Searching into the Cause of Southward Displacement of ITCZ in CFS Simulation

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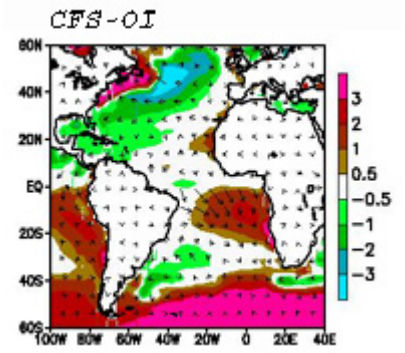
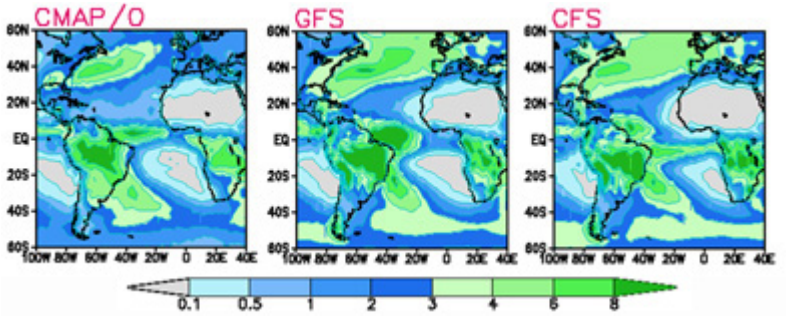
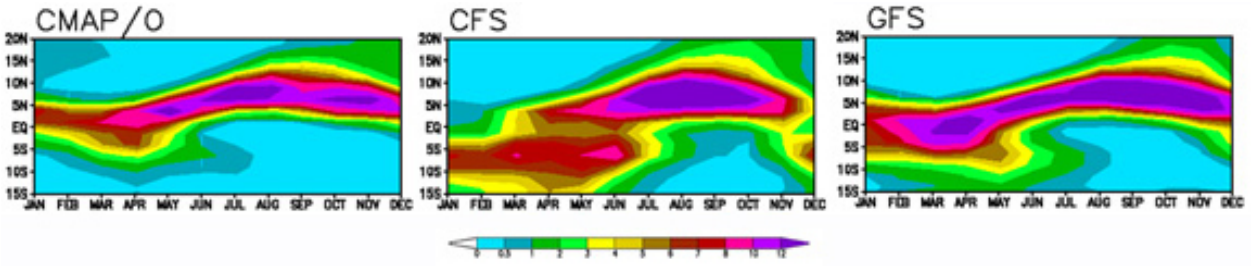
In a recent presentation, Pingping Xie et al. of NOAA/NWS/Climate Prediction Center showed that the Climate Forecast System (CFS) free runs differed from the Global Forecast System (GFS, the atmospheric component of CFS) AMIP runs during winter and spring with ~10 degree southward displacement of ITCZ. Meanwhile, CFS SST simulation was found significantly higher than the observation over the southeast Atlantic dry zone and the southern ocean poleward throughout the year. Further diagnoses revealed insufficient cloud amount especially over the southeast Atlantic dry zone could be responsible, where the clouds were mostly marine stratus with relatively low cloud top and distinct diurnal cycle of maximum cloudiness observed in the early morning. Currently, CFS does air-sea coupling once a day, not resolving the diurnal cycle. Similar problems were also found in the subtropical eastern Pacific dry zone.



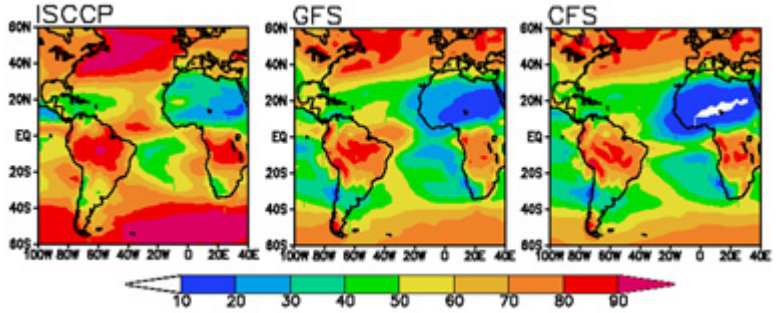
▲ CFS simulation bias of DJF SST climatology. It clearly shows the warm bias of the tropical-subtropical eastern south Atlantic SST in association with anomalous northwesterly winds above.



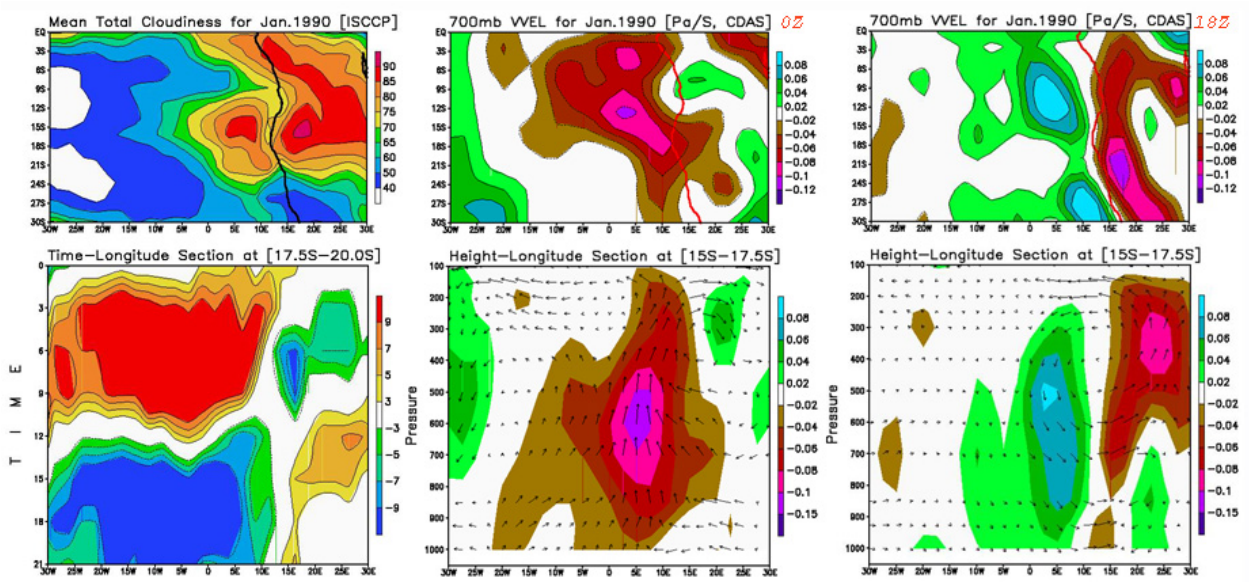
◀ DJF precipitation climatology. From left to right are plots of CMAP merged observation, GFS and CFS simulations, respectively. The figures show distinct differences in amplitude and southward displacement of the Atlantic ITCZ in CFS simulation.



▲ Mean annual cycle of Atlantic ITCZ (time-longitude section of 30 - 20W mean precipitation). Substantially strong amplitude is found in both GFS and CFS simulations. CFS simulation also shows a false double ITCZ during spring and early summer time.



◀ DJF total cloud amount observed by ISCCP (left) and simulated by GSF (middle) and CFS (right). Overall, both simulations generate less cloud compared to the observation. Over the tropical-subtropical southeast Atlantic dry zone, the simulated cloud amount is particularly insufficient.



▲ (a) Jan 1990 ISCCP cloudiness. The upper panel shows the daily mean and the lower panel the time-longitude plot of 17-20N mean. A bi-polar structure seen over the dry zone and the nearby continent could be caused by the sea breeze, which presents a diurnal cycle.
Jan 1990 CDAS local circulation with daily mean removed (b) at 00Z and (c) at 18Z. The upper panels show 700 hPa vertical velocity and the lower panels the height-longitude section of 15-17S mean. Strong rising motion over ocean and descending motion over vicinal land at 00Z are reversed at 18Z.

Contact Information: Dr. Pingping Xie, NOAA/NWS/Climate Prediction Center
E-mail: Pingping.Xie@noaa.gov