Constraining Congo Basin rainfall in the CMIP5 ensemble: a process-based assessment

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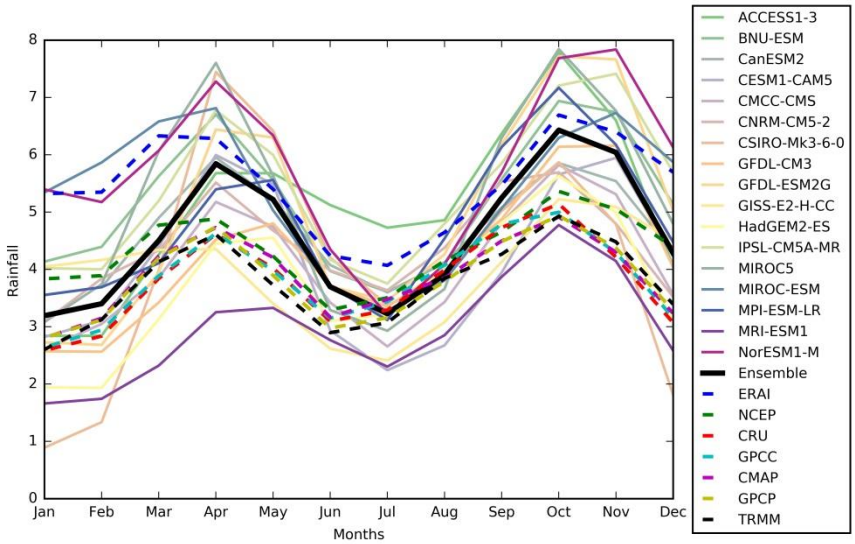
The Congo Basin is a significant driver of the global and regional climate, constituting one of three global hotspots of convective activity and dominating global rainfall totals in the transition seasons. Despite its importance, the region has received limited scientific attention, largely as a result of the extreme scarcity of observational data. As a result, coupled climate models, the tools used to diagnose future climate changes, are critically under-evaluated. This study uses processes-based assessments to try and determine the credibility of rainfall-producing mechanisms amongst models.

Model rainfall magnitude and distribution is evaluated across 17 CMIP5 models. Whilst models reproduce the bimodal annual rainfall cycle, monthly mean rainfall differs by a factor of five in some months. The distribution of rainfall also varies significantly across models, resulting in ensemble mean plots which do not resemble any individual model climatology. Thus the regular use of ensemble means as a 'best-estimate' is found to be misleading in the Congo. Moisture flux (qflux) convergence is established as a useful process with which to better understand the spectrum of model rainfall. As a dynamic field rather than a parameterised one, qflux is assumed to be better constrained in the models than rainfall. Significant relationships are found between low-level moisture flux convergence and rainfall in all seasons across models. In addition, qflux into the basin is related to rainfall; DJF rainfall is related to flow from the north and east, and SON rainfall is related to westerly flow. A targeted field campaign at these boundaries could help to constrain the range of rainfall climatologies. Future work will investigate the source of differences in these fluxes, including how they relate to sea-surface temperature biases in the region.



Long term mean (1971-2000) rainfall (mm/day) in CMIP5 models, reanalysis and observation datasets. From Creese and Washington (2016), JGR