The NASA Ames Mars Global Climate Model: Benchmarking Publicly Released Source Code and Model Output

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We have recently publicly released source code from the new NASA Ames Mars Global Climate Model (MGCM), which is based on NOAA/GFDL cubed-sphere finite volume (FV3-based) dynamical core (https://github.com/nasa/AmesGCM). We also we have a manuscript in preparation that aims to document the status of the new MGCM, and present selected simulations generated from it with interpretations and comparisons to both observations and the Ames Legacy MGCM. Output from our reference simulation will be made publicly available as well. One of our ongoing goals is to understand the underlying causes for differences between results produced with the new FV3-based dynamical core compared to the Legacy C-grid dynamical core. While the thermal and dynamical fields predicted with the new and Legacy GCMs are broadly similar for much of the year, there are key differences at low resolution when no external drag is applied to the new MGCM. This is particularly clear during a seasonal window of ~100 degrees of Ls surrounding southern summer solstice, when the predicted northern hemisphere polar warming is significantly over-predicted in the new MGCM. When we apply Rayleigh drag throughout much of the tropics and sub-tropics to the new MGCM, the simulated zonal mean structure of the atmosphere is much more consistent with both MCS observations and Legacy MGCM simulations. We note that the Kling et al. (2023; this meeting) study demonstrates that the behavior that we see with Rayleigh drag here can be recovered with high resolution simulations (in the horizontal and in the vertical) or with parameterized orographic and non-orographic gravity waves at lower resolution. While this work is still in progress, our preliminary conclusion is that the new dynamical core is less dissipative than the Legacy dynamical core. At low to moderate resolution, users of the new MGCM will need to be careful to use some sort of external drag, either in the form of gravity wave drag parameterizations or the simpler Rayleigh drag.