



Urban Development and the Effects upon the Environment in Hanoi Based on the Observations During 1999-2016

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The metropolitan city, Hanoi in Vietnam, has rapidly developed since 1990 with the continuous increase of socio-economic indicators. However, the environmental consequences of urban development can cause considerable concern. Therefore, this study intends to give evidence for the effects of urban development on urban sprawl, UHI phenomena and on the quality of urban life in period 1999-2016. The Landsat images at three time-points 1999, 2009 and 2016 and the data from ground-based stations were used to achieve these purposes. The spatial distribution changes are shown in Land use/land cover, the normalized difference vegetation index (NDVI), the normalized difference built-up index (NDBI) and land surface temperature (LST) maps indicate the influence of urban sprawl on the development of UHI. The UHI map was produced shows the expansion of the UHI zone outside the city center over time and towards the north, creating the potential for the formation of new UHI area in the future. Furthermore, the intensified UHI has been driven by the increase in urbanization indicators based on the regression analysis. Urban Thermal Field Variance Index (UTFVI) was used for ecological assessment, showing that in general, over 30% of the city has a bad ecological quality. The analysis of meteorological parameters revealed that the urbanization in Hanoi also affects regional weather in relative humidity, total rainfall, temperature and wind speed over both urban and rural areas. The overall results might imply that urban development and its effects on the environment are challenges to the sustainable development of an increasingly urbanized Hanoi, which should be paid more attention.