NCEP's UNIFIED POST PROCESSOR(UPP)

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Based on Hui-Ya Chuang, 2011 presentation

OUTLINE

- Overview
- Components and Functions
- Sample fields generated
- Installation
- Running unipost
- Running copygb
- Visualization

Overview

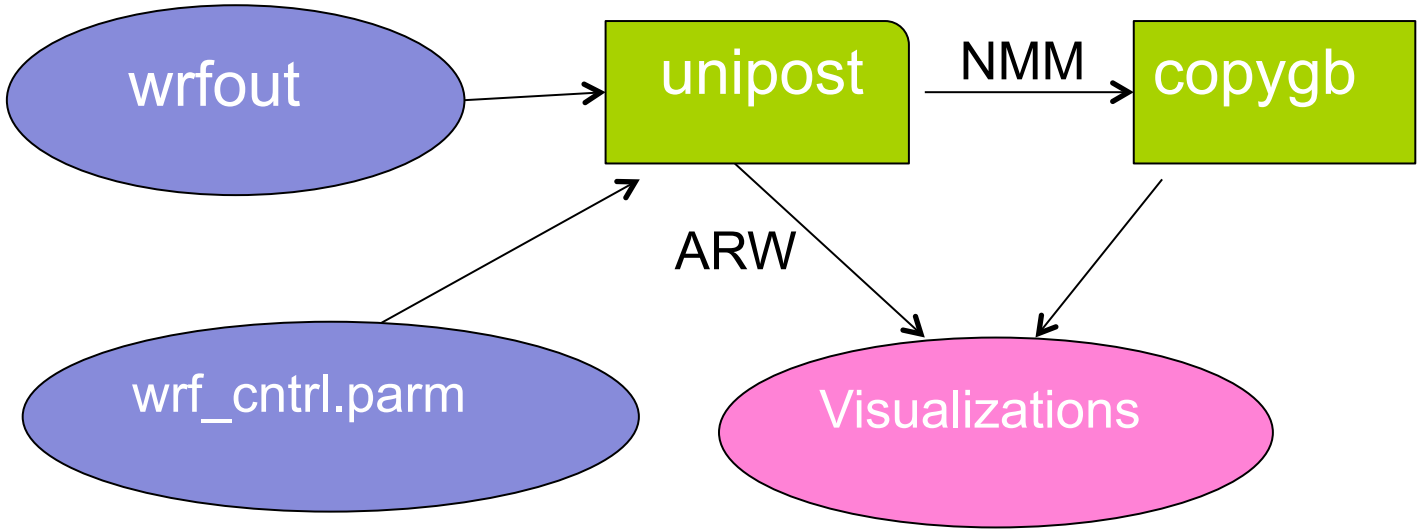
- Process model output from both the NMM and the ARW dynamic cores
  - Vertical interpolation: native model levels ➔ NWS standard levels (pressure, height)
  - There is also an option to output fields on model's native vertical levels
  - Horizontal options: native model grids ➔standard output grids (AWIPS, Lambert Conformal, polra-stereographic, regular lat-lon grids, etc)

Overview (cont)

- The Unified Post Processor (UPP) generates output in GRIB
- The UPP enables product generation on any output grid

Components of UPP

unipost and copygb



UNIPOST: Functions and Features

- Performs vertical interpolation onto isobaric and other non-model surfaces
- Computes diagnostic fields
- Destaggers wind onto mass point (ARW)
- An MPI-parallel code

Ingesting WRF model output

- The unipost ingests WRF model output in netCDF or binary format using WRF I/O package
  - Users are encouraged to use netCDF format data for simplicity
  - Binary I/O is quicker for large file sizes. DTC is working to improve binary support using MPI-IO
  - One time per output file is best with sample UPP run scripts

Ingesting WRF model output

- By default WRF will provide all fields that UPP needs to ingest
  - Be cautious to remove fields from wrfout files
  - Unipost will abort at run time if a requested variable is missing
- The Users' guide lists the fields read in by unipost for both dynamical cores
  - See table 1 (NMM) and table 2 (ARW)
- Not a concerns unless modifying the Registry

COPYGB

- copygb is a program to change grids of a grib file.
- Performs destaggering (NMM only) and horizontal interpolation to a defined output grid
- Creates an output grid different than the model integration domain (i.e. change the resolution, the projection, etc)

Fields generated by UPP

- The UPP outputs hundreds of possible fields
  - See complete list in Users' Guide
- Sample fields generated by UPP:
  - T, Z, humidity, wind, cloud water, cloud ice, rain, and snow on isobaric levels
  - SLP + shelter level T, humidity, and wind fields
  - Precipitation related fields

Fields generated by the UPP

- Sample fields generated by UPP (cont.):
  - PBL-related fields
  - Diagnostic products
  - Radiative/Surface fluxes
  - Cloud related fields
  - Aviation products
  - Satellite look-alike products

UPP download and compile

- The UPP source code can be obtained from:

  http://www.dtcenter.org/wrf-nmm/users/downloads
- The latest version available is:

  UPPV1.1.tar.gz
- Unpack the downloaded file:

  tar –zxvf UPPV1.1.tar.gz

Important Contents in UPP

- scripts/: sample scripts for running UPP
- parm/: contains the control file used when running the unipost
- clean, configure, compile: scripts used to build UPP

How to build UPP

- The build mechanism follows the WRF model build paradigm:

  ./configure: respond to screen prompts about target computing platform

  ./compile >& compile_upp.log

  (*Please note: this build relies on the existence of a built WRF source directory)

How to build UPP (cont.)

- If compilation is successful, these three executables will be present in exec/:
  - Copygb.exe
  - Ndate.exe
  - Unipost.exe
- Available build options: IBM (AIX) and Linux (PGI/Intel/Gnu compilers)

Running unipost and copygb

unipost needs three input files to run:

- Itag: sepcifies details of WRF output to process
  - Wrfout_d01_yyyy-mm-dd_hh:00:00: history output file
  - Netcdf: format of wrfout files
- *wrf_cntrl.parm:* control file specifying fields/levels to output
- *eta_micro_lookup.dat: binary look-up table for Ferrier MP*

unipost control file: wrf_cntrl.parm

- Users specify which fields or which level(s) of fields to output by modifying control file, e.g.,

GRIB packing precision

(PRESS ON MDL SFCS) SCAL=(6.0)

- **L=(11000 00000 00000 00000 00000 00000 00000…**

(HEIGHT ON MDL SFCS) SCAL=(6.0)

- **L=(11000 00000 00000 00000 00000 00000 00000…**

Each column represents a single model/isobaric level: "1" (or "2" - special case) = output, "0" = no output

unipost control file: *wrf_cntrl.parm*

- The included *wrf_cntrl.parm file has entries for* every possible output field.

- The users' guide "Fields produced by *unipost"* table more fully explain the character string abbreviations used in the control file.

Output fields on different vertical coordinates

- Unipist outputs on several vertical coordinates:
  - Native model levels
  - 47 isobaric levels
  - 15 flight/wind energy levels: 30, 50, 80, 100, …, 2743, 3658, 4572, 6000m (above ground or above MSL)
  - 6 PBL layers: each average over a 30hpa deep layer
  - 2 AGL levels: 1000 and 4000 m (radar reflectivity)
- Except for AGL and isobaric levels, vertical levels are counted from the ground surface up in wrf_cntrl.parm

Examples

- Output T every 50 hPa from 50 hPa to 1000 hPa:

  (TEMP ON PRESS SFCS) SCAL=(4.0)

  L=(00000 01001 01010 10101 01010 10101 01010 10101 01010 10000…)

  From left to right, the isobaric levels increase 2, 5, 7, 10, 20, 30, 50, 70, then 75-1000 hPa every 25 hPa.

- Isobaric levels every 50 hPa:

  L=(00000 01001 01010 10101 01010 10101 01010 10101 01010 10000 00000 00000 00000 00000 00000)

- Isobaric levels every 25 hPa:

  L=(00000 01011 11111 11111 11111 11111 11111 11111 11111 10000 00000 00000 00000 00000 00000

Examples

- Output instantaneous surface sensible heat flux:

  (INST SFC SENHEAT FX) SCAL=(4.0)
  L=(10000 00000 00000 00000 00000 00000 00000 00000 00000 00000…)

- Output the U-wind component at the 5 lowest model levels:

  (U WIND ON MDL SFCS) SCAL=(4.0)
  L=(11111 00000 00000 00000 00000 00000 00000 00000 00000 00000…)

- Output U-wind component at 30, 50, and 80 m AGL:

  (U WIND AT FD HEIGHT) SCAL=(4.0)
  L=(22200 00000 00000 00000 00000 00000 00000 00000 00000 00000…)

copygb: target grid definition

- The generic command to run copygb and horizontally interpolate onto a new grid is:

  copygb.exe –xg"${grid}" in.grb out.grb

- Three options on how to specify the target $grid:
  1. Pre-defined NCEP standard grid number
  2. Grid navigation file created by *unipost (NMM only)*
  3. User-defined grid definition

Run copygb – Option 1

- Interpolate to a pre-defined NCEP standard grid (restrictive but simple)

  Example: to interpolate onto NCEP grid 212:

  copygb.exe –xg212 in.grb out.grb

- Descriptions of NCEP grids are available online:

  http://www.nco.ncep.noaa.gov/pmb/docs/on388/tableb.html

Run copygb – option 2

- Read in grid navigation file created by *unipost*

  (unipost produces two ASCII files containing grid navigation information)

  - *copygb_gridnav.txt for a Lambert Conformal grid*
  - *copygb_hwrf.txt for a regular Lat-Lon grid*

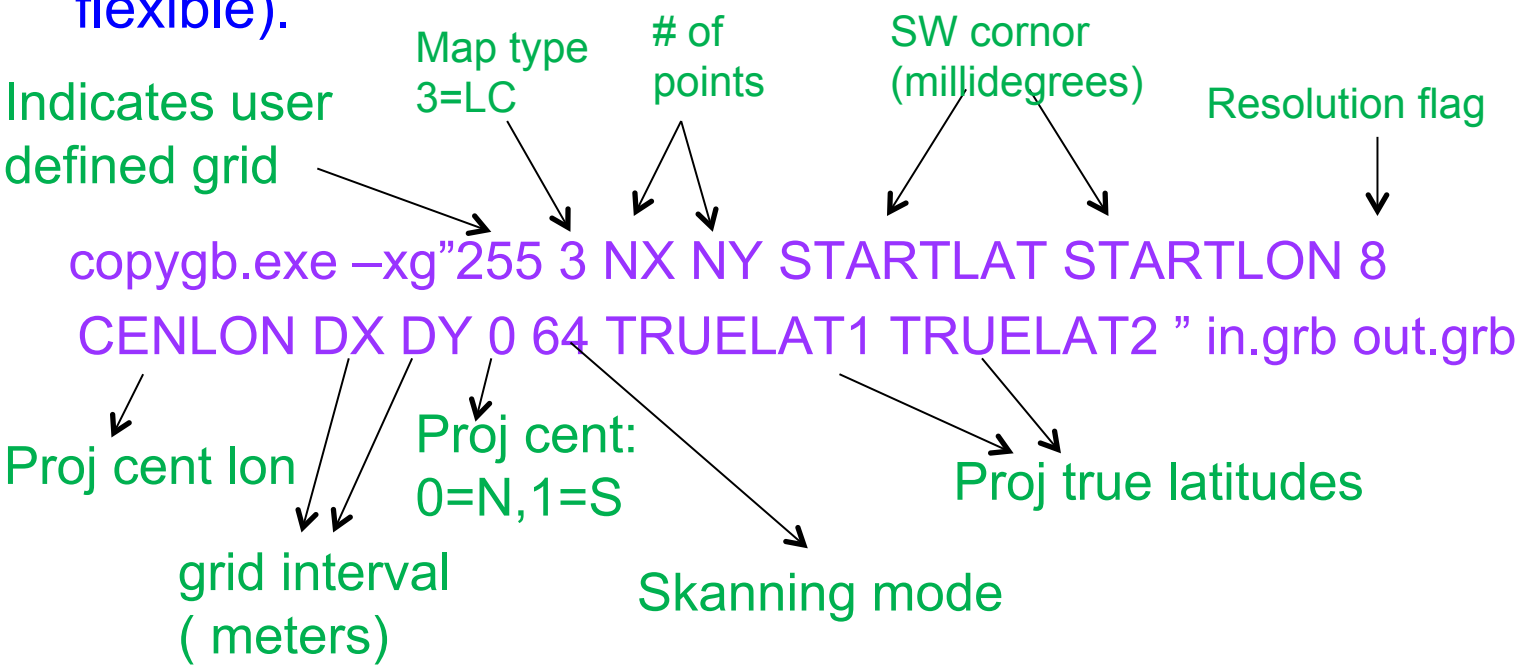
- Example:

  read nav < 'copygb_gridnav.txt'

  copygb.exe –xg”${nav}” in.grb out.grb

Run copygb – Option 3a

- Create a user-defined Lambert Conformal grid by specifying a full set of grid parameters (complicated but flexible).



Run copygb – Option 3b

- Create a user-defined Polar Stereographic grid by specifying a full set of grid parameters (complicated but flexible).

  copygb.exe –xg”255 5 NX NY STARTLAT STARTLON 8 CENLON DX DY 0 64” in.grb out.grb

  copygb –xg”255 5 580 548 10000 -128000 8 -105000 15000 15000 0 64” in.grb out.grb

Run copygb – Option3c

- Create a user-defined Latitude-Longitude grid by specifying a full set of grid parameters (complicated but flexible).

copygb.exe –xg”255 0 NX NY STARTLAT STARTLON 136 ENDLAT ENDLON DLAT DLON 64” in.grb out.grb

copygb –xg”255 0 401 401 10000 -130000 136 50000 -90000 100 100 64” in.grb out.grb

GRIB visualization with GrADS

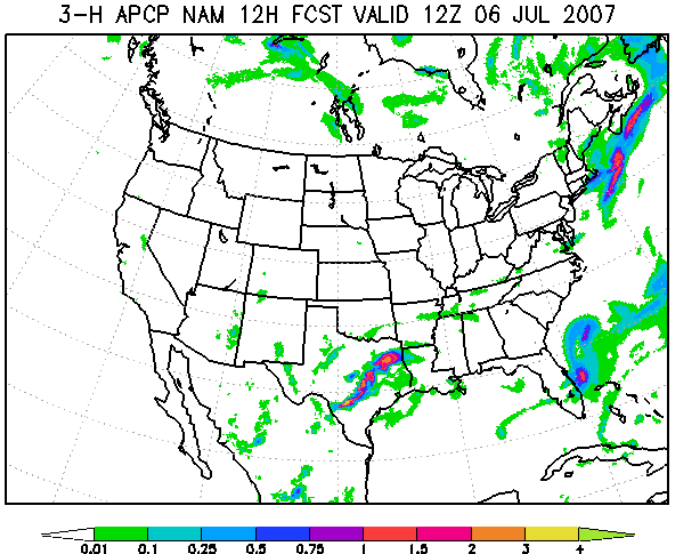
- GrADS has utilities to read GRIB files on any nonstaggered grids and generate GrADS “control” files.

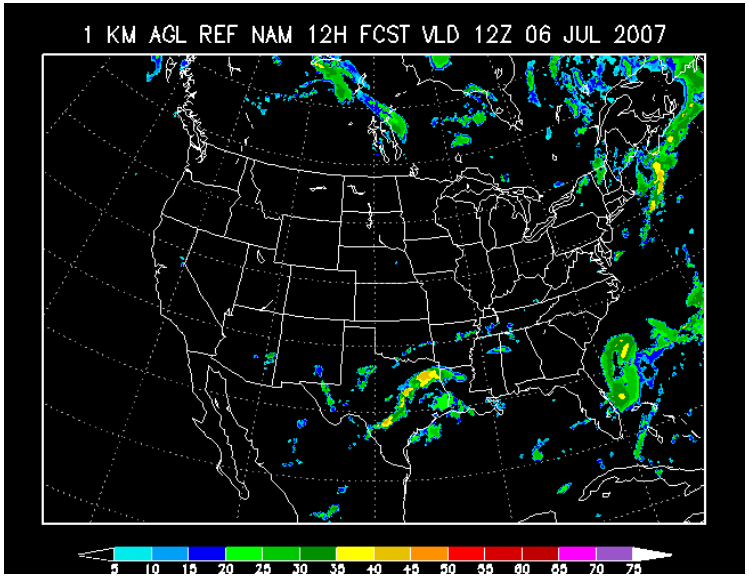
The utilities grib2ctl and gribmap are available via:
http://www.cpc.ncep.noaa.gov/products/wesley/grib2ctl.html

- Package download and user guide for GrADS are available online: http://grads.iges.org/grads/gadoc/

- A sample script named *run_unipostandgrads is included* in scripts/ that can be used to the run *unipost, copygb,* and then plot various fields using GrADS.

Forecasts plotted with GrADS





Future Plan

- NCEP/EMC and the DTC are working on an updated version that will have the option to write GRIB1 or GRIB2 (currently just writes GRIB1).
- As mentioned earlier, better support for reading WRF model binary output also is in the plans.
- Please pay attention to update release.