Heat Island of Mashhad Metropolis

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Extended abstract
1. Introduction
More than 45 percent of the world population lives in cities which will reach over sixty percent until 2030 (Small & Miller, 1999). The urbanization, population growth, physical development, land-use changes to benefit from construction, and urban micro-climate makes urban climatology. An increase in urban surface temperatures in relation to the suburban is called heat island. Temperature differences between downtown and the suburbs is occasionally 5-6°C. On calm and clear nights, the temperature is reported even 6-8°C in big cities (Barry & Chorley, 1987). “With TM images of Landsat on 5 July 1992 and 6 August 2002, heat island of Mashhad is determined” (Mosavi Bayegi, Batool, Farid Hossaini, Mianabadi, 2012, p.35). “Most heat island areas of Tehran are located in Dushan Tapeh, Fatemi, Mehrabad, Bahman and maximum thermal centers are in the station of Azadi, Bahman and Bazar” (Shmsipour, Mahdian Mahfrozi, Hoseinpour, 2012, p.197). “From 1986 to 2010, new heating clusters, increasing thermal clusters and spatial extent in Tehran is evident” (Sadeghinia, Alijani, & Ziaeiyan, 2012, p.1). “Heat island of Beijing in China is identified using Landsat TM images” (Jun, Peng, JinXing, HuABing & Lei, 2010, p. 67). “Heat island intensity of New York at night is related to the establishment of the center of cold air mass, clear sky, and northwes breeze wind” (Gedzelman et al., 2003, p. 29). “Heat island of San Juan in Puerto Rico has increased 2.4°C in the past forty years” (Velazquez, Lozada, Gonzalez & Winter, 2006, p. 1731). Urban heat island affects the urban economy, air pollution, water consumption, energy, decrease of mental and physical health, and quality of life of citizens. The city of Mashhad, Iran’s second city in the northeast between Binalud Mountain in the south and Hezarmasjed Mountain, is located in Kashaf Rood Valley. With an increase in population (over three million) and non-resident population (religious tourists and tourism), land-use change to residential, commercial, temporary accommodation (hotel-apartment), urban and suburban transportation is clear. Change of shape and pattern in cities is associated with the risks of urban heating and air pollution, and heat island. The present study thus aims to investigate the spatial distribution of heat islands of Mashhad metropolis through Landsat TM images.

2. Methodology
Heat island of Mashhad was identified through TM Image four of Landsat. Images in the warm period included 25 July 1992, 23 July 2000, 16 July 2009, and 7 August 2011, extracted from the Geological Survey of America. Humidity and temperature of Mashhad synoptic station was used to calculate the surface temperatures parameters and then the surface temperature maps were identified in this way. The land surface temperature to the sixth band TM images (thermal band) of Landsat was determined. “The extraction of land surface temperature to single-band algorithm includes the passing capacity of atmosphere, the average atmosphere, and the effective temperature of atmosphere, and surface emissivity” (Qin, Karnieli, & Berliner, 2001, p. 3719). Two meteorological parameters (air temperature near the surface and the amount of water vapor in the atmosphere of the area) along with the satellite overpass were used to calculate the passing capacity of atmosphere-average of atmosphere effective temperature. To calculate the surface emissivity, the vegetation index and other required parameters were used through the data files of TM images. The details of the temperature extraction model calculated from these sources were used (Sadeghinia, Alijani, & Ziaeiyan, 2012, p.1).

3. Discussion
Heat islands on 25 July from West to East are in the urban regions of twelve, ten, nine, two, and

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eight. In the main urban area of District 12, Northwest and Southern of District ten (the highway of Imam Ali), North of District two and South of District eight (municipality of District eight and bus terminal), and District 9 with the land use of military and barren lands have most surface temperature (55-59°C). The lowest temperature belongs to the gardens and urban green spaces, gardens of Malekabad, Ferdowsi Square, woodland gardens in southeast of Mashhad, North and East of marginal agricultural lands with temperatures less than 40°C. The surface temperature minimum is 28°C while maximum temperature is 59°C and the temperature variation is 31°C. The highest temperature (56-52 °C) on 23 July 2003 belongs to a large part of District twelve with dirt and rocky barren lands and empty space to high adsorption capacity, the south of Districts of ten and eight, and the southeast of District seven, respectively. Low temperatures of 34-26°C belongs to the two areas in Districts of two and nine with gardens, green spaces, villas, low population density and few high buildings. On 16 July of 2009, minimum and maximum temperature of the surface is 26 and 57°C with variation of 31°C belonging to District twelve, the south of Districts of seven, eight, nine, ten have maximum temperature to 52-62°C, respectively. Urban District 2 having gardens of Astan Quds Razavi between Ferdowsi Square and Khayyam has the minimum surface temperature of 36-25°C. Mellat Park in the North of urban nine areas and Kohsangi Park in northeast east of urban eleven areas have low surface temperature. Surface temperature in 7 August 2011 in urban District 12 and south of urban districts of seven, eight, nine, and ten is 41-49°C. In the center of urban District 2, the southeast of District 11 and Northeast of District 9 have the lowest surface temperature (27-31°C) and surface temperature is 44-49°C in District 12. The surface temperature is high in Piroozi Boulevar, Fakouri area and residential areas between the Ghaem and Imam Ali, the large area of desert and dry due to the lack of vegetation and the presence of Imam Ali Highway. Temperature in the Hashemi Nejad International Airport with wasteland and lack of vegetation land is 49°C. The surface temperature of Mellat Park is 31-27°C. The reduction of relative humidity on 16 July 2009 to 16 percent caused an increase in the surface and air temperature to 62 and 33°C, respectively.

4. Conclusion and suggestion
Heat island in city of Mashhad with physical development and urbanization has increased and this is more evident after eighty decades. Heat islands are created in areas of land use of user-covered wasteland, mountains and open vacant space, railways, airports, industries, urban and inter-urban highways. Heat island in the urban Districts of twelve, eight, and Samen with surface coverage of pavement, buildings, construction density, street pavement, and heavy traffic jams are barren lands having much moisture without vegetation. First center of heat island during four years of study is urban District 12 with further land use and possible high radiation absorption and reduction of vegetation. The second center of heat island is urban District 8 with land use of asphalted highway and coverage, the high volume of traffic and two military zones with barren lands. The temperatures are low in parks and gardens with green space due to the tree vast vegetation, humidity, shadow, and evapotranspiration process. The areas with high temperature are created through the change and loss of vegetation in the gardens in the city. Given the physical development of Mashhad, the increase of heat island is an inevitable process. In addition, using the appropriate managerial and common practical methods in other parts of the world are required here due to the environmental capabilities of the region.

Keywords: Surface Temperature, Heat Island, Metropolitan of Mashhad, Spatial Distribution
References (in English)


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