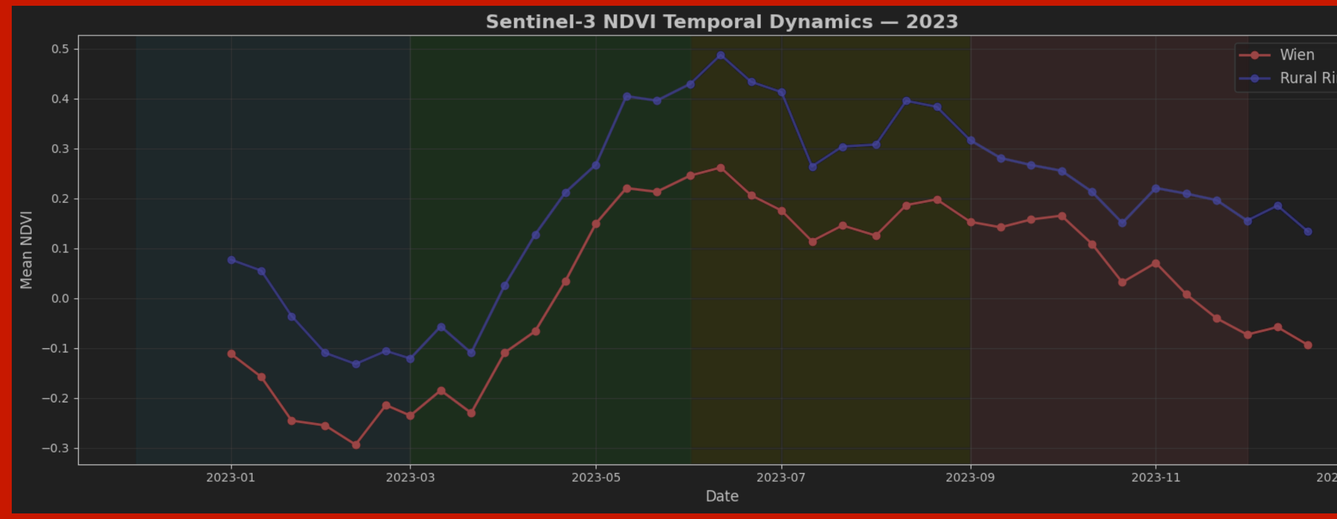
LATENT-SPACE [16]

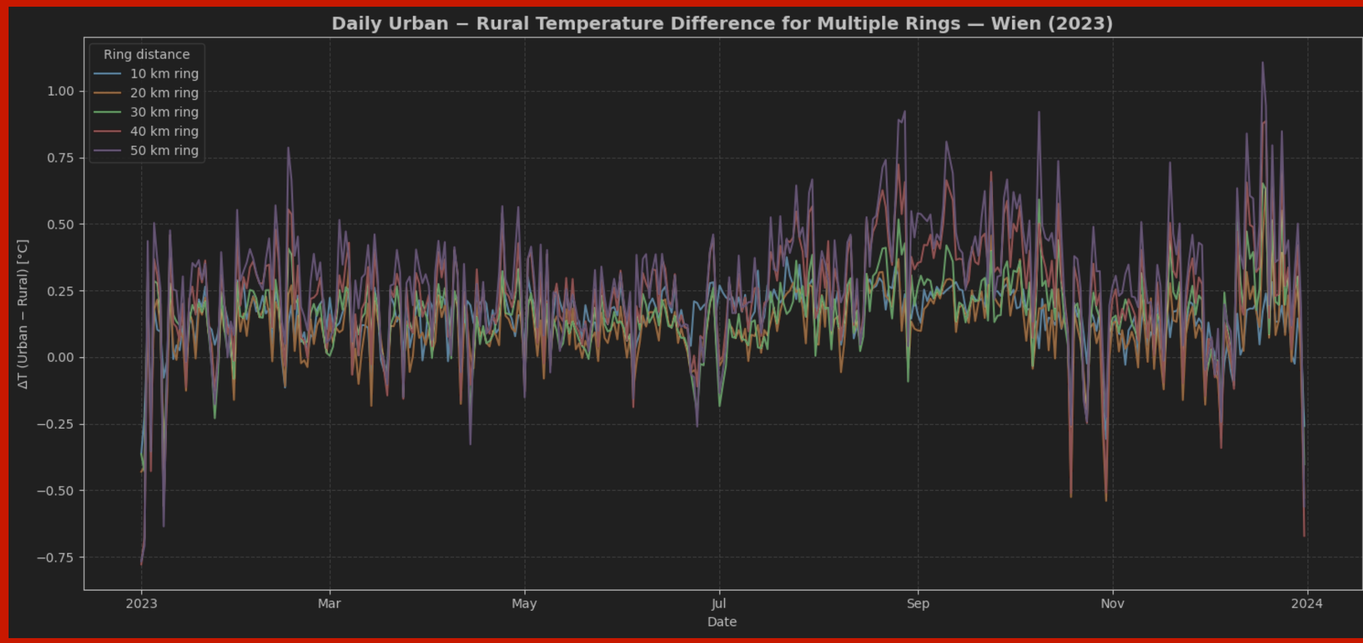
QUANTITATIVE INSIGHTS FOR URBAN HEAT ISLAND – WEEK 3 [GENHACK]

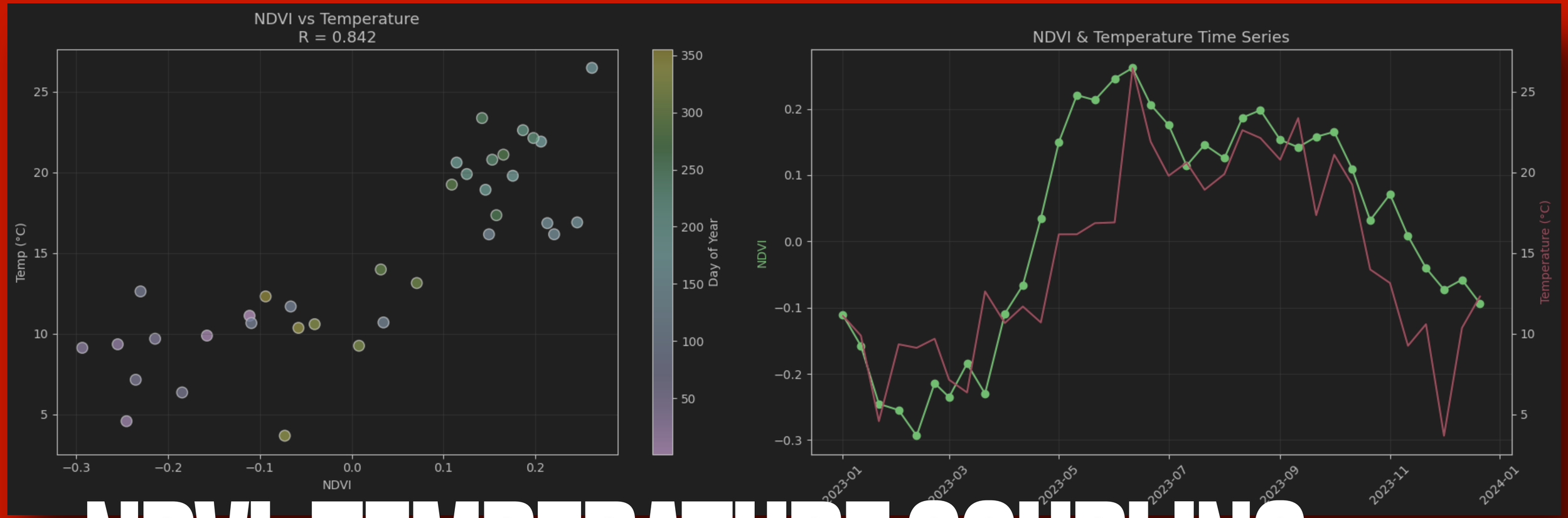
VEGETATION STRUCTURE CONTROLS UHI

- *Wien consistently shows **lower NDVI** than the rural ring (Δ ≈ 0.20)*
- *Vegetation rises sharply from March ➜ June; declines after August*
- *Rural NDVI reaches **0.45–0.50**, Wien peaks at **0.25***

—> VIENNA'S BUILT SURFACES SUPPRESS VEGETATION RECOVERY — THIS VEGETATION GAP IS A FOUNDATIONAL DRIVER OF ITS UHI.





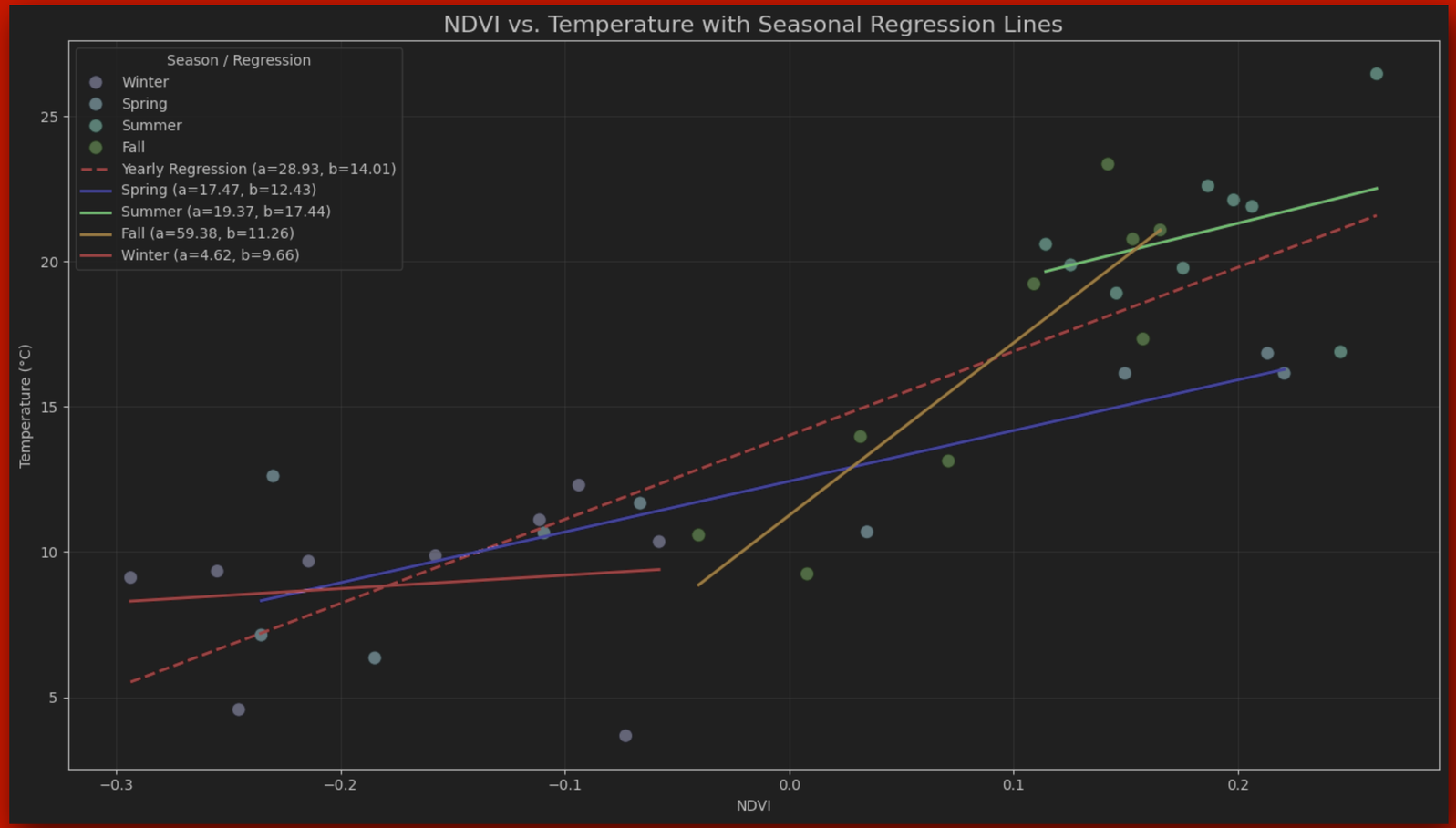


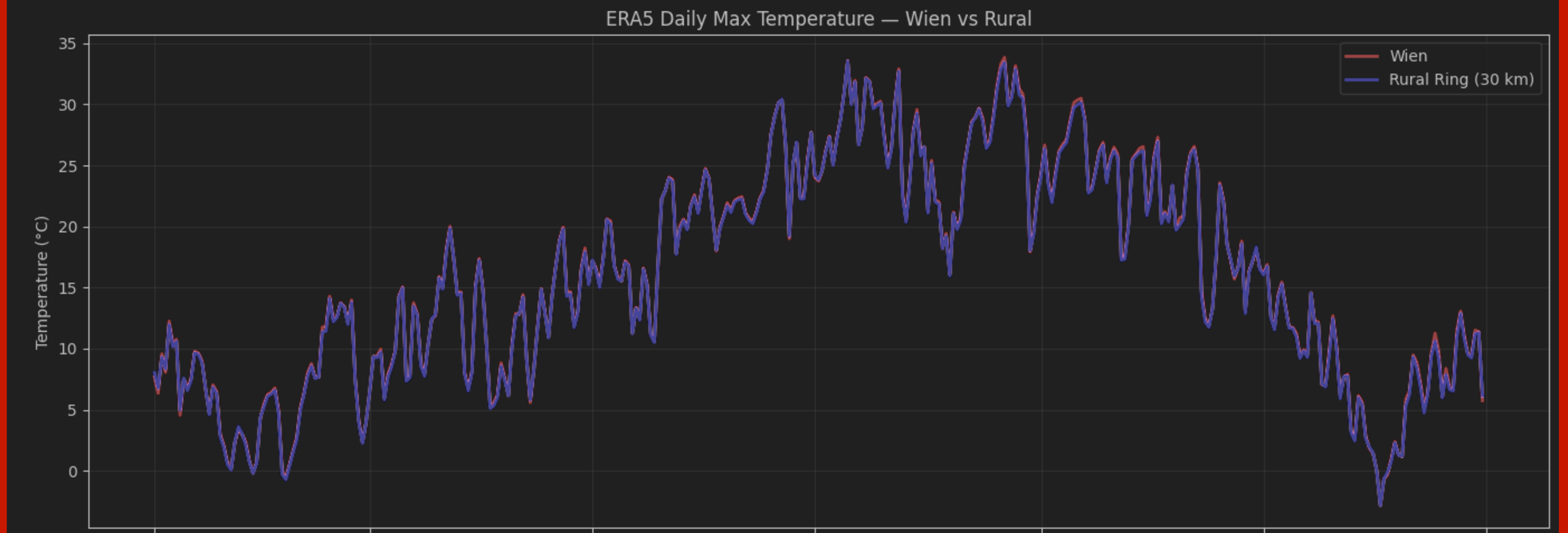
NDVI–TEMPERATURE COUPLING

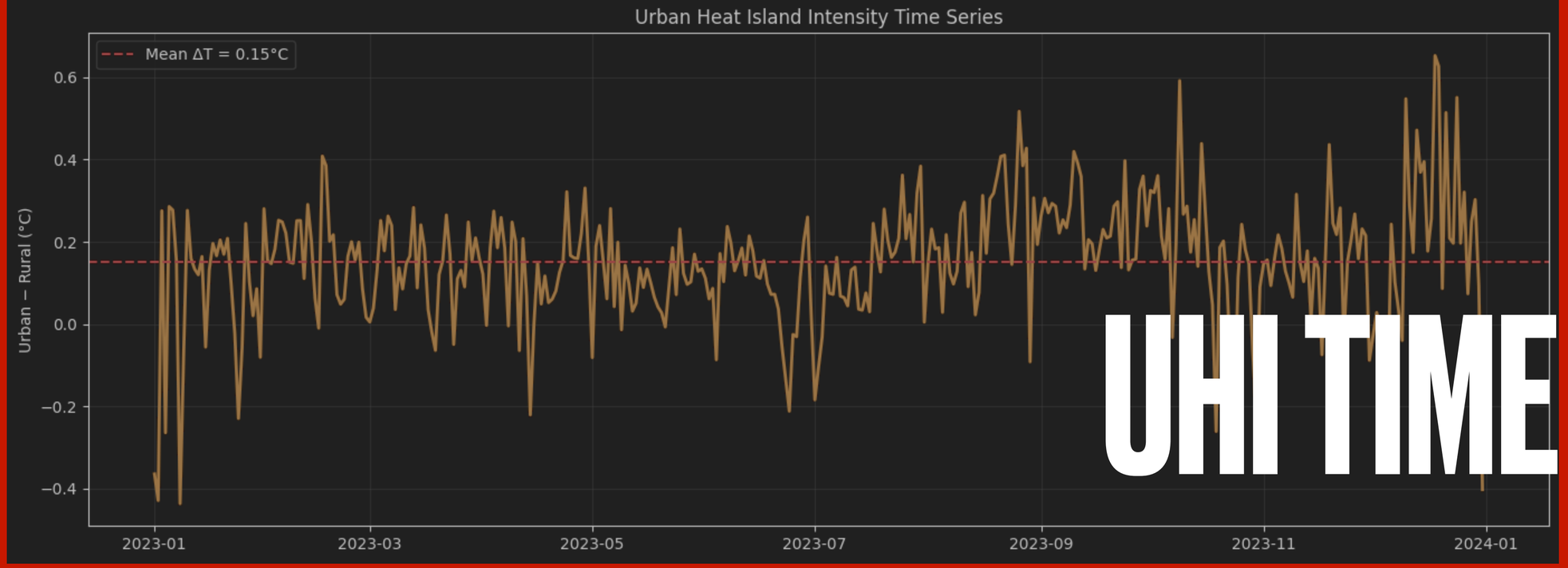
SEASONAL NDVI REGRESSION SLOPES

—> THE VEGETATION–TEMPERATURE RELATIONSHIP IS SEASONAL — WHICH INFLUENCES HOW UHI EVOLVES ACROSS THE YEAR

- **Winter:** nearly flat slope → NDVI insensitive to temperature.
- **Summer & Fall:** steeper slopes → vegetation highly sensitive to temperature.
- **Fall shows rapid NDVI decline vs only moderate cooling.**







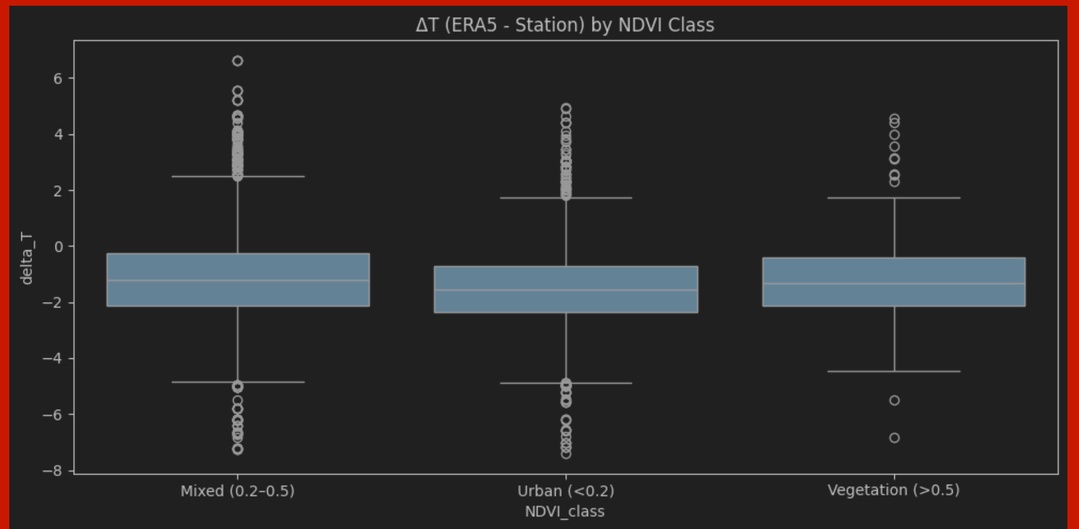
—> EVEN AT COARSE ERA5 SCALE, WIEN'S URBAN THERMAL FOOTPRINT IS PERSISTENT AND SEASONALLY STRUCTURED

UHI TIME SERIES

SEASONAL UHI PATTERNS & STATION VALIDATION

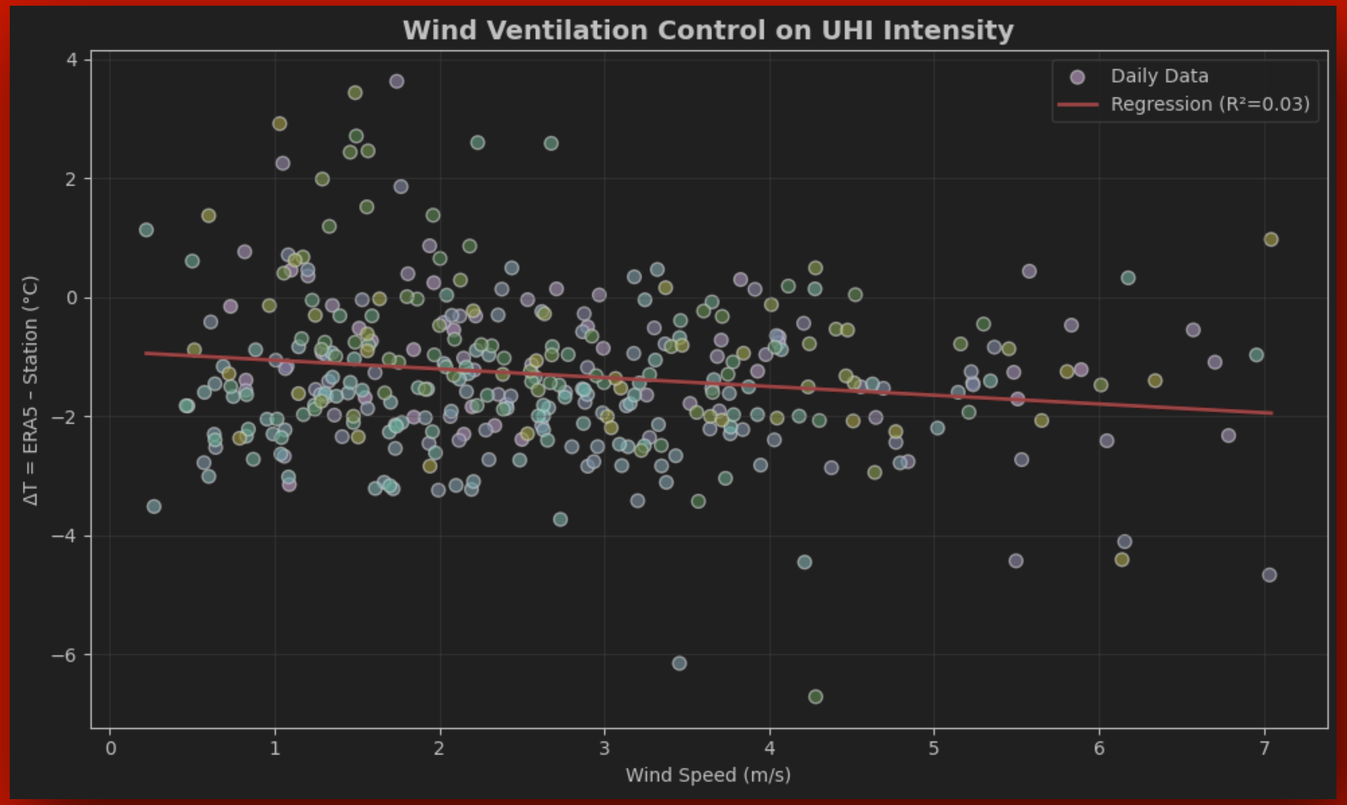
—> UHI INTENSITY FOLLOWS VEGETATION SEASONALITY AND LAND COVER — CONFIRMING THE PHYSICAL ORIGIN OF THE SIGNAL

- *Autumn shows strongest median UHI (~0.19°C).*
- *Spring weakest (~0.12°C)*
- *Station-validated urban areas (low NDVI) exhibit **stronger warming** than vegetated areas*
- *xNDVI class analysis confirms: **Urban pixels** → higher ΔT & **Vegetated pixels** → lower ΔT*



METEOROLOGICAL CONTROLS

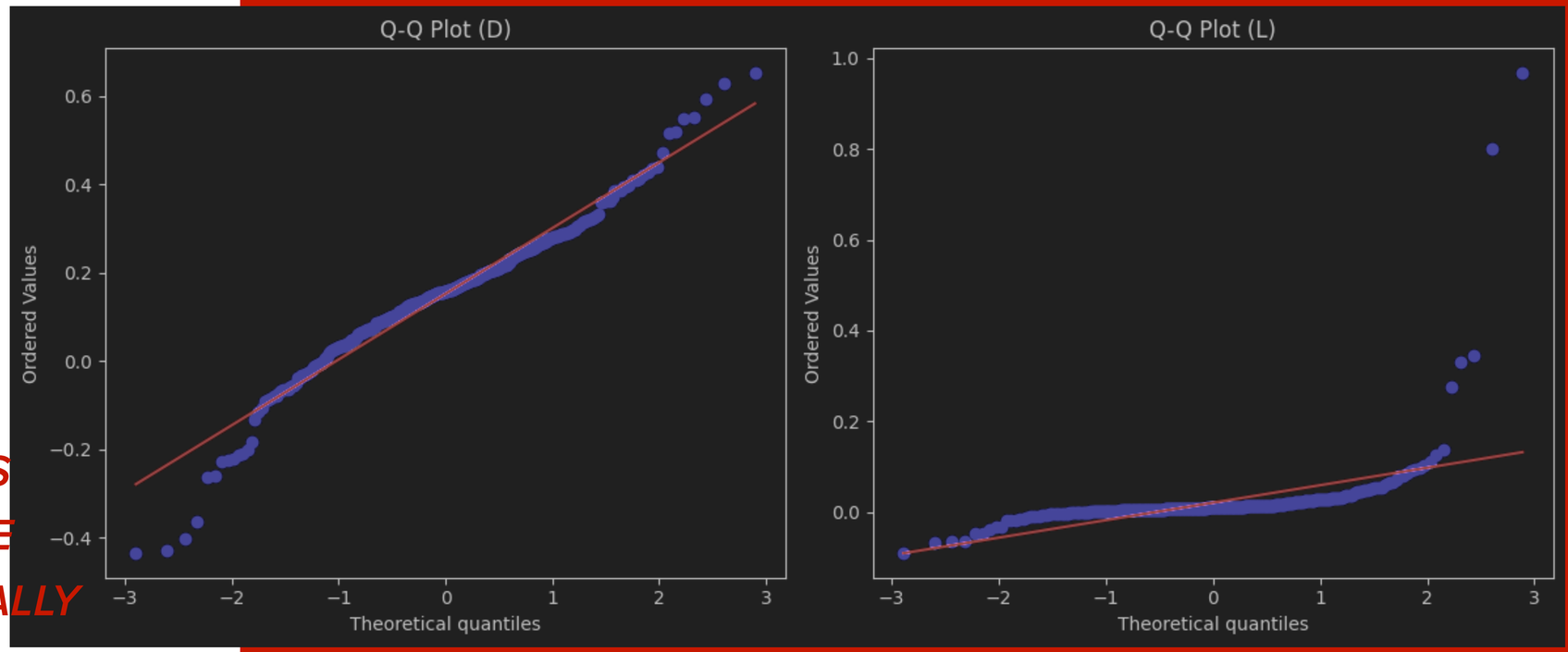
- *Weak negative wind–UHI relationship ($R^2 \approx 0.03$)*
- *Maximum correlation at **lag –14 days**: UHI strengthens 2 weeks after persistent temperature anomalies & **Heat accumulation** in buildings + soil dryness*

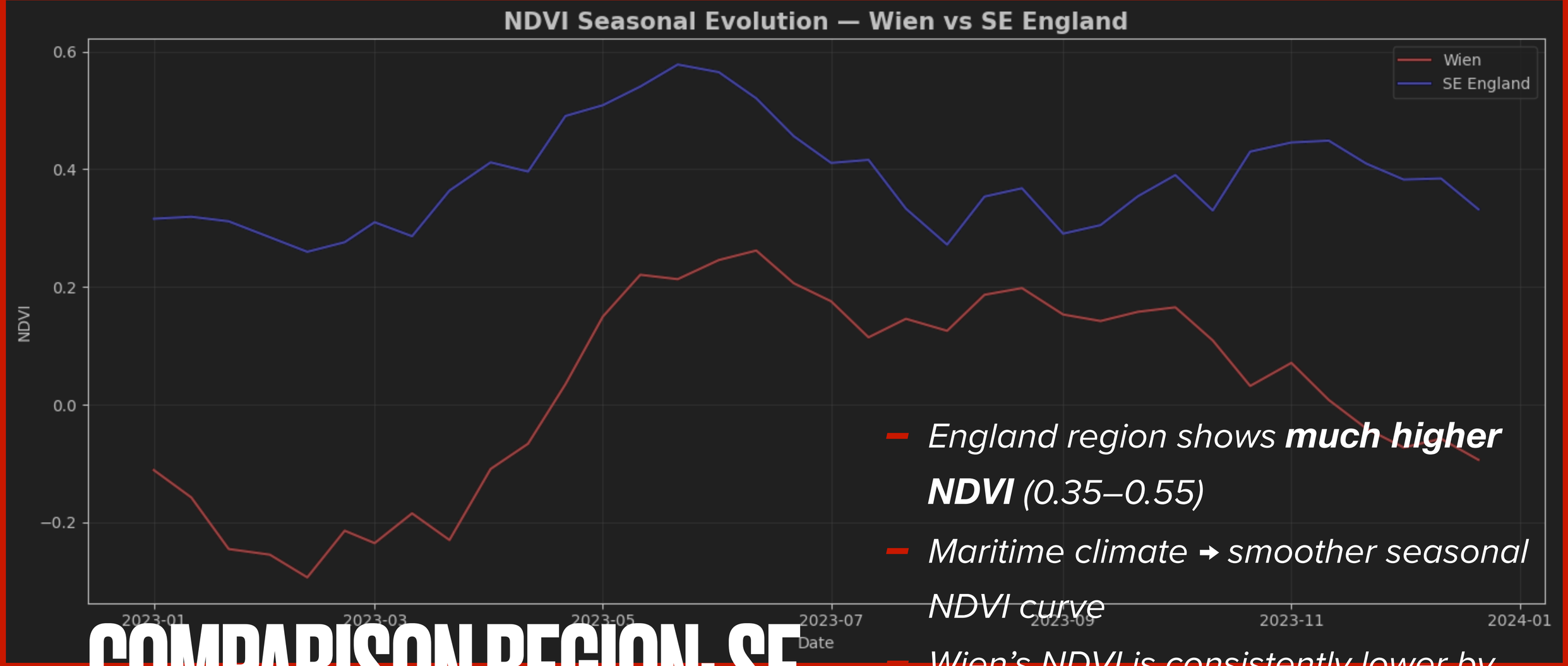


ADDITIVE VS MULTIPLICATIVE UHI

*—> THE UHI BEHAVES MAINLY AS AN **ADDITIVE PHENOMENON** IN WIEN (URBAN TEMP = RURAL TEMP + CONSTANT OFFSET + NOISE)*

*—> THE MULTIPLICATIVE MODEL DOES **NOT** EXPLAIN WIEN'S UHI WELL — THE CITY DOES NOT WARM PROPORTIONALLY TO RURAL TEMPERATURE*





COMPARISON REGION: SE ENGLAND (MARITIME CLIMATE)

- *England region shows **much higher NDVI** (0.35–0.55)*
- *Maritime climate → smoother seasonal NDVI curve*
- *Wien's NDVI is consistently lower by **0.15–0.30***

Stations well distributed around cities → reliable rural baseline

UHI COMPARISON: WIEN (CONTINENTAL) VS SE ENGLAND (MARITIME)

—> THE CONTINENTAL CITY (WIEN) RETAINS HEAT MORE AND IS MORE SENSITIVE TO WIND; THE MARITIME CITY (SE ENGLAND) MIXES HEAT MORE EFFICIENTLY