

## Supplementary figures

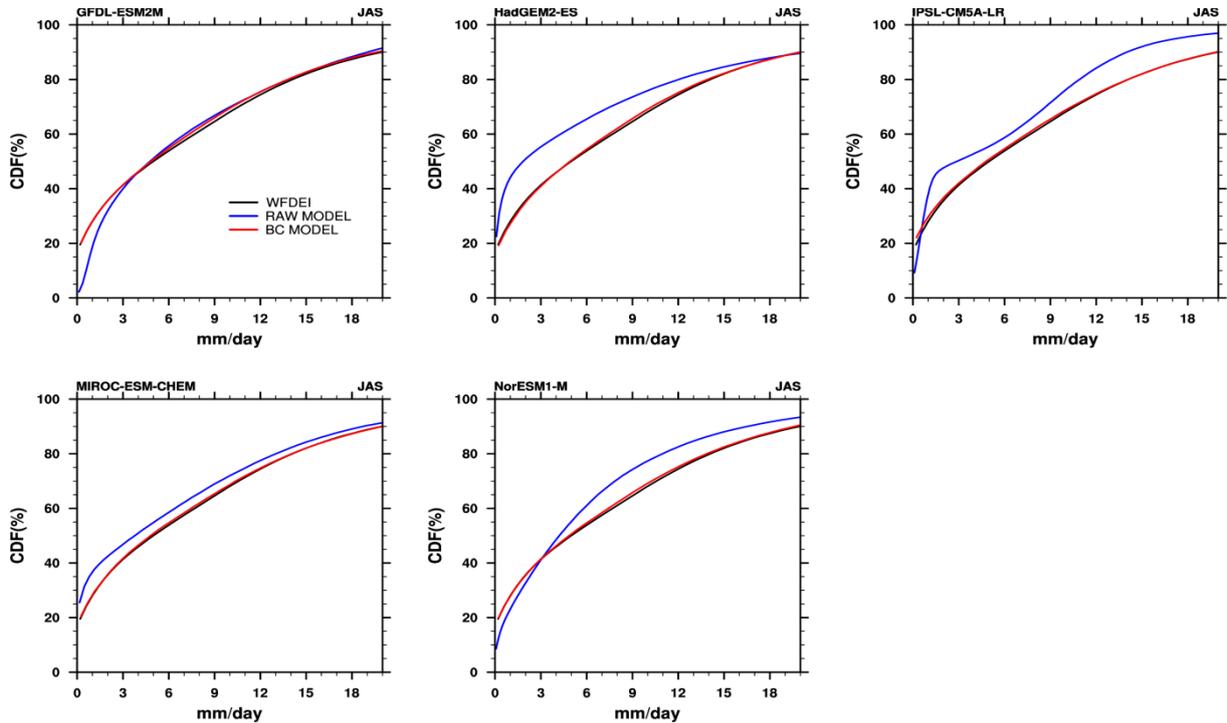


Figure S1 : CDF of 5 individual GCMs daily precipitation rate (mm/day) computed over West-Africa over period from 1979 to 2001 in summer for WFDEI (black curve), raw GCMs data (blue curve) and bias corrected data (red curve).

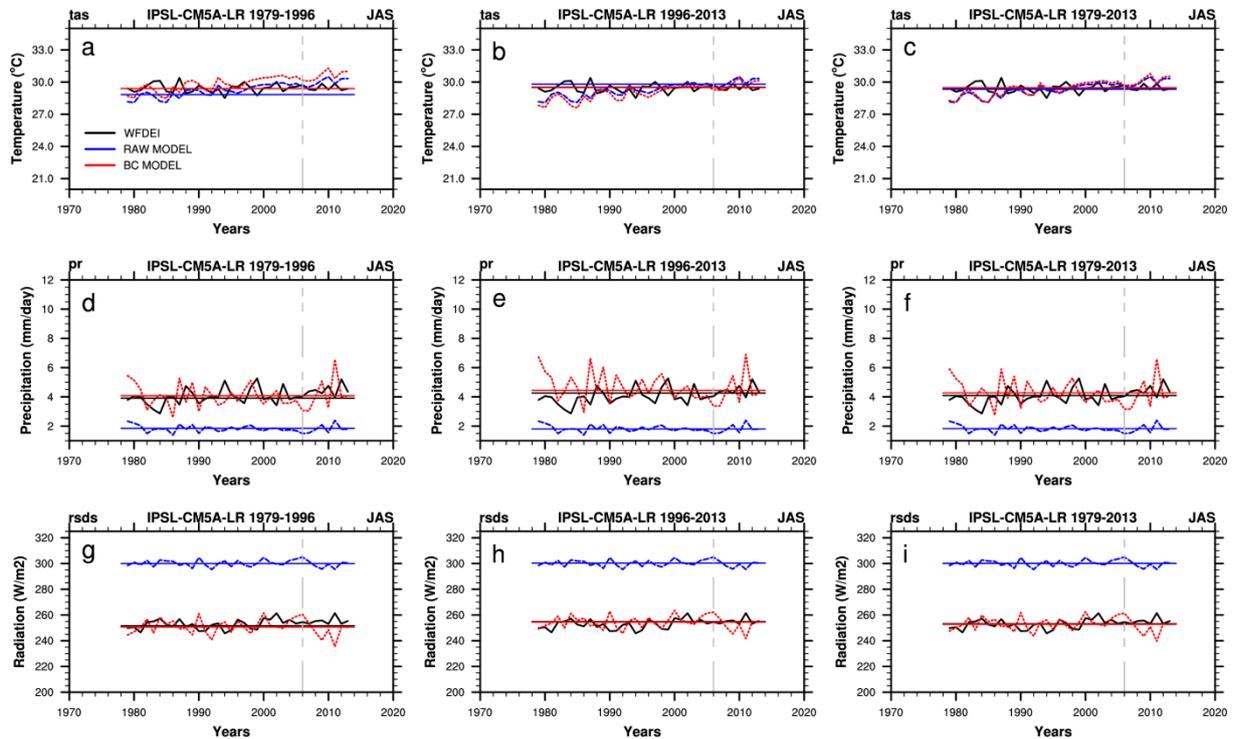


Figure S2 : Time series of surface temperature in °C (a-c), precipitation rate in mm/day (d-f) and solar radiation in W/m2 (g-i) computed for IPSL-CM5A-LR model over the Sahelian box (18°W-10°E; 10°N-20°N) in summer. The curves show the index obtained from observations, raw model and bias-corrected data with three different calibration period : 1979-1996 (first column), 1996-2013 (2<sup>nd</sup> column) and 1979-2013 (3<sup>rd</sup> column). The horizontal lines show the mean over the calibration period for each data.

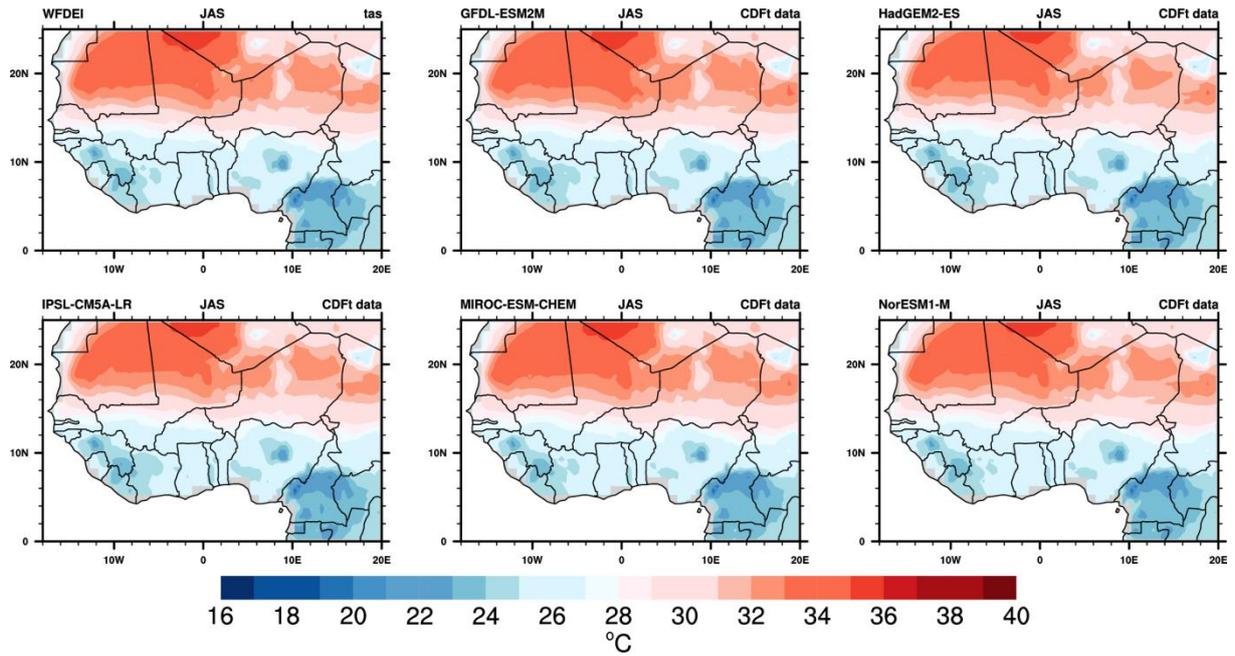


Figure S3 : Mean surface temperature (°C) from WFDEI and 5 CMIP5 models bias corrected data field over period 1979-2001 in summer.

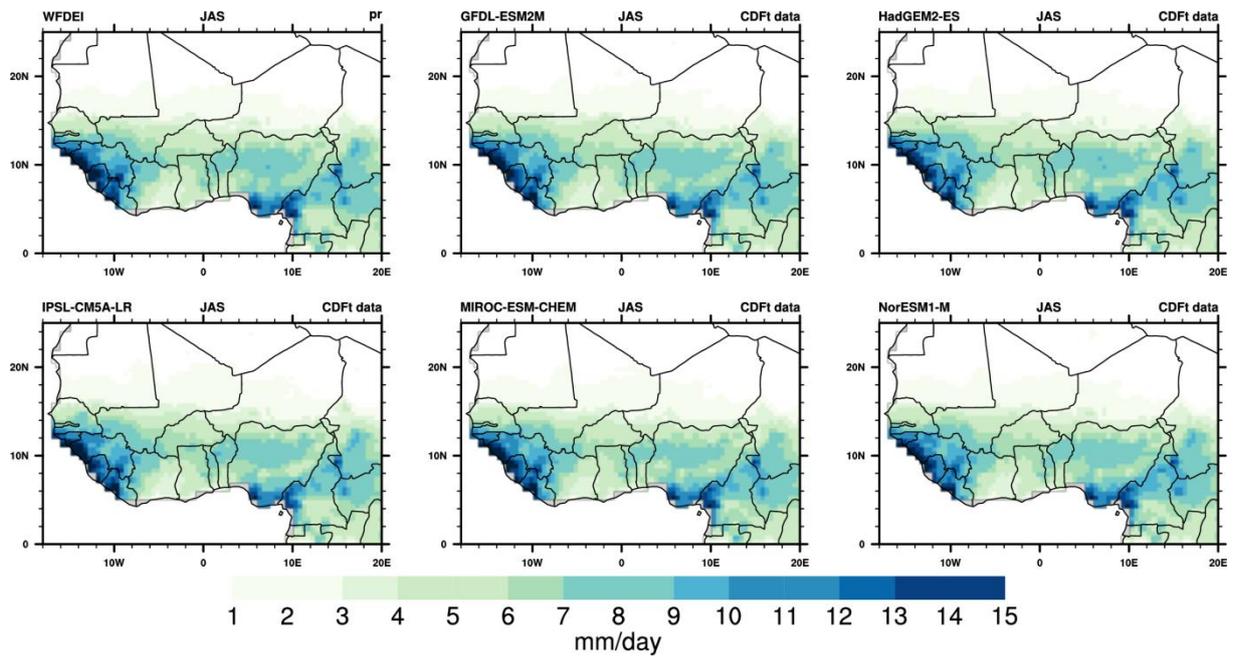


Figure S4 : Same as Figure S3 but for precipitation rate (mm/day).

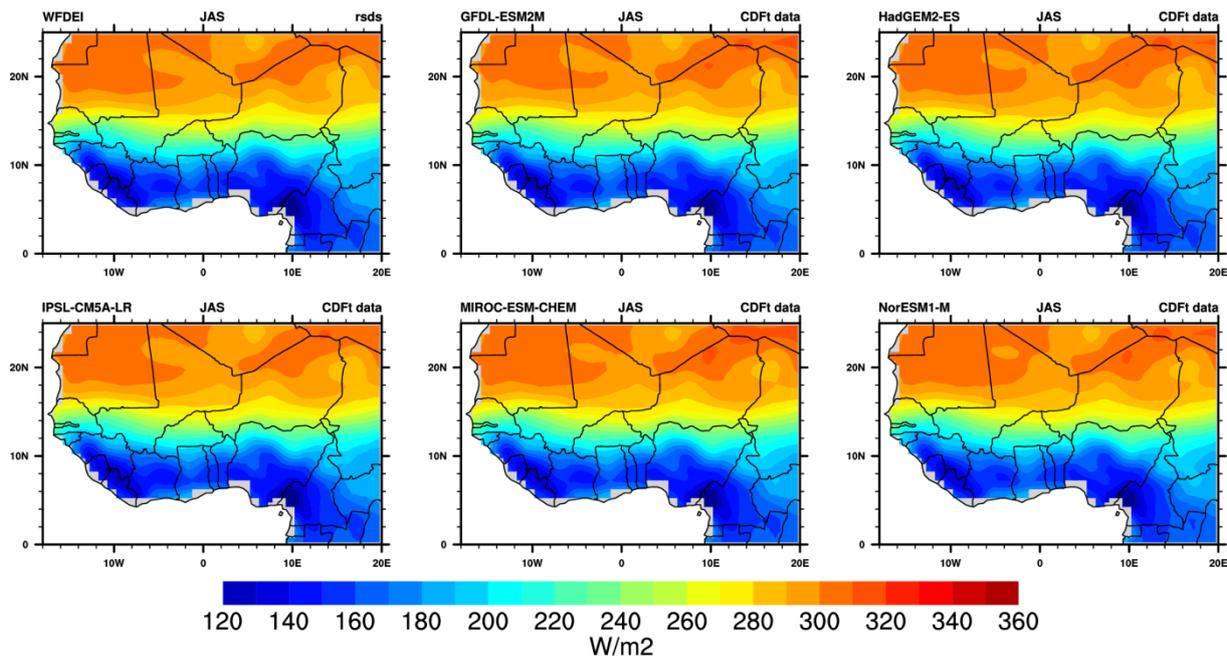


Figure S5 : Same as Figure S3 but for solar radiation (W/m<sup>2</sup>).

Supplementary Fig.S6 and Fig.S7 provide analysis similar to Fig.11 and Fig.12 for the number of days with  $t_{as} \geq 30^{\circ}\text{C}$ . Again, WFDW, FDEI, and dEW provide similar values (Fig.S6) combined with a strong seasonality: an extended area located north of  $12^{\circ}\text{N}$  of more than 55 days (out of 91 days) in spring (not shown), limited to north of  $15^{\circ}\text{N}$  in summer, and a drastic decrease in fall leading to 20 to 40 days over the western part of Sahara (not shown). More to the south, in the Guinea area, less than 16 days by season have  $t_{as} \geq 30^{\circ}\text{C}$ . CDF-t bias-corrected GCM data have biases respect to WFDEI less than  $\pm 2$  days over a large part of the domain but biases up to +6 days still remain for some GCMs (especially HadGEM2-ES and IPSL-CM5A-LR), and down to -3 days for the other GCMs north of  $10^{\circ}\text{N}$  with some local peaks at -5 days. Taylor diagrams (Fig.S7) depict a good performance of CDF-t bias-correction method except over the Guinea area in summer and in fall (not shown), in particular in terms of normalized standard deviation due to the very low variability of the reference field leading to a high ratio (a lot of GCMs dots are outside of the Taylor circle and not plotted).

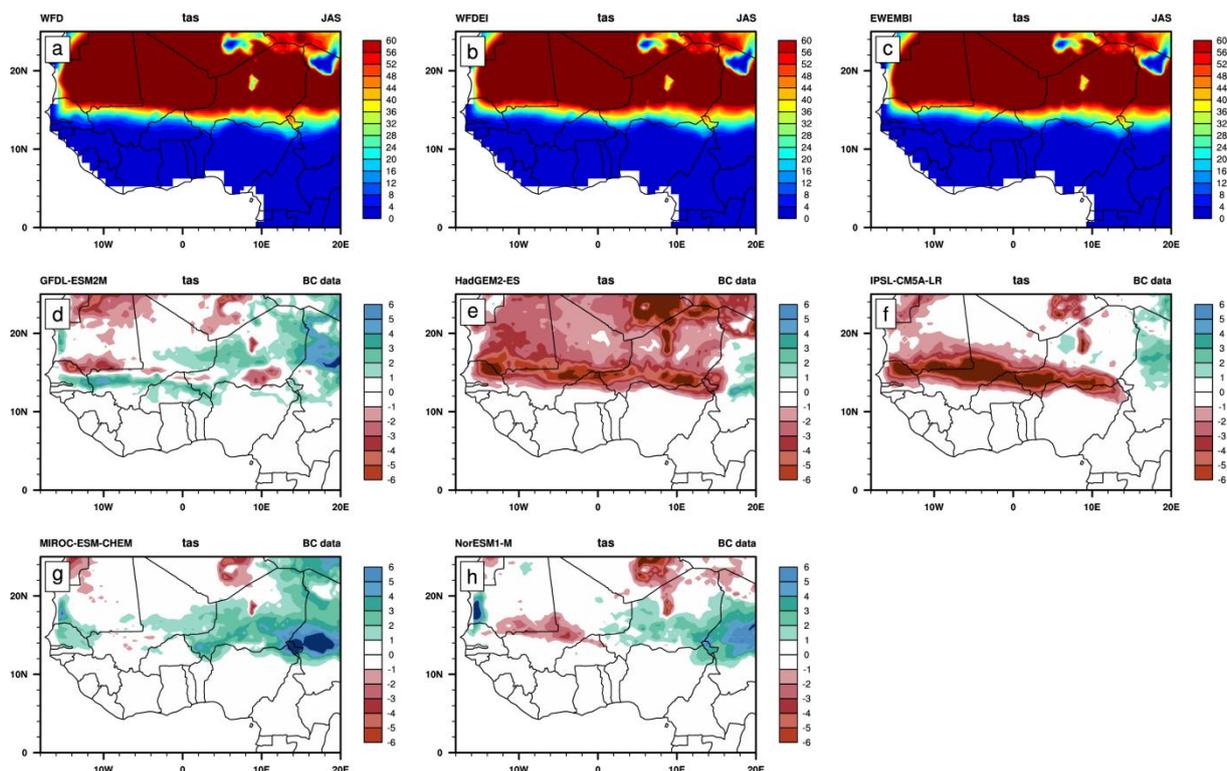


Figure S6 : Seasonal mean of number of days where near-surface temperature is greater or equal to 30°C (30°C is spatial mean of 95<sup>th</sup> percentile over West Africa box) from various observations dataset: WFD (a), WFDEI (b), EWEMBI (c) and difference relative to WFDEI data from 5 individual CDF-t bias-corrected models (d-h) over period 1979-2001.

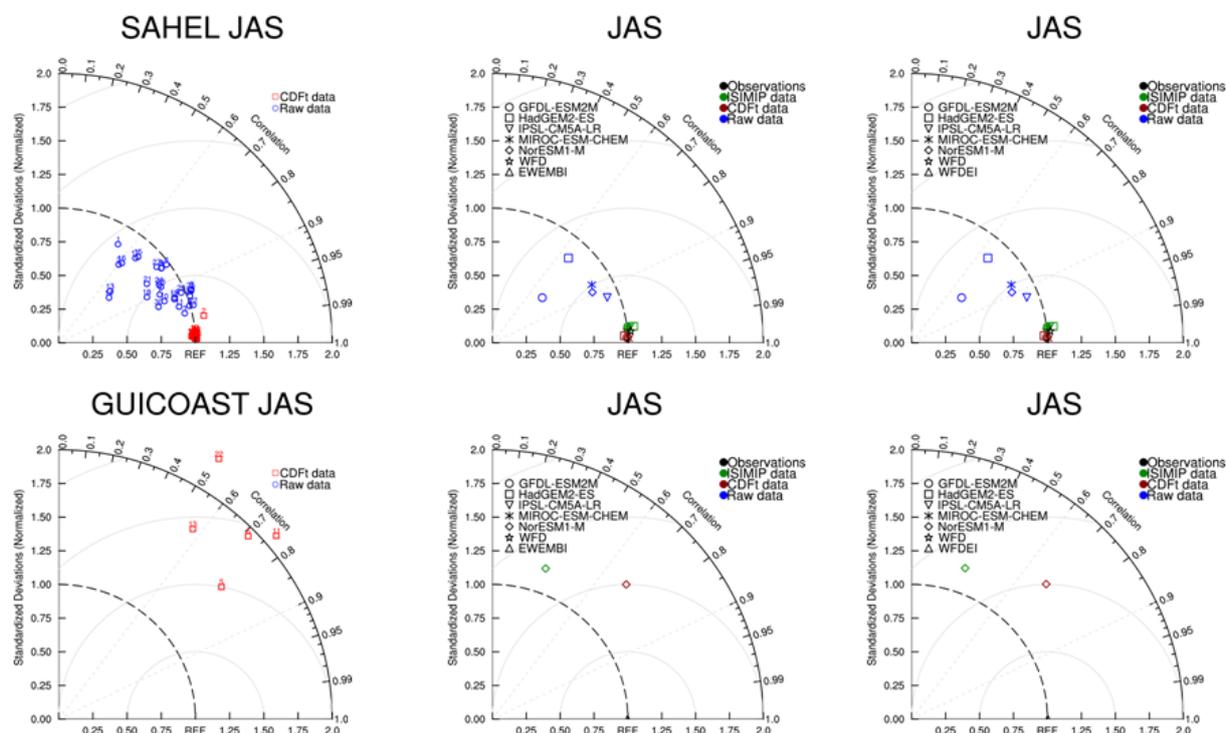


Figure S7 : Taylor diagrams relative to the number of days where surface temperature is greater or equal to 30°C from 29 individual models and multimodel (first column) and 5 five models (2<sup>nd</sup> and 3<sup>rd</sup> columns) from results involved in CMIP5 historical experiment over 1979-2001 period. Two areas are considered for temperature fields : Sahelian Box (SAHEL : 18°W-10°E ; 10°N-20°N), Guinean box (GUICOAST : 18°W-10°E ; 3°N-10°N). Data are compared to WFDEI data (1<sup>st</sup> and 2<sup>nd</sup> columns) and to EWEMBI (3<sup>rd</sup> column). Taylor diagrams provide three statistics: the correlation coefficient between any tested field and the reference field (angle), the normalized standard deviation of the tested field in respect to the reference observation (x-axis and y-axis), and the centred root mean square difference between the tested field and the reference field (grey circles from 1 (with the lowest radius) to 4 (the highest radius)).

Supplementary Fig.S8 to Fig.S9 provide similar analysis for the number of wet days ( $pr \geq 1 \text{ mm day}^{-1}$ ) per season (expressed in mean number of days per month). WFD, WFDEI and EWEMBI provide values consistent with the ITCZ location including high values over the mountain areas (Fig.S8). For all seasons, WFDEI and EWEMBI have very similar fields while the values for WFD are clearly lower, with values from 18 to 25 in the ITCZ in summer for WFD in contrast with values up to 30 for the two other reference data sets. Remaining biases in respect to WFDEI in the CDF-t corrected data are rather weak (except over East Sahel in summer for all 5 GCMs), mainly negative in spring (not shown) and summer, and positive in fall (not shown). Taylor diagrams (Fig.S9) show that raw GCMs have a lower skill in the Guinea area than in the Sahel area, and show again the good performance of the CDF-t bias-correction method, the higher dispersion of the ISIMIP bias-corrected GCMs than CDF-t corrected GCMs in respect to their respective reference data set (WFD and WFDEI respectively), and the close distance of CDF-t bias-corrected data to EWEMBI reference for the Sahel area but not over the Guinea area. A similar analysis for the number of dry days ( $pr < 1 \text{ mm.day}^{-1}$ ) provides by definition complementary results both for observations and CDF-t bias-corrected data, so it is not presented here.

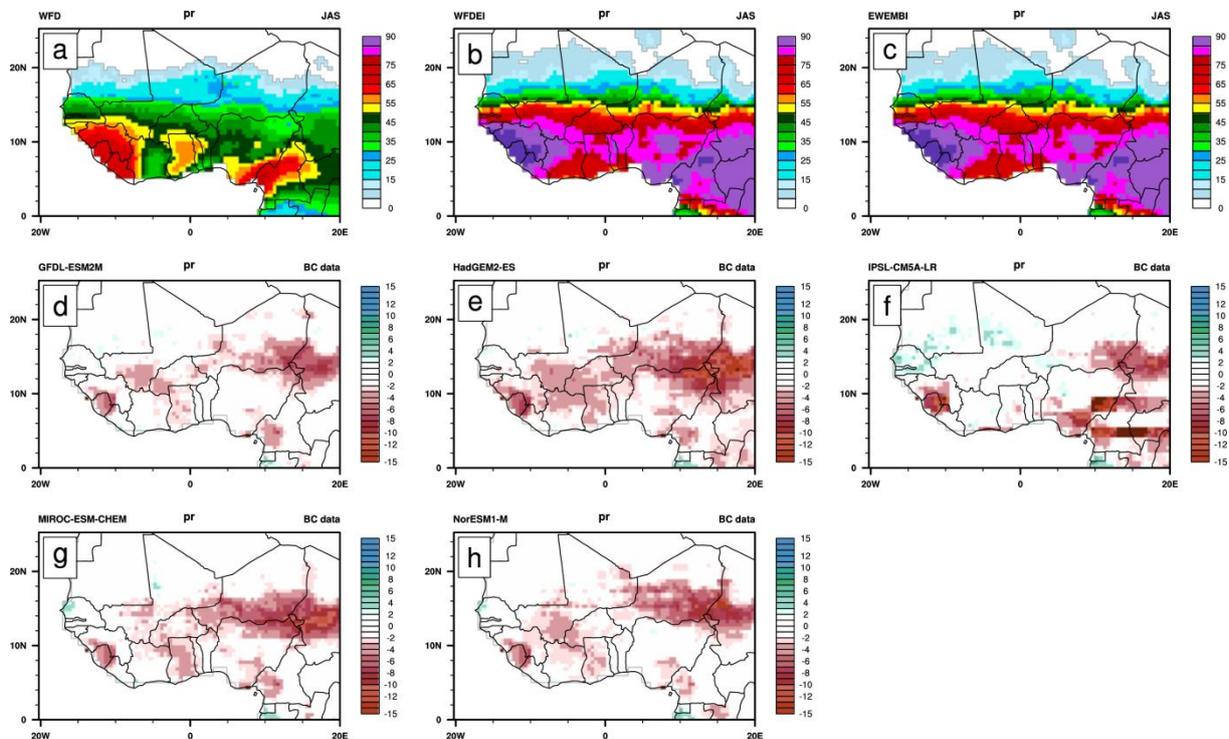


Figure S8 : Seasonal mean of number of wet day ( $pr > 1 \text{ mm/day}$ ), expressed in mean number per month, from various observations dataset: WFD (a), WFDEI (b), EWEMBI (c) and difference relative to WFDEI data from 5 individual CDF-t bias-corrected models (d-h) over period 1979-2001.

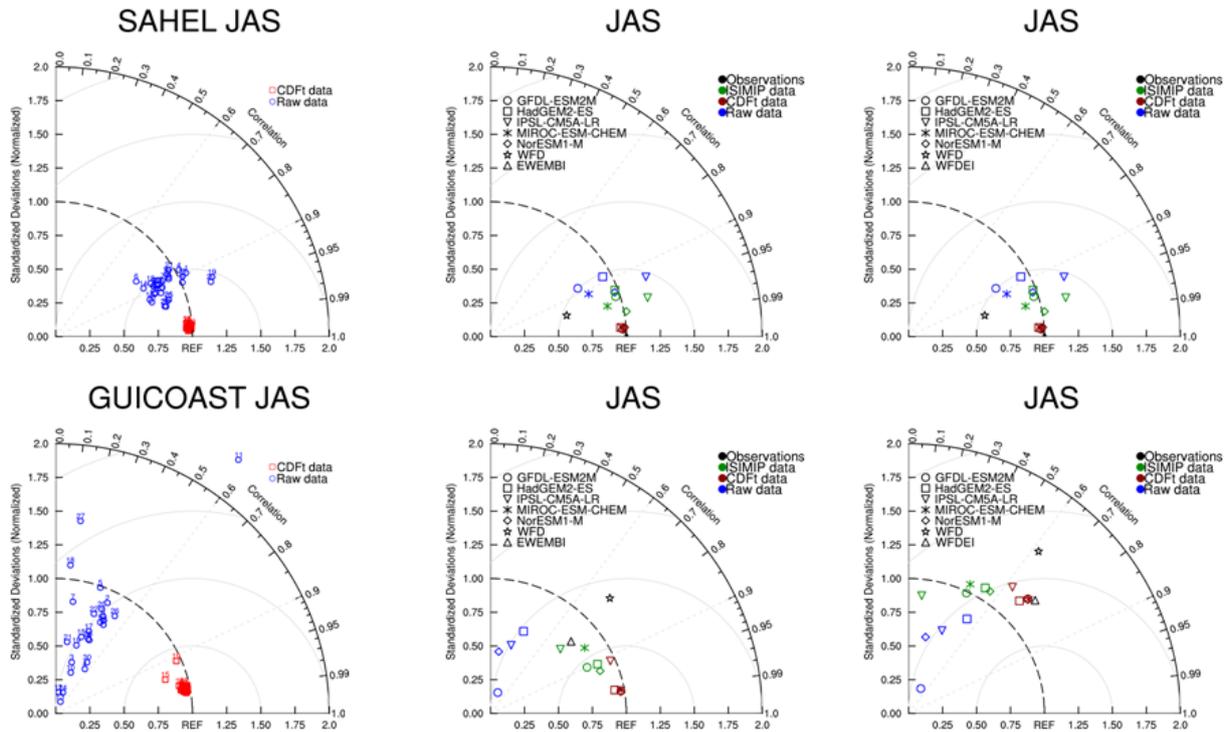


Figure S9 : Same as Figure S7 but for number of wet days.

Supplementary Fig.S10 and Fig.S11 provide similar analyses for the 95th percentile of the duration of consecutive dry days sequences per season. Again, while the three reference data sets are consistent with the ITCZ location, WFDEI and EWEMBI are very similar and somewhat different from WFD (SI Fig.10). Within the ITCZ the 95% percentile is lower than 10 days for WFDEI and EWEMBI while it can reach 20 days in WFD. In summer the little dry season south of the ITCZ is very well marked in WFDEI and EWEMBI, and not so clearly for WFD. The northern boundary of the ITCZ is very well marked for all three reference data sets with a steep meridional gradient. CDF-t bias-corrected GCMs have remaining weak biases in respect to WFDEI, except for GFDL-ESM2M in summer over the northern boundary of the ITCZ. The Taylor diagrams (Fig.S11) show rather good statistics. CDF-t bias-corrected data have the lowest biases but at some distance to the reference point and with some inter-model dispersion.

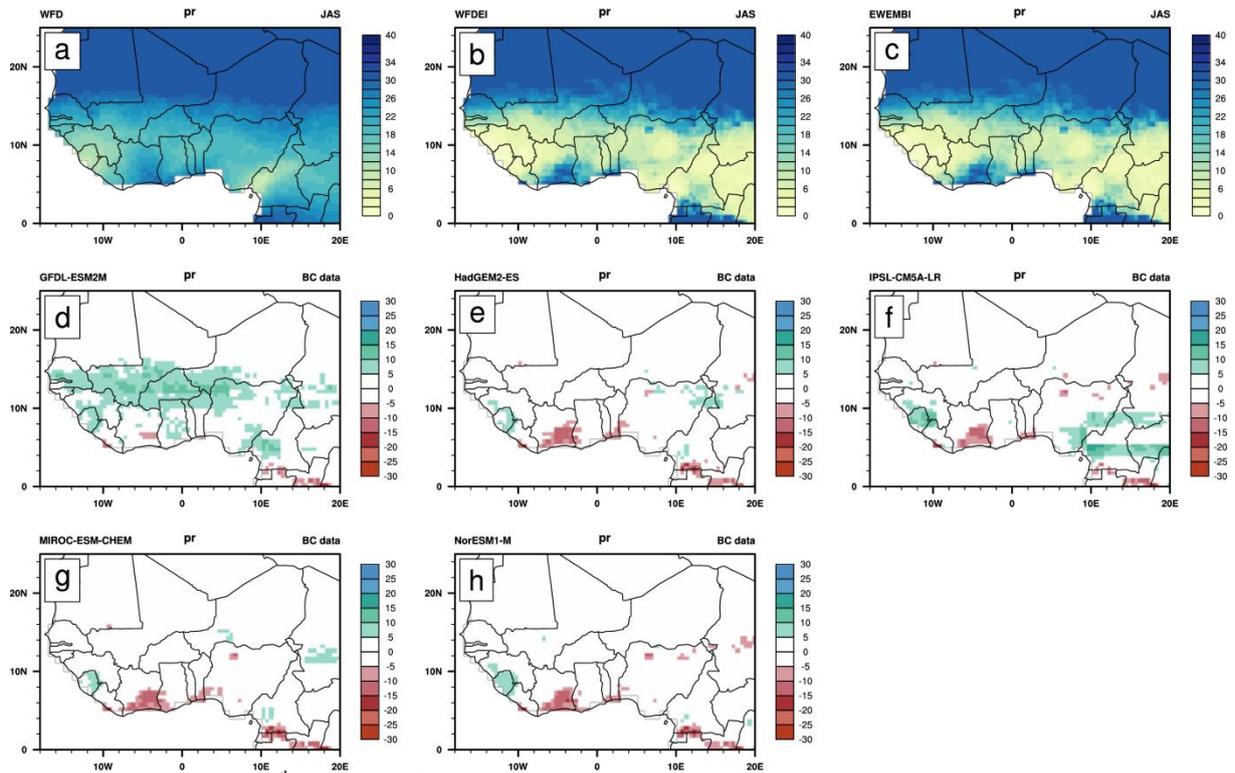


Figure S10 : Maps of the 95<sup>th</sup> percentile of the duration of consecutives dry days from various observations dataset: WFD (a), WFDEI (b), EWEMBI (c) and difference relative to WFDEI data from 5 individual CDF-t bias-corrected models (d-h) over period 1979-2001

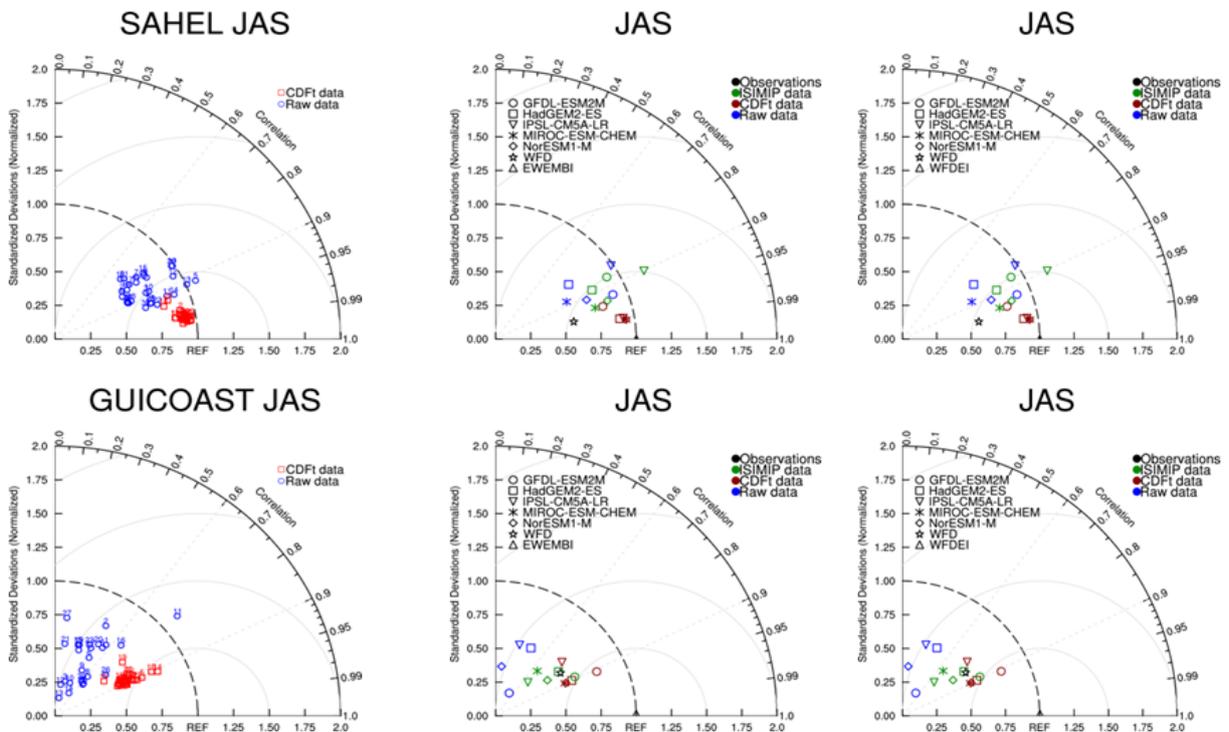


Figure S11 : Same as Figure S7 but for the 95<sup>th</sup> percentile of the duration of consecutives dry days.