FIG WORKING WEEK 2023
28 May - 1 June 2023 Orlando Florida USA
Protecting Our World, Conquering New Frontiers

Presented at the FIG Working Week 2023,
28 May - 1 June 2023 in Orlando, Florida, USA

Geo-Data-based Policymaking:

National Tree Canopy Cover Example

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Outline

- Introduction
- National Tree Canopy Map Generation
- Tree Canopy Cover & Shade Maps
- Summary & Future Work

Introduction I

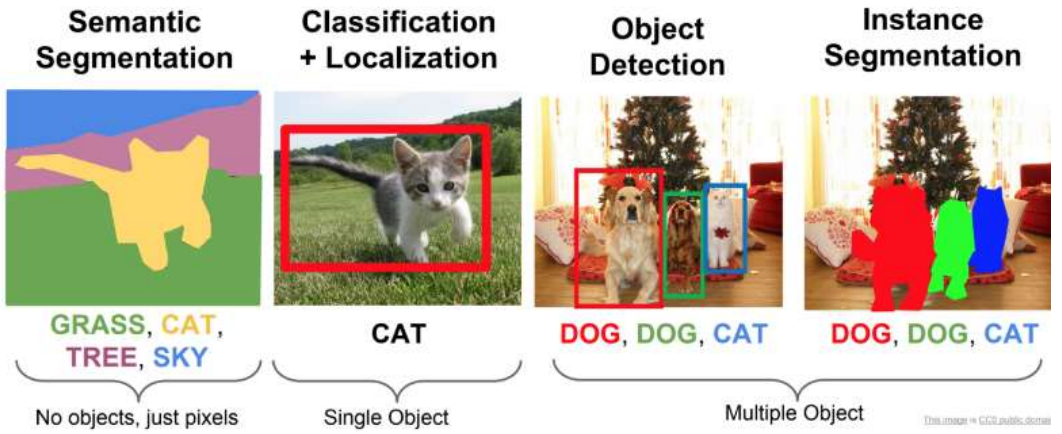
- Era of global challenges
- Data and Science-based decisions
- Geospatial data - facilitator of informed strategies
- Climate Change – global cause of concern
- **Cities** and **Urban concentrations** – mostly affected by climatic transformation
- Urban Heat Island – UHI

Introduction II

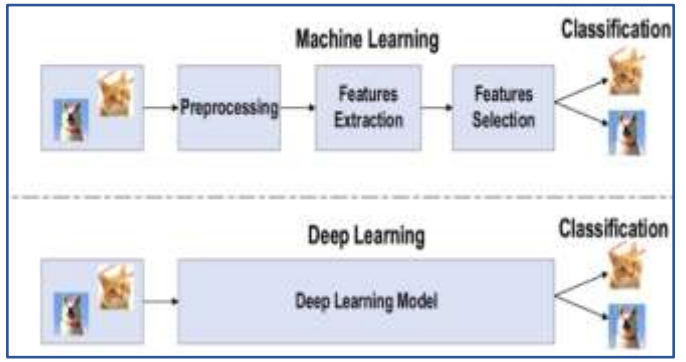
- Urgent need for urban-scale adaptation solutions
- **Urban forest** – key ***heat mitigation*** measure
  - *Shade-giving trees*
  - *Critical resource and infrastructure to be preserved and expand*
  - *Solar radiation absorption*
  - *Heat mitigation – urban forestry plans*
- High resolution systematic ***Tree Canopy Cover*** (TCC) mapping

National Tree Canopy Map Generation I

- Government Decision 1022
  - *Shading and cooling of urban space using trees*
  - *Urban Forest Inventory*
  - *Tree Canopy Cover (TCC) calculation*
  - *Preparation of Operational Plan by local authorities*
- TC & TCC production for cost estimation by ***Survey of Israel***
  - *Top-down approach for UTC assesment based on DL techniques*
  - *Transfer Learning (U-net Convolutional Neural Network pretrained on IMAGENET)*
  - *Semantic Segmentation method*



Detection, Classification vs. Segmentation



Deep learning vs. Traditional Machine Learning (Alzubaidi et. al., 2021)

National Tree Canopy (TC) Map Generation II

❖ Mask Production

- *Orthophoto tiles – manual digitization of TC*
- *Masks dataset – rasterization of vector data* *(GDAL library)*
- *SOI Orthophoto*
  - ✓ *20 cm per pixel*
  - ✓ *4 bands (RGB + NIR)*

Orthophoto → Digitization → Mask

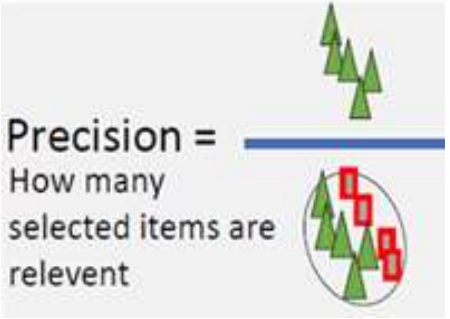
❖ Training Set

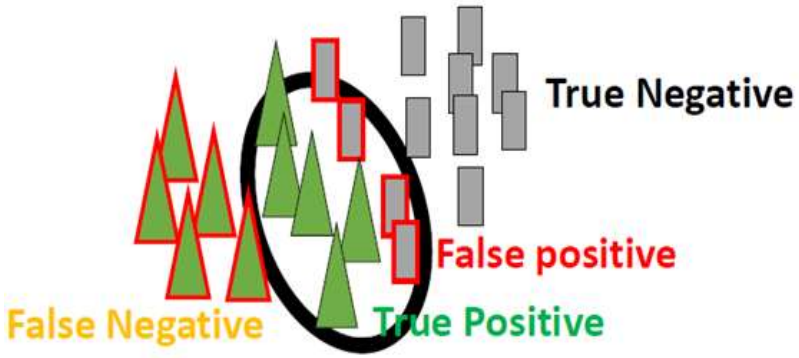
- *Pairs of orthophoto tiles + B&W masks*
- *RGB bands were used*

Image Folder + Masks Folder = *Training Set*

National Tree Canopy Map Generation III

- Prediction
  - *New raster image*
  - *Manual quality control – ground truth*
  - *Precision rate 96%*





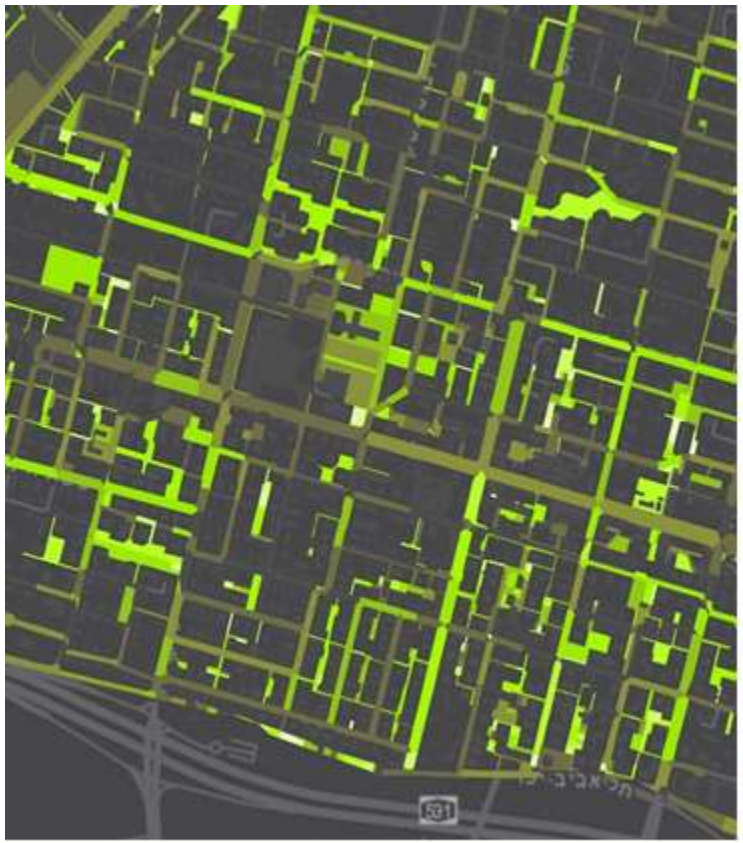
$$Precision = \frac{True\ Positive}{All\ Predicted\ Positives} * 100\%$$

$$Precision = \frac{TP}{TP + FP} * 100\%$$

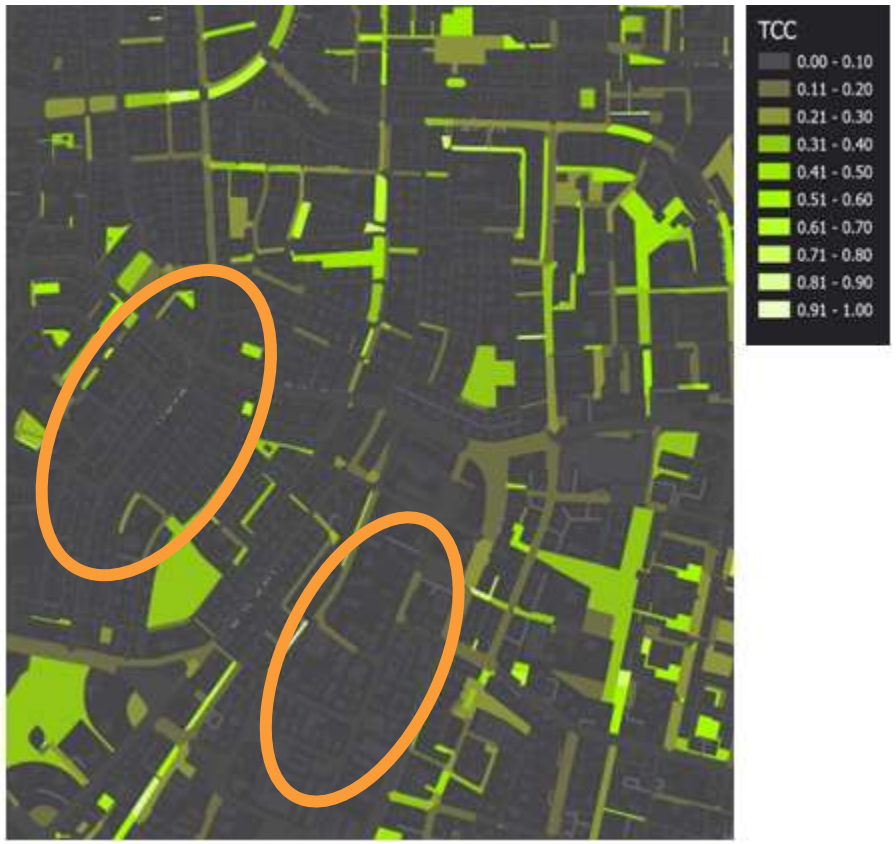
Tree Canopy Cover & Shade Maps I

❖ Street Tree Canopy Cover

- *TCC ratio*
  - ✓ *[0 to 1] scale – **TC** total **projection** area/the **total area** of the same space (segment)*
- *Important tool for planning future tree planting and urban forestry management*
- *Indicator of street-level shade originating from trees*



Kefar Saba
High TCC



Bat Yam
Low TCC

Tree Canopy Cover & Shade Maps II

$$SI_p = 1 - \left(\frac{Insolation_p}{Insolation_r}\right)$$

❖ Shade Index - SI

- *Quantitative evaluation of shade provision*
  - ✓ *[0 to 1] scale – **blocked** insolation at ground level/max insolation of an **unobstructed** horizontal surface (reference)*
- *Considers all urban elements that cast shadow*
  - ✓ ***Trees***
  - ✓ ***Buildings***
  - ✓ ***Other major objects***

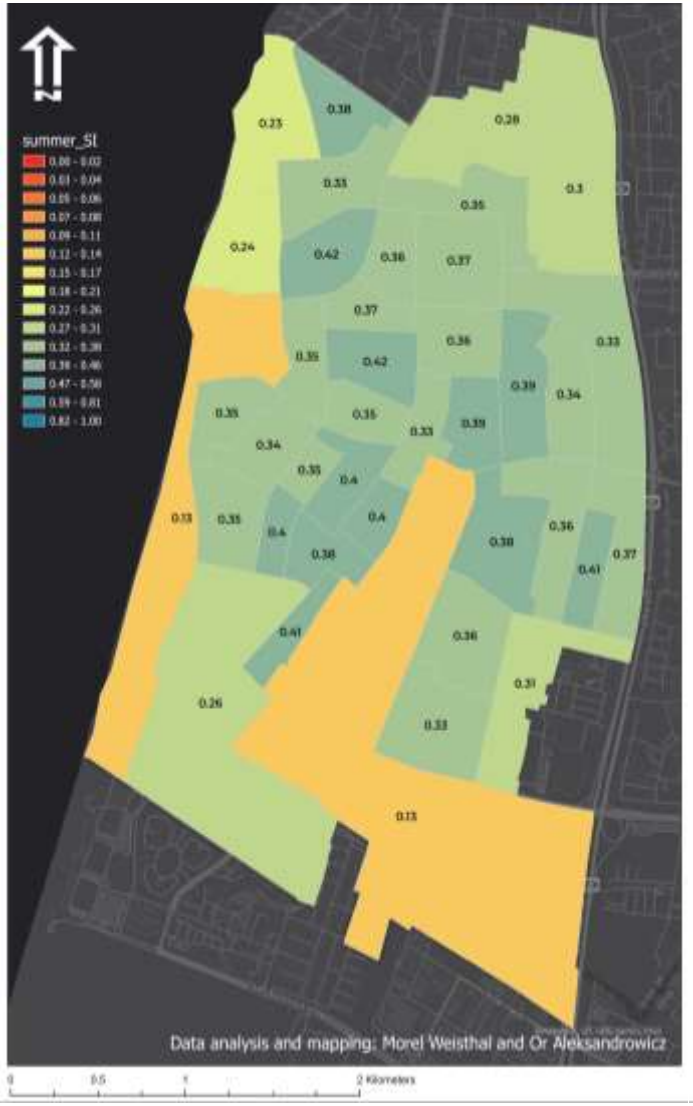
Be'er Sheva
Low SI

Akko
Low SI

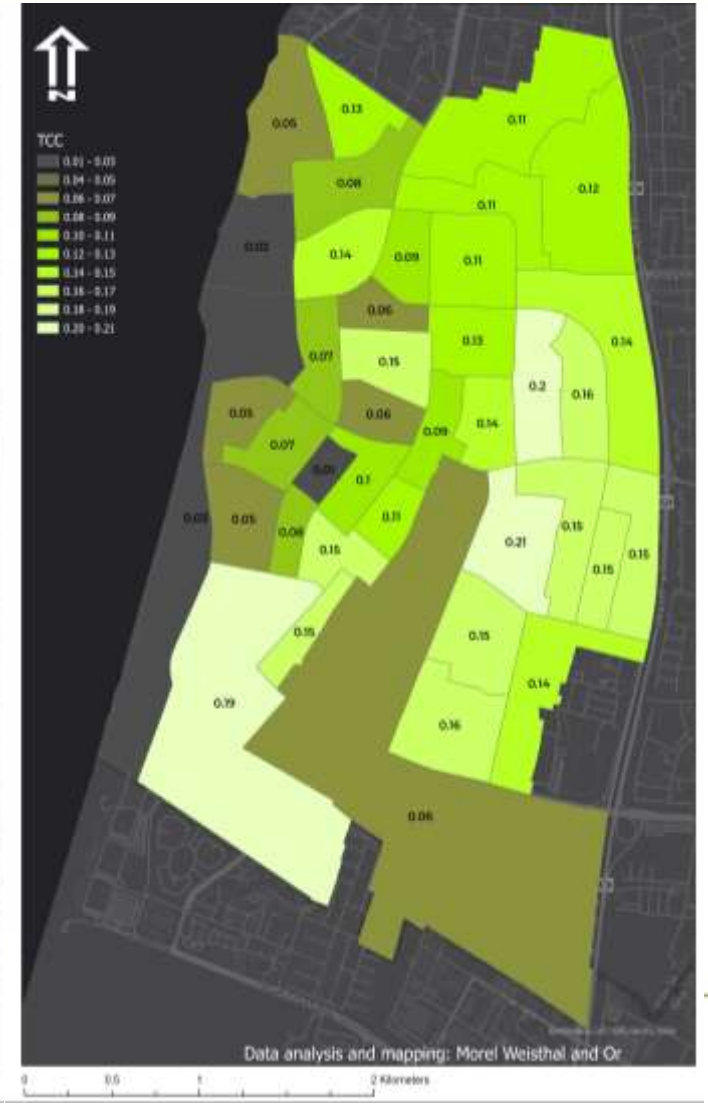
Tree Canopy Cover & Shade Maps III

- Neighborhood Shade Index and TCC mapping
  - *Shade Index vs. Tree Canopy Cover maps Comparison*
  - *Trees availability & outdoor shade correlation*

Bat Yam



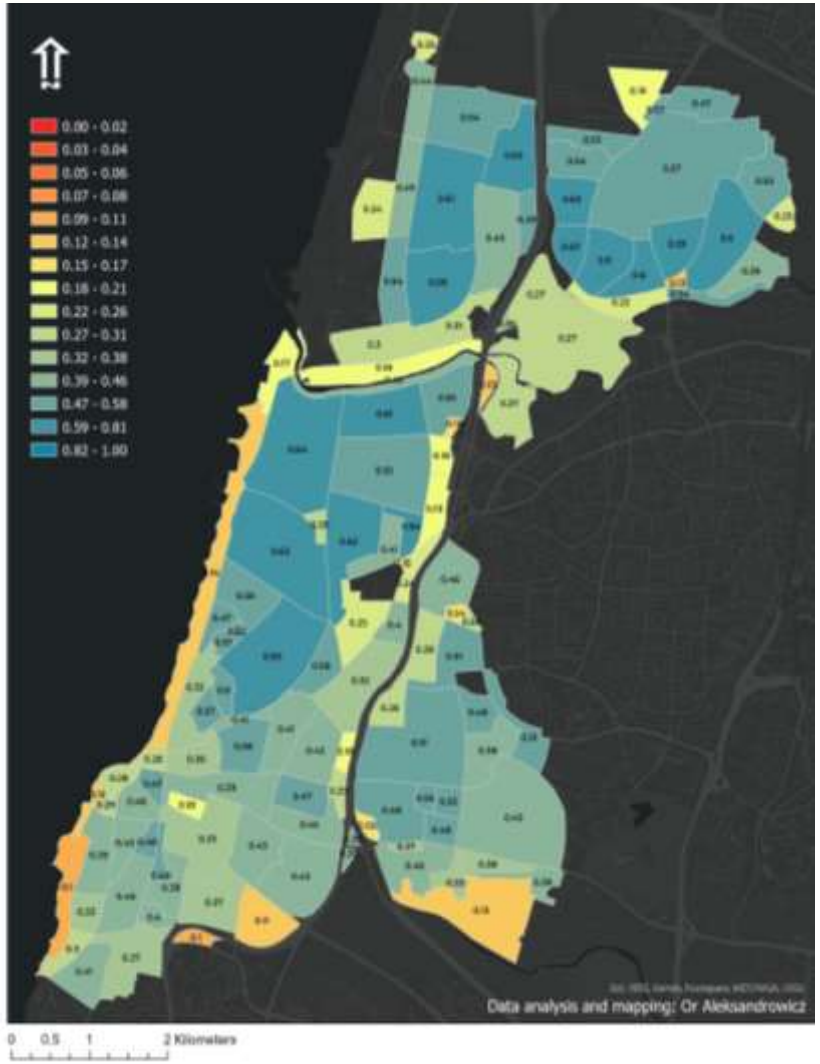
Shade Index



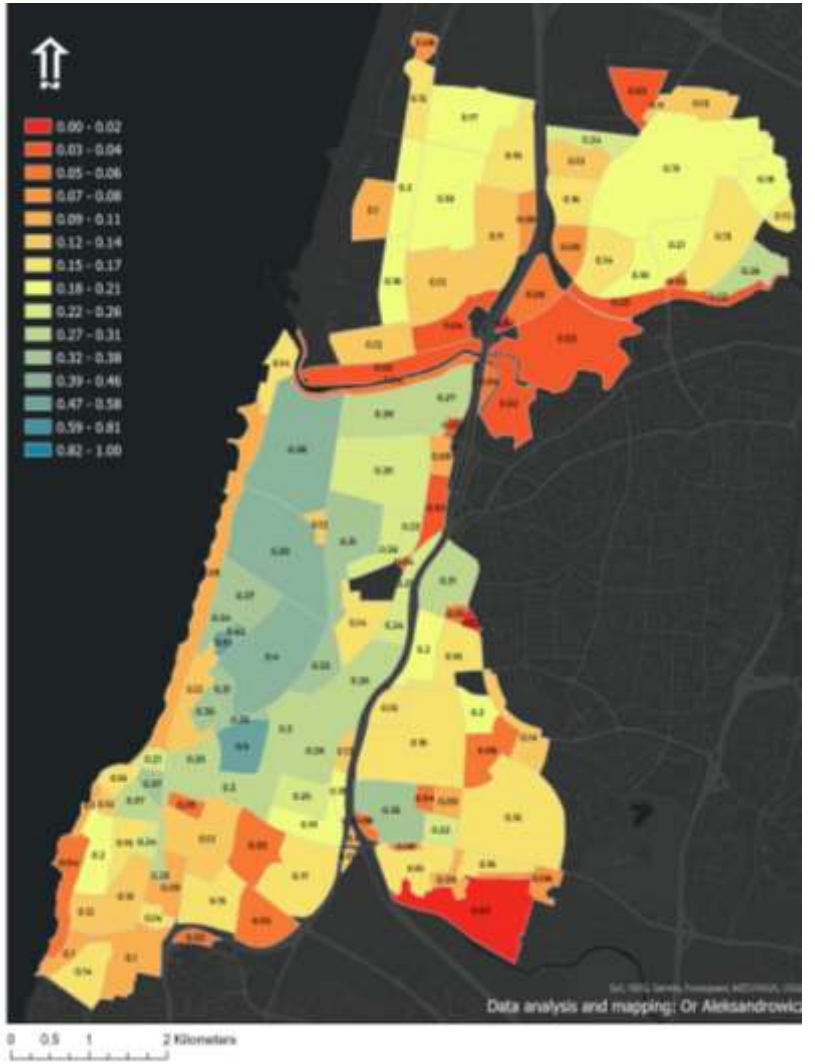
Tree Canopy Cover

Tree Canopy Cover & Shade Maps IIII

- Neighborhood-level Shade Index mapping
  - *Shading effect of trees*
  - *Exclusion of trees from SI calculation is facilitated by the comprehensive tree canopy mapping*



SI inc. Trees



SI excl. Trees

Summary & Future Work

- **Geodata** holds an enormous potential in addressing the negative effects of climate change
- **Informed** and **knowledge-based** decisions
- Fine-tuning of the TC algorithm
- **National TCC & Shade** maps (**SI**)
- Tree Planting Potential research
- **Digital Platform** – urban planting scenarios

- Tree Canopy and TCC maps - SOI

https://www.govmap.gov.il/sites/Tree1022.html

Afeka Rich neighbourhood

Rishon

Poor

neighbourhood