

Human Planet updates and new data and services for GEO's engagement priorities

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Columbia Climate School, Columbia University

16 June 2023, Geneva, Switzerland
GEO Open Data Knowledge Workshop

HPI updates and new data and services

1. Global Human Settlement Layer (GHSL) 2.0 Release (March 2023)
2. Copernicus EMS –Exposure Component
3. Use Cases
4. Selected SDG Indicators and Associated Services
5. Other New HPI-Related Data and Scenarios

GHSL 2.0 Main Features

Data and tools to monitor planet Earth through **time series** of **global information** on **built-up areas**, **population**, and **settlements**

- **Improved spatial resolution**
 - Built-up surface fraction at 10 m spatial resolution
 - Population density at 100 m
- **Built-up classification:** residential and non-residential uses
- Building height and Volume information at 100 m spatial resolution
- **Extended time series:** 1975-2030 in 5 year intervals at 100 m

Open and Free Geospatial Data for Download

GHSL 2.0

<https://ghsl.jrc.ec.europa.eu/download.php>



GHS built-up surface (R2022)

[Read the technical details for this product](#)

Current selection:

Product: **GHS-BUILT-S**, epoch: **2030**, resolution: **100m**, coordinate system: **Mollweide**, classification: **Total RES+NRES**, scenario for the prediction: **LIN**

Select the classification and (for the projection epochs) the scenario

Classification (RES/NRES)

- Total RES+NRES
 Non residential
ⓘ Residential (RES) or non residential (NRES) classification.

Scenario (LIN/PLY/MED)

- linear (LIN)
 second-order polynomial (PLY)
 median (MED)
ⓘ Scenario for the prediction: linear (LIN), second-order-polynomial (PLY), and median (MED).

ⓘ To be noted that some variation might be available only for a certain product (e.g. the 30m resolution is only available for the GHS-BUILT multi-temporal classification)

Epoch

- 2030
 2025
 2020
 2018
 2015
 2011
 2010
 2005
 2000
 1995
 1990
 1985
 1980
 1975

Resolution

- 2m
 10m
 100m
 1km
 3 arcsec
 30 arcsec

Coord. system

- Mollweide
 WGS84
 UTM

GHSL 2.0 knowledge package available soon

The screenshot shows the GEO Knowledge Hub interface. At the top, there's a search bar with 'Global Human Settlement Moc' and a search icon. Below the search bar, it says '330 result(s) found'. On the left, there are filters for 'Status' (Published) and 'Resource types' (Publication, Knowledge Package, Software, Dataset, User Story, Lesson (Training material)). The main content area displays two search results:

- GHSL Data Package** (2019 (2019) Dataset) by Florczyk, Aneta J., Corbane, Christina, Ehrlich, Daniele. Description: 'The technical note provides a summary of the the GHS-BUILT, GHS-POP, and GHS-SMOD released in 2019 that is referred produces new global spatial information, evidence-based analytics and knowledge describing the human presence on the pl'. Uploaded on October 28, 2022.
- Degree of Urbanisation Grid User Guide** (2019 (v4.0) Publication) by Maffneni, Luca, Schiavina, Marcello, Melchiorri, Michele. Description: 'The Degree of Urbanisation Grid (GHS-DUG) Tool (- version 4) is an information system developed in the framework of the G settlement classes and extract related statistics. The settlement classes are derived from the "Degree of Urbanisation" metno'. Uploaded on October 28, 2022.

Download by tiles (click on each box to download a single tile):

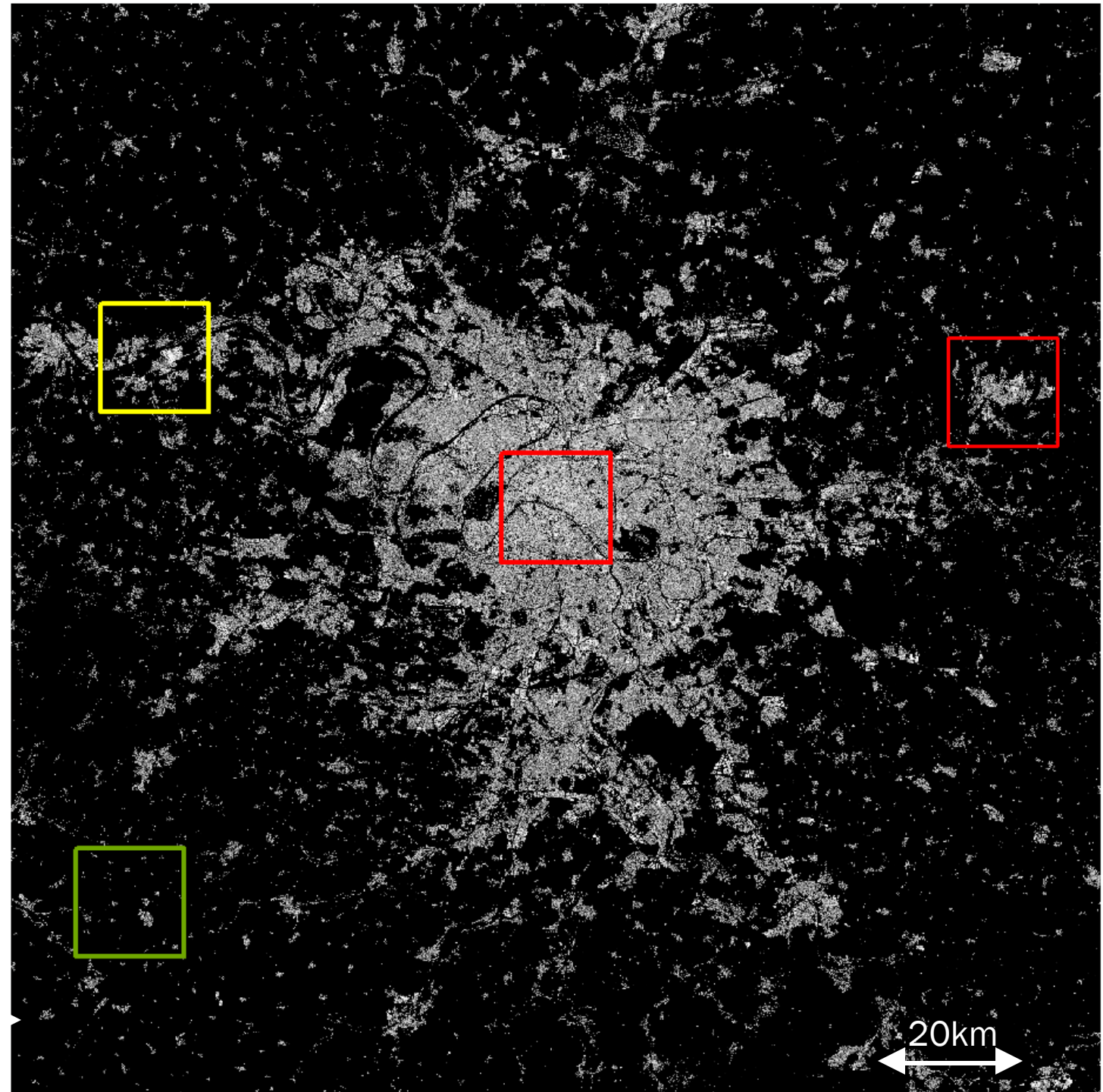
[Interactive visualisation of the GHS built-up surface \(R2022\)](#)



GHSL R2023

Input Sentinel 2 Imagery
Built-up Surface 10 m

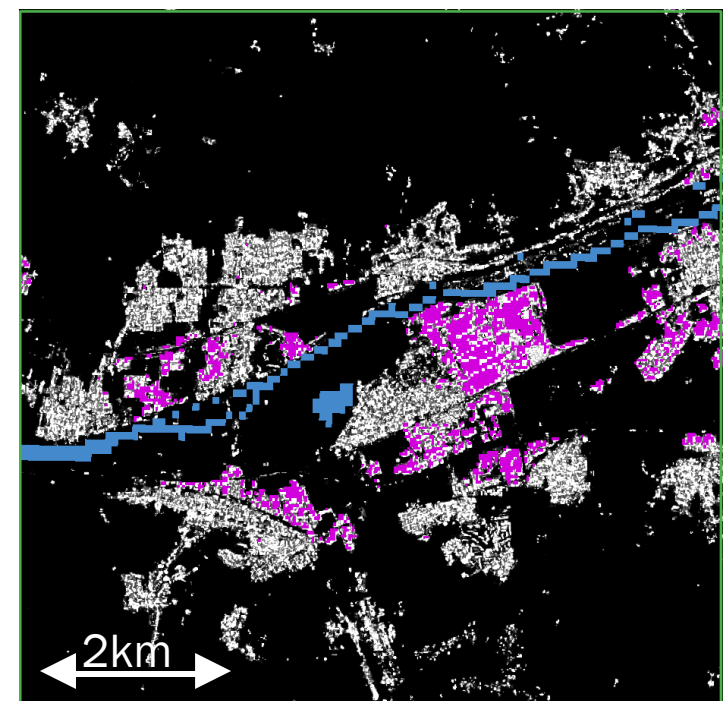
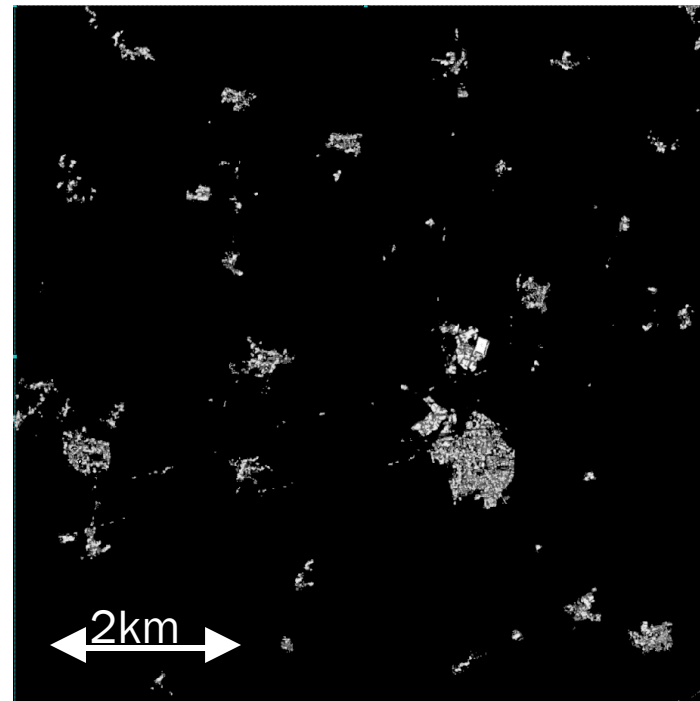
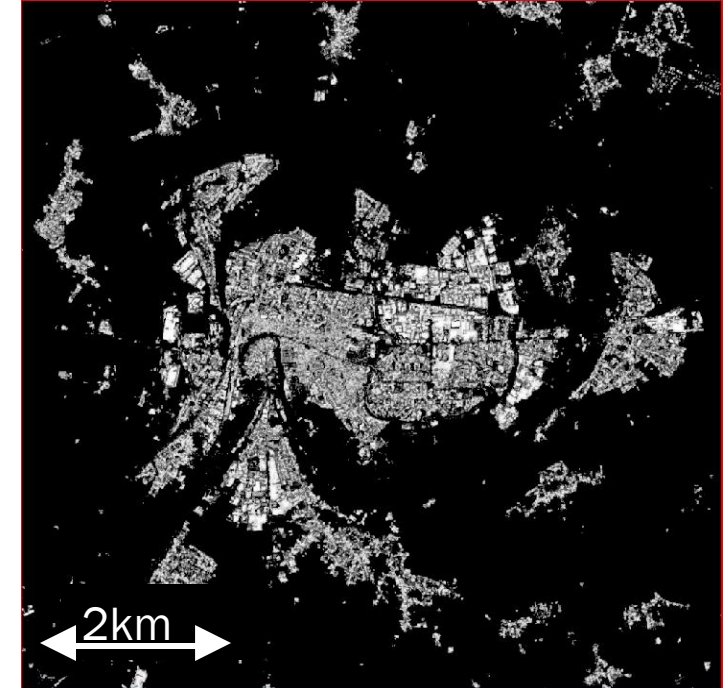
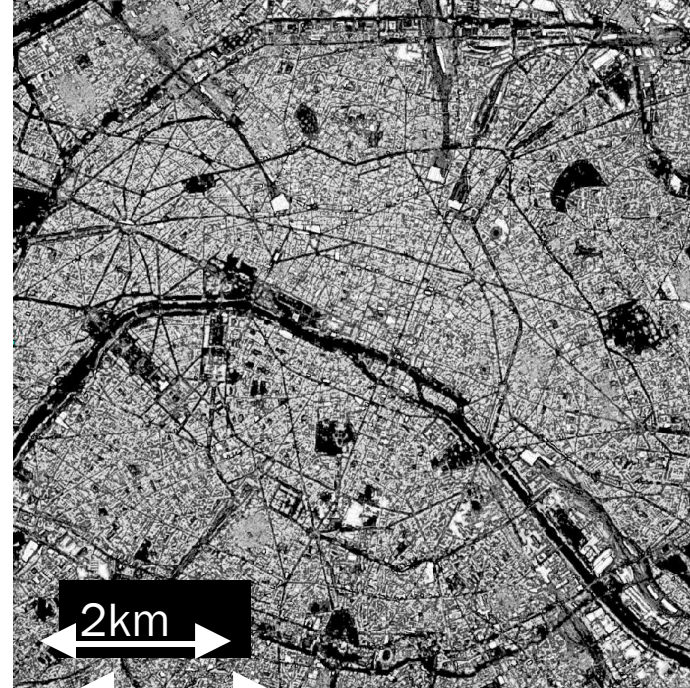
Building footprints on a
10m spatial grid → Surface



GHSL R2023

Input Sentinel 2 Imagery
Built-up Surface 10 m
Built-NR 10 m

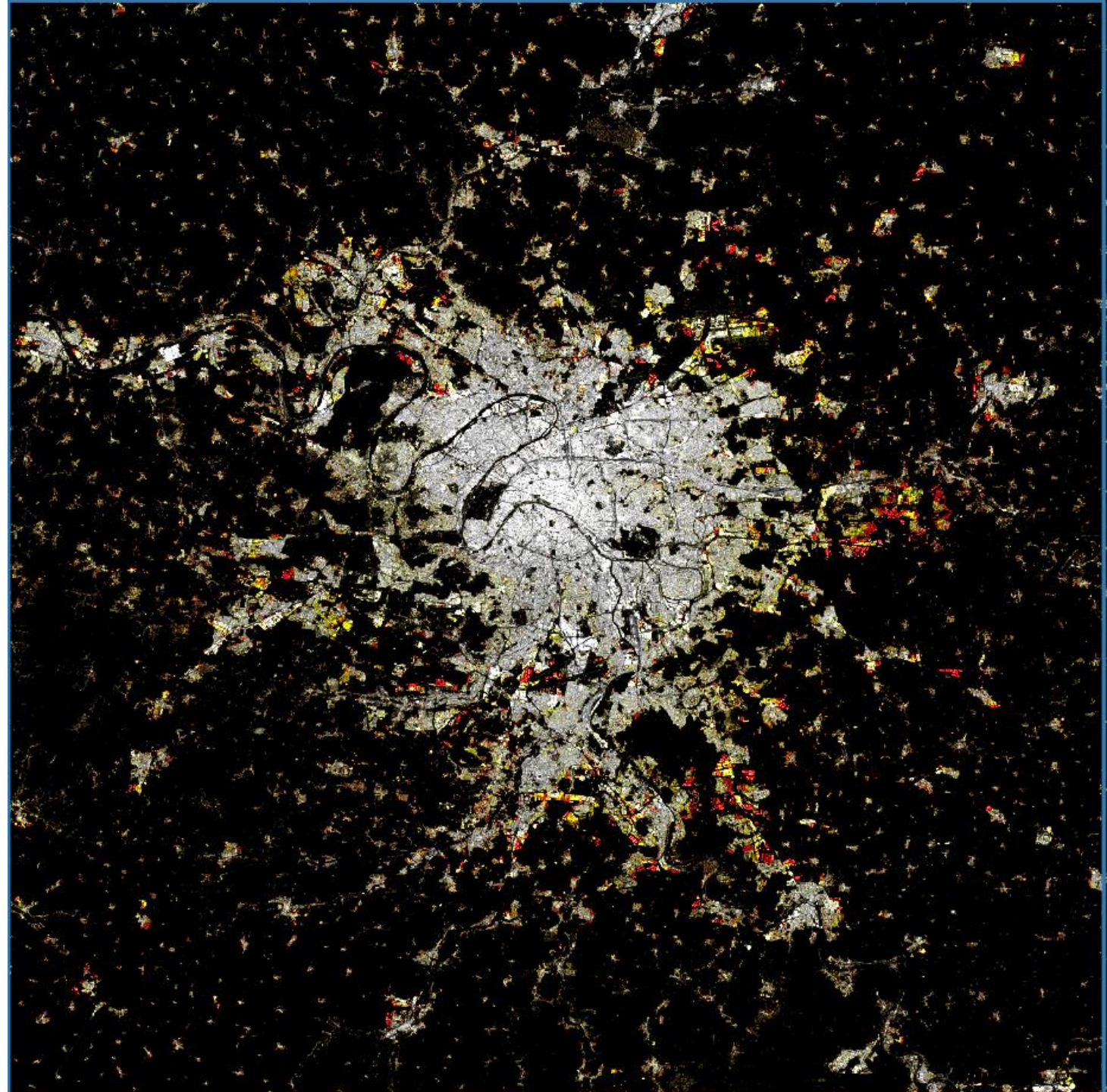
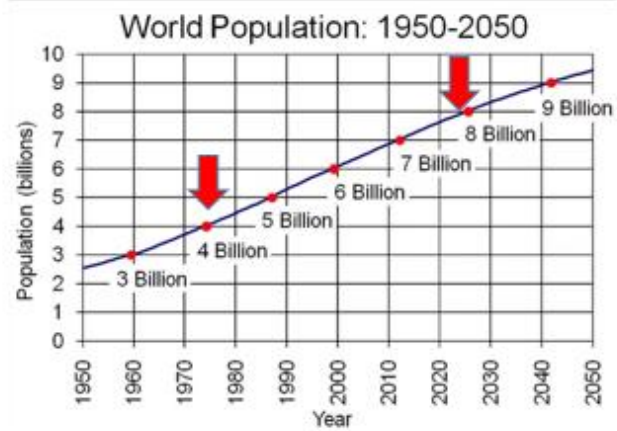
Building footprints on a
10m spatial grid → Surface



GHSL R2023

Built-up over time 100 m

- Legend
- Built-up in 1975
 - Built-up in 2000
 - Built-up in 2020



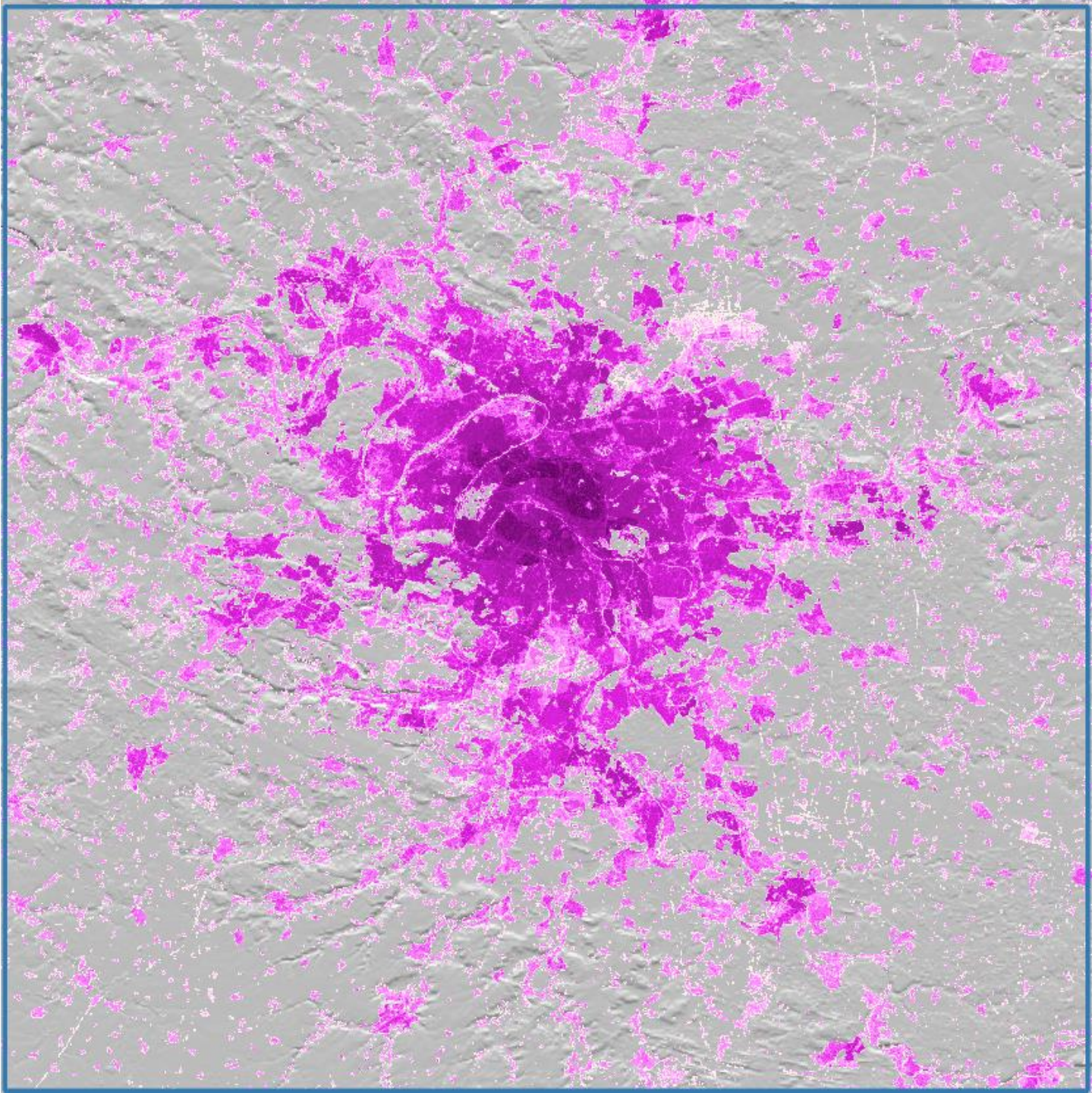
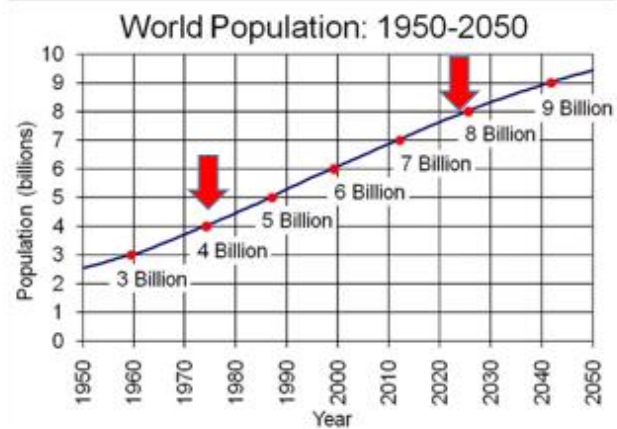
GHSL R2023

Input: Built-up, Census

Multi-temporal Population 100 m

Population

- no data (transparent)
- 0 - 5
- 6 - 20
- 21 - 100
- 101 - 300
- 301 - 500
- 501 - 1,000
- 1,000 - Max



GHSL R2023

Input: Built-up, Population

Settlement Model (SMOD)

Legend

Degree of Urbanisation

Urban centre (City):

■ Urban centre (City)

Urban cluster (Town & suburb):

■ Dense and semi-dense urban cluster (Town)

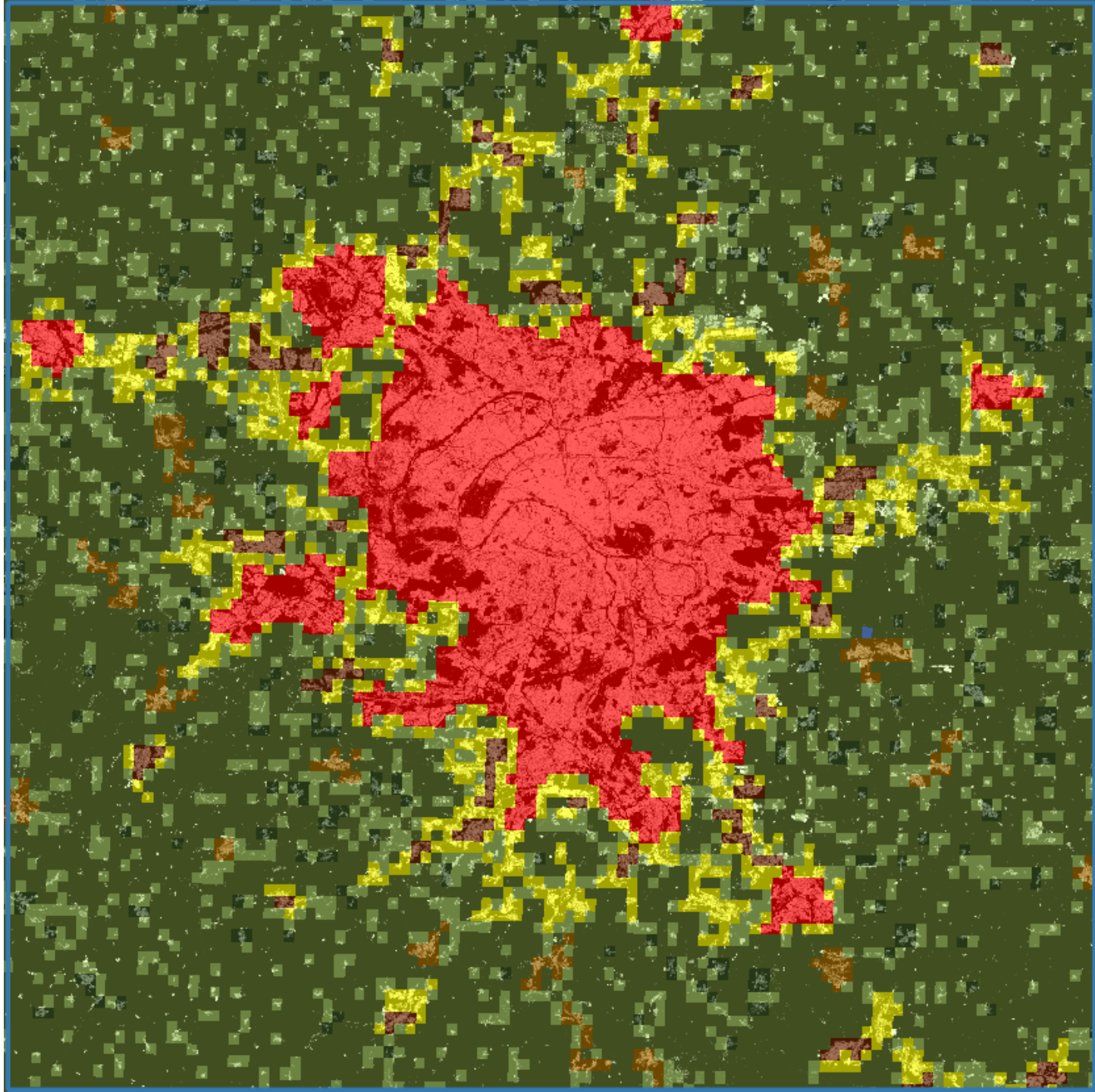
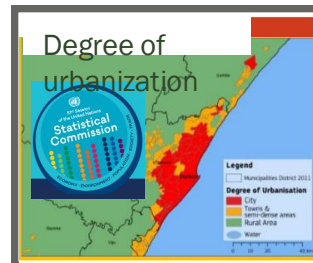
■ Suburban or peri-urban cells (Suburb)

Rural grid cells (Rural area):

■ Rural cluster (Village)

□ Low density rural grid cells (Dispersed rural area) - transparent

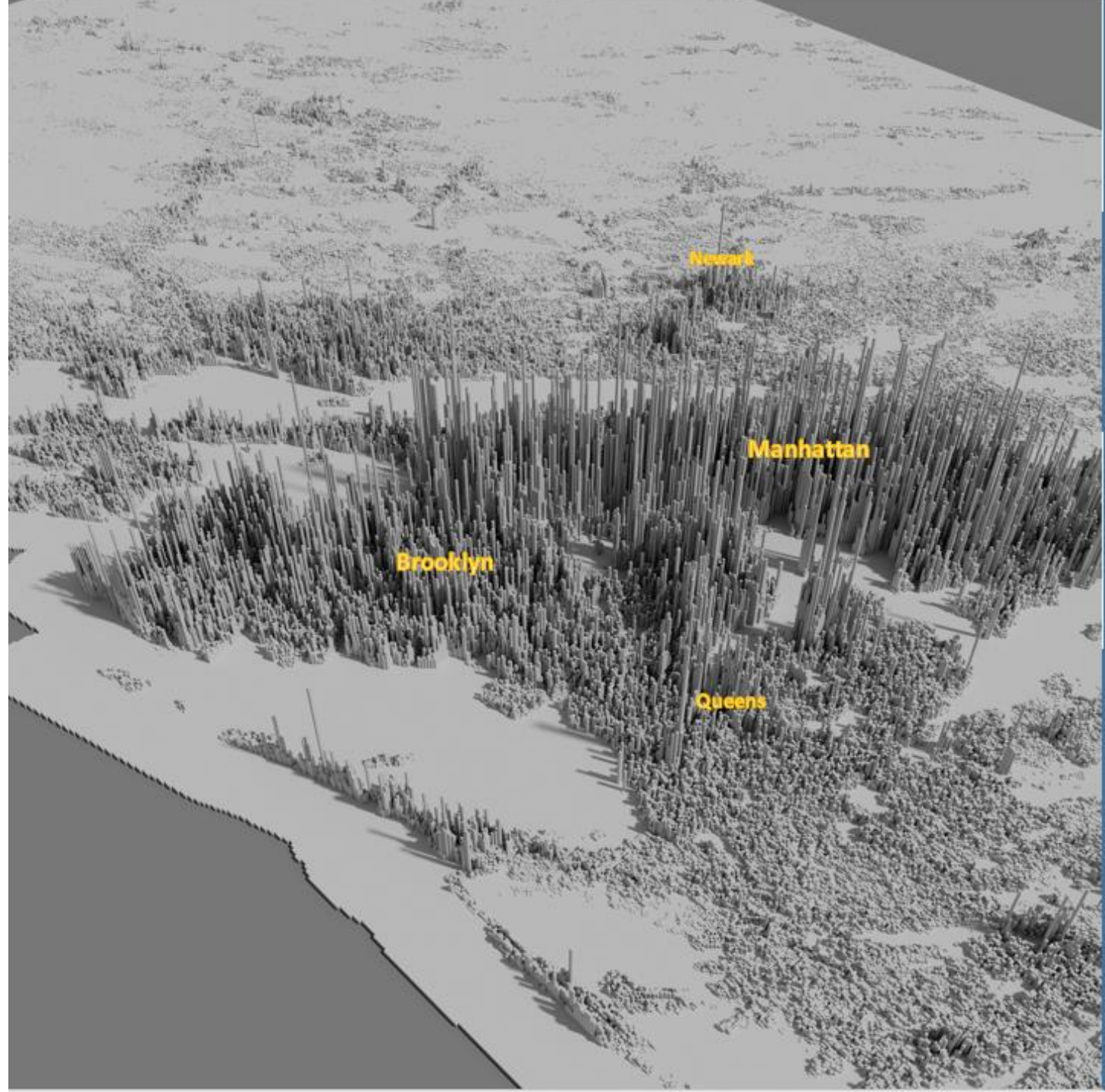
□ Very low density rural grid cells (Mostly uninhabited area) - transparent



GHSL R2023

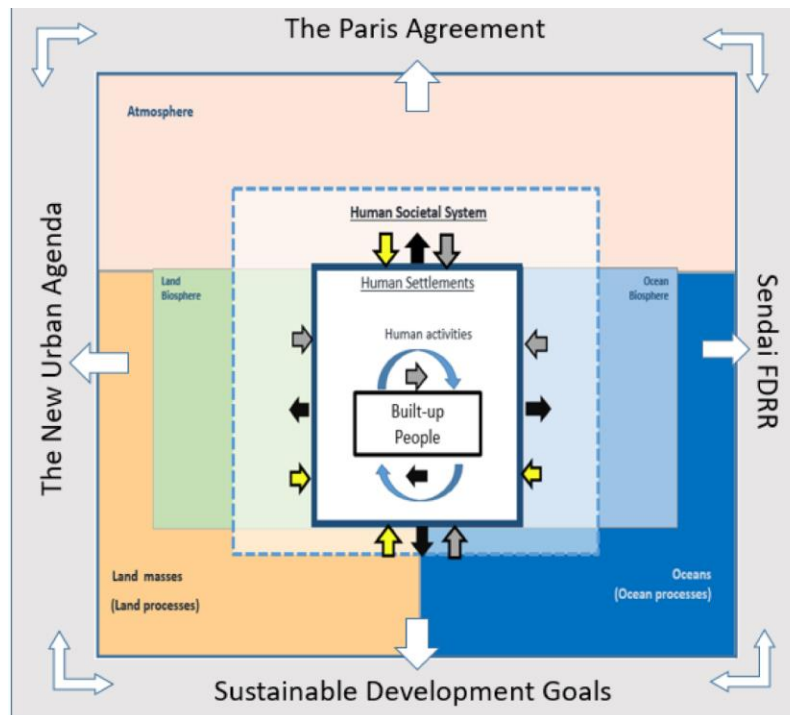
Built-up Height 100m

NEW feature

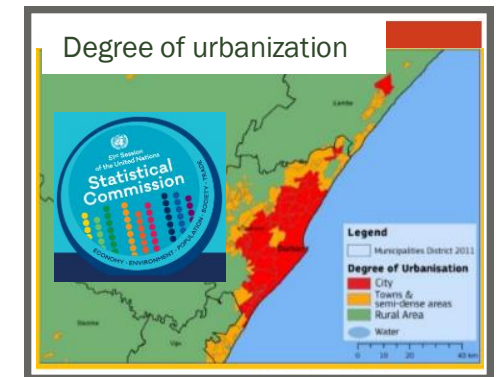


Essential societal variables

...to address GEO's **societal** challenges



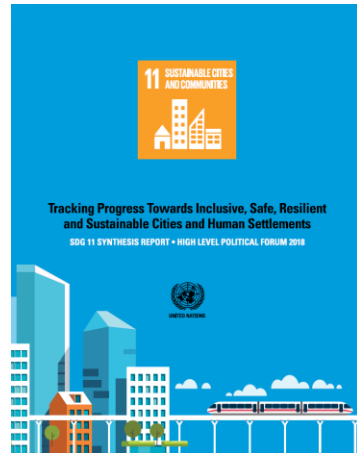
... to Analyze Human Presence, Societal Impact and Sustainability <doi.org/10.3390/su13147851>



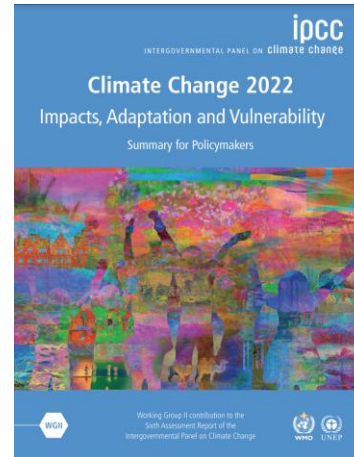
Use cases of GHSL in international policy frameworks



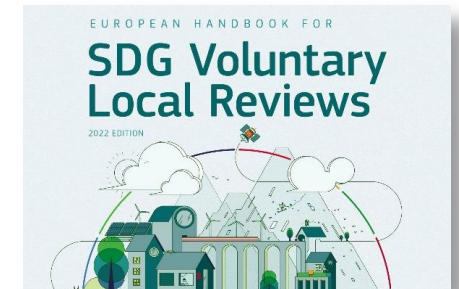
GEO 6 & GEO 6
Cities by UNEP
urbanization
statistics from
GHSL Data



UN-Habitat SDG
11 synthesis
report



UNEP WMO IPCC
6th Assessment
Report



And many more ...



EARTH OBSERVATIONS FOR THE
SUSTAINABLE DEVELOPMENT GOALS



Earth Observations Toolkit for
**SUSTAINABLE CITIES
AND HUMAN SETTLEMENTS**

Use Case: Pediatric Exposure to Pollution

- Achakulwisut, P., Brauer, M., Hystad, P., & Anenberg, S. C. 2019. Global, national, and urban burdens of paediatric asthma incidence attributable to ambient NO₂ pollution: estimates from global datasets. *The Lancet Planetary Health*. doi: 10.1016/S2542-5196(19)30046-4.
 - Used 2015 GHS-POP from JRC & SEDAC
 - Estimated pediatric populations by applying GPWv4.10 Demographic Characteristics for ages 1-4, 5-9, 10-14, and 15-18
 - Compared with surface & satellite-based NO₂ estimates

THE LANCET
Planetary Health

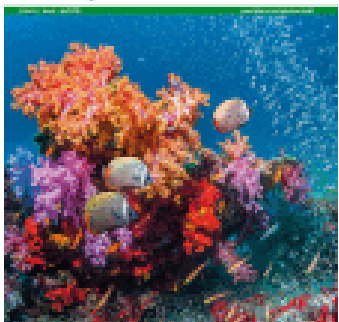
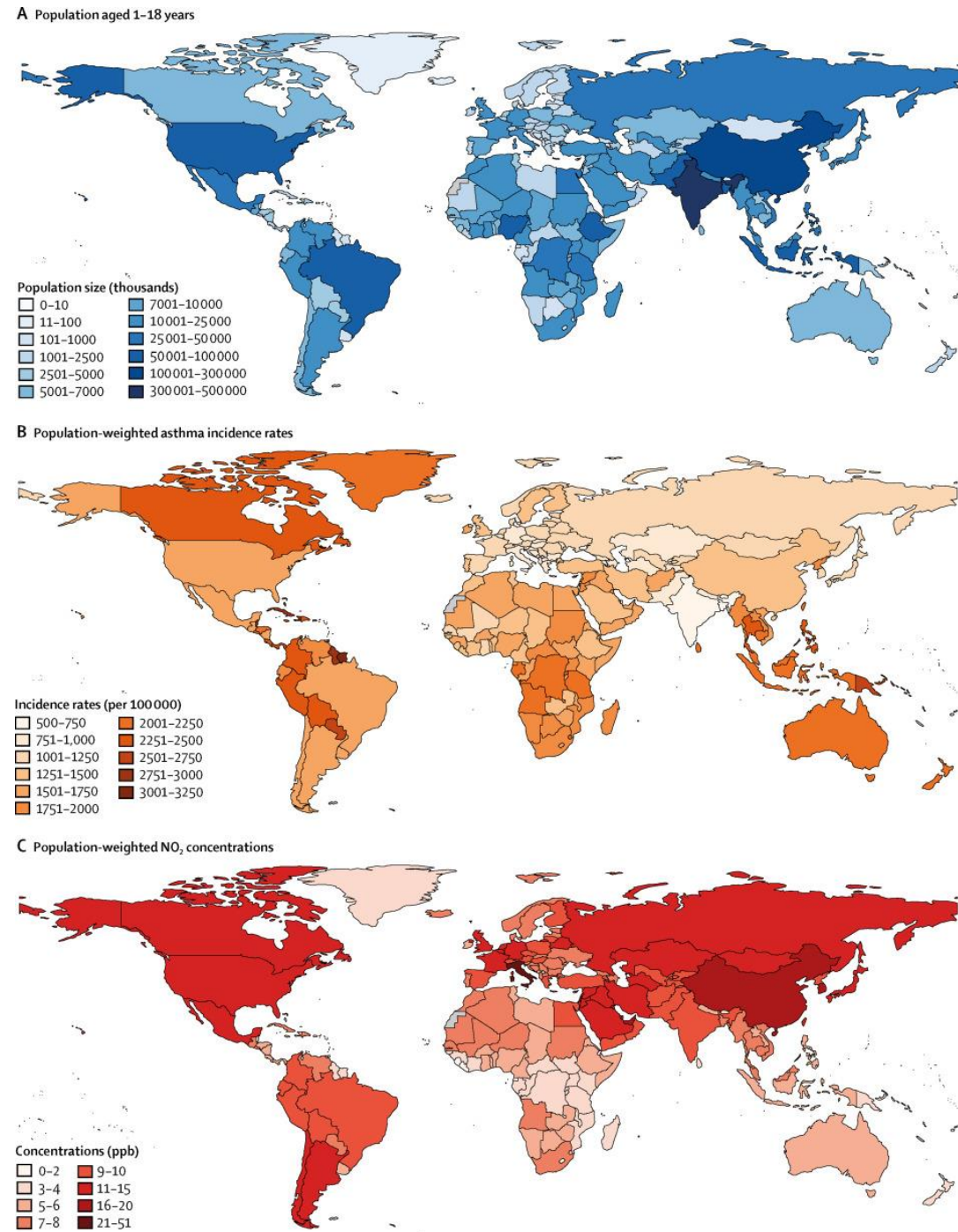


Figure 1 National estimates of population aged 1–18 years (A), population-weighted annual asthma incidence rates (B), and population-weighted annual average nitrogen dioxide (NO₂) concentrations (C)



Use Case: Exposure to Multiple Hazards

■ OECD, 2022. *Monitoring Exposure to Climate-Related Hazards: Indicator Methodology and Key Results*. <https://doi.org/10.1787/19970900>.

- Uses GHSL-POP as common population exposure layer for assessing different hazards
- Assesses extreme temperature, extreme precipitation, drought, wildfire, wind threats, river flooding, coastal flooding

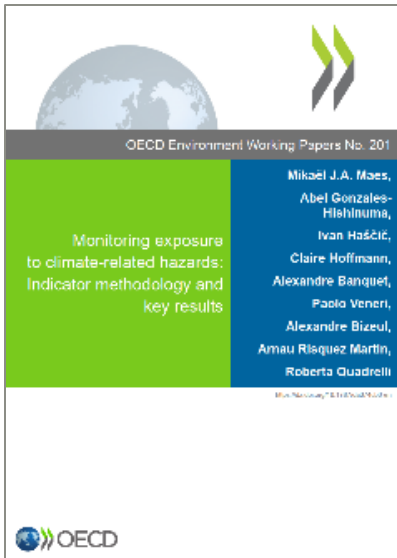


Figure 27. Most countries experience at least one climate-related natural hazard

	Extreme temperature			Extreme precipitation	Drought	Wildfire		Wind threats		River flooding	Coastal flooding
	Hot days	Tropical nights	Heat stress	Cropland exposure	Cropland exposure	Population exposure	Forest exposure	Population exposure	Built-up area exposure	Built-up area exposure	Built-up area exposure
Argentina	3	11	11		5	11	11	34	32	8	30
Australia	6	13	18		3	2	5	26	26	37	30
Austria	28	37	32		24	25	35	19	20	7	NA
Belgium	20	15	38		4	39		6	7	20	2
Brazil	8	6	4	5	9	7	12	44	44	32	30
Bulgaria	18	30	24		15	10	15	42	43	33	
Canada	36	28	34			34	32	21	18	16	24
Chile	35	47	27	13	35	9	20	27	28	27	35
China	4	5	9	13	18	6	18	31	31	1	3
Colombia	27	38	7	3	13	20	21	47	46	22	
Costa Rica	40	8	5	4	36	12	14			50	
Croatia	21	18	21		26	33	23	24	25	5	17
Czech Republic	33	35	36		17	36	31	22	22	15	NA
Denmark		45	46	11	37	29		12	13	49	5
Estonia		43	43		31	40	27	41	41	30	
EU27	23	25	26	13	22	19	22	17	17	18	7
Finland		44	47	13		42		40	40	9	11
France	14	22	29		10	17	19	15	15	14	15
Germany	24	27	35		7	22	29	8	9	19	9
Greece	7	16	14		40	15	10	33	34	42	23
Hungary	13	4	22		30	26	36			6	NA
Iceland					41			1	1	48	10
India	1	1	2			5	8	36	37	13	20
Indonesia	30	10	1	1	33	24	25	45	45	26	12
Ireland			50	7	39			2	2	36	25
Israel	5	19	6			8	2			43	
Italy	16	12	15			21	17	23	23	29	14
Japan	17	14	19	11		44	39	3	3	17	6
Korea	12	7	20		23	27	33	9	10	21	21
Latvia		40	42		21	37		37	35	2	13
Lithuania		42	41		14	41	24	28	30	35	22
Luxembourg	31	41	39		2			10	11	40	NA
Malta		2	25			28	16	13	12		
Mexico	22	33	8	8	19	3	3	35	36	24	29
Netherlands	29	29	40		6	23		4	4	3	1
New Zealand		31	45			35	38	16	14	46	30
Norway		48	49	6				11	5	41	4
Peru	37	32	13	2	32	43	28			25	
Poland	34	36	37	9	16	31	26	38	39	23	19
Portugal	26	24	28		11	4	6	14	16	44	27
Romania	19	26	23		8	13	30	43	42	11	
Saudi Arabia	2	3	3		12	45	1	46		45	16
Slovakia	25	39	31		29	30	34	39	38	4	NA
Slovenia	32	21	30		38	46		30	29	10	
South Africa	11	23	12		1	1	4	29	27	47	
Spain	9	17	17	13	28	18	9	18	19	38	34
Sweden		46	48		27	32	37	25	24	28	18
Switzerland	38	34	33		25			7	8	12	NA
Turkey	15	20	16		20	14	7	32	33	31	28
United Kingdom	39	49	44	9	34	38		5	6	39	8
United States	10	9	10			16	13	20	21	34	26

Find Geospatial Data by SDG

1 NO POVERTY 2 Datasets	2 ZERO HUNGER 3 Datasets	3 GOOD HEALTH AND WELL-BEING 3 Datasets	4 QUALITY EDUCATION 2 Datasets	5 GENDER EQUALITY 3 Datasets	6 CLEAN WATER AND SANITATION 3 Datasets	7 AFFORDABLE AND CLEAN ENERGY 1 Datasets	8 DECENT WORK AND ECONOMIC GROWTH 3 Datasets	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE 2 Datasets
10 REDUCED INEQUALITIES 1 Dataset	11 SUSTAINABLE CITIES AND COMMUNITIES 5 Datasets	12 RESPONSIBLE CONSUMPTION AND PRODUCTION 1 Dataset	13 CLIMATE ACTION 4 Datasets	14 LIFE BELOW WATER 2 Datasets	15 LIFE ON LAND 4 Datasets	16 PEACE, JUSTICE AND STRONG INSTITUTIONS 3 Datasets	17 PARTNERSHIPS FOR THE GOALS 3 Datasets	

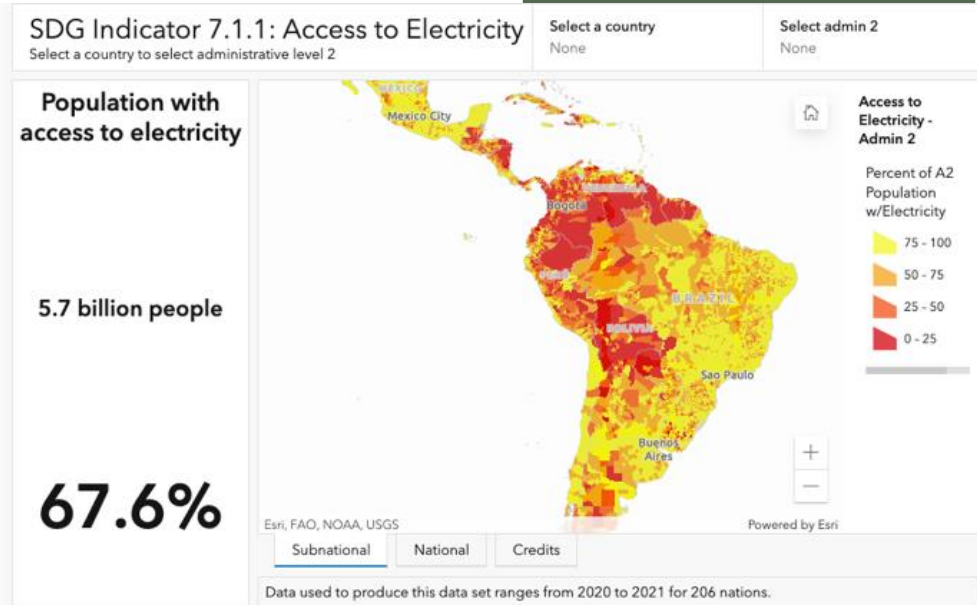
<https://sdgstoday.org/>

Four SDG indicator datasets and associated StoryMaps now available via **SDGs Today** and **GEO Knowledge Hub**:

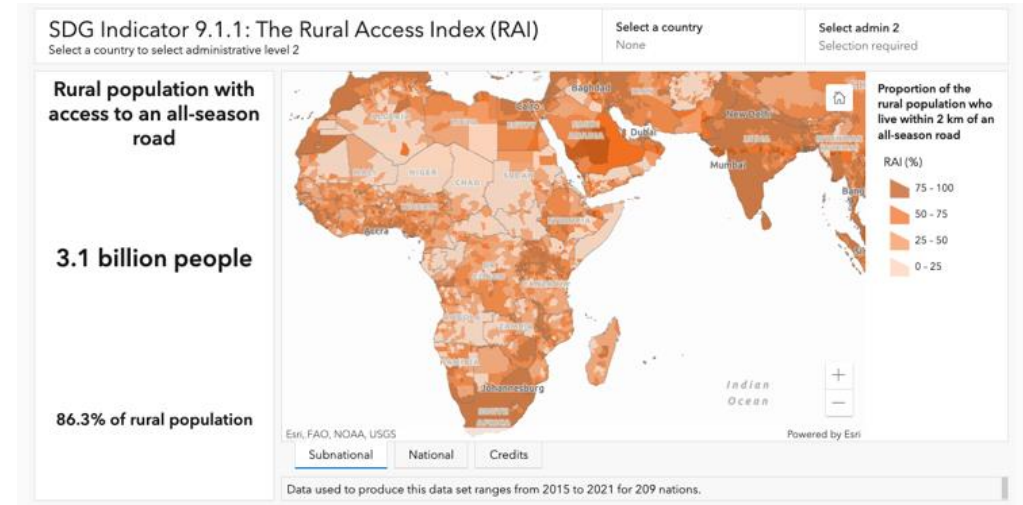
- 7.1.1 Access to Electricity
- 9.1.1 Rural Access Index
- 11.2.1 Urban Access to Public Transport
- 11.7.1 Urban Public Space



<https://gkhub.earthobservations.org/>



The maps do not imply the expression of any opinion on the part of SDGs Today and partners concerning the legal status of any country, territory, or area, or of their authorities.



14 result(s) found

Sort by Newest

Versions

View all versions

Status

Published 14

Resource types

Knowledge Package 14

GEO Work Programme Activities

GEO Human Planet (HUMAN-PLANET) 10

Digital Earth Africa (DE-AFRICA) 1

GEO Global Ecosystems (GEO-ECO) 1

Global Network for Observations and Information in Mountain Environments (GEO-MOUNTAINS) 1

Target Audience

Administrative Officer in the spatial planning domain 10

National Statical Officer 10

Digital Cartography Technician 8

Geographer 8

Urban planner 8

Policy maker in territorial 8

HUMAN-PLANET October 20, 2022 (v1) Knowledge Package Metadata-only

Mapping Rural Access to Roads (RAI) with Global Open Data

Center for International Earth Science Information Network

Sustainable Development Goal (SDG) 9 aims to "build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation." Addressing inadequate access to roads, especially in rural areas, is critical to achieving SDG 9. Sustainable transportation helps to eliminate poverty, promote food security, improve access to...

Uploaded on January 23, 2023

HUMAN-PLANET December 2, 2022 (v1) Knowledge Package Metadata-only

Mapping Access to Electricity with Global Open Data (SDG Indicator 7.1.1)

Center for International Earth Science Information Network

Tracking SDG 7: The Energy Progress Report estimated that in 2019, 759 million people around the world lacked access to electricity. Due to current policies and the effects of the COVID-19 crisis, it is predicted that by 2030, 660 million people will still not have access to electricity, with a majority of these people residing in Sub-Saharan Af...

Uploaded on January 23, 2023

HUMAN-PLANET December 6, 2022 (v1) Knowledge Package Metadata-only

Mapping Convenient Access to Public Transport in Cities with Global Open Data (SDG Indicator 11.2.1)

Center for International Earth Science Information Network

United Nations (UN) Sustainable Development Goal (SDG) 11 is "Make cities and human settlements inclusive, safe, resilient, and sustainable." Improving access to public transport services is integral in achieving the objectives of SDG 11. According to Sustainable Transport, Sustainable Development, a 2021 UN interagency report, "Only about half ...

Uploaded on January 23, 2023

HUMAN-PLANET December 6, 2022 (v1) Knowledge Package Metadata-only

Mapping Availability and Access to Urban Public Space with Global Open Data (SDG Indicator 11.7.1)

Center for International Earth Science Information Network

United Nations (UN) Sustainable Development Goal (SDG) 11 is "Make cities and human settlements inclusive, safe, resilient and sustainable." Prevalence of and access to public space is critical for achieving SDG 11. Aside from environmental benefits, public space can also help improve public health, bolster community, and encourage economic exch...

Uploaded on January 23, 2023

Elements of the Knowledge Package

Dataset 0 resources  Publication 0 resources  Software 6 resources  Other 2 resources 

SDGs Today Dashboard for SDG Indicator 9.1.1: The Rural Access Index (RAI)

SDG's Today; Center for International Earth Science Information Network;

Oct 28, 2022 HUMAN-PLANET Web Portal Metadata-only

OGC Web Feature Service - National Level SDG Indicator 9.1.1, the Rural Access Index (RAI)

Center for International Earth Science Information Network;

2022 HUMAN-PLANET OGC Web Feature Service Metadata-only

OGC Web Map Service - National Level SDG Indicator 9.1.1, the Rural Access Index (RAI)

Center for International Earth Science Information Network;

2022 HUMAN-PLANET OGC Web Map Service Metadata-only

OGC Web Feature Service - Subnational Level 2 SDG Indicator 9.1.1, the Rural Access Index (RAI)

Center for International Earth Science Information Network;

2022 HUMAN-PLANET OGC Web Feature Service Metadata-only

OGC Web Map Service - Subnational Level 2 SDG Indicator 9.1.1, the Rural Access Index (RAI)

Center for International Earth Science Information Network;

2022 HUMAN-PLANET OGC Web Map Service Metadata-only

ArcGIS Online Feature Service - National and Subnational Level 2 SDG Indicator 9.1.1, the Rural Access Index (RAI)

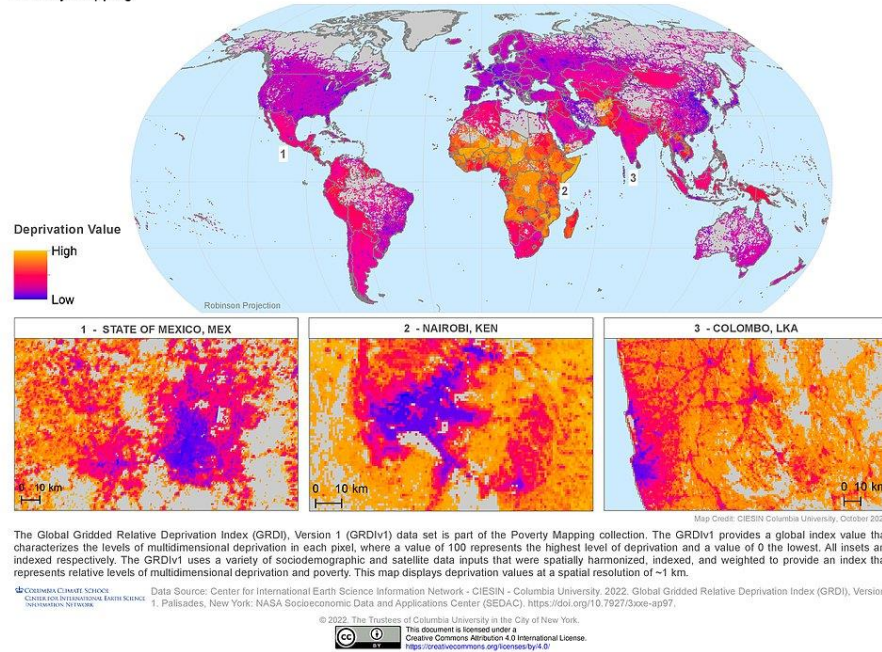
Center for International Earth Science Information Network;

2022 HUMAN-PLANET Data Service Metadata-only



Gridded Relative Deprivation Index (GRDI), Version 1

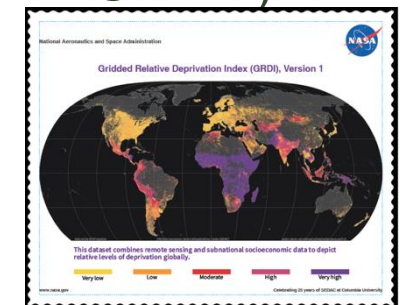
Poverty Mapping



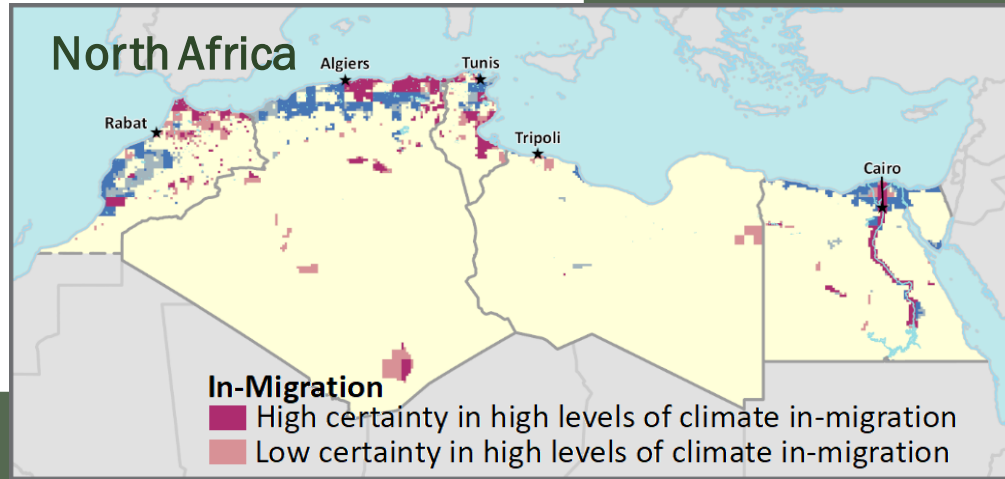
Relative deprivation on a 1-km grid-cell basis, incorporating the following layers:

1. Subnational human development index (from Smits & Permanyer 2019)
2. Child dependency ratios (from SEDAC's GPWv4 Basic Demographic Characteristics)
3. Infant mortality rates (from SEDAC's Global Subnational Infant Mortality Rates, Version 2.01)
4. Building footprints as a proportion of each grid cell (from HRSL, Microsoft, and Geofabrik/OSM)
5. Current nighttime lights (from VIIRS DNB)
6. Change in nighttime lights (from VIIRS DNB)

Global Gridded Relative Deprivation Index (GRDI), v1



<https://doi.org/10.7927/3xxe-ap97>



Groundswell Spatial Population and Migration Projections at One-Eighth Degree According to SSPs and RCPs, 2010-2050

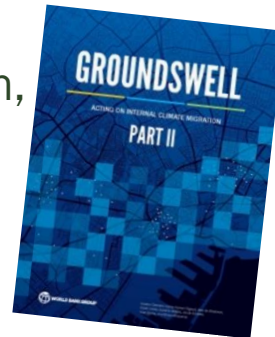
Projections of the effect of slow-onset climate change impacts on water availability and crop productivity, coupled with sea-level rise and storm surge, on future population distribution and climate-related internal migration in low to middle income countries.

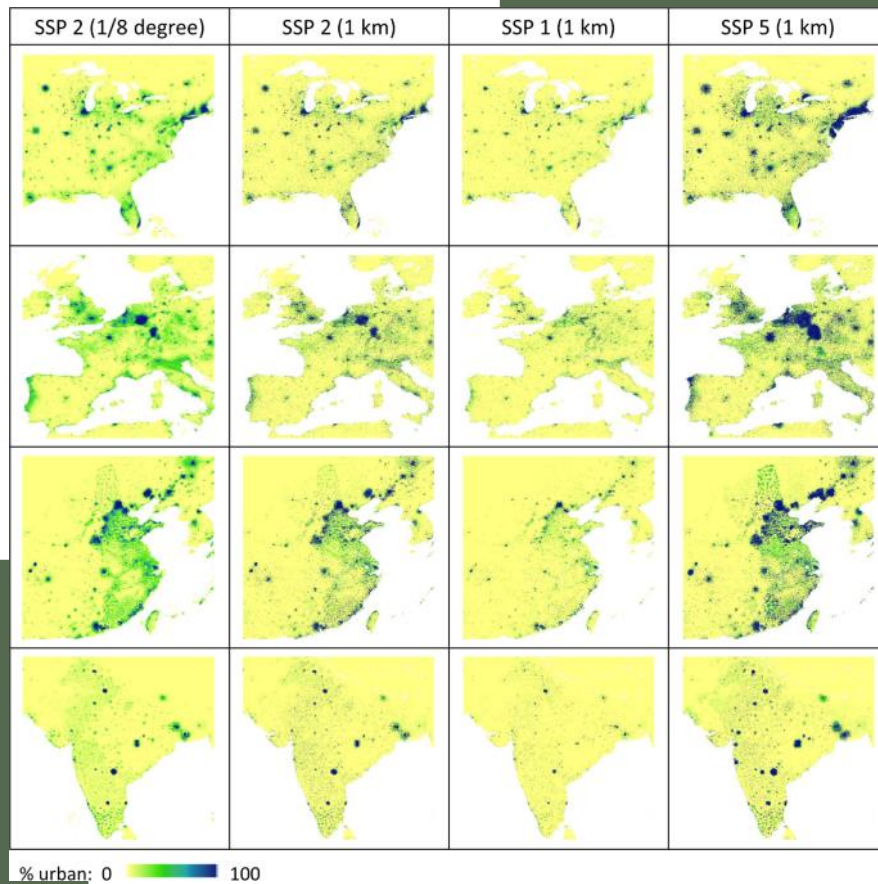
Rigaud, K.K., A. de Sherbinin, B. Jones, J. Bergmann, V. Clement, K. Ober, J. Schewe, S. Adamo, B. McCusker, S. Heuser, and A. Midgley. 2018. *Groundswell: Preparing for Internal Climate Migration*. Washington DC: World Bank.

<https://openknowledge.worldbank.org/handle/10986/29461>

Clement, V., K.K. Rigaud, A. de Sherbinin, B. Jones, S. Adamo, et al. 2021. *Groundswell Part 2 : Acting on Internal Climate Migration*. Washington, DC: The World Bank.

<https://openknowledge.worldbank.org/handle/10986/36248>





% urban: 0 100

Global 1-km Downscaled Urban Land Extent Projection and Base Year Grids by SSP Scenarios, v1 (2000–2100)

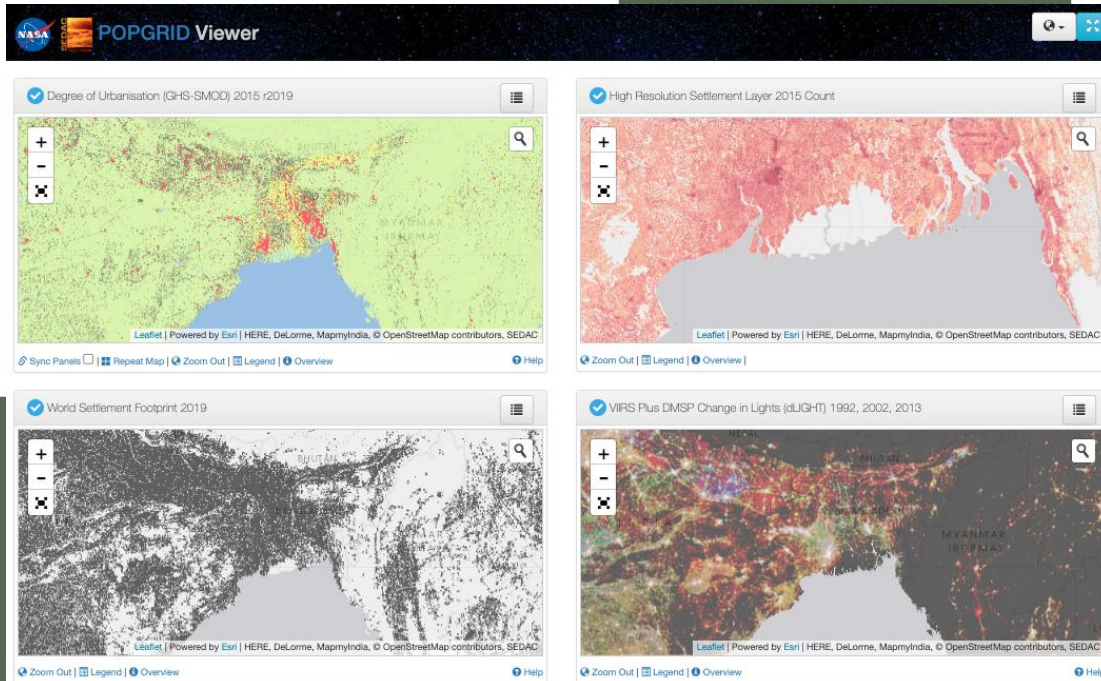
Global SSP-consistent spatial urban land fraction data for the base year 2000 and projections at ten-year intervals for 2010-2100 at a resolution of 1-km

- Inputs from Global Human Settlement Layer (GHSL) developed by JRC

Gao, J. and M. Pesaresi. 2021. Downscaling SSP-consistent Global Spatial Urban Land Projections from 1/8-degree to 1-km Resolution 2000-2100. *Scientific Data* 8(1): 281.

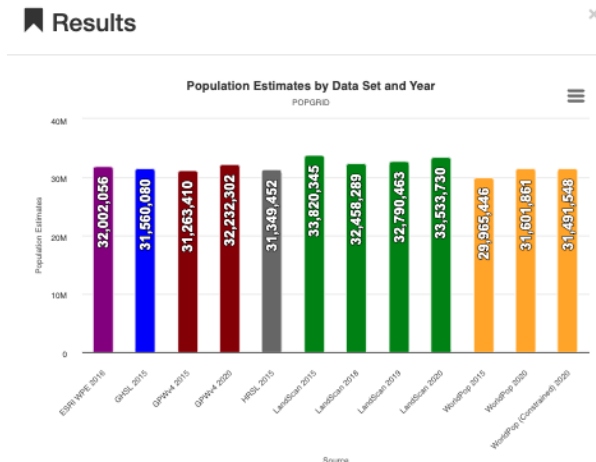
<https://doi.org/10.1038/s41597-021-01052-0>.

Fig. 2. 2100 urban land projections for various parts of the world (North America, Europe, East Asia, South Asia) under urban land expansion scenarios consistent with SSP 2 (middle of the road), SSP 1 (sustainability), and SSP 5 (fossil-fuelled development).



SEDAC POPGRID Viewer with Settlement Layers

- **POPGRID Data Collaborative** facilitates access to multiple global gridded population and settlement data sets
- **SEDAC POPGRID Viewer** facilitates visualization and intercomparison



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GATES foundation

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INFORMATION NETWORK

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