

MEASURING THE URBAN HEAT ISLAND INTENSITY

Challenges with “Urban-Rural” Differentiation
and the East Asian City

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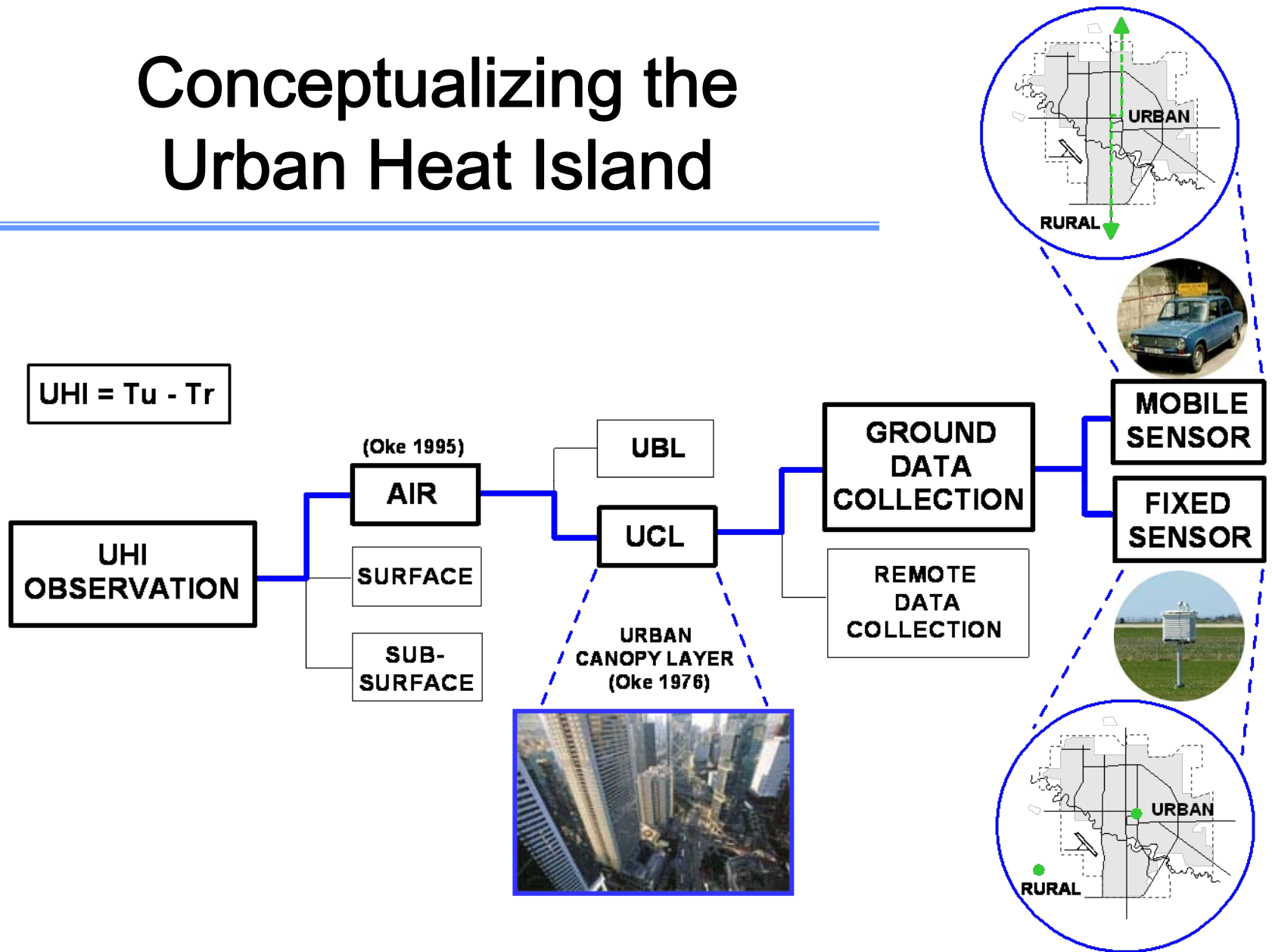
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Outline

- Conceptualizing the urban heat island (UHI)
- Problems and concerns with UHI intensity as an “urban-rural” difference
- Suggestions and possible solutions for re-defining UHI intensity

Conceptualizing the Urban Heat Island



“Urban-Rural” Differentiation

Background





- “Urban-rural” temperature differentiation provides a simple means of assessing UHI intensity
- UHI literature is geographically rich and it serves a variety of interests

Problem

- Describing measurements as “urban” or “rural” is not intuitively clear
- Standardized and universally functional measures of UHI intensity have not been established

“Urban-Rural” Differentiation

Examples from the field...





	“URBAN” SITES		“RURAL” SITES
SENDAI Japan <i>(Sakaida & Egoshi, 2006)</i>		SEOUL South Korea <i>(Kim & Baik, 2005)</i>	
SEOUL South Korea <i>(Kim & Baik, 2005)</i>		NAGANO Japan <i>(Sakakibara & Matsui, 2005)</i>	

“Urban-Rural” Differentiation

Examples from the field...

“RURAL”

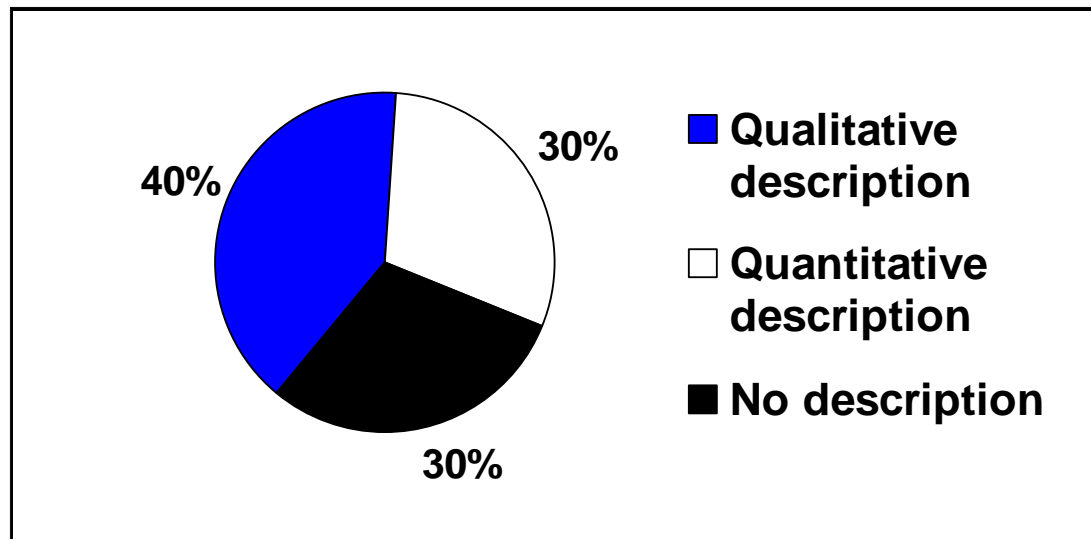
“URBAN”

	???	???	
TOKYO Japan		VIENNA Austria	
TOKYO Japan		PHOENIX USA	

“Urban-Rural” Differentiation

Specific Concern #1

- Use of “urban” and “rural” leads to incomplete reporting of micro- and local-scale site characteristics (surface cover, exposure)
- In a survey of 180 UHI studies, 30 percent gave no description of the “urban” and “rural” measurement sites defining UHI intensity



“Urban-Rural” Differentiation

Specific Concern #2

- “Urban” and “rural” are ambiguous terms that are open to interpretation

Sites representing T (urban) and T (rural) in the literature:

URBAN

street canyons
rooftops
residential yards
railyards, shipyards
city squares
parks, gardens...



RURAL

paddy fields
grain fields
fruit farms
plantations
villages, forests,
ranchland, desert...



URBAN AND RURAL

airports/airstrips
college campuses
experimental farms
met. institutes
school yards...



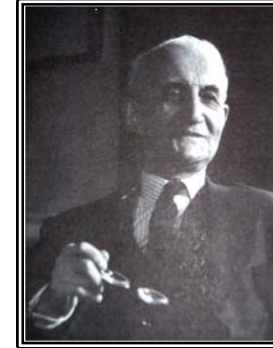
- It is the classification, not the diversity, of sites that is problematic

“Urban-Rural” Differentiation

East Asian Context

Jean Gottmann 1915–1994

- cultural geographer, urban theorist
- *Megalopolis* (1961)



“ There are today *two* great areas of densely agglomerated people: one of them is highly *urbanized*, in North America and Western Europe... The other is predominantly *rural*, in the south and east of Asia. ”

Ekistics: The Problems and Science of Human Settlement (1966)

“Urban-Rural” Differentiation

East Asian Context

- Peculiarities of the urban periphery:



- Large *in situ* population



- Heterogeneity of land uses



- Blurry urban-rural divide

“Urban-Rural” Differentiation

East Asian Context



UHI = Tu - Tr



Regina: *city-based urbanism*



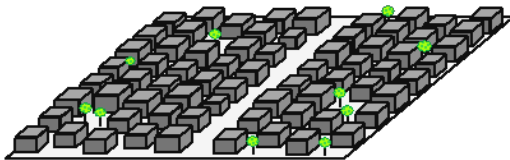
Guangzhou: *region-based urbanism*

- Urban-rural dichotomy is too simplistic for universal landscape classification

Re-defining UHI Intensity

Suggestions

- Provision of site metadata (Oke 2004; Peterson 2003)
 - Detailed information about micro- and local-scale site character
 - H/W ratio, built fraction, thermal properties, artificial heat...
 - maps, photos, sketches, tables...



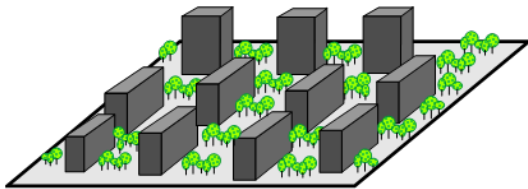
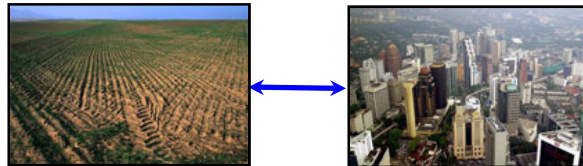
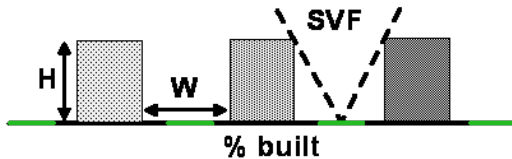
SITE	H/W	BUILT %	Z ₀
RES 1	1	65	1
CBD 2	5	95	3
FARM 1	0.5	10	0.25
PARK 2	---	15	0.5

- But...metadata alone don't constitute a framework

Re-defining UHI Intensity

Possible Solution

- A new landscape classification scheme...



- objective measures of surface cover and geometry (i.e., metadata)
- continuum of natural and built landscapes
- standardized local-scale surface types

METADATA

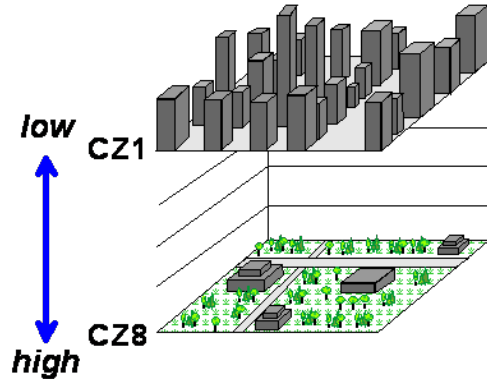
Site Assessment



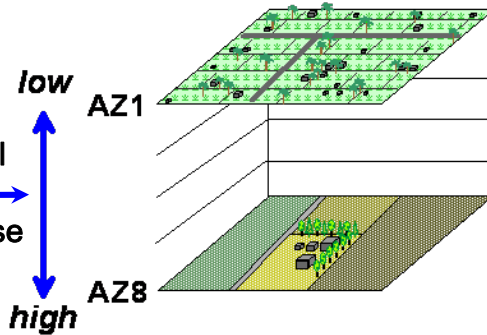
- H/W ratio
- built fraction
- thermal admittance
- surface roughness
- artificial heat
- albedo

CLIMATE ZONE CLASSIFICATION

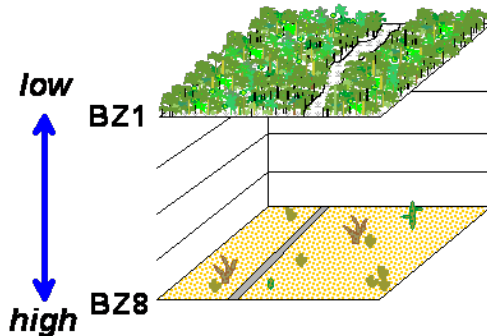
City Zones (CZ) (Oke 2004)



Agricultural Zones (AZ)



Bioclimatic Zones (BZ)



UHI INTENSITY

HONG KONG



T (CZ1 – CZ3)

PHOENIX



T (CZ4 – BZ8)

Conclusions

- UHI intensity should be re-defined in universally understood terms and through a new climate-based landscape classification scheme:
 - re-classify existing observational UHI literature
 - understand regional variation in UHI intensity
 - communicate future UHI observations