Geophysical Research Abstracts, Vol. 7, 05985, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05985

Preliminary summary of aeolian dust experiment on climate impact -Japan-Sino joint project ADEC-

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Aeolian dust particles in the atmosphere play an important role in the radiative forcing of the atmosphere via scattering and absorbing of short and long wave radiation. After being deposited in the ocean, aeolian dust is thought to act as nutrient salts which will cause changes in the primary production of phytoplanktons. This process is one of the major factors of the carbon dioxide cycle in the global scale. However, there still remains large uncertainties in the understanding of the whole process of dust, including generation, long-range transport, deposition, chemical and physical property, and in the model representations of dust distribution and its radiative forcing in the global and/or regional scale.

With this background, the Japan-Sino joint project, Aeolian Dust Experiment on Climate impact (ADEC) was initiated in April 2000. The main objective of this project is to understand the impact of aeolian dust on the climate system via radiative forcing. For this purpose, we have conducted field experiments and numerical simulations in order to understand the following whole processes of aeolian dust:

(1) Wind erosion process.

(2) Dust concentration, vertical distribution, and deposition processes.

(3) Characterization of aeolian dust: physical, chemical, and optical properties.

(4) Climatic impact of aeolian dust via radiative forcing direct effect.

The research fields are located within Northwestern China (80º E) and Japan (140º E) including the source region, the Taklimakan desert, and the deposition area. To accomplish these scientific aims, we have developed instruments, tools, and numerical

models and organized a dust monitoring network in East Asia as follows:

(1) In order to introduce the erosion process into the dust model, understanding the overview of the whole process based on the observational fact is necessary. For this, we have developed the Sand Particle Counter for the monitoring of moving sand and the Optical Particle Counter specially designed for monitoring dust particles on desert surface.

(2) It is well known that Lidar is one of the most useful instruments for monitoring vertical distribution of dust. Thus, we have built a lidar monitoring network from the outbreak area, Aksu; north of the Taklimakan desert, to Japan.

(3) In addition to the lidar network, sky-radiometer for the monitoring of dust optical properties and high-volume and low-volume dust particle samplers for analyzing the dust particle characteristics were settled and operated at the same sites as the lidar observation.

(4) For monitoring horizontal distribution of dust in the East Asia, we have analyzed the time series of horizontal distribution of dust aerosol optical thickness derived from the Geostationary Meteorological Satellite Measurements.

(5) We have developed a spectrally detailed radiative transfer model to evaluate the direct radiative forcing by aeolian dust.

(6) For investigating dust storm occurrence and its structure, dust outbreak and the uplift of dust particles to the free atmosphere from the Tarim Basin, atmospheric dust supply from East Asia, and global dust distribution and its direct radiative forcing, we have developed a meso-scale dust model, a dust scheme coupled with local circulation model, East Asia regional scale dust model, and a global scale dust model coupled with radiation scheme, respectively.

So far, three Intensive Observations, April 2002 (IOP1), March 2003 (IOP2), and March to April 2004 (IOP3), were initiated. During these periods, in situ observation for monitoring dust events and erosion processes were conducted at the south of the Taklimakan desert and Dunhuang and network observation for monitoring the long-range transport process of dust has been made. Although we are still on the way to a synthetic analysis of the comprehensive understanding of the whole process of aeolian dust in East Asia, preliminary results indicate:

1) Saltation flux at the gobi surface using Sand Particle Counter indicated that it is one order larger than that of a sand dune. It was caused by the difference of parent soil size distributions in each ground condition.

2) Spatial characteristics of Asian dust were figured out in contrast to the Saharan

dust.

3) Radiative forcing by mineral dust strongly depend on the dust optical parameter, the single scattering albedo and the surface albedo.

4) GCM dust model well represented the global distribution of dust, which clearly showed the characteristics of Asian dust. And the radiative forcing direct effect on the global scale during 28 years from 1974 to 2001 was estimated to be -0.3W/m^2.

As a summary of the achievements of this project, ADEC special issue is to be published from JMSJ (Journal of Meteorological Society Japan) by the end of March 2005.