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SDG 11.3.1 ESTIMATION AND EV'S. 3TH JUNE, KYIV, UKRAINE

Methodology

Methodology

Computation Method:

The formula to estimate the land use efficiency will be provided with two stages.

Stage 1: Estimate the population growth rate.

Population Growth rate i.e. PGR=LN(Popt_(t+n)/?Popt_t)/((y))

Where
Popt Total population within the city in the past/initial year
Popt+n Total population within the city in the current/final year
y The number of years between the two measurement periods

Stage 2: Estimating the land consumption rate

This rate gives us a measure of compactness which indicates a progressive spatial expansion of a city.

Land consumption rate i.e LCR=LN(Urb_(t+n)/Urb_t)/((y))

Where
Urb_t Total areal extent of the urban agglomeration in km2 for past/initial year
Urb_(t+n) Total areal extent of the urban agglomeration in km2 for current year
y The number of years between the two measurement periods

The formula to estimate the ratio of land consumption rate to population growth rate (LCRPGR) is provided as follows:

LCRPGR= (+ (Land Consumption rate)/(Annual Population growth rate)¦)

And the overall formula can be summarized as:
LCRPGR=(((LN(Urb_(t+n)/Urb_t))/y))/((LN(Pop_(t+n)/Pop_t)/y))

The periods for both- urban expansion and population growth rates should be at comparable scale.

Methodology for indicator calculation recognized by UN - https://unstats.un.org/sdgs/metadata/files/Metadata-11-03-01.pdf

The main problem is land consumption definition because it is related to “urban agglomeration (built-up area)” which is also a term with no clear definition around the world. Namely, limitations or variations of the available statistical and geographical data on each country are deterring parameters for comparing different agglomerations around the world

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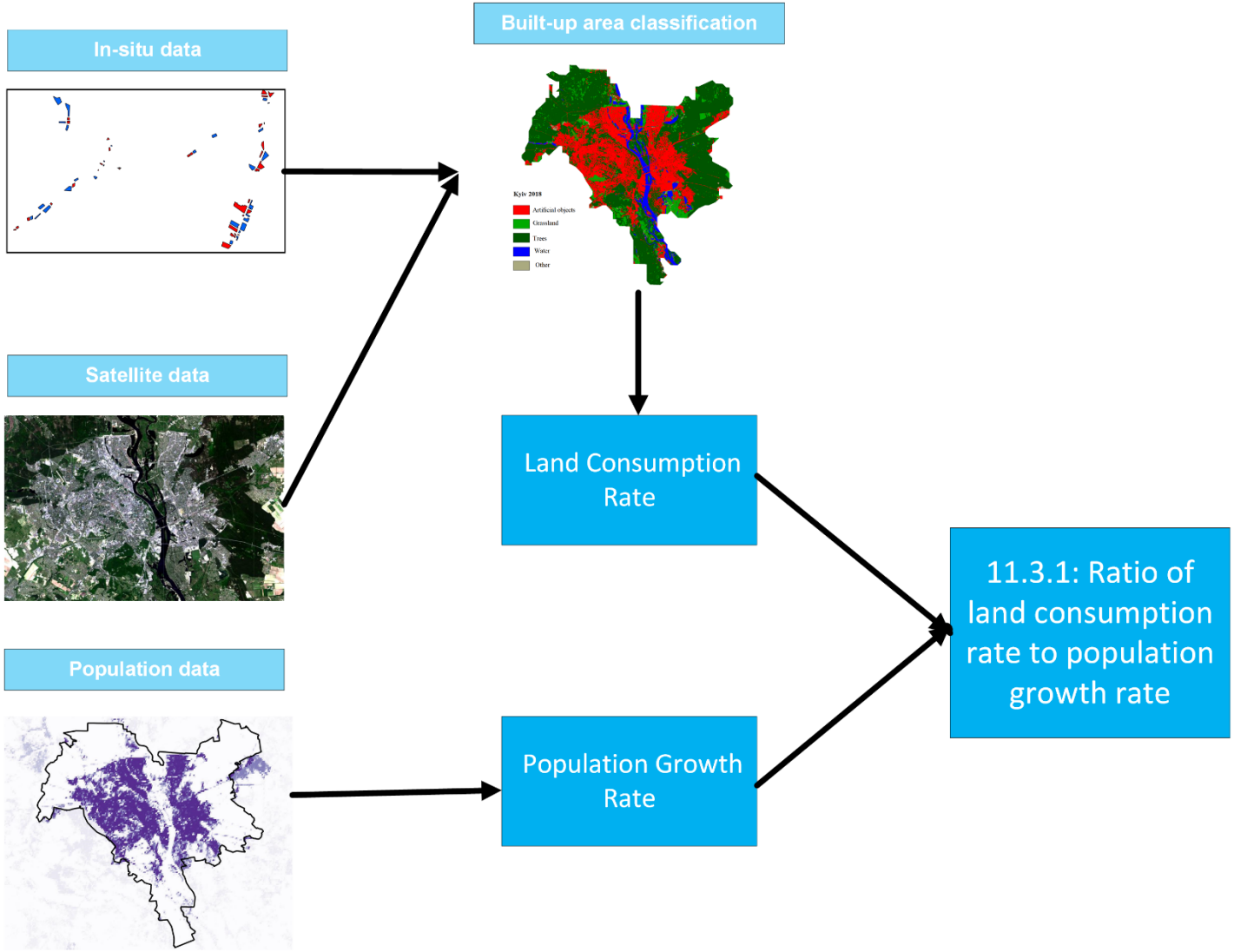
SDG 11.3.1 calculation workflow



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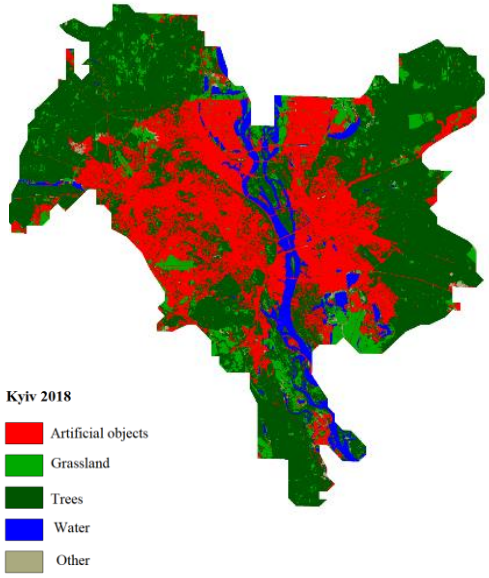
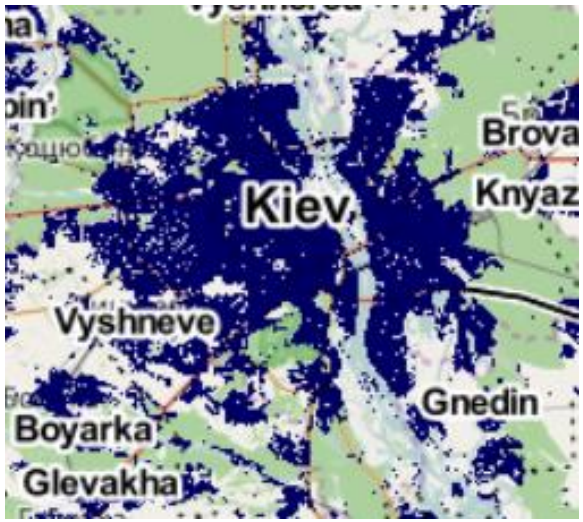
Land consumption

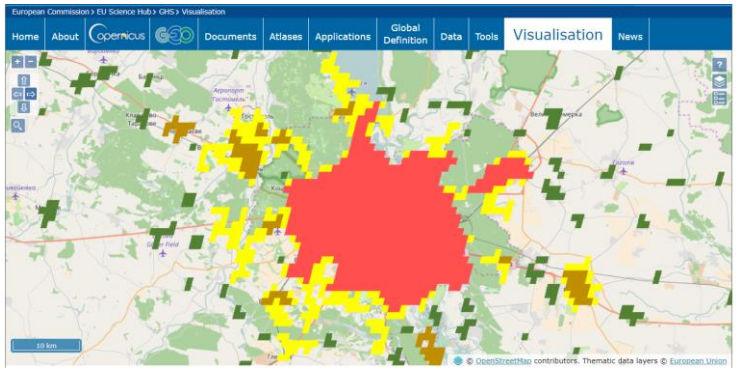
Kyiv classification Map



GHSL classification Map



GHSL degree of urbanization



- Land consumption - built-up area in city borders
- Land consumption can be calculated using city's land cover classification map
- To estimate land consumption can be used global products such as GHSL and also local land cover classification maps
- Land consumption rate can be calculated using historical land cover classification maps by formula:

$$LCR = LN(\frac{Ubn_{t+n} - Ubn_t}{n})$$

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Built-up area classification

Neural Network Ensemble

As one of the most powerful approach for classification maps retrieval we can propose to use ensemble of neural networks, which was developed by SRI team using Sentinel-1 and Sentinel-2 data . Complexity of this method is necessity of additional computation resources for data processing and classification but results usually are more accurate and applicable for indicator 11.3.1 estimation.

Google Earth Engine Classification

GEE platform provides the great opportunities to use large satellite data sets. The most suitable satellite data are: Sentinel-1 and Sentinel-2 with 10 m spatial resolution, Landsat-8 with 30 m spatial resolution and 15 m pan-sharpening channel.

Link to Google Earth Engine — https://code.earthengine.google.com/

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GROUP ON EARTH OBSERVATIONS

Copernicus

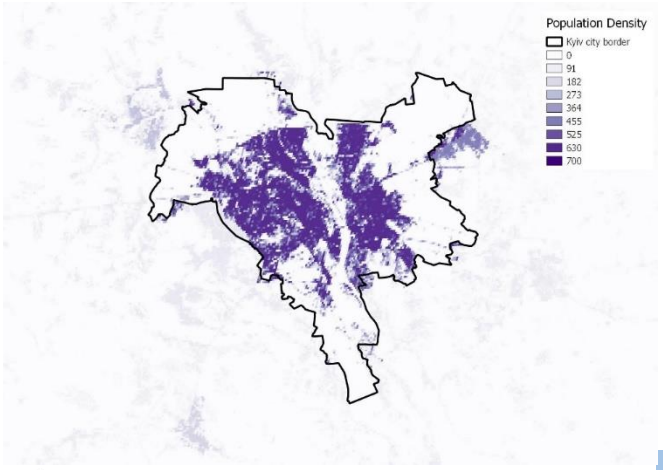
Population Statistics

Kyiv Administration Statistics

Population (estimated) on April 1, 2019 and the average number in January-March 2019

	Available population		Permanent population	
	on April 1, 2019	the average number in January-March 2019	on April 1, 2019	the average number in January-March 2019
m. Kyiv	**2951482**	**2951151**	**2910175**	**2909844**
districts				
Goloseevsky	253012	253148	250914	251050
Darnytsky	344391	344035	337892	337536
Desnyansky	369402	369521	366512	366631
Dniprovsky	357911	357767	356182	356038
Obolonsky	319596	319789	316722	316915
Pechersky	161451	161265	156728	156542
Podilsky	205672	205376	202262	201966
Svyatoshinsky	342214	342220	336294	336300
Solomensky	376073	375991	374027	373945
Shevchenko	221760	222039	212642	212921

GHSL population density



- City's population statistics can be provided by governmental city's administrations
- To estimate SDG 11.3.1 there is a need for reliable statistics with high update rate
- For indicator estimation on country level can be used UN statistics (https://population.un.org/wpp/) and global products as GHSL and ORNL's LandScan
- Population Growth Rate can be calculated using city's population statistics by several years by this formula:

$$\text{PGR} = LN\left(\frac{Pop_{t+n} - Pop_t}{n}\right)$$

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