**PROJECT-BRIEF**

**Title:**

*"Is My City Getting Hotter? A Satellite-Based Study of Urban Heat Islands in Nuremberg"*

To measure and analyze the spatial intensity of urban heat across Nuremberg, and to identify urban hotspots associated with the Urban Heat Island (UHI) effect.

**Objectives:**

* To extract and map land surface temperature (LST) from satellite thermal bands for selected summer days.
* To identify and measure UHI intensity, defined as the temperature difference between urban and surrounding rural areas.
* To detect urban heat hotspots and analyze their spatial distribution across Nuremberg.
* To explore how land cover affects temperature intensity using NDVI and NDBI indices.

**Research Methods:**

1. Study Area Selection:

* City: Nuremberg, Germany (Source: Collect ready data/GADM maps/Digitization)
* Extent: Urban boundaries + 5 km radius surrounding rural buffer zone

1. Satellite Data Collection:

| Source | USGS Earth Explorer |
| --- | --- |
| Satellite | Landsat 8 OLI/TIRS |
| Dates | Summer months (July–August, September 2013-2025) |
| Bands Used | Thermal bands, Red, NIR, SWIR |

1. Data Processing, Analysis, and Mapping:

| **Tools** | **Usage** |
| --- | --- |
| QGIS/ArcGIS | Data ProcessingDefine Urban and Rural Areas Data Calculation Mapping and Visualization |
| RStudio | Analyze Spatial and Temporal ChangesExplore RelationshipMapping and Visualization |

**TIMEFRAME**

| **Required Time** | **Tasks** | **Deliverables** |
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| **Phase 1: Project Setup & Literature Review** | | |
| 4 weeks  (end of July) | * Conduct literature review on UHI, satellite-based LST, NDVI, and NDBI. * Set up software (QGIS, RStudio) and ensure compatibility. * Identify and verify access to USGS Earth Explorer for Landsat 8 data. | * Literature review summary (key findings on UHI and methods). * Software setup confirmation. * Draft research protocol. |
| Phase 2: Data Collection and Preparation | | |
| 2 weeks (mid-August) | * Download Landsat 8 OLI/TIRS data for July–August (2013–2025) from USGS Earth Explorer. * Select cloud-free images for thermal, red, NIR, and SWIR bands. * Define study area boundaries (Nuremberg + 5 km rural buffer) in QGIS. | * Dataset of Landsat 8 images (2013–2025, summer months). * Dataset of shapefiles |
| **Phase 3: Data Preprocessing** | | |
| 4 weeks (mid-September) | * Preprocess satellite imagery (radiometric calibration, atmospheric correction). * Clip all rasters to Nuremberg + 5 km rural buffer zone * Extract LST from thermal bands using QGIS/RStudio. * Calculate NDVI and NDBI indices to assess vegetation and built-up areas. * Validate preprocessing steps with sample data. | * Preprocessed satellite imagery dataset. * Preliminary LST, NDVI, and NDBI maps. |
| **Phase 4: UHI Intensity and Hotspot Analysis** | | |
| 3 weeks  (Early October) | * Calculate UHI intensity (urban vs. rural LST differences) for each year. * Identify urban heat hotspots using spatial analysis in QGIS. * Map hotspot distribution across Nuremberg. * Perform initial statistical analysis in RStudio | * UHI intensity dataset (2013–2025). * Hotspot distribution maps. * Preliminary statistical summary. |
| **Phase 5: Land Cover and Temporal Analysis** | | |
| 3 weeks  (end of October) | * Analyze the relationship between land cover (NDVI, NDBI) and LST using regression in RStudio. * Assess temporal changes in UHI intensity (2013–2025). * Validate findings with cross-year comparisons. * Refine maps and visualizations in QGIS. | * Correlation analysis report (land cover vs. LST). * Temporal trend analysis (UHI changes over time). * Finalized QGIS maps (LST, NDVI, NDBI, hotspots) |
| **Phase 6: Mapping & Interpretation** | | |
| 3 weeks  (late-November) | * Finalize maps: LST, UHI intensity, NDVI/NDBI overlays, heat hotspots * Interpret spatial patterns: which zones are warming fastest? * Compare built-up vs. vegetated areas * Highlight vulnerable regions | * Draft research report. * Finalized visualizations (maps, graphs). |
| **Phase 7: Writing, Finalization, and Submission** | | |
| 5 weeks  (End of December) | * Finalize research report with conclusions and recommendations. * Prepare presentation. * Cite all references. * Proofread, format, and finalize the report. * Submit the report to StudOn | * Final research report. * Presentation. |