Economic and Social Commission for Western Asia

ESCWA's Contribution to Regional Geospatial Data For SDGs-Environment Indicators and Disaster Risk Management

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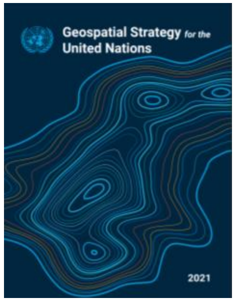
ESCWA-Statistics Mandates on Geospatial



The Geospatial Strategy for the United Nations aims to contribute to the data ecosystem by enabling location information for the Organization. The vision is to build synergy on activities and investments on geospatial information management in the United Nations, “Delivering as One” by bringing geospatial data to innovate and to act for a better world

UNESCWA-Statistics contribution to the UN-GGIM for the Arab States

UN Task Force on Population and Housing Census for Arab Countries in 2020 Census Round, going back to 2005

Geographical Information System (GIS) in population Censuses Dedicated Site for Arab Population and Housing Censuses Events and Resources

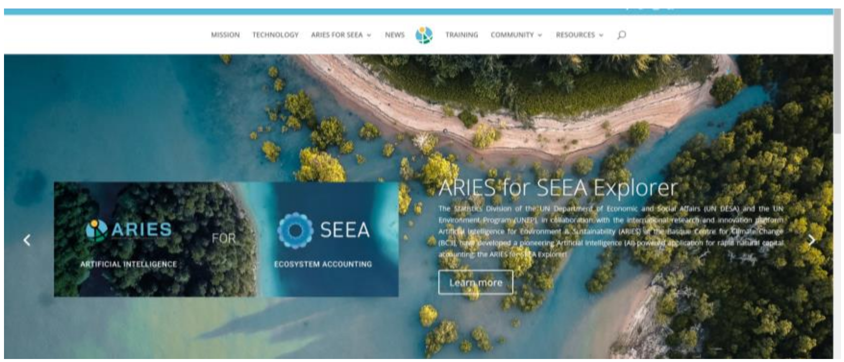
UNESCWA-Statistics support to Member States on SDGs monitoring

Regional and Inter-regional methodologies and Capacity building:

- Regional Workshop on the Integration of Big Data and Geospatial Information for the Compilation of SDG Indicators in Arab Countries 13-15 October 2020
- Integration of Geospatial Information With Statistical Information in Support of the SDG Indicators.
- First Expert Forum for Producers and Users of Disaster-related Statistics, 07 - 10 June 2021 online Session 3 this after noon on Geosptail Dimension

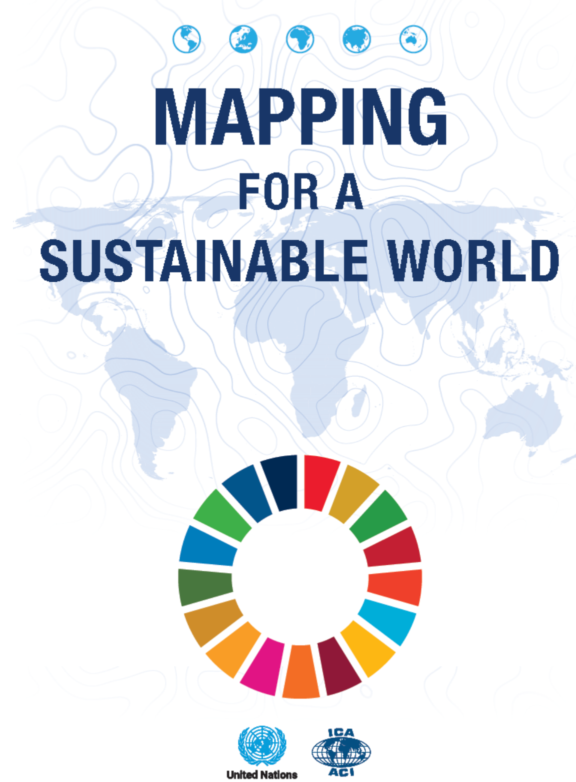
Geospatial and Earth observations for SDGs

https://www.earthobservations.org/documents/publications/201703_geo_eo_for_2030_agenda.pdf



https://aries.integratedmodelling.org/

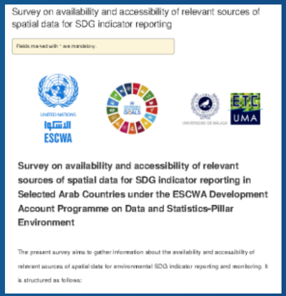
Mapping for a Sustainable World 2020 ICA and UN



www.un.org/geospatial/sites/www.un.org.geospatial/files/MappingforaSustainableWorld20210124.pdf

Needs Assessment of Arab NSOs
On-Line Surveys on Geospatial Data Use

1. UN-ESCWA and ETC-UMA EU- survey in 2018 for 3 countries: population, human settlements and infrastructure; land use and land cover; biodiversity; water; air quality and marine ecosystems. and that addressed the following: a) availability of relevant sources of spatial data for SDG indicator reporting b) data needs and data gaps select the thematic areas where data is needed to meet the requirements and c) spatial data analysis, management and storage capacities
2. ESCWA's Survey in 2018: Assessing the Status and Needs of Arab Countries to Produce and Utilize Geospatial Information as a Data Source for the SDGs
3. Questionnaire to monitor the status quo regarding administrative records, big data and geospatial information in the Arab countries in 2020



Survey on availability and accessibility of relevant sources of spatial data for SDG indicator reporting

Fields marked with * are mandatory.

Survey on availability and accessibility of relevant sources of spatial data for SDG indicator reporting in Selected Arab Countries under the ESCWA Development Account Programme on Data and Statistics-Pillar Environment

The present survey aims to gather information about the availability and accessibility of relevant sources of spatial data for environmental SDG indicator reporting and monitoring. It is structured as follows:

United Nations
Economic and Social Commission for Western Asia

Self-assessment guidance questionnaire Regional Workshop on the Integration of Administrative Registers, Big Data and Geospatial Information for the Compilation of SDG Indicators in Arab Countries

The objective of this self-assessment questionnaire is to provide the organizers and participants of the regional workshop with specific national information on good practices and challenges regarding the application of modern technologies and new data sources in the mainstreaming of statistical activities. This is with a view to support the implementation of the 2030 Agenda, as well as tracking progress toward the SDGs. The survey covers the overall National Statistical System (NSS) with some questions more focused on the National Statistical Offices (NSO).Assessing the capability of Arab States to use geospatial data, administrative data, and big data to track SDG progress is necessary for identifying their needs in terms of capacity building programs and technical assistance that ESCWA could provide in this regard.The information collected in this survey are strictly confidential. Country-level results will not be shared without the express consent of the concerned NSO. The organizer kindly asks you to complete the questionnaire online. Additional attachments can be sent electronically to Mr. Ismail Lubbad (lubbad@un.org).

1- Survey on Developing and Utilising Geospatial Data and Workflows to Monitor Environmental -Sustainable Development Goal in 3 countries

Country Scoping and Assessment

- Data availability for environmental SDG monitoring
    - Population, human settlements and infrastructure
    - Land use and land cover
    - Biodiversity, Water, Air Quality, Marine
- Data needs and data gaps select the thematic areas where data is needed to meet the requirements
- Spatial data analysis, management and storage capacities

2.National Workshops for stakeholders on SDGs, environmental data, and geospatial information systems, in Egypt Jordan and Palestine (May 2018)

3. Undertook basic training and raising awareness in these 3 countries on the importance of geospatial workflows, global initiatives and technologies, and publicly accessible data that is relevant to SDG monitoring.

4. Overview of data and expertise availability and needs for establishing effective geospatial workflows for measuring and monitoring SDGs.

5. Final report on http://www.etc.uma.es/un_escwa_etcuma/

SDGs considered

6.6.1 Change in the extent of water-related ecosystems over time

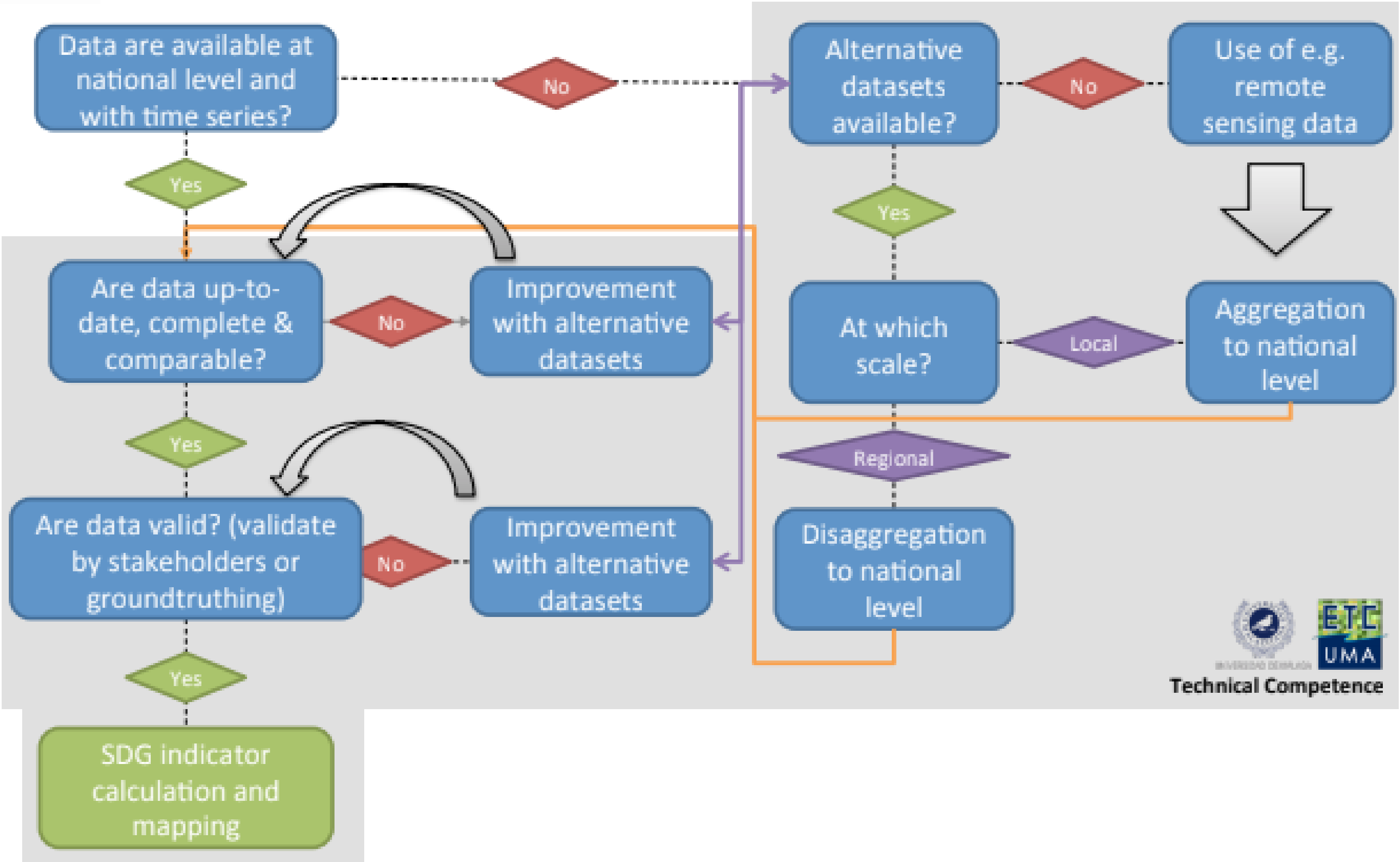
11.3.1 Ratio of land consumption rate to population growth rate

11.6.2: Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities

14.5.1 Coverage of protected areas in relation to marine areas

15.3.1 Proportion of land that is degraded over total land area

Workflow to develop SDG indicators based on spatial data



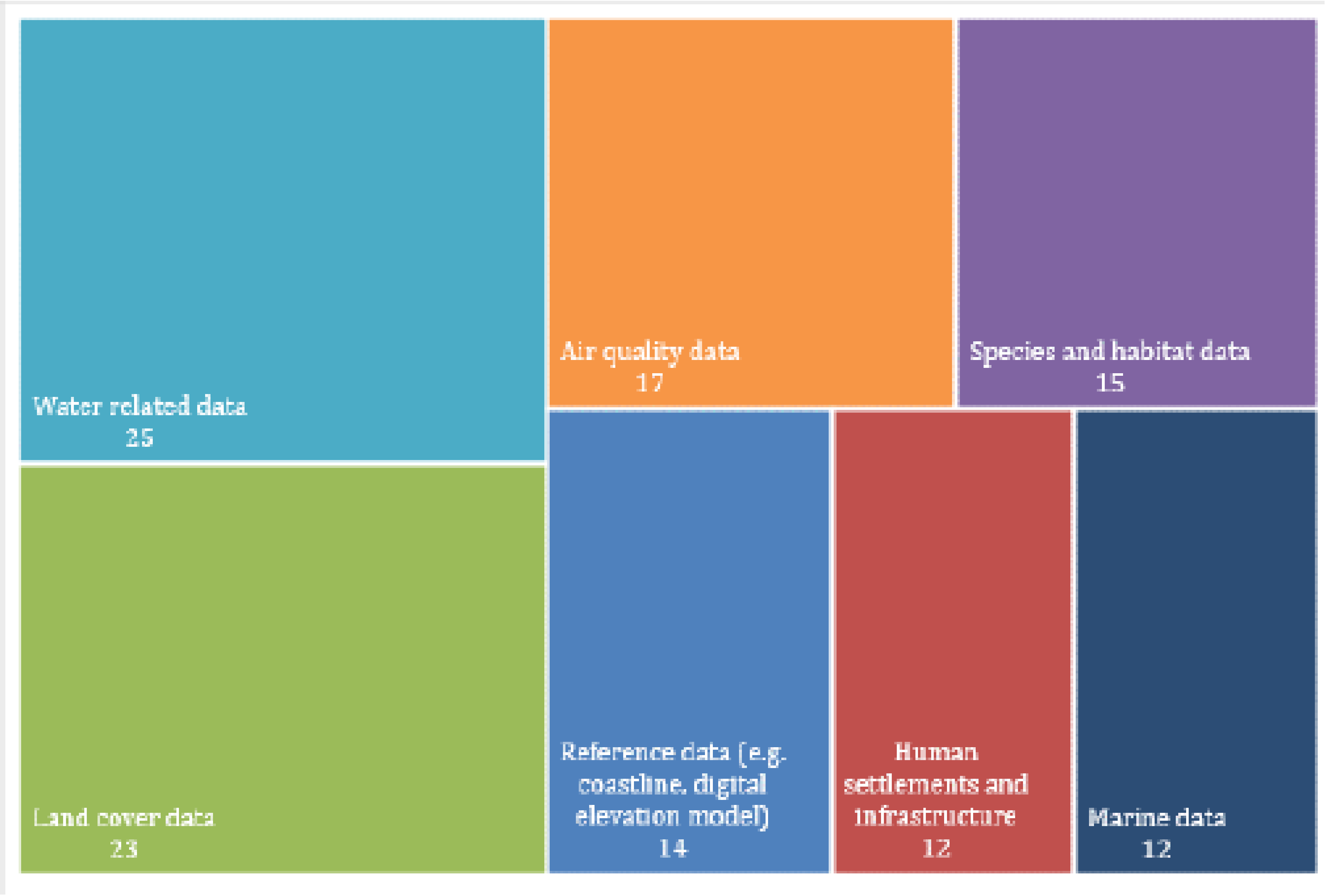


Figure 4: Data gaps identified per thematic domain

Data availability for environmental geospatial SDG indicators

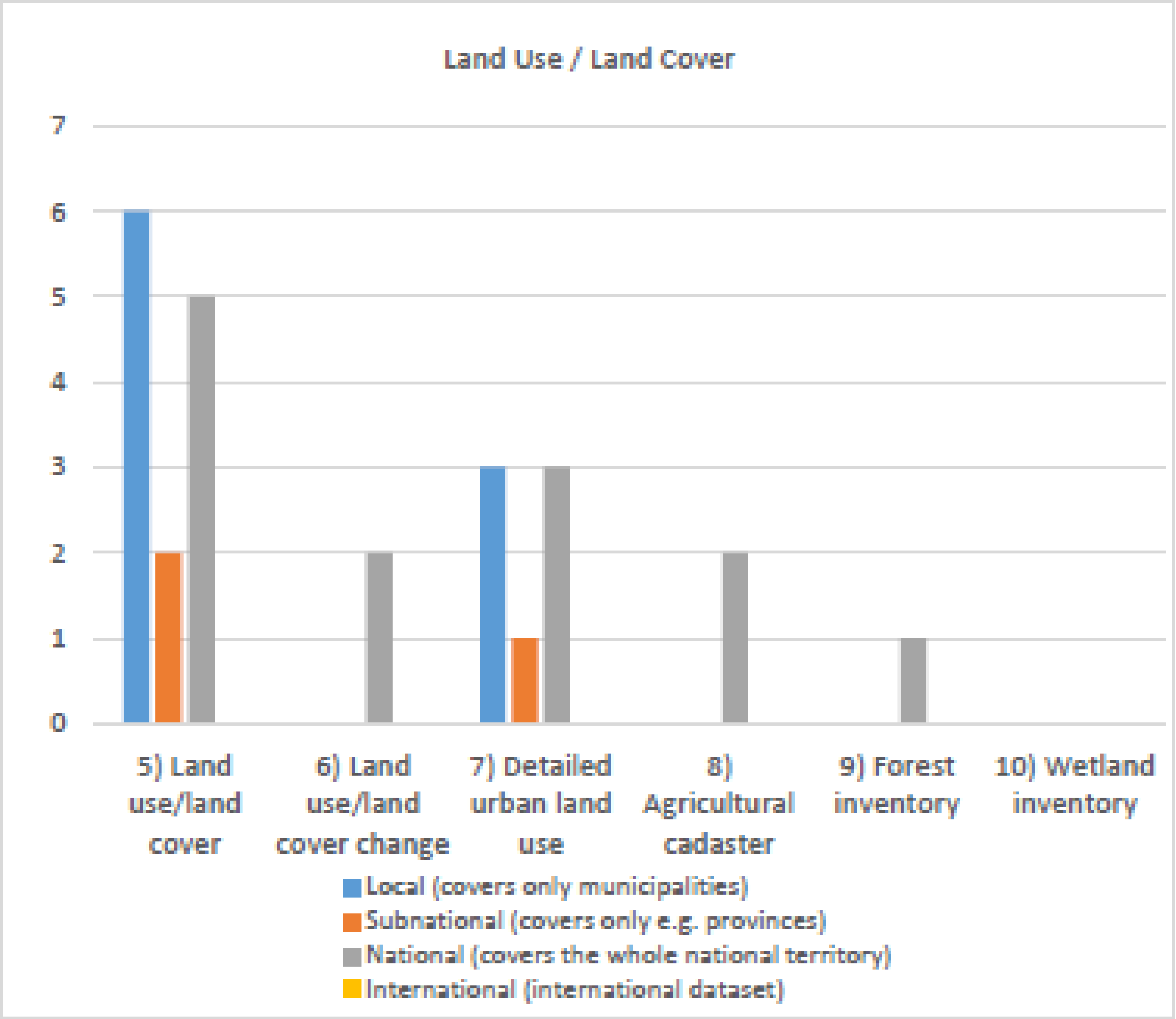
Table 1: Data availability for environmental geospatial SDG indicators

● Adequate data available | ○ Data available (requires further validation) | • No data available | ◦ unknown

Relevant target	Indicators	Jordan	Palestine	Egypt
2 End hunger, achieve food security and improved nutrition and promote sustainable agriculture				
2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	2.4.1 Proportion of agricultural area under productive and sustainable agriculture	●	●	○
6 Ensure availability and sustainable management of water and sanitation for all				
6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally	6.3.1 Proportion of wastewater safely treated	●	●	•
	6.3.2 Proportion of bodies of water with good ambient water quality	○	○	○
6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity	6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	○	○	○
6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	6.6.1 Change in the extent of water-related ecosystems over time	•	○	○

Assessment of Spatial Data in Jordan

On
Population, human settlements and infrastructure
Land Cover
Biodiversity
Water
Air Quality
Marine Env



Explore the use of remote sensing for disaster monitoring and impact evaluation- ESCWA Pilot Project with Google Earth Engine and GEO

Objectives

- Explore the effectiveness of remote sensing for detecting disaster areas
- Estimate disaster areas
- Estimate the area of affected land cover types (urban vs vegetation)
- Estimate the number of affected population

What is Google Earth Engine?

https://console.cloud.google.com/home/dashboard?project=ee-disasterimpacts-gee4geo

- Earth observations platform powered by Google's Data Center Infrastructure
- Access to petabytes of remotely sensed datasets
- Geospatial data processing
- Allows for focusing on analysis rather than data management and storage
- 40 years of Landsat data
- Non-satellite imagery (elevation, topography, climate data, …)
- Fully-featured development environment (JavaScript, Python APIs)
- Easy data ingestion and asset management

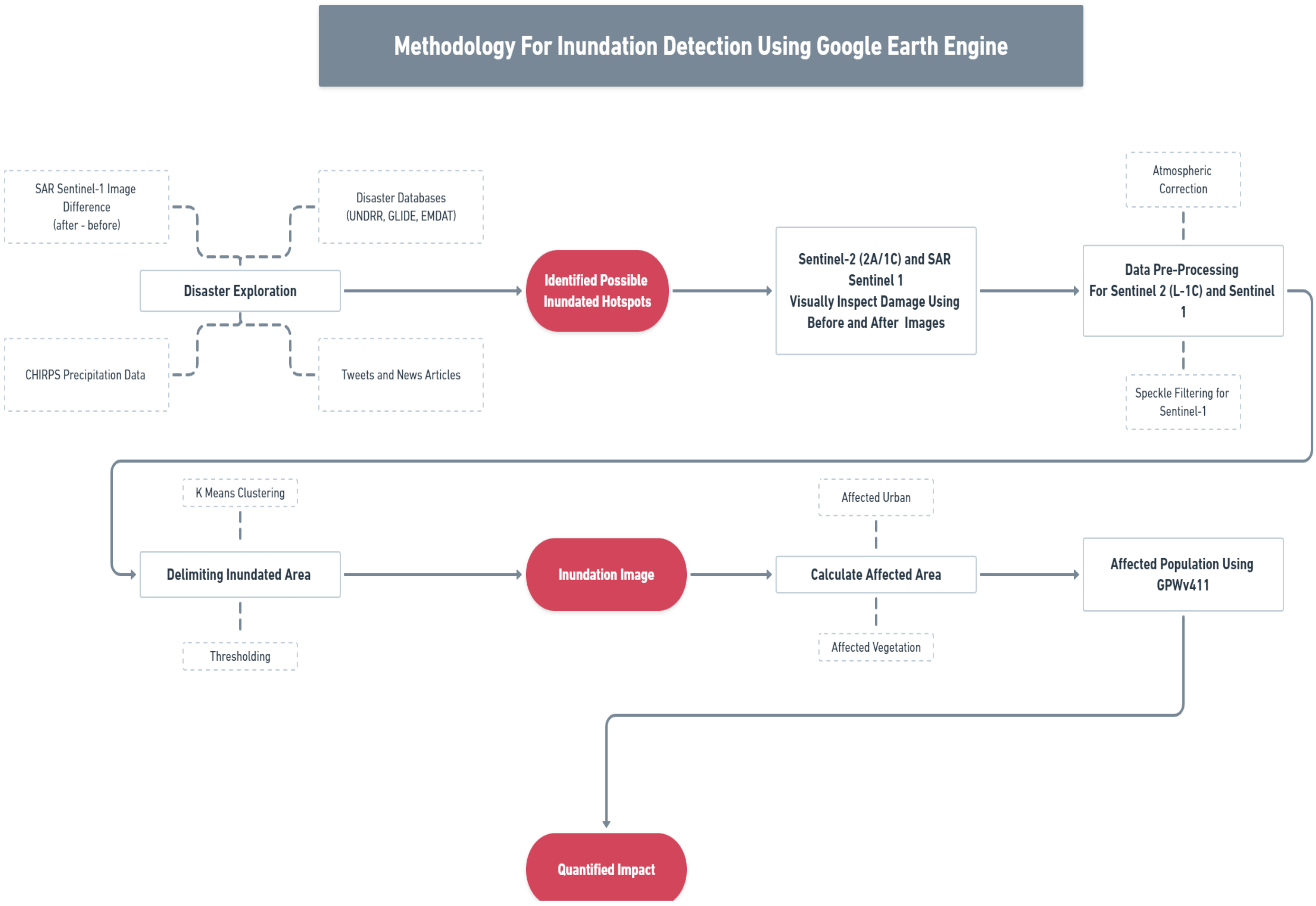
https://developers.google.com/earth-engine/images/ee_earth_satellite_1440.png

- Egypt is characterized by vast deserts.
- Mediterranean and Red Sea.
- Vegetation landcover concentrated around the Nile river and the Nile delta.
- Focus: coastal Egypt and the Nile basin.

Data Sources

NSO Collaboration

Remote Sensing Data	National Sources Data	Other Data Sources
Sentinel-1 Synthetic Aperture Radar Imagery	2010 Census Data	Emergency Events Database (EM-DAT). Centre for Research on the Epidemiology of Disasters (CRED)
Sentinel-2 Multispectral Optical Imagery	National data on disasters	GLIDE datasets – Asian Disaster Reduction Center (ADRC)
Gridded Population of the World, Version 4 (GPWv4): Population Count, Revision 11	National data on infrastructure	UNDRR Disaster loss database
Copernicus Global Land Cover Layers: CGLS-LC100 Collection 3		
CHIRPS Daily: Climate Hazards Group InfraRed Precipitation with Station Data (version 2.0 final)		


Methodology For Inundation Detection Using Google Earth Engine
SAR Sentinel-1 Image Difference (after - before)
Disaster Databases (UNDRR, GLIDE, EMDAT)
Disaster Exploration
CHIRPS Precipitation Data
Tweets and News Articles
Identified Possible Inundated Hotspots
Sentinel-2 (2A/1C) and SAR Sentinel 1 Visually Inspect Damage Using Before and After Images
Atmospheric Correction
Data Pre-Processing For Sentinel 2 (L-1C) and Sentinel 1
Speckle Filtering for Sentinel-1
K Means Clustering
Delimiting Inundated Area
Thresholding
Inundation Image
Affected Urban
Calculate Affected Area
Affected Vegetation
Affected Population Using GPWv411
Quantified Impact

2020 Floods Background

- Heavy rain and bad weather resulted in floods[1]
- More than 40 people were killed[1]
- More than 400 were injured[1]
- Infrastructure's capacity to handle the rain was exceeded[2]

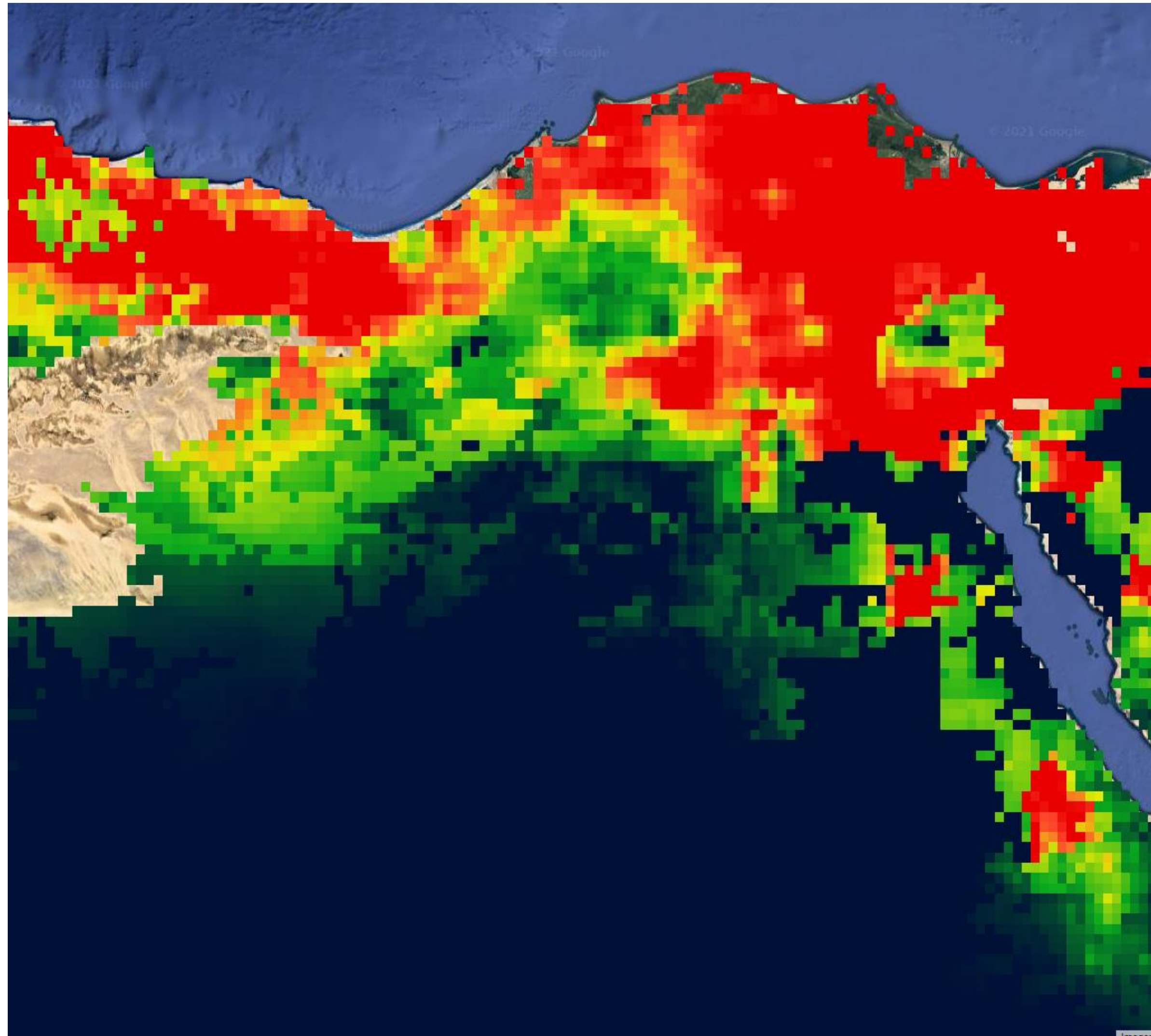
- State of emergency declared.
- Airports and ports were shut.
- Heavy precipitation between March 11 and March 12, 2020.
- Maximum estimated daily precipitation: 139 mm.

Submerged cart in Cairo - Reuters[2]

1. https://reliefweb.int/report/egypt/egypt-flash-floods-emergency-plan-action-epoa-dref-operation-n-mdreg015
2. https://www.aljazeera.com/news/2020/3/13/storms-bring-widespread-floods-to-egypt-killing-5

2020 Floods Background

- Inspect SAR images before and after the flood
- Create a SAR difference image (after – before)
- Delimit the areas with detected inundation
- Use K-Means Clustering, an unsupervised machine learning algorithm, to extract the inundated areas
- Calculate the total area from the resulting image pixels
- Calculate the affected agricultural area and affected urban area
- Calculate the number of affected population



CHIRPS Daily Precipitation Data on March 12, 2020 for Egypt

Importance and Impact

For Egypt

- In-house capacity for use of the data available from satellite imagery for damaged areas detected for past disasters (training was provided to ESWA staff and Egypt Statistical office) .
- Improve disaster assessment.
- Improve understanding of flood-prone areas (like Wadi Al Natron and Ras Ghareb).
- Highlights areas where remote sensing performs well for disaster detection.
- Understand limitations of remote sensing for damage assessment in the case where ground-truthing data is not available.
- Better understanding of future changes in the flow and level of the Nile river due to Al Nahda Dam

For the region

- Advocacy for better use and integration of geospatial data to improve data-driven decision making in Egypt and other Arab countries in relation to disaster risk management.
- Expand the case study of Egypt for applications in other areas in the Arab region.
- Inform on the SDGs Goals and Targets (1.5 and 13.1) related to disasters and The Sendai Framework for Disaster Risk Reduction 2015-2030 four priorities for action to prevent new and reduce existing disaster risks: (i) Understanding disaster risk; (ii) Strengthening disaster risk governance to manage disaster risk; (iii) Investing in disaster reduction for resilience and; (iv) Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction.

Other Case Studies that benefited from Satellite Imagery for SDGS
https://www.earthobservations.org/documents/publications/201703_geo_eo_for_2030_agenda.pdf

Case 1: Agriculture Monitoring
SDG: 2.c Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility. GEOGLAM can also support other Targets (2.1, 2.4, 2.a, 2.3) and other Goals (12 and 13, with Indicators 12.3 and 13.3).
Data: remote sensing satellites such as: Sentinel 2, MODIS, Landsat.

- Is-Situ (on site data) such as temperature, and precipitation
- crowd-sourced information – e.g. land use, weather, and crop characterization

Methodology:

- crop land monitoring through remote sensing indices like Normalized Difference Index
- crop land monitoring through machine learning to predict crop type
- forecasting crop production based on NDVI, crop type, temperature, precipitation

Case 2: Water body threats include cyanobacterial (blue-green algal) blooms also known as algal blooms.
SDG:6.3.2 Proportion of bodies of water with good ambient water quality
Data: Landsat 7, Landsat 8, sentinel 2, sentinel 3 and Freshwater shapefiles
Methodology:

- Algal bloom sensitive indices can be used
- Regression or other machine learning models can also be used to estimate the concentration

Case 3: Flood prediction and early warning
SDG:6.5.1 Degree of integrated water resources management implementation (0-100)
Data: Global Satellite Mapping of Precipitation (GSMaP) dataset and ground observations
Methodology:

- Predict extreme weather events using forecasting/ml from calibrated satellite precipitation data
- River run off models (hydrological models)

Case 4: Mapping Extent and Annual Changes in the Global Mangrove Cover
Mangroves are of critical importance as breeding and nursery areas for birds, fish and shellfish and play an important role in the regulation of freshwater, nutrients and sediment inputs into the marine coastal waters
SDG:6.6.1 Change in the extent of water-related ecosystems over time
Data:L-Band Synthetic Aperture Data (SAR): L band is great for vegetation structure detection

- Landsat 7, Landsat 8, Sentinel 2 (all are optical sensors) and SRTM elevation data

Methodology:

- Coastal masking and mangrove habitat location classification using SRTM, water mask (JRC 2016) and historical mangrove extent maps from around 2000 (USGS World Distribution of Mangroves and ITTO World Atlas of Mangroves).
- Mangrove extent classification of L-band SAR
- Compare classified images to see if they increased or decreased

Case 5: mapping urban growth
SDG:11.3.1 Ratio of land consumption rate to population growth rate
- 3.9.1

Data: C-band SAR data (sentinel 1) and Optical data: landsat 7-8, sentinel 2
Methodology: SAR data can be thresholded for urban area detection or can be fed as an input to a ML model
- Optical data can be used to create a built up index or can also be used as an input to a ML model

Case 6: air pollution monitoring
Detection of PM2.5 and PM10 tiny particles in the air that reduce visibility and cause the air to appear hazy when levels are elevated
SDG:11.6.2 Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)
- 3.9.1 Mortality rate attributed to household and ambient air pollution

Data: GOSAT, GOSAT-2, Sentinel 5 all are air quality focused satellites and On site air quality data
Methodology: Use pretrained numerical models to estimate aerosols and other air quality related particles (PM2.5, PM10)

Case 7: Water quality monitoring of barrier reef
SDG:14.1.1 Index of coastal eutrophication and floating plastic debris density
Data: Modis Aqua satellite (optical satellite that detects bands required for water monitoring)
- Sentinel 3 can also be used
- In-situ (on site) ground truth measurements

Methodology: Ml models can be used
- Some satellites can have bands that already provide the estimates directly

Case 8: Forest extent and change
SDG:15.1.1 forest area as a proportion of total land area
- 15.2.1 progress towards sustainable forest management

Data: Landsat and sentinel optical imagery
- L-band sar can also be used

Methodology: Machine learning models can be used and image differencing
- L-band SAR thresholding and differencing can also be used

Thank You