Climate Dynamics of Africa in the NCEP Reanalysis and Climate Forecast Reanalysis

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An intercomparison of the representation of the African climate in NCEP Reanalysis-1 hereafter referred to as CDAS and Climate Forecast System Reanalysis (CFSR) is conducted for the boreal and austral summers. The purpose of the paper is to make an informed decision about which reanalysis is more suitable for operational climate monitoring and diagnostics of the African climate system. CDAS has records starting from 1948 through present. The CFSR data starts from 1979. The CFSR has a higher horizontal and vertical resolution than CDAS. In assessing the reanalysis, we focus on key features of the African climate system. Both the basic state and the interannual variability are discussed. An analysis of the 850 hPa geopotential height overlaid with winds for the DJF season suggests that CDAS and CFSR place the subtropical ridges across both hemispheres as well as the continental heat low at approximately the same location. The Acores and Asian Highs in the northern hemisphere and the St Helen and Mascarene Highs in the southern hemisphere are well represented. CDAS exhibit two distinct lows, the weakest located in East Africa and centered over the Lake Victoria, and a deeper low, known as the Angola low located over southwestern southern Africa near the outflow of the St Helena High. The continental low in the CFSR is so deep and spread out that the two lows merge to form one deep system that expands from about 10N to 30S. An examination of the difference in the geopotential height field between CFSR and CDAS reveal that CFSR height values across Africa are lower than CDAS. Low level easterlies are stronger in CFSR than in CDAS. The bulk of DJF rainfall in Africa is located over southern Africa. CMAP rainfall analysis for the DJF season reveals a maximum rainfall placed over Madagascar and a secondary maximum near Zambia. Consistent with lower geopotential height values, the CFSR precipitation amounts were far greater than observed, while CDAS underestimate precipitation in southern Africa. Lower geopotential height values are also present in CFSR during the boreal summer. An extension of the Asian low well into West Africa is observed. The southwesterly flow across the Gulf of Guinea is stronger in CFSR than in CDAS. However, the upper level Tropical Easterly Jet, an outflow of the Tibetan High is placed farther south in the CFSR than in CDAS. Thus, Sahel (Gulf of Guinea) rainfall is lower (stronger) than observed in CFSR than in the observations. An examination of the interannual varibility of the West African monsoon system reveals that patterns associated with rainfall interannual variability are more coherent in CDAS than in CFSR. The thermal heat low and meridional temperature gradients across West Africa, the latitudinal shift of the African Easterly Jet (AEJ), and the strength of thelow level westerly jet during wet years are not well represented in CFSR. As a result precipitation interannual variability in CFSR exhibits a strong departure from observations. In southern Africa however, the precipitation interannual variability in CFSR is close to observations and CDAS, despite higher magnitudes in CFSR and CDAS than observed. The reason for the inconsistency in capturing reasonably well the dynamics associated with the interannual variability in the West African monsoon system are investigated and presented. Results from a comparision study between sounding data from Africa and CDAS and CFSR are also presented.

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