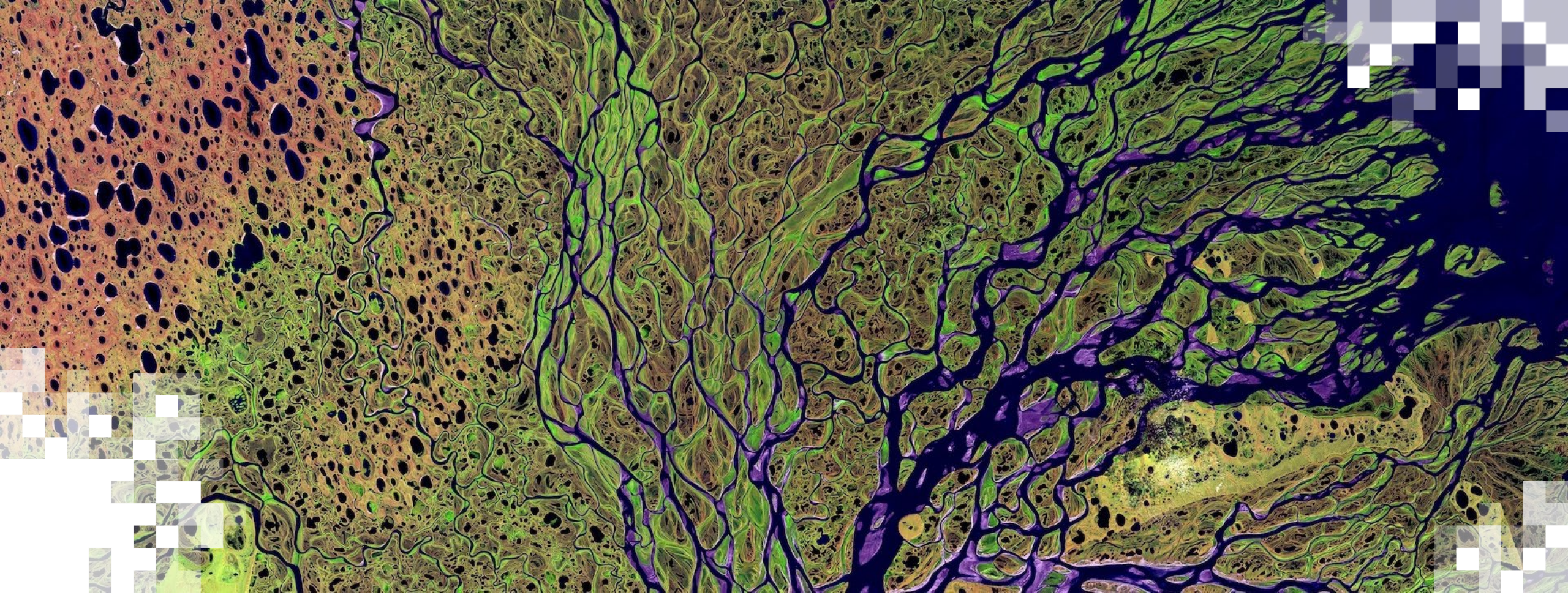
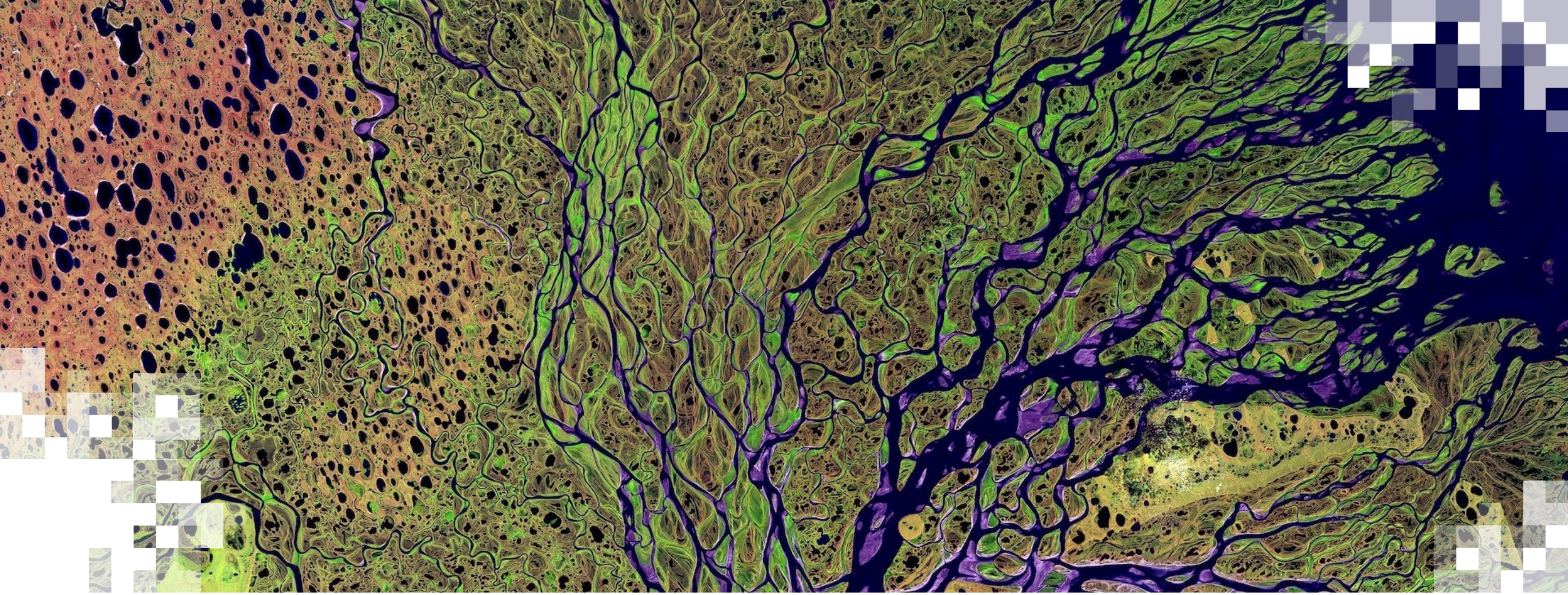


Energizer



Earth Observations Toolkit for Sustainable Cities & Human Settlements

Sustainable Development Goal (SDG) 11

https://sdgs.un.org/goals/goal11

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

UN HABITAT FOR A BETTER URBAN FUTURE

EARTH OBSERVATIONS FOR THE SUSTAINABLE DEVELOPMENT GOALS

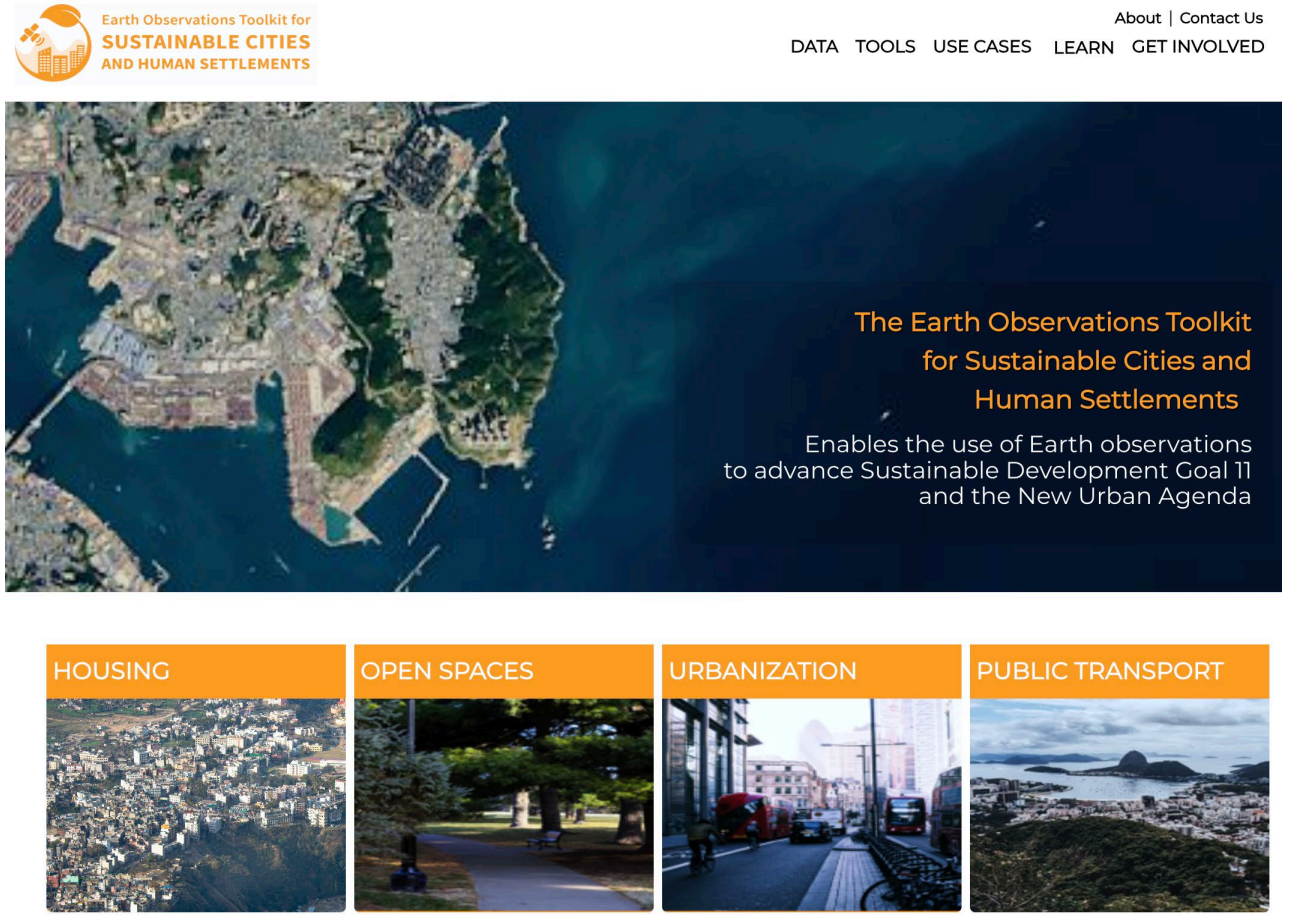
GEO GROUP ON EARTH OBSERVATIONS

Earth Observations Toolkit for Sustainable Cities and Human Settlements

Free and open, ready-to-use Earth observation data sets.

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

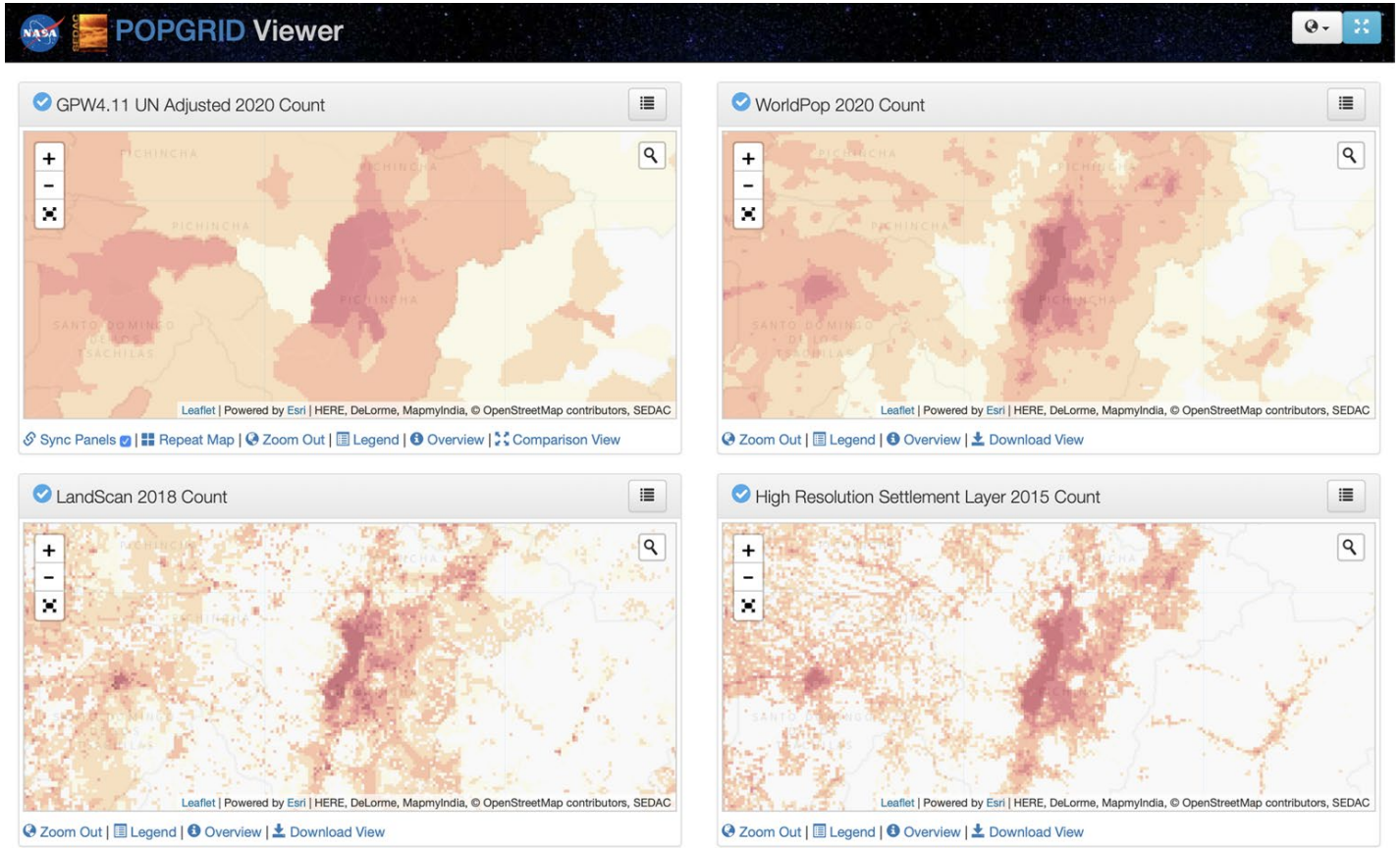
Documented use cases from cities and countries.



https://eotoolkit.unhabitat.org/

What is Gridded Population Data?

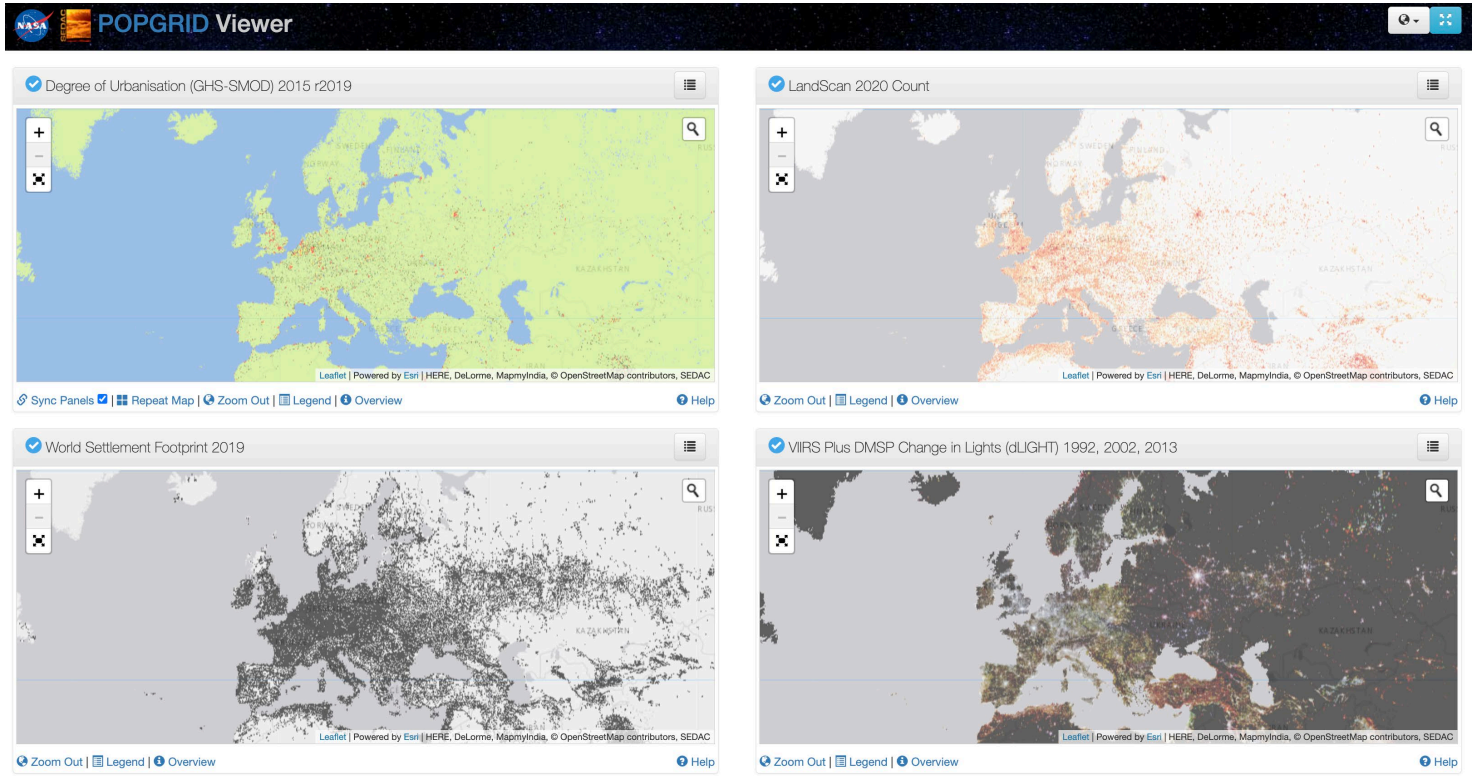
- Population density estimates are allocated to grid-cells.
- Many gridded population products exist.
- Several products identify "urban" vs. "rural" settlement types.

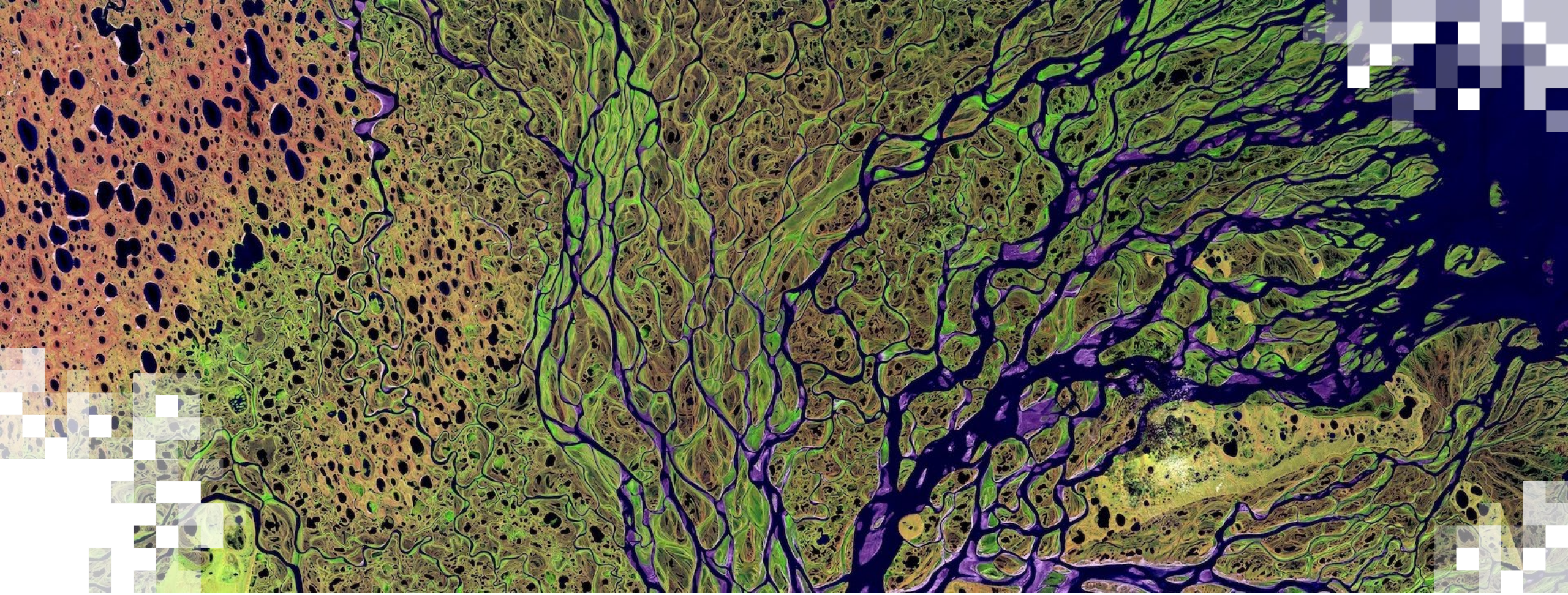


https://sedac.ciesin.columbia.edu/mapping/popgrid/

POPGRID Viewer

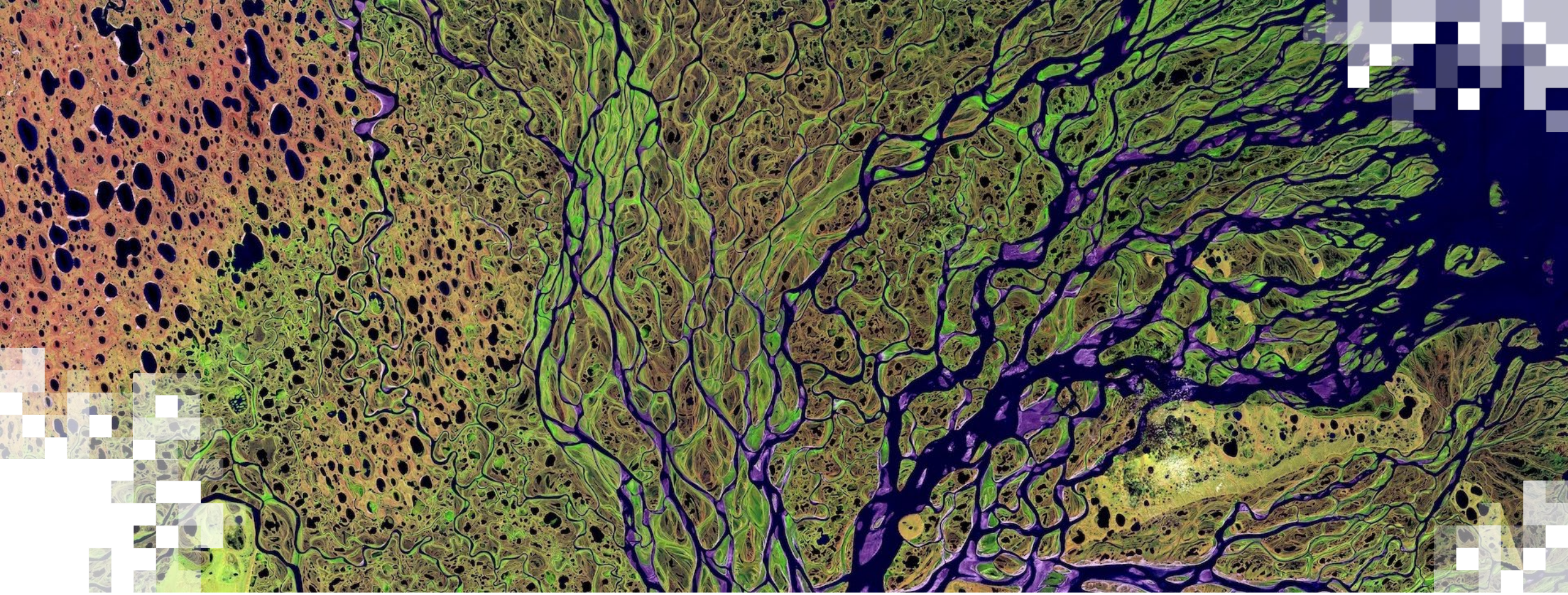
- NASA Socioeconomic Data and Applications Center (SEDAC) provides resources, data, and tools to use gridded population data products to track SDG 11.
- The POPGRID Viewer and other mapping tools are available via the EO Toolkit.
- POPGRID-Compare will be formally released in the near future.





Demo:
Earth Observations Toolkit for Sustainable Cities and Human Settlements

eotoolkit.unhabitat.org



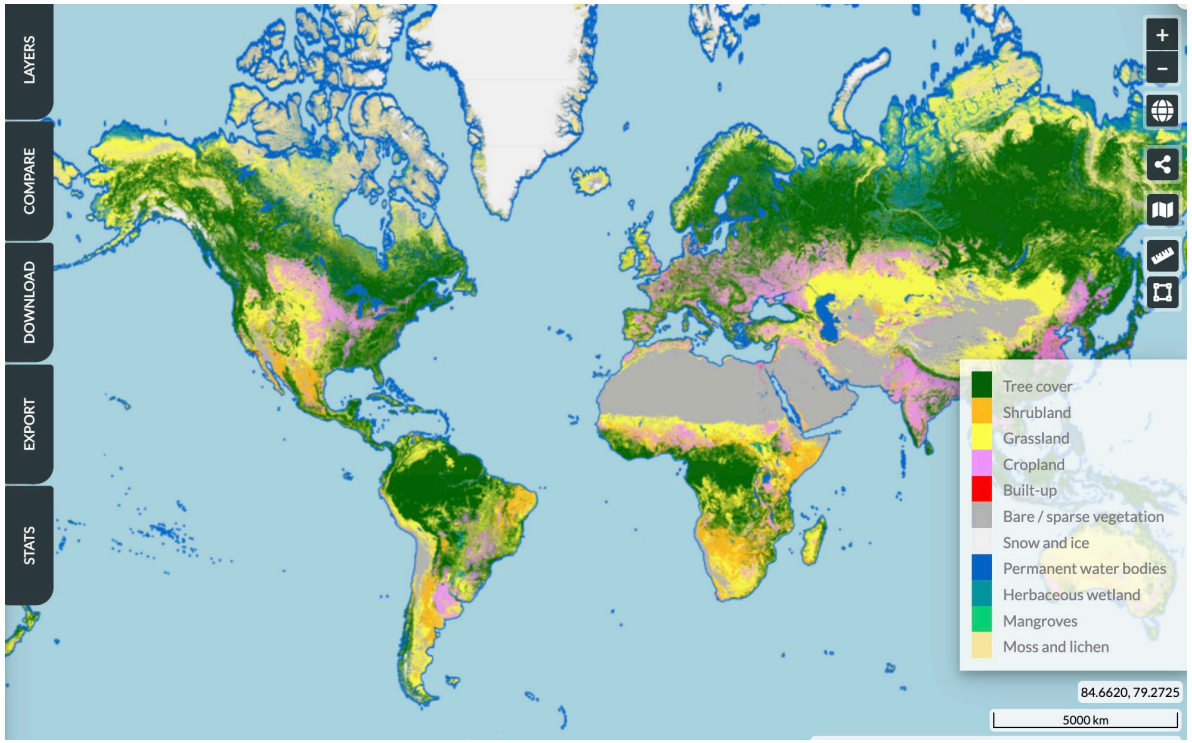
Land Use and Landcover Products

ESA WorldCover

- **Source**: Optical data from Sentinel-2 and radar data from Sentinel-1
- **Spatial Resolution**: 10 meters
- **Temporal Resolution**: Yearly (2020 with V1 and 2021 with V2)
- **Coverage**: Global
- **Classes**: 11 classes: tree cover, shrubland, grassland, cropland, built-up, bare/sparse vegetation, snow and ice, permanent water bodies, herbaceous wetland, mangroves, moss and lichen
- **Platform**: Freely available

  https://esa-worldcover.org/en

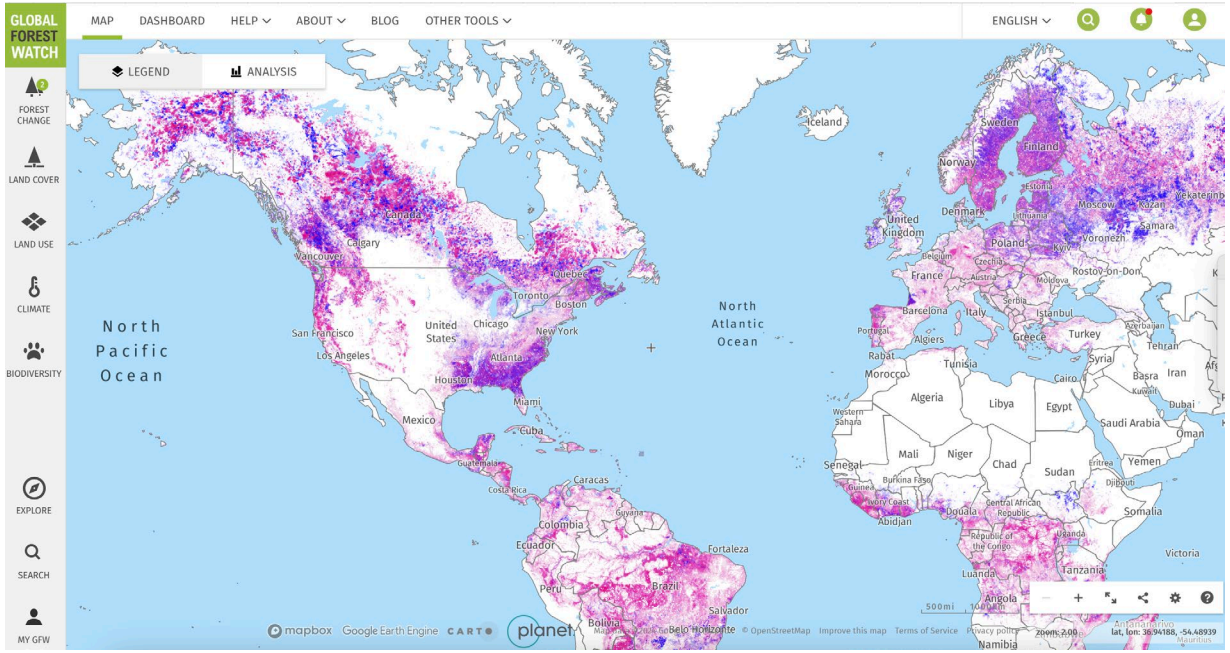
  *Also available on GEE



Global Forest Watch

- **Source**: Optical data
- **Spatial Resolution**: 30 meters
- **Temporal Resolution**: Yearly (2000 – 2023)
- **Coverage**: Global
- **Classes**: Forest cover, forest loss, forest gain
- **Platform**: Freely available

  https://www.globalforestwatch.org/map/

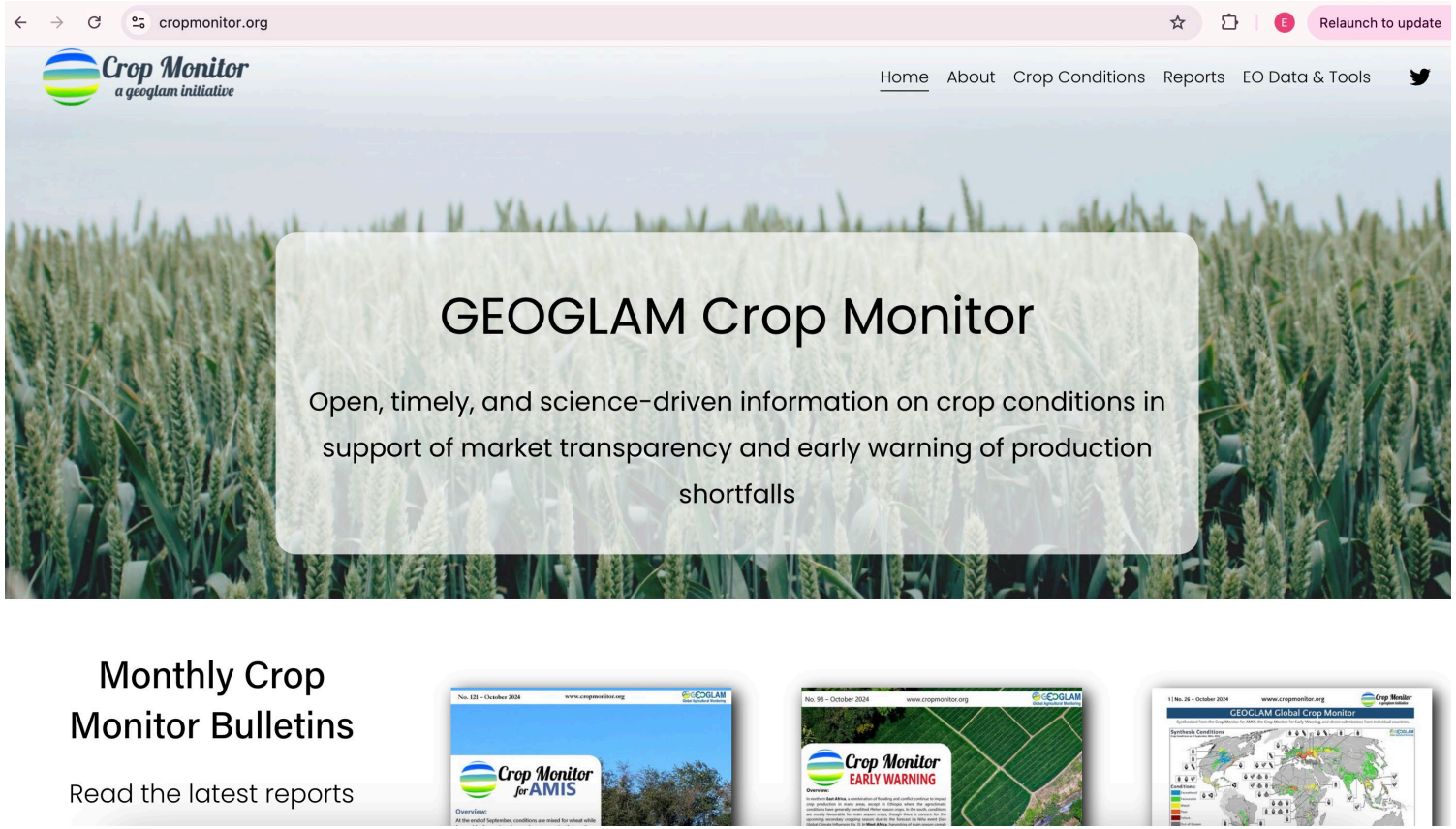


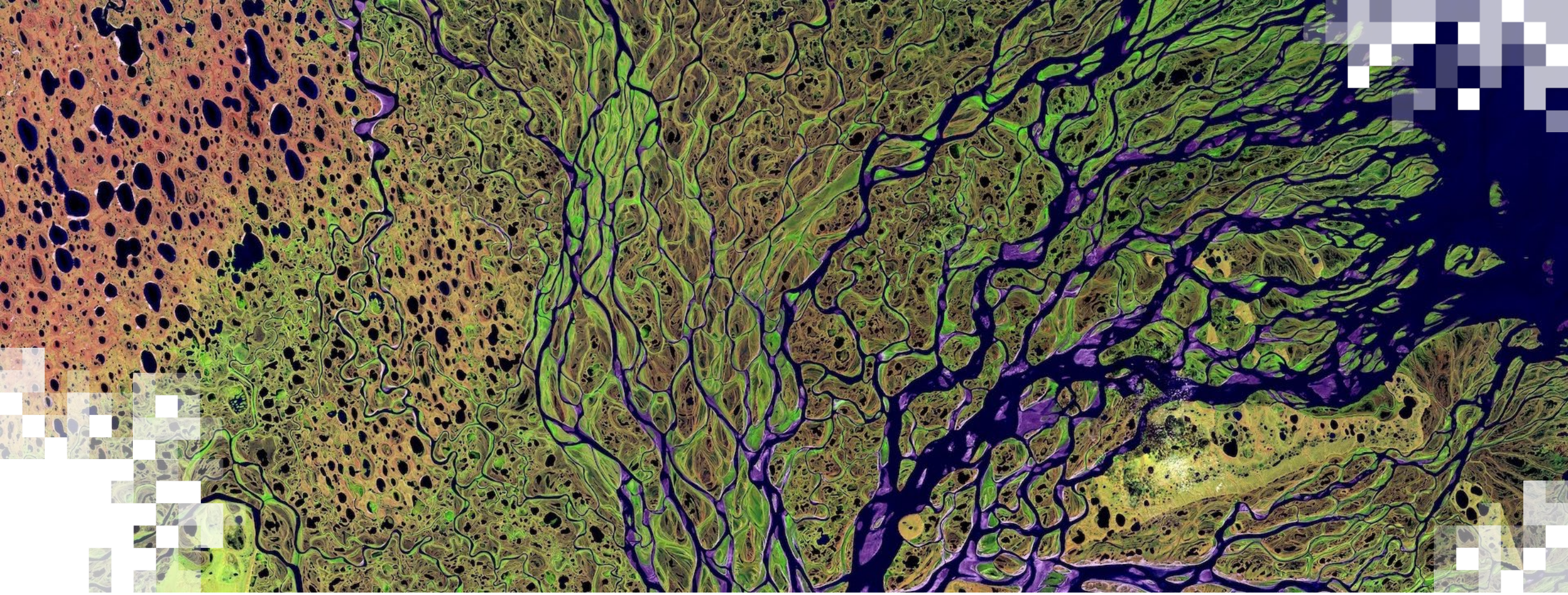
Global Land Analysis and Discovery (GLAD)

- **Source**: Optical data
- **Spatial Resolution**: 30 meters
- **Temporal Resolution**: Yearly (2000 – 2023)
- **Coverage**: Global
- **Products**: Forest height dynamics (2000, 2020), Global cropland dynamics (2000–2019), Global forest canopy height (2019), etc.
- **Platform**: Freely available: https://glad.umd.edu/

GEOGLAM Crop Monitor

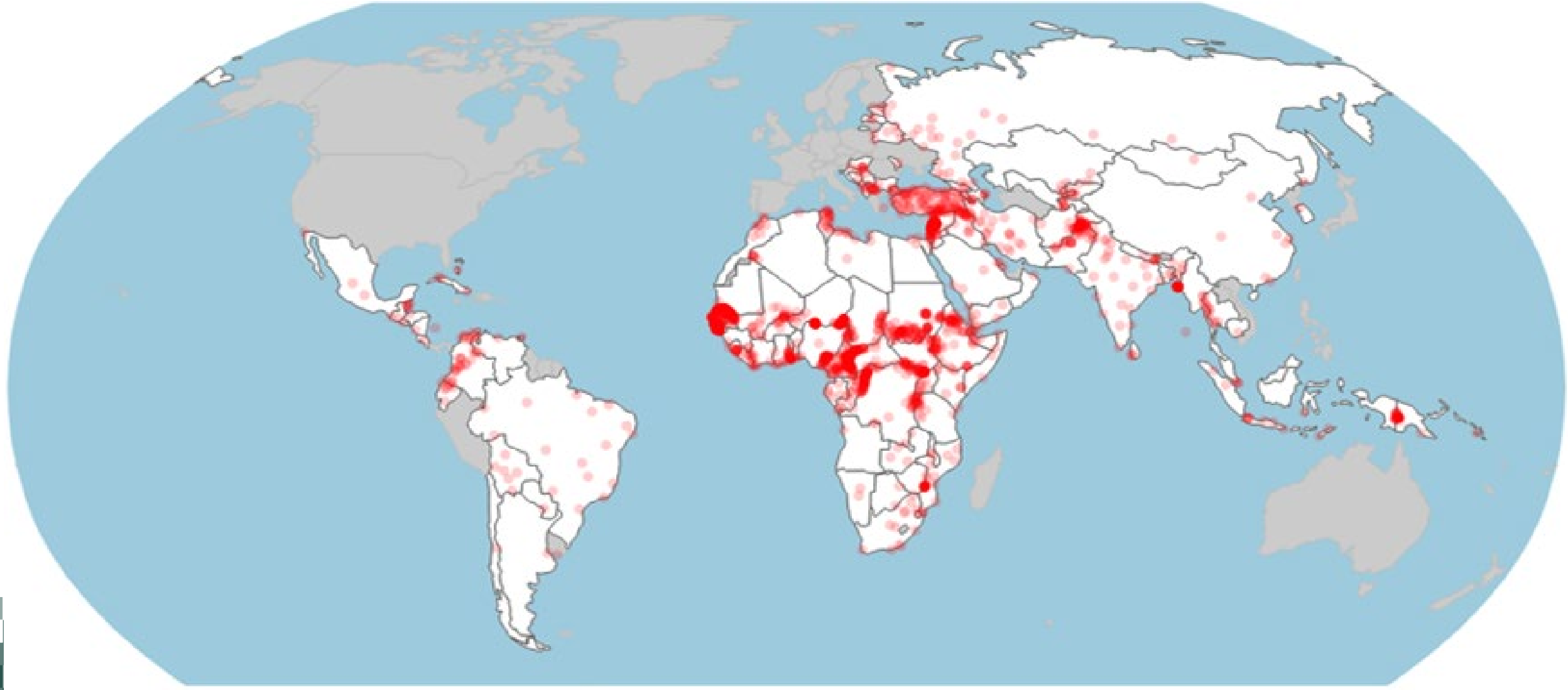
- **Source**: Optical data
- **Spatial Resolution**: 500 meters
- **Temporal Resolution**: Yearly
- **Coverage**: Global
- **Classes**: Forest Cover with
- **Platform**: Freely available
  https://esa-worldcover.org/en
  *Also available on GEE





Humanitarian Applications

At the end of 2019, there were 26 million refugees across 170 of the world's 195 countries.



Refugees are international migrants who have been forcibly displaced from their home countries due to violence or persecution and have been granted protection under international law.

Source: UNWRA (2021)

Syria – 6.7 million refugees mainly in Turkey, Jordan, and Lebanon (UNHCR, 2022)

73% of refugees seek asylum in neighboring countries.

Source: UNHCR (2016)

Source: WorldVision (2017)

South Sudan – 2.2 million refugees mainly in Kenya and Uganda (UNHCR, 2022)

Due to the need for immediate relief, refugee settlements tend to be rapidly established and populated.

Much geospatial data on dwellings, land use, and infrastructure are collected during these initial months following refugee arrival.

Camp siting and conditions conform to the local context.

A Rohingya refugee camp in Bangladesh…

Source: Guardian (2017)

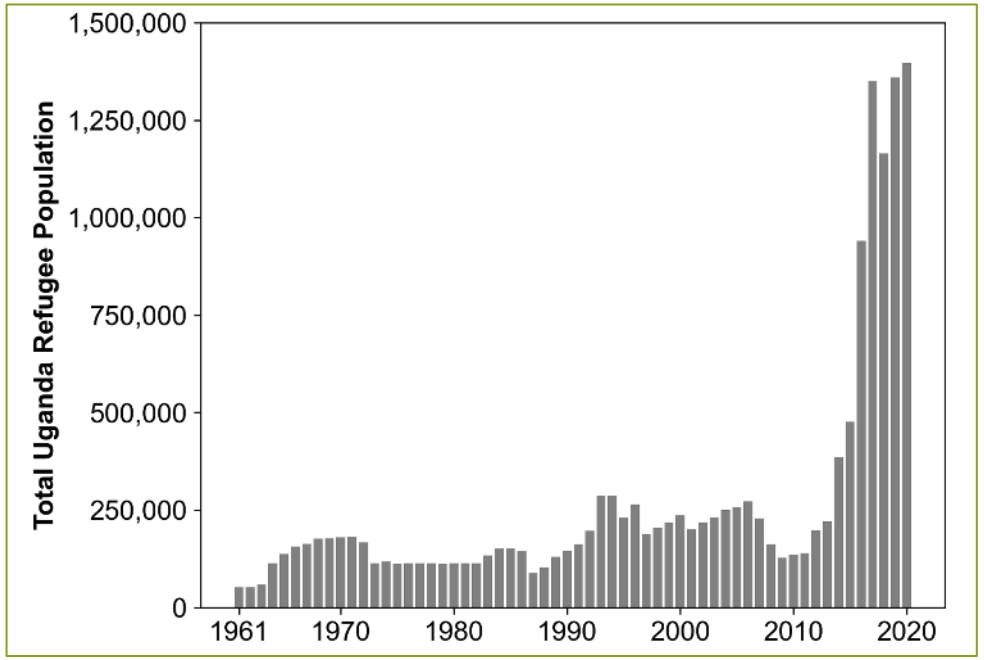
…looks very different from a Syrian refugee camp in Jordan.

Source: Getty Images (2013)

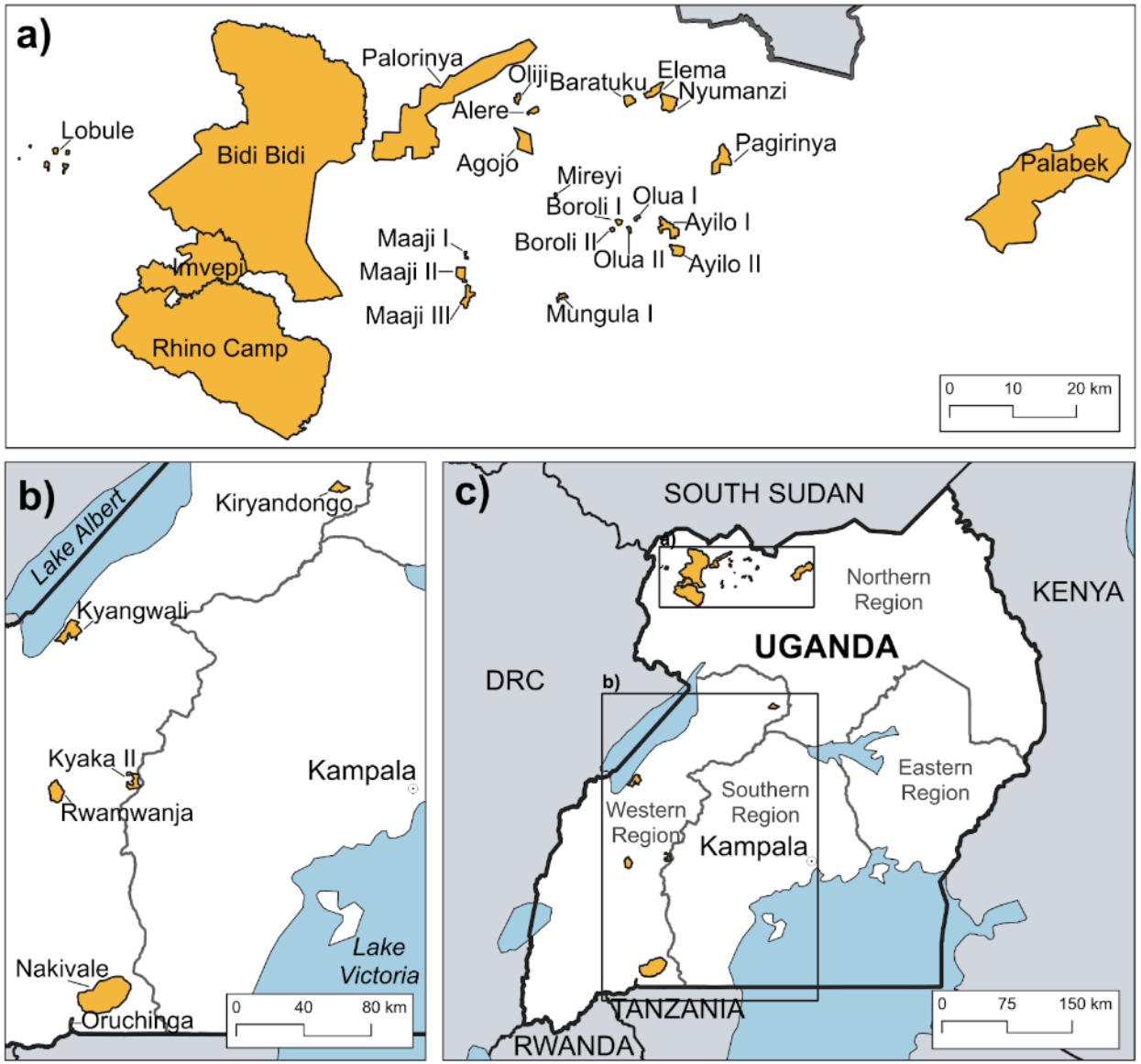
Satellite remote sensing data are uniquely valuable for monitoring humanitarian conditions at refugee settlements.

- Satellites are not inhibited by the limited physical access to or remote locations that typify many refugee settlements.
- Geographically expansive coverage means that we can contextualize conditions in refugee settlements within the region or hosting country.
- Satellites offer near-real time – daily or sub-weekly – data collection that can offer a sustained, long-term monitoring framework of settlement conditions.
- Satellite data are flexible and can be adapted to support different lines of inquiry at different stages of a settlement's lifespan.
- Satellite-derived information on environmental and climatic conditions in and around refugee settlements help to localize insights on refugee livelihoods, sustainable development, disaster risk reduction, and climate adaptation.

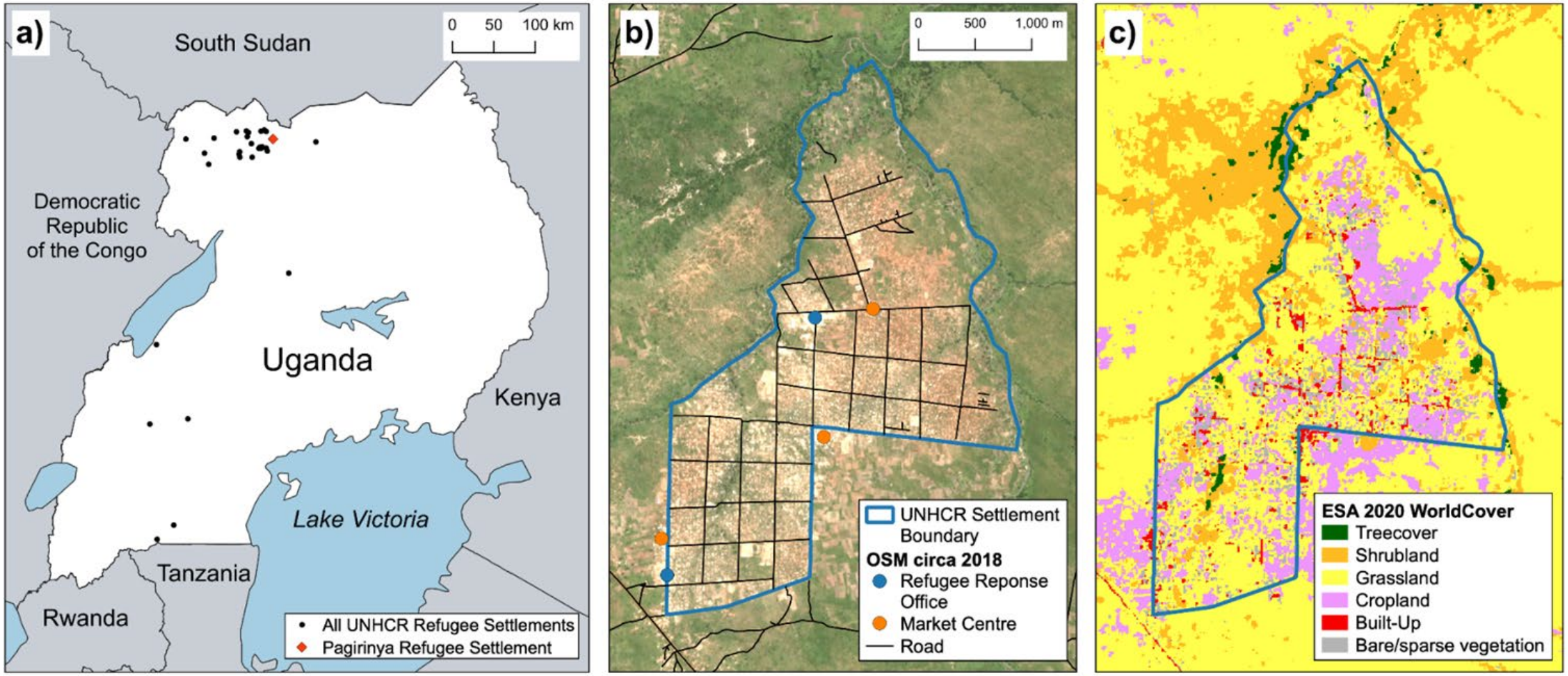
There are 32 UNHCR-Managed Refugee Settlements in Uganda.



Source: Van Den Hoek & Friedrich (2021)

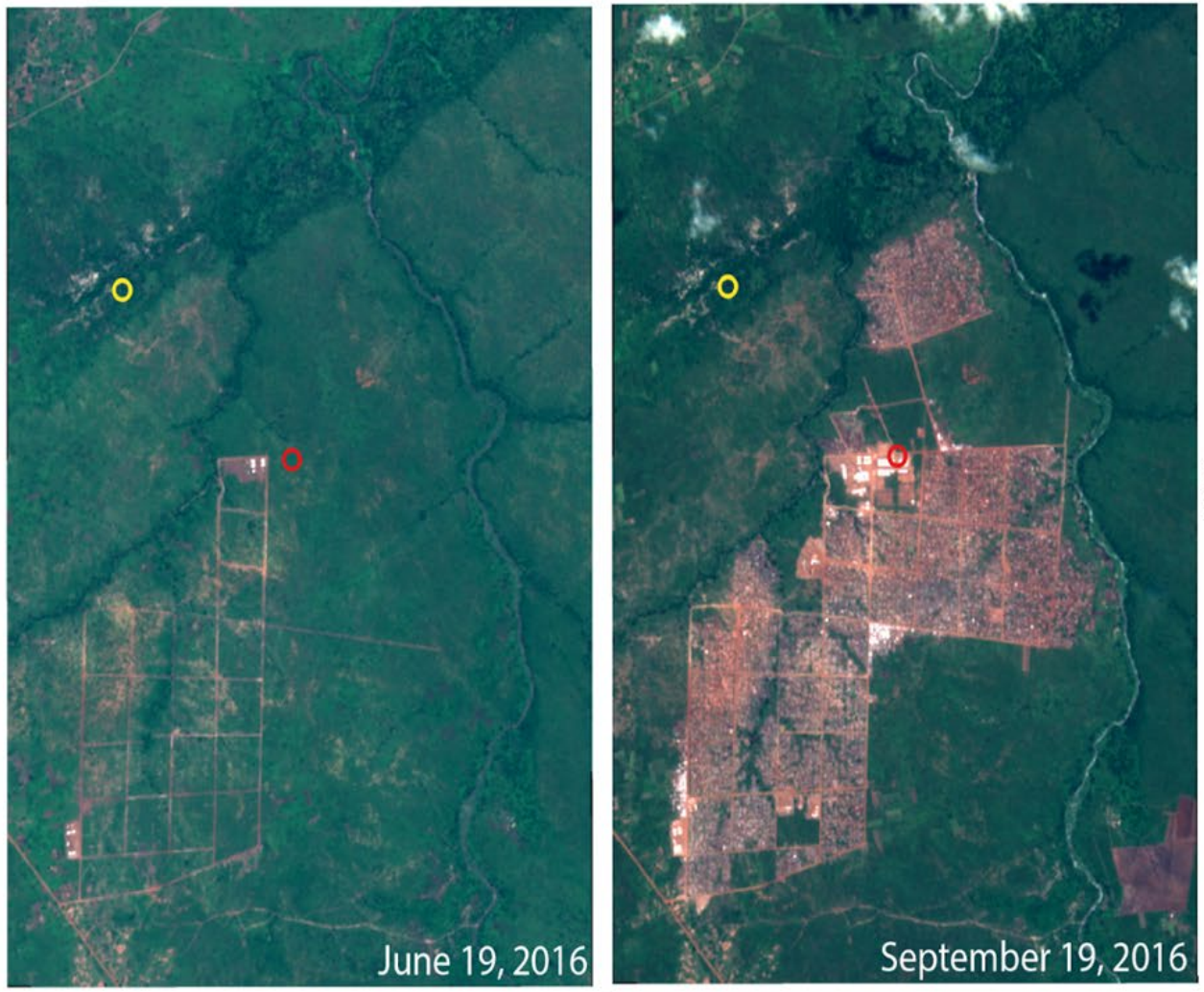


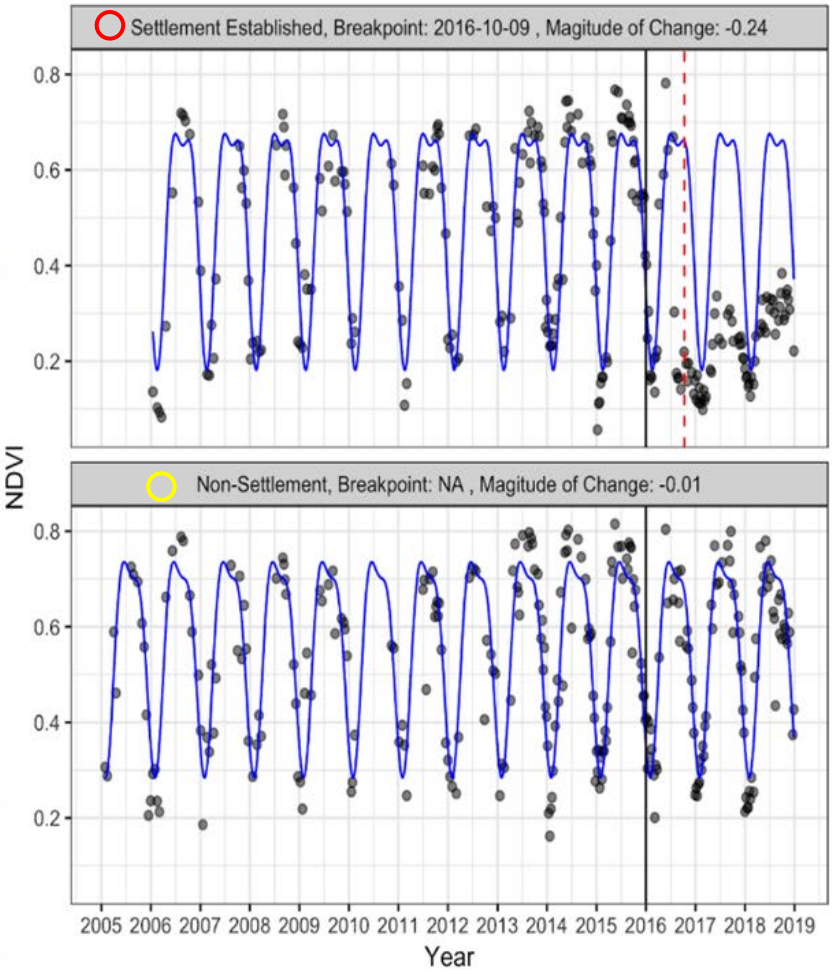
We'll focus on Pagirinya Refugee Settlement, established in 2016.



Source: Van Den Hoek & Friedrich *(forthcoming)*

Results at Pagirinya Refugee Settlement, Opened in 2016



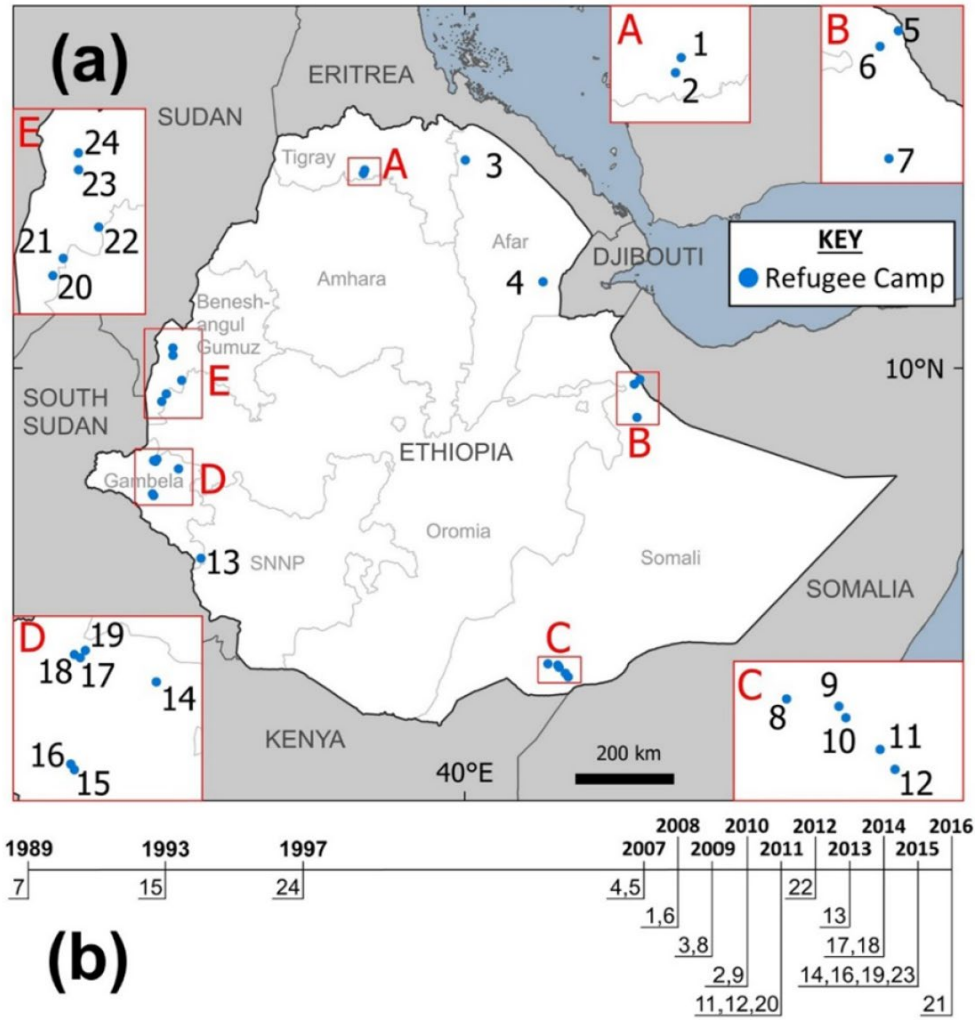


Source: Friedrich & Van Den Hoek (2020)

Refugee Flood Risk Context – Location of Camps

- Placement dictated by complex decision choices, including political components, and may not include a full understanding of risks
- Choice often related to land that is available rather than optimum low risk locations assessed rigorously
- Commonly located close to international borders rather than main populated areas
- Often in remote locations, so there is minimal infrastructure and data/information about locations

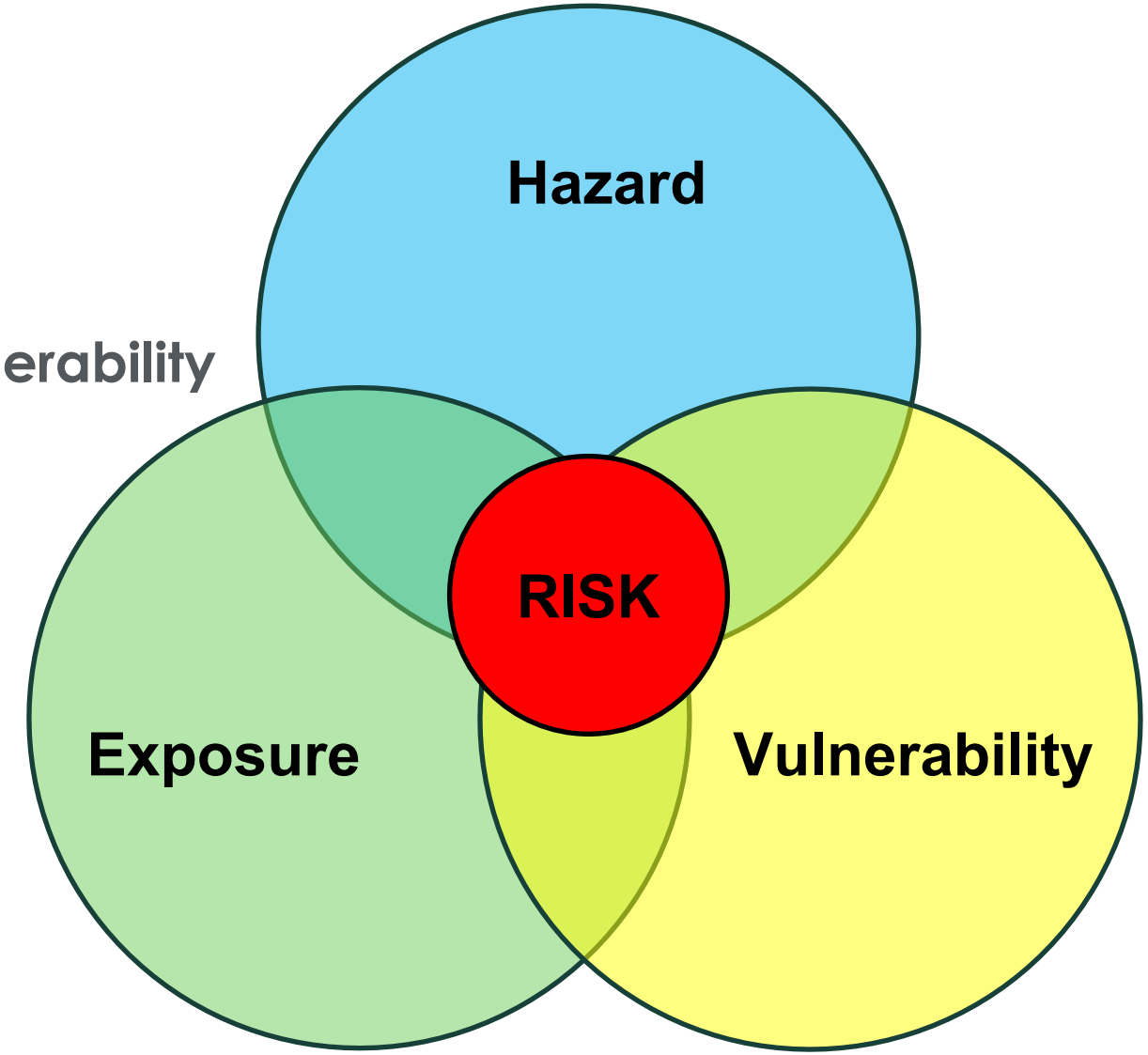
Ethiopia example:
(a) Camp locations and (b) establishment timeline 1989-2016



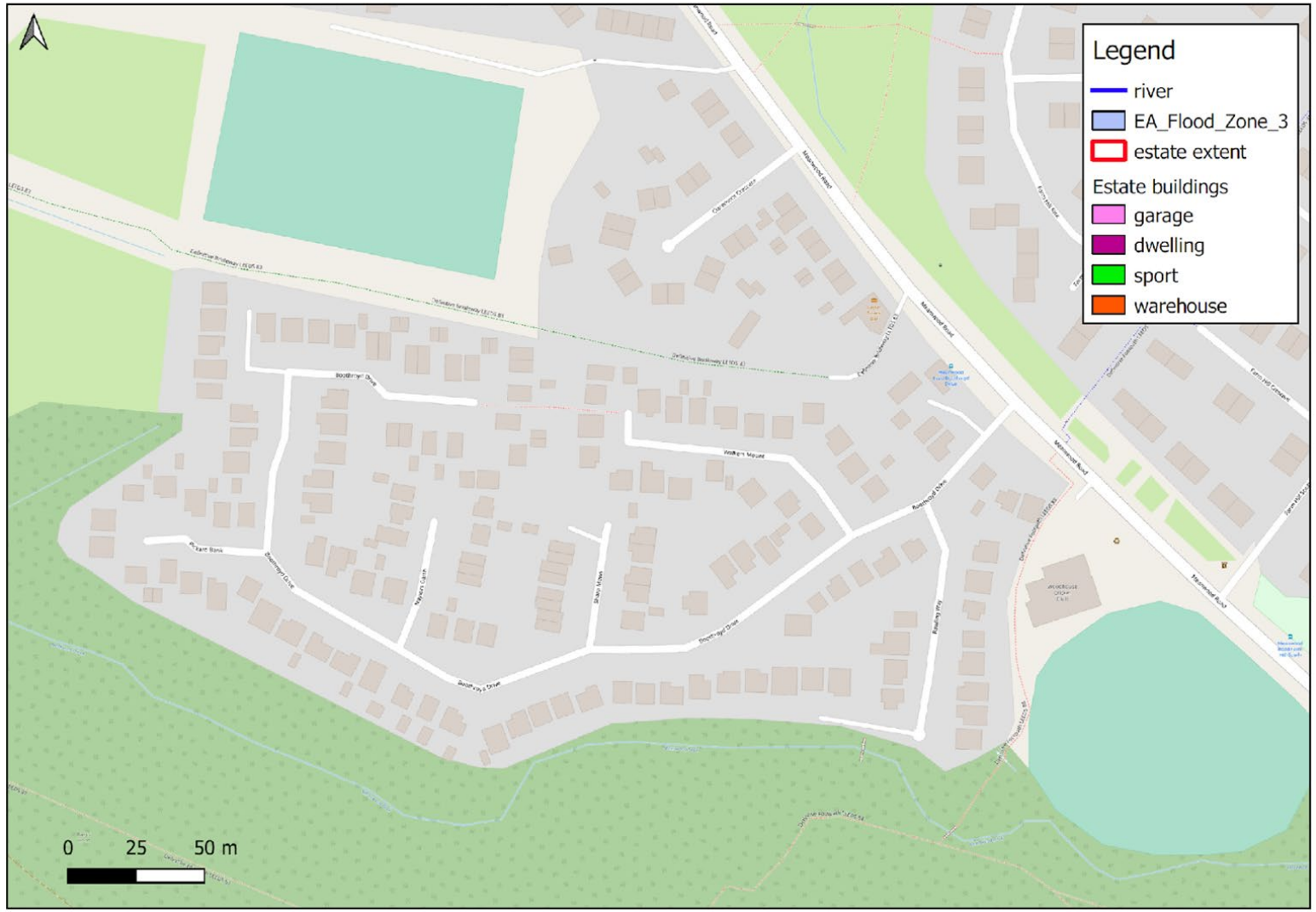
Bernhofen et al. 2023. Unknown risk: assessing refugee camp flood risk in Ethiopia, ERL

Risk is Composed of Three Components:

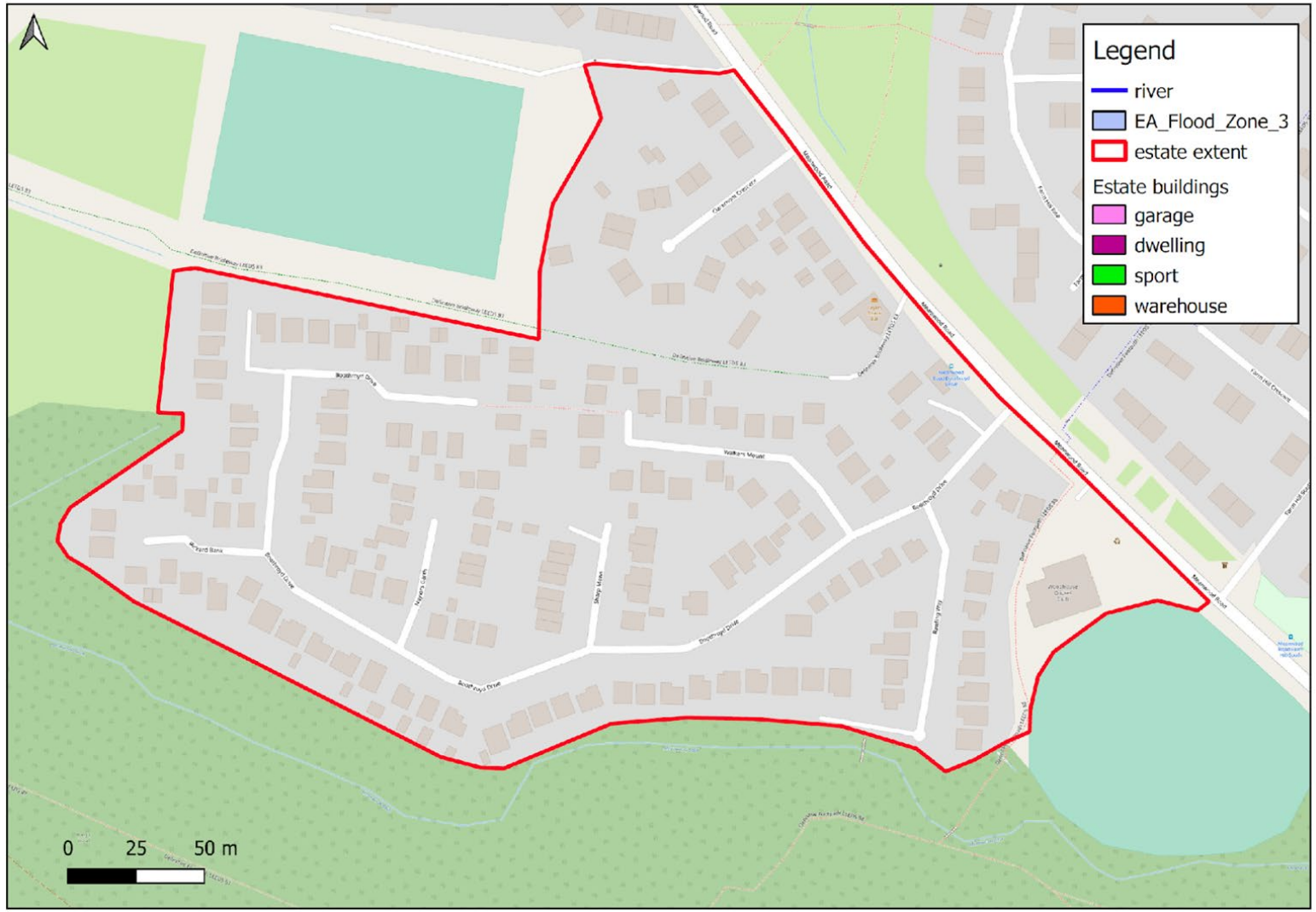
Flood Risk = Hazard × Exposure × Vulnerability



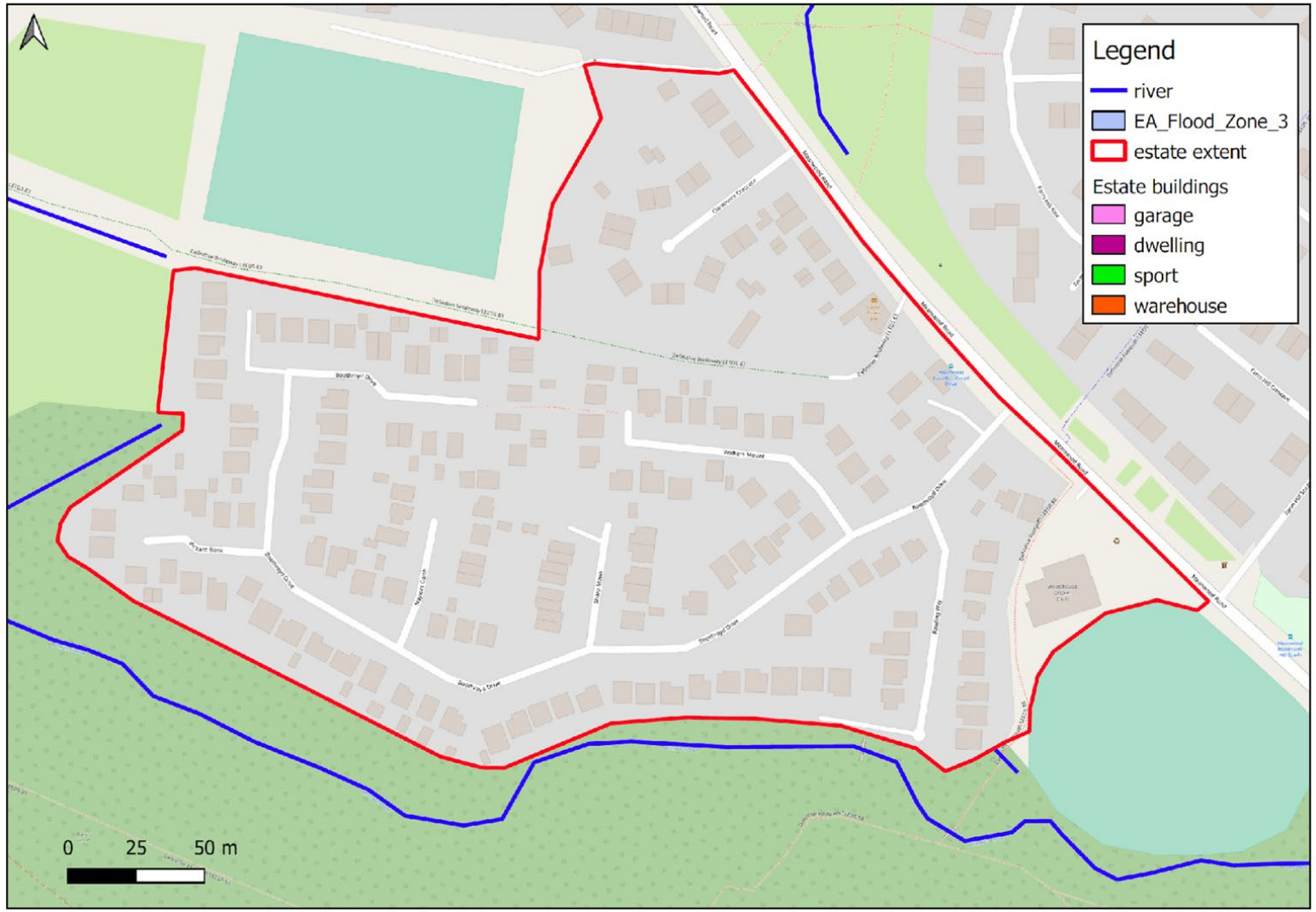
Flood Risk Assessment for Housing Estate



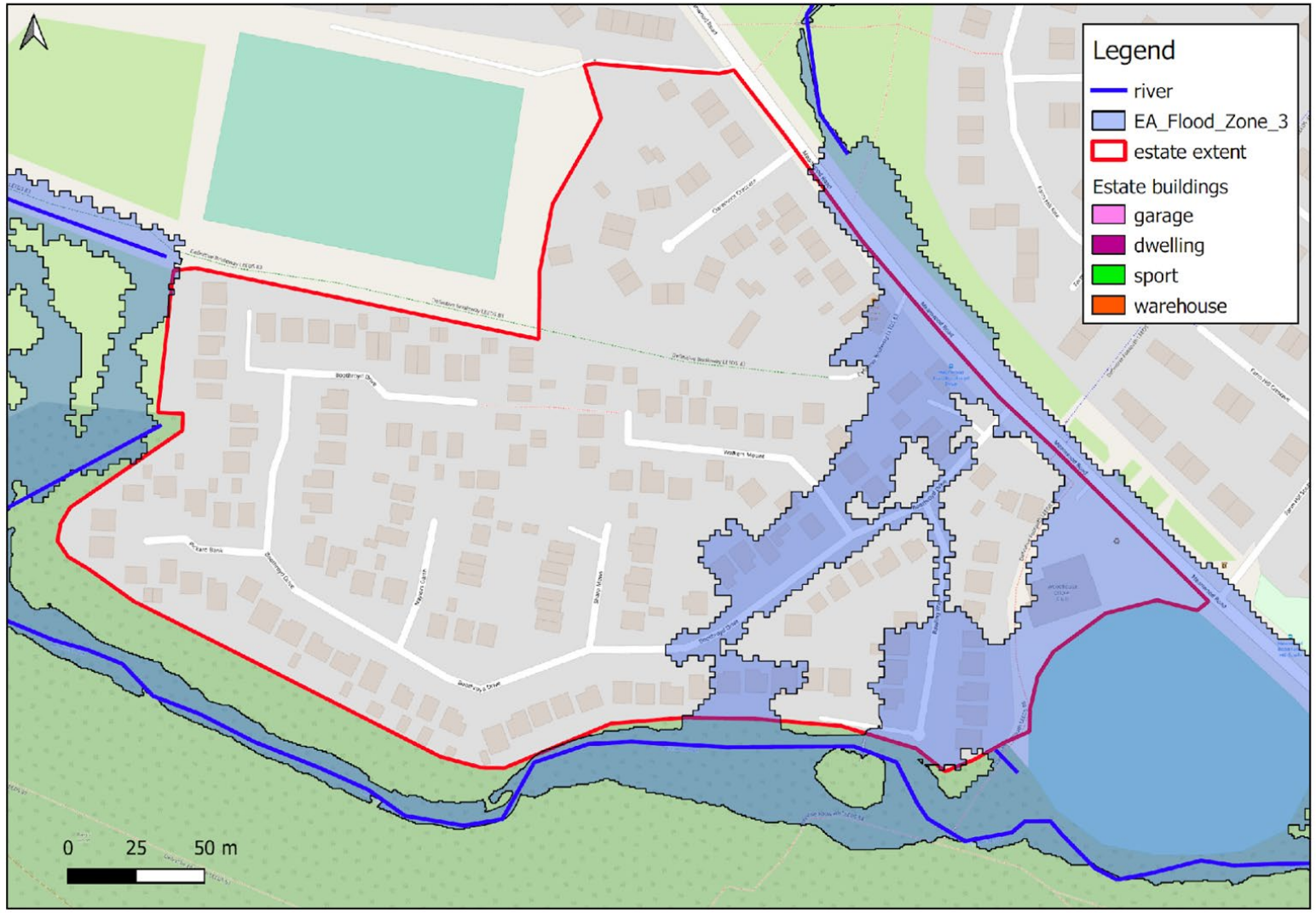
Identify Area for Assessment



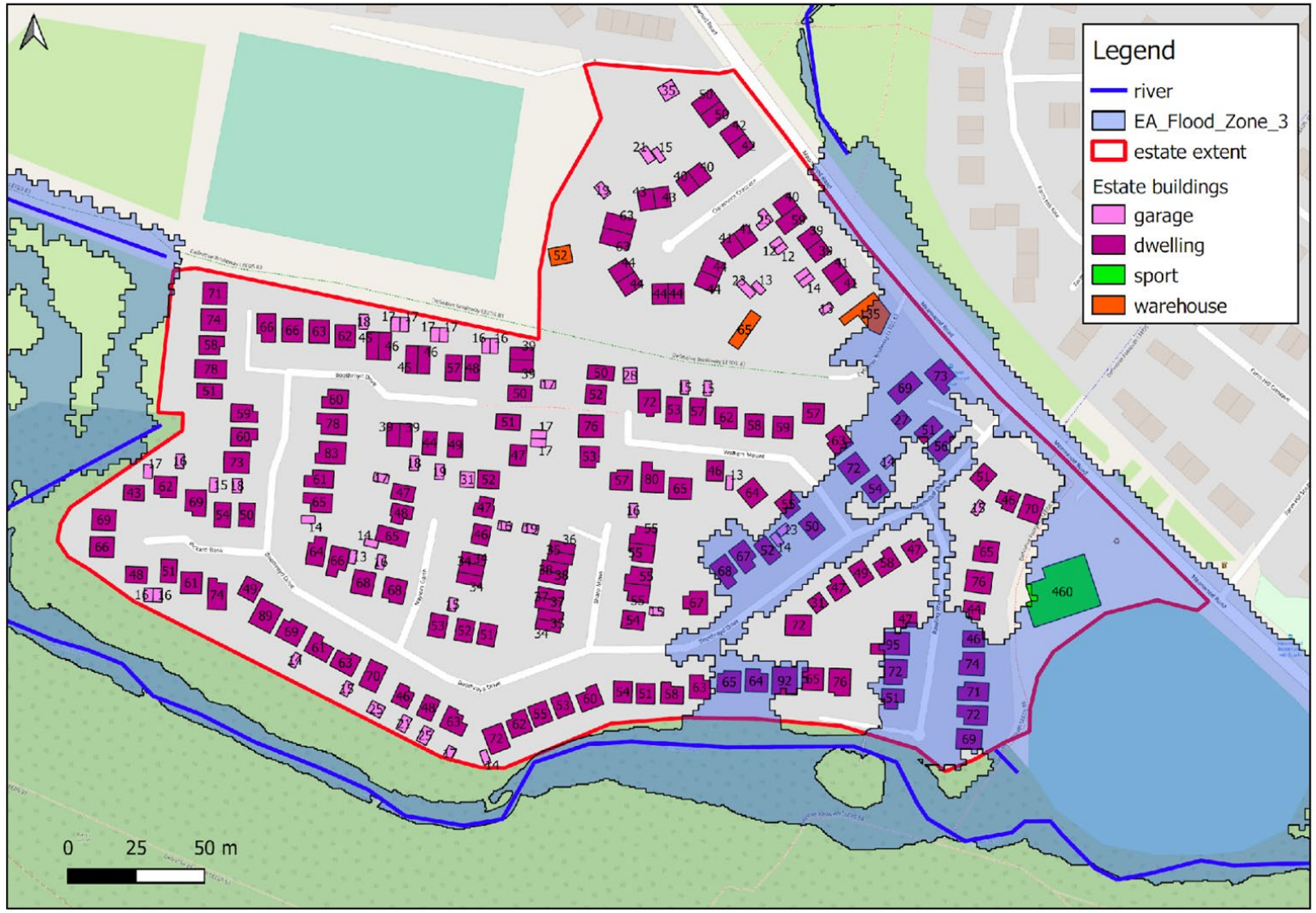
Identify Sources of Flood Hazard



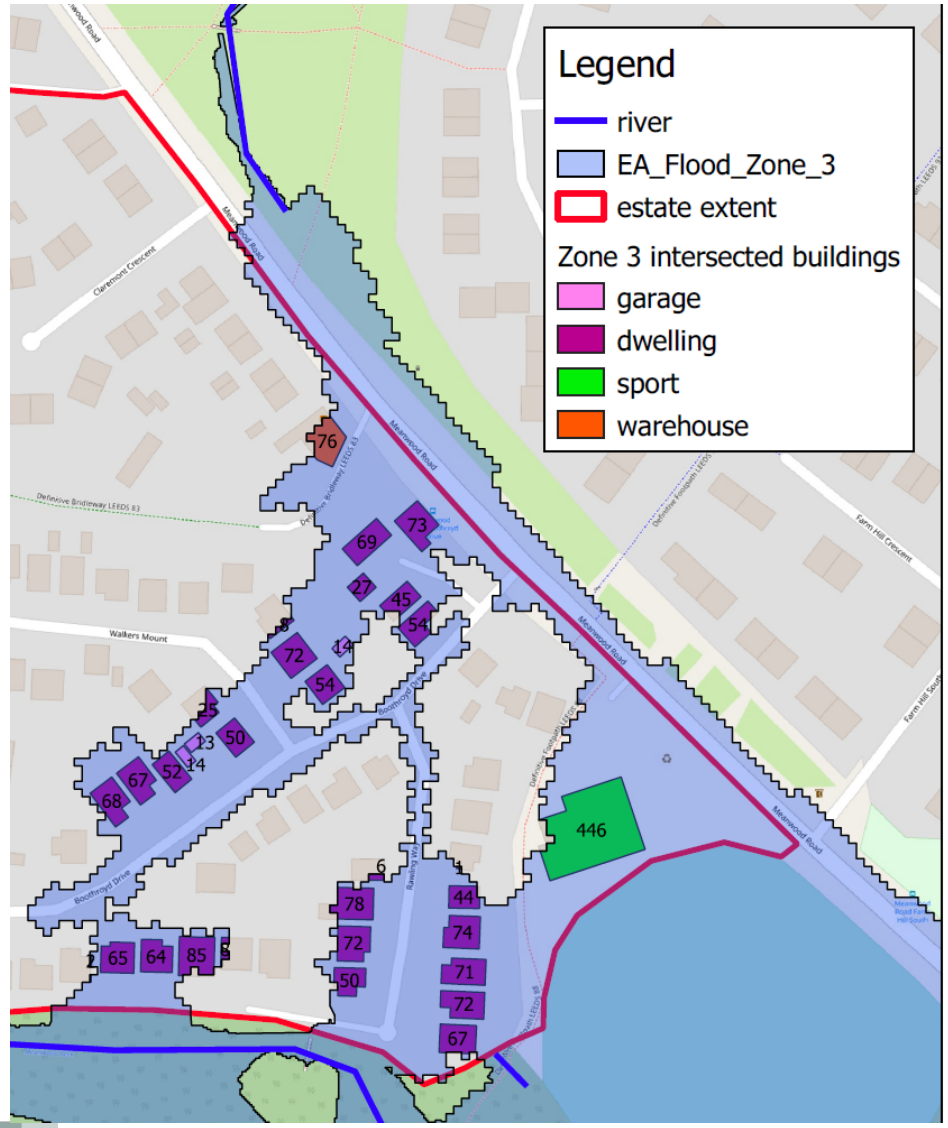
Quantify Hazard (Flood Model)

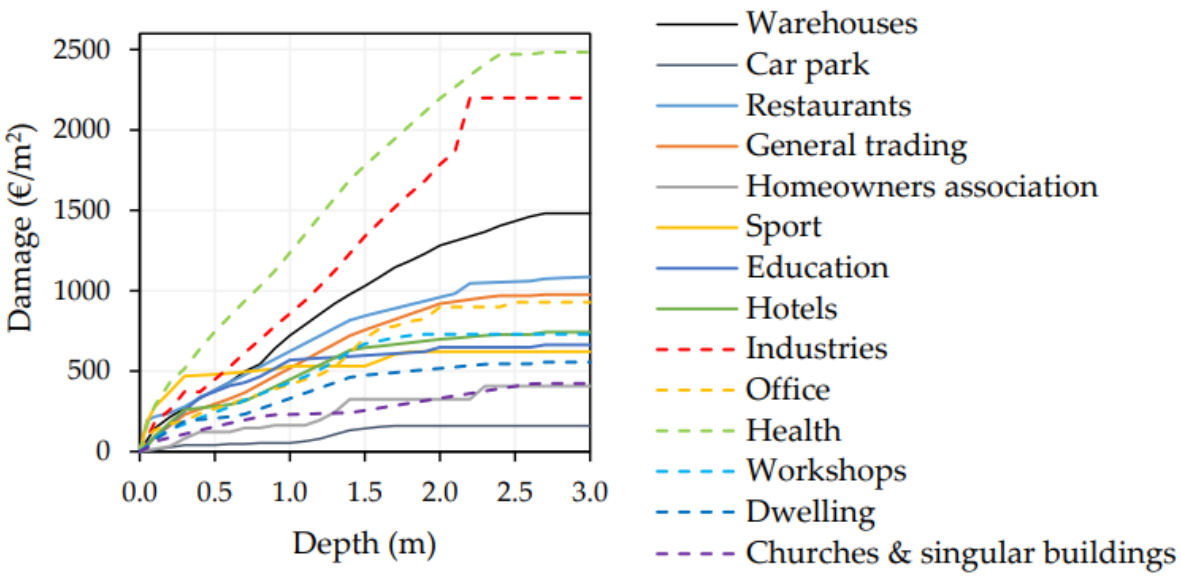


Identify Exposure to Hazard



Quantify Risk Through Vulnerability (Numbers, Economic Value)





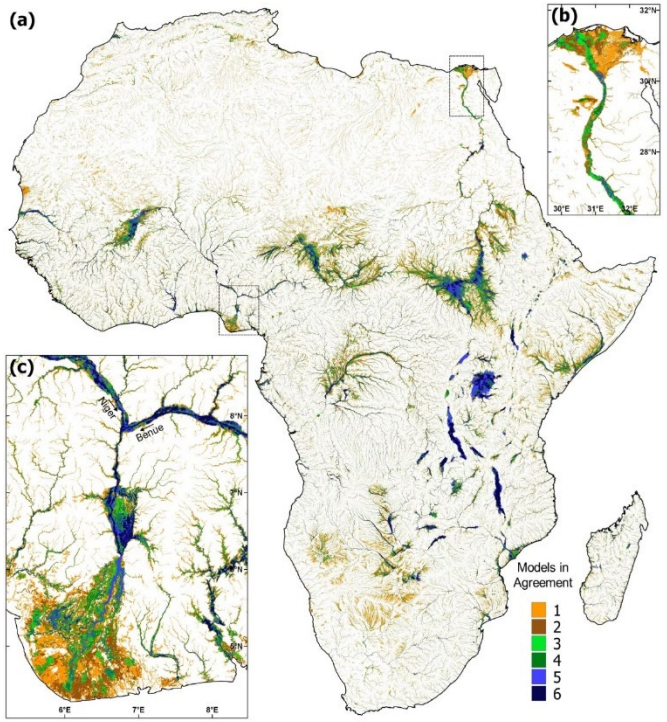
Martínez-Gomari et al., (2020)

Can quantify potential flood impact through:

- Number of buildings exposed
- Number of people living in buildings exposed
- Building footprint area exposed
- Economic value of building exposed to hazard (risk)

Advances in Data Availability – The Role of Earth Observation Data

- Recently, global data availability for flood risk assessments has improved significantly.
- This is due to several factors:
  1. Improvements in types of EO data, sensor resolution & coverage.
  2. Increases in computing power.
  3. New rapid flood modelling algorithms.
- Higher resolution flood hazard models everywhere – even in data scarce regions.
- EO data underpins this global coverage, proving globally consistent, higher resolution topography (e.g. SAR data), land cover/use (e.g. Landsat/Sentinel), and rainfall data (e.g. GPM), all of which are key to a good flood model.

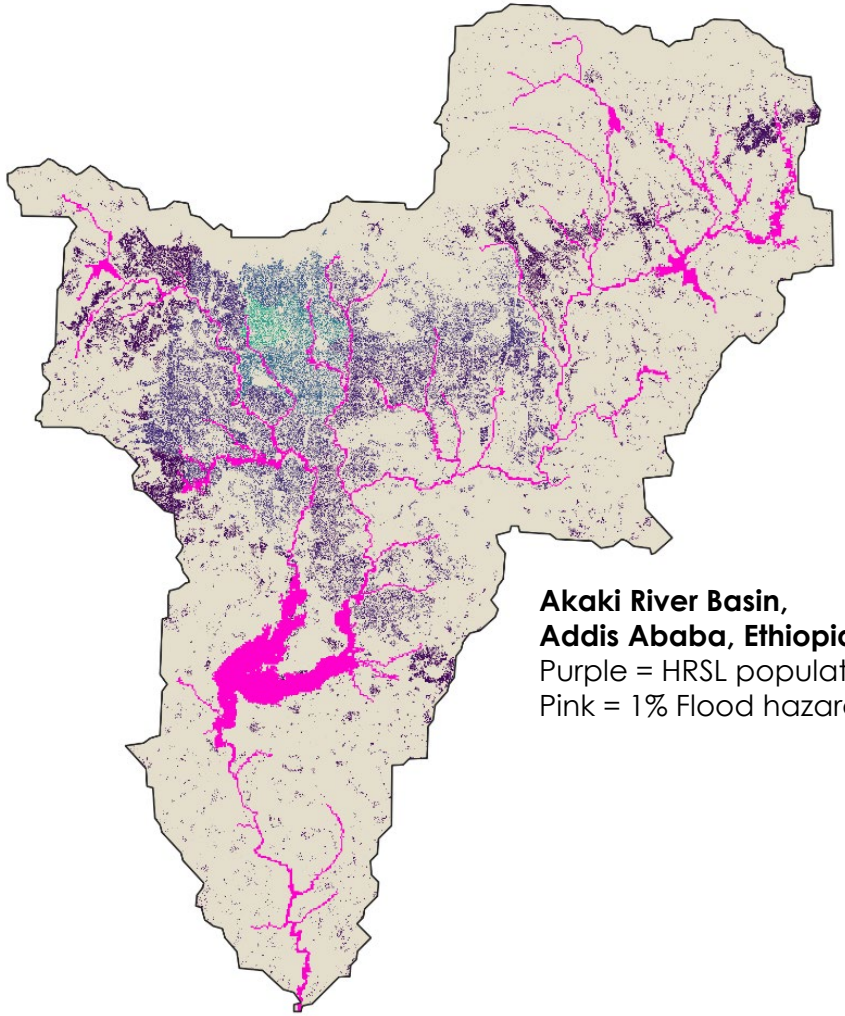


Trigg et. al. 2016. The credibility challenge for global fluvial flood risk analysis, ERL

Advances in Data Availability – Exposure Data Improvements

- Exposure data has also improved due to higher resolution remote sensing imaging and machine learning.

- Initiatives such as Humanitarian OpenStreetMap which are especially important for fusing local crowd sourced knowledge with high resolution remote sensing.

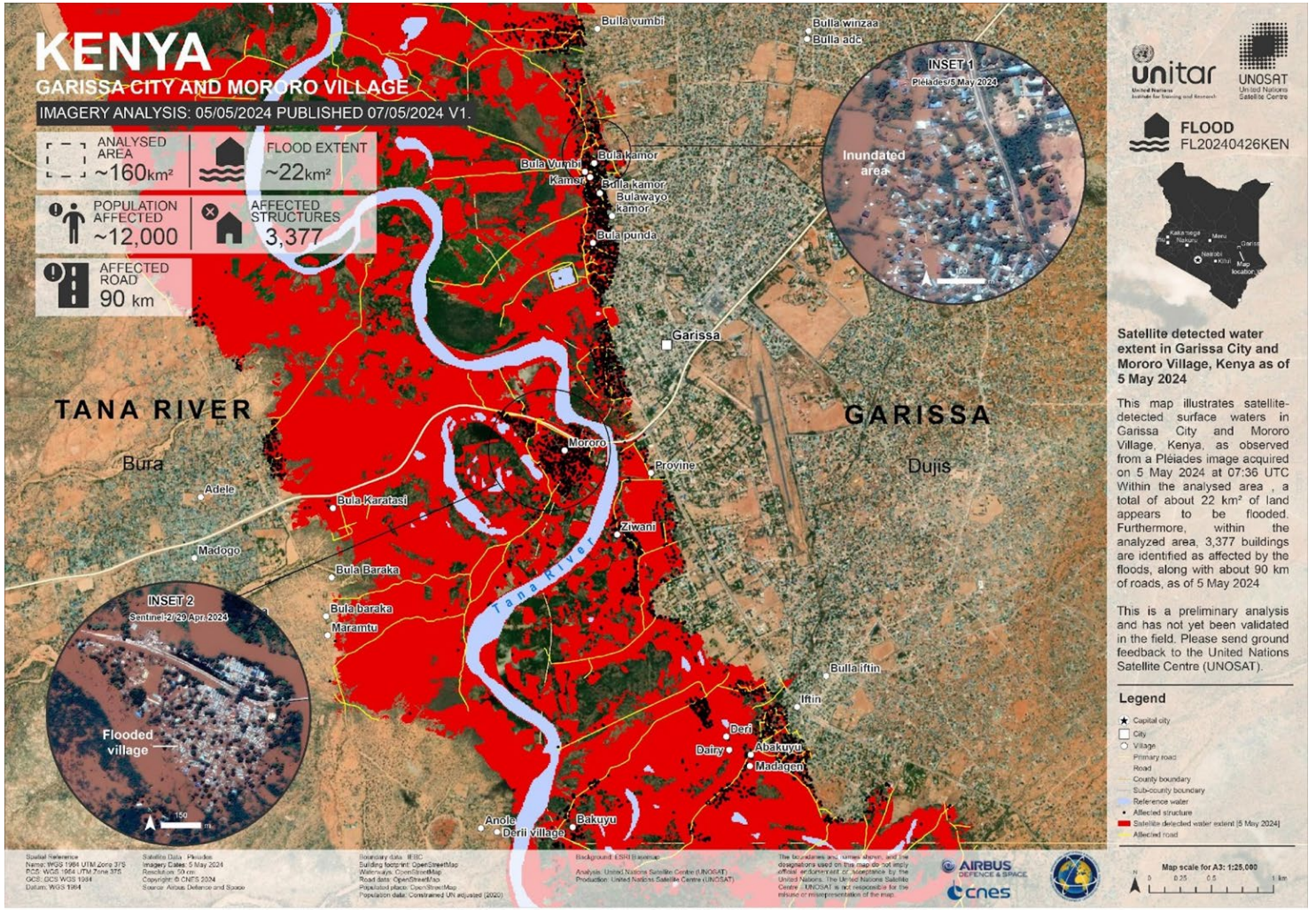


Akaki River Basin,
Addis Ababa, Ethiopia
Purple = HRSL population data
Pink = 1% Flood hazard probability

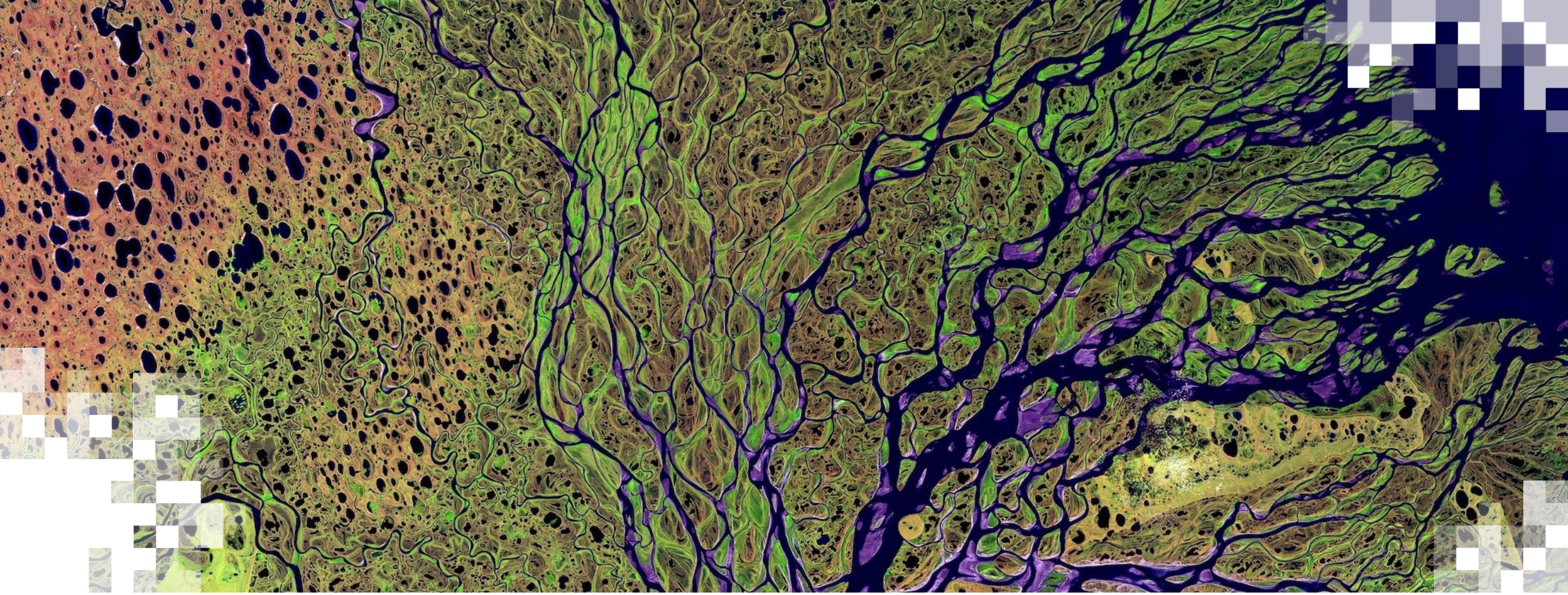
Bernhofen et. al. 2022. The role of global data sets for riverine flood risk management at national scales. Water Resources Research

Advances in Data Availability – Remote Sensing of Flooding

- Observations of flooding from space also play a crucial role.
- It allows the new hazard models to be validated against real events.
- Allows ongoing monitoring of flooding for disaster response and management.



Bernhofen et al. 2018. A first collective validation of global fluvial flood models for major floods in Nigeria and Mozambique. ERL



Question & Answer Session

ARSET Resources

- ARSET Website
- Online Resource Guide
- Fundamentals of Remote Sensing
- Earth Observations for Humanitarian Applications
- Introduction to NASA's "Black Marble" Night Lights Data
- Humanitarian Applications Using NASA Earth Observations
- Satellite Observations and Tools for Fire Risk, Detection, and Analysis
- An Introduction to Synthetic Aperture Radar (SAR) and Its Applications
- Earth Observations Toolkit for Sustainable Cities and Human Settlements
- Earth Observations for Monitoring the UN Sustainable Development Goals
- Satellite Remote Sensing for Measuring Urban Heat Islands and Constructing Heat Vulnerability Indices

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Thank You!