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ABSTRACT

Atmospheric aerosols are widely known to have detrimental health and climate impacts and this issue is a serious concern in Metro Manila, the most densely populated region in the Philippines, since it affects the welfare of 12.9 million residents in the region. Most local studies focus on the health impacts but the aerosol patterns in the region has not been studied in-depth and the effect on climate is not given much emphasis. To better understand their optical evolution, temporal and spatial evolution and radiative forcing effects, MODIS Terra and Aqua aerosol datasets from 2003 to 2017 were studied for trends in aerosol optical depth (AOD), angstrom exponent (AE) and single scattering albedo (SSA), to be used as input in radiative forcing calculations. From the retrieved AOD, it was found out that aerosol loading in Metro Manila is higher during the wet season (May to October) than the dry season (November to April). Higher relative humidity was found to increase AOD due to their effect on the hygroscopic growth of aerosols. This leads to aerosols high scattering values, as revealed by the very high SSA values (above 0.9). The presence of anthropogenic aerosols in the morning is confirmed by the higher AE and lower SSA values compared to afternoon. From the Mann-Kendall trend test, there is a significant decrease in mean afternoon dry season AOD in Metro Manila from 2004 to 2017, with a rate of -0.0042/year, and this is faster than the reported global negative trend. The decrease in dry season AOD coincided with the decreasing black carbon, nitrogen oxides and sulfur dioxide in recent year. MODIS aerosol maps revealed that seasonal haze events from neighboring countries like Indonesia and very high aerosol loading from China do not affect the aerosol loading in Metro Manila through long range transport. From the TUV radiative transfer model, the computed aerosol radiative forcing (ARF) values were all negative indicating that aerosols in the region tends to cool the climate, and this is due to the highly scattering nature of the particles. Among the input variables in the model, sensitivity analysis revealed that AOD has the biggest impact on radiative forcing. Mann-Kendall test revealed a significant increase in mean afternoon dry season ARF in the 14-year period which is caused by decreasing AOD through the years. Mean dry season ARF and land surface temperature were found to have a weak positive correlation (average $R^2 = 0.3$) signifying that the decreasing aerosols in the region causes warmer condition in the region.