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Interactive Comment

Interactive comment on "Wet and dry deposition of mineral dust particles in Japan: factors related to temporal variation and spatial distribution" *by* K. Osada et al.

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We thank anonymous Referee #2 for constructive comments with respect to the overall clarity of the article. Modified words and sentences are highlighted as yellow in the text.

General Comment: I would like to see more discussion and interpretation of the results and of the findings. What are the controlling processes which lead to dry deposition? Just to present the results without any further attempt to link them to the underlying processes of dust removal is not sufficient.

Response: We extended the discussion and added new figures related to transport processes and dust deposition with many modifications to sections 3.2 and 3.3. We also renewed section 3.4 to discuss implications of giant dust deposition in relation to model simulations. We hope that these revisions are satisfactory to address your comments.

Detailed remarks #1: Abstract, lines 19-22: Why is the maximum dust layer height or thickness so important? From the point of view of sedimentation? Or do you think that vertical downward mixing by wind shear and convective turbulence play an important role and if the lofted layers are higher up, downward mixing has a minor impact? So provide more information, may be not in the abstract but later on.

Response: We added summary sentences to the Abstract corresponding to newly added discussion in the main body of the manuscript. Although vertical mixing processes are important for dust transport, we think that the transport height of giant dust is a key factor for carrying giant dust to Japan. We added discussion of this subject using new figures and new references related to dust transport.

Detailed remarks #2: Introduction, p 21805, lines 9-19: I would like to see a general paragraph on all available processes that contribute to dry deposition. . . such as gravitational deposition or settling, turbulent downward mixing, what else? And in addition: how well are these processes parameterized in models. This is then probably the motivation for all the lidar observations and the dust deposition measurements presented here for comparisons with model results to check model quality. Please provide more information on this.

Response: We added a general paragraph to the Introduction, which includes key processes of dry dust deposition. In section 3.4, we also added discussion of frequent deposition of giant dust particles in relation to model simulations. However, we did not present further details related to model simulations and comparison with simulation results because they are beyond the scope of this paper.

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Detailed remarks #3: Results, p 21812, lines 21-26: Again, what is mainly controlling dry deposition. Downward mixing or just gravitational settling? P 21813, line 22: Why does monthly dry deposition not follow monthly Kosa days? Any idea about the reason? Because the dust layers were at large heights? Downward mixing was not effective. . .? Please discuss! Section 3.2, p 21814, line 11: Any idea why the dry deposition fluxes were not so high? P 21814, kine 28: Long distance transport and then. . .? How gets the dust deposited? By downward mixing? Please provide some discussion. P 21815, line 4: The maximum height or dust layer thickness is an important restriction for long-range transport of dust. What basic process does control this link? Sedimentation or downward mixing, or what? When the dust layer is transported at low height, measured deposition strenght is well correlated? P 21815, line 18: suggesting depletion of giant particles during transport. . . How? By sedimentation or maybe cloud processing (without washout, wet depoistion). . .? Page 21817, line8: So at the end, please provide more information on the dry removal processes! What is more important: Sedimentation or downward mixing? Summary and conclusions, p 21818, lines 3-6: Again give some suggestions for the underlying reasons. Do lofted layers interact with PBLs? That would trigger significant downward mixing.

Response: These comments are mutually related. Mismatches of monthly dry dust deposition and Kosa frequency are interesting and important points to discuss. They are related to dust transport processes and dust particle size. Using new figures and additional references related to dust transport, we rewrote and added some discussion to sections 3.2, 3.3, and 3.4. We also modified the Summary section and conclusions accordingly.

Detailed remarks #4: Figure 7: When dust is seen by lidar, then it is observed at low heights, why? Just transport? Or caused by descending motions on a larger scale or just downward mixing? We need more information on this?.

Response: We augmented the discussion of vertical profile and transport patterns of Asian dust with new references to show the typical transport height of Asian dust

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Interactive comment on Atmos. Chem. Phys. Discuss., 13, 21801, 2013.

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