# Progress Report

This analysis investigates whether embeddings generated from Sentinel-2 imagery through the Clay Foundation Model can effectively model urban growth in Johnston County, North Carolina, over time. Johnston County, located near the Raleigh-Durham-Chapel Hill area, spans approximately 2,050 square kilometers and provides a relevant setting for studying urban expansion due to rapid growth in the surrounding region. Sentinel-2 imagery, acquired from 2016 to 2024 at regular intervals, was accessed via the Microsoft Planetary Computer STAC API, offering high-resolution data essential for generating embeddings that capture both spatial and temporal features. Urban imperviousness data from the National Land Cover Database (NLCD) was also obtained for 2016. To ensure consistent spatial resolution, each Sentinel-2 image was divided into 600x600 meter tiles aligned with the NLCD data.

In the data processing stage, the Clay Foundation Model produced embeddings for each tile across 20 distinct dates, capturing both spatial and temporal patterns in urban growth. These embeddings were combined with corresponding NLCD urban imperviousness values to build a structured dataset for modeling urban density over time. The anticipated outcomes include maps that reveal areas of significant urban growth within Johnston County. By integrating Clay embeddings with traditional imperviousness data, this approach offers an enhanced capability to analyze urban expansion patterns. An additional benefit of this model is its potential to estimate urban growth solely from satellite data, enabling more granular temporal analysis, as NLCD data updates occur only every 4–5 years. Challenges included variability in image availability across tiles for specific dates, requiring the use of a date buffer to iteratively exclude dates where imagery was unavailable within a defined threshold.

