Earth Observations Toolkit for Sustainable Cities and Human Settlements

Part 1: Introduction to the EO Toolkit for Sustainable Cities and Human Settlements

Argyro Kavvada, Ph.D., NASA Headquarters, GEO EO4SDG Initiative

January 27, 2022

Presenter Bio

I am an Earth scientist, working with NASA's Earth Science Division Applied Sciences Program.

I serve as the Executive Director for the international GEO EO4SDG initiative.

My current work focuses on extending Earth science applications and research to advance sustainable development around the world, in alignment with the United Nations Sustainable Development Goals.

I received my PhD and MS degree in Atmospheric and Oceanic Science from the University of Maryland, an MS degree in Applied Mathematics and Statistics from Georgetown University, and a BS degree in Physics from the Johns Hopkins University.

Argyro Kavvada, PhD
Program Manager, Sustainable Development Goals, NASA
Executive Director, GEO EO4SDG
argyro.kavvada@nasa.gov

@EO4SDG

About ARSET

About ARSET

- *ARSET provides accessible, relevant, and cost-free training on remote sensing satellites, sensors, methods, and tools.*

- Our trainings are:

  - Online and *in-person
  - Open to anyone
  - Live, instructor-led or self-guided
  - Tailored to those with a range of experience in remote sensing, from **introductory** to **advanced**

*ARSET is not currently offering in-person trainings due to the COVID-19 pandemic.

- ARSET offers trainings for:
  - Disasters
  - Health & Air Quality
  - Land Management
  - Water Resources
  - Climate

For more information, visit
appliedsciences.nasa.gov/arset

Course Information and Prerequisites

- Three 90-minute sessions on January 27, February 3, and February 10 from **10:00-11:30 EST (UTC-5)**

- Webinar recordings and PowerPoint presentations can be found on the training webpage: https://appliedsciences.nasa.gov/join-mission/training/english/arset-earth-observations-toolkit-sustainable-cities-and-human

- Fundamentals of Remote Sensing:
  - https://appliedsciences.nasa.gov/join-mission/training/english/arset-fundamentals-remote-sensing

- Introduction to Population Grids and their Integration with Remote Sensing Data for Sustainable Development and Disaster Management:
  - https://appliedsciences.nasa.gov/join-mission/training/english/arset-introduction-population-grids-and-their-integration-remote

Homework and Certificate

- One homework assignment:
  - Answers must be submitted via Google Form accessed from the ARSET [website](#)
  - Homework will be made available on February 10, 2021.
  - Due date for homework: February 24, 2022.

- A certificate of completion will be awarded to those who:
  - Attend all three live webinars and complete exercise
  - Complete the homework assignment by the deadline
  - You will receive a certificate approximately two months after the completion of the course from: marines.martins@ssaihq.com

Training Objectives

By the end of this training attendees will be able to:

- Understand the value and usefulness of Earth observations to monitor and report on urban Sustainable Development Goal (SDG) indicators and the New Urban Agenda.

- Learn from inspiring examples of cities using Earth observations for SDG 11 (sustainable cities and human settlements) and the New Urban Agenda.

- Understand how to apply Earth observation-based Toolkit resources to enhance urban resilience and improve decision making
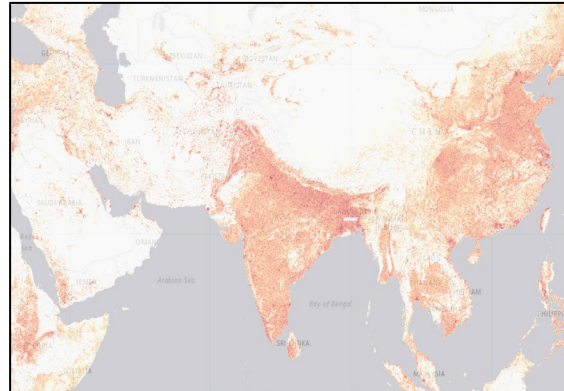
Training Outline

Three 90-minute sessions:

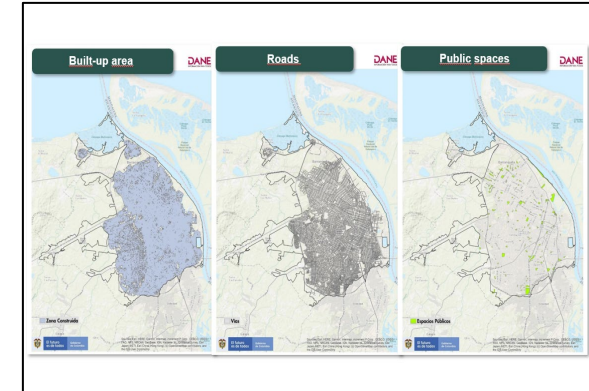**Part 1: January 27, 2022**
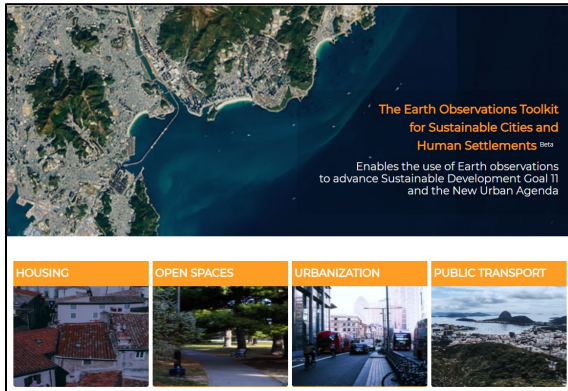
Introduction to Cities and the EO Toolkit for Sustainable Human Settlements

Part 2: February 3, 2022

Applications of the EO Toolkit to Measure and Analyze Sustainable Development Goals

Part 3: February 10, 2022

Use Cases from the National and City Level

Overview - Intro to Role of Earth Observations for SDG 11 Indicators, Earth Observations Toolkit for Sustainable Cities and Human Settlements

- Overview of the role of Earth observations in monitoring, tracking, and implementing Sustainable Development Goals (SDGs)

- The Earth Observations for Sustainable Development Goals (EO4SDG) Initiative

- Background and introduction to the main components of the Earth Observations Toolkit for Sustainable Cities and Human Settlements

- Demonstration of the Earth Observations Toolkit for Sustainable Cities and Human Settlements

National Aeronautics and Space Administration

Earth Observations Toolkit for Sustainable Cities and Human Settlements, Part 1

Dennis Mwaniki, UN-Habitat

January 27, 2022

The 2030 Agenda for Sustainable Development

The 2030 Agenda, adopted by 193 countries in Sep 2015 is the shared blueprint for a better and more sustainable world, where peace and prosperity for people and the planet prevail, now and into the future.
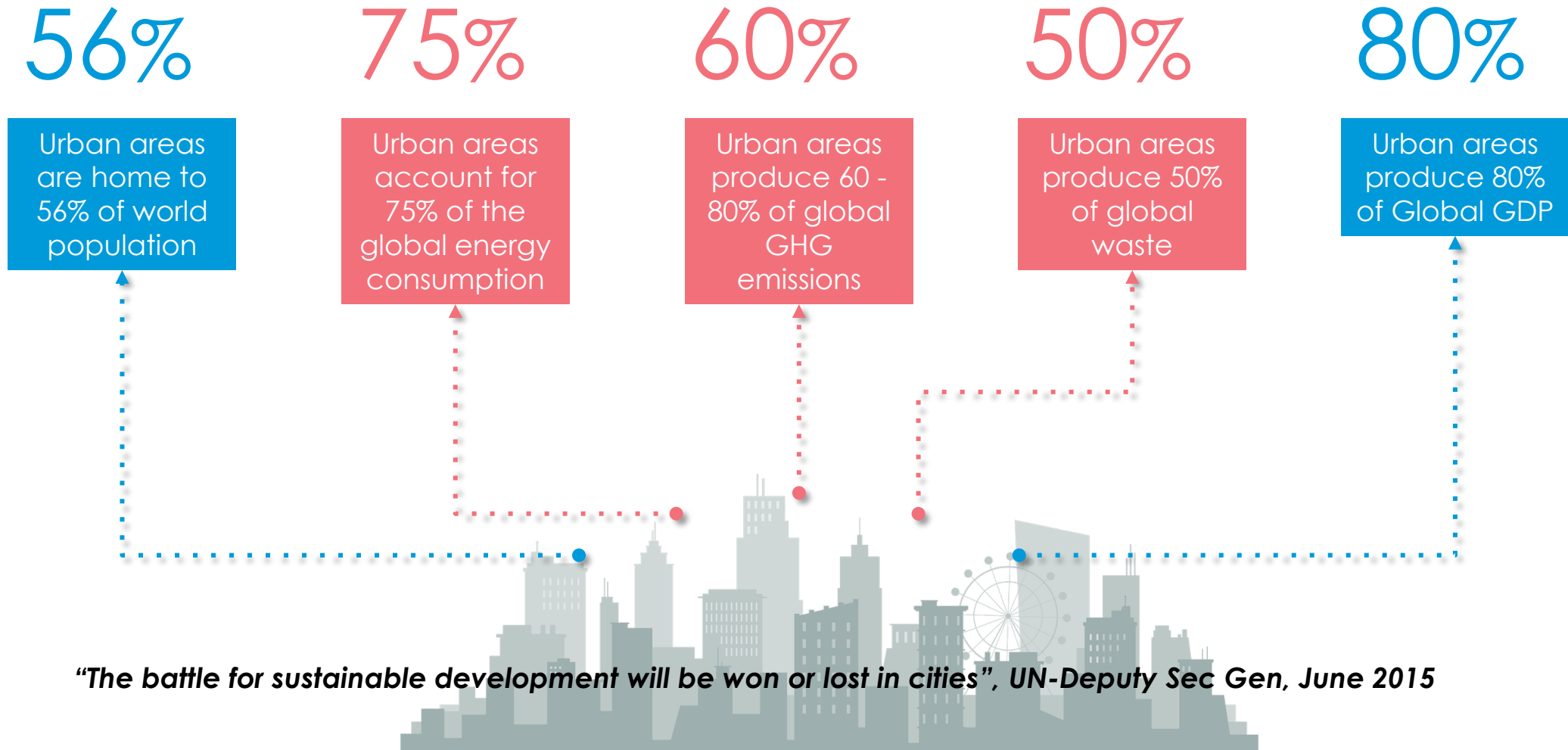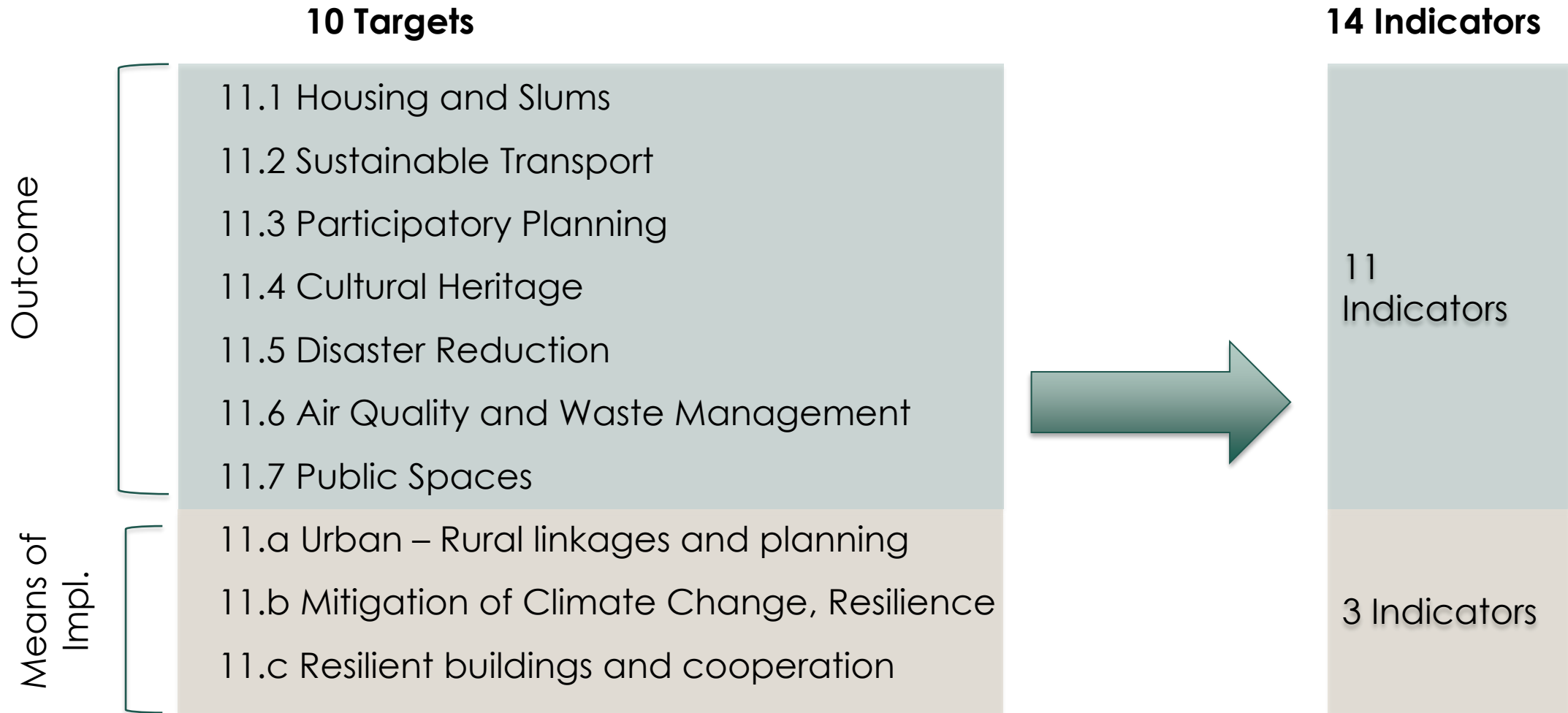
5 Main Areas

17 Goals

169 Targets

231 Indicators

People   Prosperity   Planet   Peace   Partnership

https://sdgs.un.org/goals

https://unstats.un.org/sdgs/indicators/indicators-list/

Cities, the Epicenter of the Fight for Sustainability

56%
Urban areas are home to 56% of world population

75%
Urban areas account for 75% of the global energy consumption

60%
Urban areas produce 60 - 80% of global GHG emissions

50%
Urban areas produce 50% of global waste

80%
Urban areas produce 80% of Global GDP

"The battle for sustainable development will be won or lost in cities", UN-Deputy Sec Gen, June 2015

SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable

10 Targets

14 Indicators

Outcome

11.1 Housing and Slums

11.2 Sustainable Transport

11.3 Participatory Planning

11.4 Cultural Heritage

11.5 Disaster Reduction

11.6 Air Quality and Waste Management

11.7 Public Spaces

11 Indicators

Means of Impl.

11.a Urban – Rural linkages and planning

11.b Mitigation of Climate Change, Resilience

11.c Resilient buildings and cooperation

3 Indicators

The New Urban Agenda (NUA)

Focuses on **interventions** required to ensure that cities and human settlements are **planned, developed, and managed in sustainable ways** in supporting the implementation of the 2030 Agenda.

5 Pillars
1. National Urban Policies (NUPs)
2. Rules and Regulations
3. Urban Planning and Design
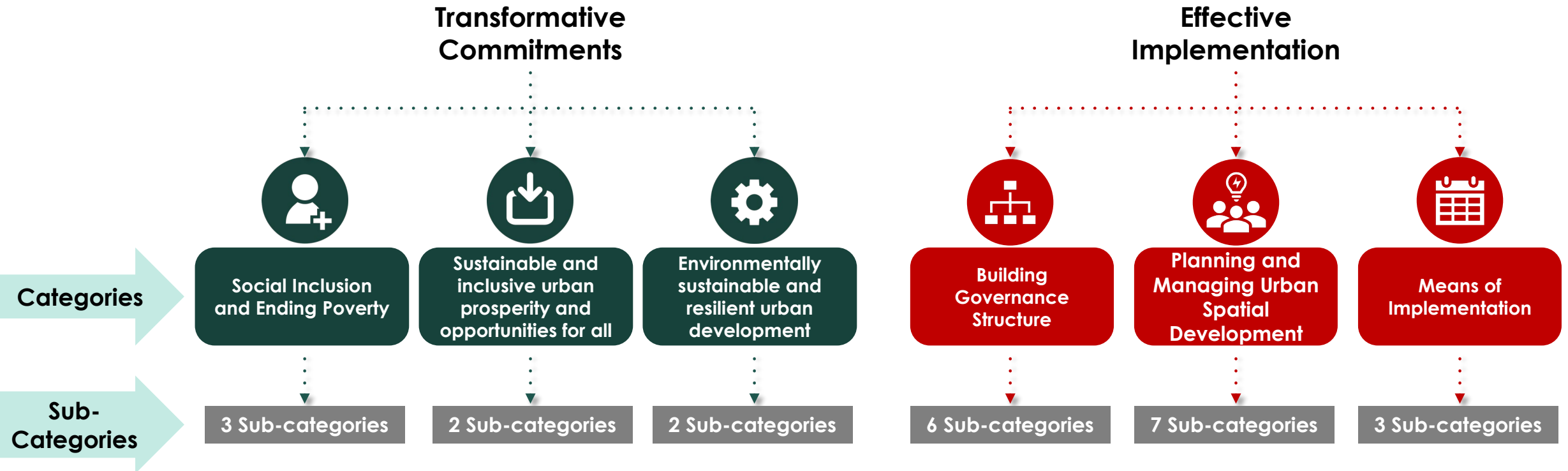4. Financing Urbanization
5. Local Implementation
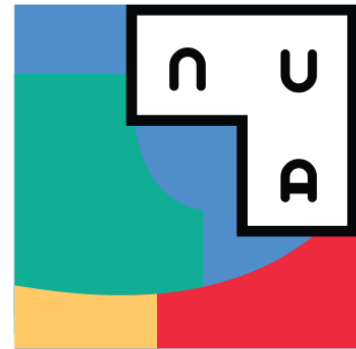
- Extension of the 2030 Agenda for Sustainable Development (complements SDGs processes)

- **Builds on SDG 11,** but addresses a wider range of urbanization and human settlements issues

- Enables implementation of SDG 11 in a more expansive and integrated way
  - by addressing essential strategic spatial and governance frameworks
  - National urban policies, legislation, spatial planning, and local finance frameworks.

- **Provides spatial framework for the delivery of SDGs** within urban areas by **focusing on local level implementation**

- **Places emphasis on the need to develop capacity of local authorities** and other local actors for NUA and SDG implementation at the urban local level

The New Urban Agenda Monitoring Framework

Transformative Commitments

Effective Implementation

Categories
- Social Inclusion and Ending Poverty
- Sustainable and inclusive urban prosperity and opportunities for all
- Environmentally sustainable and resilient urban development
- Building Governance Structure
- Planning and Managing Urban Spatial Development
- Means of Implementation

Sub-Categories
- 3 Sub-categories
- 2 Sub-categories
- 2 Sub-categories
- 6 Sub-categories
- 7 Sub-categories
- 3 Sub-categories

- NUA draws on many global frameworks such as SDGs
- Total of 77 indicators in the current version combines quantitative and qualitative measures

Overview of Earth Observations/Geospatial Information (EO/GI) Contributions in SDG 11 Monitoring

In SDG 11,

– How you define area of analysis affects results in at least 8 indicators: 11.1.1, 11.2.1, 11.3.1, 11.5.1, 11.5.2, 11.6.1, 11.6.2, 11.7.1

– At least 3 indicators require direct spatial data, use of GIS techniques for measurement: 11.2.1, 11.3.1, 11.7.1

– Characteristic specific estimates can be achieved for other indicators: 11.1.1, 11.5.1

Spatial data and geospatial technologies in SDG 11 are needed to:

– Identify/distinguish urban from non-urban areas

– Extract indicator specific data/information

– Disaggregate population data

– Visualize data and show variations of trends by location

11 SUSTAINABLE CITIES AND COMMUNITIES

Example of EO/GI Application in Computation of Indicator 11.3.1

SDG 11.3.1: Ratio of land consumption rate to population growth rate

Use 1: Identification of urban area based on harmonized approach – Degree of Urbanization (DEGURBA)

1. Disaggregating population to grids

2. Determining level of urbanization at the grid level – the DEGURBA settlement model

3. Applying level of urbanization to local administrative unit level

Source: https://ec.europa.eu/eurostat/documents/4337659/6125716/degurba-poster-2levels-2018.pdf
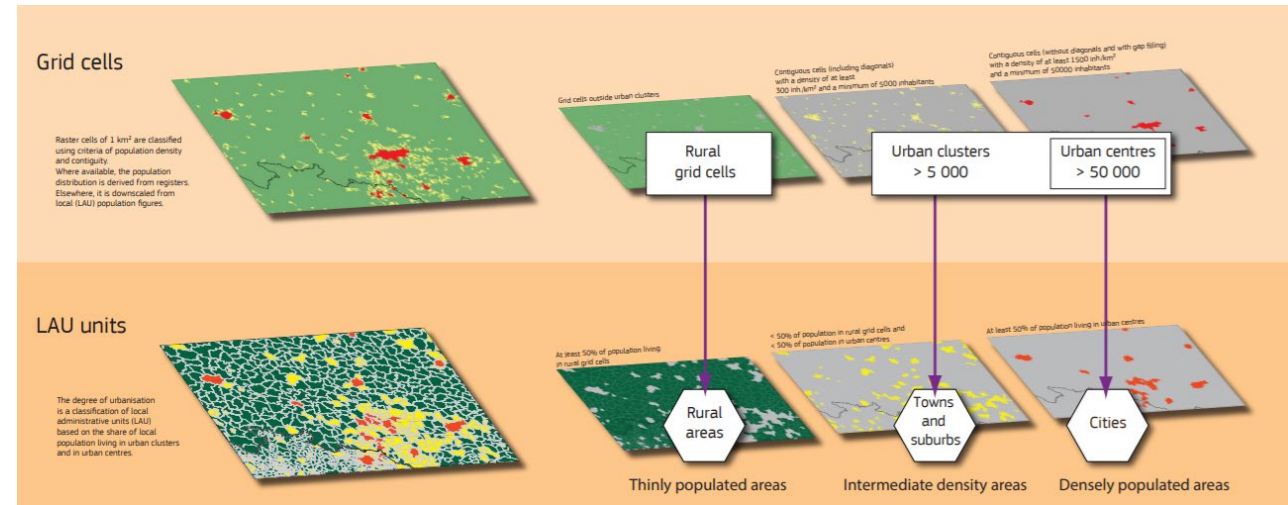
Example of EO/GI Application in Computation of Indicator 11.3.1

Use 2: Extraction of built-up areas from multi-temporal satellite imagery

Year 1

Year 2

Image Source: Google Earth

Built up areas year 1
Built up areas year 2
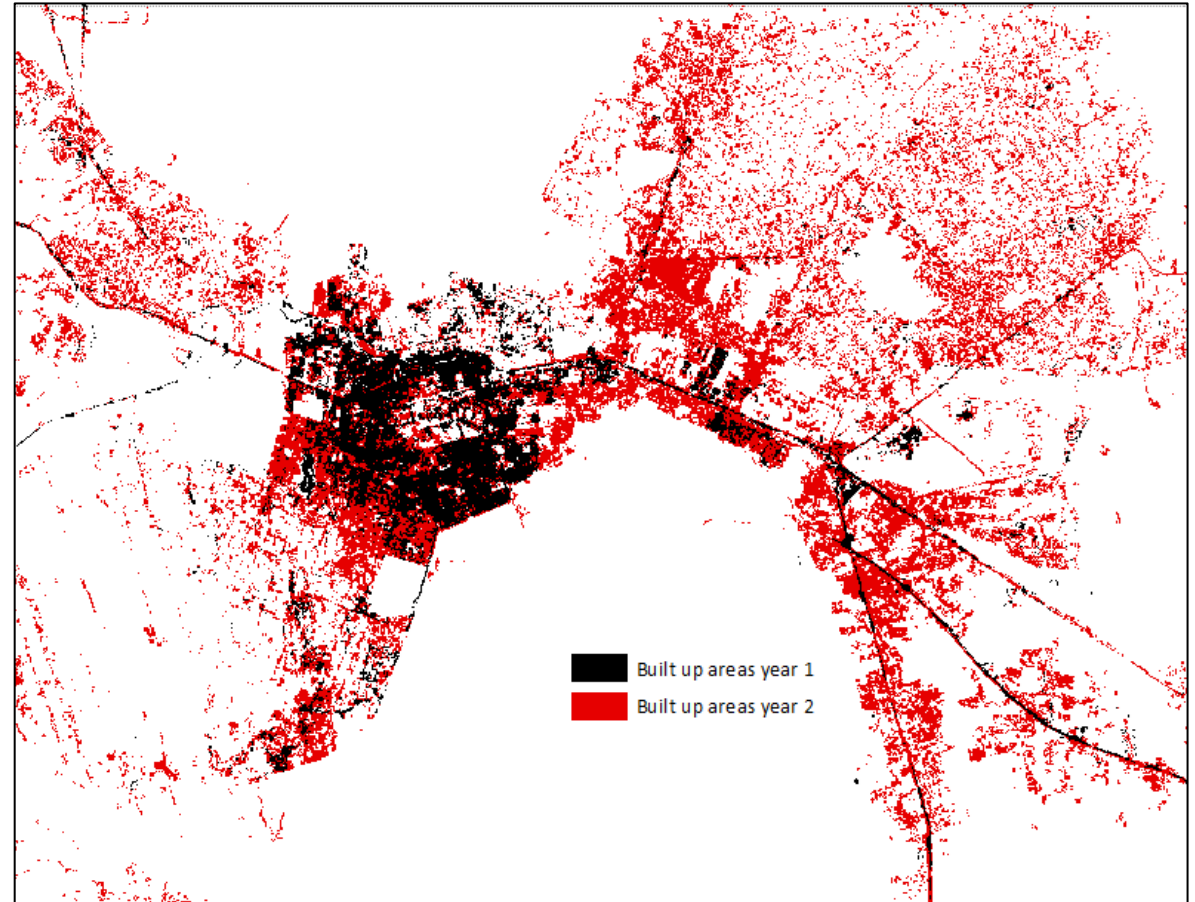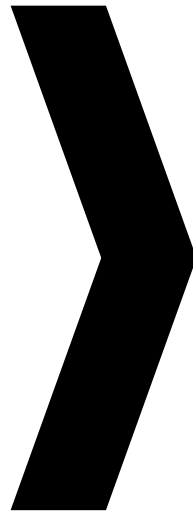
Source: UN-Habitat, 2021

Example of EO/GI Application in Computation of Indicator 11.3.1

Use 3: Disaggregation of population

Credits: HRSL/CIESIN/Facebook

Block Level/Census Enumeration Area Tracts

Aggregation of Individual Household Data

Modeled Population/Grids

Why the EO Toolkit for Sustainable Cities and Human Settlements

- SDG 11 monitoring and reporting requires more use of EO and GI.

- Available resources are spread in multiple locations and not always easily accessible, even when they are high value.

- The value of each resource can vary by indicator, requiring the need to match resources to their applications.

- Learning through others' experiences is a major means to spread the message on the value of EO & GI for SDG 11 monitoring.

The Earth Observations Toolkit for Sustainable Cities and Human Settlements Beta

Enables the use of Earth observations to advance Sustainable Development Goal 11 and the New Urban Agenda

https://eotoolkit.unhabitat.org/
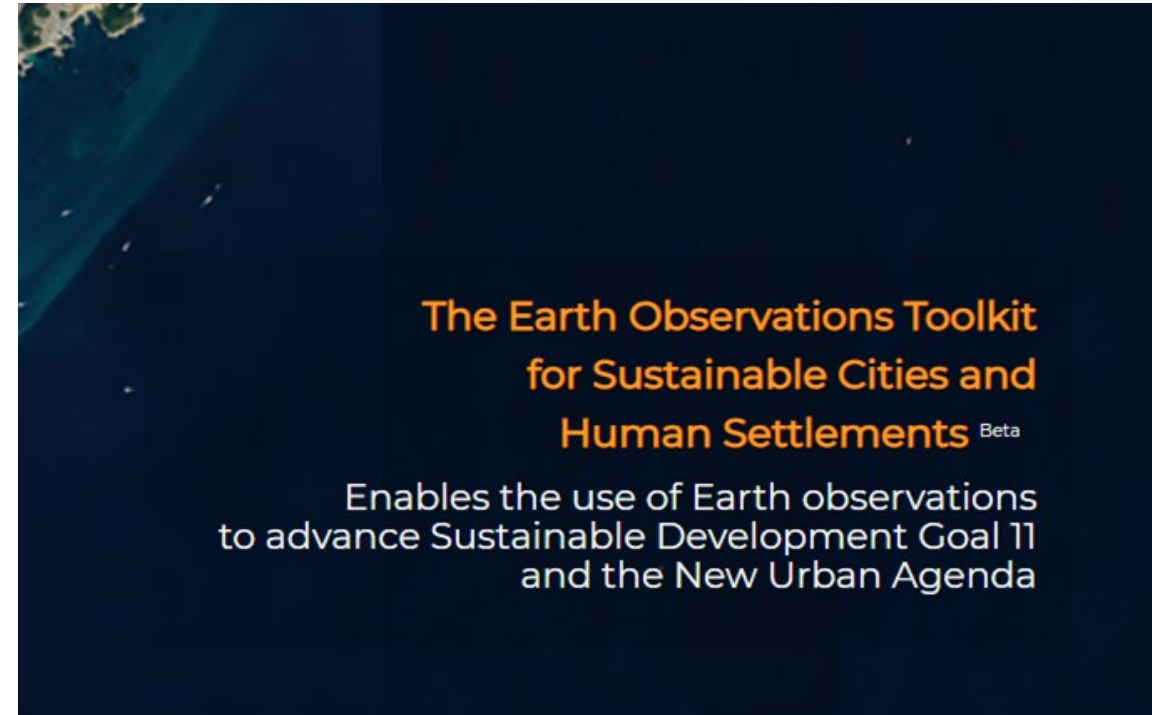
The EO Toolkit for Sustainable Cities and Human Settlements

- The EO Toolkit is a contributed resource that:
  - brings in one place data, tools, use cases, and learning opportunities on application of EO & GI for SDG 11 measurement
  - brings together EO/GI data producers and users and works towards increased harmonization of approaches
  - is a multi-partner and stakeholder initiative governed through a steering committee

https://eotoolkit.unhabitat.org/
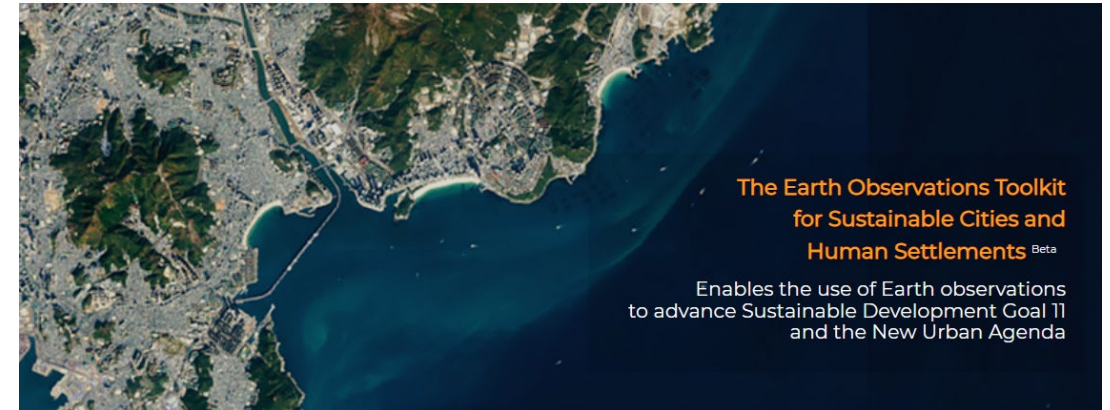
Alignment of Earth Observations to the Sustainable Development Goals, Targets, and Indicators

Target — Contribute to progress on the Target, not necessarily the Indicator									Goal		Indicator — Direct measure or indirect support to the Indicator				
						1.4	1.5	1	No poverty	1.4.2					
						2.3	2.4	2.c	2	Zero hunger	2.4.1				
					3.3	3.4	3.9	3.d	3	Good health and well-being	3.9.1				
									4	Quality education					
								5.a	5	Gender equality	5.a.1				
6.1	6.3	6.4	6.5	6.6	6.a	6.b			6	Clean water and sanitation	6.3.1	6.3.2	6.4.2	6.5.1	6.6.1
			7.2	7.3	7.a	7.b			7	Affordable and clean energy	7.1.1				
							8.4		8	Decent work and economic growth					
			9.1	9.4	9.5	9.a			9	Industry, innovation and infrastructure	9.1.1	9.4.1			
				10.6	10.7	10.a			10	Reduced inequalities					
11.1	11.3	11.4	11.5	11.6	11.7	11.b	11.c		11	Sustainable cities and communities	11.1.1	11.2.1	11.3.1	11.6.2	11.7.1
			12.2	12.4	12.8	12.a	12.b		12	Responsible consumption and production	12.a.1				
			13.1	13.2	13.3	13.b			13	Climate action	13.1.1				
	14.1	14.2	14.3	14.4	14.6	14.7	14.a		14	Life below water	14.3.1	14.4.1	14.5.1		
15.1	15.2	15.3	15.4	15.5	15.7	15.8	15.9		15	Life on land	15.1.1	15.2.1	15.3.1	15.4.1	15.4.2
							16.8		16	Peace, justice and strong institutions					
17.2	17.3	17.6	17.7	17.8	17.9	17.16	17.17	17.18	17	Partnerships for the goals	17.6.1	17.18.1			

https://eo4sdg.org

SDGs with most opportunities for EO contributions

Earth Observations for Sustainable Development Goals

Countries, stakeholders, and the global community desire additional Earth observations and geospatial information to continue progress on improved social, economic, and environmental sustainability.

Contributors

https://eo4sdg.org

EO4SDG Initiative Purpose:
Extend uses of Earth observations and geospatial information to advance the 2030 Agenda and enable societal benefits through achievement of the SDGs.
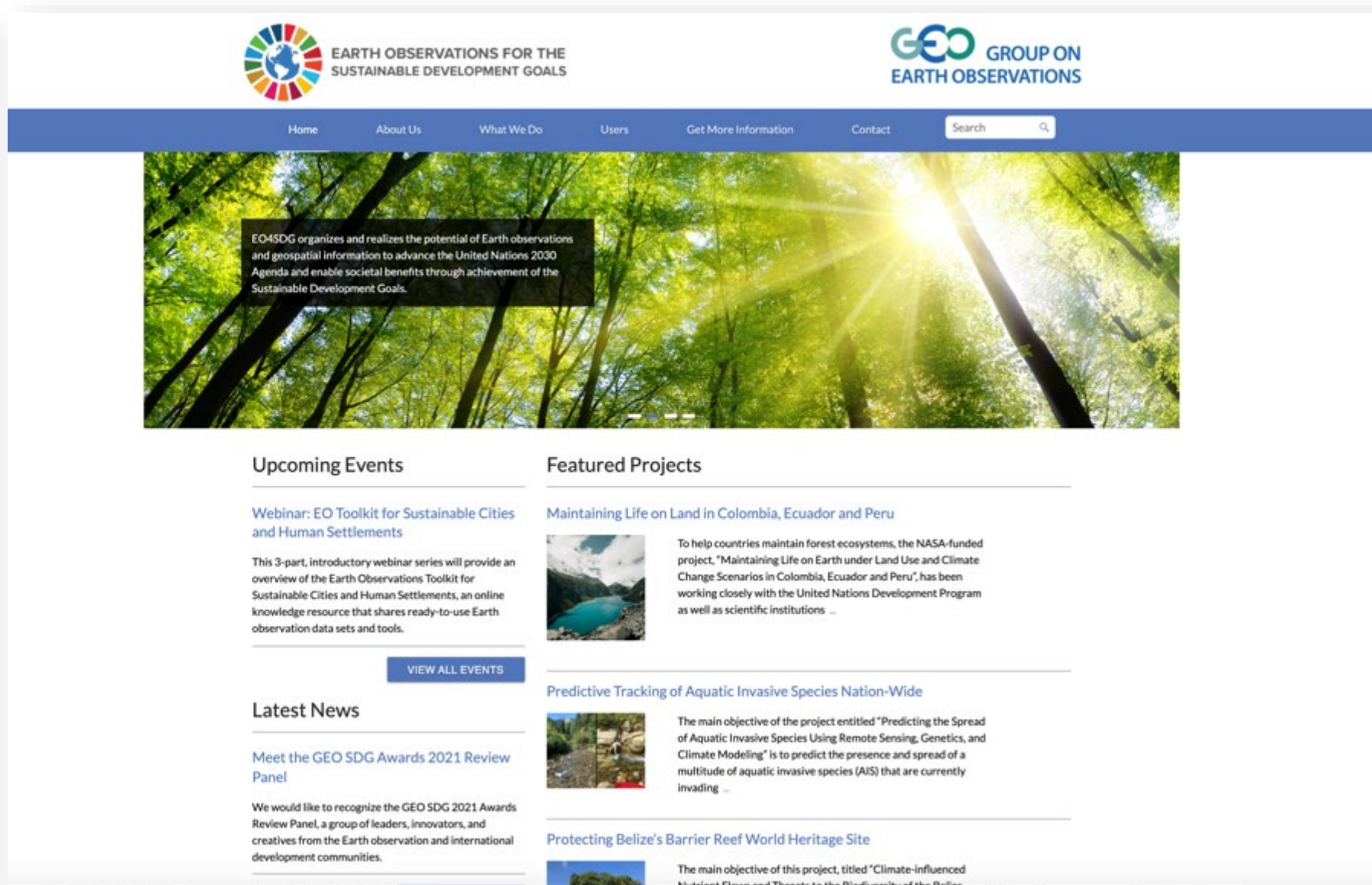
Co-Chairs: U.S., Japan, Mexico

Exec. Dir.: U.S.

Key Emphasis:
Working with national statistical offices, line ministries, national mapping agencies, local governments, UN Agencies. Demonstrating benefits, building skills, and sharing knowledge on EO uses for SDGs.

EARTH OBSERVATIONS FOR THE
SUSTAINABLE DEVELOPMENT GOALS

https://eo4sdg.org

Examples of SDG 11-Related Earth Observation Data & Products

Land Surface Reflectance

Land Cover/Land Use
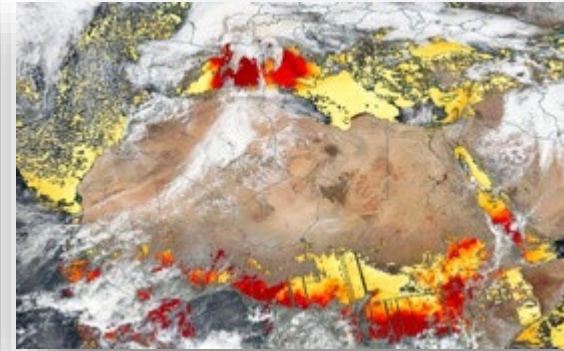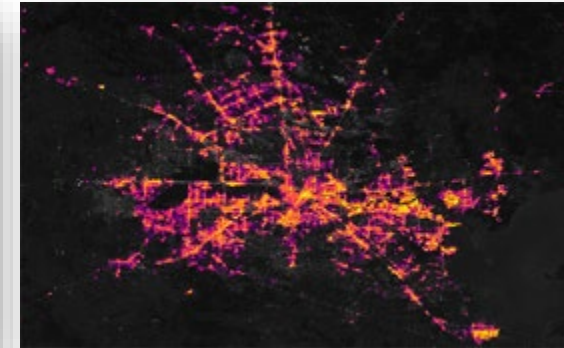

Air Quality
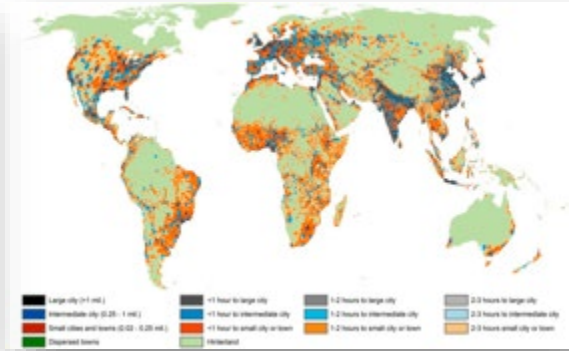
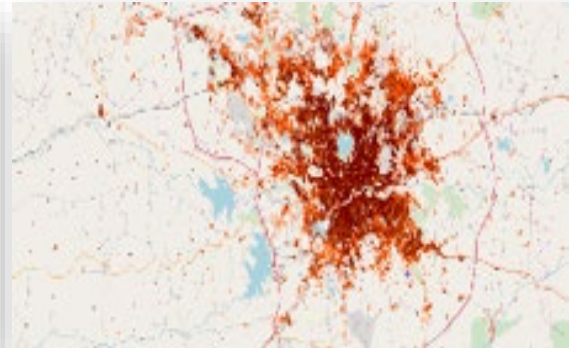**Urban-Rural Continuum**
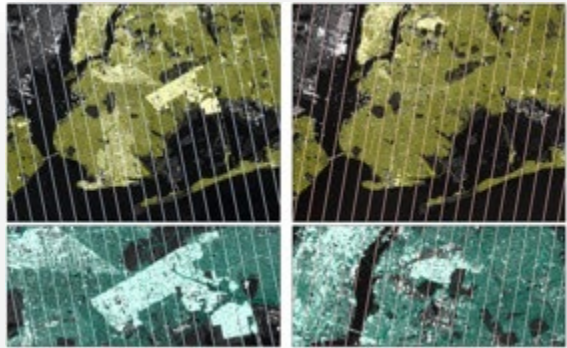
Synthetic Aperture Radar (SAR) Data Products

Vegetation Greenness/Phenology

Nighttime Imagery

Impervious Surface

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

An **online knowledge resource** that integrates local participation and enables the use of Earth observations to advance Sustainable Development Goal 11 and the New Urban Agenda

The web portal hosts use cases, data and tools for SDG 11 applications on **housing, open spaces, urbanization** and **public transport**

The Toolkit relies on a **partnership** of over 40 international organizations and experts

https://eotoolkit.unhabitat.org

Earth Observations Toolkit for Sustainable Cities and Human Settlements
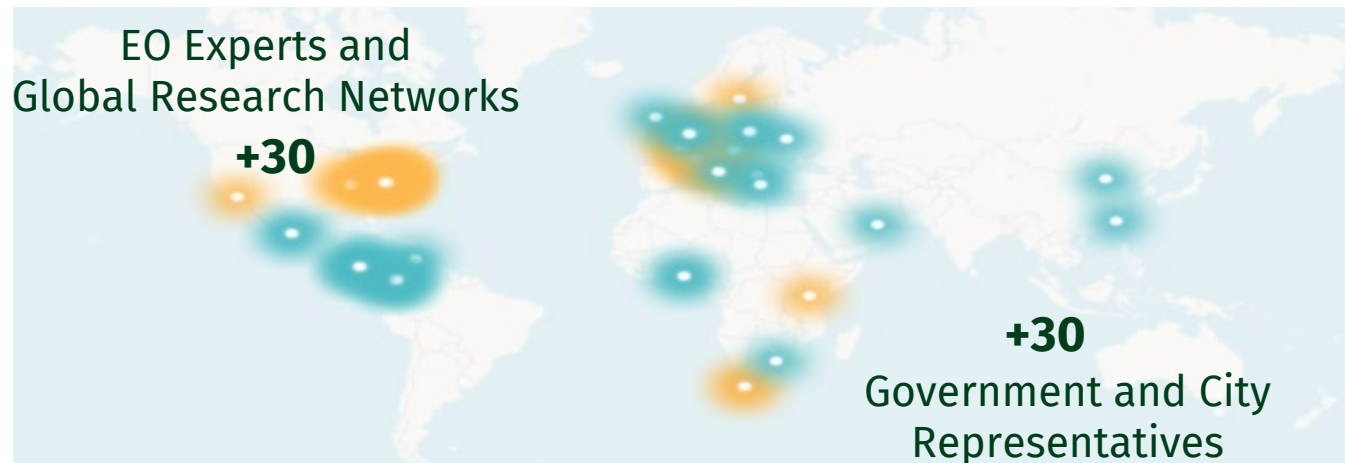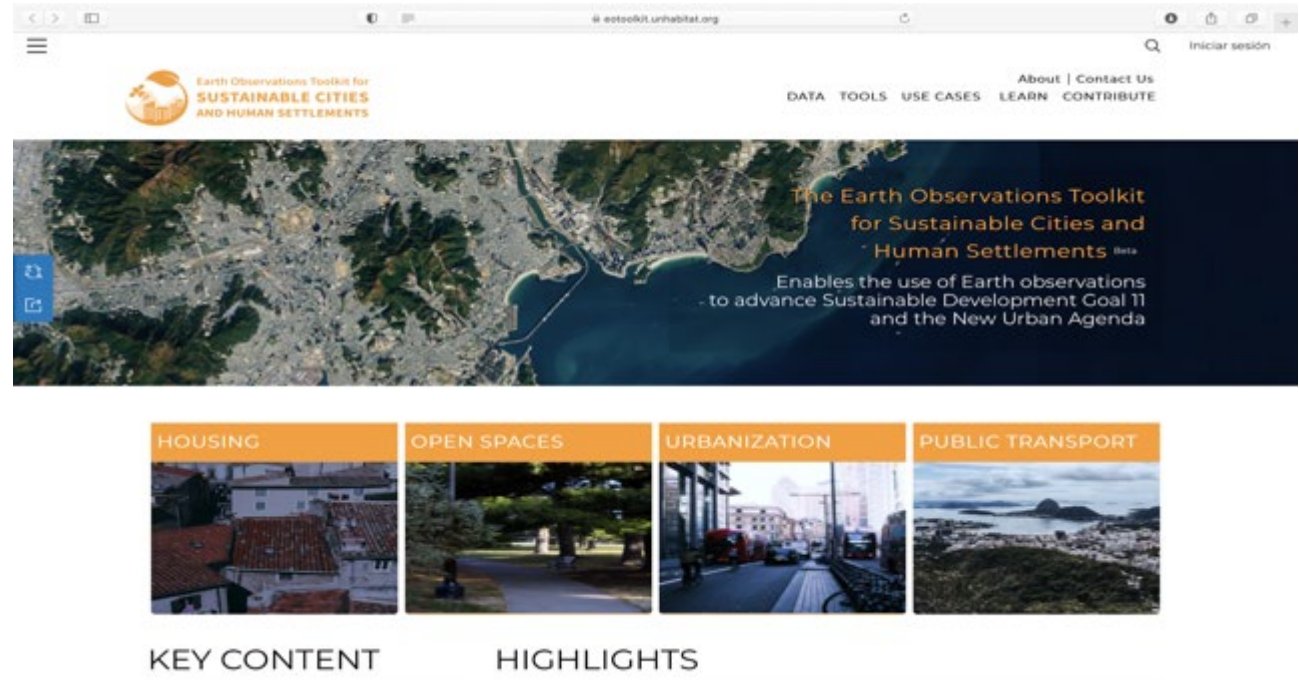
Free and open, ready-to-use EO data sets.

Tools to produce SDG 11 indicators and enable visualization and access to available data.

Documented use cases from cities and countries.

Visit: **eotoolkit.unhabitat.org**

EO Experts and Global Research Networks
+30

+30
Government and City Representatives

Earth Observation Processing Tools

- Users can filter by topic of interest, data source, data characteristics, tool coding environment, SDG indicator.

- For example, the NASA **SEDAC POPGRID Viewer** is a mapping tool that provides side-by-side comparison of population estimates, leveraging global gridded population data sets.
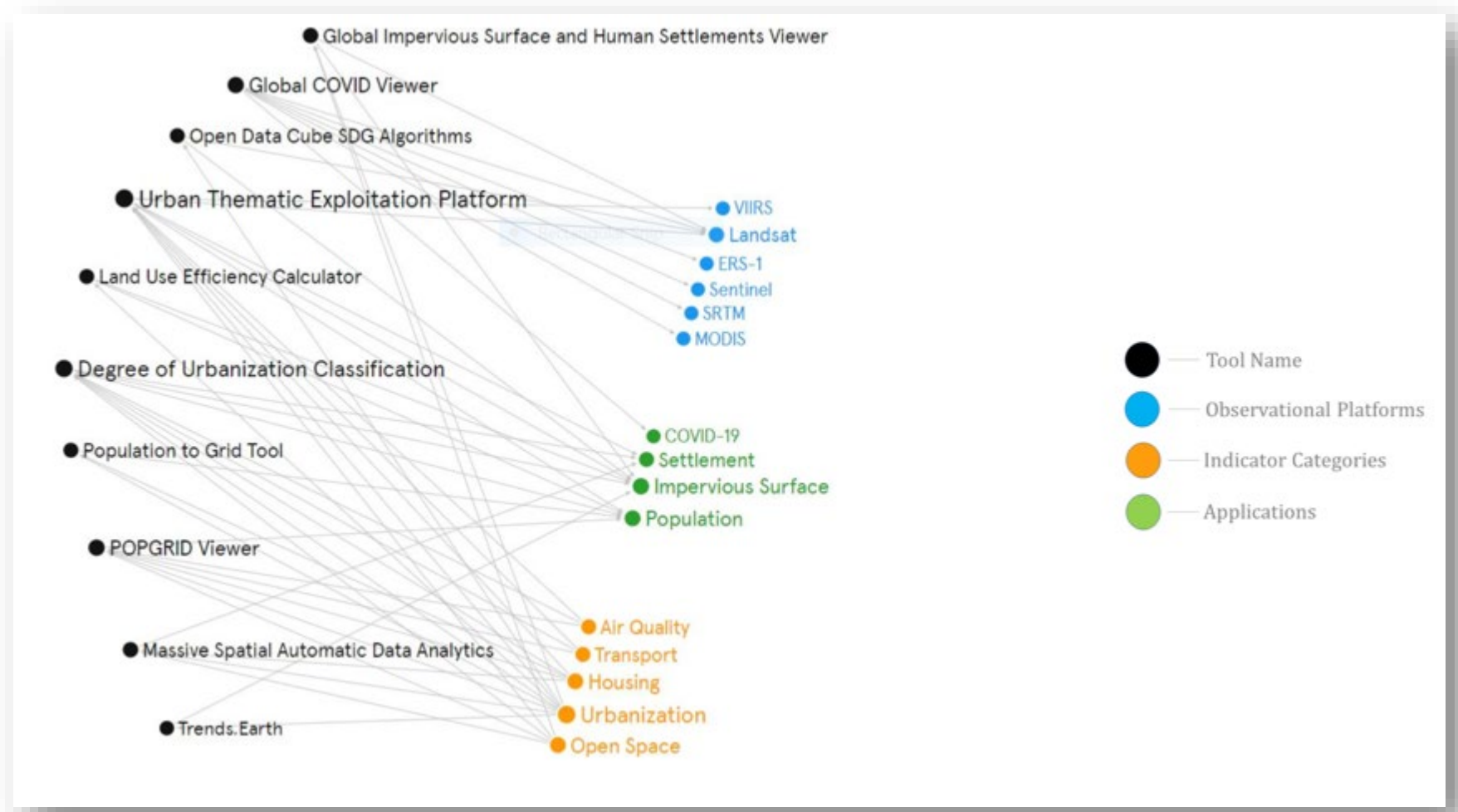
Visit: **eotoolkit.unhabitat.org**

Country and City Use Cases

Indicator 11.1.1

Adequate housing (Mexico)

Indicator 11.3.1

Sustainable Urbanization (Mexico, Colombia, South Africa, Poland, UAE)

Indicator 11.2.1

Rural population who live within 2km of all-season roads (Indonesia, China)

Indicator 11.6.2

Levels of fine particulate matter (population weighted) (Greece, Poland)

Indicator 11.7.1 & 11.7.2

Open spaces for public use (Greece, Poland, Colombia)

Visit: **eotoolkit.unhabitat.org**

Demonstration
eotoolkit.unhabitat.org

Demonstration (slide not actually used)

- Show eotoolkit.unhabitat.org.
- Provide brief tour of data sets, tools, use cases.

References

- The Earth Observations Toolkit for Sustainable Cities & Human Settlements. Available online: https://storymaps.arcgis.com/collections/6f87b83bf8d243a688a6f732cbede898?item=1

- Remote Sensing of Environment Special Issue, Earth Observation for the Sustainable Development Goals. Available online: https://www.sciencedirect.com/journal/remote-sensing-of-environment/special-issue/10RFDS7BFNH

- The Earth Observations Toolkit for Sustainable Cities and Human Settlements. Overview and Progress to Date. Available online: https://eotoolkit.unhabitat.org/pages/eo-guidance-document

- Kavvada, A., Metternicht, G., Kerblat, F., Mudau, N., Haldorson, M., Laldaparsad, S., ... & Chuvieco, E. (2020). Towards delivering on the sustainable development goals using earth observations.

- Prakash, M., Ramage, S., Kavvada, A., & Goodman, S. (2020). Open Earth Observations for Sustainable Urban Development. Remote Sensing, 12(10), 1646.

- SDG 11 Data Pathfinder. Available Online: https://earthdata.nasa.gov/learn/pathfinders/sdg-data-pathfinders/sdg-11-data-pathfinder
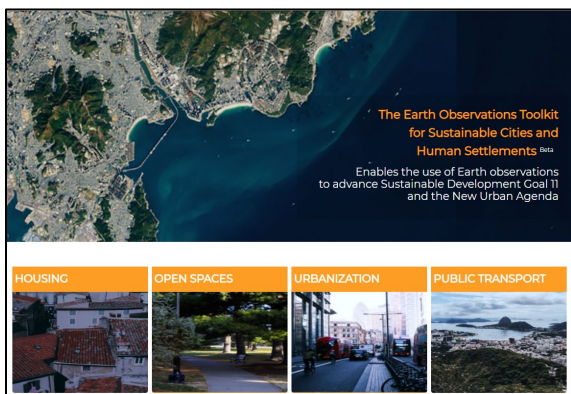
Contacts

- Trainers:
    - Argyro Kavvada: argyro.kavvada@nasa.gov
    - Dennis Mwaniki: dennis.mwaniki@un.org

- Training Webpage:
    - https://appliedsciences.nasa.gov/join-mission/training/english/arset-earth-observations-toolkit-sustainable-cities-and-human

- ARSET Webpage:
    - https://appliedsciences.nasa.gov/what-we-do/capacity-building/arset
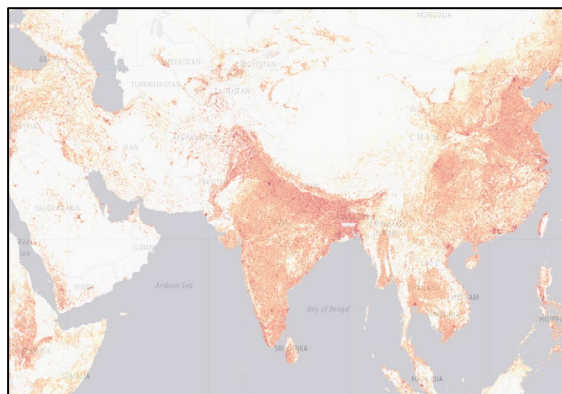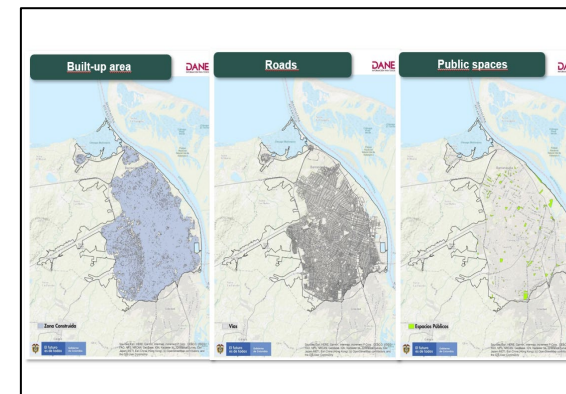
Next Week

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Use Cases from the National and City Level

Thank You!