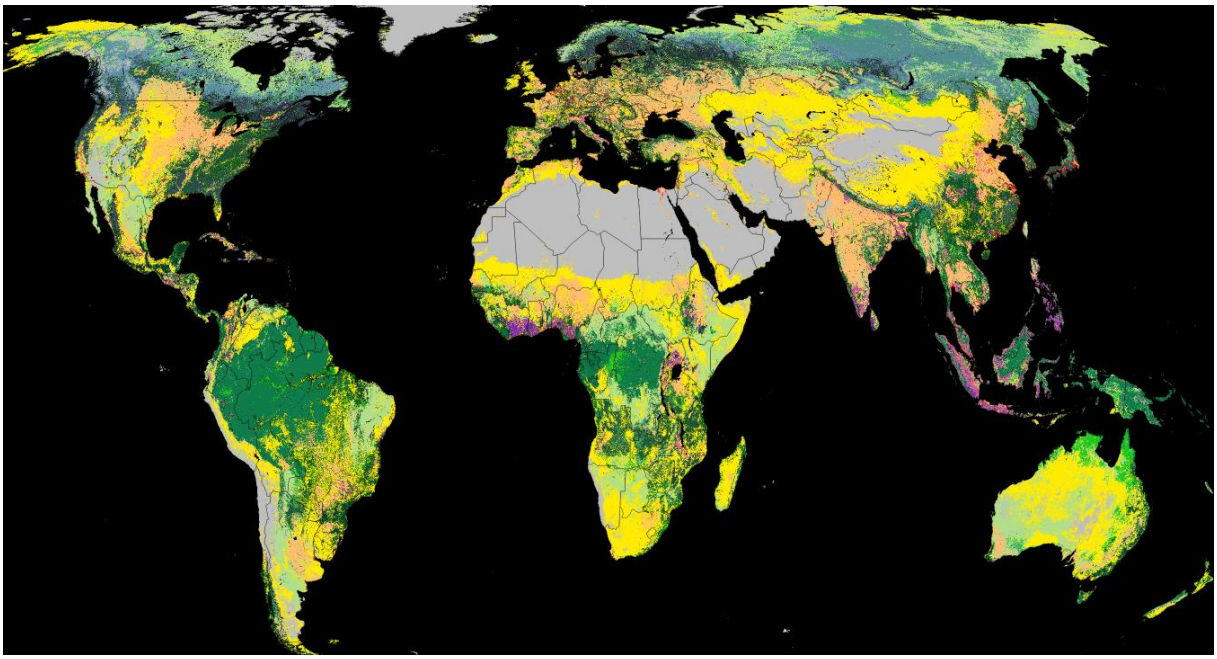
HILDA+ Global Land Use Change version 2.1 crop

Specifications **vGLOB-2.1-crop_geotiff**



HILDA+ land use/cover 2020

Specifications of vGLOB-2.0_geotiff

Data set	Land Use/Cover states (1) and transitions (2)
Thematic classes	**1) Land Use/Cover categories (states)**
	00 ocean 11 urban 22 annual crops 23 tree crops 24 agroforestry 33 pasture/rangeland 40 forest (unknown/other) 41 forest (evergreen, needle leaf) 42 forest (evergreen, broad leaf) 43 forest (deciduous, needle leaf) 44 forest (deciduous, broad leaf) 45 forest (mixed) 55 unmanaged grass/shrubland 66 sparse/no vegetation 77 water 99 no data
	2) Transitions between Land Use/Cover categories (transitions) with 4-digit codes (XXYY, where XX is LULC category of previous year and YY is LULC category of reference year)
	e.g. 1111 urban (stable) 1122 urban to annual crops

1123 urban to tree crops
1124 urban to agroforestry
1133 urban to pasture
1140 urban to forest (unknown/other)
1141 urban to forest (evergreen, needle leaf)
1142 urban to forest (evergreen, broad leaf)
1143 urban to forest (deciduous, needle leaf)
1144 urban to forest (deciduous, broad leaf)
1155 urban to shrub/grassland
1166 urban to other land
…
etc.

hildap_vGLOB-2.1-crop_geotiff_eckert4 (equal-area projection)

Format	GeoTIFF
Projection	EPSG:54012 - World_Eckert_IV
Spatial coverage/extent	-180, 90, 180, -90
Temporal coverage	1960-2020
Spatial resolution	1 km
Temporal resolution	1 year

General/ data basis for change allocation procedure

- HILDA+ period **1960-2020**: land use/cover and transitions are based on
    - reported (and extrapolated) FAO land use (forest, cropland, pasture area) and population estimates
    - remote sensing-based maps of class area fractions (harmonisation of multiple EO-based land cover products, see table below)
    - data-derived (from ESA CCI LC, AAFC, Australia DLCD, CORINE, LULC India, MoFor Indonesia, NLCD USA), country-specific mean transition matrices
- base map 2020: built from ESA World Cover (10m) and calibrated to FAO forest, cropland and pasture data from 2020, used as starting point for annual change allocation

Definitions and data basis for cropland subclasses: annual crops, tree crops and agroforestry

- Tree crops: Crops produced by trees, including the following FAO crop categories:
  Almonds, with shell; Apples; Apricots; Areca nuts; Apricots; Avocados; Cashew nuts with shell; Cashewapple; Cherries; Cherries, sour; Chestnut; Coconuts; Cocoa, beans; Coffee, green; Dates; Figs; Grapefruit (inc. pomelos); Grapes; Gums, natural; Hazelnuts, with shell; Jojoba seed; Kapok fibre; Kapok fruit; Kapokseed in shell; Karite nuts (sheanuts); Kiwi fruit; Kola nuts; Lemons and limes; Mangoes, mangosteens, guavas; Oil palm fruit; Oil, coconut (copra); Oil, olive, virgin; Oil, palm; Oil, palm kernel; Olives; Oranges; Peaches and nectarines; Pears; Pepper (piper spp.);

Persimmons; Pistachios; Quinces; Rubber, natural; Tangerines, mandarins, clementines, satsumas; Tung nuts; Vanilla; Walnuts, with shell.

- Agroforestry: Crops grown among trees (mixture of cropland and tree cover)
- Annual crops: Crops that complete their life cycle within one year/growing season (all cropland which was not classified as tree crops or agroforestry).

Spatial datasets used for cropland mapping in HILDA+ version 2.0

Dataset	Variables used in this study	Spatial coverage/ resolution	Reference time	References
SDPT 1.0	• Tree crops	82 countries/ scale varies by country	2015	(Harris et al., 2019)
Lesiv et al. Forest management	• Oil palm plantations • Agroforestry	Global/ 100m	2015	(Lesiv et al., 2022)
Descals et al. Oil palm map	• Industrial oil palm plantations • Smallholder oil palm plantations	Global/ 10m	2019	(Descals et al., 2021)
SPAM 2010	• Tree crops: banana, cocoa, coconut, coffee, oil palm, plantain, tropical and temperate fruit	Global/ 5 arc min (~10km)	2010	(Yu et al., 2020)
Agroforestry maps	• Tree cover on agricultural land	Global/30 arc sec (~1km)	2000, 2010	(Zomer et al., 2016)

In this updated HILDA+ version 2.0, additional cropland-related land use categories tree crops, agroforestry and annual crops were derived from a combination of remote sensing-based spatial datasets and crop production statistics (tree crops defined as above) from the FAO (FAO, 2022). Fractional information from the spatial data was used for a potential reallocation of HILDA+ version 1.0 land use categories cropland, pasture/rangeland, grass/shrubland or forests (not matching ESA CCI forest categories).

Descals, A., Wich, S., Meijaard, E., Gaveau, D.L.A., Peedell, S., Szantoi, Z., 2021. High-resolution global map of smallholder and industrial closed-canopy oil palm plantations. Earth Syst. Sci. Data 13, 1211–1231. https://doi.org/10.5194/essd-13-1211-2021

FAO, 2022. FAOSTAT Production, crops and livestock products [Dataset], last update: February 17, 2022, Food and Agriculture Organization of the United Nations (FAO), http://www.fao.org/faostat/en/#data/QC [WWW Document]. URL https://www.fao.org/faostat/en/#data/QCL (accessed 12.18.22).

Harris, N., Goldman, E.D., Gibbes, S., 2019. "Spatial Database of Planted Trees Version 1.0." Technical Note. Washington, DC: World Resources Institute. Available online at: https://www.wri.org/publication/spatial-database-planted-trees. [WWW Document].

Lesiv, M., Schepaschenko, D., Buchhorn, M., See, L., Dürauer, M., Georgieva, I., Jung, M., Hofhansl, F., Schulze, K., Bilous, A., Blyshchyk, V., Mukhortova, L., Brenes, C.L.M., Krivobokov, L., Ntie, S., Tsogt, K., Pietsch, S.A., Tikhonova, E., Kim, M., Di Fulvio, F., Su, Y.-F., Zadorozhniuk, R., Sirbu, F.S., Panging, K., Bilous, S., Kovalevskii, S.B., Kraxner, F., Rabia, A.H., Vasylyshyn, R., Ahmed, R., Diachuk, P., Kovalevskyi, S.S., Bungnamei, K., Bordoloi, K., Churilov, A., Vasylyshyn, O., Sahariah, D., Tertyshnyi, A.P., Saikia, A., Malek, Ž., Singha, K., Feshchenko, R., Prestele, R., Akhtar, I. ul H., Sharma, K., Domashovets, G., Spawn-Lee, S.A., Blyshchyk, O., Slyva, O., Ilkiv, M., Melnyk, O., Sliusarchuk, V., Karpuk, A., Terentiev, A., Bilous, V., Blyshchyk, K., Bilous, M., Bogovyk, N., Blyshchyk, I., Bartalev, S., Yatskov, M., Smets, B., Visconti, P., Mccallum, I., Obersteiner, M.,

Fritz, S., 2022. Global forest management data for 2015 at a 100 m resolution. Sci. Data 9, 199. https://doi.org/10.1038/s41597-022-01332-3

Yu, Q., You, L., Wood-Sichra, U., Ru, Y., Joglekar, A.K.B., Fritz, S., Xiong, W., Lu, M., Wu, W., Yang, P., 2020. A cultivated planet in 2010 – Part 2: The global gridded agricultural-production maps. Earth Syst. Sci. Data 12, 3545–3572. https://doi.org/10.5194/essd-12-3545-2020

Zomer, R.J., Neufeldt, H., Xu, J., Ahrends, A., Bossio, D., Trabucco, A., van Noordwijk, M., Wang, M., 2016. Global Tree Cover and Biomass Carbon on Agricultural Land: The contribution of agroforestry to global and national carbon budgets. Sci. Rep. 6, 29987. https://doi.org/10.1038/srep29987

Spatial land use/cover datasets used for HiLDA+ land use change (version 2.0 and 2.1) and their specifications (thematic, spatial and temporal coverage):

Dataset and reference	Used thematic coverage	Spatial coverage	Used temporal coverage	Spatial resolution	Data type
Copernicus LC100 https://land.copernicus.eu/global/products/lc	LCCS 22 classes	global	2015-2019	100 m	raster
ESA CCI Land Cover http://maps.elie.ucl.ac.be/CCI/viewer/download.php	LCCS 22 classes	global	1992-2019	300 m	raster
ESA WorldCover https://esa-worldcover.org/en/data-access	LCCS 11 classes	global	2020	10 m	raster
GLAD UMD VCF https://glad.umd.edu/dataset/long-term-global-land-change	tree canopy, bare ground, short vegetation	global	1982-2016	0.05 deg	raster
GLC2000 http://forobs.jrc.ec.europa.eu/products/glc2000/glc2000.php	LCCS 22 classes	global	2000	1 km	raster
GLCNMO https://globalmaps.github.io/glcnmo.html	LCCS 22 classes	global	2003 2008, 2013	30 arc sec 15 arc sec	raster
Global Human Settlement Layer (GHSL) https://ghslsys.jrc.ec.europa.eu/datasets.php	built-up area (fractional)	global	1975, 1990, 2000, 2014	1 km	raster
Global Urban Footprint (GUF) https://www.dlr.de/eoc/en/desktopdefault.aspx/tabid-11725/20508_read-47944/	built-up area (fractional)	global	2011/12	2.8 arc sec	raster
GlobCover http://due.esrin.esa.int/page_globcover.php	LCCS 22 classes	global	2005/2006, 2009	300 m	raster
Globeland30 http://www.globeland30.org	10 LULC classes	global	2000, 2010	30 m	raster
Gridded Livestock World v3 (GLW) http://www.fao.org/livestock-systems/en/	density of ruminants	global	2010	5 arc min	raster

Hansen GFC https://storage.googleapis.com/earthenginepartners-hansen/GFC-2021-v1.9/download.html	tree cover (fractional) loss and gain year	global	2000-2019 (loss) 2000-2012 (gain)	30 m	raster
HYDE 3.3 (preliminary version, requested from authors) https://www.pbl.nl/en/image/links/hyde	cropland, grazing land	global	1900-2019	5 arc min	raster
MODIS MCD12Q1 https://lpdaac.usgs.gov/products/mcd12q1v006/	IGBP 17 classes	global	2001-2013 (yearly)	500 m	raster
Ramankutty cropland (update) http://www.ramankuttylab.com/data.html	cropland	global	1900-2011	5 arc min	raster
AAFC Land Use Canada https://open.canada.ca/data/en/dataset/18e3ef1a-497c-40c6-8326-aac1a34a0dec	15 LULC classes	Canada	1990, 2000, 2010	30 m	raster
Australia DLCD V2.1 https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search#/metadata/83868	LCCS 22 classes	Australia	2002-2014	500 m	raster
CORINE https://land.copernicus.eu/pan-european/corine-land-cover/view	44 LULC classes with change layers	Europe (changing extent)	1990, 2000, 2006, 2012, 2018	100 m	raster
LULC classification of India https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=1336	11 LULC classes (IGBP scheme)	India	1985, 1995, 2005	100 m	raster
MoEF Indonesia http://webgis.dephut.go.id:8080/kemenhut/index.php/en/feature/download	22 LULC classes	Indonesia	2000, 2003, 2006, 2009	300 m	raster
NLCD Land Cover (CONUS) https://www.mrlc.gov/data?f%5B0%5D=category%3Aland%20cover	16 LULC classes	U.S.	2001, 2006, 2011	30 m	raster
RCMRD Land Cover http://opendata.rcmrd.org/search?tags=land%20cover	6 LULC classes with country-specific sub-classes	Botswana, Ethiopia, Lesotho. Malawi, Namibia, Rwanda, Tanzania, Uganda, Zambia	different years between 2000 and 2014	30 m	raster
South Africa Land Cover http://www.sasdi.net/sresults.aspx?text=Land+cover&offset=0&f_text=land%20cover	35/72 LULC classes	South Africa	1990, 2013-14	30 m	raster

* LULC = land use/land cover, LCCS = Land Cover Classification System, IGBP = International Geosphere-Biosphere Programme