Supplementary Files

Cropland expansion drives vegetation greenness decline in Southeast Asia

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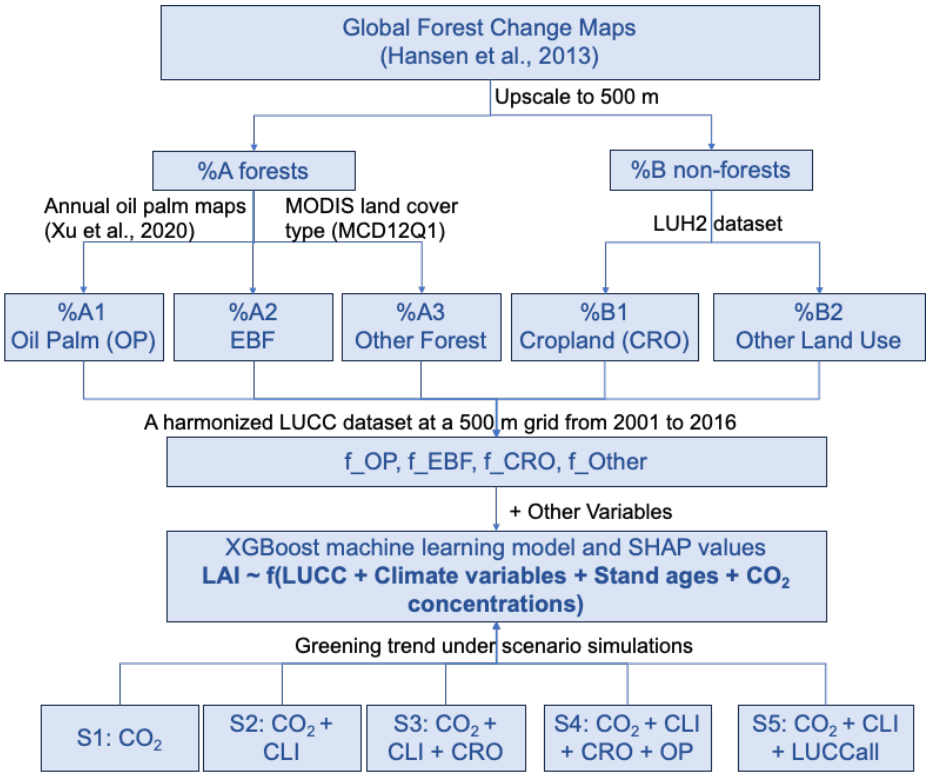

Figure S1: Workflow of the harmonization of land-use dataset and conduction of scenario-based simulations in this study.

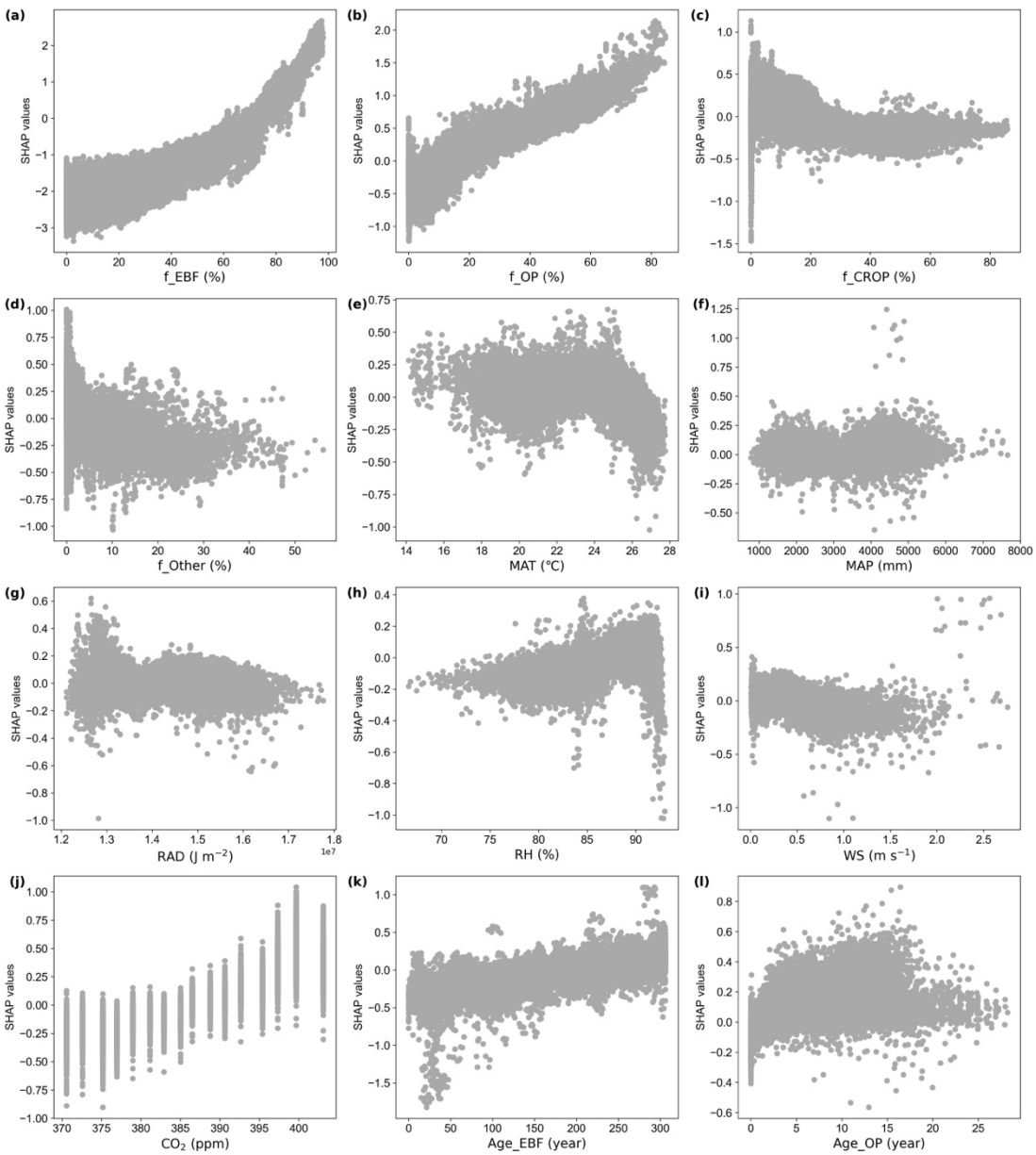

Figure S2: Scatter plots of the SHAP values of each factor.

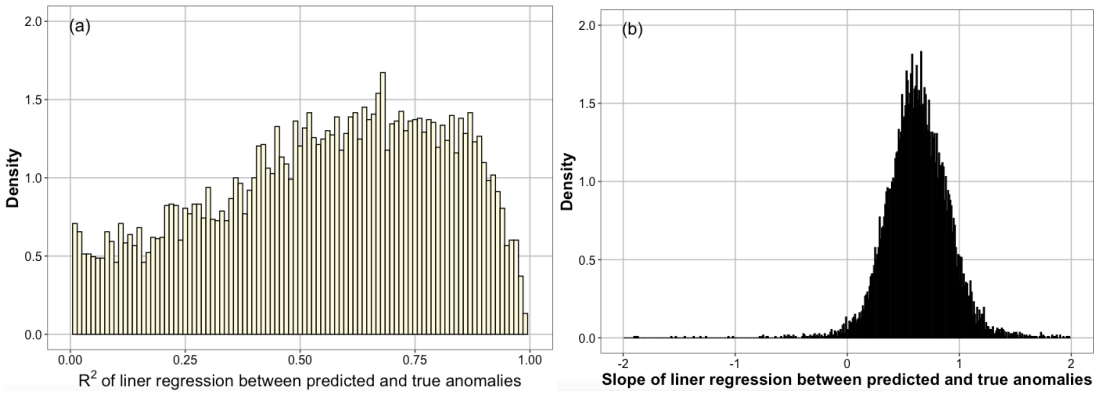

Figure S3: Histogram of R^2 (a) and slope (b) for linear regression between anomalies of predicted LAI and observed LAI.

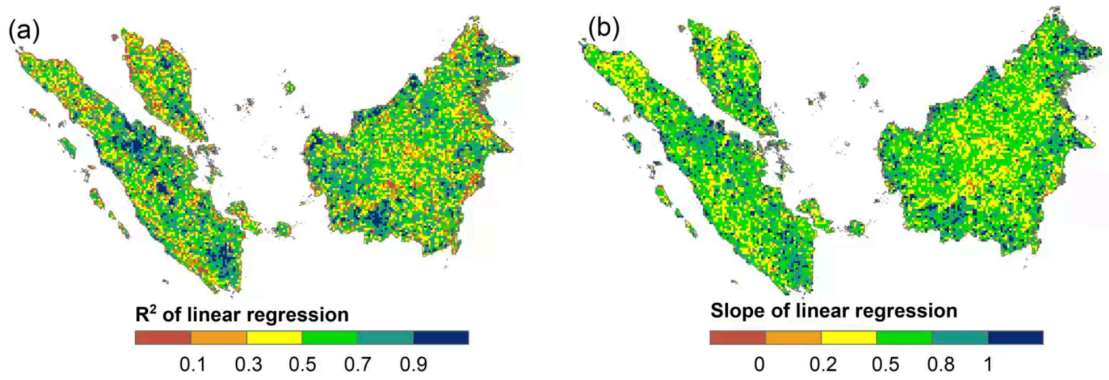

Figure S4: Spatial distribution of R^2 (a) and slope (b) for pixel-wise linear regression between anomalies of predicted LAI and observed LAI.

Table S1: The details of land use datasets in our study used to generate harmonized land uses in Southeast Asia.

Datasets	Time span	Spatial resolution	Sources
Global Forest Change maps (GFC)	2000-2022	30 m × 30 m	Hansen et al., 2013; https://glad.earthengine.app/view/global-forest-change
Land-use harmonization datasets (LUH2)	0850-2019	0.25° × 0.25°	Chini et al., 2021; https://luh.umd.edu/data.shtml
MODIS Land Cover Type Product (MCD12Q1)	2001-2000	500 m × 500 m	https://lpdaac.usgs.gov/products/mcd12q1v006/
Annual oil palm area dataset (AOPD)	2001-2016	100 m × 100 m	Xu et al., 2020; https://doi.org/10.5281/zenodo.3467071

Table S2: The annual fractions of each land use type in our study area from 2001 to 2016 (%).

Land Uses	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EBF	73.41	72.67	71.92	70.83	69.76	68.57	66.97	65.46	63.77	62.82	61.66	59.84	58.67	57.01	55.84	53.09
CRO	14.45	14.69	14.94	15.57	15.81	16.37	16.97	17.57	18.53	19.13	19.80	20.82	21.50	22.53	23.31	24.56
OP	3.91	4.44	5.06	5.50	5.96	6.45	7.31	8.10	8.65	9.03	9.37	9.81	10.31	10.67	10.85	12.05
Pasture	3.20	3.20	3.04	3.01	3.24	3.30	3.38	3.44	3.51	3.49	3.55	3.73	3.68	3.78	3.84	3.98
Grass	0.63	0.64	0.62	0.62	0.65	0.66	0.67	0.67	0.69	0.70	0.71	0.74	0.74	0.76	0.77	0.79
Other Forest	0.08	0.02	0.02	0.03	0.04	0.07	0.04	0.04	0.04	0.02	0.02	0.03	0.03	0.04	0.04	0.03

Note: EBF, CROP, and OP are short for evergreen broadleaf forests, croplands, and oil palm plantations, respectively.

Table S3: The variables used to explain LAI variations using XGBoost model.

Categories	Variables	Descriptions and Units	Sources
Land use types	f_EBF	Fraction of evergreen broadleaf forest in the grid cell (%)	see Methods
	f_OP	Fraction of oil palm in the grid cell (%)	
	f_CRO	Fraction of cropland in the grid cell (%)	
	f_Other	Fraction of other land uses in the grid cell (%)	
Climate variables	MAT	Mean annual temperature (℃)	https://cds.climate.copernicus.eu/
	MAP	Total annual precipitation (mm)	
	WS	Wind speed (m s^{-1})	
	RAD	Shortwave downward radiation (J m^{-2})	
	RH	Relatively humidity (%)	
Stand Ages	Age_EBF	Stand ages of evergreen broadleaf forests (year)	https://doi.org/10.17871/ForestAgeBGI.2021
	Age_OP	Stand ages of oil palms (year)	http://dare.iiasa.ac.at/85/
CO_2 concentrations	CO2	Annual CO_2 concentrations (ppm)	https://gml.noaa.gov/dv/data/