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The effect of snow cover on dust emission in Mongolia

Yasunori Kurosaki[1]; Masao Mikami[2]; Akihiko Kondoh[1]

[1] CEReS, Chiba Univ.; [2] Applied Met. Div., MRI

Soil dust aerosols have a large impact on the climate through their direct radiation effect such as the scattering and absorbing of solar and thermal radiation, their indirect radiation effect through their interaction with cloud particles, and the changes in ice cap albedo by their depositions. To evaluate these effects, many numerical experiments of dust transport have been conducted by climate model. However, the amount of dust emission is different among models (Zender et al., 2004). To resolve this problem, we need the precise information of land surface (e.g., soil wetness, soil particle distribution, vegetation cover, snow cover). Moreover, we need to clarify the effect of these land surface elements on dust emission.

Grassland region in Mongolia, which is located on the north of the Gobi Desert, is a large dust source as well in East Asia, although the largest one is the Gobi Desert (Kurosaki and Mikami, 2005). While frequent strong winds cause frequent dust emissions in Mongolia during spring, it is difficult to estimate the dust emission amount by numerical models because of snow cover and vegetation cover. Although the frequency of emission is smaller in comparison with in spring, dust emissions occur in winter as well.

In this study, we used the data of present weather and surface wind speed at a 10-m height observed at surface meteorological observatories during March 1988 to June 2005. We calculated the strong wind frequency and the dust emission frequency for each month, and we investigated the correlation between these frequencies. We defined the strong wind by a constant threshold 6.5 m/sec, although the threshold wind speed of dust emission varies according to the land surface conditions in the real field. This means that this correlation should be high where the land surface environment is the almost constant. On the other hand, this correlation should be low where the land surface environment largely changes. About the existence of snow cover, we used the data from SSM/I.

The correlation is the highest in February, and its correlation coefficient is 0.78. The correlation is high at a confidence level of 5% from February to May, though it gradually decreases with seasonal march. From June to January, we cannot find the correlation between strong wind frequency and dust emission frequency. We can recognize that the reasons of low correlation during summer and autumn are the large year-to-year difference of soil wetness, vegetation cover, etc. However, the year-to-year difference of snow cover fraction is also large in February and March. This result suggests that we cannot parameterize the dust emission by our used snow cover data in these months. After this study, we have a plan to discuss the snow quality and heterogeneous distribution of snow cover by the temperature data and other snow cover product.

Kurosaki and Mikami (2005), Regional difference in the characteristics of dust event in East Asia: relationship among dust outbreak, surface wind, and land surface condition, J. Meteor. Soc. Japan, 83A, 1-18.

Zender et al. (2004), Quantifying Mineral Dust Mass Budgets: Terminology, Constraints, and Current Estimates, Eos, 85(48).