Biogeosciences
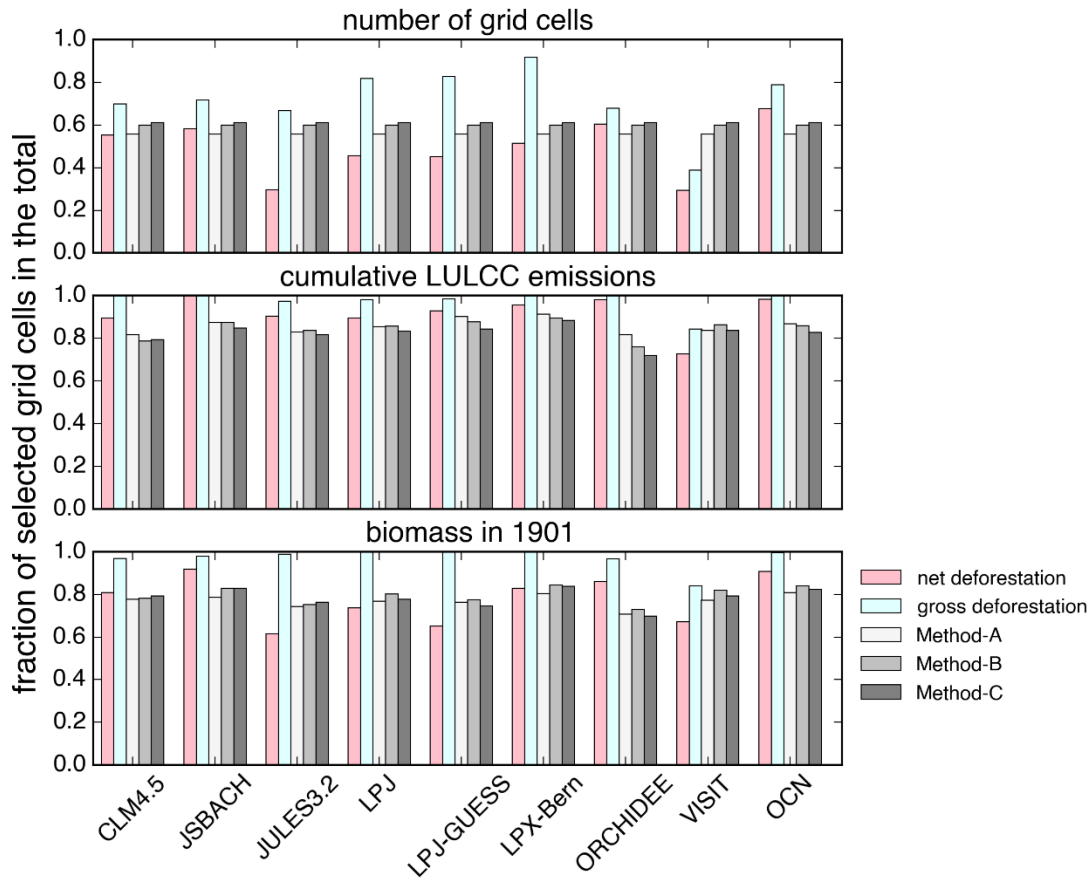
Supplement of

Land-use and land-cover change carbon emissions between 1901 and 2012 constrained by biomass observations

Wei Li et al.
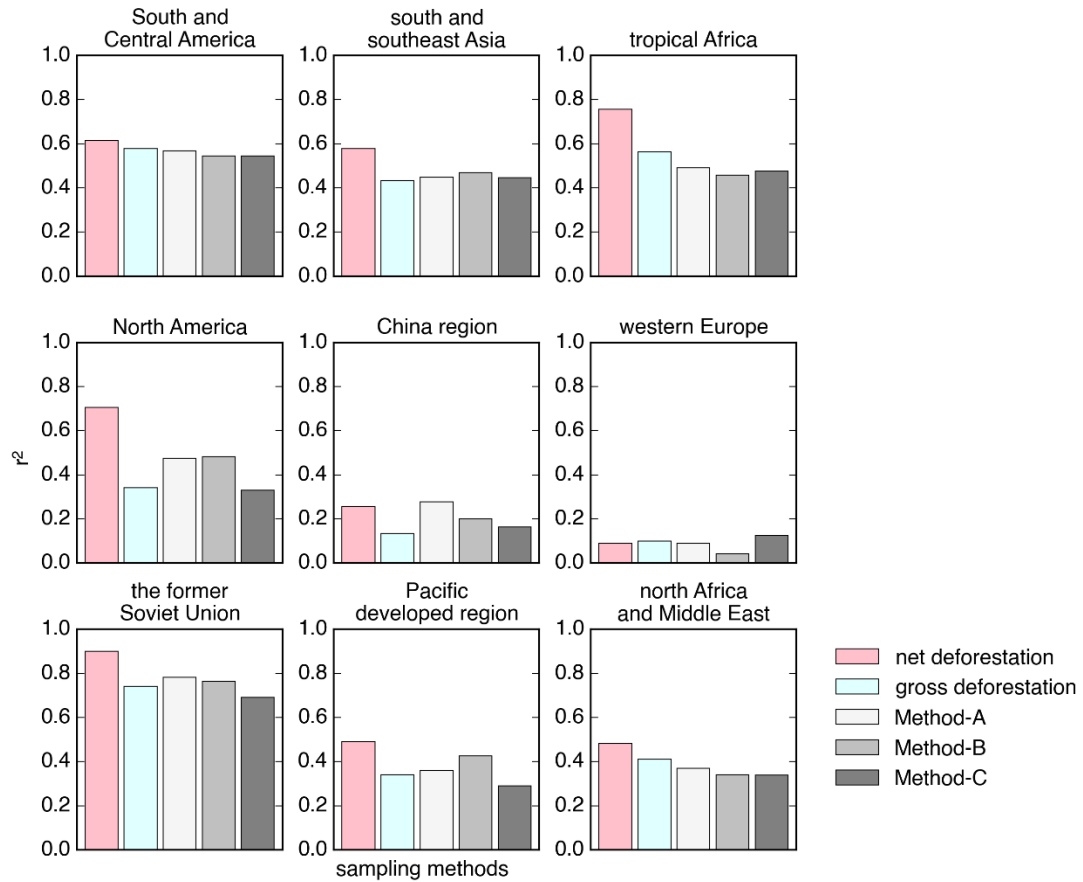
Correspondence to: Wei Li (wei.li@lsce.ipsl.fr)

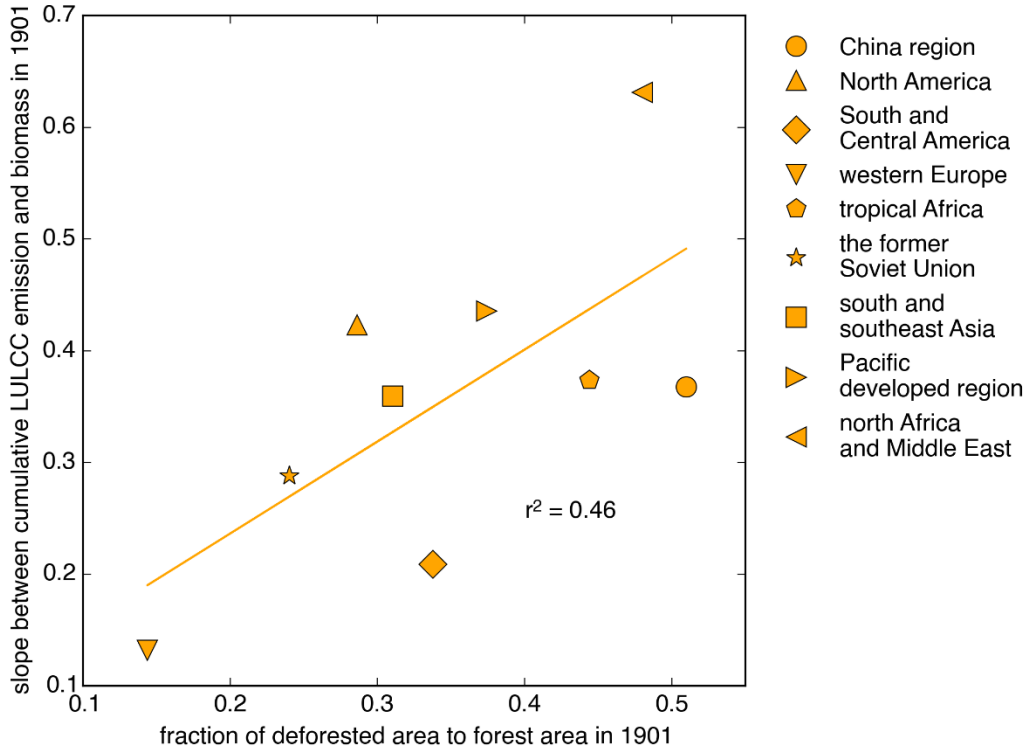**Figure S1.** The percentage of the total number of grid cells, the total cumulative land-use and land-cover change (LULCC) emissions and the total biomass amount in 1901 that the deforestation grid cells account for in each model using different methods to define deforestation grid cells. Net deforestation refers to comparing vegetation cover maps between the year 1901 and the year 2012 for each DGVM and selecting the deforestation grid cells; gross deforestation represents comparing vegetation maps year-by-year during 1901 and 2012 and selecting the deforestation grid cells; Method-A, Method-B and Method-C represent selecting deforestation grid cells by assuming the increase of cropland in HYDE v3.1 data from forest, all the increase of cropland and pasture in HYDE v3.1 data proportionally from other natural vegetation types, and backward extrapolated map based on HYDE v3.1 data and meanwhile constrained by regional deforestation data, respectively.

Figure S2. The coefficient of determination (r^2) of the regression between biomass in 1901 and cumulative land-use and land-cover change (LULCC) emissions during 1901-2012 across the nine TRENDY models using different methods to define deforestation grid cells. Net deforestation refers to comparing vegetation cover maps between the year 1901 and the year 2012 for each DGVM and selecting the deforestation grid cells; gross deforestation represents comparing vegetation maps year-by-year during 1901 and 2012 and selecting the deforestation grid cells; Method-A, Method-B and Method-C represent selecting deforestation grid cells by assuming the increase of cropland in HYDE v3.1 data from forest, all the increase of cropland and pasture in HYDE v3.1 data proportionally from other natural vegetation types, and backward extrapolated map based on HYDE v3.1 data and meanwhile constrained by regional deforestation data, respectively.

Figure S3. The relationship between the fraction of deforested area to forest area in 1901 (median value across the nine models) and the slopes of cumulative land-use and land-cover change (LULCC) emissions during 1901-2012 against biomass in 1901 from TRENDY models (the slopes of black solid lines in Figure 2).
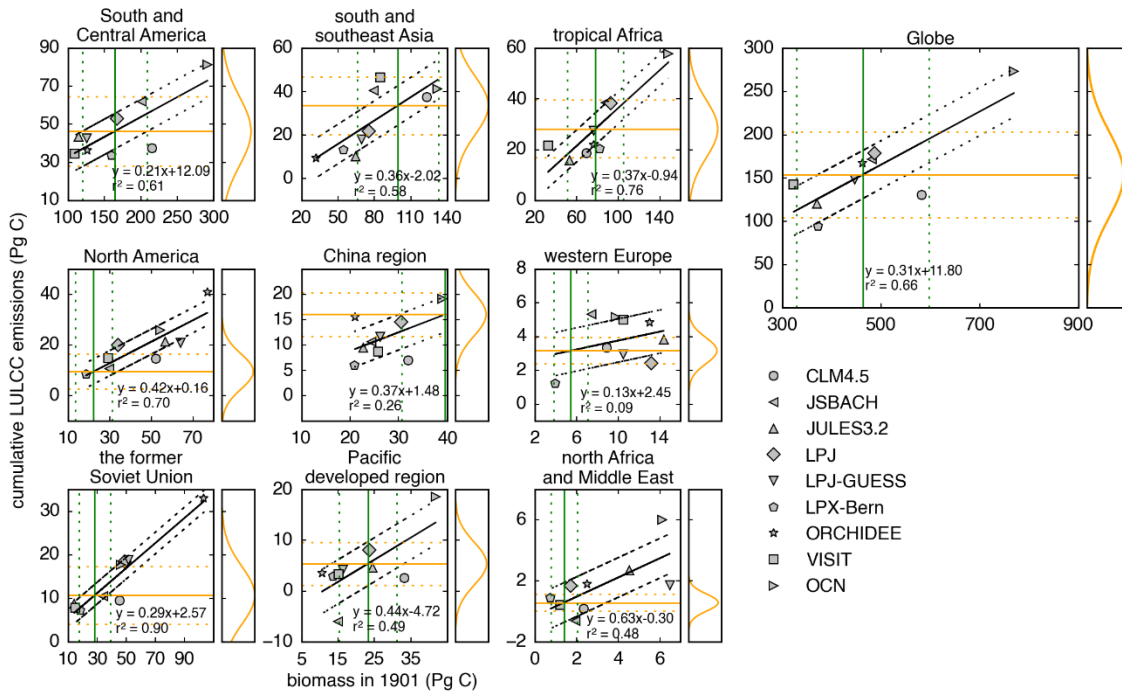
Figure S4. Relationship between biomass in 1901 and cumulative land-use and land-cover change (LULCC) emissions during 1901-2012 across the nine TRENDY v2 models. The black solid line is the linear regression line. The vertical green solid line indicates the reconstructed biomass in 1901 from Carvalhais et al. (2014) using **Method-B** method (all the increase of cropland and pasture in HYDE v3.1 data proportionally from all natural vegetation types). The orange solid horizontal line indicates the cumulative LULCC emissions constrained by reconstructed biomass in 1901. Dashed lines represent 1-σ uncertainties. The probability density function of the constrained cumulative LULCC emissions is shown on the right.
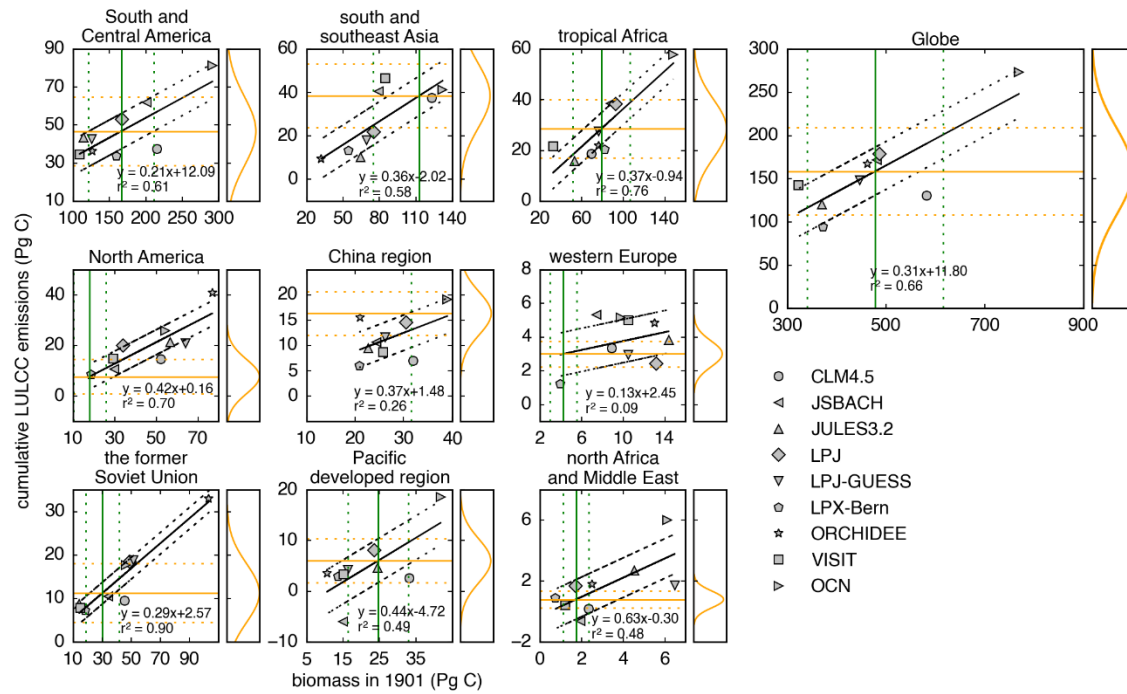
Figure S5. Relationship between biomass in 1901 and cumulative land-use and land-cover change (LULCC) emissions during 1901-2012 across the nine TRENDY v2 models. The black solid line is the linear regression line. The vertical green solid line indicates the reconstructed biomass in 1901 from Carvalhais et al. (2014) using **Method-C** method (backward extrapolated map based on HYDE v3.1 data and meanwhile constrained by regional deforestation data). The orange solid horizontal line indicates the cumulative LULCC emissions constrained by reconstructed biomass in 1901. Dashed lines represent 1-σ uncertainties. The probability density function of the constrained cumulative LULCC emissions is shown on the right.
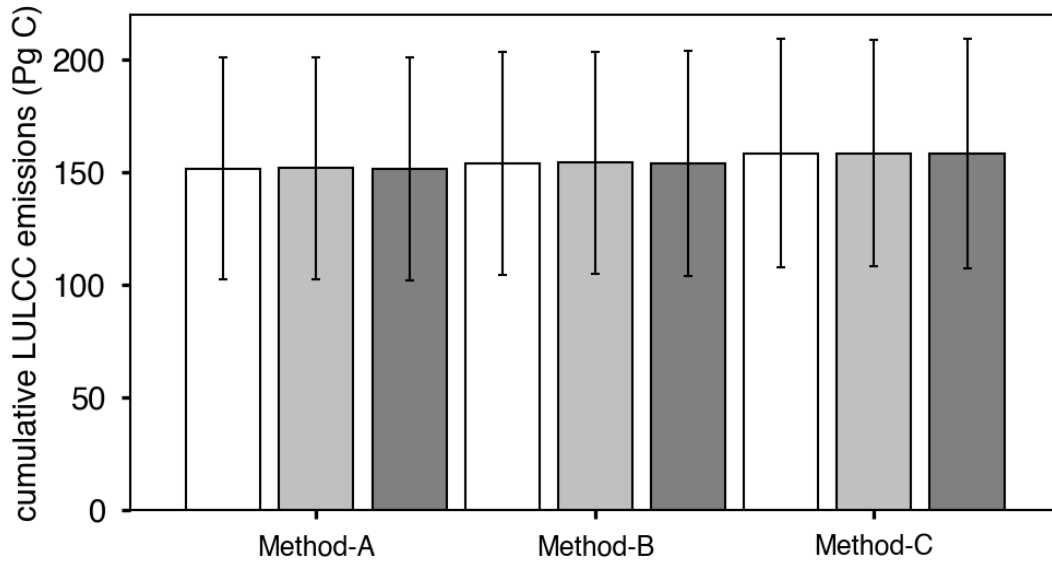
Figure S6. The global constrained E_{LUC}^c using the original method (white bars), using the regression between E_{LUC}^c and present-day biomass (Method-S1, light gray bars) and using ΔB (Method-S2, dark gray bars). In this example the observation-based biomass dataset from Carvalhais et al. (2014) is used. The error bars represent the 1-σ Gaussian errors.

Table S1. The interquantile ranges of the global and regional cumulative land-use and land-cover change (LULCC) emissions (Pg C) during 1901-2012 from original TRENDY models and from the estimates constrained by different biomass datasets with different methods to define deforestation grid cells.

	TRENDY	Carvalhais et al. (Carvalhais et al., 2014)			Liu et al. (Liu et al., 2015)			GEOCARBON (Avitabile et al., 2016; Santoro et al., 2015)			Pan et al. (Pan et al., 2011)		
	median	Method-A	Method-B	Method-C	Method-A	Method-B	Method-C	Method-A	Method-B	Method-C	Method-A	Method-B	Method-C
China region	5.9	5.7	5.8	5.8	5.4	5.4	5.4	5.7	5.8	5.9	5.3	5.3	5.3
North America	6.9	8.0	7.7	7.3	7.7	7.4	7.0	10.1	9.0	8.9	6.7	6.6	6.6
South and Central America	17.0	17.9	18.3	18.4	16.7	16.8	16.8	16.2	16.4	16.4	16.7	16.9	17.0
western Europe	2.0	1.8	1.7	1.7	1.7	1.7	1.7	2.4	1.8	1.8	1.7	1.7	1.7
tropical Africa	17.9	14.9	16.1	16.3	13.1	13.8	13.8	17.9	20.1	21.9	14.9	16.2	16.4
the former Soviet Union	9.7	5.5	5.5	5.7	5.2	5.2	5.2	5.4	5.1	5.2	4.4	4.4	4.4
south and southeast Asia	27.3	21.7	20.4	22.2	14.8	14.2	14.6	16.6	16.0	17.0	15.9	15.2	16.0
Pacific developed region	1.8	7.8	7.7	7.8	7.2	7.1	7.1	7.0	6.8	6.9	6.7	6.7	6.7
north Africa and Middle East	1.4	1.9	1.9	1.9	2.3	2.1	2.1	5.9	4.3	5.0	1.9	1.9	1.9
globe	41.0	66.3	66.8	68.1	54.3	53.7	53.5	62.0	61.2	63.4	51.2	51.7	52.4