The Weather Research and Forecasting Model: 2008 Annual Update

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NCAR/MMM

WRF Versions

- Version 1.0 (December 2000)
- V2.0 (May 2004)
  - V2.1 (August 2005)
  - V2.2 (December 2006)
    - V2.2.1 (November 2007)
- V3.0 (April 2008)
    - V3.0.1 (planned soon)
- V3.1 (in 2009)

New in Version 3.0

- Global capability for ARW core
  - Lat/long grid
  - Polar filter
  - See talk 1.2 (Skamarock)
- Digital Filter Initialization (ARW)
  - Significantly reduces initial noise
  - See talk 1.3 (Peckham)

New in Dynamics

- NMM Nesting with two-way capability
- ARW upper boundary conditions
  - New implicit upper gravity-wave absorber (*damp_opt=3*). See 1.9 (Klemp)
  - New upper lid (*w=0*) for idealized cases (*top_lid*)
- ARW automatically variable time step for speed-up (Hutchinson 2007)

New in Dynamics

- ARW Diffusion Additions
  - *mix_isotropic* to choose whether vertical mixing length scales with grid aspect ratio ($\Delta z/\Delta x$) or not
  - LES PBL capability (*km_opt=2* or *3)* where 3d sub-grid mixing replaces PBL and uses physical surface fluxes (sensible heat, moisture, and stress) suitable for ~100 m grids

New Physics Options

- Goddard microphysics (*mp_physics=7*)
- Morrison 2-moment microphysics (*mp_physics=10*)
- Grell-3 cumulus (*cu_physics=5,* talk 10.2)
- ACM2 PBL and surface layer (Pleim) (*bl_pbl_physics=7, sf_sfclay_physics=7*)
- Pleim-Xiu land-surface model (*sf_surface_physics=7,* talk 3.4)

New for Regional Climate

- Time-dependent lower boundary file can now be used to
  - update sea ice from analyses (like SST)
  - update albedo from monthly climatology (like vegetation fraction)
- Lateral boundary can use an exponential function (*spec_exp*) suitable for broad boundary zones

New for Hurricane Applications

- Ocean Mixed-Layer model (*olmcall=1*)
  - One-layer (slab) mixed-layer
  - Predicts mixed-layer depth, horizontal current, temperature
  - Includes surface stress and thermal forcing, and deep-layer mixing (cooling)
  - Includes Coriolis
  - No advection
- Option for using hurricane-specific surface flux (C_d and C_k) formulations (*isftcflx=1*)

New Output Diagnostics

- *diag_print=1* can be used to output domain-averaged noise level, rainfall, and surface fluxes in model print-out
- Time-series outputs are available for points selected in a *tslist* file

New Idealized Test Cases

- *em_heldsuarez* is an idealized test case for the global version (only 64x36x40 points). This does the Held-Suarez dynamics test with temperature relaxation producing a jet and baroclinic waves
- *em_seabreeze2d_x* is a 2d sea-breeze case with a land-water domain and land-surface, PBL and radiation physics sufficient to produce a sea breeze in a 2-km grid domain
- *em_les* is a 3d periodic test case with a 100-m grid (only 40x40x40 points) and specified surface flux to produce a dry large-eddy simulation of the boundary layer with Coriolis effects

Updated Physics

- The Dudhia shortwave scheme has had an option to include slope and shadowing effects at the surface (Zaengl), *slope_rad, topo_shading.*
- The YSU PBL scheme has a new way to mix in the stable regime (Hong talk 3.3) and is also now available with NMM

Updated Physics

- The Noah Land-Surface Model is now unified between NCEP and NCAR versions (talk 3.1 by Tewari)
- LSM snow emissivity effects are made consistent with radiative schemes
- The Urban Canopy Model now has anthropogenic heating that can be specified

Updated Physics

- CAM longwave and shortwave schemes are now separated and can be called with other shortwave and longwave schemes
- WSM6 microphysics has updated treatment of snow/graupel fall speeds to represent gradual snow to graupel transition (poster P3.5 by Dudhia et al.)

Updated Physics

- NCEP physics suite updated to reflect changes in operational code
  - BMJ cumulus significant changes
  - Ferrier microphysics changes for supercooled water

Planned Additions

- QNSE PBL (poster P3.8 by Sukoriansky et al., Galperin et al. 2007 talk)
- Orographic gravity-wave drag (Hong)
- Monotone advection
- WDM microphysics (poster P3.6 by Lim et al.)
- Surface analysis nudging (Penn State)
- CCSM physics
  - CLM, Neale-Richter cumulus, Morrison CCSM microphysics, PBL (e.g. UW)
- Many other schemes in development (see session 3 and 10 talks, P3 posters)

Bug-fix release 3.0.1

- Due soon
- Major bugs fixed
  - Adaptive step with KF schemes, and certain other options such as BLDT non-zero and nesting
  - OpenMP not active (Known Problems page has fix)

Bug-fix release 3.0.1

- Minor bugs fixed
  - OpenMP
    - Morrison and Goddard microphysics (not a problem until OpenMP is activated)
  - CAM radiation
    - Aerosols should have been given a non-zero value
    - Ozone monthly data time-interpolation corrected
  - LES PBL friction term (u* staggering and OpenMP issues)
  - Held-Suarez global test case fixed (map projection issue)

Bug-fix release 3.0.1

- Additional changes
  - Some defaults in Morrison scheme
  - Isftcflx surface fluxes for hurricanes (newer formulation)
  - Surface layer and Noah (minor change of surface pressure)
  - Grell-3 (index correction)
  - Vertical diffusion (damp_opt=1, cos profile to cos squared)
  - PBL cloud tendencies for
    - MYJ + non-Ferrier
    - ACM + Ferrier
- Recently reported problems with Lin microphysics scheme not yet resolved

Timeline for Version 3.1

- New features to be added by December 2008
- Test phase January till March 2009
  - May provide 3.1-beta code for outside testing
- Release of Version 3.1 in March/April 2009

Tutorials

- New User Tutorial (filled): July 14-18, 2008
- WRF-Var Tutorial (filled): July 21-22
- WRF-Chem Tutorial: July 23-24
- These have 60 places maximum
- Next New User Tutorial: January 2009