MUSA 6950 AI for Urban Sustainability

Final Project - Deep Learning-Based Mapping of Urban Heat Risk in Summer: A Case Study of Philadelphia

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Background

With the increasing frequency and intensity of heatwaves, urban heat risk has become a growing threat to human health, especially in densely built urban environments. The Urban Heat Island (UHI) effect exacerbates local temperatures due to surface characteristics such as imperviousness, vegetation loss, and lack of water bodies. Identifying and predicting spatial heat risk patterns is essential for informed urban planning and heat mitigation strategies.

Research Goal

Build a 30m resolution heat risk level model based on the LULC index and deep learning to provide scientific decision-making assistance for urban planning.

Study Area

Philadelphia

Data Source

- Landsat 8 images
- Philadelphia administrative boundary

Methods

1. Data Preprocessing
    - Download Landsat 8 images (cloud free, June- August)
    - Clip the image to the Philadelphia boundary
    - Calculate **LST** from Band 10 and resample LST from 100m to 30m resolution
    - Detrive LULC index from surface reflectance bands (**NDVI, NDBI, MNDWI, SAVI)**
    - Ensure all index rasters and LST are aligned and have the same resolution and extent.
2. Label Creation
    - Convert continuous LST to categorical **heat risk levels** (high, medium, low)
    - Treat this as a **multi-class classification problem**, Y is heat risk level, and X is the four LULC index
3. Model building and Evaluation
    - train test split
    - Use CNN to build the model. This study draws on the CNN structure introduced by Fu et al. (2024).
    - Evaluate model performance

Outcome

- Apply the trained model to generate a **heat risk level prediction map**.
- Compare the predicted risk map with the actual LST-derived map to analyze consistency and potential errors.

References

Fu, S., Wang, L., Khalil, U., Cheema, A. H., Ullah, I., Aslam, B., Tariq, A., Aslam, M., & Alarifi, S. S. (2024). *Prediction of surface urban heat island based on predicted consequences of urban sprawl using deep learning: A way forward for a sustainable environment. Physics and Chemistry of the Earth, Parts A/B/C, 135*, 103682. https://doi.org/10.1016/j.pce.2024.103682