

Supplementary Material

1 Supplementary Figures

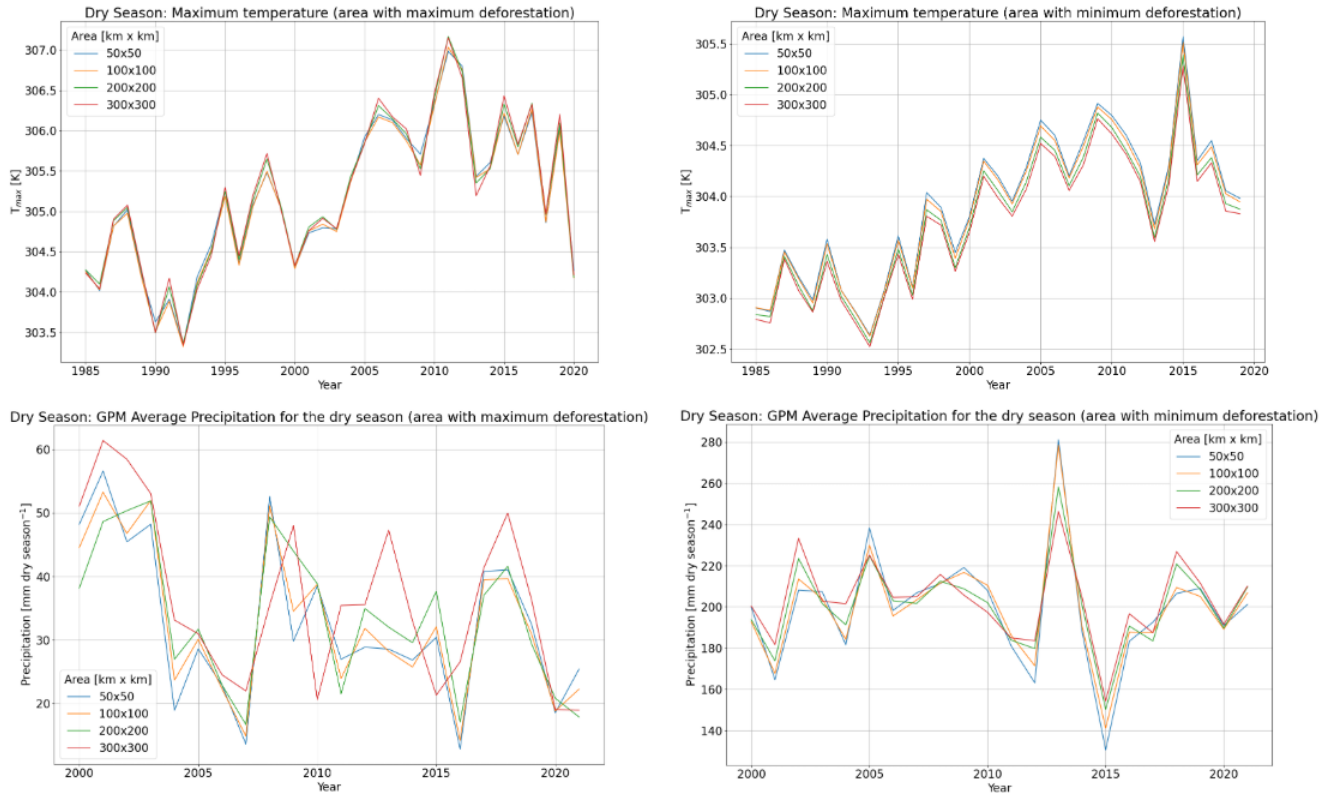


Figure S1. Sensitivity analysis of grid size on climate variable trends in areas with maximum (left panels) and minimum (right panels) forest loss over the analysed 35 years. Top panels: Time series of dry-season maximum surface temperature (T_{max}) for different grid sizes ($50 \times 50 \text{ km}^2$, $100 \times 100 \text{ km}^2$, $200 \times 200 \text{ km}^2$, and $300 \times 300 \text{ km}^2$). Bottom panels: Corresponding time series of dry-season GPM precipitation for the same grid sizes. Each curve represents the spatial average over a grid centered in the target area. Despite minor differences in absolute values, the overall trends are consistent across scales, supporting the robustness of the methodology regardless of grid size.

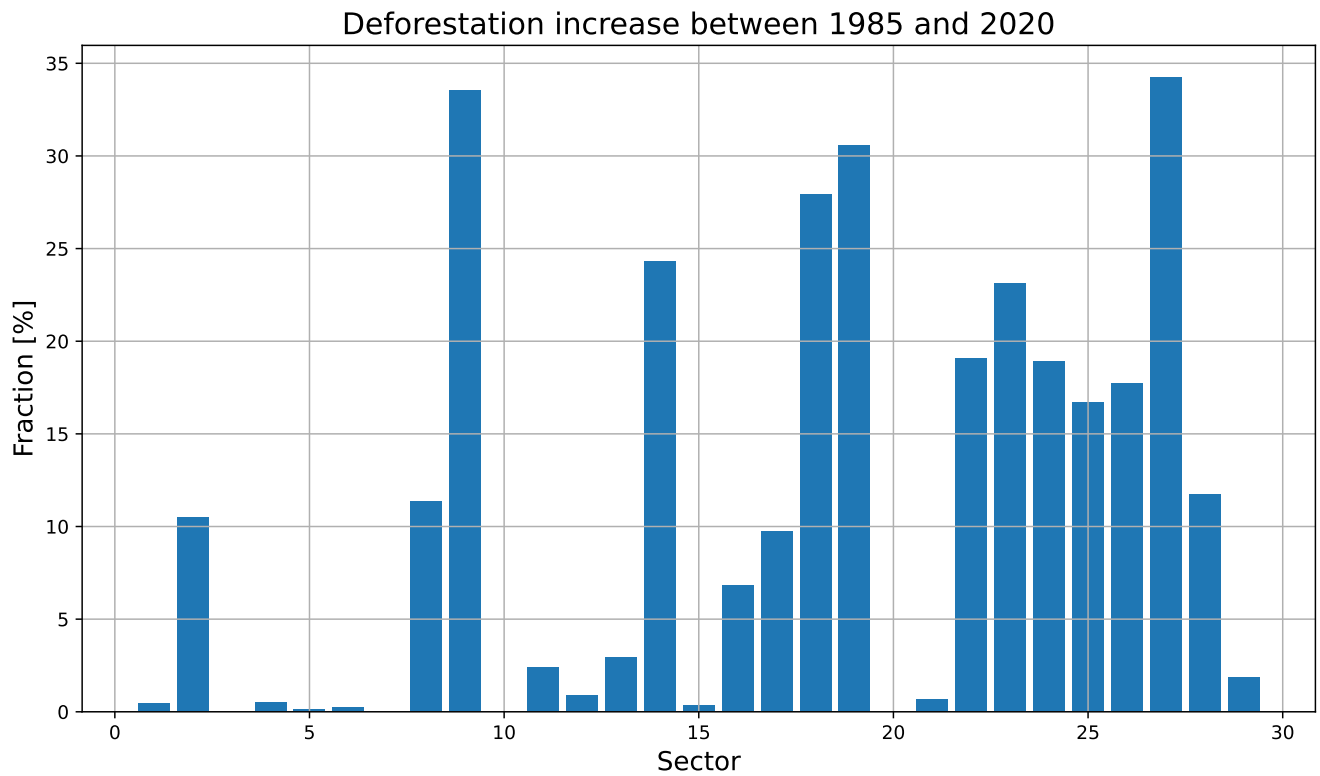


Figure S2. Temporal evolution of forest cover loss for each of the 29 study areas across the Brazilian Legal Amazon, calculated as the change in forest fraction between 1985 and 2020. This panel-based format allows a direct comparison of deforestation trends across all regions, supporting the identification of spatial heterogeneity in deforestation trajectories.

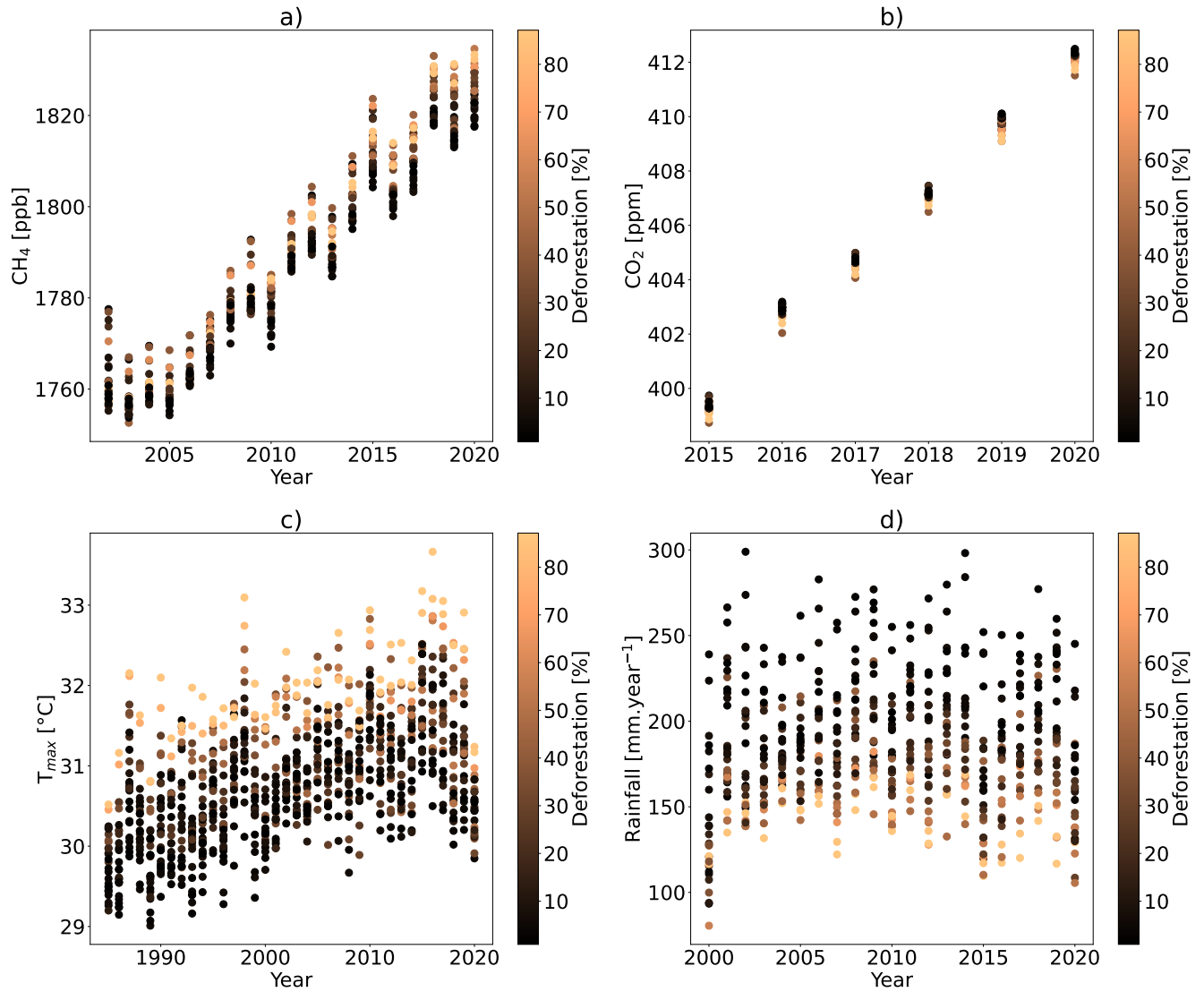


Figure S3. Temporal evolution of selected variables across the 29 Amazonian areas, based on the full dataset without seasonal separation. Different colors represent the percentage of deforestation in each area. CH₄ (a), CO₂ (b), maximum surface temperature (c), and rainfall trends(d) were obtained as a yearly average (e). CO₂ and rainfall data cover shorter periods, 2015-2020 and 2000-2020, respectively.

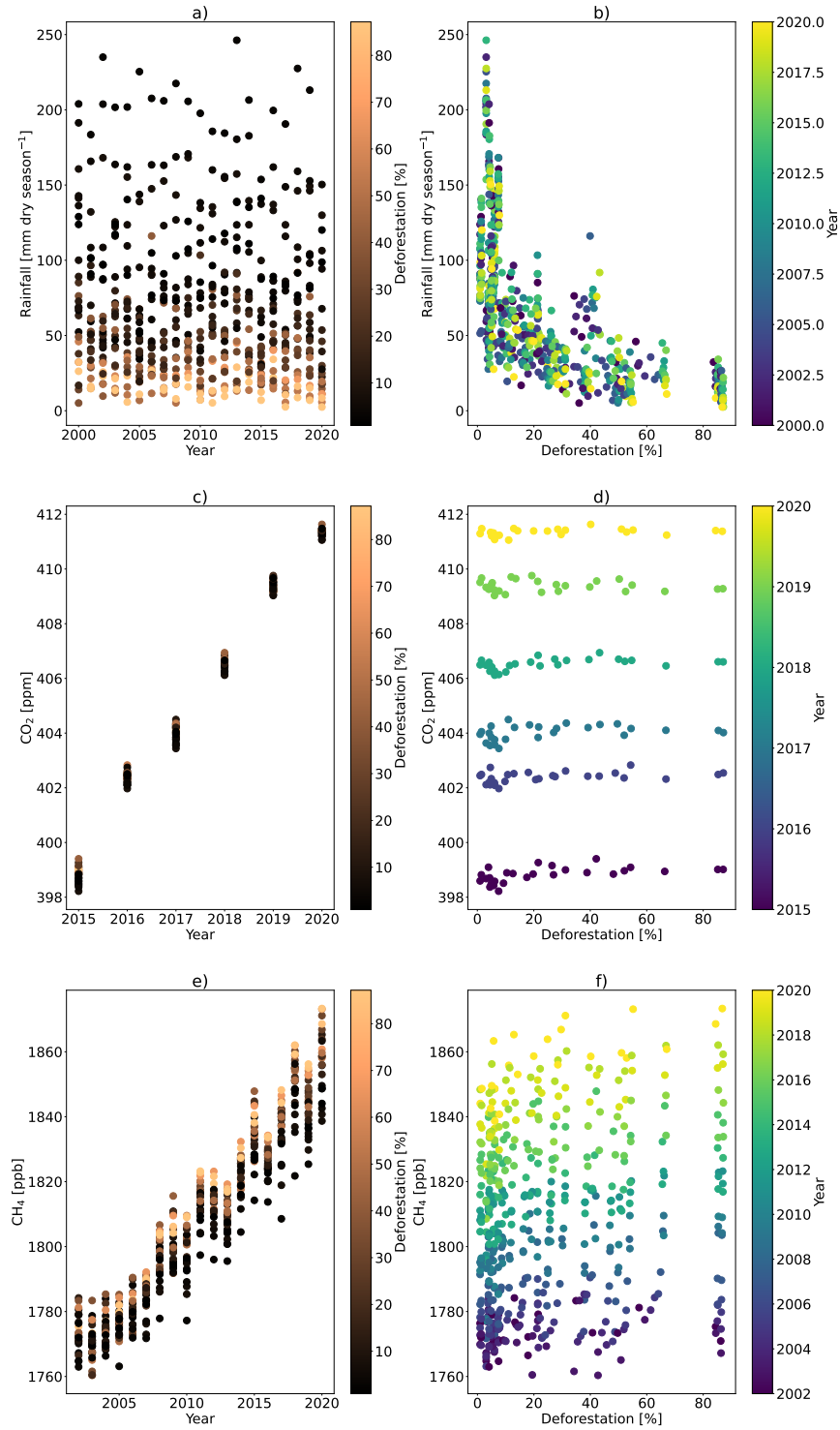


Figure S4. Relationship between dry season precipitation (a, b), CO₂ mixing ratios (c, d), and CH₄ mixing ratios (e, f) for each year (dots are colored by deforestation percentage), and deforestation percentage (dots are colored by year), respectively, for all 29 areas.

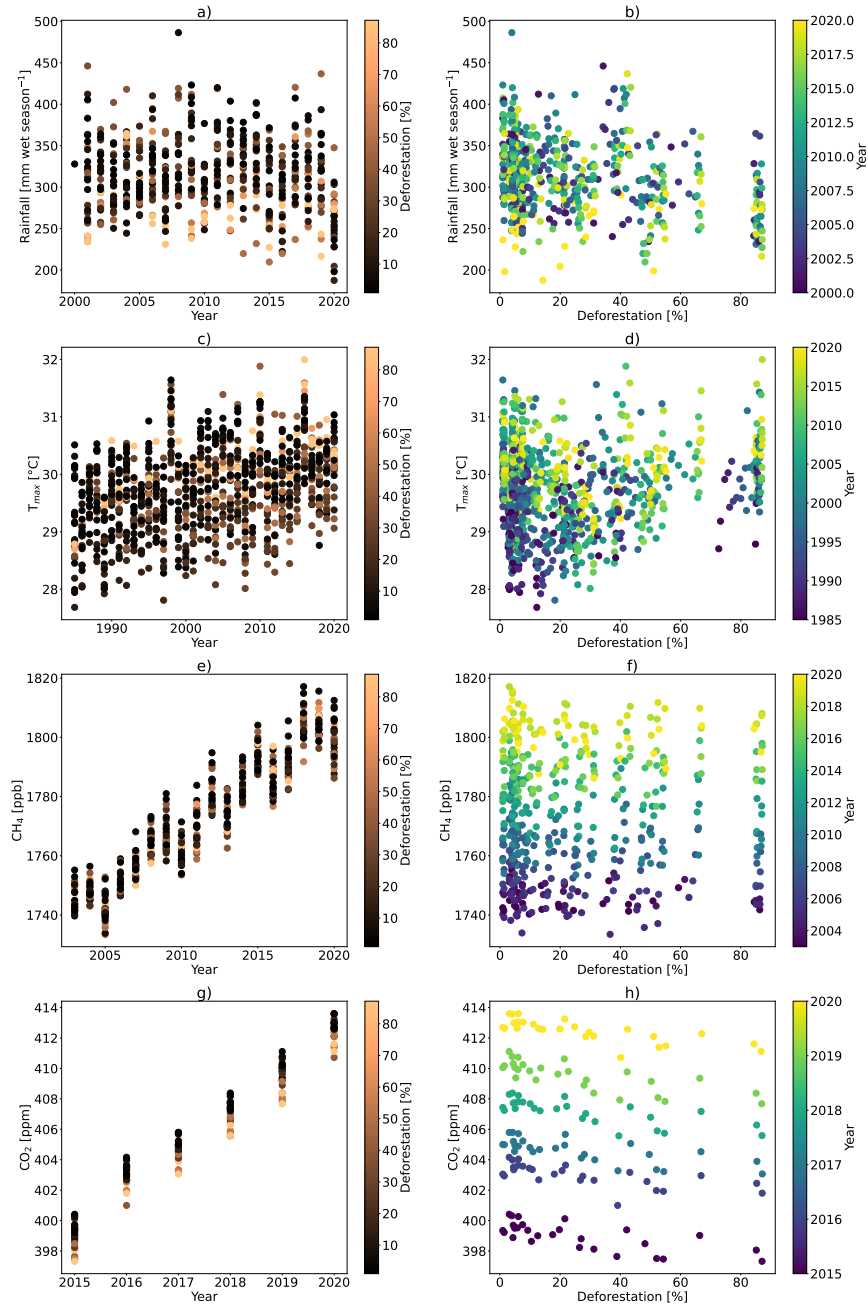


Figure S5. Relationship between wet season precipitation (a, b), maximum surface temperature (c,d), CO₂ mixing ratios (e, f), and CH₄ mixing ratios (g, h) for each year (dots are colored by deforestation percentage), and deforestation percentage (dots are colored by year), respectively, for all 29 areas.

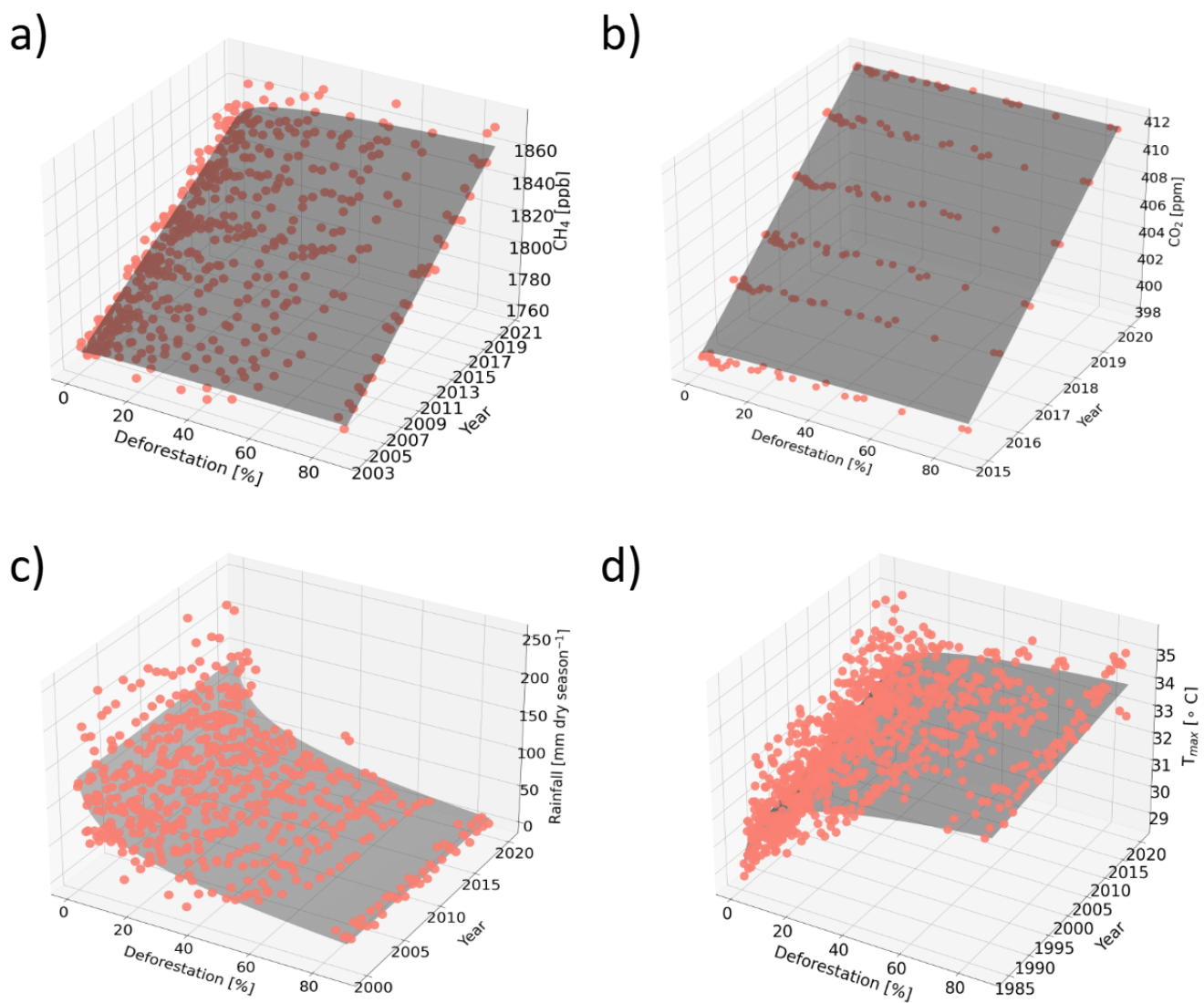


Figure S6. Three-dimensional representation of observation (orange) and parametric surface (gray) of (a) CH₄, (b) CO₂, (c) total precipitation during the dry season, and (d) maximum surface temperature as a function of deforested fraction and year during the dry season.

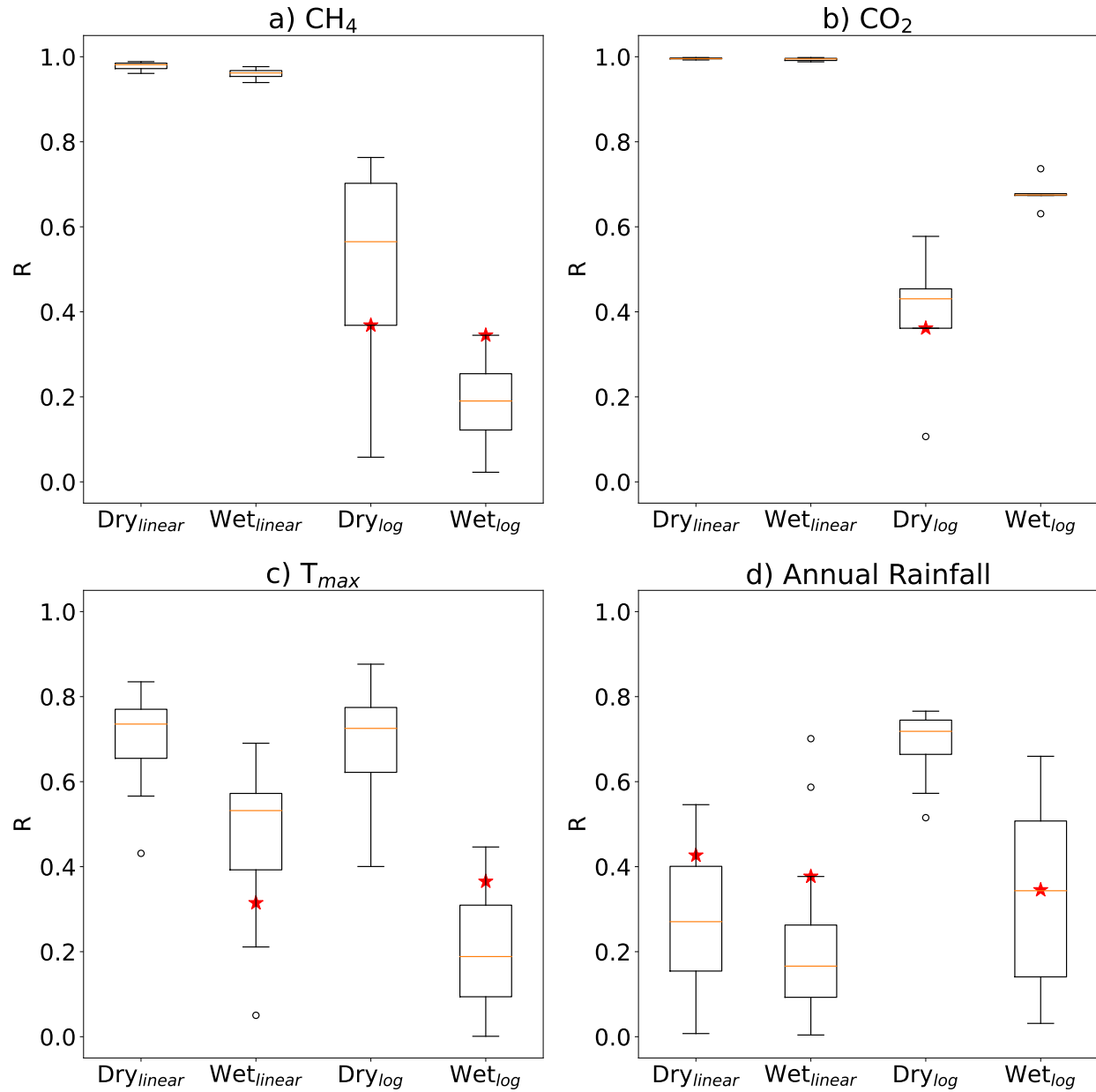


Figure S7. Boxplots obtained with the correlation coefficients (R) considering only the linear and the logarithmic components of the fits in Equation 4 of (a) CH₄, (b) CO₂, (c) T_{max}, and (d) total precipitation during the dry season during the wet and dry seasons. Red stars represent the limit at which p-value < 0.05. The absence of stars means that all fits were statistically significant.

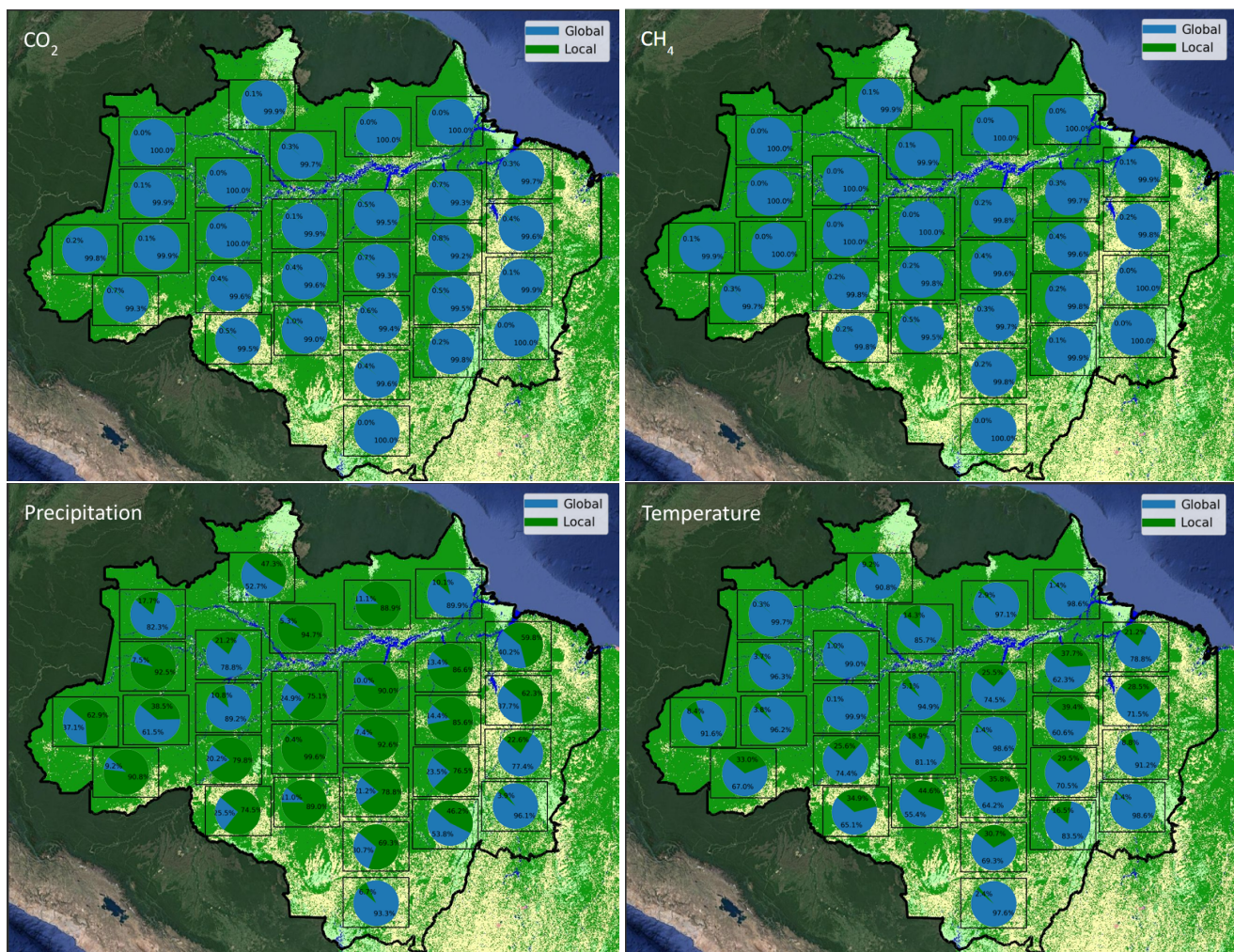


Figure S8. Pie charts showing the relative contributions of global (blue) and regional/deforestation-driven (green) factors to changes in CO₂, CH₄, precipitation, and maximum surface temperature during the dry season across the 29 study areas. The modeled values used to compute these contributions are derived from the parametric fits in Table 2. The panels are organized following the geographic arrangement presented in Figure 1, facilitating spatial comparison.

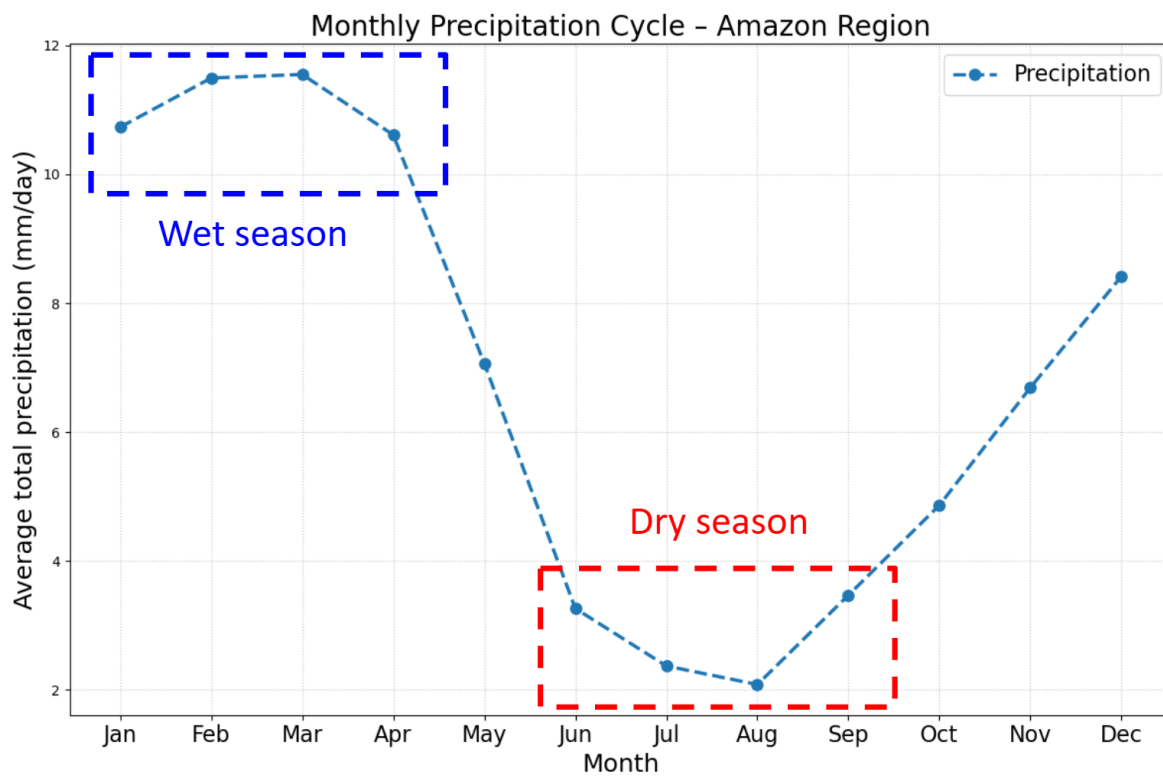


Figure S9. Annual precipitation cycle above a forested region (Area 16 of Figure 1). The wet season months are shown in blue, and red denotes dry season months.