Attribution of changes in precipitation patterns in African rainforests

Supplementary Information
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Additional figures for correlation and attribution analysis
The Congo Basin (10°S-9°N, 13°-30°E) has been identified as the region in the African tropical forest with two wet seasons in March, April, May (MAM) and September, October, November (SON) and two dry seasons in June, July, August (JJA) and December, January, February (DJF). We concentrate in the analysis on the JJA season, however, especially for the North Congo Basin the second dry season in DJF is more important as precipitation in that season over the North Congo (0°-9° N, 13°-30°E ) is on average below 50 mm/month. The main consequence of this fact can be seen in figure 2 of the main manuscript with the ratio of external and internal precipitation being considerably lower in the Northern Congo Basin in DJF. We speculate that a generally very low precipitation north of the Equator in that season leads to low values of the variance ratio.

Here we present in addition to figure 3 in the main manuscript correlation plots of precipitation in the South West Congo season with global precipitation and global SSTs for JJA (figure 1S) and DJF (figure 2S) and correlation plots for the North Congo with global precipitation and SSTs in JJA (figure 3S) and DJF (figure 4S)

Correlations in DJF are generally higher, which would make attribution studies more difficult in that season as disentangling anthropogenic influences from SST driven changes would be required.

Figure 1S Correlation of global SSTs (left) with area mean dry season (JJA) precipitation in the North Congo Basin in HadAM3P and correlation of global precipitation (right) with precipitation in the North Congo Basin indicated by the black square.
Figure 2
Correlation of global SSTs (left) with area mean dry season (DJF) precipitation in the North Congo Basin in HadAM3P and correlation of global precipitation (right) with precipitation in the North Congo Basin indicated by the black square.

Figure 3
Correlation of global SSTs (left) with area mean dry season (JJA) precipitation in the South West Congo Basin in HadAM3P and correlation of global precipitation (right) with precipitation in the South West Congo Basin indicated by the black square.

Figure 4
Correlation of global SSTs (left) with area mean dry season (DJF) precipitation in the South West Congo Basin in HadAM3P and correlation of global precipitation (right) with precipitation in the South West Congo Basin indicated by the black square.

The attribution analysis in the main manuscript concentrates on changes in the JJA dry season precipitation and cumulative water deficit (CWD), because the model seems more reliable in that season and predictability of precipitation from SSTs is much higher. While no significant changes in Congo Basin precipitation and CWD can be found analysing JJA, DJF precipitation (figure 5Sa) suggest
significantly lower precipitation in extreme precipitation events comparing the 2000s with the counterfactual 2000s ensemble. This is especially apparent for the extreme low precipitation events, shown as CWD in figure 5Sb. However, changes are not significant comparing with the 1960s. Therefore no robust conclusion can be made at this stage but the results clearly indicate that more analysis is needed to quantify the uncertainty of simulating “the world that might have been”.

Figure 5S Return periods of precipitation and cumulative water deficit in the dry season (DJF) of the tropical forest in the Congo basin for the 1960s (black), 2000s (blue), and 2000s in a counter factual world (green). The error bars give the 5-95% confidence interval of the return periods, derived from bootstrapping several thousand times from the individual ensemble. a) Precipitation in the Congo Basin b) Cumulative water deficit in the Congo Basin.