First Technical meeting on Human Settlements Indicators for SDGs
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Techniques for measuring Street Connectivity

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Introduction

- Well connected street network
  - Many short links / numerous intersections.
  - Few cul-de-sacs.
  - Balance between the street network length and the streets width.
- Benefits
  - Encourages walking and cycling
  - Better infrastructures and public services
  - More efficient public transport
  - Less use of individual transport
  - Less traffic jams
  - Less pollution
  - More livable cities

Introduction

- Some connectivity Indicators
  - Land Allocated to Streets (%)
  - Street Density (Km/Km2)
  - Intersection Density (#int/Km2)
  - Average Block Size (Hec)
  - Walkability Ratio

Introduction

- Street Connectivity benchmark (CPI Methodological Guide)
  - Land Allocated to Streets: 36%
  - Street Density (Km/Km2): 20 Km/Km2
  - Intersection Density (#int/Km2): 100 int/Km2

Methodology

1. Delimitation of the Built-up Area [1]
2. Sampling [2]
3. Calculation of aggregated metrics [2]
4. Assessment of the degree of confidence [2]
5. Calculation of disaggregated metrics and aggregated metrics excluding Open Space

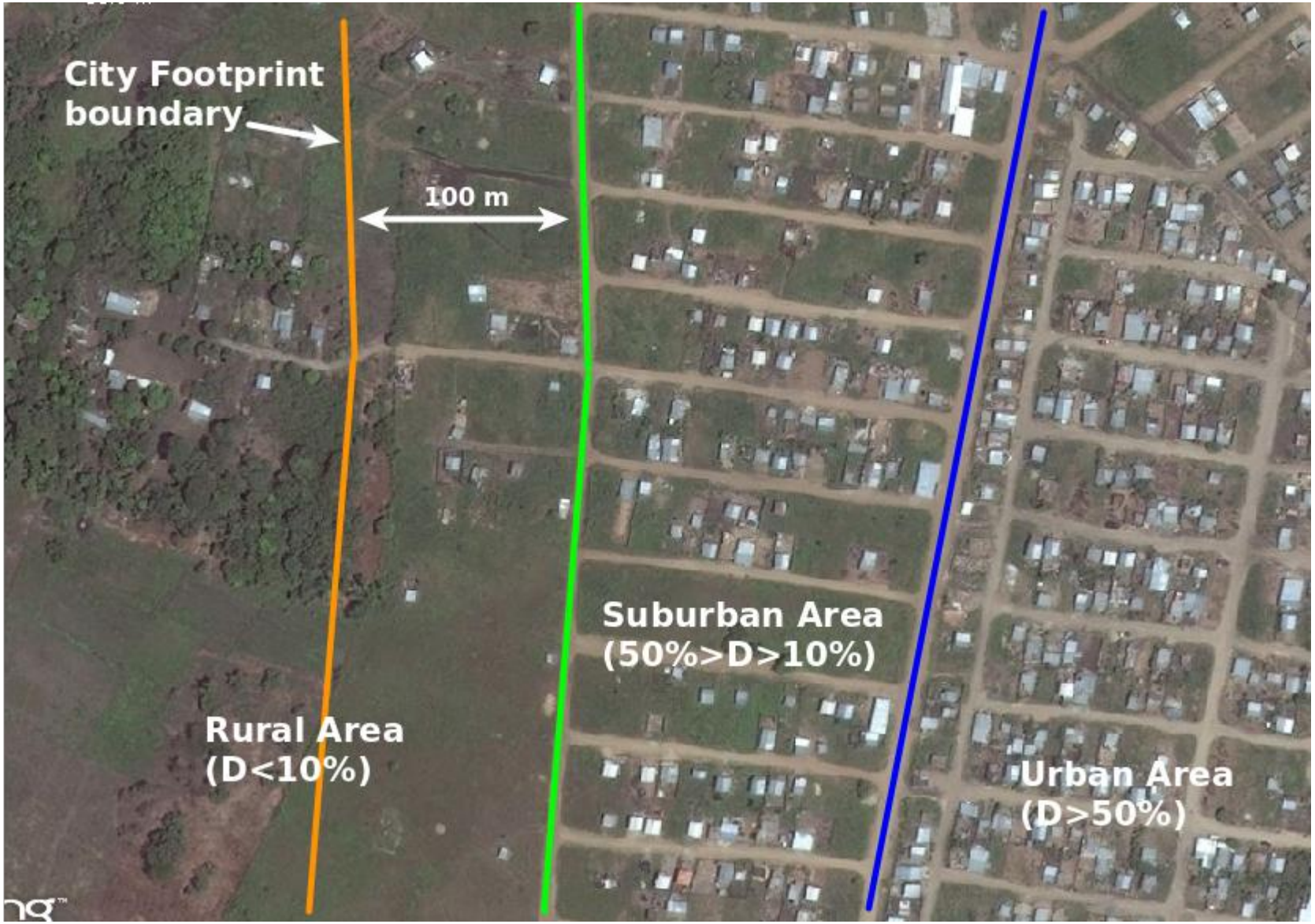
[1] Based on the methodology used in Angel et al., Atlas of Urban Expansion, Lincoln Institute of Land Policy, 2012.

[2] Based on the methodology used in Angel et al., Atlas of Urban Expansion—2016 Edition, Volume 2: Block and Roads, New York: New York University, Nairobi: UN-Habitat, and Cambridge, MA: Lincoln Institute of Land Policy, 2016.

1. Delimitation of the Built-up Area

- Definition of “city footprint” given in “Atlas of Urban Expansion” (Angel et al., Lincoln Institute of Land Policy, 2012): The total area occupied by the built-up area of the city and its urbanized open space
  - Built-up areas
    - Urban
    - Suburban
    - Rural
  - Urbanized Open Spaces
    - Fringe open space
    - Captured open space

1. Delimitation of the Built-up Area



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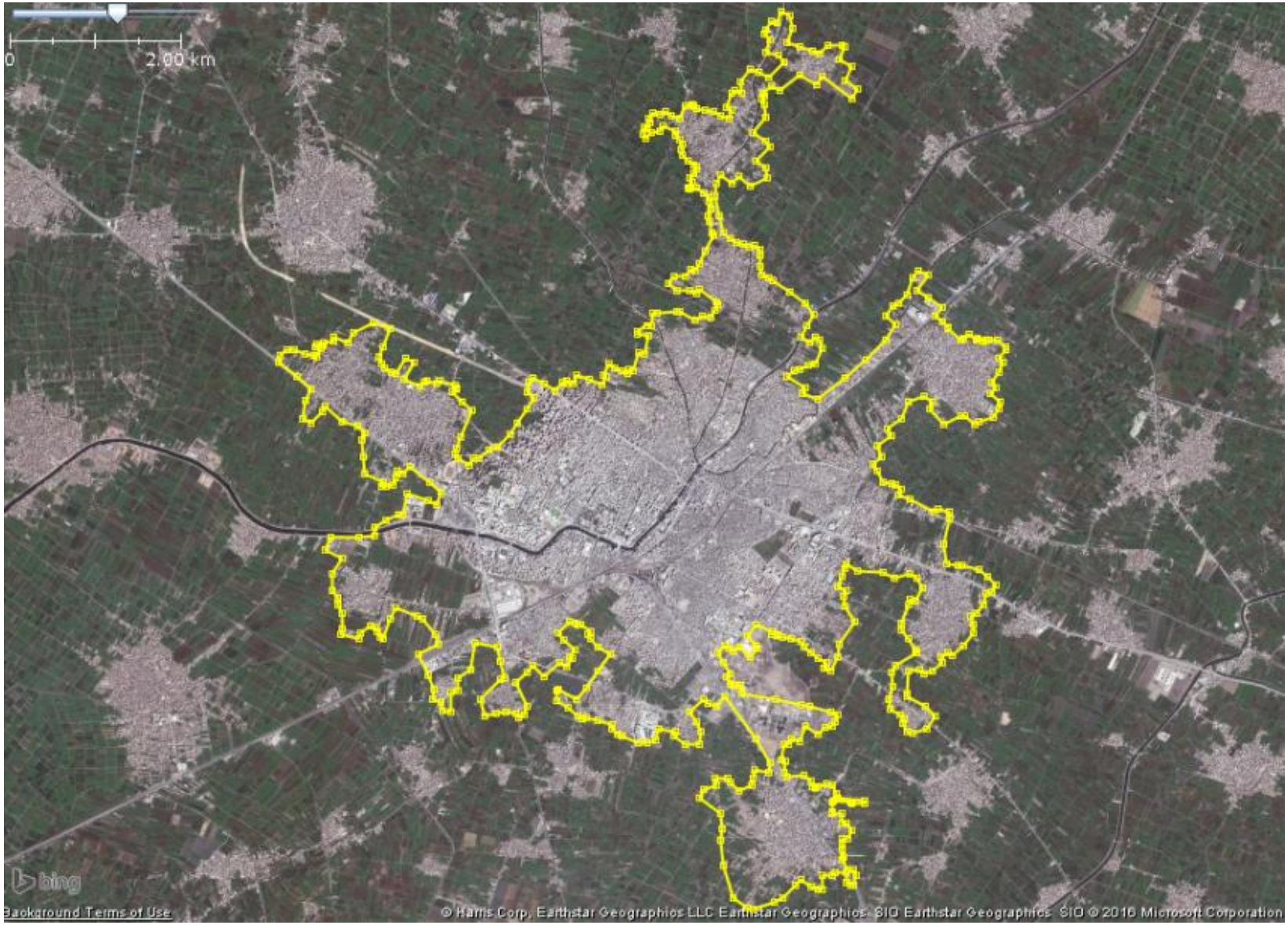

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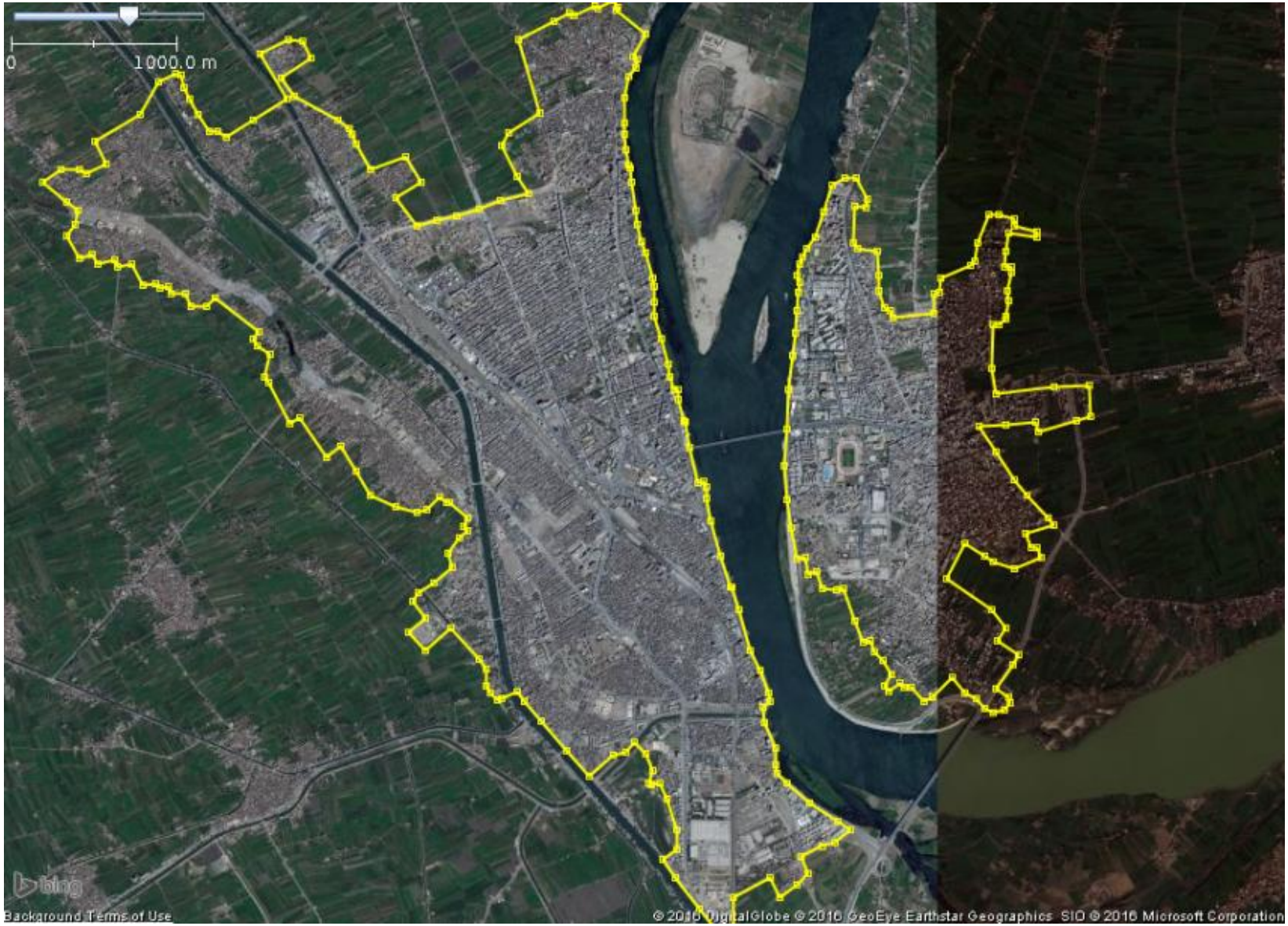
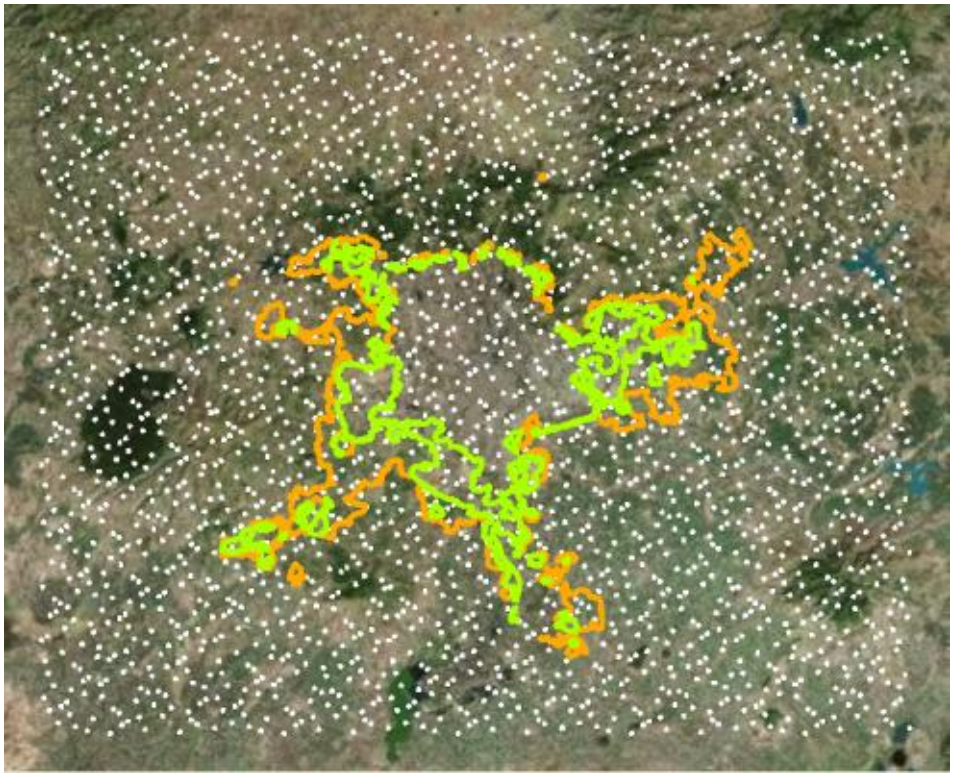
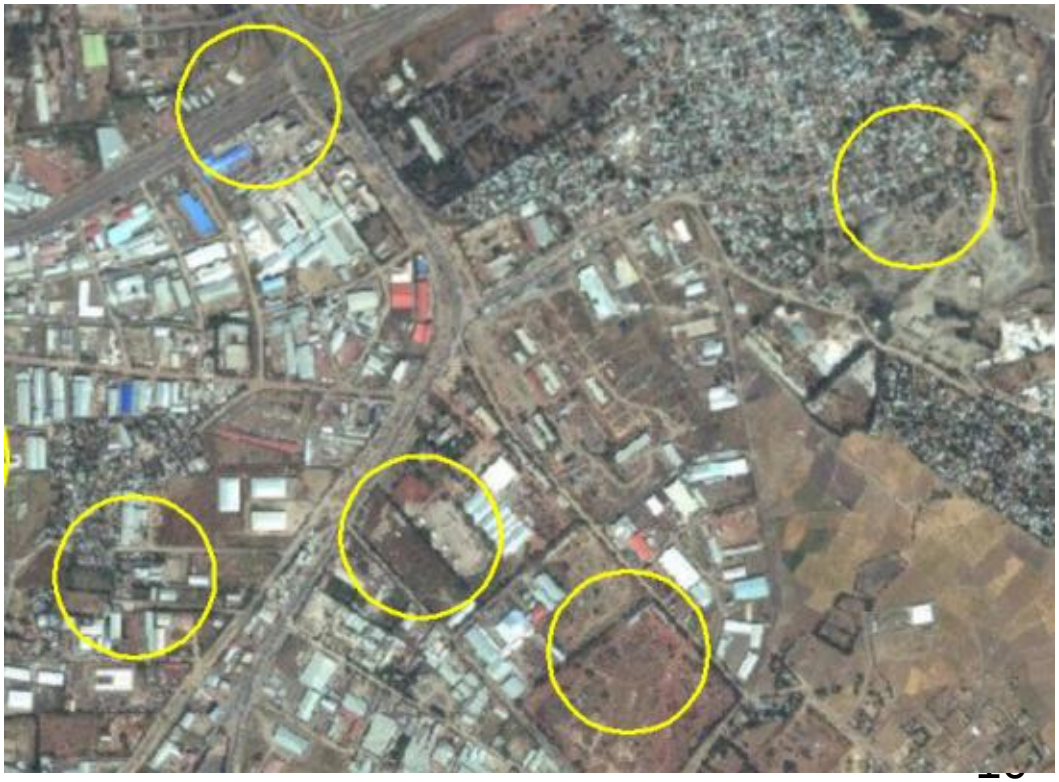


2. Sampling

- Halton sequence (quasi-random set of points)
- 10 Hectares circles





3. Calculation of aggregated metrics

- Digitization of block boundaries
  - Block space vs Street Space
  - Street Space:
    - Main purpose (current or potential) is mobility
    - Public Right of Way
    - It includes:
      - Carriage ways
      - One car park line on each side if the road
      - Sidewalks
      - Bike paths
      - Traffic islands
      - Median strips and green areas in the center of boulevards
      - Tram ways

3. Calculation of aggregated metrics

- Digitization of block boundaries

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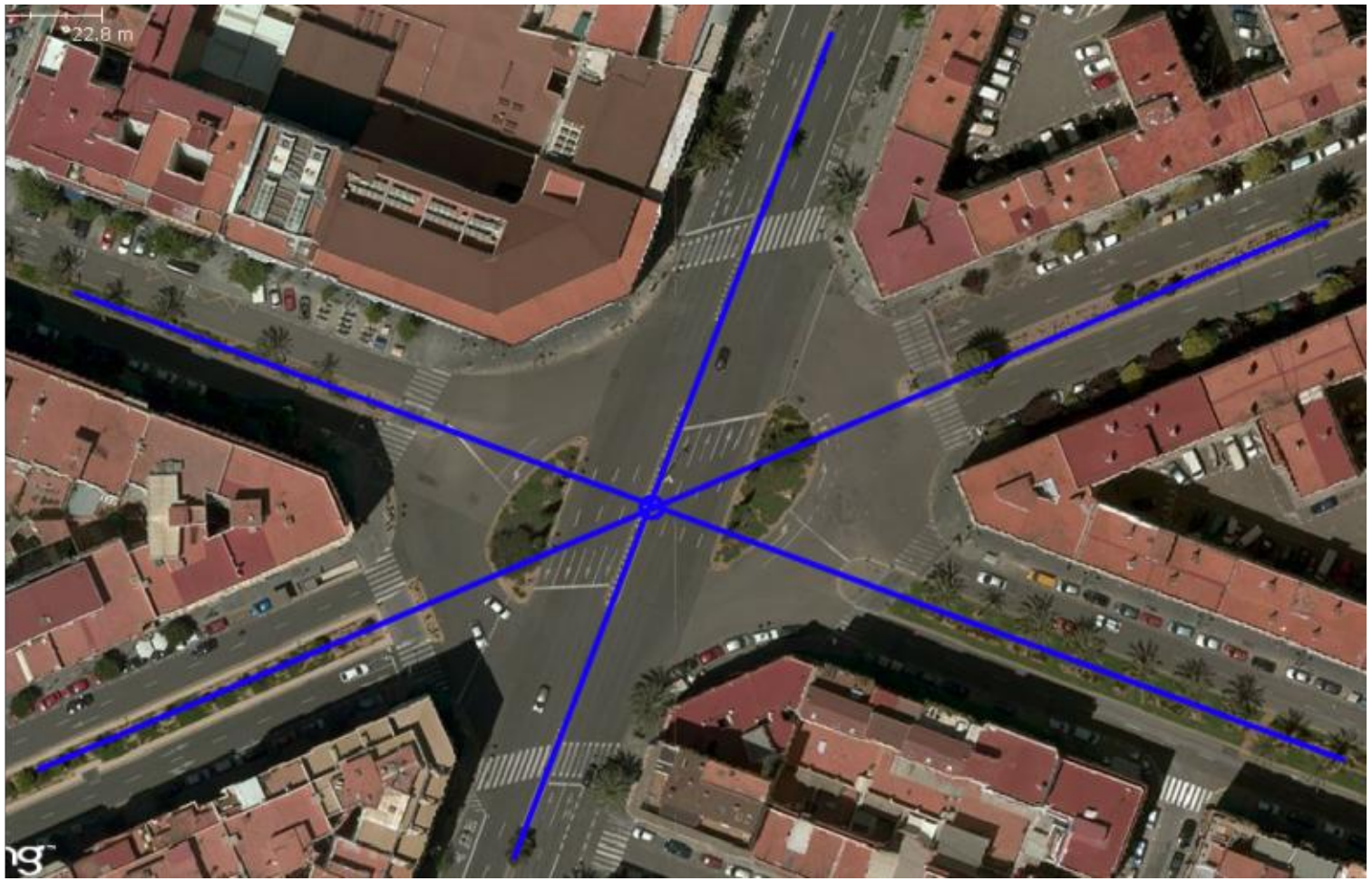
3. Calculation of aggregated metrics

- Digitization of street medians



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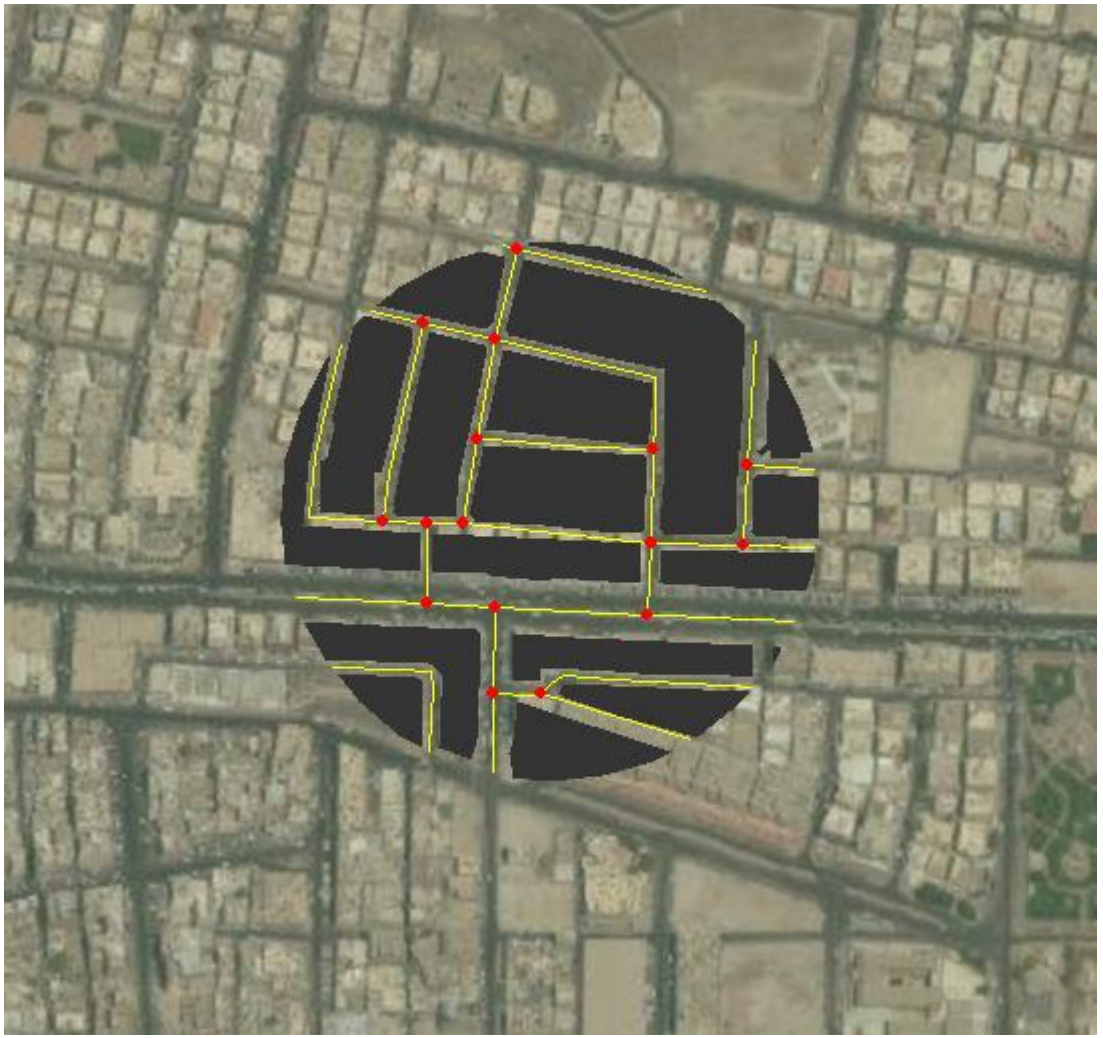
- Digitization of street medians

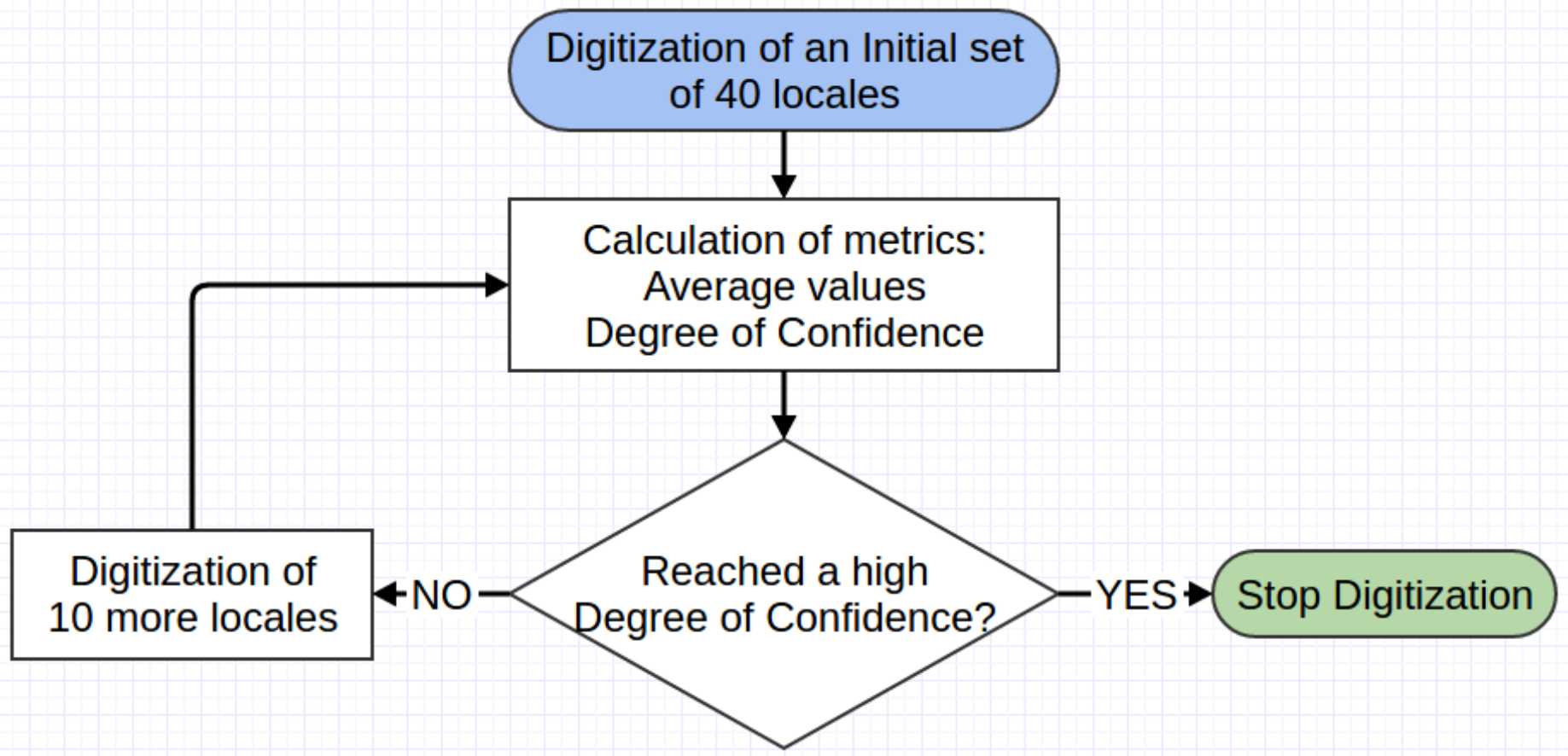


3. Calculation of aggregated metrics

- Formulas

Land Allocated to Streets	$LAS_{agg} = 100\left(1 - \frac{Blocks\ Total\ Area}{Locales\ Total\ Area}\right)$
Street Density	$SD_{agg} = \frac{Streets\ Total\ Length \cdot 1E\text{-}3}{Locales\ Total\ Area \cdot 1E\text{-}6}$
Intersection Density	$ID_{agg} = \frac{Total\ Number\ of\ Intersections}{Locales\ Total\ Area \cdot 1E\text{-}6}$

4. Assessment of the degree of confidence

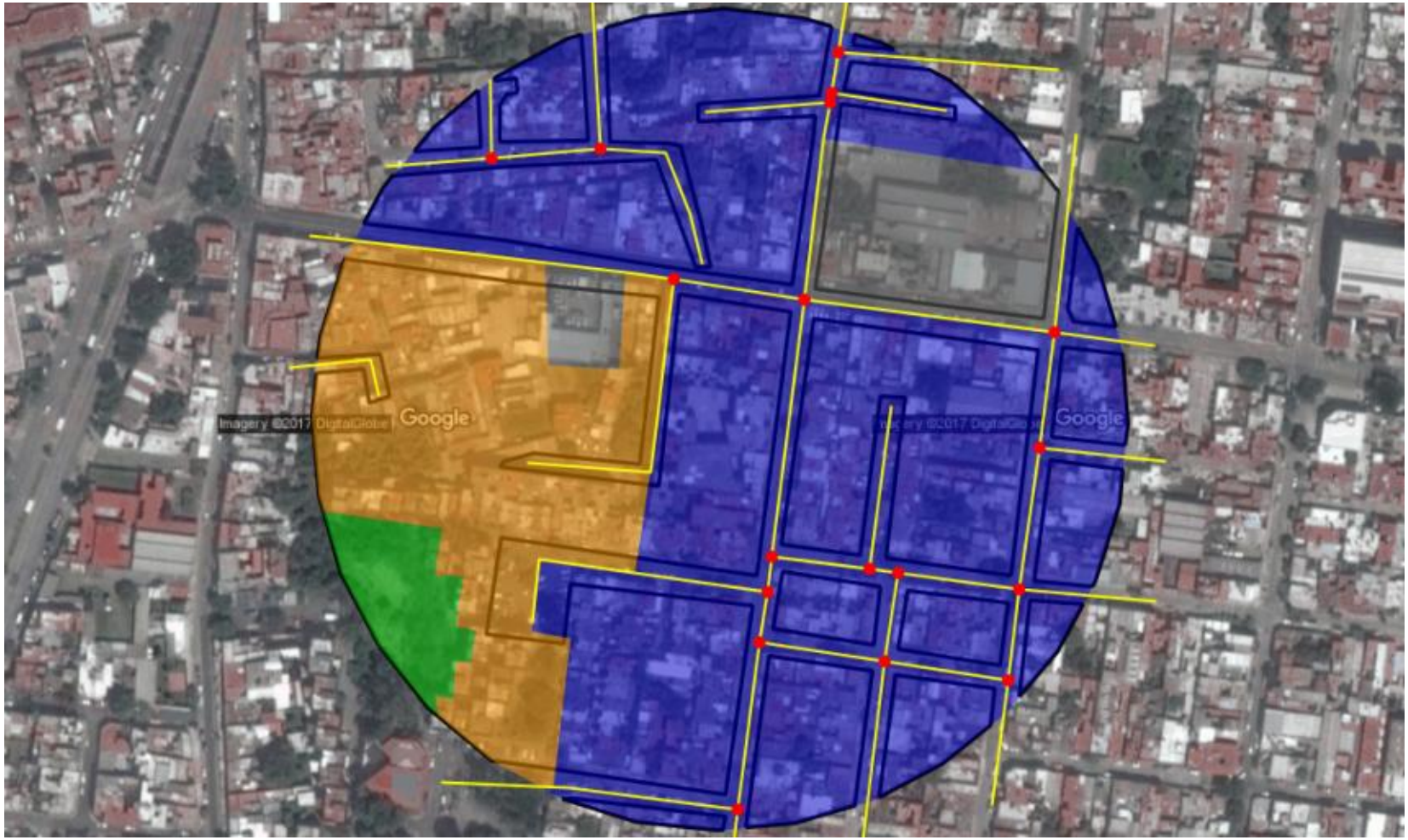


5. Calculation of disaggregated metrics and aggregated metrics excluding Open Space

- Variables
  - Land Use
    - Open Space
    - Non-Residential
    - Residential
      - Atomistic / organic (not laid-out)
      - Informal
      - Formal
      - Housing Project
  - Plot coverage
    - High
    - Medium
    - Low

5. Calculation of disaggregated metrics and aggregated metrics excluding Open Space

- Digitization of dividing lines



5. Calculation of disaggregated metrics and aggregated metrics excluding Open Space

- Formulas

Land Allocated to Streets	$LAS_{disagg} = 100\left(1 - \frac{Blocks\ Total\ Area \text{ in } the\ category}{Dividings\ Total\ Area \text{ in } the\ category}\right)$
Street Density	$SD_{disagg} = \frac{Streets\ Total\ Length \text{ in } the\ category \cdot \left(\frac{1}{2}\right) \cdot 1E\text{-}3}{Dividings\ Total\ Area \text{ in } the\ category \cdot 1E\text{-}6}$
Intersection Density	$ID_{disagg} = \frac{Total\ Number\ of\ Intersections \text{ in } the\ category}{Dividings\ Total\ Area \text{ in } the\ category \cdot 1E\text{-}6}$


Thank you for your attention!

References

- The relevance of street patterns and public space in urban areas, Nairobi: UN-Habitat, 2013.

  http://unhabitat.org/the-relevance-of-street-patterns-and-public-space-in-urban-areas/
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- Angel et al., Atlas of Urban Expansion, Lincoln Institute of Land Policy, 2012.

  http://www.lincolninst.edu/publications/books/atlas-urban-expansion
- Angel et al., Atlas of Urban Expansion—2016 Edition, Volume 2: Block and Roads, New York: New York University, Nairobi: UN-Habitat, and Cambridge, MA: Lincoln Institute of Land Policy, 2016.

  http://www.atlasofurbanexpansion.org