Utilizing the Mesoscale Model Evaluation Testbed (MMET) to Transition Promising New Techniques from Research to Operations

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DTC Mission

The fundamental purpose of the DTC is to facilitate the interaction & transition of NWP technology between research & operations.

DTC facilitates:

• **O2R** transition by making the operational NWP systems available to the research community & providing community user support
• **R2O** transition by performing testing & evaluation of new NWP innovations in a functionally similar operational environment over an extended period
• **Interaction** between research & operational NWP communities through the organization of community workshops/meetings on important topics of interest to the NWP community & hosting a DTC Visitor Program

*DTC strives to be an **efficient** and **effective** community facility for the transition of innovations in NWP between research and operations.*
Testing Protocol Motivation

- Wide range of NWP science innovations under development in the research community
- Testing protocol imperative to advance new innovations through the research to operations (R2O) process *efficiently* and *effectively*.

- **Three stage process:**
  1) Proving ground for research community
  2) Comprehensive T&E performed by the DTC
  3) Pre-Implementation testing at Operational Centers
Mesoscale Model Evaluation Testbed (MMET)

- **What**: Mechanism to *assist* research community *with initial stage of testing* to efficiently demonstrate the merits of a new development
  - Provide model input and observational datasets to utilize for testing
  - Establish and publicize baseline results for select operational models
  - Provide a common framework for testing; allow for direct comparisons
- **Where**: Hosted by the DTC; served through Repository for Archiving, Managing and Accessing Diverse Data (RAMADDA)

[www.dtcenter.org/eval/mmet](http://www.dtcenter.org/eval/mmet)
MMET Cases

- Initial solicitation of cases from DTC Science Advisory Board Members and Physics Workshop Participants – great response and enthusiasm towards endeavor

- **Cases current available within MMET**
  - **20090228** – Mid-Atlantic *snow storm* where North American Mesoscale (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** – High-Resolution Window (*HIRESW*) runs *underperformed* compared to coarser NAM model
  - **20091217** – “Snowapocalypse ‘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 with an atmospheric river event
  - **20110404** – Record breaking *severe* report day
  - **20110518–26** – Extended period of *severe weather* outbreak covering much of the mid-west 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 (Lackmann)

20091217 12 UTC – Single initialization focused on the “Snowpocalypse” of 2009 where NAM produced high QPF over mid-Atlantic, lack of cessation of precipitation

Forecasts: WRF v3.4 ARW baseline configuration namelist from DTC
WRF v3.4 ARW namelist with mp_physics=9 activated
CONUS domain at 15km resolution

Utilized IC and BC files provided by DTC for model initialization
User Case #1 (Lackmann)
Composite Reflectivity Forecasts and Observations

12 UTC 20091217 through 00 UTC 20091220 (every 3 hours)
User Case #1 (Lackmann)
24-h WRF Forecast

Snapshot valid at 12 UTC 18 Dec 2009
User Case #1 (Lackmann)
48-h WRF Forecast

Snapshot valid at 12 UTC 19 Dec 2009
User Case #1 (Lackmann)
72-h Total Precipitation Accumulation

Both WRF forecasts captured main features of observed precip:
• Western extent of precip shield
• Local min of precip over Florida
• Axis of heavier precip in coastal Carolinas

However…
• Significant over-prediction of precip, including areas of North and South Carolina and Virginia
• Issue with cessation of precip appeared with both microphysics schemes tested
User Case #2 (Jimenez and Dudhia)

20100428-20100504 – Extended case focused on historic Tennessee flooding associated with an atmospheric river event

Forecasts: WRF v3.4 ARW baseline configuration namelist from DTC
WRF v3.4 ARW namelist with `topo_wind=1` activated
CONUS domain at 15km resolution

Utilized IC and BC files provided by DTC for model initialization
Utilized observation files provided by DTC for verification
User Case #2 (Jimenez and Dudhia)
Wind Speed Observations

00 UTC 20100428 through 00 UTC 20100504 (every 3 hours)

Average observed wind speed across the domain
User Case #2 (Jimenez and Dudhia)
Wind Speed Time Series

![Wind Speed Time Series Graph]

- Default
- Topowind
- Observations

Time (days)

Wind speed (m/s)
User Case #2 (Jimenez and Dudhia)
Wind Speed Error (topo_wind=1)

00 UTC 20100428 through 00 UTC 20100504
(every 3 hours)

Average wind speed across the domain
• topo_wind=1
• Observed
User Case #2 (Jimenez and Dudhia)

Wind Speed 6-day Average Error

Status of development:
• Overall 6-day domain average with topo_wind=1 smaller than default
• Reduces diurnal mean bias but does not capture full diurnal amplitude
• Looking into reduction of convective mixing and vertical transport of momentum causing overall lower speeds
MMET Case Expansion

Nominating new cases of interest
MMET Expansion
Case Nomination Form

Here is a MMET Case recommendation:

Time Period: 20 June - 30 June 2012
Type of Case: Mid-Atlantic Derecho event, June 2012.
Forecast Model: GFS, NAM, RAP
Forecast Response: Operational numerical forecasts would be challenged to represent a MCS of this type, but some HRRR/Rapid Refresh runs may have represented the system.
Domain: Central and Eastern US and offshore western North Atlantic
Observation Source: Radar, surface observations, severe wind reports
Observation Format: GEFS, etc.
Contact: Gary Lack mann

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Conclusion

- Established data sets for nine MMET cases
  - Open solicitation for cases recommendations for future expansion
- Assist community in efficiently testing new innovations
  - Easy to use – model input and observational datasets provided
  - Allows for quick comparisons to be made against published baseline results
  - Provides a common framework for testing; allow for direct comparisons among community results
- Promising results nominated for extensive T&E performed by DTC

**R2O Test Protocol Document:**


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