



Tendency Bias Correction in Coupled and Uncoupled Global Climate Models with a Focus on Impacts over North America

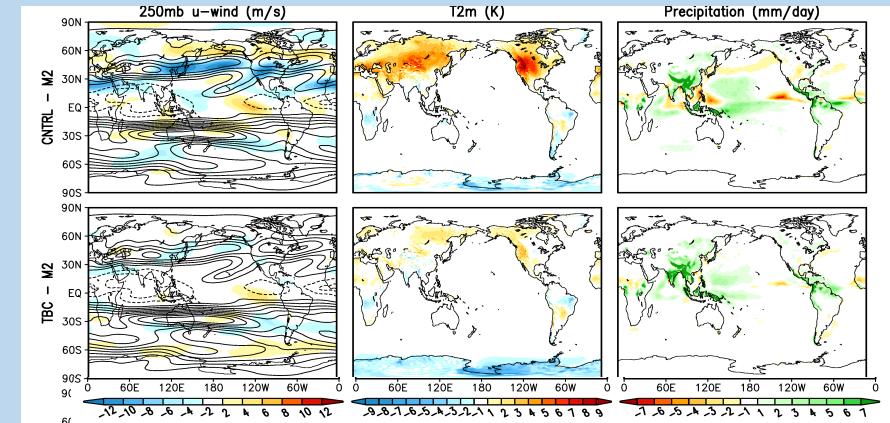
Background: Despite substantial progress made to improve the ability of climate models to reproduce the observed climate, current climate models are far from perfect. Specific model biases can be detrimental to the simulation and prediction of climate variability on subseasonal to seasonal (S2S) time scales.

Significance: This study develops a Tendency Bias Correction (TBC) approach to correct NASA GEOS model bias, and uses it to investigate and shed light on the effect of correcting model bias on improving the model's climatology, variability, and forecast skill at S2S time scales.

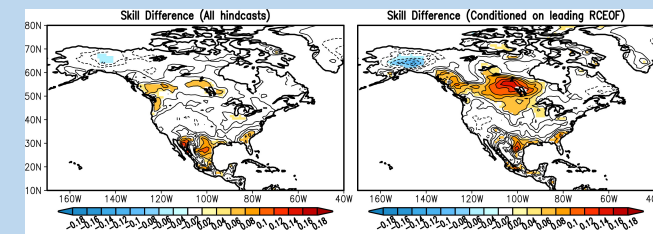
Analysis: This study employs MERRA-2 and modern data assimilation tools to correct the systematic model tendency errors in both NASA GEOS uncoupled (AGCM) and coupled (AOGCM) models. With extensive GEOS simulations and hindcasts performed using the standard GEOS model and the bias-corrected model, we examined the extent to which correcting the short-term model tendency biases improves the model's long-standing mean climate biases, and whether there are any associated improvements in the simulation and prediction of weather and climate variability at S2S time scales.

Findings: The TBCs produce substantial improvements in the simulated mean climate and its variability (e.g. SST, ENSO teleconnection, subtropical jet). Despite these improvements, the improvement in S2S forecast skill over North America is only modest at best, due to the competing influences of predictability loss with time and the time it takes for climate drift to first have a significant impact on forecast skill.

An example of the effect of Tendency Bias Correction: GEOS AGCM in JJA



Simulation: The 250mb zonal wind (m/s, left), two-meter temperature ($^{\circ}\text{K}$, middle), and precipitation (mm/day, right). The shading indicates the CNTRL (control simulation) minus MERRA-2, and TBC (bias corrected simulation) minus MERRA-2. In the left panels, the contours indicate climatological mean 250mb zonal winds from MERRA-2 (contoured every 5 m/s). All fields are averaged for JJA over the years 1980-2015.



Prediction: (Left) Differences in skill (correlation between the hindcasts and MERRA-2 for 250mb meridional wind anomalies) at day 10 between TBC and CNTRL using all the hindcasts. (Right) same as left, except for only those hindcasts when the leading Rossby wave has an amplitude greater than 1 standard deviation in the initial conditions.