

## LUH2

### **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 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, synthetic nitrogen 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:

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**LUH2 v2f****2 DESCRIPTION OF FUTURE DATA (2015-2100)**

LUH2 v2f is a release of the future harmonized land-use forcing dataset, and covers the period 2015-2100. It transitions continuously from the new gridded historical dataset (LUH2 v2h), to 8 new future scenarios identified in ScenarioMIP for CMIP6 and provided by Integrated Assessment Models (IAMs).

Future scenarios included in this version (LUH2 v2f) are:

- SSP1 RCP1.9 (from IMAGE)
- SSP1 RCP2.6 (from IMAGE)
- SSP4 RCP3.4 (from GCAM)
- SSP5 RCP3.4OS (from REMIND-MAGPIE)
- SSP2 RCP4.5 (from MESSAGE-GLOBIOM)
- SSP4 RCP6.0 (from GCAM)
- SSP3 RCP7.0 (from AIM)
- SSP5 RCP8.5 (from REMIND-MAGPIE)

A publication and DOI are also planned for this dataset.

**2.2 Files**

Files can be downloaded from: <http://luh.umd.edu/>

Note: The Land-Use Harmonization 2 (LUH2) datasets are made freely available for use by the scientific community, with attribution. Please use the following citation in any presentations or publications that result from, or include, the use of the LUH2 datasets:

Hurtt, G., L. Chini, R. Sahajpal, S. Frolking, et al. "Harmonization of global land-use change and management for the period 850-2100". Geoscientific Model Development (In prep).

The datasets are comprised of several NetCDF files:

LUH2 v2f future scenarios:

- 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 Annual Transitions:

Annual transitions between land use states (units fraction of grid cell per y)

All in format <state1\_to\_state2>; e.g., primf\_to\_range:

forested\_primary\_land to rangeland

Annual 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

Annual wood harvest: (units kg C per year)

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 Annual 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  
crpbf\_total: Fraction of total cropland area grown as 2<sup>nd</sup>  
generation biofuels

Biofuel wood harvest (units of 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