Improved intraseasonal variability in the NASA GEOS AGCM with 2-moment microphysics and a shallow cumulus parameterization

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Summary

Weather and climate models have long struggled to realistically simulate the Madden-Julian Oscillation (MJO). Here we present a significant improvement in MJO simulation in NASA’s GEOS atmospheric model with the implementation of 2-moment microphysics and the UW shallow cumulus parameterization. Comparing ten-year runs (2007-2016) with the old (1mom) and updated (2mom+shlw) model physics, the updated model has increased intraseasonal variance with increased coherence. Surface fluxes and OLR are found to vary more realistically with precipitation, and a moisture budget suggests that changes in rain re-evaporation and the cloud longwave feedback help support heavy precipitation. Preliminary results also show improved MJO hindcast skill.

Mean Precipitation

Stronger intraseasonal variability

Maps of intraseasonal (20-100d) standard deviation.

Composites of OLR and 850hPa wind for eight phases of the RMMS index.

Lag-correlation of precipitation (shading) and U850 (contours) against 20-100d precip at 90E.

Conclusions

• The addition of 2-moment microphysics and a shallow cumulus parameterization leads to much stronger MJO activity in the GEOS model.
• The proximate cause is greater moistening coincident with and east of intra-seasonal precip over the Indian Ocean.
• Coincident moistening seems due to enhanced re-evaporation of precipitation, and shallow WTG ascent associated with an improved longwave feedback.
• Mechanisms of eastward moistening are less clear, but due in part to enhanced shallow ascent.