IMPACT OF URBANIZATION ON EXTREME HEAT EVENTS IN METROPOLITAN CEBU USING WEATHER RESEARCH AND FORECASTING MODEL

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ABSTRACT

Metropolitan Cebu is the principal urban area of Cebu province in the Philippines. It covers 19.9% of the province's land and houses 61.5% of its population according to the 2020 census. It comprises Cebu City and twelve surrounding cities and municipalities. As of 2020, Metro Cebu is the largest metropolitan area in Visayas and the third largest in the Philippines by urban population, following Metro Manila and Metro Davao, respectively. Urbanization occurs as a consequence of the physical expansion of urban areas driven by population growth. The rising demand for housing in urban areas has led to significant shifts in land use, where green spaces are frequently replaced with high-rise buildings and roads. These changes often contribute to the Urban Heat Island (UHI) effect, causing urban areas to experience higher temperatures than their rural counterparts due to human activities and infrastructure. By assessing this impact, we can better understand how much warmer Metropolitan Cebu is compared to its rural surroundings, which is essential for developing strategies to mitigate these effects. Comprehensive data on the influence of urbanization on extreme heat events will be invaluable for policymakers, urban planners, and researchers, enabling informed, evidence-based decision-making for sustainable urban growth. Thus, this study aims to analyze the role of the UHI effect and anthropogenic heat in rising surface temperatures during extreme heat events in Metropolitan Cebu, utilizing both observational data and modeling techniques. Extreme heat events are selected following the methodology of Russo et al. (2015), which defines the threshold as the 90th percentile over a 31-day moving window. By applying this percentile-based threshold, extreme heat events are effectively defined as periods when daily maximum temperatures exceed this value, thereby capturing the most intense and anomalous heat occurrences within the study area. From this, the longest five extreme heat events will be selected for detailed analysis. Daily maximum temperature data from 1980 to 2020 will be sourced from the National Centers for Environmental Information's Global Surface Summary of the Day (NCEI-GSOD). The study period was selected because major infrastructure projects were constructed in Metropolitan Cebu during this time. With additional infrastructure currently being developed, this study holds significant relevance. For this study, the meteorological data of the European Centre for Medium-Range Weather Forecasts ERA5 (ECMWF-ERA5) reanalysis with a grid resolution of $0.25° \times 0.25°$ that is prepared every hour will be utilized as the initial and boundary conditions of the model. The Weather Research and Forecasting (WRF) Model Version 4.5 coupled with Urban Canopy Model (UCM) will be utilized in the study. The output of the model will be validated using historical data from Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA).

Keywords: *urbanization, WRF, Metropolitan Cebu, urban heat island*