

Characterizing the Urban Heat Island Phenomenon in Cabanatuan City using Weather Research and Forecasting (WRF) Model

Cabanatuan is one of the emerging cities in the country and the center of commerce and industrialization in the province of Nueva Ecija. Land conversion from green spaces into impervious surfaces is imminent in the recent years and population in the area are continuously increasing. With this, the researcher hypothesized the existence of Urban Heat Island (UHI) phenomenon there. This study aimed to investigate and characterize UHI phenomenon in Cabanatuan using Weather Research and Forecasting (WRF) model (Skamarock et al., 2008).

Correlations of meteorological parameters such as relative humidity, station pressure, rainfall and wind speed with temperature were determined. Relative humidity ($R=-0.7459$), station pressure ($R=-0.1826$), rainfall ($R=-0.1948$) and wind speed ($R=0.0334$) were found to be significantly correlated with temperature.

Trend detection were analyzed for T_{\max} , T_{\min} and diurnal temperature range (DTR). In both northeast seasons, significant trends were found for T_{\min} and (DTR). There is a significant monotonic increasing trend in T_{\min} rate of increase of $0.0667\text{ }^{\circ}\text{C/year}$ (NE) and $0.04\text{ }^{\circ}\text{C/year}$ (SW). For DTR, there is a significant monotonic decreasing trend for DTR with rate of decrease of $-0.0833\text{ }^{\circ}\text{C/year}$ (NE) and $-0.0571\text{ }^{\circ}\text{C/year}$ (SW). No significant trend were detected for T_{\max} in both seasons.

The WRF modelling system was compared and evaluated against synoptic observations. It was found to be satisfactorily demonstrate skill in simulating near-surface air temperature. During NE monsoon season, two peaks are discernable in the diurnal UHI intensity evolution: (i) before the sun rises ($0.51\text{ }^{\circ}\text{C}$); and (ii) before the sun sets ($0.58\text{ }^{\circ}\text{C}$). On the average, the temperature in the city is relatively hotter compared to neighboring non-urban areas during this season. The UHI intensity during SW monsoon season is lower compared to NE monsoon season with only peak during late afternoon ($0.18\text{ }^{\circ}\text{C}$). Spatio-temporal analysis of temperature variation in the area suggested that temperature in the study area is highly dependent with topographical height with temperature lower in higher areas. There were also no discernable hot spots or cold spots in the city which may be linked to city's relatively small size and built-up fraction. Overall, this showed that UHI in Cabanatuan City is relatively small in magnitude as well as small in temperature gradient between urban-to-non-urban areas, which is more prominent during the NE monsoon season.

Keywords: urbanization, WRF modelling, UHI, DTR Trends