INTERACTIONS BETWEEN AEROSOLS, PLANETARY BOUNDARY LAYER DYNAMICS, AND SEA-LAND BREEZE CIRCULATIONS UNDER DIFFERENT SYNOPTIC CONDITIONS IN METRO MANILA

Melliza Templonuevo Cruz

A Dissertation Proposal Submitted to the
Institute of Environmental Science and Meteorology
College of Science
University of the Philippines
Diliman, Quezon City

November 24, 2020

ABSTRACT

Aerosols, which are suspensions of solid and liquid particles in air, are known to have adverse effects on human health, visibility, climate, and the hydrological cycle. Its concentrations in a given area is dependent on emissions, secondary formation, transport, and meteorological conditions. It is therefore important to understand the complex interactions of these factors not only to aid in crafting effective control policies but also to improve air quality and climate predictions. The ability of aerosols to scatter and absorb solar radiation reduces the shortwave radiation reaching the surface and results in decreased surface fluxes that drive the evolution of the planetary boundary layer (PBL). In turn, PBL dynamics modulate aerosol concentrations through its influence on aerosol dispersion, mixing, transport, transformation, and deposition. Other than PBL dynamics, synoptic and mesoscale meteorology also influence aerosol concentrations through its effects on aerosol transport and distribution. In Metro Manila, known to have high aerosol concentrations with immense amounts of light-absorbing components, studies on the effects of PBL dynamics and synoptic as well as mesoscale meteorology have been scarce. This study will fill this gap by investigating the aerosol-PBL interactions as well as the influence of various synoptic (monsoons and transition periods) and mesoscale (sea-land breeze circulations) meteorological phenomena on aerosol concentrations. The radiative effect of aerosols will be determined using the Fu-Liou Radiative Transfer Model with aerosol optical depth (AOD) input derived from the AERONET (AErosol RObotic NETwork) sun photometer installed at the Manila Observatory (MO). Aerosol-PBL interactions will be analyzed using surface aerosol concentration measurements as well as aerosol backscatter profiles from a High Spectral Resolution Lidar (HSRL) installed in MO as part of the Cloud, Aerosol, and Monsoon Processes Philippines Experiment (CAMP^{2}Ex) weatHEr and CompoSition Monitoring (CHECSM) campaign. Trends in the observed winds from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) and MO stations will be compared with surface aerosol concentrations under different synoptic conditions in order to investigate the effect of sea-land breeze circulations on aerosol concentrations. Lastly, the Weather Research and Forecasting - Chemistry (WRF-Chem) model will be used to aid in synthesizing these interactions temporally and on a three-dimensional spatial scale.