Influence of continental outflow events on the aerosol composition at Cheju Island, South Korea

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Abstract. The chemical composition of aerosols measured at Cheju Island, Korea, over the 3-year period March 1992 to February 1995 are presented and discussed, with a particular emphasis on the Pacific Exploratory Mission in the Western Pacific (PEM-West B) time period. Cheju Island is under the influence of continental outflow conditions nearly 70% of the year, and as a result the aerosol loading of sea salt as well as continental aerosol components is high. The 3-year mean values derived from the daily tape filters are non-sea-salt (nss) SO$_4^{2-}$ = 6.8 µg/m$^3$, NO$_3^-$ = 1.2 µg/m$^3$, Cl$^-$ = 1.9 µg/m$^3$, Na$^+$ = 1.7 µg/m$^3$, Ca$^{2+}$ = 0.5 µg/m$^3$, NH$_4^+$ = 1.3 µg/m$^3$, Mg$^{2+}$ = 0.3 µg/m$^3$, and K$^+$ = 0.4 µg/m$^3$. Sea-salt components show peak values in winter, while calcium, nitrate, potassium, and to a lesser extent, sulfate and ammonium, show higher values in the spring, and all species exhibit a pronounced minimum in summer. Trajectory and principal component analysis show that elevated levels of primary aerosols (both sea salt and soil-derived) occur with strong wind conditions associated with winter and spring, and high concentrations of non-sea-salt components are most strongly associated with springtime continental outflow events. During the PEM-West B period, nitrate and calcium are found to be ~60% higher than the annual mean, sea-salt components ~30% higher, and sulfate ~10% higher. The aerosol data are combined with gaseous SO$_2$ concentrations, precipitation chemistry data and companion aerosol measurements taken at the same site, to provide further insights into the aerosol composition at Cheju. At Cheju, sulfate and ammonium are found mostly in the fine fraction (~80 to 90%), while calcium and nitrate reside in the coarse size fraction. Sulfate and nitrate are not associated with the primary aerosols, but rather become associated with the aerosol during the long-range transport process.