

## LUH2 v0.1

### 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 testing, refinement, and augmentation with input from the community beginning with this initial prototype release. Ultimately, the major attributes of the datasets are planned to include:

- Global domain
- 1500-2100, 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)

### 2 DESCRIPTION (v0.1)

**\*\*\*Note: LUH2 v0.1 is an initial prototype release, 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.\*\*\***

The first release of LUH2 (v0.1) is for the period 1500-2015 only, and for development purposes relies mainly on the same inputs as used in CMIP5 set, albeit extended to 2015. For new functionality, additional major inputs for this version control contemporary crop functional type distribution, gridded historical irrigation, and global fertilizer use. The main advances here are in model processing and output. The code base for LUH2 has been entirely rewritten, and all planned states, transitions, and management layers noted above for the final release are computed and available here as \*draft\* values over the historic period. These data are suitable for model testing and development only. Major updates planned for future versions include:

- Updated static basemaps
- Updated historical inputs
- Updated management data and algorithms
- Multiple subgrid landcover types
- Non-trivial crop rotations
- Harmonized future scenarios

## 2.1 Files

Files can be downloaded from: <https://luh.umd.edu/~LUH2/v0.1/>

The dataset is comprised of 4 netcdf files:

- states.nc (2.5GB)
- transitions.nc (5.3GB)
- management.nc (773 MB)
- staticData\_quarterdeg.nc (32 MB)

## 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

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 / 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)