

Supplementary Information for

**An Integrated Analytical Framework Linking Green-Blue Infrastructure
Spatial Patterns to UTCI-derived Thermal Stress**

Urban Ecosystem

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Table 1 Landscape metrics Derived from Previous Studies

Level	Abbreviation	Definition	Calculation function	Parameter description
Class	PLAND	Percentage of Landscape	$P_i = \frac{\sum_{j=1}^n a_{ij}}{A} \times 100$	P_i = proportion of the landscape occupied by patch type (class) i. a_{ij} = area (m^2) of patch ij. A = total landscape area (m^2).
	AREA_SD	Standard Deviation of Patch Area	$\sqrt{\frac{1}{n} \sum_{j=1}^n \left(a_{ij} - \frac{1}{n} \sum_{j=1}^n a_{ij} \right)^2}$	a_{ij} = area (m^2) of patch ij. n = total number of patches of a given type.
	AREA_MN	Mean patch area	$\sum_{j=1}^n a_{ij} \left(\frac{a_{ij}}{A} \right)$	a_{ij} = area (m^2) of patch ij. A = total landscape area (m^2).
	CA	Class Area	$\sum_{j=1}^n a_{ij} \times \frac{1}{10,000}$	a_{ij} = area (m^2) of patch ij.
	LPI	Largest Patch Index	$\frac{\max_{j=1}^n a_{ij}}{A} \times 100$	a_{ij} = area (m^2) of patch ij. A = total landscape area (m^2).
	FRAC_AM	Area-weighted fractal dimension index	$\sum_{j=1}^n \left(\frac{2 \ln 0.25 p_{ij}}{\ln a_{ij}} \right) \left(\frac{a_{ij}}{A} \right)$	p_{ij} = perimeter a_{ij} = area (m^2) of patch ij. A = total landscape area (m^2).
	FRAC_MN	Mean fractal dimension index	$\frac{1}{n} \sum_{j=1}^n \left(\frac{2 \ln 0.25 p_{ij}}{\ln a_{ij}} \right)$	p_{ij} = perimeter a_{ij} = area (m^2) of patch ij. n = total number of patches of a given type.
	SHAPE_AM	Area-weighted mean patch shape index	$\sum_{j=1}^n \left(\frac{0.25 p_{ij}}{\sqrt{a_{ij}}} \right) \left(\frac{a_{ij}}{A} \right)$	p_{ij} = perimeter a_{ij} = area (m^2) of patch ij. A = total landscape area (m^2).

	SHAPE_MN	Mean patch shape index	$\frac{1}{n} \sum_{j=1}^n \left(\frac{0.25 p_{ij}}{\sqrt{a_{ij}}} \right)$	p _{ij} = perimeter a _{ij} = area (m ²) of patch ij. n = total number of patches of a given type.
	CONTIG_MN	Mean patch contiguity index	$\frac{1}{n} \sum_{i=1}^n \left(\frac{\frac{\sum_{r=1}^z c_{ijr}}{a_{ij}^*} - 1}{v - 1} \right)$	c _{ijr} = contiguity value for pixel r in patch ij. a _{ij} [*] = area of patch ij in terms of number of cells. v = sum of the values in a 3- by-3 cell template (13 in this case). n = total number of patches of a given type .
	LSI	Landscape Shape Index	$\frac{0.25 \sum_{k=1}^m e^*_{ik}}{\sqrt{A}}$	e _{ik} [*] = total length (m) of edge in landscape between patch types (classes) i and k; includes the entire landscape boundary and some or all background edge segments involving class i. A = total landscape area (m ²).
	ED	Edge Density	$\frac{\sum_{k=1}^m e_{ik}}{A} \times 10,000$	e _{ik} = total length (m) of edge in landscape involving patch type (class) i;

				includes landscape boundary and background segments involving patch type i. A = total landscape area (m ²).
	DIVISION	Landscape Division Index	$\left[1 - \sum_{j=1}^n \left(\frac{a_{ij}}{A} \right)^2 \right]$	a _{ij} = area (m ²) of patch ij. A = total landscape area (m ²).
	PD	Patch Density	$\frac{n_i}{A} \times 10,000 \times 100$	n _i = number of patches in the landscape of patch type (class) i. A = total landscape area (m ²).
	NP	Number of Patches	n _i	n _i = number of patches in the landscape of patch type (class) i.
	AI	Aggregation Index	$\left[\frac{g_{ii}}{\max - g_{ii}} \right] \times 100$	g _{ii} = number of like adjacencies (joins) between pixels of patch type (class) i based on the single-count method. max-g _{ii} = maximum number of like adjacencies (joins) between pixels of patch type (class) i (see below) based on the single-count method.

	IJI	Interspersion and Juxtaposition Index	$\frac{-\sum_{k=1}^m \left[\left(\frac{e_{ik}}{\sum_{k=1}^m e_{ik}} \right) \times \ln \left(\frac{e_{ik}}{\sum_{k=1}^m e_{ik}} \right) \right]}{\ln(m-1) \times 100}$	e_{ik} = total length (m) of edge in landscape between patch types (classes) i and k. m = number of patch types (classes) present in the landscape, including the landscape border, if present.
	SPLIT	Splitting Index	$\frac{A^2}{\sum_{j=1}^n a_{ij}^2}$	a_{ij} = area (m²) of patch ij. A = total landscape area (m²).
	ENN_AM	Area-weighted mean Euclidean nearest neighbor distance	$\sum_{i=1}^n d_{mini} \left(\frac{a_{ij}}{A} \right)$	d_{mini} = shortest distance between path i and its nearest neighboring patch. a_{ij} = area (m²) of patch ij. A = total landscape area (m²).
	ENN_MN	Mean Euclidean nearest neighbor distance	$\frac{\sum_{i=1}^n d_{mini}}{n}$	d_{mini} = shortest distance between path i and its nearest neighboring patch. n = total number of patches of a given type
	COHESION	Patch Cohesion Index	$\left[1 - \frac{\sum_{j=1}^n p_{ij}^*}{\sum_{j=1}^n p_{ij}^* \sqrt{a_{ij}^*}} \right] \left[\left[1 - \frac{1}{\sqrt{Z}} \right]^{-1} \right] \times 100$	p_{ij}^* = perimeter of patch ij in terms of number of cell surfaces.

				a_{ij}^* = area of patch ij in terms of number of cells. Z = total number of cells in the landscape.
	NDVI__mean	Mean Normalized Difference Vegetation Index	$NDVI = \frac{NIR - RED}{NIR + RED}$ $NDVI_{mean} = \frac{1}{n} \sum_{i=1}^n NDVI_i$	n = the total number of NDVI pixels within the target area.
Landscape	TA	Total Area	$A \times \left(\frac{1}{10,000}\right)$	A = total landscape area(m ²).
	LPI	Largest Patch Index	$\frac{\max(a_{ij})}{A} \times 100$	A = total landscape area(m ²). a _{ij} =area(m ²) of patch ij
	SHAPE_MN	Mean patch shape index	$\frac{1}{n} \sum_{j=1}^n \left(\frac{0.25 p_{ij}}{\sqrt{a_{ij}}} \right)$	p _{ij} = perimeter a _{ij} = area (m ²) of patch ij. n = total number of patches in the <u>entire landscape</u>
	LSI	Landscape Shape Index	$\frac{0.25 E^*}{\sqrt{A}}$	E* = total length (m) of edge in landscape; includes the entire landscape boundary and some or all background edge segments. A = total landscape area (m ²)
	ED	Edge Density	$\frac{E}{A} \times 10,000$	E = total length (m) of edge in landscape. A = total landscape area(m ²)

	DIVISION	Landscape Division Index	$\left[1 - \sum_{i=1}^m \sum_{j=1}^n \left(\frac{a_{ij}}{A} \right)^2 \right]$	a_{ij} = area (m ²) of patch ij. A = total landscape area(m ²).
	PD	Patch Density	$\frac{N}{A} \times 10,000 \times 100$	N = total number of patches in the landscape. A = total landscape area(m ²).
	AI	Aggregation Index	$\left[\sum_{i=1}^m \left(\frac{g_{ii}}{\max - g_{ii}} \right) P_i \right] \times 100$	g_{ii} = number of like adjacencies (joins) between pixels of patch type (class) i based on the single-count method $\max - g_{ii}$ = maximum number of like adjacencies (joins) between pixels of patch type (class) i (see below) based on the single-count method. P_i = proportion of landscape comprised of patch type (class) i.
	SPLIT	Splitting Index	$\frac{A^2}{\sum_{i=1}^m \sum_{j=1}^n a_{ij}^2}$	a_{ij} = area (m ²) of patch ij. A = total landscape area(m ²).
	COHESION	Patch Cohesion Index	$\left[1 - \frac{\sum_{i=1}^m \sum_{j=1}^n P_{ij}^*}{\sum_{i=1}^m \sum_{j=1}^n P_{ij}^* \sqrt{a_{ij}^*}} \right] \times \left[1 - \frac{1}{\sqrt{Z}} \right]^{-1} \times 100$	P_{ij}^* = perimeter of patch ij in terms of number of cell surfaces. a_{ij}^* = area of

				patch ij in terms of number of cells. Z = total number of cells in the landscape.
	SHDI	Shannon's Diversity Index	$-\sum_{i=1}^m P_i \times \ln P_i$	P _i =proportion of the landscape occupied by patch type(class) i.

Note: The landscape metrics summarized in this table are derived from and informed by McGarigal (2015), the FRAGSTATS Version 4 documentation.