Physical and chemical characteristics of aeolian dust over Asian dust source regions

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1. Introduction

Asian dust, known as Kosa (Kosa, 1991), has been attracting increased attention because it has a significant influence on both the global climate (Tegen and Fung, 1995) and on geochemical mass cycles (Iwasaka, 1988). According to an IPCC report (1996), mineral aerosols provide the greatest uncertainty in the estimation of radiative forcing in climate models. In order to obtain a better understanding of the physical and chemical characteristic of soil-derived mineral aerosols, aerosol samples were collected at four observation stations in the Asian dust source regions.

2. Sampling location and instrumentation

Four observation stations were selected for Asian dust experiments over north western China. Aksu at northern part of Tarim Basin, Qira at the southern periphery of Taklimakan Desert, Dunhuang at He-Xi Corridor and Shapotou at upper drainage basin of Yellow River and adjacent to south-east of Tengger Desert. We installed two types of air-samplers and one dry deposit sampler. High-volume air-samplers (Sibata HV1000F) are used for bulk aerosol sampling and low-volume air-samplers of the Andersen type (Sibata AN200) are used to obtain size-segregated information. Dry depositions are also collected at Qira and Aksu Stations. Aerosol particle number concentration is measured by using Optical Particle Counter (OPC) at Qira Station.

Results

1. Mass concentration of aeolian dust at 4 observation stations

Mass concentrations of aeolian dust in March, April and May, are incomparably larger than other seasons. Among 4 observation stations, Qira Station shows obviously higher mineral dust concentration (max: 26mg/m3) than other areas. It is partly because Qira Station is situated almost desert periphery, while Aksu or Dunhuang Stations are inside oasis areas. However, Shapotou Station is also adjacent to Tenger Desert, but aeolian dust concentration is less than one to five of Qira.

2. Deposition ratse of aeolian dust at Qira and Aksu Stations.

Deposition rates of aeolian dust at Qira, max. 25g/m2/day, are more than 20 times larger than Aksu. Qira area shows high atmospheric concentration and high deposition rate of aeolian dust. Our results show Tarim Basin is one of the most important potential sources of Asian dust.

3. Correlation between OPC (Optical Particle Counter) and AN200

The output data of Andersen sampler are size segregated aerosol mass concentration. These data can get by measuring the weight of collected samples through continuous sampling. So time resolution is low. On the other hand, OPC can provide us the variation of aerosol concentration from time to time. It is very useful for model calculation. However, mineral aerosol particles are essentially non-spherical, so there is some discrepancies between mass concentration calculated from OPC and results of AN200. To correlate AN200 data with Optical Particle Counter (OPC) data, we carried out simultaneous measurements of the OPC at the same place with Andersen sampler and converted the results to the mass concentrations by using aspect ratios. Previously reported aspect ratios of dust-like aerosol are 2.0 (Hill et al., 1984), 1.7 (Nakajima et al., 1989), 1.4 for two dimension and 1.7 for three dimension (Okada et al., 1987) and 1.8 (Michehenko, et al., 1997). Our results are between 1.4 and 1.6, mainly 1.6. The results of OPC are consistent with those of AN200 in the range of smaller-than-5um-particles diameter.

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