# MPAS Physics Evaluation Through Cycled Data Assimilation


**Byoung-Joo Jung and Chris Snyder**

*Mesoscale and Microscale Meteorology Laboratory, National Center for Atmospheric Research, Colorado USA*


## Background

- MPAS = Model for Prediction Across Scales
- NCAR/MMM development efforts now concentrate on MPAS, rather than WRF
- WRF can be configured with **many** different physical parameterizations ("physics")

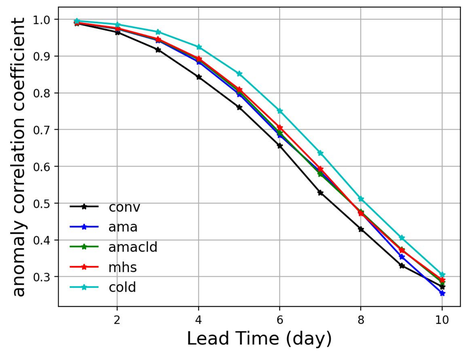
Seeking a happy medium for MPAS:
Vibrant development community for physics,
but fewer, better tested physics schemes

## Aims

- Use cycled DA to identify especially good or bad changes in MPAS physics
- Use minimal human effort (automate!)
- Hierarchical, allowing further tests at higher resolution or with more sophisticated DA
- Extensible metrics and scores, allowing tailoring to specific aspects of physics

## DA System

- JEDI-MPAS, see Liu et al 2022
  (JEDI = Joint Effort for Data assimilation Integration)
- Credible results for cycling global DA




*500-hpa ACC, mid April-mid May 2018.*

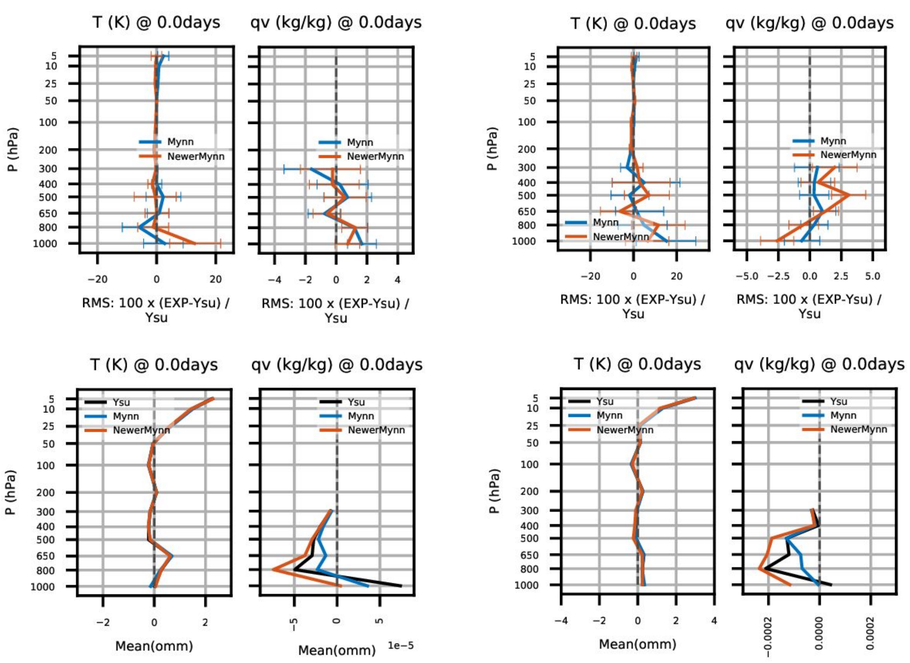
*30 km forecasts & analyses, 3DEnvar with 20-member ensemble from NOAA GEFS.*

*Conventional obs (black), adding AMSU-A (blue) or AMSU-A and MHS (red), and cold-start forecasts from GFS analyses (cyan)*

## Example results

Compare boundary-layer schemes: YSU (Hong et al. 2016), MYNN (Nakanishi & Niino 2006), and "newer" MYNN

*NH extratropics* *Tropics*




*6-hour fits to radiosonde observations for experiments using the three PBL schemes, as a function of pressure level. Statistics are averaged over one month and over the NH extratropics (left columns) or the tropics (right columns).*

*(top panels) Normalized difference (percent) in RMS relative to results with YSU for MYNN (blue) and "newer" MYNN (red). Error bars indicate 95% bootstrapped confidence intervals for the differences.*

*(bottom panels) Bias for YSU (black), MYNN (blue), and "newer" MYNN (red).*

## Next steps

- Cute, compact score cards as first output for users
- More experience with how results depend on resolution
- Improve automation and decrease human time required. Containerization too, for community developers.
- Develop baseline for "practical" significance; probably relative to changes produced by randomly omitting a subset of observations
- Diagnostics for average tendencies over DA cycle from each parameterization scheme
- Application to locally convection-permitting MPAS (using variable resolution meshes)

## References


Liu, Z., and co-authors, 2022: *Geosci. Model Dev. Discuss*. [preprint], https://doi.org/10.5194/gmd-2022-133
Hong, S., Y. Noh and J. Dudhia, 2006: *Monthly Weather Review*, https://doi.org/10.1175/MWR3199.1
Nakanishi, M., and H. Niino, 2006: *Boundary-Layer Meteorol.,* https://doi.org/10.1007/s10546-005-9030-8