New Features in Version 3.3

Jimy Dudhia
NCAR/MMM

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 3.2.1: August 2010
- Version 3.3: Released April 2011

V3.2 Highlights (2010)

- Microphysics options: Milbrandt-Yau double-moment (Environment Canada)
- BEM urban option in Noah (Martilli, Salamanca, CIEMAT)
- Nonlinear Backscatter sub-grid stress model for LES (Mirocha, Kosovic, LLNL)
- WRF-Fire (Coen et al., NCAR)
- NDOWN vertical refinement (Moustaoui, Arizona State U)
- Multiple other changes (see last year's slides)

New Version 3.3 Options

- Microphysics
- CESM physics package
- Radiation
- PBL
- Cumulus parameterization
- WRF-Chem physics

New Microphysics Option

- Stony Brook University Y. Lin (SBU_YLIN) microphysics (mp_physics=13)
  - Cloud, ice, rain, snow variables plus diagnostic riming intensity to account for snow-graupel transition
  - Provided by Y. Lin and B. Colle (SBU, New York)

New CESM Physics

- CESM physics from NCAR CESM 1.0 climate model (to be used for IPCC AR5)
  - Zhang-McFarlane cumulus parameterization (cu_physics=7)
    - Mass flux, CAPE removal time scale closure
  - University of Washington PBL (bl_pbl_physics=9) and shallow cumulus scheme (shcu_physics=2) by Park and Bretherton
  - Code provided by W. Gustafson, P. Rasch and J. Fast (Pacific Northwest National Lab) [workshop talk 9.1]

New Radiation Options

- New Goddard shortwave and longwave radiation (ra_sw_physics=5, ra_lw_physics=5)
  - Updates previous Goddard shortwave (still option 2) and add new longwave
  - From R. Shi (NASA Goddard)

New PBL Option

- Total Energy Mass Flux (TEMF) PBL (bl_pbl_physics=10)
  - Uses concept of total energy instead of TKE
  - Also includes a shallow convection scheme
  - From W. Angevine (NOAA/ESRL)
  - Workshop talk 5.1

New Cumulus Options

- Simplified Arakawa-Schubert (SAS) scheme (cu_physics=3) now works in ARW (was NMM only).
  - Includes mixing-type shallow convection for ARW only.
- New (NCEP) SAS scheme (NSAS, cu_physics=14)
  - Newly operational in GFS global model
  - Mass-flux deep and new mass-flux shallow scheme
  - Provided by NCEP/EMC and S.-Y. Hong (YSU)
- Tiedtke cumulus scheme (cu_physics=6)
  - A CAPE-removal mass-flux type deep and shallow scheme
  - Provided by Y.-Q. Wang (U. Hawaii)
- Note that the Zhang-McFarlane, NSAS, and Tiedtke schemes all include momentum transport terms in ARW, while SAS includes them in NMM

Other New Physics

- New Kain-Fritsch trigger option (Ma and Tan 2009, Yu and Lee 2010) - modified thermal perturbation
- Shallow cumulus driver added (currently only UW option, more in future)
- Wind farm parameterization
  - Interacts with MYNN PBL, advects TKE, provides turbine effects and power output
  - Provided by A. Fitch (U. of Bergen, Norway)
    - Posters P16, P17

Physics for WRF-Chem

- Previously had Lin microphysics and old Goddard shortwave radiation
- New WRF-Chem-coupled options (from PNNL)
  - Morrison microphysics
  - RRTMG longwave and shortwave radiation

New Features

- Stochastic kinetic energy backscatter (Berner et al., 2011)
  - Random up-scale energy transfer
  - Aids ensemble spread (similar to ECMWF method)

New Features

- Idealized tropical cyclone example (G. Bryan, based on D. Nolan)
  - Balanced vortex initial state
  - test/em_tropical_cyclone

New Features

- Digital filter works with nesting (1-way)
- WPS and real.exe have speed-up option to process just boundary points for times after the initial conditions

Improvements and fixes

- Thompson microphysics updated
- TKE_MYJ renamed to generic TKE_PBL (also EL_PBL). This is now used by
  - MYJ, QNSE, BouLac, CAM UW
  - Note: MYNN still uses QKE (which is on half-levels)

Improvements and fixes

- Noah LSM
  - Roughness length now seasonally varying for long runs
    - Previously albedo, emissivity, vegetation fraction, leaf-area index were seasonally varying based on monthly vegetation fraction climatology map
- RRTMG longwave
  - Improvement from V3.2 RRTM added
    - Helps prevent cool bias for tops in upper stratosphere ($p < 50$ hPa) by adding extra radiation layers above model top (Cavallo et al., 2011, MWR)

Plans

- Regional climate diagnostics (max, min, mean, std of 2m temperature, moisture, 10 m wind, plus sunshine hours, etc.)
  - Thanks to U. Cantabria, Spain
  - Planned to be in V3.3.1 (~August 2011)
  - Added to separate auxhist files

Plans for 2012 release

- Items under consideration
  - SSiB LSM from UCLA (Y. Xue, F. de Sales)
  - UCLA (Fu-Liou) radiation
  - Reflectivity diagnostic output consistent with microphysics choice (G. Thompson)
  - New SAS cumulus for HWRF (possibly in 3.3.1)

Plans for 2012 release

- Items under consideration
  - Ozone (initialization from analysis, advection, interaction with radiation, S. Cavallo)
  - Year-dependent CO2 for more radiation schemes
  - ARW hybrid (eta-pressure) vertical coordinate (Klemp)
  - Mod for vertical height/pressure relation (T. Wee, possibly in 3.3.1)

Contributions for next release

- New options for contribution should come to NCAR by October 2011
- Code freeze and final test phase starts December 2011
- Release planned for April 2012

Thanks