

## Global exposure datasets – Population and Environment built

**Abstract:** GAR15 global exposure database is based on a top-down approach where statistical information including socio-economic, building type, and capital stock at a national level are transposed onto the grids of 5x5 or 1x1 using geographic distribution of population data and gross domestic product (GDP) as proxies.

**Geographic location of the datasets:** West: -180 / East: 180 / South: -90 / North: 90

**Dataset language:** eng

**Metadata standard name:** ISO 19115:2003/19139

**Dataset character set:** utf8

**Dataset reference system:** GCS\_WGS\_1984

**Dataset number of rows:** 4,573,567

**Dataset number of columns:** 55

**Dataset responsible party:** UNISDR – Risk Knowledge Section - Palais des Nations - Geneva

**Use constraints:** *This dataset was generated using other global datasets; it should not be used for local applications (such as land use planning). The main purpose of GAR 2015 datasets is to broadly identify high risk areas at global level and for identification of areas where more detailed data should be collected. Some areas may be underestimated or overestimated. Given this analysis was conducted using global datasets, the resolution of which is not sufficient for in-situ planning, it should not be used for critical (like life saving) decisions. UNISDR and collaborators should in no case be liable for misuse or misinterpretation of the presented results. The designations employed and the presentation of material on the maps do not imply the expression of any opinion whatsoever on the part of UNISDR or the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.*

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## Columns explanation

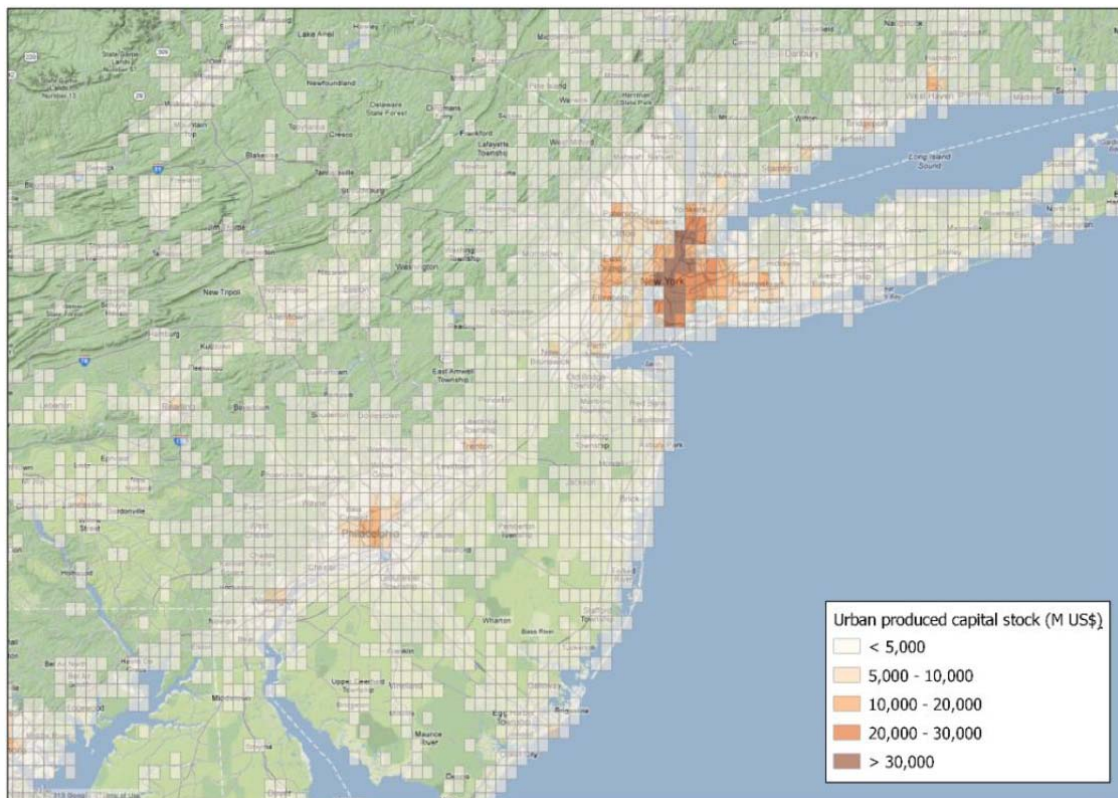
			Proxy	
bed: refers to health	prv: refers to private sector	... bed_prv_cr	0.0044	cr: refers to capital stock rural (built environment) in million US\$
		... bed_prv_cu	0.0000	
		... bed_prv_pr	0.0810	
		... bed_prv_pu	0.0000	
	pub: refers to public sector	... bed_pub_cr	0.0039	cu: refers to capital stock urban (built environment) in million US\$
		... bed_pub_cu	0.0000	
		... bed_pub_pr	0.0720	
		... bed_pub_pu	0.0000	
edu: refers to education		... edu_prv_cr	0.0390	
		... edu_prv_cu	0.0000	
		... edu_prv_pr	0.8000	
		... edu_prv_pu	0.0000	
		... edu_pub_cr	0.3803	pu: refers to urban population
		... edu_pub_cu	0.0000	
		... edu_pub_pr	7.8000	
		... edu_pub_pu	0.0000	
emp: refers to employment	agr: refers to agricol sector	... emp_agr_cr	0.0000	
		... emp_agr_cu	0.0000	
		... emp_agr_pr	0.3000	
		... emp_agr_pu	0.0000	
	gov: refers to government sector	... emp_gov_cr	0.2536	pr: refers to rural population
		... emp_gov_cu	0.0000	
		... emp_gov_pr	3.8000	
		... emp_gov_pu	0.0000	
	ind: refers to industrial sector	... emp_ind_cr	0.6236	
		... emp_ind_cu	0.0000	
		... emp_ind_pr	5.4000	
		... emp_ind_pu	0.0000	
ic: refers to housing	ser: refers to service sector	... emp_ser_cr	1.0743	
		... emp_ser_cu	0.0000	
		... emp_ser_pr	16.1000	
		... emp_ser_pu	0.0000	
	high: Income group high	... ic_high_cr	8.5128	
		... ic_high_cu	0.0000	
		... ic_high_pr	42.8000	
		... ic_high_pu	0.0000	
	low: Income group low	... ic_low_cr	0.0051	
		... ic_low_cu	0.0000	
		... ic_low_pr	0.8000	
		... ic_low_pu	0.0000	
	mhg: Income group Upper middle	... ic_mhg_cr	0.3984	
		... ic_mhg_cu	0.0000	
		... ic_mhg_pr	6.9000	
		... ic_mhg_pu	0.0000	
	mlw: Income group : Lower middle	... ic_mlw_cr	0.0962	
		... ic_mlw_cu	0.0000	
		... ic_mlw_pr	2.5000	
		... ic_mlw_pu	0.0000	
... id_5x			3188655	id of grids of 5X5
... iso3			USA	ISO_3_code
... tot_cr			11.3918	Total capital stock rural (sum of all cr)
... tot_cu			0.0000	Total capital stock urban (sum of all cu)
... tot_pob			87.3530	Total population (tot_pr + tot_pu)
... tot_pr			87.3530	Total rural population (sum of all pr)
... tot_pu			0.0000	Total urban population (sum of all pu)
... tot_val			11.3918	Total capital stock (tot_cr + tot_cu)

## Methodology

More detailed information on GAR15 - Annex1 : <http://goo.gl/WKXaPK>

Global exposure database was developed for GAR15 by UNEP-GRID with close collaboration and inputs from WAPMERR (World Agency of Planetary Monitoring and Earthquake Risk Reduction), EU Joint Research Center (JRC), and Kokusai Kogyo. This database includes estimation on the economic value of the exposed assets, as well as their physical characteristics in urban and rural agglomerations including estimation of population too. This information is key to assess the potential damages from different hazards to each of the exposed elements.

The global exposure database is developed at 1km spatial resolution at coastal areas and at 5km spatial resolution everywhere else on the globe. It includes economic value, number of residents, and construction type of residential, commercial and industrial buildings, as well as hospitals and schools (De Bono et al., 2015).



Accessing national census has proved to be quite challenging. For estimating the non-residential distributions, especially for the countries for which no relevant published census data were available, several other sources such as “World Housing Encyclopedia” as well as expert judgment are used to make assumptions necessary to estimate the properties of the building stock (Tolis et al., 2013).

Combining all the components mentioned above, the economic value of each building class in one cell is assessed based on the disaggregation of the (national) Produced Capital at grid level. This downscaling was done by using the sub-national values of economic activity as a proxy. The result is the global distribution of the economic value of the urban and rural produced capital by construction class.

Further details on the GAR Global Exposure Dataset can be found in technical background papers (De Bono, et.al, 2015), (Tolis et al., 2013) and (Pesaresi, et.al, 2015).

## **Main components of the global exposure dataset:**

### **Reference Grid**

The so 5x5km reference grid for GAR global exposure dataset includes the whole earth land surface, comprising uninhabited land areas. In this way the reference Grid will be able to handle eventually future data on crops pastures and forest areas. The total number of cells of the grid is 9,008,829. Inhabited cells correspond to 4,574,010. The 5x5km grid size was the choice balancing three criteria of (a) satisfactory size to capture effects for large scale hazards such as earthquake and cyclones at global scale, (b) consistency with the openly available socio-economic datasets with national or global sources, (c) optimizing the computation time. Another grid at 30" resolution (around 1x1 km at equator) was set in order to hold exposure data related to coastal areas. The grid was only built for a sector including the first 10 km of coast worldwide.

### **Boundaries of built-up environment (using BUREF)**

The next task is to define the boundaries of human settlements or building stock on the global and identified as urban, sub-urban, or rural. The boundaries of building stock is defined using satellite-imagery of land cover. The Global Built-up Reference Layer (BUREF2010) generated by JRC is a spatial raster dataset containing an estimation of the distribution and density of built-up areas (Pesaresi et al., 2015). It uses publicly available satellite-derived land cover information and per grid population density data to define the percentage of land occupied by buildings per each grid.

## **Defining the “content” of each grid in exposure dataset using combination of various datasets:**

### **Population distribution**

The primary source of global exposure information is the distribution of people on the earth surface. A gridded population dataset is based on a regular grid, where each cell indicates the number of people living on it.

In GEG-2015 development, the new LandScan data published on June 2012 by Oak Ridge National Laboratory was used and refer to the population as of July 2011 at 30" resolution (approx. 1 km equator).

### **Night time light intensities or Visible Infrared Imaging Radiometer Suite (VIIRS)**

The intensities of nighttime lights represents a good proxy of human activities and they were already used at global scale to map economic activity. (Gosh, T. et al., 2010)

### **Produced capital stock**

The economic value of buildings (capital stock) per country is estimated using a dataset for 152 countries from The World Bank (World Bank, 2011) has provides broad estimates of the current (2005) capital stock of machinery and structures, based on the Perpetual Inventory Method (PIM) and historical Gross Capital Formation (GCF) data. Furthermore, the World Bank scale-up this estimate by 24% to account for the value of Urban Land.

### **Gross regional product**

A raster of Gross Regional Product (GRP) distribution is generated by collecting and assembling all available information for 71 major countries using the following sources:

- ☒ Eurostat: 25 countries
- ☒ Beijing Normal University: 1 country (China)
- ☒ OECD: 1 country
- ☒ World Bank DECRG: 44 countries

The GRP will be further integrated with the outputs from night time light intensities in order to generate a new indicator showing the GDP variation between national and subnational scales. These regional variations of economic activity within a country are used as the basis for geographical distribution of capital stock.

### **Socio-economic indicators**

Socio economic indicators are used as proxies to estimate the use of the building stock for various sectors of commercial, industrial, public, education and health and various economic level for residential sector.

### **Defining construction classes and distribution**

Once the density, values, and sectorial distribution of building stock in each cell are defined, the next step is to define the construction classes and the distribution of various construction classes in each grid.

The World Agency of Planetary Monitoring & Earthquake Risk Reduction (WAPMERR) gathered data on the sub-national distribution of building types for 18 countries using household data from national census as proxies. Countries selected include the largest heterogeneous ones (China, India and Indonesia) and represent 3.6 billion people, about 50% of the total population of the world. Data on characteristics of houses or households are given for residential/nonresidential groups and mainly divided in large urban small urban and rural areas classification. WAPMER developed the dataset for all countries using construction types defined by PAGER, a program of USGS.