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Seasonal variations in the physico-chemical characteristics of aerosols in North Taiwan

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From 2007 to 2012, this study investigated the mass concentration and chemical composition of ambient aerosols (i.e. PM10, PM2.5, and PMc = PM10-PM2.5) at Cape Fuguei, Yangminshan, and NTU (National Taiwan University) stations in northern Taiwan. It was found that the concentration and composition of aerosols exhibited significant seasonal variations but without an inter-annual trend during the study period. Moderate correlations (R2 = 0.4-0.6) were observed among the aerosol concentrations at the respective stations, indicating that the aerosol concentrations were dominated by factors on regional scales. During the seasons of northeasterly winter monsoons, long range transport of dust and particulate air pollutants from the Asia Continent had negatively impacted the atmospheric environment in this area. On the other hand, as a highly developed urban area, Taipei has substantial local emissions of air pollutants that should have transported to the surrounding areas of Taipei basin and caused deterioration of air quality and visibility in Cape Fuguei and Yangminshan. The results indicated that the major components of aerosols in Taipei include sulfate, sea salts, dust, and organic matters. In addition, contributions from nitrate, ammonium, and elemental carbon were also significant. In terms of mass concentration, most of the sea salts and dust particles existed in the coarse mode of aerosols, whereas sulfate and EC were confined within PM2.5. This suggests that the dust and sea salts particles were externally mixed with EC and sulfate in the aerosols over Taipei area. Further, it was found that nitrate were closely associated with sea salts in aerosols, suggesting the reaction between nitric acid and sea salt particles. Different seasonality was observed for sea salt and dust: sea salts peaked in fall and dust reached the maximal level in springtime, implying their sources were regulated by independent seasonal factors. Particulate pollutants (i.e. sulfate, nitrate, OM and EC) were consistently reaching their respective maxima in spring, agreeing with dust particle, suggesting the influences of long range transport of air pollutants. This study also found that both the mass fraction of OM in aerosols and OC/EC ratio exhibited peaks in summertime. Secondary organic aerosols (SOA) produced from photochemical reactions and heteo-nucleation were among the major factors controlling the seasonal variations of aerosol concentration in Taipei area. Because the formation of SOA could alter the interactions between aerosols and cloud/fog and, in turn, have potential impacts upon the regional radiation budget, this study suggests conduct an in-depth study upon the relationship between cloud condensation nuclei (CCN) and SOA in this region.