Investigating Urban Heat and Cool Island in Semi-arid Cities, With the Case Study of Erbil.

Azad Rasul, Prof Heiko Balzter and Dr Claire Smith

1. Study Area

Erbil is located in northern Iraq. It is situated between 43˚ 57' – 44˚ 03' East and 36˚ 08' – 36˚ 14' North. The study area experiences warm and dry summers and cool, rainy winters. It has an average annual temperature of 21.85˚C and 386.2 mm of precipitation. July is the hottest month of the year, averaging at 36˚C, and January is the coldest month, with an average of 8˚C.

2. Objectives

- Analyse the spatial variation of Land Surface Temperature (LST) and Urban Heat Island (UHI).
- Explain the temporal variation of LST and UHI in the study area.
- Identify the main factors affect on LST and UHI in the semi-arid cities.

Figure 1: Study Area

3. Data

Dataset	Date	Time of Taken	Resolution (Thermal Band)
Landsat 5	31-07-1992	06:47 AM	120 m
Landsat 7	27-07-2002	07:27 AM	60 m
Landsat 8	17-07,21-10,24-12,28-04 2013	07:40 AM	100 m
MODIS Terra and Aqua	2002-2013	10:30 AM & PM	1000 m

4. Methods

Lλ= gain * ND + offset *

SUHI = Urban (core) mean LST - Rural (buffer) mean LST ***

Figure 2: Proposed flowchart of methodology

TB=K2/ln(K1/(Lλ)+1) *

St =Tb/1+ (λ x TB/ρ)lnε **

ρ = h x c/σ =0.1438

5. Preliminary Results

Image (3) indicates that LULC type with the lowest average of LST (44.7 °C) is water bodies. While the highest mean of LST (56.6 °C) exist in the Barren Land. Mean surface temperature for South Industrial and grass are 53 °C and 49.4 °C respectively.

UHI in the bare land is 4.87 °C and in the south industrial is 1.28 °C. The Urban Cool Island (UCI) intensity of each the dense trees and the grass is -3.6 °C and -2.3 °C respectively.

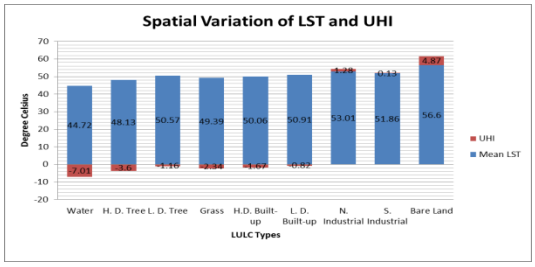

Figure 3: Spatial Variation

Results indicate that at night the city area's 2.23°C higher temperature than the surrounding area proves the existence of nocturnal SUHI. However the initial result of both Landsat and MODIS confirms the existence of a diurnal Urban Cool Island (UCI) (-1.22 °C).

6. Acknowledgements

Many thanks to HCDP and Soran University for their support of this research. My great acknowledgment to CLCR team for creating cooperative working environment.

7. References

* LANDSAT, P. S. O. 2002. Landsat 7 Science Data Users Handbook.

** ZHANG, H., SATO, N., IZUMI, T., HANAKI, K. & ARAMAKI, T. 2008. Modified RAMS-Urban Canopy Model for Heat Island Simulation in Chongqing, China. Journal of Applied Meteorology and Climatology, 47, 509-524.

*** SCHWARZ, N., SCHLINK, U., FRANCK, U. & GROßMANN, K. 2012. Relationship of land surface and air temperatures and its implications for quantifying urban heat island indicators—An application for the city of Leipzig (Germany). Ecological Indicators, 18, 693-704

aor4@le.ac.uk