

# The urban heat island and its influence on building energy consumption in England and South Korea

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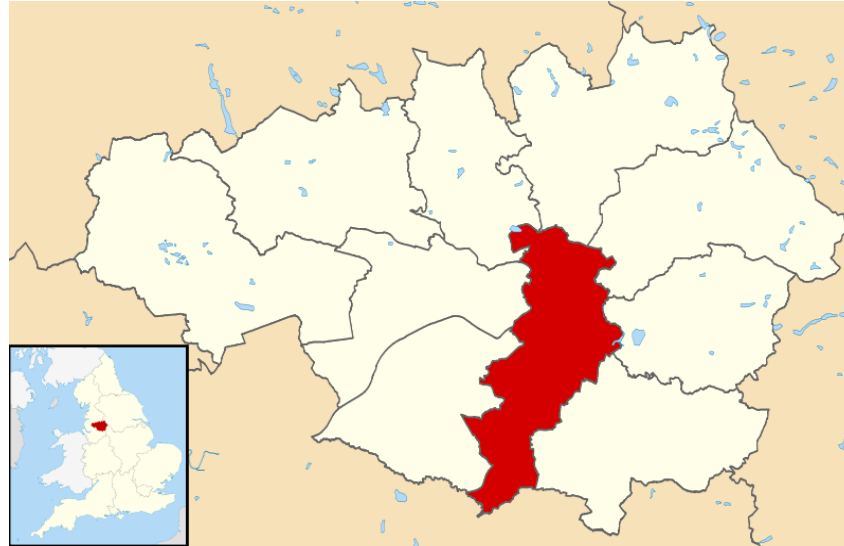
# Radiation shield



# Measurement station on lighting column



# Manchester and Greater Manchester United Kingdom



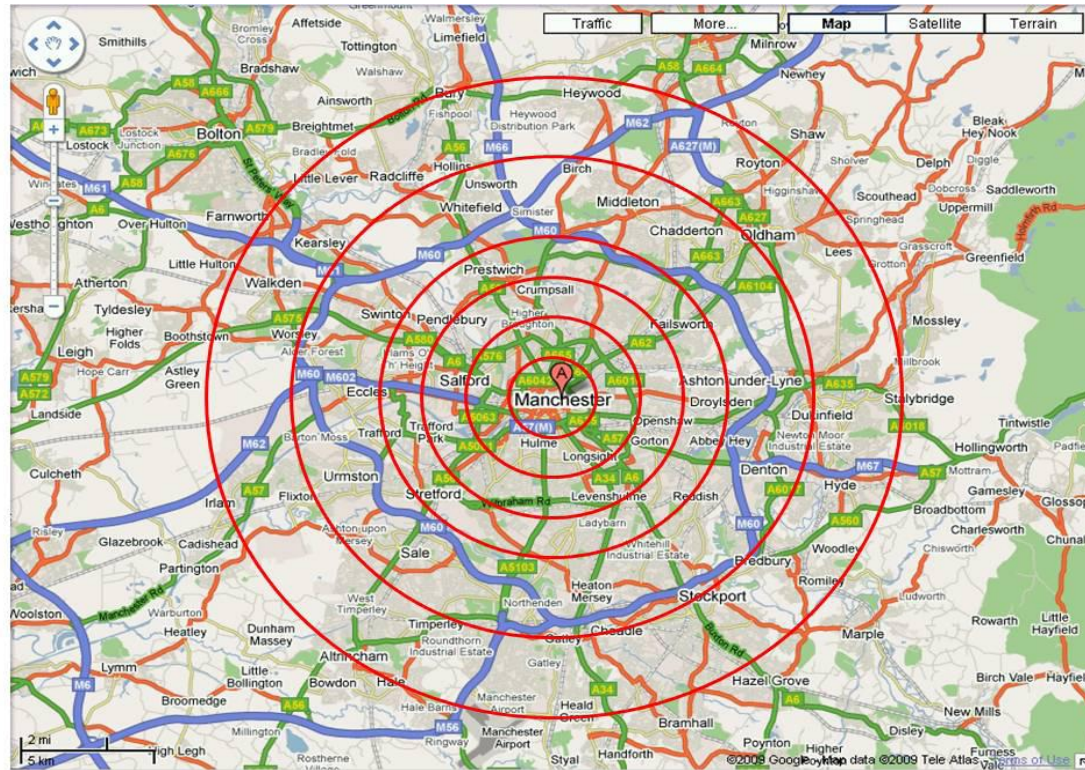
- Manchester, population 514,417 in 2013, is In the United Kingdom's 2<sup>nd</sup> most populated urban area, with a population of 2.55 million in Greater Manchester.
- Manchester expanded at an astonishing rate in the 19<sup>th</sup> century due to the development of textile manufacturing. Manchester became the world's first industrialised city.
- The Greater Manchester economy is the 3<sup>rd</sup> largest in the United Kingdom and is the third-most visited city in the UK by foreign visitors, after London and Edinburgh.

# Manchester (53°28'N 2°14'W)

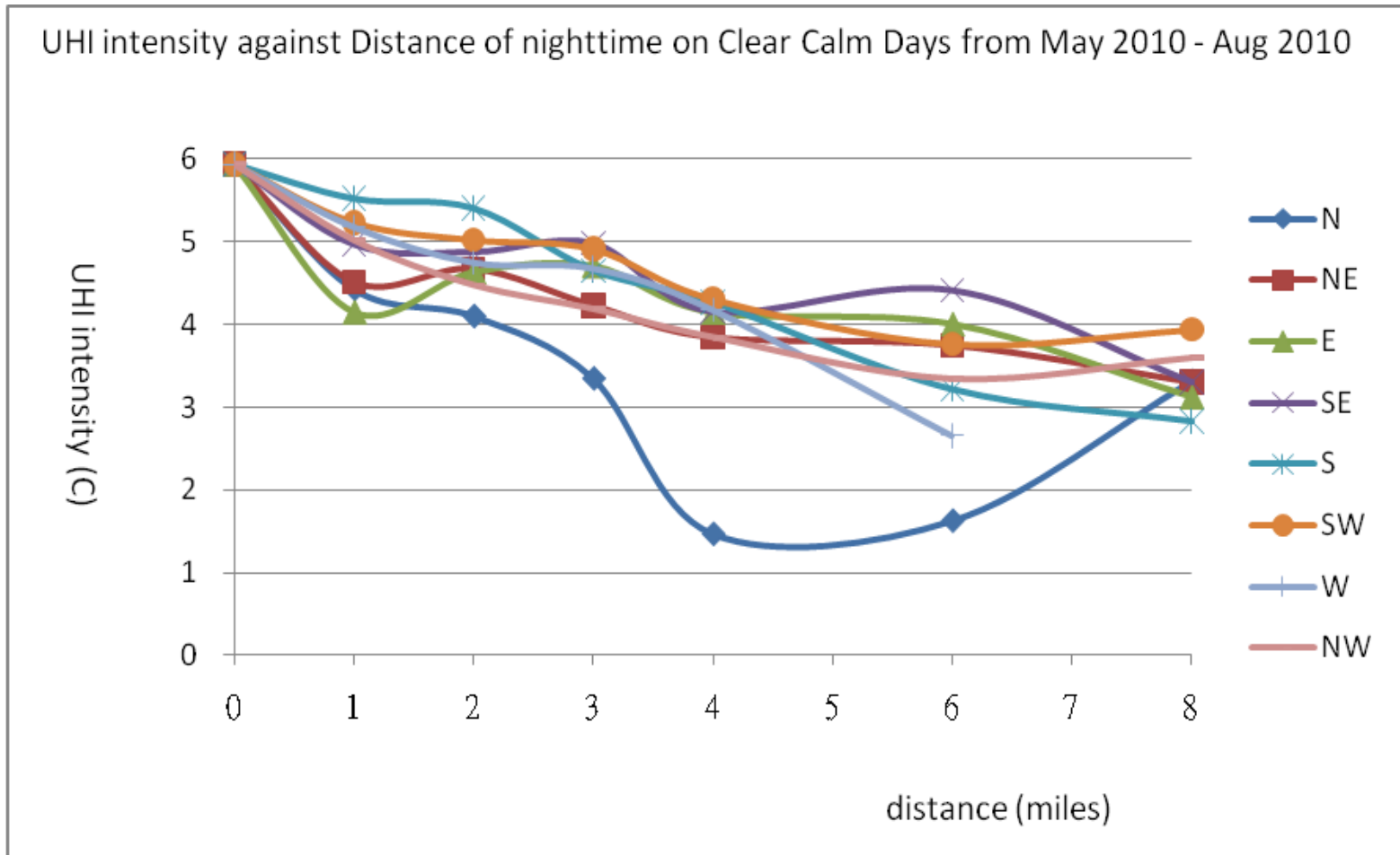
- Manchester has a temperate Oceanic climate, like much of the British Isles, mild summers and cool winters.
- Relatively high humidity levels and soft water, important for the textile industry.
- Monthly mean temperatures: January 4.4 °C , July 16.2 °C
- Light precipitation throughout the year. Average annual rainfall is 806.6 millimetres (UK average of 1,125.0 millimetres).



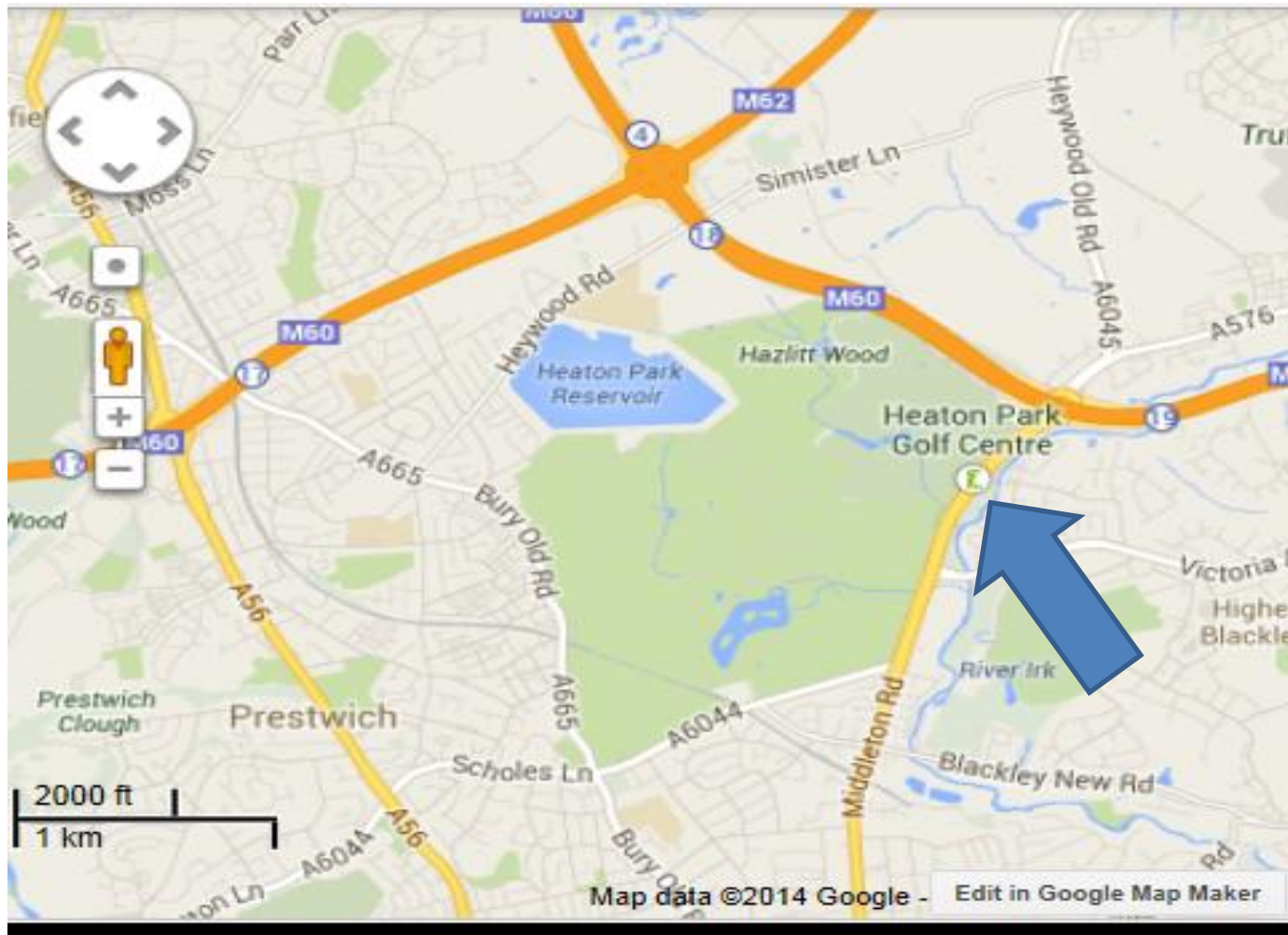
# Stations positioned radially from the city centre



# The urban heat island effect in Greater Manchester reduces with distance from the city centre



The reason for the reduced UHII on the northern transect: Heaton Park







# The future in Manchester





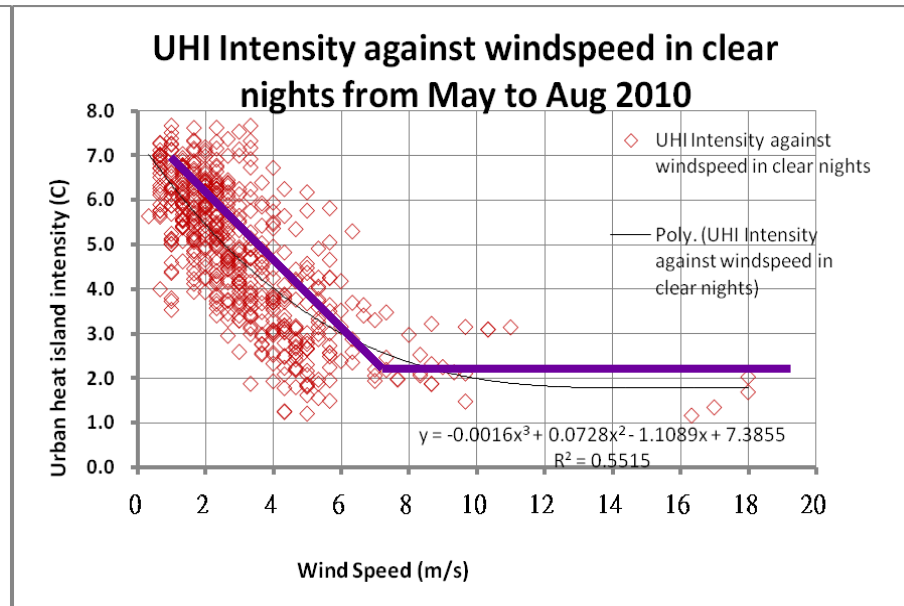
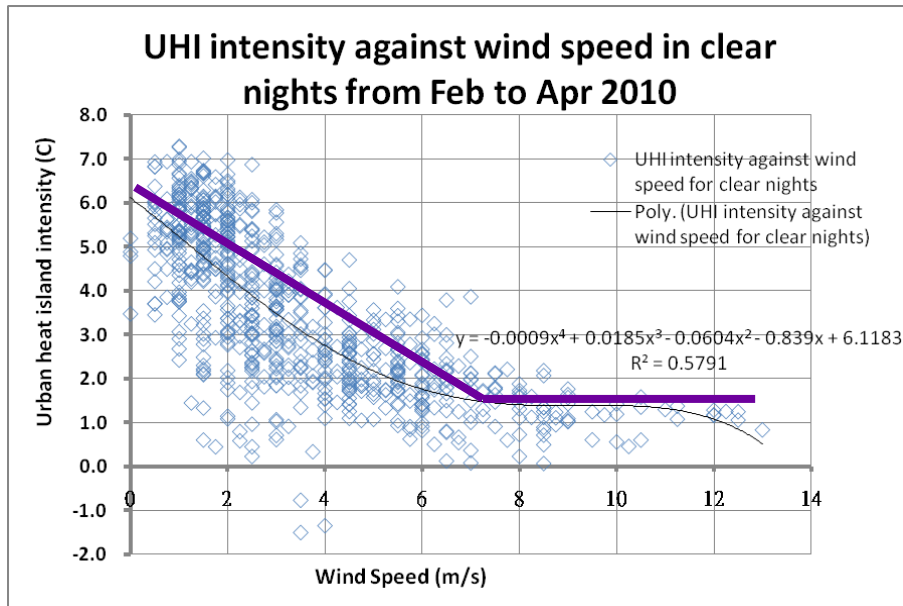
# Green roof in Manchester, UK



# The roof before it became green



# The Urban Heat Island Effect in Greater Manchester reduces as the wind speed increases





Can reduce the UHI with wider streets  
to allow more ventilation



# Ulsan, South Korea

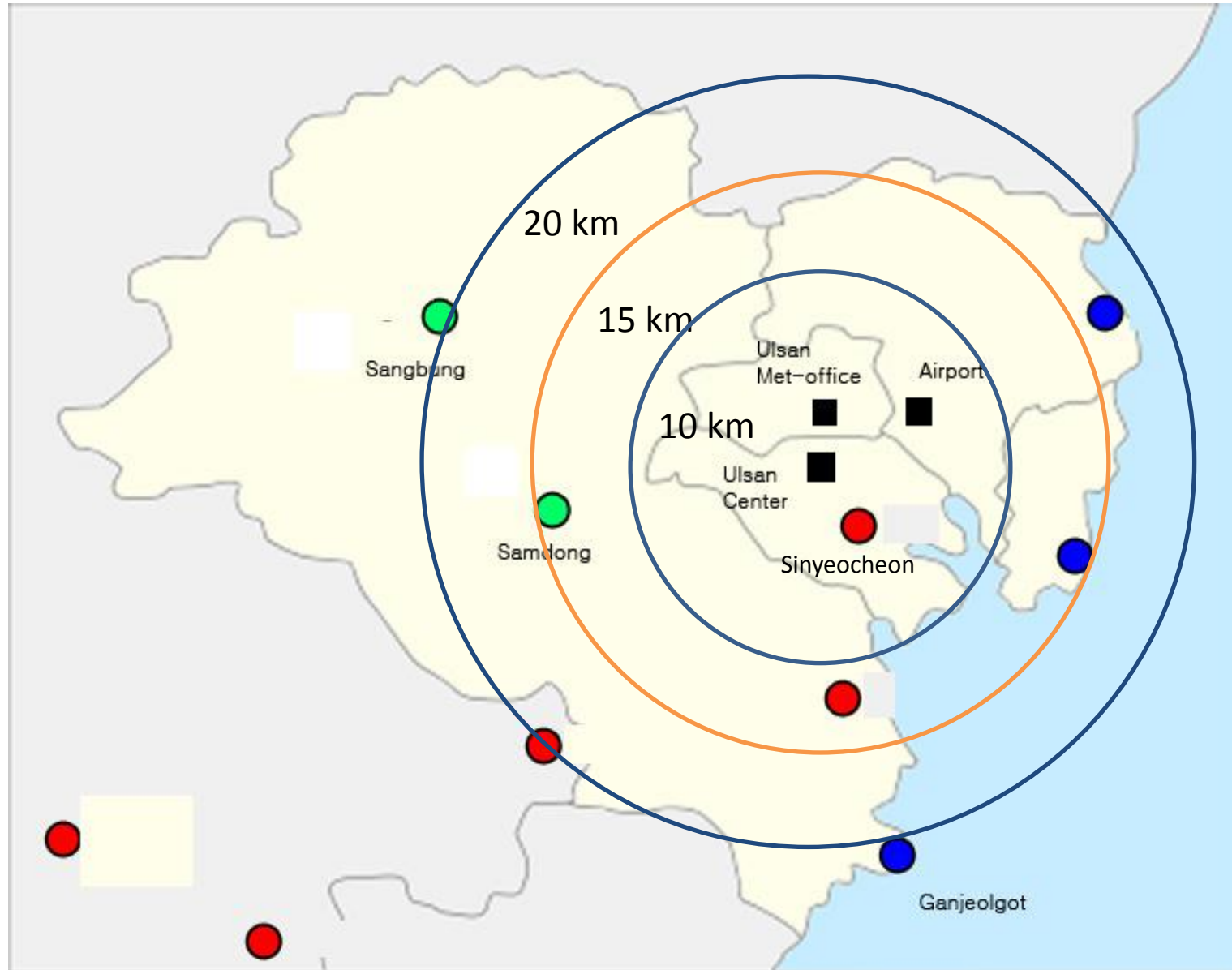
- Ulsan is South Korea's 7<sup>th</sup> largest city, population of over 1.1 million.
- Ulsan is the industrial powerhouse of South Korea, with the world's largest automobile assembly plant (Hyundai Motor Company), the world's largest shipyard (Hyundai Heavy Industries) and the world's second largest oil refinery, owned by SK Energy.
- In 2012, Ulsan had the highest GDP per capita (\$79,623), in South Korea.



# Ulsan (35°33'N 129°19'E)

- Ulsan has a monsoon-influenced humid subtropical climate
- Cold but dry winters, and hot, humid summers.
- Monthly means 2.0 °C in January to 25.9 °C in August, with diurnal temperature ranges generally low.
- Precipitation is relatively low in the winter months, but is made up by the high rainfall falling from April to September.

# Kwanho Lee work on Ulsan, South Korea

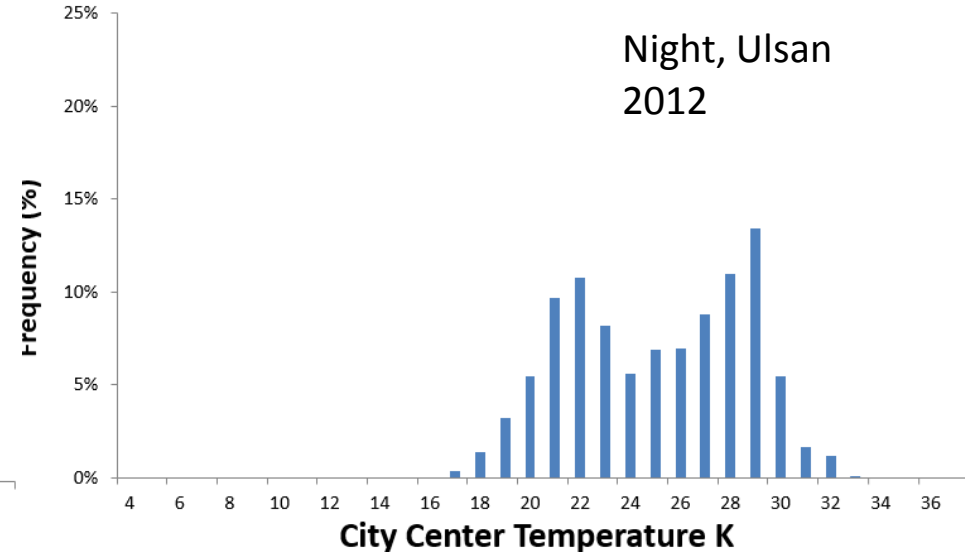
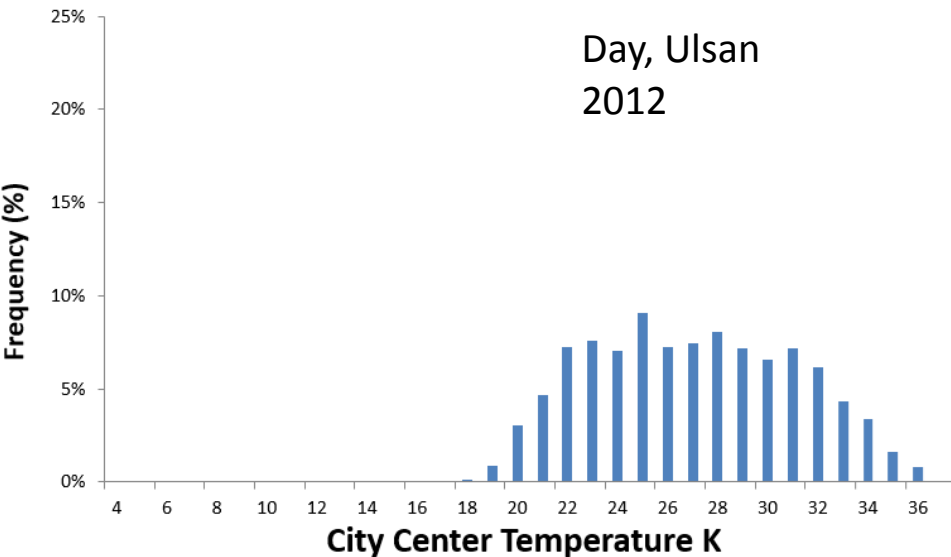
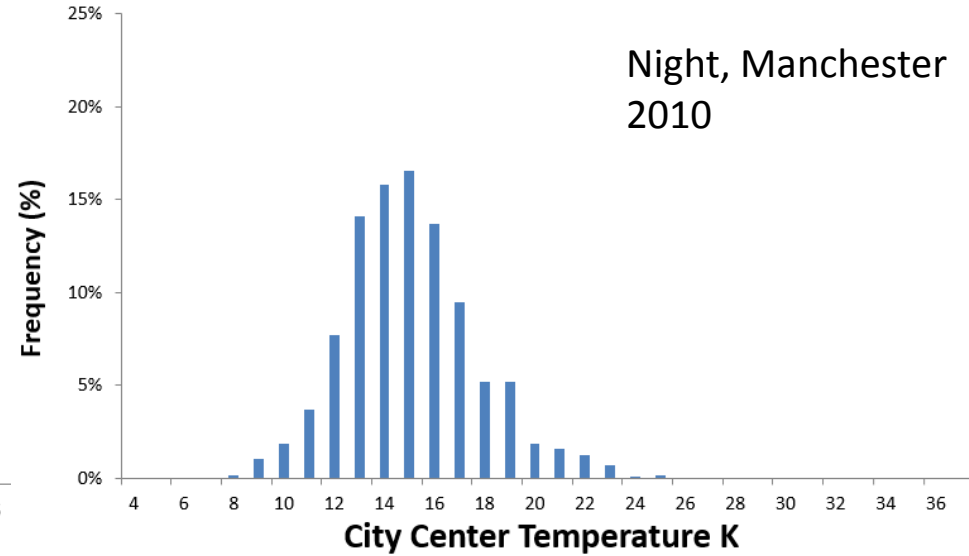
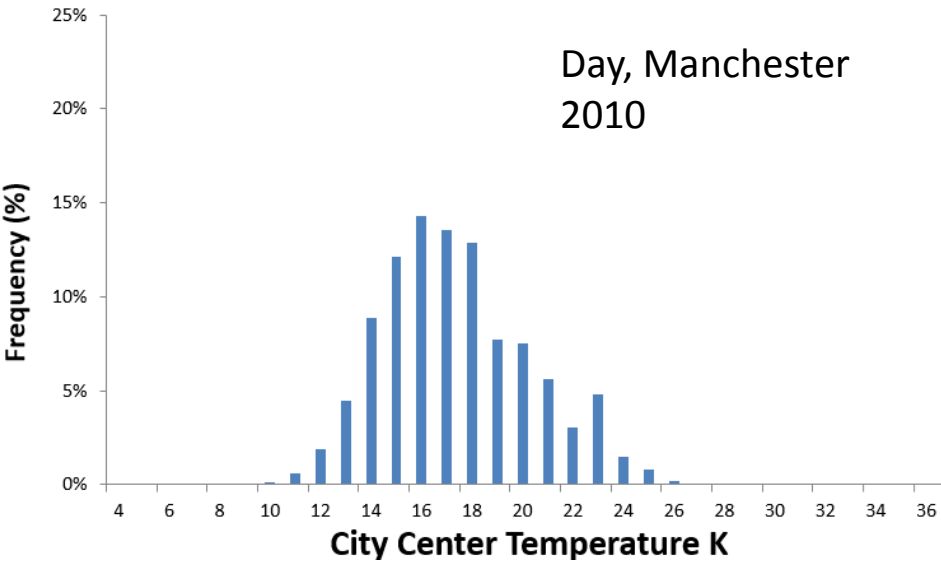




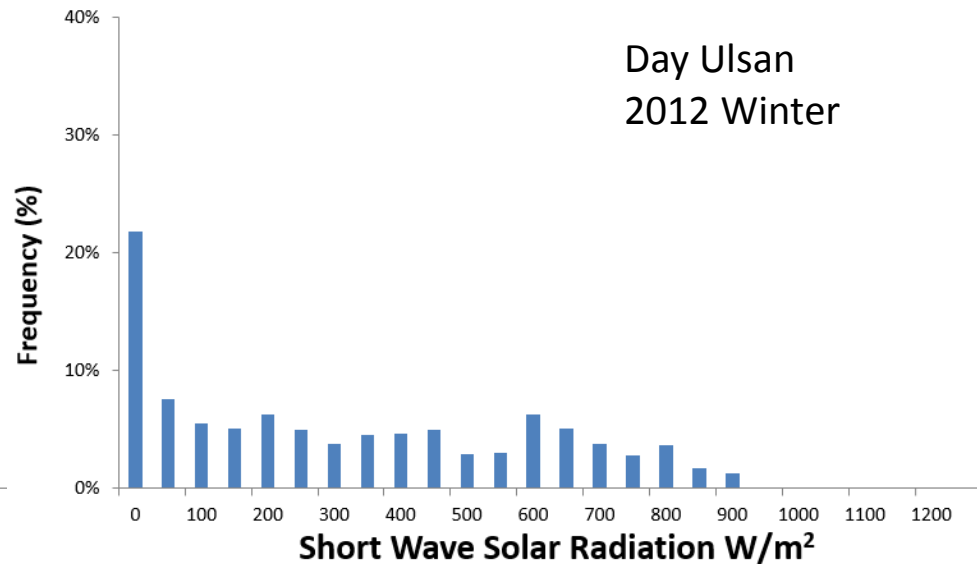
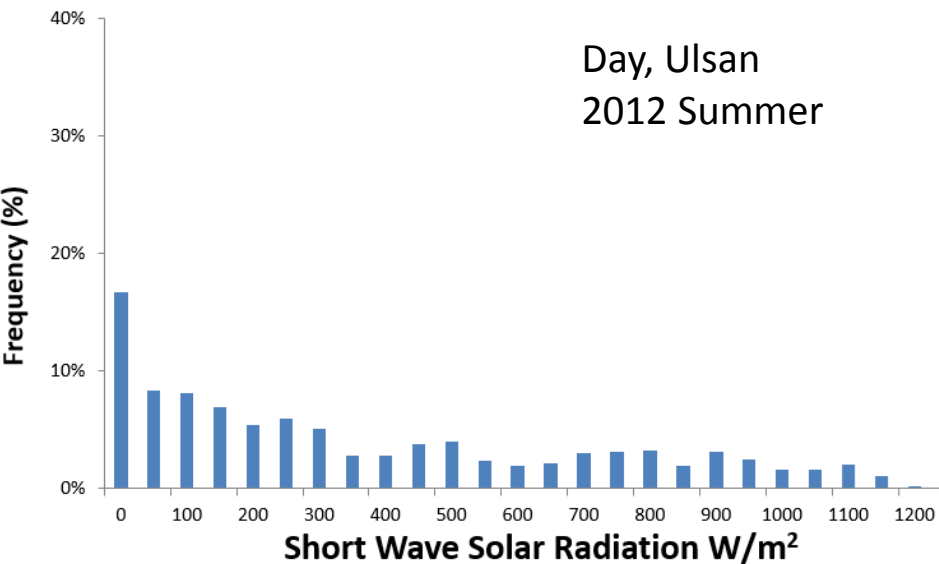
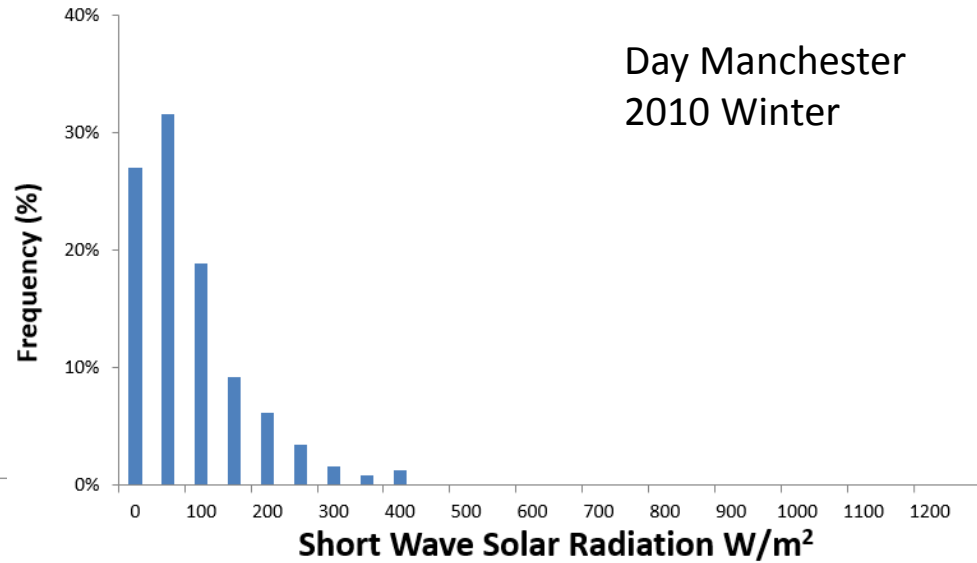
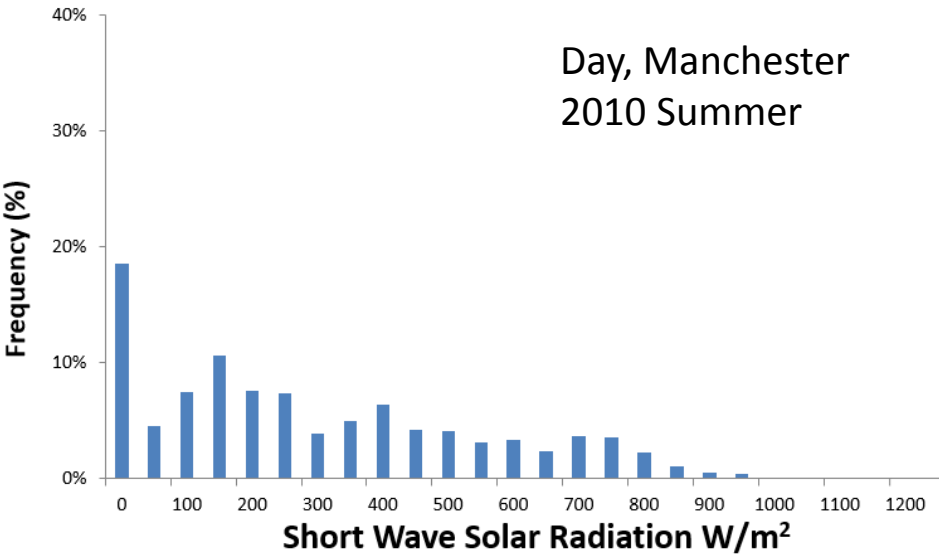
Ulsan Met-office, 2.5 km, 35m (151)



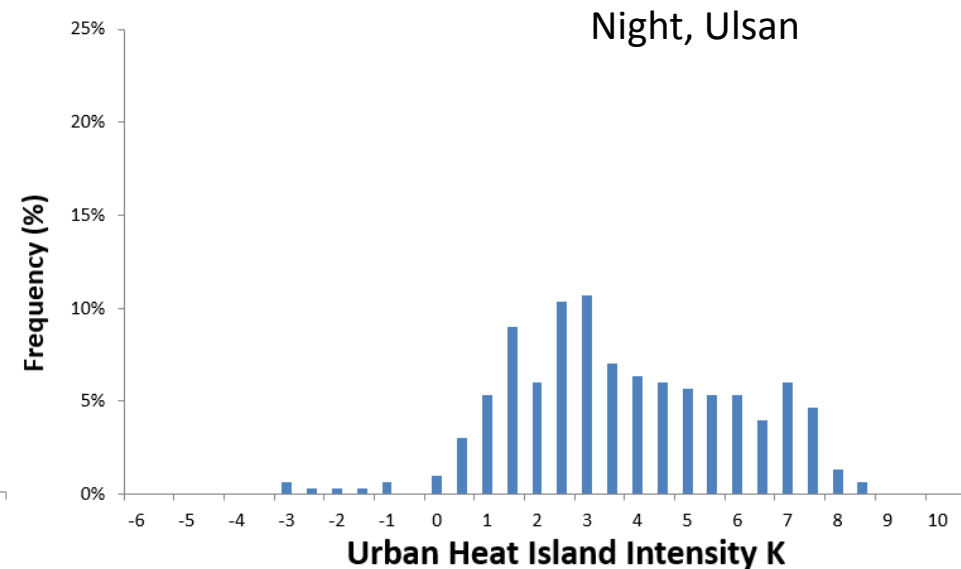
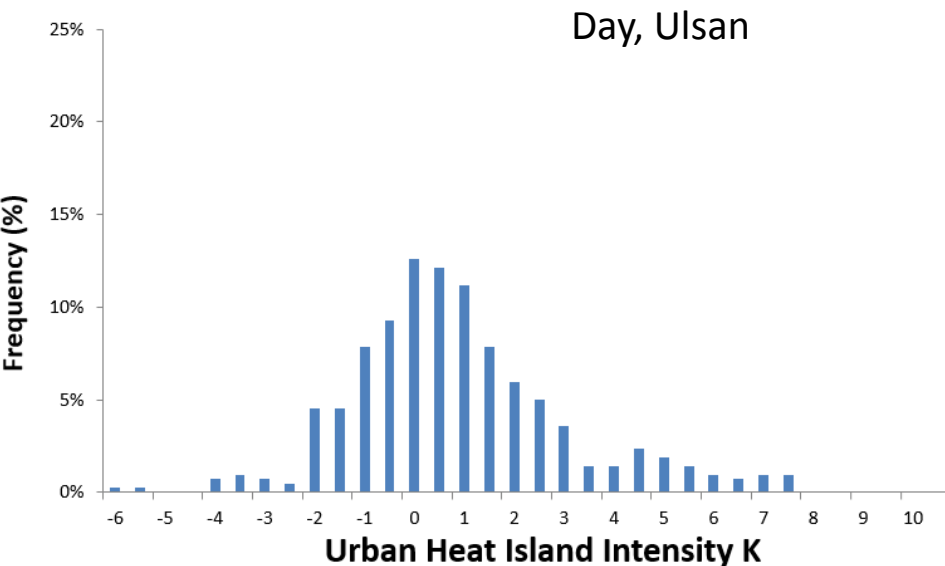
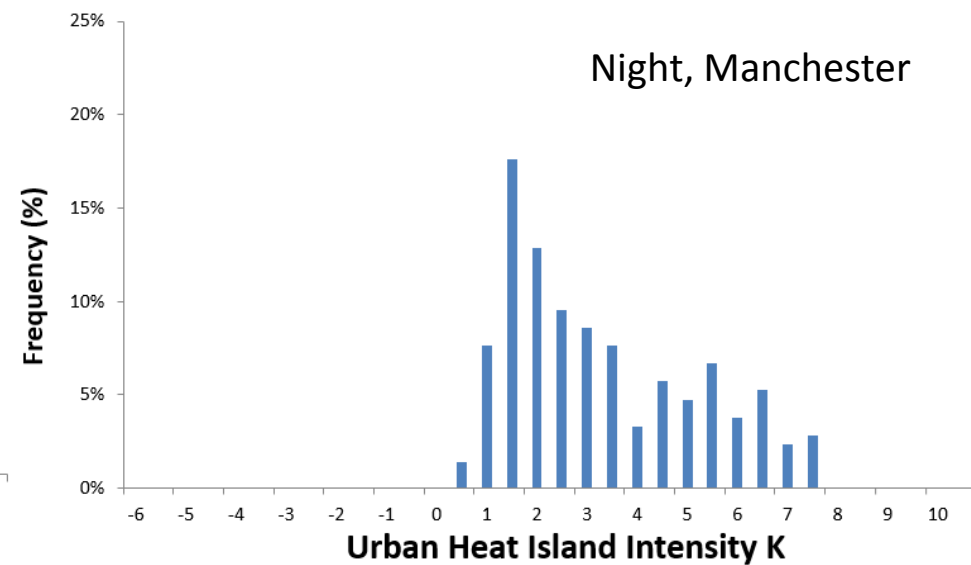
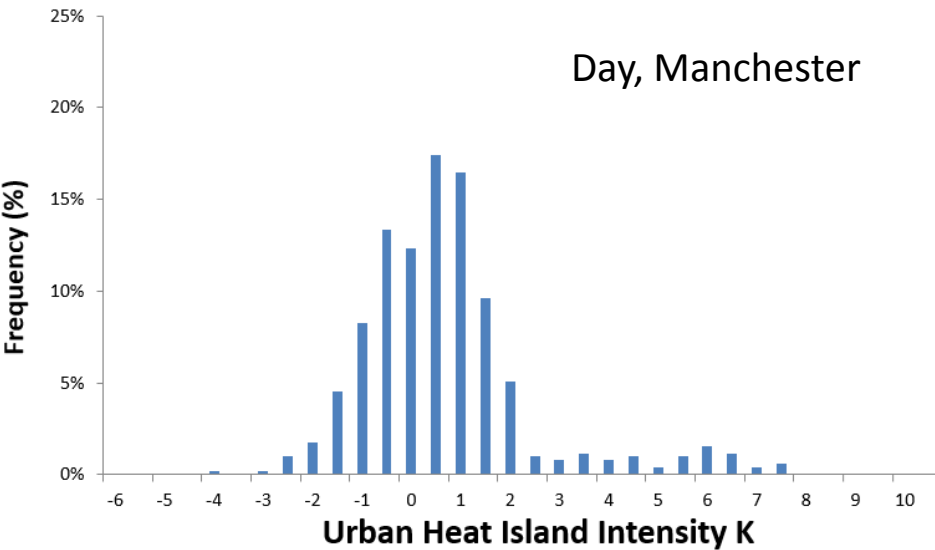
# Dry Air Temperature, Summer



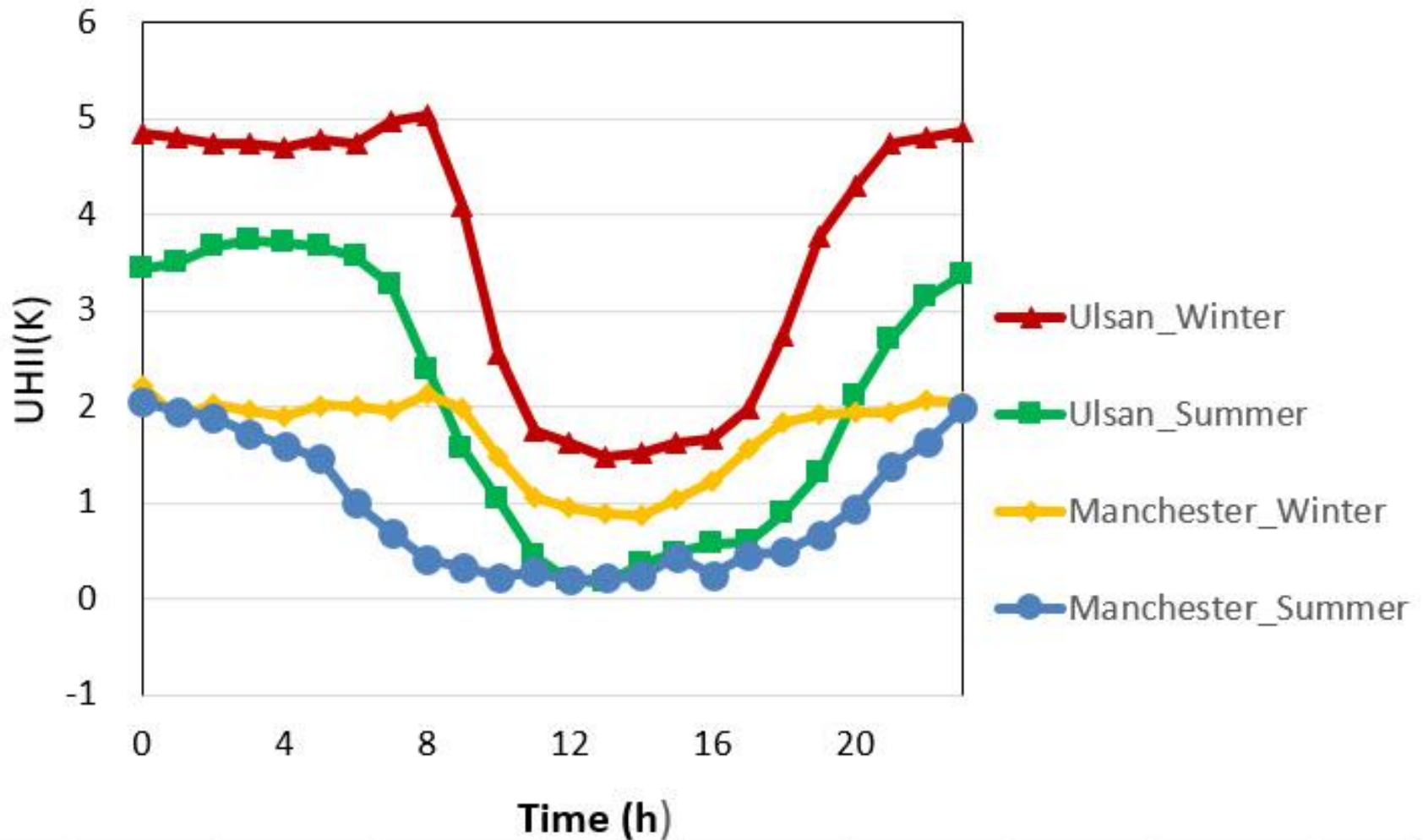
# Short Wave Solar Radiation



# UHI Intensity (UHII), Summer



# Correction factors for Ulsan and Manchester



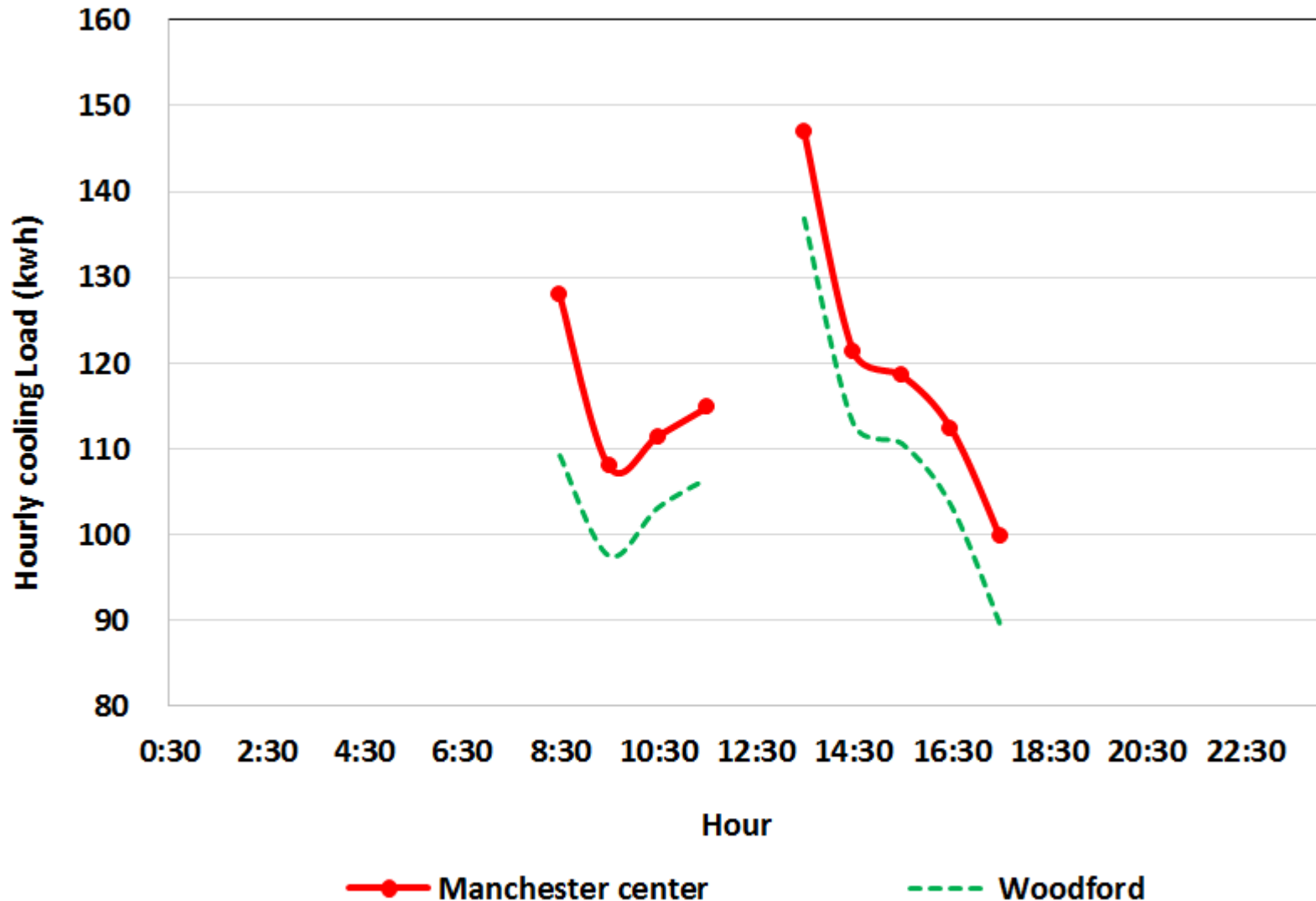
# Office simulation (IES) with and without UHI (K Lee)

## Building envelope parameters

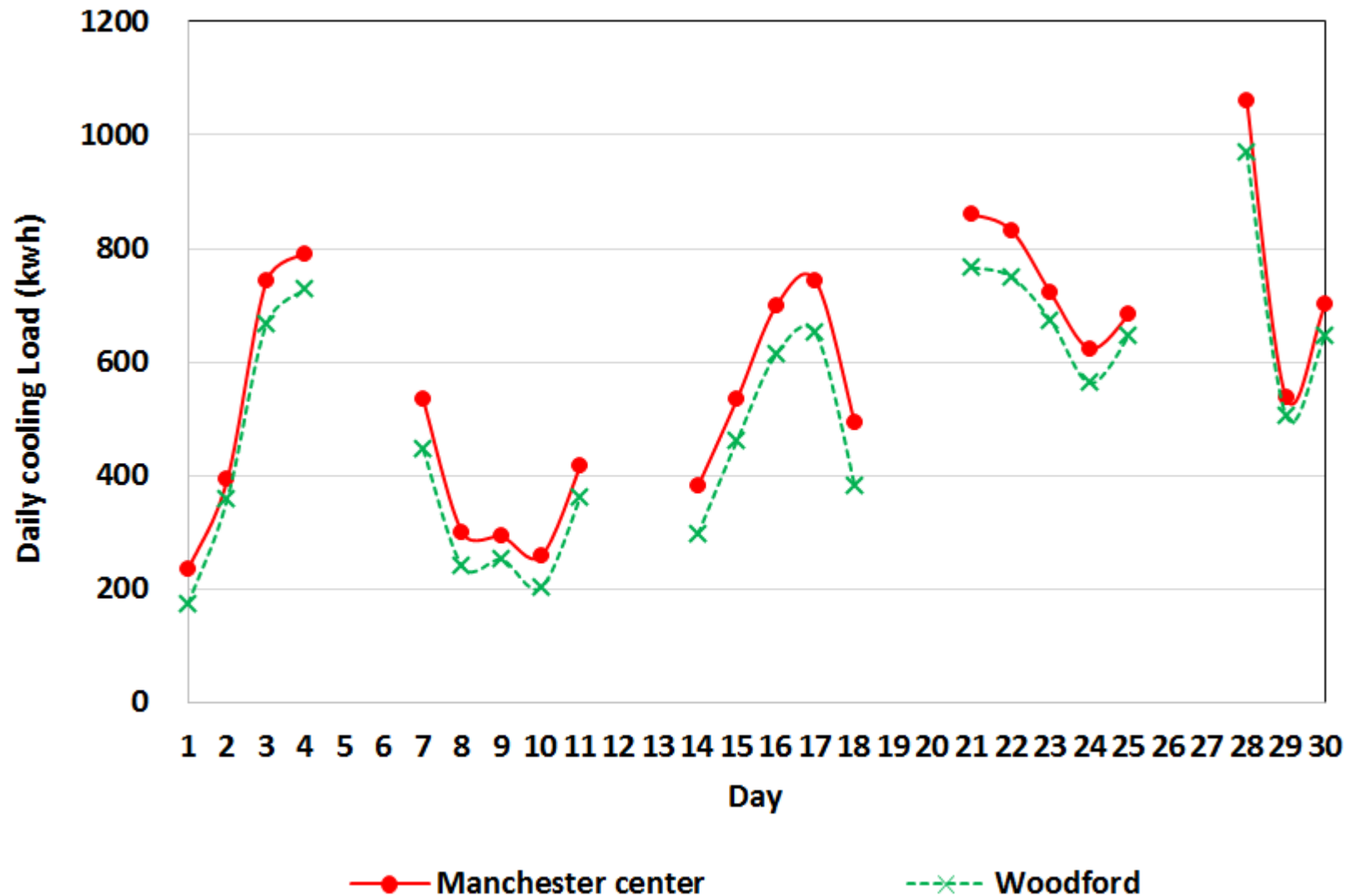
		Area(m <sup>2</sup> )	U-value
Floor		100	0.250
Ceiling		100	0.250
Wall	Exterior	60	0.350
	Windows	60	1.977
Height (m)		3	
Story		1	

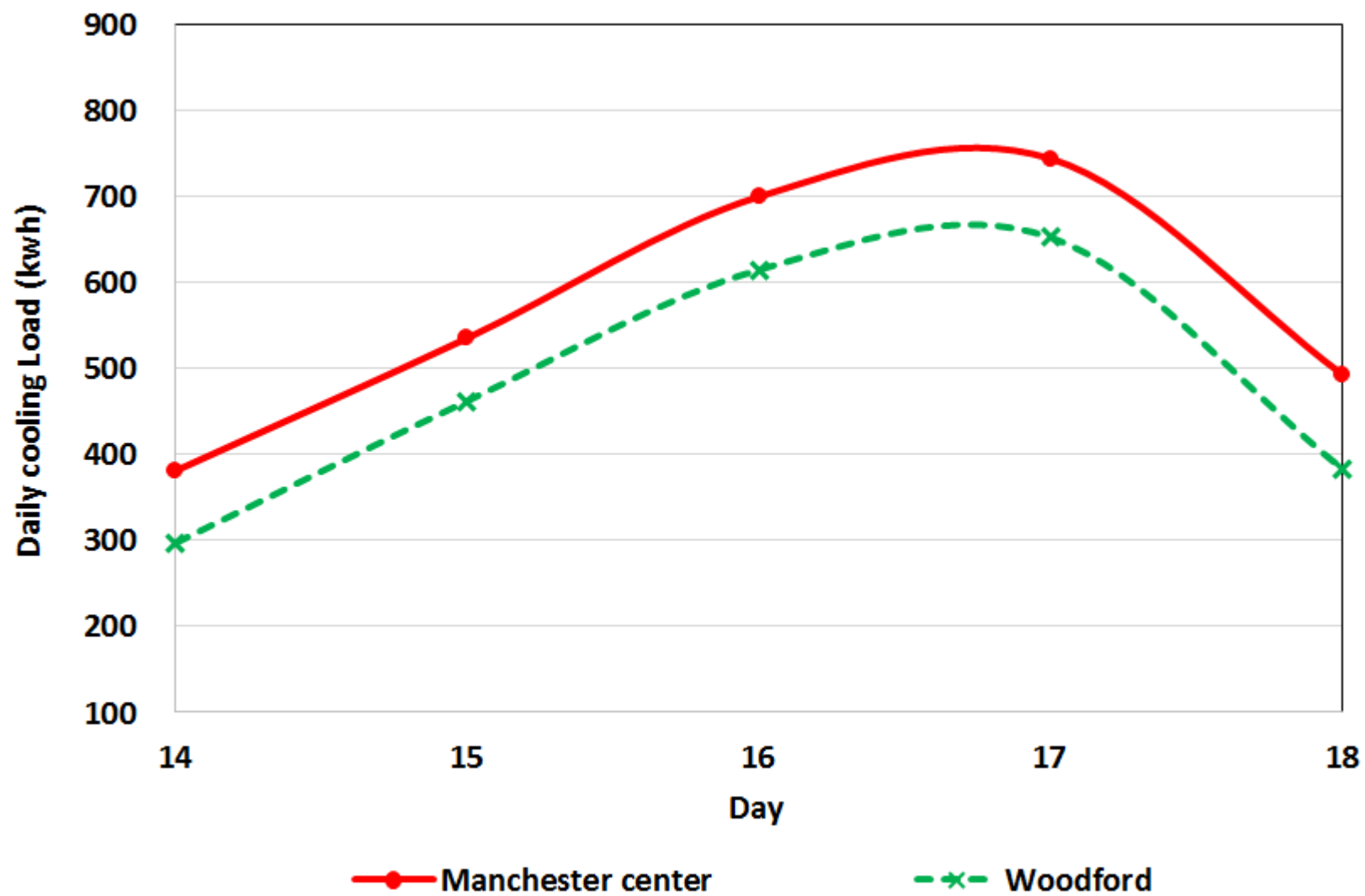


# Cooling load for Manchester on June 2010

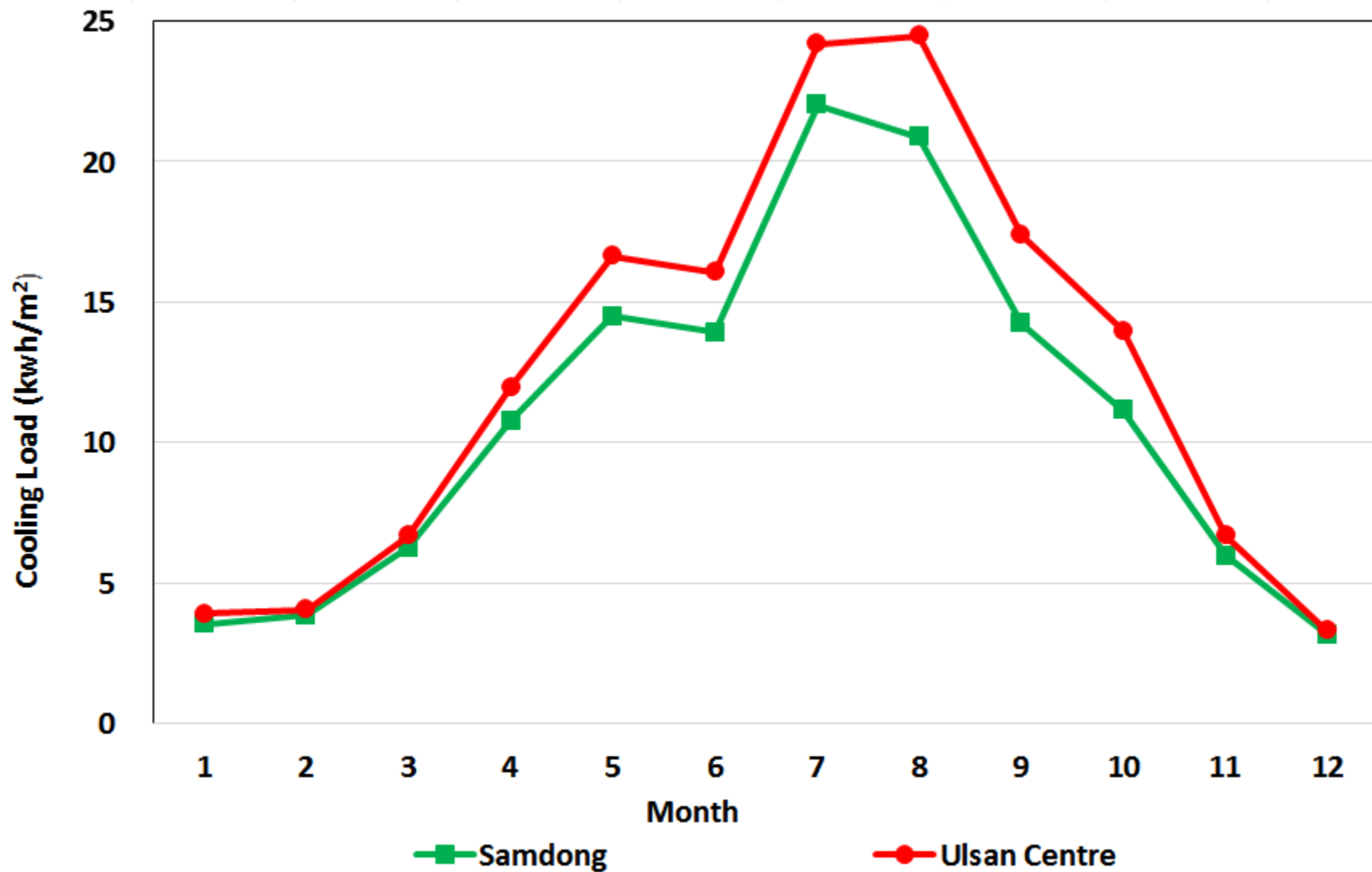


# Cooling load for Manchester on June 2010

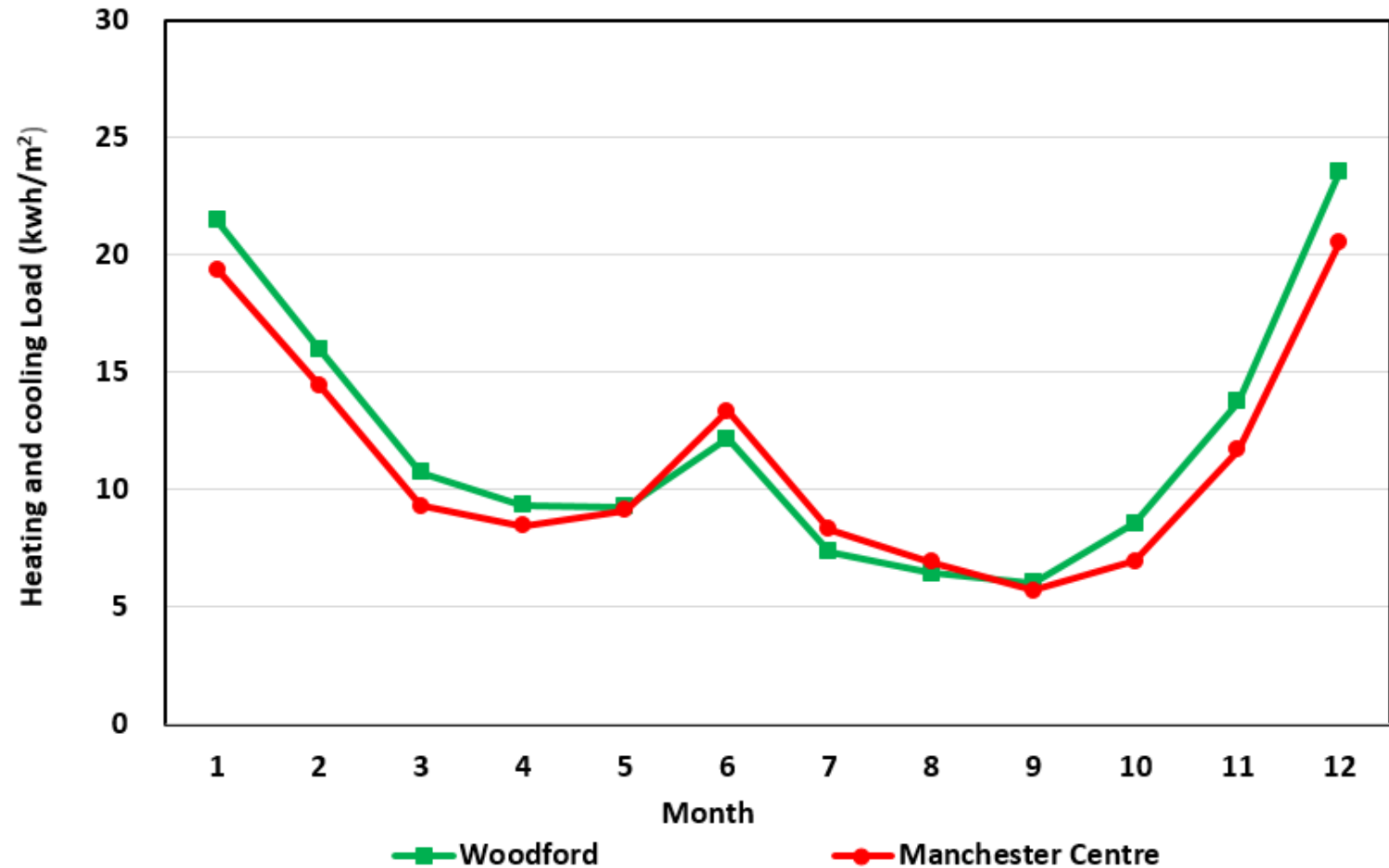




# Compare to Ulsan Centre and Rural Area

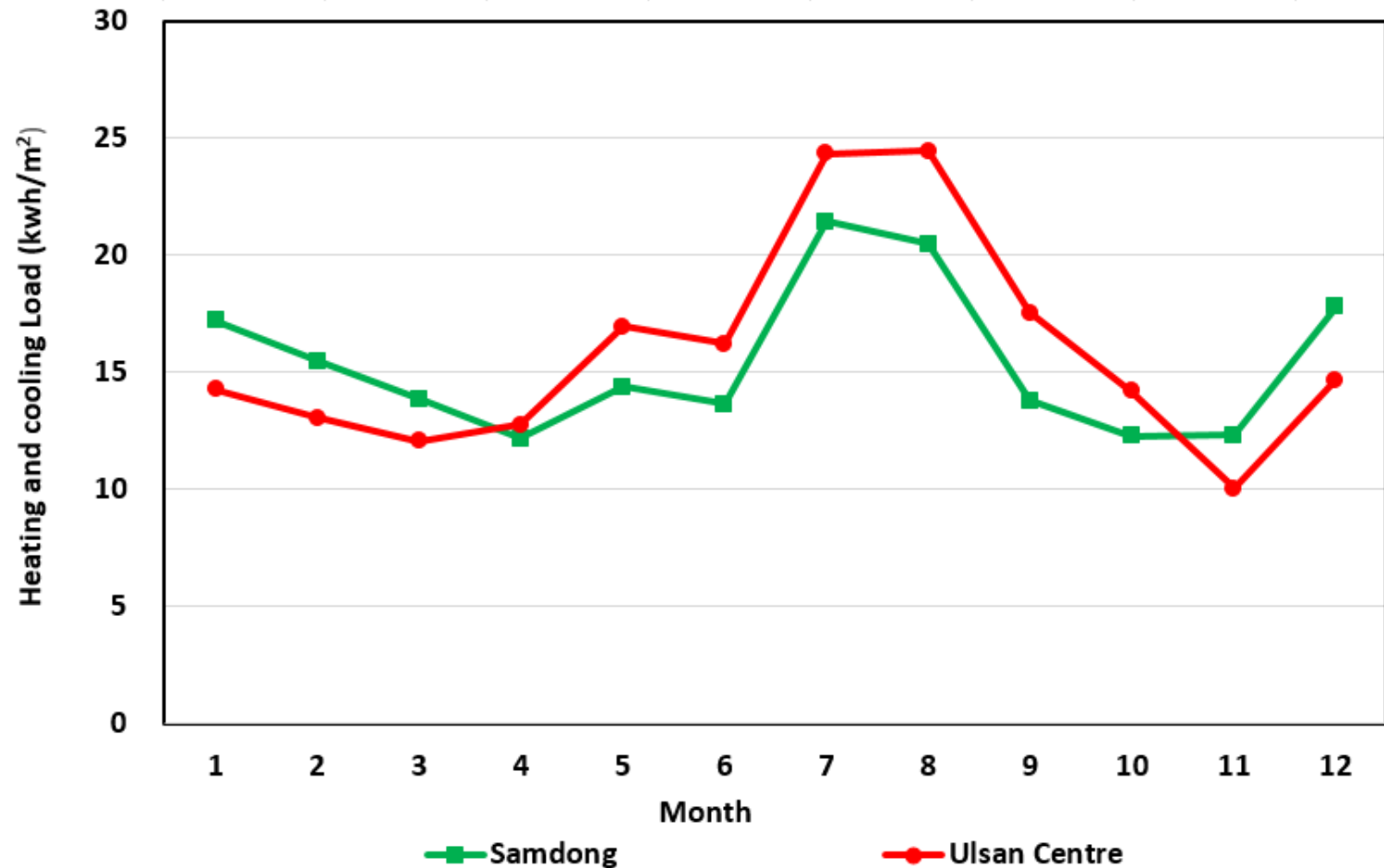


# Manchester heating and cooling loads with and without UHI





# Ulsan heating and cooling loads



# Conclusion

- The UHI does have a significant effect on the heating and cooling loads for Manchester and an even greater effect on the loads for Ulsan.