Supporting Information

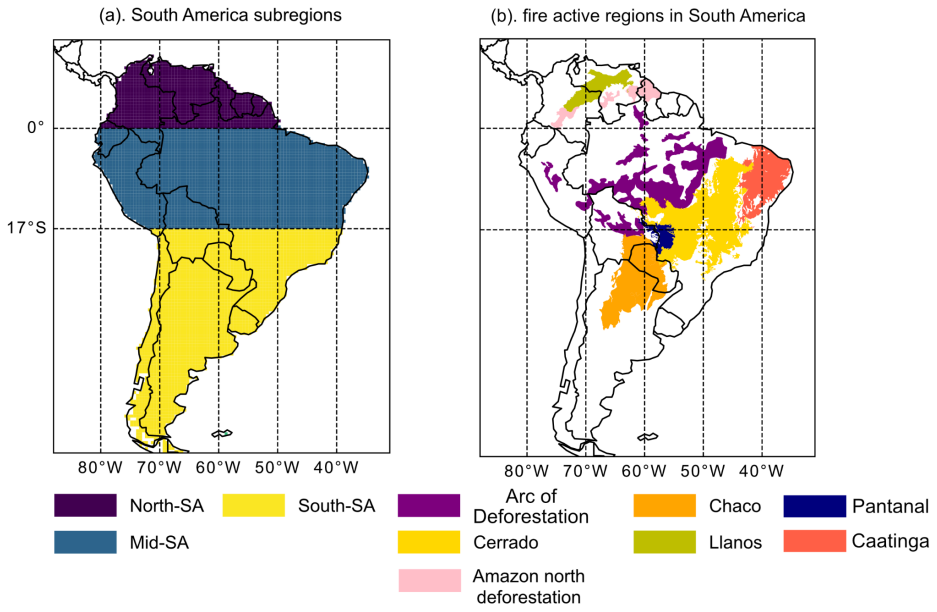

Figure S1: *Studied (a) subregions and assessed (b) fire-prone regions in South America.*

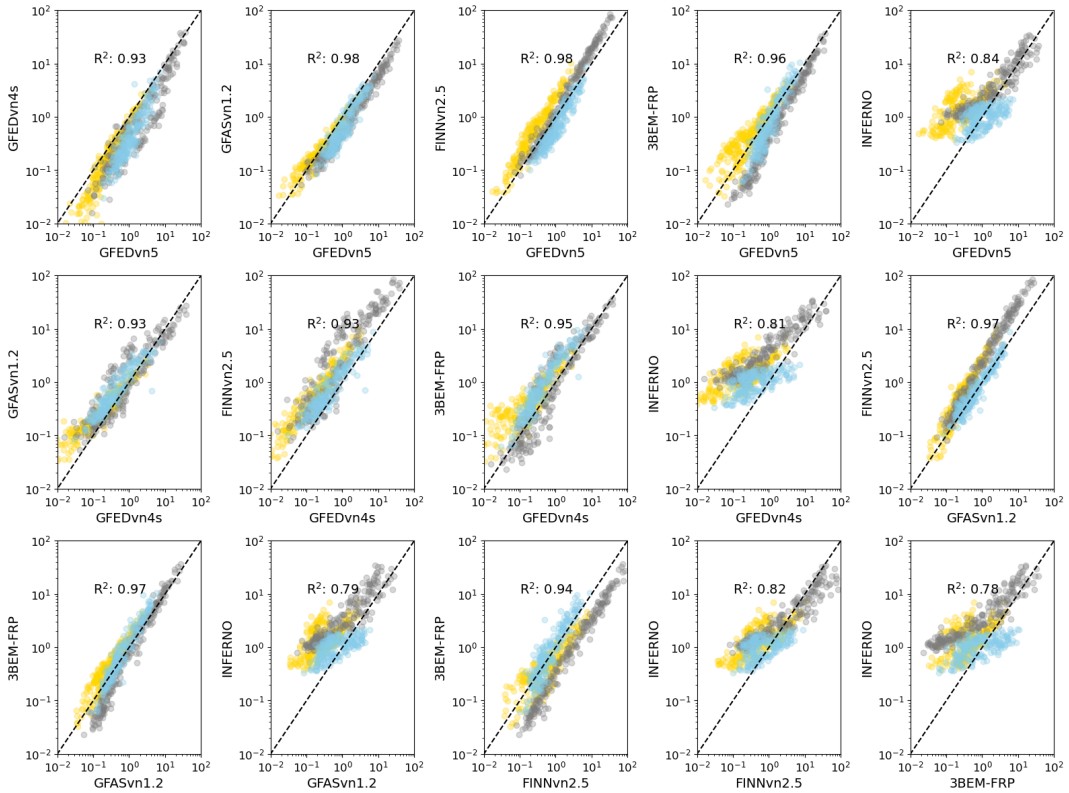

Figure S2: *Spatial scatter plots of the comparison of total monthly surbregional CO emissions* [Tg month^{-1}] between pairs of the inventories studied. *The correlation squared (R^2) between emissions is also shown. The yellow, grey and light blue scatter represent the emissions in North-SA, Mid-SA and South-SA, respectively. Notice that the y- and x-axes are on a logarithmic scale.*

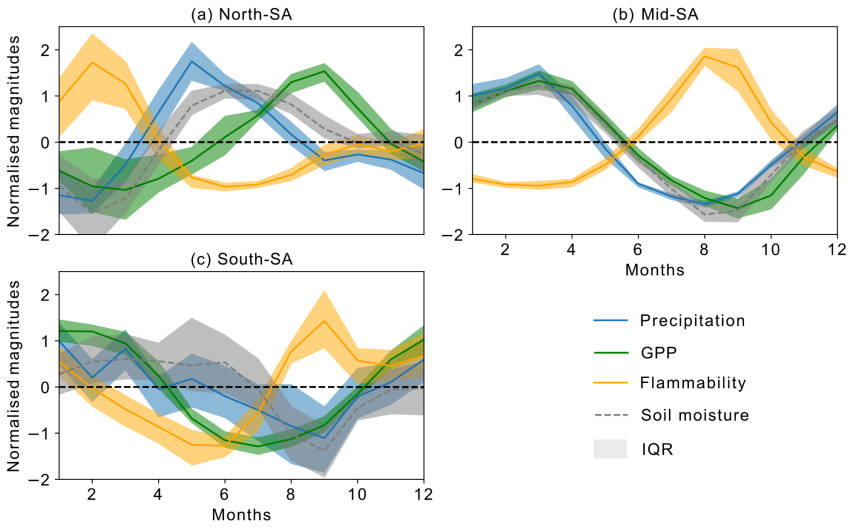

Figure S3: *Normalised seasonal cycle of precipitation, gross primary productivity (GPP), flammability, and soil moisture in (a) North-SA, (b) Mid-SA and South-SA. Every cycle has its interquartile range described by the shaded region.*

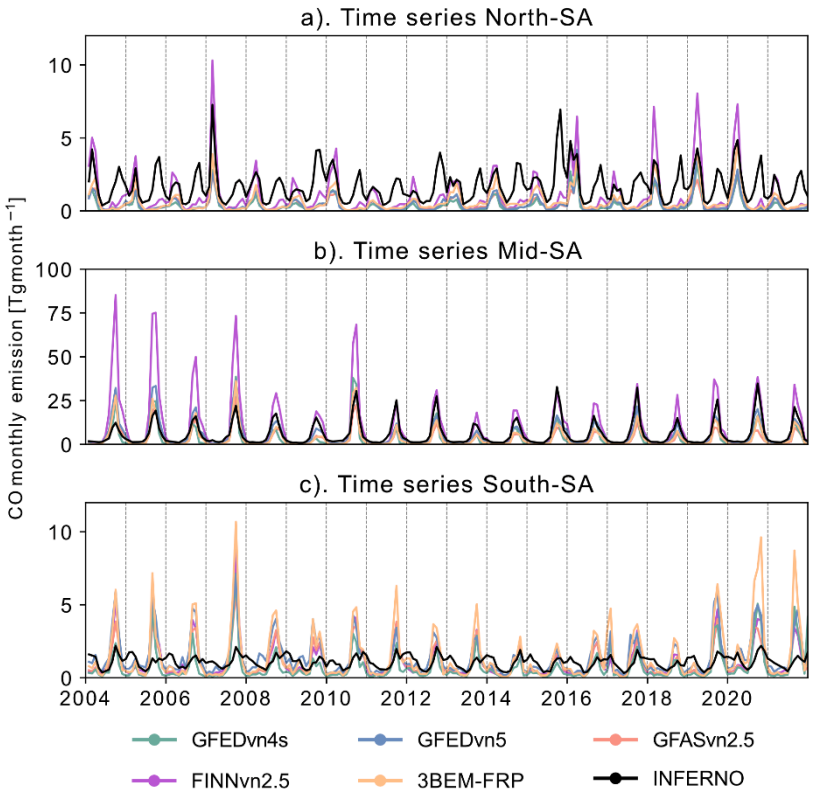

Figure S4: *Estimated carbon monoxide (CO)emissions time series for (a) North-SA, (b) Mid-SA and (c) South-SA (SA = South America).*

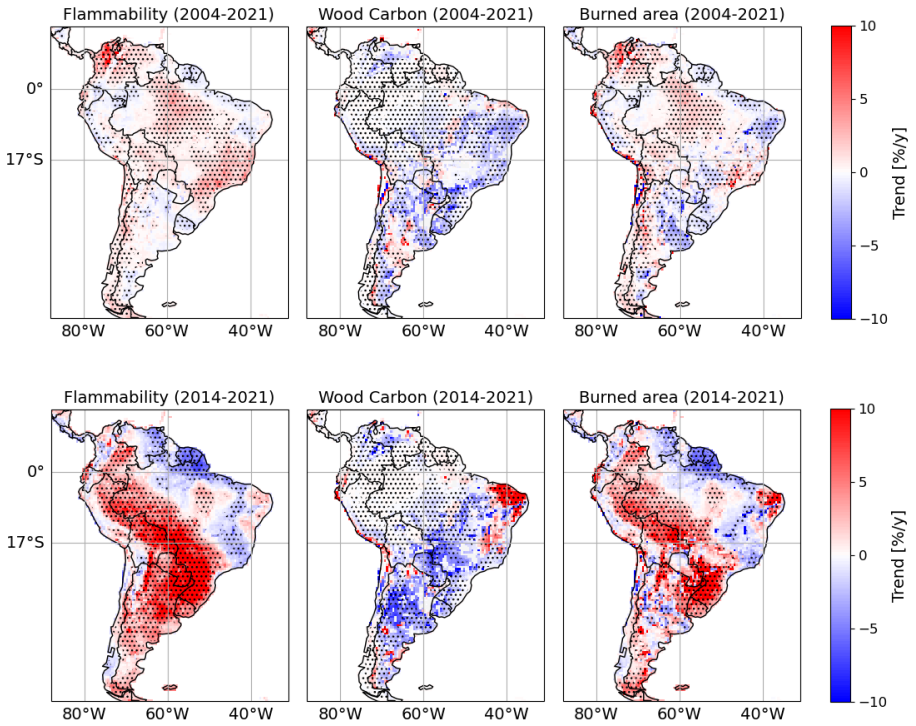

Figure S5: *Long-term and short-term trends (%/year) of the JULES-INFERNO modelled flammability, wood carbon and burned area.*

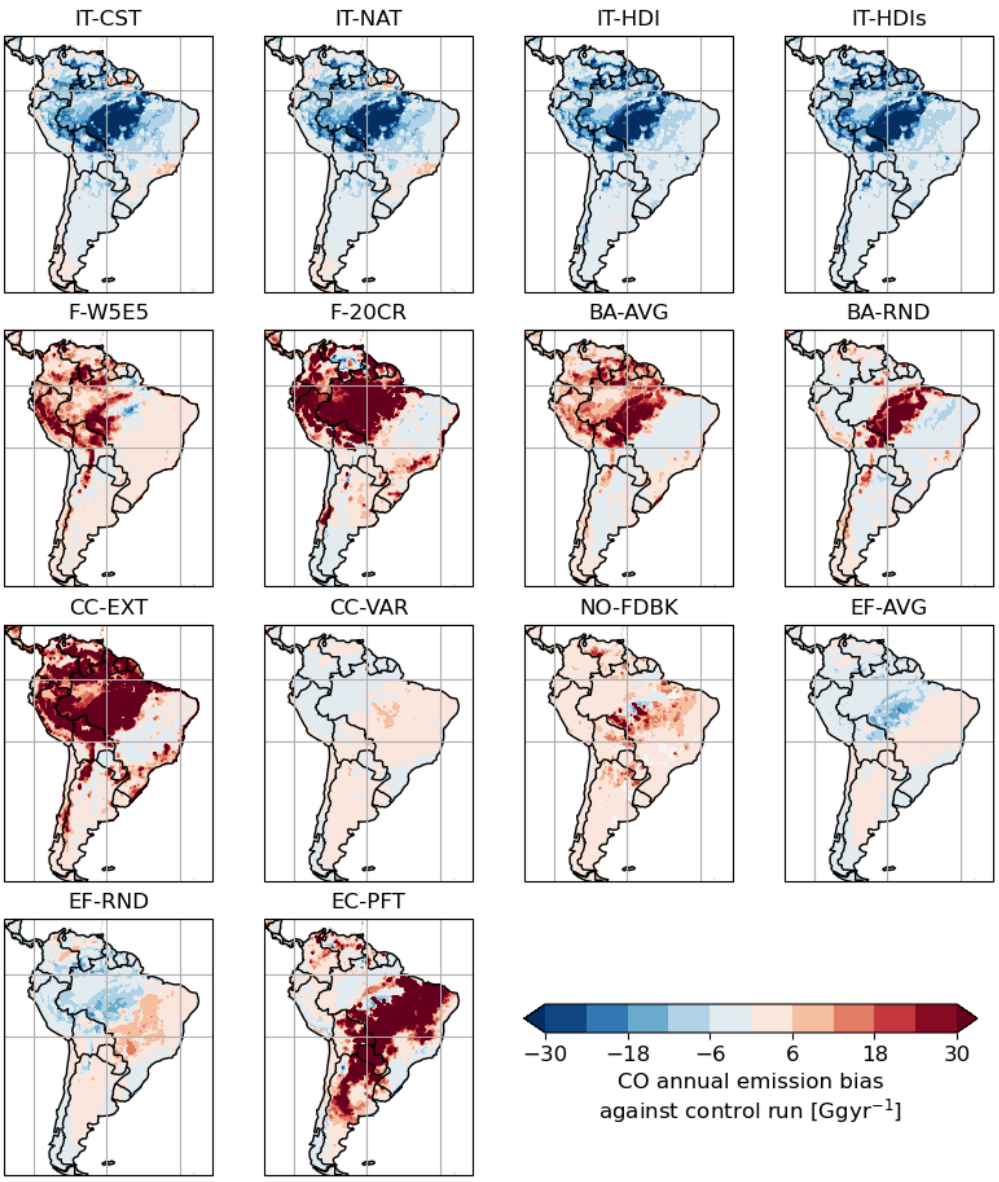

***Figure S6**: CO emission differences for INFERNO Experiment - Control. See Table 2 of the main manuscript for the description of the different INFERNO experiments.*

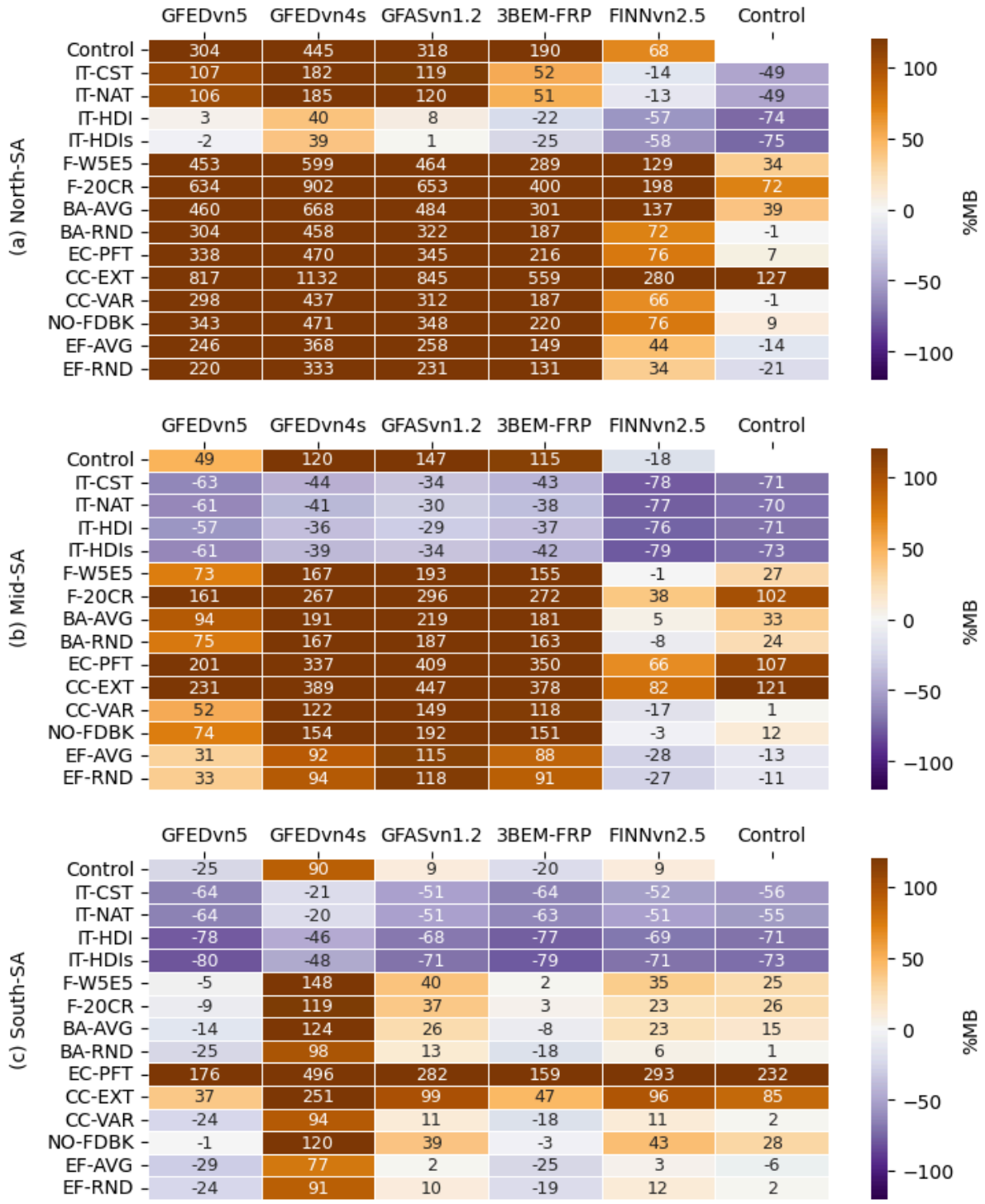

***Figure S7**: Spatiotemporal Average Percentage Bias (APB) of INFERNO simulations against the inventories.*

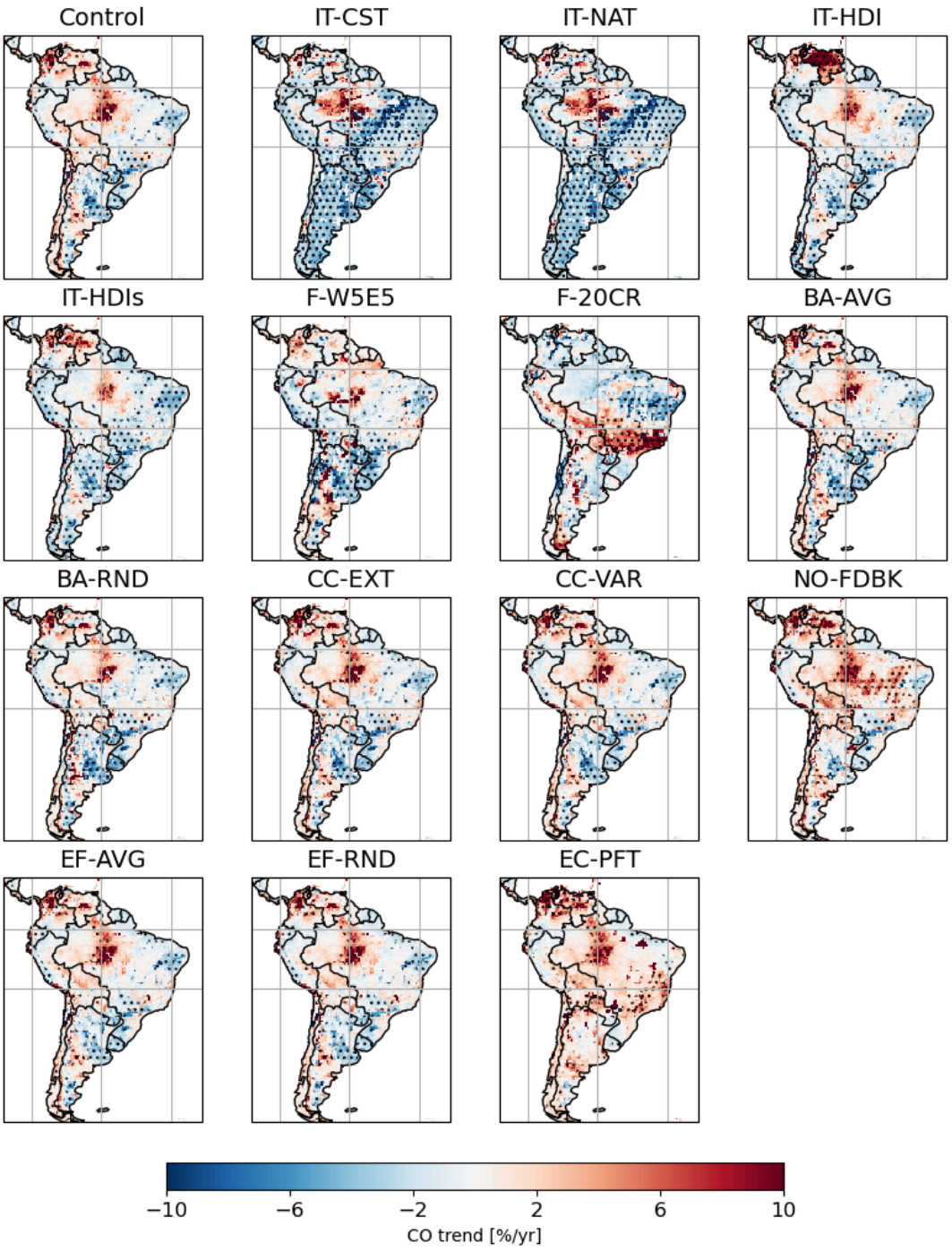

Figure S8: *Long-term (2004-2021) CO emission tendencies for the different INFERNO simulations/experiments. See Table 2 of the main manuscript for the description of the different INFERNO experiments.*

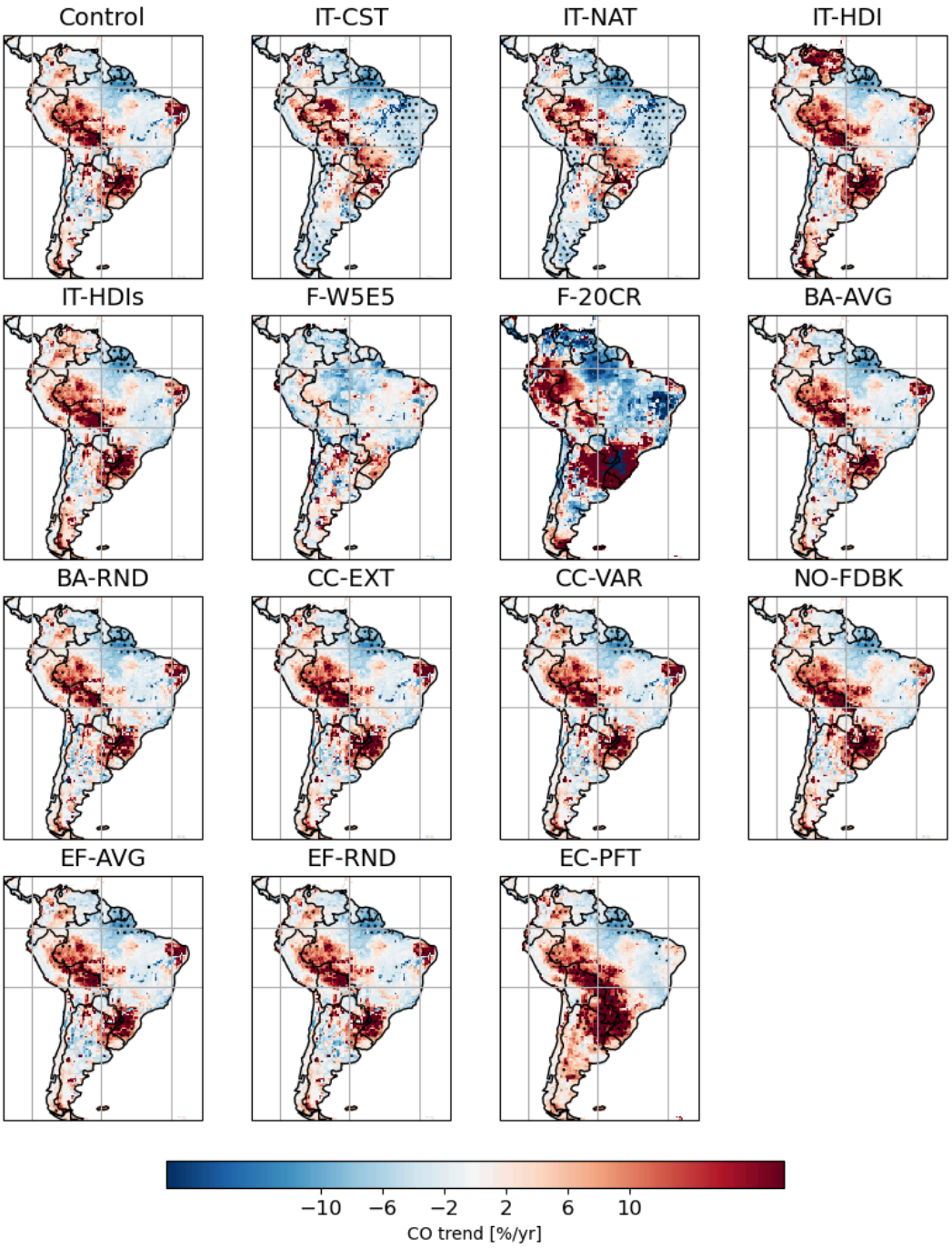

***Figure S9**: Short-term (2014-2021) CO emission tendencies for the different INFERNO simulations/experiments. See Table 2 of the main manuscript for the description of the different INFERNO experiments.*

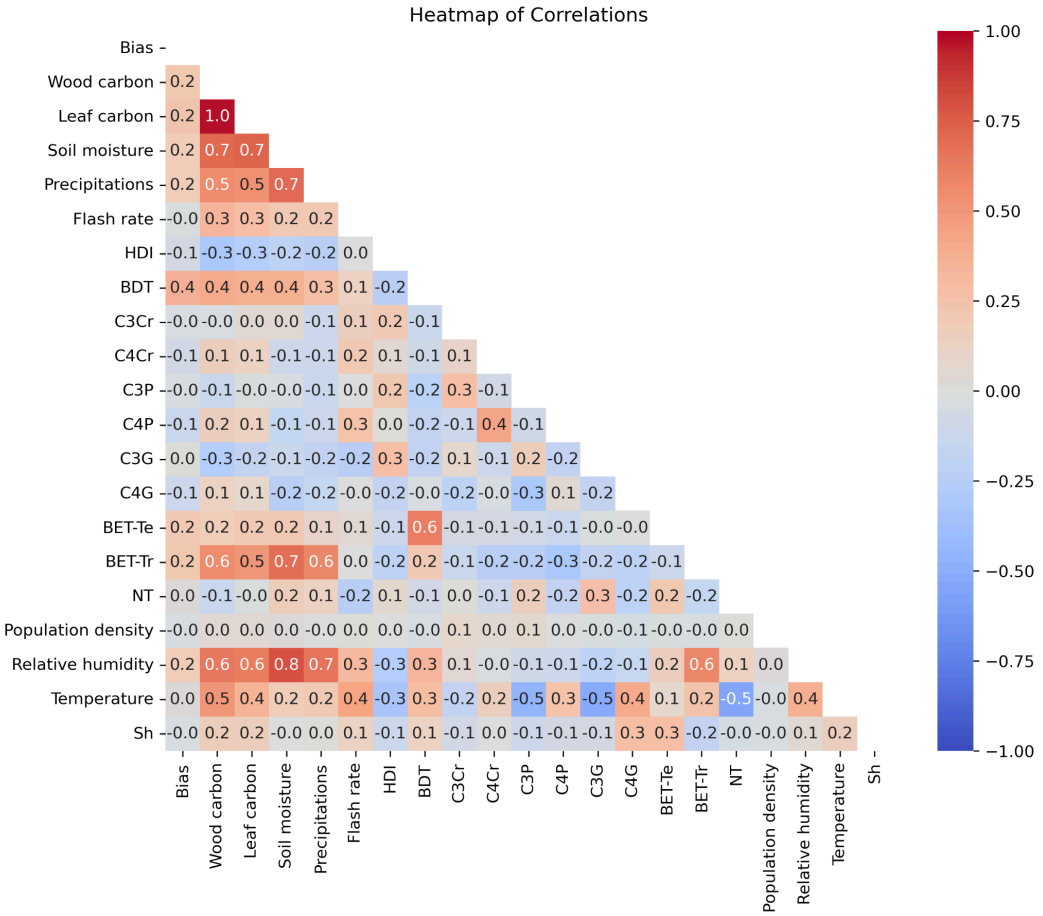

***Figure S10**: Pearson correlation between pairs of selected predictors. This step aims to prevent the model from potential multicollinearity.*

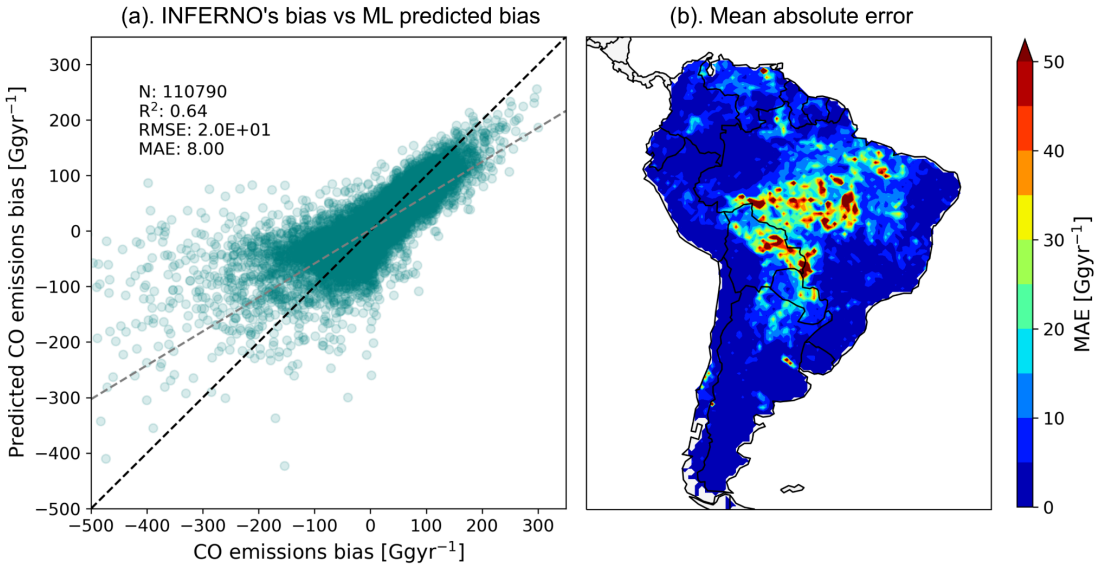

***Figure S11**: (a) Scatter plot of the comparison through South America of the actual INFERNO-inventory biases in CO emissions (Ggy^{-1}) vs. the machine learning predicted INFERNO-inventory CO emission biases and (b) Mean absolute error (MAE) by pixel. N represents the sample size, R2 is the correlation between the two variables, RMSE is the root mean square error.*