

**LUH2 v1.0h****1 OVERVIEW OF LAND USE FORCING DATA (850-2100)**

In preparation for sixth phase of the Coupled Model Intercomparison Project (CMIP6), a new set of global gridded land-use forcing datasets are being developed to link historical land-use data and future projections in a standard format required by climate models. This new generation of “land use harmonization” (LUH2) builds upon past work from CMIP5, and includes updated inputs, higher spatial resolution, more detailed land-use transitions, and the addition of important agricultural management layers. The major attributes of the dataset will include:

- Global domain
- 850-2100 annual land-use states, transitions, and gridded mgt layers
- Common history
- Official CMIP6 future scenarios
- 0.25 x 0.25 degree spatial resolution
- 12 possible land-use states including separation of Primary and Secondary natural vegetation into Forest and Non-forest sub-types, Pasture into Managed Pasture and Rangeland, and Cropland into multiple crop functional types
- >100 possible transitions per grid cell per year, including crop rotations
- Agriculture management layers including irrigation, fertilizer, and biofuel management

These datasets are being developed as a contribution of the Land-Use Model Intercomparison Project (LUMIP) to the Forcings Group for CMIP6. The primary points of contact for these data are:

G. Hurtt ([gchurtt@umd.edu](mailto:gchurtt@umd.edu))  
L. Chini ([lchini@umd.edu](mailto:lchini@umd.edu))  
S. Frolking ([steve.frolking@unh.edu](mailto:steve.frolking@unh.edu))  
R. Sahajpal ([ritvik@umd.edu](mailto:ritvik@umd.edu))

**2 DESCRIPTION OF HISTORICAL DATA (850-2015)**

LUH2 v1.0h is the release of the historical land-use forcing dataset, and covers the period 850-2015. This product is the result of a series of prototypes released previously, uses the established data format, and will connect smoothly to gridded products for the future. A DOI is planned for this dataset.

In addition to the attributes listed above, major new attributes of the historical dataset include:

- Agriculture and urban land-use based on HYDE 3.2
- Wood harvest reconstruction based on FAO and other sources
- Spatial pattern of wood harvesting constrained by Landsat data
- Updated shifting cultivation estimates
- Crop rotations
- Fraction of crop biomass harvested
- Fraction of crops grown as biofuels
- Fraction of cropland flooded
- Fate of wood harvest
- NetCDFs are CF (climate and forecast) convention compliant

## 2.1 Files

Files can be downloaded from:

[https://luh.umd.edu/~LUH2/LUH2\\_v1.0h/](https://luh.umd.edu/~LUH2/LUH2_v1.0h/)

The datasets are comprised of several NetCDF files:

- states.nc
- transitions.nc
- management.nc

## 2.2 Variable Names and Units

2.2.1 States: (units fraction of grid cell unless otherwise specified)

primf: forested primary land

primn: non-forested primary land

secdf: potentially forested secondary land

secdn: potentially non-forested secondary land

pastr: managed pasture

range: rangeland

urban: urban land

c3ann: C3 annual crops

c3per: C3 perennial crops

c4ann: C4 annual crops

c4per: C4 perennial crops

c3nfx: C3 nitrogen-fixing crops

secma: secondary mean age (units: years)

secmb: secondary mean biomass density (units: kg C/m<sup>2</sup>)

### 2.2.2 Transitions:

Transitions between land use states (units fraction of grid cell per y)  
All in format <state1\_to\_state2>

Wood harvest: (units fraction of grid cell)

primf\_harv: wood harvest area from primary forest  
primn\_harv: wood harvest area from primary non-forest  
secmf\_harv: wood harvest area from secondary mature forest  
secyf\_harv: wood harvest area from secondary young forest  
secnf\_harv: wood harvest area from secondary non-forest

Wood harvest: (units kg C)

primf\_bioh: wood harvest biomass from primary forest  
primn\_bioh: wood harvest biomass from primary non-forest  
secmf\_bioh: wood harvest biomass from secondary mature forest  
secyf\_bioh: wood harvest biomass from secondary young forest  
secnf\_bioh: wood harvest biomass from secondary non-forest

### 2.2.3 Management:

Irrigation: (units fraction of crop area)

irrig\_c3ann: irrigated fraction of C3 annual area  
irrig\_c3per: irrigated fraction of C3 perennial area  
irrig\_c4ann: irrigated fraction of C4 annual area  
irrig\_c4per: irrigated fraction of C4 perennial area  
irrig\_c3nfx: irrigated fraction of C3 N-fixing area  
flood: flooded fraction of C3 annual crop area

Fertilizer: (units kg N/ha/yr (crop season))

fertl\_c3ann: fertilizer rate for C3 annual crops  
fertl\_c4ann: fertilizer rate for C4 annual crops  
fertl\_c3per: fertilizer rate for C3 perennial crops  
fertl\_c4per: fertilizer rate for C4 perennial crops  
fertl\_c3nfx: fertilizer rate for C3 N-fixing crops

Biofuel crops (fraction of crop type area occupied by biofuel crops)

crpbf\_c3ann: C3 annual crops grown as biofuels  
crpbf\_c4ann: C4 annual crops grown as biofuels  
crpbf\_c3per: C3 perennial crops grown as biofuels  
crpbf\_c4per: C4 perennial crops grown as biofuels  
crpbf\_c3nfx: C3 N-fixing crops grown as biofuels

Wood harvest product split (units: fraction of wood harvest biomass)  
rndwd: industrial roundwood fraction of wood harvest  
fulwd: traditional fuelwood fraction of wood harvest  
combf: commercial biofuels fraction of wood harvest

Harvest (units of fraction of biomass harvested annually)  
fharv\_c3per: fraction of C3 perennial crops harvested annually  
fharv\_c4per: fraction of C4 perennial crops harvested annually

#### 2.2.4 Static:

ptbio: potential biomass density of natural vegetation (units: kg C / m<sup>2</sup>)  
fstnf: forest/non-forest mark (units: binary flag for forest (1) or non-forest (0))  
carea: area of grid cell (units: km<sup>2</sup>)  
ccode: country codes (units: ISO 3166-1 numeric code)  
icwtr: icew/water fraction (units: fraction of grid cell area)