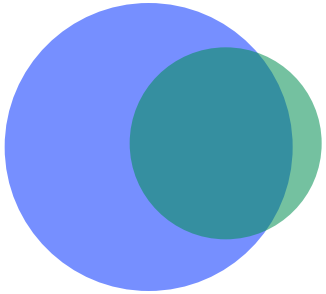
/usr/local/ncl

*compile <util>*

**NCARG_ROOT**

/usr/local/ncarg





*ncl myscript.ncl*

*compile <util>*

**NCARG_ROOT**

/usr/local/ncl

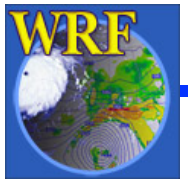
# Compiling with ncl

```
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**

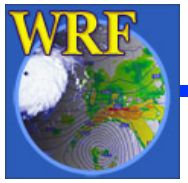


# ripdp & rip

- **ripdp**
  - RIP Data Preparation
  - Converter
    RIPDP converts WRF formatted data (*netCDF*) into RIP format (*B – grid*)
  - Output
    RIPDP puts each Variable at each Time into a separate file
    Creates LOTS of files

**mkdir RIPDP**

- **rip**
  - Reads the output generated by *ripdp*
  - Makes use of a User Input File (UIF) *(rip_sample.in)* to control plots
  - Output
    X11, pdf, ps, cgm



# Running ripdp & rip

ripdp_wrf*xxx* [-n namelist-file]
<model_data_name> \ [basic/all]
<input_file(s)>

rip [-f] <model_data_name> rip-execution-name

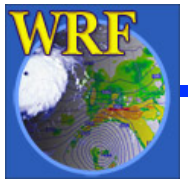
Example:

**ripdp_wrfarw RIPDP/test all wrfout***

**rip [-f] RIPDP/test rip_sample.in**

**output**

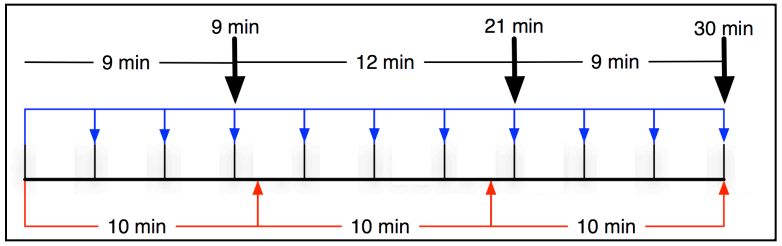
***[rip_sample.out]***
***rip_sample.TYPE***



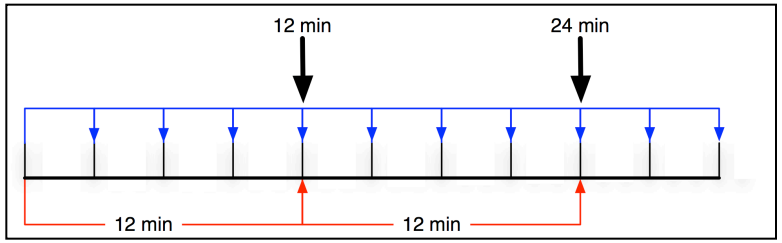
# ripdp namelist

- **ptimes** *(times for ripdp to process)*
  - `0,1,2,3,4,5,6` (0,1,2,3,4,5,6)
  - `0,-6,1` (0,1,2,3,4,5,6)
  - `0, 2,-4,1, 6` (0, 2,3,4, 6)
- **tacc**: *input files not on exact times* [`time_step=180` (3 min)]

**history_interval=10**




**history_interval=12**



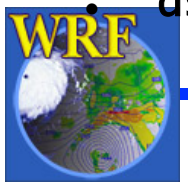

- **discard**: fields if '**all**' is selected on the command line
- **retain**: fields if '**basic**' is selected on the command line

# ripdp namelist

•NMM only

- **iinterp = 1**: interpolate to a new B-grid
- **dskmcib**: grid spacing, in km, of the coarse domain on which the new B-grid will be based
- **miycorsib, mjxcorsib**: number of grid points in the y and x directions of new B-grid
- **nprojib**: map projection number (0: none/ideal, 1: LC, 2: PS, 3: ME, 4: SRCE) of new B-grid
- **xlatcib, xloncib**: central latitude and longitude of new B-grid
- **truelat1ib, truelat2ib**: two true latitudes of new B-grid

- **miyib, mjxib**: number of grid points in the y and x directions, of the fine domain
- **yicornib, xjcornib**: coarse domain y and x locations of the lower left corner point of the fine domain
- **dskmib**: grid spacing, in km, of the fine domain



# rip UIF

```
&userin
    .......
&end
```

**Namelist controlling general parameters**

```
&trajcalc
    .......
&end
```

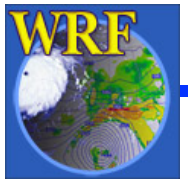
**Namelist for trajectory calculations**
***Only used if itrajcalc=1, in userin namelist***

```
=====================================
---------    Plot Specification Table   ----------
=====================================
feld= .........
feld= .........
=====================================
feld= .........
feld= .........
=====================================
```

**Frame specification group (FSG)**

**Plot Specification Table (PST)**

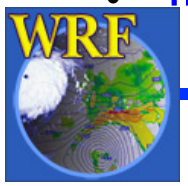
**Plot specification line (PSL)**



# rip namelist - *&userin*

- Use namelist to control
  - processing times, intervals, title information, text quality on a plot
  - whether to do time series, trajectory, or to write output for Vis5D
  - *Full explanation for namelist variables is available in the user document*

- ptimes, ptimeunits – times to process
- tacc – tolerance for processing data
- iusedaylightrule – 1 applied, 0 not applied
- idotser – generate time series output
- icgmsplit – split metacode into several files
- itrajcalc – 0, 1 ONLY when doing trajectory calculations
- rip_root – override RIP_ROOT
- ncarg_root – output type: X11, cgm, pdf, ps

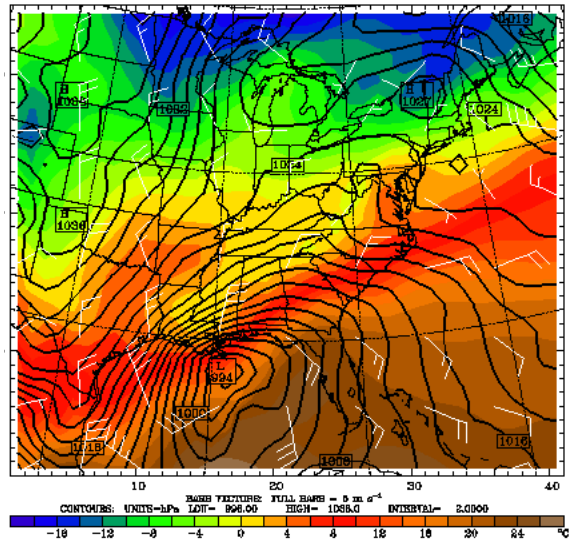


# Creating a Plot

**feld=**
**diagnostics - *tmc***
**native - *PSFC***

vcor=s; **levs=2fb**
vcor=s; **levs=1,2,3**
vcor=p; **levs=800,500**
vcor=p; **levs=800,-300,100**

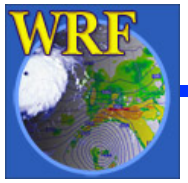
```
==========================================
feld=tmc; ptyp=hc; vcor=s; levs=1fb; >
   cint=2; cmth=fill; >
   cosq=32,light.violet,-16,blue, >
   0,yellow,16,orange,32,light.gray
feld=slp; ptyp=hc; cint=2; linw=2
feld=uuu,vvv; ptyp=hv; vcmx=1; >
    colr=white;intv=5
feld=map; ptyp=hb
feld=tic; ptyp=hb
==========================================
```



# Common Error Message

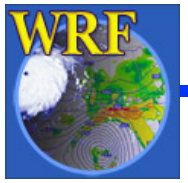
- **Most often this is NOT a graphics error.**
- **More often this is an error with the times you are asking RIP to process**
  - Check the ptimes in your .in file
  - Check the xtimes files created by RIPDP

```
GKS ERROR NUMBER   2 ISSUED FROM SUBROUTINE
GCLKS :--GKS NOT IN PROPER STATE: GKS SHALL BE IN
STATE GKOPFORTRAN STOP
```



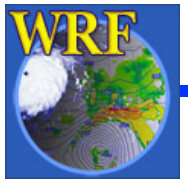
# ARWpost

- Converter
  - Requires GrADS to display data
- GrADS software only needed to display data, not needed to compile the code
- Generate a number of graphical plots
  - Horizontal, cross-section, skewT, meteogram, panel
- Version 2 (old – not recommended)
  - Could produce vis5d output
  - Needed WRFV3 complied

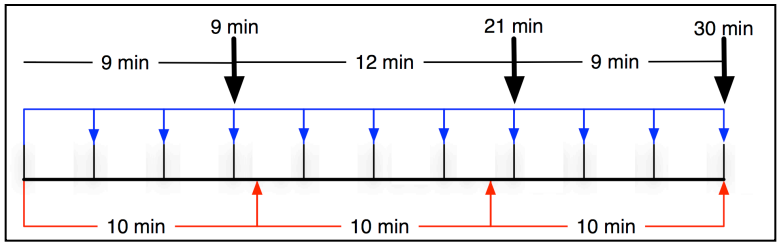


# ARWpost - *converter*

- **Download Code** (http://www.mmm.ucar.edu/wrf/users)
- **OnLine Tutorial**
  http://www.mmm.ucar.edu/wrf/users/graphics/ARWpost/ARWpost.htm
- **Compile** ***(similar to WPS)***
  *./configure & ./compile*
- **For GrADS output**
  - GrADS libraries only needed to display data *(freely available)*
  - http://grads.iges.org/grads/grads.html

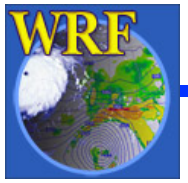


# namelist.ARWpost

| | |
|---|---|
| *start_date*<br>*end_date* | Start & end date<br>Format: *YYYY-MM-DD_HH:mm:ss* |
| *interval_seconds* | Seconds between times to process. *Code will skip times not required. Data can be in multiple files.* |
| *tacc* | If model output is not at regular intervals, use closest time within *tacc* seconds of time requested. *(150 sec)*<br>  |
| *debug_level* | Set high for extra information |

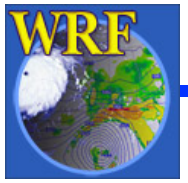
# namelist.ARWpost

| | |
|---|---|
| *input_root_name* | **Path** and **root** name of files to use as input.<br>*Do not only provide directory name.*<br>Can use wild characters. |
| *output_root_name* | Output root name.<br><br>output_root_name.**dat** &<br>output_root_name.**ctl** |
| *mercator_defs* | Set to true if mercator plots are distorted |

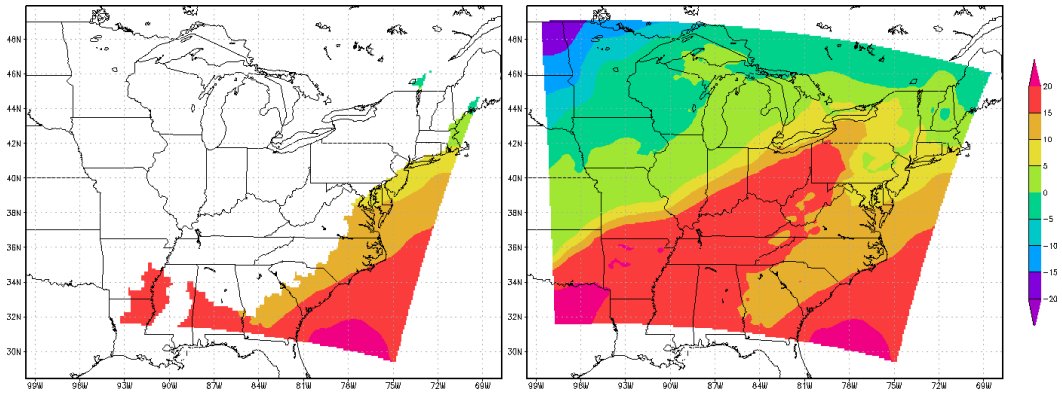


# namelist.ARWpost

| | |
|---|---|
| *split_output* | Split your GrADS output files into a number of smaller files *(a common .ctl file will be used for all .dat files).* |
| *frames_per_outfile* | If *split_output* is .**True.**, how many time periods are required per output (.dat) file. |
| *plot* | Which fields to process. (*all, list, all_list)* Order has no effect, i.e., "all_list" and "list_all"<br>"**list**" – list variables in "**fields**" |
| **fields** | Fields to plot. Only used is list was used in the "plot" variable. **Must use to generate diagnostics.** |
| *Available diagnostics*: cape, cin, mcape, mcin, clfr, dbz, max_dbz, geopt, height, lcl, lfc, pressure, rh, rh2, theta ,tc, tk, td, td2, slp, umet, vmet, u10m, v10m, wdir, wspd, wd10, ws10 | |



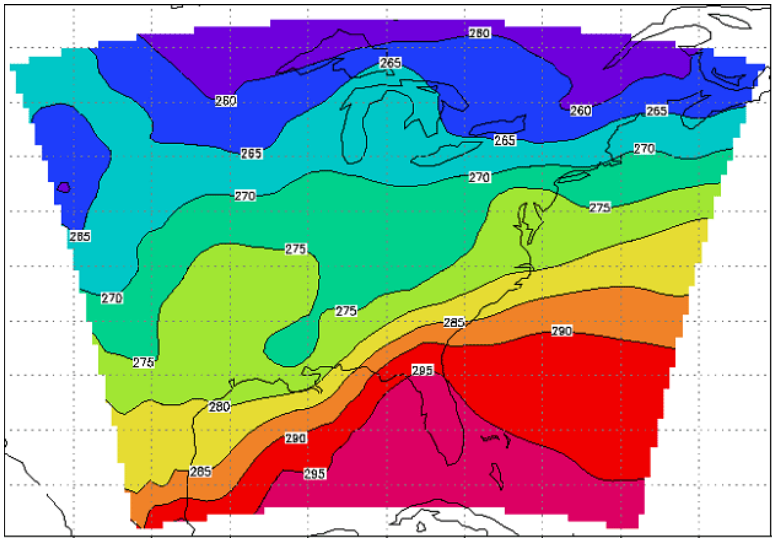
# namelist.ARWpost

| | |
|---|---|
| interp_method | 0 = sigma levels,<br>-1 = code defined "nice" height levels,<br>1 = user defined height or pressure levels |
| interp_levels | Only used if interp_method=1<br>Supply levels to interpolate to, in hPa (*pressure*) or km (*height above sea level*)<br>Supply levels bottom to top |
| *extrapolate* | Extrapolate below ground *(default .false.)*  |

# GrADS specific notes

- **To display images**
  - Requires GrADS software
  - Freely available from: http://grads.iges.org/grads/grads.html
  - Documentation: http://grads.iges.org/grads/gadoc/index.html

- **Projection**
  - Data is plotted on model projection

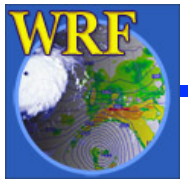


# GrADS - .ctl file

```
dset ^test.dat
options byteswapped
undef 1.e37
title  OUTPUT FROM WRF V2.2 MODEL
pdef  259 163 lcc  40.000  -98.000  130.000   82.000
      60.00000  30.00000  -98.00000  22000.000  22000.000
xdef  877 linear -141.49254   0.09909910
ydef  389 linear   18.88639   0.09909910
```

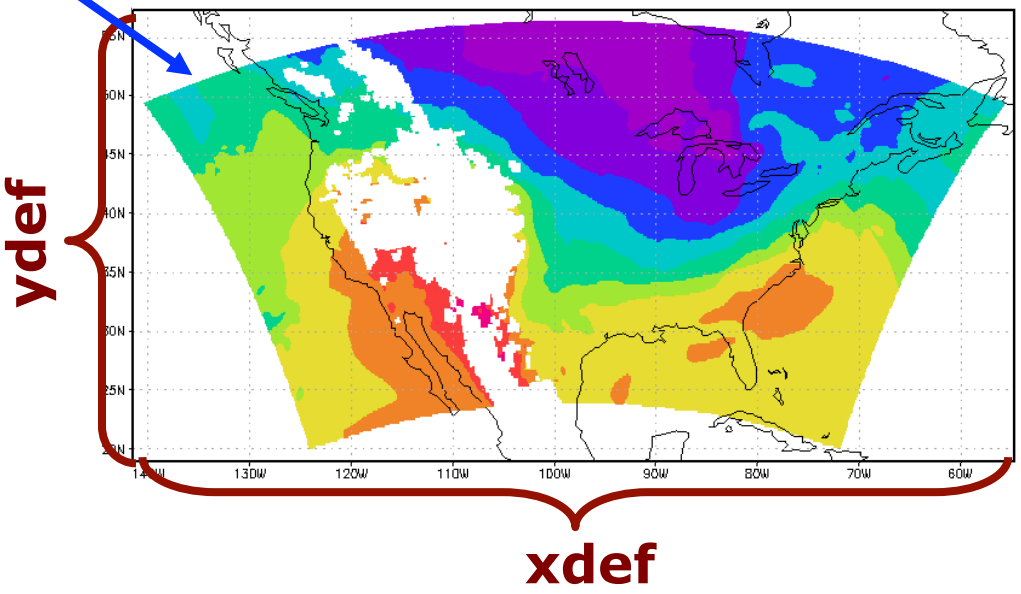
**options byteswapped**

*Needed on some machines - if you get NaNs when you plot,* ***remove*** *this line from .ctl file*



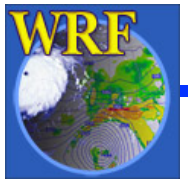
# GrADS - .ctl file

```
dset ^test.dat
options byteswapped
title  OUTPUT FROM WRF V3.2 MODEL
pdef  259 163 lcc  40.000  -98.000  130.000   82.000
60.00000  30.00000  -98.00000  22000.000  22000.000
xdef  877 linear -141.49254   0.09909910
ydef  389 linear   18.88639   0.09909910
```



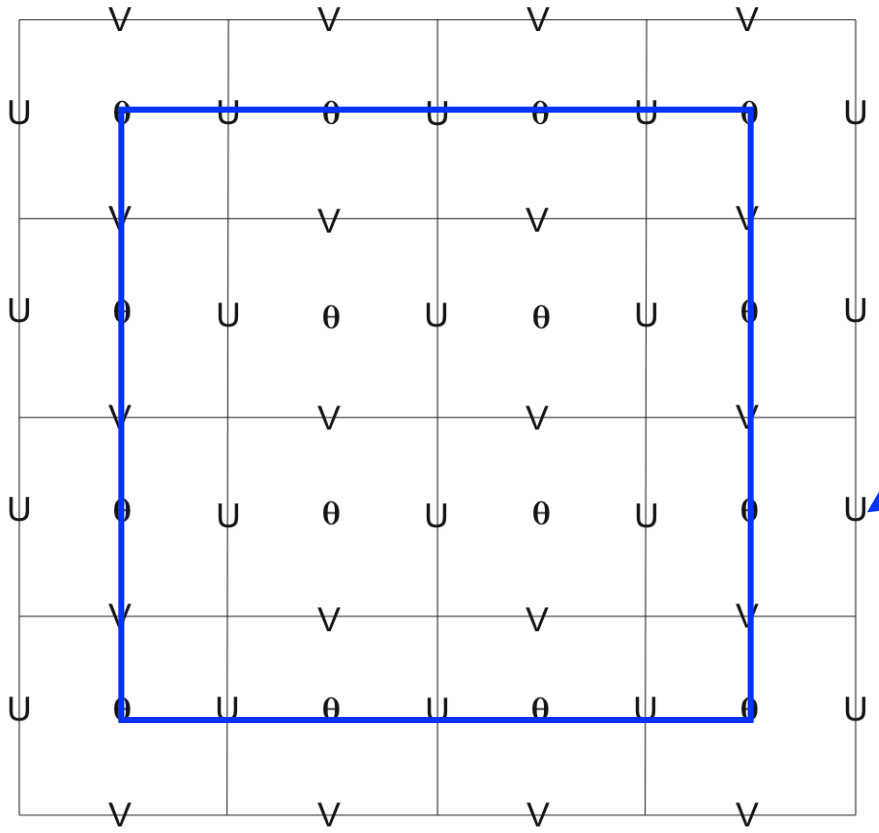
# GrADS conversion - question

- **Why is a converter needed if GrADS can display netCDF files?**
  - Can only display model surface coordinates
  - Cannot interpolate to height or pressure levels
  - All diagnostics must be added via GrADS script files
  - GRIB1 model output can also be read directly by GrADS, but above issues are still valid
  - For GRIB1, there is also a stagger problem



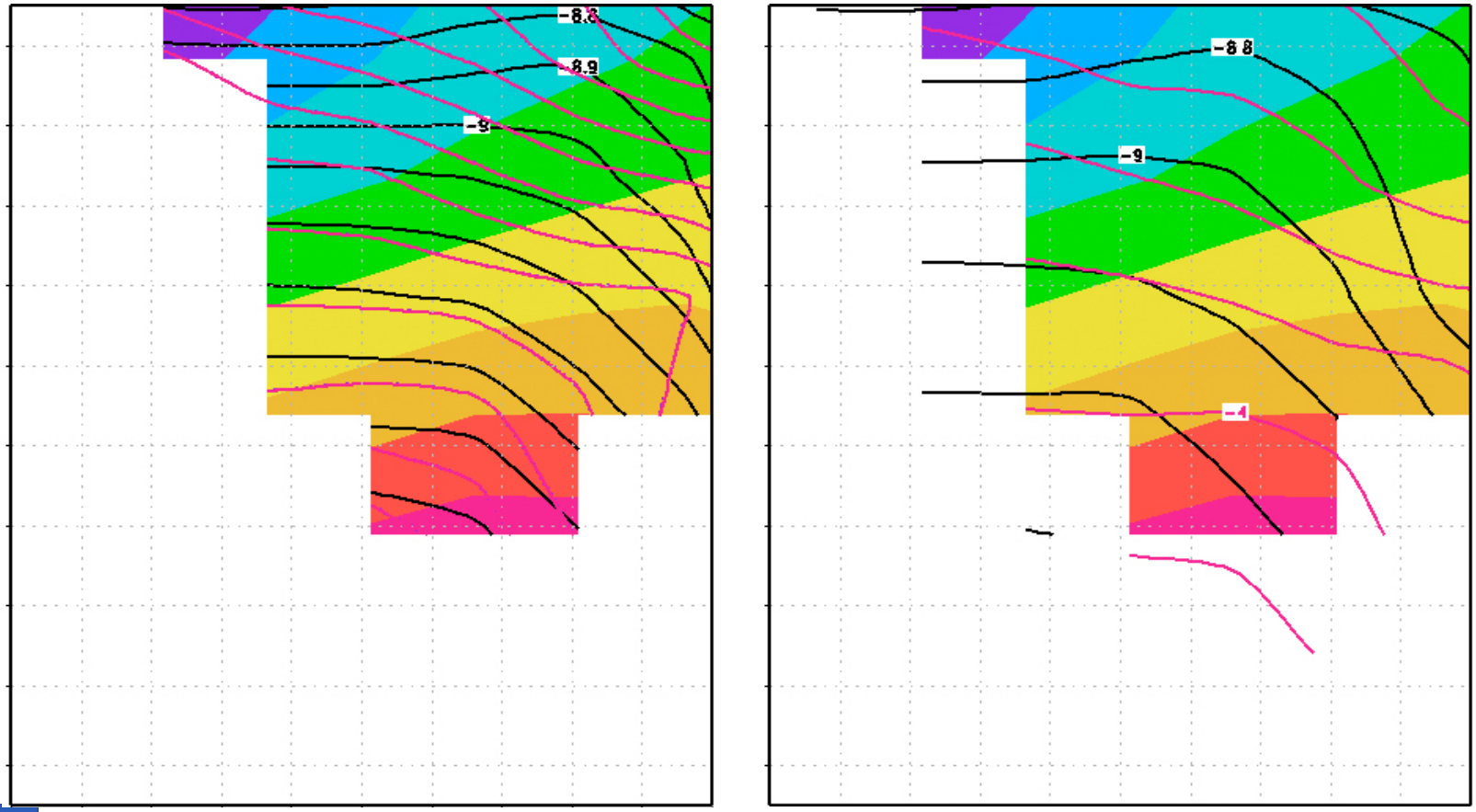
# GrADS conversion - question

- Why is a converter needed if GrADS can display netCDF files?



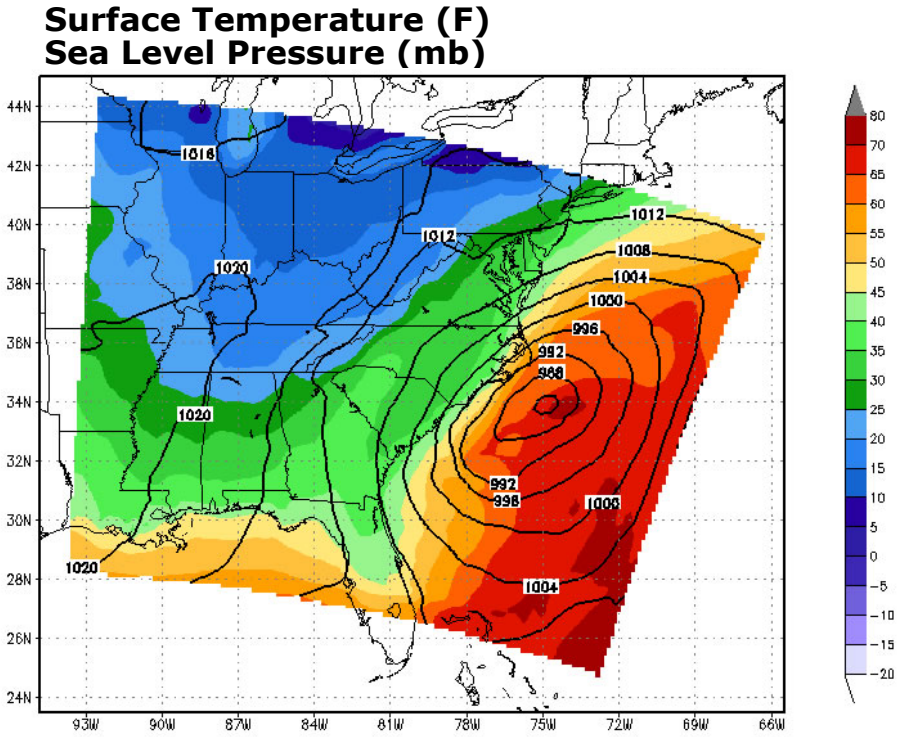
# Staggering

**shaded=T ; black=U ; red=V**



# Creating a Plot

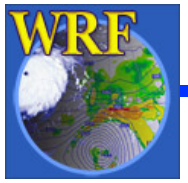
```
open em_real.ctl
set mpdset hires
set display color white

define tf=1.8*tc + 32
set gxout shaded
set z 1
d tf
run cbar.gs

set gxout contour
set ccolor 1
set cint 4
d slvl
```



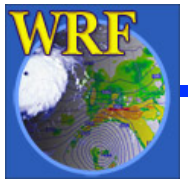
# How to add diagnostics

- **RIP4**
  - Create a subroutine (note RIP4 expects the code to be in “j/I/-k” orientation)
  - Add links to the RIP4/src/fields.f routine
  - Add new subroutine to RIP4/src/Makefile

- **ARWpost**
  - Create a subroutine
  - Add links to ARWpost/src/module_diagnostics.f90
  - Add new subroutine to ARWpost/src/Makefile



# Other Post-processing Tools

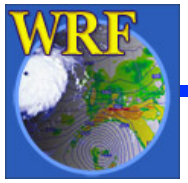


# VAPOR


Computational and Information Systems Laboratory
National Center for Atmospheric Research

## Visualization and Analysis Platform for Oceanic, atmospheric and solar Research

*Alan Norton*
*alan@ucar.edu*
*vapor@ucar.edu*
*National Center for Atmospheric Research*



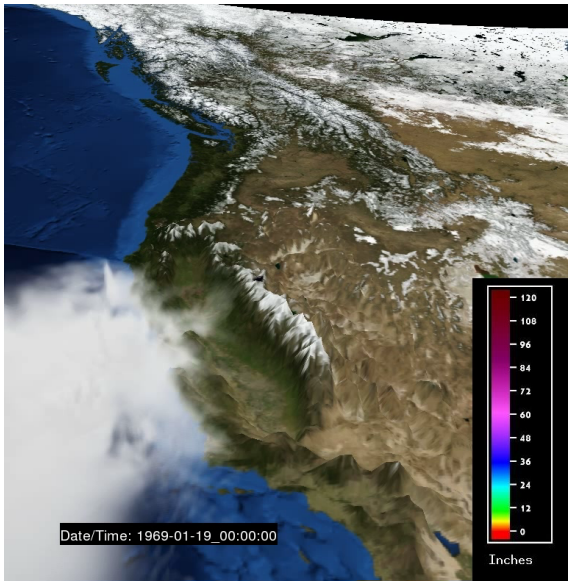
# WRF in VAPOR

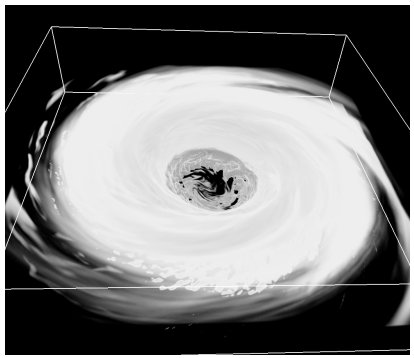

Computational and Information Systems Laboratory
National Center for Atmospheric Research

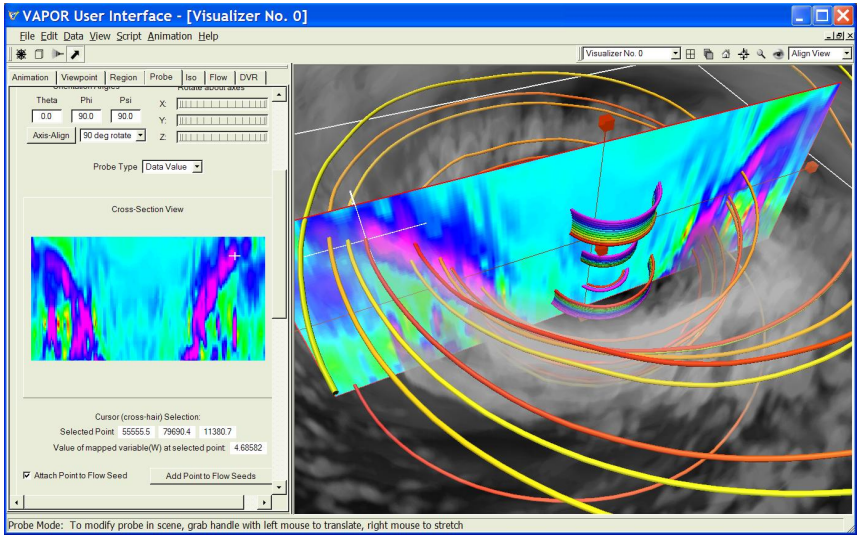
- Interactive 3D visualization of WRF-ARW data *(wrfout files only)*
- Available free on Linux, Windows, Mac
- Interactive rendering and animation (using GPU acceleration)
- Simple 2-step data conversion from WRF output to VAPOR
  - wrfvdfcreate & wrf2vdf
- Steady and unsteady flow integration
- Data probing
- Downloads, documentation, examples at: http://www.vapor.ucar.edu
- http://www.vapor.ucar.edu/doc/WRFsupport.pdf

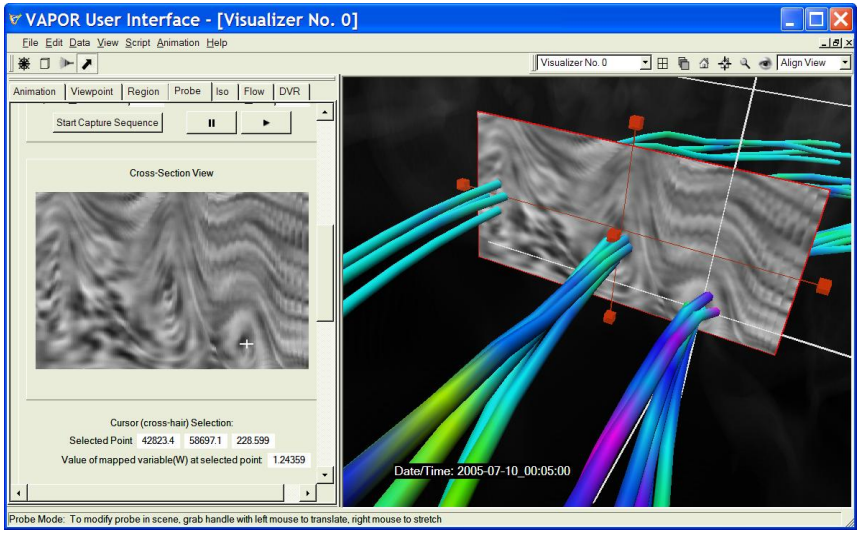
# WRF in VAPOR

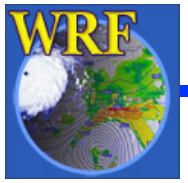
Computational and Information Systems Laboratory
National Center for Atmospheric Research





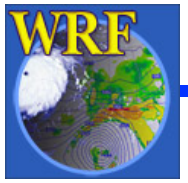



# IDV

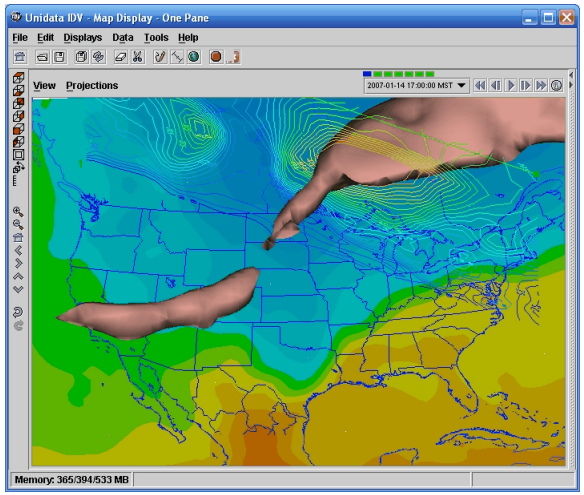
## Integrated Data Viewer

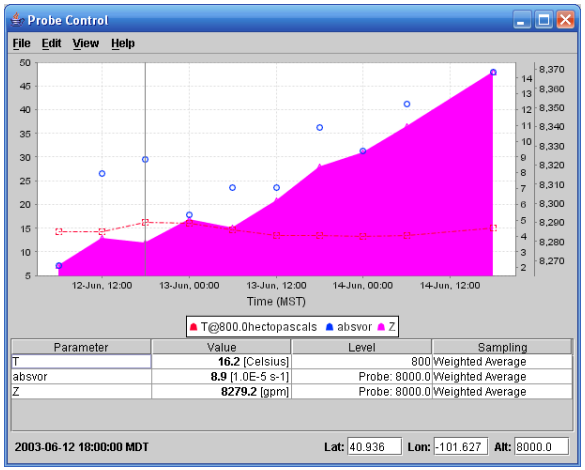
Yuan Ho and Julien Chastang
Unidata Program Center/UCAR

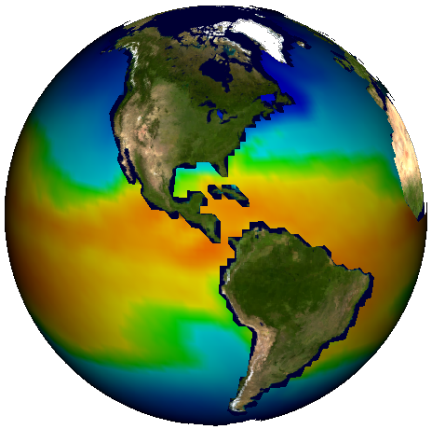


# What is the IDV?

- Visualization and analysis tool for geoscience data developed and supported by Unidata
- Freely available Java™ framework and application
- Integrated 2D/3D displays of a wide range of data
- Built on VisAD library

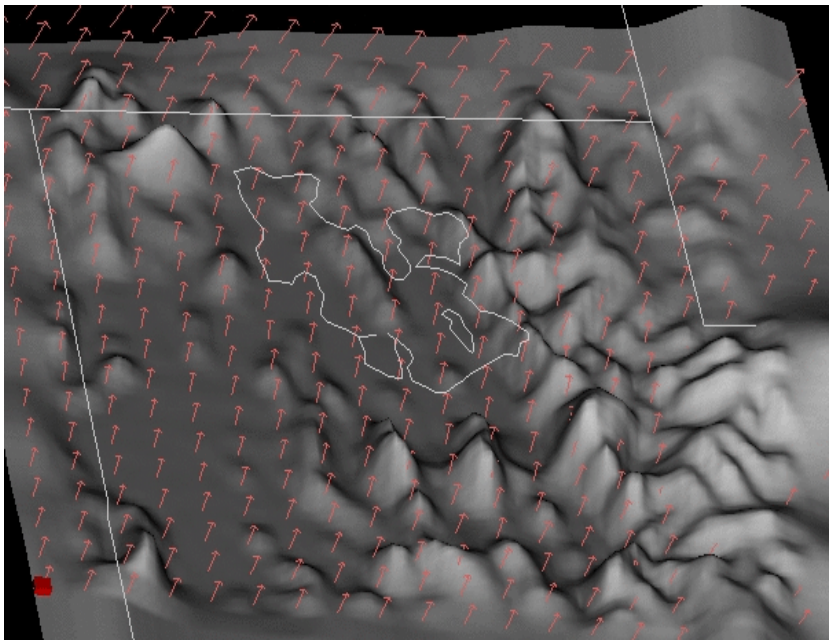


# IDV Strengths

- Easy to download and install on any platform
- Remote and local access to datasets
- 2D/3D visualization
- Bundle mechanism
- Support for multi-disciplinary datasets integrated from a variety of sources
- Flexible framework supports customization (GEON-IDV, field projects, McIDAS-V)
- Extensive documentation
- Community driven development



Model simulation of wind, isentropic potential vorticity and low level moisture flow over the Great Salt Lake basin

# Supported Data Sources

- **Data Types:**
  - Gridded model output
  - Satellite imagery
  - Radar data
  - Point observations
  - Balloon soundings
  - NOAA Profiler Network winds
  - Aircraft Tracks
  - Fronts
  - GIS data (WMS, shapefile)
  - Quick Time movies
  - Web Cams
- **Vertical Coordinates**
  - Pressure
  - Height/Depth
  - Other (2D only)
- **Sample of Supported Formats:**
  - netCDF
  - GRIB
  - Vis5D
  - KML
  - CSV
  - GEMPAK grid
  - ADDE
- **Access Methods:**
  - Local files
  - HTTP
  - ADDE, TDS and OPeNDAP servers
  - WMS

**ADDE** = Abstract Data Distribution Environment
**TDS (THREDDS) =** Thematic Realtime Environmental Distributed Data Services

# For Further Information

- Integrated Data Viewer homepage
  - http://www.unidata.ucar.edu/software/idv
- RAMADDA homepage
  - http://www.unidata.ucar.edu/software/ramadda/
- VisAD homepage
  - http://www.ssec.wisc.edu/~billh/visad.html
- All IDV questions/comments
  - support-idv@unidata.ucar.edu