World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:14, No:07, 2020

Investigating the Urban Heat Island Phenomenon in A Desert City Aiming at Sustainable Buildings

Authors : Afifa Mohammed, Gloria Pignatta, Mattheos Santamouris, Evangelia Topriska

Abstract : Climate change is one of the global challenges that is exacerbated by the rapid growth of urbanizations. Urban Heat Island (UHI) phenomenon can be considered as an effect of the urbanization and it is responsible together with the Climate change of the overheating of urban cities and downtowns. The purpose of this paper is to quantify and perform analysis of UHI Intensity in Dubai, United Arab Emirates (UAE), through checking the relationship between the UHI and different meteorological parameters (e.g., temperature, winds speed, winds direction). Climate data were collected from three meteorological stations in Dubai (e.g., Dubai Airport - Station 1, Al-Maktoum Airport - Station 2 and Saih Al-Salem - Station 3) for a period of five years (e.g., 2014 – 2018) based upon hourly rates, and following clustering technique as one of the methodology tools of measurements. The collected data of each station were divided into six clusters upon the winds directions, either from the seaside or from the desert side, or from the coastal side which is in between both aforementioned winds sources, to investigate the relationship between temperature degrees and winds speed values through UHI measurements for Dubai Airport - Station 1 compared with the same of Al-Maktoum Airport - Station 2. In this case, the UHI value is determined by the temperature difference of both stations, where Station 1 is considered as located in an urban area and Station 2 is considered as located in a suburban area. The same UHI calculations has been applied for Al-Maktoum Airport - Station 2 and Saih Salem - Station 3 where Station 2 is considered as located in an urban area and Station 3 is considered as located in a suburban area. The performed analysis aims to investigate the relation between the two environmental parameters (e.g., Temperature and Winds Speed) and the Urban Heat Island (UHI) intensity when the wind comes from the seaside, from the desert, and the remaining directions. The analysis shows that the correlation between the temperatures with both UHI intensity (e.g., temperature difference between Dubai Airport - Station 1 and Saih Al-Salem - Station 3 and between Al-Maktoum Airport - Station 2 and Saih Al-Salem - Station 3 (through station 1 & 2) is strong and has a negative relationship when the wind is coming from the seaside comparing between the two stations 1 and 2, while the relationship is almost zero (no relation) when the wind is coming from the desert side. The relation is independent between the two parameters, e.g., temperature and UHI, on Station 2, during the same procedures, the correlation between the urban heat island UHI phenomenon and wind speed is weak for both stations when wind direction is coming from the seaside comparing the station 1 and 2, while it was found that there’s no relationship between urban heat island phenomenon and wind speed when wind direction is coming from desert side. The conclusion could be summarized saying that the wind coming from the seaside or from the desert side have a different effect on UHI, which is strongly affected by meteorological parameters. The output of this study will enable more determination of UHI phenomenon under desert climate, which will help to inform about the UHI phenomenon and intensity and extract recommendations in two main categories such as planning of new cities and designing of buildings.

Keywords : meteorological data, subtropical desert climate, urban climate, urban heat island (UHI)
Conference Title : ICUC 2020 : International Conference on Urban Climate
Conference Location : Toronto, Canada
Conference Dates : July 16-17, 2020