

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 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, 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_beta

2 DESCRIPTION OF FUTURE DATA (2015-2100)

*****Note: LUH2 v2f_beta is a prototype, intended for model testing and development only. The emphasis in this version is on the format of the intended data products; data values are close to final but will likely change in the finished product, and are not intended nor suitable for publication quality work. *****

LUH2 v2f_beta is a beta 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 6 new future scenarios identified in ScenarioMIP for CMIP6 and provided by Integrated Assessment Models (IAMs). All land-use states, transitions, and management layers are computed and available here as *DRAFT* values. These data are suitable for model testing and development only, and are not suitable for applications or publications. A subset of management variables (including agricultural flooding, biofuels, and fate of wood harvest) are not fully harmonized with the historical data in this beta release and will be revisited in the next version of the LUH2 future dataset.

Future scenarios included in this version (LUH2 v2f_beta) are:

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

Following the release and testing of this beta dataset, a revised version is planned for April 2017. 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_beta future scenarios:

- states.nc
- transitions.nc
- management.nc
- staticData_quarterdeg.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/m²)

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 (not fully harmonized in LUH2 v2f_beta)

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

Tillage: (units fraction of cropland area)

tillg: tilled area of cropland (not fully harmonized in LUH2 v2f_beta)

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

crpbf_c3ann: C3 annual crops grown as biofuels (not fully harmonized in LUH2 v2f_beta)
crpbf_c4ann: C4 annual crops grown as biofuels (not fully harmonized in LUH2 v2f_beta)
crpbf_c3per: C3 perennial crops grown as biofuels (not fully harmonized in LUH2 v2f_beta)
crpbf_c4per: C4 perennial crops grown as biofuels (not fully harmonized in LUH2 v2f_beta)
crpbf_c3nfx: C3 N-fixing crops grown as biofuels (not fully harmonized in LUH2 v2f_beta)

Biofuel wood harvest (units of fraction of wood harvest biomass)

rndwd: industrial roundwood fraction of wood harvest (not fully harmonized in LUH2 v2f_beta)
fulwd: traditional fuelwood fraction of wood harvest (not fully harmonized in LUH2 v2f_beta)
combf: commercial biofuels fraction of wood harvest (not fully harmonized in LUH2 v2f_beta)

Harvest (units of fraction of biomass harvested annually)

fharv_c3per: fraction of C3 perennial crops harvested annually (not fully harmonized in LUH2 v2f_beta)

fharv_c4per: fraction of C4 perennial crops harvested annually (not fully harmonized in LUH2 v2f_beta)

2.2.4 Static:

ptbio: potential biomass density of natural vegetation (units: kg C / m²)

fstnf: forest/non-forest mask (units: binary flag for forest (1) or non-forest (0))

carea: area of grid cell (units: km²)

ccode: country codes (units: ISO 3166-1 numeric code)

icwtr: ice/water fraction (units: fraction of grid cell area)