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Interactive Comment

Interactive comment on "Long-range transport of giant particles in Asian dust identified by physical, mineralogical, and meteorological analysis" *by* G. Y. Jeong et al.

G. Y. Jeong et al.

jearth@andong.ac.kr

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We appreciate the anonymous referee's valuable comments.

The referee pointed out that the transport of unusual coarse particles over long distance should be physically consistent with settling velocity of the particles, and we agree. If a spherical soil particle has a diameter of 50 μm and a density of 2.3 g cm^{-3}, the settling velocity is about 0.17 m s^{-1} (or 15 km day^{-1}). This value is even higher than the settling velocity suggested by the referee. Considering that the Asian dust events reach 4–8 km altitude in general, such a large settling velocity is too high to carry the

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Interactive Discussion

Discussion Paper

coarse particles over the long distance of about 2000 km. However, there are two considerable points that could reduce the settling velocity of the dust particles.

Firstly, the soil particle shape is not spherical as shown in Figs. 2 and 4. The irregular shapes of the particles induce larger drag force than spherical particles and reduce settling velocity. Although the values of dynamic shape factor to the particle's drag coefficient vary widely depending on particle shape, the settling velocity can be reduced to 0.11 m s^{-1} ($\sim$ 9 km day^{-1}) if we adopt the factor 1.57 for "sand" like species (Please refer to Reid et al., 2013, and Eqs. (2) and (3) therein).

Secondly, the Asian dust event occurs behind the developing low-pressure system where the local updraft is usually located. In the balance between the upward velocity and settling velocity, the particles could be suspended longer during the transport. The meteorological conditions during the 2012 dust events are shown in Fig. S1 with 6-hourly ERA-Interim data set. At 06 UTC (15 KST) on 30 March 2012 shown in Fig. S1b, the high surface wind speed behind the low-pressure system appears over the Gobi desert (105°E–115°E, 40°N–45°N). At the same time, vertical velocity at 700 hPa ($\sim$ 3 km altitude) over the region reaches about -0.5 Pa s^{-1} ($\sim$ +0.05 m s^{-1}). As the dust are transported along the mid-tropospheric strong wind belt (shaded regions), the locally strong updraft region (110°E, 40°N in Fig. S1c and 120°E, 40°N in Fig. S1d) is also moved southeastward with the vertical velocity of -0.8 Pa s^{-1} ($\sim$ +0.09 m s^{-1}). Considering the updraft velocity, the settling velocity of the particle is reduced to 0.02 m s^{-1} ($\sim$ 1.7 km day^{-1}). Although the vertical motion is weakened just before the dust arrival at the western coast of Korea (Figs. 1Se and 1Sf), the reduced settling velocity is enough to carry the coarse particles over long distance with short transport time (28 hours) in the 2012 dust event.

In this final stage of manuscript processing, we have very little time insufficient to retrieve, integrate, and interpret full meteorological data such as rawinsonde and CALIPSO. The systematic works on the mechanics of the long-range transport of giant particles will be done in the follow-up research. However, above discussion will be

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concisely included in the revised manuscript.

Thank you very much for the review of our manuscript.

Sincerely

G. Y. Jeong (corresponding author) J. Y. Kim J. Seo G. M. Kim H. C. Jin Y. Chun

Caption

Figure S1. 6-hourly ERA-Interim meteorological fields during the Asian dust event in March 2012. Blue solid contours represent 10 m wind speed larger than 8 m s^{-1} with 2 m s^{-1} intervals. Red soild contours represent 700 hPa updraft velocity below 0.2 Pa s^{-1} with 0.2 Pa s^{-1} intervals. The 500 hPa high wind region above 30 m s^{-1} and 40 m s^{-1} are marked by light and dark shading.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 21041, 2013.

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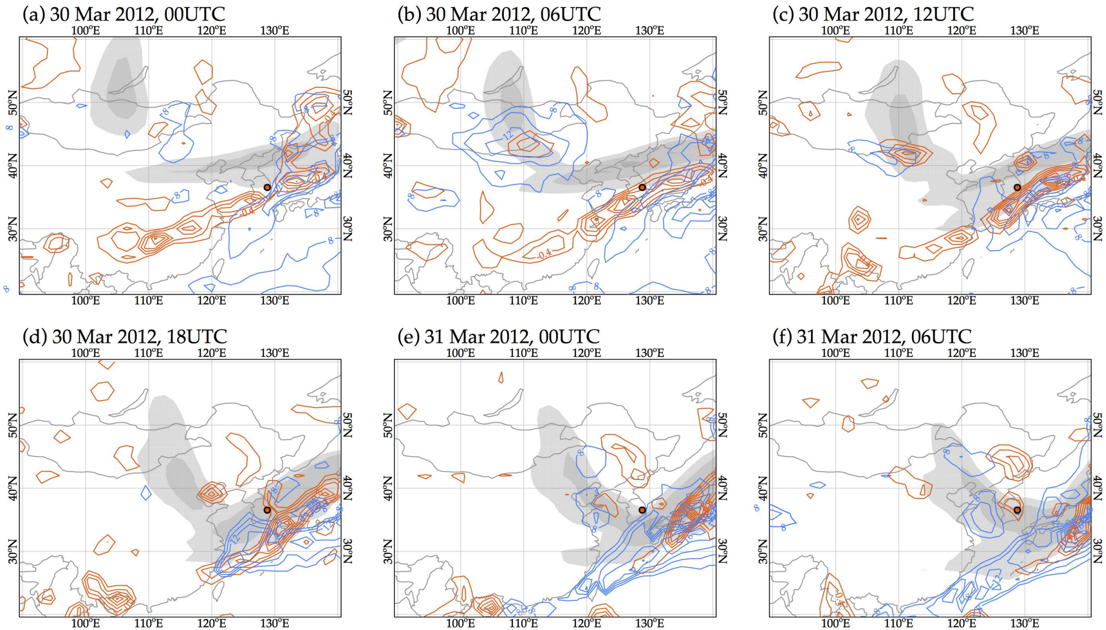

Fig. 1. 6-hourly ERA-Interim meteorological fields during the Asian dust event in March 2012.