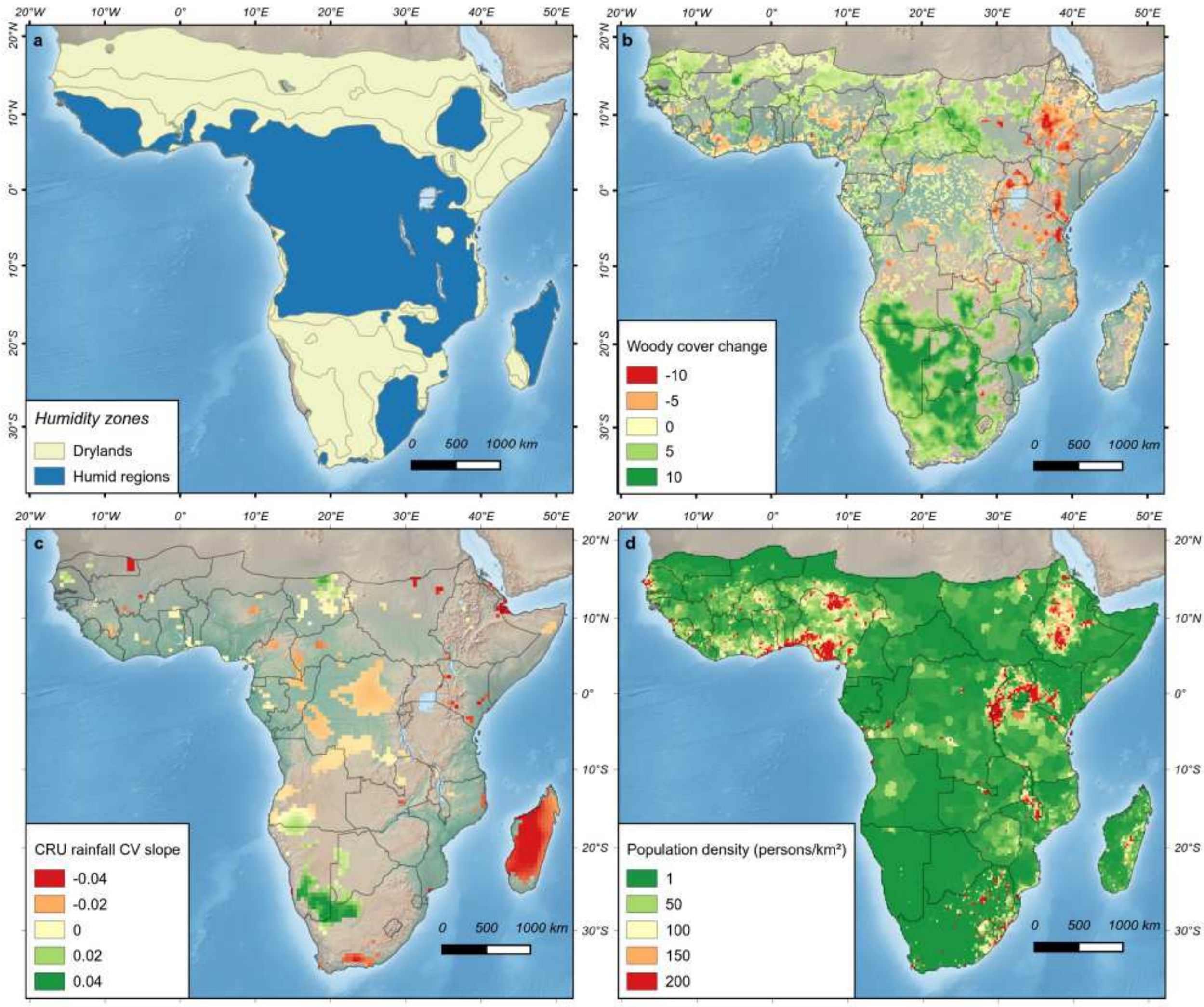
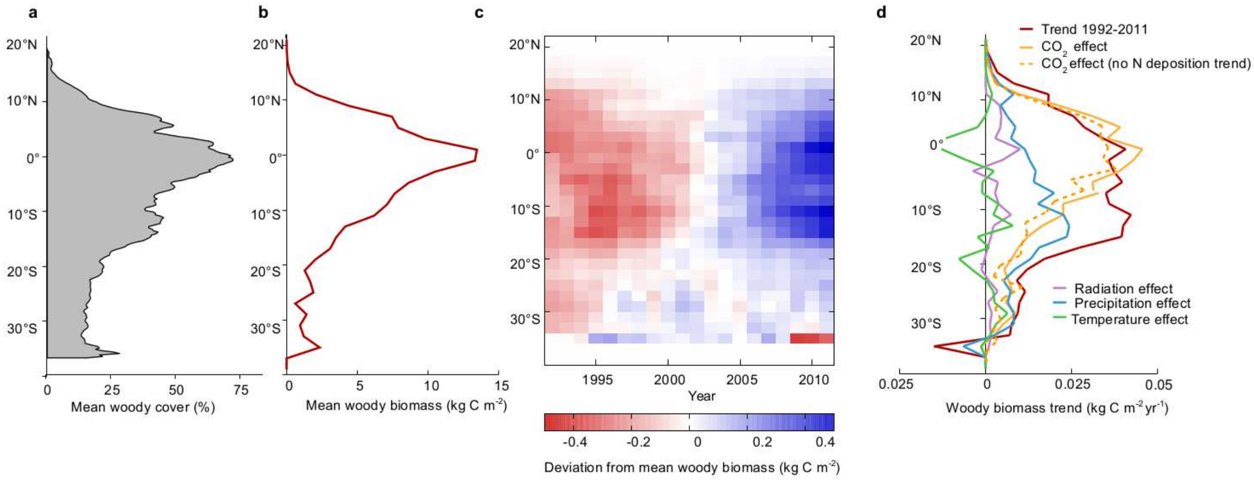
Postprint of: Brandt, Martin et al. "Human population growth offsets climate-driven increase in woody vegetation in sub-Saharan Africa" in *Nature Ecology & Evolution* 1 (2017). The final version is available at: DOI 10.1038/s41559-017-0081

Human population growth offsets climate-driven increase in woody vegetation in sub-Saharan Africa

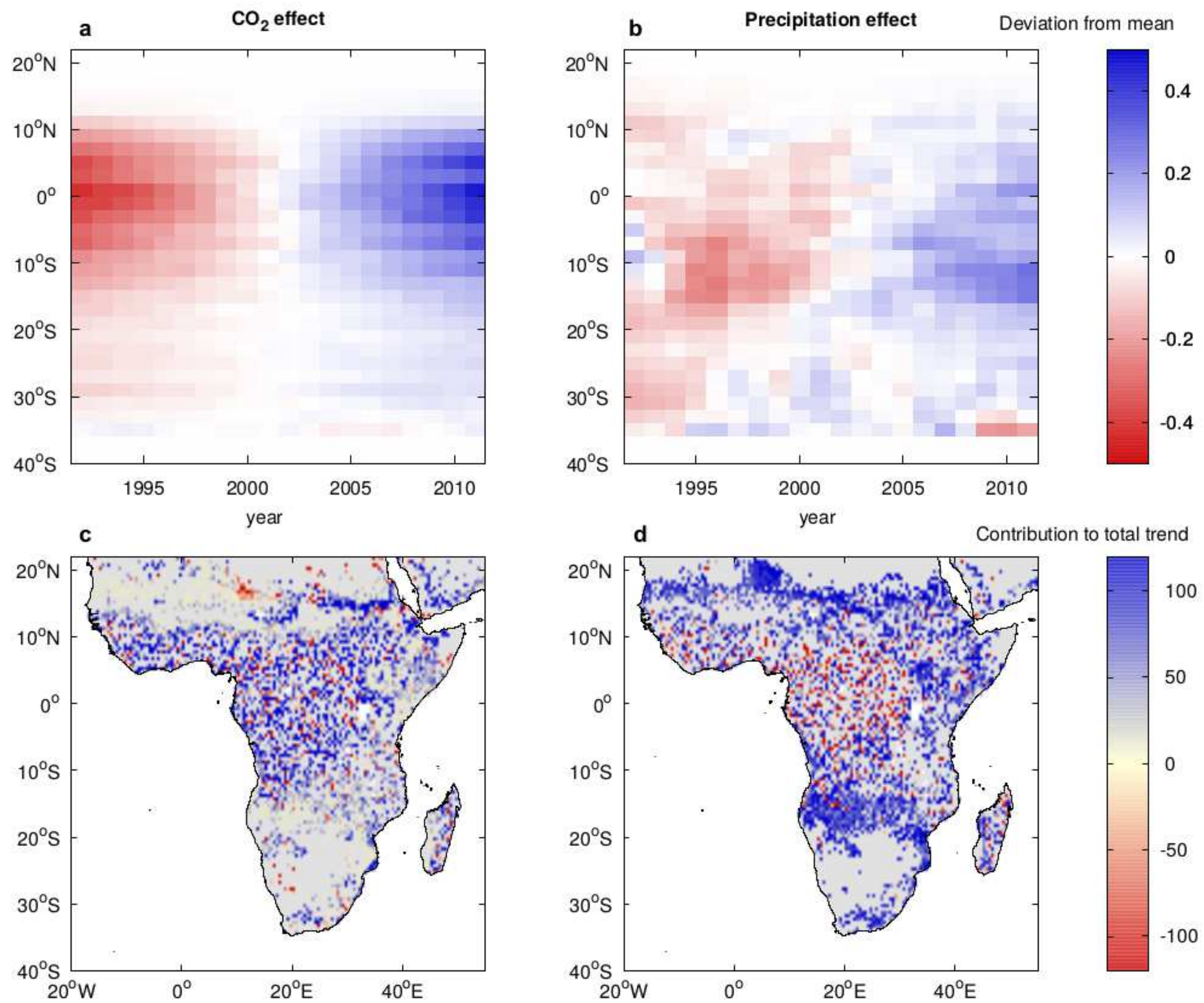
Martin Brandt, Kjeld Rasmussen, Josep Peñuelas, Feng Tian, Guy Schurgers, Aleixandre Verger, Ole Mertz, John R.B. Palmer, Rasmus Fensholt



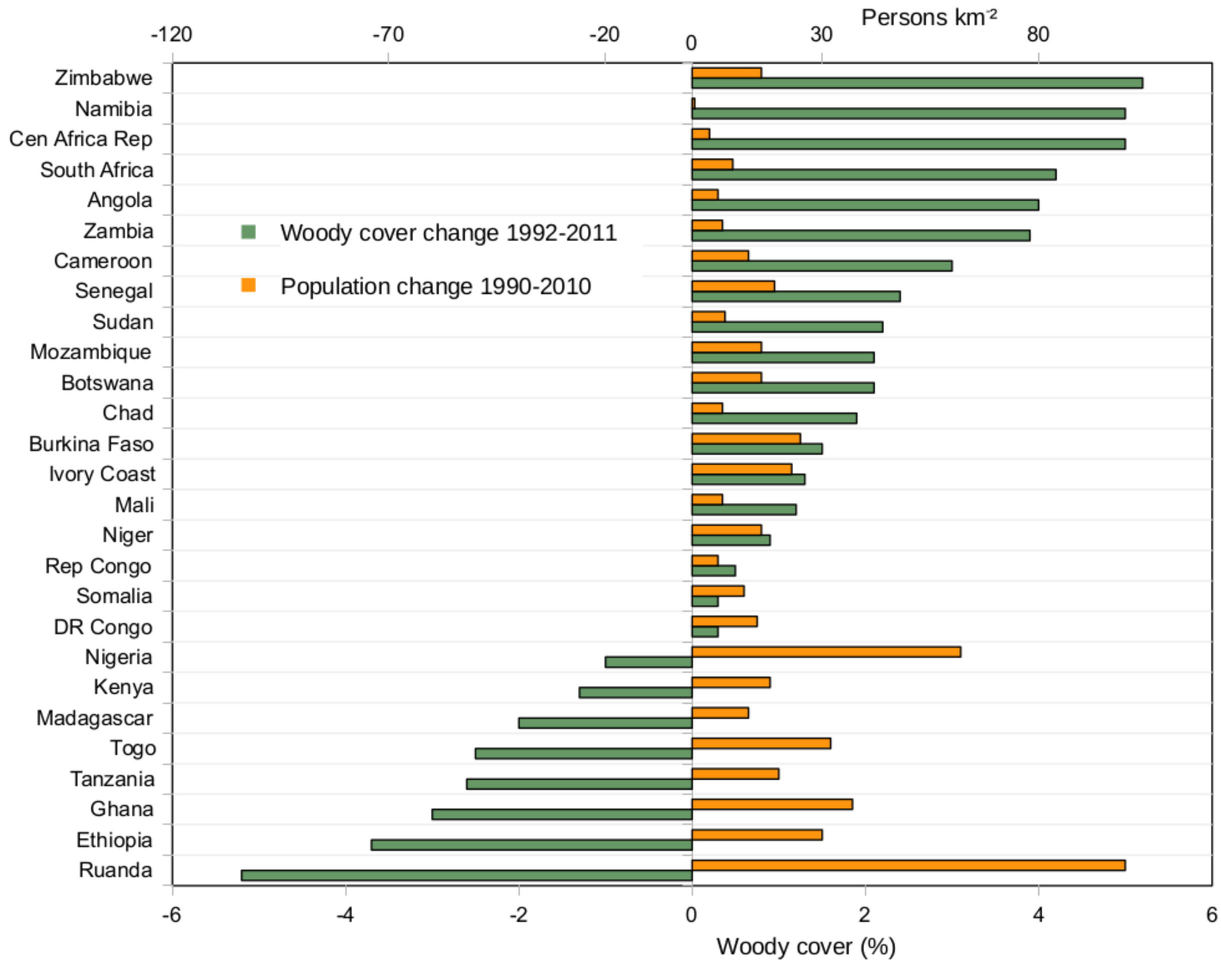
Supplementary Figure 1 | Humidity zones, changes in woody cover, trends in precipitation variability, and mean population density. a, Humidity zones showing Africa's drylands (arid, semi-arid, and dry-subhumid regions) and humid areas. These zones are based on the ratio between annual precipitation (P) and potential evapotranspiration (PET) for 1951-1980 and were obtained from http://www.grid.unep.ch/index.php (humid zone: $P/PET \geq 0.65$, drylands: $P/PET<0.65$). **b,** Absolute changes in woody cover (%) (estimated from annual VOD minimum) for 1992-2011. **c,** Significant ($p<0.05$, n=20) slope of linear regression of the annual coefficient of variation (CV) of CRU precipitation for 1992-2011 showing an increasing CV in Southern Africa and parts of the Sahel. **d,** Mean population density for 1990-2010.



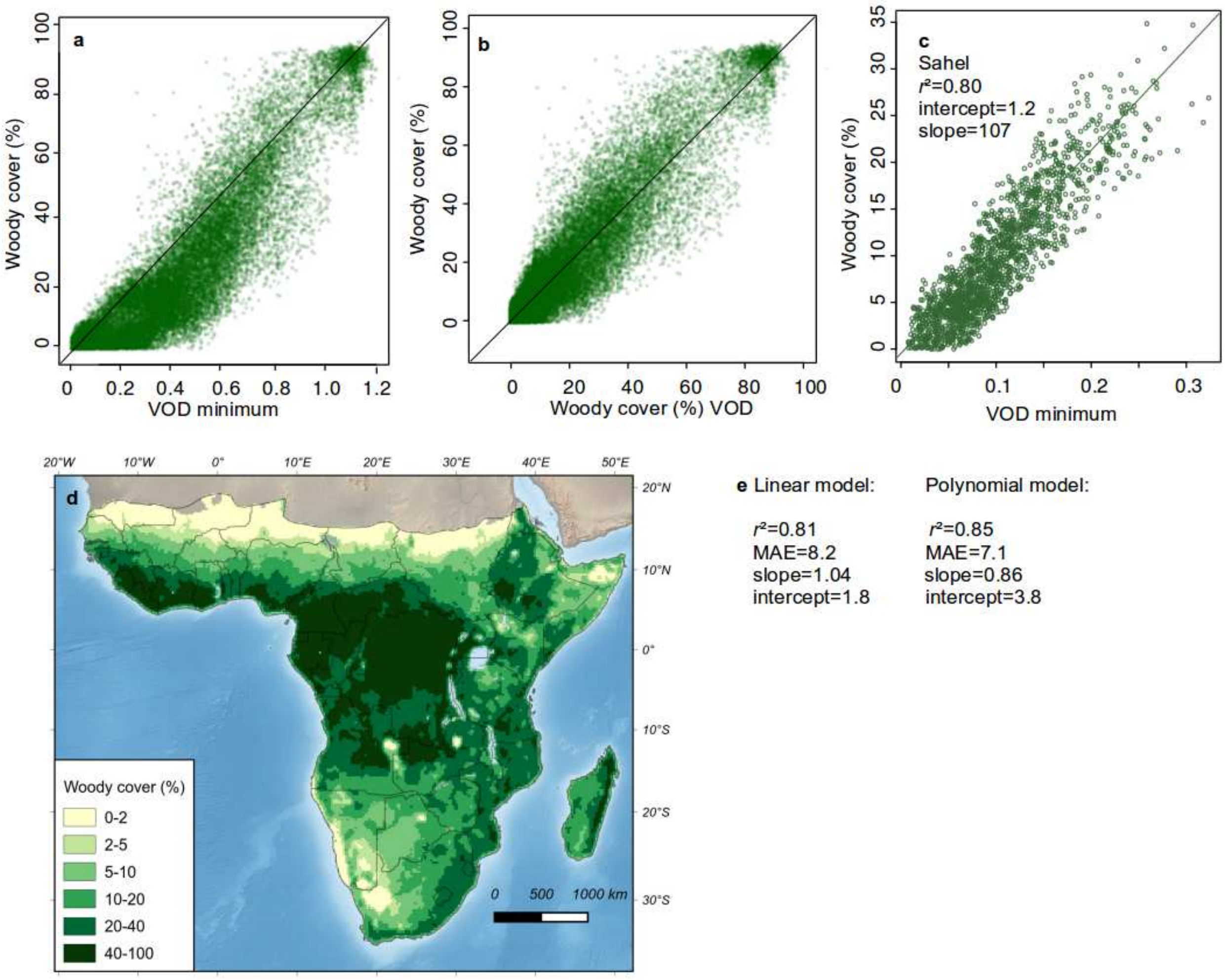
Supplementary Figure 2 | Trends of woody biomass and their drivers. a, Mean woody cover (VOD) and **b,** Mean woody-biomass carbon (LPJ-GUESS) averaged per latitude. Differences are due to the different variables (woody cover vs total woody aboveground biomass, which differs mostly in humid forests because most woody material is stored in the stems hidden below the canopy), the saturation of VOD in the humid forests, and the poor capability of LPJ-GUESS to assess dryland shrubs, which omits large parts of southern Africa's woody vegetation. **c,** The deviation from the inter-annual mean woody biomass shows a steady temporal increase in woody biomass. **d,** The total trends of woody biomass from north to south confirm the positive trend. The relative effects of CO_2, precipitation, radiation, and temperature on the trends identify CO_2 and precipitation as the main drivers.



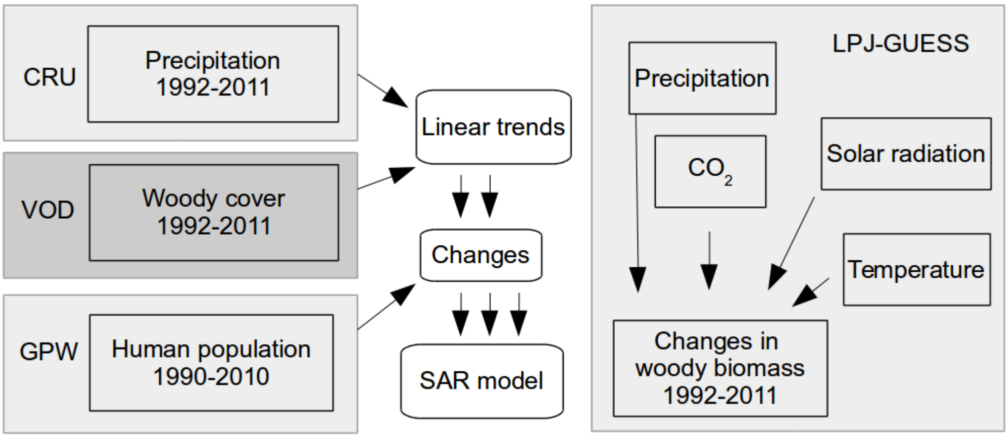
Supplementary Figure 3 | Drivers of simulated trends of woody biomass (LPJ-GUESS). a, b, Deviation from the mean for 1992-2011. **c, d,** Contribution of CO_2 and precipitation to the total trend. A negative value indicates an opposing trend and a positive value implies a high contribution to the total trend. CO_2 is identified as the dominant driver of the trends of woody biomass in humid areas, and precipitation is the dominant driver in drylands. Grey indicates non-significant linear trends (p<0.005, n=20).



Supplementary Figure 4 | Changes in VOD woody cover and human population by country. Note that not only forests but all woody vegetation is captured, so these statistics are not comparable with forest losses and gains. Moreover, a change does not imply a replacement of a forest by a non-forested area.



Supplementary Figure 5 | VOD and woody cover calibration and validation. a, Raw annual VOD minimum is plotted against the woody cover map (http://www.iscgm.org/gm/ptc.html#use) which was used for transforming VOD minimum to the unit woody cover for sub-Saharan Africa. A third-degree polynomial regression was used for the transformation. Woody cover <10% was predicted with an exponential regression to avoid underestimating very low values. **b**, The predicted woody cover map (using VOD) agrees well with the global map (r^2=0.85, slope=0.86) and the unit woody cover (%) was thus used throughout the manuscript. **c**, For validation purpose, VOD minimum is plotted against a field data (43 sites) trained woody cover map of Sahel[1]. **d**, The mean woody cover estimated with VOD minimum is shown. **e**, A linear transformation is compared with the applied polynomial model shown in (**b**).



Supplementary Figure 6 | Flowchart of the applied data sets and methods.

Supplementary Table 1 | SAR model of the changes in woody cover. Response variable: VOD (woody-cover change, 1992-2011). Explanatory variables: log(change in population) (persons km^{-2}, 1990-2010), log(population density) (persons km^{-2}, 1990-2010), change in precipitation (mm $year^{-1}$, 1992-2011), and mean annual precipitation (mm $year^{-1}$, 1992-2011).

Variable (standardized slope)	**r^2** (n=26925)
Population change (-0.17) Precipitation change (0.07) Population density (-0.07) Precipitation mean (-0.16)	0.47; *p*<2.2e-16
Population change (-0.27) Precipitation change (0.08)	0.45; *p*<2.2e-16
Population density (-0.22) Precipitation mean (-0.17)	0.46; *p*<2.2e-16
Population change Precipitation change	0.45; *p*<2.2e-16 0.39; *p*<2.2e-16

References

1. Brandt, M. et al. Woody plant cover estimation in drylands from Earth Observation based seasonal metrics. Remote Sens. Environ. 172, 28–38 (2016).