WRF Version 3.0 Pre- and Post-processor Updates

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Outline

- Pre-processing
  - WPS
  - real.exe (for ARW)
- OBSGRID
- Post-processing
 - NCL
  - New utility programs

Updates to the WPS: geogrid

- Added support for regular lat/lon projection
  - Projection may be rotated
  - May be used for either global or regional domains
  - Rotated grid is not yet well supported among graphical/visualization utilities
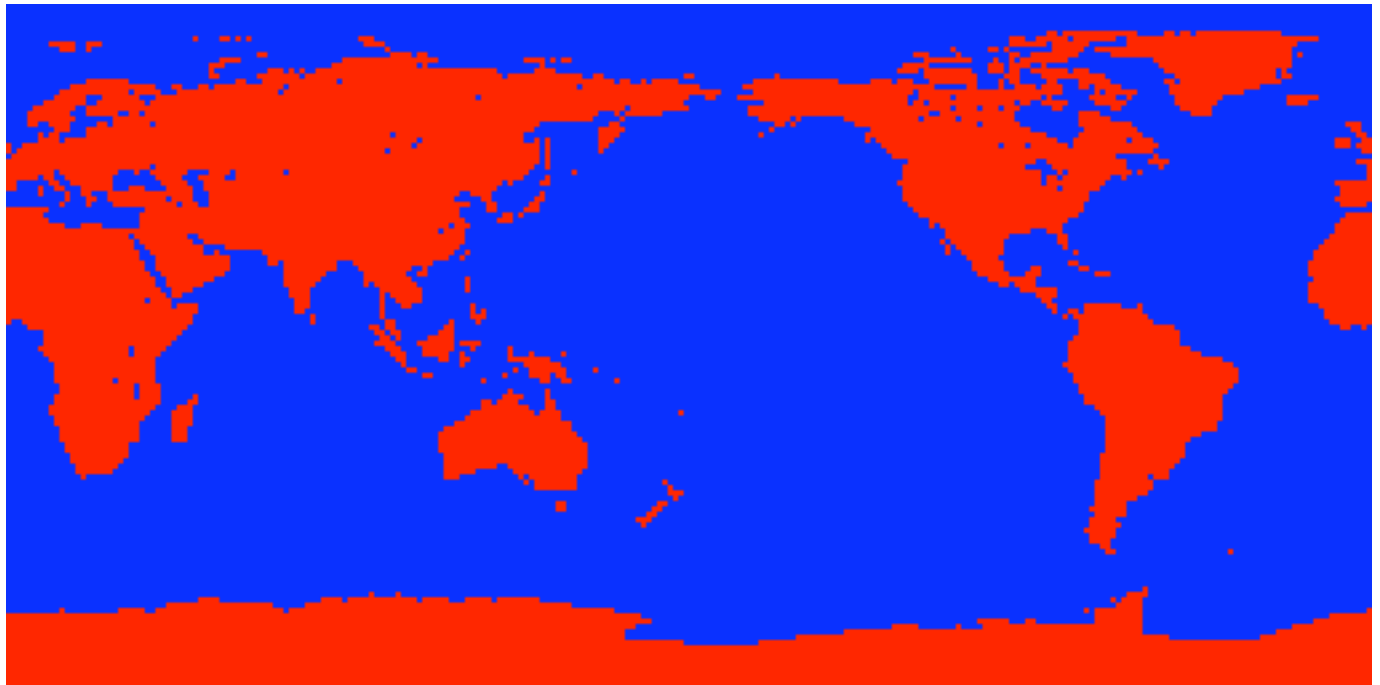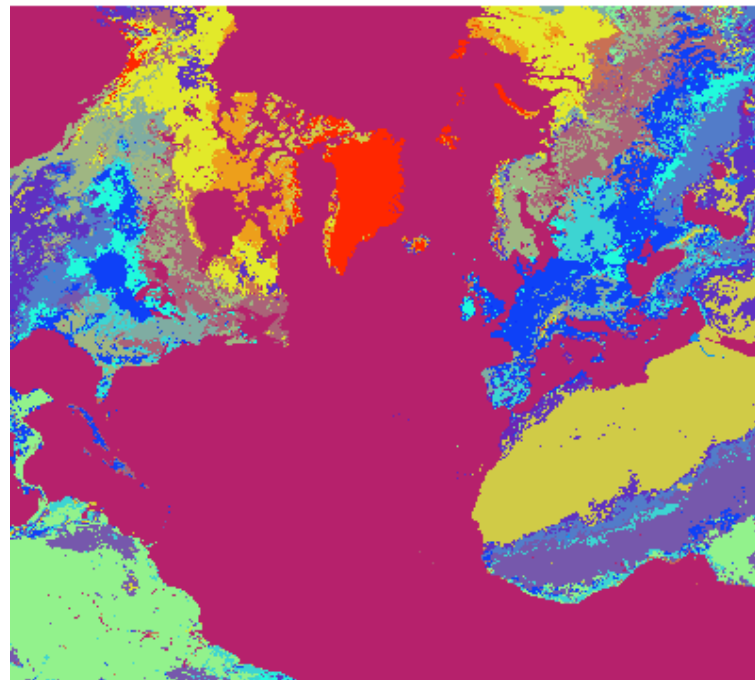
Updates to the WPS: geogrid

- An additional benefit of rotated lat/lon projection support in ARW: user can now create an ARW domain that matches (ignoring grid staggering) any NMM domain
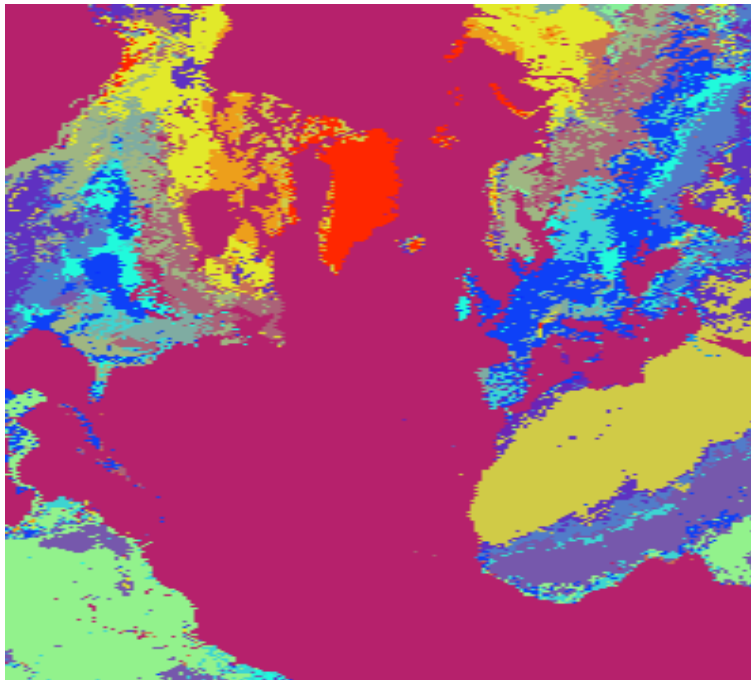
An NMM domain centered over the north Atlantic

A matching ARW domain using the rotated lat/lon projection
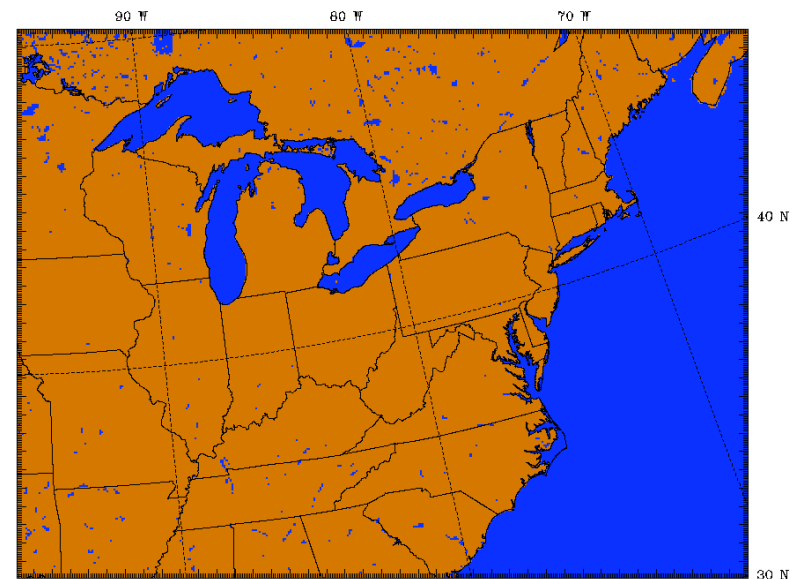
Updates to the WPS: geogrid

- A sequence of geographical data sources may now be specified for *geog_data_res* variable in `namelist.wps`
  - Useful when adding a new resolution of data for only one field
  - E.g., '9s+30s' to use '9s' data for those fields that provide such a resolution, and '30s' otherwise

Updates to the WPS: geogrid

- Geogrid can now handle multiple water categories
  - Previously, only one water category possible for LANDMASK calculation
  - Useful for land use data sets that distinguish inland water bodies from ocean, for example
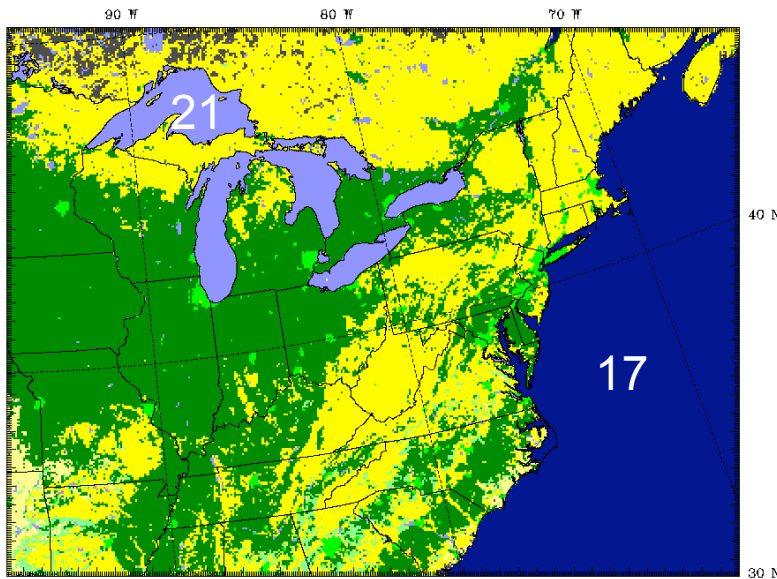
Land use category for WRF domain 17=ocean, 21=inland water body

Resulting land-sea mask with "landmask_water=17,21" in GEOGRID.TBL
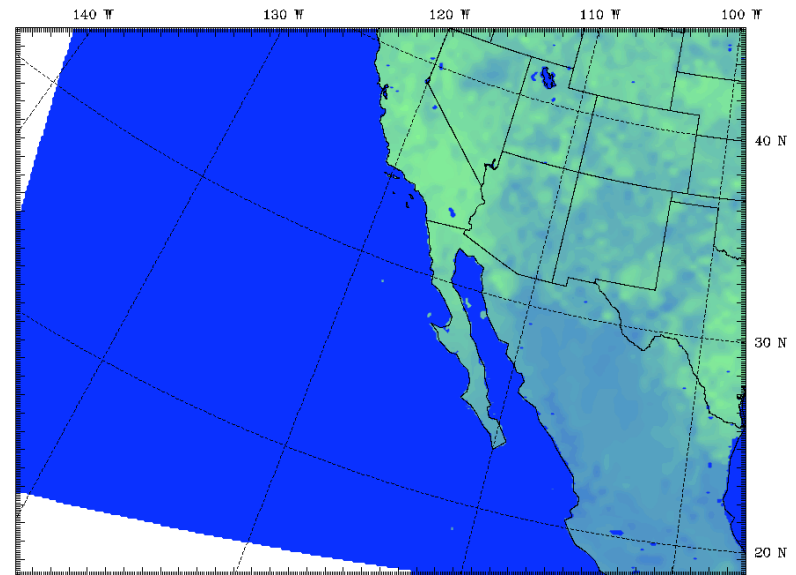
Updates to the WPS: ungrib

- New support for JMA GSM and NCEP GFS ensembles

- Support for RUC hybrid grid files (thanks to T. Smirnova)

- Ability to decode tropopause and max wind levels from NCEP GriB files
  - Can't yet use these levels during vertical interpolation, though

- Optional Product Definition Template column in GriB2 Vtables to distinguish between instantaneous and accumulated fields

Updates to the WPS: metgrid

- **Metgrid will now stop if areas in a domain are not covered by data**
  - Useful when using regional GriB data as first guess
  - But, user can tell metgrid to allow areas without data on a field-by-field basis

Using the *fill_missing* keyword in a field's METGRID.TBL entry will fill areas that did not receive interpolated values from first guess data and let metgrid continue *- useful if un-covered areas can safely be given some default value*

If no filling is performed and WRF grid points for the field do not receive a value, metgrid will halt with an informative message

Soil moisture field from NAM; white regions identify areas not covered by NAM domain

Updates to the WPS: Utility Programs

- **New utility program: calc_ecmwf_p**
  - Given ECMWF *PSFC* or *LOGSFP* field and list of model level coefficients, computes 3-d pressure field for ECMWF model-level data (thanks to G. Zaengl)
  - Can also compute 3-d RH field from P, T, and SPECHUMD
  - Resulting fields are written to separate intermediate files
    - Used in metgrid by setting, e.g., *fg_name='FILE','PRES'*

Updates to ARW real.exe

- A number of vertical interpolation options are available to users
- The options can have a significant impact on the initial conditions passed to the model
- More information is contained in the info file **README.namelist** in the **run** directory
- Options are located in the **&domains** namelist record of **namelist.input**
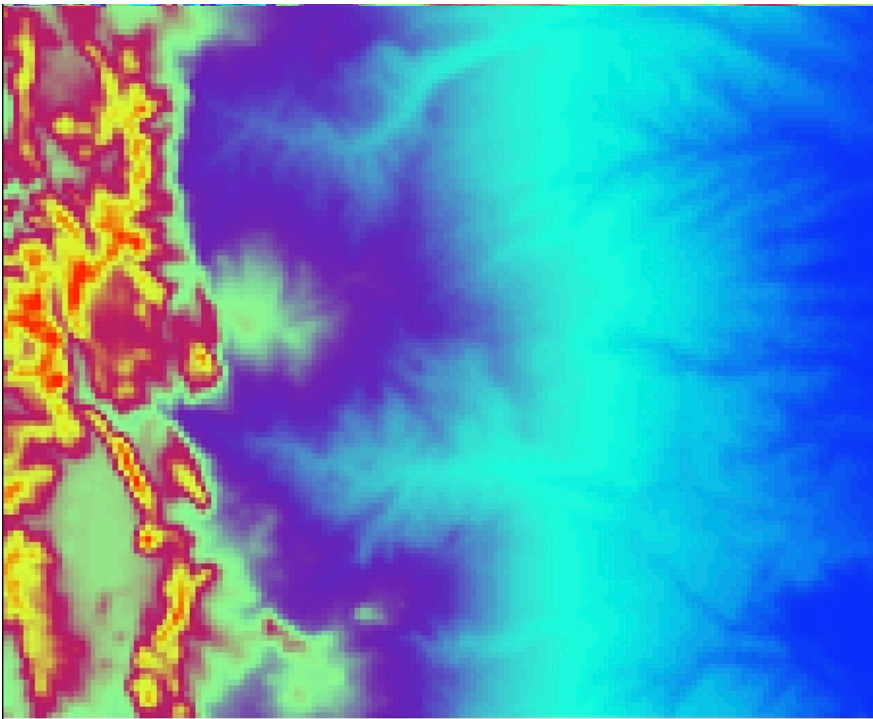
Vertical Interpolation Options

force_sfc_in_vinterp	Integer, **1**, how many η levels are required to use the surface data from metgrid (0-6 typical)
lagrange_order	Integer, **1**, 1 = linear, 2 = quadratic vertical interpolation
lowest_lev_from_sfc	Logical, **F**, set the lowest η level directly from the surface data from metgrid, no vertical interpolation
smooth_cg_topo	Logical, **F**, smooth the outer rows and columns of the coarse topography wrt to the first guess input, similar to how the coarse and fine grid topo is handled in the model
use_surface	Logical, **T**, is the surface level data from metgrid to be used in the vertical interpolation
zap_close_levels	Integer, **500**, pressure thickness (Pa), isobaric levels closer than this to the surface level data from metgrid are ignored

Vertical Interpolation Options

- Impact: *Expected region of changes*
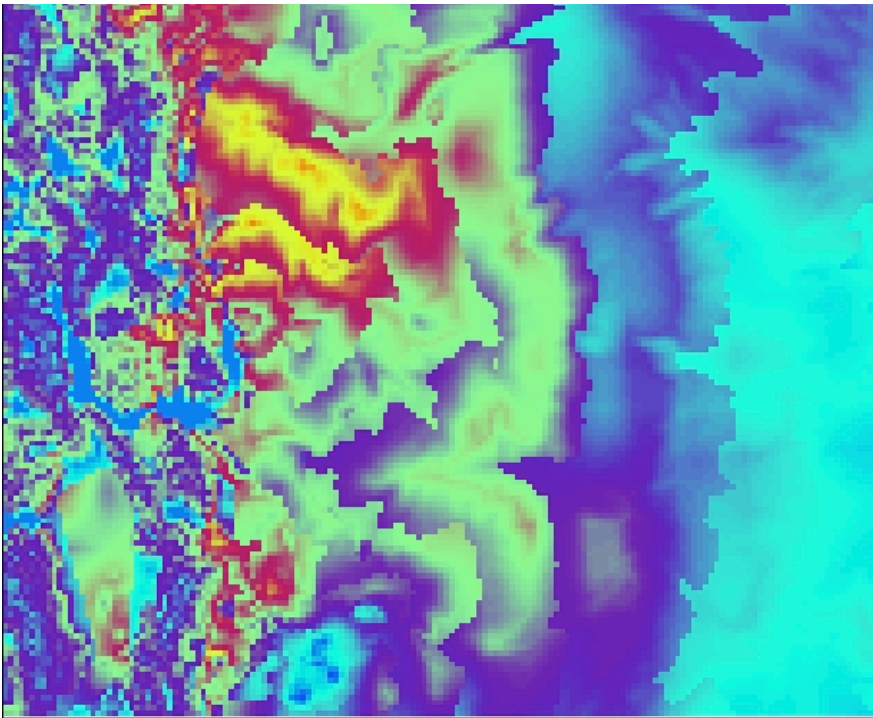- *Non-standard setting*
- Which level is being viewed

Topography and domain for difference plots, 160x140, 4 km, input = 40 km NAM
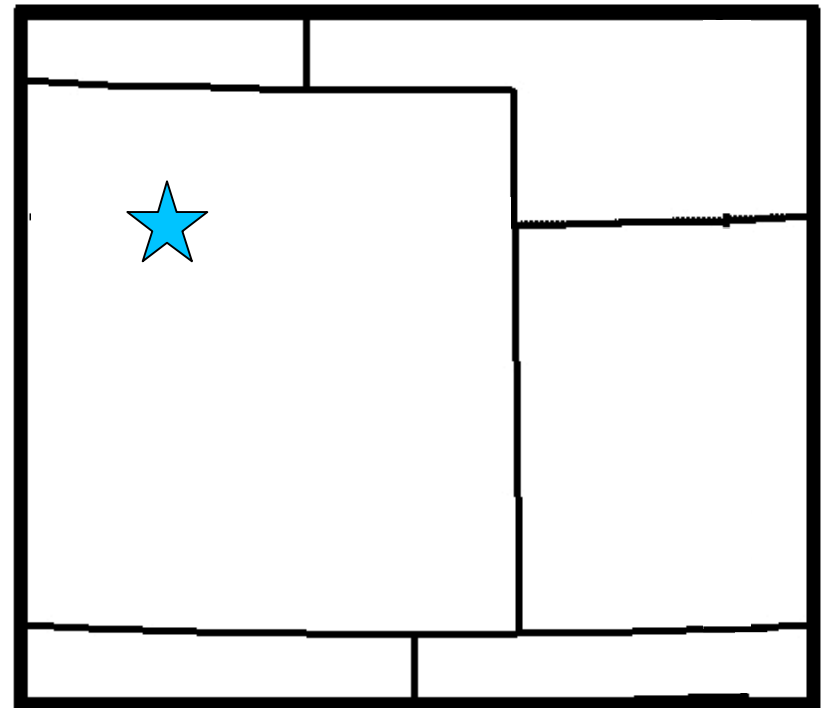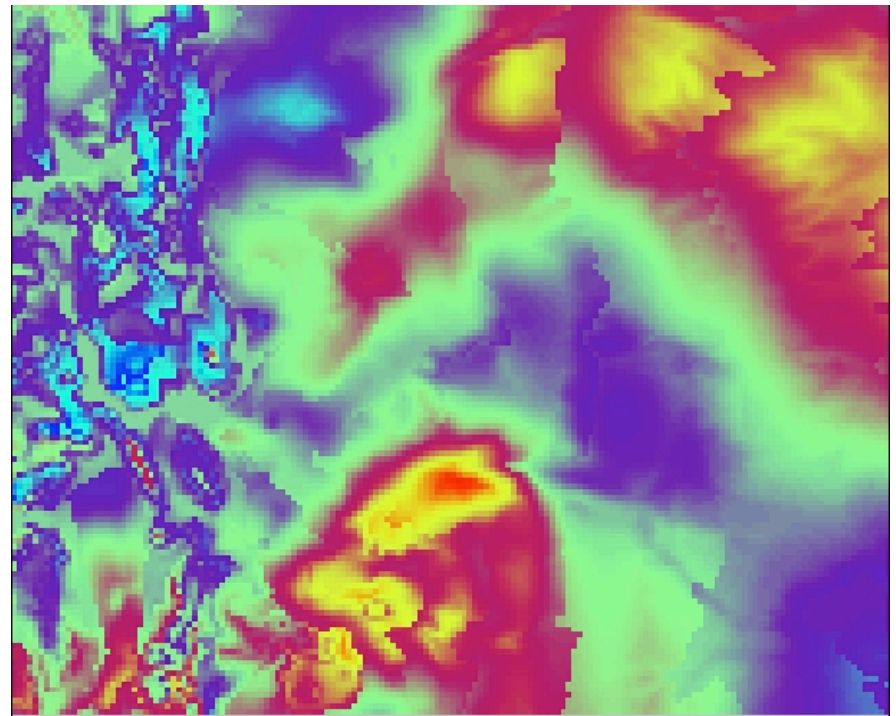
Vertical Interpolation: force_sfc_in_vinterp

- Impact: few lowest levels only
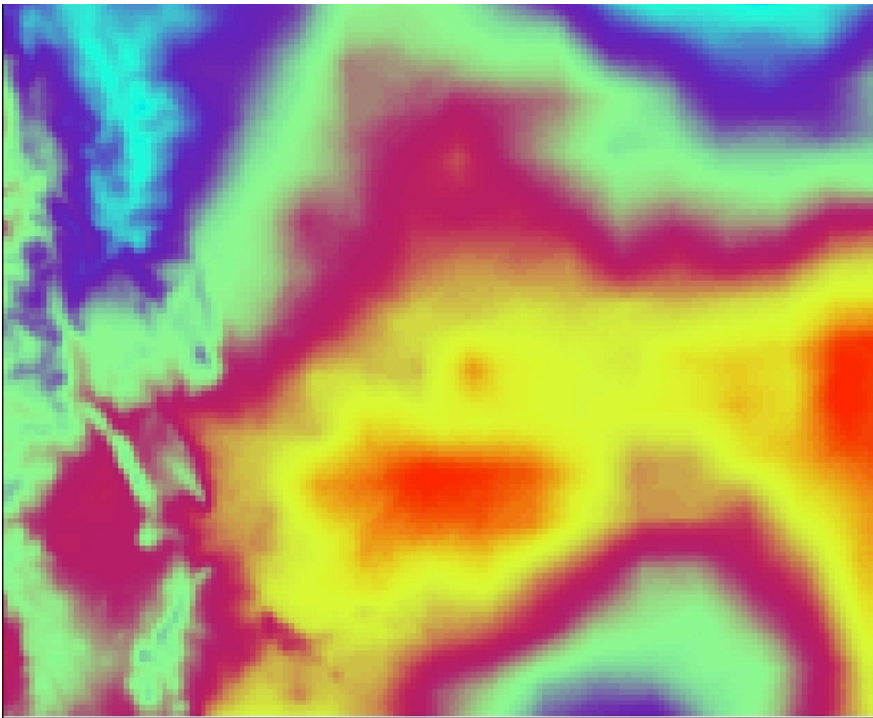- force_sfc_in_vinterp = 6
- η level 4

Theta (0 K blue, 10 K red)
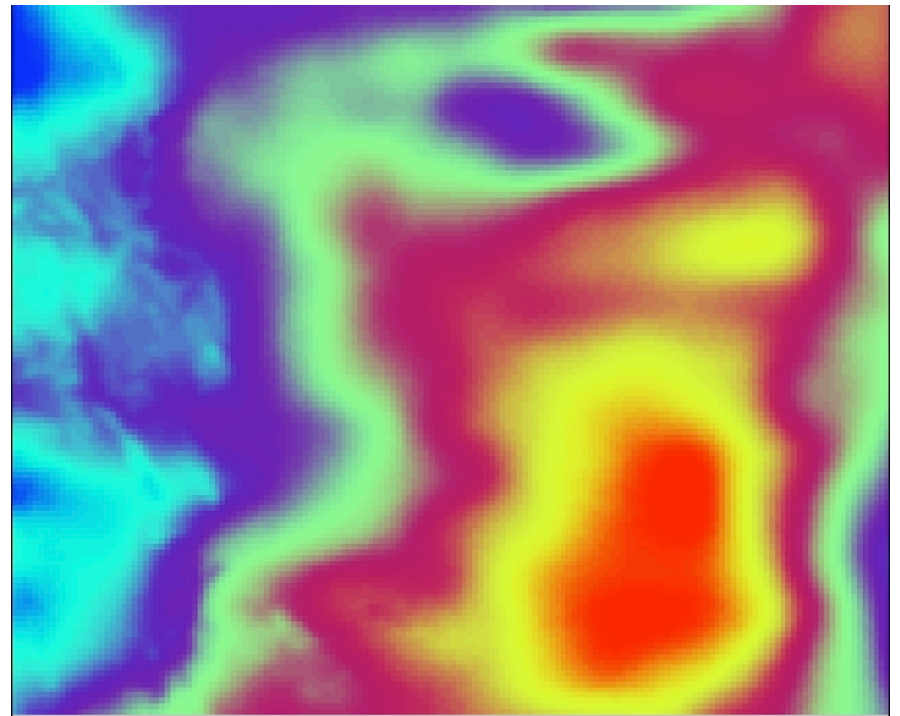
U (-5 m/s blue, 6 m/s red)

Vertical Interpolation: lagrange_order

- Impact: above first 4 levels, most near tropopause

- lagrange_order = 2
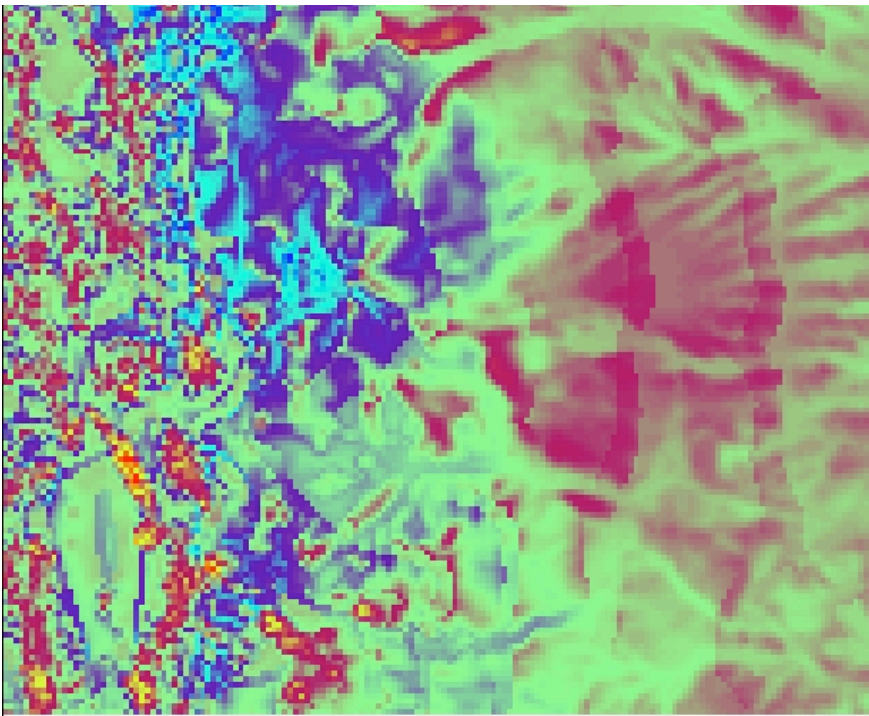
- η level TOP

Theta (0.7 K blue, 1.6 K red)

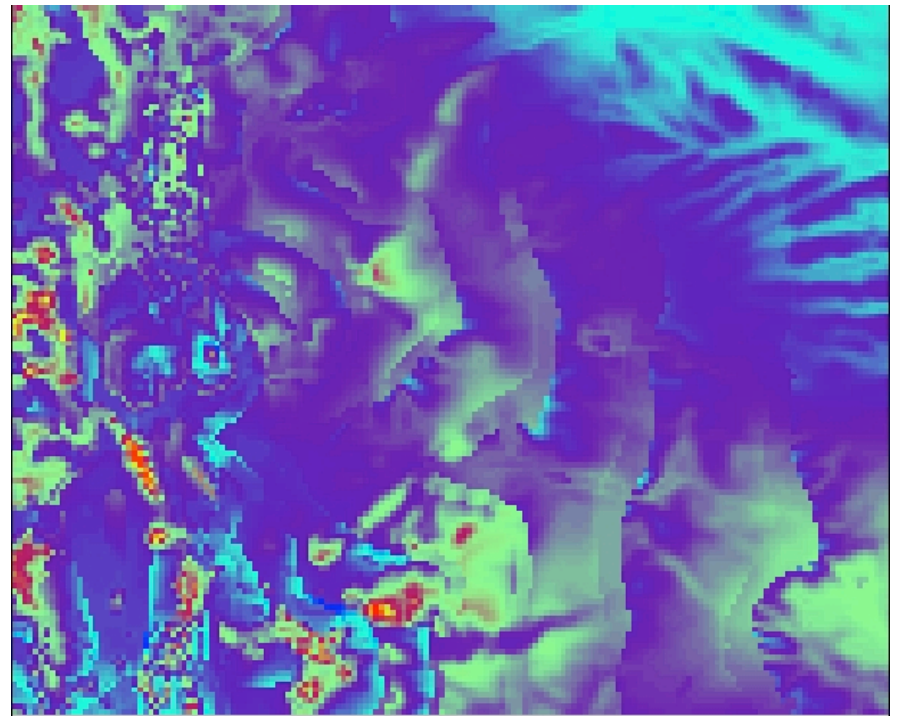U (0.4 m/s blue, 1.4 m/s red)

Vertical Interpolation: lowest_lev_from_sfc

- Impact: lowest level only
- lowest_lev_from_sfc = T
- η level 1

Theta (-10 K blue, 8 K red)

U (-3 m/s blue, 7 m/s red)

Vertical Interpolation: smooth_cg_topo

- Impact: outer few rows and column, amplitude damps upward
- smooth_cg_topo = T
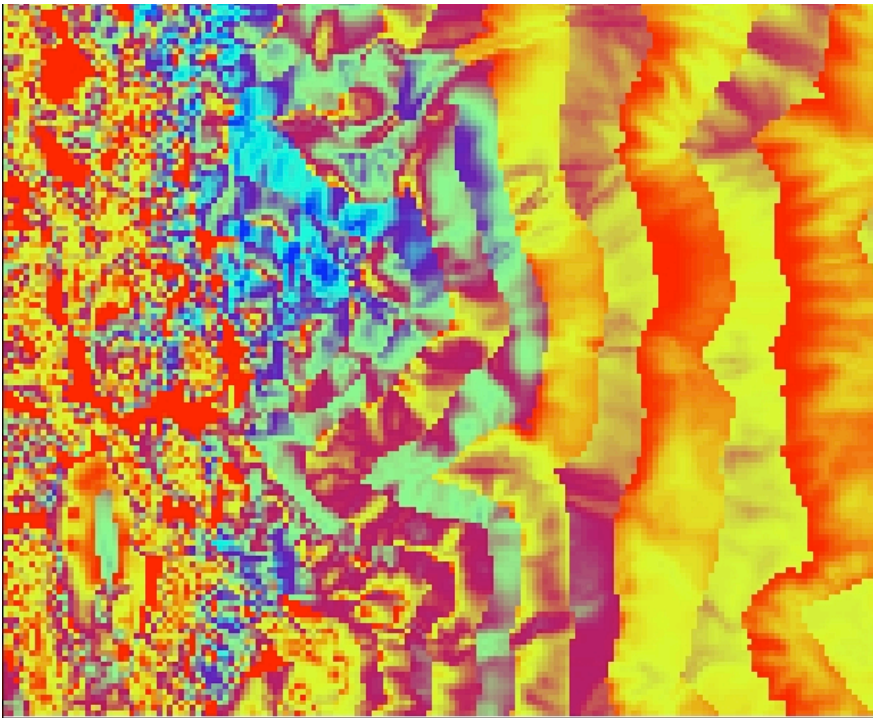- η level 1

Theta (-10 K blue, 9 K red)

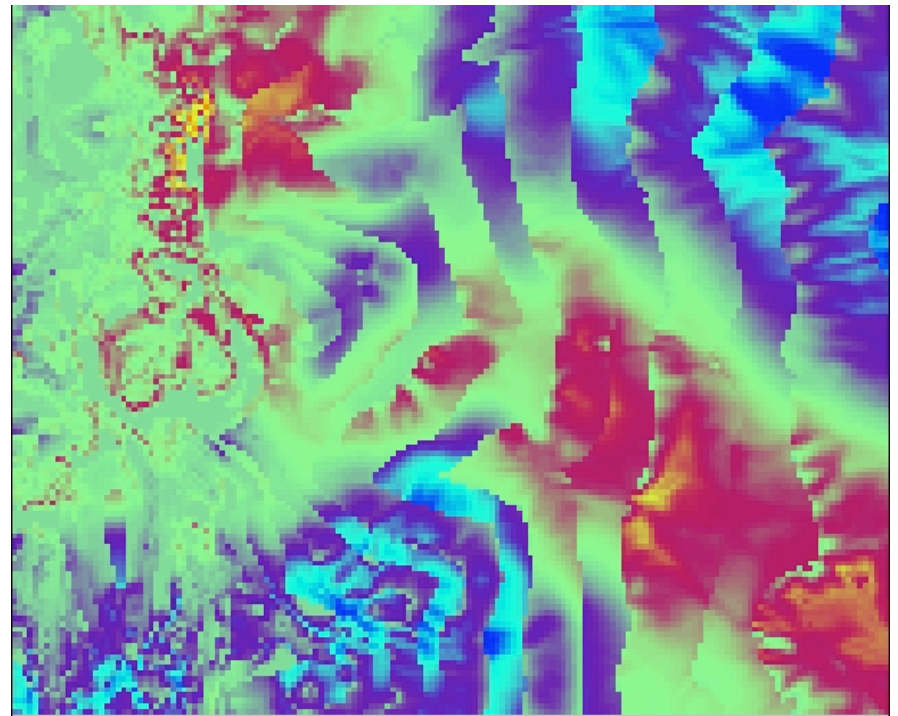U (-6 m/s blue, 6 m/s red)

Vertical Interpolation: use_surface

- Impact: lowest few levels

- use_surface = F

- η level 1

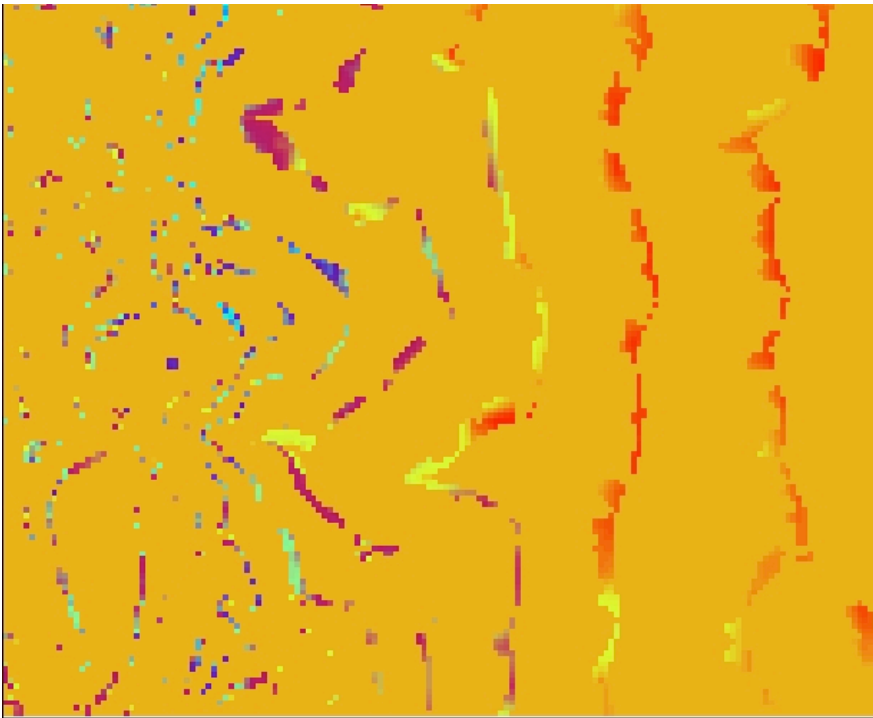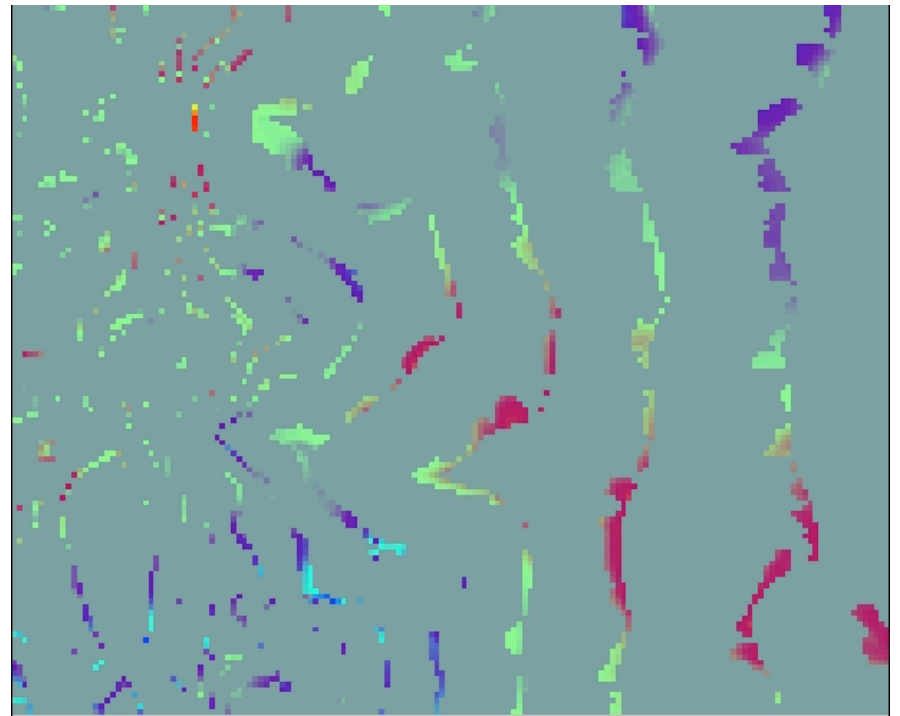Theta (-11 K blue, 0 K red)   U (-3 m/s blue, 4 m/s red)

Vertical Interpolation: zap_close_levels

- Impact: lowest few levels, where surface intersects isobaric levels

- zap_close_levels = 50

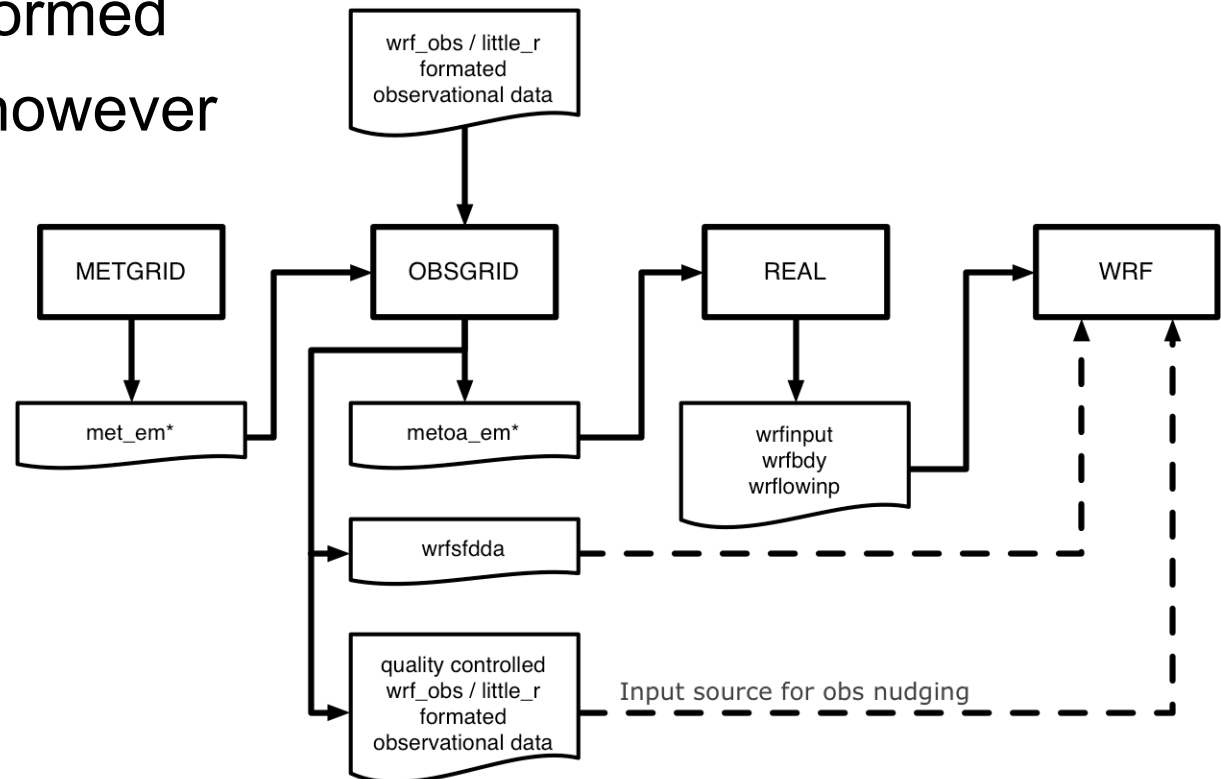- η level 2

Theta (-10 K blue, 1 K red)

U (-3 m/s blue, 4 m/s red)

OBSGRID: Objective Analysis

- OBSGRID is an objective analysis package for ARW

  - Similar to MM5's LITTLE_R program (actually based on LITTLE_R)

  - I/O in NetCDF format from/to "C" grid

  - Analysis is performed on an "A" grid, however

Post-processor Updates

NCL

- Since version 4.3.1 (August 2007), many new functions and diagnostics added to NCL libraries
  - Can be use directly with WRF-ARW output without need to link extra Fortran code with NCL libraries

All other packages updated to work with V3 data (and maintain backward compatibility)

- RIP4, ARWpost, etc.

New Utilities: pinterp and vinterp

pinterp

- Used to interpolate wrf model output to pressure levels
- Requested pressure levels are specified in a namelist

vinterp

- Can be run on wrfinput and wrfbdy files (wrfout and wrfrst should also work)
- Vertically interpolates to a new set of eta levels
- Useful for adding vertical levels after running program *ndown.exe*
- (Not yet released)

WRF-ARW support in VAPOR,Version 1.3

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National Center for Atmospheric Research
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VAPOR Visualization of WRF-ARW

- VAPOR 1.3 is available (free), with WRF documentation at
  http://www.vapor.ucar.edu

- Interactive 3D support for:
  - Volume rendering
    - Interactive color/opacity editor
  - Isosurfaces
    - Color mapped from other variables
  - Contour planes
    - Arbitrary orientation
  - Terrain images
  - Volume rendering
  - Data probing
  - Streamlines and particle tracing
    - Interactive seed placement
  - Image-based flow visualization
  - Interactive access to massive data
  - Animation with animation capture
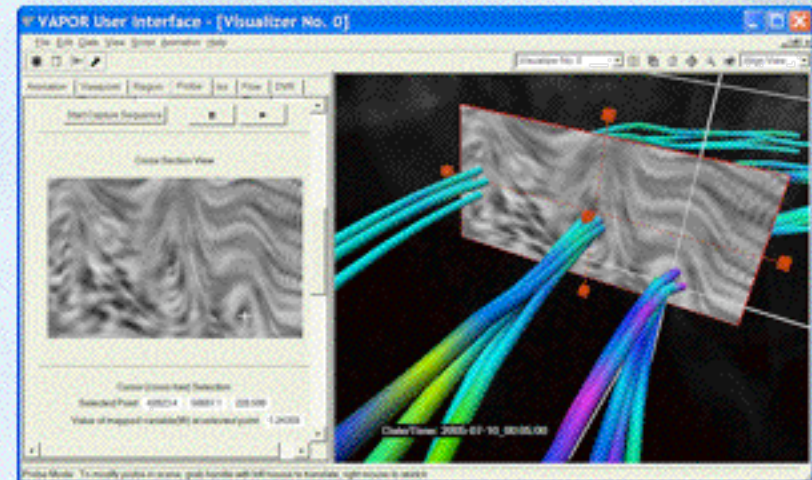
Streamlines in hurricane, Y. Chen, NCAR
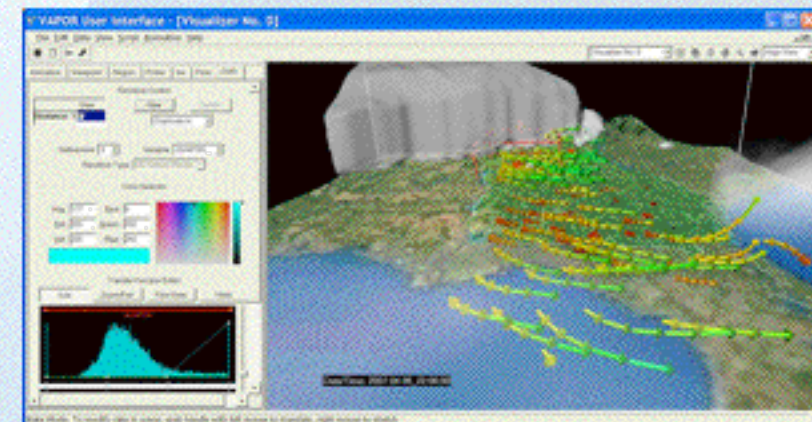
Particle traces from Atlanta GA, T. Prabharakan, U. of Ga.

VAPOR and WRF

Questions?