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Numerical Simulation of the atmospheric circulations and emission and dispersion of dust particles in the Tarim Basin

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It is widely accepted that the Tarim Basin with the Taklimakan desert is one of the major sources of aeolian dust in East Asia. However mechanisms responsible for emission and transport of dust from surface to free atmosphere is not clear, and evaluations of dust supply to free atmosphere have large uncertainties. Dust events in the Tarim Basin, including dust haze and blowing dust, have rather long-lasting character, in contrast to those in the Gobi desert occur in phase with the passage of synoptic cyclone. The effects of topographic features and local circulations may account for this contrast. We have performed a numerical simulation for a dust event in spring there to examine the importance of those effects and to evaluate the dust supply with more certainty.

The Regional Spectral Model (RSM; the equivalent horizontal grid size is 20km) and the Non-Hydrostatic Model (NHM; 10km) of the Japan Meteorological Agency (JMA) is employed to represent atmospheric circulation. The Lagrangian transport model with a simple spectral dust emission scheme by Shao (2003, personal communication) is coupled with the NHM to simulate dust emission and transport. Effects of soil texture, vegetation, and snow cover fraction on dust emission are formulated in Shao's scheme.

The model reasonably simulates space and time variations of surface wind field and dispersion of dust. Though dust emission occurs at only a fraction of the basin, dust covered almost the entire basin in a day (Figure 1). Three characteristic types of mesoscale flow can be distinguished in the simulation. The dust dispersion is dependent on not only the surface wind intensification, but also the vertical motions arising in or between these circulations. Contribution of the various types of the flow to the persistent dust suspension will be discussed.

Keywords: aeolian dust; Lagrangian transport model; the Taklimakan desert; the Tarim Basin; dust dispersion; dust emission.

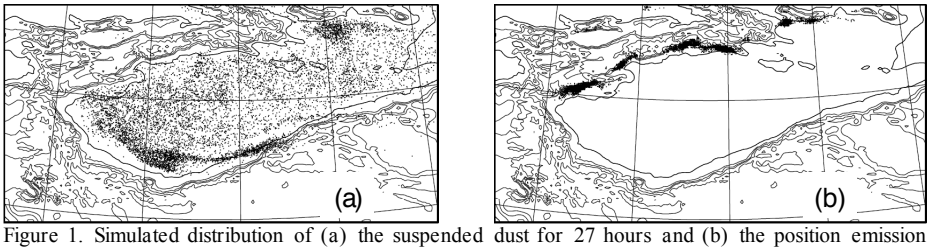

Figure 1. Simulated distribution of (a) the suspended dust for 27 hours and (b) the position emission occur.