

ABSTRACT

THE INFLUENCE OF PLANETARY BOUNDARY LAYER HEIGHT ON PARTICULATE MATTER CONCENTRATION OVER QUEZON CITY

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The planetary boundary layer (PBL) height is the key parameter for several air pollution studies. It controls how the atmosphere interacts with the underlying surface and determines the available air volume for aerosol dispersion and transport. This study aims to examine the planetary boundary layer and how it evolves together with the particulate matter concentration over Quezon City, a highly urbanized city in the Philippines. Five-year PBL heights were extracted from wind profiler and radiosonde data using the algorithms based on median of the maxima range-corrected sound-to-noise ratio method and maximum gradient of potential temperature method. Spatiotemporal analysis was done using information from the observed measurements and an atmospheric model namely Weather Research and Forecasting (WRF). Results were compared to particulate matter measurement from the Lung Center of the Philippines in 2015 and from the Institute of Environmental Science and Meteorology in 2014. Based on the results, Strong diurnal and seasonal change was observed for both radiosonde and wind profiler PBL height. For wind profiler, the PBL peaks at 1000PST (2308.7 m) and its lowest point is at 0600 PST (1512.6 m). On average, the PBL height was highest in June (2648.3 m) and lowest in December (1072.7 m). WRF simulations shows similar behavior as compared to the observation and it depends on the seasonality and topographic characteristics. During the northeast monsoon, high PBL height was observed over Tanay mountain terrains due to mechanical turbulence brought by moderate wind speed (5 ms⁻¹ to 10 ms⁻¹) and the rest of the year thermal convection dominates the area of Metro Manila and the rest of Rizal's flat terrains. Highest PBL heights was observed over the area of Valenzuela, Northern Caloocan, Quezon City, Marikina, Pasig, Pateros and Taguig while the lowest PBL height was observed over Sierra Madre mountain terrains. PBL height near bodies of water and river is affected by marine boundary layer and high heat capacity of water which leads to lower PBL height. Correlation between the PM concentration and PBL height was found to be significantly correlated for fine particles counts (-0.42), PM2.5 (-0.65) and PM10 (-0.65). This study provides more information on how PBL affects the air quality over Quezon City and this serve as a tool in forecasting air pollution episodes and strengthen the connection of meteorology and air quality study in the country.

Keywords: PBL, wind profiler, radiosonde, WRF, particulate matter