POPGRID Comparative Matrices of Population and Settlement Products

The following tables are intended to assist data users in selecting appropriate population and settlement (urban extent) grids for research and applied uses. They are provided as part of the POPGRID (www.popgrid.org) data collaborative. Questions should be directed to ciesin.info@ciesin.columbia.edu.

This table is current as of 26 November 2018

Table of Contents

Table 1. Global and Continental Population Grids: Summary Characteristics

Dataset	Source	Concept	Method	Grid Cell Size	Year(s) Represented	Source for National Level Population Totals	Distribution Policy
Unmodeled Population Grids							
Gridded Population of the World (GPW), version 4	Center for International Earth Science Information Network (CIESIN) - Columbia University	Nighttime population (population counted at place of domicile)	Areal weighted such that population is spread across all grid cells covering a census unit based on the proportion of the grid cell that falls in the census unit. See table of input layers below. Details.	30 arc-seconds (1 km)	2000, 2005, 2010, 2015, 2020	Two versions: 1) official country totals from census; 2) Country totals adjusted to United Nations Population Division (UNPD) estimates and projections	Open access
Lightly Modeled Population Grids							
Global Human Settlement Layer – Population (GHS-POP)	European Commission Joint Research Centre (JRC) and Center for International Earth Science Information Network (CIESIN) - Columbia University	Nighttime population (population counted at place of domicile)	Binary dasymetric* using Landsat-derived built up areas and proportional allocation to distribute population data from subnational census data to the settlement extents. See table of input layers below. Details.	7.5 arc-minutes (250 m), 30 arc-seconds (1 km) (World Mollweide projection)	1975, 1990, 2000, 2015	United Nations Population Division (UNPD) estimates and projections	Open access
Global Rural Urban Mapping Project (GRUMP)	Center for International Earth Science Information Network (CIESIN) - Columbia University, International Food Policy Research Institute (IFPRI), The World Bank, Centro Internacional de Agricultural Tropical (CIAT)	Nighttime population (population counted at place of domicile)	Binary dasymetric* using DMSP-OLS nighttime lights and proportional allocation to distribute population data from subnational census data to the settlement extents. See table of input layers below. Details.	30 arc-seconds (1 km)	1990, 1995, 2000	United Nations Population Division (UNPD) estimates and projections	Open access

Table 1. Global and Continental Population Grids: Summary Characteristics (continued)

Dataset	Source	Concept	Method	Grid Cell Size	Year(s) Represented	Source for National Level Population Totals	Distribution Policy
Highly Modeled Population Grids							
History Database of the Global Environment (HYDE) Population Grids, version 3.1	Netherlands Environmental Assessment Agency (PBL)	Nighttime population	Historical population, cropland and pasture statistics are combined with satellite information and specific allocation algorithms (which change over time) to create spatially explicit dasymetric* population maps. Details.	5 arc-minutes (10 km)	10,000 BC to 2000 AD (10,000 BC, 5,000 BC, 0 AD, 500 AD, 1000 AD, 1500 AD, 1600 AD, 1700 AD, 1800 AD, 1900 AD, 1950 AD, 2000 AD)	Population estimates are generally on the high end of the range of past estimates	Open access
LandScan Global Population database	Oak Ridge National Laboratory (ORNL)	Day time (ambient) population	Spatial data and imagery analysis technologies and a multi-variable dasymetric* modeling approach are used to disaggregate census counts within an administrative boundary. The population distribution models are tailored to match the data conditions and geographical nature of each country and region. See table of input layers below. Details.	30 arc-seconds (1 km)	annual releases 2000 - 2016 (current version)	US Census Bureau	Commercial / Free for research use

Table 1. Global and Continental Population Grids: Summary Characteristics (continued)

Dataset	Source	Concept	Method	Grid Cell Size	Year(s) Represented	Source for National Level Population Totals	Distribution Policy
World Population Estimate	ESRI	Mixed (45% of countries are nighttime populations), based on available national population estimates, though progressing toward nighttime with each new release	Dasymetric* mapping based on four inputs: BaseVue 30-m landcover for urban classes; 75-m grid of presence/absence of road intersections; 75-m geonames populated place points buffered by 5 cells; landsat8 15-m panchromatic rugosity with regional threshold for levels of landscape disturbance equating to human settlement. Details. See table of input layers below.	150 meter (2016), 250 meter (earlier)	2013, 2015, and 2016, with 2017 planned for fall 2018.	Country-official estimates with 134 countries processed further by Michael Bauer Research GmbH.	Commercial / Free to ArcGIS Users
WorldPop	WorldPop	High spatial resolution, temporally-explicit data on human population and demographic distributions	Top-down approach that relies on a statistically-based weighting layer combined with a dasymetric* redistribution. See table of input layers below. Details.	3-arc second (100 meter)	2000-2020 globally and country-specific years	Two versions: 1) Country-official estimates, and 2) United Nations Population Division (UNPD) estimates and projections	Open access

* Dasymetric mapping approaches rely on ancillary data to spatially disaggregate census counts from administrative / census units in an effort to develop higher resolution data products that more faithfully represent population distribution on the ground. The simplest approach is binary dasymetric mapping, which uses one other data layer (such as satellite-derived built-up areas or urban extents) to move populations from census units (which are sometimes large) to areas identified as settlements. Other techniques use a variety of ancillary data, including urban extents, land cover data, and slope, as well as spatial "masks" to exclude populations from protected areas or military reserves, to move populations using statistical weighting algorithms to inform final gridded outputs.

Table 2. Input Layers for Global Gridded Data Sets

	Input Variables									
Dataset	Population	Roads	Land Cover	Built structures	Cities or Urban areas	Nighttime lights	Infrastructure	Environmental data (climate, topography, elevation)	Protected areas	Water bodies
Gridded Population of the World (GPW)	x								x	x
Global Rural-Urban Mapping Project (GRUMP)	x				x	x			x	x
LandScan Global Population database	x	x	x	x	x		x	x	x	x
Global Human Settlement Layer – Population (GHS-POP)	x			x						
World Population Estimate	x	x	x		x					x
WorldPop	x	x	x	x	x	x	x	x	x	x

* Protected areas are not masked in GPW and GRUMP, but the census bureaus often define the protected areas as no data or 0 (zero), regardless of whether people live in them.

Table 3. Continental and Country Population Grids: Summary Characteristics

Dataset	Source	Concept	Method	Grid Cell Size	Year(s) Represented	Continent or Countries Represented	Distribution Policy
Continental Population Grids							
GEOSTAT 1B	Eurostat	Nighttime population (population counted at place of domicile)	Bottom-up aggregation for most countries; intelligent dasymetric* mapping for others	1 km (vector grid)	2011	Europe (total populations are based on official country data)	Open access
GHS population grid	European Commission Joint Research Centre (JRC)	Nighttime population (population counted at place of domicile)	Intelligent dasymetric* mapping	100 meter	2011	Europe (total populations are based on official country data)	Open access
Country Population Grids							
Gridded Population Mapping (Demobase)	US Census Bureau	Nighttime population (population counted at place of domicile)	A classification and regression tree methodology was used to create a percent impervious-area layer based on Landsat data. Dasymetric* mapping was used to distribute population proportionately to impervious areas. Details.	100 meter	Country specific	Haiti (details), Pakistan, Rwanda	Open access
High Resolution Settlement Layer (HRSL)	Facebook Connectivity Lab and CIESIN	Nighttime population (population counted at place of domicile)	Binary dasymetric* using Digital Globe 0.5 meter imagery to identify houses/ settlements and proportional allocation to distribute population data from subnational census data to the settlement extents. Details.	1 arc-second (30 meter)	2015	Algeria, Argentina, Burkina Faso, Cambodia, Ghana, Guatemala, Haiti, Indonesia, Ivory Coast, Kenya, Madagascar, Malawi, Mexico, Mozambique, Nigeria, The Philippines, Puerto Rico, Rwanda, South Africa, Sri Lanka, Tanzania, Tunisia, Thailand, Uganda	Open access

Table 3. Continental and Country Population Grids: Summary Characteristics (continued)

Dataset	Source	Concept	Method	Grid Cell Size	Year(s) Represented	Countries Represented	Distribution Policy
OpenPopGrid	GeoData, University of Southampton and based on the UK Office for National Statistics (ONS) 2011 Census and Ordnance Survey OpenData.	Nighttime population (population counted at place of domicile)	Postcode headcounts are redistributed over a grid based on OS OpenData Vector Map District buildings dataset. Building polygons have been filtered to remove non-residential areas using unpopulated postcode centroids. Details.	10 meter	2011	United Kingdom	Open access (Open Database License)
European Forum for Geography and Statistics	Multiple sources	Depends on country	Depends on country	Depends on country	Depends on country	Finland, Netherlands, Norway, Portugal	Open access

* Dasymetric mapping approaches rely on ancillary data to spatially disaggregate census counts from administrative / census units in an effort to develop higher resolution data products that more faithfully represent population distribution on the ground. The simplest approach is binary dasymetric mapping, which uses one other data layer (such as satellite-derived built-up areas or urban extents) to move populations from census units (which are sometimes large) to areas identified as settlements. Other techniques use a variety of ancillary data, including urban extents, land cover data, and slope, as well as spatial "masks" to exclude populations from protected areas or military reserves, to move populations using statistical weighting algorithms to inform final gridded outputs.

Table 4. Global and Continental Urban Extent / Settlement Layers: Summary Characteristics

Dataset	Source	Concept	Method	Imagery Used	Spatial Resolution	Year(s) Represented	Distribution Policy
Global Human Built-up And Settlement Extent (HBASE) Dataset From Landsat, v1	NASA Goddard Space Flight Center (distributed via NASA SEDAC)	Extent of settlements	Integrates spatial texture and contextual information to map the spatial extent of an urban area (i.e. HBASE) using Landsat imagery, which is then used as an input to impervious surface mapping (GMIS below). Details.	Landsat	30 meter, 250 meter, and 1 km	2010	Open access
Global Human Settlement Layer – Built Up (GHS-BUILT)	European Commission Joint Research Centre (JRC)	Presence of buildings	Landsat imagery are used to estimate the proportion of building footprint and impervious surfaces within each grid cell. Details.	Landsat	38 m	1975, 1990, 2000, 2014	Open access
Global Human Settlement Layer – Settlement Model (GHS-SMOD)	European Commission Joint Research Centre (JRC)	Multiple classes of settlement based on combination of population density, population size, and density of built-up areas	Uses GHS-BUILT built up density and GHS-POP population grid as inputs to create classes (urban center, urban cluster, and rural) derived from combinations of population density, size, and density of built-up. Details.	Landsat	1 km	1975, 1990, 2000, 2015	Open access
Global Man-made Impervious Surface (GMIS) Dataset From Landsat, v1	NASA Goddard Space Flight Center (distributed via NASA SEDAC)	Percent impervious surface per grid cell	High resolution satellite imagery are used to calculate the percent man-made impervious surface for each 30m Landsat pixel, masking out non-urban areas using HBASE (above). Details.	Landsat	30 meter, 250 meter, and 1 km	2010	Open access

Table 4. Global and Continental Urban Extent / Settlement Layers: Summary Characteristics (continued)

Dataset	Source	Concept	Method	Imagery Used	Spatial Resolution	Year(s) Represented	Distribution Policy
Global Rural Urban Mapping Project: Urban Extent Grids, v1	Center for International Earth Science Information Network (CIESIN) - Columbia University, International Food Policy Research Institute (IFPRI), The World Bank, and Centro Internacional de Agricultura Tropical (CIAT)	Broader footprints of human settlements	Thresholded DMSP-OLS nighttime lights plus buffered settlement points. Details.	Defense Meteorological Program Optical Line Scan (DMSP-OLS) nighttime lights	15 km	Circa 1995	Open access
Global Rural Urban Mapping Project: Urban Extent Polygons, v1.01	Center for International Earth Science Information Network (CIESIN) - Columbia University, CUNY Institute for Demographic Research (CIDR), International Food Policy Research Institute (IFPRI), The World Bank, and Centro Internacional de Agricultura Tropical (CIAT)	Broader footprints of human settlements	Thresholded DMSP-OLS nighttime lights plus buffered settlement points. The gridded data set was converted to polygons and settlement names were associated with each polygon. Details.	Defense Meteorological Program Optical Line Scan (DMSP-OLS) nighttime lights	15 km	Circa 1995	Open access
Global Urban Footprint	German Aerospace Center (DLR), Earth Observation Center (EOC)	Very high resolution built up areas	A total of 180,000 TerraSAR-X and TanDEM-X radar scenes were processed to create the GUF. Details.	TanDEM-X	12 meter	2011 / 2012	Commercial / Free for research use