

Satellite Based Assessment of Urban Heat Island Effects on Major Cities of Pakistan

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Abstract : In the last few decades, urbanization worldwide has been sprawled manifold, which is denunciated in the growth of urban infrastructure and transportation. Urban Heat Island (UHI) can induce deterioration of the living environment, disabilities, and rises in energy usages. In this study, the prevalence/presence of Surface Urban Heat Island (SUHI) effect in major cities of Pakistan, including Islamabad, Rawalpindi, Lahore, Karachi, Quetta, and Peshawar has been investigated. Landsat and SPOT satellite images were acquired for the assessment of urban sprawl. MODIS Land Surface Temperature product MOD11A2 was acquired between 1000-1200 hours (local time) for assessment of urban heat island. The results of urban sprawl informed that the extent of Islamabad and Rawalpindi urban area increased from 240 km² to 624 km² between 2000 and 2016, accounted 24 km² per year, Lahore 29 km², accounted 1.6 km² per year, Karachi 261 km², accounted for 16 km²/ per year, Peshawar 63 km², accounted 4 km²/per year, and Quetta 76 km²/per year, accounted 5 km²/per year approximately. The average Surface Urban Heat Island (SUHI) magnitude is observed at a scale of 0.63 °C for Islamabad and Rawalpindi, 1.25 °C for Lahore, and 1.16 °C for Karachi, which is 0.89 °C for Quetta, and 1.08 °C for Peshawar from 2000 to 2016. The pixel-based maximum SUHI intensity reaches up to about 11.40 °C for Islamabad and Rawalpindi, 15.66 °C for Lahore, 11.20 °C for Karachi, 14.61 °C for Quetta, and 15.22 °C for Peshawar from the baseline of zero degrees Centigrade (°C). The overall trend of SUHI in planned cities (e.g., Islamabad) is not found to increase significantly. Spatial and temporal patterns of SUHI for selected cities reveal heterogeneity and a unique pattern for each city. It is well recognized that SUHI intensity is modulated by land use/land cover patterns (due to their different surface properties and cooling rates), meteorological conditions, and anthropogenic activities. The study concluded that the selected cities (Islamabad, Rawalpindi, Lahore, Karachi, Quetta, and Peshawar) are examples where dense urban pockets observed about 15 °C warmer than a nearby rural area.

Keywords : urban heat island , surface urban heat island , urbanization, anthropogenic source

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