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Size distribution of functional groups in Asian outflow aerosols

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Size distribution of chemical constituents in atmospheric aerosols is critical for a precise assessment of their impacts on either radiative forcing or public health. To investigate the size resolved physico-chemical properties of the aerosols transported from the East Asia to the western North Pacific region an intensive field experiment was conducted in Taipei, Taiwan in January 2003. In addition to mass concentration, the abundances of major functional groups in size-segregated aerosol samples were measured using Fourier transform infrared (FTIR) spectroscopy. Size distribution parameters of aerosol mass and the associated functional groups were analyzed. The results of infrared spectroscopic analysis showed that the content of sulfate and ammonium in Taipei's sub-micron aerosols were significantly increased due to the outbreaks of continental pollution. In addition, it was also showed that the Asian outflow aerosols contained higher levels of silicate and nitrate in super-micron size range. The size-resolved functionalities of the aerosol samples collected during Asian outflow episodes were compared with those of local pollution samples. The comparison revealed that ammonium and sulfate generally coexisted in sub-micron aerosols, suggesting that there were substantial emissions of ammonia in this region to neutralize the acidity of sulfate via the formation of ammonium sulfate particles. The nitrate got a bimodal distribution over the size range between 0.1 and 10 μm. Significant enhancement in coarse nitrate was found during the Asian outflow episodes, implying the heterogeneous reactions of nitric acid on the surface of dust and sea salt particles along the transport processes. The abundant sub-micron nitrate particles observed before the frontal passage were suggested as a result of the formation of ammonium nitrate, an important indicator of secondary pollution in urban areas. The aliphatic and carbonyl carbon in the aerosols were suggested mostly due to local pollution in

Taipei. Nevertheless, our analysis found that the aerosols of Asian outflows got higher infrared absorbance ratio of carbonyl to aliphatic carbon than those of local pollution. The enrichment of carbonyl carbon in the Asian outflow aerosols is most likely due to the emissions of biomass burning aerosols.

Keywords: Aerosol composition, Size distribution, Asian outflows, Infrared spectroscopy.