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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A new parameterization of dust dry deposition over rough surfaces" *by* J. Zhang and Y. Shao

Anonymous Referee #3

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Review on the manuscript Âń A new parametrization of dust dry deposition over rough surfaces"

submitted to Amospheric Chemistry and Physics By J. Zhang and Y. Shao

General comments : This paper investigates the question of the representation of dry deposition processes for dust particles and the influence of surface roughness on the deposition velocity. This is an important topic since the mass budget in 3-D dust model is largely under-constrained due to uncertainties in both emissions and deposition. The proposed parameterization is compared to the parameterizations proposed by Slinn (1980) and Slinn and Slinn (1982), that are widely used in 3-D aerosol models, and with experimental data, showing the improvement brought by this new parameteriza-

tion. On original aspect of this work is to explicitly describe the relative influence of the roughness elements and of the bare fraction of the surface on the different terms involved in the deposition processes by analogy with the drag partition theory widely used to describe the erosion threshold over rough surfaces. The second original aspect is the comparison of this new parameterization with deposition velocity measurements performed in wind-tunnel for different surfaces with contrasted roughness properties. The paper is in general well written and well organized. In particular, the very detailed description of the main assumption is extremely valuable. Figures are clear and well described. A few clarifications on the assumptions made to establish the parameterisation and on the sensitivity study (listed below) would make the results even more convincing. I recommand the publication of the manuscript after minor revisions.

Specific comments : - Page 8065 lines 10-16 : the author argued that existing approaches have two deficits. It is not clear how or if the new parameterization provides a solution to the first deficit (gravitational settling). - Page 8065 lines 26-28 : the comment on the results of the SS80 and S82 seems too severe regarding the figure 1... - Page 8068 line 9 : the choice of the value of 1 for ïĄą and ïĄş as U* should be further justified. - Page 8069, line 1-4 : B1 has been determined from the wind-tunnel measurements. Is it a sensitive parameter ? - Page 8071 line 10 : the impaction efficiency is taken from Petroff et al. (2008) and is assume constant whatever the roughness elements. Should it vary depending on the type of surface, for example, stone versus vegetation ? - Page 8071 line 13 : is it really relevant to take into account particle growth for mineral dust ? Are the parameterization from Fitzgerald (1964) and Gerber (1985) appropriate for such particles ? - Page 8075 line 8 : the definition of ïĄć , that can be found in table A1, should be given here. In addition, arguments on the choice of a unique value should be given. Based on wind tunnel measurements, Walter et al (Boundary Layer Metorol.,2012) estimated this value to 137 for blocs and 93 for vegetation elements. - Page 8076-8077 : in the description of the comparison between the new parameterization and the measurements, more details on what parameters really makes the difference from one surface to the other should be given, in particular for

the parameters that will further used in the sensitivity analysis. - Page 8076 line 5-15 : it is quite surprising to read that sand grains are treated as individual obstacles, since they does not really fits the representation of figure 2, and especially when the final sentence states that sand grains are smooth. The size of the sand grains should be given explicitly. It is stated that in this case hc=30.Z0 and three values of Z0 are given. I cannot imagine that the size of the sand also changes. - Page 8076 line 22 : it is difficult to imagine trees in a wind tunnel. May be "Shrubs" or "plants" would be more appropriate. - Page 8076 line 27 - page 8077 line18 : This part of the discussion is not clear, in particular concerning the role of bubbles and spay dropplets. Are the wind tunnel measurements made at such wind velocity that it creates waves on the water surface that produce such bubbles and sprays ? In this case, there would be a change in the roughness length (mentioned as constant and low in table 3). So even if the parameterization fits very well the measurements, I am not convinced by the discussion and by the final sentence ("We have shown ... droplets". - Page 8077 : this sensitivity analysis is very welcome at this point of the manuscript and very interesting. However, it would be more convincing with some arguments on the selected range of values for the different parameters. As an example, the roughness element size vary from 1 to 10 mm, which is very low, especially compared to the height of the roughness elements fixed to 150 mm. This makes very long and thin obstacles : what kind of surface can is it supposed to represent ? On the opposite, the range of roughness density is very large. Similarly, particle density has been taken from 1000 to 5000 kg.m-3 : Is it realistic compared to the density of typical minerals composing mineral dust ? - Page 8079 line 20-21 : please, comment the figures or remove them. - Page 8010 line 5-7 : Additional test on different or larger range of roughness element dimensions could also be mentioned to treat deposition on urban surfaces or forest.

Technical corrections :

- page 8068 line 3 : does "neutral particle" refer to their electrical charge ? - Page 8073 line 20 : "depended" should be replaced by "dependent" - Page 8075 line 24 :

"absence" should be replaced by "absent". - Page 8078 line 8 : in the sentence " dust deposition is suppressed ..", replace "suppressed by "negligible", for example. - Page 8078 : line 13-16 : It should be clearly stated that it is not very sensitive.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/14/C5073/2014/acpd-14-C5073-2014-supplement.pdf

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