

Supplementary Figures

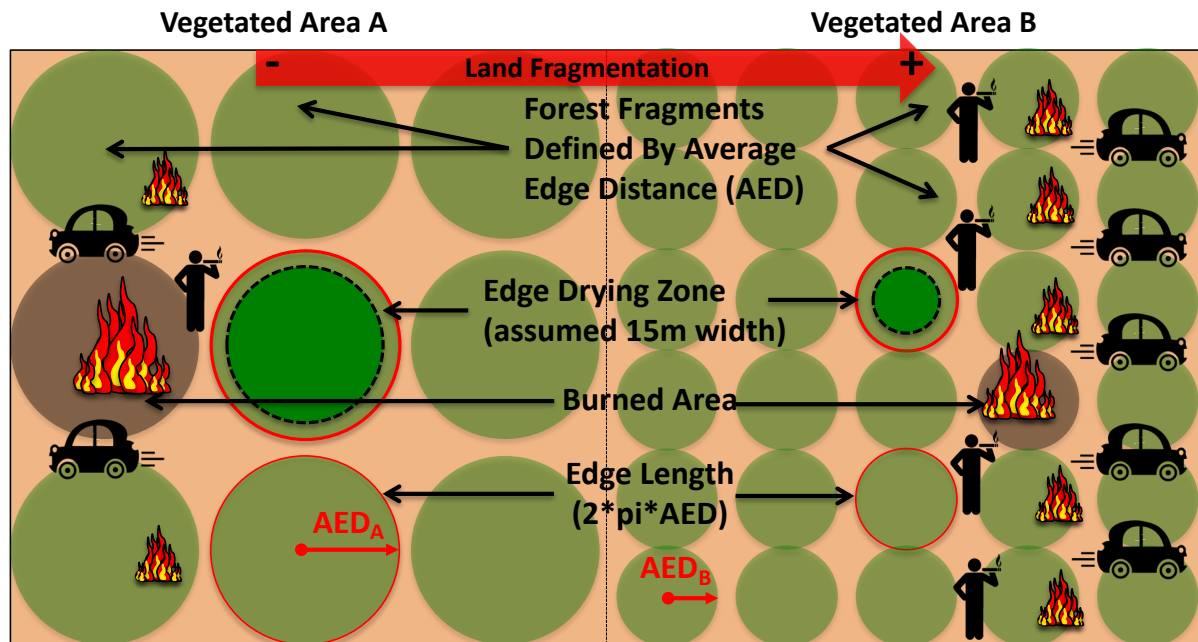


Figure S1: Schematic of the fragmentation concept in this study. Road Length (RL) is calculated to circles of equal area satisfying both RL (sum of grid cell circle perimeters) and grid cell area; their radius gives the per-grid average edge distance (AED, Eq.1). Comparison of two 'grid cells' (Vegetated Area 'A', 'B') of differing road densities and fragmentation, whereby more RL means more fragmentation and a smaller AED. Smaller AED $\rightarrow$ increased %(landscape) exposed to potential human ignitions (proportional to edge length), a larger area exposed to edge drying effects, higher wind speeds and smaller individual fire sizes. AED in each grid cell modulates SPITFIRE's pre-existing human ignition function, itself a $f(\text{population density})$.

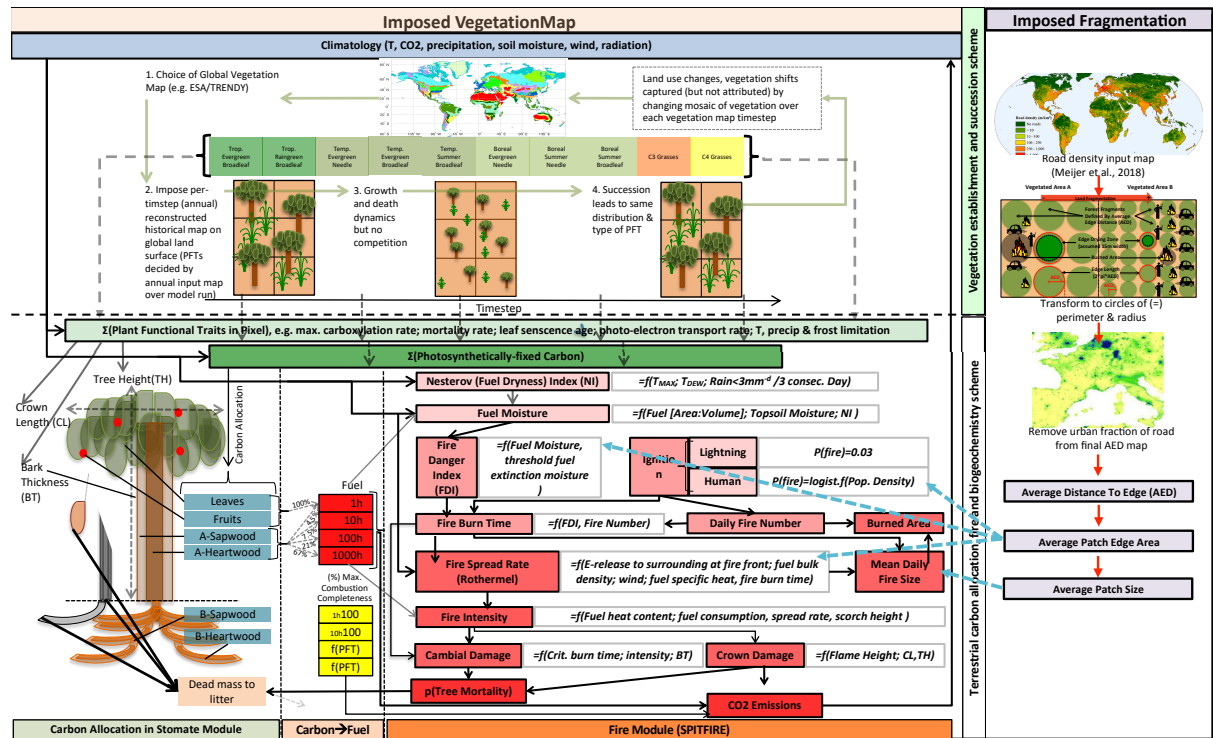


Figure S2: Simplified schematic diagram describing the combined vegetation and fire modules of ORCHIDEE-SPITFIRE, and the relation of the AED-defined fragmentation scheme devised here, to fire-relevant variables in the model. Companion figure to Figure 1b in the Main Text. Adapted from Bowring et al. (2022), *SI*.

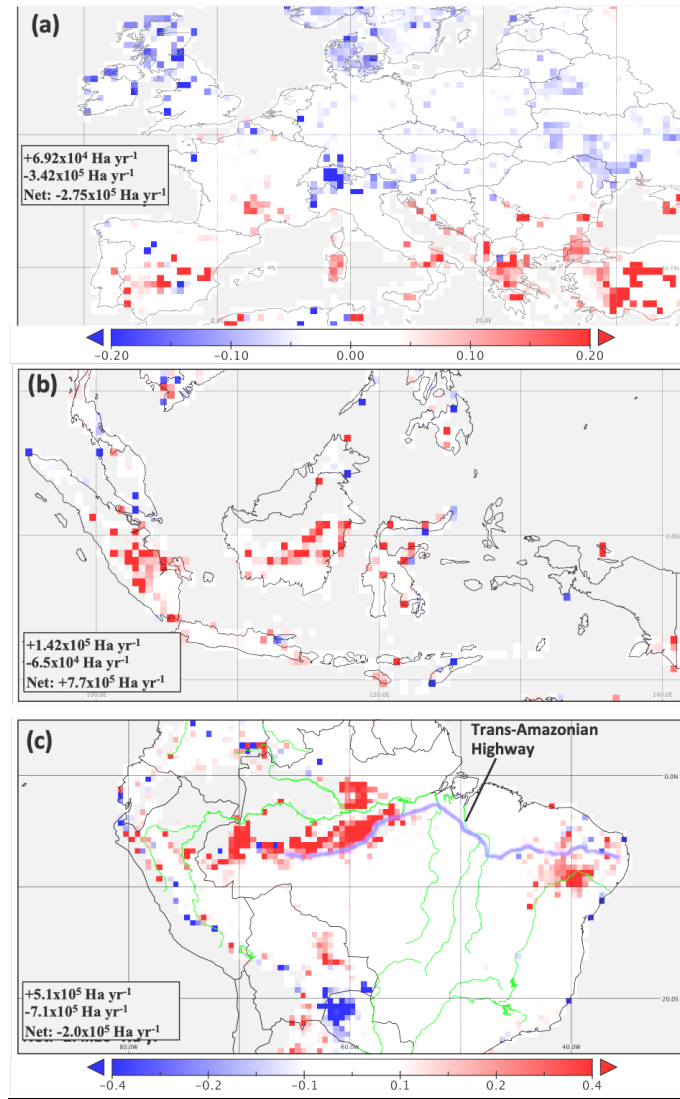


Figure S3: (a-c) Mean annual fractional changes in simulated grid cell burned area due to fragmentation representation in (a) western Eurasia, (b) southern SE Asia, (c) northern South America. Gross increases, decreases and net burned area values (Ha yr⁻¹) over the displayed area are shown inset in each panel.

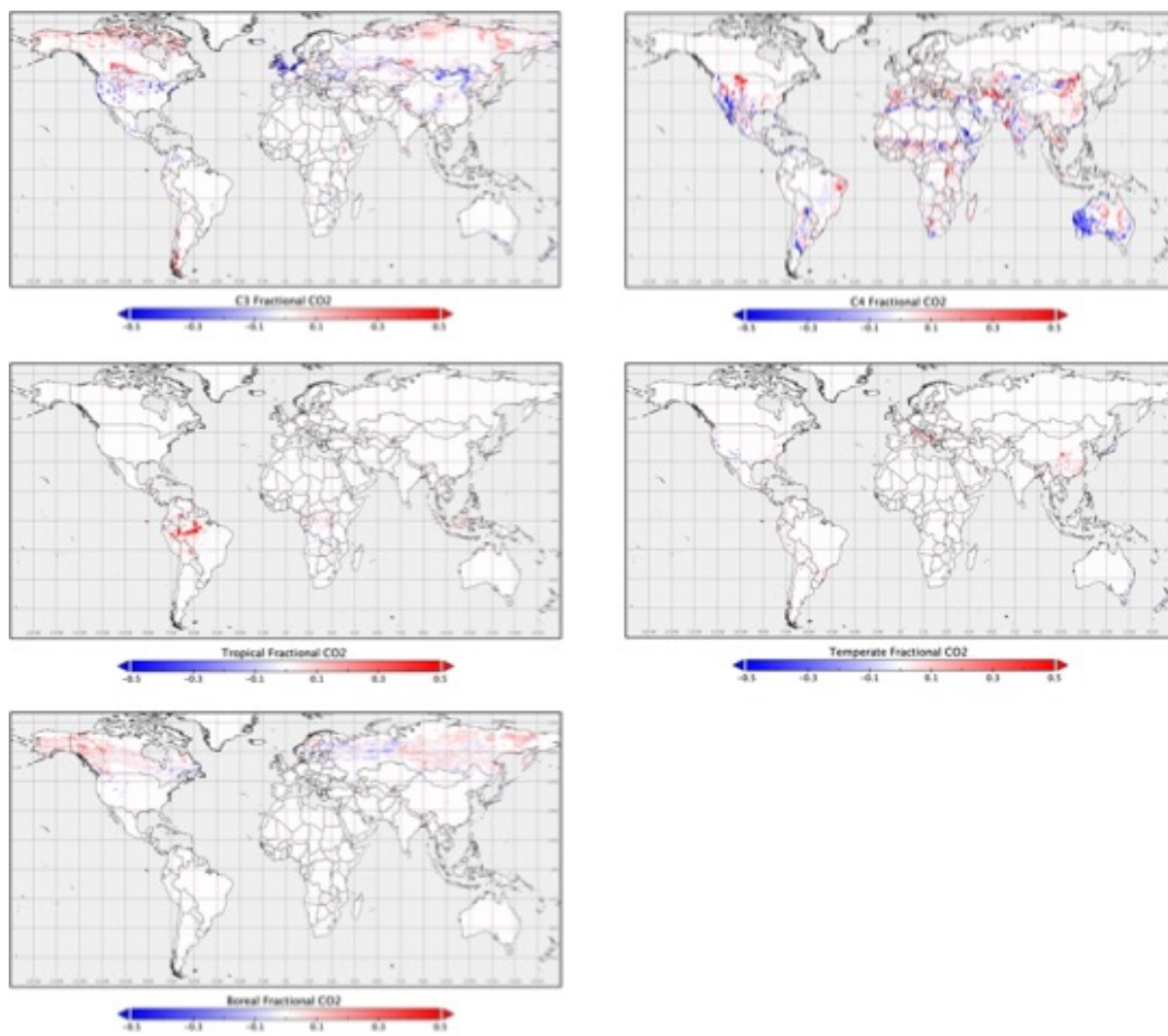


Figure S4: Annual mean fractional fire CO₂ emission differential relative to the control simulation for each biome type.

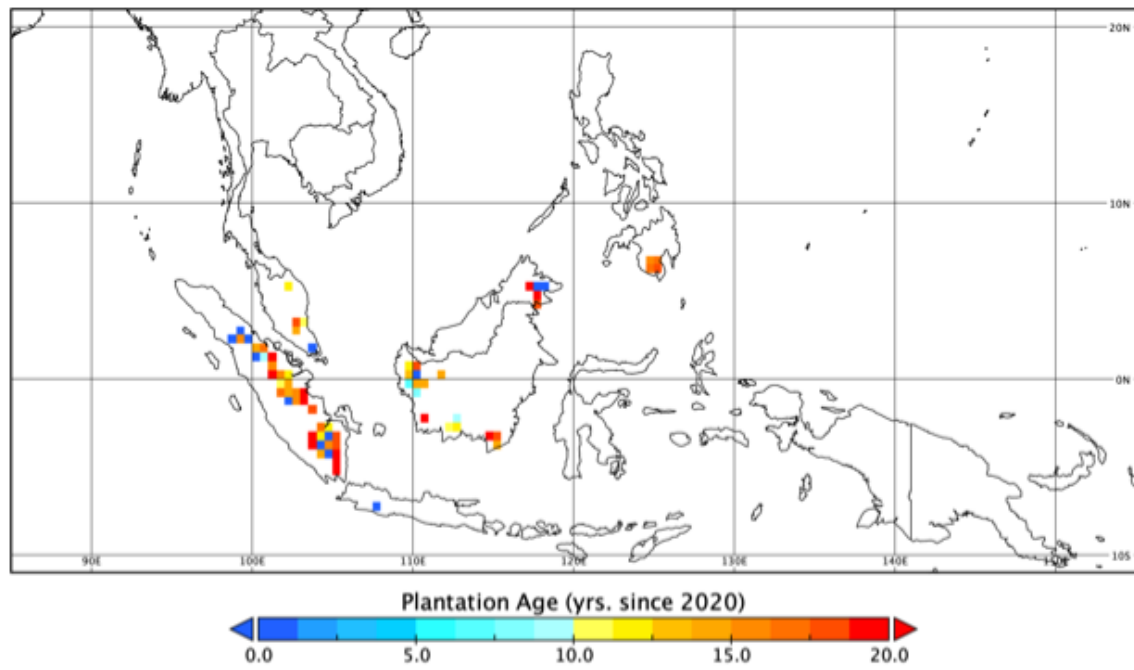


Figure S5: Post-2000 mean tree plantation age derived from Du et al. (2022) and upscaled to 0.5 degree resolution, used in Fig. 3.

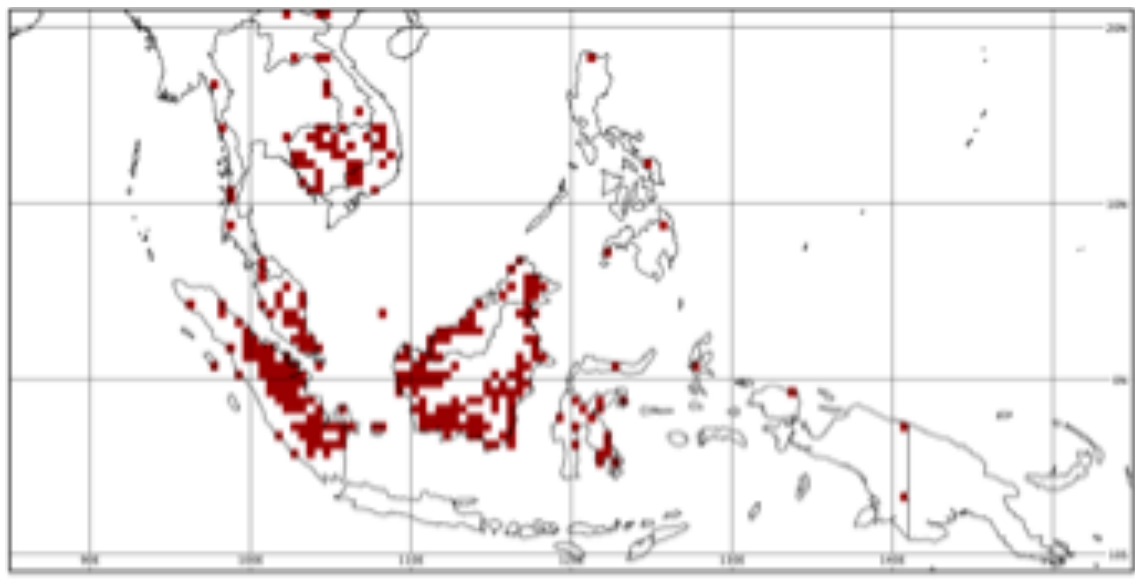


Figure S6: Post-2000 deforestation mask derived from Curtis et al. (2018) and upscaled to 0.5 degree resolution, used in Fig. 3.

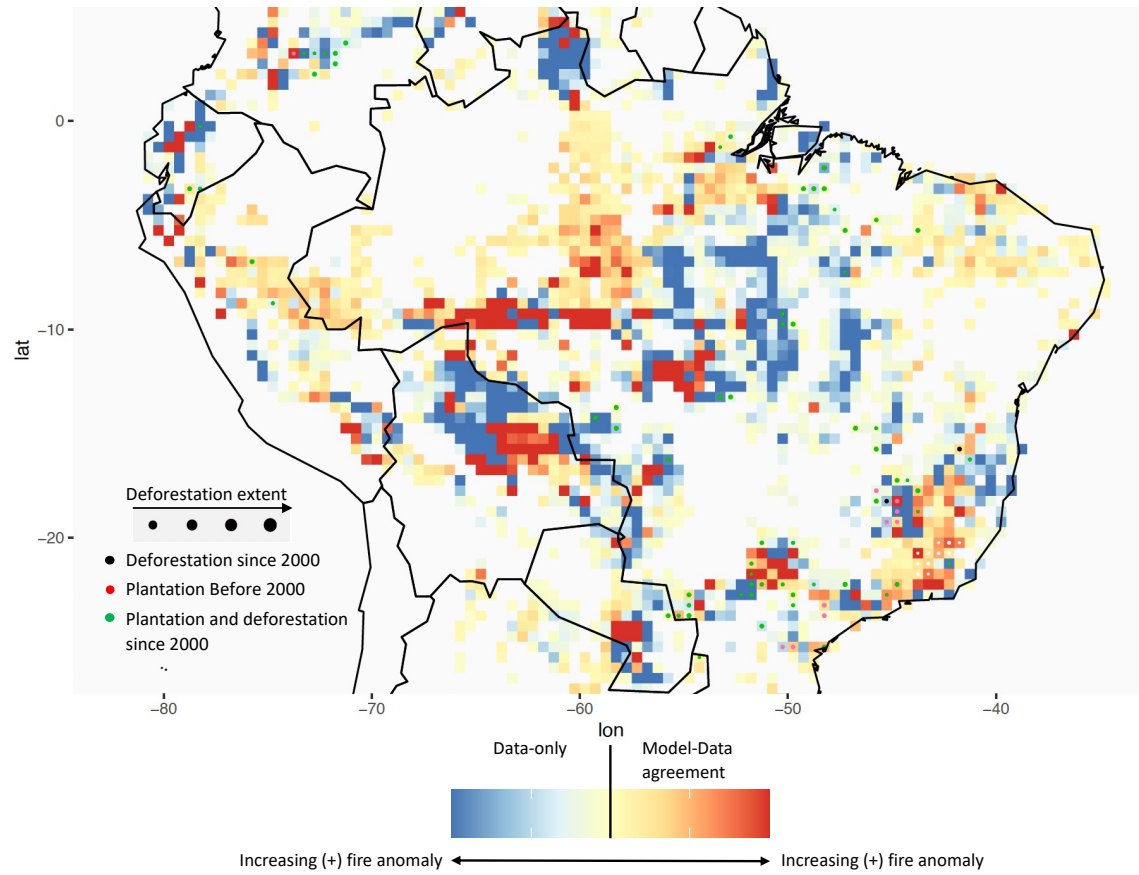


Figure S7: Comparing fragmentation-associated simulated increases in fire activity $f(\Delta BA_{Frag.})$ with observed (FireCCI) BA anomalies from a 1982-1999 baseline, over northern South America during the period for which satellite-based fire data are available (post-2000). Simulation-observation agreement (yellow-red) and observation-only fire anomaly grid cells (green-blue) are shaded darker along a gradient of increasing observed fire anomaly (Methods). Dots correspond to areas of significant deforestation activity(ref) and/or plantation establishment (ref) since the year 2000 (black, green), or preceding it (pink). Dot size is proportional to deforestation severity where applicable.

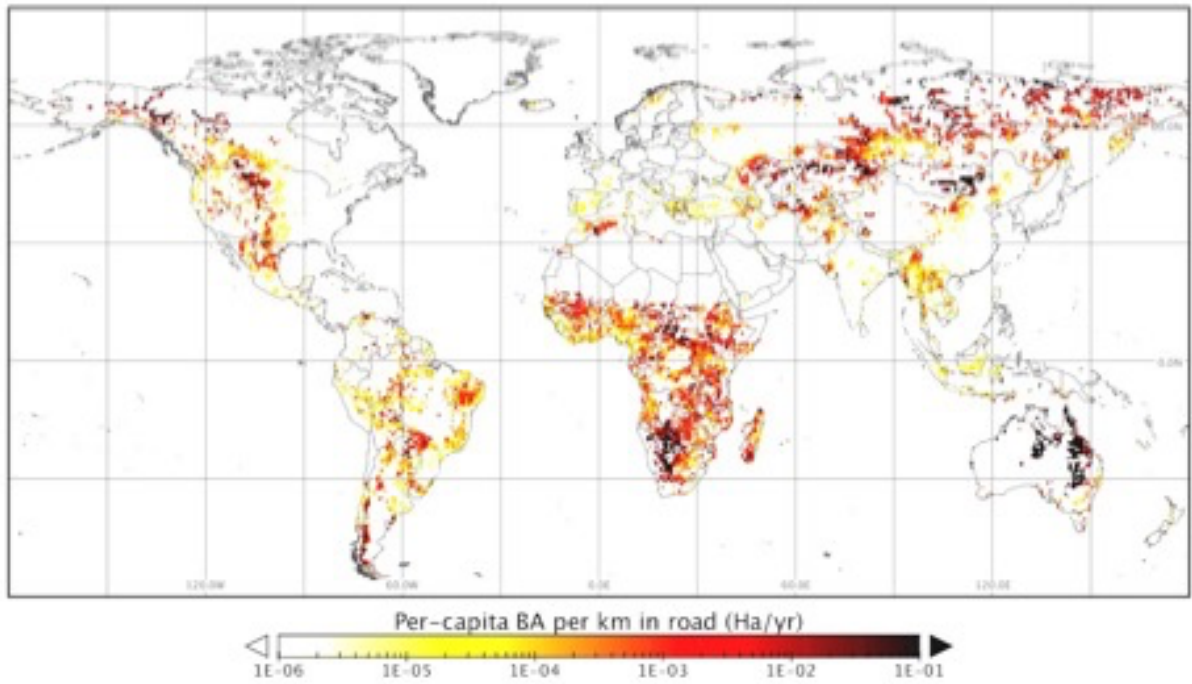


Figure S8: The additional burned area per per-capita road length ($\text{Ha yr}^{-1} \text{ km}^{-2} \text{ person}^{-1}$), which shows the amount of additional burned area per additional person or km of road laid, in each grid cell, per year.

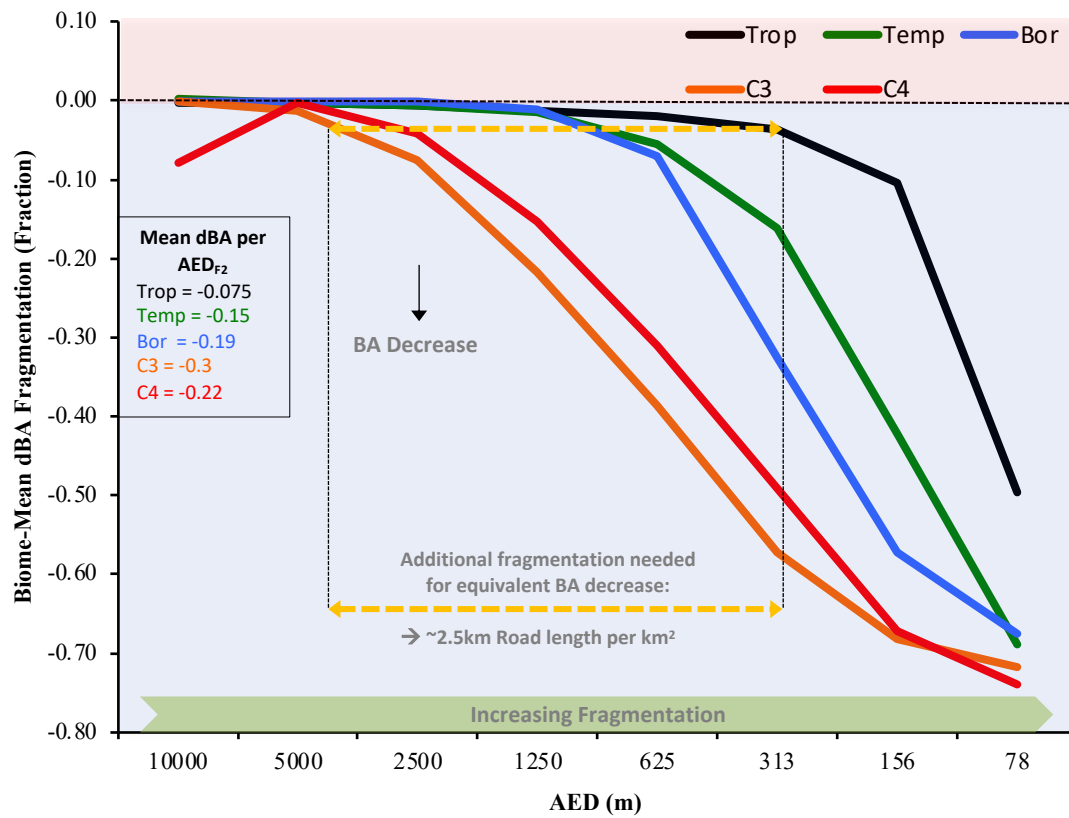


Figure S9: The average change in fractional BA of each biome for each AED_{F2} level, where change is calculated in the direction of increasing fragmentation. Averages across all AED levels are printed inset. Highlighted is the large difference in fragmentation extent required to produce the same BA decrease between tropical forest and C3 grassland biomes.

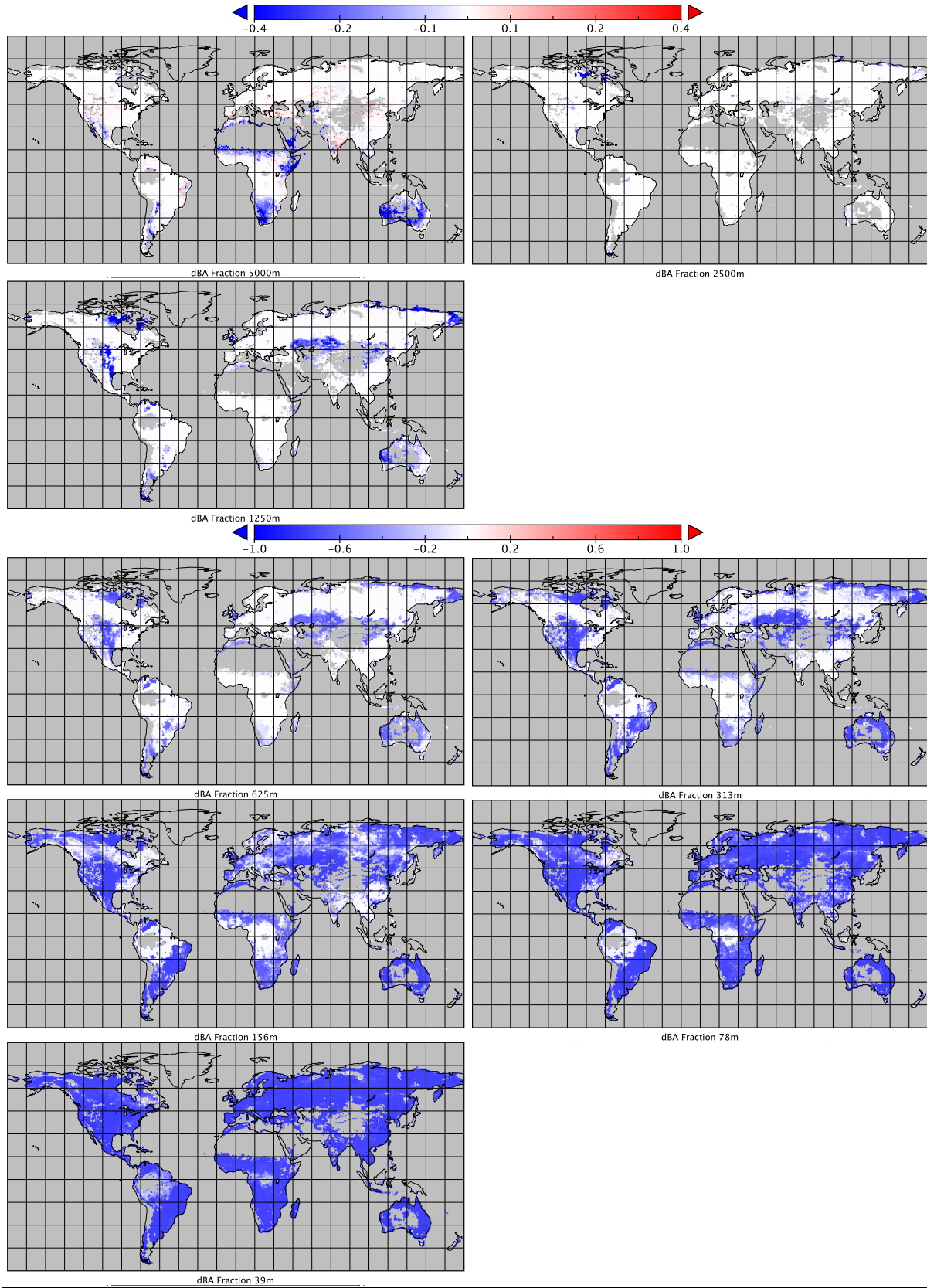


Figure S10: Per-grid cell fractional changes in BA due to globally equal doubling of fragmentation extent in the AED_{F2} simulation suite, whereby the BA change denotes that change in BA from the preceding AED_{F2} level (e.g. the change BA due to the change in global AED from 10000m to 5000m).