Changes in ground-level PM mass concentration and column aerosol optical depth over East Asia during 2004-2014

SANG-WOO KIM AND JIHYUN NAM[1]

[1]School of Earth and Environmental Sciences, Seoul National University, Seoul 151-747, Republic of Korea

Understanding local and regional air quality degradation and climate change is an important concept to perceive the impact of aerosol concentrations in human health and climate. Multi-year records of MODIS onboard Aqua, space-borne lidar CALIOP onboard CALIPSO, Mie lidar, and particulate matter (PM) mass concentration measurements in East Asia are analyzed to investigate the changes in column aerosol optical depth (AOD) and ground-level PM mass concentration over the past decade. We present estimated trends of aerosol properties for five regions from 2004 to 2014, using Weatherhead's statistical trend analysis model (Weatherhead et al., 1998, 2000). Regions were selected to represent main source of anthropogenic and natural mineral dust aerosols in East China, Yellow sea region with transported anthropogenic aerosols from adjacent China industrial region, and three pacific regions with main source of sea salt aerosols in between Korea Peninsula and Japan, South of Japan, and East of Japan, respectively. AODs from both MODIS and CALIOP for five selected regions show no significant trends. For regions heavily influenced by anthropogenic aerosols, a positive trend in Ångström exponent (Å) observed with maximum magnitude of 1.6% per year, however, remote ocean regions influenced by sea salt aerosols show negative trends with maximum magnitude of -1.2% per year. In general, increasing trend of Å can be explained by an increasing proportion of fine mode particles emitted mainly from industrialized areas of Asian continent. It has further been investigated by choosing 8-station in China and 2-station in Korea that annual variations of column AOD for these stations agrees well with the regional trends. However, ground-level PM mass concentration measurements of each stations show mostly significant decreasing trend with magnitude up to -3.8% per year and -4.7% per year in China and Korea, respectively. Vertically resolved AOD at Seoul, Korea is calculated from ground-based lidar measurement during the study period 2007-2014. Surface AOD, which is obtained by an integral of aerosol extinction coefficient from surface to 1 km altitude, has decreased with magnitude of -1.95% per year, but AOD for free atmosphere (i.e., between 1 km to 5 km altitude) are shown no significant trend.