IMPACTS OF AEROSOL-CLOUD INTERACTIONS ON SIMULATED THUNDERSTORM EVENTS OVER METRO MANILA AND ILOCOS NORTE, PHILPPINES

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ABSTRACT

The increasing rate of urbanization and industrialization entails more anthropogenic emissions resulting in an increased concentration of airborne pollutants in the atmosphere like aerosols. Aerosols are tiny solid or liquid particles suspended in the atmosphere. Despite being small in size, they play a significant role in regulating the Earth's climate by influencing the planet's radiative balance and acting as cloud condensation nuclei (CCN) during cloud formation. The complex forcing mechanisms of aerosols in the atmosphere contribute to large uncertainties in modeling climate scenarios. Thus, this study aims to provide a better understanding of aerosol-cloud-precipitation interactions to reduce uncertainties in model estimates for convective systems by incorporating aerosol feedback in numerical simulations.

The study will focus on the mechanisms of aerosol-cloud interactions for convective systems over Metro Manila and Ilocos Norte, two regions with different levels of urbanization. Numerical experiments using Weather Research and Forecasting (WRF) model with the framework of the Thompson aerosol-aware microphysics scheme will be used to simulate three cases of thunderstorm events during the months of June, July, and August from 2018 to 2020 over the regions of interest. Sulfates, sea salt, organic carbon, and black carbon will be ingested in convective systems as cloud condensation nuclei (CCN), while mineral dust will be activated as ice nuclei (IN). CCN number concentrations will be varied per case simulation representing clean, control, and polluted conditions. Results of the simulations will be analyzed to determine (1) the effect of varying aerosol concentration to cloud formation and thunderstorm precipitation, (2) the relationship between aerosol concentration and convective cloud microphysical properties, and (3) the mechanisms of aerosol-cloud-precipitation interaction in an urban versus a rural setting.

Keywords: Aerosol-cloud interactions, thunderstorm, Weather Research and Forecasting