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Demonstrating the utility of the Mesoscale Model Evaluation Testbed (MMET) in a research environment

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Developmental Testbed Center

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Motivation: The *Mesoscale Model Evaluation Testbed (MMET)* was established by the Developmental Testbed Center (DTC) to *assist the research community* in efficiently demonstrating the merits of a new technique by *providing datasets to utilize for testing* in a common framework in order to effectively *transition promising new advances into operations*.

MMET & DTC Baseline Testing

- MMET is hosted by the DTC, with data served through Repository for Archiving, Managing and Accessing Diverse DAta (RAMADDA)
- The DTC provides the user community with:
  - *Model input* and *observational datasets* for testing
  - *Baseline results* established by the DTC for select Operational Configurations (OCs), allowing for direct comparisons between new innovations and OCs
  - *Scripts* to assist with post-processing, graphics generation, and model evaluation
  - For *further information* on the testing protocol, case descriptions, access to RAMADDA or to nominate additional cases of interested to be included in MMET, please visit: http://www.dtcenter.org/eval/mmet

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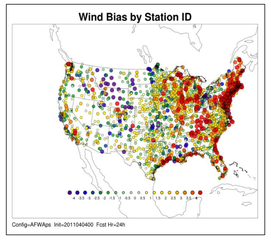
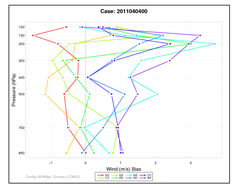
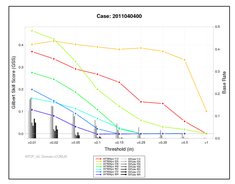
Example of baseline results:
4 Apr 2011 00 UTC
(Record breaking severe day)







Statistics generated by the
Model Evaluation Tools (MET)

MMET Cases	Meteorological Scenario
20090228	Mid-Atlantic *snow storm* where NAM model produced high QPF shifted too far north
20090311	*High dew point* predictions by NAM over the upper midwest and in areas of snow
20091007	*HIRESW* runs *underperformed* compared to coarser NAM model
20091217	"*Snowpocalypse '09*": NAM produced high QPF over mid-Atlantic, lack of cessation of precipitation associated with decreasing cloud top over eastern North Carolina
20100428-0504	Historic Tennessee *flooding* associated w/ an atmospheric river
20110404	Record breaking *severe* report day
20110518-26	Extended period of *severe weather* outbreak covering much of the midwest and into the eastern states later in the period
20111128	*Cutoff low* over SW US; NAM had difficulties throughout the winter of breaking down cutoff lows and progressing them eastward
20120203-05	*Snow storm* over Colorado, Nebraska, etc.; NAM predicted too little precipitation in the warm sector and too much snow north of front (persistent bias)

User Case #1: 28 Apr – 4 May 2010 Flooding in TN

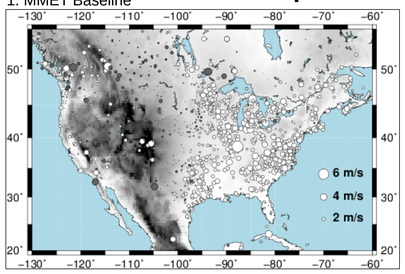
Submitted by Pedro Jimenez & Jimy Dudhia

Case Details

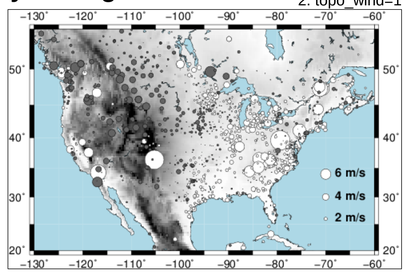
Forecasts: All simulations:15-km grid length
1. WRF v3.4 ARW baseline configuration namelist from DTC (MMET Baseline Configuration)
2. WRF v3.4 ARW namelist w/ *topo_wind=1* activated
Model Initialization: Utilized IC/BC files from DTC
Verification: Utilized observation files provided by DTC

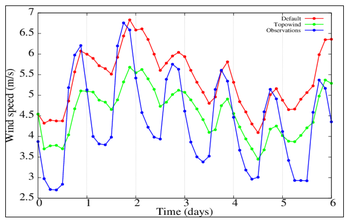
Wind Speed 6-day Average Error

1. MMET Baseline



2. topo_wind=1





Case Summary

- Overall 6-day domain average with *topo_wind=1* smaller than default
- Reduces diurnal mean bias but does not capture full diurnal amplitude
- ***Future work:*** reduce the effect of *topo_wind=1* in daytime convective planetary boundary layer

User Case #2: 17 Dec 2009 "Snowpocalypse"

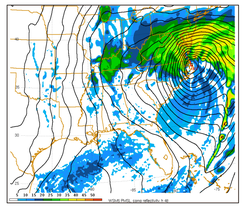
Submitted by Gary Lackmann

Case Details

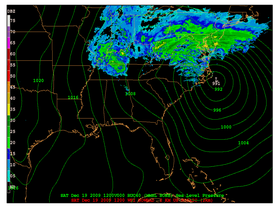
Forecasts: All simulations: 15-km grid length
1. WRF v3.4 ARW baseline configuration namelist from DTC (MMET Baseline Configuration w/ *WSM5* microphysics)
2. WRF v3.4 ARW namelist w/ *Milbrandt-Yau* microphysics
Model Initialization: 12 UTC 17 Dec, utilized IC/BC files from DTC

48-h WRF Forecast

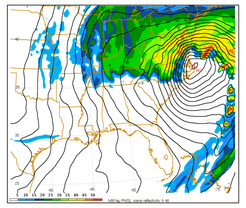
1. MMET Baseline – WSM5



RUC SLP analysis, radar composite

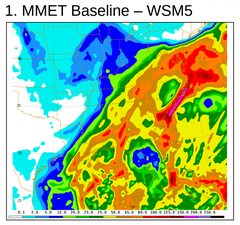


2. Milbrandt-Yau

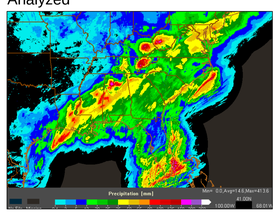


72-h Total Precip Accumulation

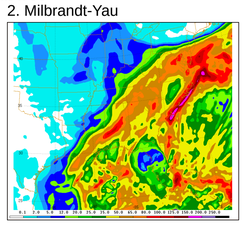
1. MMET Baseline – WSM5



Analyzed



2. Milbrandt-Yau



Case Summary

- Both forecasts captured main features
  - Axis of precipitation over coastal Carolinas and VA
  - Precipitation minimum over FL
- Significant over-prediction over NC, SC, and VA and issues with cessation of precipitation
- ***Future work:*** perform verification of simulations with MET

User Case #3: 1 – 3 May 2010 Flooding in TN

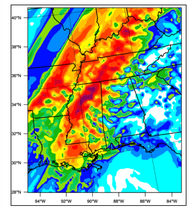
Submitted by Kelly Mahoney

Case Details

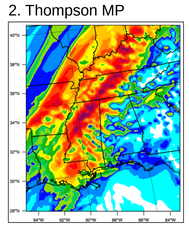
Forecasts: Simulations #1-3: 15-km grid length; Simulation #4: 4-km grid length/1.3-km inner nest
1. WRF v3.5 ARW baseline configuration namelist from DTC (MMET Baseline Configuration w/ *WSM5*)
2. WRF v3.5 ARW namelist w/ *Thompson* microphysics
3. WRF v3.5 ARW namelist w/ *Thompson* MP and *no CP scheme*
4. WRF v3.5 ARW namelist w/ *#3 physics* and *4-km/1.3-km grid length*
Model Initialization: Utilized IC/BC files from DTC for simulations #1–3, NAM 00 UTC 20100501 forecast from DTC to produce IC/BCs for #4

48-h Total Precip Accumulation

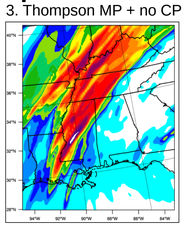
1. MMET Baseline



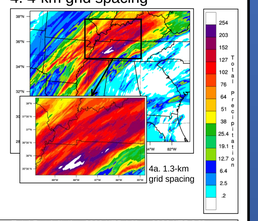
2. Thompson MP



3. Thompson MP + no CP

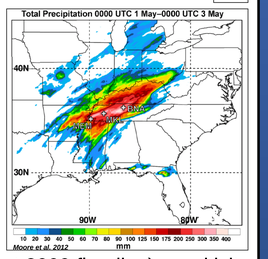


4. 4-km grid spacing



Case Summary

- Strong synoptic-scale dynamical forcing; all simulations generate precipitation maxima > 150 mm in 48-h period
- Significant over-forecast of precip found in LA and TN in all runs; timing error vs. location error? Need longer simulation to test.
- KF CP scheme generates NW-SE-oriented precip banding not seen in explicit convection (no CP) runs
- Increased horizontal resolution increases precipitation maxima



- Relative to less strongly-forced cases (e.g., Atlanta, GA Sept 2009 flooding) sensitivity to model resolution, physics is reduced
- ***Future work:*** perform verification of simulations with MET; couple forecast output files to WRF-Hydro and compare to observed streamflow; compare to sensitivity tests altering model topography and upstream moisture.

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