

# Creating an Urban Environmental Quality index: a pixel-based approach

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**Introduction** Urban environmental management is rising in importance due to increasing urban development alongside maintaining green spaces, crucial for human well-being.

Urban environmental quality (UEQ) provides a quantitative measure by assessing physical characteristics of urban landscapes. This study builds on a previously created Lower Super Output Area (LSOA) UEQ index, by creating an index using 30 m pixels.

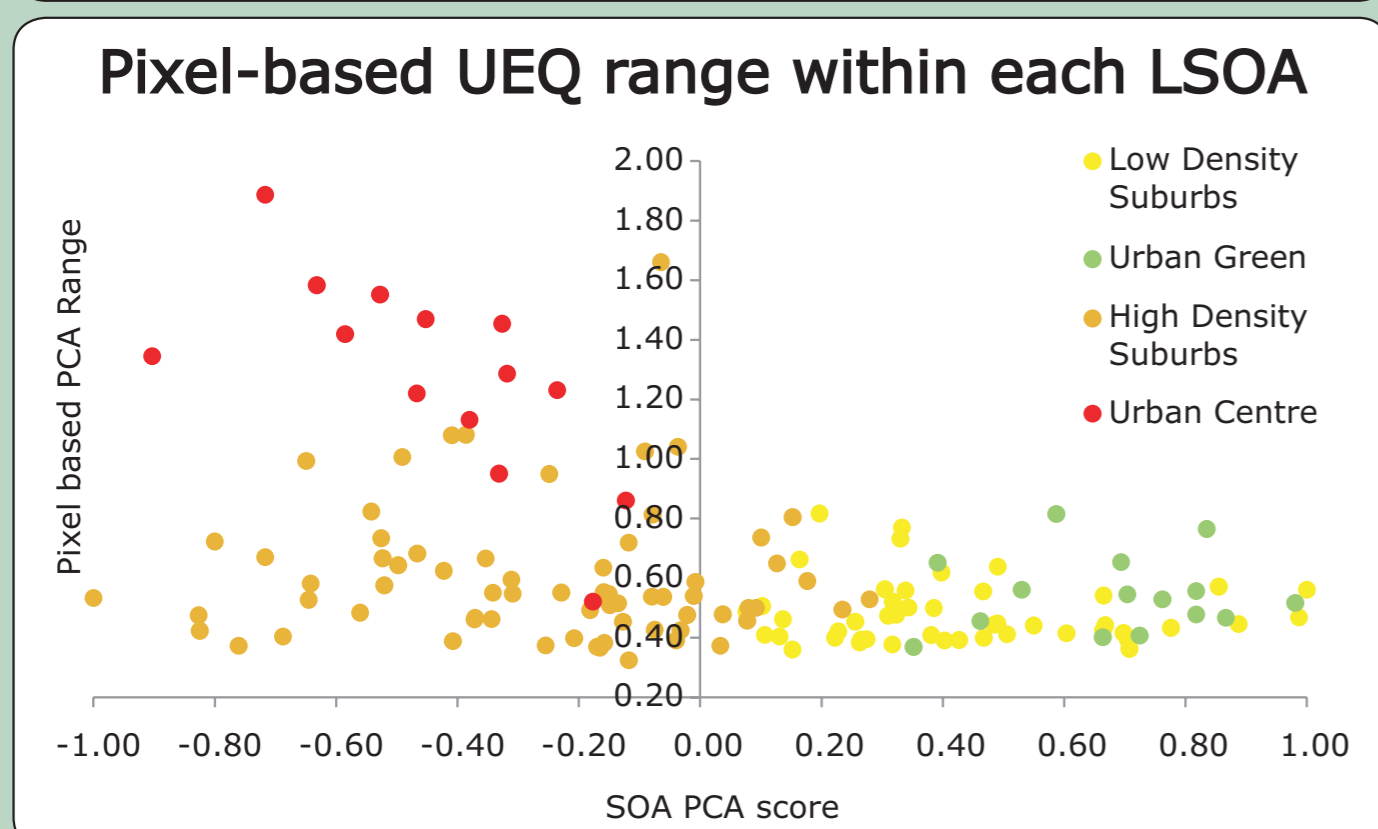
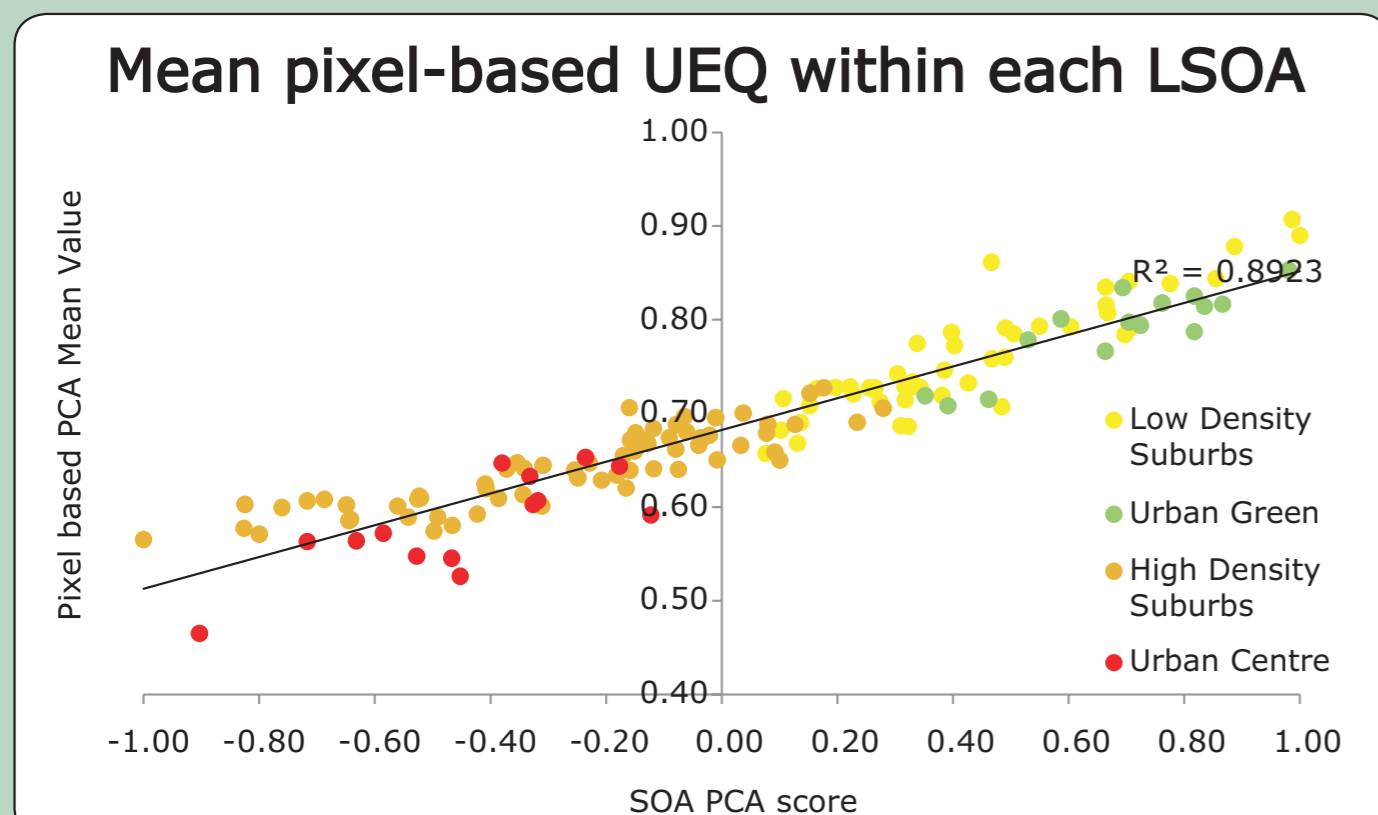
Environmental variables used	Indicator	Rationale
Urban vegetation	Normalised Difference Vegetation Index (NDVI)	Positive influence on physical and social health
Built environment	Normalised Difference Built-up Index (NDBI) Building height	Integral component of the urban environment Distinguishes between urban types
Land surface temperature	Surface temperature	Urban Heat Island effect
Proximity to water	Distance from water	Related to residential attraction

## Creating the index

- Principal Component Analysis (PCA) was used to combine highly correlated indicators, enhancing dimensions of variability.
- PCA component eigenvalues were used to weight the pixel index scores and summed assuming a linear relationship.
- The table below displays the strength and direction of variability for each indicator in four Principal Components
- Pixel values were normalised and compared against a LSOA-based analysis from Gunawan and Armitage (2011).

Components	PC1	PC2	PC3	PC4
Eigenvalues	1.93	1.02	0.86	0.81
NDVI	0.60	0.13	0.32	0.06
NDBI	-0.59	-0.34	-0.27	0.06
Height	-0.37	0.45	0.46	-0.66
Temperature	-0.30	-0.27	0.76	0.50
Water	0.25	-0.77	0.18	-0.55

## Results



LSOA urban types were derived by Gunawan and Armitage (2011).

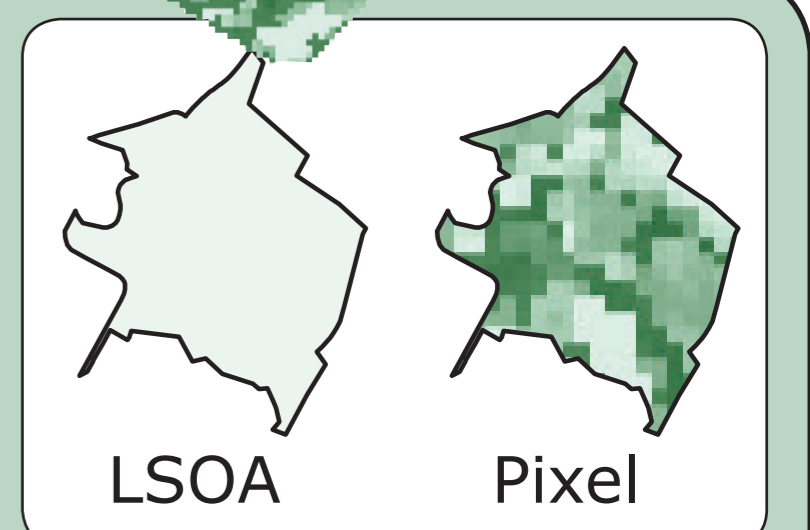
- There is a strong correlation between LSOA index scores and mean pixel values.
- Low Density Suburbs and Urban Green generally have higher UEQ values than high Density Suburbs and Urban Centre areas.
- Higher pixel ranges in Urban Centres and High Density Suburbs LSOAs highlight large variability in land cover.

Dark green areas indicate higher quality areas



## Conclusions

- The use of objectively shaped pixels has revealed varying heterogeneity within LSOAs.
- This research provides a useful basis for a deeper study of UEQ, combining both physical and socio-economic characteristics of the urban landscape.
- Further work needs to focus on verification of the index and further testing on different urban landscapes.



Reference: Gunawan, O. and Armitage, R.P. (2011) Measuring Urban Environmental Quality across Salford using an integrated Geographic Information Systems and Remote Sensing approach, Proceedings of GISRUUK, 27-29 April 2011, Portsmouth, UK.