

## Adapting the MPAS Dynamical Core for Applications Extending into the Thermosphere

## Joe Klemp and Bill Skamarock NCAR/MMM

Typically weather and climate models focus on simulating the atmosphere throughout the troposphere and stratosphere. However, atmospheric disturbances in these regions can also impact important physical processes at much higher altitudes, even extending into the upper thermosphere (~500 km). The Model for Prediction Across Scales (MPAS) was designed to simulate a broad range of atmospheric phenomena, from cloud scale up to global scale. Recently, we have been modifying the model and testing its viability for deep-atmosphere applications that include the thermosphere. This raises new challenges for the model numerics due to the extreme variation in the atmospheric parameters, such as density, for example, that deceases by  $\sim 12$  orders of magnitude between the surface and the upper thermosphere. The variability of the constituents of the atmosphere must now be included in the dynamical model as well as influences such as molecular viscosity and thermal conductivity, which are negligible in the lower atmosphere. Because significant vertical expansion/contraction of the atmosphere occurs due to deep radiative heating/cooling, the rigid lid upper boundary employed in MPAS is not well suited for applications extending into the thermosphere. We have developed and tested a simple modification to the height-based coordinate formulation that allows the height of the upper boundary to adaptively follow a constant pressure surface, without significant retooling of the model numerics. In simulating idealized test cases in a simplified 2-D slab version of MPAS, we demonstrate that numerical integration of the model equations continues to provide a stable and efficient nonhydrostatic framework for applications in the thermospheric environment.

Thursday, 16 February 2023, 2:00pm Refreshments 1:45pm Please also join colleagues for refreshments and informal discussion after the seminar until 3:30pm NCAR-Foothills Laboratory, 3450 Mitchell Lane FL2-1022, Large Auditorium

## Seminar will also be live webcast

<u>https://operations.ucar.edu/live-mmm</u> Participants may ask questions during the seminar via Slido.



