A model for global biomass burning in preindustrial time: LPJ-LMfire (v1.0) (Supplementary Material)

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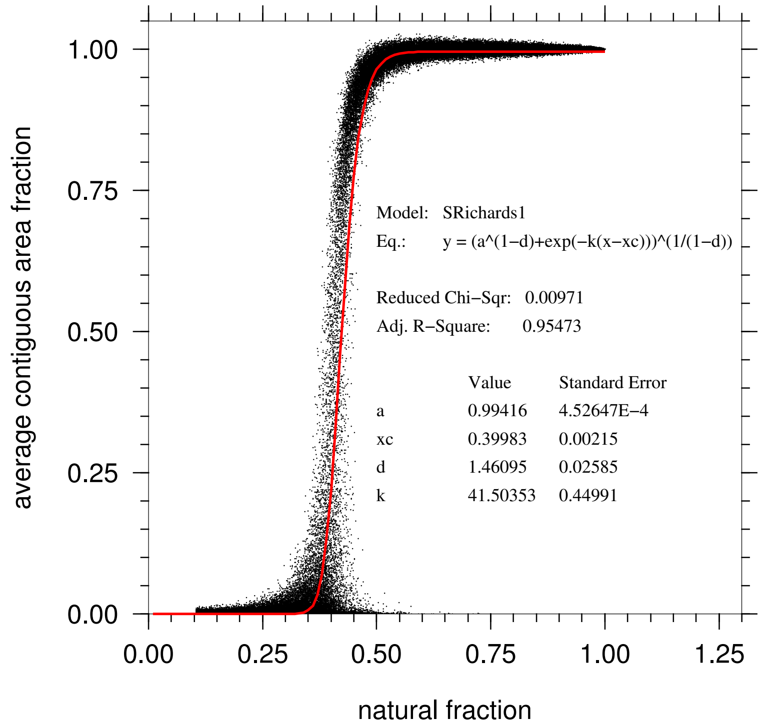

Fig. S1: Scatterplot of Monte Carlo simulation results on a 100 x 100 grid. For each fractional combination of natural land vs. agricultural land on a step size of 0.01, pixels on the 100 x 100 grid were randomly assigned to be either natural land or cropland, and the average contiguous area fraction of natural patches was calculated based on an 8-cell neighborhood, for 1000 repetitions at each land use fraction.

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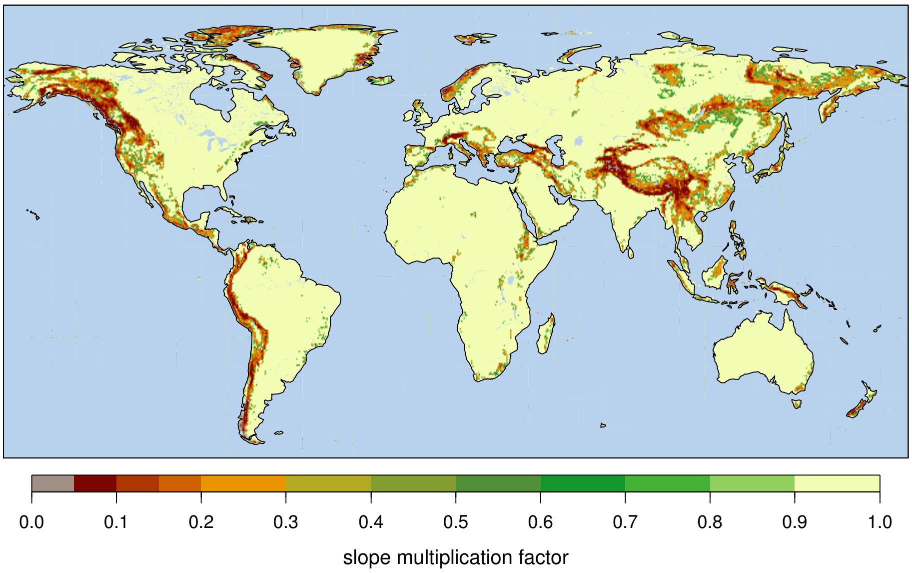

Fig. S2: Spatial distribution of the slope factor (slf). Constraining effects of terrain size on the average size of fires are estimated by using slf as a multiplication factor on the default average fire size calculated by the fire model.

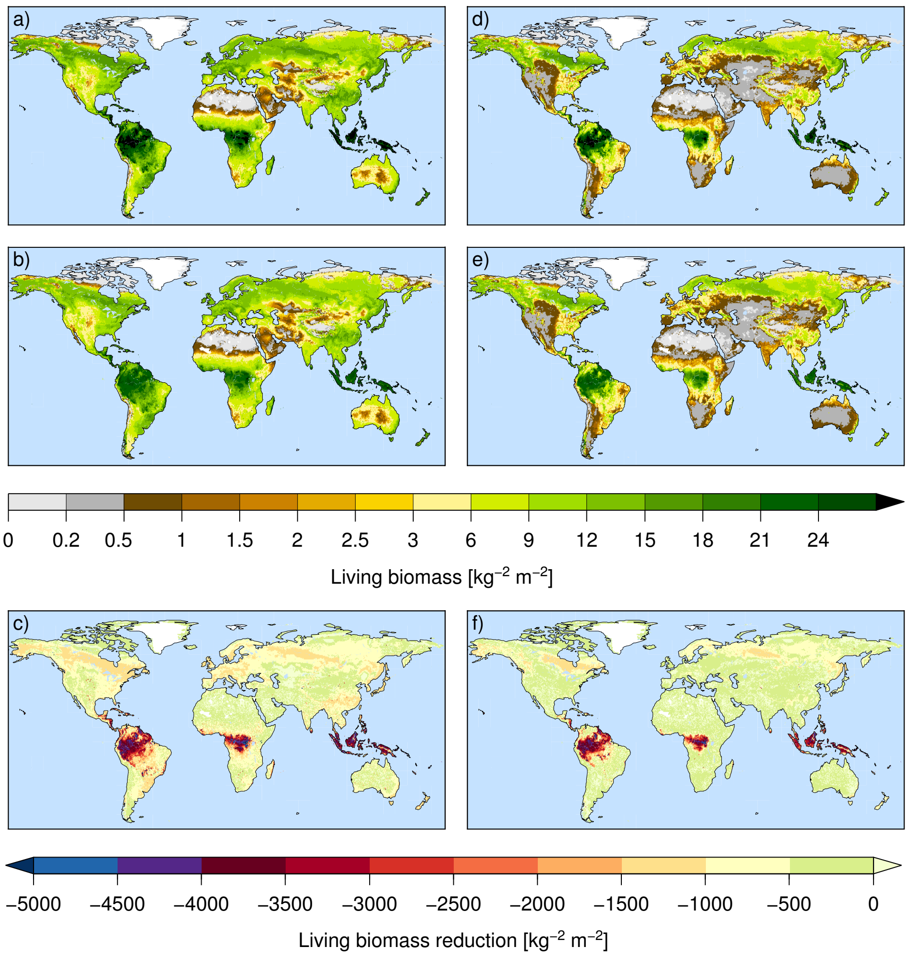

Fig. S3: Effect on global biomass caused by the changes to maximum crown area and maximum establishment rate in LPJ. Panels a) to c): Scenario completely excluding fire, to illustrate how the underlying basis biomass for fires changes. Panel a): Old LPJ parameterization, with a maximum crown area constraint of 15 m^2 and a maximum establishment rate of 0.12 individuals m^{-2}. Panel b): New parameterization with a maximum crown area constraint of 30 m^2 and a maximum establishment rate of 0.15. Panel c) Difference in biomass between b) and a): a reduction in living biomass can be observed globally, but total values of reduction are highest in the equatorial tropics where total biomass is highest. Panels d) to f) show global biomass for a simulation run including anthropogenic land use based on HYDE land use and lightning-caused burning on non-agricultural land, for the old parameterization of maximum crown area and maximum establishment rate in panel d) and the new parameterization in panel e), and the difference between e) and d) shown in panel f).

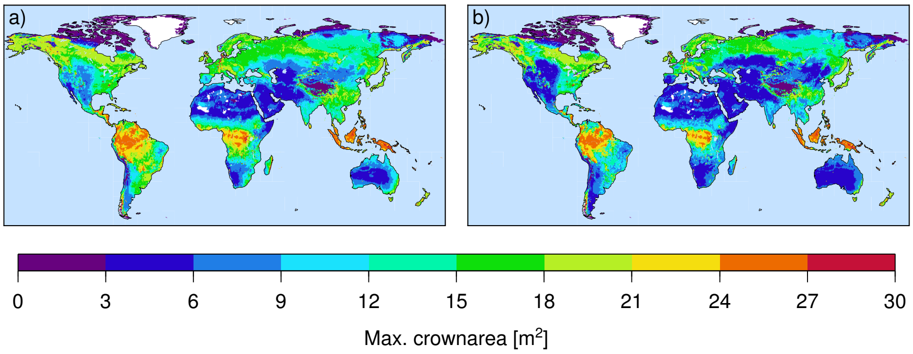

Fig. S4: Panel a): Simulated maximum crown area for a world without fire after implementation of a maximum crown area threshold of 30 m^2 instead of 15 m^2. Panel b): Simulated maximum crown area for a simulation run with lightning-caused fire. All places with maximum crown area between 15 m^2 and 30 m^2 are areas where the increase of maximum crown area contributes to the reduction of live biomass by decreasing individual density compared to the old parameterization.

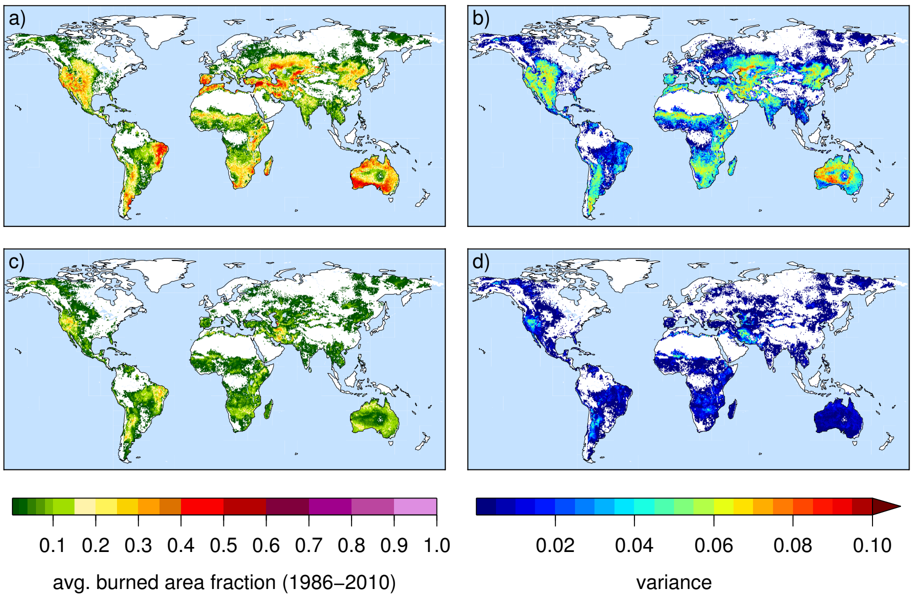

Fig. S5: Panel a) Average annual burned area fraction for a simulation run without agricultural land use, and lightning-caused fires over 25 years. Panel b) Variance in annual burned area fraction in reference to panel a). Panel c) Average annual burned area fraction for a simulation run with lightning-caused fires, but fires being excluded from agricultural land. Panel d) Variance in annual burned area fraction in reference to panel c).

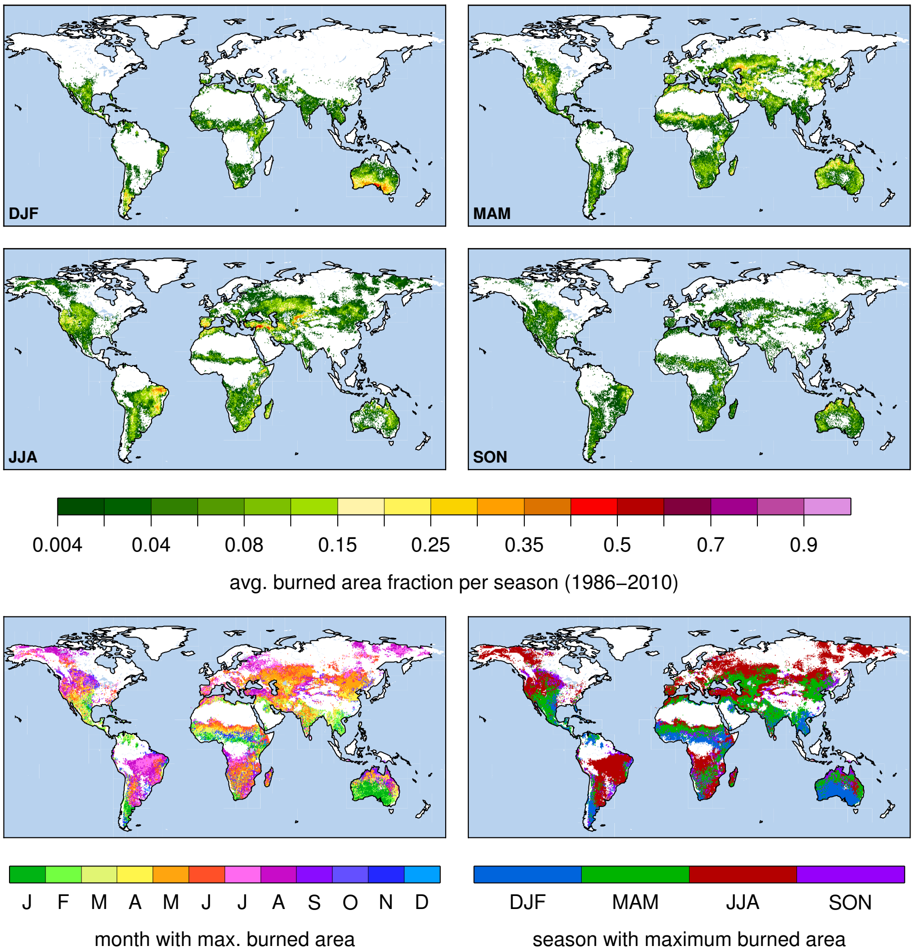

Fig. S6: Seasonality of fire under natural conditions (no land use, lightning ignitions). The top four panels show the average burned area fraction per season over 25 years. The two bottom panels identify simulated peak fire month based on burned area fraction and a seasonal summary highlighting which season has the highest simulated burned area fraction at a given location.

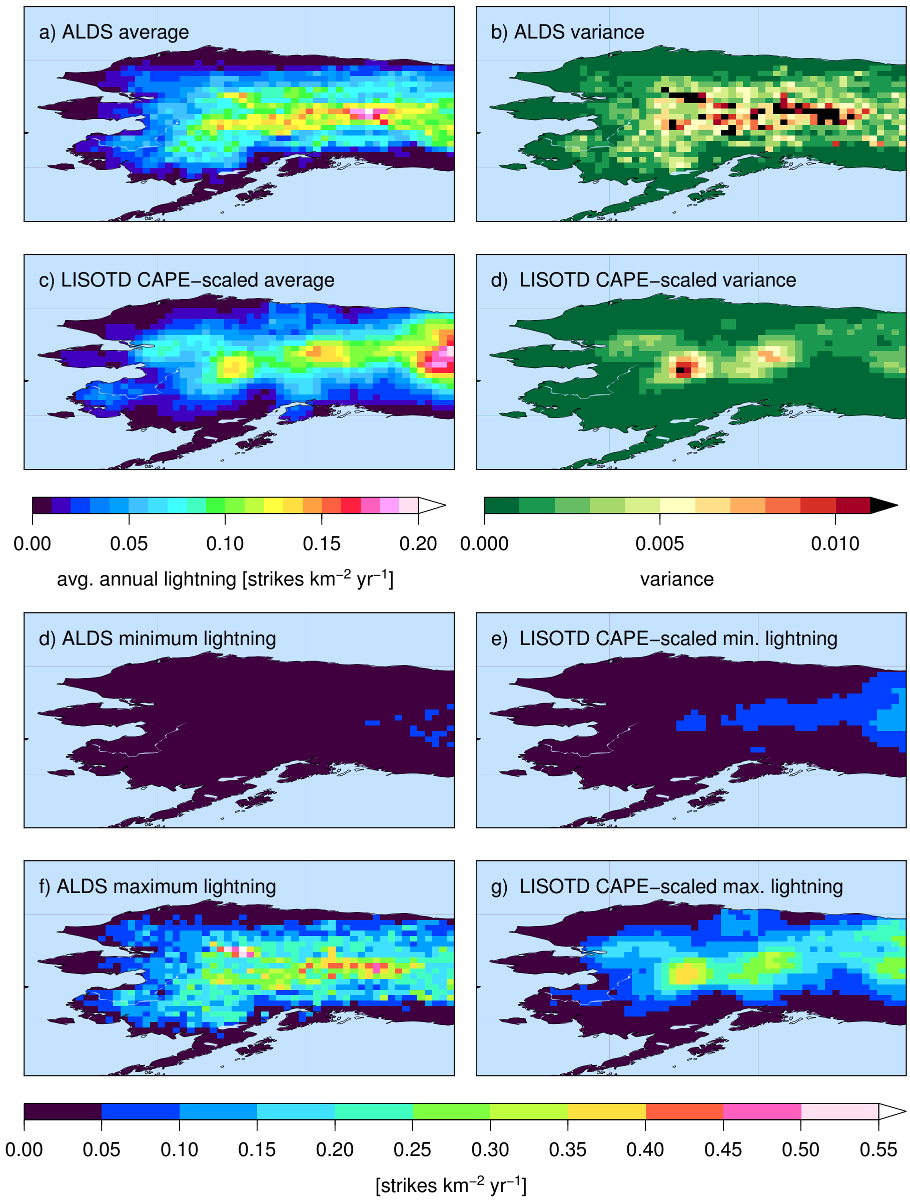

Fig. S7: Statistical comparison between ALDS lightning observations and LIS/OTD-derived, CAPE-scaled lightning for the time period 2001-2010. While average annual lighting strikes between ALDS (panel a)) and LIS/OTD-derived data (panel s)) are comparable, the variance between years is higher for the ALDS data (Panel b)) than for the LIS/OTD CAPE-scaled data, indicating that even with the scaling to CAPE anomalies the total range of interannual variability in lightning is still underestimated. Using LIS/OTD-data for Alaska is in general problematic as there are overall only four years of data available. Panels d) and e) compare the minimum lightning strike density for each grid cell between ALDS data and LIS/OTD-derived data, and panels f) and g) the maximum lightning strike density. The underestimate in interannual variability for the LIS/OTD-derived data is both due to an underestimate of maximum lightning strike density as well as a tendency to overestimate minimum lightning strike density.

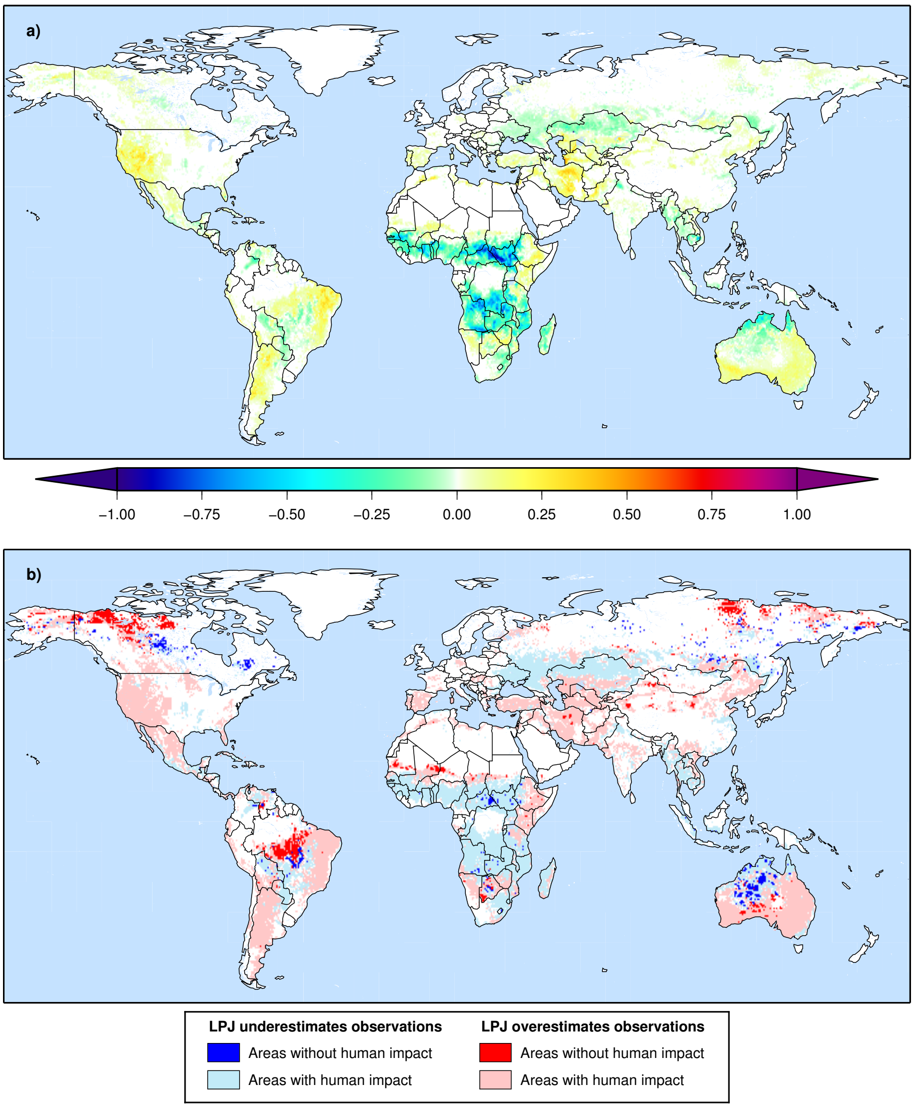

Fig. S8: Panel a) Residuals between average annual area burned in Randerson et al. (2012) and LPJ-LMfire simulation results; b) Residuals between observed and simulated annual area burned in context of anthropogenic imprint on the global land surface

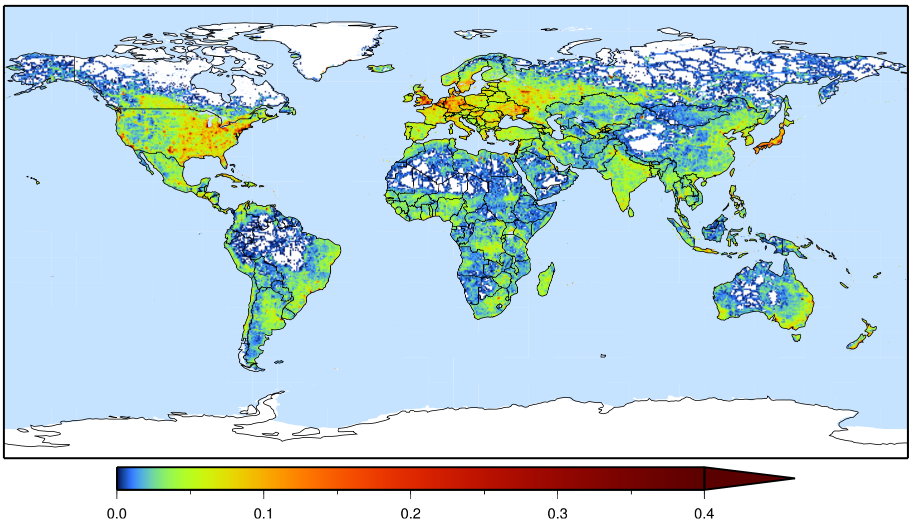

Fig. S9: Human impact based on settlements and infrastructure (roads, powerlines, pipelines, etc.) (Ahlenius 2005)