



Supplement of

Drought effects on leaf fall, leaf flushing and stem growth in the Amazon forest: reconciling remote sensing data and field observations

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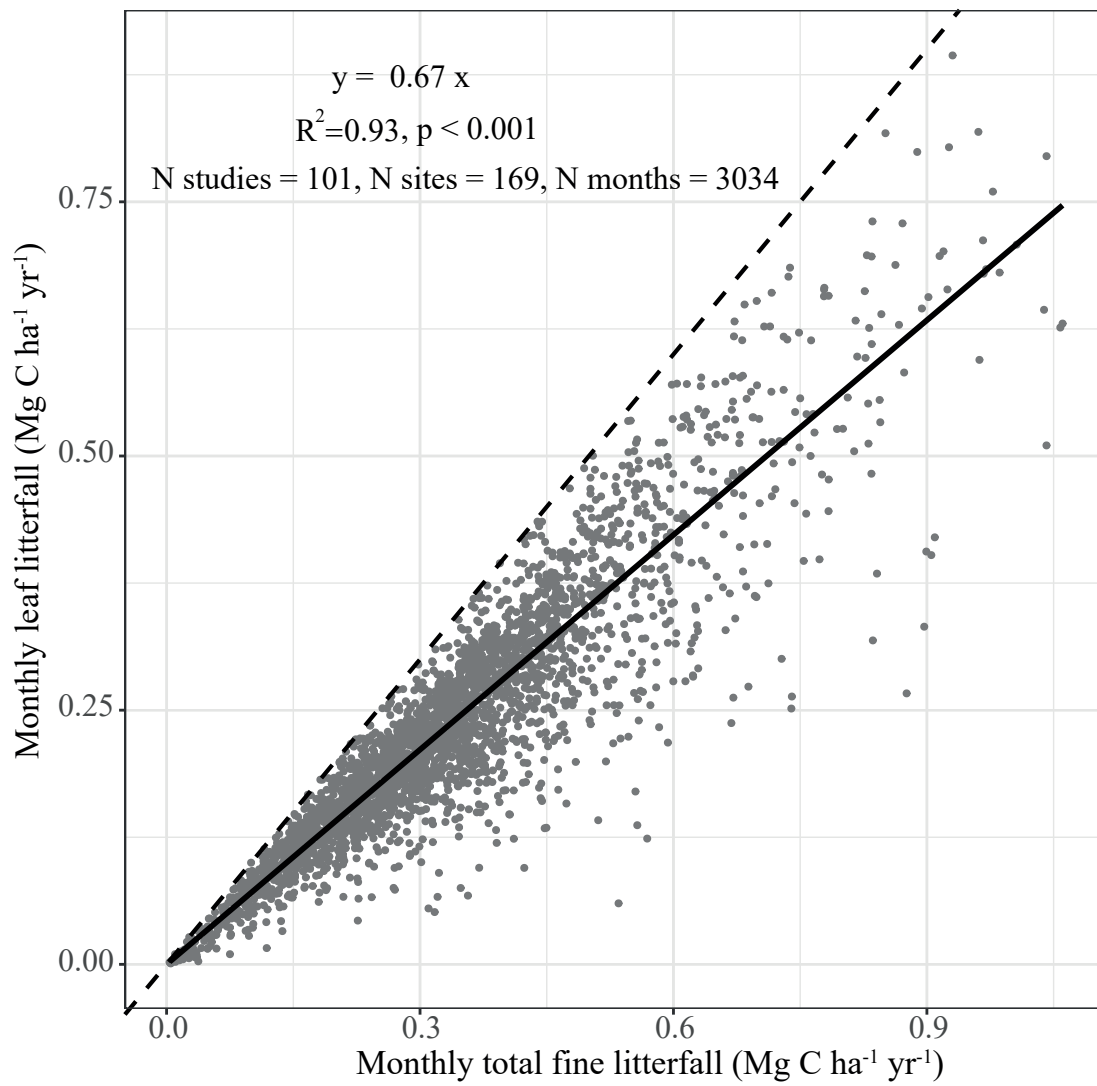


Figure S1: Relationship between monthly leaf litterfall and total fine litterfall. The solid black line represents a linear regression fit that is forced through the origin, which is used to estimate monthly leaf litterfall from studies that only reported total litterfall. The dashed black line represents the 0:0 line where total litterfall is equal to leaf litterfall.

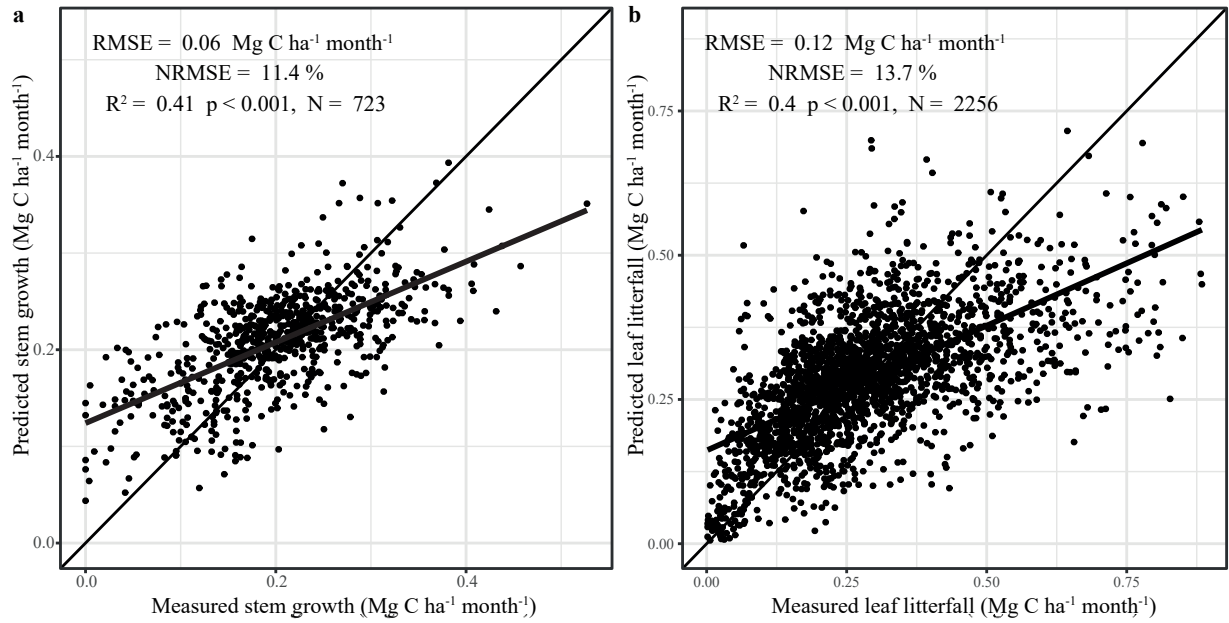


Figure S2: Model evaluation of the XGBoost models trained on complete time series from 60% of the sites. The scatterplots show the predicted biomass production versus the measured biomass production of the test data that was used to validate the stem growth (a) and leaf litterfall (b) models. The dashed black line is the 1:1 line and the solid black line the least squares linear regression fit.

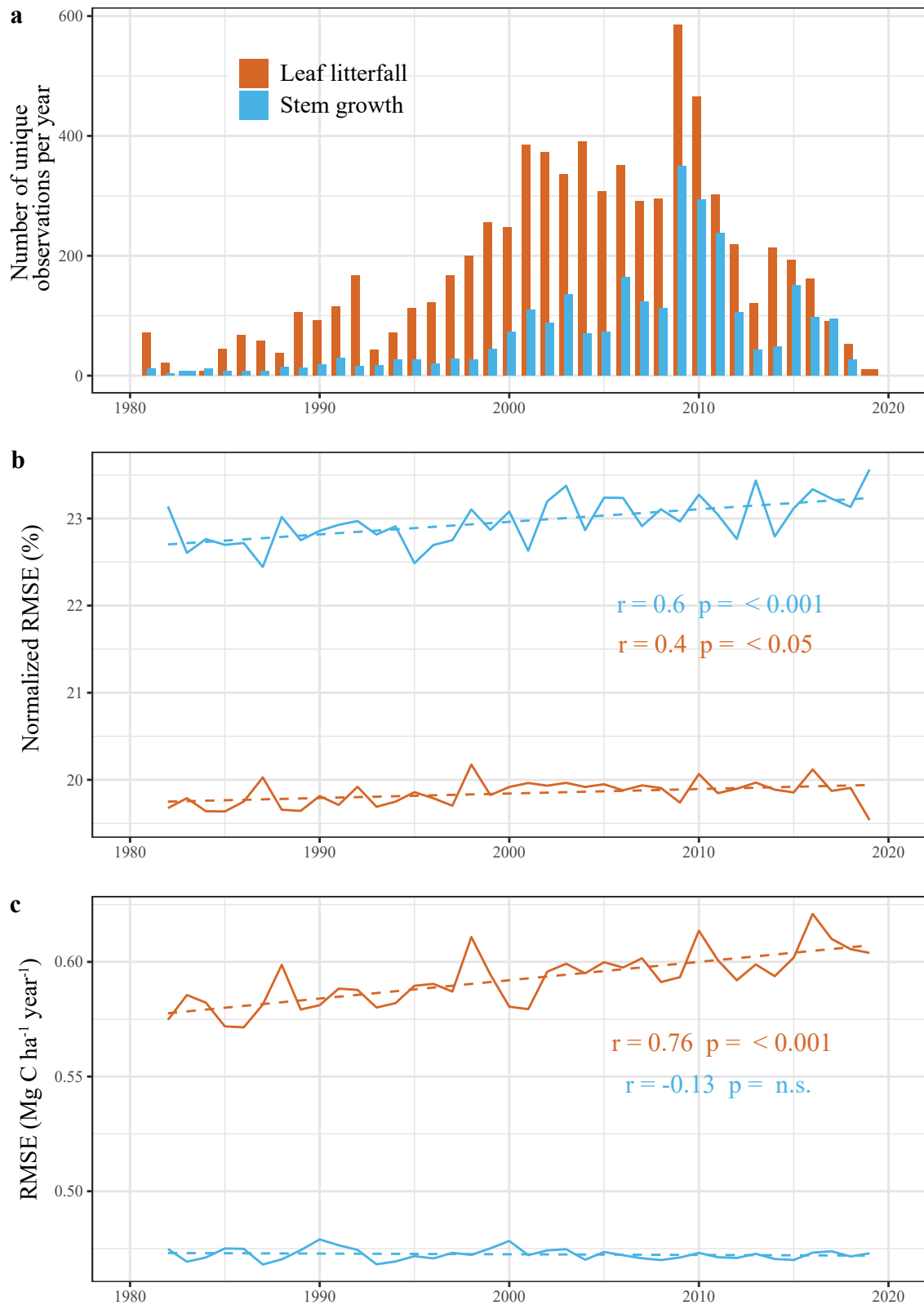


Figure S3: Temporal trends in observation frequency and estimated model uncertainty. The relative model error (b) is expressed as the normalized root mean squared error (RMSE) which is the RMSE of the model scaled by the leaf litterfall and stem growth values for that month. The RMSE (c) is used to show the development of the absolute model error over time.

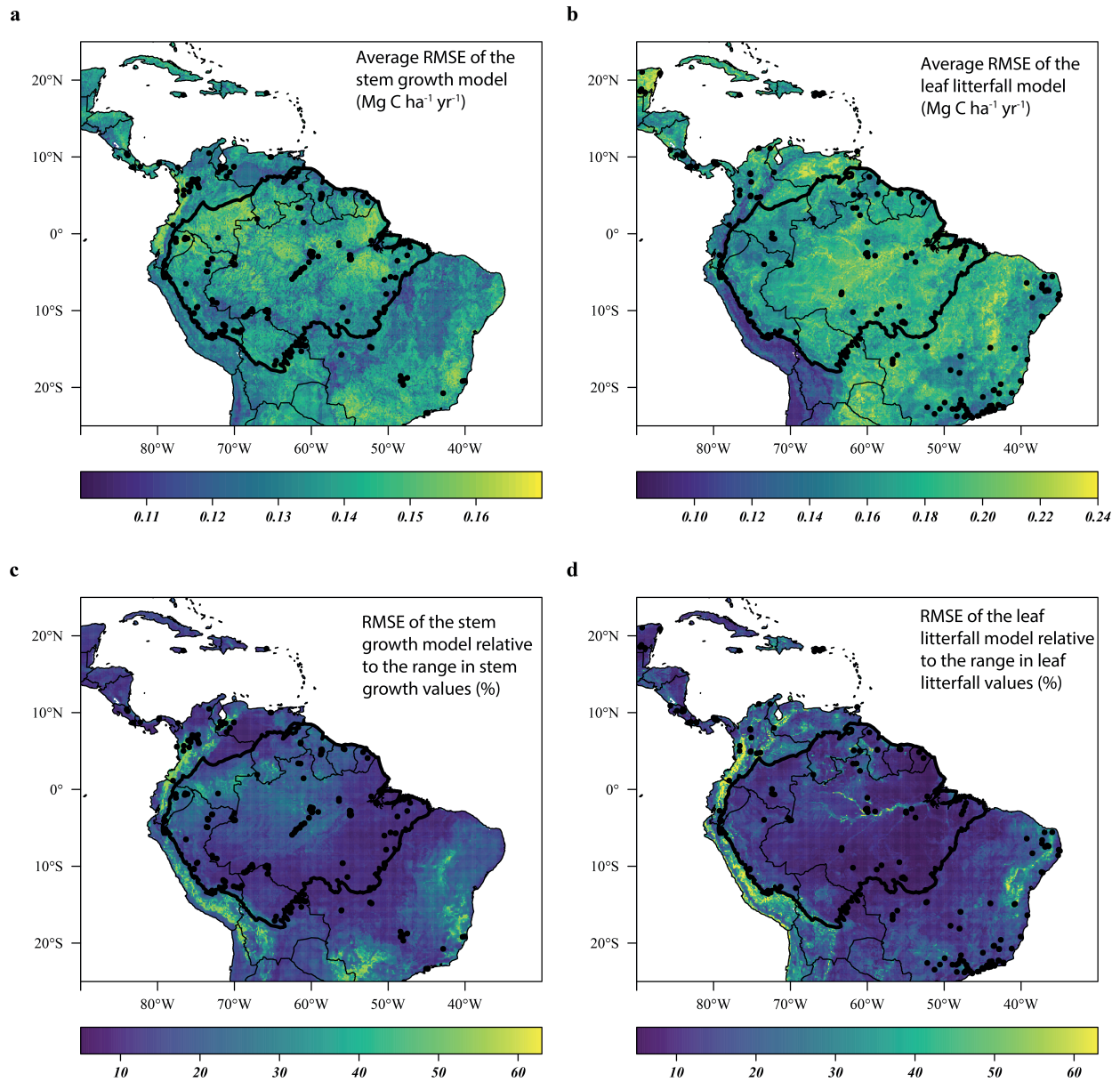


Figure S4: Spatial trends in estimated model uncertainty. The top two panels show the average absolute model error, or the root mean squared error (RMSE) for the stem growth (a) and leaf litterfall (b) models. In the bottom two panels the normalized RMSE is shown, which is the RMSE of the stem growth (c) and leaf litterfall (d) models divided by the average seasonal range in values in each pixel.

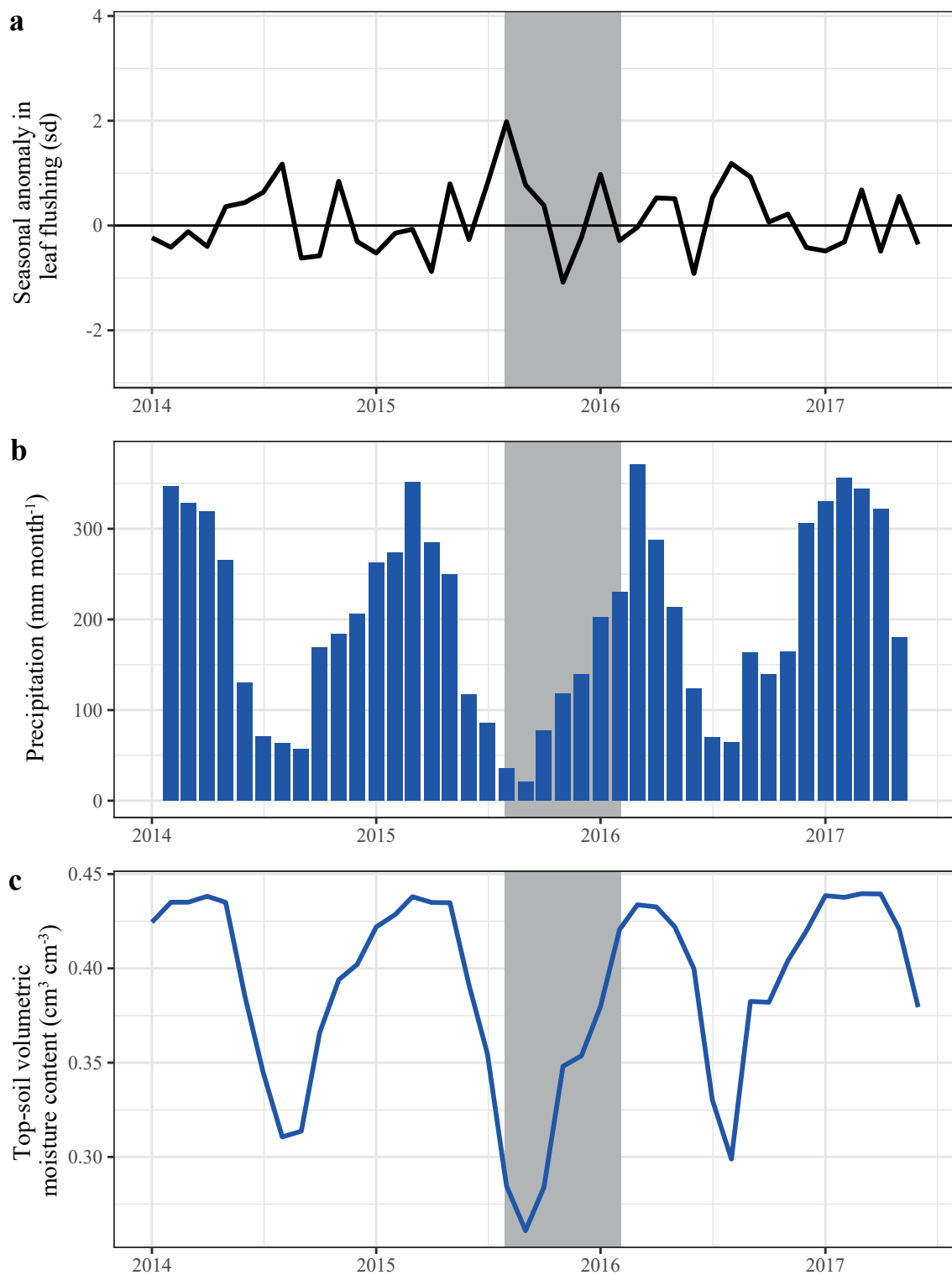


Figure S5: Temporal trends in modelled leaf flushing, precipitation and top-soil volumetric moisture during the 2015-2016 drought in the eastern Amazon. The seasonal anomaly in leaf flushing (a) is the difference in leaf flushing compared to the average leaf flushing in that month divided by the standard deviation of leaf flushing in that month. Precipitation and soil moisture content were both derived from the ERA5-Land reanalysis product.

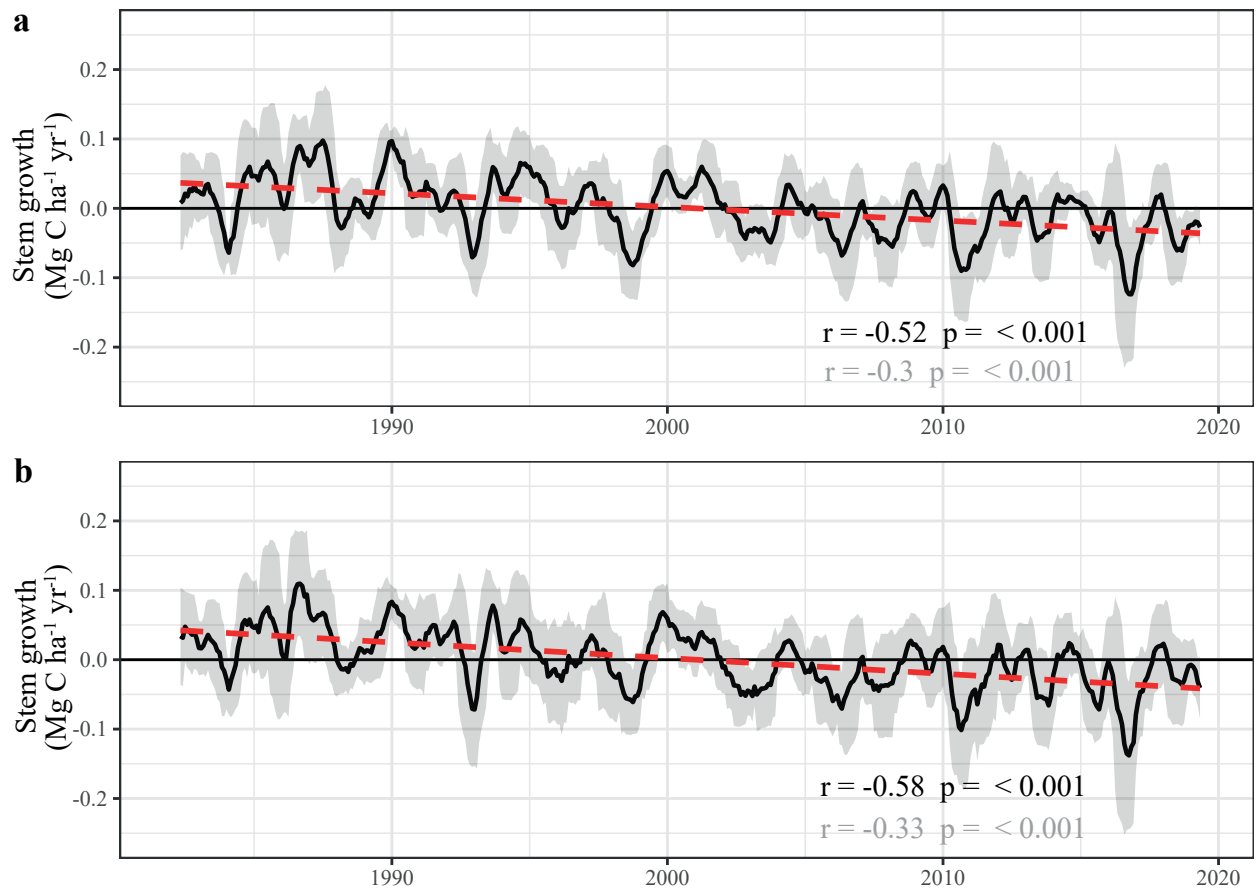


Figure S6: Long-term predictions of seasonally detrended anomalies in stem growth. In the top panel (a) the long-term trend in modelled stem growth is averaged for the entire Amazon basin while in the bottom panel (b) the long-term trend from the 190 Amazon forest inventory plot locations (Brienen et al., 2015; Hubau et al., 2020) is shown. Black lines are the 9 month moving average of the anomalies and the dark grey uncertainty bands show the moving standard deviation of the same data. Red dashed lines represent the least squares linear regression fit through the averaged time-series. Test statistics are provided for both the linear regression of the moving average (black) and the original monthly data (grey).

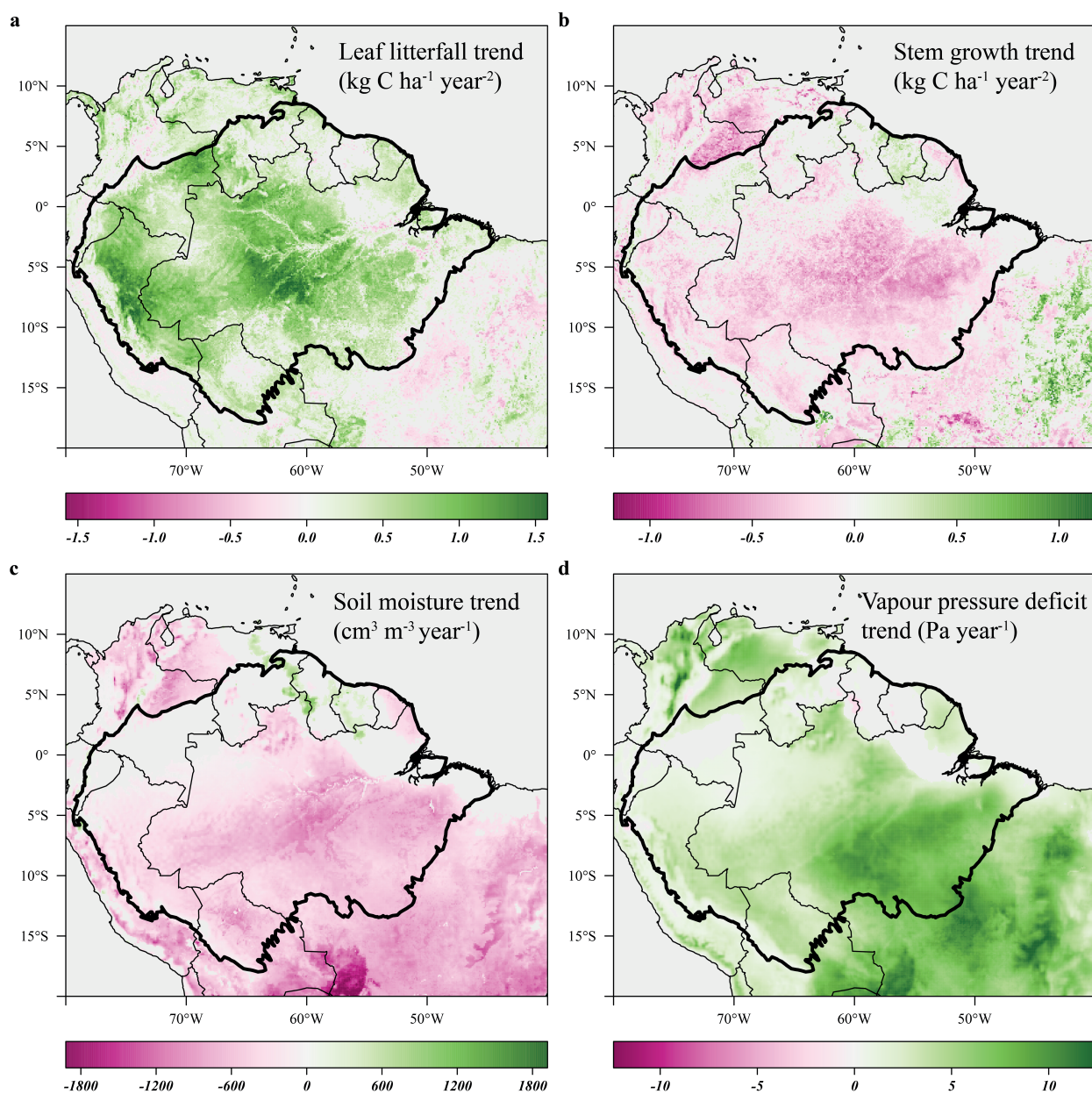


Figure S7: Long-term trends in modelled leaf litterfall and stem growth (1982-2019) and ERA5 topsoil volumetric moisture content and vapour pressure deficit (1981-2019). Only significant trends ($p < 0.05$) are shown. Country borders and the extent of the Amazon basin are marked by thin and thick black lines, respectively.