

LUH2 v0.3**1 OVERVIEW**

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 finalization of the new datasets is planned for January 2016, following one year of development and testing with input from the community beginning with the initial prototype release, and continuing with this and future updates. Ultimately, the major attributes of the datasets are planned to include:

- Global domain
- 850-2100 annual land-use states, transitions, and gridded mgt layers
- Common history
- Official CMIP6 Tier 1 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, tillage, 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)
L. Chini (lchini@umd.edu)
S. Frolking (steve.frolking@unh.edu)

2 DESCRIPTION

*****Note: LUH2 v0.3 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 ad hoc or experimental, and not intended nor suitable for publication quality work. Future updates will refine static datasets, update historical estimates, and add future projections.*****

LUH2 v0.3 is a prototype of historical and future conditions, and covers the period 850-2100. It extends the previous prototype by starting in 850 A.D. It uses new HYDE 3.2 draft historical data on cropland, pasture, urban and irrigation to enable this increase in temporal domain and thematic resolution. Grazing lands are now split into managed pasture and rangeland categories, and crop type disaggregation, management layers, and irrigation are included. A new historical wood harvest dataset based on updated FAO and HYDE was developed and incorporated. Like the previous release, future land-use inputs are from draft SSP4_3.7 GCAM; data on cropland, pasture, and wood harvest are now used in harmonization. Finally, we have included a new quarter-degree country code map. As with LUH2 v0.2, all states, transitions and management layers are computed and available here as *DRAFT* values over the future period. These data are suitable for model testing and development only, and are not suitable for applications or publications.

Major new attributes of this version include:

- Extended time domain (850-2100)
- New HYDE 3.2 draft historical data.
- Partitioning of grazing lands into pasture and rangeland
- New historical wood harvest reconstruction based on updated FAO data and new HYDE population data.
- Harmonization of crop, pasture, wood harvest data (2015 – 2100) from one IAM/RCP/SSP
- New 0.25 x 0.25 degree country code list and map

2.2 Files

Files can be downloaded from:

https://luh.umd.edu/~LUH2/v0.3_historical/
and
https://luh.umd.edu/~LUH2/v0.3_future/

The datasets are comprised of several NetCDF files:

LUH2 v0.3 historical:

- states.nc (5.6GB)

- transitions.nc (12.0GB)
- management.nc (1.5GB)

LUH2 v0.3 future:

- states.nc (599MB)
- transitions.nc (1.0GB)
- management.nc (170MB)

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 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

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

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

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

2.2.4 Static:

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

fstnf: forest/non-forest mark (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: icew/water fraction (units: fraction of grid cell area)