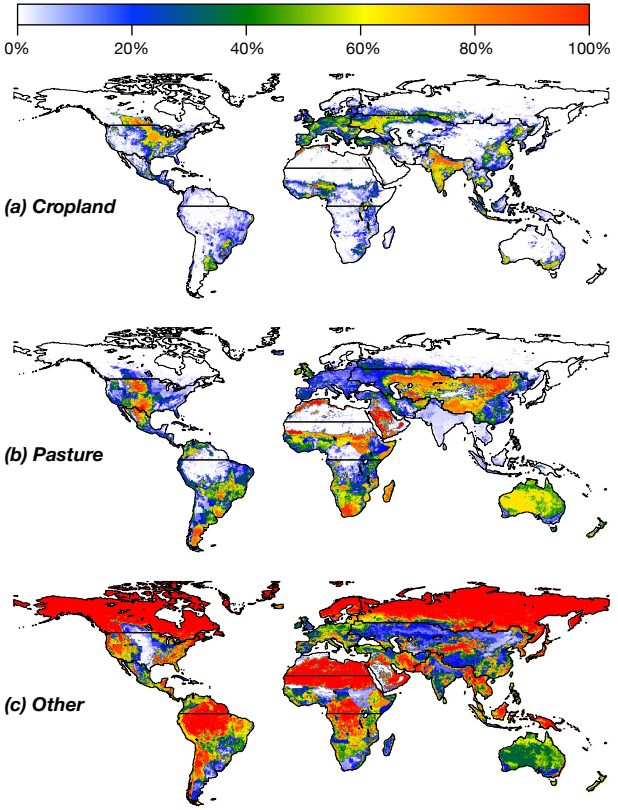


**Figure S1.** Maps of mean land cover distributions from the HYDE dataset for the years 2001–2009: **(a)** cropland, **(b)** pasture, and **(c)** other land.

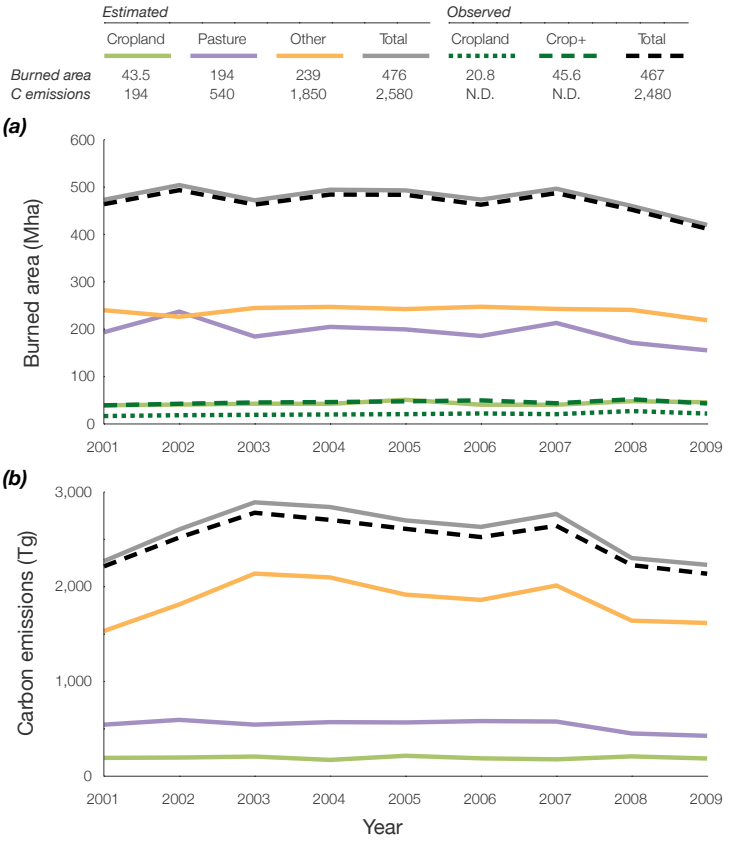


**Figure S2.** Observed and estimated annual timeseries of net observed and estimated global burned area (**a**; Mha) and C emissions (**b**; Tg = Mt) from the constrained-$\widehat{F_k}$ analysis. Numbers in table represent annual means. "N.D." = no data; "Crop+" = cropland + cropland-natural mosaic. Corresponds to Fig. 2 in main text.

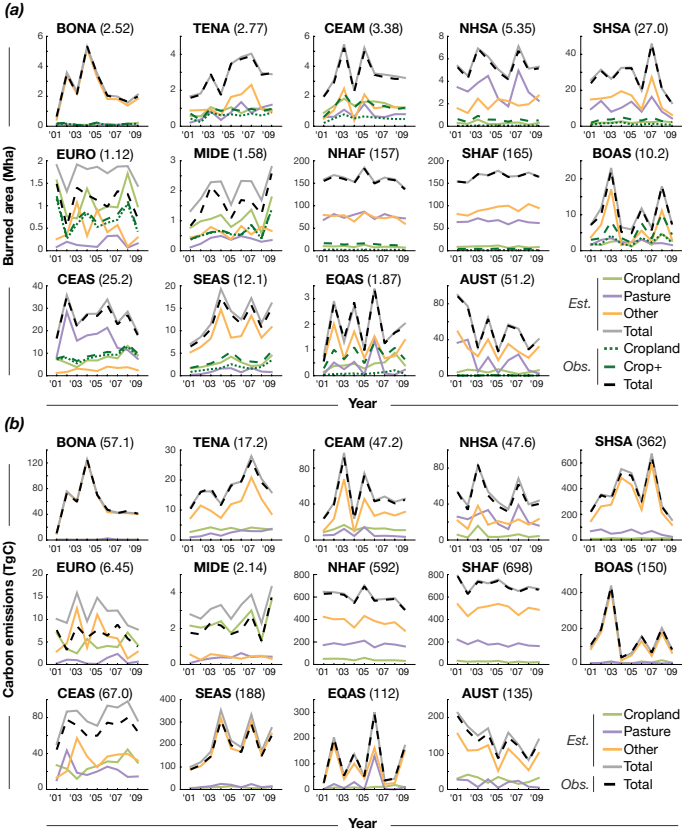


**Figure S3.** Annual timeseries of different fire types in each GFED region based on constrained-$\widehat{F_k}$ analysis of burned area (**a**; Mha) and C emissions (**b**; TgC). Numbers in parentheses next to region names represent mean annual observed fire there (either burned area or C emissions). "Crop+" = cropland + cropland-natural mosaic. Corresponds to Fig. 3 in main text. Data available in Supplement.

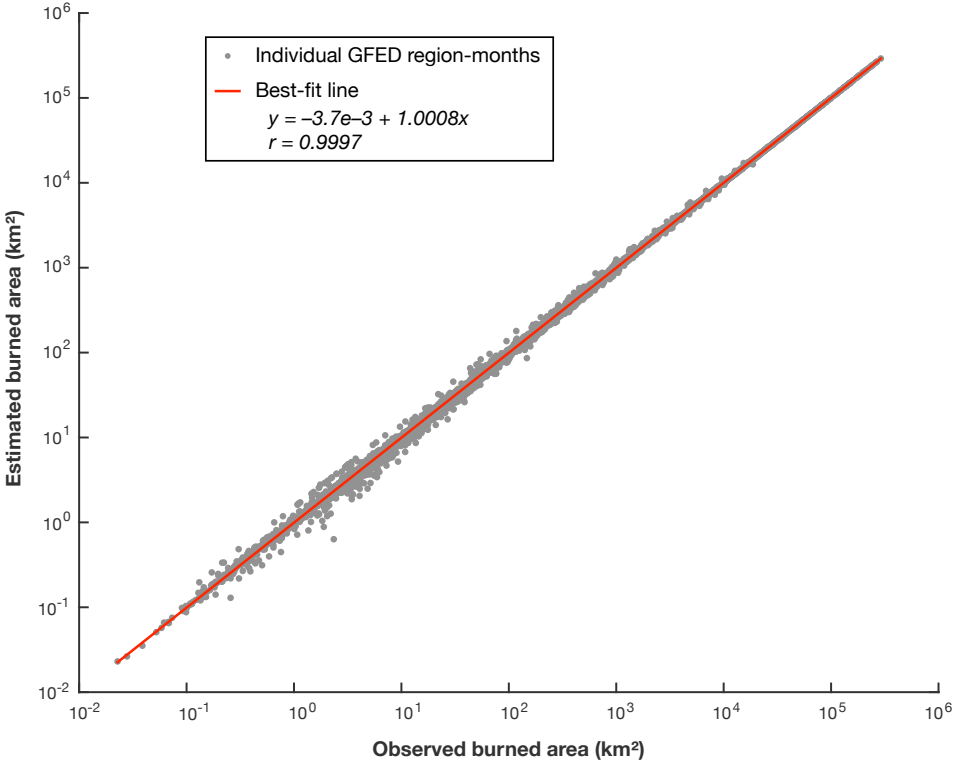


**Figure S4.** Scatter plot comparing observed and estimated total burned area for each GFED region and month (gray points), with results of linear regression (red line).

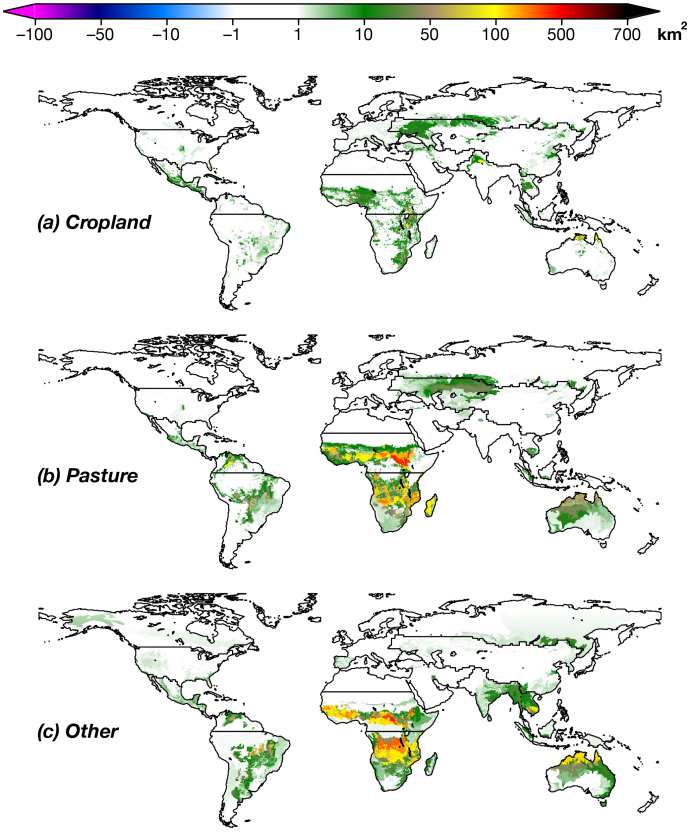


**Figure S5.** Maps, from constrained-$\widehat{F_k}$ analysis, of mean annual burned area ($km^2$) associated with **(a)** cropland, **(b)** pasture, and **(c)** other land. These are calculated from monthly maps generated by the equation $B_i = \widehat{F_k} A_{k,i}$ for each month and region. The results can be interpreted as how much more (or less) fire would be expected if the area of the given land cover were to double (and the others remain the same). Corresponds to Fig. 4 in main text.

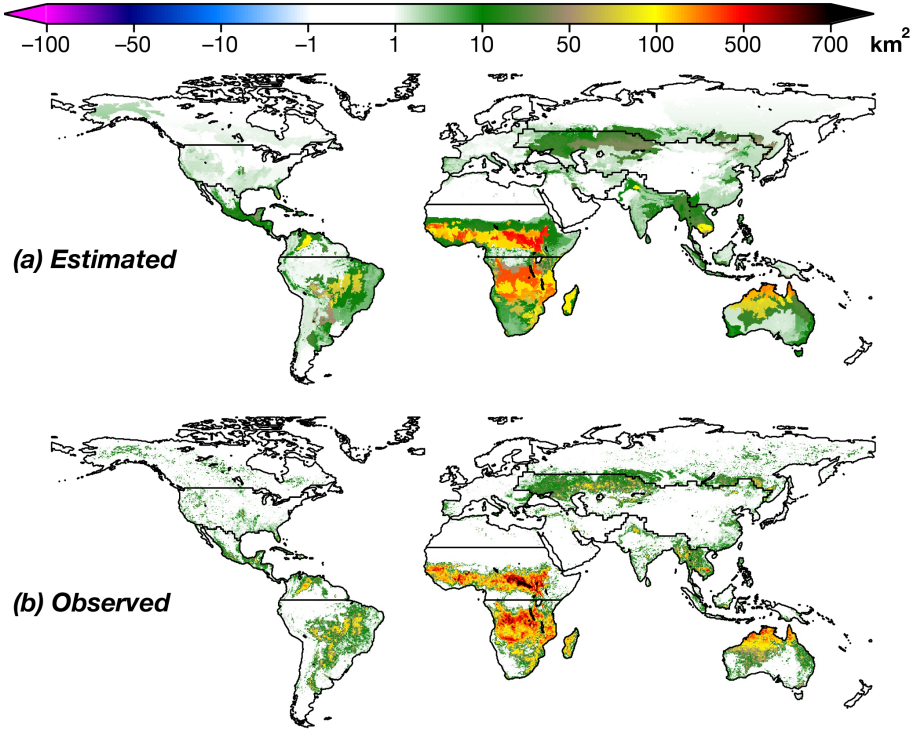


**Figure S6.** Maps of mean annual total burned area ($km^2$): **(a)** Estimated by constrained-$\widehat{F_k}$ analysis. **(b)** Observed. Corresponds to Fig. 5 in main text.

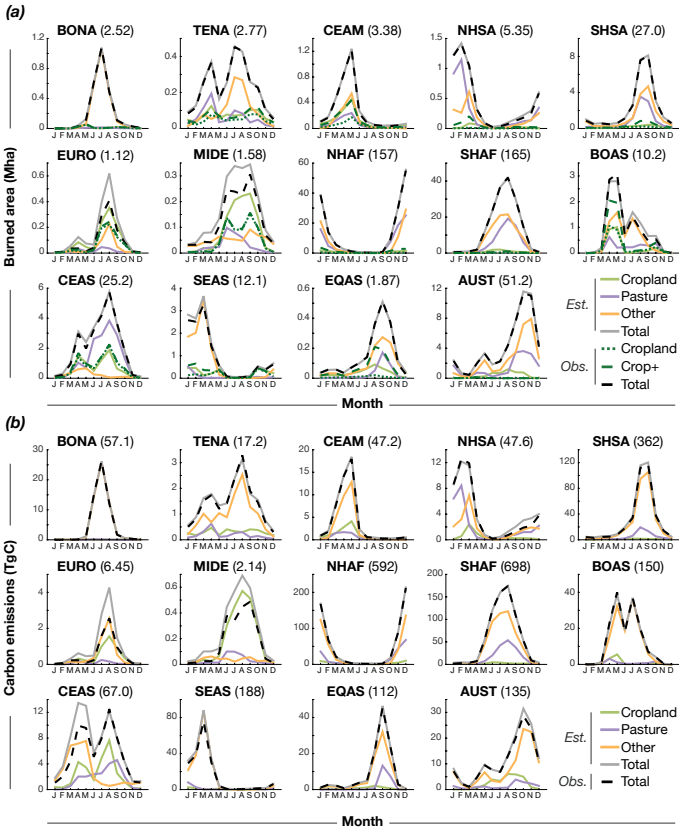


**Figure S7.** Seasonality of different fire types in each GFED region based on constrained-$\widehat{F_k}$ analysis of burned area (**a**; Mha) and C emissions (**b**; TgC). Numbers in parentheses next to region names represent mean annual observed fire there (either burned area or C emissions). Corresponds to Fig. 6 in main text. Data available in Supplement.

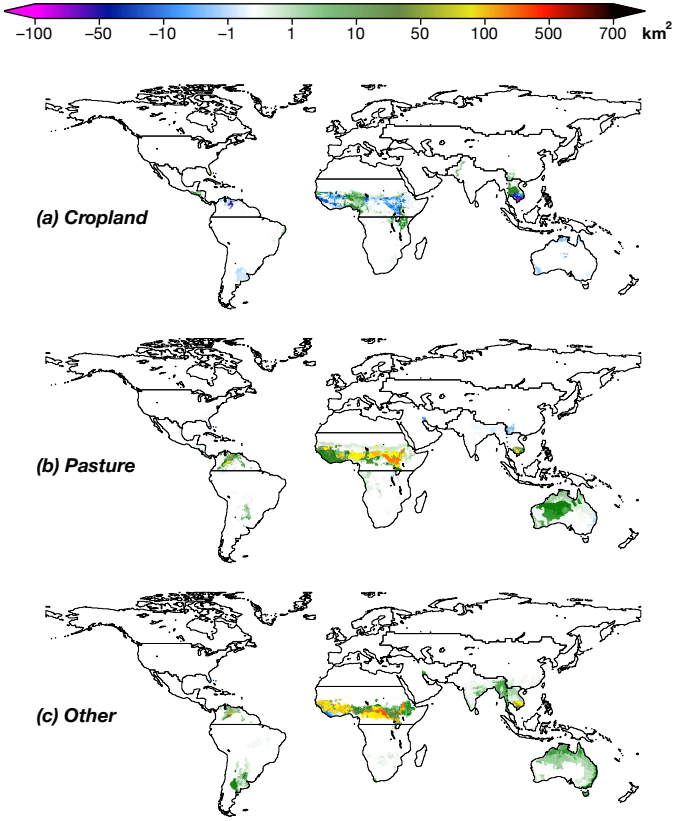


**Figure S8.** Maps of mean burned area ($km^2$) during December, January, and February (DJF) associated with **(a)** cropland, **(b)** pasture, and **(c)** other land. Compare with annual means in Fig. 4.

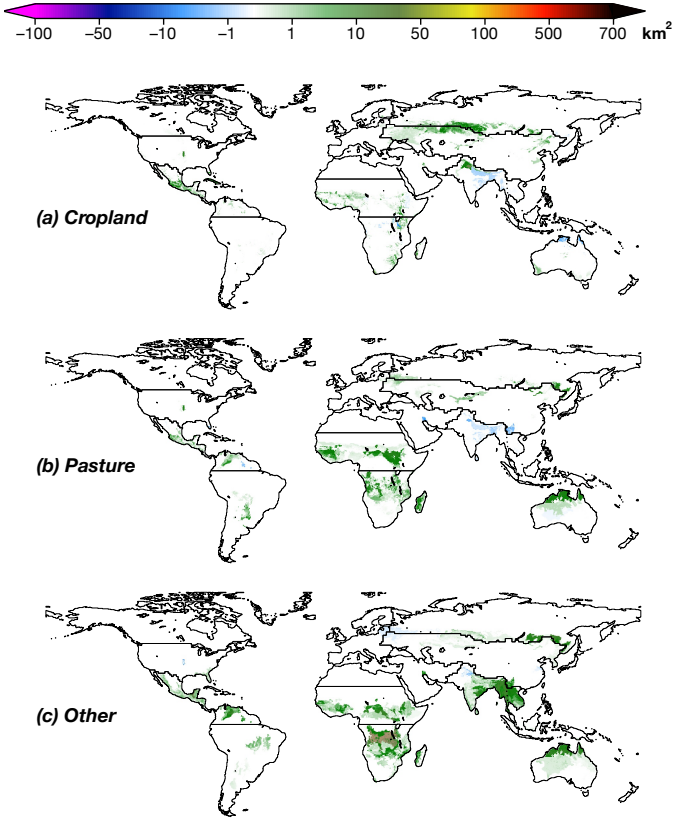


**Figure S9.** Maps of mean burned area ($km^2$) during March, April, and May (MAM) associated with **(a)** cropland, **(b)** pasture, and **(c)** other land. Compare with annual means in Fig. 4.

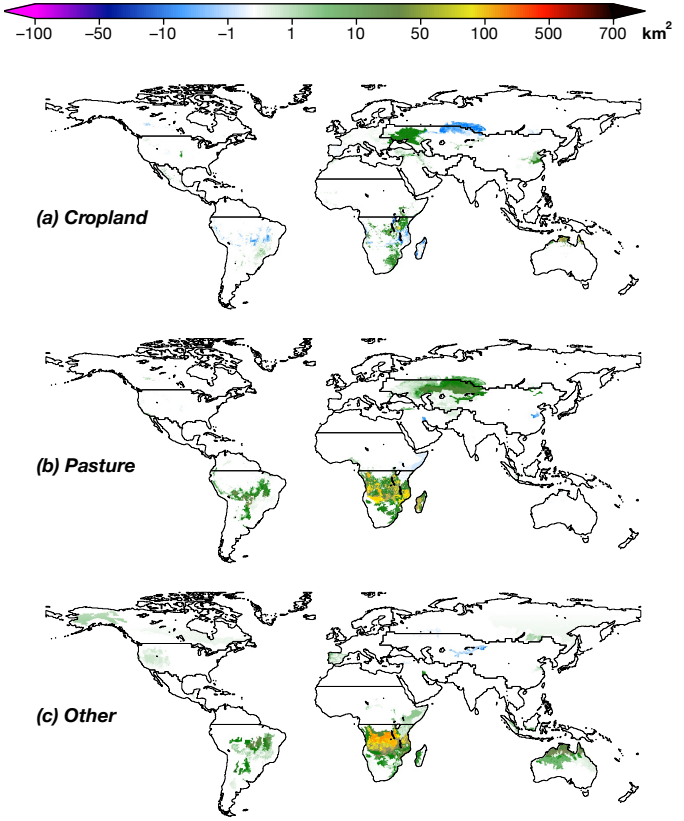


**Figure S10.** Maps of mean burned area ($km^2$) during June, July, and August (JJA) associated with **(a)** cropland, **(b)** pasture, and **(c)** other land. Compare with annual means in Fig. 4.

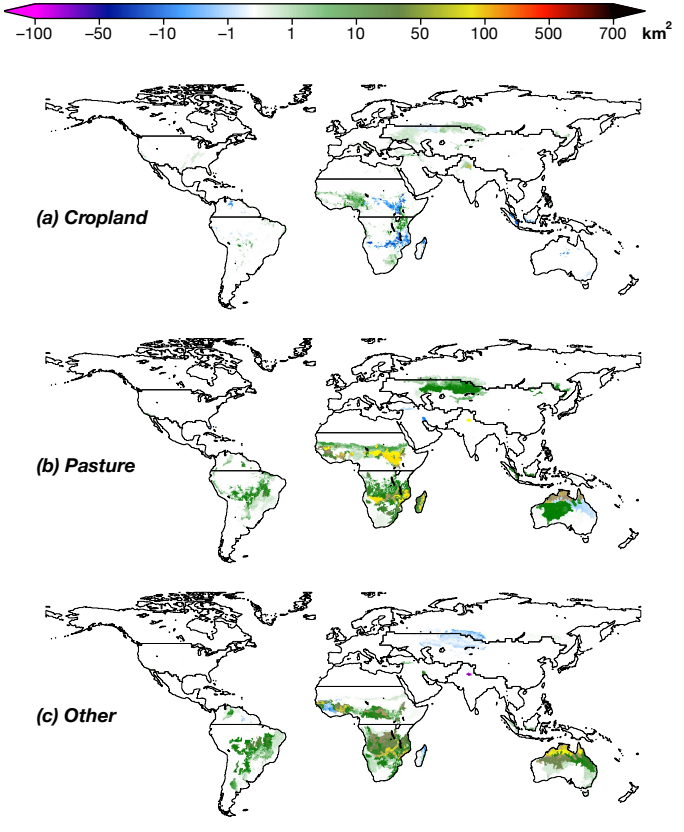


**Figure S11.** Maps of mean burned area ($km^2$) during September, October, and November (SON) associated with **(a)** cropland, **(b)** pasture, and **(c)** other land. Compare with annual means in Fig. 4.

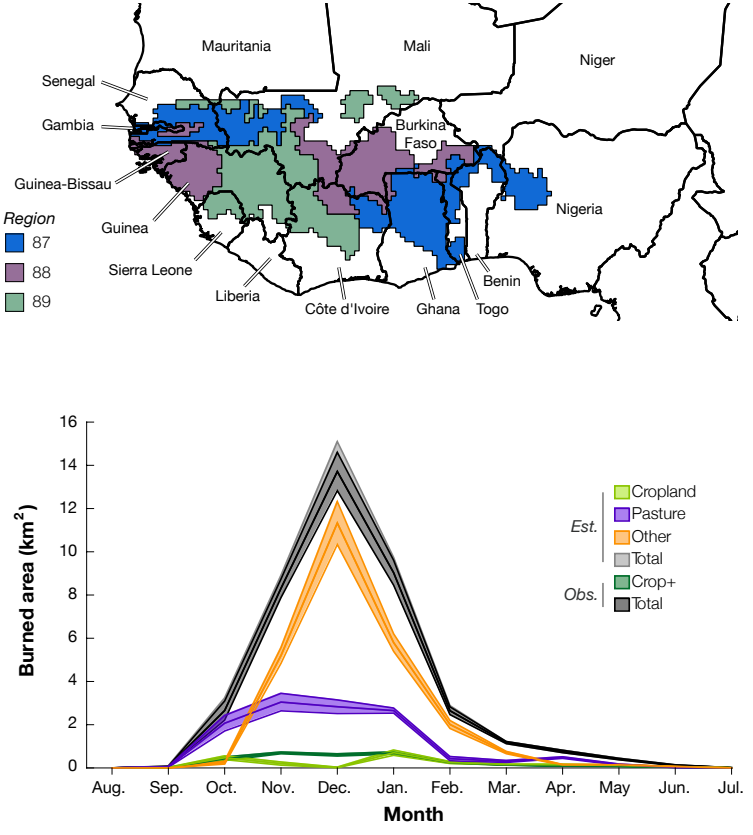


**Figure S12. (a)** Area included in West African case study, color-coded by analysis region. **(b)** Mean seasonality of burned area in case study regions based on constrained-$\widehat{F_k}$ analysis. Shading represents interannual variability ($\pm 1$ SEM). Note that the $X$ axis begins in August. Corresponds to Fig. 7 in main text.

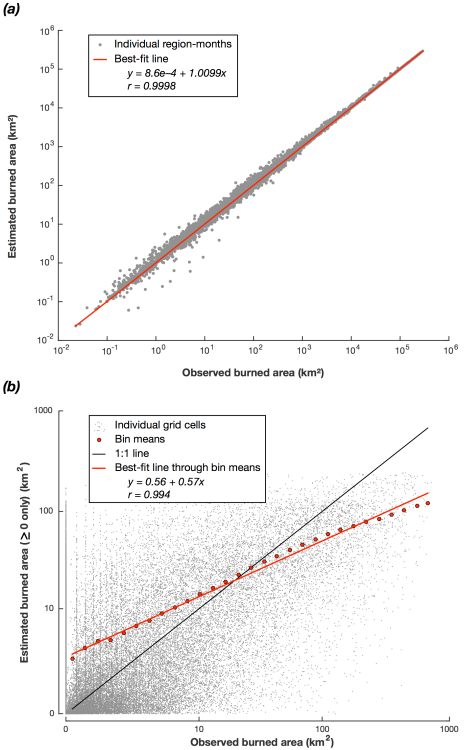


**Figure S13.** Scatter plots comparing estimated burned area from constrained-$\widehat{F_k}$ analysis with observations. Gray points represent **(a)** each analysis region and month (region-month), or **(b)** individual grid cells ($\frac{1}{75}$ of cells chosen at random for plotting). Red lines represent the best-fit line from linear regression, with the regression in **(b)** fit to the red points, which represent mean observed and estimated values of grid cells in bins of observed burned area equally spaced along the X axis (with at least 100 grid cells required for a bin to be included). Values $\leq 0$ not shown due to log-scale axes. Grid cells in region-months with no observed fire, where the analysis was not performed, were excluded from both plots and regressions. Corresponds to Fig. 8 in main text.