



The Weather Research and Forecasting Model: 2013 Annual Update

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WRF Community Model

- Version 1.0 WRF was released December 2000
- Version 2.0: May 2004 (NMM added, EM nesting released)
- Version 2.1: August 2005 (EM becomes ARW)
- Version 2.2: December 2006 (WPS released)
- Version 3.0: April 2008 (add global ARW version)
- Version 3.1: April 2009
- Version 3.2: April 2010
- Version 3.3: April 2011
- Version 3.4: April 2012
 - Version 3.4.1: August 2012
- Version 3.5: April 2013

New In Version 3.4.1

- Reflectivity outputs consistent with microphysics for a number of schemes (do_radar_ref=1)
- Pressure level outputs (namelist &diags)

Reflectivity Outputs

- Namelist option: *do_radar_ref=1*
- Provided by Greg Thompson
- Uses option's own size distributions to give consistent reflectivity output
- Works for microphysics options:
Thompson, Morrison, Goddard, Lin,
WSM5, WSM6, WDM5, WDM6

Pressure-level Outputs

- Provided by Dave Gill
- Namelist option: *p_level_diags*
- Can choose levels
- Will output standard variables in separate output file
- See examples.namelist for usage

New Physics Options in Version 3.5

- CESM microphysics (based on Morrison and Gettelman) (mp_physics=11)
- CLM4 (Community Land Model) (sf_surface_physics=5)
- Grell-Freitas cumulus (cu_physics=3, replaces GD)
- Grenier-Bretherton Mixing PBL (bl_pbl_physics=12)
- GRIMS shallow convection (shcu_physics=3)
- 3d simple PWP ocean model (sf_ocean_physics=2)
- WRF-Hydro coupling (hydrological model coupling)
- UW surface drag option (Mass, topo_wind=2)

CESM 1.0 Microphysics

- Provided by PNNL
- Option: *mp_physics=11*
- Based on Morrison and Gettelman climate-model microphysics
(*module_mp_cammgmp_driver.F*)
- Produces its own cloud fraction for RRTMG radiation
- Interacts with WRF-Chem aerosol option

Community Land Model (CLM4)

- Provided by Jiming Jin (Utah State U)
- Option: *sf_surface_physics=5*
- CESM land component
- 10-level soil, 5-level snow
- Sub-grid tiling
- Further capabilities not activated: dynamic vegetation, lake model, carbon-nitrogen cycle

Grell-Freitas Cumulus Scheme

- Provided by Georg Grell (NOAA) and Saulo Freitas (Brazil)
- Option: *cu_physics=3* replaces GD scheme (now 93)
- Ensemble scheme
- *ishallow=1* option to add shallow convection

Grenier-Bretherton Mixing PBL

- Provided by Natalie Perin (Oregon State University) – also developed by Jim McCaa
- Option: *bl_pbl_physics=12*
- Mellor-Yamada TKE approach
- Developed for marine boundary layer applications

GRIMS Shallow Convection

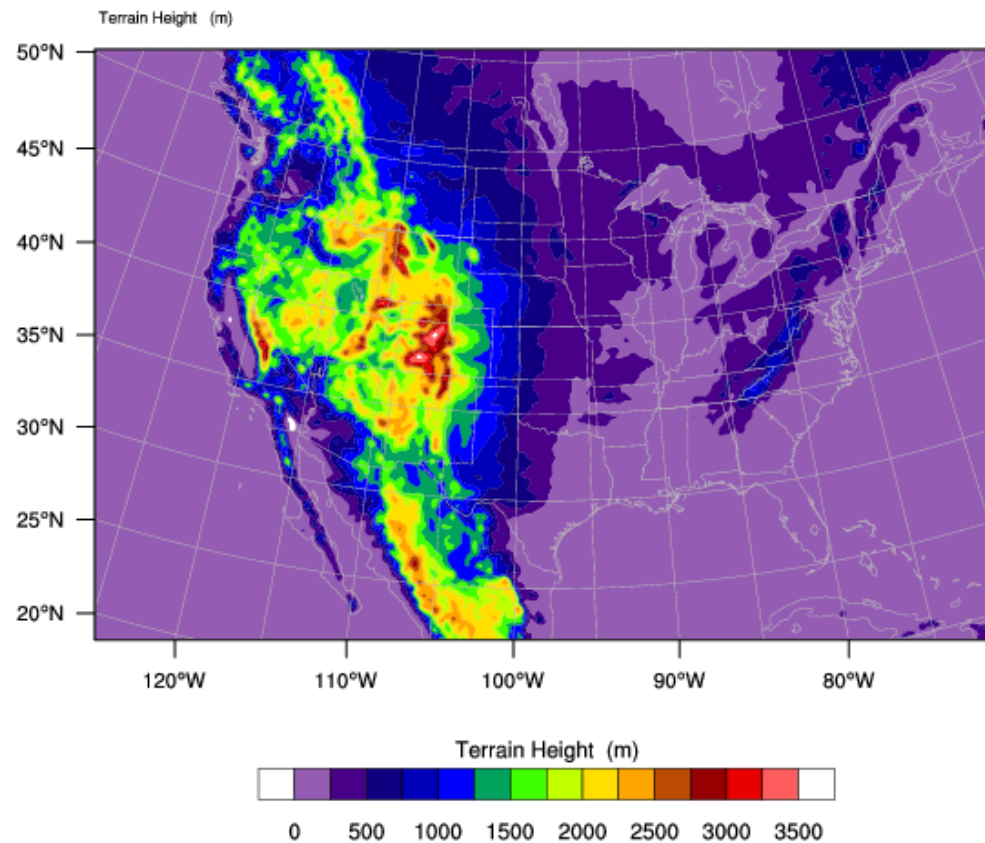
- Provided by Songyou Hong (YSU, Korea)
- Option: *shcu_physics=3*
- To be used with YSU PBL
- Shallow cumulus mixing scheme

Quick Tests of New Options

- 20 km US domain (40 levels)
- 28 runs (48h)
 - Initialized 00Z June 1-28 2010
- Control (YSUbl, KFcu, WSM5mp, Noahlsm, RRTMlw, Goddardsw)
- 6 tests (GBMbl, GFcu, CESMmp, CLM4lsm, GRIMSshcu, aer_opt1)
- Results compared to GFS (and ERA) analyses

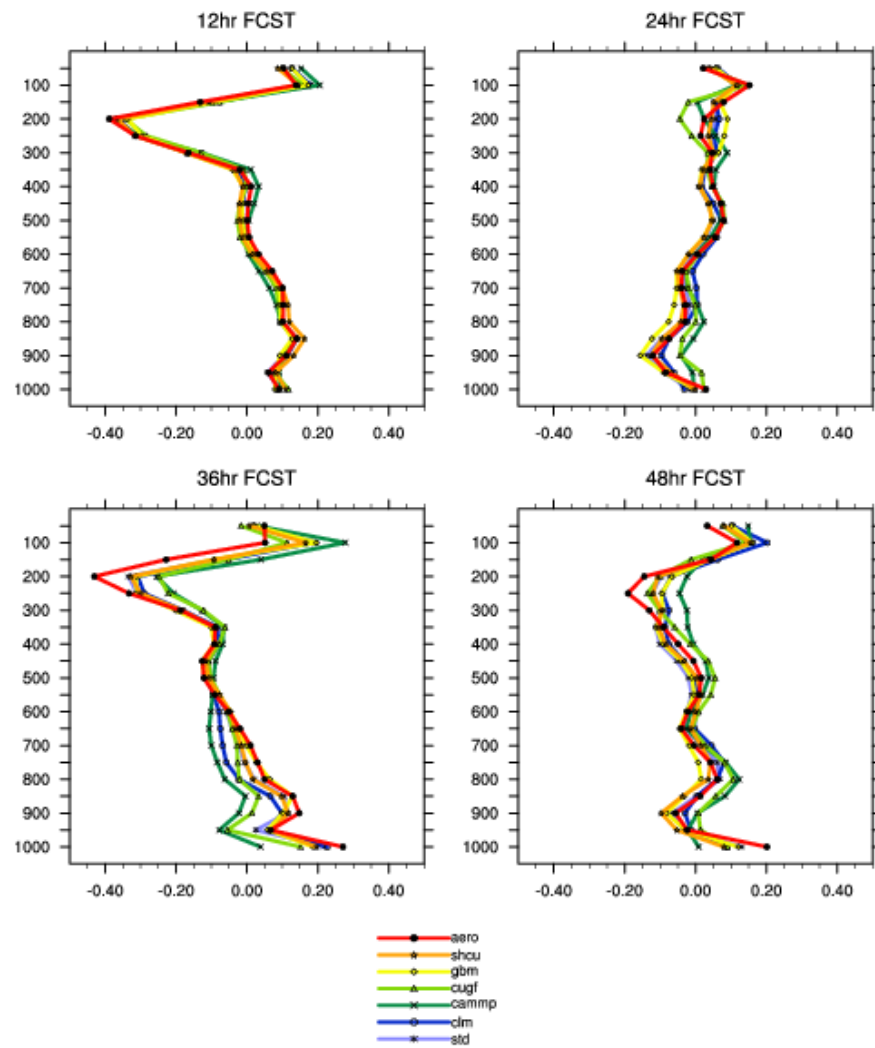
GEOGRID FIELDS

Init: 2010-06-01_00:00:00

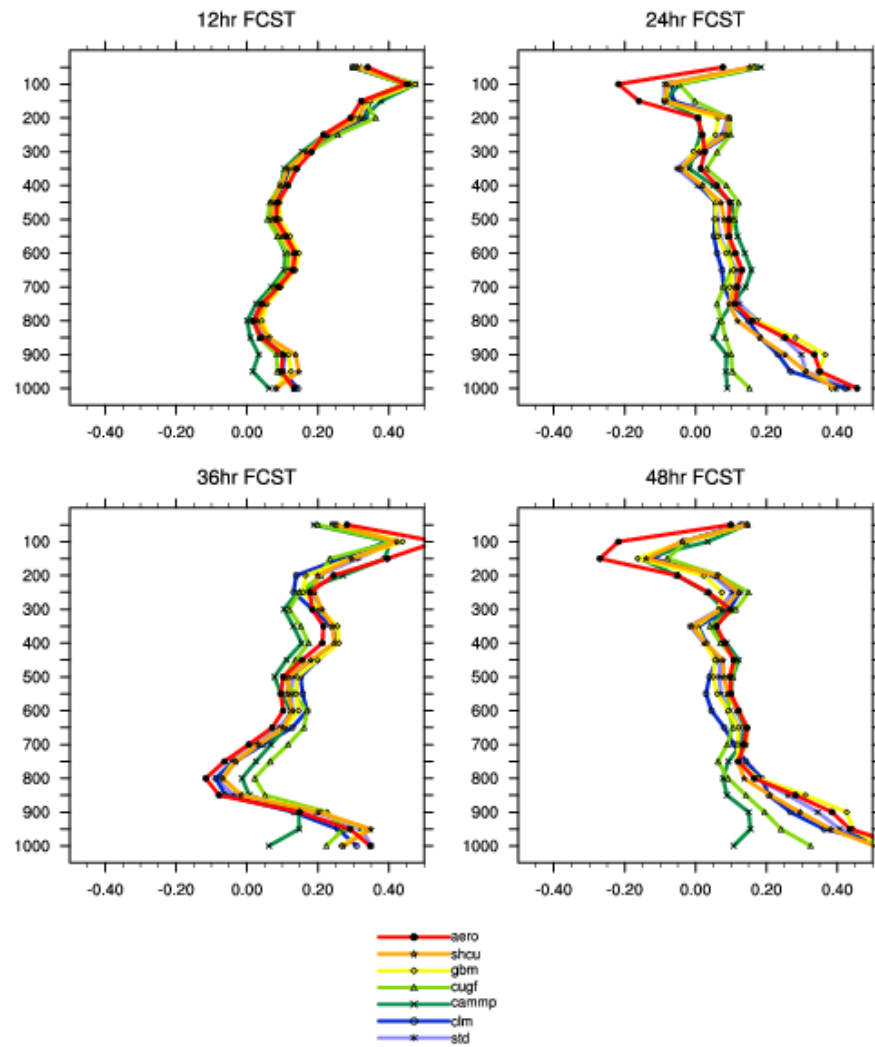


OUTPUT FROM REAL_EM V3.4.1 PREPROCESSOR
WE = 290 ; SN = 190 ; Levels = 40 ; Dis = 20km ; Phys Opt = 4 ; PBL Opt = 1 ; Cu Opt = 1

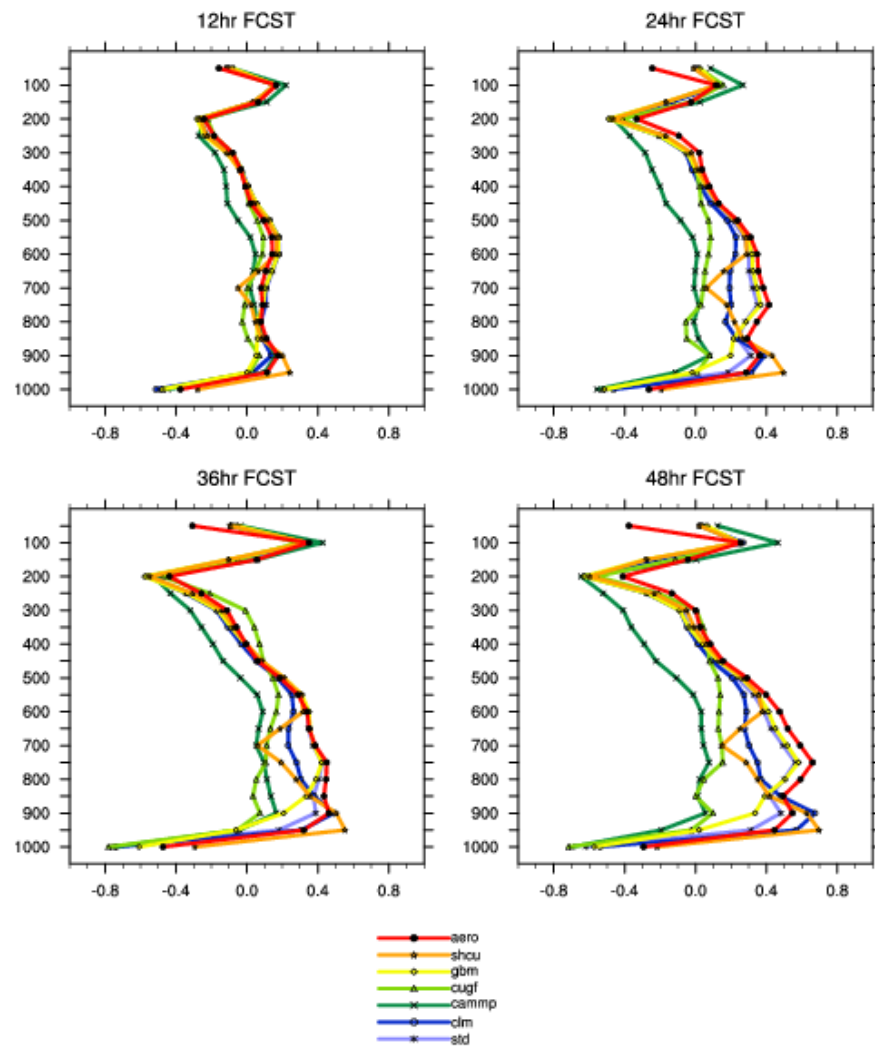
V35 TEST (20km, 201006, FNL) UBias



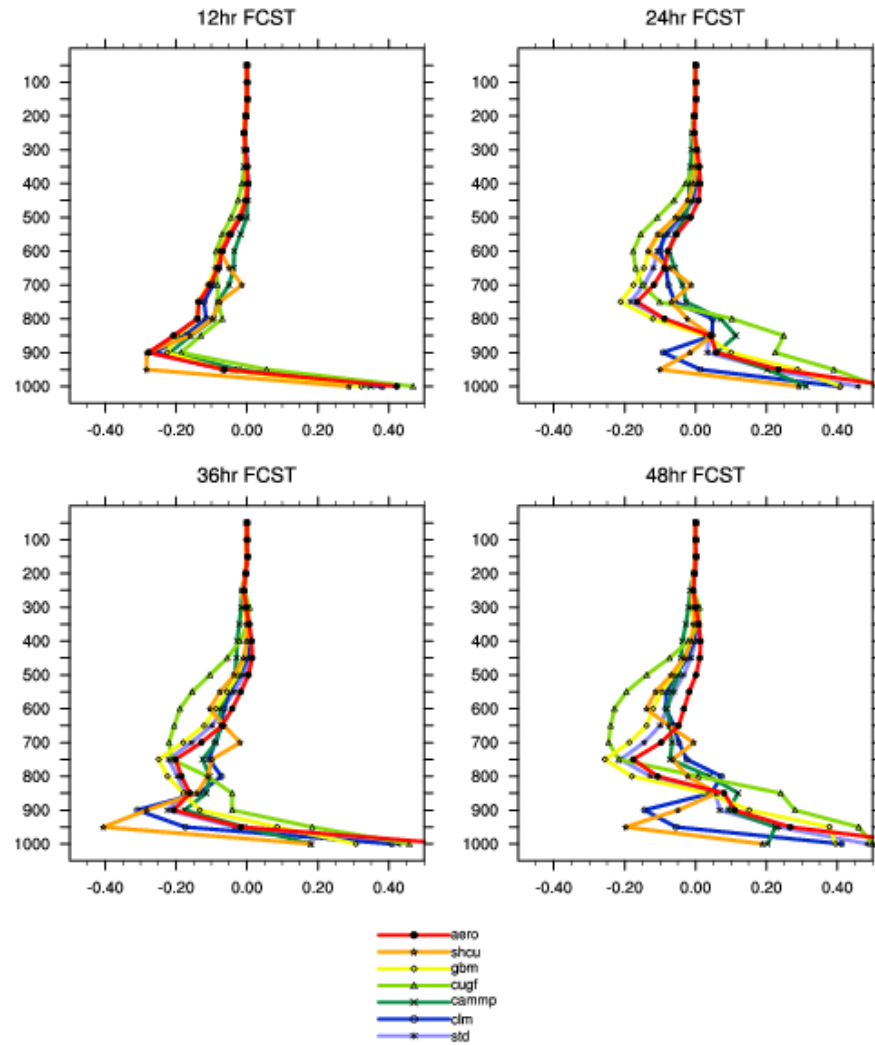
V35 TEST (20km, 201006, FNL) VBias



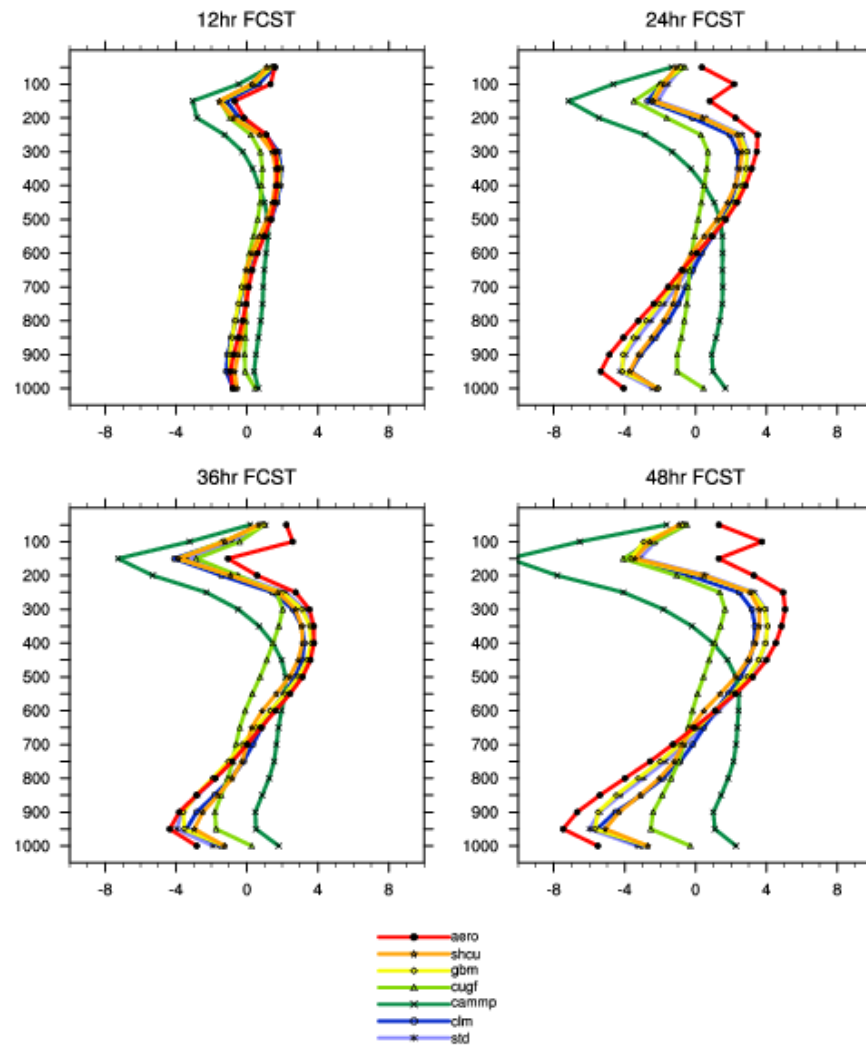
V35 TEST (20km, 201006, FNL) TBias



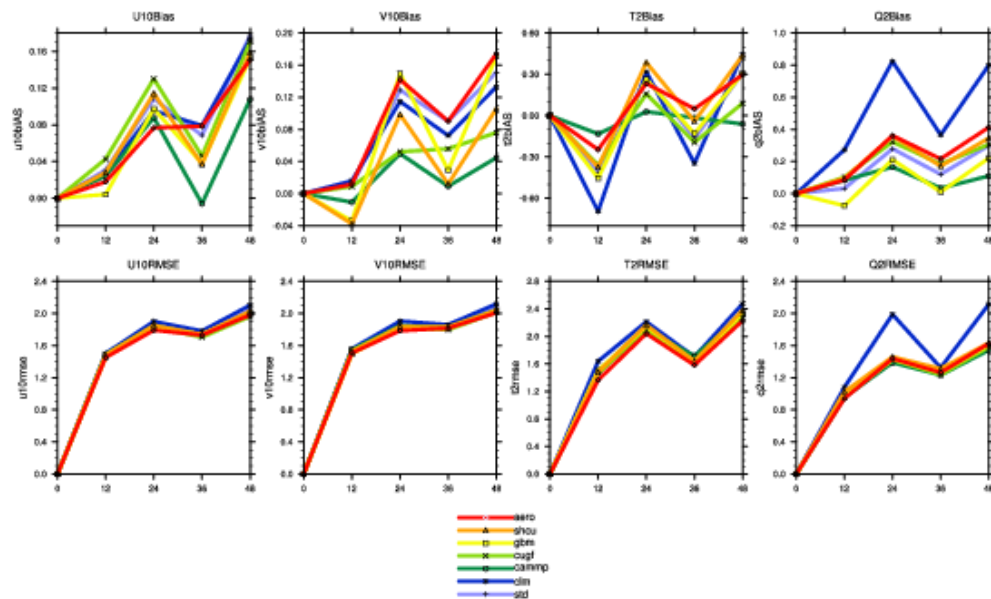
V35 TEST (20km, 201006, FNL) QBias



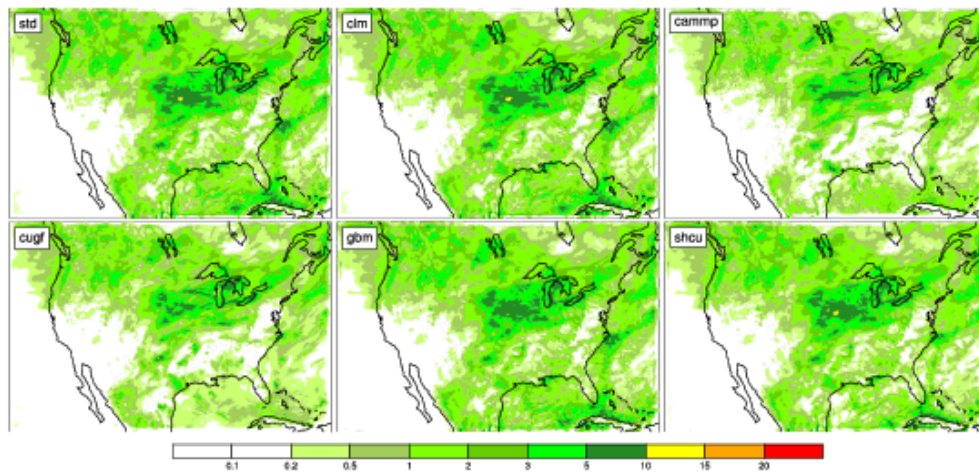
V35 TEST (20km, 201006, FNL) GHTBias



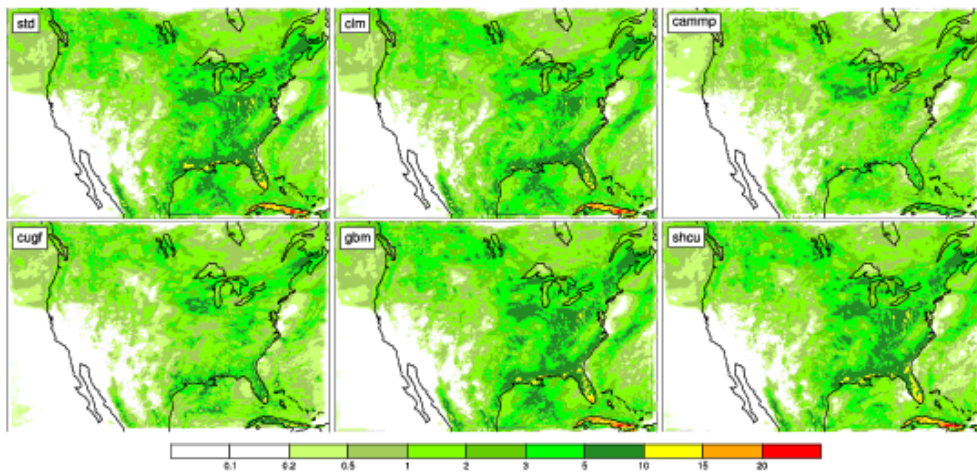
V35 TEST : SFC VERIFICATION (20km, 201006, FNL)



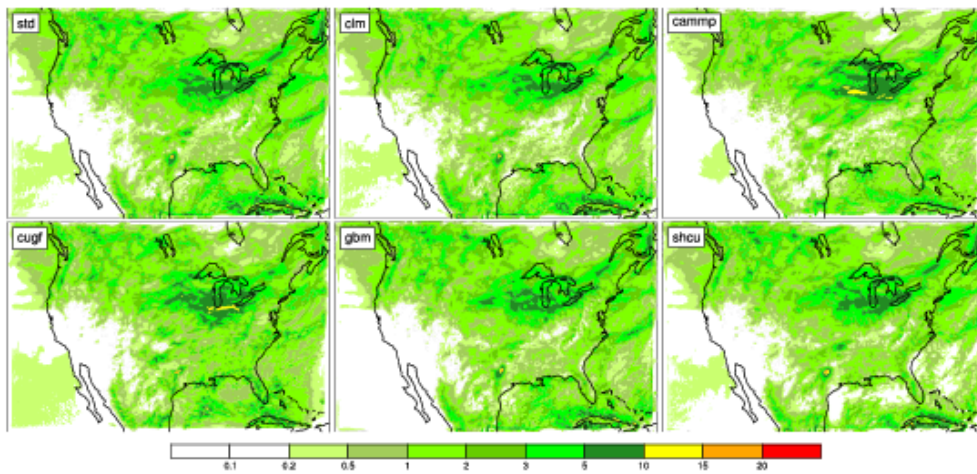
V35, 201006, 0-12hr FCST Precip



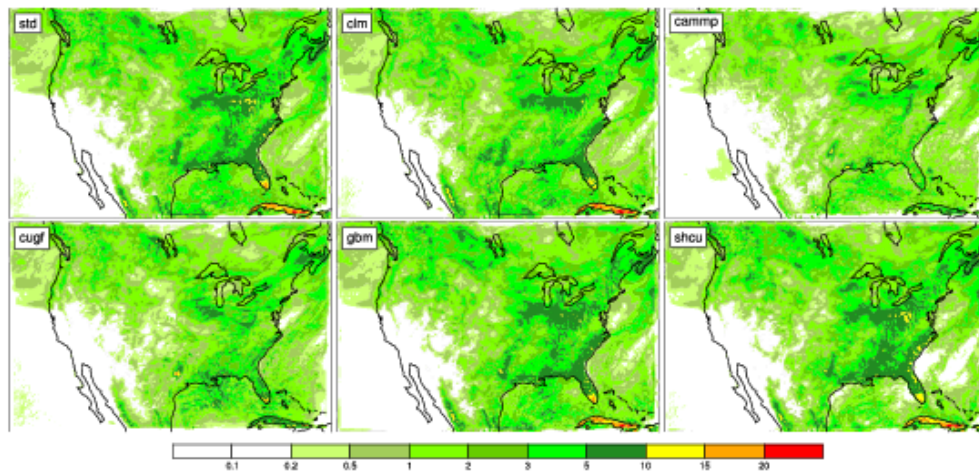
V35, 201006, 12-24hr FCST Precip



V35, 201006, 24-36hr FCST Precip



V35, 201006, 36-48hr FCST Precip



PWP 3d ocean

- Provided by Chiaying Lee (U. Miami)
- Option: *sf_ocean_physics*=2 (1d OML is now option 1 replaces *omlcall* switch)
- Price et al. (1994) 3d ocean model
- Allows 3d effects (100 levels)
- Simple bathymetry (no coastal ramp)

UW Surface Drag Option

- Provided by Cliff Mass et al. (U. Washington)
- Option: *topo_wind=2*
- To be used with YSU PBL
- An alternative method to reduce surface high-wind bias in complex terrain

WRF-Hydro

- Contributed by Dave Gochis and Wei Yu (NCAR/RAL)
- See talk by Dave Gochis for details
- WRF coupled to hydrology model for interactive streamflow computations
- Sub-grid tiling to ~100 m for hydrology
- Directory for hydro in tar file

Other New Capabilities In Version 3.5

- Climatological ozone and aerosols for RRTMG radiation
- Updating capability for CO₂, CH₄, etc., in long climate runs for RRTMG and CAM radiation
- NSSL storm diagnostics (max w, etc.)
- Trajectory parcel-following diagnostics
- Profile time series
- Lightning diagnostic
- NUDAPT data for urban models (US cities)
- New MODIS monthly vegetation fraction (30" res)

Other New Capabilities In Version 3.5

- Climatological ozone and aerosols for RRTMG radiation
 - Provided by Wei Wang (NCAR)
- Option: *o3input=2*
 - Using CAM ozone climatology (month, lat, pres)
 - *o3input=0*: 1d climatology (old method)
- Option: *aer_opt=1*
 - ECMWF (Tegen) aerosol climatology (month, lat, long, pres)
 - *aer_opt=0*: no aerorol (old method)

Other New Capabilities In Version 3.5

- Updating capability for CO₂, CH₄, N₂O, in long climate runs for RRTMG, RRTM and CAM longwave radiation
 - Activated with `#ifdef CLWRFGHG (-D CLWRFGHG)`
 - Provided by Claire Carouge, Luis Fita (U.NSW, Australia)
 - Reads data files for chosen greenhouse-gas scenario (user can edit these)
 - A2, RCP6, RCP8.5, etc., annual values
 - Default uses constant values of these gases
 - Note also: RRTM constant CO₂ value updated to 379 ppm

Other New Capabilities In Version 3.5

- NSSL storm diagnostics (max w, etc.)
 - Provided by NSSL
 - Option: *nwp_diagnostics=1*
 - Maxima of storm-relevant quantities between history outputs at each grid point (2d)
 - Vertical velocity in updraft/downdraft
 - Helicity
 - Reflectivity
 - Surface wind
 - etc.

Other New Capabilities In Version 3.5

- Trajectory parcel-following diagnostics
 - Provided by Chiaying Lee (U. Miami)
 - Option: *trajcall=1*
 - Run-time trajectories using model velocity to advect
 - Initial positions and number chosen in namelist
- Profile time series
 - Previous time series were surface variables only

Other New Capabilities In Version 3.5

- Lightning diagnostic
 - Provided by John Wong (U. Colorado), Mary Barth (NCAR)
 - Enables lightning flash rates estimated from microphysics relectivity and/or cumulus (GD, G3, GF schemes) cloud top
- NUDAPT data for urban models (45 US cities)
 - Provided by Jason Ching, Tim Glotfelty (U. North Carolina)
 - Additional city-specific mapped data for BEP/BEM urban models
- New MODIS monthly vegetation fraction (30" res)
 - Provided by Mike Barlage (NCAR)

Contributions for next release

- New options for contribution should come to NCAR by October 2013
- Code freeze and final test phase starts December 2013
- Release planned for April 2014



Thanks

Credits:

Tests and Graphics: Ming Chen