Using Earth Observation Data to Support the Achievement of the Sustainability Agenda

Monitoring Land Degradation (SDG 15.3.1)

When: Thursday October 10, 2019 at 4 pm (1 hour and 20 min)
Where: Embajadores Hall

CONSERVATION INTERNATIONAL NASA gef TRENDS.EARTH

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TRENDS.EARTH - WHAT IS LAND DEGRADATION

"Land degradation is defined as the reduction or loss of the biological or economic productivity and complexity of rain fed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from a combination of pressures, including land use and management practices"

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TRENDS.EARTH - MONITORING LAND CONDITION

SDG Indicator 15.3.1

"Proportion of land degraded over total land area"

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TRENDS.EARTH - MONITORING LAND CONDITION

SDG Indicator 15.3.1

"Proportion of land degraded over total land area"

SDG Indicator 15.3.1

Land Productivity

Land Cover

Carbon Stocks

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TRENDS.EARTH - MONITORING LAND CONDITION

Tier 1: Indicator is conceptually clear, has an internationally established methodology and standards are available, and data are regularly produced by countries for at least 50 per cent of countries and of the population in every region where the indicator is relevant.

Tier 2: Indicator is conceptually clear, has an internationally established methodology and standards are available, but data are not regularly produced by countries.

Tier 3: No internationally established methodology or standards are yet available for the indicator, but methodology/standards are being (or will be) developed or tested.

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TRENDS.EARTH - MONITORING LAND CONDITION

- Identification of degraded lands
- Can set baselines, and track progress
- Best global datasets
- Allows use of best-available local information

Supports all three components of SDG Indicator 15.3.1

Land Productivity

Land Cover

Carbon Stocks

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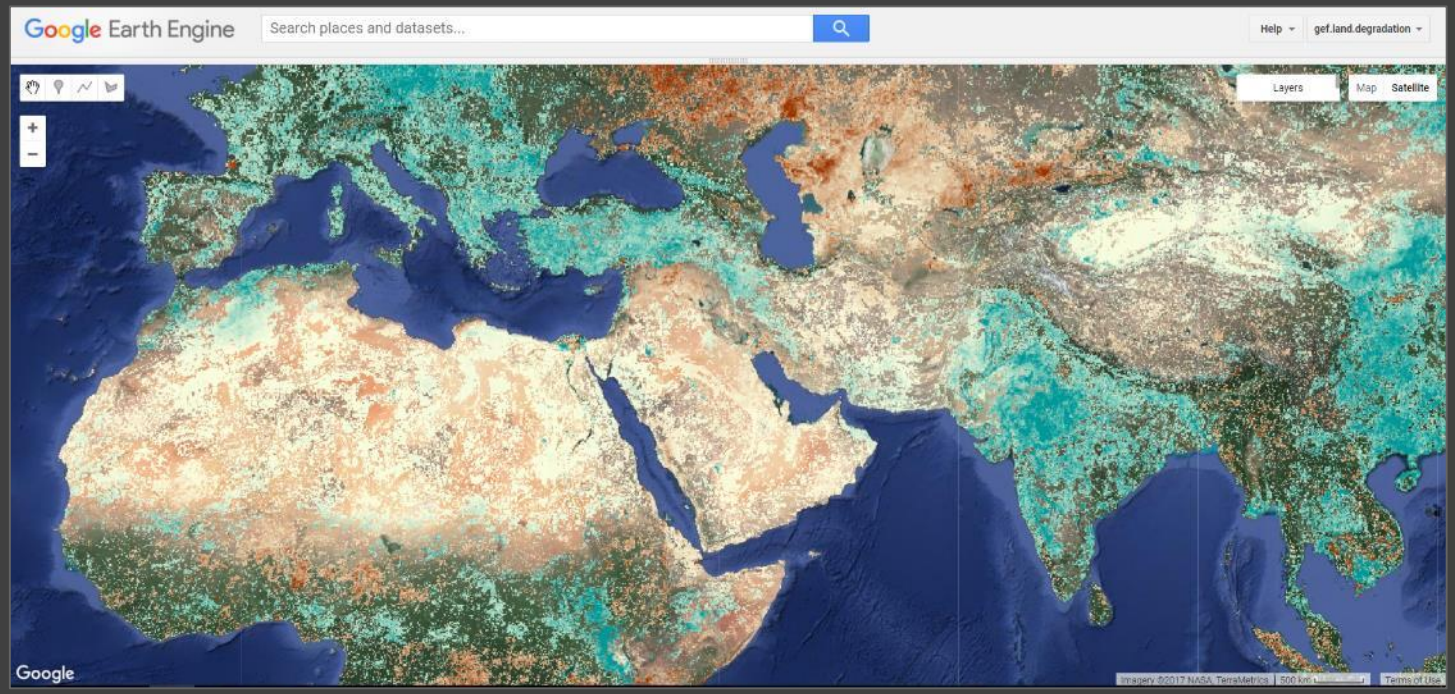
TRENDS.EARTH - WHAT IS IT?



TARGET 15·3
END DESERTIFICATION AND RESTORE DEGRADED LAND

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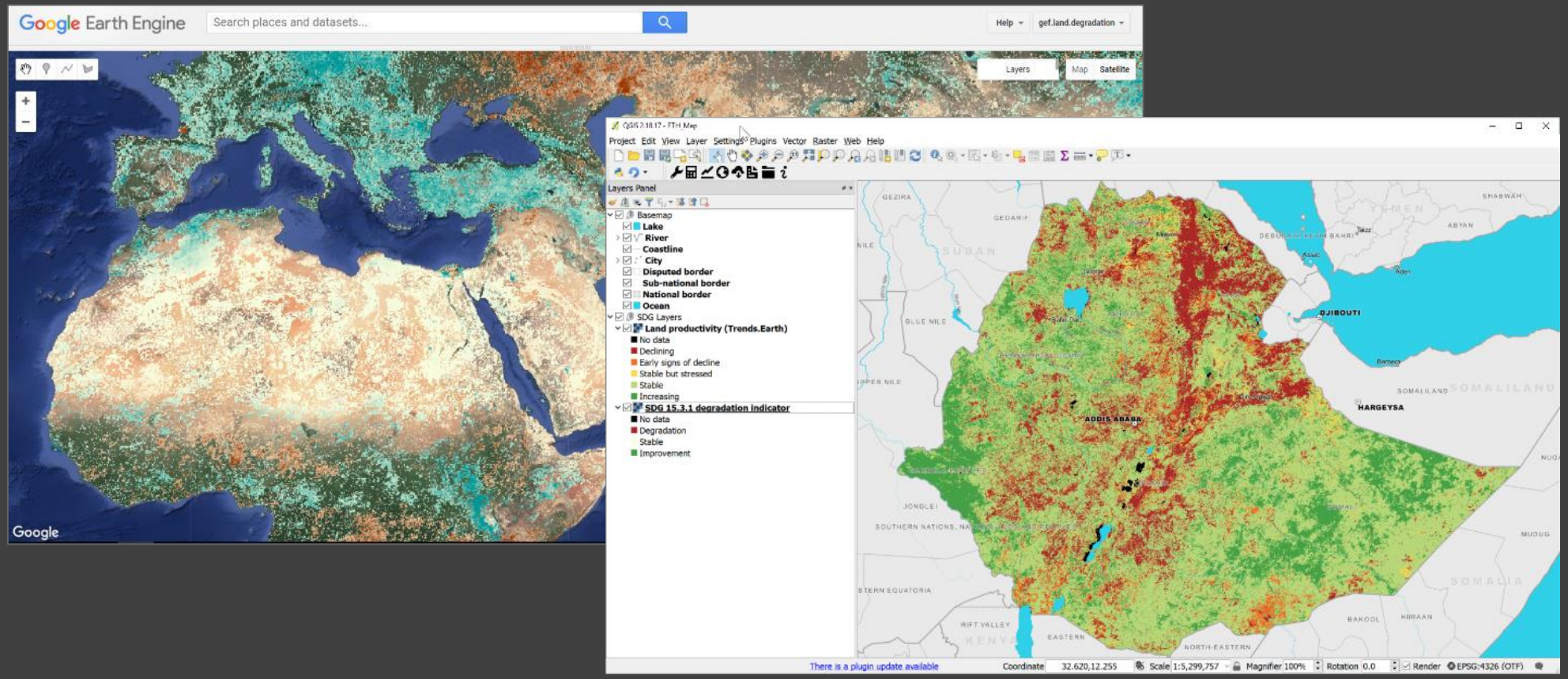
TRENDS.EARTH - WHAT IS IT?



TARGET 15·3

END DESERTIFICATION AND RESTORE DEGRADED LAND

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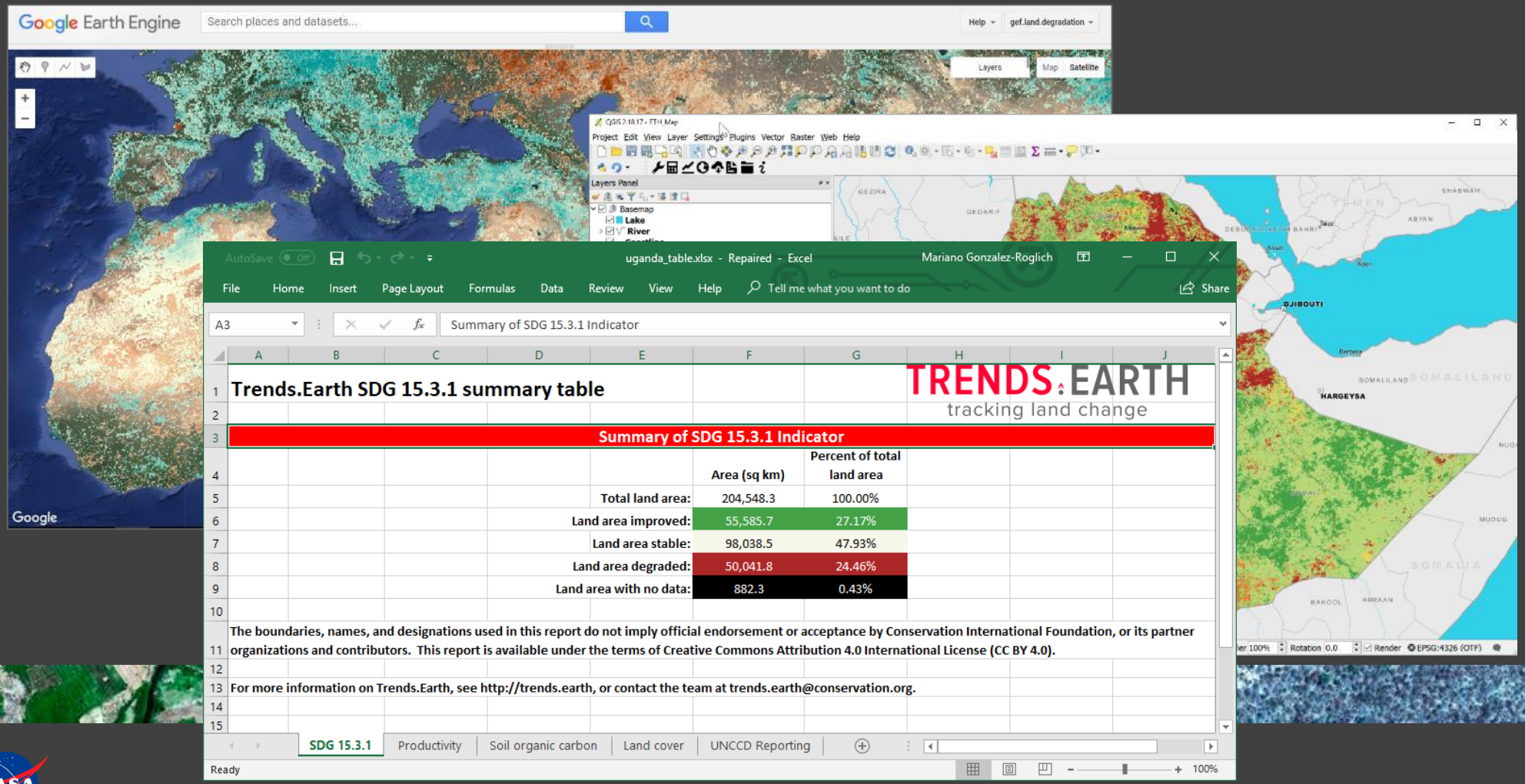
TRENDS.EARTH - WHAT IS IT?

TARGET 15·3

END DESERTIFICATION AND RESTORE DEGRADED LAND



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TRENDS.EARTH - SDG 15.3.1

Proportion of land that is degraded over a total area

1.	**Land Productivity**	**Net Primary Productivity**
2.	Land Cover	Land Cover Change
3.	Above and Below Ground C	Soil Organic Carbon

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TRENDS.EARTH - PRODUCTIVITY

- **Land productivity** is the biological productive capacity of the land, the source of all the food, fiber and fuel that sustains humans (United Nations Statistical Commission 2016).

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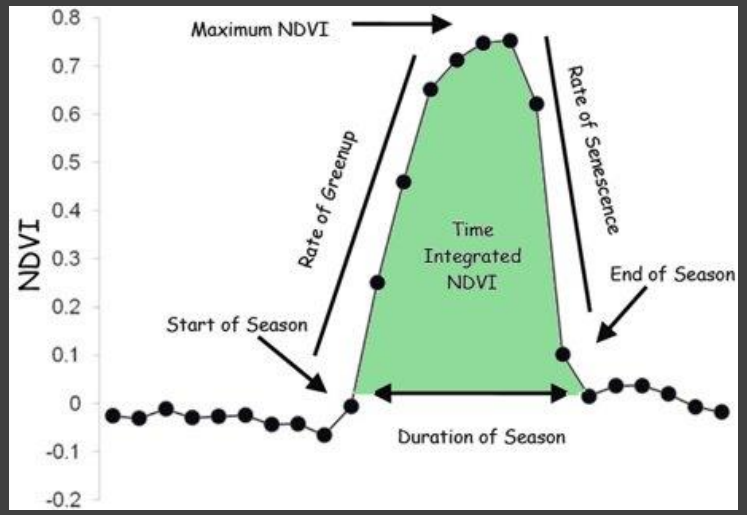
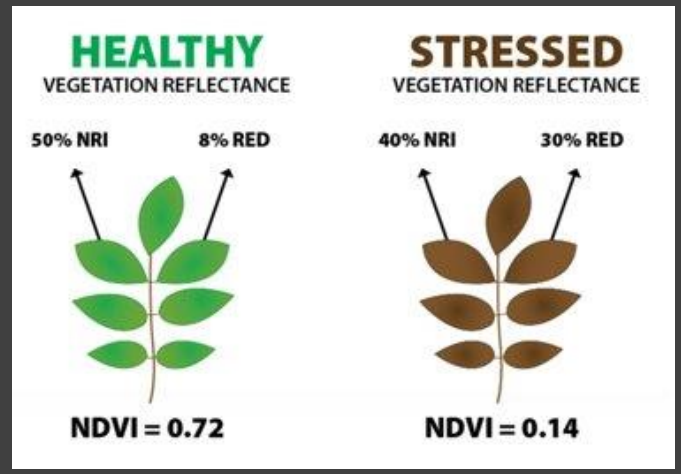
TRENDS.EARTH - PRODUCTIVITY → PRIMARY PRODUCTIVITY

TARGET 15.3
END DESERTIFICATION AND RESTORE DEGRADED LAND

- **Net primary productivity** (NPP) is the net amount of carbon assimilated after photosynthesis and autotrophic respiration over a given period of time (Clark et al. 2001) and is typically represented in units such as kg/ha/yr.



$$NDVI = \frac{NIR - RED}{NIR + RED}$$



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TRENDS.EARTH - PRODUCTIVITY INDICATORS

Trajectory:

- Measures the rate of change in primary productivity over time.

State:

- Compares the current productivity level in a given area to historical observations of productivity in that same area.

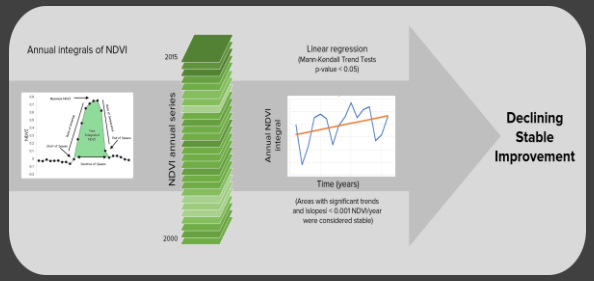
Performance:

- Measures local productivity relative to other similar vegetation types in similar land cover types or bioclimatic regions throughout the study area.

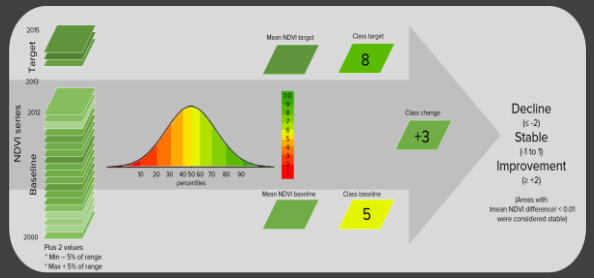
TRENDS.EARTH - PRODUCTIVITY INDICATORS

TARGET 15·3
END DESERTIFICATION AND RESTORE DEGRADED LAND

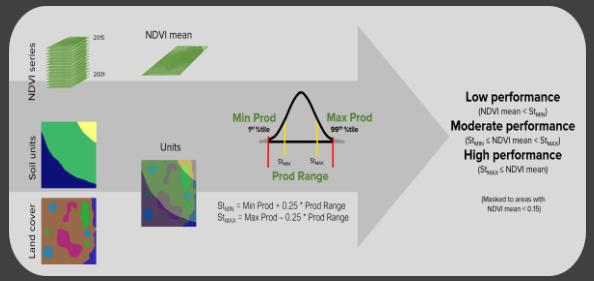
Trajectory:



State:



Performance:



For details, check:
http://trends.earth/docs/en/index.html

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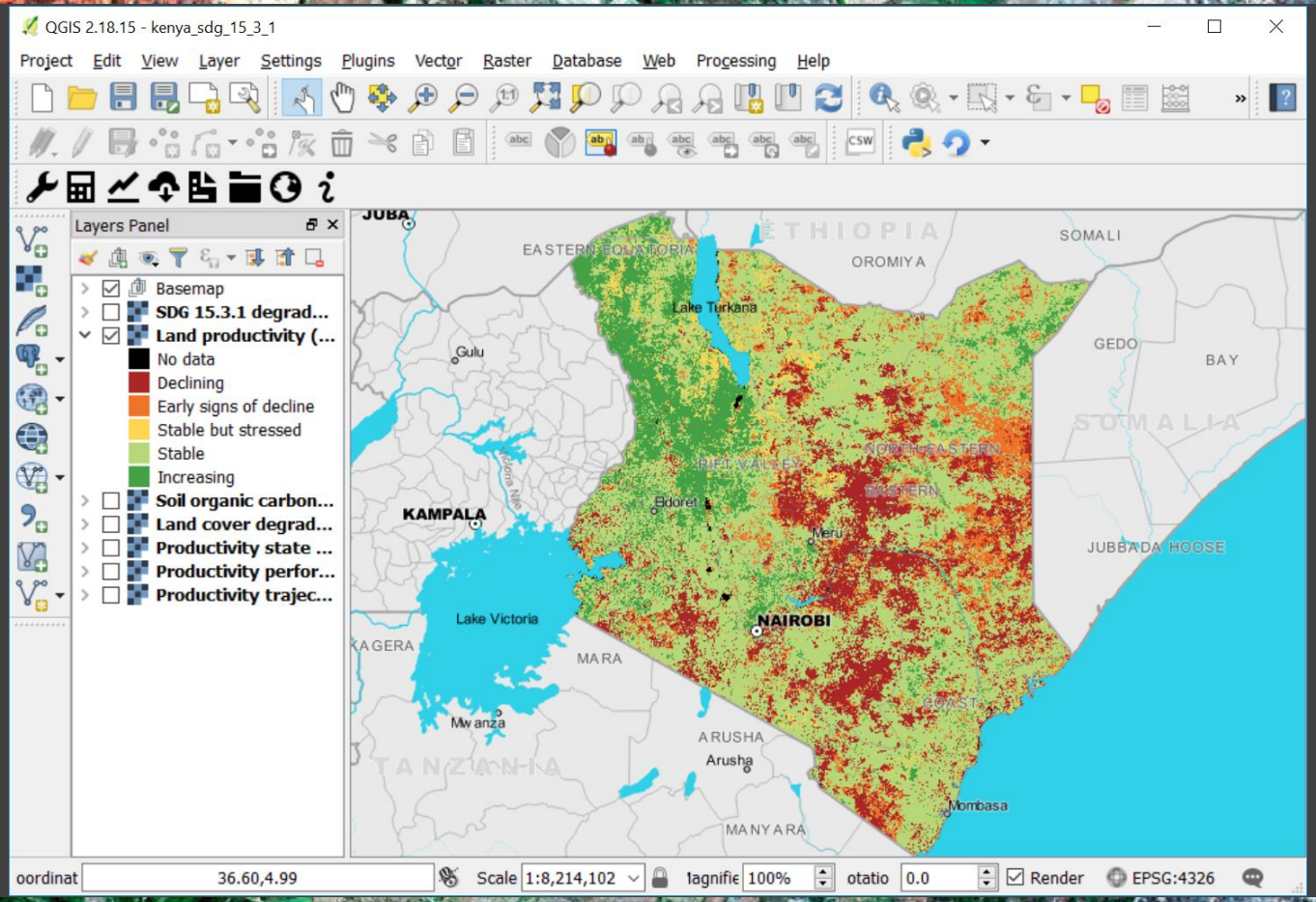
TRENDS.EARTH - LAND PRODUCTIVITY



TARGET 15·3
END DESERTIFICATION AND RESTORE DEGRADED LAND

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TRENDS.EARTH - SDG 15.3.1

Proportion of land that is degraded over a total area

1.	Land Productivity	Net Primary Productivity
2.	**Land Cover**	**Land Cover Change**
3.	Above and Below Ground C	Soil Organic Carbon

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TRENDS.EARTH - LAND COVER CHANGE

- …describes changes in the observed biophysical character of the earth's surface to help identify areas that may be subject to change. A transition from one land cover type to another may be considered an improvement, a neutral change or degradation, depending on the perspective of the country in question.

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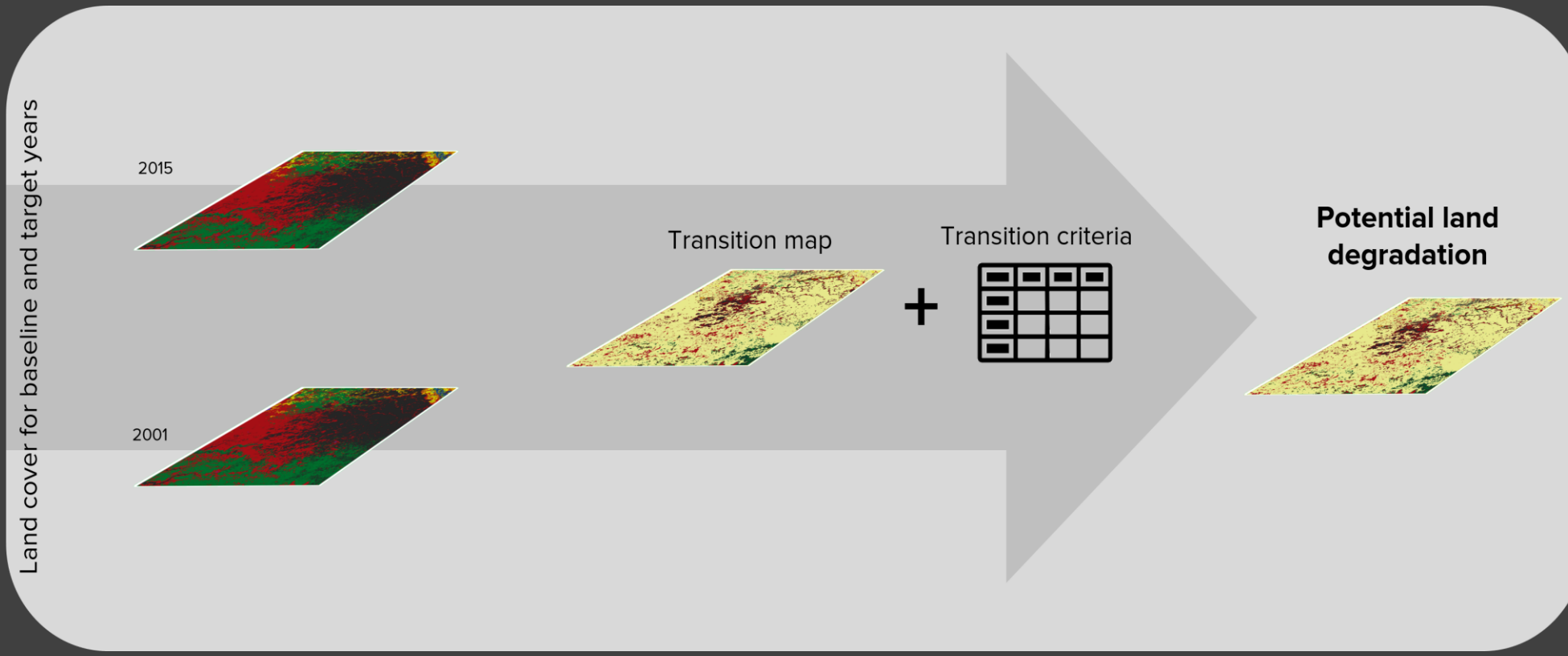
TRENDS.EARTH - LAND COVER CHANGE



TRENDS.EARTH - LAND COVER CHANGE

TARGET 15·3
END DESERTIFICATION AND RESTORE DEGRADED LAND

Land cover in target year

Land cover in initial year	Tree-covered	Grassland	Cropland	Wetland	Artificial	Bare land	Water body
Tree-covered	0	-	-	-	-	-	0
Grassland	+	0	+	-	-	-	0
Cropland	+	-	0	-	-	-	0
Wetland	-	-	-	0	-	-	0
Artificial	+	+	+	+	0	+	0
Bare land	+	+	+	+	-	0	0
Water body	0	0	0	0	0	0	0

Legend

Degradation	Stable	Improvement
-	0	+

*The "Grassland" class consists of grassland, shrub, and sparsely vegetated areas (if the default aggregation is used).

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TRENDS.EARTH - SDG 15.3.1

Proportion of land that is degraded over a total area

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TRENDS.EARTH - SOIL ORGANIC CARBON

- Carbon stocks reflect the integration of multiple processes affecting plant growth and the gains and losses from terrestrial organic matter pools. The metric used to assess carbon stocks adopted for Indicator 15.3.1 is soil organic carbon (SOC).

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TRENDS.EARTH - SOIL ORGANIC CARBON

$$SOC_{final} = SOC_{ref} \times FLU \times FMG \times FI$$

- **FLU**: land-use factor that reflects carbon stock changes associated with type of land use,
- **FMG**: management factor representing the main management practice specific to the land-use sector (e.g., different tillage practices in croplands)
- **FI**: input factor representing different levels of carbon input to soil.

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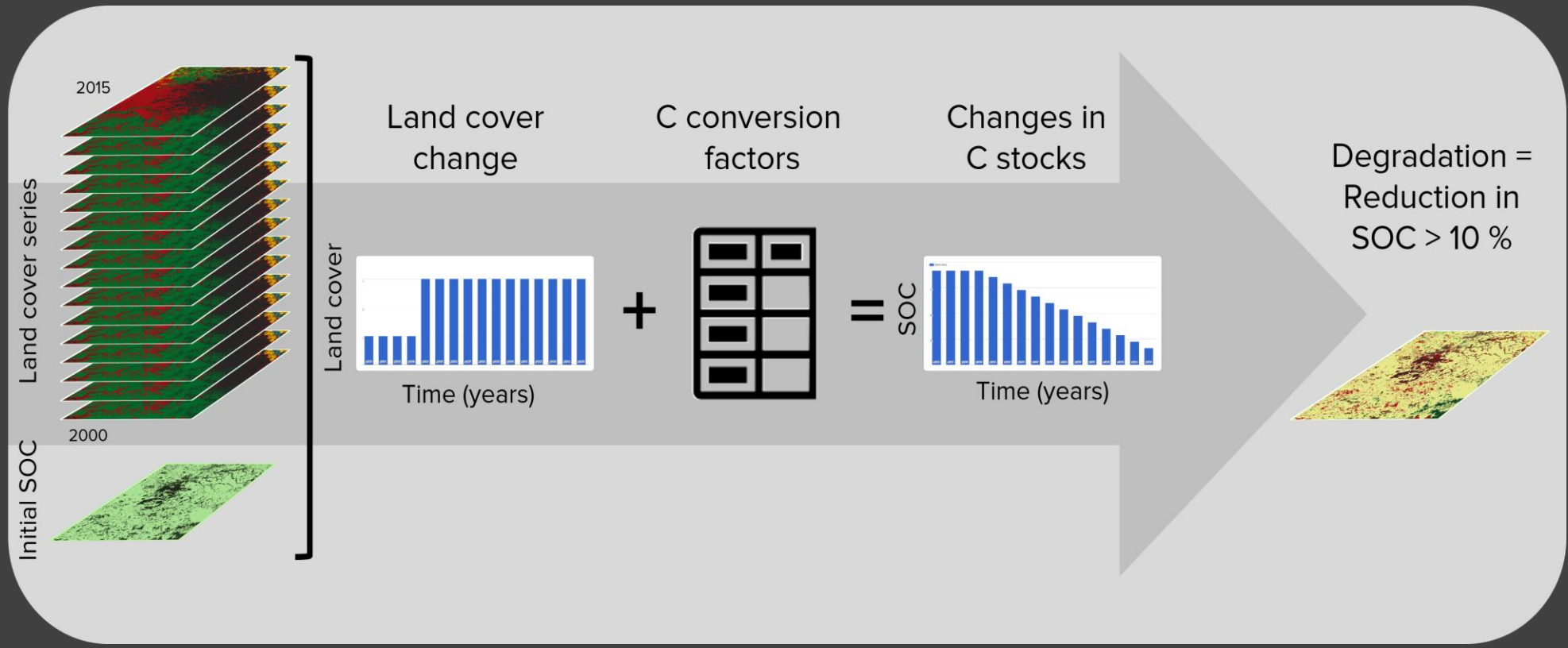
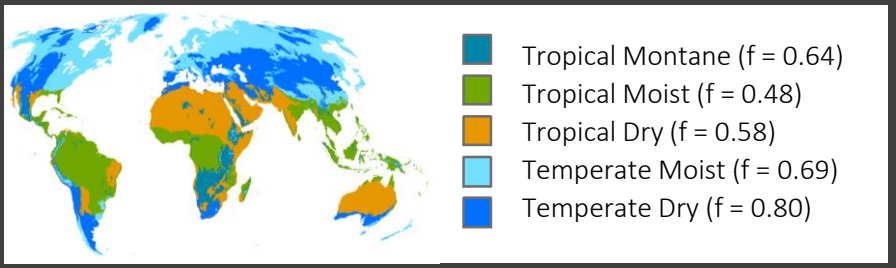


TRENDS.EARTH - SOIL ORGANIC CARBON

TARGET 15·3
END DESERTIFICATION AND RESTORE DEGRADED LAND

Land use factors		Final land cover						
		Forest	Grassland	Croplands	Wetlands	Artificial	Bare lands	Water
Initial land cover	Forest	1	1	f	1	0.1	0.1	1
	Grassland	1	1	f	1	0.1	0.1	1
	Croplands	1/f	1/f	1	1/0.71	0.1	0.1	1
	Wetlands	1	1	0.71	1	0.1	0.1	1
	Artificial	2	2	2	2	1	1	1
	Bare lands	2	2	2	2	1	1	1
	Water	1	1	1	1	1	1	1



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TRENDS.EARTH - SDG 15.3.1 one out-all out

Productivity	Land Cover	SOC	SDG 15.3.1
Improving	Improving	Improving	Improving
Improving	Improving	Stable	Improving
Improving	Improving	Declining	Declining
Improving	Stable	Improving	Improving
Improving	Stable	Stable	Improving
Improving	Stable	Declining	Declining
Improving	Declining	Improving	Declining
Improving	Declining	Stable	Declining
Improving	Declining	Declining	Declining
Stable	Improving	Improving	Improving
Stable	Improving	Stable	Improving
Stable	Improving	Declining	Declining
Stable	Stable	Improving	Improving
Stable	Stable	Stable	Stable
Stable	Stable	Declining	Declining
Stable	Declining	Improving	Declining
Stable	Declining	Stable	Declining
Stable	Declining	Declining	Declining
Declining	Improving	Improving	Declining
Declining	Improving	Stable	Declining
Declining	Improving	Declining	Declining
Declining	Stable	Improving	Declining
Declining	Stable	Stable	Declining
Declining	Stable	Declining	Declining
Declining	Declining	Improving	Declining

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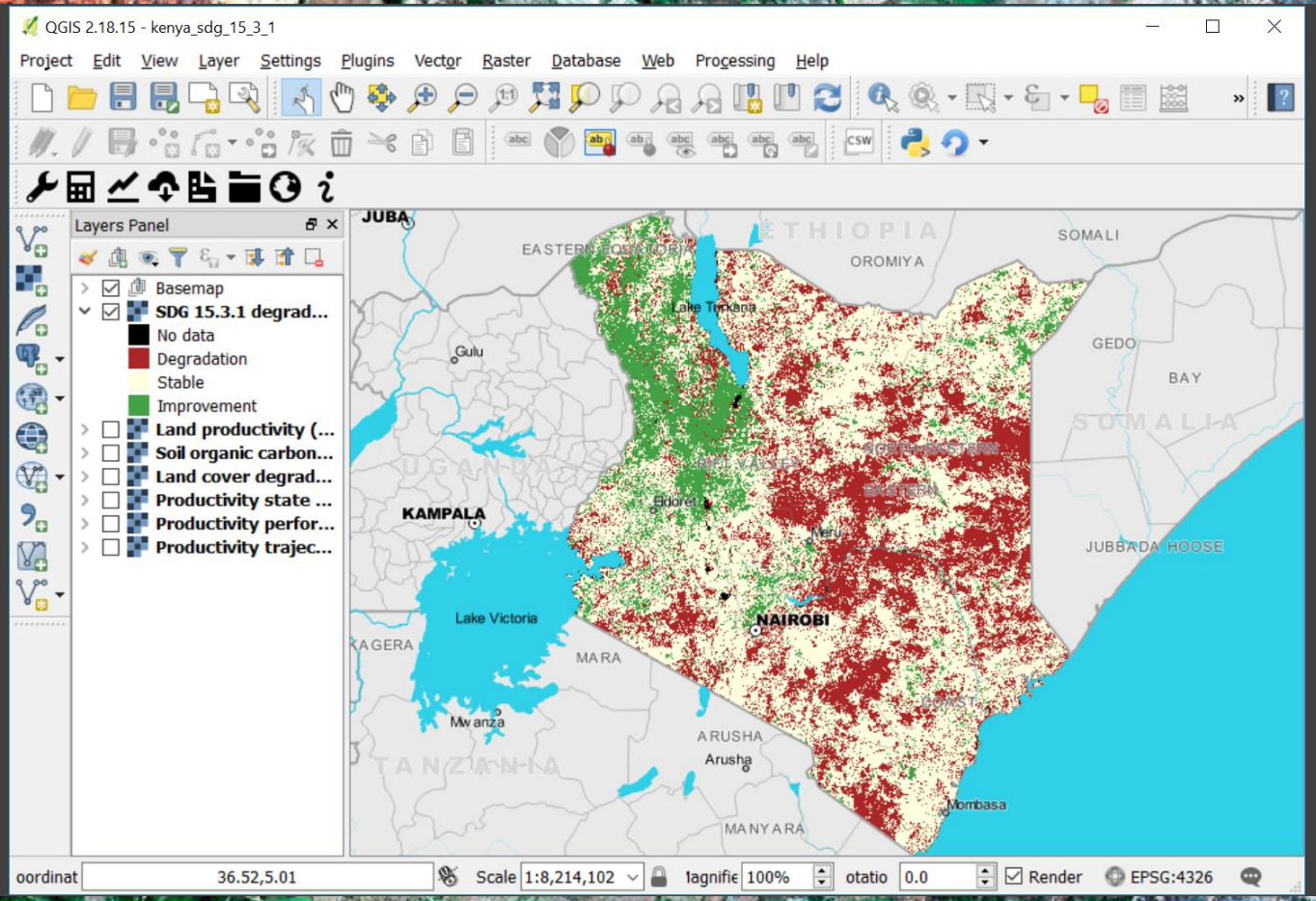
TRENDS.EARTH - THE OUTPUTS



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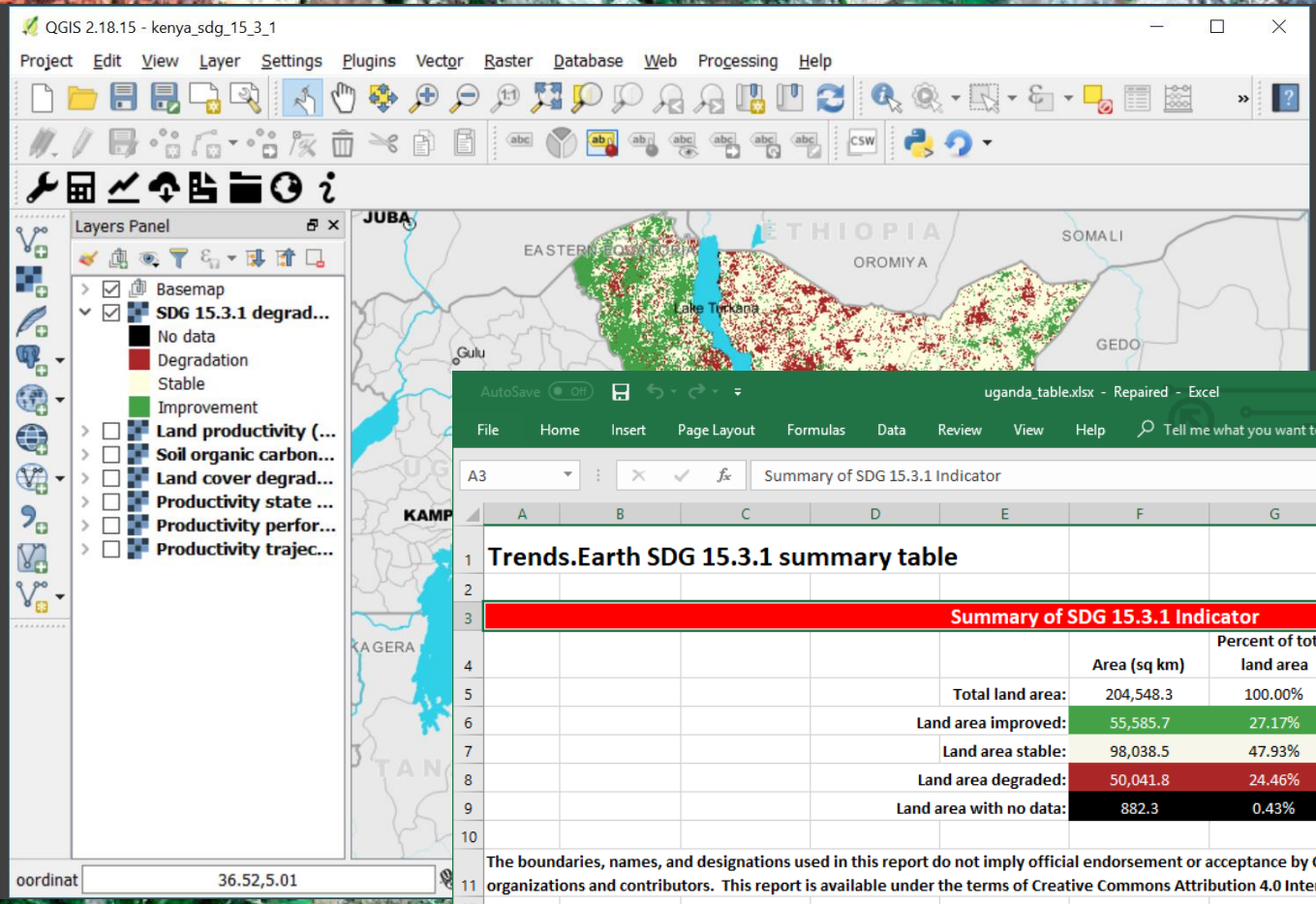
TRENDS.EARTH - THE OUTPUTS

TARGET 15·3

END DESERTIFICATION AND RESTORE DEGRADED LAND



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TRENDS.EARTH - IMPACTS SO FAR

More than **2500 users** from over **170 countries** are using Trends.Earth for assessing land condition and planning for LDN

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TRENDS.EARTH - NEXT STEPS

- Increases spatial resolution datasets
- Update to QGIS 3
- We on integration with **WOCAT** and **LandPKS** (and other tools) to support decision makers from field to national scale.
- Decision support tool, not just for monitoring, but for planning.

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Using Earth Observation Data to Support the Achievement of the Sustainability Agenda

Monitoring Sustainable Cities (SDG 11.3.1)

When: Thursday October 10, 2019 at 5:30 pm (1 hour and 20 min)
Where: Embajadores Hall

CONSERVATION INTERNATIONAL NASA gef TRENDS.EARTH

Mariano Gonzalez-Roglich, Conservation International
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TRENDS.EARTH - SDG 11.3.1

- Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable
  - Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries
    - Indicator 11.3.1: Ratio of land consumption rate to population growth rate
- Data needs:
  - Urban extent
  - Population data

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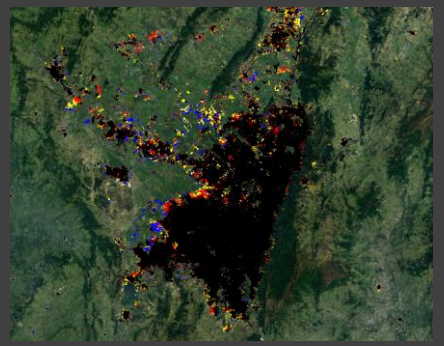
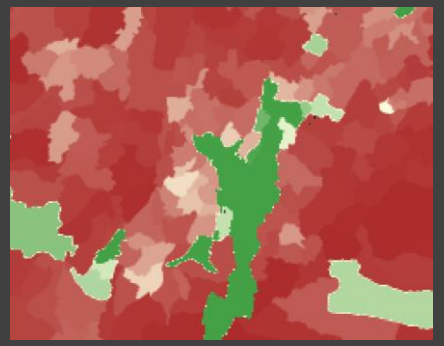
TRENDS.EARTH - SDG 11.3.1

Trends.Earth urban extent series



Gridded Population of the World V4



- Part 1: Estimating the population growth rate
- Part 2: Estimating the land use consumption rate
- Part 3: Estimating SDG 11.3.1

$$PGR = \frac{(LN(Pop_{(t+n)}/Pop_t)}{(y)}$$

$$LCR = \frac{(LN(Urb_{(t+n)}/Urb_t)}{(y)}$$

$$LCRPGR = \frac{(\text{Annual Land Consumption rate})}{(\text{Annual Population growth rate})}$$

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UN HABITAT FOR A BETTER URBAN FUTURE

TRENDS.EARTH - MONITORING CITIES

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TRENDS.EARTH - COMPUTE SDG 11.3.1

2000

Satellite images → Impervious Index → Built-up area → City extent → City population

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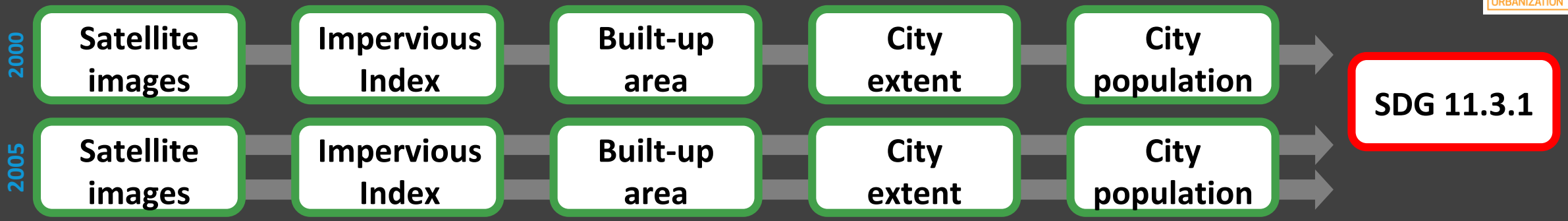
TRENDS.EARTH - COMPUTE SDG 11.3.1



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TRENDS.EARTH - COMPUTE SDG 11.3.1

2000	Satellite images	Impervious Index	Built-up area	City extent	City population	SDG 11.3.1
2005	Satellite images	Impervious Index	Built-up area	City extent	City population	SDG 11.3.1
2010	Satellite images	Impervious Index	Built-up area	City extent	City population	

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TRENDS.EARTH - COMPUTE SDG 11.3.1

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2005	Satellite images	Impervious Index	Built-up area	City extent	City population	SDG 11.3.1
2010	Satellite images	Impervious Index	Built-up area	City extent	City population	SDG 11.3.1
2015	Satellite images	Impervious Index	Built-up area	City extent	City population	

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TRENDS.EARTH - COMPUTE SDG 11.3.1

2000	Satellite images	Impervious Index	Built-up area	City extent	City population	SDG 11.3.1
2005	Satellite images	Impervious Index	Built-up area	City extent	City population	SDG 11.3.1
2010	Satellite images	Impervious Index	Built-up area	City extent	City population	SDG 11.3.1
2015	Satellite images	Impervious Index	Built-up area	City extent	City population	

Pre-Computed

(2.3 M Landsat scenes
1.15 Petabytes of data)

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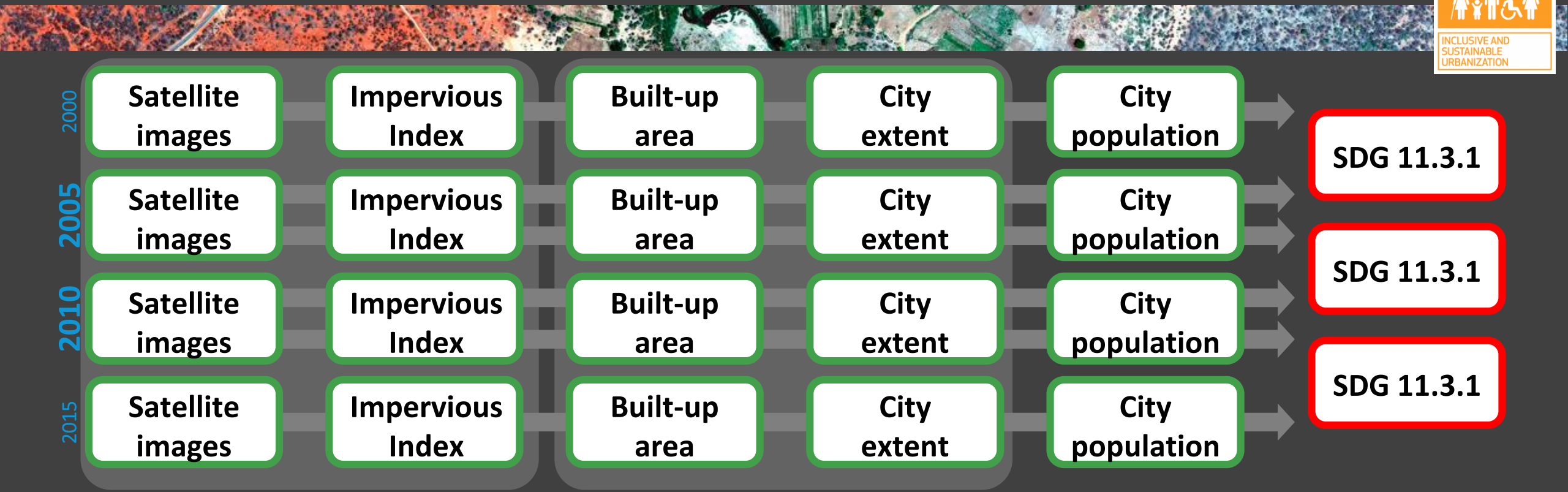
TRENDS.EARTH - COMPUTE SDG 11.3.1



TARGET 11·3
INCLUSIVE AND SUSTAINABLE URBANIZATION

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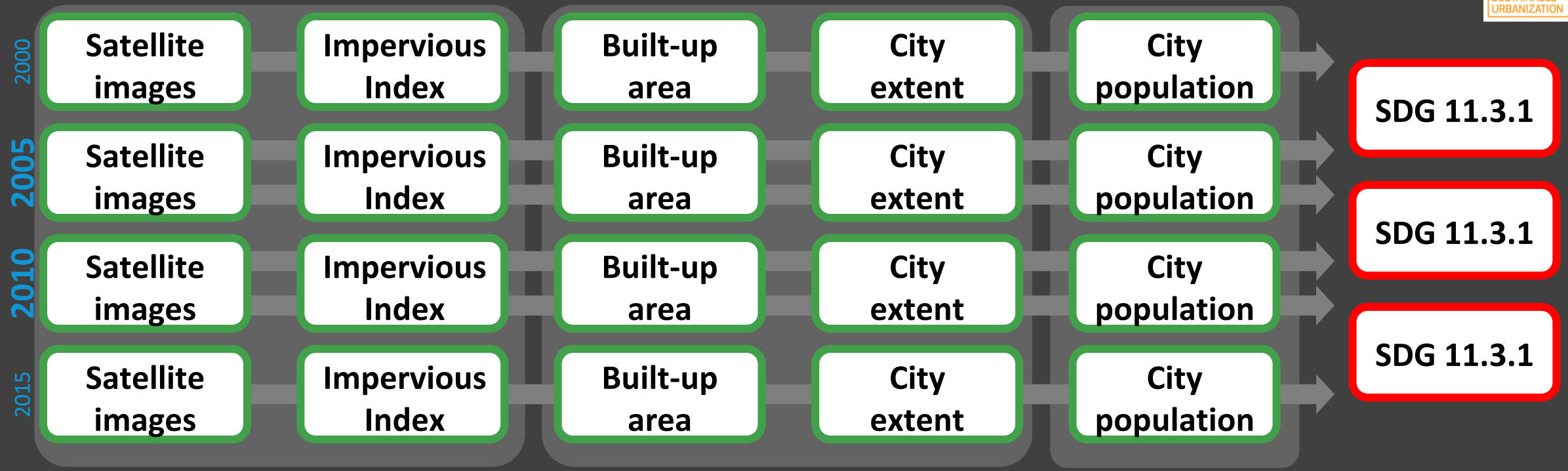
TRENDS.EARTH - COMPUTE SDG 11.3.1



TARGET 11·3
INCLUSIVE AND SUSTAINABLE URBANIZATION

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TRENDS.EARTH - COMPUTE SDG 11.3.1

	Satellite images	Impervious Index	Built-up area	City extent	City population	
2000						
2005	Satellite images	Impervious Index	Built-up area	City extent	City population	SDG 11.3.1
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2015	Satellite images	Impervious Index	Built-up area	City extent	City population	SDG 11.3.1

Pre-Computed
(2.3 M Landsat scenes
1.15 Petabytes of data)

User Input

Global Data

Summary Maps & Tables

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TRENDS.EARTH - COMPUTE SDG 11.3.1

TARGET 11·3

INCLUSIVE AND SUSTAINABLE URBANIZATION

Training Data

Global Man-made Impervious Surface (GMIS)*

High quality URBAN
GMIS IS_percentage > 1
GMIS standard_error < 25
ESA CCI land cover = urban

Hi quality NON-URBAN
GMIS IS_percentage = 0
GMIS standard_error = 0
ESA CCI land cover <> urban

Base remote sensing data

Landsat derived 24-band stack 1998, 2000, 2005, 2010, 2015, 2018

Model trained with GMIS 2010 & Landsat derived stack 2010

846 terrestrial ecoregions from RESOLVE

Random Forest Model (per ecoregion)

Impervious Surface Index (ISI) 1998, 2000, 2005, 2010, 2015, 2018

Model run on the 6 Landsat derived stacks

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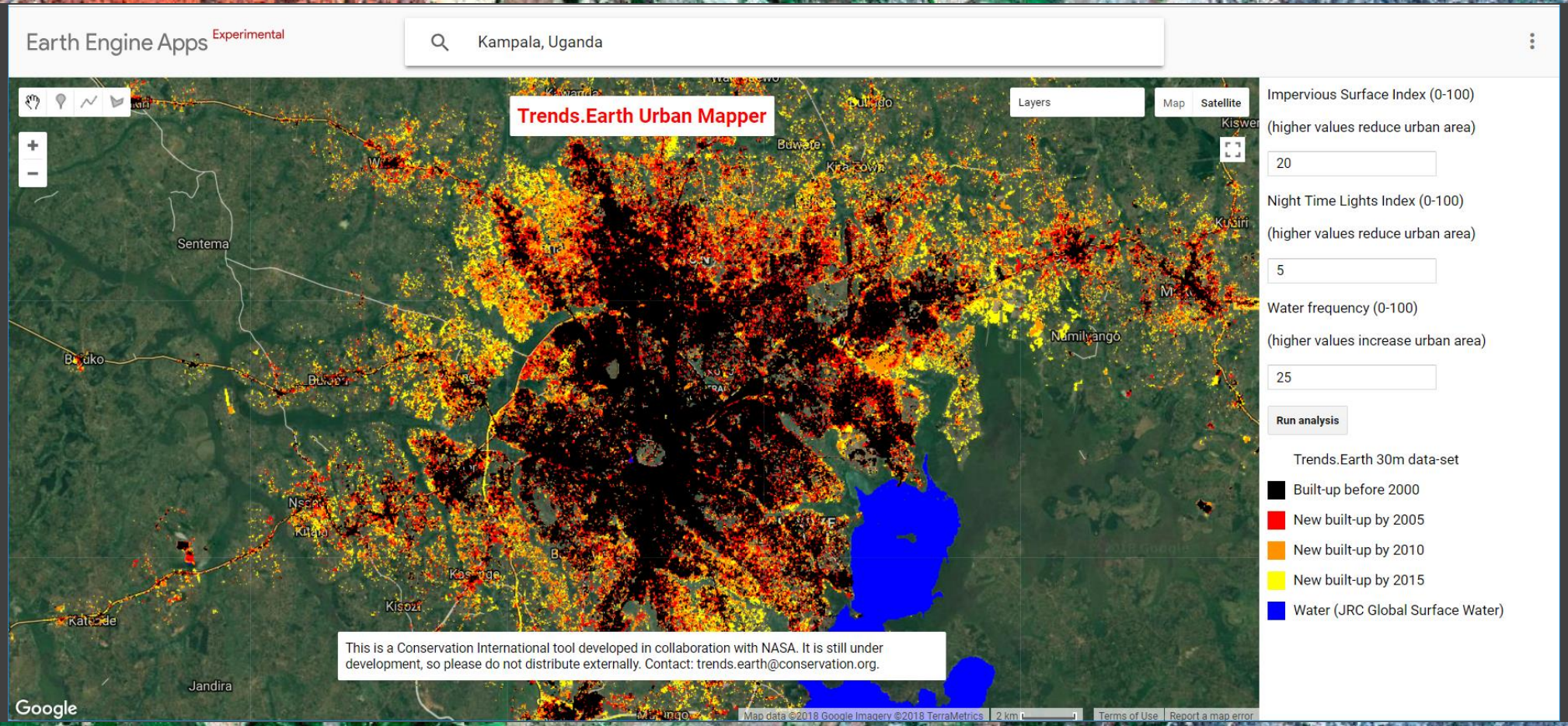
TRENDS.EARTH - URBAN MAPPER

TARGET 11·3

INCLUSIVE AND SUSTAINABLE URBANIZATION



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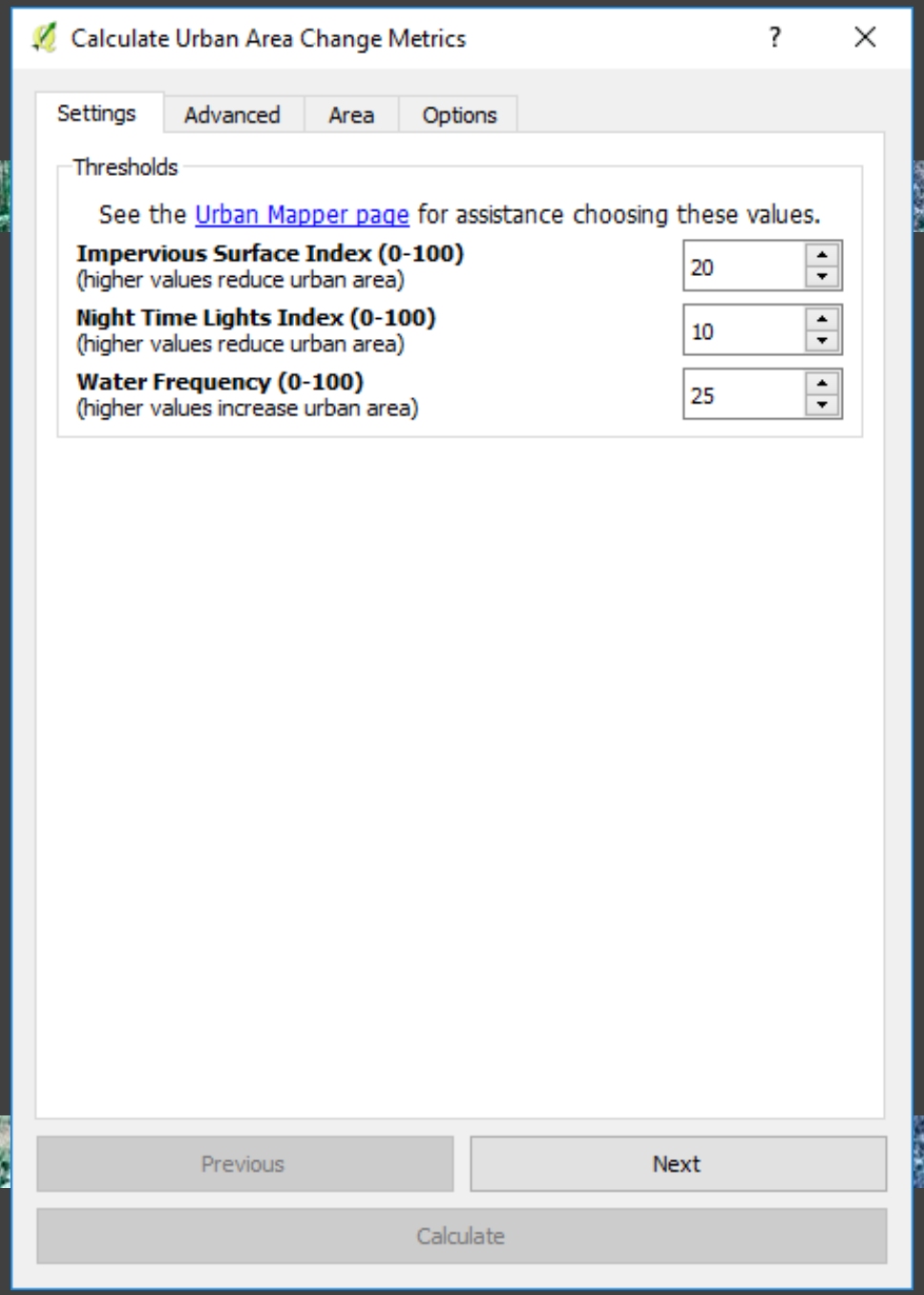
TRENDS.EARTH - QGIS

Define built-up area



TARGET 11·3
INCLUSIVE AND SUSTAINABLE URBANIZATION

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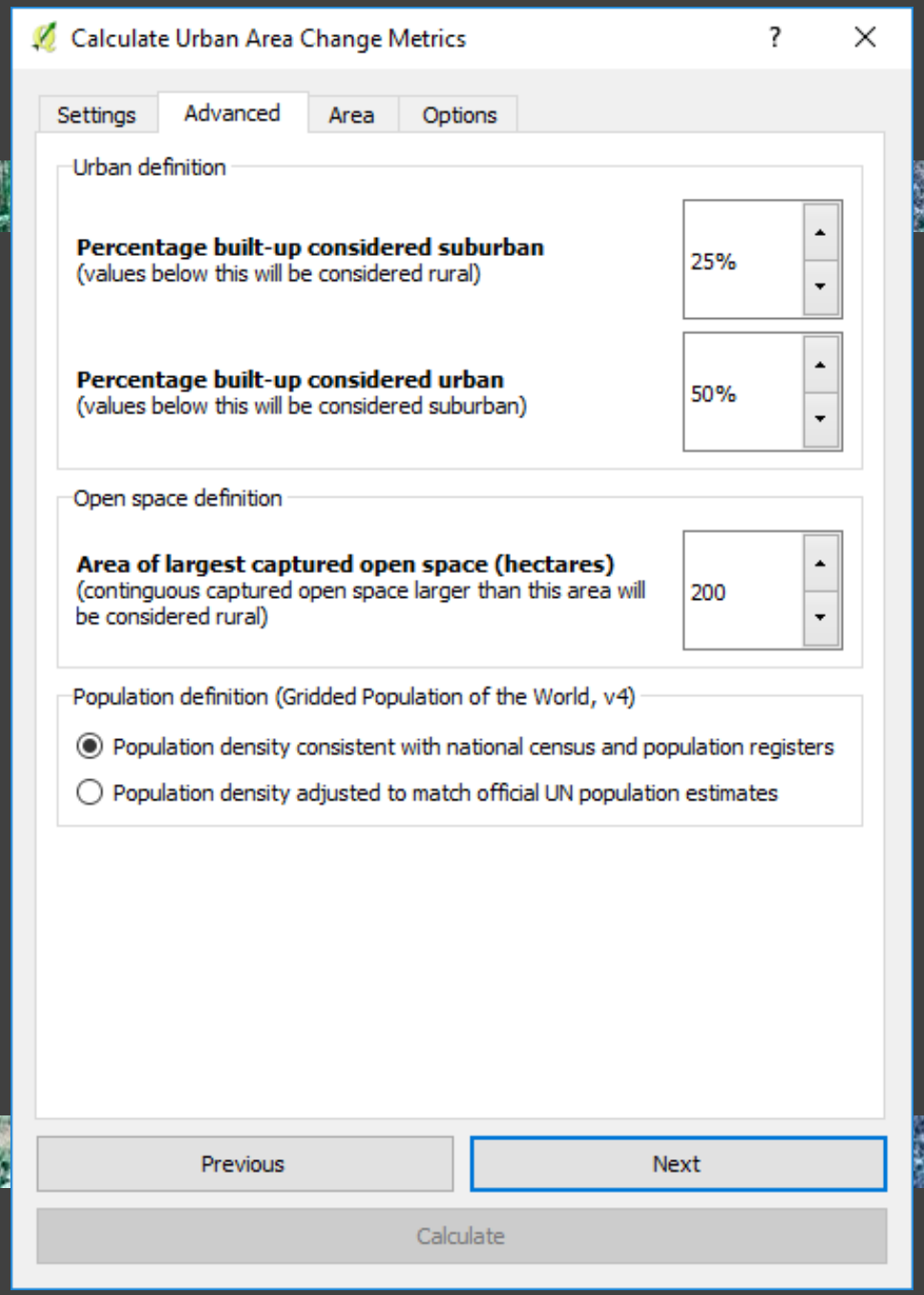
TRENDS.EARTH - QGIS

Define urban areas (zonation)



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INCLUSIVE AND SUSTAINABLE URBANIZATION

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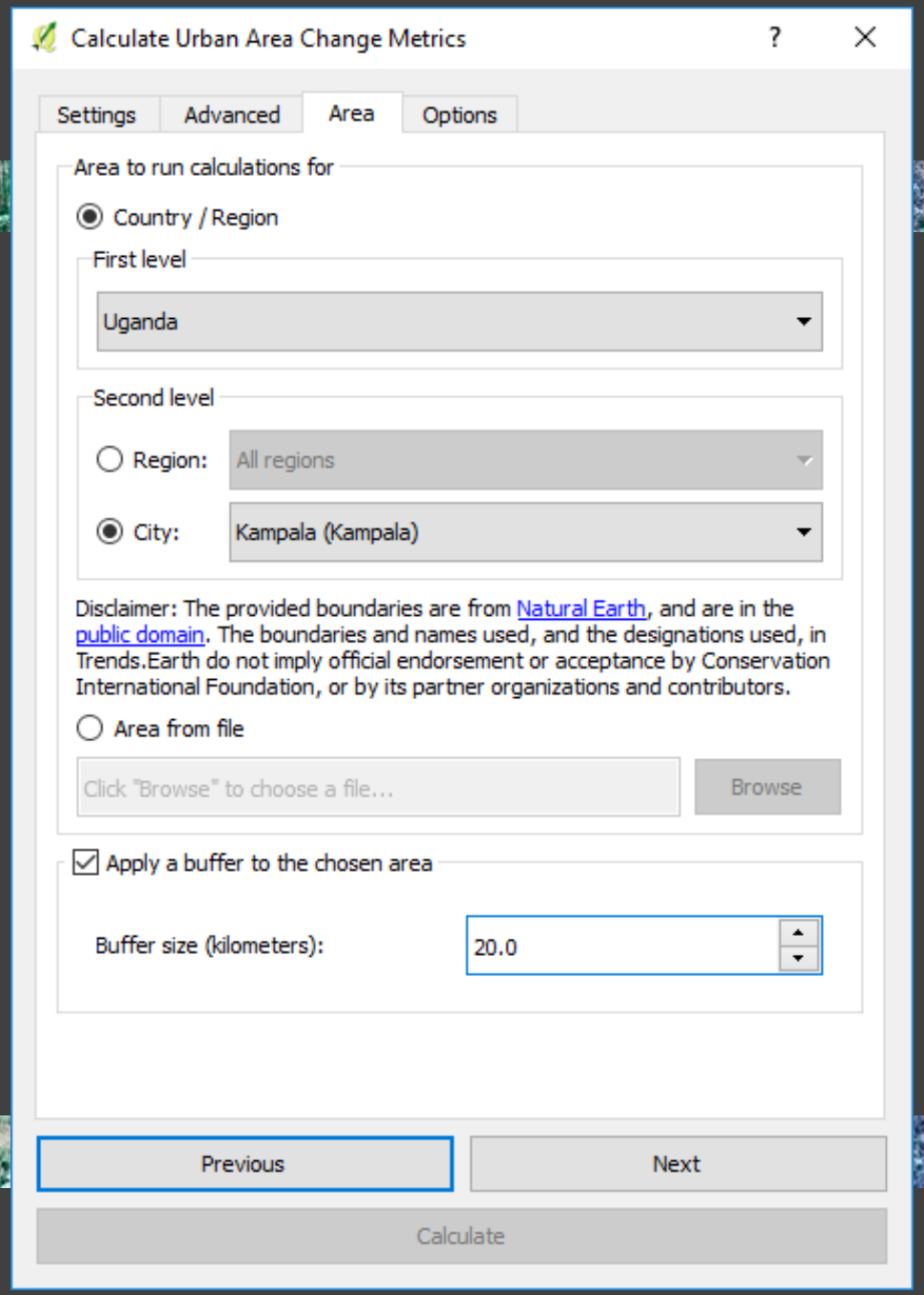
TRENDS.EARTH - QGIS

Define area of analysis



TARGET 11·3
INCLUSIVE AND SUSTAINABLE URBANIZATION

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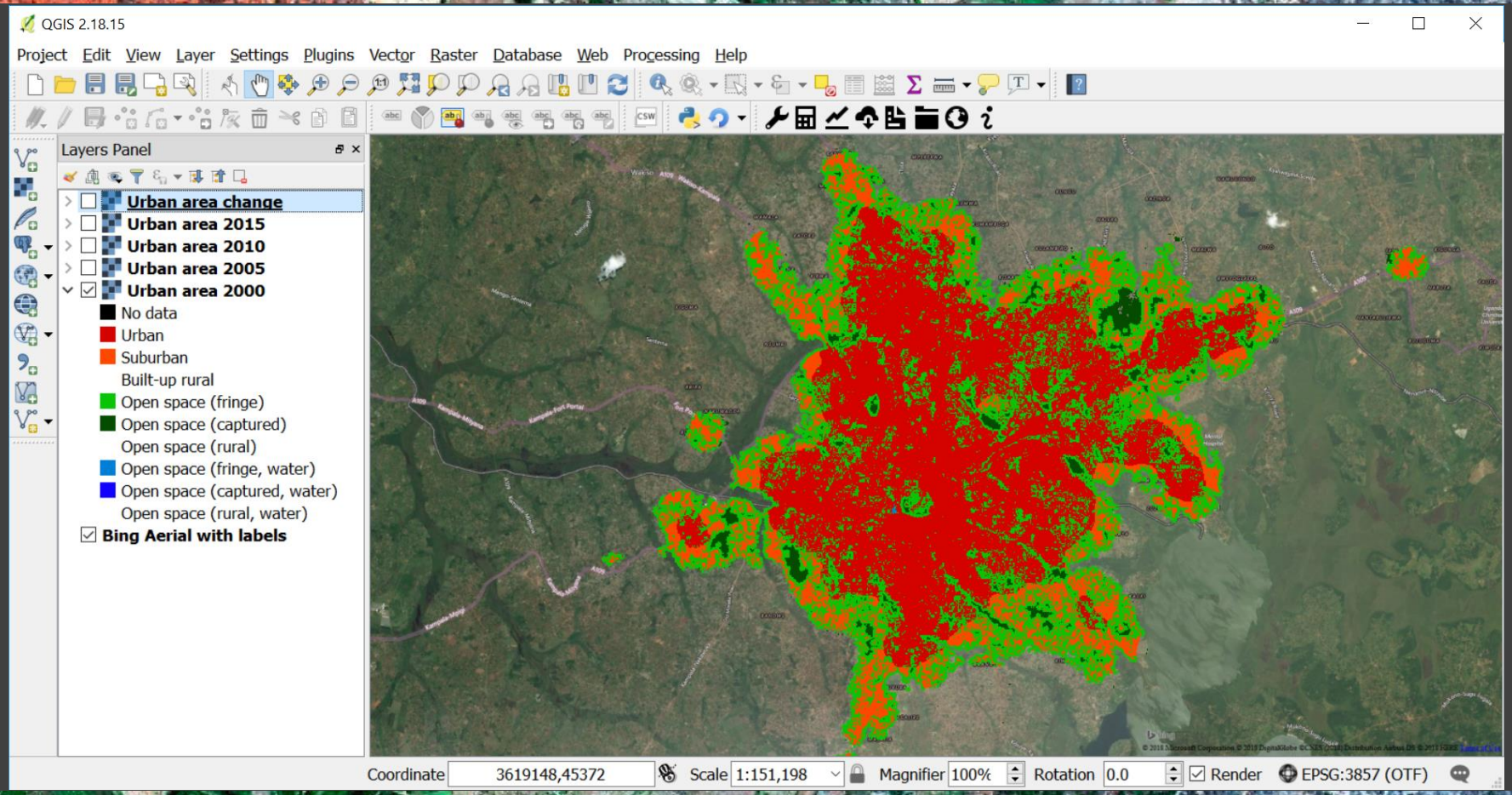
TRENDS.EARTH - QGIS

TARGET 11·3

INCLUSIVE AND SUSTAINABLE URBANIZATION

Kampala, Uganda – 2000



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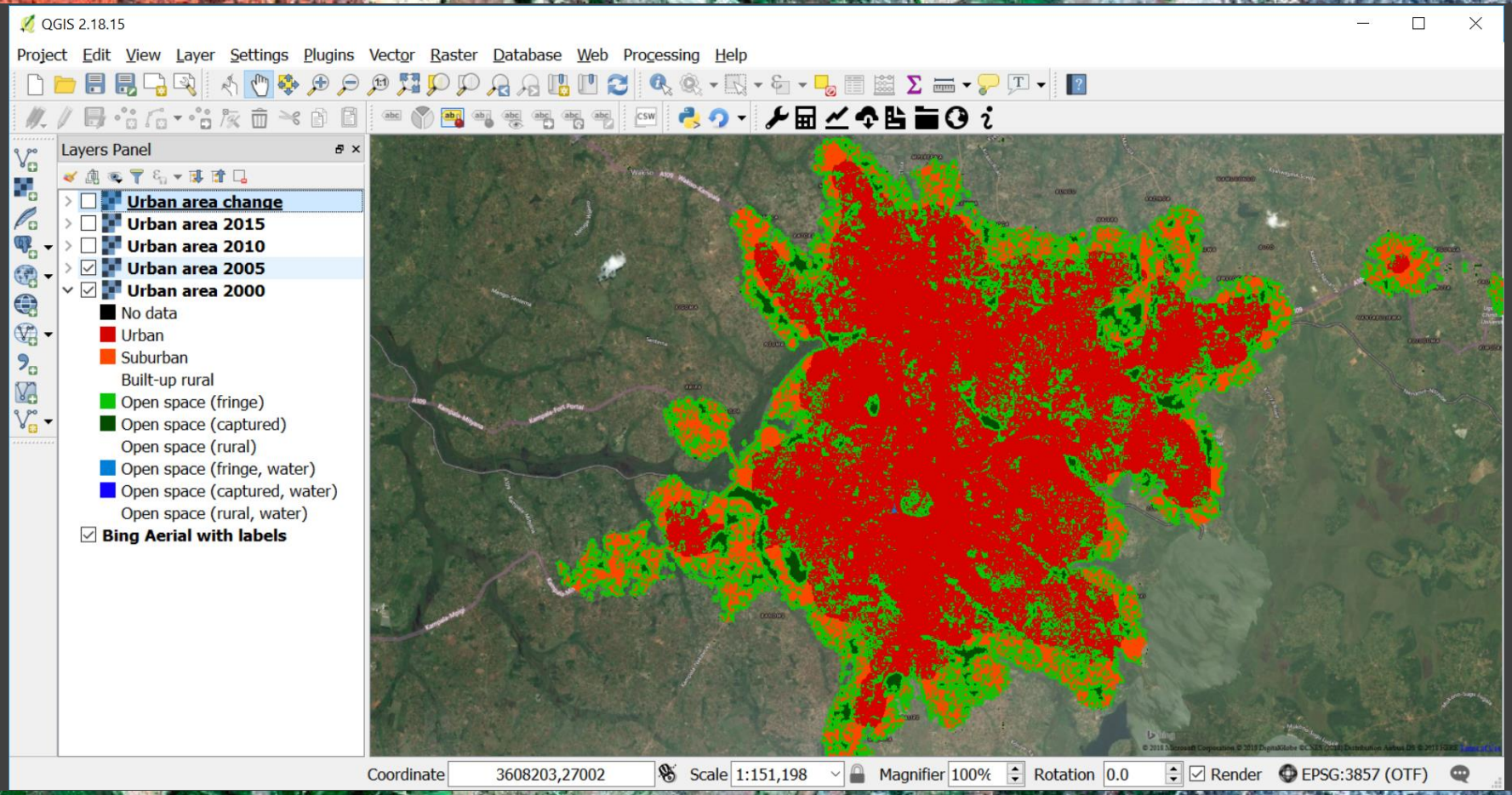
TRENDS.EARTH - QGIS

TARGET 11·3

INCLUSIVE AND SUSTAINABLE URBANIZATION

Kampala, Uganda – 2005



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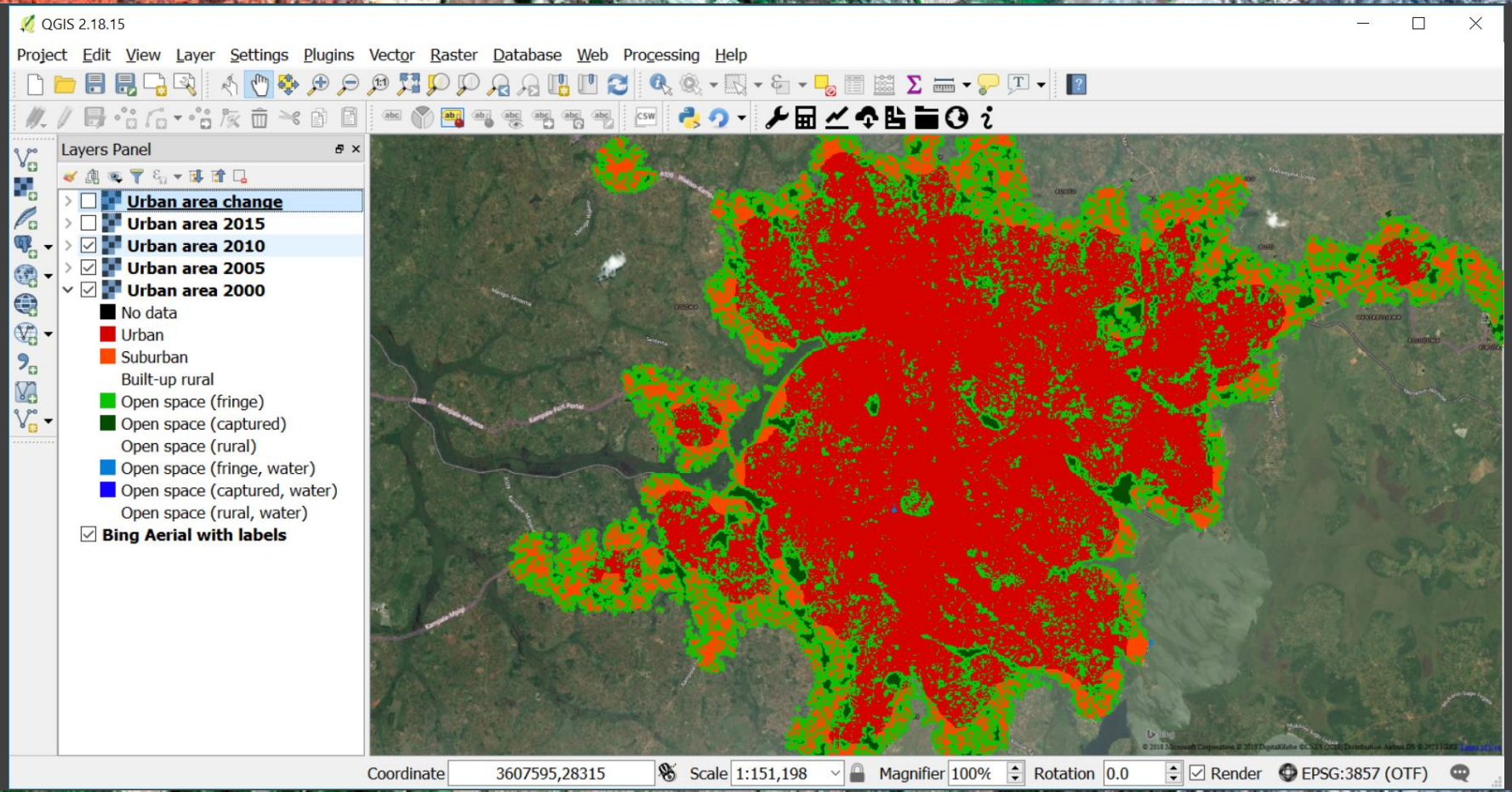
TRENDS.EARTH - QGIS

TARGET 11·3

INCLUSIVE AND SUSTAINABLE URBANIZATION

Kampala, Uganda – 2010



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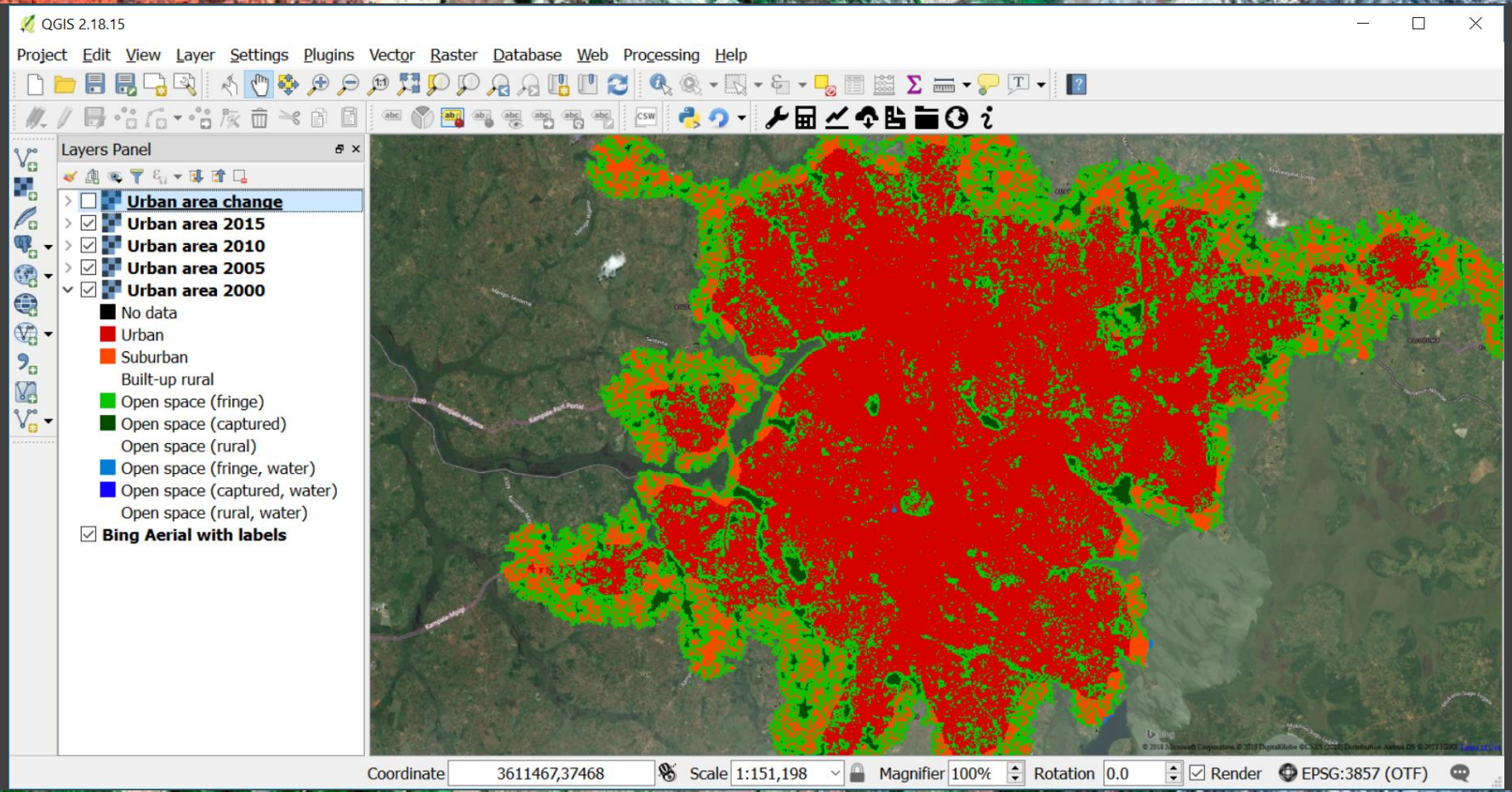
TRENDS.EARTH - QGIS

TARGET 11·3

INCLUSIVE AND SUSTAINABLE URBANIZATION

Kampala, Uganda – 2015



CONSERVATION INTERNATIONAL

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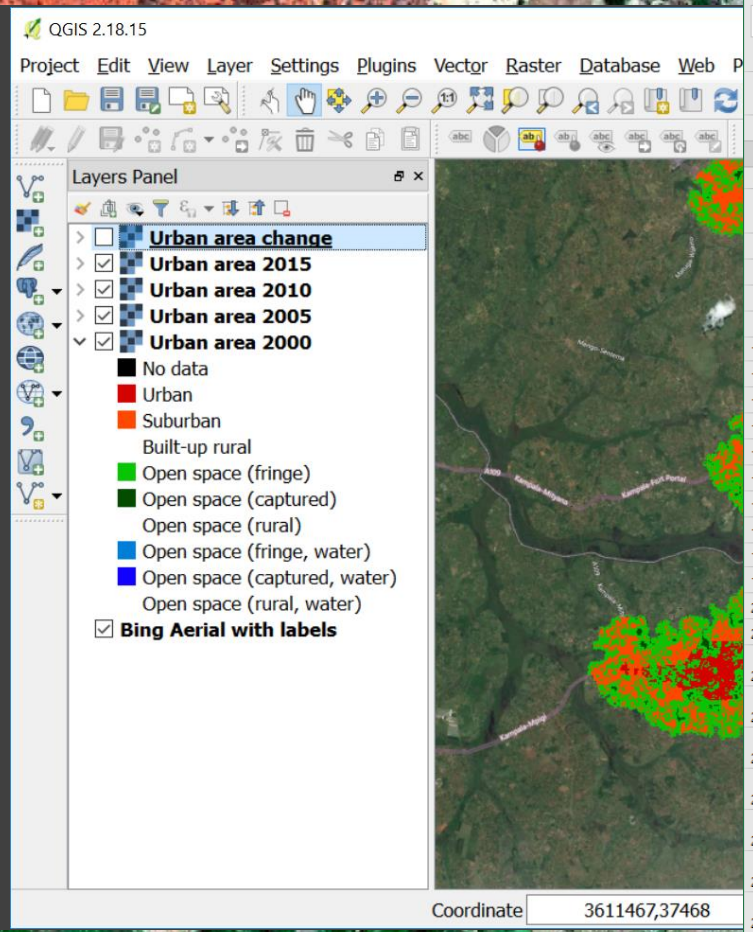
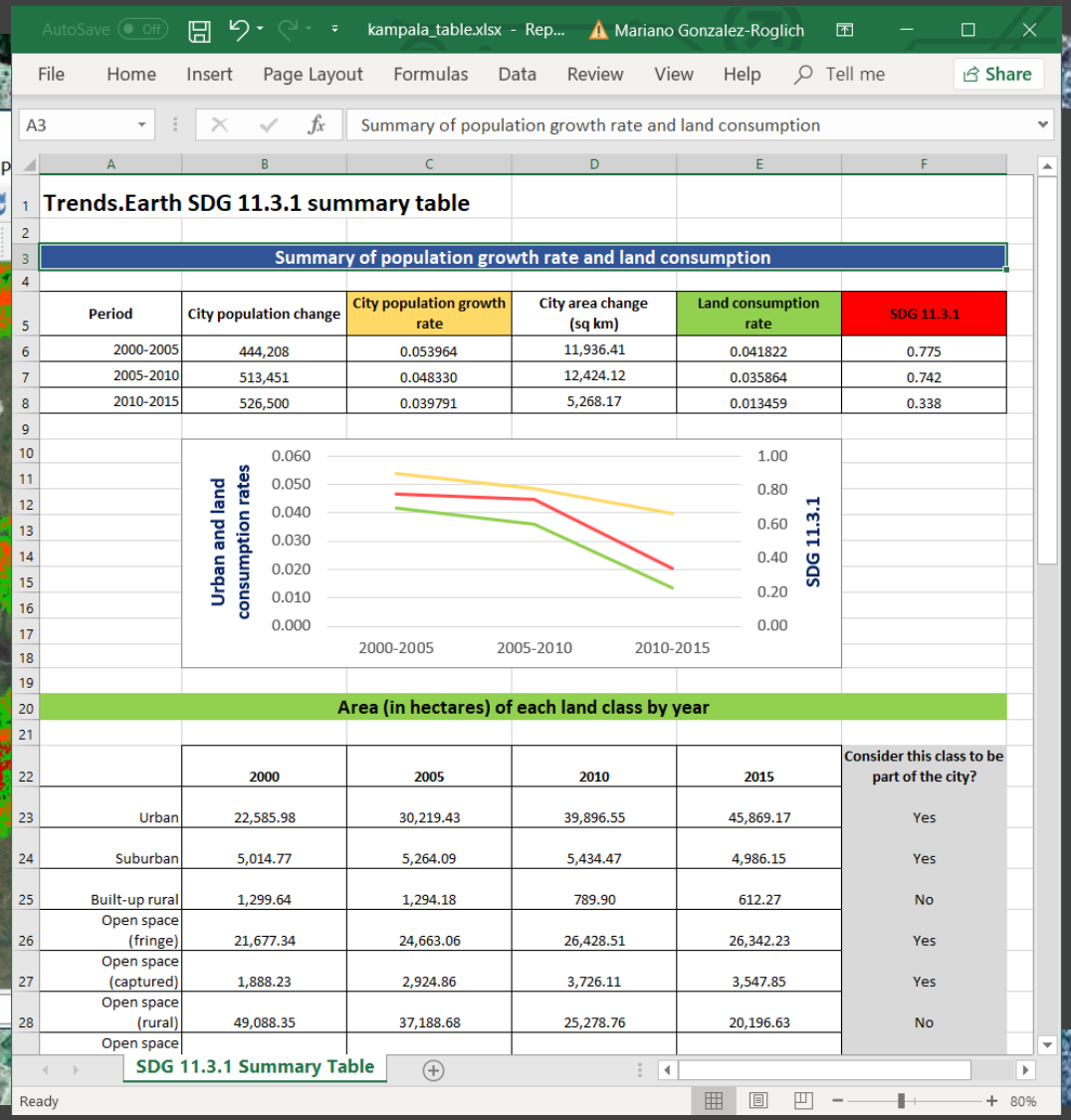
TRENDS.EARTH - QGIS

TARGET 11·3

INCLUSIVE AND SUSTAINABLE URBANIZATION

Kampala, Uganda – Time series





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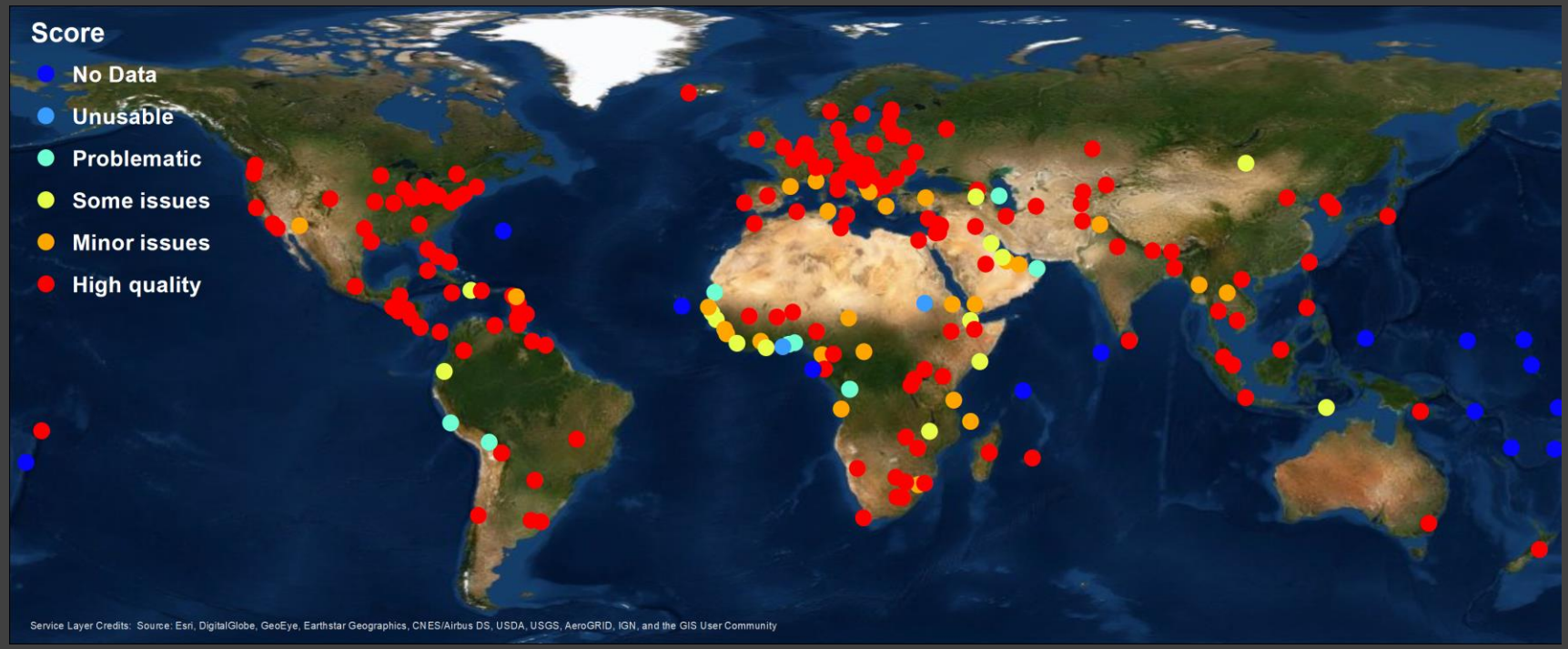
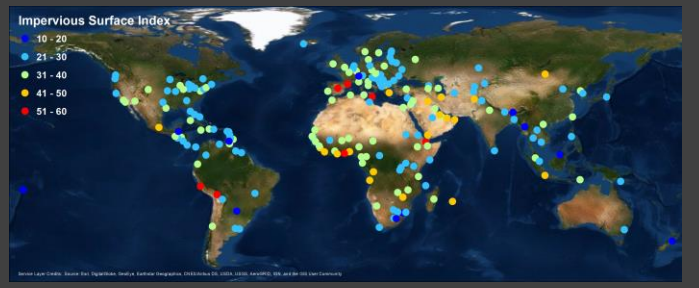
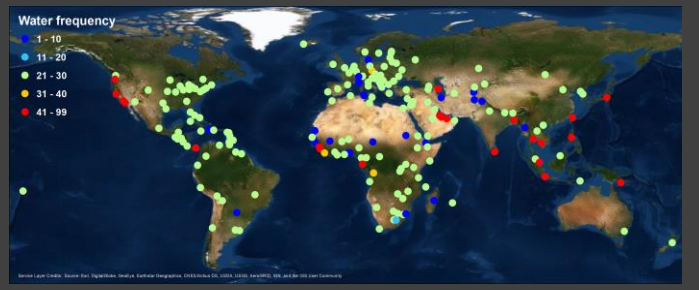
TRENDS.EARTH - TESTING

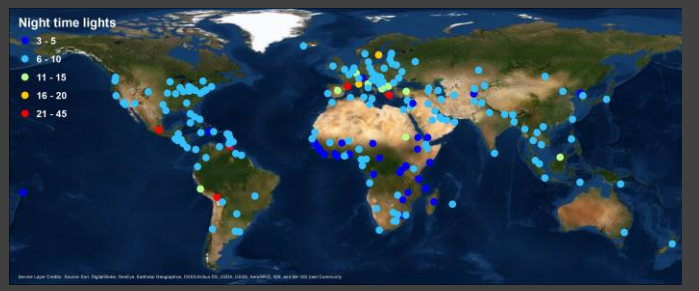
TARGET 11·3

INCLUSIVE AND SUSTAINABLE URBANIZATION









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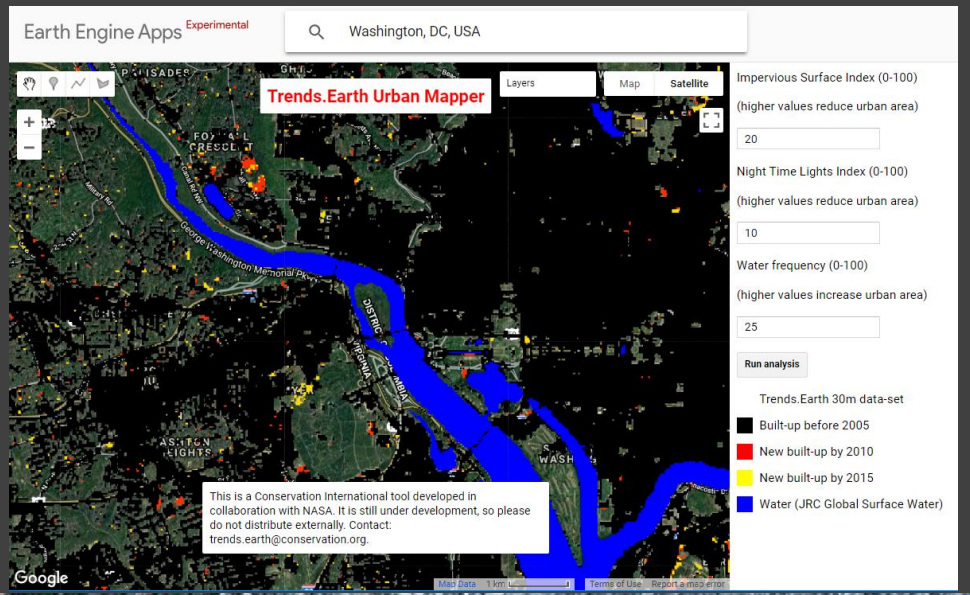
TRENDS.EARTH - NEXT STEPS

TARGET 11·3

INCLUSIVE AND SUSTAINABLE URBANIZATION

- Continue the verification process to provide regional guidelines.
- Address limitation on hyper arid regions
- Work with gridded population data providers to improve relevance of population data at city level.
- Continue capacity building efforts
  – (ARSET webinar & in person)



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Muchas Gracias!

Preguntas?

- QGIS Plug-in: Trends.Earth
- Website: http://trends.earth/
- Outputs: http://maps.trends.earth

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