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Evaluation of the Double ITCZ Biases in new versions of FGOALS

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ABSTRACT

Double ITCZ biases have been a key scientific issue involved in the development of coupled models over at least two decades. State-of-Art models with realistic topography cannot reproduce the observed asymmetry in precipitation over tropical Pacific. Although flux correction can fix this problem, it certainly influences future climate predictions like ENSO phenomenon and wreck the ocean-atmosphere feedback because Interannual variability in tropical area is intimately linked to its climatological state and seasonal cycle. In addition, meridionally asymmetry especially must be simulated correctly for reasonable results in other aspects. In the present study, we evaluate the double ITCZ biases in serval versions of FGOALS without any flux correction. FGOALS-f3-L shows improvements off Peru and tropical Eastern Pacific in simulations of climatological precipitation as well as SST . It also reproduce the annual cycle over the Eastern Pacific and the semi-annual cycle in West Pacific better than the last versions FGOALS-g2. The lifespan of simulated SPCZ in FGOALS-f3-L which last from February to May for about 4 months is much shorter than that in FGOALS-g2 and FGOALs-g3 even though it only exist for 3 months in observations. The precipitation in ITCZ and SPCZ are all overestimated in all versions of Models.

Data

Model: historical simulations from FGOALS-g2,FGOALS-g3,FGOALS-f3-L
Observation: SST from HadISST, precipitation from GPCP, other wind from NCEP reanalysis, surface net shortwave flux from OAflux
Time length: 1980-2004

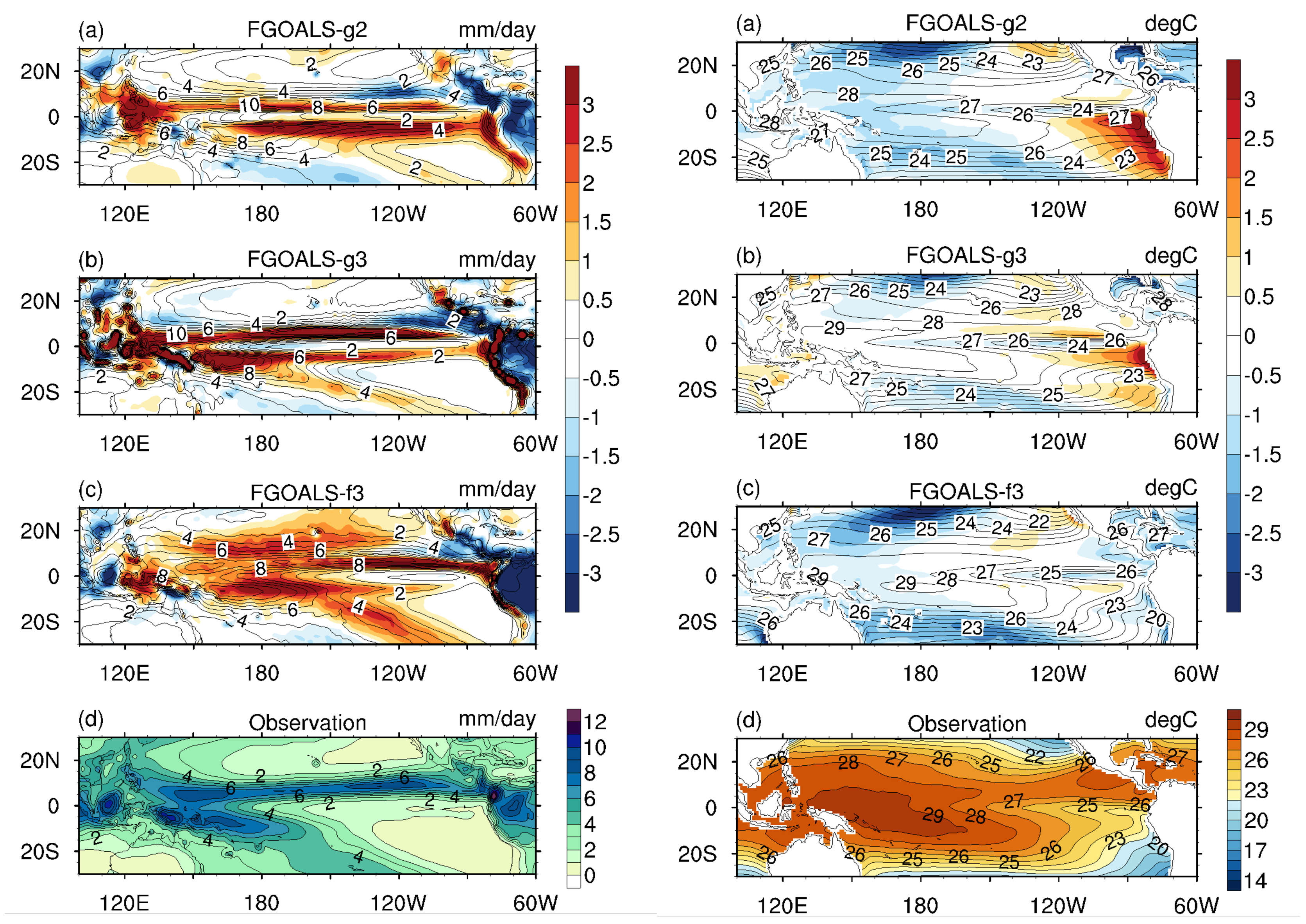

Figure 1. Climatology of simulated precipitation rate (contours) and biases (shaded) in (a) FGOALS-g2 and (b) FGOALS- g3 and (c)FGOALS-f3 and (d) observed climatology of precipitation from GPCP(1980-2004). Same but for SST on the right panel.

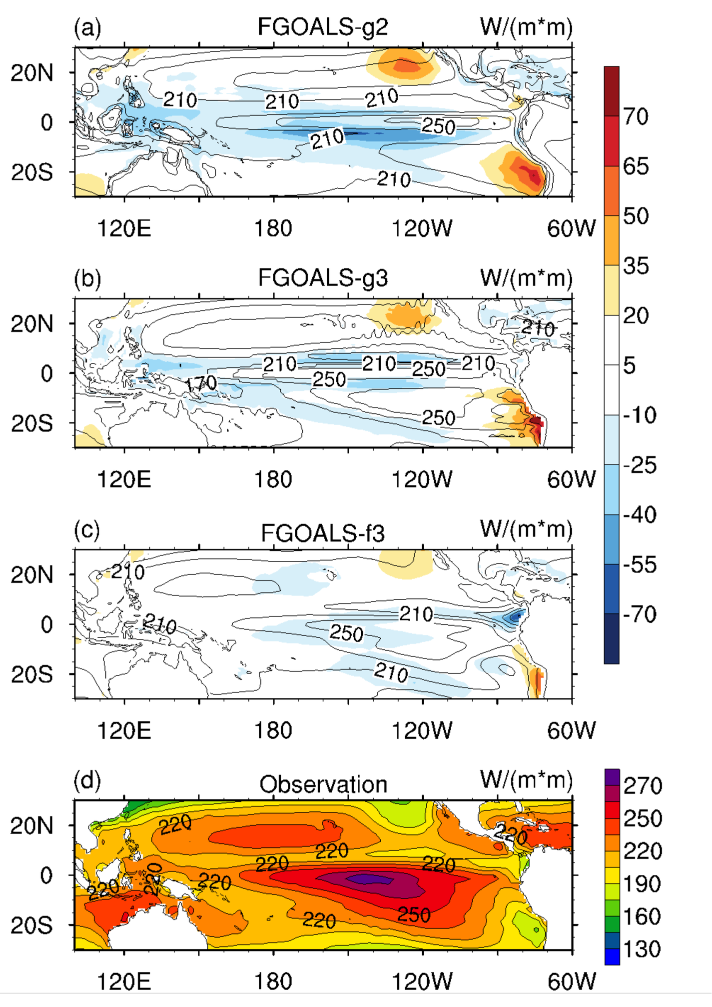

Figure 2. Climatology of simulated net shortwave radiation flux at the sea surface water(contours) and biases (shaded) in (a) FGOALS-g2 and (b) FGOALS- g3 and (c)FGOALS-f3-L and (d) observed climatology of RSNTDS from OA flux(1985-2004).

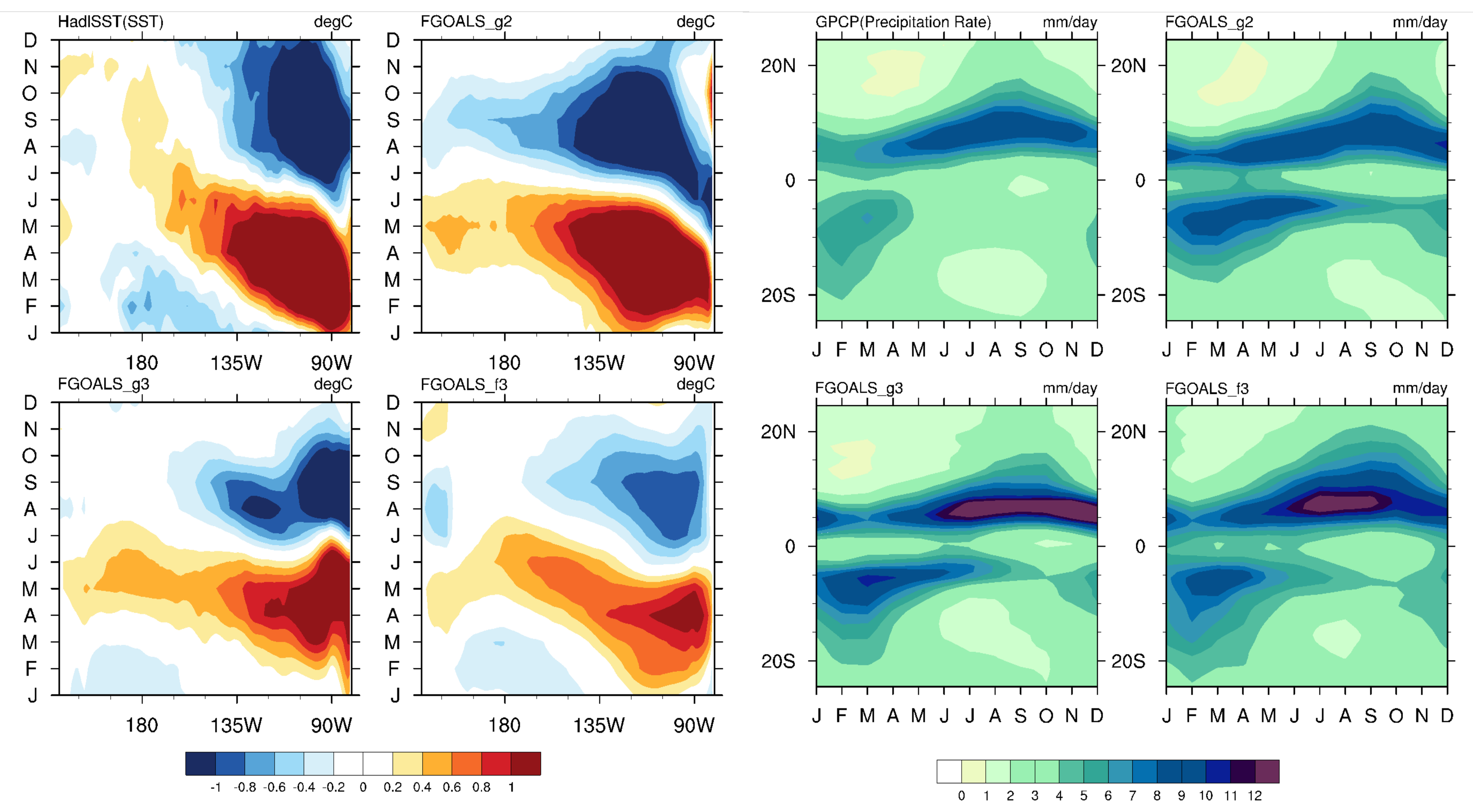

Figure 3.The left panel is seasonal cycle in equatorial SST departure from their annual mean (averaged over 2°S-2°N,unit: °C) along the equator in the Pacific Ocean calculated from (a)HadISST observation and (b) FGOALS-g2 and (c) FGOALS- g3 and (d)FGOALS-f3-L.The right panel is the same but for seasonal cycle of precipitation rate (mm/day) averaged between 140°E and 90°W in contrast of GPCP observation.

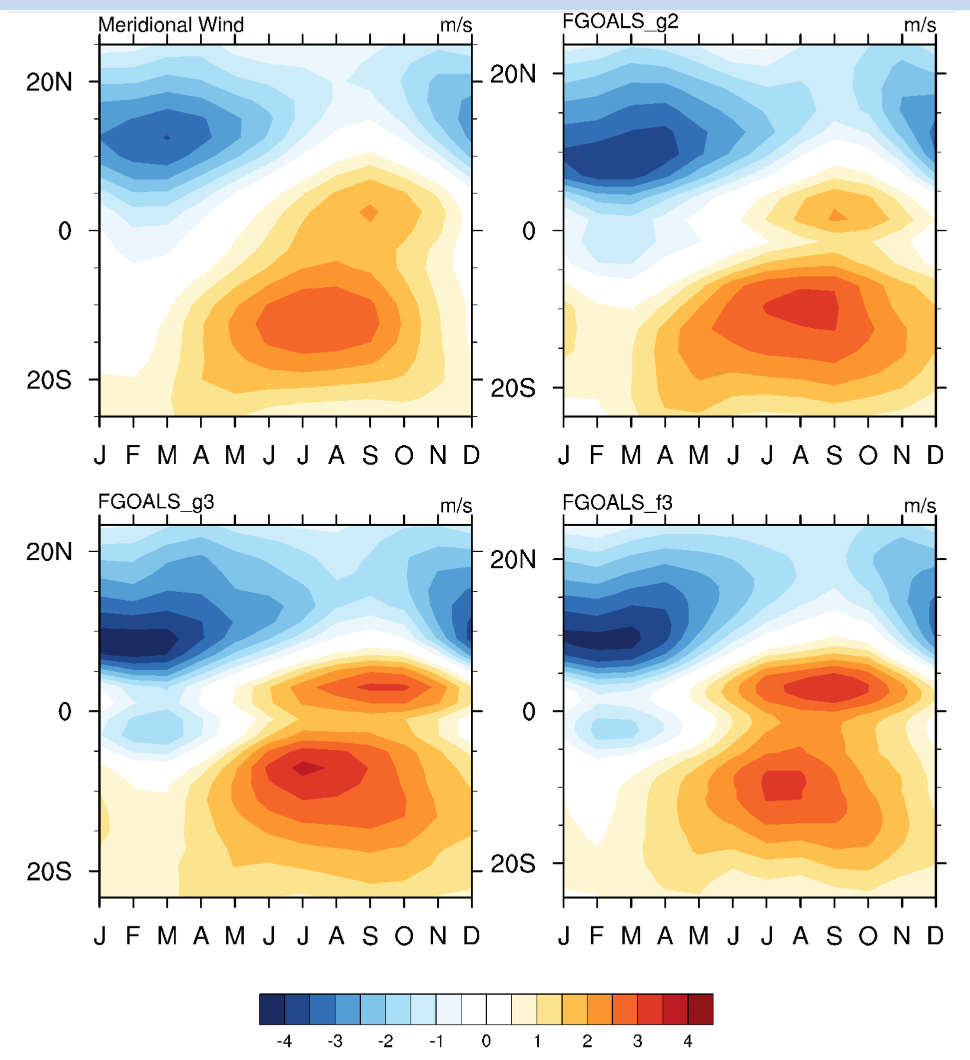

Figure 4.Seasonal cycle in meridional wind (m/s) averaged over 140°E-90°W calculated from (a)NCEP reanalysis and (b) FGOALS-g2 and (c) FGOALS-g3 and (d)FGO

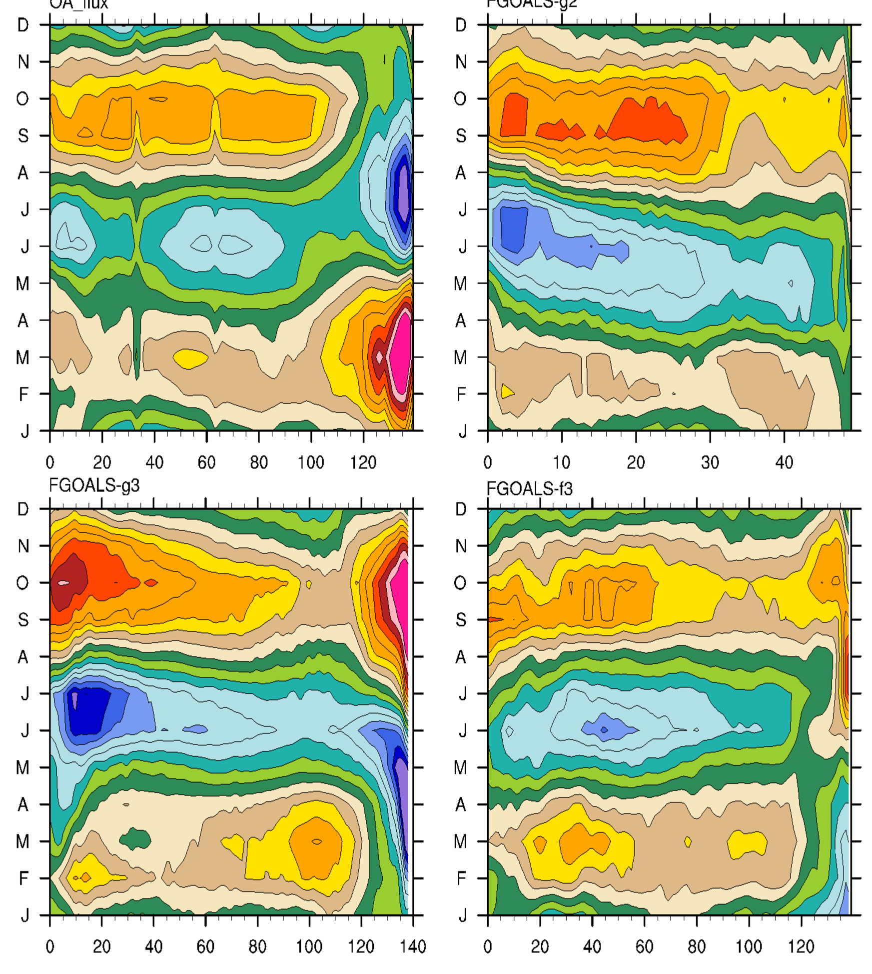

Figure 5. Seasonal cycle in net shortwave radiation flux at the sea surface water(averaged over 2°S-2°N,unit=W/m^2 calculated from (a)OA flux and (b) FGOALS-g2 and (c) FGOALS- g3 and (d)FGOALS-f3-L.

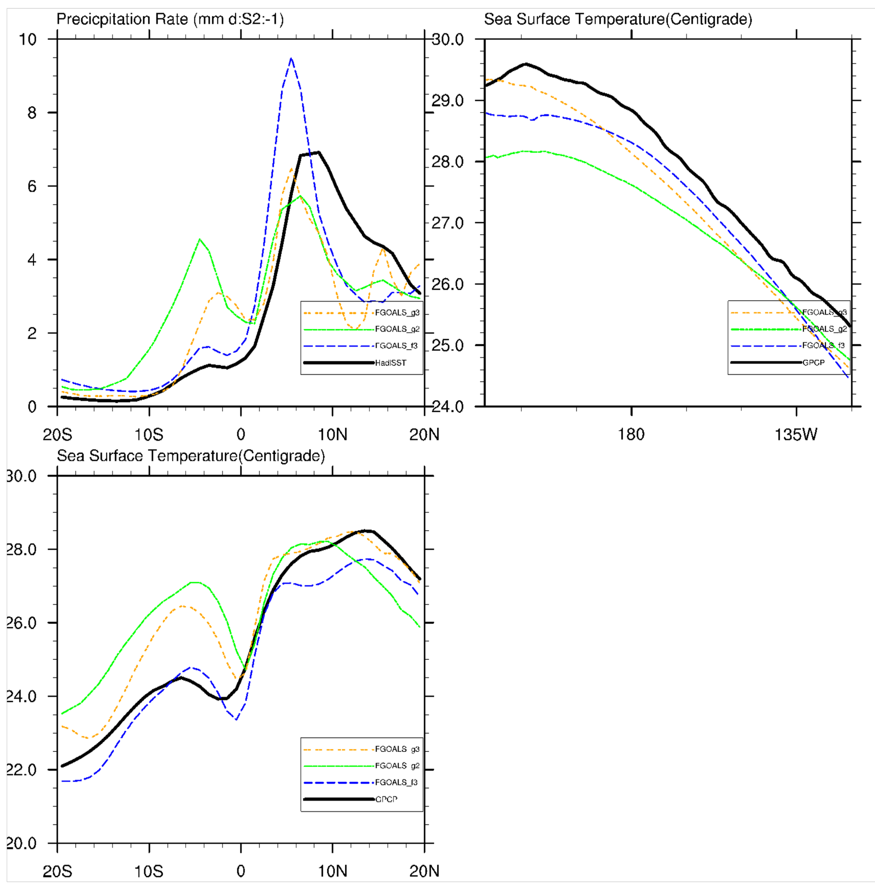

Figure 6. Climatological mean (a)precipitation rate(mm/day)and(c)SST(°C) averaged over 110°W-80°W and(b)SST (°C) averaged over 2°S-2°N from observation(black solid) ,FGOALS-g2(green solid),FGOALS-g3(orange dashed) and FGOALS-f3(blue dashed).

Concluding Remarks

- FGOALS-f2 and FGOALS-g3 do reduce the double ITCZ biases .They all capture the annual cycle in SST and precipitation west off Peru better than FGOALS-g2 even though the amplitude of SST is much weaker than observation.
- FGOALS-f3 also give more realistic semi-annual cycle in the eastern Pacific in terms of SST and net shortwave flux.