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Tier 1 Global Estimations of E/R from Forest Living Biomass and Deforestation in the EU Forest Observatory

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Background

The JRC developed a global database of emissions and removals from Living Biomass in Forest Land and of emissions from Deforestation (Forest Land converted to other land uses) following as closely as possible the IPCC Tier 1 approach. The dataset is aimed at providing a globally-consistent independent benchmark of Tier 1 estimates at the country level.

Activity data are derived from Earth Observation-derived datasets. The parameters are those provided in the IPCC Guidelines for National Greenhouse Gas Inventories and their 2019 Refinement. Every cell in the activity data raster map is matched with the appropriate parameters by means of ancillary spatial and tabular datasets as suggested by the Guidelines, such as the Global Ecological Zones, shares of planted forests on total secondary forest, forest ages, etc.

All results are here compared against the NGHGI Dataset (Grassi et al, 2023), which collects all the reporting to the UNFCCC (e.g. GHG Inventories, Biennial Update Reports, etc), produced by countries with a variety of approaches, using by definition the best locally available data and methods.

Forest Living Biomass

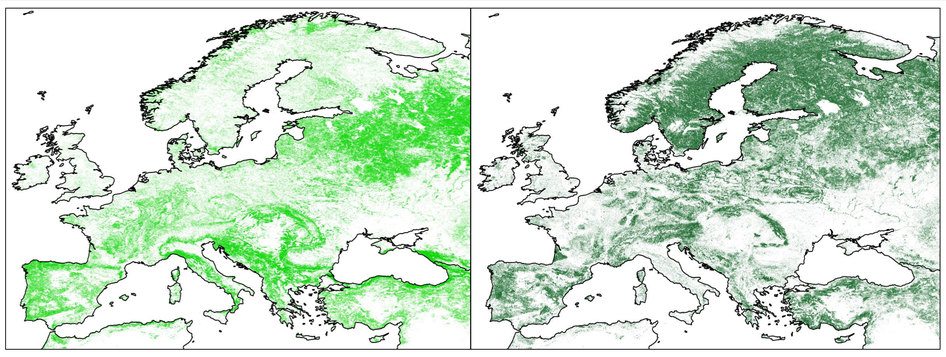
The Forest Living Biomass module follows the Tier 1 Gains/Losses approach.

GAINS: Land use areas (activity data) are obtained from the satellite-derived 300m land cover dataset originally developed by the ESA Climate Change Initiative and now part of the Copernicus Climate Change Service (C3S). This dataset was chosen because it provides the longest time series of yearly land cover maps available through the harmonization of different sensors, ranging from 1992 to the present day, and allowed the mapping of all IPCC Land Use categories. The original Land Cover Classification System (LCCS) legend is remapped assigning different shares of pixel area to the IPCC Land Use categories, also separating Needleleaf forests from Broadleaf forests. The Intact Forest Landscapes (IFL) dataset is used as a proxy to map unmanaged forest, which is excluded from the modelling of emissions/removals.

Forest areas are further stratified by Global Ecological Zone (FAO), type of management (plantations or naturally growing, from FAO/FRA), and age (GFAD dataset). Compared to the standard IPCC approach where only two age classes are defined (<=20 yrs and >20 yrs), we introduced a third class (>100 yrs) in order to limit the forest carbon removal in older forests. Forest growth parameters are selected mainly from the 2019 Refinement of the 2006 IPCC Guidelines for National GHG Inventories.

LOSSES: the official wood production country statistics in FAOSTAT are the activity data for this component, subdivided by tree type (Needleleaf or Broadleaf) and use (Fuelwood or Industrial Roundwood).

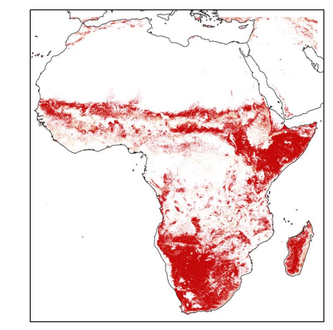
Total harvest is statistically allocated to the various Global Ecological Zones. Biomass Conversion and Expansion Factors (BCEF) for the different zones are obtained from the IPCC Guidelines. When possible, results are corrected with estimated shares of illegal logging (Gan et al. 2016).



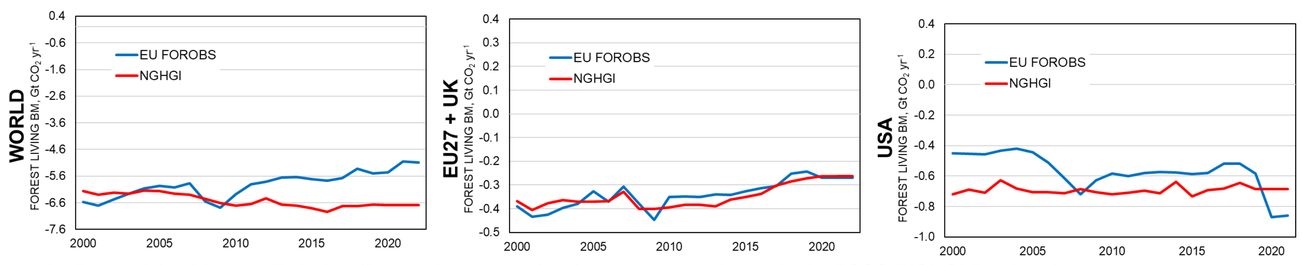
Area of IPCC Land Use categories Forest Land- Broadleaf (left) and Needleleaf (right) derived from C3S Land Cover (year 2022).

Above-Ground Net Biomass Growth (tonnes dry matter/ha/year) - South Asia								
Climate domain	Ecological zone	AGnetBM Growth NATURAL <=20 yrs	AGnetBM Growth NATURAL 21-100 yrs	AGnetBM Growth NATURAL >100 yrs	AGnetBM Growth PLANTED <=20 yrs	AGnetBM Growth PLANTED 21-100 yrs	AGnetBM Growth PLANTED>100 yrs
Tropical	Tropical rain forest	3.4	2.7	0.7	5	5	5
Tropical	Tropical moist deciduous forest	2.4	0.9	0.4	5	5	5
Tropical	Tropical dry forest	3.9	1.6	0.85	11	11	11
Tropical	Tropical shrubland	3.6	1.2	1	6	6	6
Tropical	Tropical mountain systems	2.9	1.1	0	6.3	6.3	6.3
Tropical	Tropical desert						
Sub- tropical	Subtropical humid forest	2.5	1	1	8	8	8
Sub- tropical	Subtropical dry forest	6.5	1.8	1.75	11	11	11
Sub- tropical	Subtropical steppe	3.5	1.2	1.15	6	6	6
Sub- tropical	Subtropical desert						
Sub- tropical	Subtropical mountain systems	2.5	0.5	0.5	4	4	4
Temperate	Temperate oceanic forest	6.3	9.1	9.1	6	10	10
Temperate	Temperate continental forest	3.3	3.6	3.6	5	4	4
Temperate	Temperate steppe	2.3	3.5	3.5	11	11	11
Temperate	Temperate mountain systems	3.1	4.4	4.4	10	9	9
Temperate	Temperate desert	0.5	0.6	1.1	0.5	0.6	0.6
Boreal	Boreal coniferous forest	1.1	1.1	0.4	1	1	1
Boreal	Boreal tundra woodland	0.4	0.4	1.3	0.4	0.4	0.4
Boreal	Boreal mountain systems	1	1.3	0	1	1.3	1.3
Polar	Polar						
Water	Water						

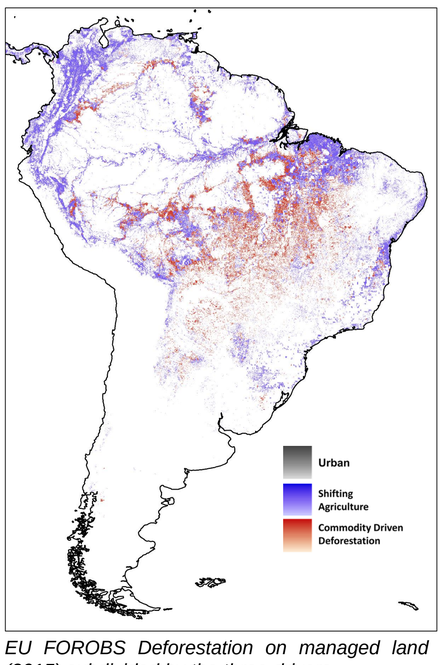
An example of a parameter table derived from the IPCC Guidelines. We added an new age class >100 years old to improve the estimation of removals from older forests.



Area of IPCC land use category Grassland (2015)



Net Forest Living Biomass Emissions/Removals compared to the country reporting to the UNFCCC (NGHGI Database).



EU FOROBS Deforestation on managed land (2015) subdivided by the three drivers.

Deforestation

Emissions from Deforestation are based on the "Global Maps of Forest Cover Changes and their Drivers" on the *EU Observatory on Deforestation and Forest Degradation* (https://forest-observatory.ec.europa.eu). This dataset is a combination of two different products: the Tropical Moist Forest (TMF) forest cover change 1990-2022 dataset (Vancutsem et al. 2021) for the tropical moist forest developed at the JRC using 41 years of Landsat time series to map, and the Global Forest Change 2000-2022 Dataset (Hansen et al., 2013), also based on Landsat, for the rest of the World. The dataset subdivides Deforestation as caused by three different drivers as identified by Curtis et al. (2018): Urbanization, Shifting Agriculture, and Commodity-Driven Deforestation.

The estimation of the resulting carbon losses is carried out through the Tier 1 IPCC approach, with Forest Carbon content parameters for different ecological zones and age classes obtained from the 2019 Refinement. Ancillary spatial data on age (GFAD) and on Global Ecological Zones (FAO) are used to match the correct parameters to each deforested area.

Above: CO_2 losses from deforestation. For our results, the total emissions and the total emissions without deforestation driven by Shifting Agriculture are displayed.

Left: the three drivers of forest loss (URB: Urbanization, CDD: Commodity Driven Deforestation, SA: Shifting Agriculture).

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